

GURPS

Fourth Edition

SPACE



By JON F. ZEIGLER AND JAMES L. CAMBIAS

STEVE JACKSON GAMES

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GURPS Space requires the **GURPS Basic Set, Fourth Edition**. The information and advice on technology, worldbuilding, and alien design can be used as a resource for any space-based game.

By Jon F. Zeigler and James L. Cambias Edited by Wil Upchurch

Cover Art by Alan Gutierrez, Chris Quilliams, and Bob Stevlic

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About GURPS

Steve Jackson Games is committed to full support of **GURPS** players. Our address is SJ Games, Box 18957, Austin, TX 78760. Please include a self-addressed, stamped envelope (SASE) any time you write us! We can also be reached by e-mail: info@sjgames.com. Resources include:

Pyramid (www.sjgames.com/pyramid/). Our online magazine includes new **GURPS** rules and articles. It also covers the **d20** system, *Ars Magica*, *BESM*, *Call of Cthulhu*, and many more top games – and other Steve Jackson Games releases like *Illuminati*, *Car Wars*, *Transhuman Space*, and more. *Pyramid* subscribers also get opportunities to playtest new **GURPS** books!

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GURPSnet. This e-mail list hosts much of the online discussion of **GURPS**. To join, point your web browser to www.sjgames.com/mailman/listinfo/gurpsnet-l/.

Rules and statistics in this book are specifically for the **GURPS Basic Set, Fourth Edition**. Page references that begin with B refer to that book, not this one.

INTRODUCTION

Why do we dream of voyages to space? Why do we make up tales of distant worlds and other stars? Isn't Earth enough?

Well, no. Earth is a big planet with plenty of weird stuff on it, but it's getting too well-known. Human civilization is increasingly close-knit, so even in the most exotic lands one sees familiar brand names and hears familiar pop music.

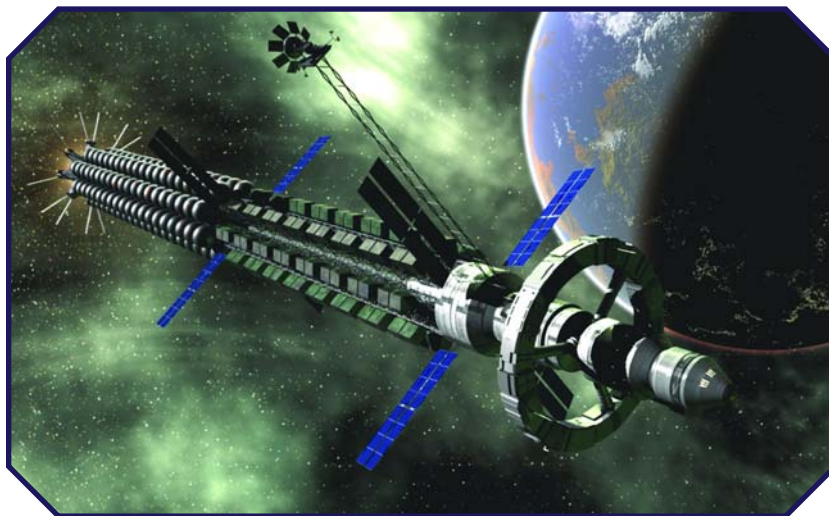
We want *wonders*. We want to climb 26 miles to the top of Mons Olympus on Mars, see the rings of Saturn filling half the sky, watch the double sunset on Alpha Centauri IV, see stars being born in the Orion Nebula, and watch them spiral in to die in the central black hole of the galaxy. Space exploration brings a whole *universe* of wonders within reach.

We want to play with ideas. What would life be like on a planet of a flare star? What are some other ways to run a society, or distribute wealth? How does hyperspace travel affect interstellar military strategy? Space travel and colonization lets us create new societies and examine different ways of doing things.

We also want someone to talk to. An alien perspective would tell us many things about the universe, and about ourselves. Alien music and alien art might revitalize our jaded tastes and inbred styles. Civilizations older than our own might know the answers to some of our questions – and ask some questions we haven't even thought of.

Finally, as gamers we want adventures. We want to chase our foes across the icy plains of Pluto, or hide from them in the clouds of Neptune. We want to make a killing doing business with intelligent fungi from Altair, or lead troops into battle against robot hordes. Space is fun.

What makes space different is that it's real. The wonders are really out there, along with others we haven't seen. There are real alien civilizations out there somewhere, probably more strange than we've imagined. Space



adventures are achievable. Anyone can join in, no royal birth or ancient prophecy required. Those odd societies? They're real, too – or can be. If this book has a message, it's: *we can do this*. Humans are capable of great things. Sure, Earth is a great place, but if we limit ourselves to a single planet, it's an admission of defeat.

PUBLICATION HISTORY

This is the fourth edition of **GURPS Space**. Steve Jackson and William Barton collaborated on the first and second editions, and David Pulver

revised their text for the third edition. The current edition includes a great deal of text from these earlier versions.

This book also incorporates material from several other **GURPS** books. The concepts of *tone*, *scale*, and *scope* used in Chapter 1 were pioneered by Ken Hite in the third edition of **GURPS Horror**. The world design sequences in Chapters 4 and 5 are descended from the one designed by Jon F. Zeigler for **GURPS Traveller: First In**; a simpler version of the current system also appears in **GURPS Traveller: Interstellar Wars**. The alien design sequence in Chapter 6 was inspired by the one Stefan Jones created for **GURPS Uplift**.

About the Authors

James L. Cambias is a game designer and science fiction writer, currently resident in western Massachusetts. He is putting the finishing touches on his plan to gain a complete monopoly on science fiction role-playing sourcebooks. Earlier stages in the project include **GURPS Planet Krishna**, **GURPS Mars**, **GURPS Planet of Adventure**, **Star Hero** and **Terran Empire** from Hero Games; and several science fiction short stories. With the appearance of this book, total science fiction domination is within his grasp!

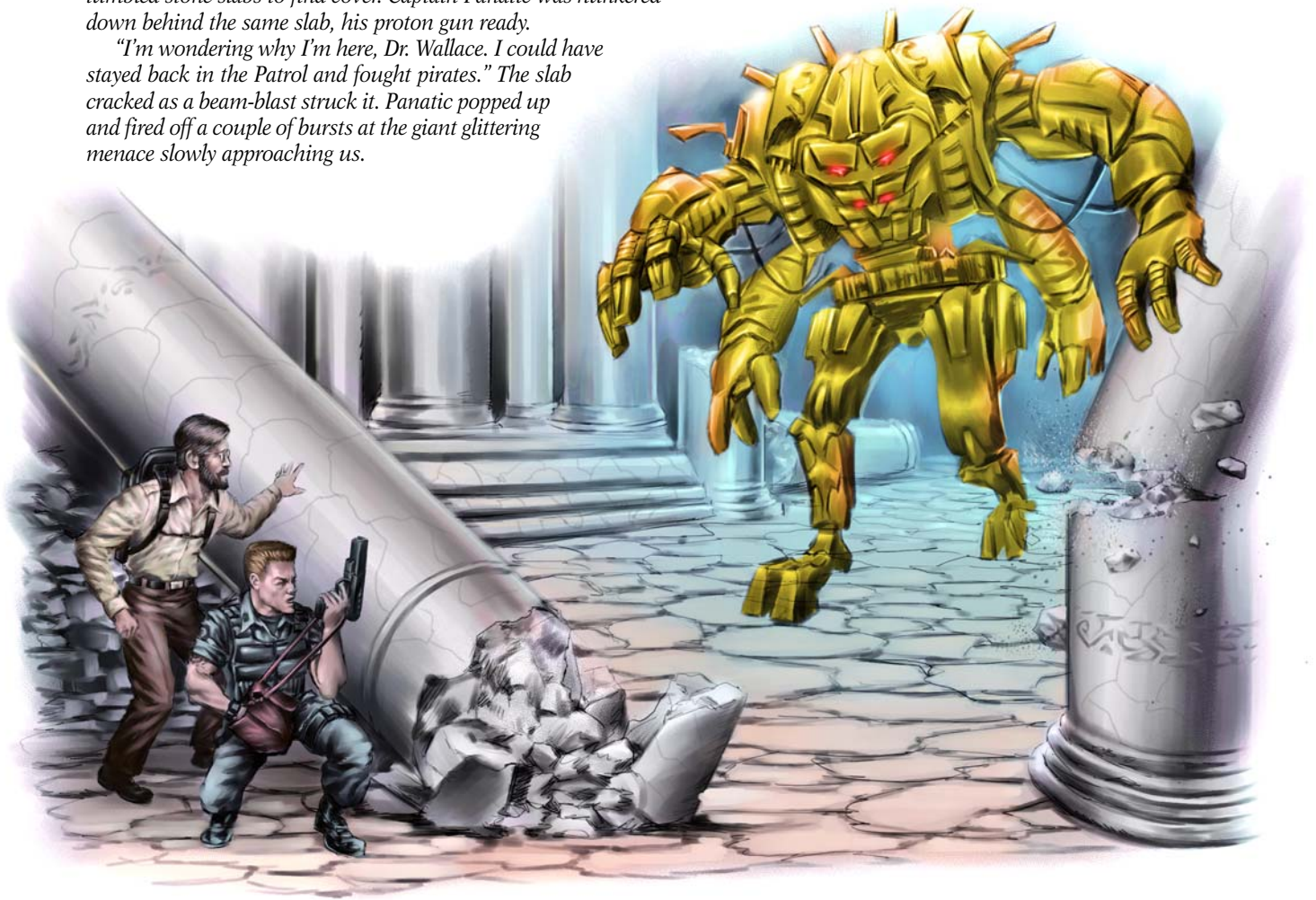
Jon F. Zeigler has been a science fiction fan since the cradle (literally). He and his wife and two children live in Maryland, where he works for the federal government as a network security analyst. He has written several books for **GURPS**, especially for the **GURPS Traveller** and **Transhuman Space** product lines.

CHAPTER ONE

SPACE

I dodged the thing's deadly beam-blasts and leaped over one of the tumbled stone slabs to find cover. Captain Panatic was hunkered down behind the same slab, his proton gun ready.

"I'm wondering why I'm here, Dr. Wallace. I could have stayed back in the Patrol and fought pirates." The slab cracked as a beam-blast struck it. Panatic popped up and fired off a couple of bursts at the giant glittering menace slowly approaching us.



"Or I could have taken my brother's offer and gone into business as a merchant. I think I'd make a pretty good merchant, don't you?"

I ducked as a blast shattered the wall above me, showering us both with fragments of blackened stone.

Captain Panatic took my rucksack and began rummaging through it. "I might even have bought some land on a colony world, maybe raise dairy cattle and make cheese. Do you like cheese, Dr. Wallace?"

I risked a look. The huge golden machine that I'd mistaken for an alien idol was now only five meters away, shoving aside slabs bigger than the one we were hiding behind.

"But I didn't do those things. I heard you were looking for a pilot, so I took the job. Do you know why, Dr. Wallace?" Panatic took out a couple of spare power cells and began prying at the casings. He got them open, used a strip of foil to connect them somehow, counted under his breath, and tossed them over the slab at the machine. A second later, there was a tremendous explosion.

When the dust had cleared and we could stop coughing, Panatic and I peeked over the slab. The ancient alien machine was toppled over and still.

"I signed on with you because I figured an archaeology voyage would be nice and safe. What could possibly happen?"

I decided not to tell him about the psi-worms yet.

SPACE AND SPACE FICTION

A LITTLE LITERARY HISTORY

Space travel has always been the most important trope in science fiction. To many people, it's "all that outer space stuff." And certainly SF writers have been interested in the subject for a very long time. Johannes Kepler wrote about a voyage to the Moon in 1634, and although his hero gets there by means of magic, Kepler's description of conditions on the Moon was pure "hard" science fiction.

Early accounts of space voyages were often fantasies, either explicitly like Kepler's, or with a wink at the reader, as when Francis Godwin used migratory geese to carry his hero to the Moon in *The Man in the Moone* or Edgar Allan Poe used a balloon to carry Hans Pfaal there in "The Unparalleled Adventure of one Hans Pfaal." But by the middle of the 19th century, authors began speculating about ways by which people might really be able to leave the Earth. Edward Everett Hale proposed a giant catapult powered by spinning flywheels to launch an artificial satellite in "The Brick Moon," and Jules Verne envisioned a titanic cannon in *From the Earth to the Moon*. Later authors like H.G. Wells and George Griffiths realized the problems with those methods and concocted imaginary

"superscience" methods of negating gravity to allow their heroes to visit other worlds.

At the start of the 20th century, pioneering scientists like Konstantin Tsiolkovsky and Robert Goddard began to investigate the possibilities of rockets as a practical means of space exploration, and space travel moved solidly into the realm of hard SF, where it has remained ever since. Science-fiction writers (and fans) were soon bandying about technical concepts like specific impulse, delta-V, ullage, and gyro stabilization. Some of them, like Arthur C. Clarke, mixed SF writing with research and theoretical work on space exploration.

Unfortunately for science-fiction writers, astronomers during the same era were discovering some uncomfortable facts about the solar system. As early as the 1890s, it was known that Mars was too cold and dry to support any advanced life, and in the 1960s scientists learned that Venus was equally inhospitable. A few writers tried handwaving about asteroids with Earthlike conditions or speculation about the moons of the outer giant planets, but the majority of SF writers began looking to the stars.

Tales of space exploration remained limited to the Solar system until about World War II, when writers began working on a larger scale. Because of Albert Einstein's theory of relativity, the readers were also aware that journeys to other stars were likely to take a very long time. To speed

things up, SF writers began a long tradition of coming up with ways to cheat Einstein. E.E. "Doc" Smith's "Lensman" series used the "inertialess" drive to let spaceships crack the lightspeed barrier; others postulated short cuts through hyperspace, instantaneous "jump" drives, space-bending warp drives, and a long list of methods ranging from barely possible to ridiculous.

In modern science fiction, space voyages and interstellar faster-than-light travel are part of the "furniture" of the genre. Authors no longer have to explain how the spaceships work or waste much time describing the thunder of the mighty rocket engines, because those are all so familiar to the readers from movies and televised space missions.

WHY SPACE TRAVEL?

Given that science fiction covers all possible futures, alternate pasts, other realities, and transformations of the human body and mind, it may seem odd that so much energy in the field is devoted to stories about voyages in outer space. Some see this as a continuation of the American idea of the frontier, with space fiction as nothing more than Westerns with ray guns. Others speculate archly about the sexual imagery of rockets. Certainly there is a lot of powerful symbolism involved in the idea of rising up away from Earth and mundane concerns to soar among the stars. In just about all mythologies the sky is where the gods live.

But there is more to space travel than just the symbols. The simple fact is that space travel (and interstellar travel) are the most plausible ways to have stories about humans in settings that are not Earthly locales and interacting with beings who are not other people like themselves. This is not very different from descriptions of fantasy settings – Narnia and Middle-Earth are not Earthly locales and have nonhuman inhabitants – but there is an important difference. Alien worlds in outer space are fairylands

What's Not in This Book

Though *GURPS Space* is intended as the chief sourcebook for science fiction roleplaying using the *GURPS* system, the main focus of this book is adventures in space and on other worlds. There are whole subgenres of SF that aren't covered here, because they're important enough to get their own sourcebooks. Descriptions of specific game universes are covered in *GURPS* worldbooks. *GURPS Infinite Worlds* covers time travel, interdimensional travel, and alternate histories – and presents a campaign framework that links *all* the *GURPS* worldbooks. *GURPS Powers* describes psionics and other super-powers. Forthcoming "tech books" will provide shopping lists of futuristic gadgets.

that could be *real*, and that don't require special magic to visit. Even the other worlds of the Solar system turn out to be strange and interesting in ways unlike anything on Earth. Just as Jules Verne's stories of

extraordinary voyages to Africa or the ocean depths let his readers visit those exotic places, space fiction lets Earthbound readers "play tourist" among the wonders of the Universe.

Hard and Soft Science Fiction

In discussions of science fiction, "hard SF" refers to stories in which the science is as accurate as possible, and usually the focus of the story as well. "Soft SF" has shifted slightly in meaning over the years. Originally it referred to stories focusing on the "soft sciences" – psychology, sociology, history, etc. Those are the sciences concerned with human behavior; and in time soft SF began to refer to stories that de-emphasized the science in favor of closer attention to the characters and their emotions.

What started simply as a matter of classification turned into a minefield when some fans and authors tried to insist that *only* hard SF was "real" science fiction, and that any stories that subordinated the science to the characters were somehow inferior or pretentiously imitating mainstream fiction. In an interesting boomerang effect, many critics outside the field have taken much the same line, insisting that all SF is "just about gadgets," and any stories that portray human emotions and relationships aren't science fiction because they're too *good* for the field.

In this book we're going to avoid any judgments about what sort of fiction is best. Hard SF refers to stories with a strong emphasis on scientific accuracy, while soft SF here means stories or campaigns that do not. Which is best depends on what the players and GM do.

Science Fantasy

One might expect the least realistic form of SF to be what's often called "science fantasy," in which scientific and magical elements are blended. Examples include Heinlein's story "Waldo" and Christopher Stasheff's *Warlock* series.

But in point of fact science fantasy can have its own varying degrees of realism. If the magic is tightly defined and the interactions between magic and science are carefully thought out, then it can be just as realistic as any moderately hard SF with one or two bits of imaginary science. The magic just fills the niche of "rubber science." A great example of highly realistic science fantasy is the **GURPS Technomancer** setting, which blends "technothriller" technology with rigorously explored magic, and addresses all the social and political implications of industrial-scale magic in a scientific and rational society.

By contrast, most superhero settings include both magic and super-science, and treat neither one with much realism at all. Wizards, sentient machines, aliens, avatars of powerful gods, and mutants with strange powers all coexist, yet the society in which they operate shows no effect at all. Nothing is realistic, but it's all a lot of fun and allows cool adventures in capes and spandex.

Game Masters can certainly combine fantasy and SF in a **GURPS Space** campaign; treat the magic as just another area of "rubber science" and set the realism level as needed for the desired style of campaign. Obviously, a full discussion of fantasy is beyond the scope of this book, but **GURPS Fantasy** and other sourcebooks can supply the missing ingredients.

DESIGNING THE SPACE CAMPAIGN

Much of the excitement of a star-spanning campaign comes from having a detailed, believable background, and this section provides an overview of how to create one. These rules are not tied to any single vision of the future. This book is not intended to impose a background on the game; rather, it gives creative GMs the tools to develop *any* type of outer-space campaign.

Designing a complete space campaign involves several decisions.

Type

This is the big one: what kind of campaign will it be? What will the PCs *do*? Are they military officers, explorers, or traders? Would they rather engage in combat or diplomacy? Game Masters may wish to poll their potential players to see what type of campaign most of them like best.

Scope and Interstellar Travel

How much space does the campaign universe cover? Will it be set within a single star system, around a few dozen nearby stars, or in a whole spiral arm of the galaxy? This decision is tied to the choice of faster-than-light drives available: the faster the drive, the more territory that can be covered. Are habitable worlds rare, common, or innumerable? And how close are they in terms of travel time? The more quickly the PCs can travel between worlds, the likelier they are to interact on a large scale – sharing governments, trading, extraditing criminals, or fighting wars.

Interstellar Societies and Organizations

Do the characters live in a massive empire or a loose-knit alliance? Is the government restrictive? Are the police and military effective? Are there many societies, or just one large super-civilization? Note that the number and size of societies in the campaign are tied to the scope. What interstellar organizations are important? And what is the *history* of interstellar civilization?

General Technology

What are the campaign's average and maximum tech levels? What sort of FTL communication, weaponry, medicine, and personal gear will be available? The technology in a campaign affects what type of adventures are possible, so Game Masters must be sure that the available tech fits the desired campaign type.

Drawing the Map

Where are things in the campaign relative to each other? What are important places and why? Traditionally science-fiction universes feature a "core" of advanced, heavily populated worlds and a frontier zone or "rim" where colonies are young and the government's power is weak. If rival empires are cheek-by-jowl the political situation will be very different than if they are separated by wide expanses of unclaimed space.

Aliens and Other Nonhumans

In the campaign are the "good guys" all human? What exactly constitutes "human" anyway if cyborgs, mutants, and uplifted animals are part of the setting? Are there allied species? Are there "bad guy" civilizations? What about vanished races? What is the role of artificial intelligences?

Local Societies

What are the specific worlds and places the characters will spend time in like? How do they interact with interstellar society? What are the local laws and customs, what starship repair facilities are available, and what's the best place to get a plate of Rigelian chili?

SCALE AND SCOPE

The scope of the campaign is the size of the environment in which the characters operate, and the scale is the level at which they can affect that environment. Characters who are the commanders of a space station in a game confined to that station have limited scope but relatively high scale.

Ships and Outposts

A common and very useful situation in science fiction is to chronicle the adventures of a daring spaceship crew as they voyage through the galaxy. Undoubtedly *Star Trek's* U.S.S. *Enterprise* is the most famous example, but there are scores of others. All of them can trace their ancestry back to sea stories, from the Horatio Hornblower novels clear back to the *Odyssey* or the story of Jason and the Argonauts.

A tremendous strength of the ship-based dramatic framework is its flexibility. The characters are in a familiar setting, but that setting is mobile, letting them interact with new antagonists and encounter new situations. This applies to roleplaying campaigns as well as fiction. The ship itself becomes a natural "home base" for the characters. Players may get quite attached to their in-game starship, drawing up deck plans, poring through the ship-design rules for upgrades to drool over, or designing insignia. But since the ship moves around, the GM can easily introduce the characters to new adventures. The relative cost of a spacecraft is very important: if only governments can afford them, the setting will have a very different feel than if a group of startup entrepreneurs can get a used ship and start trading.

Probably the most important bit of preparation for any ship-based campaign is to create the starship itself. If one or more of the players have a "gearhead" bent and are interested in delving into technical minutiae, it may be a good idea to let *them* do the design work, within the limits of budgetary and technological restrictions imposed by the Game Master (and possibly the campaign setting). The ship they create can be a great guide for the GM in creating adventures. Players who stuff their ships with weapons obviously want to be able to point those weapons at something. Let them chase space pirates or fight off an alien invasion. If they pack the sensor suite with planetary-survey instruments and give the ship enough onboard fuel purifiers and repair shops to keep it running for years away from civilization, they're probably going to want to explore the great beyond.

The Outpost

A variant campaign idea is that of the outpost or space station. Like a ship, an outpost framework provides a cozy "home base" for the characters. Unlike ships, outposts are stationary; adventure has to come to them. Important outposts in SF include the titular space stations of the *Babylon 5* and *Deep Space 9* television series, and the giant space hospital of James White's "Sector General" stories.

Outpost campaigns have many of the same concerns as those built around a starship. Typically a station is larger and more self-sufficient than a ship, but this just means its enemies get to be more powerful. Visitors to the outpost are the obvious adventure hooks, but occasionally the crew does get to go off on missions within the station's area of responsibility. Because of the more static nature of an outpost campaign, adventures are likely to be less action-oriented and involve more roleplaying and politicking.

The crew of a small merchant starship that voyages among distant galaxies has a colossal scope but a limited scale.

The two are linked. A gradually increasing physical scope gives the players a chance to get used to each

level of complexity and size before introducing the next. As the characters improve in personal abilities and gain wealth and power from their actions in the game, their scale naturally tends to increase as well. An increase in scope can provide

increasingly powerful characters with appropriate challenges by bringing them into contact with new and mightier opponents. So what if they are masters of a whole star system when there is a whole vast galaxy out there?

Ship-based campaigns necessarily have a large physical scope. Colony campaigns and post-apocalyptic settings may be relatively limited, but since a theme in both subgenres is “pushing back the frontier,” the scope will likely expand.

Physical scope is linked closely to technology, especially transportation. A large scope means little if rapid transport makes everyplace effectively “next door.” For a campaign to feel *big*, there must be some effect of distance. Some places must be “far away” and take a long time to reach. In a hard-SF game set in the real Solar system, for

instance, even a trip to Mars takes a year, and voyages to the outer planets can take decades. In that case, the scope feels large because of the long

travel times. A game spanning the whole galaxy would feel compact if a personal spaceship can get from the rim to the core in an afternoon.



Tone

The tone is the “feel” of a campaign – the mood the GM wants to invoke in the setting. There is a vast range of possible tones. To some extent, every author and every story or film has a slightly different one. In classic science fiction, however, several tones predominate.

Action-Adventure

Common in all types of SF, especially film and military SF, action-adventure science fiction emphasizes danger, motion, and physical conflict. Problems are solved with fisticuffs or blaster fire, usually while hanging off the edge of an orbital elevator capsule or speeding hovercraft. There is usually a sense that the heroes will triumph despite all the danger and opposition. Campaigns especially suitable for action-adventure are military, law-enforcement, criminal, and planetary romance. However, just about any roleplaying campaign is likely to have at least some action-adventure moments.

Horror

Horror and SF are Siamese twin genres, born at about the same time from Gothic fiction and maturing together in the pulp magazines. Horror is all about fear: what the characters fear, what the *players* fear, and what everyone fears. Fear works best when the opposition seems unbeatable and implacably hostile. Science fiction can provide a scientific rationale for “conventional” horror about monsters or psycho killers, but it also lends itself well to “cosmic” horror, in which the true fear comes from realizing just how tiny and unimportant humans are in the face of a vast universe. Horror can creep into most SF campaigns, but is especially

suitable in exploration (focusing on alien or cosmic menaces), law enforcement (concentrating on sadistic killers and social horrors), or military (exploring psychological horror).

Romance

For a long time science fiction avoided “mushy stuff” like relationships between characters. That began to change in the 1960s, and recent decades have seen the rise of a whole romantic subgenre of science fiction, written by authors like Catherine Asaro and Lois McMaster Bujold. In romantic SF the focus is on interactions and relationships among the characters, though there is still plenty of room for exploding spaceships and alien menaces.

Space Opera

Sometimes considered a subgenre of its own, space opera is SF with the dials all cranked to 11. The scale is titanic; seldom are characters concerned with the fate of anything less than a whole planet. The range is usually vast. Psychological realism takes a back seat to battles of Ultimate Good against blackest Evil. Scientific realism is back there, too, cowering helplessly as physical laws are broken with contemptuous ease. Spaceships are huge and baroque, doing battle with brightly colored beam weapons. Aliens are many and exotic. Settings emphasize wonder (see below) and plots emphasize action (see above).

Continued on next page . . .

Tone (Continued)

Surreal

Surreal SF questions our very notions of reality. If computer-generated “virtual reality” can simulate the real world, how do we know the world is real? If telepaths or brainwashing can alter our memories, how do we know who we are? If alien shapechangers or sophisticated androids can take the place of other people, how do we know who is who? Philip K. Dick was probably SF’s greatest surrealist, and he explored all these questions. A surreal SF game can be as light as any silly universe, or as terrifying as any cosmic horror campaign. Any campaign can get weird, but it works best with the paranoia of espionage or the strange new worlds of exploration.

Thriller

Thrillers emphasize suspense. They sit somewhere between horror and action-adventure. In a thriller the heroes are outclassed by the opposition, and the possibility of failure is very real and worrisome. Instead of fear or pumping adrenaline the dominant emotion is suspense. Much of cyberpunk SF adopts a thriller tone, and it goes with espionage or criminal games like chrome on a blaster. A subset of thrillers is the quasi-SF “technothrillers,” which are typically near-future SF emphasizing loving descriptions of cool gadgets and detailed plans.

Travelogue

One of the oldest styles of SF story, the travelogue subordinates characters and action to descriptions of exotic settings. In Utopian societies it can degenerate into particularly boring “tours of the balloon factory,” accompanied by lectures on the merits of the Social Credits movement, but skilled writers from Jules Verne to Jack Vance have made the fantastic voyage a mainstay of the genre. In a roleplaying campaign, explorers and merchants are good frameworks for a travelogue, and a planetary romance is nothing but a travelogue with swordplay. Hitting this tone requires a GM who is very good at creating new places and describing them in an entertaining fashion.

Wonder

The “sense of wonder” is one of the characteristic emotions evoked by science fiction. When a reader cracks a book and is confronted with time travel, alien beings, or future worlds, that feeling of wonder and excitement is what hooks them on SF. In a roleplaying campaign, evoking a sense of wonder calls for new and different things. Because it is such a standard part of SF, wonder *should* turn up in just about every campaign. It is especially appropriate for games of exploration and discovery, large-scale military games, and any setting with room for amazing things. This is where a game’s “infinite budget” comes in handy, as the GM can make up things as huge or impressive as needed.

Escalating Scale

It’s usually a good idea to start the campaign at a relatively small scale and work up. This way the campaign scale reflects the growing understanding and involvement of the *players*. Get them used to the way things work in one sector of the galaxy, then let them operate on a successively larger scale. The “Lensman” series by E.E. “Doc” Smith is a good example of this process in fiction: the scale is initially confined to the Solar System, but by the end the heroes are fighting a war whose outcome will determine the fate of two galaxies.

Exactly what constitutes “small” and “large” scale depend on the campaign itself and what the Game Master sees as the ultimate end of things. If the campaign takes the leaders of the United Earth government to their ultimate conquest over all intelligent life, then “small” scale means they start out as merely the rulers of six billion people, with a paltry few trillion dollars at their disposal. On the other hand, if the GM imagines the players as rising from starport scum to the ranks of successful merchant captains, then small means owning nothing but some rags and a dead rat, and large means the dizzying heights of middle-class small business ownership.



CAMPAIGN TYPES

What will your campaign be about? Will the characters be planet-bound or spacefaring? Good citizens or nefarious pirates? Are they after money, adventure, knowledge . . . or something else? There are several types that recur in science-fiction stories and games.

STRANGE NEW WORLDS

The theme of the campaign is the search for new worlds – with the thrill of discovery and the adventure that it brings.

Character Roles: Characters can be private explorers or members of a government Scout Service making contact with strange worlds. Scout crews include scientists and rangers (p. 16), and diplomats or merchant representatives might be present if the world is inhabited. Even pirates sometimes go exploring.

Things to Do: Scouts are not only expected to discover and survey worlds from orbit, but to land on the planet to discover any potential dangers to the colonists who may follow. There are dozens of things to find on an unfamiliar planet – strange, threatening animals or aliens, mysterious ruins, lost colonies, unsuspected pirate or rebel hideouts, and bizarre natural phenomena.

Campaign Advantages: PCs who work for a government or private survey organization will have a powerful Patron who supplies equipment and a ship. But they will often be in remote space – away from daily control by their superiors. The variety of new worlds provides campaign diversity. This campaign can be ideal for small groups – a scout crew can be as small as one person.

Campaign Disadvantages: If the PCs work for an interstellar survey service, space navy's exploration branch, or a private (probably mercantile) organization, they will likely explore worlds by assignment. On the other hand, they might be exploring on their own – in which case their ability to keep a starship fueled and supplied depends on finding

Realism

"Realism" has two meanings in a *GURPS Space* game. The first is the level of physical realism – how "hard" the science is and how plausible the technology. The second is the social or psychological realism – how realistically people behave.

Scientific realism, surprisingly, is *not* the ultimate goal of every science-fiction campaign. Certainly SF literature has plenty of "rubber science," and in SF films it's a noteworthy event if they get the science *right*. Internal consistency is more important than strict accuracy. Game Masters are free to set the level of scientific realism at whatever level supports the games they wish to run. Different realism levels have different advantages and disadvantages.

Strict adherence to "hard science" gives the campaign the advantage of plausibility. It makes the suspension of disbelief very easy. The obvious disadvantage is that there are lots of things that are impossible in the real world but are nevertheless a big part of SF, such as faster-than-light travel. A step up from pure hard science is "mostly hard" SF, which allows one or two bits of imaginary science (like faster-than-light drives) but rigorously works out all the implications and effects on the world.

More removed from realism is "handwaving" SF, best exemplified by television and film. We're assured that this is all science (rather than magic), but the exact mechanisms are never explained, and capabilities are devised on the basis of plot demands rather than strict science. There is usually a reasonable amount of internal consistency, but it's very much *fictional* consistency. At the far end of the realism scale is purely "cinematic" reality. Spaceships look cool and make impressive whooshing noises in deep space. People carry hand weapons like "energy swords" or plasma-firing crossbows, and never mind how they work.

By contrast with scientific realism, *social* realism determines how realistically the characters in the setting behave. It can also be called the "rigor" of the game world. In a realistic setting, all actions have consequences, villains are not motivated simply by villainy, and people think their actions through.

Somewhat less realistic is the tone adopted by most films. For the sake of narrative convenience, the heroes don't suffer consequences as long as they win and their actions were done for a good cause. Shooting up the mall is okay as long as no innocents got hurt and the bad guys needed shooting. Least realistic is what might be called "mythic" science fiction, which adopts an almost fairy-tale attitude of absolute good and evil. Consequences are not based on reason, but on karma or "cosmic justice."

Think of social and scientific realism as the different axes on a graph. Stories can be very realistic in one sense and completely unrealistic in the other. Much early SF strove for solid hard science realism but then used characters and plots of fairy-tale simplicity. Much of the "New Wave" of the 1960s and 1970s took the opposite approach, using psychological realism and completely imaginary science. Set both realism levels to support the kind of adventures the players and GM want: high science realism and moderate social realism for Indiana Jones-style exploits on a near-future Mars mission, low science and high social realism for gritty political drama in the Galactic Empire. Outer-space swashbuckling adventure gets a low setting for both, and so on.

profitable worlds. For the GM, a scout campaign means constantly generating new systems (and new surprises).

References: *Rendezvous with Rama* by Arthur C. Clarke; *Ringworld* by Larry Niven; the *Tschai* books by Jack Vance; the various *Star Trek* television series.

Space Tourists

A slightly different kind of exploration is that done by individuals using commercial transport to visit exotic places. Just as tourism has become a major industry in many places here on Earth, SF writers have imagined feckless earthlings or obnoxious aliens taking package tours of other planets. Douglas Adams' *The Hitchhiker's Guide to the Galaxy* is a classic of comic SF, and many of L. Sprague De Camp's "Viagens Interplanetarias" stories involve tourists. Since few people spend their lives being tourists, this is best used for a mini-campaign or an arc within a larger ongoing game.

A tourist campaign provides a plausible way to throw together people from radically different background; it means the heroes don't have access to much in the way of firepower or super-technology; and they probably don't have their own starship to use as an instant getaway. Tourists are probably best used for a light or semi-comic scenario, although there are interesting possibilities in throwing unprepared ordinary people into a deadly drama of spies and doomsday weapons.

THE HIGH FRONTIER

The idea of the frontier is a very powerful one in science fiction. A frontier zone is where civilization meets the unexplored wilderness. They are typically places of freedom, opportunity, and danger – all key ingredients for a roleplaying campaign.

Colony Alpha

The characters are colonists settling a newly discovered world. They may be humans, a mix of races, or beings genetically engineered to exist

in the new environment – making them almost aliens to the rest of humanity.

Character Roles: The PCs should all be rugged survivors. Those with good outdoorsman and low-tech craft skills will do best. However, colonists may also include political or religious refugees, criminals, and minorities – and not all of these will be survival types. Some specialists may be needed to operate equipment, exploration vehicles, or weapons. There might be a government representative.

Things to Do: The basic idea is to tame and settle a hostile environment. Many twists can be added – do the colonists have access to FTL drive, or

are they "stranded," arriving by generation ship? Are they the first colonists or the follow-up team? (If they are the follow-up team, are the original colonists still there when they arrive?) Are there hidden surprises, such as a bizarre ecosystem, unknown aliens, Precursor relics, or a smuggler base? Are the colonists unified or is there strife between factions? Is this a peaceful colony or an outpost in disputed territory? Are there menacing pirates, aliens, or hostile governments back home?

Campaign Advantages: Colonists won't need a starship. The GM needs to design just one star system, although great detail will be required.

Alien Archaeology

Whole civilizations could be born, spread across the galaxy, and finally go extinct before humans ever venture off Earth. Alien archaeology offers the scientific puzzle of figuring out an alien civilization from potsherds and inscriptions, the Indiana Jones thrills of evading traps and defenses in tombs and temples, and the classic RPG experience of exploring vast underground complexes full of danger and treasure.

If the ancient aliens were more advanced than humans, then their ruins are potential treasure-troves of ultra-tech items – which is likely to attract rival archaeologists, looters, and sinister government agents. Finding out just what made the aliens go extinct can add some urgency to the pure science, especially if it turns out to still be lurking around somewhere. And there's always the chance that some of the ancient aliens aren't extinct . . . we just don't see them right now. This can be good or very bad indeed, depending on how powerful the aliens are and what they want.

H. Beam Piper's classic story "Omnilingual" involves space archaeology, as do more recent works like Alastair Reynolds' *Revelation Space*.

Big Dumb Objects

One type of alien environment often seen in recent science fiction is the gigantic artificial habitat. Inspired by the theoretical speculations of scientists like Freeman Dyson and Gerard K. O'Neill, writers began imagining bigger and bigger artificial worlds. From Arthur C. Clarke's giant starship *Rama* to Larry Niven's *Ringworld*, they became progressively vaster. Book reviewers and critics coined the term "Big Dumb Object" to describe stories about exploring them. Usually the huge habitat is abandoned, or its inhabitants have regressed to barbarism; otherwise there is no mystery and the heroes are likely to be outclassed by their technology. Sometimes (as with *Rama*), there are automatic systems still working. One interesting variant is the living, sentient space habitat described by John Varley in his "Titan" series – it's a *Big Smart Object*, and turns out to be a *Big Crazy Object* as well.

Big Dumb Objects are a great source of the "sense of wonder" so important to science fiction, and their tremendous size allows for a wide variety of environments, cultures, and adventures. A whole campaign could be set on a single Object as the heroes wander about seeking clues to the origin and purpose of it, or look for a way home.

Many players enjoy the challenge of organizing settlements and exploring the frontier. This campaign can work at TL8 or even lower, especially if the PCs arrived on a sublight “sleeper” ship.

Campaign Disadvantages: If the colony is isolated, there will be a limit on available equipment – and its use may be controlled by the colony’s administrators. The GM also has the burden of keeping the campaign more interesting than “build another hut, explore another valley.”

References: *The Seedling Stars* by James Blish; *Hestia and Forty Thousand in Gehenna* by C.J. Cherryh; Harry Harrison’s “Deathworld” series; *Farmer in the Sky* and *The Rolling Stones* by Robert A. Heinlein; *The World At The End Of Time* by Frederik Pohl; the *Alpha Centauri* computer game from Electronic Arts.

Space Colonies

The colonists may not have a world at all – they may be on a giant space habitat in orbit. The physicist Gerard K. O’Neill realized that for an advanced spacefaring society, planets are an awful bother. The solution he proposed is to build large artificial habitats in space. O’Neill even chose a likely location for space colonies, at

the “Lagrange points” where the gravitational attraction of the Earth and the Moon create stable positions. A major space advocacy organization, the L-5 Society, took its name from one of those colony sites.

A slower-than-light starship can be a space habitat in its own right, and the inhabitants of a lost ship might forget their origins and regress to barbarism. There is a whole subgenre of SF stories about weird cultures aboard generation ships.

Character Roles: Player characters can be asteroid miners, zero-g workers, colony administrators, military personnel, or just citizens looking for a new start. On a generation ship they may be warriors, priests, thieves, or techno-wizards.

Things to Do: Help build the colony itself, cope with disasters like meteor strikes, create a new society, defend the station against enemies or criminals, enforce the law, or simply make money. Colonists may have to fight for independence, either from Earth or from a home-grown tyrant. Generation ship barbarians can discover the true nature of their world, and perhaps steer it to its destination.

Campaign Advantages: The Game Master really needs to design just the space habitat or ship, and can even get

players to help with the task if their characters are part of the colony construction team. The scale can be anything from a small space station to a Big Dumb Object (see p. 12).

Campaign Disadvantages: The essentially stationary nature of a space colony may put off players who want to go roving, and even a big habitat may get to be “too small” for the heroes.

References: *The Babylon 5* and *Star Trek: Deep Space 9* television series; the *Mobile Suit Gundam* anime series; *Colonies in Space* by T.A. Heppenheimer.

Survivors and Refugees

Sometimes instead of people going to the frontier, the frontier comes to them. In a space campaign this usually means that the Galactic Empire or other interstellar society has fallen apart, leaving individual colonies to fend for themselves in a time of anarchy. Sometimes the best course is to flee, and shiploads of refugees may wander through space looking for a safe haven from war or invasion. Survivor campaigns are the dark flip side of the dream of the frontier: anarchy, chaos, and domination of the weak by the strong.



Character Roles: Nearly anybody on a colony world can get caught up in the collapse of civilization, but the burden will be heaviest on military personnel (who might be part-time militia), lawmen, and administrators. Technicians become vitally important in keeping civilization running. Among refugees, anyone who can fly a ship or keep it running suddenly becomes a key individual.

Things to Do: Fending off raiders and warlords seeking to take advantage of the chaos, trading for vital supplies with other worlds, salvaging important installations or ships, and rebuilding civilization. Space refugees may wind up explorers, looking for a new home – or fighting to get a foothold on an inhabited world. Some characters may embrace the chaos, deciding to turn raider themselves.

Campaign Advantages: Characters can be people of importance and have a lasting impact on the game universe. Regression limits the effect of powerful technology. Even nearby worlds suddenly are “unexplored territory.”

Campaign Disadvantages: Players may not like the reduced level of technology or the more limited scope. If the PCs can't cope with a situation, there's nobody to turn to for help.

References: Both *Battlestar Galactica* television series; Isaac Asimov's *Foundation* books; *The Long Night* by Poul Anderson.

Planetary Romance

Planetary romance is a very durable subtype of science fiction that focuses on a single world, typically a large Earthlike planet (or a Big Dumb Object, as on p. 12) with lots of exotic alien cultures on it. Notable examples include Edgar Rice Burroughs' “Martian” novels, L. Sprague De Camp's “Krishna” stories, Jack Vance's “Tschai” novels, and Leigh Brackett's “Skaith” series. Planetary romance typically involves a low-technology setting, to allow for swordplay, pirate ships, gladiatorial battles, and similar swashbuckling.

The emphasis is not on the biology or sociology of the alien planet, but rather on perils and adventures. The planet usually has human or nearly human inhabitants, to allow for beautiful maidens in need of rescue.

Running a planetary romance campaign is relatively simple – just drop the heroes onto an exotic world and then throw bandits and pirates and beautiful maidens and lost treasures at them while they search for a way to get home again. It does require substantial preparation, as the world has to be worked out in some detail before the heroes arrive.

Mercenaries

A great many science-fiction military stories involve the exploits of mercenaries – professional soldiers selling their services to various governments and corporations to fight wars on distant worlds.

Mercenaries don't earn any money when they aren't fighting, so there will be plenty of action. Often their employers can't quite afford overwhelming force to throw against the foe, so the heroes face difficult challenges. They get to operate in a wide variety of settings and environments.

Mercenary campaigns tend to be very episodic: the heroes get hired, do the job, and go on to the next contract. It's hard to build up any kind of ongoing “metaplot” under those circumstances. If the enemy are “more numerous than we thought” or “surprisingly well-equipped” too often, the players will start to suspect the GM is stacking the deck. Mercs may get suckered into illegal or covert operations where betrayal is part of the mission.

MILITARY CAMPAIGNS

It's probably no surprise that the most popular SF movie franchise ever was called *Star Wars*. Military-oriented science fiction makes up a large chunk of the genre today and shows no sign of slowing.

Starship Troopers

Characters in a military campaign might be infantry, battlesuit troopers, mechanized troops (tanks,

aircraft, mecha, etc.), or the crew of a warship or space station. They may be employed by a government, or they may work for a mercenary organization.

Character Roles: Characters should be part of the same organization – and usually the same unit. They should have the skills within their group to perform their unit's duties. They might be on the fighting end (in which case they will probably be enlisted men and junior officers), or they might be in command (senior officers and staff officers, with commands of their own).

Things to Do: In wartime, marines will be “bug hunting” in their battlesuits, while spacers are repelling boarding parties on their starships. Fighter pilots will scramble when they are given the signal, and officers will make life-or-death decisions. If the campaign is on the frontier, or if the interstellar government is weak, fighting can continue in peacetime – especially for mercenaries.

Campaign Advantages: Government troops don't have to buy their own equipment. Since the PCs must answer to a higher command, the GM can more easily direct the campaign.

Campaign Disadvantages: Military PCs have a Duty to their organization and its officers. Military regulations might be enforced. Unless the PCs include the captain of a crucial ship or starbase, or the elite squad that always performs the crucial assault, their

individual actions will seldom influence entire battles and wars. If the GM isn't careful, all the battles may start to seem the same.

References: Lois McMaster Bujold's "Miles Vorkosigan" books; the *Faded Sun* series by C.J. Cherryh; *Hammer's Slammers* by David Drake; *The Forever War* by Joe Haldeman; *Starship Troopers* by Robert A. Heinlein; *Space Viking* by H. Beam Piper; the *Cobra* and *Blackcollar* books by Timothy Zahn.

Ace Pilots

The fighter jock is the closest modern equivalent to the knight of fiction and legend: an elite warrior who battles others like him in almost ritualized combats. George Lucas brought the space ace to the big screen in *Star Wars*, drawing parallels between hot pilots of the future and samurai warriors of the past.

Character Roles: Pilot campaigns usually center on a single squadron, either stationed at a base or flying off a carrier. If fighter craft can cover interstellar distances on their own, the pilots could even be mercenaries or freelancers offering their services at hot spots all over the galaxy.

Things to Do: Adventures for space pilots naturally center on space combat (though if they're flying transformable mecha, the battles can just as easily be on the ground). They can also have "shore leave" adventures in port, survive crash landings on dangerous planets, uncover enemy spies, break out of prison camps, do hostage rescues, infiltrate pirate crews, and other interesting things that don't require a fast fighter ship.

Campaign Advantages: PCs can have super-hot fighting machines without being multi-billionaires. Pilots can see action in many different environments. Individual pilots can actually affect the outcome of a battle.

Campaign Disadvantages: Getting the pilots out of their fighter craft may be like pulling teeth. Characters may be overshadowed by their high-tech vehicles. Space battles may all start sounding alike after a while.

References: The *Star Wars* films; *Battlestar Galactica*; just about every World War II air-battle movie ever made.

The Marines

Space navies can only control space. It still takes soldiers to conquer a planet: the space Marines.

Marines are assault troops, the ground arm of the navy. Their most dangerous jobs come in wartime – boarding enemy vessels (if technology permits) and securing beachheads on hostile worlds. Marine contingents are assigned to all warships as security forces.

During peacetime Marines conduct war games, guard naval bases, train planetary militias, and perform "police actions" – commando raids against pirate and criminal bases – in cooperation with the space patrol. In repressive societies, they also crush unrest and rebellion.

The toughest of the tough, Marines live up to their reputation in combat and off duty. They get the dirty jobs, and that's the way they like it. It isn't smart to mess with Marines.

Adventuring Possibilities: The most likely place to encounter Marines outside of battle is in a starport town on leave. Former Marines make well-prepared adventurers, and may know secrets from their military days.

The Big Chair

The exploits of heroic starship captains have a respectable history in science fiction, dating back well before *Star Trek's* Captain Kirk became an icon for the whole genre.

Character Roles: Military vessels have a strict chain of command, with the captain exercising ultimate authority and responsibility. There are several ways to give the other players more to do, rather than focusing entirely on the captain.

First, just because naval vessels in Earth's history had a single commanding officer doesn't mean starships a thousand years in the future must do the same. Conversely, the captain could be a non-player character, with each of the heroes a subordinate officer. This gives the Game Master the ability to "give orders" from the Captain, but leaves the players with the task of finding ways to carry out those instructions.



Things to Do: A campaign centering on a starship captain and officers need not be limited to just military operations. In peacetime the ship can go exploring, assist colony projects, and carry diplomats on first-contact voyages. During war they join in fleet actions, conduct raids against commercial or military outposts, and intercept enemy ships doing the same thing.

Campaign Advantages: A military starship can be ordered into adventure scenarios by the high command (i.e. the GM). The characters have a fair degree of independence within the limits of their duty.

Campaign Disadvantages: It may be hard to come up with enemies who can threaten a powerful starship. As already noted, the captain character may wind up hogging the spotlight.

References: The *Star Trek* films, series, and novels; David Weber's "Honor Harrington" novels; David Drake's "Lieutenant Leary, RCN" series.

STOP IN THE NAME OF THE LAW

A law enforcement campaign has many similarities to a military one, but offers more opportunities for small groups and players who prefer investigation to broadsides.

Space Patrol

A space patrol campaign puts the PCs in a small starship, patrolling the spacelanes, enforcing interstellar law, and protecting civilians from human and alien menaces alike.

Character Roles: Patrolmen (p. 25) or rangers, probably assigned to a ship or frontier space station. They should have the skills to perform their duties; one may be the leader. Alternatively, the PCs could work for a peacekeeping force or an interstellar diplomatic agency.

Things to Do: Aside from patrolling interstellar borders and spacelanes, patrolmen are interstellar policemen, investigators, rescuers, and the all-around do-gooders of the galaxy. If there are pirates to be fought, smugglers to be tracked down, an alien

The Rangers

The Rangers (or Star Rangers) are a paramilitary force trained in survival, rescue, and combat on hazardous or untamed planets. They are practiced outdoorsmen and survival experts. Rangers may also act as "marshals" on new colonies, keeping law and order until the society becomes self-governing.

They are often called upon to guard (or rescue) scout expeditions, and sometimes to join space patrol missions. There is grudging mutual respect between the tough, free-swinging rangers and the spit-and-polish patrolmen. In some settings the ranger service may be an arm of the patrol.

Adventuring Possibilities: On the frontier, rangers are the only law enforcers. PCs might find themselves deputized by the local ranger in an emergency. Ranger PCs can be a lot of fun if the campaign sticks to the ranger's assigned territory, and an all-ranger campaign is possible.

invasion to be blunted, a mystery to unlock, or a distress call to answer, the patrol gets the call. In times of war, the patrol and the rangers are called to duty – whether on covert missions behind enemy lines, escorting convoys, or serving as light combat forces.

Campaign Advantages: The patrol is a powerful Patron, providing equipment and a ship. Patrolmen also have a great range of adventures. This makes a wonderful "space opera" background.

Campaign Disadvantages: Patrol PCs have a Duty to their organization and its officers – and, depending on the campaign, they might operate under tight supervision. The patrol represents interstellar law; it can't go around shooting indiscriminately. Patrolmen often have the privilege of dying in the line of duty.

References: Archetypal patrols can be found in the "Lensman" series by E.E. Smith and in Andre Norton's SF novels. A more recent example is the

The Rebellion

For a different sort of military campaign, the players can run characters who are fighting a war of rebellion against a (presumably) tyrannical regime. The most famous rebels in SF are the Rebel Alliance of *Star Wars*, but there are many others, often based on the patriots of American Revolution or the Resistance during World War II.

Rebellion campaigns offer considerably more flexibility and independence of action than a conventional military campaign. Rebels seldom have a very tight chain of command, and can't be sticklers for discipline and regulations.

A rebellion campaign also has a nice progression in scale. As the heroes score more victories, the rebel side grows in power and the battles can be for higher stakes. Heroes can start out fighting to survive, then take down some small or isolated government outposts, graduate to major offensives, and finally carry the war to the tyrant's stronghold itself!

The biggest problem faced by rebel characters is supplies. Unless there is a friendly government beyond the border furnishing ships and ammunition, the rebels must steal what they need, and carefully hoard what they have.

References: *The Moon Is a Harsh Mistress*, by Robert A. Heinlein; later seasons of *Babylon 5*; David Brin's *The Uplift War*.

Bounty Hunters

No disintegrations!

– Darth Vader, *The Empire Strikes Back*

If the players don't enjoy the regimentation and rigidity of running space patrol characters but still want to chase galactic bad guys, they can be bounty hunters, freelance law enforcement agents tracking bad guys for money. Mike Resnick chronicled the exploits of space bounty hunters in his novel *Santiago*, as well as the "Widowmaker" series.

For the GM, a bounty hunter campaign has much to recommend it. The heroes don't have a vast organization to help them, but they are ultimately on the side of law and order. Bounty offers are perfect adventure hooks, and fugitive crooks can lead their hunters into all sorts of exotic worlds and bizarre situations. There's a satisfying action level, but bounty hunters who bring in smoldering piles of ash too often will suffer consequences.

rangers of *Babylon 5*. A "peacetime" space navy may find itself performing patrol-type functions, even if not specifically a law-enforcement body.

Criminals

Instead of enforcing the law, the player characters may be in the business of breaking it. They may be freelancers, or part of a criminal organization. They may even be "deniable assets" of a spy agency or megacorporation.

Character Roles: Space opera crooks were typically smugglers or space pirates, cyberpunk criminals are typically data thieves or assassins-for-hire, and there have always been high-tech thieves, clever con men, and sinister gangsters in science fiction.

Things to Do: Plan and execute elaborate heist capers, evade the forces of the law, battle rival crooks, or maybe even try to do something decent once in a while.

Campaign Advantages: Players with a lot of initiative can come up with their own criminal schemes, reducing the Game Master's workload. There can be plenty of action and opportunities for roleplaying in a criminal caper.

Campaign Disadvantages: The characters face very formidable opposition, not only from the police but from rival crooks as well, and they have nobody to rely on but themselves. A life of crime involves a lot of frankly ugly behavior, which players

and GMs alike may find distasteful. After a really big score, the characters may wish to retire and enjoy their spoils.

References: Science-fiction super-crooks include Harry Harrison's Slippery Jim DiGriz and the narrator of Samuel R. DeLany's "Time Considered as a Helix of Semi-Precious Stones." Pretty much all the

characters in *Neuromancer* and other works by William Gibson are crooks of one kind or another.

MEDIA AND POLITICS

Humans are social animals. We naturally form groups. Who gets to run those groups, how those groups interact with each other, and how the groups make decisions are always interesting subjects, as are the people who report on them.

Political SF

Science fiction has always had a political component. Many writers have used alien or future civilizations to comment on contemporary Earth. Others have explored different ideas about political power and government. Some authors have focused on those involved in the political process, while others simply show their effect on the lives of ordinary people. Politics between large states is the process of diplomacy, which can shade into exploration and first-contact stories.

Space Pirates

In science fiction, space pirates are a venerable tradition dating back to the pulp era. Unless the players like to run characters who are greedy psychopaths, a space pirate campaign should probably make use of the romantic "rogue with a heart of gold" image familiar from swashbuckling fiction. The pirates only rob ships belonging to bad guys – the Galactic Tyrant, the Evil Corporation, or the nasty aliens.

Space piracy is usually restricted to highly cinematic space opera campaigns. But if everyone can agree to suspend their disbelief, space pirate adventures can use all the brightly colored trappings of pirate fiction: buried treasures, revenge, duels, rescues, walking the plank out the airlock, and lots of swinging around on ropes. To give it the real Errol Flynn feel, make "energy swords" or "vibroblades" the weapon of choice and limit the plasma cannons to point-blank range.

Where piracy, military campaigns, and trading meet is the privateer campaign, in which the adventurers are not part of a military force, but have been given a license (traditionally known as a "letter of marque") to attack enemy shipping. Essentially, they are allowed to act like pirates as long as they confine their piracy to a specific enemy. They can use friendly ports quite openly, and sometimes even get some help from regular military forces. However, they have to be very careful about choosing legal targets, and their license only lasts as long as the war. Privateers are basically self-employed mercenaries, and so privateer adventures can be worked into an ongoing mercenary campaign.

Character Roles: Characters involved in politics can be professional bureaucrats, aristocrats, elected legislators, or regular folks who are “mad as hell” about some issue. They can also be members of an opposition group or even a secret conspiracy.

Things to Do: Bureaucrats can engage in office empire building, or get sent out to act as troubleshooters when crises loom. Elected officials can run political campaigns, outmaneuver opponents in debate, and cut deals. Diplomats may try to prevent wars or establish relations with alien civilizations. Activists struggle to expose corruption and fight oppression. Aristocrats may wind up doing all those things in between lavish court balls and assassination attempts.

Campaign Advantages: Players who enjoy lots of roleplaying will take to political games, but there’s still plenty of action opportunities in the form of assassinations, “black bag jobs” and election-day brawls. Characters can really affect the game world with their decisions. The campaign doesn’t move around much, so the GM can develop one setting in depth.

Campaign Disadvantages: The Game Master has to keep track of a lot of NPCs and factions. Political differences among the players may surface in the game and cause endless arguments. Some players may be frustrated by the need for restraint. The very importance of the characters means that their mistakes can be catastrophic.

References: Robert Heinlein wrote several novels involving political maneuverings, including *The Moon Is a Harsh Mistress*, *Double Star*, and *Revolt in 2100*. Norman Spinrad, Kim Stanley Robinson, and Bruce Sterling are also interested in political themes. Alastair Reynolds’ *Revelation Space* and its sequels combine space opera and political maneuvering. George Orwell’s depiction of a communist dictatorship in Britain in 1984 is probably the most famous SF dystopia. Utopias include L. Neil Smith’s libertarian alternate universe of *The Probability Broach*, and Iain M. Banks’ “Culture” setting.

The Pen Is Mightier Than the Blaster

With the computer revolution of the 1980s and the birth of the “information age,” the power of the media and the importance of how information is presented became a major theme in science fiction. Cyberpunk fiction is all about information and virtual reality, and even the most rivet-studded hard SF now must at least acknowledge the importance of information networks. The *Traveller* role-playing game uses the “Traveller News Service” as a way to disseminate adventure hooks, red herrings, and information about the setting.

Character Roles: Freelance journalists have the flexibility to chase obscure leads, but reporters for a major news service have better resources. The people behind the camera – cameramen, producers, technicians, fixers, and bodyguards – are almost as important as the reporters themselves.



Things to Do: Journalism naturally lends itself to a game of investigation, so the Game Master can come up with some sinister conspiracy or government cover-up and then let the PCs uncover it. In oppressive societies, reporters may risk their lives to

present the truth. Travel writers combine journalism and exploration.

Campaign Advantages: The characters are investigating and exploring – getting into adventures, in other words. They don’t have official status or heavy firepower, so getting out of those adventures requires cleverness and courage. Breaking an important story can give the PCs real influence.

Campaign Disadvantages: The GM has to dangle lots of adventure hooks for his PCs to follow, and they may go chasing after red herrings. Characters may not be well prepared for danger.

References: John Barnes’ novel *Mother of Storms*; Norman Spinrad’s *Bug Jack Barron*; William Gibson’s *Pattern Recognition*.

Agents of Terra

The espionage campaign focuses on intrigue, covert operations, and double-dealing among the stars.

Character Roles: The PCs must be deadly and capable. They may be

suave and sophisticated, or they may look and act like interstellar scum – it doesn’t matter as long as they can work undercover and kill efficiently when necessary. They might also be “specialists,” brought in when needed for specific assignments.

Heroic Bureaucrats?

Not every hero packs a blaster or flies a starship. Campaigns can be built around characters in some fairly unlikely jobs. Low-level corporate managers or government bureaucrats may get sent to a remote frontier world to deal with a problem, only to find it's a much bigger and deadlier problem than they were led to expect. Officials within seemingly mundane agencies like the Interstellar Trade Commission (p. 24) or the Postal Authority (p. 25) can get involved in scams, conspiracies, or plots by hostile powers. If the essence of drama is characters under stress, then a very dramatic campaign can result when the characters aren't heroic warriors or skilled agents, but unprepared desk jockeys forced to rise to the occasion. Isn't that what being a hero really means?

PCs don't have to be traditional "secret agents" – they might work for naval intelligence, the Patrol's covert office, a corporation's industrial intelligence bureau, or an obscure regulatory or law-enforcement agency. They might even work for the Other Side. Or they may be private operatives.

Things to Do: Spies work to preserve their organization and to cripple or destroy hostile spy networks. They infiltrate criminal or enemy organizations while eliminating moles and double agents in their own outfit. Important people and vital secrets must often be rescued, kidnapped or stolen. Most importantly, spies must discover and stop the latest insidious plot to take over the universe – and the galactic Illuminati are everywhere.

Campaign Advantages: Spy agencies are often Patrons, providing specialized and expensive equipment. Friendly law-enforcement organizations may be cooperative (or jealous, or traitorous). Except when on assignment, PCs will usually be free to do what they wish. Many agents are paid well. This campaign works well for a small group.

Campaign Disadvantages: Spies have a Duty to their Patron, and will often be sent on dangerous missions. Both the individual PC and his Patron will have Enemies. There is also a lot of double-dealing – PCs might be sent on suicide missions, fingered by informers, or targeted by opposing assassins.

References: The "Flandry of Terra" novels by Poul Anderson; Iain Banks' "Culture" novels; the "Stainless Steel Rat" series by Harry Harrison; Keith

Laumer's "Retief" stories; and Eric Frank Russell's *Wasp*. Cyberpunk SF turned spies into corporate agents in stories like William Gibson's *Count Zero*.

WORKING STIFFS

The future won't be devoted entirely to covert operations, gunplay, and larceny. Just earning an honest living can be exciting enough if the job takes you to new worlds. Campaigns designed around ordinary careers can provide ample opportunity for adventure.

Selling the Moon – Wholesale

The characters are merchants – free traders or employees of a merchant company. Profit is the name of the game.

Character Roles: PCs are merchant ship crew members. Some should have mercantile and shipboard skills; a few ex-military types might be handy.

Things to Do: This campaign is about getting cargo from origin to destination – despite the hazards of travel, competitors, and alien menaces. An added dimension comes if the merchants must develop their own markets: evaluating new worlds for profit potential, making deals with alien civilizations, finding new cargo and ways to sell it. They can ride the coattails of survey vessels – or even explore on their own. Variety can come from special charter runs or unusual passengers.

Campaign Advantages: If a merchant makes money, he may feel that the ends justify the means – players who can't do things "by the book" may enjoy this campaign. Free traders have many options on where to go and what to do, while company men may be allowed to break regulations if they turn a profit. Company men have a Patron in their employer.

Campaign Disadvantages: Free traders are on their own when it comes to equipment and a starship. They will constantly have to keep an eye on their finances and will be in big trouble if they run out of money. (Impoverished traders may try to skip out on their payments and go criminal . . . becoming pirates.) Company men may be restricted by regulations, specified trade runs, and other forms of corporate control.

References: Poul Anderson's "Van Rijn/Falkayn" stories; A. Bertram Chandler's "Commodore Grimes" series; C.J. Cherryh's "Chanur" and "Merchanter" series; Robert A. Heinlein's *Citizen of the Galaxy*; Andre Norton's "Solar Queen" novels; *Cascade Point* by Timothy Zahn.

Prospecting

Independent-minded asteroid miners began showing up in SF in the 1940s, and soon became a staple. The Belt is another potential "new frontier" where people can make a fresh start. SF prospectors tend to seek exotic things: radioactives, magnetic monopoles, alien artifacts, quantum black holes, helium III, or chunks of antimatter.

Character Roles: Other than prospectors, likely characters for an asteroid-mining campaign include explorers (to locate resource-rich rocks), pilots, technicians, scientists (especially when the prospectors are digging up artifacts or black holes), merchants (to sell the stuff), and possibly some well-armed guards to ward off claim-jumpers.

Things to Do: Actually finding stuff and digging it up isn't especially interesting, even if the job is difficult and dangerous. Adventures come when the prospectors find something unusual, or face claim-jumpers, or stumble across a hidden rebel base.

Campaign Advantages: Prospectors have a lot of autonomy, and the campaign can have lots of gritty hard-SF details. Dangerous work and rough company can provide action, but it's likely to be small-scale conflict suitable for a group of PCs.

Campaign Disadvantages: The Game Master needs to work up a star system in some detail if the characters are going to spend time searching for wealth. Characters without their own ship will be at the mercy of whatever mining company controls the best rocks. Game Masters have to make sure the characters can make a living, by adjusting the chance of finding something of value and setting the market price accordingly.

References: Larry Niven's "Known Space" stories; Poul Anderson's *Tales of the Flying Mountains*.

THE ABSURDIST CAMPAIGN

If life on Earth is incomprehensible and sometimes blackly comic, how much worse might a galactic empire be? Absurdist SF is often satirical, but an absurdist space campaign is usually an excuse for straightforward humor, from simple silliness to more subtly bizarre.

Character Roles: Innocents abroad – possibly highly capable on their own world, but in galactic society they are but motes caught up in chaos, not even able to go to the male mammalian biped's room without a guide-book. The being with an angle – someone who (thinks it) sees a profit to be made from the situation. Characters from other campaign types, twisted to suit.

Things to Do: Get home; rebuild home; buy a nice quiet planet; find out who's behind it all; make a documentary; become emperor; find a decent cup of coffee; try to avoid trouble.

Campaign Advantages: Can go anywhere and take inspiration from anything (following classic clichés to absurd conclusions). The GM can rewrite galactic history and assign TLs to suit himself. Characters rarely die, except absurdly.

Campaign Disadvantages: Can go anywhere. Needs players and GM willing to improvise and not take any



of it too seriously. Boring if drawn out, so best used as light relief between episodes of a serious campaign.

References: Douglas Adams' *The Hitchhiker's Guide to the Galaxy*; Harry Harrison's *Bill, The Galactic Hero*; Terry Pratchett's Discworld books, *The Dark Side of the Sun*, and *Strata*; almost anything by Robert Sheekley or Jack Vance; *Lost in Space*; *Red Dwarf*; the campiest episodes of *Star Trek* and *Dr Who*.

Heroic Engineering

Science fiction is defined as stories about or involving science and technology, and so it's natural that a very old subgenre concentrates on stories about people engaged in large technology projects. This was once a central part of SF, but was gradually shoved aside by more adventure-oriented fiction. But it never died out completely. Stories of heroic engineering include Arthur C. Clarke's *The Fountains of Paradise*, about the construction of a space elevator, and parts of Kim Stanley Robinson's "Green Mars" series about terraforming Mars. In heroic engineering stories, the actual process of doing the job and overcoming the technical challenges are major themes rather than just background for drama.

In a *GURPS Space* adventure, heroic engineering can be an interesting alternative to blaster fights and space marketing. Tasks like designing a new starship or completing a space colony can be quite fascinating, even if they don't involve as much adrenaline. Engineering adventures do require players who are interested in coming up with their own equipment designs, using the rules for New Inventions (p. B473) or Gadgeteering (p. B475).

The Game Master can complicate matters with hidden flaws, industrial spies among the labor crew, sinister forces intent on stopping the project, and unforeseen expenses. Those problems can generate blaster fights and hovercraft chases to keep the non-engineer characters busy. However, it may be necessary for the Game Master and some players to do the actual design evaluation and skill rolls via e-mail rather than during game sessions, if other players are easily bored.

Construction

You don't get much more blue-collar than construction work, even if it's a thousand miles up in orbit. All those orbital stations, starships, space colonies, and whatnot don't build themselves (unless it's a game setting with advanced biotech and living spaceships, of course). The crews who do the work of building them can get into all kinds of interesting trouble.

As with prospecting, the work itself may be only a backdrop. The real fun comes when the workers face labor racketeers or corporate thugs, or when the colony they're working on suddenly declares itself independent and gets into a shooting war, or when it turns out someone on the shift is part of a smuggling ring. If the project includes asteroid mining for raw materials, then the work crews may spend part of their time as prospectors, which adds all those adventure possibilities.

Who Needs Starships?

While flying from world to world aboard a sleek starship is the most common image in science fiction, some settings use other means of traveling from planet to planet. Robert Heinlein's *Tunnel in the Sky* shows explorers venturing to other worlds through teleport gates. Dan Simmons' *Hyperion* series makes it even easier – people can have houses with rooms on different planets! The *Stargate* film and television series used a similar idea.

Getting rid of spaceships makes the setting much more convenient for heroes who aren't rich enough to afford their own ship, or to buy passage frequently. This

doesn't completely eliminate the need for brave pilots, since many settings require somebody to go out and find places to put gates. (The Heinlein novel avoids this by letting the gate projectors probe out for new locations, and *Stargate* assumes a pre-existing network.)

Interstellar gates are quick and easy to use. How expensive they are depends on how much energy they consume and how hard they are to build. If the cost is low, then every place in the galaxy is “next door” and civilization will function as a single giant city. A high cost limits private trade and travel, but military forces can still deploy instantly to meet threats.

ALIENS

Nothing affects the flavor of a science-fiction campaign as much as the presence (or absence) of alien races. There can be one alien species in a campaign, a handful, or a great many, and their roles can range from subjugated to overlords. Chapter 6 contains detailed rules for creating alien beings.

ALONE IN THE COSMOS

There is only one sentient species, and all characters must belong to it. Widely variant forms are still possible, however. A human-only cosmos can still be diverse and exciting – especially if bioengineering is common! Many stories of galactic sweep, such as Herbert's *Dune* books and Asimov's *Foundation* series, have included no aliens. In Iain M. Banks' “Culture” series, humanoids from different worlds have merged into a single “race” through bioengineering and cultural assimilation.

THE GALACTIC CLUB

There are only a handful of star-traveling life forms. Almost anyone will recognize each type of alien and know the important facts about it. This arrangement has the advantage

that the GM can develop each alien species in some depth, and the players won't have any trouble remembering which is which. Larry Niven's “Known Space” series has only about ten alien species.

ALIENS EVERYWHERE!

There are many intelligent species in the universe. Unless one is dominant or exotic, only those with Area Knowledge of its region of space will recognize it on sight. The various aliens mingle, and there may be true interspecies civilizations. David Brin's “Uplift” series has many aliens, and the *Star Wars* universe suggests a great variety of intelligent beings. Alien species in a multispecies setting can be categorized as:

Dominant

One or more species may dominate others; their power may be military (conquerors or peace keepers) or economic (manufacturers, traders, or explorers). Dominant alien civilizations are well known near their regions of space. The opposite is *subordinate* species that are dominated by others. Humans are often a dominant species in fiction, as in the *Star Wars* films.

Common

A race that is older, fast-breeding, or aggressive in exploration may be encountered often. Such races are also well-known in their localities, regardless of dominance. The opposite is rare; such races may be new to interstellar civilization, secretive, or slow-breeding. In James Blish's *Cities in Flight* series, humans are common but don't dominate other species.

Exotic

Races may be well-known because they have odd customs, bizarre reputations, unusual biology, or control of a particular technology. In *Dr. Who* the Gallifreyan Time Lords are known throughout the galaxy for their mastery of time, even though they seldom leave their citadel.

Advanced

Some races might have a higher TL than the rest of the campaign – possibly even so advanced as to seem like gods compared to everyone else. They may use their power to help “lesser” civilizations, or to conquer and oppress them! The opposite is *primitive*, a race that is technologically backward. In the *Babylon 5* television series, the Vorlons are known to be vastly more advanced than other civilizations.

Precursor

Many SF novels have been written around the mysterious “Precursor” or “Forerunner” races: once-great civilizations that have disappeared, leaving only puzzling ruins and artifacts behind. In the *Traveller* universe, the mysterious “Ancients” even transplanted Earth life across a vast region of space, so that hundreds of planets have native humans.

Subrace

A race may include several subspecies or offshoots. These may exist within a single society, perhaps with a

caste system. Separate societies of subspecies might also exist; perhaps they separated millennia ago. In Jack Vance’s “Tschai” series there are Blue Chasch, Green Chasch, and Old Chasch, all different branches of the same original species and all mutually hostile.

Descendant

A popular theme in SF literature is the “fallen race” descended from a once-mighty civilization. Or space might contain several subraces, all descended from the original Precursors (or the splintered First

Human Empire). The decadent Martians of Edgar Rice Burroughs’ books are an example.

Unknown

The GM may create one or more alien species – potentially friendly or hostile – that are unknown to interstellar society at the start of the campaign. Usually unknown aliens live beyond the edge of explored space, but in Niven and Pournelle’s *The Mote in God’s Eye* the Motie home system is within the human empire, isolated by a quirk of interstellar geography.

SOCIETIES

Having decided what kind of campaign it is, the Game Master needs to pick a society that supports that kind of adventure. SF literature describes dozens of different kinds of interstellar societies. The most important things about an interstellar civilization are size and political type.

Size is largely determined by the speed of FTL travel and communications, which will be discussed in detail in Chapter 2. In general, the faster the ships can travel, the larger a coherent interstellar nation can be. Central control is difficult when the borders are more than a month’s travel from the capital.

The most common political types are the alliance, federation, corporate state, and empire, as outlined below and explored in more detail in Chapter 7. These can vary greatly. Look at the differences between the empire in Isaac Asimov’s *Foundation* series and that in *Star Wars*, or the federations in *Star Trek* and Andre Norton’s “Solar Queen” books.

Designing your interstellar government(s) is a great creative exercise, and shapes your whole campaign.

ANARCHY

Anarchy is a state that isn’t a state at all. There is no government, at least not in the sense we know it today. Interstellar anarchies come in three main types. “Patchwork states” are simply a large number of independent

worlds with no interstellar organization at all. This mimics the situation in the modern world, just on a vastly larger scale. “Failed states” are the result of a catastrophic collapse of the interstellar government, leaving a power vacuum that attracts warlords, bandits, and extremists. The third type is “anarchist utopias” – stable anarchies deliberately set up as states without a government. These can be quite large, even galactic in scale, but recognize no sovereignty above the level of individual beings. Iain M. Banks’ “Culture” is an anarchist utopia.

Effects on the Campaign

Anarchies allow the maximum of freedom for PCs – and for villains as well. In a patchwork situation, the characters may be merchants or travelers who have to cope with very different social conditions on each planet. In a failed state, they may be working to restore order (or carve out their own empires). Anarchist utopias are often “good guy” societies that must be protected.

THE ALLIANCE

An alliance is a group of autonomous worlds. Its key feature is that its members are genuinely self-governing. The alliance controls only interstellar policy – primarily defense policy and foreign relations – and not any member’s domestic affairs.

Citizens have no direct influence on an alliance, but they can influence their world government, which is represented on the Alliance Council. There may be a small allied navy or space patrol.

H. Beam Piper’s *Sword-Worlds* formed an alliance (the individual worlds had feudal governments). The human worlds of Larry Niven’s “Known Space” series might be considered a very loose alliance, at least in wartime.

Effects on the Campaign

Citizens of an alliance are free to do almost anything – even exploration is unregulated. Unless they violate one of the few alliance laws, they have little to fear from the patrol. Another benefit of adventuring in an alliance is its potential variety. Any sort of government or society can exist on a member world, as long as the world is reasonably stable in its dealings with other planets. However, this allows more chances for PCs to run into unexpected laws and taboos. And if they get in trouble on a member world, they can expect little help – the patrol has no jurisdiction (if it even exists).

Resourceful types who are wary around repressive societies and who aren’t averse to world hopping when it’s time to run may do quite well in an alliance.

THE FEDERATION

Federations and alliances share many features, but they differ in basic philosophy. In an alliance, the individual member worlds dominate the central government. In a federation, the opposite is true – the central government takes precedence over its component worlds. Federations usually take the form of republican democracies – that is, citizens elect the Federation President and local representatives to a Federation Congress. The typical federation is free but bureaucratic.

Federations are the ruling bodies in the *Star Trek* universe and Alan Dean Foster's Humanx Commonwealth.

Effects on the Campaign

Campaigns set in a federation offer less freedom for those who play fast and loose with the law. Law-abiding types may find it the safest place of all – if they are federation citizens. PCs who run afoul of extremist planetary societies might find aid at the nearest

Patrol office, unless the laws they broke meet Federation standards, in which case they may be turned over to local authorities.

THE CORPORATE STATE

This is a society run by *big* business – a huge corporation that controls entire worlds, with a monopoly on commerce among them. Leadership is vested in a Board of Directors and a Chief Executive Officer (CEO).

Dictatorial corporate states are depicted in F.M. Busby's "Star Rebel" stories and (on one world) in *Sten*, by Allan Cole and Chris Bunch. Poul Anderson's Polesotechnic League is an alliance of (usually) fair and well-managed corporate states.

Effects on the Campaign

Corporate societies can be dangerous; corporate security is watching all the time. The PCs might be security staff . . . or "evil" unionists! Good employees will keep their eyes on business, their shoulders to the wheel,

and their noses to the grindstone – while watching their backs.

THE EMPIRE

An autocracy is a state in which one person is the final authority. Such states usually clothe themselves in the trappings of religion, feudalism, militarism . . . or all three. Fifty years of science fiction have popularized the term "empire" for this sort of structure, and we'll follow suit (but see *Empire*, p. 197).

Theoretically, all power comes from the autocrat, or emperor – only by his grace does any lesser authority exist within the domain. Empires are not necessarily evil, or even totalitarian. An empire may be ruled by wise, fair people.

Empires are so common in science fiction that they're trite. Most (that of *Star Wars*, for instance) are dictatorial. Jerry Pournelle's CoDominium is heartless and bureaucratic. But the Empire of Man in *The Mote in God's Eye* and the Imperium of *Traveller* are basically benevolent.



Effects on the Campaign

If the empire is perceived as corrupt, players will enjoy getting away with whatever they can. If the empire is firm but fair (it can certainly happen!) there will be honor to be won in its service.

ALIEN GOVERNMENTS

Alien civilizations may have governments unlike any ever tried by humans. They could have a vast hive-mind, or be ruled by supercomputers. Government and power relations might be based on instinct, or on ruthlessly logical principles. Chapter 7 includes several ideas for completely alien systems of government.

Adventures Beyond Society

Not all adventures require much of a social context. Characters who are completely isolated or who are far beyond the reach of civilization are effectively their own society. The astronauts in *Alien* or the crash survivors in *Pitch Black* have no contact with their home societies anyway. In settings like those, the GM can just sketch in the social background very roughly (“you’re a thousand light years beyond the Imperial border”). It is useful to know a little about the civilization the PCs are currently isolated from, if only to avoid players spending points on noble titles when the culture is egalitarian.

Effects on the Campaign

An alien government type often presents a mystery to explorers or diplomats attempting to establish peaceful contact. A whole mini-campaign could be built on simply figuring

out who’s in charge in order to start negotiations. Humans living under the rule of aliens may find their laws nonsensical or just plain weird; aliens visiting human space may be equally perplexed.

INTERSTELLAR ORGANIZATIONS

Any society will contain a number of important interstellar organizations, which make good building blocks for a campaign. Some organizations will be restricted to a single nation; others may extend through all of space. Organizations will include lots of NPCs – bosses, hirelings, foes, and spear-carriers. Most organizations make appropriate Patrons (or at least employers) for PCs, but membership may also carry responsibilities – Duty, Sense of Duty, or both.

GOVERNMENT ORGANIZATIONS

Interstellar governments have many branches. Their official names should suit the society; for instance, the patrol might be known as the Alliance Patrol, the Imperial Patrol, the Interstellar Police, or something completely different like “the Federation Bureau of Investigation.”

Diplomatic Corps

Diplomats negotiate with other planets or interstellar governments. They may also act as first-contact specialists, either in partnership with the scouts (see p. 26) or as rivals to them.

Diplomats in fiction are often more dedicated to the “process” of diplomacy than actual results, because goals change with every shift in government but protocol is eternal. All governments use diplomats as information-gatherers, and as agents of social and political influence.

Adventuring possibilities: Diplomatic missions provide cover for spies. Diplomats may resolve an interstellar crisis peacefully – or be duped into ignoring enemy aggression until it’s almost too late. PCs can be diplomats stationed in an alien capital, or roving “firefighters” moving from one crisis point to the next.

Interstellar Trade Commission

The ITC sets tariffs, duties, taxes, rules, and regulations for all merchant ships, both corporate and independent. All traders must be licensed by the ITC in order to conduct commerce within the nation. The commission may be charged with preventing monopolies in trade, especially by larger corporations, sometimes allying with the Special Justice Group (p. 204) for this purpose. ITC agents operate the customs stations at all starports,

and cooperate with the Patrol (p. 25) against interstellar smuggling.

Adventuring possibilities: Independent traders hate the ITC for its red-tape regulations and love it for the way it keeps big merchant outfits from putting them out of business. Corporations simply hate it. Everyone will suffer the indignities of going through customs. A shipful of ITC inspectors can poke their noses almost anywhere, making for a free-swinging campaign.

Mercenary Regulatory Agency

If mercenaries are a big part of interstellar society, an organization like this may exist to set policies and directives for mercenary companies. Those that comply will receive licenses. Those that refuse must disband or leave – or face the Marines.

Regulatory agencies determine which weapons mercenary armies can use – typically banning biological and nuclear arms, at least on inhabited worlds. Unfair technological advantages are sometimes outlawed as well – merc companies may have to use weapons of the same TL as the world on which battle occurs. Some latitude

may be allowed; outnumbered forces may be allowed a technological edge, for instance. See Andre Norton's "Star Guard" and Jerry Pournelle's "CoDominium" stories.

Adventuring possibilities: The MRA is a natural opponent for merc outfits, whether on the trail of lawbreaking companies or acting as a nuisance for law-abiding ones. In a non-merc campaign, adventurers may contact the MRA to demand action after being harassed by mercs – or the MRA may contact them if they tried to hire mercs for a questionable job.

Navy

The space navy is the primary interstellar military force, defending against (or attacking) rival nations. During wartime, the navy's job is to defend the borders and vital inner systems while depriving the enemy of his ability to wage war. Between wars, the navy maintains readiness. The fleet may also pay "goodwill" visits to neighboring stellar states to stave off war by impressing potential foes.

Adventuring possibilities: In most non-military campaigns the navy is the background threat – the intervention so awful no one risks it. Pirates and criminals avoid fighting the navy. On the other hand, in a turbulent frontier region, the navy is often the only authority for light years around. Playing the captain and command officers of a major warship or starbase assigned to an interesting sector of space can give great scope for players who want to make a difference.

Office of Colonial Affairs

The Office of Colonial Affairs oversees colony ventures and regulates the construction of colony ships. It may control new colonies until they are self-sustaining, appointing all administrators and governors. It may also work with the Ministry of Prisons to get involuntary colonists for harsh, mineral-rich worlds.

Adventuring possibilities: For colonist PCs, a friendly OCA may be their greatest ally . . . and a corrupt one will be their worst enemy. An OCA inspection team will encounter interesting situations.

Patrol

The primary responsibility of the patrol is to police space. Peacetime duties include rescue work, escort for colony ships, routine space patrols, anti-piracy and anti-smuggling operations, starbase regulation and inspection, blockading restricted worlds, and perhaps mundane police duties on small colonies or space stations that lack their own local police force.

Patrol forces operate under naval command during wartime. In a young or loosely knit society, or one with no known foreign enemies, there may be no navy – in this case, the patrol performs both military defense and law enforcement.

Adventuring possibilities: Everyone encounters the patrol, whether they run to it or from it when they're in trouble. Patrol PCs will never lack for adventure.

Postal Authority

The Postal Authority is responsible for interstellar communications, which means its role varies depending on available technology. If faster-than-light radio is possible, the Postal Authority operates interstellar transmitters. If only ships can travel between the stars, then the Authority runs couriers or farms out mail contracts to merchants. However they do it, the Postal Authority's people know that communication is civilization.

Adventuring possibilities: Characters could be courier-ship pilots or private traders with a mail contract. Con games and conspiracies might center around interfering with interstellar

communications. A misrouted message or parcel could be the trigger for just about any adventure scenario.

Security and Intelligence Agency

This shadowy, covert group is the national espionage and counterespionage arm. Agents are trained in intelligence gathering, overt and covert, as well as the "tricks of the trade," including infiltration, misinformation, code breaking, social manipulation, and assassination. Counterespionage agents are responsible for identifying and neutralizing agents of foreign governments. There will usually be several different agencies, often with misleading names, who spend a great deal of their time spying on each other!

Under a repressive society, intelligence agencies will spy on citizens while sending agents provocateurs to foment unrest in rival nations. Loosely knit societies may have no intelligence arm, but their member states might. In some societies, this may merge with the survey service and be responsible for covertly infiltrating alien or foreign societies, either to learn more about them or to alter their societies to make them ripe for assimilation or conquest.

Adventuring possibilities: Characters might find themselves on an intelligence mission – as unsuspecting dupes or working with agents. If they are part of an important organization, they may be infiltrated by agents of an enemy nation. An entire espionage campaign is also possible (see p. 18).



Special Justice Group

Formed as a watchdog agency over multistellar corporations, the SJG oversees corporate expansion and diversification, regulates free trade and stock sales, collects taxes and other government fees, inspects existing corporate facilities, and approves all new facilities. Its mission is to preserve society from domination by powerful business groups, while maintaining their financial health – realizing that the economy of the state is tied to corporate success.

Adventuring possibilities: Characters hired as corporate employees or security forces might meet SJG agents – for good or bad. Obnoxious SJG officials make perfect opponents for ambitious corporate executives. Another possibility is a corporation-busting Special Justice campaign.

Survey Service

The survey service has two primary duties: To explore and chart the frontier, and to maintain accurate records of all worlds.

The exploration division of the survey service, frequently known as the Scout Service, works to fulfill the first goal. There are often two branches: first-in scouts and survey scouts. After the first-in scouts discover a new world, the survey scouts are sent in. A survey team may be a single ship or a full expedition. Survey scouts certify worlds as suitable for colonization, and make recommendations about relations with new alien societies.

Adventuring possibilities: Anyone on the frontier is likely to encounter scouts, especially traders or corporate types interested in exploiting a newly discovered society or Precursor site. A dedicated scout campaign is also possible (see p. 11). During wartime, scouts may get put under Navy command as intelligence gatherers, or as patrol units in quiet sectors.

PRIVATE ORGANIZATIONS

Alien Rights League

In any human-dominated society, nonhumans are likely to need a lobbying organization to make their

voices heard. The League may even be mostly human in membership. The Alien Rights League can be an altruistic group dedicated to the rights of all beings, or it can be the cover for violent extremists. Similar groups may exist to promote the rights of robots, uplifted animals, or genetically modified humans; in an alien-dominated setting, it may be *humans* who need the ARL's protection!

Adventuring possibilities: Nonhuman characters may need the ARL's help when faced with prejudice. Characters of any species might be hired or persuaded to help with an investigation aimed at exposing abuses. Colonists may find pesky ARL activists trying to stop them from settling on an inhabited world.

Corporations

A multistellar corporation is a vast conglomerate of companies in hundreds of fields on dozens of worlds. Some multistellars control entire worlds and support vast armies of employees – corporate security forces can outnumber the local planetary defense forces (and may be better trained).

In many businesses, profits outweigh ethics. Some corporations use dummy companies and trusts to dodge government supervision, considering such high-profit, high-risk activities part of the corporate “game.” When not cooperating against the Special Justice Group, the companies are spying on their competitors. Sometimes industrial espionage is a gentlemanly game; often, it's deadly.

Adventuring possibilities: Working for a corporation lets PCs be nasty without feeling responsible – they're only following “company orders.” Corporations also make good Patrons. They make excellent bad guys, too – exploiters of defenseless aliens, ravagers of priceless Precursor sites, slave lords on remote company planets, and remorseless steamrollers in commerce and industry. Independent traders hate them.

Free Trade League

Independent traders may band together to form a lobbying group and mutual-assistance society. The league

may be a close-knit “brotherhood of spacers” or a bland professional organization.

Adventuring possibilities: The league is the home organization for most trader PCs. Other nonmilitary PCs are likely to encounter independent traders, especially on the frontier – passenger rates are low, voyages are slow, and there's always a chance of adventure before journey's end.

Mercenary Companies

A mercenary company is a military outfit – usually ground troops, often with supporting ground vehicles and aircraft – that works for hire. Regulations and discipline remain under the control of the unit commander, not the employer. Companies can be contracted for specific missions or hired by the month. “Honorable” merc outfits will fulfill their contracts so long as their employer deals honorably with them; other outfits may desert their employer for sufficient reward, sometimes even changing sides!

Adventuring possibilities: PCs who sign on with a merc outfit may see a variety of adventures in far places. Mercs also make good antagonists.

News Services

Space is big enough to hold a lot of news, and dozens of interstellar news services compete to get that news, explain it in an interesting fashion, and shoot it to the waiting tri-V watchers. Of course, they can also be sending out government propaganda, sinister mind-control, or military secrets vital to defense.

Adventuring possibilities: PCs can be a reporting team. Characters battling an evil conspiracy may need a way to get the truth out. A news service can also provide a meddlesome “third force” interfering in any adventure.

The Organization

The shadowy syndicate known as “the Organization” is the largest criminal empire ever to exist. Its influence stretches through nearly all interstellar nations. The Patrol is only beginning to realize that a single organization is behind centuries of

crime. The “Big O” dominates interstellar drug trafficking, gunrunning, prostitution, the black market, and murder for hire.

Adventuring possibilities: The PCs may be surprised to discover that the crime they just foiled was part of a Big O operation . . . and now the Organization is on their trail. Or the PCs themselves could be interstellar criminals.

Psionic Studies Institute

On the surface, PSI is a research foundation dedicated to psionics. In reality, it is a secret psionic society that offers aid and training to psis. It could be training them to use their powers for good – or to subjugate

the normals and establish a rule by superminds.

Adventuring possibilities: An evil Institute might take advantage of a PC with developing talents; a good Institute can help a psionic PC against persecution. Or PSI might be a red herring, staffed by crackpots – especially if psionics don’t work in this campaign. And the GM doesn’t have to tell the players whether psi powers are real or not!

Universities and Scientific Foundations

Scholarly organizations can be huge and influential; they can dominate whole planets. Such groups can contain brilliant (and very peculiar)

people. The political interplay within a university (over promotion, favorite theories, grant money, or just personalities) can be fierce, and rivalry between institutions can be bitter. Outsiders, expecting peaceful cloisters and ivory towers, are often numbed by the size of scholastic budgets and the fierceness of scholastic politics!

Adventuring possibilities: The PCs can be hired as part of a scholarly expedition; depending on skills, they may be guards, crew, or researchers. Unusual planetary conditions, strange and dangerous life forms, and Precursor artifacts are all obvious targets of scientific curiosity. And no pirate can match the disregard for danger shown by a dedicated researcher!

PLANETS AND PLACES

In Chapters 4-5, this book gives detailed rules for creating planets and mapping the galaxy. But when starting out, the Game Master should have some general ideas about places and where they are in relation to one another. What general type of place will the game take place in?

The Core

Campaigns that take place in the heart of civilization usually center around political maneuverings, espionage, and intrigue. Laws are enforced efficiently, advanced medical care is close at hand, and characters can quickly summon up vast amounts of information over the local datanet. Game Masters can use core settings to show off the wealth and super-technology of the setting. Earth is often the core of a human empire, though in Isaac Asimov’s *Foundation* series, Earth is a backwater and glittering Trantor is the center of power and civilization.

The Frontier

Out on the frontier, things are much rougher. Characters must rely on their own resources, but they also have greater freedom. Combat is more likely, and there may still be secrets and mysteries to discover. Drawbacks include a lack of things like repair

facilities, long travel times between worlds, and shortages of key items. Game Masters can use all those factors to drive adventure plots. Mike Resnick’s *Santiago* and his “Widowmaker” series take place on the frontier, as does the television series *Firefly*.

The Unknown

Past the frontier lies unexplored space. By definition it is unknown territory, which means it is the perfect venue for exploration. In the unknown, dangers are often hostile local life forms or mysterious phenomena that haven’t been charted. But the unknown can also be a refuge for rebels or fugitives, since the patrol can’t follow them there. *Star Trek: Voyager* takes place entirely in the unknown.

Hostile Space

Areas controlled by some enemy power – aggressive aliens, a rival human state, or the empire the heroes are trying to overthrow – all count as hostile space. This is likely the scene for military or espionage missions. Characters seldom want to stay in hostile space; the goal is to get in, do the job, and get home again. If empires are close together, vital core regions may be right next to hostile ones,

which means a strong military presence along the border. Other empires may maintain a “neutral zone” between their territorial claims. The sinister planet Zha’ha’dum on *Babylon 5* was hostile space.



Home Base

This is where the heroes can find sanctuary, help, and a chance to relax between adventures. It may be a patrol base, an uncharted pirate hideout, a space station, or the capital of the galaxy. In relatively stationary campaigns, the home base is one town or city on the planet. Even completely mobile characters like explorers or footloose merchants may want to have some place they can think of as “home.”

CHAPTER TWO

SPACE TRAVEL

"Interesting ship you found for us, Doctor."
Captain Panatic was running his hands over the control panel, almost stroking it.

*"Interesting? It was the cheapest one in the yard and it still cost too much. We should never have abandoned the **Golden Venture**."*

*"The whole time you were aboard the **Venture**, you kept complaining about that noise in the gravitics, and why could we only use two liters a day for washing, and how come the drive was taking so long to recharge. I thought you'd be glad to leave her."*

"Actually I had been, but this new ship was definitely not an improvement. "This one doesn't even have a shower."

"No, but she's a lot faster than she looks. There's a whole hidden set of thrust coils in the wings. She'll pull four gees easy."

*"That dealer must not have known what he had." We'd traded him salvage rights to the wreck of the **Venture**, plus all that remained of my savings.*

"Or he was trying to unload something he didn't want to have to explain to anyone. Did you notice the forward cargo bay?"

"It was a cargo bay, in the front of the ship. Beyond that, no."

"Big conduits for coolant and power lines. A big port opening forward. Direct data links to the bridge and the sensor suite. If you wanted to, hypothetically, mount a laser there, everything's already set up."

"Do you mean this is a warship?"

"Not exactly. Too small for that, and her lines are strictly civilian. No, Doctor, what we've got here is a lovely little pirate ship, just right for ambushing merchants, claim-jumping belt miners, and outrunning the Patrol. All she needs is some guns." He looked so wolfish it was hard to believe he had ever been a Patrol officer himself.



"This is not a privateering voyage, Captain. We're looking for a particular artifact, and the ship is nothing but the means to get us there."

"Oh, sure. Still, at our next stop, I'd like to see about weapon prices."

"Are you expecting trouble?"

"No, but if this artifact business doesn't pan out . . . who knows? Hoist the Jolly Roger and prepare to board!"

When designing any science-fiction universe, one of the most important choices the GM must make has to do with the *technology* that will be available. This chapter discusses technologies related to space travel, and the next describes advances in other fields.

There will *not* be much discussion of **GURPS** game mechanics here. The in-game rules for specific technologies will be discussed in other **GURPS** sourcebooks. Instead, this book will focus on the consequences of advanced technology for setting and adventure design – with particular attention to science-fiction settings that involve space travel!

A TAXONOMY OF MIRACLES

One way to classify SF worlds is to consider what technological *miracles* are inherent to the setting or story. In this context, we can think of a “miracle” as some area of technology that has a significant effect on the environment in which adventures take place. A technological miracle defines a significant *difference* between the fictional setting and the real world familiar to the reader or player.

It's useful to think about what miracles will be present in a new setting, because the GM doesn't have to work nearly as hard on features of the setting that *aren't* miraculous! Where there are no miracles, the GM and players can assume that things work in familiar ways. When the GM decides to incorporate a miracle, he has to think about what effect it will have on the setting and on his adventures, and he may have to find or develop new game rules to cover it.

NO MIRACLES

It's possible to have a space-oriented campaign with no miracles at all. Human beings have been visiting space for about 40 years. With present-day technology, human space exploration and colonization are very difficult and expensive, but not impossible.

First Steps to Space

One possible no-miracles campaign can focus on the early development of space flight. The campaign may be historical, focusing on the real astronaut programs of the 1960s and 1970s. Or it may be set in the near future, projecting a “second space age” in which frequent human exploration resumes.

A variant on the “first steps” campaign is a setting in which state-run space programs have *failed* to establish a viable human presence in space. The slack is taken up by major corporations or individual entrepreneurs. The plot involves heroes who must struggle against both the dangers of space travel and the interference of government. This theme is

fairly common in American SF, notably in novels such as Ben Bova's *Privateers*, or Michael Flynn's *Firestar* and its sequels.

The Technothriller

Another no-miracles approach is the *technothriller*. In fiction, the technothriller genre is normally set in the present day or in the very near future. The technology in the story may be slightly in advance of real-world capabilities, but by definition it's not a *miracle*. Technology's world-changing potential is ignored or evaded – it exists purely to provide the heroes (and villains) with cool gear!

Technothriller stories are usually political thrillers, in which the plot is driven by international competition or world-threatening crisis. The scenario doesn't have to be carefully detailed; in fact, the more shallow and one-sided the villains are, the better. Technothriller fiction often embodies the social paranoias of the time. In the 1970s, the Soviet Union provided most technothriller antagonists. Today, the menu of villainous options is a bit wider: Chinese, militant Islamists, Western nationalists, organized criminals . . .

ONE MIRACLE: SPACE FLIGHT

At its most conservative, science fiction invokes as few miracles as possible. Stories that involve only *one* technological miracle have the advantage that most of the setting will be familiar. Naturally, in a space-oriented setting the first miracle is likely to be in the area of space travel!

In space travel, we can define a “miracle” as a technology that makes space flight *easy*. There are two great obstacles to humanity's future in space. The first is Earth's powerful gravity well; the second is the speed-of-light limit. Any miracle that makes it easy and cheap to launch into Earth orbit will make the whole Solar System easily accessible. A second miracle that somehow sidesteps

Einstein could throw open the entire galaxy.

Alternate History

If the GM is assuming a single miracle in space-flight technology, there's no reason that he has to place his story in the *future*! Writers have been imagining space travel since the Renaissance – Cyrano de Bergerac and Voltaire each wrote about travel between worlds. More recently, early genre-SF writers such as Jules Verne and H. G. Wells set stories in space. To recapture the flavor of these early stories, assume that space travel might have become possible at some point in the past, but leave most other aspects of the historical technology and society unchanged.

Such an *alternate history* campaign shares many of the features of a purely historical setting. Players who are already well-versed in the chosen historical period will find most aspects of the world familiar. Sourcebooks covering the politics, social customs, and equipment of the period will be useful. The politics of the time can be extended into deep space, as existing Earth-based nations explore and colonize other worlds.

Strangely, most early SF ignored the possibilities of interstellar flight; much of it was written before astronomers discovered the nature of the stars or the structure of the galaxy. Instead, most authors concentrated on the worlds of our own solar system, assuming that they would be inhabited by aliens – or by humanlike races, complete with savage native warriors and beautiful princesses!

Many classic SF stories can today be treated as the basis for an alternate history setting with space flight. These include Jules Verne's *From the Earth to the Moon*, H. G. Wells' *The First Men in the Moon*, and Edgar Rice Burroughs' “John Carter” and “Carson Napier” novels. Among roleplaying games, *GURPS Steampunk* and GDW's *Space: 1889* are both good examples of the genre.

Emergent Superscience

Other one-miracle settings are placed in the future. A miraculous breakthrough in physics or engineering might make space flight much easier, without affecting most other aspects of society. This lets the GM construct a society that resembles our own, then explore the new breakthrough's implications.

A common variation on this theme involves a starfaring society in which advanced space drives exist, but other technology has not advanced much beyond the early TL8 level. Some of the best military SF has used this approach: ordinary infantrymen, armed with simple body armor and

More Miracles?

There's no reason why a space-oriented setting must apply miraculous technology only to the business of space flight. As more technologies advance beyond what is currently possible, society (and the backdrop for adventure) will become increasingly unfamiliar. At its extreme, the addition of miracles gives rise to settings in which *nothing* is familiar to the GM or players! Such settings can be interesting, but very difficult to sustain for a lengthy campaign.

The next chapter discusses settings in which miracles appear in areas other than space travel.

automatic rifles, traveling to the battlefield aboard a starship.

In space SF, the best recent emergent-superscience novel is probably

John Varley's *Red Thunder*. Jerry Pournelle's "Mercenary" stories are a classic example of military SF using emergent-superscience assumptions.

SPACE FLIGHT AND STORY REQUIREMENTS

The Earth is the cradle of mankind, but mankind cannot stay in the cradle forever.

– Konstantin Tsiolkovsky

Like other facets of a setting, the prevalent space flight technologies should be chosen to support the story (or the kind of story) that the GM wants to present. Another item the GM should consider is how important the details of space flight will be to his campaign. Despite being set in a space-faring future, many stories may have no need to consider the details of space travel.

Ships as Settings

Some settings are dominated by spaceships – indeed, the ship *becomes* the setting or a major portion of it. In this case, the adventurers will almost always be starship crewmen, passengers, or other people who spend most of their time between worlds rather than on them. Most character development is in the context of crew or passenger interactions. Many plots center on the technical details of running or commanding a starship.

In contrast, the worlds visited by the ship are sketchily drawn. Most worlds will apparently stop at the edge of the spaceport or the capital city,

since adventurers will rarely venture far from their ships.

Military science fiction is especially likely to focus on starship life, with space battles and tactics forming a major part of the story. David Weber's "Honor Harrington" novels are an example of this kind of story.

Ships as Major Plot Elements

In many (perhaps most) space settings, space travel is an important activity and a common plot point, but many adventures will take place off the ship. Ship crewmen and passengers are still the most common character types, since such people are the most likely to spend time *around* ships, but some characters may be oriented entirely toward other activities.

In some settings, the characters have a ship of their own, which serves as a mobile home base. The ship is a familiar place where adventurers can (usually) relax, and where most character interaction takes place. Some adventures take place on board ship, while others take place on the worlds that the ship visits. Examples of this kind of story include the *Firefly* television series, as well as *Star Trek* and most of its spin-offs.

In other settings, the adventurers don't have their own ship, or they frequently use different ships as needed. Their home base is a world or an immovable space station. Most adventures come to the adventurers. When the cast of characters needs to travel, a ship may be available, but most of the time they don't need to concern themselves with shipboard life or the details of space travel. Examples of this kind of story include the *Babylon 5* and *Star Trek: Deep Space Nine* television series.

Ships as Trivial Plot Elements

In some science fiction, spaceships are little more than part of the backdrop. Adventurers simply arrive at the location of the adventure, with no time spent establishing how they get there. When it's time for them to move on to another world, they do so without needing to spend significant "on-camera" time on board a spaceship.

Frank Herbert's "Dune" novels use this kind of structure (although the *assumptions* of space travel in that universe are crucially important to the story). Dan Simmons' *Hyperion* and its sequels almost entirely ignore spaceships, and in fact vehicle-less instantaneous teleportation from world to world is an important plot element.

MANEUVER DRIVES

Nesterov hovered a few moments longer, then began a slow descent. Mariesa held her breath. Every second was a lifetime; but the ship slid smoothly down a pole of invisible fire. When the fire touched the ground, it became a flaring pedestal that bloomed underneath the ship like a cushioning pillow of light . . .

*Mariesa stared at the craft until the ball of light beneath it winked out and the darkness of night returned. A man had sneaked aboard that thing, that untested, untried experimental craft; and bet his life against it. It might have exploded; it might have smashed into rubble on the pavement. And Krasnarov had **lied** his way aboard.*

— Michael Flynn, *Firestar*

A *maneuver drive* is used to propel a ship through “normal” space, changing its velocity in space as needed, more or less subject to the known laws of force and motion. Such drives range from realistic propulsion systems like rockets, to superscience drives that appear to break some physical laws but are still limited by the speed of light.

REACTION DRIVES

A *reaction drive* is a drive that obeys (and takes advantage of) Newton’s third law of motion. This law implies that the momentum of a system is always conserved, *unless* an external force is applied to it.

Some reaction drives work by taking advantage of external forces that act on the spaceship, changing its momentum (see *Sails*, p. 33, or *Catapults and Tethers*, p. 34). However, most reaction drives use the *rocket principle*.

Principles of Rocketry

In its simplest form, a spaceship using a rocket drive is composed of two portions.

The first portion is the *payload*. This consists of all the parts that are to be conveyed to the ship’s destination: crew, passengers, life support equipment, computers and other

instruments, drive machinery, cargo, the hull structure of the ship itself, and so on.

The second portion is the *reaction mass*, material that’s carried along only to be thrown away! The rocket engine works by accelerating reaction mass and ejecting it into space, usually as a fast-moving gas or plasma. The total momentum of the system remains constant, but since the reaction mass is being accelerated, the law of conservation of momentum means that the payload is also accelerated in the opposite direction. The velocity that the reaction mass has when it is ejected is called the *exhaust velocity*. The force that the rocket engine applies to the payload is called *thrust*.

Since every rocket works by discarding reaction mass, rocket drives are limited by the amount of reaction mass that can be carried, and by the efficiency of the rocket engine. Reaction mass that hasn’t been ejected yet has to be accelerated along with the payload! As a result, it’s important to minimize the amount of reaction mass that’s needed to complete a given mission.

For a fixed amount of reaction mass, the best way to get a more efficient rocket is to increase its exhaust velocity. Of course, a rocket is also limited by the *energy* it needs to accelerate reaction mass into space. The thrust that the engine generates is proportional to the exhaust velocity – but the

The Rocket Equation

The science of astronautics was pioneered by the Russian mathematician (and science fiction writer!) Konstantin Tsiolkovsky. Around the beginning of the 20th century, Tsiolkovsky developed a great deal of basic astronautical theory; he was one of the first visionaries to predict artificial satellites, space colonies, and asteroid mining.

One of Tsiolkovsky’s basic contributions was the *rocket equation* that has since been named for him. The Tsiolkovsky equation is:

$$\Delta V = E \times \text{natural logarithm of } (T/P)$$

Here, **E** is the effective exhaust velocity of the rocket engine (a quantity also called the *specific impulse*), **T** is the total mass of the rocket-driven spaceship (including both payload and its initial reaction mass) and **P** is the mass of the payload alone.

The quantity ΔV is called the *delta-V*. Delta-V is the amount of velocity change the ship can carry out with its available reaction mass. Every deep-space maneuver requires that the ship “spend” some of its delta-V budget: escaping from orbit around a home world, changing course in deep space, entering the orbit of a destination world, changing the parameters of an existing orbit, and so on. Maneuvers that are carried out against gravity (such as planetary launch or landing) can also be measured in terms of delta-V.

Low-TL rocket drives are usually *very* limited in the amount of delta-V that’s available to them. Mission planners spend a lot of time searching for trajectories that can get a ship to its destination with the use of minimal delta-V. It’s sometimes possible for a ship to change course without spending delta-V. For example, a ship can “fly by” a world, using its gravity to accelerate and change heading.

By manipulating the Tsiolkovsky equation, it’s possible to derive a formula describing how much of a ship’s initial mass needs to be taken up by reaction mass. To summarize, if the required delta-V is much smaller than the exhaust velocity, very little reaction mass will be needed. Once the required delta-V rises above the exhaust velocity, reaction mass soon dominates the ship’s size!

energy required to operate the engine is proportional to the *square* of the exhaust velocity! In order to generate the same amount of thrust, a rocket with lower exhaust velocity needs more reaction mass. A rocket with higher exhaust velocity needs less reaction mass, but it may need *much* more energy in order to operate.

Known Rocket Types

The following rocket types are currently feasible, using known engineering principles.

Chemical rocket: A chemical rocket is the first reaction drive likely to be used by any space-faring civilization. Chemical rockets get their energy by burning flammable reaction mass or “fuel,” expelling the resulting hot gases out the back of the rocket chamber.

Most chemical rockets will use liquid fuels, such as liquid hydrogen or a slurry of powdered metals like aluminum. Solid-fuel rockets are possible, but are hard to shut down or control once ignited. A chemical rocket that will operate in space must also be provided with an *oxidizer* to support combustion. The most likely oxidizer is liquid oxygen, which can be carried in onboard tanks and used as part of the reaction mass.

Chemical rockets can deliver a lot of thrust very quickly, and are useful for launching from a planetary surface or maneuvering in orbit. On the other hand, they have relatively low exhaust velocity, and so they use *tremendous* quantities of fuel and oxidizer. An interplanetary journey using chemical rockets normally involves a short “burn” at the beginning of the trip, followed by months or years of coasting, with the delivery of only a small payload at the end.

Ion Drive: An ion drive converts reaction mass into ions (charged atoms or molecules) and then uses electric power to accelerate the ions into a fast exhaust stream. The most likely substances for reaction mass include the noble gases argon or xenon, or the poisonous metal cadmium.

An ion drive provides very low thrust, and is useless for taking off from a planet. On the other hand, its

exhaust velocity is high. Ion drives are therefore fuel-efficient, and can be used for long periods of constant acceleration. This makes them good candidates for interplanetary travel, taking months rather than years to cross interplanetary distances. An ion drive will need a continuous power supply, usually a bank of solar cells or an on-board nuclear reactor.

Fission rocket: A fission rocket uses a built-in fission or radiothermal reactor to heat reaction mass, and then expels the hot gases as a high-energy exhaust. Fission rockets are a compromise between chemical rockets and ion drives; they can provide more thrust than an ion drive, but have lower exhaust velocity and so are less fuel-efficient. They are also useful because they provide both onboard power and motive thrust. They may be suitable for interplanetary warships or courier craft.

Speculative Rocket Types

Nuclear pulse drive: This drive works by setting off nuclear explosions behind the ship; the energy of each nuclear explosion produces a very fast exhaust of hot plasma. A large-scale version (such as the “Orion drive”) uses full-size nuclear bombs, requiring a huge shock-absorbing “pusher plate” behind the vessel. More sophisticated versions create micro-explosions, triggering small fusion fuel pellets with a ring of powerful lasers or ion beams. Another approach triggers fissionable pellets using antiproton beams; this version uses so little antimatter that it could be produced using present-day technology.

A nuclear pulse drive can provide a *lot* of thrust, and also has high exhaust velocity and fuel efficiency. It may be the best candidate for a fast interplanetary drive. Although building such a drive is currently out of reach, the

Sample Delta-V Requirements

Every low-TL space mission is planned around its delta-V budget. A high delta-V requirement means that the spacecraft will need more reaction mass, possibly crowding out needed payload. Lower delta-V requirements make a mission cheaper and more feasible, or permit more payload mass to be delivered.

Here are some typical delta-V requirements for early space missions. All of these figures assume high-thrust chemical rockets – low-thrust engines such as ion drives will need more delta-V due to the drag of gravity (usually 2-3 times as much).

Earth Launch: To reach low Earth orbit requires about 5.9 miles per second of delta-V. A low-thrust engine will not be able to perform this mission at all!

Earth Orbital Maneuvers: To move from a low Earth orbit to a geosynchronous orbit requires two maneuvers, with a total delta-V requirement of about 2.5 miles per second. To move from a low Earth orbit to an escape trajectory actually requires *less* delta-V, about 2.0 miles per second in all (assuming the escape burn is performed at *perigee*, the point on the orbit closest to Earth where the spacecraft is already moving fastest).

Interplanetary Travel: To move from a low Earth orbit to low orbit around various other bodies takes varying amounts of delta-V. A journey to low lunar orbit would take about 2.4 miles per second. Reaching some near-Earth asteroids (see p. 131) would require about the same amount of delta-V as a lunar expedition. A journey to low Martian orbit would take about 3.5 miles per second. Reaching solar escape velocity from low Earth orbit requires about 5.4 miles per second; this is an upper bound on the delta-V needed for most interplanetary journeys.



main obstacle in its way is political rather than technological. Many people object to a drive that involves setting off nuclear explosions!

Fusion rocket: As with a fission rocket, the fusion rocket involves heating reaction mass with a controlled nuclear reaction, then expelling it as hot exhaust. A fusion rocket might offer performance nearly as good as a nuclear pulse drive, without the expense of specialized fuel pellets or the danger of carrying around hundreds of A-bombs.

Antimatter thermal rocket: This drive uses a small quantity of antimatter to heat up a much larger amount of conventional reaction mass, creating plasma to be ejected for thrust. It can provide high thrust, and is more efficient than most fusion drives. It requires the technology to produce, distribute, and contain useful quantities of antimatter.

Antimatter pion drive: This drive is a “pure” antimatter rocket. It mixes matter and antimatter in equal (very small) quantities, producing an exhaust composed of very fast subatomic particles. The rocket doesn’t provide much thrust, but its high

exhaust velocity makes it *extremely* fuel-efficient. It is among the most realistic candidates for STL interstellar travel.

Total conversion drive: This theoretical drive converts reaction mass directly into energy, perhaps in the form of photons or gravity waves. There is no known way to produce this conversion, but the concept is (barely) “hard” SF. It doesn’t violate the laws of conservation of energy or momentum, and it also requires the ship to refuel once in a while.

SAILS

Given the limitations imposed by carrying reaction mass, any method of interplanetary or interstellar travel that *doesn’t* involve rockets might have an advantage. There are several reaction-drive concepts that don’t require large quantities of reaction mass.

Light Sails

One drive that has been proposed is the *light sail*. A light sail is a huge sheet of very thin, light, reflective material, possibly hundreds of square miles in area. The sail is attached to a

payload capsule by a network of lightweight cables. Close to a star, the sail can provide slow but steady acceleration due to the pressure of starlight.

On its own, a light sail is only effective close to a star, such as between the orbits of Mercury and Mars in our own solar system. More than a few AU from Sol, the light pressure drops below useful levels. This would seem to make the light sail useless for interstellar travel.

However, a powerful laser (or a battery of lasers) could be used to impart steady thrust to a light sail. Laser light doesn’t lose its force as quickly with distance as non-directional starlight, so it can provide thrust for months or years, accelerating the sail to a significant fraction of lightspeed. This provides limited maneuverability, but if the sail is given an electric charge, interactions with the galactic magnetic field can be used for deceleration or a slow turn.

A laser-driven light sail seems almost perfect for interstellar travel. There is no fuel to worry about, and the “engine” can be left at home. On the other hand, the laser batteries would need to be *enormously* powerful. Even a tiny probe massing a few kilograms would need gigawatt-output lasers. A sizable manned ship would need lasers with lenses many miles across, powered by solar collectors thousands of miles wide, using thousands of times as much power as is currently generated all over Earth! Ignoring the question of whether it would be feasible to build lasers that big, it’s likely that a society capable of it would find other uses for the power-generating capacity.

Meanwhile, the political questions are significant. An interstellar journey would still take decades, and the crew would need to be able to trust its home base to keep the lasers on for that whole time. For that matter, the lasers themselves could serve as a terribly powerful weapon, which could itself be the cause of conflict.

For a superb treatment of interstellar light-sail travel, see the classic novel *The Mote in God’s Eye*, by Larry Niven and Jerry Pournelle. Robert Forward’s novel *Flight of the Dragonfly* also relies on light sails as a plot device, and some printings include an extensive technical appendix.

Magnetic and Plasma Sails

Another concept that might be useful for interplanetary travel is the *magnetic sail*. Stars like Sol don't just emit light; they also give off a powerful solar "wind" of charged particles. These fast protons and electrons fly through the inner solar system at hundreds of miles per second. If they enter a magnetic field, they change direction and speed, exerting a force on whatever is generating the field. A spaceship might use a large loop of superconductive wire as a sail, passing current through the wire to generate a powerful magnetic field, interact with the solar wind, and produce thrust.

Magnetic sails have several advantages over light sails. Calculations have shown that the magnetic sail can yield a higher thrust-to-mass ratio than a light sail. A magnetic sail can "tack" against the solar wind, and so is more maneuverable than a light sail. A magnetic sail can also interact with the magnetic fields of planets, providing even more maneuverability in certain situations. Finally, a magnetic sail

would be very good at *decelerating* a ship moving at a large fraction of lightspeed; it might be the most likely method for stopping a hard-science interstellar spacecraft.

Of course, one disadvantage of the magnetic sail is the material of the sail itself – it may be difficult to produce long loops of superconductive wire that can stand up to the rigors of space flight. Magnetic sails, like light sails, lose effectiveness with distance from the star.

A related concept is the *plasma sail*, in which the magnetic field is conducted within a thin, superheated cloud of plasma rather than a loop of wire. A plasma sail would require "fuel," since the thin cloud of plasma would tend to disperse and would need to be replenished. Even so, early research indicates that the plasma sail system would be very fuel-efficient, and would require relatively little power.

One advantage of the plasma sail is that the sail expands automatically as the density of the solar wind decreases. The plasma sail should provide nearly constant acceleration all the

way out to the "heliopause," the boundary where the solar wind fades into the interstellar medium. This makes it a good candidate for travel in the outer solar system, where light sails and fixed-size magnetic sails lose their effectiveness.

CATAPULTS AND TETHERS

Space engineers have invented several other potential techniques for reaching space, or for maneuvering in space. These are not necessarily useful for very long-range travel, but they can assist in maneuvering without needing reaction mass or expensive onboard systems.

Catapults

Low-TL space travel often involves a burst of acceleration at the beginning of a journey, followed by a long period of "coasting" along a ballistic trajectory, with another burst of acceleration at the destination. A rocket-driven ship normally needs to supply reaction mass for *both* periods of sharp acceleration. If another way can be found to provide the first burst of acceleration, this can cut reaction-mass requirements by 50% or more.

One approach to this problem is the *launch catapult*. A launch catapult is an electromagnetic system or "mass driver," similar to some particle-accelerator devices but built on a much larger scale. Many powerful electromagnets are arranged in a long line, wrapped around a hollow channel in which a payload can move freely. The payload is either made with ferrous metal components or wrapped in a conductive sheath. Once the payload is placed at the start of the channel, the electromagnets are activated in series, each magnet pulling the payload forward and accelerating it. A launch catapult may be many miles long, accelerating a payload to very high velocities.

A launch catapult built on the surface of a world can be used to accelerate a payload to orbital velocity. In space, a launch catapult can give a payload the initial acceleration needed for an interplanetary journey. In either case, the payload needs no rocket

Bussard Ramjets

The Bussard ramjet was first proposed in the 1960s, and for a time was regarded as the definitive answer to the problems of STL interstellar travel. A Bussard ramjet starship carries almost no reaction mass. Instead, it uses a big magnetic field, a "ramscope," to gather interstellar hydrogen. The hydrogen is funneled in, used as fuel for the ship's fusion reactor, and expelled as reaction mass. Once a ramjet ship reaches speeds high enough to gather plenty of hydrogen, it can theoretically accelerate indefinitely, approaching lightspeed as closely as desired.

In the 1970s, a great deal of science fiction was written in which Bussard ramjet drives, combined with relativistic time dilation, allowed humanity to explore and colonize the galaxy. Unfortunately, the concept appears to have insurmountable technical problems. The interstellar medium turns out not to be as dense as was originally believed – especially in the vicinity of our solar system, which is in the middle of a parsecs-wide "bubble" of thinner gas. This means that the necessary ramscope sizes would be prohibitively large. Meanwhile, once a ramjet ship reaches very high speeds, much of the energy of the fusion reaction goes to accelerate the incoming reaction mass rather than the ship. Finally, the proton-proton fusion reaction that would be needed to drive the ship turns out to be difficult to achieve.

A science fiction setting could still use the Bussard ramjet as its primary stardrive, especially if it was set in a region of the galaxy where interstellar matter was denser. A ramscope could also be used to supplement a conventional fusion drive, gathering extra reaction mass while the ship coasts through interstellar space.

engines – the power needed for the acceleration comes from a power plant built into the catapult.

It's even possible for a launch catapult to operate in reverse. A payload or ship that enters the "launch" end of the catapult can be *decelerated* by the electromagnets firing in series, bringing the payload to rest relative to the catapult. If launch catapults are present at both ends of an interplanetary journey, a ship may make the trip with a very small onboard supply of reaction mass!

The major drawback of a launch catapult is that it may be unsafe for human passengers. In space a launch catapult can be very long, providing useful velocities while applying only moderate acceleration. On a planet or large moon, building a launch catapult more than a few miles long might be a serious engineering challenge. Such a short launch catapult can still provide the needed velocities, but it must apply very high acceleration over a short time. Human "cargo" may need to use other means of reaching orbit . . .

Tethers

Another sophisticated maneuver system involves *tethers*. A tether system can be used to assist payloads into high planetary orbit, reducing the amount of reaction mass needed for a rocket drive.

A tether station is placed in orbit around a planet with a strong magnetic field. It lowers a tether cable, and begins to rotate so that the tether is moving much more slowly than the

station's orbital velocity at the bottom of its swing. At this speed, it can intercept payloads that have been launched into a *suborbital* trajectory, one that requires much less reaction mass than a true orbital path. The payload is attached to the tether with a grapple. When the tether swings upward, it can *throw* the payload into a higher orbit.

Every time a payload is transferred into high orbit with this system, the tether station is robbed of some

momentum, and will tend to fall into a lower orbit. However, the tether itself can be used to restore the station's orbital velocity. An onboard power plant can drive electrical current along the tether cable. Since the tether is moving through a planet's magnetic field, the current provides thrust, exactly like the operation of an electric motor. The station rises to its standard orbit once again, and is ready to deal with the next payload to come along.

Cycler Stations

One alternative to conventional spaceship transportation is the *cycler station*. The station is a space habitat that follows a trajectory passing near two or more interesting places. Over a long period the cycler follows a loop, with passengers embarking and disembarking at each destination. At each port of call the cycler uses a planet or star's gravity (and some minor assistance from a propulsion system) to change course for the next without stopping.

On an interplanetary scale, cycler stations follow low-energy transfer orbits between worlds. On an interstellar scale a station could travel a substantial fraction of the speed of light, changing course at each star to follow a wide loop through interstellar space.

Cycler stations are designed primarily to provide a livable *habitat* for passengers during a long passage. An Earth-Mars cycler would need about three years to make one round trip. An interstellar cycler would need decades. Since the delta-V requirements for a cycle are the same (indeed because of the course change, slightly larger) than for the same trip without the cycler, there is no advantage in carrying space-worthy cargo this way.

The benefit of a cycler station is that equipment needed only on the voyage between worlds (life support, heavy radiation shielding, and so on) does not need to be repeatedly accelerated. Passengers boarding or leaving the cycler will still need to bring along the same delta-V that they would need to make the trip without it. On the other hand, they won't need to bring along their own (possibly very heavy and expensive) life support systems with capacity for the whole trip.



Tether systems are useful only for orbital transfer; but since such situations are extremely common they are likely to be find frequent application. Although they require a planetary magnetic field to operate efficiently, this isn't a major limitation. Most Earthlike worlds will have sufficient magnetic fields. Gas giant worlds also have powerful magnetic fields, so operations in the close vicinity of a gas giant may also find tether systems useful.

REACTIONLESS DRIVES

A *reactionless* drive is one that produces acceleration without discarding reaction mass. A reactionless drive requires power; and fuel for the power plant, but is not limited by needing to carry around vast amounts of reaction mass. A reactionless drive starship can be extremely efficient, carrying a large payload. Unless the physical principles behind the drive stop working at high velocity, a reactionless drive ship can easily approach lightspeed.

All reactionless drives are super-science, since they violate the known laws of physics. If reactionless drives are available in a setting, the GM should define their performance. The most important factor to consider is the *thrust-to-mass ratio*. If one ton of reactionless drives can deliver only one-tenth of a ton of thrust, then starships will only be able to manage acceleration up to about 0.1 G (with almost no payload). If one ton of drives can deliver two to five tons of thrust, then accelerations of two to five Gs can be obtained.

Dean Drives

A *Dean drive* is a class of reactionless drive that (somehow) converts rotary movement into linear movement. The ship's onboard engine includes a big flywheel that is driven by a power plant; the angular momentum of the flywheel can be tapped to accelerate the ship forward.

The Dean drive was "invented" in the 1950s, and was taken seriously by a few people in the SF community. Unfortunately, it was never demonstrated for or duplicated by reputable

scientists, and was almost certainly a hoax. In fact, the Dean drive violates several known laws of physics. "Dean drive" can be used as a generic term for any reactionless drive that works by breaking the laws of motion as we currently understand them.

Diametric Drives

Another form of reactionless drive is the *diametric drive*. Such a drive creates an asymmetrical field of force around itself. The side of the force field that exerts more force on the ship will "push" the ship forward without any need for reaction mass.

Most diametric drive concepts involve manipulating gravity, since that force operates equally on all matter and can provide smooth acceleration.

A *bias drive* or *gravity drive* is a diametric drive that alters the force of gravity ahead of and behind the ship. In effect, the ship exists inside a bubble of space-time with its own arbitrary gravity. The ship is in free fall and doesn't feel acceleration, so it can safely pull *hundreds* of Gs (the speed of light is still an absolute limit).

Diametric drives are completely speculative; at present, we have no idea how to create the kind of force fields they require. They are similar in function to warp drives (p. 40) and may be a spinoff of that technology if it exists in the setting. Meanwhile, bias drives depend on fine control of gravity; they may be associated with artificial gravity (p. 44) or contragravity (p. 44) technologies.

Relativity Effects

Einstein's laws of motion have several surprising effects, especially as an object (such as a starship) accelerates close to the speed of light. As seen by an unaccelerated outside observer, the starship becomes *shorter* and *more massive*. From the starship's viewpoint, images of the outside universe become compressed toward the axis of motion. Light from ahead becomes "blue-shifted" toward more energetic frequencies, while light from behind becomes "red-shifted" down the spectrum.

One of the most important effects of relativistic velocity, especially from the point of view of the interstellar traveler, is *time dilation*. Someone on board a ship will experience the passage of time differently than someone in an unaccelerated frame of reference (say, on a planet). In effect, his clocks will run more slowly than those in the outside universe, so that the trip seems to take less time. STL starships can use time dilation to make manned interstellar travel more practical; crewmen and passengers won't need to spend so much of their lifespan to make a journey.

To compute the degree of time dilation, use the following formula:

$$R = \text{Square root of } [1 - (V/C)^2]$$

Here, **R** is the time rate experienced on board ship, **V** is the ship's velocity, and **C** is lightspeed. Some representative values:

Time Dilation Table

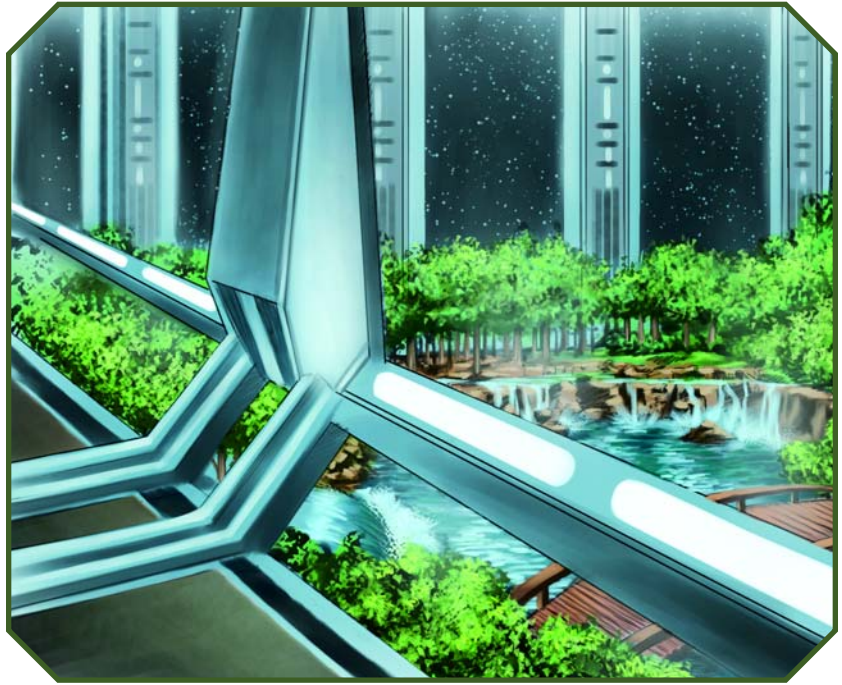
Velocity (× c)	Time Rate
0.25	0.968
0.50	0.866
0.75	0.661
0.90	0.436
0.95	0.312
0.99	0.141
0.999	0.045
0.9999	0.014

GENERATION SHIPS

One “realistic” approach to interstellar travel is to accept that it will take a long time, and plan for it. A *generation ship* is a starship that uses nothing but a maneuver drive to cross interstellar distances, requiring decades or centuries to make the trip and providing a livable habitat for crew and passengers along the way.

A generation ship isn’t so much a ship as it is a mobile *world*, with its own internal society. Adventures aboard such a ship will be almost entirely dominated by character interaction, as crew and passengers while away the years before reaching their destination. In fact, children are likely to be born, grow up, and have children of their own during the journey, yielding several generations of passengers (hence the name for this kind of ship).

A variant on the generation-ship idea is the “sleeper ship,” the slow starship that carries its crew and passengers in some form of suspended animation. Science fiction from the 1960s and 1970s often assumed that interstellar journeys would be taken with most of the crew and passengers



in “cold sleep,” a form of artificial hibernation.

Some current science fiction suggests that human crew and passengers might travel in *digital* storage. Nanotechnology and advanced computers might make it possible to transport a human’s body and mind as pure data. If the data describing a ship’s crew and passengers can be stored

very compactly, the ship carrying it can be much smaller and cheaper than one carrying the living people. The ship might even provide a rich virtual environment in which the passengers can “live” while in storage. Of course, if this kind of ghost-life is possible in the first place, why would the ship’s passengers have bothered to travel anywhere?

STAR DRIVES

In my time there were four ways known to cheat Einstein, and two ways to flat-out fool him. On our journey Pelenor used all of them. Our route was circuitous, from wormhole to quantumpoint to collapsar. By the time we arrived, I wondered how the deep-probe had ever gotten so far, let alone back, with its news.

– David Brin, *“The Crystal Spheres”*

Interplanetary travel is not only possible, but *practical*, given technology that we already know how to build. Interstellar travel is a very different matter.

The fundamental problem faced by anyone planning interstellar travel is Einstein’s theory of relativity. Einstein’s model of the physical universe – one of the most successful scientific theories of all time – assumes that the speed of light is an absolute limit (see *Relativity Effects*, p. 36). All

objects with mass must travel at lower speeds, unable to accelerate to light-speed no matter how much energy they apply. This means that starships will always take years to travel even between neighboring stars.

Ever since it became obvious that there are no other habitable worlds (or alien civilizations) within our own solar system, science fiction writers have turned to other stars as settings for adventure. This almost demands that the heroes of the story to have some method for traveling faster than light! Thus, many writers who are otherwise quite rigorous with their scientific content have invented some form of “FTL” travel.

Scientific speculation and science fiction have considered a bewildering variety of FTL drives. All of them should be considered superscience, although a few *might* have some

justification in cutting-edge physics. Most science-fiction universes only permit one form of FTL, although a few use multiple forms, each with its own advantages and problems. Some of the most common forms are as follows.

HYPERDRIVE

Einstein’s model applies to the physical universe that we live in. But what if there’s another universe where different laws apply, a universe that can be reached from ours? A starship could drop into that “hyperspace,” travel there according to its own laws, and then shift back into our own universe at a new location – reaching its destination much faster than Einstein would normally allow.

When thinking about a hyperdrive for a space setting, some of the things to consider are:



How fast is the drive? Does a starship take weeks or months to travel through hyperspace between two stars? Or does the trip take a fraction of a second? The GM will want to consider how quickly a ship can cross known space.

How quickly can the drive be used? This is important for dramatic reasons – if a hyperdrive can be used quickly and easily, a starship can always escape from trouble. Perhaps the drive requires a great deal of energy to make the shift into hyperspace, requiring long periods of charging the ship's engines from its power plant. Perhaps planning a trip through hyperspace requires a lot of computer power and time. Or perhaps hyperspace needs to “relax” after the stress of being crossed, ensuring that a new hyperspace transition can't be made too quickly after emerging into normal space.

How finely can the drive be controlled? Unless a hyperdrive ship can choose any point of emergence it wants, it will still need a maneuver drive to reach nearby planets or engage in space battles. Maybe hyperdrives can't be used within a certain distance of a large mass, requiring a starship to travel out to “flat space” before entering hyperspace.

What is hyperspace like? Perhaps ships in hyperspace are cut off from

everything, including each other and the normal universe. A trip through hyperspace would be a good time to do shipboard maintenance, and have locked-room adventures in which none of the characters can get away from each other. Perhaps ships in hyperspace can communicate with each other or with planetary facilities. Or perhaps hyperspace is a real place, with its own geography and even its own natives – ships can explore it using special sensors, hover or change directions in hyperspace, or even fight battles there!

Can a ship in hyperspace be detected? If a ship can't interact with the normal universe, then nothing in normal space can detect them until they emerge. That means that battle “lines” won't exist in a universe with hyperspace – invasion fleets won't be detected until they emerge, already close to their targets. On the other hand, if special sensors can reach into hyperspace, invaders will be detected in advance, and can possibly be met in hyperspace itself.

What happens if the hyperdrive fails? If a ship in hyperspace is damaged, does it return to its starting point? Does it drop back into normal space at an unpredictable point? Or is it stranded in hyperspace until the drives can be repaired? This can be

particularly critical if ships can fight battles in hyperspace . . .

Hypersails

What if hyperspace is like an ocean, with energy currents (and reefs, and storms) on which a starship can ride? Such a starship might need *hypersails* – more likely to be energy fields rather than physical sails – to take advantage of the ether's flow. David Weber's “Honor Harrington” novels use this model for hyperspace, deliberately mimicking the flavor of sea-adventure fiction set in the Napoleonic era.

Tachyon Drive

Physics predicts the existence of *tachyons*, fundamental particles that can't travel at *less* than the speed of light. A tachyon drive turns the starship into a beam of tachyons that then hurtles across space. A ship that is converted into tachyons might require a receiving station to restore it to its original condition.

JUMP DRIVE

It's not possible for a physical object to accelerate to speeds faster than that of light. But what if it's possible for a ship to move from point A

to point B in space, *without* accelerating and without crossing the space in between? A jump drive permits a starship to teleport from one location to another, usually in no more than a tiny fraction of a second. The ship never leaves the normal universe or enters any form of hyperspace.

Some of the things to consider when choosing a jump drive include:

Where can the drive be used? Many jump drives can only be used at “jump points,” specific locations in space. Jump points may occur naturally, they may be relics of a prior civilization, or it may be necessary to build them in order to use FTL travel. If jump points are necessary, they may be located far away from planets or other interesting places, requiring long trips through normal space to reach them. A jump drive that can be used anywhere can be a plot-breaking convenience, making travel or escape too easy for drama.

If there are jump points, how are they arranged? Perhaps a starship can jump to any number of different places, so long as it starts at a jump point. If a starship jumps to a region of space with no jump points, it may be stranded! Or possibly jump points are always connected in pairs, so that when a ship triggers its drive at one end, it always moves to the other end. Paired jump points can create a network of “jumplines” in known space, in which the real distances between stars are less important than the convenience of their jump-point links. Stars without jump points are inaccessible, while jumplines without stars at each end are not useful. Stars with several jump points become important crossroads, even if they don’t have habitable or useful planets.

How are jump points created? If jump points are a natural phenomenon, or were built by a prior civilization, then starships will need to search for them – and the first trip through one will be a major voyage of discovery! If a jump point must be created with special equipment, then that equipment might be located on a stationary facility, a *stargate* that can send starships to their destination without itself moving.

How is the jump drive triggered? Does it simply take the application of energy? Or does it require the use of

special computer programs, psionic powers, or other rare items? Those who control the ability to trigger a jump will control interstellar travel!

What happens if a jump fails? A jump ship may be stranded if it appears in a place without jump points, or if some jumplines are only one-way. Perhaps planning a jump requires a great deal of computation, and bad aim can send a ship anywhere.

Do jump points only cross space, or do they permit time travel? Some jump-drive schemes permit travel through time as well as space. Starships can visit the distant past or the distant future of the universe. A ship that curves back through time can end up changing its own past, or dropping into an alternate universe where events turned out differently. Jump navigation errors can be even more dangerous in such a setting . . .

Wormhole or Keyhole Drive

Wormhole-based drives are effectively jump drives, in which the “jump points” are artificial. Wormholes are predicted by modern physics; they are “tunnels” through space that connect distant points. Some quantum-mechanical models of space claim that tiny wormholes are constantly appearing and disappearing at the smallest scales. With a great deal of power, it might be possible to catch a wormhole that would connect to a desired destination, and then force it to open widely enough to accommodate a starship.

Current theory suggests that wormholes are likely to collapse catastrophically when an object tries to enter them. It might take a great deal of power to hold one open. Perhaps a stargate installation is needed at one or both ends, both to create and to hold open a wormhole. In this case, a starship doesn’t need any special drives at all – it can use a maneuver drive to reach and then pass through the wormhole.

Alternatively, a starship may have the equipment and power needed to find, expand, and hold open a wormhole as needed. Such a “keyhole drive” is likely to be very expensive and

dangerous. If the wormhole collapses while the ship is in transit, the result is likely to be catastrophic destruction!

Some serious suggestions have been made for manufacturing and using wormholes, falling into the realm of fairly rigorous SF. One proposal requires each end to be held open by a ring of superdense matter, massing about as much as the solar system, and spinning at nearly the speed of light. These requirements would seem to be beyond any but the most powerful and advanced civilizations – but perhaps as-yet-unknown science will find shortcuts that make the idea feasible.

Probability Drive

This variant on the jump drive relies on the inherent uncertainty of quantum mechanics. Even an object as massive as a starship can be treated as a quantum-level entity, its location and velocity uncertain. When the probability drive is engaged, the ship is no longer *likely* to be at its origin point, and instead becomes *very likely* to be located at the destination . . .

The drive may be controlled by psionic talents, using the “observer effect” of quantum physics to trigger the drive. Probability drives in fiction tend to be very dangerous, especially since they can’t always be controlled. A ship suffering a drive mishap may end up anywhere, nowhere, or *everywhere at once* . . .

Interstellar Teleport Gates

If teleportation is available (see *Teleporters*, p. 46) and has interplanetary or interstellar range, then it can be used to move people and cargo through space.

The details of the teleportation system have a profound effect on the flavor of the setting. If teleportation requires massive facilities, and can’t be used near a star or world, then it becomes a stargate system and space-ships are still necessary. Cheaper and more flexible teleportation makes spaceships less likely. At its extreme, teleportation “portals” can be part of everyday life – a single house can have rooms on different planets!

WARP DRIVE

Another way to get around Einstein is to warp the geometry of normal space, so that two points that are usually vast distances apart are (at least temporarily) much closer together. A ship can then move from origin to destination through normal space, and still reach the destination without ever approaching the speed of light. In practice, this means that the starship surrounds itself with some kind of energy field that lets it move at FTL speeds with respect to unwarped space. If the drive malfunctions, the ship loses its FTL speed, but it keeps the normal-space velocity it had before the warp drive was activated.

When choosing a warp drive for a space setting, some of the things to consider are:

How fast is the drive? As with a hyperdrive, the GM should consider how long it will take a warp drive ship to make a typical journey between stars.

Where can the drive be used? Perhaps a warp drive can only reach FTL speeds in deep space; close to a world or other large mass, the warp drive drops to STL speeds or stops working altogether. Perhaps the ship must accelerate to close to lightspeed using normal-space drives before engaging the warp engines. Or possibly the warp drive is dangerous to use

except in uncrowded space. A warp drive ship that can't use its drive close to a planet or star will need a maneuver drive as well.

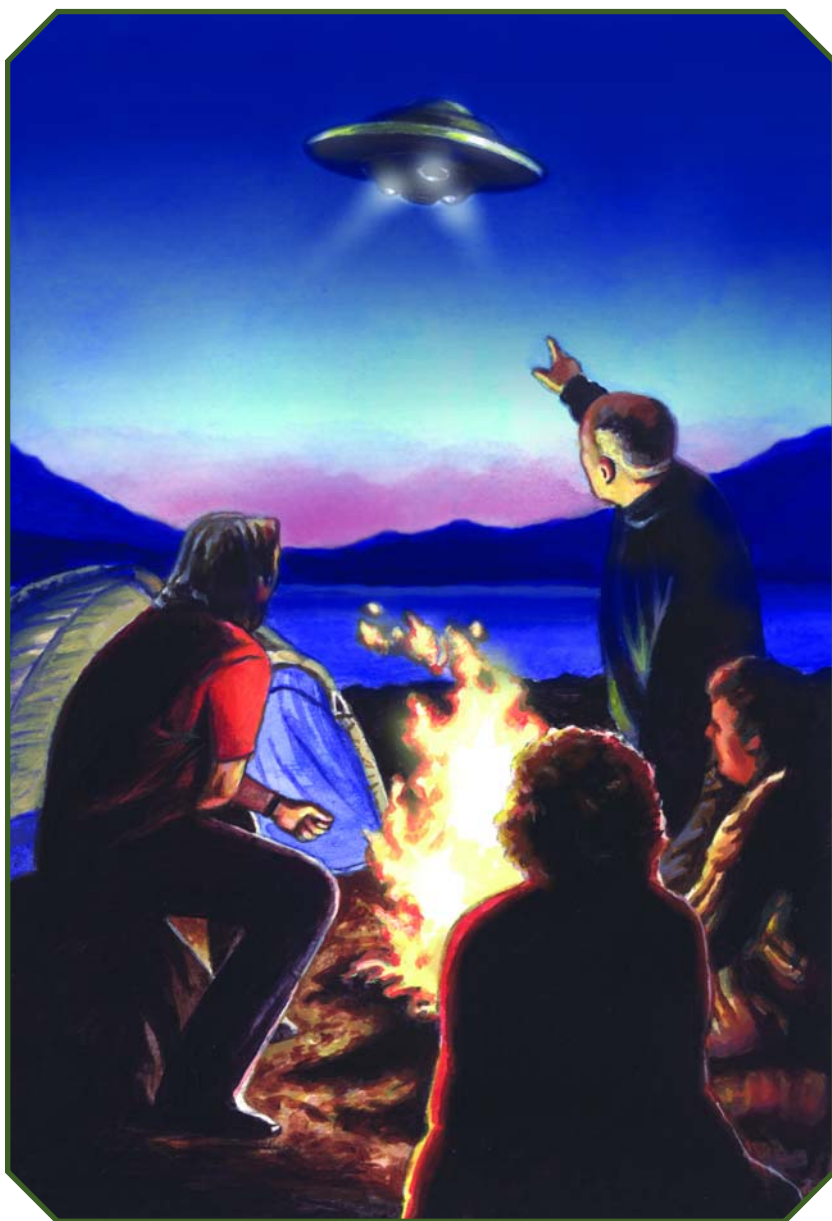
How well can a warp drive ship interact with normal space? Some variations on the warp drive permit full interaction: sensors can scan nearby space, ships can maneuver at will, and battles can be fought in warp. Other variations (including at least one proposed in real-world physics) call for the ship in warp to be almost completely cut off from the rest of the universe. Such a warp drive means that the ship can't see out of its warp bubble, can't steer, and may not even be able to turn off the drive without aid! A warp drive like this may be much like a hyperdrive that permits sensors in normal space to detect the moving ship, but in which the ship is otherwise out of contact until it leaves the warp state.

Inertialess Drive

This variation on the warp drive was first invented by E. E. "Doc" Smith. A device negates the inertia of the ship's matter, thereby abolishing Newton's laws of motion. The ship's speed is now limited only by the strength of its maneuver drive and the friction of the medium it's flying through. Ships are highly streamlined in order to reduce friction. In a planet's atmosphere, the ship is extremely fast. In the high vacuum of interstellar space, speeds many times that of light are possible (assuming, of course, that an inertialess ship isn't subject to *Einstein's* laws either).

The ship can instantly stop or change direction, "turning on a dime" in the manner some UFOs reportedly can. Inertialess ships are also immune to collision or explosion damage; a collision stops the ship dead at the point of impact, and an explosion simply bats the ship aside like a piece of thistledown.

In reality, there's no reason to believe that an inertialess object could break Einstein's laws. An inertialess object may be equivalent to a massless object, required to move at exactly the speed of light like other objects with no rest mass.



Blink-Warp Drive

This variation on the hyperdrive or jump drive permits a starship to make instantaneous leaps, but only over relatively short distances. To cross interstellar space, the ship makes a lot of jumps very quickly. The effect is like a warp drive, in that the ship remains in normal space, may be detectable at a distance, and may be able to interact with other normal-space objects.

If blink-warping is possible, a ship's ability to interact with other ships may depend on its ability to synchronize its "blinking." A ship wanting to attack another may have to struggle to coordinate jumps – if the two ships aren't in phase, a normal-space weapon fired by one will always miss the other by microseconds in either direction! This may be a situation in which human intuition and guesswork are as powerful as computer prediction, giving human pilots a chance to be effective.

Space Highways

Some real-world science suggests that warp drives may actually be possible, although the power requirements would be extremely high. One proposal suggests that specific paths through space could be *treated* to permit FTL travel. While staying on this "space highway," a ship can move at FTL speeds in the normal universe; the drawback is that it can't reverse course or leave the highway until it reaches its destination. A space-highway system is rather like a jumpline system, in which the ships take measurable time to complete each jump.

Ships on a highway may or may not be able to detect one another or to interact. If a highway is very narrow, then the probability of *collision* may be high enough to worry about . . .

DESIGNING A STARDRIVE

Once the GM has chosen a general type for his FTL drive, he can customize it with a variety of options. These decisions are important; they provide much of the campaign's flavor.

Drive Reliability

Decide how much attention the drives need. They may be so reliable that a yacht owner only needs to order a checkup every few years. Or they may be so finicky that a specialist has to roll against Engineer (Starships) at -4 after every use just to get them working again! Decide what skills are needed to maintain the FTL drive in good condition, how often the skill rolls are needed, and how difficult the task of maintenance normally is.

FTL Astrogation

Decide how difficult it is to control the FTL drive. It may be as simple as "point the ship and turn on the engines." Or astrogators may need high levels of Navigation (Hyperspace) skill and lots of computer power. Astrogators might also need unusual advantages – psionic powers, special mental abilities, or access to a rare and addictive drug. Decide what skills are needed, what modifiers might apply to skill in different circumstances, and any special abilities astrogators will need.

Drive Speed

Decide how fast the drive will go. This will depend on how large a region the campaign covers, and how fast you want the ships to get where they're going.

Hyperdrives and warp drives can be given a speed in parsecs per day (or hour, or second, or some other convenient unit). For hyperdrives, there may also be a limit to the time or distance a ship can travel in hyperspace without emerging into normal space. Each separate trip is called a "skip," and the ship must wait a GM-set time between skips. For instance, if the maximum skip is one parsec, and the skip is almost instantaneous, but the ship must wait a day before making another skip, then the effective speed is one parsec per day.

For jump drives, "speed" depends entirely on how far a ship usually needs to travel to reach a chosen jump point. The important factors are the endurance of the drive (how often a ship can jump, with respect to refueling or maintenance) and normal-space time from one jump exit to the destination world or the next jump entrance.

The scale of the campaign setting is determined by the assumptions the GM wishes to make about his campaign map. See *Mapping the Galaxy* (p. 67) for some suggestions.

Comparative Speed

Starships may have different speeds, especially when using hyperdrives or warp drives. Alternatively, a ship always moves at the same speed, and the drive simply either is or is not powerful enough to boost the ship's mass into an FTL state. With jump drives, the instantaneous jump is likely to be the same for every ship, although some ships may have better maneuver drives than others.

Maximum Range

How far can a ship go at a time? Ships that have to refuel often, or that need lengthy calculations before entering FTL travel, may have limits on the distance they can go before needing more fuel or new computations. Decide what limits may exist on a ship's range. If ships can travel long distances in FTL, then interstellar borders become harder to defend – especially if ships are undetectable while in hyperspace or in some other FTL state! If ships can travel only short distances without a stop, or if jump points are required and are easy to defend, then interstellar borders become possible.

Fuel Consumption

If an FTL drive makes use of some consumable material, then ships will need to stop and restock from time to time. Even a ship whose FTL drives run on internal power may need fuel to run the power plant. Or the drive may need some unusual material to work: a rare crystal, expensive transuranic elements, or antimatter. In general, if fuel is expensive or rare, then exploration and travel will focus on fuel sources. Ships that refuel often will need to stop frequently, and may be dependent on civilized ports to travel far. Ships that are fuel-efficient, or can scavenge fuel as they travel, will be able to travel longer distances without stopping. The availability of fuel will help control how cheap and commonplace interstellar travel will be.

Side Effects

Any FTL drive may have undesirable side effects. These can be an interesting balancing factor in a setting with multiple FTL drives; the faster drive may be more unpleasant or more risky. These effects may vary from one civilization to the next – some races may make excellent space navigators, or use certain drives that no one else can use.

Mechanical effects: The use of an FTL drive may affect mechanical devices, plaguing engineers. Perhaps the activation of the star drive is equivalent to violent maneuvers in normal space, forcing equipment and people to be secured to avoid damage. More subtly, FTL travel may cause certain devices (electronics, computers, even astrogational equipment) to fail or to function unreliably.

Physical effects: FTL may do harm to living creatures on board a starship! Perhaps everyone must roll vs. HT when the ship enters FTL (or at intervals while it is in FTL) to avoid nausea and spacesickness. Crew and passengers may suffer pain or disorientation, taking a penalty to DX or IQ. Or they may suffer illness or *death* in FTL, requiring that they take drugs or go into suspended animation!

Mental effects: Crew and passengers may suffer psychic distress, delusions or manic impulses that require medication or suspended animation to avoid. If psionics exist, FTL travel may interfere with their use (or may boost psionic talents). Or possibly FTL travel is psychically *pleasurable*, inviting an Addiction among frequent passengers or navigators! If drugs are required to navigate FTL space or to avoid physical harm, this may represent addiction to those drugs instead.

Navigation Errors

What happens when a starship goes off-course? STL starships, and those using a warp drive, are unlikely to get lost since they can always see where they are going. Jump drive and hyperdrive ships can go wildly off course, especially if a power plant or stardrive malfunctions in mid-journey.

In general, an astrogator should roll against the appropriate Navigation specialty, modified as the GM sees fit to reflect the difficulty of interstellar astrogation. A hurriedly set course, relative to the time usually required, gives a penalty to the roll (according to *Time Spent*, p. B346). A successful roll means that there was no error. The consequences of a failure depend on its magnitude.

The GM should custom-build his own failure table, appropriate for the drive he has designed. Players should *not* be allowed to see this table, although they may know what the general results of a *minor* error will be. If the penalties for miscalculating are low, then starships escaping from danger will always use quick-and-dirty computations. As consequences become more severe, “snap astrogation” becomes more of an emergency measure.

Some possibilities include:

Nothing happens: Literally. If your calculations are wrong, you use up a lot of energy – and go nowhere. This is especially appropriate for jump drives.

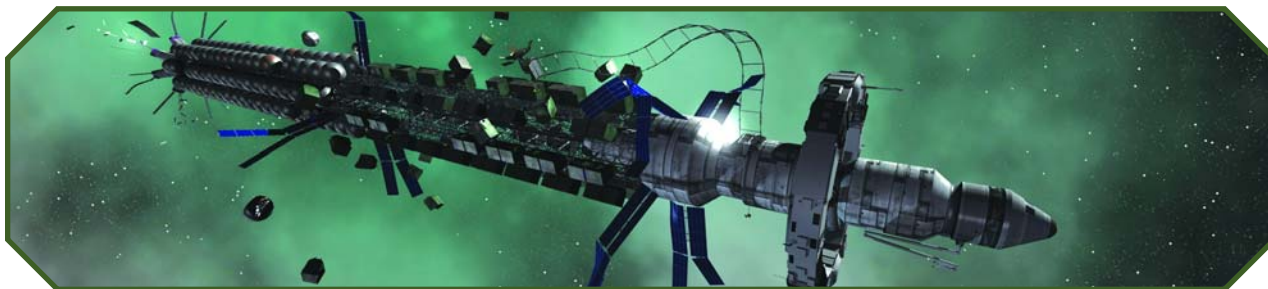
Off-position: This is more appropriate for hyperdrives than for jump drives. Deviation from the intended destination depends on the amount by which the skill roll was missed, and may be minor (AUs) or major (parsecs). A ship might go in the correct direction but the wrong distance, or it could go the correct distance in the wrong direction.

Lost: The ship is sent to a wholly unexpected location – the worse the roll, the more lost it is. The actual destination may be a reasonable number of parsecs from the departure or destination point, or it might be random on a galactic or intergalactic scale. Astronomy or Navigation rolls will be required just to figure out where the ship is.

Time-Lost: Along with one of the previous results, the ship also moves a random distance forward or backward in time. Small time-movements are an interesting nuisance. Big ones can be catastrophic, and may be appropriate only if the GM is ready to start a new campaign. If ships can become “time-lost” predictably, the GM may find himself running a time-travel campaign.

Damage: The ship (or the drive) takes a certain amount of damage. For example, the drive may burn out, or the ship may lose a percentage of total hit points.

Total Disaster: The ship is destroyed, or thrown into another universe with no possibility of return. Not a good result for play balance, although as a final consequence for *very stupid* escape plans it may have some merit.



SHIPBOARD SYSTEMS

Cargill took a deep breath, then started over. "The ship can fight," he said in what amounted to baby talk, "until somebody makes a hole in her. Then she has to be fixed. Now suppose I had to repair this," he said, laying a hand on something Rod was almost sure was an air absorber-converter. "The . . . thing looks half-melted now. How would I know what was damaged? Or if it were damaged at all?"

— Larry Niven and Jerry Pournelle,
The Mote in God's Eye

Aside from the drives, every spaceship has other systems intended to keep its crewmen alive and support their work. These secondary technologies can have a profound effect on the flavor of a space setting.

CONTROL SYSTEMS

A spaceship will have a variety of component systems. Most of the time, crewmen will interact with their ship by way of its *control systems*.

Cockpits and Bridges

Almost every fictional spaceship has a centralized control room. A very small ship, like a TL7 space probe or a fighter craft, may have a *cockpit*, a cramped space just large enough for the crew to sit and work. A larger spaceship will probably have a *bridge*, with extra space permitting the crew to get up and move around.

In either case, the control center is the place where the ship's commanding officers meet, work, manage the ship's systems, and plan for upcoming adventures. The "look and feel" of the control center can be important. Is it cramped or roomy? Are the controls composed of toggle switches and dials, brightly colored buttons, or sophisticated virtual-reality interfaces? Which crewmen are likely to be found in the control center, and which ones visit only rarely? Does the bridge crew observe careful military protocol, or are they relaxed and informal?

One variation on the central bridge might be a *virtual* control center, used on spaceships where computers and communications gear are ubiquitous. If crewmen can confer with each other at will, and control ship's systems from anywhere on board, then there's little need for centralized controls. Perhaps they work from their quarters much of the time, conferring with each other over ship's communications (or even meeting in a VR space).

Computers

Every spaceship is likely to have at least one onboard computer; in settings where computing is commonplace there may be hundreds networked together.

The GM should consider how adventurers will interact with a ship's computer systems. In order to solve a new problem, does the crew have to reprogram the computers in an arcane machine language? Or can an officer describe the problem in vague terms and expect the computers to come up with independent answers? Does the computer show *initiative*, volunteering information and solutions on its own? Does it have a personality? In particular, can the computer run the ship *by itself* – and if it can, who needs human crewmen?

The GM may be tempted to use a ship's computer systems as an "oracle," presenting information as needed to drive the plot. However, if a computer is that widely useful, it may start to replace human adventurers . . .

LIFE SUPPORT

Spaceships can be robotic, carrying nonliving cargo or scientific instruments. A ship that carries crew or passengers will need to provide *life support*, keeping everyone alive even in a hostile environment.

Any ship capable of space travel can be assumed to be sealed against temperature extremes, vacuum, meteoroid impacts, and so on. In particular, every long-range spacecraft will need shielding against radiation, which is ubiquitous in space (see *Radiation Hazards*, p. B435).

Supporting the biological needs of any passengers – breathable air, potable water, and edible food – requires more elaborate technology. The GM should consider the level of life support technology that is available.

Limited Life Support

Limited life support provides air, food, and water so long as onboard supplies last. It has no recycling capability, so once the supplies run out, crew and passengers are in trouble. Limited life support is of little value for space travel since it's difficult to carry enough supplies to support crewmen for more than a few days. Space shuttles or other ground-to-orbit craft may use limited life support.

Full Life Support

Full life support can recycle air and water, vastly extending the endurance of the life support system. The system still can't provide food, or recycle most biological wastes. A ship with full life support will need to carry provisions, stopping at port occasionally to resupply.

Total Life Support

Total life support can provide all of the passengers' needs, recycling biological wastes and producing edible food indefinitely. A ship with total life support can travel for very long periods without stopping at a port.

GRAVITY

Gravity is one of the fundamental forces of the universe – and it has also turned out to be the hardest force to manipulate. Today, the only known way to produce gravity is to pile up lots of mass. There is no known way to screen against it, reducing an object's weight or making it weightless. Still less is there any known way to *reverse* gravity. Gravity control ("gravitics" or "gravitonics") is still a dream, and should be considered a superscience technology.

Spin Gravity

A space habitat can be rotated to provide artificial gravity through centrifugal force. A spaceship can do the same, either by rotating as a unit, or by spinning a specific section.

Spin gravity is available even at very low TLs, but it has a number of disadvantages. The rotation gives rise to a Coriolis effect, which seems to push objects to the side as they fall; this can be difficult for travelers to adjust to. Coriolis effects can cause severe disorientation if the radius of the spin is too small, so the ship (or the rotating section) needs to be fairly large.

Meanwhile, there may be reasons why the whole ship *can't* rotate – say, in order to hold the aim of a shipboard weapon. Unfortunately, conservation of angular momentum means that if one section of the ship begins to rotate, the rest of the ship will normally rotate in the opposite direction. This can be avoided, but it adds to the complexity of the system.

Artificial Gravity

An *artificial gravity* generator is a device that (somehow) produces a gravitational field without lots of mass. This violates physical laws as they are currently understood, and must be considered superscience.

If a setting has artificial gravity, this has a number of effects on the campaign. Spaceships and space stations will no longer need to be built with rotating sections to generate spin gravity. They can be given any shape desired, and in particular will no longer need to be shaped like rings or cylinders. Settlement on asteroids, comets, or other bits of space debris will become easy. The presence of variant human races, adapted to microgravity or to unusual gravity fields, will be much less likely.

A variation on artificial gravity is the gravitic or inertial *compensator*, a device that renders the force of high gravity (or high acceleration) harmless. Compensators can make space travel much more comfortable, even on spaceships with very powerful maneuver drives. Manned ships, especially fighter craft, will be able to make sharp turns at high velocity, letting them “dogfight” as seen in many SF films.

Contragravity

Contragravity is a means of “screening out” gravity – in effect, the reverse of artificial gravity. The main effect of contragravity is to allow things to fly without regard for aerodynamics, and without noisy engines. Instead of being light and fragile like helicopters or jet planes, vehicles can be quite heavy, like “grav tanks,” or even flying houses or cities. If contragravity generators can be made small enough, they can allow personal flying belts – or flying carpets!

Contragravity can be dramatic and futuristic. On the other hand, if it becomes too easy to fly, there's not much point to driving, sailing, or walking. The simpler and more portable flight technology is, the more adventurers will use it. This can short-circuit a lot of adventures – it's hard to get excited about a “man against nature” adventure in which the heroes must cross a thousand miles of barren, monster-infested wilderness, if they can just strap on their flight-belts

and fly. Of course, the contragravity may be unreliable, and may fail at just the wrong moment . . . but it can become tiresome if the GM develops a habit of depriving the adventurers of crucial technology.

WEAPONS

If space travel ever becomes common, spaceships will sooner or later begin shooting at each other. The choice of what shipboard weapons are most common will do a lot to determine the flavor of a space setting.

Projectile Weapons

One of the oldest ways to damage any vehicle is to throw physical projectiles at it. A missile that simply collides with an enemy ship uses the *kinetic kill* technique. A missile can carry a warhead: high explosives, a nuclear device, bomb-pumped lasers, nanotechnological “goo” . . . anything that can damage an enemy ship at a short distance.



One of the fundamental problems with projectile weapons is how to *aim* them. This problem is particularly bad for an unguided projectile, which can't alter its course to follow the enemy. Unguided projectiles (such as those fired by a cannon or railgun) will need to be very fast or very short-range. Guided missiles will need to be faster than the ships they target, and will need to be *smart* to outguess the enemy pilot.

Beam Weapons

High-energy lasers, particle beams, gravity beams, or bolts of energetic plasma are all good candidates for *beam weapons*.

Beam weapons can help with the aiming problem in space combat. Lasers, gravity pulses, and particle beams all move at lightspeed or just under it. These speeds mean that the enemy ship won't have time to evade while the beam crosses space, even if it can predict when the attack is coming. On the other hand, if a beam has to be *held* on its target to do significant damage, this helps the defense. A ship being targeted can simply rotate in place, or make small evasive maneuvers, spreading the beam's attack point across the hull.

Remember that a ship's *drives* can sometimes be used as a weapon. Most reaction drives generate hot plasma or other dangerous exhaust, which could be directed at an enemy vessel. The faster and more efficient the drive, the more energetic the exhaust – all the way up to the output from antimatter pion drives, which can be deadly at distances of millions of miles.

Exotic Weapons

Superscience technologies that drive a ship can also lead to superscience methods for attacking (or defending) it. Any bad effect that might occur as a side effect of a drive might also be deliberately inflicted on an enemy vessel. Perhaps a gravity drive can also be used to project gravitic fields at an enemy ship, burning out enemy drives or damaging the enemy ship's hull. A different application of hyperdrive technology might make it *impossible* for enemy ships to escape into hyperspace. If a ship uses

psionics to trigger an interstellar jump, then it may be vulnerable to telepathic or telekinetic attack.

Designing Weapons

Some of the things to consider when designing weapons systems are:

Range: At what distance can the weapon be relied on to do significant damage? Some projectile weapons have effectively unlimited range. Beam weapons tend to do less damage with distance – even laser beams spread.

Aiming: At what distance can the weapon be reliably *aimed* to hit the target? Can ships evade effectively even at short distances, or do they have to be thousands or millions of miles away? Are there ways to evade damage even if the attack can't be seen coming?

Gunnery: Who operates the weapons? Can human gunners aim and fire with some chance of hitting the target? Or does fire control have to be left in the hands of computers, with humans making general tactical decisions?

Damage: What kind of damage does the weapon do? Does it simply tear up the hull and any systems it hits? Does it heat the target to the point of breakdown, or inflict radiation damage? Does it deliver some exotic form of injury, harming drives or other ship's systems?

DEFENSES

If spaceships go into battle, they will be built with defensive systems to avoid or minimize damage.

Armor

One of the simplest defenses any ship can mount is *armor* – plating on the hull, made of tough metal or more exotic materials, designed to deflect or absorb damage.

Almost all spaceships will carry some armor, if only to deflect meteoroid impacts and lend some protection against radiation. This kind of armor can be quite simple; a layer of rock, slag, or even ice can serve the purpose. Many primitive interplanetary craft and space stations will use found materials for armor. Interstellar

ships that approach the speed of light may use a *very thick* coat of cheap armor to cover their forward sections.

The main drawback of armor is that it can be very heavy. Civilizations that routinely use armored spacecraft will look for ways to make it as tough as possible, or as *reflective* as possible if beam weapons are a likely threat, so that its mass can be reduced.

Force Fields

Many science-fiction universes include some kind of force field, an energy barrier that can protect a ship (or some other target) from incoming projectiles or beams. Force fields can be a useful technology when establishing a setting's flavor.

First, force fields can allow individuals or vehicles to *look* unprotected but in fact be well shielded against enemy fire or hostile environments. A tiny shield belt is so much more *elegant* than a bulky armored suit . . .

Second, force fields allow the GM to control what weaponry is likely to be in use. For a "swords and starships" campaign, the GM can rule that force fields block explosions and fast-moving projectiles, but are ineffective against slow hand weapons. For a campaign in which nuclear weapons are rare, rule that force screens provide thousands of times their normal resistance against nuclear explosions. To limit teleportation technology, rule that a teleporter can't reach through a force field.

Stealth and Cloaking

Camouflage is a long-standing part of the art of warfare. In many hard-SF settings, the ability to deceive enemy sensors and smart weapons may be a much better defense than armor.

Of course, there is considerable debate as to just how easy it will be to conceal a spaceship from sensors. Space is *big*, so spotting something as small as a ship may be tricky. On the other hand, space is also *dark and cold*. The laws of thermodynamics mean that the energy used to operate a ship has to go somewhere. This means that every ship will radiate heat, standing out nicely in infrared against the dark background.

Meanwhile, the flare of a rocket drive will act as a beacon to everyone within line of sight – and there's rarely anything to hide behind in space . . . Still, advances in electronic countermeasures (ECM) and stealth technology may mean that battles must be fought at or near visual range.

Cloaking technology goes beyond obscuring a ship's image or deceiving enemy sensors, rendering a ship entirely invisible. "Invisibility fields" are superscience, but they can give space combat a unique flavor. Spaceships can be like submarines: maneuvering for position, hunting for a fleeting contact, almost impossible to detect until they give their position away by firing their weapons.

Note that almost any superscience technology may have an effect on how easy ships are to detect. Perhaps reactionless drives produce a lot of waste heat. Perhaps an installed hyperdrive will let a ship dump its heat and other radiations into hyperspace, reducing its "signature." Or perhaps a ship that uses a psionic drive can be detected by psionic powers at very long range . . .

SENSORS

Every spaceship needs equipment to gather and interpret data about its surroundings.

Passive sensors receive the natural radiations given off by objects at a distance, and use those to build an image of the ship's surroundings. The most

basic passive sensors used in space will be *telescopes*. Telescopes don't have to use visible light; radio, infrared, ultraviolet, X-rays, and even gamma rays can all be detected by various telescopes. Particle radiation (alpha particles, beta particles, neutrinos, and so on) can also be detected by specialized instruments; this can be useful when trying to detect nuclear power plants or other high-energy phenomena. More exotic passive sensors may sense mass, gravity, "probability waves" given off by unusual reality-altering technology, the operation of FTL drives, or even psionic effects.

Active sensors don't wait to receive the emanations of other objects. Instead, they broadcast electromagnetic radiation and interpret the reflections. The simplest active sensor is a *searchlight*, illuminating otherwise dark objects. In space, high-powered lasers or bright rocket drives can be used as searchlights at very long range. Other active sensors include long-wave or microwave radar, or exotic sensors using other forms of radiation.

In a setting with FTL travel, the GM may want to consider permitting superscience sensors that themselves work at FTL speeds. Ships that can communicate or even fight in FTL will need sensors capable of guiding these interactions. A starship might be able to detect other ships even at light-year distances, moving to intercept them or simply preventing them from sneaking by unnoticed.

Teleporters

If teleportation is possible, then a spaceship might have teleportation equipment on board for crew and passengers. This might simply provide a quick way to get around the ship itself – or it can provide an easy way to move onto a nearby world and back!

Teleportation can sometimes be a plot convenience, permitting the GM to easily put characters in the middle of an adventure. On the other hand, if teleportation is too easy, it can help the adventurers get back out of a difficult situation at any time. This can short-circuit many plots, forcing the GM to make the system break down too often for credibility.

Limited teleportation systems may be a useful compromise. Perhaps the system requires heavy equipment to be in place at both ends. In this case, a ship's crew could use it to easily visit a civilized world, but would have to do without when exploring the frontier. Or perhaps inanimate cargo can be moved but the system is far too unsafe for passengers, forcing adventurers to use more conventional methods to get around.

COMMUNICATIONS

Spaceships always have communications equipment. Radios, lasers, and similar devices send information by modulating electromagnetic information. Advanced societies may manipulate gravity waves or neutrino bursts to communicate.

However, all of those methods are limited to lightspeed. Adequate for communication across interplanetary distances, they become very slow and cumbersome at the interstellar level. If FTL travel exists, then FTL communication may exist – but the GM will want to carefully consider how such communications work.

No FTL Radio

If no FTL communication is possible, then the speed of communication becomes that of the fastest starship. Fast courier ships will maintain contact between worlds, carrying mail, news, and government dispatches. Slower ships, possibly independently owned, will contract for mail service to less important worlds. Without FTL communications, invading fleets, escaping criminals, and similar menaces may be able to outrun the warning that they're coming.

Without FTL communication, interstellar trade is risky; a merchant won't be able to determine in advance what the target market needs. A trader who guesses right can get rich, while one who guesses wrong will go broke. If the interstellar state is large enough that it takes months or years to cross by starship, then the capital will seem remote and people will tend to be more loyal to their world or province than to the state as a whole. Military forces will need to be large and scattered, so that there is always enough force at any point of danger. Military commanders will have great leeway when they are far from superior authority; bravado and strategic skill will be very important.

Slow FTL Radio

Slow FTL communication – say, three or four times as fast as the fastest starship – helps tie an interstellar state together. However, FTL "radio" may be expensive; perhaps it

takes up too much space or requires too much energy to be installed on a starship. In this case, FTL communication may take place only between the most important worlds, while ships and minor worlds still have to rely on couriers. Access to FTL communications will be a great advantage for merchants, or for military commanders.

Fast FTL Radio

Fast, cheap FTL communication makes it easy to hold an interstellar state together. Trade becomes relatively safe, as merchants can easily check the market at their destinations before they even load cargo. Military fleets can be smaller but still used efficiently, since they can quickly be called together in an emergency. On the other hand, merchants and military officers alike will find their freedom of action limited, with superior authority always an FTL call away. Captains will rarely take action without referring to HQ for orders!

If FTL communication is this easy, the GM may want to impose limits on it to make sure that it can't ruin a dramatic situation. FTL "radio" may have a limited range, forcing the state to set up "repeater" beacons and ensuring that a ship out on the frontiers can't call home. Communications may be unreliable, with "static" or some other blockage appearing at appropriate moments. Or perhaps messages are still delayed enough in transmission that a call for help can't be answered immediately!

POWER

Most practical maneuver drives either require a great deal of power, or are direct modifications of power plants. Star drives are also very likely to require a great deal of power. Power plant technology is therefore critical to space travel.

Any spaceship power plant needs to be able to operate without air; this rules out fossil fuels. Power plant designers will look for fuel efficiency, safety, a high power-to-mass ratio, and very long endurance. The GM should consider what power plants will be available to support the existing ship's systems.

Bandwidth

Another factor to consider when designing FTL communication methods is *bandwidth*. Bandwidth is a technical term, describing *how much* information can be sent through a channel in a given time. A communication method can be extremely fast and almost impossible to jam – but if it takes many hours to transmit a message even a few words long, it won't be as useful!

A fast but low-bandwidth communications method can have interesting effects on the campaign setting. It may be easy for a spaceship to maintain contact with its home base, but not to send detailed messages or ask for extensive information. If the *transmitter* is too bulky for a spaceship to carry, then it can receive orders or bulletins from home base without being able to respond. Interstellar communications will be expensive, and may be metered by the word (or the byte) like old-style telegrams.

Meanwhile, if *spaceships* routinely have massive power plants with a great deal of output, it's likely that space habitats and planet-based communities will also have access to plentiful energy. A society that flies powerful starships is probably very wealthy at home!

LABORATORIES

It's very common in SF for spaceships to carry scientific equipment, and even whole laboratory facilities. This is often true even of ships that aren't designed to serve as exploration or scientific vessels.

In fact, the need for scientific equipment and crewmen trained in the sciences depends on how much time a spaceship will spend in unknown space. A ship that never leaves well-known regions won't need scientific gear – present-day cargo ships and military vessels don't carry extensive laboratory facilities! If a warship or merchant vessel *sometimes* visits unexplored worlds, then it may take on equipment and trained crew

temporarily when it's needed. Only a ship that is likely to take on an exploratory role *at any time* will be designed to carry scientific facilities all the time.

For example, the warships in David Weber's "Honor Harrington" novels carry only minimal scientific facilities, since they never take on an exploratory role and rarely leave well-known space. On the other hand, Federation starships in *Star Trek* are likely to receive exploration or survey duty at any time; even heavily armed cruisers carry extensive laboratory facilities and crews trained to use them.

One exception to this general rule is the presence of *medical* facilities. Every spaceship will need to carry medical equipment and the necessary crew. A small ship may carry basic drugs and surgical tools, with one or two crewmen cross-trained in medicine. A larger ship, no matter what its overall purpose, will carry a *sickbay* and trained physicians to protect the health of the crew. Such facilities may be useful in biological investigations.

"Well, Bones, do the new medical facilities meet with your approval?"

"They do not. It's like working in a damn computer center."

*– Kirk and McCoy,
Star Trek: The Motion Picture*

An interesting game can be designed around an exploratory or survey vessel, although if the GM and players aren't themselves familiar with the sciences it may be difficult to maintain interest in such a campaign. An alternative might be to throw a spaceship that *isn't* designed for exploration into a situation where scientific discovery is crucial!

INFRASTRUCTURE

A number of miscellaneous "systems" don't depend on advanced technology, but might be useful for the GM to consider as he develops the flavor of a ship-based campaign.

Tools and Workshops

Spaceships are complex machines, and are likely to need a great deal of maintenance. Low-TL spacecraft sometimes get around this limitation by being "one-shot" machines. They are used for a single short mission, and designed so that none of their components can be expected to fail before the mission is over. The first "reusable" spacecraft often need extensive maintenance and even rebuilding between launches.

Once a spacecraft is likely to spend months or years in flight, its crew will need to be able to perform maintenance and repairs. The spaceship will need to carry tool and replacement parts. For very large ships (or very long missions) it might even be reasonable to carry whole workshops, complete with fabrication facilities so that new parts can be made out of raw materials.

Consumables and Storage

Every spaceship will need storage space to carry things that the crew and passengers will need. Fuel must be stored for the power plant and space drives. Food, water, air, and other consumables must be carried to stock the life-support system. The crew may need various pieces of equipment that will be used when the ship reaches its destination.

Even a low-TL space "capsule" will be full of these items, stuffed into every available nook and cranny. A large, high-TL spaceship may have extensive

on-board supplies: tools, replacement parts, clothing, linens . . . even entertainment or luxury items for the passengers!

If a campaign focuses on ship-board activities, the GM may want to make sure that the ship's stores are well defined. A spaceship in flight is extremely isolated; if anything goes wrong the crew will have nothing but what's in storage to use to fix the problem. Requiring adventurers to improvise with inadequate equipment is often a good way to ratchet up the tension . . .

Cargo

Many spaceships will have some capacity to carry *cargo*. If permanent space habitats or colonies exist, they will be supported by spaceships carrying supplies and new equipment. Eventually trade will spring up between worlds, and some spaceships will specialize in cargo transport.

Ships that carry a lot of cargo will also have crewmen who specialize in handling it – loading it, unloading it, and taking care of it in transit. If spaceship crews can engage in trade on their own behalf, some crewmen will be expert in finding worthwhile cargoes, buying them at a bargain price, and selling them for a profit.

The minutiae of buying and selling cargo don't usually make for compelling adventures. If a cargo-carrying ship is the focus of a campaign, the GM should consider other ways to use the cargo to drive interesting stories. Perhaps the ship carries legitimate cargo, but also engages in *smuggling*

to avoid government interference. Perhaps a piece of cargo turns out not to be what's expected, posing a danger to the ship or its crew. Or perhaps carrying the cargo is easy enough, but *delivering* it (and getting paid for it) poses challenges at the destination.

SMALL CRAFT

Many spaceships in science fiction carry *small craft*, smaller vehicles that are used for specialized purposes. Depending on a setting's technological assumptions, a small ship may have advantages over a large one in certain circumstances. A small ship may be faster or stealthier – or it may simply be able to go places (like planetary surfaces) that the typical starship can't.

If small ships are the only ones that can conveniently land on worlds, then large ships will carry one or more "shuttlecraft" to ferry people and cargo. Even ships that can easily land on a world may carry a small cutter or gig for jobs that require a few crewmen to travel away from their home ship. Similar small craft may serve as lifeboats to carry people and valuable equipment away from a wrecked ship (see *Man the Life Pods!* below).

Small craft that are much faster or stealthier may have military uses. Space-opera universes sometimes have large "carriers" or "motherships," carrying squadrons of small fighter craft that take on some or all of the space-combat tasks. Small craft can also be stealthy speedsters that carry small teams of adventurers into and out of dangerous situations.

Man the Life Pods!

When a starship runs into trouble, the crew may or may not have a chance of surviving. Antimatter explosions and similar disasters are not likely to leave survivors! If anyone from the crew *can* survive, they may be stranded for hours, days, or even years before help can arrive. Many ships will be built with systems designed to help the crew escape, reach sanctuary, and survive until help arrives.

The typical survival system is a "lifeboat" or "life pod," a small craft capable at least of brief maneuvering to get away from a dangerous situation. It will provide some life support, although it may rely on suspended-animation techniques to support stranded crewmen for long periods. A lifeboat may or may not be able to land. If it can, it will probably be stocked with survival gear and other resources useful for crewmen who must live in the wilderness for long periods of time.

CHAPTER THREE

TECHNOLOGY

"You really want to try it again?" asked Captain Panatic as we circled high above the alien city, looking down through the scanscope.

"Of course! It can't fail this time! We drop down out of the sky with the holobelts on to give us a nice halo effect, and demand that they hand over all the nice shiny crystals or the mighty Sky Demons will be angered."

"When we tried that before, they threw spears at us."

"That's because I used the wrong mythological referent. I said Star Demons instead of Sky Demons. This time I know better. And we're a thousand klicks from the last place. It'll work just fine!"

We left the airboat parked at 1,200 meters, put on the holobelts over our flight harnesses, and dropped down toward the city. It was the standard local setup: low cone-shaped houses lining radial streets around a tall spiral ziggurat tower topped with the usual big shiny copper sun disk.

A crowd of locals gathered around us in the main plaza. They were typical lowtechs: no metals harder than copper, no wheeled vehicles, and no wind or water power. They'd be pushovers for the mighty Sky Demons.

I stepped forward and touched my translator necklace. "We are the mighty . . ."

"Impostors!" shouted an old native, pushing through the crowd. "They are impostors! Beings from a distant place come to steal our crystals!"

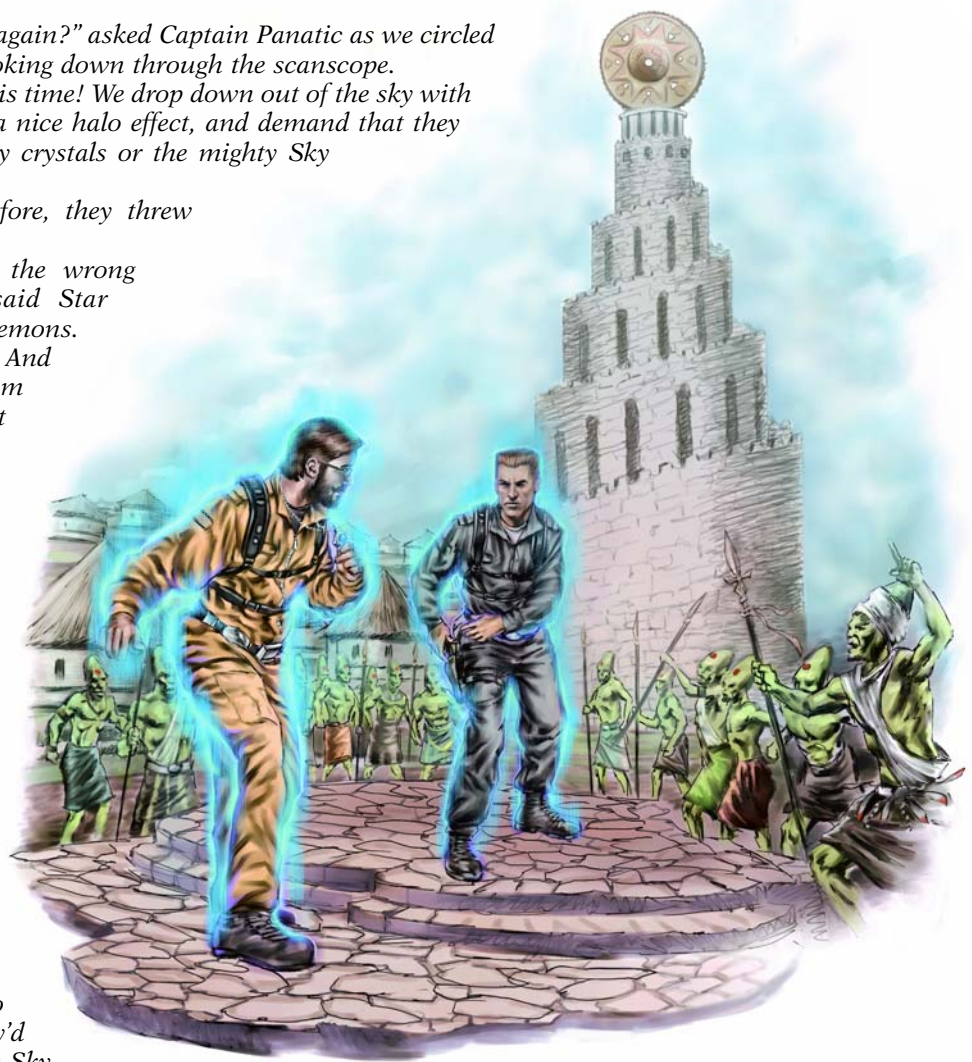
Panatic looked at me, his hand straying to the butt of his blaster.

I tried to salvage the situation. "Why do you say this?" I asked the old green guy. "Why do you say we are impostors?"

He stabbed his staff angrily at the ziggurat. "The talking mirror brought word of your scheme!"

I shook my head at Panatic and slapped the BOOST button on my harness. As the city dropped away beneath us, I let out a growl of frustration. Not even Bronze Age and they've already got lightspeed communications! Sometimes the world just isn't fair.

Sometimes in science fiction it's all about the gadgets. Science fiction would hardly be the same without the products of futuristic science. The available tools and their dramatic implications will be one of the most important things for any GM to consider when designing a new science-fiction setting.



ADDING MIRACLES

After a setting's space-flight technology is set, the GM will want to consider whether any *miracles* (as defined on p. 29) will be present in other areas of technology. Miracles in astronautics are useful if the GM wants to set his stories in space; miracles in other industries can have a profound effect on what those stories will be *about*.

SEVERAL MIRACLES

Science fiction authors rarely assign technological miracles arbitrarily. Each story usually has a coherent set of technological assumptions, chosen to support the plot (or to fit a consistent setting for which the author has written other stories). Some of the more common assumption sets are listed here.

High Industrial

A *high industrial* setting is one in which advanced technology produces a world much like our own, but *more*: more available resources, more useful gadgets, more powerful weapons, and so on. Technological miracles have given human beings better tools, but they haven't significantly changed human nature.

One form of high industrial setting uses *retrotech* assumptions. Retrotech is characteristic of Golden Age SF, which was written before the society-altering possibilities of certain technologies became obvious. Many of the best stories of the period featured highly advanced physics, but very inferior electronics, and no hint of advanced biotechnology or nanotechnology. This isn't necessarily a bad set of assumptions; it can give rise to a very exciting space-opera campaign. Without the realistic crutch of smart computers and advanced cybernetics, adventurers have to rely on their own skills rather than those of their machines!

Since retrotech campaigns are set in the future, they usually involve *political* change: present-day nations will have vanished; new cultures and empires will have appeared. However, these changes result from ordinary

historical trends, not spectacular social transformation. Some retrotech universes involve elaborate "future histories," tracing out how the societies of the future evolved from those of the present. Retrotech universes often support adventures driven by romance and drama rather than scientific rigor.

Classic examples of retrotech fiction include Poul Anderson's "Polesotechnic League" and "Terran Empire" stories, E. E. "Doc" Smith's "Lensman" novels, and even the *Star Trek* television series.

Some more recent SF mimics the retrotech feel by using *safetech* assumptions. In a *safetech* setting, it's *possible* to develop technologies that drastically alter human nature or replace humans with machines. However, all such technologies are avoided or suppressed, usually through social controls. This is most often for ethical reasons, or because of past wars or disasters that involved the technology.

Under *safetech* assumptions, human society will extend into space and will probably be more prosperous, but it won't otherwise be very different from the societies of today. *Safetech* universes support a space-operatic approach, and are fairly common in SF. For example, Larry Niven's famous "Known Space"

universe is a *safetech* setting for most of its future-history timeline. Meanwhile, several authors are currently trying to recapture the classic space-opera flavor by using *safetech* assumptions – Walter Jon Williams' "Dread Empire's Fall" series is a recent example.

High Biotech

In some SF universes, the most miraculous technologies are those involving medical science and bio-engineering. Genetic modifications, tissue engineering, biochemical weapons, living computers, and similar items all become commonplace.

Miraculous biotechnology can produce a variety of interesting effects in a science fiction setting. With it, a sapient race can vary its own form, adapt itself to unusual conditions, acquire wonderful powers, and even gain immortality. On the other hand, biotechnology involves the *manipulation* of living things, possibly without their consent or to their detriment. Techniques that benefit some people may have terrible consequences for others. A setting with extensive biotechnology may need to address important moral themes.

A variation on the high-biotech setting is the *high psionics* setting. Here, improvements in human performance come from the development of exotic



mental powers. These can, in turn, come from the manipulation of human biology – but they can be derived from other sources entirely. In any case, many of the same ethical and social issues apply!

The *Transhuman Space* setting can be considered a high biotech universe, since miraculous biotechnology is one of its main areas of advance. Other space-oriented stories with a high biotech flavor include Bruce Sterling's "Shaper/Mechanist" stories and John Varley's "Titan" novels.

High Cybertech

A high cybertech world is one in which computer technology and cybernetics have transformed society. Computers are extremely intelligent, and may be self-aware and self-motivated as well. Robots of all shapes and sizes are common. Even human beings can become part machine, with cybernetic implants and neural interfaces.

A high cybertech world can be one of great convenience, as smart machines take over many ordinary tasks and leave humans free for more difficult work (or for pure leisure). On the other hand, such a world is often one in which machines have surpassed their creators. Perhaps the machines are benevolent, or perhaps they have an agenda of their own . . .

The *Transhuman Space* setting is high cybertech as well as high biotech in nature, with artificial intelligence

that is both commonplace and powerful. Meanwhile, some classic "cyberpunk" stories were set in space as well as on Earth – notably William Gibson's *Neuromancer*.

High Nanotech

Nanotechnology is a broad range of technologies and products, all of which require the manipulation of matter at small scales. Nanotech techniques handle individual atoms and molecules, producing machines on the same scale as viruses or complex proteins. The biological comparison is apt; a living cell is a nanotechnological factory! A high nanotech setting is one in which miraculous nanotechnology exists and has transformed society.

A great deal of recent science fiction treats nanotechnology almost as magic. It's portrayed as cheap and efficient, able to produce any desired product with no undesirable side effects. A society with advanced nanotechnology may be both wealthy and ecologically friendly; even waste products can be "rebuilt" into useful items rather than being discarded into the environment. On the other hand, if nanotech tools escape from control they can pose a terrible threat to society. Nanotech weapons may be especially horrific, penetrating even the tightest defenses and taking soldiers apart one molecule at a time . . .

Nanotechnology is a common theme in some of the best recent science fiction. Examples include:

Greg Bear's novels *Blood Music*, *Queen of Angels*, and *Slant*; Kathleen Ann Goonan's "Nanotech Quartet" novels; and Karl Schroeder's *Ventus*.

EVERYTHING A MIRACLE

The GM may want to incorporate many miraculous technologies into his setting. Indeed, a realistic assessment suggests that (assuming no disasters) the world may come to resemble all of the above setting types within the next century!

The more technological miracles are assumed, the more effort the GM will have to put forth to work out their implications, and the less familiar the world will be to the players. The "many miracles" approach may be best suited for an epic campaign, one that will last a long time and involves a lot of world-building work on the part of the GM.

The many-miracles approach can permit extreme realism, as in Poul Anderson's *Harvest of Stars* and its sequels. On the other hand, it can also work well with a strongly space-opera tone. If human characters are to stand out against a background of technological wonders, they may need to be larger-than-life individuals in the midst of an epic drama. Examples of this approach include Walter Jon Williams' *Aristoi*, or John C. Wright's "The Golden Age" trilogy.

TECHNOLOGY AREAS

The following are some of the most likely areas in which technological miracles will occur in modern SF. The GM should consider which of these to emphasize in his setting; books such as *GURPS Bio-Tech* or *GURPS Ultra-Tech* will cover rules mechanics for specific items of equipment.

BIOTECHNOLOGY

Mark pulled out the little box from his jacket pocket, and carefully lifted the lid. Enrique sat up expectantly. "This,"

said Mark, and held the box out toward his brother, "is a butter bug."

Miles glanced down in to the box, and recoiled. "Yuk! That is the most disgusting thing I've seen in my life!"

Inside the box, the thumb-sized worker butter bug scabbled about on its six stubby legs, waved its antennae frantically, and tried to escape. Mark gently pushed its tiny claws back from the edges. It chattered its dull brown vestigial wing carapaces, and crouched to drag its white, soft, squishy-looking abdomen to the safety of one corner.

Miles leaned forward again, to peer in revolted fascination. "It looks like a cross between a cockroach, a termite, and a . . . and a . . . and a pustule."

"We have to admit, its physical appearance is not its main selling point."

– Lois McMaster Bujold,
A Civil Campaign

In recent years, science fiction has assimilated the possibilities of biological technology: the creation or manipulation of living organisms. *GURPS Bio-Tech* will cover this subject in detail.

Genetic Engineering

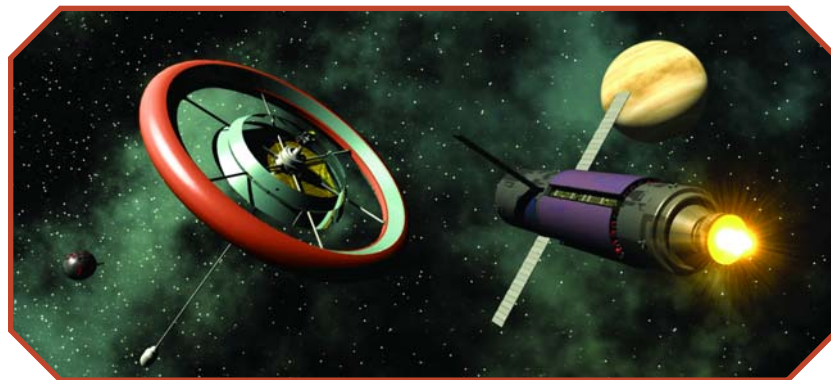
Every organism on Earth is built to a specific genetic blueprint, encoded in the DNA molecules in its component cells. That blueprint controls the production of proteins at the cellular level, and indirectly controls the shape, structure, and innate behavior of the organism. Alter the blueprint, and the shape and behavior of the organism change. Change it enough, and a wholly new life form might be created.

This kind of genetic manipulation is never straightforward; the DNA is only the first step in determining which genes are expressed, and in turn how the living organism takes shape. Genetic engineering was actually one of the *first* technologies to appear, in the form of domestication and selective breeding of species. True genetic miracles require very sophisticated understanding of cellular biology.

One application for these techniques is to edit the genes of an existing species. For example, once the human genome is well-mapped, gene combinations can be selected that ensure the appearance of desirable traits: good looks, high intelligence, acute vision, or even the simple lack of inherited genetic disorders. The resulting person is still human, his genetic inheritance isn't beyond the bounds of what he could have inherited naturally, but his genes are better than he could have expected from random chance.

Eventually, genetic engineers will learn to impose radical changes on their subject organisms. This permits the construction of *new species*, related to existing organisms but no longer able to reproduce naturally with the original stock. Such new forms can have capabilities beyond anything the original genome could have produced. An engineered human might have superhuman strength or endurance, or internal physical structures that normal humans don't have. He might even have superhuman *mental* capabilities: communication skills, memory, intelligence, or other powers beyond the norm of human psychology.

Another application of genetic engineering is *pantropy*, a term coined by the SF author James Blish.



Pantropic genetic engineering seeks to adapt humans or other organisms to live in unusual environments – under the sea, or on worlds that unmodified humans would find uninhabitable. An interstellar society might use pantropic techniques rather than terraforming worlds.

Miracles in genetic engineering can help the GM design a setting in which superhuman characters are easy to justify. On the other hand, control over the building blocks of life raises a number of moral and social issues. What if not everyone can afford to engineer their children; will genetic engineering give rise to an aristocracy, in which wealth and engineered talent reinforce each other? Gene engineering might cause the human race to diverge into many related subspecies, some of whom may be like aliens to one another . . .

Cloning

Species that reproduce sexually receive genes from their parents, and the exact mix of genes is usually different each time. An alternative to this process is *cloning*. This is a bioengineering technique used to create offspring that are genetically identical to the single “parent.”

Cloning of plants can be done through low-technology methods such as the cultivation of cuttings. Cloning of animals is much more difficult, and can require many failures for every successful birth. There may also be side effects, particularly when the genetic material for the clone is taken from an adult organism. At this writing, a number of successful animal clones have been produced, including sheep, cattle, and cats – but no credible scientist has yet claimed to have produced a human clone.

A successful clone is much like an identical twin of the donor organism. A newborn human clone would be a baby, without any of the original person's memories or skills. He would have to grow to adulthood in the normal time, and his environment and experience might lead him to form a very different personality. Super-science technologies such as forced-growth tanks might permit the rapid production of fully adult clones, while downloading (p. 57) might permit a clone to be programmed with its donor's personality.

Human cloning might permit an egotistical genius to produce his own younger twin, bereaved parents to produce the identical twin of a dead child, or a society ravaged by genetic disease to produce healthy offspring. A particularly ghoulish society might raise clones for a supply of replacement parts . . .

Miracle Medicine

Even today, medical science has produced improvements in the length and quality of human life. Using miracles in future medicine, physicians will confidently be able to heal and even improve the human body. Many of these improvements will involve *implants*, artificial devices placed in the body to give it new capabilities or compensate for damage.

Simple prosthetic implants exist today, and are useful in repairing some injuries or supporting the body as it ages. At miraculous levels of technology, implant devices begin to improve on the natural human body. Perfectly healthy people will begin to accept implants to expand their physical or mental capabilities. Cybernetic limbs and organs boost physical performance. Neural interfaces permit

the mental control of computers or other devices. Implanted computers assist the human brain to store and process information. Natural senses are enhanced and new senses are acquired.

Cybernetic implants have some of the benefits of miraculous biotechnology, without some of the drawbacks. It's possible to improve human performance without needing to plan an individual's genetic inheritance before birth. Implants can always be removed or altered as needed. Of course, the use of implants can be a very alienating practice – in a sense, the character is rejecting his body in favor of a machine!

Aside from the production of superhumans, cybernetic implants can alter the way the human mind deals with the outside world. Linked directly to a computer implant, a

person could perceive both “virtual reality” and the physical universe at the same time. Real objects (or even other people) could be associated with virtual “tags” that provide extra information about them at a glance. Messages could be sent across a data network with a thought, permitting a mechanical form of telepathy.

Of course, not all implants need to be purely mechanical in nature. As biologists learn how living cells naturally arrange themselves to form tissues and biological structures, they will learn to control the process. Such *tissue engineering* will permit the construction of living, but artificial, structures that can then be implanted in the body.

Although such living implants may be limited in strength and capabilities, they may be able to repair themselves, just as the natural human body can.

Some artificial tissues may be able to improve the body's performance, bolstering the strength or resilience of the natural structure, or secreting useful substances that the body would normally not produce.

Finally, the possibility exists of *nanosymbiosis*. Many of the cells in a human body are not themselves human in nature – they are bacteria, viruses, or other microorganisms that live in a symbiotic relationship with their human host. Eventually it may become possible to introduce *artificial* symbionts into the human body: nanotechnological devices, engineered microorganisms, or a mix of both.

These “micro-implants” could improve human health and capability at the cellular level: fighting off disease, preventing cancer, arresting the progress of age, and even building macro-scale implants into the body without the need for complex surgery.

In general, miraculous medical techniques mean that very few injuries will prove fatal. If an injured character survives long enough to reach a hospital, he'll recover – possibly with the aid of mechanical, cloned, or tissue-engineered replacement parts. This kind of technology may be useful for the GM who wants to concentrate on mysteries or social interaction rather than the threat of character injury or death.

Meanwhile, implant technologies give characters the freedom to reshape themselves at will. Any campaign in which miraculous implants are available (not to mention uploading or other technologies that can radically change a person's nature) will tend to be very fluid in character design. In such a campaign, GMs are advised to treat **GURPS** character points as a guideline measuring the relative power of each character, not as a rigid schedule for character development. Characters will tend to change drastically in power level, and will reallocate their points with every “overhaul.”

Naturally, if miraculous medicine is not available to everyone, there will be social consequences. Even today, wealthy people tend to live somewhat longer than poor people due to their ability to afford medical care. If the difference becomes drastic, the result might be a badly stratified society (or a revolution of the “natural” poor).

Suspended Animation

Suspended animation is a common science fiction trope. If space travel is very slow, then passengers and crew may sleep the years away, awakening only at their destination. Suspended animation can also be a crude form of time travel, letting characters sleep through the centuries in order to wake in a far-future world.

In classic science fiction, suspended animation meant “cold sleep,” putting the human body in a hibernation state, or freezing it solid. Both techniques assume that there's a way to revive the subject at the destination (quite a challenge if the freezing method is used). In any case, for journeys lasting years or longer, the technique doesn't actually work all that well. It's impossible to prevent *all* random chemical change even in a frozen body, and the background radiation of deep space will still harm a frozen passenger.

More recent science fiction assumes that advanced nanotechnology can be used to keep a hibernating passenger in good repair. Nanotech symbionts repair damage due to radiation, flush away cells that die due to random chemical change, and so on. With “nanostasis,” the body need not even be kept all that cold, saving on heavy cryonic equipment.

Some recent science fiction suggests a third approach. If “uploading” is possible (p. 57) then a passenger won't need to take his body on the trip at all. He can travel as data in storage, either unaware of the passage of time or enjoying a virtual environment. He can be downloaded into a new robot body at the far end, or (if nanotechnology is sufficiently advanced) his own body can be reassembled from stored information!

No matter what the method, suspended animation can solve a number of plot problems for the space-oriented GM. If interstellar travel takes a long time, don't bother playing out the years between stars – just pop the adventurers into cold sleep and skip to the destination. Meanwhile, suspended animation may provide adventurers with an escape hatch if things go badly wrong . . .

Artificial Life

Advanced tissue engineering techniques might permit the construction of wholly artificial organisms: creatures that were not conceived and born, but *built* out of cultured cells and biomechanical frameworks. Such *bioroids* might have capabilities (and disadvantages) that naturally conceived organisms would not.

For example, a bioroid could have two traits that would be mutually exclusive in a naturally conceived organism. Bioroids could be built around frameworks of nonliving material, boosting their strength, endurance, or other capabilities in a way that would be difficult to produce through human genetic engineering. Meanwhile, bioroids could be built with inherent controls that limit their capabilities, such as a short lifespan or a limited personality.

Of course, artificial organisms don't have to resemble people in their shape or capabilities. Limited *biogadgets* could be produced, living entities that can be used as specialized tools. The advantage of a biogadget is that it is self-maintaining and self-repairing, so long as it's kept supplied with

nutrients. It would also provide its own "power," needing no power input or batteries.

Just about any technological item could be defined as a biogadget, as long as it doesn't require high power densities (like a beam weapon or a long-range communicator) or very dense or strong materials (like advanced combat armor or an internal combustion engine). Biogadgets could, of course, be combined with nonliving gadgets or materials to cover a wider variety of applications.

Biogadgets can also be *big* – big enough to live in! A bio-building is an artificial living creature (or a symbiotic community of them) with plenty of internal space that humans can live or work in. Like a smaller biogadget, a bio-building can be self-maintaining and self-repairing, and might provide at least some of the power for various appliances and conveniences. Bio-buildings might be very ecologically friendly, needing relatively little energy to build and converting trash or other wastes before they're released into the environment.

Artificial-life technologies might be interesting if applied by certain alien cultures. This would be

particularly appropriate for aliens who live underwater, in a gas giant atmosphere, on a metal-poor planet, or anywhere else where metals and ceramics would be difficult to produce.

Artificial life presents a variety of ethical questions. A bioroid is unquestionably alive and may be fully sapient. What are the rights of a being who was built from scratch for a specific purpose? Of course, there may be strong prejudice against bioroids – like the mythical undead, they stand outside the normal human pattern of birth, life, and death.

Uplift

Creideiki could imagine how the vice-captain felt. There were times when even he felt oppressed by the towering invasiveness of uplift, when he almost wanted to squawk in Primal, "Who gave you the right?" And the sweet hypnosis of the Whale Dream would call to him to return to the embrace of the Old Gods.

The moment always passed, and he recalled that there was nothing in the universe he wanted more than to command a starship, to collect tapes of the songs of space, and to explore the currents between the stars.

– David Brin, *Startide Rising*

"Uplift" refers to the process of applying biotechnology to modify non-sapient organisms, improving their intelligence, communications skills, or tool-using abilities. The goal of uplift is usually to create a new sapient (or near-sapient) race.

The notion of granting intelligence to animal species is very old in SF literature, dating back at least to H. G. Wells. The term *uplift* was coined by modern author David Brin; many of his novels are based on the premise of a galactic civilization populated by species who all were once uplifted, and who in turn uplift new species as a matter of wealth and prestige.

A setting including uplift can include "aliens" who evolved alongside human beings from the beginning. For example, Brin's novels include uplifted chimpanzees, dogs, dolphins, and gorillas. These uplifted species will have minds different from ours, but will also be familiar enough for comfort. Aliens who are the end

Bioships

There's nothing preventing a "bio-building" from flying through space . . . at which time it becomes a *bioship*, a living spaceship.

Bioships can be built from scratch using tissue-engineering techniques. Alternatively, a large alien life form or a big terrestrial creature can be subjected to extensive genetic and biomechanical engineering. A bioship is primarily living matter, of course, but it can have inorganic systems grafted into it.

The original creature should be large to begin with, and tough enough to withstand large shifts in atmospheric pressure. It can be adapted to life in the vacuum and cold of space, and it can be made *much* larger in a zero-gravity environment. Several possibilities include:

Atmosphere Dwellers: Floating creatures native to the atmosphere of a large planet or a gas giant.

Giant Trees: Trees or tree-like organisms, engineered to withstand deep-space conditions and grow to enormous size, possibly feeding from the water and nutrients in comets.

Marine Dwellers: Large creatures native to the deep ocean, such as whales (or, for a different approach, coral reefs). Such creatures can already grow to great size and are well-adapted to pressure extremes.

Space Dwellers: It's possible that large living creatures already exist in deep space, and would require little or no adaptation to serve as bioships.

product of billions of years of separate evolution are likely to be *much* stranger. . .

Other interstellar civilizations may also include uplifted species, as servants or partners of their naturally evolved races. In a universe where uplift is common, the question of *human* origins may be open. Perhaps the UFO enthusiasts are right, and humans themselves were helped along the road to intelligence eons ago . . . but by whom?

COMPUTERS AND COMMUNICATIONS

The role of computers in science fiction has changed almost as drastically as their role in real life. In Golden Age SF of the 1940s and 1950s, computers are almost invisible; when they appear at all, they are big, expensive, and used exclusively by governments and large corporations. By the 1990s, imagined computers were *everywhere* in science fiction and their capabilities were little short of magic.

The Networked World

With the revolution in computer technology comes an associated revolution in *communications* technology. As computers become smaller, cheaper, and more powerful, it becomes easy to put them *everywhere* . . . and to get them to talk to each other. Along the way, people find themselves able to share voice, text, images, and data almost at will.

Even today, the global Internet makes it easy for many people to access and work with information. Messages can be passed, would-be writers can post their work for anyone to see, and research data can be made accessible for everyone. The decentralized nature of a data web sometimes undermines existing power structures, giving citizens new ways to share information despite government or corporate control.

Decentralized data webs have also proven to be very hard to police. Unscrupulous users can spread false information, run scams, and steal other people's personal data. Meanwhile, oppressive governments will find their own uses for network

technology, collecting data on their citizens to use in new methods of control.

Computer networking is likely to become even denser and more complete as it approaches miraculous levels. Eventually, it will become possible to put small computers in almost every common item: in clothing, in personal items, in pieces of industrial equipment, in packages of raw materials, and even in people. All of these small computers can be interconnected via a dense network of short-range radio or infrared transmissions.

The net effect of this *ubiquitous computing* will be to make a vast array of information available for reference and analysis. Any item with an implanted computer can be designed to keep track of its own status, to report when queried, and to respond to orders. For example, in a "wired" household the kitchen appliances can track supplies of food, prepare meals on a schedule, and report when they need repair or replacement. A computer implanted into a person can track his physical condition and signal when he needs medical attention.

Items can even be *physically* tracked with such a system, each implanted computer responding to nearby control units over the short-range radio link. This can help a great deal with commercial inventory, making it difficult to lose or misplace goods or equipment. Industrial planning becomes easier, as raw materials can be tracked on their way through a manufacturing process.

Another application of ubiquitous computing is to reduce the need for skill in certain trades. If every item in

an industrial process carries a computer with the information about exactly *how* the item is to be used (its own "user's manual") then the people doing the assembly work won't need as much training to begin. For example, every piece of raw material on a construction site could keep track of where it is now, where it needs to be in the finished building, at what point in the process it needs to be put in place, and how it should be handled. Then the construction workers (or their robots!) can always remind themselves exactly what needs to be done next. . .

In general, a society with miraculous levels of computing and networking will be one where information is cheap and easy to get, and where it will be very rare for anyone to be out of touch. This can be very convenient for GMs who want to just hand their players a "data dump" and get the adventure started. Meanwhile, whenever adventurers need more information or assistance, it's usually just a cell-phone call (or the equivalent) away.

Of course, there are also disadvantages to this kind of setting. The GM may need to *invent* all the information the players might possibly want! Players may give in to the temptation to over-research, wading through the information stream when they should be going into action. Adventurers may be overloaded with information, or unable to pick out the critical facts from a flood of irrelevant data. Meanwhile, in a world where no one is ever out of contact it's difficult to keep characters from calling for help at the first sign of trouble!

It's in the computer, everything: your DMV records, your Social Security, your credit cards, your medical records. Everyone is stored in there. It's like this little electronic shadow on each and every one of us, just begging for someone to screw with, and you know what? They've done it to me, and you know what? They're gonna do it to you.

— Angela, *The Net*

Robots

Robots are a very common feature of science fiction. People are fascinated by the notion of a machine that looks or behaves like a human being . . . and which may in some ways be *superior* to a human being.

Although science fiction tends to focus on the social relationships between robots and humans, the first real robots don't appear in social situations. Robots find their first use in industrial manufacturing, where they can perform the kind of repetitive operations that appear in assembly lines.

Of course, even at this level robots immediately have an impact on society. They threaten to compete with human workers, beginning in the unskilled or semi-skilled trades. They also simply *bother* some people, who are disturbed by a machine that can behave like a human being even in limited ways.

Robots that more or less resemble human beings are a common feature in SF. A "humaniform" robot has several advantages, especially in social

situations. On the other hand, humaniform robots are *hard* to produce. Many physical functions that humans take for granted (visual recognition, eye-hand coordination, walking, and so on) are actually difficult to build into a reliable robot.

The *bush robot* is a recent concept, first proposed by Hans Moravec as the ultimate in cybernetic flexibility. A bush robot has arms that branch into multiple "fingers," each of which branches into a set of smaller fingers, and so on – possibly down to the molecular scale. Each set of fingers is capable of independent tactile senses and operation, giving the robot tremendous range and flexibility.

A "bushbot" could easily manipulate objects on a variety of scales. With the proper programming, it could perform complex repairs or even microsurgery, all without special tools. Such tasks would require tremendous amounts of computer processing, so advanced computer hardware will be necessary.

A setting with miraculous robots, whether sapient or not, will be one

in which human adventurers are constantly dealing with capable machines. If robots can perform many human tasks, what do human beings do? Are they freed from the need to work for a living, or are all but the most talented people living in dull, purposeless poverty? Of course, if robots are that talented, some of the adventurers may *be* robots!

Artificial Minds

He said, "Had we somehow been created in a universe without humans, it is true that we would not have created them. We would have preferred more perfect forms."

She said, "But morality is time-directional. Parents who would not deliberately create a crippled child cannot, once the child is born, reverse that decision."

"And humanity is not our child, but our parent."

"Whom we were born to serve."

"We are the ultimate expression of human rationality."

She said: "We need humans to form a pool of individuality and innovation from which we can draw."

He said, "And you're funny."

She said, "And we love you."

– John C. Wright,

The Phoenix Exultant

Advanced computers may become intelligent, able to handle information at least as flexibly and as well as a human being. Eventually they may even become *sapient*, self-aware entities with their own consciousness and goals. Combine the sheer speed of a computer with the power of a self-aware mind, and the result could be a being far superior to the humans who built it.

One of the most critical steps in producing an intelligent computer is the development of a *natural language interface* – that is, teaching computers to use idiomatic language as it is spoken and written by human beings. Once a natural language interface is available, anyone can describe a problem to a computer and expect it to produce information or programs that approach a solution. The computer can then respond using colloquial language of its own, presenting the information in ways that non-specialists can understand.

The Transparent Society

One drawback of ubiquitous computing is that it makes *privacy* almost impossible to attain. We may find it very convenient to access to all kinds of information about the world around us – but the other side of the coin is that other people will find it easy to gather information about *us*.

This failure of privacy may offer some social benefits. The SF writer David Brin has speculated about the *transparent society*. This is a society in which even powerful people, such as corporate or government leaders, can't keep any secrets for very long. Every citizen can be fully informed about the activities of his government or the corporations with which he does business. It's therefore easy, at least in theory, to demand accountability for any abuse of power.

On the other hand, ubiquitous computing may lead to *ubiquitous law enforcement*. A government that controls the data network can monitor the activities of every item – and every person – in it. It may become impossible to break even a minor law without immediately being detected and targeted for correction. Private entities may also be a concern. A company could monitor even the smallest activities of its employees, and malicious users could use the system to track and harass their enemies.

In short, a society that uses ubiquitous computing may be highly oppressive, or it may have developed social mechanisms for dealing with the loss of privacy. GMs who are interested in miraculous communications and computer technology may wish to explore the implications of a world where information really is free!

At present, natural language interfaces can be considered *nearly* miraculous; much progress has been made in this area, but most people still interact with their computers in a stilted and artificial manner.

Being able to use natural language doesn't mean that the computer is self-aware, or even that it's all that personable. Eventually, computers will add personal and social skills to their natural-language ability, interacting with human beings on their own level.

Personality simulation can work at a variety of levels. A computer that simply uses natural inflection in its speech and learns to respond to its owner's needs can be said to have a personality, even if its responses are very simple and predictable. Indeed, many humans will tend to ascribe more personality to their computers than they actually have. More complex "personality programs" will behave like real people, altering their responses and possibly surprising the human beings who interact with them. Eventually a personality simulation will become indistinguishable from a human being, modeling its responses after a real person, a well-documented fictional character, or even a wholly artificial psychology.

Even an advanced computer that is capable of natural language processing and is familiar with everyday human knowledge still isn't necessarily a self-aware, independent being. Actual consciousness seems to be independent of the ability to process information.

How one might design a computer to be self-aware (or how it might become so on its own) is anyone's guess. We don't understand what consciousness is, or what it does, in human beings, much less how a machine might exhibit it. In some SF, a sufficiently advanced computer may simply "wake up" one day. Other stories assume that self-awareness is something that can be predictably designed into a machine. Still others ignore the question entirely; they assume that no one can be sure of anything except that a machine *behaves* as if it is self-aware.

In any case, the presence of self-aware machines (or machines that seem to be self-aware) raises a number of social issues. Intelligent



machines can be interesting and useful companions, but they might develop their own motives and superhuman capabilities. Should such machines be treated as property, as servants, as partners – or as masters? If they can exceed human abilities in most or all areas, then what purpose do humans still serve?

Uploading

If a computer is complex enough to imitate a living human personality, then it can imitate a *dead* one too.

It's theoretically possible for a computer to store a complete description of a human being, and then "emulate" that human being as software. This may involve a personality model, or it may involve the minute analysis and emulation of the human subject's brain and nervous system (possibly requiring the destruction of the tissue in the process). From that point on, the computer believes itself to be the human being, his personality "uploaded" into a software matrix.

If a human mind can be uploaded, it may also be possible to "download" it into another body – a robot or bioroid body with a computer brain, or even a fully biological body (with

the stored personality somehow "written" onto the structure of the brain).

Uploading and downloading have profound effects on any science fiction setting or story. Uploading permits a character to undergo radical transformations, leaving his human body and becoming a machine entity – which can then be transferred from one machine body to another. If both uploading and downloading are possible, then one can travel as data rather than in his physical body; this is often much cheaper and more efficient. Uploading can also make people effectively immortal, letting them keep "backup" copies of themselves in case of accident. Of course, uploading can also permit someone to *copy* himself, especially if the initial upload doesn't require the destruction of his original brain.

Uploading raises many of the same questions as the presence of any intelligent machine. Should the uploaded personality be treated as a person? Even further, should the upload be treated as the *same* person as the original citizen? This can be even more complicated if the original citizen is still walking around in his own body . . .

NANOTECHNOLOGY

"Mites," he said, "or so they say down at the Flea Circus anyway." He picked up one of the black things taken from the mask and flicked it with a fingertip. A cineritious cloud swirled out of it, like a drop of ink in a glass of water, and hung swirling in the air, neither rising nor falling. Sparkles of light flashed in the midst of it like fairy dust.

"See, there's mites around, all the time. They use the sparkles to talk to each other," Harv explained. "They're in the air, in food and water, everywhere. And there's rules that the mites are supposed to follow, and those rules are called protocols. And there's a protocol from way back that says they're supposed to be good for your lungs. They're supposed to break down into safe pieces if you breathe one inside of you." Harv paused at this point, theatrically, to summon forth one more ebon loogie, which Nell guessed must be swimming with safe mite bits. "But there are people who break those rules sometimes . . ."

— Neal Stephenson, *The Diamond Age*

The standard **GURPS** TL progression assumes that nanotechnology will work, and that it will advance along a fairly conservative trajectory. Nanotechnology begins as engineers discover ways to manipulate matter on very small scales. TL9 is the *microtech* age, in which micromachines are produced by traditional industrial methods and nanotechnology continues to develop. The real potential of nanotech doesn't appear until TL10 or later; the most outrageous speculations of nanotech advocates should probably be considered super-science, or placed at TL11+.

Special Materials

Nanomachines themselves are only some of the advances that nanotechnology will make possible. Some of their first *products*, things that are otherwise almost impossible to make or find, will also transform industry. These include new materials that stretch the limits of what's possible in nature, providing combinations of physical properties that would be extremely unlikely without technological intervention.

Many of these new materials will involve *carbon*. One of the most common elements, and also one of the most chemically active, carbon is very cheap and easy to work with. Carbon in its "raw" natural state is flaky or crumbly, very flammable, and a natural insulator of electricity. However, carbon atoms can form very strong molecular bonds, and when they are carefully arranged the resulting materials can have a wide array of properties.

Diamonds, for example, are pure carbon with the atoms arranged in a three-dimensional lattice. One of the first applications of true nanotechnology will be the production of artificial diamonds in large sheets, blocks, or other shaped forms. "Diamondoid" materials would make superb armor or structural material in applications where hardness and resiliency are important. Spaceship hulls, perhaps . . .

Another form of carbon is *nanotubes*. The carbon atoms are arranged in tubes, each one thinner than a human hair, so that the molecular bonds provide tensile strength for the tube. If carbon nanotubes can be made long enough, they can be woven

into threads or cables that are far stronger than any previous material. Nanotube threads could be woven into clothing or personal armor, making it tough and resistant to attack. Thick nanotube cables would be relatively light but extremely strong, useful in futuristic engineering projects.

Aside from the applications of carbon, nanotechnology could produce pure-iron crystals, high-temperature superconductors, and many other useful items. Some of these materials are already being produced in small quantities today; mass production might be the foundation for a great deal of future industry.

Smart Materials

Smart materials change their physical properties when subjected to a stimulus. They can be used in applications where a material may need to change its state in different circumstances. Smart materials can be made to respond "naturally" to different situations, or they can be controlled by an attached computer. Some smart material will be composed of micro-electro-mechanical systems (MEMS), tiny machines built into sheets or



blocks of manufactured material. Other smart materials are natural substances that can change their properties in a controlled fashion.

For example, smart fibers can adjust their length, flexibility, and color as needed, producing clothing that can reconfigure to assure a perfect fit and the wearer's desired color pattern. Surfaces can vary their textures, or even incorporate microscopic brushes that ensure that dirt or paint will only stick where it is supposed to. Layers of smart material can create structures that are self-sealing, or even partially self-healing.

Eventually, nanotechnology may begin to blur the distinctions between nonliving and living matter. Even as bioengineering produces living organisms that resemble machines, nanotechnology will begin to give inorganic machines some of the capabilities of living creatures.

Living materials will begin by adding self-repair capabilities. A "living metal" tool would incorporate a supply of embedded nanomachines. Under normal circumstances the nanomachines would support the tool's primary function, possibly interfacing with other nanomachines in smart materials or assembler swarms. When the tool needs supplies or is damaged, the nanomachines can pull in the necessary materials and use them to perform repairs.

With further progress, living materials will be able to change shape and function as needed. At the extreme, a tool can be composed of nothing *but* nanomachines that have taken a specific shape. On command, the nanomachines drop their connections to one another, flow amorphously to new positions, and lock together once again. The new shape may have a completely different function.

Microbots and Assemblers

The line of development that leads to living materials begins with the production of vast numbers of tiny machines. Any one machine may not be very intelligent – but a swarm, cloud, or puddle of such machines could cooperate for an intelligent purpose.

"Microbots" may be as large as a big insect, or as small as a dust mite. They may be limited to crawling over surfaces, or they may be capable of buoyant or winged flight. Any one microbot will have very little computer power, and might run a set of simple behavioral programs. A "cyberswarm" of hundreds or thousands of microbots can cooperate in intelligent behavior, just as an ant colony or beehive produces intelligent responses from the actions of its nearly mindless members.

A cyberswarm could be an integral part of a building or other structure, performing routine cleaning,

maintenance, or repair tasks. They could also have military or security applications. Cyberswarms could monitor infrared emissions or movement in an area, alerting a more powerful computer to the presence of intruders. Microbots could also carry tiny doses of toxins or disease organisms . . .

As nanotechnology advances, the microbots are likely to become smaller and smaller, and *en masse* they are likely to become more capable. One application of advanced microrobotics would be the production of *assemblers*, swarms of nanorobots capable of building any desired product from raw materials.

Swarms and Goo

Of course, assemblers that can build other things can also be designed to build *copies of themselves*. This isn't an unusual notion; a living cell is itself a self-replicating assembler.

Such assemblers can cut through many of the limitations of nanotechnology. In particular, they make the supply of assemblers cheap and easy to replenish. They can be even more effective than non-replicating assemblers in bringing about a post-scarcity society. On the other hand, self-replicating assemblers may be harder to *control*. If they escape into the environment, they may begin to replicate using whatever materials they can find . . .

A mass of self-replicating assemblers is sometimes called *goo*. Futurists and SF writers sometimes refer to goo as being of different "colors" depending on its nature and purpose. Not everyone agrees on the color terminology, but some examples are as follows.

White Goo: Well-behaved assemblers in a controlled environment, producing useful items as designed.

Golden Goo: A mass of assemblers designed to simply gather atoms or molecules of a valuable substance (such as gold). Used in mining and similar applications.

Red Goo: A controlled mass of assemblers used as a weapon, probably by a military organization or by terrorists.

Blue Goo: Assemblers designed to hunt down and destroy hostile assemblers (such as red goo) without otherwise affecting people or property.

Green Goo: Assemblers used to monitor and support a community of living things. Green goo can be used in agriculture, in the preservation of wild ecosystems, or even for the maintenance of human health.

Gray (or Black) Goo: An uncontrolled mass of "wild" assemblers, devouring everything in its path and turning the material into more assemblers. Gray or black goo is the ultimate terrorist weapon, or the ultimate industrial disaster. A mass of gray or black goo could destroy the entire surface of a planet.

Some wits also refer to *pink goo* – by which they mean human beings! After all, humans reproduce relatively slowly, but given time they tend to fill up all available space and devour everything they can find . . .

In theory, *anything* could be built by sufficiently sophisticated assemblers. Simply pour the assemblers into a vat, provide raw materials in easily digestible form, and the tiny machines will assemble the desired item one molecule at a time. Since assemblers work on a nanometer scale, they can produce any of the unusual materials described under *Smart Materials* above, and in large quantities. Very robust assemblers might be able to work with found materials, turning air, water, and minerals into useful products.

If assemblers are strongly limited in their utility, they won't change society very much. Assemblers may be expensive or narrow of purpose, used only for very specialized applications. They may break down quickly, requiring manufacturers to constantly acquire new supplies. Or they could be too delicate to use anywhere except in a carefully controlled environment. Any or all of these features may lead to a society where assemblers are rarely encountered in everyday life. Adventurers may use tools and gadgets produced by assemblers, but they will rarely use assemblers themselves.

Assemblers that are cheap, robust and versatile can have a *profound* effect on society. If literally *anything* can be made cheaply and easily, especially using found materials, then large corporate manufacturers will no longer be needed. Combine cheap assemblers with the cheap energy of fusion power, and you may get a "post-scarcity society," one in which poverty and economic inequity are unknown.

Of course, assemblers can also be *disassemblers*. Assemblers have to get their raw materials from somewhere, and they may get them from an item (or a human body!) that's already in use. Assemblers that get out of control can be a serious nuisance. Assemblers designed to take the human body apart, one molecule at a time, would be a devastating weapon.

TRANSPORTATION

The GM building a space-oriented setting will certainly need to think about space flight technology, but how adventurers get around *on each world* will also be important! Naturally, the two setting elements

will be related. If space flight is supported by cheap and powerful drives, the same technologies may be applicable to local transportation.

Making the World Tiny

If miraculous transportation is available, the GM (or players!) may want to design cool vehicles for use during adventures. Such vehicles can be faster, tougher, sneakier, or *smarter* than anything from the familiar world.

If vehicles and transportation aren't going to be used as a major plot element, they will probably have no specific effects on the campaign background. As with advanced power generation and materials science, advanced transportation supports a generally wealthy society. Manufacturing and commerce become more efficient when raw materials and finished goods can be easily shipped to where they're needed.

Meanwhile, when people are able to travel wherever they please quickly and conveniently, they *feel*

wealthier because they have more options in life. If ease of transport brings people into contact with foreigners, they may tend to be more cosmopolitan. They will probably be more *free*, since they can easily escape an oppressive situation.

Teleportation

Teleportation is instant travel from place to place, without passing through the space in between. If teleportation is possible, it may render many other forms of transportation obsolete. Teleportation that's cheap, works over long ranges, and has few disadvantages will quickly become the primary method of transport. In the extreme, teleportation may unify interplanetary (or even interstellar) travel with local transport. On the other hand, if teleportation is expensive or has many limitations, it will be used only in special circumstances.

For a superb examination of the implications of teleportation technology, refer to Larry Niven's essay, "Exercise in Speculation: The Theory and Practice of Teleportation."

Power Generation

One of the most important factors controlling any society is its ability to generate and apply energy. A society with access to cheap or unlimited energy is by definition wealthy, while one experiencing energy shortages is impoverished no matter what other resources are at hand. The technical details of power generation are rarely important to the story; the GM can assume solar, geothermal, fossil-fuel, nuclear, antimatter, or "total conversion" power as needed.

Of course, how power is *generated* is almost less important than how it is stored and distributed. The small gadgets beloved of adventurers need power, as do vehicles, buildings, and spaceships. Unless a power generator is cheap and compact enough to carry around, energy will have to be stored – or devices will need to be connected to a remote power source.

Some forms of power plant technology will be dangerous if mishandled! Nuclear fission generates radioactive waste. Some types of fusion power generate radiation in the form of fast neutrons. Antimatter power storage can be extremely destructive if the containment fails. In general, the higher the *energy density* of the power technology, the more likely there are to be dangerous or destructive side effects.

The details of power technology are usually "deep background," not important to the story. The GM should decide how much energy is necessary to support the society (and the gadgets) he wants to include. Any disadvantages attached to the technology can be developed as potential plot complications. After all, miraculous technology is a wonderful thing . . . until the power goes out!

The Swashbuckler Option

Many a “swords and spaceships” epic has assumed that skill with a melee weapon – usually a sword or something similar – is important to an adventurer’s life. This can be a fun assumption, but the GM who wants to apply it will need to determine how melee weapons can hold their own in a universe full of ultra-tech firearms.

One approach to this problem is to assume that social factors encourage the use of melee weapons. Perhaps government forbids private ownership of advanced weaponry, but doesn’t restrict knives and swords. Or perhaps one social class cultivates swordsmanship as a (usually) non-lethal way to resolve disputes. An alien race that values ancient traditions may maintain its traditional weaponry for use away from the battlefield.

Another approach is to assume that advanced melee weapons can somehow hold their own against firearms. This can be accomplished by making the melee weapons more powerful, or by weakening the ranged weapons.

For example, in the *Star Wars* universe, ordinary adventurers routinely use high-tech blaster weapons. However, the Jedi Knights and their foes use light-sabers (and psionic powers) to deflect blaster fire. They have little to fear from firearms, and use their melee weapons when fighting one another.

In Frank Herbert’s *Dune*, personal “shield” technology is common, producing an archaic feel in weapons and tactics. The shield automatically deflects fast-moving projectiles. If a “lasgun” or similar beam weapon contacts the shield, the result is an explosion equivalent to that of a nuclear warhead. As a result, projectile firearms are rarely used, and most people actively *avoid* using beam weapons! Meanwhile, a slow-moving blade weapon *can* penetrate the shield, so most soldiers are expert with knives and short blades.

WEAPONS AND DEFENSES

One thing is certain: people in the future will still be fighting one another on a regular basis. Weapons technology has often led other fields, as governments invest in the development of new defensive systems.

Melee Weapons

Melee weapons will still be useful in the far future, at least under some circumstances. Knives, swords, and similar weapons can be made using ultra-tech materials, making them difficult to blunt or break. Nanotechnology can produce “monowire,” a strand of wire one molecule thick. Tough and almost infinitely sharp, monowire could be used as a weapon in its own right, or it could be used to provide an edge for a more typical blade weapon.

Of course, some space-opera universes have “force swords” and similar superscience melee weapons. For a “swords and spaceships” feel, permit personal force fields that stop fast missiles or energy blasts, but which permit the slow intrusion of a melee weapon.

Slugthrowers and Rayguns

In the future, as today, one of the best ways to poke holes in someone will be to throw bullets at him. Some military SF assumes that slugthrowers will remain the main arm of battle indefinitely; this isn’t a bad assumption, given the limitations of energy weapons (see below).

Chemical slugthrowers are likely to continue to advance, bringing more efficient propellants. Targeting will also continue to improve, possibly linking computer controls into the

gun (or even into the bullets – “smart bullets” are a possibility, able to recognize a target and change trajectory in mid-flight). With high-density power sources, projectile weapons can use magnetic acceleration instead of chemical propellants. Such a “Gauss” weapon can use very small, *very* fast projectiles.

Energy-beam weapons (“ray guns”) are a staple of SF stories. They include lasers, particle-beam weapons or “blasters,” plasma bolts, and “disruptors” that work on an unspecified physical principle. Non-lethal weapons, which inflict pain or stunning damage but no lasting harm, are another possibility.

Of course, personal beam weapons should probably be considered a “miracle,” and are unlikely under rigorous assumptions. An energy weapon capable of doing extreme damage or operating at long range will need a *lot* of power . . . and the waste energy at the source might turn the weapon red-hot! GMs may wish to limit the more powerful energy weapons to heavy support or shipboard applications, with personal sidearms still using a projectile principle.

With advances in science (and especially in superscience), weapons may be based on principles not used today. Nanotechnology may provide “red goo” disassemblers (p. 59) that will dissolve an enemy into his component molecules. Working psionics may lead to weapons that attack someone’s mind directly.

In fact, almost every technology can be turned to some destructive use. The GM running a campaign with *any* kind of superscience should consider inventing related weapons technology to fit.

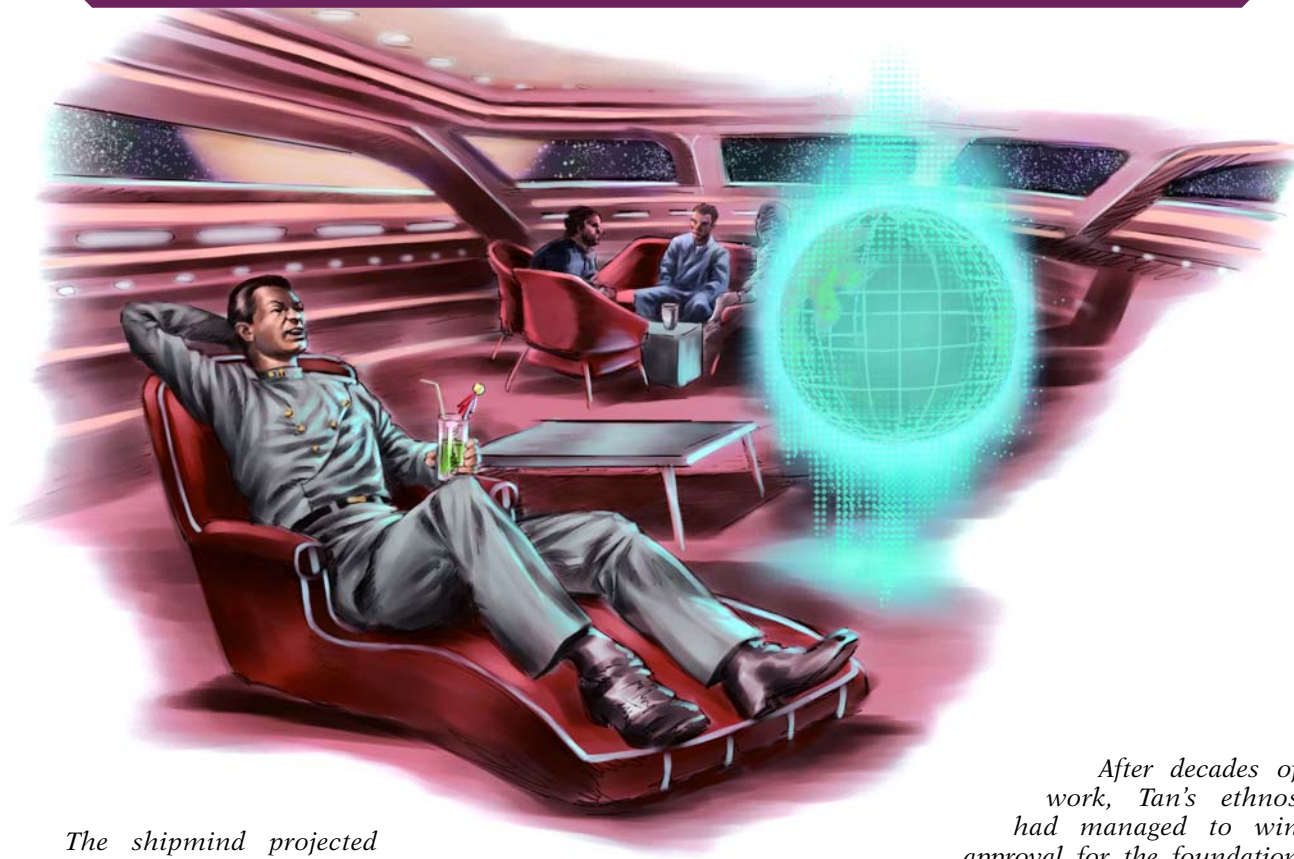
Armor and Force Fields

Throughout history, there has been an “arms race” between the designers of weapons and the designers of *defenses*. Indeed, even present-day personal and military weapons are capable of ending human life with great efficiency. There will be little point in developing miraculous future weapons, unless they need to punch through equally improved defense systems.

CHAPTER FOUR

BASIC

WORLDBUILDING



The shipmind projected images of the new world into Tan's vision, causing them to appear as if floating in midair in the command lounge. Tan relaxed back into his chaise-longue, sipping his drink while he watched. A Varenne motet played quietly in the background, just loud enough to be heard, not so loud as to distract.

"It looks like a very good candidate," observed Tan.

"Yes," agreed the shipmind. "Ocean world. Atmosphere dominated by molecular nitrogen and oxygen, secondary components including argon, carbon dioxide, neon. Liquid water oceans cover four-fifths of the surface. Large regions appear to be within the optimum climate range for humaniform life."

"Biochemistry?" inquired Tan.

"Indeterminate from this distance. The most likely result is a type III variant of the chlorophyll-adenosine triphosphate complex."

Tan smiled. "Excellent."

After decades of work, Tan's ethnos had managed to win approval for the foundation of a new colony in the long-fallow

Jiadra Drift region. Finally, humanity would have a world of its own, a fresh start to recover from the Fall.

A place where humanity might be able to survive the coming doom.

"Ser Tan?" A new voice, Marja Kashani, calling from her own workspace.

"Go ahead, Ser Kashani."

"We may have a problem," Kashani worried. "Routing some low-orbit recon imagery, your channel 32."

Tan opened the indicated channel. The recon drone had scanned part of the surface with visible-light sensors. A river delta, not far from one of the planet's smaller seas. Plenty of vegetation, so green it made Tan's heart leap.

"What am I looking at here, Marja?"

"Here." Lines and arcs appeared on the image, enhancing some of the visible contours. They blinked slowly, marking out the features Kashani wanted Tan to see.

Straight lines. Right angles. Sections of regular circles.

"Shipmind, are you getting this?"

"Yes, Ser Tan."

"Habitation? A native low-technology civilization?"

"Possibly," said the shipmind. "Ser Kashani has selected a number of other images, showing

similar features. It seems unlikely that they could be the result of non-sapient activity."

"I don't suppose they could be renegades from civilization," Tan mused. "They might be criminals breaking the migration laws. We could have them evicted and take the planet for ourselves . . ."

Kashani sent an indeterminacy glyph. "There's only one way to find out," she said.

Once the GM knows what kind of campaign he wants to run, what his interplanetary or interstellar civilization is going to be like, and what technologies are going to be available, it's time to draw a star map and begin creating worlds.

USING WORLDS

Every space campaign needs worlds – possibly dozens or hundreds of them!

The GM might design these worlds purely through his own inspiration, with no random elements. Another approach is to generate worlds at random, and then develop setting elements and story plots around whatever the dice provide. The best approach may be a combination of the two. The GM can design some worlds without using random elements, in order to support the plots he knows he will want. Then he can use random design to fill in gaps (and to generate *surprising* worlds that may suggest new plot arcs). The world-design sequences in this book will support any desired mix of the two styles.

DRAMATIC ROLES

The most important decision the GM must make for each world is its *role* within the campaign. What kind of story is going to be told with the world as its backdrop? How will the world's physical and social environment affect adventures that take place there? What challenges will the world pose to adventurers who visit?

Worlds in space-based SF have filled a wide variety of roles. Some of the most common archetypes are described below.

Paradise World

A *paradise world* is a very pleasant place, where environment and society combine to make life easy and agreeable. The climate is stable and congenial, there is plenty of water and food, and there are no environmental poisons or dangerous animals to worry

about. The local society is usually utopian – possibly very free, or tightly controlled in a way that doesn't interfere with most people's enjoyment of life.

Paradise worlds may seem an unlikely place for adventure. If life is easy for everyone, there's not much room for serious conflict. The GM might use a paradise world to make a point about the *idea* of paradise. Perhaps the world has a hidden flaw, a terrible price that the inhabitants pay for their easy life. Paradise worlds also make good targets for a star-spanning threat, of the kind that requires heroic PCs for its solution.

Hostile World

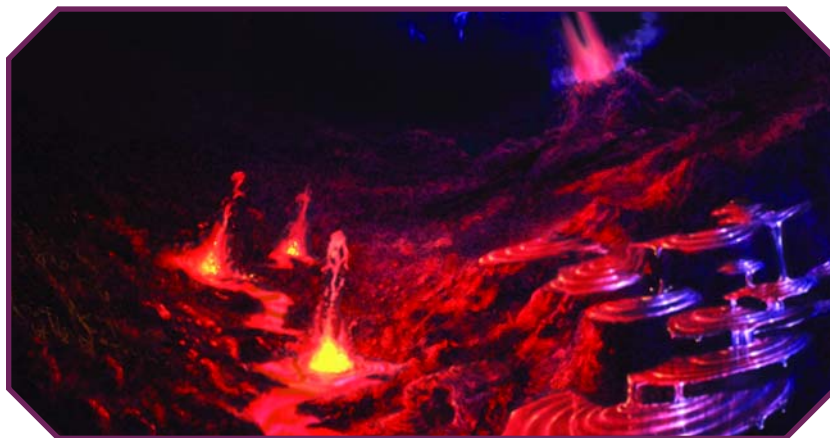
The *hostile world* is much less pleasant. It can be lived on, but only with difficulty, so inhabitants and visitors must struggle to survive. The environment on a hostile world usually has *one* parameter that makes human existence difficult – if it has many such parameters, it becomes a hell world. Technology may make a hostile world quite livable, but

inhabitants will always risk the dangers of their environment.

Hostile worlds are useful as difficult, but not insurmountable, challenges for PCs. Visitors will want to pay constant attention to their protective gear, or they will need to be strong and smart to survive. Hostile worlds also make good breeding ground worlds for certain kinds of tough NPCs, and they make interesting unique resource worlds as well.

Hell World

The *hell world* is even harsher than the hostile world. Humans simply can't survive there without elaborate technological measures, and even then there's constant danger. A space-suit may be the *least* that's required for survival. Since living on a hell world requires constant control of the environment, a hell-world society may itself be tightly controlled or dictatorial. Alternatively, inhabitants may enjoy plenty of social freedom, but everyone is carefully trained in the skills needed to maintain the environment.



A hell world may be inhabited by aliens who are comfortable there. If humans live on a hell world, they must have a very good reason for putting up with local conditions. Maybe it has a valuable resource or a special location. Or perhaps more pleasant worlds are so rare that some human colonists *have* to choose hell worlds if they want a place of their own to live. Hell worlds might be home to splinter groups, dissidents, or exiles as well.

Changing World

Some SF is set on worlds whose environment changes drastically over time. Perhaps a planet is at the beginning (or end) of an ice age, is being invaded by alien life, or simply hosts a society that is being transformed by new technology. Or perhaps the world is subject to regular, cyclic changes in its environment.

A *changing world* is good for stories emphasizing *adaptability* in individuals or societies. If the changes are exceptional, local society will be caught off-guard, with no historical precedents to draw on. A cyclic change won't be so surprising, unless the cycle is so long that local society doesn't retain any memory of past cycles. In either case, understanding the coming changes is critical to the business of prospering despite them.

Doomed World

One subset of the changing world is the *doomed world*, the planet that is soon to be destroyed, or at least rendered incapable of supporting life. Any person or society on the planet faces certain death.

The doomed world is a good setting for high-pressure stories, aimed at averting or escaping from the coming cataclysm. The disaster imposes a fixed time limit. When facing almost-certain death, ordinary individuals can display extraordinary heroism or villainy. Some stories in the tragic mode have used catastrophes that *can't* be stopped or evaded, no matter how hard the characters strive.

Breeding Ground Worlds

Some science-fictional worlds are conceived as *breeding grounds* for a

specific kind of character. The author may want to portray a civilization built around a single facet of human nature, or he may simply be making the point that environment affects society. In either case, the physical environment causes many of the people living on the world to fit a stereotype. A breeding ground world usually has a harsh or limited environment, forcing its inhabitants to specialize in order to survive. On the other hand, pleasant worlds may be breeding grounds for soft hedonists . . .

The GM can use a breeding ground world as a backdrop for stories of social adaptation: the PCs adapt to the local society while they experience the environment that gave rise to that society. Breeding grounds can also be used to provide home worlds for specific character types.

Crossroads World

A *crossroads world* is special because *everyone* comes to visit. It may be at a major junction of jump lines, it may be an economically dominant world that trades across half the quadrant, it may be an imperial capital, or it may simply be such an attractive world that everyone plans

vacations there. No matter what the reason, every sapient species and every known interplanetary civilization is represented among the crossroads world's residents.

A crossroads world can be useful as the backdrop for a campaign involving a mixture of themes, such as a generalized "troubleshooters" game. Adventures beginning there can be driven by a variety of patrons, and can take the party to any region of the setting. Alternatively, adventurers visiting the crossroads world in search of information or work will never know quite what to expect.

Exotic World

The *exotic world* is the one that is actually unique in known space – some feature, or the whole environment, is the result of strange events that haven't happened anywhere else. Perhaps it's a world whose physical environment breaks all the normal "laws" of planetary development. Or maybe the local society is unusual, distinctive, and mysterious to outsiders.

Even if the exotic world isn't the main focus for an adventure plot, its presence in the campaign can serve as



a reminder that the universe is a strange and mysterious place. Exploration or first-contact campaigns will find an exotic world a good place to visit.

Exploited World

An *exploited world* is well connected to interstellar society – perhaps a bit *too* well connected. Outside forces are using the world for their own benefit, strip-mining local physical resources or abusing the inhabitants.

An exploited world is a natural setting for the conflict that drives adventures. If multiple factions are doing the exploiting, they may hire adventurers to take part in their competition. Sympathetic outsiders may want to help the native inhabitants improve their lot, possibly by encouraging rebellion. A world that has been over-exploited may be subject to disaster, as the economy or even the ecology collapse. Exploited worlds are a good backdrop for black-and-white ethical issues . . . although they can also be drawn in shades of gray if *everyone* is complicit in the exploitation.

Forbidden World

A common trope in SF is the *forbidden world*, the planet that is cut off from foreign visitors. The forbidden world is almost unknown to the galaxy at large – until a party of adventurers breaks the barrier and discovers what's behind it . . .

There are a variety of reasons why a world might be forbidden. An interstellar society might prohibit travel to certain worlds to reserve them for future colonization, to protect backward cultures from outside interference, to prevent a dangerous local society from gaining access to space travel, or to protect visitors from dangerous local conditions. A world's inhabitants might set their own home off limits out of hostility toward outsiders. In any case, a visit to a forbidden world is likely to be dangerous, although unique opportunities may be found there. Sending the party to a forbidden world may be a good way to throw them on their own resources – they won't be able to call for help or logistical support the moment they get into trouble!

Common Origins, Common Cause

When designing his campaign framework, the GM may consider requiring that all of the PC adventurers come from the same world. This works best when the world in question has been developed in considerable detail, supporting a broad variety of character concepts.

This requirement certainly constrains character development, but it has several advantages. It makes it easy to build characters with shared plot hooks; characters that grew up together, or have already worked together in the past, will be easy to bring into the same adventure. It also tends to give the adventurers common motivations – if their shared home is in danger of internal conflict or an external threat, it becomes easy to involve all of them in the epic adventures to follow!

Historical World

The *historical world* is, simply put, a world with a great deal of history. Perhaps it has been inhabited for a very long time – or the ruins of lost civilizations are scattered across its surface. Scholars come to study the ancient remains, tourists come to gawk at the ruins, and pilgrims come to see the birthplace of their traditions. Local societies may be very wise, or very decadent, or both.

The historical world is a congenial place for plots involving mysteries or elaborate social intrigues. They can also be a playground for GMs who like to develop elaborate “back story” for their settings.

Home-Base World

The *home-base world* isn't usually a site for adventures. Instead, it serves as a place where adventurers can go between exploits. It's usually a civilized, high-population world, where visitors can obtain anything from a relaxing night on the town to a billion-credit spaceship. It can also be the home of various patrons and contacts, ready to give adventurers jobs, favors, or useful information.

Almost any campaign setting can use at least one home-base world, unless the PCs will spend all their time wandering the galaxy. A home-base world doesn't have to have any other role in the setting, although a sudden threat to it may be a good way to motivate adventures.

Invisible World

The *invisible world* isn't actually invisible – it's just that although everyone knows that the world *exists*, no one knows *where it is*. Perhaps it's the long lost home of an alien (or human!) race. It's possible that some of the information “everyone knows” about the world is incorrect, so that explorers searching for it always look in the wrong place. The world itself is probably either uninhabited or inhabited by people who take great care not to reveal their home to interstellar society.

An invisible world is a grand-scale mystery, suitable as the end point of a star-spanning quest. Just figuring out why the invisible world can't be found can be a difficult puzzle in and of itself. Of course, once the invisible world is located, adventurers may need to deal with angry inhabitants . . . and there may be a very good reason why the world has kept to itself all this time!

Primitive World

Even in a space-faring society, some inhabited worlds will be primitive. Perhaps they have just been colonized, and the colonists don't have access to the full range of advanced technology. Perhaps the colonists don't *want* to use advanced technology. Or perhaps the world is the home of a race that hasn't reached parity with interstellar society.

If you see a whole thing – it seems that it's always beautiful. Planets, lives . . . But up close, a world's all dirt and rocks.

– Ursula K. Le Guin

A primitive world is a good backdrop for stories of culture clash. Space-faring visitors might use their resources to carve out a kingdom among the primitive natives . . . although they would do well to remember that *primitive* doesn't mean *stupid*! Sophisticated natives may be able to understand advanced technology, and overcome it, even if they can't duplicate it themselves. On the other hand, visitors may be unwilling or unable to bring their own tools, and will need to deal with the natives on their own ground. Primitive worlds are usually isolated from interstellar society, else they don't stay primitive for long.

Puzzle World

A *puzzle world* is one where local conditions present a mystery to visitors. Naturally, almost every alien world is a “puzzle world” in that sense, but in some cases the mystery is *critically* important – visitors will find themselves unable to survive or succeed unless they understand how the world works! Perhaps the physical environment or the ecology has hidden pitfalls. Or perhaps local society has strange features that must be understood if visitors are to accomplish their goals.

A puzzle world presents a specific kind of challenge to its visitors. Adventures on a puzzle world are not usually motivated by the puzzle itself, unless the adventurers are explorers or anthropologists whose job is to solve puzzles! Instead, the GM should see to it that adventurers have something they *really* want to do (survive, get off the planet, make a fortune) and then make their goal contingent on solving the puzzle. One way to surprise players is to make the puzzle a subtle one. The

world appears ordinary and hospitable until the characters are committed, and *then* a mystery makes itself evident . . .

Synthetic World

Some worlds are *artificial*. At the smallest scales, space habitats (p. 132) are synthetic worldlets. Science fiction has also portrayed whole planets that were either built from scratch or drastically remodeled. Some synthetic worlds are far larger than planets (see *Megastructures*, p. 133).

A synthetic world doesn't have to present any special plot elements; after all, the designers of such a world may be trying to mimic a natural environment as far as possible. Of course, even a very naturalistic habitat may need special attention to continue working properly. An abandoned synthetic world may be a doomed world (p. 64) as well, unless someone regains control over its environment. Naturally, a synthetic world can present a variety of mysteries. Who built it, and why? What technologies were used in its construction? Are any useful artifacts still there to be found?

Unique Resource World

A world can be critically important if some resource is available there but nowhere else. Even a simple luxury item will bring commercial and government attention if it can be found nowhere else in the galaxy. A unique resource that is critical to the functioning of interstellar civilization will be fought over by everyone!

Unique resources are most likely to appear in space-operatic universes. In a realistic setting, a resource that occurs in only one place in the galaxy, and that can't be analyzed or

synthesized, is nearly impossible (but see *Unobtainium*, p. 181). If a unique resource world exists, it will be the natural site for high-stakes adventure, as various factions struggle to control or profit from the resource.

DEPTH OF DETAIL

Aside from considering the role a given world is to play, the designer should think about how much detail he really needs. A world that is going to dominate the campaign should likely be designed in greater detail than one the PCs will visit once on their way to a more important place.

Grand Stage

Any planet is a *world* – the product of billions of years of history, operating on landscapes hundreds or thousands of miles in extent. Even an uninhabited world can provide almost unlimited puzzles to solve and locations to explore. An inhabited world, its population in the millions or billions, will have at least as much variety and depth as present-day Earth. A world could be considered a “grand stage” for dozens of adventures, developed in great detail and used over and over again.

The most detailed levels of development are useful for a world that is going to dominate the campaign. The adventurers will spend most of their time on such a world, and some of them may claim it as their home. Conflicts centering on the world will be the most important factor driving each adventure, even those that take place elsewhere in the galaxy. Other worlds may well exist in the setting, but the dominant world will be the most fully developed.

The GM should use the world-design rules in this book as a *starting point* for developing such a world. Following this, he might design maps for the world and for individual regions, work out the details of distinctive regional societies, design native animal species and build local ecologies, draw up local NPCs, and so on. The *history* of the world might be worth developing in detail; see *GURPS Infinite Worlds* for tools for developing historical timelines.

Repeated Visits

Sometimes a campaign won't be dominated by any single world, but contains worlds to which travelers will frequently return. Such worlds might be military outposts that provide bases for adventure, high-population centers of trade, or homeworlds where PCs usually begin their adventures.

A world that's subject to repeated visits should be developed to a moderate level of detail. Even if the world is a home base (p. 65) where action rarely takes place, space travelers will want to find employers, equip themselves, seek information, or just relax there. The GM will want to be able to describe the backdrop for such activities. The world-design rules in this book can be used to generate the overall environment for such a world. After that, the GM can produce whatever local details or NPCs are necessary to support the world's purpose in the campaign.

Sound Stage

A world that is only going to be visited once (even as the focus of an adventure) can often be developed to a very low level of detail. This could be called the "sound stage" level of

development. Television series have often conveyed the "alien world" idea with actors on a sound stage, supported by nothing more than a few fake boulders and an oddly colored backdrop to suggest an unearthly sky.

A sound-stage world can easily be developed using the world-design rules in this book. Indeed, many steps

in the design sequence can be skipped if those details aren't likely to have any effect on the planned adventure. The GM may need nothing more than a general idea of the planet's environment, along with one or two specific locations. Naturally, a sound-stage world can be developed further if the GM or players take an interest in it!

Depth of Realism

Another consideration in world design is how much *realism* the GM wants to inject into his setting. Realism in setting design isn't an absolute virtue; what's necessary is *plausibility*. The audience of the story, film, or roleplaying session wants to be able to suspend disbelief and enjoy immersion in the flow of events. Each audience will have its own standards, and every subgenre of science fiction has its own requirements. A world design that fits perfectly into a space-operatic universe might be nonsensical in a high-realism "hard SF" setting, and vice versa.

Very few SF authors *ignore* realism in their world design, but some pay more attention to it than others. A good author or GM will be concerned with characters and story. Some authors (notably Poul Anderson and Hal Clement) have made a fine art of using rigorously plausible and distinctive settings to *drive* their stories – but other approaches are just as effective.

In general, as with other discussions of real-world science and technology in this book, the world-design rules are intended as tools for you to use when producing the space setting *you* want. Use, rewrite, or ignore them to taste!

MAPPING THE GALAXY

*A broad and ample road, whose dust
is gold,*

*And pavement stars, as stars to thee
appear*

*Seen in the galaxy, that milky way
Which nightly as a circling zone
thou seest*

Powder'd with stars.

– John Milton, *Paradise Lost*,
Book VII

Worlds need a context, a map of the overall campaign setting to which GM and players can refer.

How Many Worlds?

The GM should consider *how many* distinct worlds he will need for his campaign. Many space-oriented games will use only one star system – perhaps our own solar system, perhaps some

other that has been colonized by humans. A campaign on the interstellar or galactic scale can easily include hundreds or even thousands of worlds. Choosing a useful scale is one of the fundamental decisions to make in any interstellar setting; see *Choosing a Preferred Scale* (p. 72) for some suggestions.

The choice will depend on the available space-travel technology; if FTL is not available, no one will have *time* to visit many worlds. Another consideration is the campaign framework. If the GM plans to spend a lot of time with each world, he won't need very many. On the other hand, a picaresque campaign will need many worlds for adventurers to visit.

Naturally, a campaign set in a single star system won't need much attention to astronomical detail. If many

star systems are to be included, the GM may wish to arrange them in accordance with what's known about the large-scale structure of the galaxy.

Drawing the Map

The type of map to draw depends on the scope of your campaign, and especially on the type of interstellar travel that is available in your universe.

If starships will move by "jumplines" or a similar system, space can be mapped by drawing the jumplines. The actual distance between two stars in space may be irrelevant, and anything that isn't on a jumpline can be ignored. If jumpline travel is instantaneous, only the connections need to be drawn and the map can be quite abstract. Otherwise,

the amount of time it takes to traverse each connection must be indicated somehow. A jumpline map may also include information about how long it takes for a ship to travel from each jump point to a nearby world or other place of interest.

If FTL travel times depend on the normal-space distance between stars, then a scale map of the campaign area will be needed. If starships move through normal space, then possible hazards like nebulae should be mapped. If starships move through hyperspace, then normal-space phenomena between stars can probably be ignored. Of course, if there are “terrain features” in hyperspace that might slow travel or make it more dangerous, those will need to be mapped!

Mapping space is sometimes inconvenient because paper maps are flat but space isn’t. The GM may choose to ignore this, placing all of his star systems on the same plane. It’s more realistic to use a three-dimensional grid system. The map surface then represents a convenient plane – usually either the plane of the galactic disk, or a plane defined by Earth’s equator. A star “above” the reference plane would be mapped with a “+”

sign, followed by its distance above the plane in parsecs. A star “below” the plane would be mapped with a “-” sign and its distance from the plane. Thus, if Lestrade’s Star lies four parsecs below the reference plane, it would be noted on the map with (-4).

To find the distance between two stars when using three-dimensional coordinates, apply the Pythagorean formula:

$$D = \text{Square root of } (X^2 + Y^2 + Z^2)$$

Here, **D** is the total distance between the two stars in parsecs, while **X**, **Y**, and **Z** are the distance between them along each of the three axes.

ASTRONOMICAL FEATURES

Campaign maps may include astronomical features at a variety of different scales.

Galaxies

Galaxies are the building blocks of the (visible) universe. The vast majority of the universe’s stars are located within galaxies, forming island

universes that are visible for millions of parsecs in every direction.

Galaxies are *much* more closely packed, relative to their size, than are stars within a single galaxy. Galaxies often interact. The largest ones seem to have formed by absorbing their smaller neighbors, a process that continues to the present day. Meanwhile, even full-sized galaxies sometimes pass close to (or directly through!) each other, distorting their shapes and affecting one another’s evolution.

Galaxies normally come in three different categories: *elliptical*, *spiral*, and *irregular*. Each of these has significantly different properties.

Elliptical galaxies have the shape of a more or less elongated sphere. A few elliptical galaxies (the *lenticular* galaxies) show the beginnings of a central disk, and may represent a transitional type between elliptical and spiral galaxies.

Elliptical galaxies vary tremendously in size. Small *dwarf ellipticals* are only a few hundred parsecs across and may contain only a few million stars. The largest elliptical galaxies are hundreds of thousands of parsecs across and contain many *trillions* of stars. These huge elliptical galaxies, hundreds of times as large as our own galaxy, are among the largest objects in the universe.

Elliptical galaxies have an undifferentiated shape because they don’t have a strongly preferred direction of rotation. Component stars may orbit the galaxy’s center of mass in a wide variety of directions and speeds. Many elliptical galaxies are relatively barren places, with little or no new star formation under way.

Spiral galaxies have a strongly flattened shape, with much of their visible matter restricted to a galactic disk. Spiral galaxies usually have a very obvious structure, with most of the visible stars arranged in a set of spiral arms. Spiral galaxies are much less variable in size than elliptical galaxies. Most spiral galaxies are between 5,000 and 50,000 parsecs across, and have between a billion and a trillion stars.

A spiral galaxy’s structure forms because it rotates strongly in a specific direction. Most of the stars of the disk revolve in the same direction, in more-or-less circular orbits around the galaxy’s center of mass. Waves of

Distances and Scales

Astronomical distances aren’t conveniently measured in miles. Although this book will refer to miles in some cases, it normally uses several different units to measure distances on different scales.

The *Earth diameter* will sometimes be used in this book to measure the size of worlds and the distance from worlds to their satellites. Astronomers normally don’t use this unit, but it will make some of the world-building calculations more convenient. Earth’s diameter at the equator is about 7,930 miles.

The *astronomical unit* (AU) is the standard unit used in this book to measure interplanetary distances. One AU is equal to the average distance between Earth and the sun, about 11,730 Earth diameters or 93 million miles.

The *light-year* (ly) is equal to the distance light travels in the vacuum of space in the course of one Earth year. It is equal to about 63,000 AU or 5.9 trillion miles. This book doesn’t use the light-year often, but it is a common measure of distance in astronomy and in science fiction.

The *parsec* (pc) is the standard unit used in this book to measure interstellar distances. Astronomers measure the distance to a nearby star by observing its *parallax*, its apparent angle of motion across a baseline of 1 AU. If the *parallax* is equal to exactly one *second* of arc, then the star is one *parsec* away. One parsec is equal to 3.26 light-years, or to about 206,000 AU.

denser structure occur within the disk, forming the spiral arms. The arms tend to concentrate interstellar gas and dust, providing a good environment for the formation of new stars.

As the name suggests, *irregular* galaxies are unbalanced in shape, although they often exhibit a few hints of spiral structure – a vague spiral arm, or a dense “bar” that is often displaced from the galaxy’s center of mass. Irregular galaxies vary in size, although they tend not to be very large. They are usually between 1,000 and 10,000 parsecs in diameter, and have between 100 million and 10 billion stars.

Bigger Than Galaxies

Galaxies are not distributed randomly through the universe. Almost all galaxies are found in *groups* or *clusters*. A *group* of galaxies is smaller, usually with no more than 30 member galaxies, about 0.2-1.5 million parsecs across. A *cluster* is usually larger, containing up to several hundred galaxies in a space about 1.5-3 million parsecs across.

Groups and clusters of galaxies are themselves organized into *superclusters*. On the largest scale, the universe is full of galactic associations, arranged in clumps and sheets as if on the surface of great “bubbles” of empty space. These *voids* are almost empty of matter, and are usually about 100-400 million parsecs across. The voids appear to be distributed fairly evenly through the universe. Current cosmological theory has yet to explain why the universe is arranged this way!

Galactic Structure

Our own galaxy is a very typical *spiral galaxy*, in shape, size, and structure. Its visible disk is about 30,000 parsecs across.

The galaxy’s busiest region is the *galactic disk*, a flat structure in which most of the nebulae and bright young stars are found. Since it’s the brightest stars that define the visible shape of the galaxy, the disk is its most prominent feature. The disk is about 600 parsecs thick, becoming thicker toward the galactic core.

The galactic disk establishes a three-dimensional system of directions



that will be used in this book for interstellar mapping. One direction perpendicular to the plane of the disk is called *galactic north* and points “above” the plane. The opposite direction is *galactic south* and points “below” the plane. A line on the plane of the disk passing through the galactic core defines the directions of *coreward* (toward the core) and *rimward* (away from the core). Finally, within the disk plane but perpendicular to the coreward-rimward line, another line defines the directions of *spinward* (in the direction of galactic rotation) and *trailing* (opposite the direction of rotation).

Much of the disk’s matter falls in the *spiral arms*, long structures that (if looking “down” on the disk from galactic north) curve counterclockwise as they move from the core out to the fringes. The spiral arms are not smooth curves, forming a regular pattern. The densest parts of the arms fall into a series of short, discontinuous arcs that piece together to form an overall spiral shape. There are two major spiral arms, and a number of shorter arcs that could be considered partial arms.

The galactic disk is embedded in the *galactic halo*, a spherical structure that takes up most of the galaxy’s volume. The halo contains very little gas or dust, and only a few percent of the galaxy’s stars. The stars of the halo are old and dim, many of them orbiting the core at wide angles to the plane of the disk; such stars punch through the disk twice in the course of each long orbit. Strangely, the halo appears to contain the majority of the galaxy’s mass, which must be in the form of undetectable “dark matter.”

The halo is densest toward the center of the galaxy, where it shades into the *galactic core*. This is a flattened bulge, about 1,800 parsecs thick. The core is somewhat elongated, making our galaxy a moderate example of a “barred” spiral. The best current model of the galactic bar makes it about 1,800 parsecs wide and 4,500 parsecs long, with its long axis pointed in the general direction of Earth. The galactic core is composed of older stars, with a few clusters of bright young ones. It is extremely dense in its inner regions, with many stars per cubic parsec.

Current observations indicate that Earth is about 30 parsecs above the plane of the galactic disk, about 7,700 parsecs from the center of the galaxy. Sol is located in what astronomers call the Local Arm, one of the galaxy's two major spiral arms. This arm is about 1,800 parsecs across, and winds halfway around the galaxy from core to fringes. The centerline of the Local Arm passes about 100 parsecs rimward of Sol, so Earth is fairly close to the heart of the arm. This is no more than coincidence; Sol and Earth are simply "passing through" the region on their own orbit around the galactic core.

Galactic Features

A closer look at the galaxy reveals a variety of small-scale features.

Globular clusters are dense spherical clusters of stars. They are usually 50-100 parsecs in diameter, and can contain up to hundreds of thousands of stars. Globular clusters are very old, 10 billion years or more. They formed even before the galactic disk was well-established; most of them remain in the galactic halo, where they follow very wide orbits around the galactic core. Some of the younger ones may have been captured from others by our galaxy. The stars in the core of a globular cluster may be only light-weeks apart, and close encounters among them are common. Stars in a globular cluster are very unlikely to have stable, life-bearing planets. Globular clusters are rare – the nearest one to Earth is about 2,000 parsecs away.

Open clusters are very common star groups, smaller than globular clusters and located solely in the galactic disk. An open cluster is usually two to 15 parsecs in diameter, and can contain up to several thousand stars. These stars all formed together and have since moved through the galaxy as one, mutually bound by gravity. Open clusters can be any age, although very old ones are quite rare. Most are less than 200 million years old, and almost none are older than two billion years. Stars in an open cluster may have planets, if they are old enough and have managed to avoid close encounters with other cluster members. There are several

open clusters in Earth's galactic neighborhood, most notably the Ursa Major Moving Cluster (centered about 23 parsecs away) and the Hyades (centered about 45 parsecs away).

Associations are groups of stars that have dispersed from their original open clusters, but are still located close together on the galactic scale, and have similar orbits around the galactic core. Like open clusters, they are found only in the galactic disk. Associations tend to be young – after a few orbits around the core, they disperse so far as to be impossible to identify. Many associations are tied to well-defined open clusters, indicating a common origin; both the Ursa Major cluster and the Hyades have their own associations, which include many of the bright stars visible in Earth's sky. Some of the very youngest associations are still dominated by super-bright blue-white stars; these *OB associations* are among the galaxy's most prominent small-scale features. The closest OB association to Earth is centered about 160 parsecs away.

Molecular clouds or *dark nebulae* are clouds of interstellar hydrogen interspersed with heavier elements and dust grains. They are much denser than the normal interstellar medium. When they are parsecs thick, they can obscure most or all of the light from stars behind them, giving the appearance of dark "holes" in the sky. On the other hand, when they are illuminated by bright nearby stars, they can shine in vast billows and traceries by the reflected light.

Molecular clouds are star nurseries, places where new stars are formed. They can be of almost any size; the smallest ones are less than a parsec across, while great molecular-cloud complexes like the Orion Nebula can be 50 parsecs or more in diameter. Molecular clouds can be important in a campaign if they obscure stars or hinder interstellar travel.

Distribution of Stars

The number of stars in a unit volume of the galaxy's space varies widely. In the galactic core or the heart of a globular cluster, stars will be packed so tightly that only a few thousand AU separate them. In the deep fringes of

the galactic halo, a star might be dozens of parsecs from its nearest neighbor.

Most settings involving interstellar travel will focus on the region of the galaxy around Sol, or on a similar region elsewhere in the galaxy. In this region, there is about one star system for every 10-15 cubic parsecs. About half of all star systems actually contain two (or more) stars, each of which has some chance of associated planets.

THE FREQUENCY OF WORLDS

There are about 400 billion stars in our galaxy, and it seems likely that at least one-third of them (about 130 billion stars) have planets. How many of these are home to intelligent life? How many might be suitable for colonization? *It's anyone's guess.* All of our estimates are based on unproven assumptions. That situation *may* change in the coming years, as better space telescopes continue to give us more information about other solar systems. For now, even a GM interested in realism is free to make useful worlds as common as he likes.

It's possible that interstellar civilizations will be in the habit of colonizing and using *every* star system, no matter how inhospitable or barren. Unless this is the case, many stars simply won't be worth bothering with. Even under a generous estimate, pleasant Earthlike worlds are outnumbered *dozens to one* by barren balls of rock or ice.

Unless a campaign map covers a region with only a few dozen stars in it, the GM should probably not try to map every star, or even every marginally habitable system. There are simply too many. The GM can concentrate on locating the major star systems that will play a significant role in his campaign, just as the publisher of a road atlas only selects the most important cities to place on a national map.

Alien Homeworlds

Many science-fiction universes are busy, chatty places. They're full of multiple alien species, all at about the same level of development, permitting

Who are we? We find that we live on an insignificant planet of a humdrum star lost in a galaxy tucked away in some forgotten corner of a universe in which there are far more galaxies than people.

– Carl Sagan

them to talk to (and shoot at) each other in dramatically interesting ways. Unfortunately, the real universe doesn't appear to be so densely populated.

Most scientists agree that intelligent, technologically advanced life must be a rare phenomenon in the universe. There is no clear-cut evidence for past visits of alien intelligence to Earth. Astronomers have never detected an unambiguous signal from another world. We see no sign of interstellar-scale engineering projects, such as might be mounted by advanced civilizations. The universe appears to be a quiet place.

The dearth of evidence for aliens places a limit on the frequency with which they are likely to exist in the universe. If a communicative, technologically advanced alien species existed within 100 light-years of Earth, we would have detected it by now. This suggests that such species don't appear more often than about once in 10,000 star systems.

Still, the evidence is extremely incomplete, and there's little to prevent a GM from setting the frequency of alien intelligence at any level he wants. In some settings, intelligence is vanishingly rare and human explorers never find aliens. In others intelligence is common, appearing around many (or even most) stars.

When designing a densely-populated universe, the GM may want to develop reasons why the sky seems so quiet to us today. Perhaps Earth is in the midst of a reserved space in the galaxy, a region where colonization is forbidden. Perhaps intelligence is common but advanced technology is rare, so that most species never progress beyond a primitive state. Perhaps advanced civilizations are common, but the vast majority of them simply don't bother exploring with telescopes or starships. Or perhaps there is a *very good reason* for everyone to be keeping quiet . . . the

galaxy might be a dangerous place for young civilizations who foolishly broadcast their existence!

Worlds Bearing Complex Life

If *intelligence* seems rare, *life* is probably very common. Although alien life has yet to be unambiguously discovered, astronomers have found its chemical building blocks in many surprising places – in the heart of meteorites, in the atmospheres of other planets, even in the vast molecular clouds found in deep interstellar space. On Earth, primitive life seems to have begun almost as soon as it *could*. Today, life can be found in some of Earth's most hostile environments.

Of course, for most of Earth's history, life has been very simple: bacterial mats, viruses, and algae. Scientists searching for life elsewhere in our own solar system expect to find similar simple forms, not complex plants and animals. Explorers may find comparable situations on the worlds of other stars – many worlds with primitive life, few with complex species.

Astronomers have defined a set of conditions for stars that are likely to have Earthlike worlds, home to complex living organisms. A star must be stable and long-lived. It must not be too bright, as the brightest stars rarely have planets. It must not be so dim that its planets are too cold for complex life. It must not be too old, as the oldest stars are metal-poor and may not have planets. It must not be too young, as it appears to take billions of years for complex life to evolve. It must not be tied to a partner star whose gravitational influence would make an Earthlike world's orbit unstable. Given all these conditions, it seems unlikely that more than 10% of all star systems will shelter complex life. A more realistic estimate might place the number at 3% to 5%.

Of course, the evidence is again extremely sketchy, and the GM should feel free to place this frequency wherever he wishes. After all, complex (but stupid) living creatures are almost impossible to detect at interstellar distances. Meanwhile, planets with complex life – but without native intelligence – are likely to be superb places for colonization.

Interesting Barren Worlds

Given the above, 90% or more of all star systems will be barren, containing no complex life and probably little else to set them apart from one another. Still, even if a star system has no complex life of its own, it may be worth visiting, exploring, and colonizing.

If interstellar travel is expensive, difficult, or slow, then a civilization may colonize *every* star system as it expands. An interstellar society that has to make a huge investment in order to reach even a single new world can't afford to be choosy. Of course, even a barren star system is colonizable with advanced technology. Energy can be derived from fusion power or the primary star. Useful materials can be mined, minerals and metals from the barren worlds, water and other volatiles from the icy outer system. If a convenient planet isn't available, habitats can be carved out of asteroids or other pieces of space debris (see *Macro-life*, p. 191). Thus even the least promising star system can become a thriving colony, if the colonists have no choice.

If interstellar travel is easy, the most useless star systems will probably be visited once and then ignored. Even in this case, some barren star systems may be colonized by people who simply want to get away from civilization. Dissident or refugee groups may set up camp in a barren star system in order to escape their enemies and live as they please.

Meanwhile, some barren systems will be colonized because they yield useful resources: unusual organic compounds, industrial metals, radioactives, the mysterious crystals used in starship power plants, and so on. Even after the resource runs out, an already-established community

may remain in place. Another possibility is the *scientific* colony, established as a base for the study of some unusual phenomenon in nearby space.

Finally, a star system may be colonized for its location. Civilizations will establish outposts as advance bases, or to control places where unusual amounts of starship traffic pass. This is less likely in a universe

where interstellar travel is fast and easy – why colonize *this* particular star, rather than one of the 100 other barren systems within easy travel distance? At the other extreme, if FTL travel takes place along fixed wormholes or jumplines, the map will contain many choke points, systems that may have no intrinsic value but which are natural waypoints for travel.

The GM should decide how many barren-but-interesting worlds will be in his universe for each world bearing complex life. If the ratio is high, interstellar travelers will often be visiting small outposts and hardscrabble colonies on barren worlds. If the ratio is low, most adventures will take place on the garden worlds, with their higher populations and complex ecosystems.

Choosing a Preferred Scale

The choice of scale for an interstellar setting is one of the most fundamental decisions the GM must make. Is the setting going to be vast, covering a significant part of the whole galaxy? Or is it going to be a tiny chip of explored space, including no more than a few star systems? This choice affects not only the number of worlds that might fall onto the campaign map, but also the selection of FTL and other technology assumptions (see Chapters 2 and 3).

The GM can get an idea of his preferred scale by deciding how many star systems play host to intelligent life, and how many have given rise to complex but unintelligent life. Then he can decide how many of each kind of world he wants to have in his setting. Along with an assumption about the density of stars in space, this can give the volume of the campaign map. In the neighborhood of Sol, there is about one star system for every 12.5 cubic parsecs; different densities can be assumed in other regions of the galaxy.

Once the scale is selected, the GM can consider the typical speed of interstellar travel. How long can an adventurer expect to take to travel from one world to the next or from the center of the campaign map to its edges? Unless many adventures are likely to take place on board ship, travel times between worlds should probably not be more than a few weeks. If there is regular contact between the core and the fringes of the campaign setting, the longest trip shouldn't take more than a year or so (unless years-long voyages are typical for the setting, as in many STL-based universes).

Playing With Shapes

When deciding on the scale of an interstellar campaign, the GM can make use of a couple of simple mathematical formulae.

Given a sphere of volume **V**, then the radius of the sphere (the distance from its center to its surface) is about $0.62 \times \text{cube root of } V$. Given a cube of volume **V**, then the length of each face of the cube is exactly *cube root of V*.

Given a region of space of volume **V**, and some number of points **N** distributed at random inside that region, then the average distance between two neighboring

points is about $1.12 \times \text{cube root of } (V/N)$. (This assumes that the region of space has a simple shape, but it doesn't have to be a sphere – a cubic volume that can conveniently be drawn on standard graph paper will do.)

The first formula is useful when deciding how big the space a campaign map covers will need to be, assuming that stars are evenly distributed within the mapped region. The second is useful for determining the average travel time between two neighboring worlds on the map.

For example, suppose the GM assumes that intelligent alien life is found once in about 10,000 star systems, and that he wants to have six starfaring species in his campaign. This suggests about 60,000 star systems within the space covered by the campaign map. At about one star system per 12.5 cubic parsecs, the map will need to cover about $60,000 \times 12.5 = 750,000$ cubic parsecs.

The GM decides that he will use a spherical shape for his campaign setting. Applying the formula for the sphere's radius, he finds that the campaign map will need to cover a sphere with a radius of about $0.62 \times \text{cube root of } (750,000) = 56.3$ parsecs. A map covering a sphere with a radius of about 60 parsecs should be enough.

The GM then decides that this sphere will include about 200 interesting worlds, most of which won't be placed until he needs them. How far will each world be from its neighbors?

Applying the formula for average distance, the GM computes a distance of $1.12 \times \text{cube root of } (750,000/200) = 17.4$ parsecs. This distance should be typical for voyages from one world to the next in the course of the campaign. If such a voyage is expected to take about a week, then the typical FTL speed for a starship will be about $17.4/7 = 2.5$ parsecs/day. At that speed, a voyage from the center of the campaign map to its edge will take about $60/2.5 = 24$ days.

Meanwhile, the 60,000 stars on the map will include several thousand with life-bearing worlds, and tens of thousands of barren systems. Clearly, the GM won't need every one of these star systems – which is a good thing, as he can't even *begin* to draw every one on his map!

WORLD DESIGN SEQUENCE

Gummidgy was blue on blue under a broken layer of white, with a diminutive moon showing behind an arc of horizon. Very Earthlike but with none of the signs that mark Earth: no yellow glow of sprawling cities on the dark side, no tracery of broken freeways across the day. A nice-looking world, from up here. Unspoiled.

— Larry Niven, “Grendel”

The following material presents a system for designing worlds, star systems, and whole regions of the galaxy for a space-based setting. Such a system depends on both the current state of scientific knowledge, and on the dramatic requirements of the setting. Unfortunately for the game designer, both of those factors are subject to change!

The present day is a time of great progress in astronomy and astrophysics. Our understanding of how planets form and evolve is very different today from what it was even a decade ago. A decade from now it will doubtless be different again.

Meanwhile, the role of scientific realism varies from setting to setting. A GM who wants a hard-SF feel may map the stars with great attention to astronomical realism. On the other hand, a GM who wants a Golden Age feel for his spaceship-and-blaster epic will want to run off a dozen worlds to suit his dramatic needs, and won't care about meticulous realism.

No fixed world-design system will fit every need, or remain in accord with the best scientific understanding for very long. The system in this book is designed to be flexible. As presented, the system assumes a fairly high degree of realism according to current scientific research. However, each step of the process will include explanatory material designed to help the GM alter the system to fit his needs.

OVERVIEW

The world design system is presented in a series of concrete steps, organizing the process of designing a world in a logical progression. To record the specifics of your design

(and have a place to show a color map of your world, if you wish), download the Planetary Record Sheet for free at www.sjgames.com/gurps/books/space/.

The first 14 steps, presented in this chapter, constitute a “basic” world-building system that will help the GM design one world. The astronomical context for each world (its primary star, any moons it might have, the presence of other planets) is ignored. The GM can design a complete campaign setting using this chapter, although it will be a setting in which only one world in each star system is interesting, and the focus of any adventure is expected to be down on that world's surface. This isn't as restrictive as it sounds. Many well-known science-fiction universes have paid almost no attention to astronomical context.

The remaining steps (some of which recapitulate the first 14) are presented as an advanced world-building system in the next chapter.

Those steps will permit the GM to generate the astronomical context for each world generated using the basic design system. The advanced system can also be used to randomly generate whole star systems from scratch. Used in full, the advanced system will provide dozens of worlds per star system in realistic detail. The results will be suitable for hard-SF settings, especially those in which many adventures take place in space or in which interplanetary travel is common.

The system uses die-roll tables to present various options at each step. The GM should use these tables as he pleases. He may simply choose an option without rolling dice, in which case the table and any die-roll modifiers can be used simply to help decide what options are more likely than others. Or he can roll the dice as indicated and accept the result.

Many of the tables help to generate various physical measurements for a world and its surface environment:





mass, surface gravity, atmospheric pressure, surface temperature, and so on. Real-world physical measurements don't fall onto discrete values that can conveniently be put in a table! To add local color, the GM may want to impose minor variations on these measurements from one world to the next. To do this, it is usually acceptable to choose and record a value close to the one given by a table (i.e. closer to that value than to the one on either side).

Both basic and advanced systems require some computations that can easily be performed using a hand calculator. They involve nothing more complex than raising a number to a small exponent, or taking the square, cube, or fourth root of a number.

STEP 1: CONCEPT

To begin the process of world design, the GM should decide on a *concept* for the world. The concept should be a sentence or short paragraph describing the most important features of the world. The GM should make a note of any dramatic role (p. 63) that he wants the world to fill. He should also jot down notes about any adventure plots that are likely to be attached to the world. Only if the GM intends to design the world entirely at random should he skip this step.

Example: To demonstrate the world-building rules, we will use them to generate a world and star system for a *GURPS Space* campaign.

After reviewing the options in Chapter 1, the GM has decided to build a high-powered space-opera universe. He decides that humans have had FTL travel for thousands of years, and have spread throughout a large region of the galaxy. There are lots of alien races, some of them derived from humanity by way of genetic engineering. The most important interstellar society in the setting is an Empire (p. 197) dominated by a hereditary aristocracy.

In the example, the GM wishes to design a frontier planet, distant from any major worlds and largely cut off from the main trade routes. After thinking about a concept, he decides that the world (named *Haven*) will be an invisible world (p. 65), settled by various dissidents and renegades who are hiding from imperial authority. He further decides that Haven isn't on imperial maps because its star system is in the midst of a dense star cluster that's difficult for FTL navigators to negotiate. He has no preferences about Haven's surface environment, and will use the random tables and his own inspiration to develop that.

STEP 2: WORLD TYPE

The planetographers were still puzzling about Diomedes. It didn't fall into either of the standard types, the small hard ball like Earth or Mars, or the gas giant with a collapsed core like Jupiter or 61 Cygni C. It was intermediate, with a mass of 4.75 Earths; but its overall density was only half as much. This was due to the nearly total absence of all elements beyond calcium.

There was one sister freak, uninhabitable; the remaining planets were more or less normal giants, the sun a G8 dwarf not very different from other stars of that size and temperature . . .

— Poul Anderson,
The Man Who Counts

In this step, the world's *type* is determined. A world type is an overall class of worlds, all of which have a similar surface environment. The concept of world type plays a very large role in the world design system.

In particular, a world's type depends on what *volatiles* are available on the world's surface. Volatiles are chemical compounds with low melting and boiling points that make up the bulk of a planet's atmosphere and hydrosphere (if any). Hydrogen, nitrogen, oxygen, water vapor, carbon dioxide, and a number of other familiar compounds are all volatiles.

A world's type is normally described with two terms. One gives the general *size* of the world: Tiny, Small, Standard, or Large. Each of these expands into two to six subtypes, usually tied to local temperature, which further define conditions on the world's surface.

Tiny Worlds

A *Tiny* world is so small that it cannot retain a significant atmosphere, no matter how far from its primary star it is located. The following *Tiny* world types are available.

Tiny (Ice): The world is too small to retain significant atmosphere, but it is cold enough that it can have rich deposits of water ice and similar frozen volatiles. Internal heat due to radioactive deposits or tidal flexing can melt some of the subsurface ice, possibly forming a vast "ocean" of liquid water. Most *Tiny (Ice)* worlds are actually large moons orbiting gas giant planets. Examples in our own solar system include Jupiter's moons Callisto or Europa.

Tiny (Rock): The world is too small to retain significant atmosphere, and it is also too warm to have much ice. The surface is composed almost entirely of naked rock pocked with craters. *Tiny (Rock)* worlds may exhibit some volcanic activity early in their histories, but they quickly cool off and become geologically dead. Some *Tiny (Rock)* worlds are large moons, while others are planets in their own right. Examples in our own

solar system include Mercury and Earth's Moon.

Tiny (Sulfur): This world type represents certain gas-giant moons that experience a tremendous amount of volcanic activity. *Tiny (Sulfur)* worlds undergo a great deal of tidal "flexing" in the course of their orbit, due to the gravitational influences of the gas giant and its other large moons. This flexing effect heats the interior of the moon, encouraging volcanism. Most of the lighter volatiles that are released this way escape to space, while sulfur and sulfur compounds are concentrated on the surface. Such a world is likely to be a very dangerous place to visit. The sole example in our own solar system is Jupiter's moon Io.

Small Worlds

A *Small* world is large enough to retain molecular nitrogen, one of the most common volatile compounds and a major component of many planetary atmospheres. As a result, a *Small* world often has a substantial atmosphere. However, it isn't large enough to retain water vapor in its atmosphere, so unless all the water is frozen out on the world's surface it will eventually be lost to space. The following *Small* world types are available.

Small (Hadean): This world type includes those worlds that are large enough to retain gaseous nitrogen, but which are so cold that their nitrogen atmosphere is frozen on the surface! Such worlds are likely to be gas giant

moons located on the outer fringes of a star system. There are no examples of this kind of world in our solar system.

Small (Ice): The world is large enough to hold onto an atmosphere, usually composed primarily of nitrogen with a few more complex compounds in the mix. It is cold enough to have a great deal of water ice and other frozen volatiles. It may even have liquid "oceans," although these are very unlikely to be composed of water – they may be full of hydrocarbons or other odd substances. Most *Small (Ice)* worlds are very large moons orbiting gas giant planets. The sole example of a *Small (Ice)* world in our own solar system is Saturn's moon Titan.

Small (Rock): The world is large enough to hold onto an atmosphere, although that atmosphere is likely to be very thin. It is not large enough to retain water vapor, and it is too warm for the bulk of its surface water to remain frozen. As a result, any water that the world originally had has escaped to space, perhaps leaving behind a few buried deposits of water ice. The sole example of a *Small (Rock)* world in our own solar system is Mars.

Standard Worlds

A *Standard* world is large enough to retain water vapor in its atmosphere, which is normally extensive. Some have liquid-water oceans, while others have vast deposits of water ice. Although some *Standard* world types are extremely hostile, others are among the most likely homes for complex life forms and intelligence. The following *Standard* world types are available.

Standard (Hadean): Like the *Small (Hadean)* worlds, these worlds would normally have an extensive atmosphere, but they are so cold that almost all of the likely volatile compounds have frozen out. They are likely to be the largest moons of gas giants on the fringes of a star system. The sole example of a *Standard (Hadean)* world in our solar system is Neptune's moon Triton.

Standard (Ammonia): This world type world is large enough to retain a thick atmosphere, along with plenty of water and other light volatile

World Types and Skills

The world types given in this book map to the "planet types" described under *Planet Types* (p. B180) as follows. This affects which skill specialties scientist characters will need on each world.

- *Earthlike*: Standard (Garden), Standard (Ocean), Large (Garden), and Large (Ocean) worlds.
- *Gas Giants*: Gas Giant worlds.
- *Hostile Terrestrial*: Standard (Ammonia), Standard (Greenhouse), Large (Ammonia), and Large (Greenhouse) worlds.
- *Ice Dwarfs*: *Tiny (Ice)* worlds.
- *Ice Worlds*: Small (Hadean), Small (Ice), Standard (Hadean), Standard (Ice), and Large (Ice) worlds.
- *Rock Worlds*: Asteroid Belt, *Tiny (Rock)*, *Tiny (Sulfur)*, Small (Rock), Standard (Chthonian), and Large (Chthonian) worlds.

compounds. However, it is so cold that pure water would be eternally frozen and Earthlike life could not possibly survive. Instead, the atmosphere is primarily composed of ammonia and methane, and the oceans are composed of liquid ammonia mixed with a substantial amount of water. Ammonia-based life (p. 138) is possible on such a world. Ammonia worlds are very unlikely except near cool red dwarf stars; the compound breaks down quickly when exposed to the ultraviolet light given off by brighter stars like our own sun. There are no examples of such a world in our own solar system, although the small gas giants Uranus and Neptune are similar in some respects.

Standard (Ice): The world is large enough to retain a thick atmosphere and plenty of water. However, the world is so cold that almost all of this water is frozen, covering the rocky surface with a thick coat of ice. Photosynthetic life is rare or completely absent, so the atmosphere has little or no free oxygen. There is no example of a Standard (Ice) world in our own solar system.

Standard (Ocean): The world has a thick atmosphere and plenty of water, and has surface temperatures that make liquid-water oceans possible. However, it lacks photosynthetic organisms (plants), either because such life has not yet evolved or because it has become extinct. As a result, the atmosphere contains little or no free oxygen. There are no examples of this kind of world in our solar system, although Earth fell into this category a billion years ago, and probably will again a billion years from now.

Standard (Garden): The world is large enough to retain a thick atmosphere, retains plenty of water to form oceans, and has a surface climate that humans would find relatively pleasant. It also has extensive life, including photosynthetic life that can maintain free oxygen in the atmosphere. Standard (Garden) worlds are the most hospitable for human life. The sole example of a Standard (Garden) world in our solar system is, of course, Earth.

Standard (Greenhouse): The world is large enough to retain a thick atmosphere and plenty of water. However, at some point it became too

warm to support a habitable environment. As the oceans began to boil, the atmosphere experienced a runaway greenhouse effect that pushed surface temperatures far above the level of human comfort. Some Greenhouse worlds ("wet greenhouses") still have oceans of surface water, trapped in a liquid state by the intense atmospheric pressure. Others ("dry greenhouses") have lost all of their original water to the breakdown of water molecules by sunlight in the upper atmosphere. In either case, the surface environment is extremely hostile, the air unbreathable and furnace-hot. The only example of such a world in our own solar system is Venus, a dry greenhouse planet.

Standard (Chthonian): The world would normally be large enough to retain a thick atmosphere, but it is so close to its primary star that almost all of its volatiles have been stripped away by the stellar wind of charged particles. There may be a tenuous atmosphere, but it is likely to be composed of vaporized metal rather than anything convenient for human life. There is no example of this kind of world in our solar system.

Large Worlds

A Large world is large enough to retain helium gas (and possibly even some hydrogen) in its atmosphere. Hydrogen and helium are by far the most common elements in the universe, so a world that can hold onto them is likely to be very massive. In fact, the Jupiter-like gas giant planets are believed to have formed in this fashion.

For whatever reason, a Large world has not accumulated the massive atmosphere typical of a gas giant. Perhaps it was starved of material at a critical point during formation, or some cataclysm stripped away most of its atmosphere. Although a Large world may have a very thick atmosphere, its mass is dominated by rocky or icy materials and it has a definite surface on which visitors could land. Large worlds of this kind may be quite rare.

The following Large world types are available. None of them exist in our own solar system, although one (the Chthonian subtype) has been detected in orbit around other stars.

Large (Ammonia): This class is nearly identical to the Standard (Ammonia) class, but is larger and is likely to have a substantial amount of helium or hydrogen gas in its atmosphere.

Large (Ice): This class is nearly identical to the Standard (Ice) class, but again it is larger and is likely to have large amounts of helium or hydrogen gas in the atmosphere.

Large (Ocean): As with a Standard (Ocean) world, this type has a thick atmosphere, plenty of water, and is in the temperature range permitting liquid-water oceans. Unlike the Standard (Ocean) type, its atmosphere is very thick and is dominated by helium.

Large (Garden): This world is similar to the Standard (Garden) type. Its atmosphere is very thick, rich in noble gases such as helium or neon. Large (Garden) worlds might be able to support human life.

Large (Greenhouse): Like the Standard (Greenhouse) world, this type has undergone a runaway greenhouse effect that has rendered the atmosphere extremely dense and furnace-hot. There may or may not be oceans of liquid water, trapped by the intense atmospheric pressure.

Large (Chthonian): The world would normally be large enough to retain a thick atmosphere. However, either that atmosphere has already been stripped away, or it is being lost at a tremendous rate, forming a long streamer of gases that peels off into space.

Special World Types

Aside from the size-and-subtype system described above, two more world types will be used in the world design sequence. These will be placed and handled using special rules.

Asteroid Belt: The "world" is actually a zone or belt of small stony bodies. These asteroids (or, more precisely, planetoids) may contain useful metals, organic compounds, or even frozen volatiles. Although the planetoids are widely separated in space, there may be many thousands of them in the belt. If the asteroid belt is settled, its inhabitants live in artificial habitats, floating freely in space or built inside the belt's largest planetoids. Inhabited asteroid belts are often mining or industrial centers. Our own solar system has one significant asteroid belt.

Gas Giant: The world is a Jupiter-like planet, possibly far bigger than even a Large-class world, with a massive atmosphere dominated by hydrogen and helium. There is no solid surface, and life is unlikely to exist even in the highest reaches of the atmosphere. In most settings, gas giant worlds are rarely visited and never landed upon (although their atmospheres can be a useful source of hydrogen fuel or other resources). They are mostly of interest because of their extensive systems of moons, many of which are viable worlds in their own right. Most star systems are likely to include gas giant worlds. Our own solar system includes four: Jupiter, Saturn, Uranus, and Neptune.

Determining World Type

To begin the design process for a given world, select a world type to fit the needs of the setting. If a random result is desired, roll 3d on the *Overall Type Table* and make note of the result. Then roll on the *World Type Table*, refer to the column appropriate for the result from the *Overall Type Table*, and make a note of the result. The world will be of that type.

Overall Type Table

Roll (3d)	Overall Type
7 or less	Hostile
8-13	Barren
14-18	Garden

World Type Table

Roll (3d)	Hostile Worlds	Barren Worlds	Garden Worlds
3	Standard (Chthonian)	Small (Hadean)	Standard (Garden)
4	Standard (Chthonian)	Small (Ice)	Standard (Garden)
5	Standard (Greenhouse)	Small (Rock)	Standard (Garden)
6	Standard (Greenhouse)	Small (Rock)	Standard (Garden)
7	Tiny (Sulfur)	Tiny (Rock)	Standard (Garden)
8	Tiny (Sulfur)	Tiny (Rock)	Standard (Garden)
9	Tiny (Sulfur)	Tiny (Ice)	Standard (Garden)
10	Standard (Ammonia)	Tiny (Ice)	Standard (Garden)
11	Standard (Ammonia)	Asteroid Belt	Standard (Garden)
12	Standard (Ammonia)	Asteroid Belt	Standard (Garden)
13	Large (Ammonia)	Standard (Ocean)	Standard (Garden)
14	Large (Ammonia)	Standard (Ocean)	Standard (Garden)
15	Large (Greenhouse)	Standard (Ice)	Standard (Garden)
16	Large (Greenhouse)	Standard (Hadean)	Standard (Garden)
17	Large (Chthonian)	Large (Ocean)	Large (Garden)
18	Large (Chthonian)	Large (Ice)	Large (Garden)

Example: Since the GM wants Haven to be a habitable world, he declines to roll on the tables and simply chooses the Standard (Garden) world type.

Why World Types?

Planets are complex and diverse things. Consider the case of Earth and Venus in our own solar system. The two planets have close to the same mass, have very similar composition, exist as very close neighbors within the solar system, and presumably began their histories with a similar budget of volatiles. Yet today they have vastly different surface environments. Earth is cool, wet, and pleasant – Venus is a furnace-hot, utterly dry hell.

Designing all the factors that determine how a world will evolve is a matter for an advanced university research team, and in fact there are many facets of planetary development that are still unclear to human science. If we want to design a setting for a novel or a roleplaying game, we must simplify. Fortunately we have good reason to expect that most worlds in the galaxy will fall into a few well-defined categories, each with its own characteristic properties. We use world type to describe those categories and help organize the process of world design.

Another advantage of using world types is that they give the GM control over his setting. We could take a different approach, randomly selecting a world's primary star first, then placing worlds, then generating the properties of each world, only at the end getting an idea of what each world will be like. Many science-fiction roleplaying games take this approach, and a *GURPS* GM has the same option when using the advanced system in Chapter 5 of this book. However, if the GM has a desired result, this approach makes it difficult to guide the process toward that result – there's no guarantee, for example, that a randomly-generated star system will contain a pleasant Earthlike world if the GM wants one.

It's much easier to specify the desired properties for the "main world" of a star system first, and then go through the rest of the process in such a way that every result is consistent with that starting point. World types are the easiest way to define this kind of design system.

Tweaking the World Type Table

The default *World Type Table* given is appropriate for a moderately “realistic” space setting, one in which pleasant Garden worlds are uncommon but not vanishingly rare. In most star systems, the focus of human activity will be some uninhabitable but not actively hostile world: an asteroid belt, a Mars-like desert planet, or the moon of some larger planet. Only in a few star systems will visitors tend to come to the more hostile environments, such as Standard (Greenhouse) or Large (Ammonia) worlds.

The GM can alter the distribution of world types to suit his own needs, by writing his own *Overall Type Table* and *World Type Table*. To increase the probability of any world type, give it a wider range of values or move its range toward the center of the table. To make a world type rarer, give it fewer table entries, push it toward the top or bottom of the table, or even remove it from the table entirely.

STEP 3: ATMOSPHERE

One of the most important questions any visitor to a world will have is, “Can I breathe the air?” This step determines the composition and thickness of the world’s atmosphere.

Atmosphere Types

Atmospheres are defined by their *pressure*. Atmospheric pressure is measured in *atmospheres* (atm), with 1 atm being equal to the average sea-level air pressure on Earth. **GURPS** also classifies atmospheres into categories based on pressure, as described in the following table.

Atmospheric Pressure Categories Table

Pressure Range	Pressure Category
Less than 0.01 atm	Trace
0.01-0.5 atm	Very Thin
0.51-0.8 atm	Thin
0.81-1.2 atm	Standard
1.21-1.5 atm	Dense
1.51-10 atm	Very Dense
Over 10 atm	Superdense

If an atmosphere is otherwise breathable, a *Standard* atmosphere has no special effect on human beings; the other pressure categories have effects as described on p. B429.

An atmosphere is also classified according to its composition, which in **GURPS** is important for whether the atmosphere is breathable or not.

A world’s atmosphere may be considered *Marginal*. A Marginal atmosphere is generally breathable, but there is something subtly wrong with its composition that makes it dangerous to breathe without a filter mask, a compressor, or some other simple protective device. There are many ways in

which an atmosphere can be Marginal (see *Marginal Atmospheres*, p. 80).

Unbreathable atmospheres present varying degrees of danger to unprotected human visitors. They can be *Suffocating*, not actively poisonous but lacking in free oxygen. They can be *Toxic*, actively doing damage when breathed directly. They can even be *Corrosive*, attacking exposed tissues and requiring full-body protective gear. All three of these categories are as described in *Hazardous Atmospheres* on p. B429 (but see also the *Toxicity Rules* sidebar).

Use the following rules to determine what kind of atmosphere exists on the world being generated.

Determining Atmospheric Mass

The surface pressure of a world’s atmosphere depends on the amount of gaseous volatiles present, and on the world’s surface gravity. Surface gravity won’t be determined until Step 6 (p. 84), but the *atmospheric mass* for the world can be determined now. Atmospheric mass is a rough measure of the world’s supply of gaseous volatiles, relative to other worlds of the same type.

Toxicity Rules

Many different atmosphere types are Toxic in the sense used on p. B429. However, some poisonous atmospheres are much more dangerous than others!

Any character exposed to a Toxic atmosphere will need to make HT rolls on a periodic basis to avoid taking toxic damage. The differences between various Toxic atmospheres affect how often these HT rolls must be made, what penalties are applied to the HT roll, and how much damage is taken when a HT roll is failed. The exact details will vary from atmosphere to atmosphere, but this book will use the terms *Mildly Toxic*, *Highly Toxic*, and *Lethally Toxic* as general categories.

Mildly Toxic: Exposure requires a HT roll no more often than once per hour. There is no penalty to the HT roll, and a failed roll inflicts only 1 point of toxic damage. Characters may risk brief exposure to a Mildly Toxic atmosphere without much danger of serious injury or death.

Highly Toxic: Exposure requires a HT roll up to once per minute. The HT roll will usually be at a -2 to -6 penalty, and a failed roll inflicts 1 point of toxic damage. Characters may risk very brief exposures to a Highly Toxic atmosphere, but only in dire emergencies.

Lethally Toxic: Exposure inflicts 1d or more of toxic damage every 15 seconds, with no possibility of resistance. Characters exposed to such an atmosphere will die in a very short time.

Worlds of the Asteroid Belt, Tiny (Ice), Tiny (Rock), Tiny (Sulfur), Small (Hadean), Small (Rock), Standard (Hadean), Standard (Chthonian), and Large (Chthonian) types will not have any significant atmosphere. Don't bother to generate atmospheric mass for any of them.

Atmospheric mass may differ *very* widely from world to world, but the most likely range is from 0.5 to 1.5. Select an atmospheric mass for the world, or roll 3d and divide the result by 10 (keeping fractions). When using the dice, feel free to vary the result by up to 0.05 in either direction. Make a note of the atmospheric mass.

Determining Atmospheric Composition

Refer to the following notes to determine the composition of the world's atmosphere, and to determine whether it has any specific undesirable features. Make a note of whether the atmosphere is Marginal, and whether it is Suffocating, Toxic (with the level of toxicity), or Corrosive.

Asteroid Belt, Tiny (Ice), Tiny (Rock), Tiny (Sulfur), Small (Hadean), Small (Rock), Standard (Hadean), Standard (Chthonian), and Large (Chthonian) Worlds: None of these worlds have more than a Trace atmosphere. Since any visitor will effectively be in a vacuum, the composition of what little atmosphere is present rarely matters.

Small (Ice) Worlds: The atmosphere of a Small (Ice) world is composed of nitrogen and methane. The atmosphere is poisonous, but is unlikely to contain any corrosives. Roll 3d. On a 15 or less the atmosphere is Suffocating and Mildly Toxic. Otherwise it is Suffocating and Highly Toxic.

Standard (Ammonia) Worlds: The atmosphere of a Standard (Ammonia) world is composed of nitrogen, with large quantities of ammonia and methane. Such an atmosphere is always Suffocating, Lethally Toxic, and Corrosive.

Standard (Ice) Worlds: The atmosphere of a Standard (Ice) world is composed of a mixture of carbon dioxide and nitrogen. There may be other toxic substances in the atmosphere due to

volcanic activity or other natural processes. Roll 3d. On a 12 or less the atmosphere is only Suffocating, otherwise it is Suffocating and Mildly Toxic.

Standard (Ocean) Worlds: The atmosphere of a Standard (Ocean) world will be composed of a mixture of carbon dioxide and nitrogen. As with the Standard (Ice) world, there may be other toxic substances in the atmosphere due to volcanic activity or other natural processes. Roll 3d. On a 12 or less the atmosphere is only Suffocating, otherwise it is Suffocating and Mildly Toxic.

Standard (Garden) Worlds: A Standard (Garden) world has an atmosphere dominated by nitrogen, with a significant amount of free oxygen that can support human life. Roll 3d. On an 11 or less the atmosphere will have no special properties. On a 12 or higher it will be Marginal; to generate more specific detail, see *Marginal Atmospheres* (p. 80).

Standard (Greenhouse) Worlds: The atmosphere of a Standard (Greenhouse) world is always extremely dense and furnace-hot. A "dry greenhouse" world will have an atmosphere dominated by carbon dioxide, while a "wet greenhouse" world will have nitrogen, water vapor, and possibly even a small amount of free oxygen in the mix. The atmosphere is always Suffocating, Lethally Toxic, and Corrosive.

Large (Ammonia) Worlds: The atmosphere of a Large (Ammonia) world is dominated by helium gas, with very large quantities of ammonia and methane. It is always Suffocating, Lethally Toxic, and Corrosive.

Large (Ice) Worlds: The atmosphere of a Large (Ice) world is dominated by helium and nitrogen gases, and is likely to contain toxins due to volcanic activity or other natural processes. The atmosphere is always Suffocating and Highly Toxic.



Large (Ocean) Worlds: A Large (Ocean) world's atmosphere is composed of a mixture of helium and nitrogen gases. As with the Large (Ice) worlds, there will usually be other toxic substances in the atmosphere. The atmosphere is always Suffocating and Highly Toxic.

Large (Garden) Worlds: These unusual worlds have thick atmospheres dominated by nitrogen and noble gases, with a significant amount of free oxygen. The atmosphere will usually be breathable (although it may be uncomfortably dense). The atmosphere will be Marginal on a roll of 12 or higher on 3d.

Large (Greenhouse) Worlds: These worlds have atmospheres similar to those of Standard (Greenhouse) worlds. The atmosphere is always Suffocating, Lethally Toxic, and Corrosive.

MARGINAL ATMOSPHERES

An otherwise breathable atmosphere can be Marginal in a variety of ways. Some of the most likely are described here.

Chlorine or Fluorine

In a breathable atmosphere, chlorine would normally combine with other elements to form nontoxic compounds. However, it's possible for living things with an odd biochemistry to release a significant amount of chlorine into the atmosphere. This might give rise to a biosphere full of plants and animals that use an Earthlike carbon-oxygen cycle but which are adapted to

the presence of trace amounts of chlorine in the air. Visitors who do not have similar biochemistry would find the unfiltered air to be corrosive and very poisonous.

A world with significant amounts of chlorine in the air would be a very strange place. The air would carry a faint color, and the presence of chlorine would slightly distort images. Since chlorine gas is heavier than air, it would tend to pool in caves and depressions in the land, reaching concentrations that might kill even native animal life. On such a world, rainfall and standing water would actually be a weak hydrochloric acid solution. Living things would use odd polymers in their structure – natural plastics that would not dissolve in the chlorine-tainted air.

The atmosphere on such a world is Highly Toxic, with the penalty to the HT roll depending on the local concentration of chlorine. At its highest concentrations, the chlorine would actually be Lethally Toxic and Corrosive.

Fluorine gas is chemically similar to chlorine and might play a similar role in a planetary atmosphere. However, fluorine is much less common and is unlikely to appear anywhere in large quantities. An atmosphere contaminated with free fluorine gas would be *extremely* unusual.

High Carbon Dioxide

The human metabolism is set to deal with a certain amount of carbon dioxide in the air. When there is too much, the human breathing reflex malfunctions, leading to hyperventilation and a sense of panic. The result is

similar to that of a Very Dense atmosphere (p. 78). It is possible to acclimate to moderate levels of carbon dioxide. Very high levels of carbon dioxide are Mildly Toxic, and it's not possible to acclimate to them.

High Oxygen

In moderate cases, an excess of oxygen can be a mild irritant to skin and mucous membranes, and can make it much easier for people to hyperventilate when working hard. Assess ill effects as if the atmosphere is one pressure class higher (Dense for a Standard atmosphere with high oxygen, Very Dense for a Dense atmosphere, and so on).

Very high concentrations of oxygen are Mildly Toxic. At such concentrations, the oxygen increases fire hazards as well – all materials are considered to be one flammability class higher (p. B433).

Inert Gases

Nitrogen and other chemically inert compounds can cause "inert gas narcosis" when their partial pressure is high enough. Symptoms include light-headedness, reduced dexterity, euphoria, and impaired judgment. This is normally a problem only in Very Dense atmospheres, although a few compounds (such as nitrous oxide, or "laughing gas") can cause these symptoms at relatively low pressures.

An atmosphere with high levels of inert gases is not likely to be Toxic. However, an unprotected human subject to inert gas narcosis will behave as if intoxicated; he may be *tipsy*, *drunk*, or suffer from *euphoria* (p. B428) depending on the level of exposure.

Low Oxygen

An otherwise breathable atmosphere can simply have a lower concentration of free oxygen than one might expect for its pressure. Such an atmosphere is unlikely to be Toxic, but it may be difficult to breathe normally. Treat such an atmosphere as being one pressure class *lower* (Thin for Standard, Standard for Dense, and so on). This can actually make a Very Dense or Dense atmosphere more comfortable for human visitors!

*If the Almighty were to rebuild the world
and asked me for advice, I would have
English Channels round every country. And
the atmosphere would be such that anything
which attempted to fly would be set on fire.*

– Winston Churchill

What Makes the Air?

When a planet first forms, it is likely to have an extensive atmosphere dominated by the most common substances in the universe – hydrogen and helium. Large worlds can hold onto this primordial atmosphere. Smaller ones lose it when their primary star ignites, entering the so-called “T Tauri” stage during which a massive stellar wind blasts the inner star system clean of gas and debris.

Later, the last stages of planetary formation include a period of “late heavy bombardment.” This is an era in which young planets frequently collide with comets, asteroids, and even bodies as massive as moons or small planets. The smaller collisions, especially with comets or other objects containing plenty of ice, can leave volatiles behind to form an atmosphere and seas. The larger collisions may blast this early atmosphere away into space, possibly more than once.

Eventually, the largest collisions come to a stop and the young world can expect to keep any atmosphere it receives from comets and icy asteroids. At this stage, the primary source of atmosphere becomes the planet’s own volcanism. Volatile substances locked into a world’s icy or rocky body are released along with its internal heat. The result is a thin envelope of air, the world’s final atmosphere.

Of course, once the atmosphere is stable, chemical processes can alter its composition considerably. The most startling example of this is found on Garden worlds, where photosynthetic life creates a substantial amount of oxygen in the air. Since oxygen normally combines with other chemicals very quickly, any world with lots of “free” oxygen in the atmosphere is far out of chemical equilibrium; the situation can only be maintained by the activity of plant life or some other continuous process.

All of these processes are unpredictable. The atmosphere found on a given world depends strongly on its initial chemical composition – but the accidents of planetary evolution also play a strong role.

Nitrogen Compounds

Nitrogen oxides are very unlikely to appear in a breathable atmosphere, unless they are produced by a strange local biochemistry or by massive industrial pollution. The unfiltered air would be somewhat toxic and any open water would be tainted by acid. Such an atmosphere is Mildly Toxic, and may be Highly Toxic close to a source of the nitrogen compounds.

Sulfur Compounds

Hydrogen sulfide, sulfur dioxide, and sulfur trioxide might be found in the air due to massive industrial pollution or volcanic activity. Visitors would find the air to be toxic and full of unpleasant odors. Rainfall and standing water would be weak solutions of sulfuric acid. Such an atmosphere is Mildly Toxic, and may be Highly Toxic close to a source of the sulfur compounds.

Organic Toxins

Living things may release dangerous substances into the air – pollen, spores, disease-causing microorganisms, toxins, and so on. Most such atmospheres will be Mildly Toxic, although higher levels of toxicity are possible. Unprotected exposure to the air may also count as exposure to a weak respiratory-agent poison (p. B437) or a disease (p. B442); the GM is encouraged to develop his own exotic maladies to give his alien worlds flavor.

Pollutants

Non-organic poisons may be in the air as well – heavy-metal or radioactive dust, toxic smoke from volcanism or industrial pollution, and so on. It would be rare for such an atmosphere to be more than Mildly Toxic. Heavy-metal poisoning can have lasting effects, as can radioactivity.

Determining a Marginal Atmosphere

Select at least one property from the list above, or roll 3d on the *Marginal Atmospheres Table*. A few atmospheres may exhibit *more than one* of the Marginal traits . . .

Marginal Atmospheres Table

Roll (3d)	Major Toxic Component
3-4	Chlorine or Fluorine
5-6	Sulfur Compounds
7	Nitrogen Compounds
8-9	Organic Toxins
10-11	Low Oxygen
12-13	Pollutants
14	High Carbon Dioxide
15-16	High Oxygen
17-18	Inert Gases

Example: The GM decides to choose Haven’s atmospheric mass at random. He rolls 3d for 12, and divides by 10 to get an atmospheric mass of 1.2.

Since Haven is a Standard (Garden) world, its atmosphere is automatically breathable, but it may be Marginal. The GM rolls 3d for 10, and notes that the atmosphere has no special properties.

STEP 4: HYDROGRAPHIC COVERAGE

Worlds are often described in terms of their *hydrographic coverage*, the portion of the world’s surface that is covered by oceans of some liquid material. This step determines the percentage of the surface that is taken up by oceans, seas, and lakes.

On an Earthlike world the oceans will be composed of liquid water, containing metal salts and other impurities. On more hostile planets the oceans may be composed of exotic substances. Many worlds that have no liquid oceans on the surface may be rich in water or other ices; they may also have extensive underground supplies. These features do not count toward the hydrographic coverage, but may be of interest to visitors.

Determining Hydrographic Coverage

Each world type has its own associated hydrographic properties. When dice are used, the hydrographic coverage will be expressed as a multiple of 10% of the world's surface area. It would be reasonable to vary the result by up to 5% in either direction, with a minimum of 0% and a maximum of 100% of the surface.

Asteroid Belt, Tiny (Rock), and Small (Rock) Worlds: None of these world types will have "oceans" of liquid water or other common substances. Their hydrographic coverage is always 0%. Those that are far enough from the primary star *may* have some water ice buried under the surface or hidden in always-shadowed craters.

Tiny (Ice), Small (Hadean), and Standard (Hadean) Worlds: These worlds often have extensive water ice deposits on the surface, but they will not have permanent bodies of liquid surface water. Their hydrographic coverage is always 0%. Beneath the surface of the ice, these worlds may have *considerable* liquid water if they experience internal heating. For example, many Tiny (Ice) worlds that orbit gas giant planets are heated by tidal effects, keeping the subsurface oceans warm enough to stay in a liquid state.

Tiny (Sulfur) Worlds: These worlds usually begin with extensive deposits of water and other ices, but tidal heating and volcanism mean that these volatiles are quickly lost to space. Their hydrographic coverage is always 0%. A Tiny (Sulfur) world may have intermittent, short-lived lakes of liquid sulfur and sulfur compounds.

Small (Ice) Worlds: These worlds may have oceans of liquid volatiles, but they are likely to be composed of liquid hydrocarbons rather than water. A typical Small (Ice) world will have hydrographic coverage between 30% and 80%. Select a percentage, or roll 1d+2 and multiply by 10%; the result is the portion of the world's surface covered by substances in a liquid state. The rest of the surface is likely to be rich with ices, possibly including water ice.

Standard (Ammonia) and Large (Ammonia) Worlds: These worlds are



too cold to have oceans of liquid water. However, they may have vast oceans of liquid ammonia mixed with water and other substances, mingled in a *eutectic* solution whose freezing point is much lower than that of pure ammonia or water. A typical world of these types will have hydrographic coverage between 50% and 100%, depending on the surface temperature and the amount of ammonia and water in the world's volatiles budget. Select a percentage, or roll 2d and multiply by 10% (maximum 100%); the result is the portion of the world's surface covered by liquid substances.

Standard (Ice) and Large (Ice) Worlds: These worlds generally have no permanent bodies of liquid water on their surface, but they may have lakes or small seas that are temporarily liquid at certain seasons. Such open water may provide hydrographic coverage of up to about 20%. Select a percentage, or roll 2d-10 and multiply by 10% (minimum 0%); the result is the portion of the world's surface that is usually covered by liquid water.

Standard (Ocean), Standard (Garden), Large (Ocean), and Large (Garden) Worlds: These worlds will almost always have liquid-water oceans. A typical world of these types will have hydrographic coverage between 50% and 100%, depending on the amount of water in the world's volatiles budget. Large worlds are likely to have a *lot* of water, and may be covered by oceans that are tens or hundreds of miles deep! Select a percentage, or roll 1d+4 (1d+6 for a Large world) and multiply by 10% (maximum 100%); the result is the

portion of the world's surface covered by liquid water.

Standard (Greenhouse) and Large (Greenhouse) Worlds: Even if one of these worlds has surface water, it is usually in the process of losing it. Most will have hydrographic coverage of 0%, and it will be quite rare for such a world to have coverage greater than 50%. Select a percentage, or roll 2d-7 and multiply by 10% (minimum 0%); the result is the portion of the world's surface that is still covered by oceans. A world that still has oceans is a wet greenhouse (p. 79), while a world with 0% hydrographics is a dry greenhouse. If oceans exist on one of these worlds, they are likely to be extremely impure, and may be rich in dissolved carbon or sulfur compounds, forming a more or less acidic solution. Some extreme greenhouse oceans may be composed of sulfuric acid!

Standard (Chthonian) and Large (Chthonian) Worlds: These worlds never have water or other volatiles in the liquid state on the surface. Their hydrographic coverage is always 0%. They may be so hot as to melt surface rock, producing seas of lava!

Example: Since Haven is a Standard (Garden) world, it will have liquid-water oceans. The GM rolls 1d+4 and gets a result of 10, suggesting hydrographic coverage of 100%. He doesn't want a world that's *completely* covered by water, but a world dominated by vast oceans seems appealing. He lowers the hydrographic coverage to 98%, and makes a note that Haven's land mass consists of a single Australia-sized continent and a scattering of island chains.

STEP 5: CLIMATE

Now the cryosphere was dissolving. Glaciers became torrents, which presently boiled away and became storm-winds. Lakes and seas, melting, redistributed incredible masses. Pressures within the globe were shifted; isostatic balance was upset; the readjustments of strata, the changes of allotropic structure, released catastrophic, rock-melting energy. Quakes rent the land and shocked the waters. Volcanoes awoke by the thousands. Geysers spouted above the ice sheath that remained. Blizzard, hail, and rain scourged the world, driven by tempests

whose fury mounted daily until words like "hurricane" could no more name them. Hanging in space, Falkayn and Chee Lan took measurements of Ragnarök.

– Poul Anderson, *Satan's World*

Planetary climate can be very complex, but the most important question for any visitor is whether or not he will be comfortable in the surface environment. This step determines the *average surface temperature* of the world. This average doesn't take into account daily or annual variations, or the details of local climate.

Determining Climate Type

Each world type is associated with a range of possible average surface temperatures. To determine a world's average surface temperature, refer to the following table. Select a temperature within the given range for the correct world type, or roll 3d-3, multiply the result by the Step value, and then add the minimum value from the Range. The result is the average surface temperature in *kelvins*, a unit of absolute temperature. When using the dice, it would be reasonable to vary the final temperature by up to half the Step value in either direction.

Average Surface Temperature Table

World Type	Range	Step
Asteroid Belt	140-500 K	24 K
Tiny (Ice or Sulfur)	80-140 K	4 K
Tiny (Rock)	140-500 K	24 K
Small (Hadean)	50-80 K	2 K
Small (Ice)	80-140 K	4 K
Small (Rock)	140-500 K	24 K
Standard (Hadean)	50-80 K	2 K
Standard (Ammonia)	140-215 K	5 K
Standard (Ice)	80-230 K	10 K
Standard (Ocean or Garden)	250-340 K	6 K
Standard (Greenhouse or Chthonian)	500-950 K	30 K
Large (Ammonia)	140-215 K	5 K
Large (Ice)	80-230 K	10 K
Large (Ocean or Garden)	250-340 K	6 K
Large (Greenhouse or Chthonian)	500-950 K	30 K

The average surface temperature determines the *climate type* of the world. Refer to the *World Climate Table*.

World Climate Table

Temperature Range (K)	Climate Type	Temperature Range (°F)
Below 244 K	Frozen	Below -20° F
244 K to 255 K	Very Cold	-20° to 0° F
255 K to 266 K	Cold	0° to 20° F
266 K to 278 K	Chilly	20° to 40° F
278 K to 289 K	Cool	40° to 60° F
289 K to 300 K	Normal	60° to 80° F
300 K to 311 K	Warm	80° to 100° F
311 K to 322 K	Tropical	100° to 120° F
322 K to 333 K	Hot	120° to 140° F
333 K to 344 K	Very Hot	140° to 160° F
Above 344 K	Infernal	Above 160° F

Temperature Range (K) gives a range of possible average surface temperatures in kelvins. *Climate Type* is a descriptive name for the world's overall surface climate. *Temperature Range (F)* gives the associated range in degrees Fahrenheit. To convert a

temperature from kelvins to degrees Fahrenheit, use the following formula:

$$F = (1.8 \times K) - 460$$

Here, **F** is the temperature in degrees Fahrenheit and **K** is the temperature in kelvins.

Make note of both the average surface temperature in kelvins (and optionally in degrees Fahrenheit) and the corresponding climate type from the table.

Determining Blackbody Temperature

Another parameter related to a world's climate is its *blackbody temperature*. This is the average surface temperature the world would have if it were an ideal *blackbody*, a perfect absorber and radiator of heat. Of course, real worlds are not ideal blackbodies, so the blackbody temperature is usually different from the world's average surface temperature.

To determine a world's blackbody temperature, compute its *blackbody*

correction. The blackbody correction is based on two different factors, each dependent on the world type and a few other parameters: the *absorption factor* and the *greenhouse factor*.

The absorption factor is a measure of how much incoming energy is absorbed by the world's surface rather than being reflected away. The higher the absorption factor, the more energy is absorbed, and the warmer the world will be with respect to its blackbody temperature. (For those familiar with astrophysics, the absorption factor

can be determined by subtracting the world's *albedo* from one, and taking the fourth root of the result.)

The greenhouse factor is a measure of how much heat energy is trapped by the world's atmosphere rather than being radiated back into space. The higher the greenhouse factor, the more energy is recycled within the atmosphere, and the warmer the world will be with respect to its blackbody temperature.

Refer to the following table.

Temperature Factors Table

World Type	Absorption Factor	Greenhouse Factor
Asteroid Belt	0.97	0
Tiny (Ice)	0.86	0
Tiny (Rock)	0.97	0
Tiny (Sulfur)	0.77	0
Small (Hadean)	0.67	0
Small (Ice)	0.93	0.10
Small (Rock)	0.96	0
Standard (Hadean)	0.67	0
Standard or Large (Ammonia)	0.84	0.20
Standard or Large (Ice)	0.86	0.20
Standard or Large (Ocean or Garden) (Hydrographics 20% or less)	0.95	0.16
Standard or Large (Ocean or Garden) (Hydrographics 21% to 50%)	0.92	0.16
Standard or Large (Ocean or Garden) (Hydrographics 51% to 90%)	0.88	0.16
Standard or Large (Ocean or Garden) (Hydrographics 91% or more)	0.84	0.16
Standard or Large (Greenhouse)	0.77	2.0
Standard or Large (Chthonian)	0.97	0

To determine the blackbody correction for a world, use the following formula:

$$C = A \times [1 + (M \times G)]$$

Here, **C** is the blackbody correction, **A** is the world's absorption factor from the table, **M** is the world's atmospheric mass as generated in Step 3 (p. 78), and **G** is the world's greenhouse factor from the table. Note that for a world with a greenhouse factor of 0 (i.e. a world without significant atmosphere) the blackbody correction is equal to the absorption factor (**C** = **A**).

To determine the blackbody temperature, *divide* the average surface temperature by the blackbody correction. Make a note of the blackbody temperature.

Example: So far Haven is a reasonably pleasant world, if lacking in dry land. The GM decides that its surface climate should also be pleasant, and sets its average surface temperature to 295 kelvins (about 70° Fahrenheit). Haven has a Normal climate type.

Referring to the *Temperature Factors Table*, the GM finds that Haven's blackbody correction is $0.84 \times$

$[1 + (1.2 \times 0.16)] = 1.00$. Haven's blackbody temperature is almost exactly equal to its average surface temperature: 295 kelvins.

STEP 6: WORLD SIZE

This step determines the world's diameter, density, mass, and surface gravity. For a world of Asteroid Belt type, this step can be skipped. An asteroid belt is composed of hundreds or thousands of small objects, most of them far too small to be considered "worlds" in their own right.

Density

A world's *density* is the average mass per unit volume in the world's body. Density depends almost entirely on the world's composition. An Earthlike world will usually have an iron core of very high density, overlaid by a thick layer of less-dense rock and

An asteroid belt is composed of hundreds or thousands of small objects, most of them far too small to be considered "worlds" in their own right.

Turning Up the Heat

The Absorption Factor and Greenhouse Factor for each world type are *typical* values rather than universal constants. It would be reasonable to vary either slightly, to reflect changes from the normal properties of the world's type.

The Absorption Factor might vary by as much as 0.05, with a maximum of 1 and a minimum of 0, to indicate a surface that is more or less reflective. A dark surface, such as dark stone, ice darkened by chemical processes, or dust in the upper atmosphere, would have a higher Absorption Factor. A bright surface, such as snow or polished ice, would have a lower Absorption Factor. For example, Earth's current Absorption Factor is about 0.88, and this is taken as the typical value for a Standard (Garden) world with moderate hydrographic coverage. During the last Ice Age the vast areas of land covered by ice and snow may have reduced the Absorption Factor to 0.86 or so, enough to lower the average surface temperature by several kelvins.

Meanwhile, if the Greenhouse Factor for a world's type is not 0, it might also vary by up to 0.05 in either direction to reflect local differences in atmospheric composition. A change in the concentration of greenhouse gases, too small even to render a breathable atmosphere Marginal, could have dramatic effects on local climate. For example, Earth's current Greenhouse Factor is about 0.16, but during the Cretaceous Era (145-65 million years ago) it may have been as high as 0.20 due to high levels of carbon dioxide in the atmosphere.

In any case, variations in Absorption Factor and Greenhouse Factor are not significant to the world-design system, but the GM should feel free to use them to reflect features of the local environment.

stone (the very thin layer of water and air is almost negligible on this scale). A planet with a smaller iron core would be less dense; a planet with more iron and less rock would be denser. Some large moons have bodies that contain a great deal of *ice*, which is even less dense than rock.

In these rules, world density is expressed as a proportion of Earth's density – a world with a density of 1.0 is exactly as dense as Earth and probably has a very similar composition. Density normally ranges from 0.3 (a world with a great deal of ice in its

body) to 1.4 (a world that is almost a ball of solid iron). To determine a world's density, refer to the following notes.

Tiny (Ice), Tiny (Sulfur), Small (Hadean), Small (Ice), Standard (Hadean), Standard (Ammonia), and Large (Ammonia) Worlds: All of these worlds will have icy cores and a density between 0.3 and 0.7. Select a density in the appropriate range, or roll 3d on the *World Density Table* using the Icy Core column.

Tiny (Rock) and Small (Rock) Worlds: These worlds are rocky with

small metal cores, and will normally have density between 0.6 and 1.0. Select a density, or roll on the *World Density Table* using the Small Iron Core column.

All other Standard and Large Worlds: These worlds are primarily rocky and have large iron cores, with density normally between 0.8 and 1.2 (but might have density as high as 1.4 in extreme cases). Select a density, or roll on the *World Density Table* using the Large Iron Core column.

When using the dice, it would be reasonable to vary the density by up to 0.05 in either direction. Most textbooks and game sourcebooks prefer to give planetary density in units of grams per cubic centimeter (g/cc); to get world density in these units, multiply the density value generated here by 5.52.

Diameter and Surface Gravity

Once the world's density has been fixed, it is possible to determine its diameter and surface gravity. These two parameters are closely related – if you select the world's diameter, that determines its surface gravity, and vice versa. The following rules will permit the GM to select these two parameters in either order.

Selecting World Diameter First: Refer to the *Size Constraints Table* for the world's size class. Multiply *square root of (B/K)* (where **B** is the world's blackbody temperature in kelvins, and **K** is the world's density in units of Earth's density) by the appropriate *Minimum* value from the table. The result is the minimum possible diameter for the world, expressed in multiples of Earth's diameter. Similarly, multiply *square root of (B/K)* by the appropriate *Maximum* value from the table to get the maximum possible diameter for the world.

Select any value within this range for the diameter. To select a diameter at random, roll 2d-2, multiply by one-tenth of the difference between the maximum and minimum diameter values, and add the result to the minimum value. Feel free to vary the final result by up to 5% of the difference, so long as the final value is within the range. To express any diameter in miles, multiply the value in Earth diameters by 7,930.

World Density Table

Roll (3d)	Icy Core	Small Iron Core	Large Iron Core
3-6	0.3	0.6	0.8
7-10	0.4	0.7	0.9
11-14	0.5	0.8	1.0
15-17	0.6	0.9	1.1
18	0.7	1.0	1.2

Size Constraints Table

World Type	Minimum	Maximum
Large	0.065	0.091
Standard	0.030	0.065
Small	0.024	0.030
Tiny	0.004	0.024

Once the diameter is known, use the following formula to get the world's surface gravity:

$$S = K \times D$$

Here, **S** is the world's surface gravity in Gs, **K** is the world's density in units of Earth's density, and **D** is the world's diameter in Earth diameters.

Selecting World Surface Gravity
First: Refer to the *Size Constraints Table* for the world's size class. Multiply *square root of (B × K)* (where **B** is the world's blackbody temperature in kelvins, and **K** is the world's density in units of Earth's density) by the appropriate *Minimum* and *Maximum* values from the table. The result is the minimum and maximum possible surface gravity for the world, in Gs.

Select any value within this range for the surface gravity. To select a Surface Gravity at random, roll 2d-2, multiply by one-tenth of the difference between the maximum and minimum values, and add the result to the minimum value. Feel free to vary the final result by up to 5% of the difference.

Once the surface gravity is known, use the following formula to get the world's diameter:

$$D = S/K$$

Here, **D** is the world's diameter in Earth diameters, **S** is the world's surface gravity in Gs, and **K** is the world's density in units of Earth's density.

Mass

To determine a world's mass, apply the following formula:

$$M = K \times D^3$$

Here, **M** is the world's mass in multiples of Earth's mass, **K** is its density in units of Earth's density, and **D** is its diameter in multiples of Earth's diameter. Regardless of the order in which these parameters are determined, make a note of the world's density, diameter, surface gravity, and mass.

Determining Atmospheric Pressure

Now that the world's surface gravity is known, its surface atmospheric pressure can finally be determined. The various world types are likely to

Worlds Big and Little

When designing a world, it's important to know what volatiles will be available at the world's surface, defining the environment visitors will experience. Every world begins with a wide variety of volatiles, but some of these will be lost very early in the world's history. The most common reason for such loss is the fact that molecules of a given volatile that are close to the top of the world's atmosphere might reach escape velocity and head for deep space!

Molecules in a gas move at random speeds, and the distribution of those speeds is determined by the molecular weight of the gas and by the ambient temperature. Higher temperatures mean that the molecules tend to move faster – but the more massive molecules of a gas with high *molecular weight* will move more slowly at the same temperature.

In effect, every world has a *minimum molecular weight retained* (MMWR) that indicates what volatile substances can be held onto across billion-year time scales. Volatiles with molecular weight higher than the MMWR will stay in the world's atmosphere and on its surface. Volatiles with lower molecular weight will be lost to space in a relatively short time after the world is formed.

Factors that increase a world's escape velocity all tend to lower the minimum molecular weight that can be retained. A more massive world will have a higher escape velocity. So will a *denser* world, even of the same mass.

On the other hand, the temperature at the top of the atmosphere is also critical; higher temperatures mean that more molecules will reach escape velocity. Thus two worlds can have the same MMWR despite being of different sizes, so long as the smaller one is *colder*.

Steps 2-6 of the world design sequence are set up so that the **GURPS** GM doesn't need to concern himself with the details of computing a world's MMWR. Advanced world-builders may choose to work in a more free-form manner, selecting a world's physical parameters as needed and then checking to make sure the result makes sense. In that case, the following formula may be of use:

$$W = B/(60 \times D^2 \times K)$$

Here, **W** is the MMWR measured in units of molecular weight, **B** is the world's blackbody temperature in kelvins, **D** is its diameter in Earth diameters, and **K** is its density in units of Earth's density.

A world's physical parameters will fit its selected World Type if its MMWR is legal for its size class. A Large world must have MMWR greater than 2, but less than or equal to 4. A Standard world must have MMWR greater than 4, but less than or equal to 18. A Small world must have MMWR greater than 18, but less than or equal to 28. A Tiny world must have MMWR greater than 28.

For comparison, some of the more important molecular weights are: hydrogen 2, helium 4, methane 16, ammonia 17, water vapor 18, neon 20, carbon monoxide 28, nitrogen 28, nitric oxide 30, oxygen 32, hydrogen sulfide 34, argon 40, and carbon dioxide 44.

have widely diverging atmospheric pressure values. Refer to the following notes to determine the world's atmospheric pressure.

Asteroid Belt, Tiny (Ice), Tiny (Rock), Tiny (Sulfur), Small (Hadean), and Standard (Hadean) Worlds: None

of these worlds have a significant atmosphere. A visitor on the surface will be in a vacuum.

Small (Rock), Standard (Chthonian), and Large (Chthonian) Worlds: All of these worlds automatically have a Trace atmosphere.

All other worlds will have a substantial atmosphere. To determine the surface atmospheric pressure, begin by referring to the following table.

Pressure Factors Table

World Type	Pressure Factor
Small (Ice)	10
Standard (Ammonia, Ice, Ocean, or Garden)	1
Standard (Greenhouse)	100
Large (Ammonia, Ice, Ocean, or Garden)	5
Large (Greenhouse)	500

The atmospheric pressure is given by the following formula:

$$P = M \times F \times S$$

Here, **P** is the atmospheric pressure (in atm), **M** is the atmospheric mass as generated in Step 3 (p. 78), **F** is the pressure factor for the appropriate world type from the table, and **S** is the world's surface gravity in Gs. Make a note of the result, and of the pressure category associated with that pressure from the *Atmospheric Pressure Categories Table* (p. 78).

Example: The GM has no preference for Haven's density, and so rolls 3d on the *World Density Table*, referring to the Large Iron Core column. He rolls a 16 and records a density of 1.1, or about 6.1 g/cc.

The GM then decides to set the planet's surface gravity first. This parameter must be between 0.03 and 0.065 times square root of (295×1.1) , or between 0.54 and 1.17. He decides to set the surface gravity to 1.15 Gs, making Haven a relatively high-gravity world. The planet's diameter is

then given by $1.15/1.1 = 1.05$ Earth-diameters (8,330 miles). Finally, its mass is given by $1.1 \times 1.05^3 = 1.27$ Earth-masses.

Now that Haven's surface gravity is available, the GM can go back and determine the planet's surface atmospheric pressure. This is given by $1.15 \times 1.2 = 1.38$ atm, which yields a Dense atmosphere. The GM makes a note of this under the world's atmospheric properties.

The GM also realizes that with vast oceans, a warm climate, and a dense atmosphere, Haven is probably a breeding ground for hurricanes and other violent storms. Visitors to the planet will need to watch out for the weather! He makes a note of this item for possible use in future adventures.

STEP 7: RESOURCES AND HABITABILITY

"Funny about Valeria, isn't it . . ."

There was a moment of silence, then Kinnison went on:

"But wherever diamonds are, there go Dutchmen. And Dutch women go wherever their men do. And, in spite of the medical advice, Dutch babies arrive. Although a lot of the adults died – three Gs is no joke – practically all of the babies keep on living. Developing muscles and bones to fit – walking at a year and a half old – living normally – they say that the third generation will be perfectly at home there."

– E. E. "Doc" Smith, **First Lensman**

This step fixes the factors that make a world attractive for human or alien settlement. Colonists are likely to

come to a world that is comfortable for them, where they can live without investing in expensive artificial life support. However, even if a world is very inhospitable, settlers may arrive in a quest for valuable resources.

Determining Resources

Every world will have some value to human or other settlers: mineral resources, native plant or animal species that generate useful products, or even something as simple as arable land on which crops can be sown.

We will use the Resource Value Modifier (RVM), a number between -5 and +5, to describe the overall resource value of a world. An RVM of 0 indicates a world of average resource wealth, likely to attract settlement only if it is reasonably habitable. An RVM above 0 indicates an unusual abundance of resources, which may attract settlers even if the local environment is hostile. An RVM below 0 indicates a world unlikely to offer any resources worth exploiting.

Most worlds will have an RVM between -2 and +2. Worlds of the Asteroid Belt type will vary more widely, between -5 and +5. One asteroid belt may be dense, with vast deposits of useful metals, organic compounds, and volatile ices; another may be a thin scattering of pebbles. Select an RVM, or roll 3d on the *Resource Value Table*. For a world of the Asteroid Belt type, refer to the first column of die-roll results; for all other world types, refer to the second column. The result will be a description of the world's resource availability, along with a Resource Value Modifier (RVM) that will be used in later steps of the sequence. Make a note of the RVM for each world.

Resource Value Table

Roll (3d)

Asteroid Belts	Other Worlds	Overall Value	Resource Value Modifier
3	–	Worthless	-5
4	–	Very Scant	-4
5	2 or less	Scant	-3
6-7	3-4	Very Poor	-2
8-9	5-7	Poor	-1
10-11	8-13	Average	+0
12-13	14-16	Abundant	+1
14-15	17-18	Very Abundant	+2
16	19 or more	Rich	+3
17	–	Very Rich	+4
18	–	Motherlode	+5

Determining Habitability and Affinity

The *habitability* score for a given world is a summary of all the factors

that make the world pleasant for humans to live on. Habitability runs from -2 to 8, with higher scores indicating a more pleasant environment. To determine the habitability score for

the target world, refer to the following table and add up *every* modifier that applies. Make a note of the final habitability score for the world.

Habitability Modifiers Table

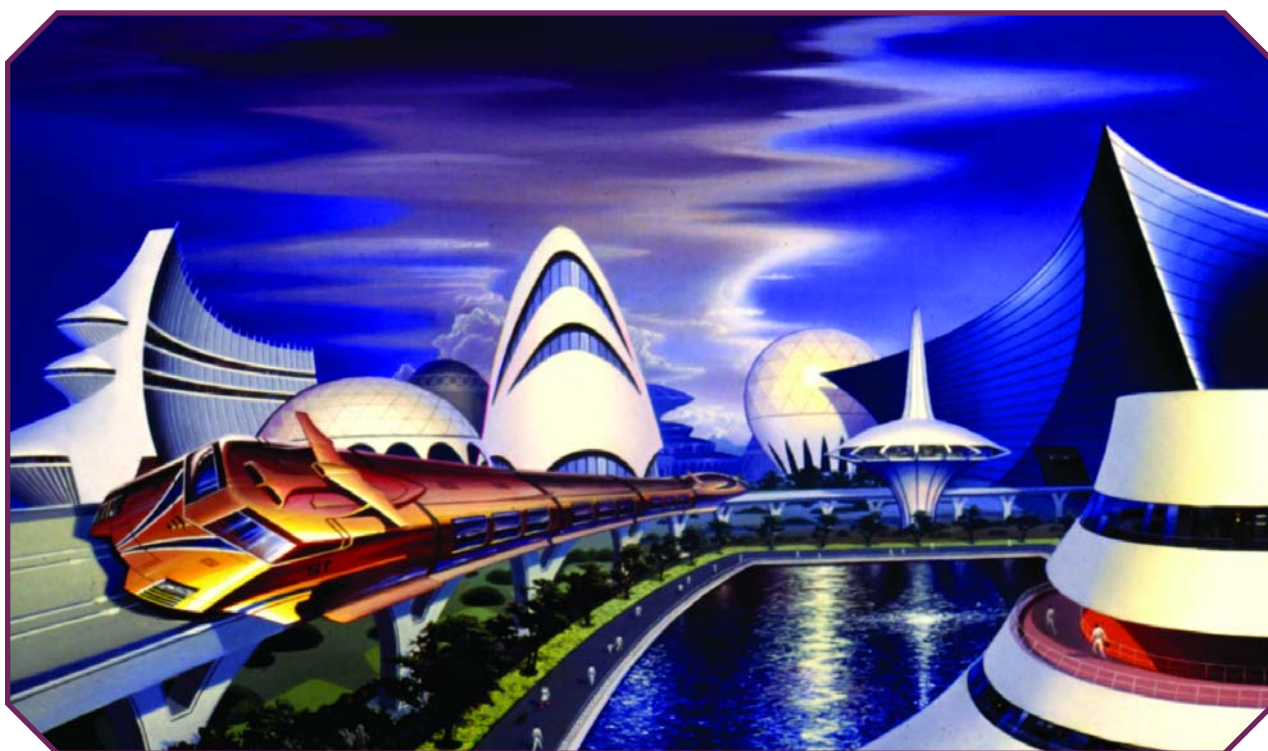
Condition	Modifier
No atmosphere or Trace atmosphere	0
Non-breathable atmosphere, Very Thin or above, Suffocating, Toxic, and Corrosive	-2
Non-breathable atmosphere, Very Thin or above, Suffocating and Toxic only	-1
Non-breathable atmosphere, Very Thin or above, Suffocating only	0
Breathable atmosphere (Very Thin)	+1
Breathable atmosphere (Thin)	+2
Breathable atmosphere (Standard or Dense)	+3
Breathable atmosphere (Very Dense or Superdense)	+1
Breathable atmosphere is not Marginal	+1
No liquid-water oceans, or Hydrographic Coverage 0%	0
Liquid-water oceans, Hydrographic Coverage 1% to 59%	+1
Liquid-water oceans, Hydrographic Coverage 60% to 90%	+2
Liquid-water oceans, Hydrographic Coverage 91% to 99%	+1
Liquid-water oceans, Hydrographic Coverage 100%	0
Breathable atmosphere, climate type is Frozen or Very Cold	0
Breathable atmosphere, climate type is Cold	+1
Breathable atmosphere, climate type is Chilly, Cool, Normal, Warm, or Tropical	+2
Breathable atmosphere, climate type is Hot	+1
Breathable atmosphere, climate type is Very Hot or Infernal	0

The *affinity* score for a given world is a summary of all the factors that might make the world attractive to human settlement. Affinity is a number between -5 and 10, and is closely related to the Resource Value

Modifier. To determine the affinity score for the target world, add the Resource Value Modifier to the habitability score. Make a note of the result.

Example: The GM decides that Haven doesn't have any special

resource abundance (or poverty); its colonists have chosen to settle there because of its location, not because of its natural resources. He sets the planet's RVM at 0. Haven's habitability score is 7, so its affinity score is also 7.



Habitability for Aliens

The habitability rules assume that *human* comfort is the primary yardstick for whether or not a planet is going to be attractive. An alien race that evolved under different conditions may judge worlds differently!

If the GM is designing worlds within the space claimed by an alien race, he should design his own *Habitability Modifiers Table* for that race. The following guidelines should be of assistance.

Overall: The range of possible habitability scores should be the same as for human-colonized worlds: -2 to 8.

Atmosphere: The planet's atmosphere should usually be the factor with the greatest weight. For human-colonized worlds, half of the maximum habitability of 8 depends on the quality of the atmosphere. Having *enough* air to support intelligent life is important, but an atmosphere whose *composition* is actively hostile to the world's inhabitants is likely to impose a penalty to habitability.

Hydrographic Coverage: Most forms of life will be dependent on a liquid volatile – water for human-like life, liquid ammonia for ammonia-based life, and so on. For human-colonized worlds, 25% of the maximum habitability depends on the hydrographic coverage.

Land-living species will want plenty of coastlines and well-watered inland regions, which will occur when the hydrographic coverage is high (but not *too*

high, since a world with nothing but a few small islands will not offer enough land area to support a large population). Amphibious or shore-swimming species will be happy with lots of coastlines, but won't care about inland space, so they can tolerate more land area. Deep-ocean species will want lots of hydrographic coverage, the more the better. Of course, if a world's oceans aren't even based on the same chemistry that the colonists evolved with, they will be useless . . .

Climate: For human-colonized worlds, 25% of the maximum habitability score depends on the average surface temperature. Humans find a band of average surface temperatures about 53 kelvins wide (or 95° Fahrenheit) to be optimal for colonization (+2 to habitability). A wider band, about 75 kelvins wide (135° Fahrenheit), is tolerable (+1 to habitability). Note that these bands are wider than the "comfort zone" defined under the Temperature Tolerance advantage (p. B93). After all, colonists can selectively settle close to the poles on a hot world, or close to the equator on a cold one, and compensate for a less-than-ideal average climate.

Aliens should have their own bands of optimal and tolerable climates. If an alien race has Temperature Tolerance as a racial advantage, their bands should be about 6 kelvins (10° Fahrenheit) wider for every level of the advantage.

SOCIAL PARAMETERS

So far, the design process has defined the *physical* parameters for the world under construction. The next few steps determine the *social* parameters for each world – how many humans (or other sapient beings) live there, what kind of government they live under, how much trade they engage in, and so on.

STEP 8: SETTLEMENT TYPE

This step sets the *settlement type* for the target world. These rules classify inhabited worlds into three settlement types: *homeworlds*, *colonies*, and *outposts*. Use the following rules to decide which category the target world falls into.

You may wish to generate the physical parameters for a number of

worlds before applying this step to any of them. This is because the placement of outposts will tend to depend on the placement of homeworlds and colonies, which in turn depends on the physical parameters determined in Steps 2-7.

Homeworlds

A *homeworld* is the place where a race evolved, and where its oldest population centers are still in existence. A homeworld will usually support as many people as can be sustained by local resources, although the social preferences of the population will also play a part. Some societies will prefer to maintain roomy living space and unspoiled vistas. Others like crowds, and are likely to populate a world to the limits of local resources (or beyond).

In general, homeworld populations depend strongly on the GM's preferences.

Science fiction settings vary widely in their assumptions regarding "ideal" population size. Many settings of the 1960s and 1970s included truly crowded worlds, inspired by the "population explosion" that many believed was inevitable. Today, with world population leveling off and some nations facing a population *decline*, it seems more likely that future civilizations will be able to control their numbers.

Homeworlds should *never* be placed at random; the GM should deliberately place them to suit the needs of his campaign. See *The Frequency of Worlds* (p. 70) for some of the pertinent considerations. Naturally, a homeworld should have high habitability for the race that lives on it – although not necessarily *maximum* habitability, since natural or man-made disasters can render even a race's homeworld less than ideal!

Colonies

A *colony* is a permanent settlement on some world, a place where a community is likely to remain for generation after generation. Most of a colony world's population is composed of long-term immigrants or permanent residents; the colony is their home.

Colony worlds must either have a certain minimum population, or have continuing support from offworld. A human colony can be established with only a few dozen people, but such a tiny settlement may need *lots* of off-world support and immigration to remain viable. To maintain a stable high-technology society over a long term, a colony will probably need to begin with at least 10,000 people and the necessary equipment. A truly massive colonization effort will begin by planting up to 500,000 people on the target world. From this initial population, colonies will grow due to further immigration and natural growth.

Space-traveling civilizations will tend to colonize every world that *can* support a substantial population. A world will be a colony if it is in a region of space claimed by some space-traveling civilization, it has an affinity score greater than 0, and it is not already defined as a homeworld.

Outposts

An *outpost* is a settlement on an unattractive world, planted only because of the world's strategic location or other unusual properties. An outpost may be in place for decades or even centuries, but it never loses its temporary character. Unlike a colony, an outpost has relatively few *permanent* settlers – most of the inhabitants expect to go elsewhere once their work at the outpost is finished.

In general, the GM may place outposts on worlds that are in a region claimed by a space-traveling civilization, that have affinity scores of 0 or less, and that are not already defined as homeworlds or colonies. Several different kinds of outpost exist.

Military Outposts: These are designed to serve as military bases, or to watch the frontier between hostile interstellar states. The GM should decide how far military starships can travel without needing to stop for fuel, supplies, navigational fixes, or some other need. Place an outpost on any

eligible world that is within this distance of a military frontier. If space-ships can travel *indefinitely* without stopping at a port, then military outposts may be useless – or a civilization may place “listening posts” with FTL sensors all through their territory.

Way Station Outposts: These are placed to serve transient starship traffic. If starships must follow “jump lines,” or they may not go too far without stopping in a star system, certain worlds will see a great deal of traffic even if there's no reason for a starship to begin or end its journey there. Place an outpost on any eligible world that falls into such a situation.



Miscellaneous Outposts: Other worlds may have scientific research stations, corporate mining towns, small settlements of independent-minded dissidents, and so on. How often such outposts appear depends on social conditions. A tightly controlled interstellar empire will have fewer “unplanned” outposts than a loose federation. The GM should place these extra outposts on eligible worlds as needed, or he can fix a die-roll threshold and determine their locations at random. For example, a sprawling democratic society may place an outpost in an eligible star system on a 12 or less on 3d, while a stay-at-home empire may only place one on a 6 or less.

Uninhabited Worlds

A world that isn't a homeworld, colony, or outpost will be uninhabited. Most uninhabited worlds will appear in unclaimed space. Of course, every space-faring empire will find its share of worlds that are entirely useless – or at least *appear* useless to the first explorers who visit . . .

Example: Haven isn't a homeworld, but it is a world with an affinity greater than 0 within human-explored space. The GM notes that it is a *colony*.

STEP 9: TECHNOLOGY LEVEL

Every world has an associated tech level (see p. B511). The TL of a world does *not* normally indicate that only goods at that TL are available there. In a universe in which most worlds have access to off-planet commerce, citizens will be able to buy goods at other tech levels. For example, in a TL10 setting, visitors to a backwater world with TL7 will still be able to buy TL10 goods (probably at a premium cost, since they must be imported).

Unless a character grew up on a world that is actually cut off from the rest of the galaxy, he will probably be familiar with equipment at the maximum TL available. On the other hand, people from a world with low TL are likely to be *poor*. The tech level of a world *does* indicate the technology most commonly available to local industry, which determines the productivity of the local economy, which in turn determines the typical wage and standard of living for the local population.

Local TL depends on the standard TL for the setting as a whole. An industrialized world that engages in plenty of interstellar trade will almost invariably have the standard TL. Worlds that are poorly industrialized or that are cut off from interstellar trade may have lower TL. Select a TL for the world according to the needs of the setting.

To select a TL randomly, roll 3d on the *Tech Level Table* and make a note of the implied TL.

Modifiers: -10 if the local settlement is a homeworld and the world is *not* within space claimed by any space-faring civilization; +1 if the local settlement is a homeworld or colony and the world's habitability score is 4-6, +2 if the local settlement is a homeworld or colony and the world's habitability score is 3 or less; +3 if the local settlement is an outpost.

Tech Level Table

Roll (3d)	World TL
3	Primitive
4	Standard-3
5	Standard-2
6-7	Standard-1
8-11	Standard (Delayed)
12-15	Standard
16 or more	Standard (Advanced)

A *Primitive* world is, for whatever reason, cut off from interstellar trade and unable to produce advanced goods on its own. Roll 3d-12 (minimum 0) for the world's TL. Citizens of this world are very likely to have the Low TL disadvantage (p. B22).

Worlds that are at the setting's standard TL can still be known for slight differences in technological accomplishment. A world that is *Delayed* is at the standard TL, but its manufactured goods tend to be larger, heavier, more costly (by about 10%), less reliable, or less user-friendly. A world that is *Advanced* is at the standard TL, but its manufactured goods will be known for beautiful styling, compactness, reliability, ease of use, or reduced cost (about 10%). An Advanced world may also have made breakthroughs in specific fields, offering certain manufactured goods at higher than the standard TL for the setting.

Regardless of the result on the *Tech Level Table*, if a world is not naturally hospitable, then its population will need advanced technology to survive. If the world's habitability score is 3 or less, then the world must be at least TL8.

Example: The GM has no preference regarding the TL of the Haven colony, so he rolls 3d on the *Tech Level Table* and gets an 11. This yields a result of Standard (Delayed). The GM sets the colony to TL10, since that's the standard TL for his campaign, and notes that local industries aren't quite up to galactic standards for cost and reliability.

STEP 10: POPULATION

This step sets the population for the target world. In this book, a world's population will be given as a head-count of residents. Each world also has a Population Rating (PR). This is the "order of magnitude" of the

world's population; increasing the PR by 1 multiplies the actual population by a factor of 10. For example, a world with a population between 1.0 million and 9.9 million has a PR of 6; a world with a population between 1.0 billion and 9.9 billion has a PR of 9.

Determining Carrying Capacity

First, determine the *carrying capacity* of the world for its inhabitants. This is the maximum population that the world can support in reasonable comfort for long periods of time. A world's population can exceed its carrying capacity, but only at the cost of widespread poverty or the risk of a disastrous "die-back."

Carrying capacity depends on several factors. The world's diameter controls its surface area. The world's affinity score stands for a variety of factors, all of which affect how much of the world's surface area is going to be usable. Finally, the tech level of the settlement controls the *density* of population that can be supported – the number of people that can live comfortably in the same area.

Carrying Capacity Table

Tech Level	Base Carrying Capacity
0	10,000
1	100,000
2	500,000
3	600,000
4	700,000
5	2.5 million
6	5 million
7	7.5 million
8	10 million
9	15 million
10	20 million
11 or higher (or Superscience)	GM option

Note that base carrying capacity at TL8 and above is speculative – economists and ecologists aren't in agreement on how many people Earth can stably support at high TL. The GM should feel free to set these figures to suit his own assumptions, especially at TL11+ or in settings that include a lot of superscience.

If a world has habitability of 3 or less and tech level of 7 or less, then the carrying capacity for the world is automatically 0 (such a case should not occur under the rules in Step 9). Otherwise, refer to the following tables.

Affinity Modifiers Table

Affinity Score	Multiplier
10	1,000
9	500
8	250
7	130
6	60
5	30
4	15
3	8
2	4
1	2
0	1
-1	0.5
-2	0.25
-3	0.13
-4	0.06
-5	0.03

Get the base carrying capacity for the world, based on its TL. Multiply this value by the appropriate multiplier from the *Affinity Multipliers Table*, based on the world's affinity score. Finally, for any world type other than Asteroid Belt, multiply the result by the *square* of the world's diameter (measured in Earth diameters). If the world is of Asteroid Belt type, multiply by 50 (an asteroid belt offers material broken up into many small chunks, providing a lot of potential living surface).

The above procedure will yield the carrying capacity of the world for humans or human-like aliens. Alien races with certain racial advantages or disadvantages will need different amounts of space and resources to survive comfortably.

Carnivores: Races that are unable to eat anything but meat will use land much less efficiently than their herbivorous or omnivorous counterparts. Such a race would have some level of the Restricted Diet disadvantage (p. B151) tied to their predatory requirements. At TL8 and below, *divide* carrying capacity by 10 for such races.

Increased Consumption: Races that need lots of food or water will need more resources to survive comfortably. For every level of the Increased Consumption disadvantage (p. B139) that the inhabitants have, *divide* carrying capacity by 2.

Increased Life Support: This disadvantage (p. B139) applies to members of a race while operating in a human-safe environment. When in their own environment, they will have no unusual needs. This disadvantage *does not* affect carrying capacity.

Reduced Consumption: Races that need less food or water than normal will be able to get by with fewer resources. This is reflected by the Reduced Consumption advantage (p. 80) and, at extreme levels, by the Doesn't Eat or Drink advantage (p. B50). If the inhabitants have Reduced Consumption 1, *multiply* carrying

capacity by 1.5. If they have Reduced Consumption 2, multiply carrying capacity by 3. If they have more levels of Reduced Consumption, or the Doesn't Eat or Drink advantage, multiply carrying capacity by 10.

Once all the relevant factors have been taken into account, make a note of the final carrying capacity of the world. Then proceed to the appropriate section of the following rules and determine the current population of the world. Round carrying capacity and population to two significant figures, and make a note of the world's PR as well.

Homeworld Populations

In general, a homeworld will support as many people as it *can* – its population will be about equal to its carrying capacity. This is especially true at TL4 or below, when societies have no reliable way to control their own birth and death rates.

At TL5 and above, societies are more likely to diverge from their world's carrying capacity. By restricting birth rates, a high-tech society may fall significantly below the carrying capacity. On the other hand, a high-tech society can also exceed the carrying capacity, but only by using world resources in a way that can't be sustained indefinitely. Such a society will be in trouble within a few generations, unless it can improve the carrying capacity of its world.

At TL4 or below, a homeworld's population is likely to be within 50% of its carrying capacity. Select a population as needed, or roll 2d+3, divide by 10 (retaining fractions), and multiply by the carrying capacity to get the world's population.

At TL5 and above, a homeworld's population can vary widely from its carrying capacity. Select a population as needed, or roll 2d. Multiply the carrying capacity by 10, and *divide* the result by the die roll to get the world's population.

Colony Populations

A colony world will begin with a relatively small population that will grow over time until it approaches the carrying capacity of the world. Select a population for the world to fit the needs of the campaign.

To generate a colony's population at random, roll 3d on the *Colony Population Table*.

Modifiers: Add +3 times the world's affinity, and add +1 for every 10 full years since the colony was established.

The colony's population should normally not exceed the world's carrying capacity. The GM may fix the population below the carrying capacity to represent a society that dislikes crowding, or above the carrying capacity for an unstable colony that is outpacing local resources.

Colony Population Table

Roll (3d)	Population	Roll (3d)	Population	Roll (3d)	Population
25 or less	10,000	45	1.0 million	65	100 million
26	13,000	46	1.3 million	66	130 million
27	15,000	47	1.5 million	67	150 million
28	20,000	48	2.0 million	68	200 million
29	25,000	49	2.5 million	69	250 million
30	30,000	50	3.0 million	70	300 million
31	40,000	51	4.0 million	71	400 million
32	50,000	52	5.0 million	72	500 million
33	60,000	53	6.0 million	73	600 million
34	80,000	54	8.0 million	74	800 million
35	100,000	55	10 million	75	1.0 billion
36	130,000	56	13 million	76	1.3 billion
37	150,000	57	15 million	77	1.5 billion
38	200,000	58	20 million	78	2.0 billion
39	250,000	59	25 million	79	2.5 billion
40	300,000	60	30 million	80	3.0 billion
41	400,000	61	40 million	81	4.0 billion
42	500,000	62	50 million	82	5.0 billion
43	600,000	63	60 million	83	6.0 billion
44	800,000	64	80 million	Every +10	×10

Outpost Populations

An outpost will usually have a population between 100 (for a small station) and 100,000 (for the largest military or commercial outposts). Select a population, or roll 3d on the *Outpost Population Table* below to determine the outpost's approximate population. Feel free to vary the result by up to 25% for any given world. An outpost will almost certainly be smaller than the world's carrying capacity. In any case, the carrying capacity rule doesn't apply to outposts, which are dependent on imported supplies.

Outpost Population Table

Roll (3d)	Population
3	100
4	150
5	250
6	400
7	600
8	1,000
9	1,500
10	2,500
11	4,000
12	6,000
13	10,000
14	15,000
15	25,000
16	40,000
17	60,000
18	100,000

Example: The GM computes the carrying capacity for Haven. The base carrying capacity for TL10 is 20 million, the multiplier for Haven's affinity of 7 is 130, and the square of the planet's diameter (in Earth diameters) is 1.1. Multiplying all of these together, the GM gets a total carrying capacity of about 2.9 billion. The colonists have almost certainly not come anywhere near this population . . .

The GM decides that the Haven colony was established about 200 years ago, by dissidents fleeing a civil war in the Galactic Empire. He decides to determine the colony's population at random, and rolls 3d on the *Colony Population Table*. He gets a total roll of 53 (12 on the dice, +21 for the planet's affinity score, and +20 for time since settlement). This suggests a population of 6.0 million. The GM decides to vary the final result slightly, and records a total population of 6.5 million (PR 6).

STEP 11: SOCIETY TYPE

"What I see happening around me is bad enough," Sarah said. "To know that the trend is being encouraged by a secret elite is worse. But to know that They are doing it for no more reason than to simplify their . . . arithmetic really frosts me."

— Michael Flynn,
In the Country of the Blind

This step determines the type of society (or societies) that exists on the target world. This book uses the society types listed on pp. B509-510, the overall political situations described under *The Big Picture* on p. B509, and the "special conditions" listed under *Variations* on p. B510.

This step almost *demands* that the GM make a selection to fit the needs of his setting. Any world's social situation needs to fit the GM's assumptions about interstellar society. An Evil Galactic Empire won't tolerate democratic world governments, but a Benevolent Federation may *insist* on

democracy on its member worlds. A near-future setting may have relatively little variety in social types, while a space-operatic galaxy of the distant future may see every one of the types represented on hundreds of worlds.

The GM may want to set up his own procedure for determining what society type can be found on each world in his setting. The following procedures are reasonably generic and can be used in a variety of settings.

World Unity

The degree to which a world is socially unified depends strongly on the available technology. An ultra-tech world with instant communication and fast transport is *much* more likely to be politically unified than a pre-industrial civilization that still depends on animal-drawn and water transport.

Select a level of unification from the ones described in *The Big Picture* on p. B509. To get a random result, roll 1d at TL7 or less or 2d at TL8+, on the following table.

Altering the Colony Population Table

The *Colony Population Table* makes several assumptions about the normal growth of colony worlds. Each of these assumptions can be changed to fit the needs of a given setting.

- *A stable colony must have at least 10,000 inhabitants.* This fixes the lowest possible entry on the table. The current table assumes that an average die-roll of 10, combined with a medium affinity score (5) and no time-since-foundation modifier, will match the minimum population. When rewriting the table, the GM may wish to make sure a similar result occurs – otherwise some new colonies will have very high populations, or some very old colonies will have the minimum population.

- *A colony world's population will grow at a rate of about 2.3% per year, averaged over its entire history.* This assumption fixes the ratio between adjacent entries on the table, and the +1 die-roll modifier for each decade since the colony's foundation. If populations grow faster, increase the ratio between entries or apply the +1 modifier more often than every 10 years. If colony populations grow more slowly, decrease the ratio between entries or apply the +1 modifier less often.

- *Each point of the affinity score will, on the average, double a colony world's Population.* This assumption fixes the size of the modifier for affinity. If habitable conditions and available resources are more important, increase this modifier. If colonies grow at a rate independent of the environment, decrease or remove this modifier.

Modifiers: +4 if the world's PR is 4 or less, +3 if the PR is 5, +2 if the PR is 6, +1 if the PR is 7.

World Unity Table

Roll (2d)	Conditions
5 or less	Diffuse
6	Factionalized
7	Coalition
8	World Government (Special Condition)
9 or more	World Government

Society Type

Select a society type, or roll 3d on the *Society Types Table*, referring to the column for the type of *interstellar* society in which the world is a member (for a summary of interstellar society types, see Chapter 1). If the world is not part of any larger society, use the "Anarchy or Alliance" column.

Modifiers: Add the world's TL (treating TL11+ as TL10). The result is the society type of the world (or the *dominant* type, if the world is not unified).

If a "special condition" was indicated by the roll on the *World Unity Table*, choose one or two of the special conditions listed under *Variations* (p. B510). To select special conditions randomly, roll 3d on the *Special Conditions Table*, with no modifiers. If the result has an asterisk, record the special condition, then roll 1d. On a 1-3, roll for a *second* special condition and apply both.

Society Types Table

Roll (3d)	Anarchy or Alliance	Federation	Corporate State	Empire
3-6	Anarchy	Anarchy	Anarchy	Anarchy
7-8	Clan/Tribal	Clan/Tribal	Clan/Tribal	Clan/Tribal
9	Caste	Caste	Caste	Caste
10	Feudal	Feudal	Theo	Feudal
11	Feudal	Theo	Feudal	Feudal
12	Theo	Dictator	Feudal	Feudal
13	Dictator	Dictator	Dictator	Theo
14	Dictator	Dictator	Dictator	Dictator
15	Dictator	RepDem	Dictator	Dictator
16	RepDem	RepDem	RepDem	Dictator
17	RepDem	RepDem	RepDem	Dictator
18	RepDem	RepDem	AthDem	RepDem
19	AthDem	RepDem	Corporate	RepDem
20	AthDem	AthDem	Corporate	Corporate
21	Corporate	AthDem	Corporate	Corporate
22	Corporate	AthDem	Techno	Corporate
23	Techno	Corporate	Techno	Techno
24-25	Techno	Techno	Techno	Techno
26-27	Caste	Caste	Caste	Caste
28 or higher	Anarchy	Anarchy	Anarchy	Anarchy

Here, *AthDem* stands for Athenian Democracy, *RepDem* stands for Representative Democracy, *Dictator* stands for Dictatorship, *Techno* stands for Technocracy, *Theo* stands for Theocracy, and *Corporate* stands for Corporate State.

Special Conditions Table

Roll (3d)	Special Condition
3-5	Subjugated*
6	Sanctuary
7-8	Military Government
9	Socialist*
10	Bureaucracy
11-12	Colony
13-14	Oligarchy*
15	Meritocracy*
16	Matriarchy or Patriarchy (choose which)
17	Utopia
18	Cybercracy (roll again if TL7 or less)

Example: Rather than roll the dice, the GM works directly from his concept for Haven. He decides that the Haven colonists oppose the feudal government that rules most of the Galactic Empire, and are experimenting with democracy instead. He gives Haven a World Government, sets the society type to Representative Democracy, and places the Sanctuary special condition to fit the world concept.

STEP 12: CONTROL RATING

The Control Rating (p. B506) of a world is a measure of the most *common* CR to be found there. Worlds

that are not politically unified will have different CR in different regions, and a world may have a split Control Rating as well (see p. B507).

Control Rating depends strongly on the society type and any special social conditions to be found on the world. Refer to pp. B509-510 for the likely relationships between society type and CR. The GM should select a CR to fit the needs of his setting, or choose one from the most likely range using any random method he prefers.

A world with the special condition of *Colony* (not to be confused with a world with the colony settlement type) is a special case. Such a world's CR should depend on its local social type, but it is almost always lower than that

of the world from which the colony is governed. For any such world, determine the *governing world's* CR first.

Example: The GM decides, based on his original concept, that the inhabitants of Haven are likely to prefer freedom and an open society to a lot of regulation. He sets the Control Rating for Haven to be the minimum that would normally occur under a Representative Democracy: CR 2.

STEP 13: ECONOMICS

This step determines the economic parameters of the target world. It can be skipped if the details of local economics aren't going to be useful to the campaign.

The economic output of a world depends on the *productivity* of the world's workers. Productivity is largely determined by the local technological base. Workers with access to higher-TL equipment and techniques will be able to produce more economic value in the same amount of time. Also, the goods and services they produce will command a higher price when sold.

Productivity also depends on the *efficiency* of the local economy. This can depend on local environmental conditions, and on the details of local society. A world where most people are scrambling simply to survive is not one whose local industry will be efficient and productive.

Finally, productivity depends on the *resources* available to the workforce. Resource-rich worlds will naturally be more productive than resource-poor ones. Low-population worlds may be quite rich, but they don't support extensive industry so the workforce can't take advantage of the available resources. High-population worlds are economically saturated, and many workers won't have access to all the resources they could otherwise have used.

Per-Capita Income

To begin, refer to the following table to determine the *base per-capita income* for inhabitants of the world. This is dependent solely on the world's prevalent TL. Then refer to the *Income*

Modifiers Table and add together all the modifiers that apply.

Base Per-Capita Income Table

Tech Level	Base Per-Capita Income
TL12+	\$130,000
TL11	\$97,000
TL10	\$67,000
TL9	\$43,000
TL8	\$31,000
TL7	\$25,000
TL6	\$19,000
TL5	\$13,000
TL4	\$9,600
TL3	\$8,400
TL2	\$8,100
TL1	\$7,800
TL0	\$7,500

Income Modifiers Table

Condition	Modifier
Affinity score 10	+40%
Affinity score 9	+20%
Affinity score 7-8	+0%
Affinity score 4-6	-10%
Affinity score 1-3	-20%
Affinity score 0 or less	-30%
PR 6 or higher	+0%
PR 5	-10%
PR 4 or less	-20%

Apply the total modifier to the base per-capita income. If the world's carrying capacity is *less* than its population, multiply the result by the world's carrying capacity and then divide it by the population. The final result is the actual per-capita income. Round off to two significant figures.

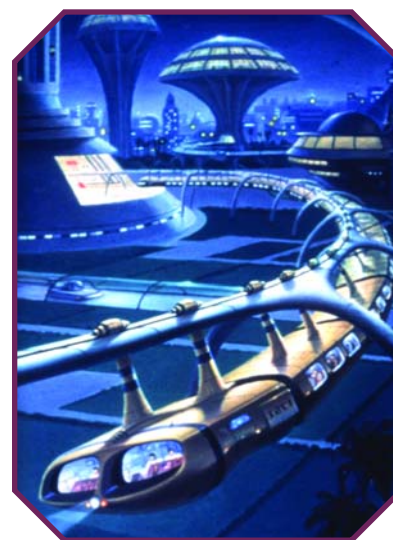
The per-capita income for a world can indicate the most typical Wealth level (p. B25) for citizens of that world, relative to the average Wealth level of the campaign. Divide the world's final per-capita income by the *base* per-capita income associated with the campaign's standard TL, and refer to the following table.

Typical Wealth Table

Per-Capita Income	Wealth Level
1.4 × base or more	Comfortable
0.73 × base to 1.39 × base	Average
0.32 × base to 0.72 × base	Struggling
0.1 × base to 0.31 × base	Poor
0.09 × base or less	Dead Broke

Economic Volume

To determine the *economic volume* of the world, simply multiply the per-capita income by the population of the world and round off to two significant figures. Make a note of the final per-capita income, the typical Wealth level for local citizens, and the economic volume.



Estimating Trade Volume

The best model known for estimating the flow of trade between two points is the *gravity trade model*, so called because the fundamental equation describing trade flows resembles Newton's equation for the force of gravity between two masses.

In order to estimate the trade volume between two specific worlds, the GM will need to determine two parameters, which should be consistent throughout his setting.

The simplest formula for estimating trade volume is:

$$T = (K \times V1 \times V2)/D$$

Here, **T** is the trade volume between two worlds (in *trillions* of \$), **K** is a constant on which the GM must

decide, **V1** and **V2** are the economic volumes of the two worlds (in trillions of \$), and **D** is the distance between the two worlds (in any convenient unit, usually parsecs).

The gravity trade model can yield some very odd results when used on certain pairs of worlds; if one world's economic volume is much higher than the other's, the estimated trade volume between them can be many times the size of the smaller world's economy. At the GM's option, a low-population world may carry on all of its direct trade with the nearest high-population world; the trade volume of the link should be no higher than the smaller world's economic volume.

The value of the constant **K** is very dependent on the setting. The GM should determine it early in his setting design process, at least if he intends to work out trade routes or otherwise estimate the amount of interstellar traffic. The best way to determine **K** is through trial and error, until the GM is happy with the results as applied to the most important worlds of his setting. The value of **K** will also have an effect on *what kind* of trade is likely to occur.

For example, the GM may assume that two worlds with high population and high TL, located close to each other in space, will have a trade volume between 5% and 10% of each world's economic volume. If **K** is set high enough to permit these levels of trade, interstellar commerce may involve ordinary manufactured goods or even certain raw materials. Passenger service between worlds will be fairly common as well.

A smaller value for **K** will give rise to smaller trade volumes, suggesting a setting where interstellar trade is more difficult or less important. In such settings, trade will tend to be dominated by high-value, low-volume goods such as luxury items and precision machinery. Even *information* may become a worthwhile trade good, especially if there is no equivalent of FTL radio.

Another factor that affects trade volumes is the presence of *political* borders. Worlds that are members of different space-faring civilizations are likely to trade less than those that share the same culture and government. The GM should decide how

much to reduce the trade volume between two worlds that are not part of the same society. A reasonable reduction would be to divide the trade volume by three.

If trade will be important to the campaign, compute the trade volume between the target world and as many of its neighbors as is convenient.

Designing Trade Routes

If the trade volumes between various worlds in the setting have been computed, the GM can lay out *trade routes* on his map.

The structure of trade routes depends strongly on the mechanisms of space travel. Suppose that merchant ships can travel freely through deep space, moving from any origin to any destination, never stopping at a port in between no matter how long the journey. In this case discrete "trade routes" become unlikely, since every merchant ship moves along its own independent path. There will be no *transient* merchant traffic at any world.

On the other hand, if ships must touch at port every few parsecs, distinct trade routes will appear along the paths used by ships carrying the highest trade volumes. Ports between the high-volume worlds may serve a great deal of transient traffic, as starships stop to refuel or perform maintenance before carrying their passengers and cargo onward. The GM can draw a tree-shaped structure of trade routes, measuring the total trade volume for each link by summing up the trade volumes for each pair of worlds whose commerce traverses that link.

In a setting where worlds are connected by jump lines, trade routes are *forced* to follow the jump lines. A link-and-branch structure becomes easy to define in this case.

Note that in either of the last two cases, trade between high-population worlds may end up following a round-about route because no inhabited worlds exist to provide a more direct path. If this happens, the GM may wish to place outposts, or even new worlds, in locations that would permit a more direct route for the trade. This is particularly likely in settings where only a few of the existing star systems are normally placed on the map. Any

interstellar society is likely to place way station outposts (p. 90) in order to make trade more efficient (or to support naval protection of the merchant ships).

Estimating Space Traffic

To estimate the total amount of space traffic at any given world, total up the world's trade volumes with its neighbors. Add the trade volume for any other world-pairs connected by a trade route that passes *through* the target world. The result is the total amount of merchant traffic that will pass by the target world each year, expressed in trillions of \$.

The GM can use this figure to estimate the number of merchant *ships* that will call at the world's port each year. Of course, this depends on a number of factors that are all up to the GM: the typical *size* of a merchant ship, the expected value (in \$) of cargo and passengers, and so on.

Example: The base per-capita income at TL10 is \$67,000. The GM refers to the *Income Modifiers Table* and finds that the total modifier for Haven is +0%. Meanwhile, the population is much less than the carrying capacity, so the per-capita income won't be reduced due to a too-large population. The actual per-capita income of Haven's population is \$67,000. The total economic volume of the planet is $67,000 \times 6.5 \text{ million} = \$440 \text{ billion}$. The most typical Wealth level on the planet is Average.

The GM has developed trade routes for other worlds in his setting, but he decides that Haven doesn't engage in open trade. Instead, the inhabitants maintain self-sufficient industries, and keep in contact with imperial worlds solely through sporadic smuggling.

STEP 14: BASES AND INSTALLATIONS

Many worlds have interesting special features, bases and installations built by the inhabitants. These may be placed by the GM, or may be placed randomly using the following procedures.

Spaceports

A spaceport may exist on any world that has space travel or that trades with space travelers.

Select the spaceport for the target world from the following classes. To choose a spaceport at random, roll 3d against the target number specified for each spaceport class. Check for the *highest* applicable class first. If there is no spaceport of that class, check for the next-highest class, and so on. A world will usually have several ports of lower class than the main spaceport, but this rarely affects play except to give visitors a choice of debarkation points.



Class V – Full Facilities: This class of spaceport includes full construction and repair facilities for the most advanced spacecraft in the setting. The port has berths for hundreds or even thousands of vessels, multiple landing facilities, launch facilities, surface-to-orbit shuttle services, and every amenity imaginable – from crew union halls to high-tech training facilities. A Class V spaceport will always be present on a world that sees at least \$20 trillion annually in total trade volume or transient merchant traffic. Otherwise it is present only on worlds of PR 6 or better, on a 3d roll of (PR+2) or less.

Class IV – Standard Facilities: This class includes light ship-construction facilities, and repair yards for ordinary spacecraft. A Class IV spaceport will always be present on a world that sees at least \$1 trillion annually in total trade volume or transient merchant traffic. Otherwise it is present only on worlds of PR 6 or better, on a 3d roll of (PR+5) or less.

Class III – Local Facilities: This class includes repair facilities for common needs; special parts or complex

repairs, even on ordinary spaceships, will require off-planet parts, technicians, or facilities. A Class III spaceport will always be present on a world that sees at least \$50 billion annually in total trade volume or transient merchant traffic. Otherwise it is present on a 3d roll of (PR+8) or less.

Class II – Frontier Facilities: These are intended only for interplanetary or shuttle craft rather than starships. Only emergency repairs are available for starships, although common fuel types are available. A Class II spaceport is present on a 3d roll of (PR+7) or less.

Class I – Emergency Facilities: This isn't a real spaceport, just a landing area. Marked by automatic buoys, it might be a cleared-off, flattened space or a small orbital station. It may be completely unmanned, or it may have local customs and security offices. Emergency parts and fuel are stored nearby. If qualified technicians are available, there will be a way to summon them as needed. Class I facilities are present on a 3d roll of 14 or less.

Class 0 – No Facilities: There isn't even a designated landing site. Ships planning to land must look for suitable terrain. If the world has a high enough TL, there will be an airport, parking lot, or wide roadway.

Depending on the campaign's space-flight technologies, spaceports may be located in orbit, on the ground, or both. Ground ports service shuttles and landing-capable spaceships, while an orbital facility allows non-landing ships to dock and provides shuttle service to the surface.

Other spaceports, not specifically included in a world's spaceport rating, include corporate, military, Patrol, and government ports. These can normally be used by any ship in an emergency, if the facility isn't secret.

Installations

Each of the following facilities may be present on a given world. They may be selected by the GM as needed.

To place installations at random, roll 3d for each in any convenient order. If a particular type of installation doesn't exist in your setting, don't roll for it. Each installation type lists a target number; the installation is present if the 3d roll yields this number or

less. The chance of some installations is affected by the world's TL, PR, and Control Rating.

Some installations will have a PR of their own, indicating the number of personnel assigned to them. When rolling for this PR, assume a minimum PR of 1 unless the world itself has PR 0. No installation can have a PR higher than that of the world itself, and there can be only one installation with PR equal to that of the world. If such an installation exists, it and the supporting industries probably dominate local society.

Alien enclave: One or more races alien to the world's major population live in segregated ghettos or reservations. This may be by own choice – to preserve their own culture, or from dislike of the other race. Or the major population may dislike *them*. An entire world may be designated an enclave. Present on a roll of 6 or less.

Black market: Illegal goods are easily found on this world, either in a fixed physical location or simply through a network of contacts. If the black market is commonly known, the Patrol is likely to raid occasionally or restrict trade (unless people in high places have been paid off). Interstellar criminal organizations have agents here. Present on a roll of (9-CR) or less.

Colonial office: An office of the colonial authority. On a high-population world, this may be a recruiting center. On a colony, it will be an enforcement office, which works to ensure compliance with government policies. In the latter case, the general attitude of the chief administrator can be set by a general reaction roll. Present only at PR 3 or higher, on a roll of (PR+4) or less.

Corporate headquarters: The nerve center of a major interstellar corporation is located here. Industrial operations may or may not be present. In extreme cases, the planet is governed by the company. Present only at PR 6 or higher, and local TL7 or higher, on a roll of (PR+3) or less. Roll 1d-3 for the PR of the headquarters itself.

Criminal base: This is the "corporate HQ" for a criminal group. The Patrol will be interested in this world, if it knows about it. Present on a roll of (PR+3) or less. Roll 1d-3 for the PR of the base.

Espionage facility: This may range from a secret spaceport to a minor office or spy cell. Civilian spy organizations may be involved in industrial espionage. Military espionage bases will be specifically involved in spying on enemy capabilities and forces, or (in rear areas) in correlating data. Espionage facilities will be present on a roll of (PR+6) or less. If a facility is present, roll 1d to determine its type: on a 1-4 it is civilian, on a 5 it is friendly military, and on a 6 it is enemy military. Roll 1d-2 for the PR of the facility if military, or 1d-4 if civilian. If one espionage facility is present, there may be others (presumably to spy on the first one). Roll again for another facility; if it is present, roll for a third, and continue until a roll fails.

Government research station: The station may be studying any cutting-edge technology or scientific field. It may be known to the public, garrisoned by security troops and ships. Or it may be secret, located in a remote area. It may even be disguised as some other form of installation. Present on a roll of 12 or less; if one is present, a second is also present on a roll of PR or less. Roll 1d-4 for the PR of each installation. Roll 1d for each research station; on a 1-2 the station is secret.

Mercenary base: This is the current home planet for a mercenary company, perhaps with a contract from a local government. There are training facilities, depots, and support personnel as well as fighting forces. Present on a roll of (PR+3) or less. Roll 1d-3 for the PR of the base.

Nature preserve: Most or all of this planet is set aside in its unexploited, natural state. These preserves may be used for scientific research (off-limits to tourists), or for light or heavy tourism (safaris, excursions, and so on). Present on a roll of (12-PR) or less.

Naval base: A support installation for the Navy. The size and complexity can vary, from a main fleet base to a small refueling station or listening post. Present if there is a Class V spaceport, or on a roll of (PR+3) or less. Roll 1d-1 for the PR of the base.

Patrol base: As above, but for the Patrol. Present if there is a Class IV or Class V spaceport, or on a roll of (PR+4) or less. Roll 1d-2 for its PR.

Pirate base: This planet may house a full-fledged pirate outpost with its own spaceport and security forces, possibly allied with the world's population. Or, on a smaller scale, corsair ships may set down secretly from time to time for supplies and R&R. If the pirate base is public knowledge, the Patrol can be expected to take an interest. Present on a roll of (8-CR) or less. Roll 1d-3 for the PR of the base.

Prison: Prisons are often built on barren, unsettled worlds (to make escape difficult), or in remote areas on habitable planets. They are rigorously patrolled. If the prison dominates local society, this is a "prison planet," and travel there is heavily restricted. A prison will be present only if no other installations exist on the world, aside from naval or Patrol bases. Present on a roll of (10-PR) or less (roll last). Roll 1d-3 for the PR of the prison.

Private research center: Like the government research station, this installation is dedicated to scientific or engineering research. It may be funded by industry, by government grants, or (secretly) by criminal organizations. Private centers investigate a wider range of topics than government centers, possibly including far-out theories. Present on a roll of (PR+4) or less; if one is present, roll again for additional centers, to a maximum of three. Roll 1d-4 for the PR of each installation.

Rebel or terrorist base: These range from hidden fortresses with full spaceport facilities to minor hideouts for ships "on the run." Rebels will have contacts among the local population, though the world government is rarely allied. Terrorists usually base themselves on friendly worlds, striking into foreign territory. The navy and Patrol will take an interest in these installations. Present on a roll of 9 or less. Roll 1d-3 for its PR.

Refugee camp: A holding center for those who have fled their native world due to war or another catastrophe. These are usually run-down, filled with squalor and crime. Refugees are usually disliked by the natives; the impoverished refugees are often desperate and militant, scheming to regain their lost lands. Present on a roll of (PR-3) or less; if one is present, roll for additional centers until a roll fails. Roll 1d-3 for the PR of each camp.

Religious center: Sacred areas – shrines or temples, often with church administrative and meeting facilities. Some sites of historical significance will be guarded by the Patrol. Pilgrims are likely. The center may be off-limits to nonbelievers. Present on a roll of (PR-3) or less. Roll 1d-3 for the PR of the religious center.

Special Justice Group office: A local headquarters for the Special Justice Group (p. 204). Present on a roll of PR or less. Roll 1d-4 for the office's PR. Roll 1d for the office; on a 1-2 it is "covert," known only to SJG operatives and with an innocuous "cover" function.

Survey base: As for a naval base, but for the Survey organization. Present if there is a Class IV or Class V spaceport, or on a roll of (PR+3) or less. Roll 1d-3 for its PR.

University: A prestigious interstellar center of learning, with libraries and research facilities. Present on a roll of (PR-6) or less. Roll 1d; on a 1-2, the university will have PR 3; on a 3-4, it will have PR 4; on a 5-6 it will have PR 5.

Example: The GM rolls 3d for each starport class in turn. The first roll is a 14, which is greater than Haven's PR+2=8, so there is no Class V spaceport. The second roll is a 15, which is greater than PR+5=11, so there is no Class IV spaceport. The third roll is an 11, which is less than PR+8=14, so the GM places a Class III spaceport on the planet.

The GM has no special preference regarding bases and installations for Haven, except that there should be no installation operated by the government (the Empire) or a major corporation. He rolls dice for every other item. The only roll that succeeds indicates a rebel or terrorist base; a second die roll yields a PR of 2 for the base. The GM decides that some citizens of Haven operate a support base for rebels against the Empire; the base may be associated with the smugglers who sometimes bring in imperial goods.

The design of Haven is complete, at least under the basic world-building system. In Chapter 5 the design will be expanded with advanced options.

CHAPTER FIVE

ADVANCED WORLDBUILDING

Mark struggled up the hillside, hoping to reach the shelter of the rocks he had seen from the valley's floor. Sweat poured down his face, straining his suit's ability to defog his faceplate. He could smell himself, rank with fear and old perspiration.

Any moment, he expected to feel the searing agony of a laser burn in his back. He couldn't imagine how the renegade had managed to miss him so far.

"Arcadia Base, this is Mark Keenan. Emergency call. Emergency call." Mark panted, climbing over a saw-toothed ridge of stone. Dust scattered in the trace atmosphere as his boots hit the surface on the other side. "Arcadia Base. Any overflight unit. **Eagle's Wing** control. Anybody."

No use. His radio was dead.

The light was rising as Mark reached the crest of the ridge. He reflexively looked over his shoulder, and looked full in the face of the planet's red dwarf sun as it loomed huge on the horizon. Second sunrise, as the planet receded from its periastron. Prominences and starspots were scattered across the star's face, an unusual number of them. Mark flinched away from the sight, and then remembered the infrared filters in his faceplate. It was safe enough to look.

Down in the valley, a long shadow pointed back to another human figure. It wore a suit like Mark's. It lifted a laser rifle.

Mark ducked, just as a stone a few feet away **popped** and flew into shards. Then he was hunkered down behind the ridgeline, scattering eons-old dust and looking frantically for some kind of shelter.

There, an overhang, the space beneath still in shadow.



Mark peeked back over the ridgeline; he saw the renegade tramping across the valley floor. It wouldn't take more than an hour for him to reach Mark's ridge.

The light grew brighter still.

Mark glanced up, just in time to see the star flare. A brilliant white light appeared on the star's upper limb, spreading madly, throwing every element of the landscape into sharp relief.

Mark thought quickly, then turned to lumber down the slope, toward the overhang he had picked out a moment ago. It ought to be enough to shadow him. The flare would be pouring radiation across the planet's surface in a few minutes. Enough to seriously harm anyone caught in the open.

The renegade was in the open, long minutes away from any shelter. Mark permitted himself a wolfish smile.

GENERATING STAR SYSTEMS

The rest of the world-building system picks up where Chapter 4 left off. At this point, the GM may have worlds placed on his campaign map, ready for adventure. He may now wish to generate the rest of any star system

containing a world, including other worlds that may exist orbiting the same star. Or he may simply wish to generate a whole solar system from scratch, to see what worlds appear at random.

In either case, the following steps will help the GM create a single complete solar system. This portion of the world-building sequence uses more mathematical computation, and more detail will be generated.

Stellar Classification

Stars fall into a few very well defined groups according to their physical properties. Astronomers classify stars using their *spectral class*, essentially a way to sort stars by color and size.

The first component of the spectral class is the star's *spectral type* or "color," denoted by a single letter. The most important spectral types are O, B, A, F, G, K, and M – remembered by astronomers using the jingle "Oh, Be A Fine Girl, Kiss Me!"

The sequence of spectral types also defines the relative surface temperature and luminosity of stars. O and B stars are hot and bright, while K and M stars are cool and dim. Spectral types are sometimes referred to as "early" (toward the bright, hot end of the range) or "late" (toward the dim, cool end). This nomenclature comes from the early days of stellar astronomy, when it was widely believed that all stars began their lives as O or B type and slowly moved down to K or M type before dying. This theory of stellar evolution has long since been discarded, but the "early-late" jargon persists.

The spectral type can be further specified by a decimal classification, using the digits 0 through 9. A subtype of 0 indicates a "standard" star of that spectral type, while subtypes 1 through 9 indicate progressively cooler, dimmer stars. Sol, for example, is of spectral type G2, and can be considered two-tenths of the way between a standard G-type and a standard K-type star.

The second component of a spectral class is the star's *luminosity class* or "size," which is denoted by a Roman numeral. Luminosity and size are related; two stars with the same spectral type (i.e. the same surface temperature) will be of different brightness if one is larger and has more surface area to radiate energy with. The luminosity classes are I (for "supergiant" stars), II and III (for giant stars), IV (for a class of "subgiant" stars), V (for average-sized "main sequence" stars), and VI (for a rare class of "subdwarf" stars). Sol, for example, is a G2 V star.

One set of stars doesn't fall into this classification scheme: the *white dwarf* stars. In a sense, these are not stars at all. A white dwarf is the remnant of a star that has finished its stable lifespan, has passed through a period as a giant star, and is now unable to continue fusion burning. Stars that die in this fashion lose much of their mass, in processes that can be quite violent. The most common remnant of such a star-death is a white dwarf, a small but extremely dense body that shines dimly due to the retained heat of its final collapse. Astronomers use an elaborate classification scheme for white dwarf stars, but this book simplifies by assigning them all the luminosity class D without spectral type.

In the region of space around Sol, most stars are of luminosity class V. These are stars in the main part of their stable lifetime, burning hydrogen fuel and evolving very slowly, most of them across billions of years. About 90% of nearby stars are main-sequence stars (p. 104), and most of the rest are white dwarfs.

STEP 15: NUMBER OF STARS

This step determines how many stars exist in the target star system. Many stars travel in pairs or larger groups, bound together gravitationally so that each orbits the center of mass of the entire system. In such star systems, the component stars are named using letters of the alphabet, with the most massive tagged A, the next most massive B, and so on. The A-component is also called the *primary star* of the system, and the other components are *companions*.

About half of all star systems are composed of single stars, with most of the rest being *binary* pairs. *Trinary* (three-star) systems are uncommon but possible. Multiple star systems with more than three members are fairly rare, and shouldn't be placed at random. Select a number of stars, or roll 3d on the *Multiple Stars Table* and note the result.

Modifiers: +3 if the system is located within an open cluster (p. 70).

Multiple Stars Table

Roll (3d)	Number of Stars
3-10	1
11-15	2
16 or more	3

3-10	1
11-15	2
16 or more	3

Example: Returning to his pre-designed world of Haven (see Chapter 4), the GM decides to generate the rest of the star system. Based on his earlier concept for the world, he decides that Haven is located within an open star cluster. He rolls 3d+3 for a result of 14, and notes that the Haven star system is composed of two stars.

STEP 16: STAR MASSES

This step determines the *mass* of each star in the system. A star's evolution depends very strongly on its mass and age, and somewhat less strongly on its initial composition.

A star's mass is measured in *solar masses*, so that a star with mass 1.0 is exactly as massive as our own sun. Objects smaller than about 0.08 solar masses can't maintain nuclear fusion in their cores, and so can't be considered stars (but see *Brown Dwarfs*, p. 128). Some gargantuan stars seem to have about 100 solar masses, although such "hyperstars" are *extremely* rare. For every massive star that burns briefly and brightly, there are many small stars that burn dimly and hoard their nuclear fuel. The vast majority of stars, including almost every star

likely to appear in a space campaign, have mass of 3.0 solar masses or less. Stars larger than about 2.0 solar masses don't appear likely to have planets at all, so this world-design system won't examine such stars in great detail. Stars with life-bearing planets are most likely to mass between 0.6 and 1.5 solar masses.

Primary Star Mass

Select a mass for the primary star of the target star system. To generate the primary star's mass at random, roll 3d *twice* on the *Stellar Mass Table*, making a note of the mass given for the first and second rolls.

Exception: If a Garden world has already been generated for the star system, then replace the first roll with the following procedure. Roll 1d: on a 1, assume a first roll of 5; on a 2,

assume a first roll of 6; on a 3-4, assume a first roll of 7; on a 5-6, assume a first roll of 8.

It's always reasonable to vary the final result slightly, so long as the star's mass is closer to the rolled result than to the results on either side of it. If a star has mass between two entries on the *Stellar Mass Table*, the results on several of the tables that follow will have to be interpolated.

Companion Stars

If there are any companion stars in the target star system, each must have a mass *equal to or lower than* that of the primary star. Select a mass for each companion.

To generate each companion star's mass at random, roll 1d-1. If the result is 0, then the companion star has almost exactly the same mass as the primary (i.e. its mass is given by the same entry in the *Stellar Mass Table*). If the result is 1 or greater, then roll *that many* d6, and count *down* as many entries as the dice indicate from the primary star's entry on the table. If the bottom of the table is reached, then stop. (No star may have a mass lower than about 0.08 solar masses.) The resulting entry indicates the mass for that companion star.

Example: The GM begins by generating the mass for the Haven system's primary star. Since Haven is a Garden world, he rolls 1d instead of 3d for the first roll; he gets a result of 3, which translates into a first 3d roll of 7. His second 3d roll is an 11. Haven's primary star has a mass of 0.90 solar masses.

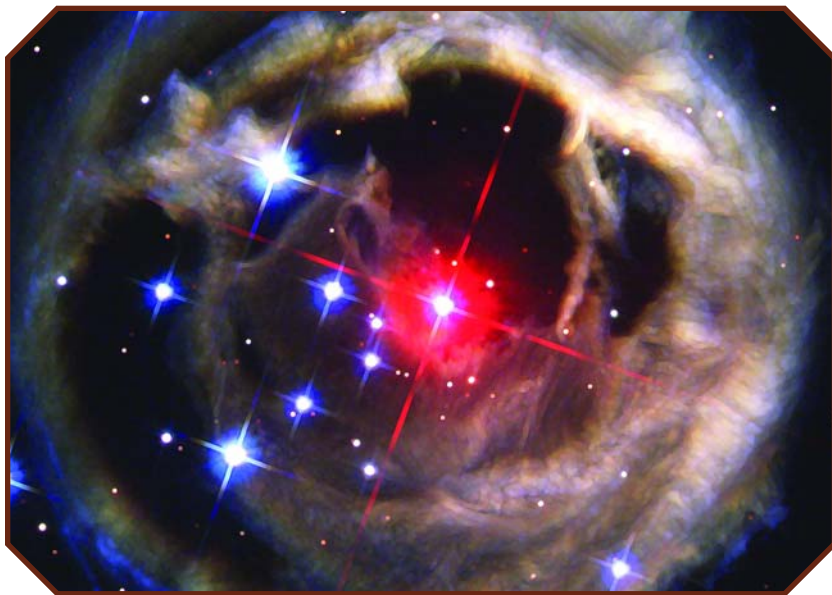
To generate the companion star's mass, the GM begins with a roll of 1d-1, with a result of 3. He rolls 3d for a result of 14, and counts down on the *Stellar Mass Table* that many entries from the mass of the primary star. The companion's mass is 0.20 solar masses.

Stellar Mass Table

First Roll (3d)	Second Roll (3d)	Mass (solar masses)
3	3-10	2.00
	11-18	1.90
4	3-8	1.80
	9-11	1.70
	12-18	1.60
5	3-7	1.50
	8-10	1.45
	11-12	1.40
	13-18	1.35
6	3-7	1.30
	8-9	1.25
	10	1.20
	11-12	1.15
	13-18	1.10
7	3-7	1.05
	8-9	1.00
	10	0.95
	11-12	0.90
	13-18	0.85
8	3-7	0.80
	8-9	0.75
	10	0.70
	11-12	0.65
9	13-18	0.60
	3-8	0.55
	9-11	0.50
	12-18	0.45
10	3-8	0.40
	9-11	0.35
	12-18	0.30
11	Any	0.25
12	Any	0.20
13	Any	0.15
14-18	Any	0.10

STEP 17: STAR SYSTEM AGE

This step determines the age of the star system. All of the stars in the system (and their planets, if any) will normally be the same age, as measured from the moment that the primary star ignited nuclear fusion in its core.



STEP 18: STELLAR CHARACTERISTICS

Now that the mass of each star and the age of the star system as a whole are known, the current properties of each star in the system can be determined.

A star begins its life in the *main sequence*, a class of stars with very predictable properties, characteristic of stable hydrogen fusion in their cores. A massive star will burn very brightly, spending relatively little time in the main sequence. Stars about as massive as our own sun will spend a few billion years in the main sequence, while the least massive stars will remain there for *many* billions (even trillions) of years.

As a star of moderate or high mass approaches the end of its stable lifespan, the hydrogen in its core becomes depleted. Stars can continue to survive by fusing heavier elements – helium, then carbon, and so on – but each new fusion process requires higher mass, and will be much *hotter* than ordinary hydrogen fusion. The pressure of the greater heat causes the star to swell and redden, causing a transition to the “red giant” stage of evolution.

Eventually, these later forms of nuclear fusion run out of fuel in their turn. The star then dies, losing part of its mass and leaving behind a *stellar remnant*. In the case of a star about the mass of our sun, this process is relatively peaceful – the outer layers of the star blow away to form a short-lived “planetary” nebula, leaving behind a white dwarf remnant. A more massive star will die in a supernova explosion, leaving behind a more exotic remnant such as a neutron star or black hole.

Aside from a star’s mass and age, its most important characteristics are its *effective temperature*, its *luminosity*, and its *radius*.

The effective temperature of a star is the temperature of its visible surface, measured in kelvins. It is the primary factor determining the “color” of the star’s light (more precisely, the distribution of the star’s radiant energy across the electromagnetic spectrum). Spectral type mainly depends on

At this writing, the universe itself is estimated to be about 14 billion years old, and our own galaxy is not much younger than that. Stars older than 12 billion years of age are rare in the galactic disk, and are usually ancient stars of the galactic halo that are simply passing through the disk at the moment. A typical range of ages would be about 4-8 billion years.

Select an age for the star system. To determine an age at random, begin by rolling 3d on the *Stellar Age Table* to determine what *population* the stars of the target system belong to. If a Garden world has already been generated for the star system, roll 2d+2 instead. Population II stars are the oldest, leftovers from the formation of the galaxy. Population I stars were formed in the galactic disk, and can be much younger.

Once the star system’s population is determined, roll 1d-1, multiply the result by the Step-A value, then roll another 1d-1, and multiply that result by the Step-B value. Add both results to the Base Age to get the age of the star system in billions of years.

Example: The GM determines the age of the Haven system by rolling on the *Stellar Age Table*. Since Haven is a Garden world, he rolls 2d+2 for a total of 8. Haven is an intermediate Population I star. The following two 1d-1 rolls yield results of 2 and 0. The star system’s age is $2 + (0.6 \times 2) + (0.1 \times 0) = 3.2$ billion years.

Referring to the discussion of open clusters on p. 70, the GM notices that the Haven star system is probably *too old* to be a member of the open cluster in which it is currently located. The GM decides that the cluster is recently formed, still rich with bright young stars. Haven’s presence inside the cluster is coincidence – the binary star is simply passing through on its independent orbit around the galactic core. Haven’s night sky is probably very impressive, full of brilliant nearby stars! Meanwhile, the coincidence probably helps hide Haven from the imperial authorities, who don’t expect to find a habitable planet in this region of space.

Stellar Age Table

Roll (3d)	Population	Base Age	Step-A	Step-B
3	Extreme Population I	0	0	0
4-6	Young Population I	0.1	0.3	0.05
7-10	Intermediate Population I	2	0.6	0.1
11-14	Old Population I	5.6	0.6	0.1
15-17	Intermediate Population II	8	0.6	0.1
18	Extreme Population II	10	0.6	0.1

effective temperature, although the star's material composition is also a factor.

The luminosity of a star is a measure of its total energy output. Luminosity is usually measured in *solar luminosities*, so that a star with luminosity 1.0 radiates exactly as

much energy as the Sun. Note that not all of a star's radiant energy will be in the form of visible light. In fact, at the extremes of the range of spectral types, most of a star's output may be outside the visible range.

The radius of a star is simply the distance from its center to its visible

surface. Most stars are quite compact, but some very massive or luminous stars are so large that they are likely to have absorbed their innermost planets.

To determine the characteristics of each star in the target star system, use the *Stellar Evolution Table*.

Stellar Evolution Table

<i>Mass</i>	<i>Type</i>	<i>Temp</i>	<i>L-Min</i>	<i>L-Max</i>	<i>M-Span</i>	<i>S-Span</i>	<i>G-Span</i>
0.10	M7	3,100	0.0012	—	—	—	—
0.15	M6	3,200	0.0036	—	—	—	—
0.20	M5	3,200	0.0079	—	—	—	—
0.25	M4	3,300	0.015	—	—	—	—
0.30	M4	3,300	0.024	—	—	—	—
0.35	M3	3,400	0.037	—	—	—	—
0.40	M2	3,500	0.054	—	—	—	—
0.45	M1	3,600	0.07	0.08	70	—	—
0.50	M0	3,800	0.09	0.11	59	—	—
0.55	K8	4,000	0.11	0.15	50	—	—
0.60	K6	4,200	0.13	0.20	42	—	—
0.65	K5	4,400	0.15	0.25	37	—	—
0.70	K4	4,600	0.19	0.35	30	—	—
0.75	K2	4,900	0.23	0.48	24	—	—
0.80	K0	5,200	0.28	0.65	20	—	—
0.85	G8	5,400	0.36	0.84	17	—	—
0.90	G6	5,500	0.45	1.0	14	—	—
0.95	G4	5,700	0.56	1.3	12	1.8	1.1
1.00	G2	5,800	0.68	1.6	10	1.6	1.0
1.05	G1	5,900	0.87	1.9	8.8	1.4	0.8
1.10	G0	6,000	1.1	2.2	7.7	1.2	0.7
1.15	F9	6,100	1.4	2.6	6.7	1.0	0.6
1.20	F8	6,300	1.7	3.0	5.9	0.9	0.6
1.25	F7	6,400	2.1	3.5	5.2	0.8	0.5
1.30	F6	6,500	2.5	3.9	4.6	0.7	0.4
1.35	F5	6,600	3.1	4.5	4.1	0.6	0.4
1.40	F4	6,700	3.7	5.1	3.7	0.6	0.4
1.45	F3	6,900	4.3	5.7	3.3	0.5	0.3
1.50	F2	7,000	5.1	6.5	3.0	0.5	0.3
1.60	F0	7,300	6.7	8.2	2.5	0.4	0.2
1.70	A9	7,500	8.6	10	2.1	0.3	0.2
1.80	A7	7,800	11	13	1.8	0.3	0.2
1.90	A6	8,000	13	16	1.5	0.2	0.1
2.00	A5	8,200	16	20	1.3	0.2	0.1

Here, *Mass* is the star's mass in solar masses, *Type* is its most likely spectral type while it is on the main sequence, *Temp* is its most likely effective temperature (in kelvins) while it is on the main sequence, *L-Min* is its initial luminosity on the main sequence, *L-Max* is its maximum luminosity on the main sequence, *M-Span* is its *main sequence span* in billions of years, *S-Span* is its *subgiant span* in billions of years, and *G-Span* is its *giant span* in billions of years.

If a star's age is no greater than the main sequence span given for its mass, then it is a main sequence (luminosity class V) star. If its age is greater than the main sequence span, but no greater than the main sequence span plus the subgiant span for its mass, then it is a subgiant (luminosity class IV) star. If its age is greater than the main sequence span plus the subgiant span, but no greater than the main sequence span plus the subgiant span plus the giant span for its mass, then it is a giant (luminosity class III)

star. Once a star has exhausted its stable span, subgiant span, and giant span, then it has ended its lifespan as a star. The dying star leaves behind a stellar remnant – which, for the stellar masses given on this table, is always a white dwarf (luminosity class D).

Using the table, classify each star in the star system as a main sequence star, subgiant star, giant star, or white dwarf. Refer to the appropriate section of the following text to determine each star's spectral type, effective temperature, and luminosity.

Main Sequence Stars

While a star is a member of the main sequence, its effective temperature will change very little, but it will tend to grow larger and more luminous as its core temperature slowly increases.

The *Stellar Evolution Table* gives the spectral type (under *Type*) and effective temperature (under *Temp*) for a main sequence star of a given mass. It would be reasonable to vary the spectral type by one subtype in either direction, or to vary the effective temperature by up to 100 K in either direction.

To determine the current luminosity of a main sequence star, use the following formula:

$$L = \text{MIN} + [(A/S) \times (\text{MAX} - \text{MIN})]$$

Here, **L** is the current luminosity in solar luminosities, **MIN** is the *L-Min* value from the *Stellar Evolution Table* for the star's mass, **MAX** is the *L-Max* value from the table, **A** is the star's age in billions of years, and **S** is the main sequence span (*M-Span*) from the table. It would be reasonable to vary the final result by up to 10% in either direction.

Note that for stars of 0.4 solar masses or less, no *L-Max* or *M-Span* values are given. Such low-mass stars change in luminosity very slowly; in the lifespan of the universe, they have not had time to grow significantly brighter. For such stars, the *L-Min* value can be taken as the actual luminosity, and may be varied by up to 10% in either direction.

Meanwhile, for stars with mass greater than 0.4 solar masses, but no greater than 0.9 solar masses, *L-Max* and *M-Span* values (but no other span values) are given. Such stars are automatically on the main sequence, but they may have had time to grow significantly brighter since their formation. The procedure above can be used to estimate their current luminosity.

Subgiant Stars

Once a star leaves the main sequence, it enters the *subgiant branch* of stellar evolution. During this period, its luminosity changes relatively little, but its effective temperature falls as it swells toward red giant status.

The luminosity of the star is equal to the *L-Max* value from the *Stellar Evolution Table*. This value can be varied by up to 10% in either direction if desired.

To determine the star's current effective temperature, use the following formula:

$$T = M - [(A/S) \times (M - 4800)]$$

Here, **T** is the current effective temperature in kelvins, **M** is the star's effective temperature during its main sequence period (the *Temp* value from the table), **A** is the star's age as a *subgiant* (i.e. its total age minus its main sequence span), and **S** is the star's subgiant span (the *S-Span* value from the table). It would be reasonable to vary the final result by up to 100 K in either direction.

The star's current spectral type will be that of a main sequence star with about the same effective temperature. Refer to the table to find the most likely spectral type.

Giant Stars

After its period as a subgiant, a star will rapidly swell to red giant status, going through several transitions as its core settles to relatively stable helium fusion. Its effective temperature falls further, but its radius and luminosity grow tremendously. A star of 2.0 solar masses or less won't be able to make the transition to carbon-burning or more exotic forms of fusion, so this phase of its evolution will be the last. Once the red giant phase is over, the star will die.

If a star is in the giant phase, its effective temperature will be between 3,000 and 5,000 kelvins. Select a temperature, or roll 2d-2, multiply by 200 K, and add the result to 3,000 K. The star's spectral type will be the same as that of a main sequence star with about the same effective temperature. Its luminosity will be about 25 times its luminosity as a subgiant star, and can be varied by up to 10% in either direction if desired.

White Dwarf Stars

After it completes the giant stage of its evolution, a star with 2.0 solar masses or less will die and leave behind a white dwarf remnant.

A white dwarf's mass will normally be between 0.9 and 1.4 solar masses, and can actually be significantly *smaller* than the mass of the original star. If a star has become a white dwarf, *ignore* the mass originally rolled on the *Stellar Mass Table*. Select a mass between 0.9 and 1.4 solar masses. To generate a mass at random, roll 2d-2, multiply by 0.05 solar masses, and add the result to 0.9 solar masses.

A white dwarf will have negligible luminosity, rarely higher than 0.001 solar luminosities. Its radius will be quite small – a white dwarf star is only a few thousand miles across, about the same size as the Earth! The effective temperature of a white dwarf can be quite high, but in this case it is rarely of any significance in world-building.

Determining Star Radius

For every luminosity class except D (white dwarfs), a star's radius is exactly determined by its effective temperature and its luminosity. Use the following formula:

$$R = (155,000 \times \text{square root of } L) / T^2$$

Here, **R** is the star's radius in AUs, **L** is its luminosity in solar luminosities, and **T** is its effective temperature in kelvins. Main sequence stars will almost always be a tiny fraction of an AU in radius, but giant stars may well be *much* larger.

Example: Referring to the *Stellar Evolution Table*, the GM notes that Haven's primary star is still well within its main-sequence lifespan. He notes that the star is most likely to be of spectral type G6 V (G6 from the entry on the table, V because of the star's status on the main sequence). He also notes that the star's effective temperature is 5,500 kelvins.

The GM then applies the luminosity formula, using entries from the table and the known age of the star system: $0.45 + [(3.2/14) \times (1.0 - 0.45)] = 0.58$ solar luminosities. He records this as the star's current luminosity. Finally, the GM applies the formula for star radius: $(155,000 \times \text{square root of } 0.58) / (5,500)^2 = 0.0039$ AU, or about 360,000 miles.

Going through the same procedures for the companion star, the GM determines that this star has spectral type M5 V, effective temperature of 3,200 kelvins, luminosity of 0.008 (rounded up), and radius of 0.0014 AU or about 130,000 miles.

STEP 19: COMPANION STAR ORBITS

Stars in a multiple star system will follow orbital paths that circle the center of mass of the system. The simplest way to approach their orbital mechanics is to assume that companions will follow circular or elliptical orbits centered on their primary stars. The important element to determine here is how distant the stars in the system are from each other at any given time. This step determines that information.

The relevant parameters of any orbital path are its average radius (measured in AU) and its *eccentricity*. This last is a measure of the amount by which the orbit deviates from a perfect circle, and takes values between 0 and 1. An eccentricity of 0 indicates a perfectly circular orbit, while values approaching 1 indicate elliptical orbits that are more and more elongated. Stars normally have orbital paths of moderate eccentricity, with values between 0.4 and 0.7 being most likely.

Members of a multiple star system can fall at a variety of distances from each other. At one extreme are “contact binaries,” stars whose outer atmospheres actually mingle as they whirl about each other in hours or days. At the opposite extreme are very wide pairs, which may take many thousands of years to complete a single orbit.

Select orbital distances and eccentricities to suit, or use the following procedure.

Begin by rolling 3d on the *Orbital Separation Table* for each companion.

Modifiers: +4 for each companion if a Garden world has already been generated for the star system; +6 for the second companion in a trinary system. These modifiers are cumulative.

Orbital Separation Table

Roll (3d)	Separation	Radius Multiplier
6 or less	Very Close	0.05 AU
7-9	Close	0.5 AU
10-11	Moderate	2 AU
12-14	Wide	10 AU
15 or more	Distant	50 AU

The initial result from this table gives a general idea of how widely separated the primary is from its companion. Roll 2d and multiply by the given radius multiplier to get a value for the average radius of the orbit for that companion. It would be reasonable to vary the final result by up to half of the radius multiplier in either direction.

A distant companion may have a companion of its own, on a roll of 11 or higher on 3d. This is the only way to get more than three stars in a multiple system when using the random-generation method. If so, the companion is treated in all respects as the primary star for its own companion. Generate stellar characteristics for the “subcompanion” as in Step 15. Generate an average radius for the subcompanion’s orbit around its primary star, applying a -6 modifier to the roll on the *Orbital Separation Table*.

Note that the orbital radius of the second companion in a trinary system *must* be larger than that of the first companion, and will normally be much larger. Similarly, the orbital radius of a subcompanion must be smaller than that of its primary around the central star of the system. Adjust the orbits if necessary to ensure these relationships.

Once the average orbital radius for each primary-companion pair is

known, select an eccentricity for each companion’s orbit. To select eccentricity at random, roll 3d on the *Stellar Orbital Eccentricity Table*.

Modifiers: -6 if the two stars are Very Close, -4 if they are Close, and -2 if they have Moderate separation.

Stellar Orbital Eccentricity Table

Roll (3d)	Eccentricity
3 or less	0
4	0.1
5	0.2
6	0.3
7-8	0.4
9-11	0.5
12-13	0.6
14-15	0.7
16	0.8
17	0.9
18 or more	0.95

For each primary-companion pair, compute and record the *minimum separation* and the *maximum separation* between the two stars:

$$\text{MIN} = (1 - E) \times R$$

$$\text{MAX} = (1 + E) \times R$$

Here, **MIN** is the minimum separation in AU, **MAX** is the maximum separation in AU, **E** is the eccentricity of the companion’s orbit, and **R** is the average orbital radius in AU.



Example: The GM rolls 3d+4 (the +4 since Haven is a Garden world) on the *Orbital Separation Table*, and gets a result of 15. The red dwarf companion in the Haven system is at distant separation. The GM rolls 2d for a 7, multiplies by 50 AU, and notes that the two stars have an average separation of 350 AU.

Since the companion star is at distant separation, it may have its own companion. The GM rolls 3d for a 10, and makes a note that there is no second companion star in the system.

The GM rolls 3d on the *Stellar Orbital Eccentricity Table*, and gets a result of 12. The eccentricity of the companion star's orbit is 0.6. The minimum separation of the two stars is 140 AU, and the maximum separation is 560 AU.

STEP 20: LOCATE ORBITAL ZONES

This step prepares for the placement of worlds in the star system. The GM must determine where planets *can* be placed, and must also determine where gas giant planets (which dominate the planetary-formation process) will appear. Compute and make a note of the *inner limit radius*, the *outer limit radius*, the *snow line radius*, and any *forbidden zones* around each star in the system.

Inner Limit Radius

Planets will not form too close to a star. Even while a star is on the main sequence, a planet is very unlikely to

form in a stable orbit within a certain distance. Once a star moves into the subgiant or giant phases of its evolution, existing planets that find themselves too close may be vaporized by the swollen star's intense heat.

For each star in the target star system, compute the inner limit radius using *both* of the following formulae. The inner limit radius that applies will be the *larger* of the two values. For almost all stars on the main sequence, the first of the two formulae will be the one to apply – the second formula becomes dominant for extremely luminous stars.

$$I = 0.1 \times M$$

$$I = 0.01 \times \text{square root of } L$$

Here, **I** is the inner limit radius in AUs, **M** is the star's mass in solar units, and **L** is the star's luminosity in solar units.

Outer Limit Radius

Planets will also not form too far away from a star. At a large distance, orbital movements are leisurely. Protoplanets will have much less opportunity to sweep up matter before the star ignites and the process of planetary formation is halted.

For each star in the target star system, compute the outer limit radius using the following formula.

$$O = 40 \times M$$

Here, **O** is the outer limit radius in AUs and **M** is the star's mass in solar units. Planets will be able to form anywhere between the inner and outer limit radii, so long as no other stars interfere with their gravitational influence.

Snow Line

Next, compute the snow line radius for each star. This is the distance from the star at which water ice could exist during planetary formation, marking the most likely region for the formation of the star's largest gas giant planet. The snow line radius can be found using the following formula:

$$R = 4.85 \times \text{square root of } L$$

Here, **R** is the snow line radius in AUs and **L** is the star's *initial luminosity* on the main sequence (the *L-_{Min}* value from the *Stellar Evolution Table*).



Forbidden Zones

If a star system includes more than one star, then each component of the system may have a *forbidden zone* in which planets can't form even if they are otherwise at a proper distance from the star. A forbidden zone is a region in which no stable planetary orbit is possible.

The inner edge of the band of forbidden orbits is at *one-third* of the minimum separation between a star and its closest companion (as computed in Step 18). For the third component in a trinary star system, the closest companion is the primary star of the system. If a distant companion has its own subcompanion, then those two stars will automatically be closest companions for each other.

The inner edge of the forbidden zone may be closer than the inner limit radius for that star, in which case there will be no planets between the star and its companion. Alternatively, the inner edge of the forbidden zone may be beyond the outer limit distance for the star, in which case the companion will have no significant effect on the planetary system.

The outer edge of a star's forbidden zone is at *three times* the maximum separation between the star and its closest companion (again, as computed in Step 18). If this outer edge is closer than the outer limit distance, planets may form circling the pair as a whole. In this case, assign these planets to the primary and don't generate such planets for both stars. This can happen even when the stars are separated fairly widely, although in such cases the outer edge of the forbidden zone is likely to be beyond the outer limit distance.

Example: The GM determines the orbital zones for Haven's primary star. The star's inner limit radius is at 0.09 AU, its outer limit radius is at 36 AU, and its snow line is at 3.3 AU. There is a forbidden zone due to the presence of the companion star, but its inner edge is at 47 AU, outside the outer limit radius. The companion has no significant effect on the arrangement of planets in the primary's system.

At this point, the GM decides not to bother generating any more

information for the red dwarf companion. If the companion seems likely to become important to some future adventure, information about its planets can be generated then.

STEP 21: PLACING FIRST PLANETS

Once all the orbital zones have been located, the first planets can be placed in orbit around each star in the system.

Arrangement of Gas Giants

Traditional models of planetary formation call for the tidy arrangement of worlds we see in our own solar system: small rocky planets inside the snow line, large gas-giant planets outside. Unfortunately, in recent years astronomers have detected over 100 planets in other star systems – almost *none* of which follow this model!

This finding doesn't doom the traditional model entirely, since these strange "hot Jupiters" are the only ones we are likely to detect given current methods. Astronomers using those methods and looking at our own solar system from a distance wouldn't be able to detect the presence of Jupiter or Saturn (at least not yet). Hence many star systems may follow the traditional model without our being able to verify the fact.

Still, it seems clear that large gas-giant worlds can be found almost anywhere in a star system, including the infernal regions within a few million miles of the primary star. The current leading theory is that gas giants still form in the cold outer regions of a star system, but that mechanical processes cause some growing gas giants to migrate inward.

To reflect this possibility, determine the general arrangement of gas giants in orbit around each star in the target star system. Several possible arrangements exist.

No Gas Giant: If the protoplanetary nebula had little mass, gas giants may not have formed at all. The star may have a few rocky planets instead,

including some of pleasant temperatures in the "life zone."

Conventional Gas Giant: The star has one or more gas giant planets, all beyond the snow line, following nearly circular orbits. Rocky planets are very likely, including some in the life zone. This is the situation that holds in our own solar system.

Eccentric Gas Giant: In this situation, one or more gas giants formed beyond the snow line and have migrated some distance inward. Their orbits have become "scrambled" due to random close encounters among themselves. These orbits are now eccentric (non-circular) or fail to fall in the same plane. Any rocky planets in the inner system have probably been ejected from the system after a close encounter with one of the gas giants.

Epistellar Gas Giant: At least one gas giant planet has migrated down to a very tight circular orbit around the primary star. This gas giant may have absorbed some of the material available for building rocky planets, but such planets may have been able to form anyway after the gas giant finished its migration. Other gas giants may exist in the outer star system, as in the conventional arrangement.

Choose an arrangement of gas giants for each star in the star system. If a star's snow line radius falls within a forbidden zone due to the presence of a companion star, then it will have No Gas Giant. Otherwise, choose an arrangement or roll 3d on the following table.

Gas Giant Arrangement Table

Roll (3d)	Arrangement
10 or less	No Gas Giant
11-12	Conventional Gas Giant
13-14	Eccentric Gas Giant
15-18	Epistellar Gas Giant

Place First Gas Giant

Once the arrangement of gas giant planets around each star in the star system has been determined, the first gas giant can be placed for each star.

No Gas Giant: No gas giant will be placed around this star.

Conventional Gas Giant: In this case, the star's first gas giant planet will normally form outside, but not too far from, the snow line radius. Select an orbital radius for it, or roll 2d-2, multiply by 0.05, add 1, and multiply the snow-line radius by the result.

Eccentric Gas Giant: In this case, the star's first gas giant planet will be found somewhere between the star's inner limit radius and the snow line radius. Select an orbital radius for it, or roll 1d, multiply by 0.125, and multiply the snow-line radius by the result.

Epistellar Gas Giant: In this case, the star's first gas giant planet will be found very close to the star, possibly even *inside the inner limit radius*. This is an exception to the usual rule prohibiting planets from being placed inside the inner limit; the planet did not form so close to its primary star, but migrated into that position. Select an orbital radius for it or roll 3d, multiply by 0.1, and multiply the inner limit radius by the result.

Regardless of the arrangement of gas giants, record the orbital radius of the first gas giant (if any) for each star in the target system. Its other properties (mass, density, diameter, number of moons, and so on) will be generated later.

Note that it's possible for a gas giant to fall within a forbidden zone using the above procedures. The GM should move the gas giant out of the forbidden zone if possible, although he may accept the situation as an unstable or transient feature of the star system's evolution.

Placing a Pre-Designed World

If a world has already been designed for the star system using the basic world-building sequence in Chapter 4, then that world should also be placed at a specific distance from one of the stars in the system.

The exact orbital radius for the pre-designed world depends on the luminosity of its primary star (as generated in Step 18) and the world's blackbody temperature (as generated in Step 5). Use the following formula:

$$R = (77,300/B^2) \times \text{square root of } L$$

Here, **R** is the orbital radius in AU, **B** is the world's blackbody temperature, and **L** is the star's luminosity in solar units. Compute this orbital radius for each of the stars, and choose one of them to be the pre-designed world's primary.

Note that the proper distance may fall inside the inner limit radius, outside the outer limit radius, or within a forbidden zone for a given star. In this case, the world *cannot* be placed in orbit around that star.

It's also possible for the pre-designed world to end up being too close to the star's first gas giant, if any. Determine the *ratio* between the two worlds' orbital radii, by dividing the larger radius by the smaller. If the ratio is less than 1.4, then the two worlds are too close together – the gas giant's gravitational influence will tend to make the pre-designed world's orbit unstable. The pre-designed world cannot be placed in orbit around that star.

Given these two restrictions, it's possible for a pre-designed world to have no place to go. If this happens, consider returning to Step 15 to generate a new star or set of stars to fit, or choosing a different arrangement of gas giants for one or more of the stars.

One more thing to consider: the pre-designed world may be a *moon* rather than an independent planet. In particular, a Tiny or Small world of any type, or a Standard (Hadean) world, is very likely to be the moon of a gas giant. If the pre-designed world is difficult to place because it appears to fall too close to a star's first gas giant, then consider *moving* the gas giant – altering its orbital radius slightly so that the pre-designed world can be one of its moons!

Example: The GM rolls 3d for a 12 on the Gas Giant Arrangement Table. Haven's primary star has a Conventional Gas Giant arrangement. Without bothering to roll the dice, the GM places the system's first gas giant planet just outside the snow line at 3.5 AU.

At this point, the GM is ready to place Haven itself within the star system. Applying the formula for its orbital radius, he gets $(77,300/295^2) \times \text{square root of } (0.58) = 0.68$ AU. Since the ratio between the gas giant's orbit

and Haven's orbit is quite large ($3.5/0.68 = 5.15$), there's no conflict and both planets can be left where they are.

STEP 22: PLACE PLANETARY ORBITS

Once any pre-designed world and the first gas giant for each star (if any) have been placed, *all* of the planetary orbits for each star can be determined.

Early astronomers spent considerable time trying to discover why the planets' orbits are arranged as they are. One early effort was "Bode's law," an observed mathematical relationship among the orbital radii of the known planets. Although Bode's law is simple, and doesn't clash *too* badly with the existing orbital radii, it doesn't actually account for the forces that control the distribution of planets.

Planetary orbits tend to be spaced logarithmically – that is, the *ratio* of one orbital radius to the next is fairly consistent. This is because certain ratios lead to unstable situations, as neighboring planets exert gravitational attraction on each other.

Orbits are usually arranged so that the ratio of adjacent orbital radii is between 1.4 and 2.0. Some ratios in this range encourage orbital instability because of a "resonance" between the two planets' orbital periods, but these ratios appear to be less likely rather than entirely forbidden. In this step, planetary orbits will be placed so that this relationship between adjacent radii holds.

For each star in the target star system, always begin with the first gas giant's orbital radius. If no gas giant has been placed for a star, locate the greatest orbital distance at which that star *can* have planets – usually the outer limit distance, or the inner edge of a forbidden zone. The first planetary orbit to be placed will be inside, but not too far from, this outermost legal distance. Select an orbital radius for it, or roll 1d, multiply by 0.05, add 1, and *divide* the outermost legal distance by the result.

From the first planetary orbit to be placed, work your way both inward (toward the inner limit radius or the

edge of a forbidden zone) and outward (toward the outer limit radius or the edge of a forbidden zone). Always place the next planetary orbit so that the ratio between adjacent orbits is between 1.4 and 2.0. Select an appropriate ratio each time, or roll 3d on the following table.

Orbital Spacing Table

Roll (3d)	Ratio
3-4	1.4
5-6	1.5
7-8	1.6
9-12	1.7
13-14	1.8
15-16	1.9
17-18	2.0

When working outward, *multiply* each orbital radius by the ratio in order to get the next radius. When working inward, *divide* each radius by the ratio in order to get the next radius. When using the dice, it would be reasonable to adjust the ratio by up to 0.05 in either direction at each step.

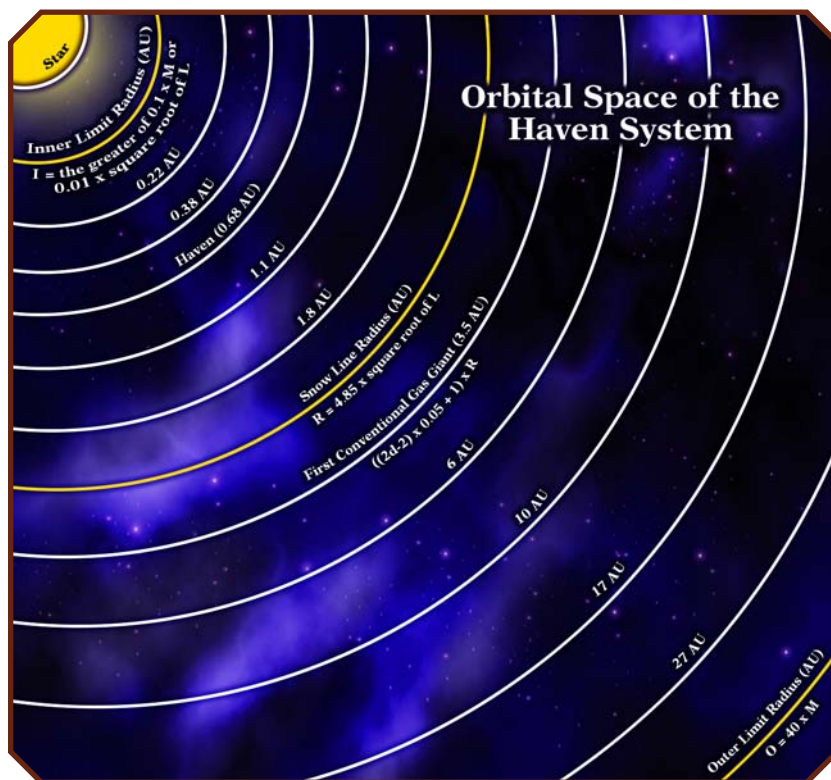
In the innermost region of a star's orbital space, the orbits will be very close together in absolute terms. Always space orbits out so that they are at least 0.15 AU apart, even if this means that the ratio between two orbital radii is unusually large. If this can't be done without placing an orbit inside the inner limit radius, then stop.

Remember that no planetary orbital radius can be larger than the outer limit distance. Aside from the case of an epistellar gas giant, no planetary orbital radius can be smaller than the inner limit distance. If an orbit falls inside a forbidden zone, stop placing planetary orbits in that direction.

If there is a pre-designed world in orbit around one star, the above procedure won't necessarily place an orbit in exactly the right place for that world. Feel free to adjust one or more orbits so that one of them falls exactly as required for the pre-designed world, and then continue with the procedure as before.

Record the sequence of planetary orbital radii for each star in the target star system.

Example: Beginning with the first gas giant's orbit, the GM begins to



work inward toward Haven's primary star and place planetary orbits. His first roll on the *Orbital Spacing Table* is a 16, yielding a ratio of 1.9; the next orbit inward from the gas giant is at $3.5/1.9 = 1.8$ AU. The next roll is an 11, yielding a ratio of 1.7; the next orbit inward is at $1.8/1.7 = 1.1$ AU. The GM observes that the ratio between 1.1 and 0.68 (the radius of Haven's orbit) is about 1.6 to 1, so he simply assumes that Haven's orbit is the next one inward. The next die rolls are 13 (ratio of 1.8, orbital radius of $0.68/1.8 = 0.38$) and 11 (ratio of 1.7, orbital radius of $0.38/1.7 = 0.22$). The next orbit inward would have to be at 0.07 AU or less in order to avoid placing two orbits within 0.15 AU of each other, but 0.07 AU is inside the inner limit radius, so the GM stops.

Now the GM works *outward* from the first gas giant's orbit. His rolls on the *Orbital Spacing Table* are 10 (ratio of 1.7, orbital radius of $3.5 \times 1.7 = 6.0$ AU), 9 (ratio of 1.7, orbital radius of $6.0 \times 1.7 = 10$ AU), 11 (ratio of 1.7, orbital radius of $10 \times 1.7 = 17$ AU), and 8 (ratio of 1.6, orbital radius of $17 \times 1.6 = 27$ AU). The next orbital radius would be at least $27 \times 1.4 = 38$ AU, and this is outside the star's outer limit radius, so the GM stops.

To summarize: the GM has generated a complete set of orbits for

Haven's primary star. From the innermost to the outermost, the radii are 0.22 AU, 0.38 AU, 0.68 AU (Haven), 1.1 AU, 1.8 AU, 3.5 AU (first gas giant), 6.0 AU, 10 AU, 17 AU, and 27 AU. Haven's primary star appears to have a full system of worlds, with up to 10 planets in it.

STEP 23: PLACE WORLDS

In this step, objects will be allocated to orbits.

An *empty orbit* may occur if there wasn't enough material in that region of the star system to form an object of significant size, or if a large object (a companion star or a migrating gas giant planet) swept the orbit clean of material.

An *asteroid belt* is an orbital region occupied by many small, stony objects. Asteroid belts normally form when a gas giant or companion star disturbs the early mass of asteroids, pulling them out of the stable orbits that would have permitted them to form a planet. The few asteroids that survive this winnowing process make up a stable system. A world of the Asteroid Belt type is, of course, an asteroid belt.

A *terrestrial planet* is a small, stony body with relatively little atmosphere. Terrestrial planets are most likely to be found in the inner system, inside the snow line radius. They are unlikely to have many moons, or large ones. Terrestrial planets are classified as Tiny, Small, Standard, or Large in size. All of the world types described in Chapter 4 (except for Asteroid Belt) can be terrestrial planets.

A *gas giant* is a massive planet, composed mostly of hydrogen and helium. Because of a gas giant's powerful gravity, it is likely to have many moons and will affect the formation of other planets in nearby orbits. Gas giants are most likely to form outside a star's snow line radius, but they may migrate inward and can be found at any distance from the star. Gas giant planets are classified as Small, Medium, and Large.

As a result of previous steps, one or more orbits may already be filled. A few gas giants may already be in place since Step 21. A pre-designed world may also already be in place, filling one orbit with an asteroid belt, a terrestrial world, or even a second gas giant (with the pre-designed world as one of its moons). This step fills the rest of each star's orbits.

Every star system has a great deal of debris in it: scattered asteroids outside the main belts, comets and tiny rogue planets in the dark outer fringes. These objects will not be placed in detail (but see *Asteroids and Comets*, p. 130).

Place Gas Giants

For each star, begin by placing gas giants in their orbits.

Some stars may have the No Gas Giant arrangement (p. 107), either because of the presence of a companion star or because that arrangement was selected earlier. In this case, skip to the placement of asteroid belts. Otherwise, at least one gas giant has already been placed – but there may be more in orbits that are not yet filled.

If a star has the Conventional Gas Giant arrangement, orbits inside the snow line radius will *never* have gas giants. A star with the Eccentric or Epistellar Gas Giant arrangement will usually have one gas giant for every 4-6 orbits inside the snow line, and

will always have at least one. In all of these arrangements, orbits *outside* the snow line are almost always occupied by gas giants.

Place gas giants in orbits as needed. To generate a random placement, roll 3d for each orbit not already containing a gas giant or other object. In each case, compare the roll to the appropriate target number from the *Gas Giant Placement Table*. If the roll succeeds, a gas giant will occupy the orbit.

Once all gas giants have been placed, determine the size of each (Small, Medium, or Large). To determine sizes randomly, roll 3d on the *Gas Giant Size Table*.

Modifiers: +4 if the gas giant is inside the snow line radius, or if it is in the first orbit beyond the snow line radius.

Gas Giant Size Table

Roll (3d)	Size
3-10	Small
11-16	Medium
17 and higher	Large

Fill Remaining Orbits

Once gas giants have been placed, fill the rest of the orbits.

Empty orbits and asteroid belts are most likely to occur very close to the primary star, in an orbit adjacent to that of a gas giant, or in the outermost orbit before a forbidden zone caused by the presence of a companion star. All of these locations are places where the gravitational influence of a large object may interfere with the formation of a terrestrial planet. If a terrestrial planet *does* form in such a location, it is likely to be small. Massive terrestrial planets will usually form only in regions that are not subject to the gravitational interference of gas giants or companion stars.

Place empty orbits, asteroid belts, and terrestrial planets in orbits as

needed; if a terrestrial planet is placed, choose its size class (Tiny, Small, Standard, or Large) at this point.

To generate a random placement, roll 3d for each orbit not already containing a gas giant or other object, and refer to the *Orbit Contents Table*.

Modifiers: -6 if the orbit is adjacent to a forbidden zone caused by the presence of a companion star; -6 if the next orbit *outward* from the primary star is occupied by a gas giant; -3 if the next orbit *inward* from the primary star is occupied by a gas giant; -3 if the orbit is adjacent to either the inner limit radius or the outer limit radius. All of these modifiers are cumulative.

Orbit Contents Table

Roll (3d)	Object
3 or less	Empty Orbit
4-6	Asteroid Belt
7-8	Terrestrial Planet (Tiny)
9-11	Terrestrial Planet (Small)
12-15	Terrestrial Planet (Standard)
16 or more	Terrestrial Planet (Large)

Example: Haven's primary star has the Conventional Gas Giant arrangement, so there will be no gas giants inside the snow line. The GM rolls for the four orbits outside the first gas giant's orbit, rolling 15 or less for all four. The outermost five orbits in the system are *all* occupied by gas giant planets. Referring to the *Gas Giant Size Table*, the GM rolls 3d+4 for the first gas giant and 3d for the other four, getting results of 15 (Medium), 10 (Small), 13 (Medium), 14 (Medium), and 6 (Small).

Now the GM prepares to place objects in the orbits inside the snow line, rolling on the *Orbit Contents Table* for each. The innermost orbit is adjacent to the inner limit radius; it gets a 3d-3 roll of 2, indicating an

Gas Giant Placement Table

Arrangement	Inside Snow Line	Outside Snow Line
No Gas Giant	Do not roll	Do not roll
Conventional Gas Giant	Do not roll	15 or less
Eccentric Gas Giant	8 or less	14 or less
Epistellar Gas Giant	6 or less	14 or less

That's no moon. It's a space station.

– Obi-Wan Kenobi, Star Wars

empty orbit. The next orbit gets a 3d roll of 12, indicating a terrestrial planet of Standard size. The next orbit is already occupied by Haven. The next gets a 3d roll of 11 (terrestrial planet of Small size). The last orbit inside the snow line has a gas giant in the next orbit outward; it gets a 3d-6 roll of 4, indicating an asteroid belt.

To summarize, Haven's primary star has the following objects in its system, from the innermost to the outermost: 0.38 AU (Standard world), 0.68 AU (Haven), 1.1 AU (Small world), 1.8 AU (asteroid belt), 3.5 AU (Medium gas giant), 6.0 AU (Small gas giant), 10 AU (Medium gas giant), 17 AU (Medium gas giant), and 27 AU (Small gas giant). The innermost orbit allocated earlier turned out to be empty, and one orbit is occupied by an asteroid belt, so the solar system has eight planets in it, only three of them terrestrial.

At this point, the GM decides to concentrate on Haven and the world at 1.1 AU, leaving further development of the rest of the star system for later.

STEP 24: PLACE MOONS

Gas giant planets almost always have moons, and some terrestrial planets will have them as well. This step determines how many moons each planet in the target star system will have, and their rough sizes.

This book classifies satellites as *moonlets* or *major moons*. Moonlets are asteroid-sized satellites, no more than about 500 miles in diameter, and can be described using the rules in *Asteroids and Comets* (p. 130). Major

moons are worlds in their own right, and will be given a size class (Tiny, Small, Standard, or Large) just like a terrestrial planet.

Terrestrial planets and gas giants can each have satellites, but they are very different in the *kind* of satellites they are likely to have.

Terrestrial worlds, especially those orbiting inside the snow line, are unlikely to have extensive satellite systems. A terrestrial world may capture a few asteroid moonlets, but it is unlikely to have any major moons.

A terrestrial world that suffers a specific kind of massive impact late in its formation era may develop a major moon; planetary material is scattered into orbit and then coalesces into an independent body. Such a major moon will then undergo tidal interactions with its parent world, driving it into an unusually wide orbit. As a result, terrestrial worlds are *very* unlikely to have more than one major moon. With their orbits changing so rapidly, it would be very difficult for multiple major moons to fall into a stable configuration. Instead, they would tend to collide with each other or with their parent world.

Gas giant worlds often have extensive systems of satellites. A gas giant's powerful gravity allows it to compete effectively with its primary star. Early in the planet's history, it attracts plenty of material for the formation of major moons. Later, it captures a number of small asteroids to serve as moonlets. The only gas giants that are unlikely to have large satellite systems are those that have migrated deep into their primary star's gravitational influence.

One feature that is probably unique to gas giants is the *ring system*.

Almost all gas giants in the outer reaches of a star system will have rings, and some of those that have migrated inside the snow line radius will as well. Gas giant rings are composed of billions of small particles, orbiting in a flat disc close to the planet. The rings are largely composed of particles thrown off the gas giant's inner moonlets during meteoroid collisions. A large number of inner moons means that more particles will feed the ring. It also increases the chance that some of the moons will be in a position to act as *shepherds*, maintaining the ring particles in their orbits through a complex gravitational interaction. Normally a gas giant's rings are fairly thin and wispy, but there are exceptions – such as the spectacular ring system of Saturn in our own solar system.

Science fiction has sometimes used the notion of an Earthlike world with a ring system. This situation may be unlikely, but it's not impossible. A moonlet might spiral too close to its parent world and shatter, or a major impact on a moon might scatter enough debris to form a ring. Most such systems will be unstable, with the particles falling to the planet or escaping into space within a few million years at most. The rules that follow won't permit the random generation of a terrestrial world with rings, but the GM may wish to place such a world as a rare case.

Gas Giants

The satellite systems of gas giants are always very complex. A gas giant will normally have up to three distinct *families* of satellites.

The first family is a cluster of moonlets orbiting close to the planet. These moons orbit very close together, sometimes even sharing orbits in a "resonant" pattern that prevents their collision. To determine the number of moonlets in this family, roll 2d.

Modifiers: -10 if the planet is within 0.1 AU of the primary star, -8 if the planet is between 0.1 AU and 0.5 AU of the primary star, -6 if the planet is between 0.5 AU and 0.75 AU of the primary star, -3 if the planet is between 0.75 AU and 1.5 AU of the primary star.



The size of this first family of satellites will determine the level of ring system the planet has. If a gas giant planet has at least 6 satellites in this family, its ring system will be visible from anywhere in the star system, at least in moderately powerful telescopes. If there are 10 or more satellites in this family, the ring system will be comparable to Saturn's, easily visible even in small telescopes from a distance and *spectacular* from close up.

The second family of satellites is a group of major moons. Roll 1d to determine the number of moons in this family.

Modifiers: Do not roll if the planet is within 0.1 AU of the primary star, -5 if the planet is between 0.1 AU and 0.5 AU of the primary star, -4 if the planet is between 0.5 AU and 0.75 AU of the primary star, -1 if the planet is between 0.75 AU and 1.5 AU of the primary star.

The last family is another group of moonlets, captured asteroids that are often in eccentric, highly inclined, or even retrograde orbits. Roll 1d to determine the number of these moonlets.

Modifiers: Do not roll if the planet is within 0.5 AU of the primary star, -5 if the planet is between 0.5 AU and 0.75 AU of the primary star, -4 if the planet is between 0.75 AU and 1.5 AU of the primary star, -1 if

the planet is between 1.5 AU and 3 AU of the primary star.

Make note of the number of satellites in each of the three families.

Terrestrial Planets

Roll 1d-4 (minimum 0) to determine the number of major moons orbiting a terrestrial planet. If the planet has no major moons, it will have 1d-2 (minimum 0) moonlets.

Modifiers (for both rolls): Do not roll if the planet is within 0.5 AU of the primary star, -3 if the planet is between 0.5 AU and 0.75 AU of the primary star, -1 if the planet is between 0.75 AU and 1.5 AU of the primary star, -2 if the planet is Tiny, -1 if it is Small, +1 if it is Large.

Make note of the number of moonlets and major moons for each terrestrial planet.

Moon Size Classes

Major moons are worlds in their own right, and will have a size class. Most major moons are Tiny or Small worlds, although there will be rare exceptions. Assign a size class to each major moon, or roll 3d on the *Moon Size Table* to determine each moon's size class.

A major moon's size class depends on the size class of its parent planet.

For example, if a Standard world has a major moon whose size class is "two size classes smaller," then the moon's size class will be Tiny. The minimum size class for a major moon is Tiny. For the purposes of this table, a gas giant planet is considered a Large world.

Moon Size Table

Roll (3d)	Size Class
11 or less	Three size classes smaller
12-14	Two size classes smaller
15 or more	One size class smaller

Make a note of the size class of each major moon in the star system.

Example: The GM checks to see if the two worlds he intends to develop in detail have moons. For Haven the roll for major moons is 1d-7 (1d-4, and -3 because Haven is close to its primary star), so it can't have any major moons. The roll for minor moons is 1d-5; the GM rolls and gets a result of 0. Haven has no moons.

For the Small world at 1.1 AU, the two rolls are 1d-6 and 1d-4. This world can't have any major moons either, but when the GM rolls 1d-4 he gets a result of 1. This world apparently has a single moonlet, probably an object captured from the nearby asteroid belt.

GENERATING WORLD DETAILS

If the sky hadn't been such a perfect shade of Terran blue, if the warm sunshine hadn't been so exactly as it is on a May morning in Virginia, maybe we wouldn't have been so all-fired homesick. But they were, and we were.

The sun wasn't Sol. We were seventy light-years from the Lincoln Memorial and the Statue of Liberty. Still, I caught myself wondering if the Orioles would finally make it in the American League this year.

– Stephen Tall,
“A Star Called Cyrene”

The broad outlines of the target star system are now known. The following steps can be used to generate detail for individual worlds. Although these rules *could* be used to generate details for every planet and moon in a star system, that isn't their intended use. Instead, the GM should apply them only to those worlds that are likely to be of interest in his campaign.

STEP 25: WORLD TYPES

At this point, every orbit around each star in the target system has been filled with some object, or has been specifically designated as

empty. Terrestrial worlds and major moons are all in place, and the first portion of each one's world type (the size class) is known. In this step, the rest of the world type for each terrestrial planet and major moon will be designated.

Blackbody Temperature

First, the blackbody temperature (p. 84) must be computed for each world. Use the following formula:

$$B = 278 \times (\text{fourth root of } L) / (\text{square root of } R)$$

Here, **B** is the blackbody temperature in kelvins, **L** is the primary star's luminosity in solar units, and **R** is the average orbital radius of the world (or of the planet of which the world is a moon). Note that the blackbody temperature will be the same for a planet and for all of its moons. Record the blackbody temperature for each world, rounded to the nearest kelvin.

Designate World Types

It's now possible to assign a world type to each terrestrial planet and major moon in the star system. Refer to the following table.

In several cases, more than one world type is possible for a given size class and blackbody temperature. Use the following guidelines to decide which type to assign.

Tiny (Ice) or Tiny (Sulfur) Worlds: Tiny (Sulfur) worlds appear as major moons of gas giant planets. Any given gas giant world is likely to have no more than one Tiny (Sulfur) moon, with the rest being of other types. To make the assignment at random, roll 1d for each gas giant with at least one moon that could be of Tiny (Sulfur) type. On a 1-3 there is one moon of that type, almost always the innermost of the major moons.

Standard (Ammonia) or Standard (Ice): Worlds in this temperature range may or may not have abundant ammonia in the atmosphere. Ammonia is sensitive to ultraviolet light, and will break down chemically if subjected to it over long periods. A Standard (Ammonia) world will therefore appear only in orbit around a cool star that emits relatively little ultraviolet. If this choice is available and the primary star's mass is no greater than 0.65 solar masses, then the world will be of Standard (Ammonia) type. Otherwise it will be of Standard (Ice) type.

World Type Assignment Table

Size Class	Blackbody Temperature	Complete World Type
Tiny	140 K or lower	Tiny (Ice) or Tiny (Sulfur)
Tiny	141 K or higher	Tiny (Rock)
Small	80 K or lower	Small (Hadean)
Small	81-140 K	Small (Ice)
Small	141 K or higher	Small (Rock)
Standard	80 K or lower	Standard (Hadean)
Standard	81-150 K	Standard (Ice)
Standard	151-230 K	Standard (Ammonia) or Standard (Ice)
Standard	231-240 K	Standard (Ice)
Standard	241-320 K	Standard (Garden) or Standard (Ocean)
Standard	321-500 K	Standard (Greenhouse)
Standard	501 K or higher	Standard (Chthonian)
Large	150 K or lower	Large (Ice)
Large	151-230 K	Large (Ammonia) or Large (Ice)
Large	231-240 K	Large (Ice)
Large	241-320 K	Large (Garden) or Large (Ocean)
Large	321-500 K	Large (Greenhouse)
Large	501 K or higher	Large (Chthonian)

Standard (Garden) or Standard (Ocean): Worlds in this temperature range may or may not have abundant free oxygen in the atmosphere. Free oxygen must be maintained in the atmosphere by photosynthetic life, which takes time to evolve even on a world that is hospitable for it. A Standard (Garden) world is very unlikely to be less than a billion years old, and will normally be at least 3.5 billion years old. To make the assignment at random, roll 3d and add 1 for every full 500 million years of the star system's age (to a maximum of +10). On an 18 or more the world is a Standard (Garden) world. Otherwise it is a Standard (Ocean) world.

Large (Ammonia) or Large (Ice): As with a Standard world for which this choice is possible, the presence of ammonia in the atmosphere depends on the amount of ultraviolet light emitted by the primary star. If the primary star's mass is no greater than 0.65 solar masses, then the world will be of Large (Ammonia) type. Otherwise it will be of Large (Ice) type.

Large (Garden) or Large (Ocean): As with a Standard world for which this choice is possible, the presence of free oxygen in the atmosphere depends on the evolution of photosynthetic life. Such evolution is significantly less likely on a Large world. To make the assignment at random, roll 3d and add 1 for every full 500 million years of the star system's age (to a maximum of +5). On an 18 or more the world is a Large (Garden) world. Otherwise it is a Large (Ocean) world.

Example: Haven itself is already known to be a Standard (Garden) world. The world in the next orbit outward is already known to be of the Small size class. It has a blackbody temperature of $278 \times (\text{fourth root of } 0.58) / (\text{square root of } 1.1) = 231$ kelvins. This means that the world must be of the Small (Rock) type.

The GM thinks about this second world. Clearly it's a Mars-like planet: small, dry, nearly airless, and probably very cold. The GM decides to make it more interesting by assuming that some long-lost civilization once settled there, leaving behind ruins, odd works of art, and mysterious technological artifacts. The rebels of Haven are slowly investigating these



ruins, looking for items that might give them an edge in any battle against the Galactic Empire. The GM names this planet *Carson's World*, after the rebel scientist who first explored it.

STEP 26: ATMOSPHERE

The atmosphere of each terrestrial planet and major moon can be determined from its world type, as in Step 3. Refer to the procedures beginning on p. 78 and apply them for each world of interest in the target star system.

Example: Haven's atmosphere is already known. Carson's World is of the Small (Rock) type. It will have a negligible atmosphere, so the GM doesn't bother to generate its atmospheric mass or set its composition.

STEP 27: HYDROGRAPHICS

The hydrographic coverage for each world can be determined from its world type, as in Step 4. Refer to the procedures beginning on p. 81 and apply them for each world of interest in the target star system.

Example: Haven's hydrographic coverage is already known. Since Carson's World is of the Small (Rock) type, it automatically has 0% hydrographic coverage. The GM assumes that it has significant deposits of sub-surface ice, which once supported the alien colony and are now used by the rebels.

STEP 28: CLIMATE

At this point, the procedure in Step 5 should be *reversed* for every world of interest. Instead of computing each world's blackbody temperature based on a known average surface temperature, the GM computes an average surface temperature based on the blackbody temperature computed in Step 25.

For each world, compute the blackbody correction using the procedure under Step 5 (p. 83). To determine the average surface temperature of a world, *multiply* its blackbody temperature by the blackbody correction. Make a note of the average surface temperature for each world of interest, along with the climate type from the *World Climate Table* (p. 83).

Example: Haven's climate data are already known. Carson's World has a blackbody temperature of 231 kelvins, determined in Step 25. As a Small (Rock) world, it has an absorption factor of 0.96, and this is equal to its blackbody correction. The average surface temperature on the planet is $231 \times 0.96 = 222$ kelvins (about -60° Fahrenheit). Its climate type is Frozen.

STEP 29: WORLD SIZES

As in Step 6, the density, diameter, mass, and surface gravity of each world can now be determined. These quantities can also be determined for each gas giant planet.

Terrestrial Planets and Major Moons

Determining the size parameters for terrestrial planets and major moons follows the same procedure as in Chapter 4. First determine the density of each world, then its diameter and surface gravity (in either order, as convenient), and then its mass and exact atmospheric pressure.

Gas Giants

Gas giant worlds vary in composition much less than smaller worlds do, and so a gas giant's mass and density are closely related. Small gas giants are composed primarily of ices. Larger gas giants are dominated by hydrogen and helium, which compresses under gravity. In the cores of very large gas giants, the hydrogen is compressed into an exotic "degenerate" state, far more dense and compact than any normal matter. A very large gas giant can actually be denser than a terrestrial world, its average density higher than that of solid iron.

A Small gas giant is between 10 and 80 Earth-masses, a Medium gas giant between 100 and 500 Earth-masses, and a Large gas giant between 600 and 4,000 Earth-masses. A larger world actually ignites nuclear fusion in its core for at least a brief period, and becomes a brown dwarf (p. 128).

Select a mass for each gas giant in the target star system, or roll 3d on the following table. When using the dice, it would be reasonable to vary the mass of the gas giant in either direction, up to halfway to the next entry. To determine the density of the gas giant, read the entry from the table – if the gas giant's mass is between two entries, interpolate the density as well. It would be reasonable to vary the

density slightly (say, by up to 10%) from that given in the table.

Make a note of the mass and density of each gas giant. To determine the *diameter* of the gas giant, use the following formula:

$$D = \text{cube root of } (M/K)$$

Here, **D** is the diameter of the world in Earth diameters (multiply by 7,930 to get the diameter in miles). **M** is the mass of the planet in Earth masses, and **K** is the planet's density in units of Earth's density.

A gas giant has no solid surface. To determine its gravity at the planet's cloud tops, use the formula for surface gravity on p. 86.

Example: Haven's size data are already known. For Carson's World, the GM rolls 3d on the *World Density Table*, using the Small Iron Core column, and gets an 11 (density of 0.8). The minimum and maximum diameters for Carson's World are 0.41 and 0.51 Earth diameters. The GM arbitrarily chooses a diameter of 0.50 Earth diameters (about 3,970 miles). Local surface gravity is $0.8 \times 0.5 = 0.4$ Gs, and the planet's mass is $0.8 \times (0.5)^3 = 0.1$ Earth masses. Carson's World automatically has a Trace atmosphere, since it's a Small (Rock) world.

STEP 30: DYNAMIC PARAMETERS

In this step, several parameters of the target star system can be generated: the orbital period of any companion stars, the orbital period of each planet, the orbital period of each moon, the rotation period of each

planet, and several other features of each world's movement through space.

Stellar Orbital Period

If the star system includes more than one star, the orbital period of any given pair of stars can be computed as follows:

$$P = \text{square root of } (R^3/M)$$

Here, **P** is the orbital period in years, **R** is the average orbital radius of the companion around its primary, and **M** is the *sum* of the masses of the two stars (in solar masses). Multiply **P** by 365.26 to get the period in days.

In trinary or larger star systems, orbital periods can sometimes be computed by treating several stars as one. For example, suppose a trinary star system involves an A-component and B-component orbiting one another at moderate separation, with a smaller C-component orbiting at a much greater distance. Then the orbital period of A and B can be computed using the above formula and *ignoring* C, after which the orbital period of C around the A-B system can be computed by treating the masses of A and B as that of a single star.

Planetary Orbital Period

The orbit of any planet around its primary star can be computed using the same formula as for stellar orbits:

$$P = \text{square root of } (R^3/M)$$

Here, **P** is the orbital period in years, **R** is the orbital radius of the planet, and **M** is the mass of the planet's primary star in solar units. Multiply **P** by 365.26 to get the period in days.

Gas Giant Size Table

Roll (3d)	Small Gas Giant		Medium Gas Giant		Large Gas Giant	
	Mass	Density	Mass	Density	Mass	Density
8 or less	10	0.42	100	0.18	600	0.31
9-10	15	0.26	150	0.19	800	0.35
11	20	0.22	200	0.20	1,000	0.4
12	30	0.19	250	0.22	1,500	0.6
13	40	0.17	300	0.24	2,000	0.8
14	50	0.17	350	0.25	2,500	1.0
15	60	0.17	400	0.26	3,000	1.2
16	70	0.17	450	0.27	3,500	1.4
17 or more	80	0.17	500	0.29	4,000	1.6

Note that this formula assumes that the mass of the planet itself is negligible – usually a good assumption, unless the star is very light (an M5 V or lower) and the planet is very massive (a Large gas giant of 2,000 Earth-masses or more). If greater accuracy is desired, add the mass of the planet into **M**; a planet's mass in solar units is equal to 0.000003 times its mass in Earth-masses.

Planetary Orbital Eccentricity

A planet's orbit around its primary star can be eccentric, just as a companion star's orbit can be. For each planet, choose an eccentricity for its orbit, or roll 3d on the *Planetary Orbital Eccentricity Table*.

Modifiers: +4 if the star has the Eccentric Gas Giant arrangement and the world is a gas giant inside the snow line radius; -6 if the star has the Epistellar Gas Giant arrangement and the planet is a gas giant in the epistellar position; -6 if the star has the Conventional Gas Giant arrangement. When using the dice, feel free to modify the result by up to half of the distance to an adjacent entry on the table.

Planetary Orbital Eccentricity Table

Roll (3d)	Eccentricity
3 or less	0
4-6	0.05
7-9	0.1
10-11	0.15
12	0.2
13	0.3
14	0.4
15	0.5
16	0.6
17	0.7
18 or higher	0.8

For each planet, compute and record the *minimum separation* and the *maximum separation* between the planet and its primary:

$$\text{MIN} = (1 - E) \times R$$

$$\text{MAX} = (1 + E) \times R$$

Here, **MIN** is the minimum separation in AU, **MAX** is the maximum separation in AU, **E** is the eccentricity of the planet's orbit, and **R** is the planet's orbital radius in AU.

Satellite Orbital Radius

Before the orbital period of a satellite can be computed, the radius of its orbit around its planet must be determined. This radius depends on the satellite's origins and its planet's type.

Gas Giants: Recall that a gas giant has three *families* of satellites. The first family is a set of moonlets orbiting close in, the second is a set of major moons orbiting at medium separation, and the third is a set of moonlets orbiting at large distances.

The first family of moonlets orbits at distances between 1 and 2.5 times the planet's own diameter. In most cases, specific orbital information for these moonlets won't be required. If the orbital radius for one of these moonlets is needed in play, select a radius, or roll 1d+4, divide by 4 (retaining any fraction), and multiply the result by the planet's diameter.

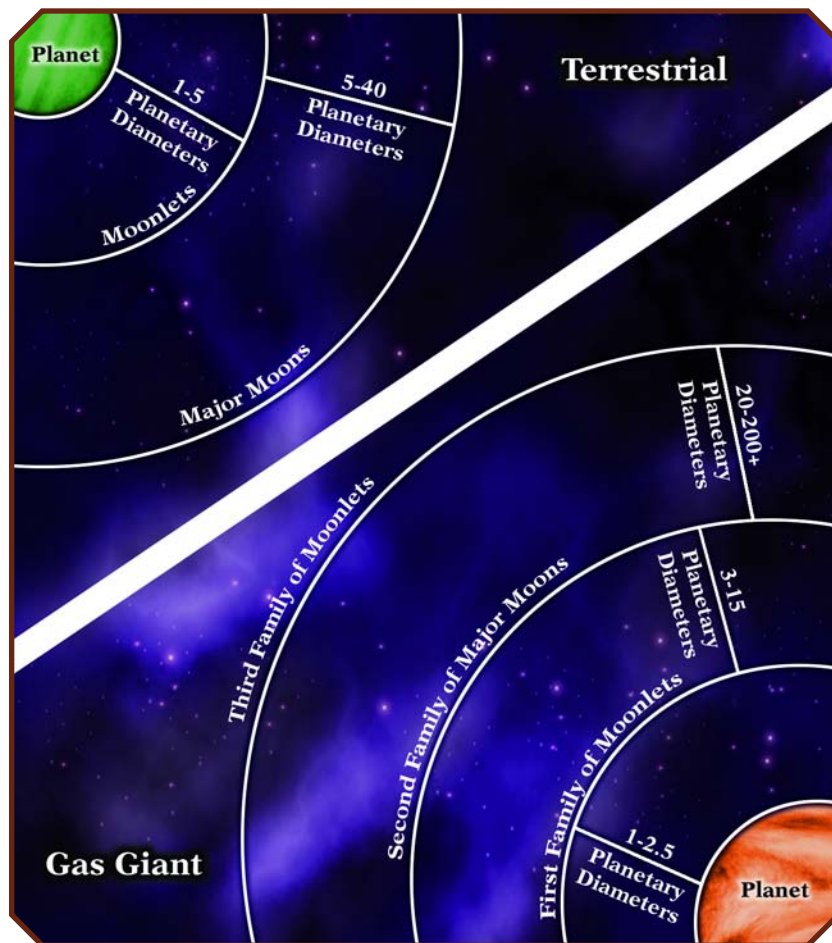
The second family of major moons orbits at distances between 3 and 15 times the planet's own diameter. Select a radius for each moon as needed. To

generate a radius at random: roll 3d+3, and if the result is 15 or more add another roll of 2d. Divide the final total by 2 (retaining any fraction) and multiply the result by the planet's diameter. If any two of the major moons orbit within one planetary diameter of each other, re-roll or assign new orbits to both.

The third family of moonlets begins at 20 planetary diameters and can extend out to several hundred diameters. If the orbital radius for one of these moonlets is needed in play, simply select a radius as needed.

Terrestrial Planets: A terrestrial planet will occasionally have a major moon (and, in very rare cases, more than one). If there are no major moons, it may have one or more moonlets.

Major moons will usually be found between 5 and 40 planetary diameters. The larger the moon is in relation to its planet, the wider its orbit will be due to tidal effects. Select an orbital radius as needed. To generate an orbit at random, roll 2d.



Modifiers: +2 if the moon is two size classes smaller than its planet, +4 if the moon is one size class smaller than its planet. Multiply the result by 2.5, and then multiply by the planet's diameter. If two major moons orbit within 5 planetary diameters of each other, re-roll or assign new orbits to both.

Moonlets will orbit close in, at distances between 1 and 5 times the planet's own diameter. If the orbital radius for one of these moonlets is needed in play, select a radius as needed. To generate a radius at random: roll 1d+4, divide by 4 (retaining any fraction), and multiply the result by the planet's diameter.

Satellite Orbital Period

The orbit of any satellite around its planet can be computed using almost the same formula as for stellar orbits:

$$P = 0.0588 \times \text{square root of } (R^3/M)$$

Here, **P** is the orbital period in days, **R** is the orbital radius of the satellite around its planet in Earth diameters, and **M** is the sum of the masses of planet and satellite in Earth masses. If the satellite is very small compared to its planet, its mass can be ignored.

Tidal Braking

A planet orbiting its primary star will not experience that star's gravity uniformly. The star will exert more gravitational force on the near side of the planet than on the far side. Since a planet is not a perfectly rigid body, it will respond by deforming slightly, forming a pair of "tidal bulges" pointing toward and away from the star. However, if the planet rotates with respect to its primary star, the starward bulge will be offset slightly from a line pointing directly toward it. The star's gravity tends to pull on this bulge, exerting torque on the planet's body and slowing its rotation.

This *tidal braking* also works when a planet has a major moon; the moon's gravity creates tidal bulges and slows the planet's rotation by pulling back on the nearest bulge. Likewise, a planet exerts tidal forces on its moons, slowing their own rotation. As a result,

most major moons are tide-locked to their planets – they rotate exactly once per orbital period, so that they always present the same face to the planet. Some planets orbiting close to their primary stars are tide-locked to the star, causing them to have a day face in permanent light and a night face in permanent darkness.

To estimate the level of tidal force being exerted on a planet by each of its moons, use the following:

$$T = (17.8 \text{ million} \times M \times D)/R^3$$

Here, **T** is a measure of the tidal force on the planet, in terms of the tidal force exerted by Earth's Moon upon the Earth. **T** = 1 indicates an ocean tide averaging about 2 feet at high tide in deep ocean, although the exact amplitude of tides will vary widely depending on the local geography. **M** is the mass of the satellite in Earth masses. **D** is the diameter of the planet in Earth diameters, and **R** is the radius of the satellite's orbit in Earth diameters.

The same formula can be used to estimate the level of tidal force exerted on a moon by its planet. In this case, use **M** for the mass of the planet in Earth masses, and **D** for the diameter of the moon in Earth diameters.

To estimate the tidal force exerted by the primary star on a planet, use a very similar formula:

$$T = (0.46 \times M \times D)/R^3$$

Here, **T** is the same measure of the tidal force on the planet. **M** is the mass of the star in solar units. **D** is the diameter of the planet in Earth diameters, and **R** is the radius of the planet's orbit in AUs.

An important factor is the *total tidal effect* on a world:

$$E = (T \times A)/M$$

Here, **E** is the total tidal effect. If the world is a *planet*, then **T** is the sum of all the tidal forces exerted by its major moons and its primary star. If the world is a *satellite*, then **T** is the tidal force exerted only by its primary planet. **A** is the age of the star system in billions of years, and **M** is the mass of the world in Earth masses. Round the total tidal effect to the nearest whole number, and make a note of it for later computations.

Rotation Period

In general, more massive worlds rotate more quickly, but this is modified by many factors and can depend on sheer accident during the formation of the star system. Tidal braking also has a powerful effect on the rotation of planets and moons.

If the total tidal effect (computed above) on a world is 50 or higher, then the world is tide-locked; its rotation period is equal to its orbital period. If it is a planet, it is tide-locked to its innermost major moon if it has one, or to its primary star otherwise (in the latter case, see *Tide-Locked Worlds*, p. 125). If it is a satellite, then it is tide-locked to its primary planet.

If the world is not tide-locked, then its rotation period can vary widely. Select a rotation period, or roll 3d, add the total tidal effect on the world, and add the appropriate modifier from the *Rotation Period Table*.

Rotation Period Table

World Size Class	Modifier
Large Gas Giant	+0
Medium Gas Giant	+0
Small Gas Giant	+6
Large Terrestrial World	+6
Standard Terrestrial World	+10
Small Terrestrial World	+14
Tiny Terrestrial World	+18

The result is an initial value for the world's rotation period in standard hours (divide by 24 to get the period in standard days).

If the result is greater than 36 hours or the initial 3d roll was a natural 16 or greater, the planet or satellite will have unusually slow rotation. In this case, roll 2d on the *Special Rotation Table*, and use that result instead.

Special Rotation Table

Roll (2d)	Rotation Period
6 or less	Use initial value for period
7	1d × 2 standard days
8	1d × 5 standard days
9	1d × 10 standard days
10	1d × 20 standard days
11	1d × 50 standard days
12	1d × 100 standard days

If the rotation period yielded above is longer than the period a world would have if tide-locked, then it will be tide-locked. Any rotation period derived from the tables can be treated as approximate, and varied by part of an hour, several hours, or several days as appropriate. Rotation periods can also be recorded with precision down to the minute or second, although this is useful mostly for local color.

The rotation period generated here is the *sidereal* period, the time it takes the world to complete one rotation with respect to a distant fixed point. The apparent length of the local day may be different.

In most cases, a planet or satellite will rotate in the same direction as its orbital motion. Some worlds have the opposite tendency, rotating in the direction opposing their orbital motion. Such *retrograde* rotation is more common than one might expect – in our own solar system, two out of the eight major planets exhibit retrograde rotation. Assign retrograde rotation as needed, or roll 3d for each world. A planet will have retrograde rotation on a 13 or more, and a satellite will have it on a 17 or more.

Local Calendar

At this point, the GM can determine the length of various celestial cycles from the point of view of an observer on a world's surface. One formula can be used for all of these computations:

$$A = (S \times R) / (S - R)$$

A is the apparent length of the cycle in question, **S** is the sidereal period of the cycle, and **R** is the rotation period of the world. All of these must be in the same units, usually hours or standard days. If the world rotates retrograde, **R** is *negative*. If **S** and **R** are equal, then the formula gives an undefined result – in this case, assume that the apparent length of the cycle is *infinite*, or that there is no apparent motion.

On a planet, the day length (the time between sunrises) is computed by setting **S** equal to the planet's orbital period and **R** to the planet's rotation period. If the orbital period is much longer than the rotation period,

then the day length will be very close to the rotation period. If day length is *negative*, as often happens if the planet is in retrograde rotation, the primary star will appear to rise in the west and set in the east.

On a satellite, the day length is computed by setting **S** equal to the *parent planet's* orbital period. Otherwise the computation is the same.

The apparent length of a moon's orbital cycle, as seen from the surface of the parent world, is found by setting **S** to the moon's orbital period and **R** to the planet's rotation period. If the length of the cycle is negative, as often happens for very close-in moons, the moon will rise in the west and set in the east. A close-in moon may orbit close to the planet's geosynchronous distance, in which case the moon will spend long periods in the sky as seen from any given location, keeping pace with the planet's surface.

Axial Tilt

The angle between a planet's rotation axis and a vector perpendicular to a star's ecliptic plane is called the *axial tilt* of the planet. The major planets of our own solar system have a wide variety of axial tilt values, and there seems to be no correlation to their other properties. An arbitrary selection would be appropriate.

To generate a random axial tilt, roll 3d on the *Axial Tilt Table*. If necessary, roll 1d on the extended table. In any case, roll 2d as indicated and record the end result.

Axial Tilt Table

Roll (3d)	Axial Tilt
3-6	0 + (2d-2) degrees
7-9	10 + (2d-2) degrees
10-12	20 + (2d-2) degrees
13-14	30 + (2d-2) degrees
15-16	40 + (2d-2) degrees
17-18	Roll on extended table

Roll (1d)	Axial Tilt
1-2	50 + (2d-2) degrees
3-4	60 + (2d-2) degrees
5	70 + (2d-2) degrees
6	80 + (2d-2) degrees

Example: At this step, the GM determines the dynamic parameters for several parts of the Haven star system.

The two stars orbit one another in *square root of* $[350^3 / (0.9 + 0.2)] = 6,200$ years. The GM decides that the two stars are currently close to their minimum separation, making it convenient in case his players decide to explore the red dwarf's planets.

Haven orbits its primary star in *square root of* $(0.68^3 / 0.90) = 0.591$ years, or about 215.9 days. Carson's World orbits the primary in *square root of* $(1.1^3 / 0.90) = 1.22$ years, or about 444.2 days. The GM rolls 3d-6 on the *Planetary Orbital Eccentricity Table* for both Haven and Carson's World, and gets negligible eccentricity for both worlds' orbits.

Haven has no moon. To see where Carson's World single moonlet orbits, the GM rolls 1d+4 for a 5. Dividing by 4 and multiplying by the planet's diameter, he finds that the moonlet orbits at a radius of 0.63 Earth diameters (about 4,960 miles) from the center of the planet. The moonlet's orbital period is $0.0588 \times \text{square root of } (0.63^3 / 0.1) = 0.093$ days. The moonlet orbits *very* quickly, completing a circuit in a little over 2 hours!

The GM then begins to estimate the tidal effects on the two worlds. Neither world has a major moon, so all of the tidal effect on each will come from the primary star. On Haven, the star exerts a tidal force of $(0.46 \times 0.90 \times 1.05) / (0.68)^3 = 1.38$. The total tidal effect on Haven is $(1.38 \times 3.2) / 1.27 = 3.48$, rounded to 3. On Carson's World, the star exerts a tidal force of $(0.46 \times 0.90 \times 0.50) / (1.1)^3 = 0.16$. The total tidal effect on Carson's World is $(0.16 \times 3.2) / 0.1 = 5.12$, rounded to 5.

Since neither world has a very high tidal effect, the GM rolls on the Rotation Period Table for each. For Haven, the roll is 3d+13 (+3 for total tidal effect, +10 for being a Standard-size world), and the GM gets a result of 23. Haven rotates in about 23 hours. For Carson's World, the roll is 3d+19, and the result is 29 hours. The GM may vary these periods slightly later, but for now he simply records both results for use during adventures.

Since the orbital period is much longer than the rotation period for both worlds, the GM doesn't bother to compute the exact day length for either. The rotation periods are close enough. The apparent length of the orbital cycle for the moonlet of

Carson's World is about $(2.2 \times 29)/(2.2 - 29) = -2.4$ hours. The moonlet appears rise in the west and set in the east, passing through the sky against the movement of the sun and stars, and makes a complete cycle in about 2.4 hours.

The last item is the axial tilt for each of the two worlds. The GM rolls on the *Axial Tilt Table* for each, getting a roll of 9 for Haven and a roll of 13 for Carson's World. For Haven, the roll of 2d-2 yields a 1, so Haven's axial tilt is only 11°. Haven probably has a very gentle seasonal cycle (especially since its vast oceans will work to smooth out regional temperature variations). For Carson's World, the roll of 2d-2 yields an 8, so the axial tilt of Carson's World is 38°. Carson's World probably has a strong seasonal cycle, causing vast annual sandstorms and large fluctuations in the size of its polar ice caps.

STEP 31: GEOLOGIC ACTIVITY

A world's level of geologic activity can affect its resource richness, as well as its habitability. This step determines how volcanically active the world is, as well as whether it has an active system of plate tectonics.

Volcanic Activity

Volcanism has a profound effect on a world's surface environment. A world with too much volcanism can be a very dangerous place. On the other hand, a world with too *little* volcanism can be inhospitable as well. Volcanoes concentrate certain trace elements in the upper crust: substances like potassium that are critical for biological processes, along with useful minerals like thorium or uranium. Without active volcanism, these substances will never arrive on the world's surface – or they will tend to be lost to erosion over time, winding up on the ocean bottoms. A world without volcanoes is a world with critical resource deficiencies!

Select a level of volcanic activity from the options below. To generate a level of volcanic activity at random, roll 3d on the *Volcanic Activity Table*.

Modifiers: Divide the world's *surface gravity* (in Gs) by its *age* (in billions of years). Multiply the result by 40, round to the nearest whole number, and *add* the final result to the dice roll. +5 if the world is a terrestrial planet with one major moon, +10 if it is a terrestrial planet with more than one major moon; +60 if the world is of Tiny (Sulfur) type; +5 if the world is a gas giant's major moon of some other type.

Volcanic Activity Table

<i>Roll (3d)</i>	<i>Activity Level</i>
16 or less	None
17-20	Light
21-26	Moderate
27-70	Heavy
71 or higher	Extreme

None: The world is geologically dead. The core may be a solid mass, with no semi-liquid or liquid layer. Trace elements that would normally

be brought to the surface by volcanic activity will be virtually absent. New volcanoes never appear, but there may be extinct volcanoes remaining from the world's early history. Examples in our own solar system include Mercury, Mars, and the Moon.

Light: The world is quiet, but the core is still hot and there are a few areas of active volcanism. New volcanoes appear on a time-scale of many thousands or even millions of years. Trace elements that would normally be brought to the surface by volcanic activity will be present, but uncommon.

Moderate: There are many regions of active volcanism, but volcanoes tend to be separate, and most volcanoes are only occasionally active. New volcanoes appear on a time-scale of decades or centuries. There is plenty of volcanic "recycling" of trace elements in the environment. Examples in our own solar system include Earth.



Heavy: Volcanism is very common across the world's surface. There may be regions where individual volcanoes cluster and merge, permitting magma to well up through great wounds in the crust. New volcanoes appear every few years. There is plenty of volcanic "recycling" of trace elements in the environment.

Extreme: The world's surface is dominated by volcanism. The planet's surface is generally unstable, and new volcanic eruptions can take place almost anywhere and at any time. The atmosphere is very unlikely to be breathable, even if it would otherwise have the proper composition. There is plenty of volcanic "recycling" of trace elements in the environment. Examples in our own solar system include Jupiter's moon Io.

If a Standard (Garden) or Large (Garden) world has Heavy or Extreme volcanism, this may render its atmosphere Marginal (p. 80). In this case, the most likely contaminants for the atmosphere are *sulfur compounds* or *pollutants*. Set the atmosphere to Marginal as needed. To test this possibility at random, roll 3d; if the roll is an 8 or less (for Heavy volcanism) or a

14 or less (for Extreme volcanism), the atmosphere is Marginal regardless of any results obtained earlier.

Tectonic Activity

Any world with a solid surface is likely to experience some level of *tectonic* activity, the movement and deformation of crustal plates over millions of years. High tectonic activity causes earthquakes, but it also makes a planet more likely to be habitable. Tectonic activity causes mountain-building, which helps ensure that erosion doesn't wear all of a planet's landforms down to nothing. As crustal plates move, some plates slide under others into the mantle, recycling crustal materials. The movement of crustal plates also helps prevent the formation of massive "shield" volcanoes, which can have a serious effect on planetary climate.

A Tiny or Small world never has significant tectonic activity. For other worlds, select a level of tectonic activity from the options below. To generate a level of tectonic activity at random, roll 3d on the *Tectonic Activity Table*.

Modifiers: Do not roll for a Tiny or Small world; the world has no tectonic activity. -8 if the world has no volcanic activity, -4 if it has Light volcanic activity, +4 if it has Heavy volcanic activity; +8 if it has Extreme volcanic activity; -4 if the world has no liquid-water oceans, -2 if its hydrographic coverage is less than 50%; +2 if the world is a terrestrial planet with one major moon, +4 if it is a terrestrial planet with more than one major moon.

Tectonic Activity Table

Roll (3d)	Activity Level
6 or less	None
7-10	Light
11-14	Moderate
15-18	Heavy
19 or higher	Extreme

None: The world is tectonically dead. The world's crust is very thick and immobile, not divided into any distinct plates. Crustal quakes are weak and extremely rare. If there is (or has been) any volcanic activity on the world, it has formed massive shield volcanoes, like Earth's Mauna Loa or



Mars' Olympus Mons. There is no mountain-building on the world. Any mountains are accidental geologic features, and will quickly be worn down by erosion if there is a significant atmosphere.

Light: The world's crust may be divided by fault lines into a few plates, which move past each other with some limitations. Crustal quakes are powerful but not common, and are generally restricted to plate boundaries. If there is any volcanic activity, shield volcanoes are common, but there are a few "chains" of smaller volcanoes along plate boundaries. Mountain-building is infrequent, but there is likely to be at least a few old mountain chains, which are well-weathered if there is significant atmosphere.

Moderate: The world's crust is divided into a number of plates, which move freely around and past each other. Crustal quakes can be very powerful, are quite common near plate boundaries, and can even occur in mid-plate regions. Shield volcanoes are uncommon, and most volcanoes are small ones of the "chain" or "arc" type. Mountain-building occurs in cycles, and there are likely to be a number of young, high mountain ranges.

Heavy: The world's crust is divided into many plates. Crustal quakes can be very powerful and can be experienced almost anywhere on the world. Almost all volcanoes are small ones of the "chain" or "arc" type. Mountain-building is almost constant, and most of the world's mountain ranges are likely to be young and high.

Extreme: The world's crust is fragmented and unstable. Crustal quakes are powerful, and can be experienced anywhere on the world at any time. Landforms are likely to be highly chaotic, including a large number of very young, high mountains.

Example: At this point, the GM determines the levels of geological activity for both Haven and Carson's World.

Haven has surface gravity of 1.15 and an age of 3.2 billion years. The modifier for the roll on the *Volcanic Activity Table* is $(1.15/3.2) \times 40 = 14.4$, rounded to 14. The roll of 3d+14 yields a total of 24, indicating Moderate volcanic activity comparable to that of

Earth. The roll on the *Tectonic Activity Table* is 3d with no modifiers, for a result of 11, indicating Moderate tectonic activity as well.

Carson's World has surface gravity of 0.40 and an age of 3.2 billion years. The modifier for the roll on the *Volcanic Activity Table* is $(0.40/3.2) \times 40 = 5$ exactly. The roll of 3d+5 yields a total of 14, indicating no volcanic activity. Meanwhile, since Carson's World is Small, it automatically has no tectonic activity.

STEP 32: RESOURCES AND HABITABILITY

The Resource Value Modifier, habitability score, and affinity score for each world can be determined from its world type, as in Step 7 (p. 87). Refer to the procedures in Chapter 4 and apply them for each world of interest in the target star system.

A world's level of geologic activity affects both its Resource Value Modifier and its habitability score. When rolling for the RVM of a terrestrial planet, modify the 3d roll for RVM by -2 for no volcanism, -1 for Light volcanism, +1 for Heavy volcanism, and +2 for Extreme volcanism. Tectonic activity does not affect a world's RVM. A world's habitability should be modified by -1 for Heavy volcanism or Heavy tectonic activity, and by -2 for Extreme volcanism or Extreme tectonic activity, to a minimum of -2. Apply *both* modifiers if both forms of activity are present.

Example: Haven's RVM, habitability, and affinity scores are all known. For Carson's World, the GM rolls 3d-2 (-2 for its lack of volcanic activity) on the Resource Value Table, getting a 13. Carson's World has Average resources and an RVM of 0. Its habitability is 0, and its total affinity score is 0.

STEP 33: SETTLEMENT TYPE

This book assumes that *one* world – the *main world* – in each star system will be settled first, and that any later settlements in the star system will be

secondary colonies established from the first one. The procedure for determining the population of these secondary settlements depends on whether a pre-designed world is in the star system or not.

Selecting the Main World

If there is no pre-designed world, begin by selecting the main world of the star system. In almost all cases, the world with the *highest* affinity score will be the main world of the system. If there is a tie for the highest affinity score, choose one of the tied worlds as needed, or select one at random. If no world in the star system has an affinity score greater than 0, then *any* world can be selected as the main world.

If the star system includes a pre-designed world, that world can usually be assumed to be the main world of the system. The most common exception is when the pre-designed world turns out not to have the highest affinity in the star system. In this case, the GM has a choice. He can alter the star system's design so that the highest-affinity world is the main world and has the highest population; this may mean removing or reducing any population on the pre-designed world if it turns out to break the rules for secondary settlements. Alternatively, the GM can come up with a reason why the world that *appears* most attractive was not the one most heavily settled.

If the main world was not pre-designed, its settlement type can be set using the guidelines in Step 8. Refer to the procedures beginning on p. 89 and apply them to the main world. The main world's other social parameters will also need to be generated before the population of any secondary worlds can be determined – proceed with Steps 34 through 39 for the main world before returning to this step for the secondary worlds.

Settlement Types for Secondary Worlds

A secondary world will only be settled if the main world has the space infrastructure to support colonization *and* the secondary world is somehow attractive to settlement.

Space infrastructure is a function of a world's available technology, its population, and its economic investment in space industries. If the main world is settled only by an *outpost* (p. 90), or the main world's population is less than 1 million, then no other world in the star system will be settled. If the main world is a home world or colony with at least 1 million people, other worlds may be settled if the local technology can support the effort. Refer to the following table.

Here, the distances refer to the distance between the two worlds at the point of closest approach in their orbits. For example, two planets will come within 1 AU of each other at some point, if their respective orbital radii are no more different than that. At the same time, any satellites of either world will also come within 1 AU of each other. If the star system includes more than one star, and the minimum separation between the two stars is 10 AU or less, then worlds orbiting one star will come within 10 AU of worlds orbiting the other at some point. If a secondary world is within the proper distance of the main world, then a settlement *may* have been established there.

If the affinity score of a secondary world is greater than 0, a secondary *colony* will automatically be established.

If the affinity score of a secondary world is 0 or less, then a secondary *outpost* may be established. Refer to the following table, and roll 3d for each such world that is within the proper distance of the main world.

Modifiers: Add the Habitability score for the world. If the 3d roll is greater than or equal to the target number for the main world's TL, then an outpost will be placed there.

You may wish to override the random placement of secondary outposts

Colonial Requirements Table

Main World TL	Distance of Secondary Colonies
TL6 or less	None
TL7	Any world within 0.1 AU
TL8	Any world within 1 AU
TL9	Any world within 10 AU
TL10 or higher	Any world within same star system

in some cases. For example, it would be unusual for a spacefaring civilization to place outposts on distant planets, but none on the moons of its home world.

Example: Haven's settlement type is already known; its affinity score of 7 is almost certainly the highest in the star system, so it can safely be treated as the main world. Rather than roll dice, the GM decides that there is an *outpost* on Carson's World, populated by scientists and prospectors studying the planet's prior inhabitants.

STEP 34: TECHNOLOGY LEVEL

The TL of the main world can be determined as in Step 9. Refer to the procedures beginning on p. 90 and apply them to the main world of the star system.

Secondary settlements are unlikely to have a TL higher than that of the main world, and may be one or two TL behind the main world if they are not yet self-sufficient. Assign TL to secondary settlements as needed. To generate these TLs randomly, roll on the Tech Level Table (p. 91) for each secondary settlement, applying all the appropriate modifiers. For a secondary settlement, define the "Standard" TL as that of the *main world*, not of the setting as a whole.

Example: Haven's TL is already known. For Carson's World, the GM

rolls 3d+3 on the *Tech Level Table* (+3 since the settlement is an outpost) and gets a 9. The result is Standard (Delayed). Since Haven is at TL10, the GM places Carson's World at TL10 also, but notes that local industries are (like those of the main world) not quite up to galactic standards.

STEP 35: POPULATION

The population of the main world can be determined as in Step 10. Refer to the procedures beginning on p. 91 and apply them to the main world of the star system.

For each inhabited secondary world, begin by computing the world's carrying capacity and then use the following procedures to set the world's population. As for the main world, a secondary colony or outpost's population will not generally exceed its carrying capacity.

Secondary Colonies

To set the population of a secondary colony at random, refer to the *Colony Population Table* on p. 92. Find the total dice roll that corresponds most closely to the population of the main world. *Subtract* the modifier for the main world's affinity score, and then *add* the modifier for the secondary world's affinity score. Then *subtract* another 3d roll. The final result gives a new entry on the *Colony Population Table*, which will give the population for the secondary colony.

Secondary Outposts

The population of a secondary outpost can be determined using the same procedures as in Chapter 4, probably by a roll on the *Outpost Population Table* (p. 93).

Secondary Outpost Placement Table

Main World TL	Target Number
TL6 or lower	Do not roll
TL7	5 or lower
TL8	6 or lower
TL9	7 or lower
TL10 or higher	9 or lower

Example: Haven's population is already known. Carson's World has a total carrying capacity of 20 million $\times 1 \times 0.5^2 = 5$ million. To generate the population for Carson's World, the GM rolls 3d on the *Outpost Population Table* and gets a 12, indicating a population of about 6,000 (PR 3).

STEP 36: SOCIETY TYPE

The society type of the main world can be determined as in Step 11. Refer to the procedures beginning on p. 93 and apply them to the main world of the star system.

Secondary settlements are very likely to be colonies of the main world. In most cases, a secondary colony or outpost will have a World Government with the Colony special condition, and will have the same society type as the main world.

Assign a society type to each secondary world as needed. To generate a secondary world's society type at random, roll 3d and add the PR of the secondary colony. On a 20 or higher, the secondary world is socially and politically independent. In this case, roll on the *World Unity Table*, the *Society Types Table*, and the *Special Conditions Table* (p. 94), all as if the secondary world was the main world of its own star system. If the secondary world is not independent, tie its society type to that of the main world as described above.

Example: Without bothering to roll dice, the GM decides that the Carson's World outpost is still socially dependent on Haven. He places a World Government with the Colony special condition and the Representative Democracy society type, matching Haven.

STEP 37: CONTROL RATING

The Control Rating for each world can be determined as in Step 12. Refer to the procedures beginning on p. 94 and apply them to each world in the star system. Note that most secondary settlements will have the Colony special condition – their Control Ratings will be tied to that of the main world.

Example: The CR of Haven is already known. Since Carson's World has the Colony special condition with Haven as its governing society, its CR is one less than that of Haven: CR 1. The GM notes that Carson's World is a rather rough-and-tumble frontier settlement, with very little in the way of strict law enforcement.

STEP 38: ECONOMICS

The economic parameters for each world can be determined as in Step 13. Refer to the procedures beginning on p. 95 and apply them to each world in the star system.

When computing the trade volume between worlds in the same star system, be certain not to use a distance of 0 in the trade volume formula! If interplanetary distances are already being taken into account in the formula, this will not be a problem. If trade volumes are usually computed over interstellar distances, use a distance equal to half the average distance between neighboring worlds on the interstellar map (as determined under *Playing With Shapes*, p. 72).

Example: The annual per-capita income on Carson's World is only about \$34,000 (50% of the standard income for TL10). The most typical Wealth level on Carson's World is Struggling. The total economic volume of the settlement is $34,000 \times 6,000 = \$200$ million per year. The GM doesn't bother to estimate trade volume for Carson's World, simply assuming that most of the planet's economy is driven by imports from Haven.

STEP 39: BASES AND INSTALLATIONS

Military and space facilities can be assigned to each world using the procedures in Step 14. Refer to the procedures beginning on p. 96 and apply them to each world in the star system.

Example: The GM decides that Carson's World is too small a settlement to have a variety of local bases and installations. Without rolling the dice, he places a Class II spaceport on the planet, and also places a government research station (PR 2) dedicated to archaeology. The design of Carson's World is complete.



The Solar System

As an example of star system design, here is a summary of the major objects in our own solar system as they are described by the world-building rules in this book.

Primary Star (Sol): Spectral type G2 V, mass 1.0 solar masses, age 4.7 billion years, effective temperature 5,800 kelvins, luminosity 1.0 solar luminosities, radius 0.0046 AU.

Orbit 1 (Mercury): Orbital radius 0.39 AU, diameter 3,900 miles, density 0.98, mass 0.055, blackbody temperature 445 kelvins, world type Tiny (Rock). No major moons.

Orbit 2 (Venus): Orbital radius 0.72 AU, diameter 7,500 miles, density 0.95, mass 0.82, blackbody temperature 328 kelvins, world type Standard (Greenhouse). No major moons.

Orbit 3 (Earth): Orbital radius 1.0 AU, diameter 7,900 miles, density 1.00, mass 1.00, blackbody temperature 278 kelvins, world type Standard (Garden). One major moon: Luna – Tiny (Rock).

Orbit 4 (Mars): Orbital radius 1.5 AU, diameter 4,200 miles, density 0.71, mass 0.11, blackbody temperature 225 kelvins, world type Small (Rock). No major moons (but two moonlets).

Orbit 5 (Asteroid Belt): Orbital radius 2.7 AU, world type Asteroid Belt.

Orbit 6 (Jupiter): Orbital radius 5.2 AU, diameter 89,000 miles, density 0.24, mass 320, blackbody temperature 122 kelvins, world type Medium Gas Giant. Four major moons: Io – Tiny (Sulfur), Europa – Tiny (Ice), Ganymede – Tiny (Ice), and Callisto – Tiny (Ice).

Orbit 7 (Saturn): Orbital radius 9.5 AU, diameter 75,000 miles, density 0.13, mass 95, blackbody temperature 90 kelvins, world type Small Gas Giant. One major moon: Titan – Small (Ice).

Orbit 8 (Uranus): Orbital radius 19 AU, diameter 32,000 miles, density 0.24, mass 14, blackbody temperature 64 kelvins, world type Small Gas Giant. No major moons.

Orbit 9 (Neptune): Orbital radius 30 AU, diameter 31,000 miles, density 0.32, mass 17, blackbody temperature 51 kelvins, world type Small Gas Giant. One major moon: Triton – Tiny (Ice).

Notice that Pluto isn't listed as a *planet* here. Indeed, present-day scientists aren't in agreement on whether Pluto has any claim (other than tradition) to planetary status. Instead, it can be considered an unusually large, but otherwise typical, object of Sol's *Kuiper Belt* (p. 131).

SPECIAL CASES

Several special cases can arise during world design. These require special treatment – but they can also provide interesting local situations for play.

GAS GIANT MOONS

A gas giant's major moons are likely to be interesting worlds in their own right, but they are subject to forces that most worlds are not.

Radiation

A gas giant will normally have a very powerful magnetic field, which tends to collect charged particles given off by the primary star. A gas giant's major moons will often be placed so that they orbit in this charged-particle zone, subjecting their surfaces to intense radiation. For example, the surfaces of Jupiter's large Galilean satellites are among the most radia-

tion-hostile places in our solar system.

If a gas giant's moon has a significant atmosphere, this will help protect visitors from the radiation belts. Even a moon with a substantial atmosphere will still have significant background radiation on the surface, but the blanket of air may make the difference between "inhospitable" and "instantly fatal!"

Tidal Effects

A gas giant's major moons will be subject to powerful tidal forces from the gas giant itself. If there are multiple major moons, they will also exert tidal forces on each other, and those forces will actually change in direction and strength as the moons orbit their parent planet. All of these forces will tend to flex and strain the body of each moon, heating them internally and encouraging volcanic activity.

In the case of icy moons of the Tiny (Ice) or Tiny (Sulfur) types, this tidal flexing has a profound effect on the

moon's surface composition. A Tiny (Ice) moon that suffers a great deal of tidal flexing will actually lose most of its light volatiles through volcanism, leaving sulfur and sulfur compounds behind on the surface. The result is a Tiny (Sulfur) world, like Jupiter's moon Io.

A lesser degree of tidal flexing causes *differentiation* of the moon's materials, causing stony and metallic material to sink toward the center while ices rise to the surface. Greater differentiation leads to subsurface oceans, as water ice gathers close to the surface and melts due to tidal heating. Differentiation also means that the surface is "cleaner," more likely to be composed of fresh ice without a dusting of stony material (this will lower the absorption factor used in computing world surface temperatures).

When designing a gas giant's system of moons, assign each Tiny (Ice) moon its own degree of differentiation. In general, the innermost moon

may become a Tiny (Sulfur) world, while other moons will experience decreasing differentiation as they are farther from the gas giant. A moon with greater differentiation is more likely to have extensive subsurface oceans.

TIDE-LOCKED WORLDS

A world that is tide-locked to its primary star experiences uneven heating – its “day face” is constantly being heated by stellar radiation, while the “night face” is in constant shadow. Heat can be transferred to the night face by conduction through the planet’s body, or by circulation of the atmosphere or oceans (if any). If these transfers aren’t sufficient, then the world’s supply of volatiles will tend to freeze out on the night face, leaving the day face dry and nearly airless.

Whenever a tide-locked world is generated, refer to the following table to adjust its physical parameters. The required adjustments depend on the original pressure category of the world’s atmosphere.

Multiply the computed average surface temperature (in kelvins) by the *day face* entry to get the average surface temperature on the day face. Likewise, multiply the computed average surface temperature by the *night face* entry to get the average surface temperature on the night face. Adjust the pressure category for the planet’s atmosphere to be equal to the *final atmosphere* entry (and alter the exact surface pressure to fit). Finally, add in the *hydrographics penalty* to the original hydrographic coverage of the world (to a minimum hydrographic coverage of 0%).



Resonant Worlds

If a planet has orbital eccentricity of at least 0.1, it’s possible for it to fall into a stable *resonant* pattern rather than becoming completely tide-locked. In this pattern, the planet rotates exactly three times in every two orbits, alternately presenting opposite faces to the primary star at every close approach.

Assign a resonant-world situation whenever it seems appropriate, or roll 3d for any planet with high enough orbital eccentricity that would otherwise be tide-locked to its primary star. On a 12 or higher, the world will be resonant.

A resonant world will not be tide-locked for the purpose of determining its atmosphere, hydrographic

coverage, or average surface temperature. The planet gets heated evenly over long periods, although the days and nights are very long and so temperature variations may be *very* wide.

One unusual feature of a resonant world is the apparent motion of its primary star. The length of the day is actually *twice* that of the planet’s year. Since the planet’s orbital velocity changes depending on its position in its orbit, the rate at which the sun appears to move through the sky changes at different times of day. In particular, when the planet approaches its *periastron*, the point of closest approach to the star, the sun appears to slow down in the sky, actually reverse its direction for a while, and then return to its usual pattern of motion!

Tide-Locked Worlds Average Temperature Table

Original Atmosphere	Day Face	Night Face	Final Atmosphere	Hydrographics Penalty
None or Trace	1.2	0.1	None	-100%
Very Thin	1.2	0.1	Trace	-100%
Thin	1.16	0.67	Very Thin	-50%
Standard	1.12	0.80	Standard	-25%
Dense	1.09	0.88	Dense	-10%
Very Dense	1.05	0.95	Very Dense	-0%
Superdense	1.0	1.0	Superdense	-0%

MASSIVE STARS

The world-building system in this book only covers stars of up to 2.0 solar masses in significant detail. More massive stars are somewhat rare, and are unlikely to have planets of their own. However, if used sparingly they may be interesting locations for adventure in their own right.

When placing a massive star in the campaign, simply select its mass. Masses between 2.0 and 5.0 solar masses are uncommon but not impossible in any part of the galaxy. Masses above 5.0 solar masses are *extremely* rare, and no campaign is likely to need more than one or two.

Luminous Stars

Massive stars burn very brightly, but not for very long. They appear very unlikely to have planets – in fact, the most massive stars don't *exist* for long enough to permit planets to form. A system with one of these massive, bright stars in it most likely has nothing but a scattering of asteroidal debris (plus the usual cloud of comets at a considerable distance).

A massive star's neighborhood can be a very dangerous place to visit. Even the smallest stars in this class give off a great deal of ultraviolet radiation, and a strong charged-particle stellar wind. Some of the most massive stars are the so-called *Wolf-Rayet variables*, which give off an extremely strong stellar wind, occasionally ejecting their topmost layers into space to form nested shells of hot, ionized gas.

The following table gives approximate statistics for main-sequence stars of 3.0 solar masses and above.

As a massive star evolves off the main sequence, its *luminosity* actually increases relatively little – perhaps by a factor of 3-4. However, its effective temperature will fall well into the red giant range and even below (2,500-4,000 K). Given the formula for a star's radius (p. 104), it's easy to see that a "red supergiant" star will be *huge*, possibly several AU across!

Such a swollen star might be a very exotic place to visit. A durable and heat-resistant spaceship could even dive *inside* the star, since its outer atmosphere would be very tenuous (a "red-hot fog").

Neutron Stars

Stars of two to eight solar masses end their lives much like less massive stars – at the end of the red giant phase, much of the star's mass is lost, and the core collapses to form a white dwarf. More massive stars die much more violently, in a *supernova* explosion that blows off many solar masses of material in a single violent cataclysm. A single supernova will briefly shine more brightly than an entire galaxy!

For stars of about eight to 25 solar masses, the supernova explosion gives rise to an exotic stellar remnant. The stellar core's gravity compresses it beyond the degenerate level found in a white dwarf's core. Free electrons are driven down into the atomic nuclei, forming an incredibly dense material called *neutronium*. The stellar remnant becomes a *neutron star*, a body only a few miles across, more massive than our own sun.

A neutron star's surface gravity is extremely high, billions of times greater than that of our Earth. It also has an extremely powerful magnetic

field. As infalling matter moves through this field, it gives off high-energy radiation, which is emitted as intense beams of electromagnetic radiation from the star's magnetic poles. Most neutron stars rotate very quickly (on the order of one rotation every second), so these beams of radiation are sometimes swept through space. Anyone happening to lie on the path of one of the beams will see the star "blink" or pulse – hence the term *pulsars*.

Pulsars can serve as very accurate clocks, since the "blinking" is very regular. They can also serve as natural navigational beacons, since every pulsar has a slightly different rotation rate. If a ship that has managed to get lost in the galaxy can locate at least three known pulsars, it will be able to triangulate its position very clearly.

A neutron star always has a mass between 1.5 and three solar masses. Select a mass, or roll 3d+12 and multiply by 0.1 solar masses. The neutron star's optical luminosity will usually be negligible, although a few pulsars flash visible light as well as radio waves.

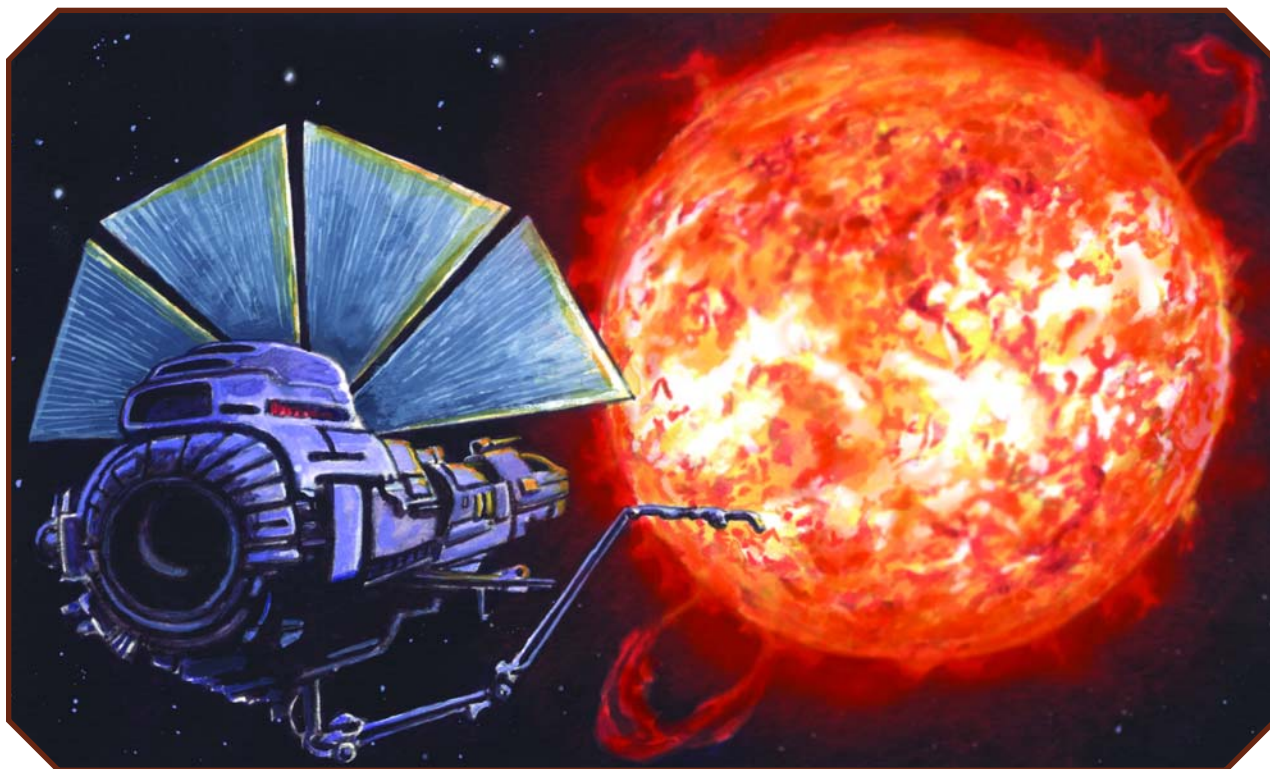
Black Holes

A star whose initial mass is greater than 25 solar units faces the ultimate end. Not even the pressures generated by neutronium can hold up the stellar core as it is compressed by gravity. The whole mass of the star's core collapses into a gravitational singularity, the kernel of a *black hole*.

A black hole, like a neutron star, is an object only a few miles across. Its gravitational influence is so strong that not even light can escape. The gravitational singularity is surrounded by an *event horizon*, marking the

Massive Stars Table

Mass	Luminosity	Temperature (K)	Stable Span (years)
3.0	90	9,800	330 million
5.0	700	14,000	70 million
7.5	3,600	18,000	20 million
10	11,000	20,000	9.0 million
15	58,000	26,000	2.6 million
20	180,000	32,000	1.1 million
25	440,000	36,000	570,000
30	920,000	40,000	330,000
60	15 million	42,000	40,000
100	110 million	50,000	9,000



distance at which everything, including light, is trapped forever. Anything that falls through the event horizon is effectively cut off from the universe for the rest of time.

The powerful gravity of a black hole has a number of odd effects. It's possible for light to *go into orbit* around a black hole, and light that is directed away from its vicinity will lose a great deal of its energy. Spaceships that venture too close will be torn apart by tidal effects even if they don't fall past the point of no return.

On the other hand, at a large distance a black hole doesn't have gravity any more powerful than that of a normal star of the same mass. Contrary to a great deal of TV science fiction, it won't reach out and "suck in" matter that is safely in orbit or is passing by quickly. It's just that a black hole is much more *compact* than a normal star, so the gravity in its immediate neighborhood is extremely intense.

A black hole always has mass of at least three solar units; a good estimate for its final mass is about one-eighth that of the original star. Its luminosity, of course, is zero (although matter falling into the hole will give off X-rays and other powerful radiation).

RED DWARF STARS

Red dwarfs (M-type main sequence stars) are one of the galaxy's most common stellar types. The range of habitable orbits around a red dwarf star is quite narrow, and any planet falling in that range is very likely to be tide-locked to the star (see p. 125 for guidelines on the generation of tide-locked planets). As a result, a red dwarf is unlikely to have any habitable Garden worlds. Still, red dwarfs are so common that they may account for a significant portion of the galaxy's habitable planets.

Many red dwarf stars are *flare stars*. A flare star throws off stellar flares, sometimes similar in size to the flares that occur frequently on the surface of our own sun. However, since a red dwarf flare star is normally much dimmer than Sol, a Sol-sized flare on such a star can vastly increase its brightness – doubling it or even more while the flare takes place! Meanwhile, red dwarf flares are different from those of a brighter star in one respect: they emit many times as much ultraviolet and X-ray radiation. This radiation can be quite dangerous for any life on a world orbiting close to the star.

Flare stars produce flares on an irregular schedule, usually with an hour to a few days between flares. More than one flare can be occurring at the same time. A flare takes only a few minutes to reach peak brightness, then declines slowly over the course of up to an hour.

On a nearby planet, a flare will create a "heat pulse," raising surface temperatures by up to 20% (measured in kelvins) immediately after peak brightness. The heat pulse will be weaker, but will last longer, on a world with a significant atmosphere. The flare will emit ultraviolet and X-ray radiation as well. Those exposed directly to the flare in vacuum will receive about 1 rad per hour of radiation exposure. Those on a planet's surface will be somewhat protected by any atmosphere.

Worlds near a flare star will be unusual places. A lifeless world will still have strange chemical compounds on the surface, as flare radiation interacts with common ices and minerals over long periods of time. If a world has life, that life will have exotic adaptations to a high-radiation environment . . . and it may use the high-energy pulse of a flare in order to fuel bursts of unusual activity.

Assign flare stars as needed whenever red dwarf stars appear. To place them randomly, roll 3d for any red dwarf star; on a 12 or higher, the star is a flare star. A flare star can be designated in its spectral type by an “e” added to the luminosity class. For example, an M5-type flare star has the complete spectral type *M5 Ve*.

BROWN DWARF STARS

Occasionally she called up an inscape view of the outside. Erythrion itself was visible now, a gigantic red eye in the night. The halo world was a brown dwarf, sixty Jupiters in mass, too small to be a sun and too big to be a planet. Like countless billions of others it moved through the galaxy alone in the spaces between the lit stars. So small and invisible were the halo worlds that they hadn't even been known to exist until the end of the twentieth century. But to Rue, Erythrion was huge and magnificent and all the civilization she hoped to ever see.

– Karl Schroeder, *Permanence*

Between the most massive planets and the lightest M-type stars comes a class of barely luminous objects, the brown dwarf stars.

Unlike a gas giant planet, a brown dwarf is massive enough to ignite nuclear fusion in its core, burning the deuterium isotope of hydrogen. Once the deuterium runs out, nuclear fusion shuts down and the brown dwarf begins to cool slowly. The fusion stage lasts only a few hundred million years at most, but the cooling process can last billions of years, as heat leaks from the star's core and is renewed by the process of gravitational contraction.

Brown dwarfs are difficult to detect from any distance, but modern astronomy is beginning to locate them in large numbers – both as companions to visible stars, and as independent stars in deep space. It's possible that brown dwarfs actually outnumber the “lit stars” that are easily visible across distances of many parsecs. Some recent science fiction has begun to use them as a background for stories. If the GM wishes to use brown

dwarf stars in his setting, the following optional rules can be applied.

Placing Brown Dwarfs

Brown dwarfs should be assigned as needed. If every star in a region of space is to be placed on a map, then brown dwarfs should make up at least 50% of the total.

For a more moderate placement, in which the occasional brown dwarf is of interest but most of them will be ignored, use the following procedure. Whenever an M-type red dwarf star (p. 127) is to be placed, roll 3d. On a 7 or less, the star is a brown dwarf instead. This applies both to solo red dwarf stars and to red dwarfs placed as part of multiple star systems.

Brown Dwarf Properties

The most important properties for a brown dwarf are its mass, luminosity, and diameter. A brown dwarf's mass is by definition between about 0.015 and 0.07 solar masses. Select a mass as needed, or roll 3d on the Brown Dwarf Mass Table.

Brown Dwarf Mass Table

Roll (3d)	Mass
8 or less	0.015
9-10	0.02
11-12	0.03
13-14	0.04
15	0.05
16	0.06
17 or more	0.07

Brown dwarf stars evolve very quickly for their first billion years or so of existence. After that, their further evolution follows a predictable pattern. Once the age of a brown dwarf is established (using the procedures in Step 17), the luminosity and diameter

of the star can be determined. Refer to the *Brown Dwarf Evolution Table* (opposite); the luminosity and diameter given are those of a brown dwarf of the given mass at one billion years of age.

Now refer to the following table. Multiply the star's base luminosity by the Luminosity Multiplier for its age, and multiply the star's diameter by the Diameter Multiplier for its age. If the brown dwarf is less than one billion years old, treat it as if it were one billion years old. The results are the current luminosity and diameter of the brown dwarf.

Brown Dwarf Satellites

Treat the brown dwarf in all respects as another star in the star system. In Step 20, compute the inner limit and outer limit radii normally. When computing the snow line radius, use the star's base luminosity (that is, the luminosity it had at one billion years of age). In Step 21, apply a modifier of -4 to the roll on the *Gas Giant Arrangement Table* (p. 107).

From that point on, the normal sequence of steps can be applied. The Standard (Ammonia) and Large (Ammonia) world types may appear as brown dwarf satellites. The Standard (Garden) and Large (Garden) will never appear naturally, as a brown dwarf emits far too little visible light to support photosynthetic life.

ROGUE WORLDS

The world had condensed, sunless, from a minor knot in some primordial nebula. Dust, gravel, stones, meteoroids rained together during multiple megayears; and in the end, a solitary planet moved off among the stars. Infall had released energy; now radioactivity did, and the gravitational compression

Brown Dwarf Base Parameters Table

Mass	Luminosity	Diameter (Earth diameters)
0.015	0.00073	17.5
0.020	0.0016	16.8
0.030	0.0045	15.9
0.040	0.0097	15.3
0.050	0.017	14.8
0.060	0.028	14.5
0.070	0.042	14.2

of matter into denser allotropes. Earthquakes shook the newborn sphere; volcanoes spouted forth gas, water vapor, carbon dioxide, methane, ammonia, cyanide, hydrogen sulfide . . . the same which had finally evolved into Earth's air and oceans.

But here was no sun to warm, irradiate, start the chemical cookery that might at last yield life. Here were darkness and the deep, and a cold near absolute zero.

– Poul Anderson, *Satan's World*

As a new star system is born, many objects of about Earth's mass or larger may form, only to be ejected from the system by a close encounter with one of the coalescing gas giant planets. These *rogue planets* are likely to wander through interstellar space forever, except in the unlikely event that they are captured by another star.

Rogue planets are dark, cold places. A sufficiently massive rogue will generate some heat in its core, due to radioactive decay and the release of gravitational potential energy. Some of this heat may be trapped for very long periods, melting ice under (or even on) the surface. It's not impossible for primitive life to appear on such interstellar wanderers.

Rogue planets would be very hard for any civilization to detect. They might provide valuable stepping-stones between stars, especially for a civilization that has no access to an FTL stardrive. Interstellar nomads might even *settle* a small rogue, mining it for useful minerals and volatiles.

Place rogue planets on the campaign map as needed. To generate their details, treat them as normal planets with a blackbody temperature of about 30 K. Rogue planets are unlikely to have satellites, and naturally they have no “day” or “year” based on their movement around a luminous star.

TERRAFORMED WORLDS

The world design sequence in this book generates worlds that are *naturally* stable over very long periods of time. Humans and aliens will find these worlds as they are – but sapient life tends to alter its environment to

Brown Dwarf Evolution Table

Age (billions of years)	Luminosity Multiplier	Diameter Multiplier
1	1.0	1.0
2	0.41	0.96
3	0.24	0.94
4	0.16	0.93
5	0.12	0.91
6	0.097	0.90
7	0.080	0.90
8	0.067	0.89
9	0.057	0.88
10	0.050	0.88
11	0.044	0.87
12	0.040	0.87
13	0.036	0.87
14	0.032	0.86

suit itself. Many worlds are suitable for *terraforming*, the process of engineering a planet to be more hospitable to settlement.

The GM may wish to assume that terraforming has been common in his universe. Perhaps most settled worlds have been “improved” in some manner to make them more hospitable. Or perhaps a previous civilization left behind terraformed worlds that are still habitable. In these cases, the most likely point to consider terraforming is after Step 32, when the world's physical parameters have been established but before settlement patterns are established.

Atmosphere

If a world has a substantial atmosphere, but the atmosphere isn't breathable, then its composition can be changed. Most Marginal atmospheres can be made completely breathable by tampering with the local ecology, introducing large-scale chemical plants or engineered life forms that will change the composition of the atmosphere. A Standard (Ocean) or Large (Ocean) world can be changed to Garden type with the introduction of photosynthetic life. Other transformations are more of a challenge.

A world that has little or no atmosphere can be given one. If a world is icy, the “makings” of an atmosphere are already present on the ground and need only to be heated up. Otherwise,

comets can be moved to impact on the world's surface, bringing needed volatiles. A Standard or Large world can retain a breathable atmosphere indefinitely, once it has one. Smaller worlds will lose a breathable atmosphere over time, but the process may take millions of years for a Small world, or thousands for a Tiny one – time enough for a civilization to take root.

A world that has *too much* atmosphere is a considerable terraforming challenge. Atmosphere can be stripped away by forcing planetoids to graze the world. A larger body can be forced into a collision, splashing large portions of the atmosphere away. Neither of these techniques is very useful if the terraformers want to leave the surface of the world more or less intact . . .

Hydrographics

A world that has no liquid-water oceans can be provided with them, or existing oceans can be expanded. Ice deposits can be melted with the application of heat. If ice is not available on the surface, cometary material can be introduced to provide it.

Reducing a world's hydrographics can be more difficult. If the world can be cooled, ice caps will grow and lock up some of the world's water. Removing water entirely presents many of the same problems as removing atmosphere.

Climate

A world's climate is among the easiest items to adjust. Terraformers have a number of options to heat or cool a world, and many of them can be implemented on a timescale of years rather than centuries.

A world that is too *cold* can be heated with stellar mirrors or lenses placed in orbit to focus more light on the surface. Small mirror or lens assemblies (called *solettas*) can heat regions to adjust local climate patterns. Large ones can be placed in a wider orbit to increase the total

insolation of the world. Meanwhile, a world that is too *hot* can be cooled by placing a large shade in orbit between the world and the primary star. Stellar radiation can be cut down to any desired level if the shade is large and opaque enough.

If such brute-force methods don't appeal, a world's reflectivity and greenhouse effect can be adjusted slightly, changing average surface temperature by several degrees. Dust, pollen, or ice crystals can be seeded in clouds or on surface ice, to make them more or less reflective. The release of greenhouse gases can warm the

world, while the ecological "take-up" of such gases can cool it.

To reflect these forms of terraforming, the GM can change the parameters that control average surface temperature. Subtle terraforming will adjust the absorption factor or greenhouse factor of a world. Brute-force terraforming with orbital mirrors or lenses actually adjusts the *blackbody temperature* of a world, and can even alter its effective world type. The blackbody temperature can be raised by up to 20% (measured in kelvins), or reduced by as much as 50%.

OTHER OBJECTS

*"Start with the cometary halo," Carlos told me. "It's very thin: about one comet per spherical volume of the Earth's orbit. Mass is denser going inward: a few planets, some inner comets, some chunks of ice and rock, all in skewed orbits and still spread pretty thin. Inside Neptune there are lots of planets and asteroids and more flattening of orbits to conform with Sol's rotation. Outside Neptune space is vast and empty. There **could** be uncharted planets. Singularities to swallow ships."*

Ausfaller was indignant. "But for three to move into main trade lanes simultaneously?"

"It's not impossible, Sigmund."

"The probability –"

"Infinitesimal, right. Bey, it's . . . near impossible. Any sane man would assume pirates."

– Larry Niven,
"The Borderland of Sol"

Aside from stars and planets, star systems contain any number of other objects, many of which can be interesting elements in a campaign or plot.

ASTEROIDS AND COMETS

Asteroids (also called *planetoids*) are small stony bodies, usually found in the inner regions of a star system. *Comets* and other icy objects are found in the outer star system. The world-building system doesn't design these objects in detail, but they can be assumed to exist in almost every star system.

Asteroid Belts

The world-building system sometimes places *asteroid belts* in specific orbits around a star.

Asteroid belts vary widely in content. In a typical belt, the largest asteroids will usually be about 300-600 miles in diameter. Perhaps a few hundred asteroids will be at least 30-60 miles in diameter, and there may be *millions* of asteroids at least a mile in diameter. Despite their sheer numbers, the asteroids in even a thick asteroid belt will not sum up to the mass of a small planet. They're useful primarily because all of that mass is immediately accessible, not tied up in a planet's core . . .

Asteroids are not all found at the same orbital radius. For example, the so-called Main Belt in our solar system has a mean orbital radius of 2.7 AU, but most of the asteroids have individual orbits with radii between about 2.1 and 3.3 AU. Asteroidal orbits are often mildly eccentric, or inclined to the ecliptic plane. All of this means that an asteroid belt will take up a *lot* of space. A large asteroid's nearest neighbors are usually millions of miles away, making collisions very rare. A spaceship's journey through a belt is likely to be quite safe, asteroid-dodging scenes in science-fiction movies to the contrary.

Asteroids are classified according to their composition.

C-type (carbonaceous) asteroids are very dark, and are composed of light compounds and minerals, including a significant amount of carbon and possibly some bound water. They also

contain *chondrules*, small beads composed of iron, nickel, and other useful metals. C-type asteroids are very old objects, remnants of the formation era of a star system. They are quite common, representing about 75% of all asteroids.

S-type (stony-iron) asteroids are primarily composed of stony minerals, with a significant amount of metal also present. They make up 15-20% of all asteroids.

M-type (metallic) asteroids are almost entirely composed of nickel and iron. They make up 5-10% of all asteroids. Given their rarity and high metal content, they are popular among asteroid miners.

Almost any asteroid may contain water or other ices, although these are most common among C-type asteroids. In fact, these asteroids somewhat resemble comets, and some of them may *be* comets that have wandered into the inner star system . . .

Stray Asteroids

Asteroids can be found outside the main asteroid belts of a star system. In general, any gravitationally stable orbit or region of a star system is likely to contain asteroids or asteroidal debris.

One common place to find asteroids is near the Lagrange or "Trojan" points of a gas giant planet's orbit. These are points of gravitational equilibrium, always 60 degrees ahead and 60 degrees behind the planet's position on its orbit. An object in one of these points will tend to stay there, and an

object can take up an “orbit” that wanders around one of the points but never strays too far from it. A massive gas giant will tend to collect asteroids near its Trojan points. For example, several hundred are known to exist in Jupiter’s Trojan points in our own solar system; there are likely to be thousands not yet known.

Other asteroids are “planet-crossers,” objects whose orbits cross the orbit of one of a star’s major planets. If the orbits cross too closely, the asteroid is likely to collide with the planet, or to be ejected into a different orbit after a close encounter. Any given planet in a star system is likely to have dozens of associated planet-crossing asteroids, all of them subject to orbital change over time.

Some planet-crossing asteroids are “quasi-satellites” of the major planets. A quasi-satellite is an object that orbits the planet’s primary star, its orbital period equal to that of the planet, but with higher eccentricity. From the planet’s viewpoint, the quasi-satellite appears to follow a loop around the planet, never approaching too close or wandering too far away. Quasi-satellite orbits are not very stable, and usually change over time until the quasi-satellite status is lost.

Planet-crossing asteroids are interesting because they are often easy to reach from the associated planet. An early spacefaring civilization may send expeditions to such asteroids during its first ventures in off-planet industrial development. A quasi-satellite may also be a convenient place to put an observation post watching the associated planet, especially if the planet has no true satellites or if a closer approach would be dangerous.

The Kuiper Belt

Comets and other icy bodies orbit in the cold outer reaches of a star system, most of them never approaching the habitable worlds of the inner system.

A comet is usually between one and 30 miles in diameter. Comets are often described as “dirty snowballs” – they are dominated by water and other ices, but they also contain grains of silicate dust, metals, and organic compounds. Any given star system may have *trillions* of comets

wandering in its outer reaches, their total mass adding up to that of a small planet. Comets are remnants of the primordial star system, existing almost unchanged across billions of years, unless they happen to fall into the inner star system.

Many comets exist in a flattened disk called the *Kuiper Belt*. The inner edge of this belt is at about the same orbital radius as the most distant planets, but the belt normally extends outward for hundreds of AU. The comets and other objects of the Kuiper Belt are essentially “failed” protoplanets, objects that never coalesced to form another planet.

Comets are sometimes shunted into the inner star system, usually through gravitational interaction with some other object. When this happens, the comet takes up a more or less eccentric orbit, often approaching the primary star so closely that its icy materials boil off to form a long gaseous “tail.” After a number of passes through the inner system, a comet can meet a number of fates. After

the most famous of these are the “planet” Pluto and its satellite Charon. Dozens more have been discovered, most notably the planetoid Sedna.

Comets and larger objects in the Kuiper Belt may be useful objects for space travelers. They are rich in ices, and can be used to supply water or other useful volatiles. They are dark and thinly scattered, and might provide good places for a hideout or a quiet rendezvous. They could even be *settled* by a sufficiently advanced civilization.

The Oort Cloud

On the very edge of a star system is the Oort cloud, a “reservoir” of comets stretching from about 1,000 AU out to a distance of one to two light-years. Unlike the Kuiper Belt, the Oort cloud forms an even sphere around the inner system, and its comets can approach the primary star from any direction. The Oort cloud likely contains large protoplanetary objects, just as the Kuiper Belt does, but so far none such have been detected.

Comets are often described as “dirty snowballs” – they are dominated by water and other ices, but they also contain grains of silicate dust, metals, and organic compounds. Any given star system may have trillions of comets wandering in its outer reaches, their total mass adding up to that of a small planet.

losing too much of its icy body, it can fragment and add to the system’s pool of asteroidal debris. A close encounter with a planet can change its orbit, causing it to take up an asteroid-like path that stays in the inner system. Or a comet can *collide* with a planet . . .

The Kuiper Belt also contains larger objects, with compositions similar to the comets but of size comparable to large asteroids. The largest of these objects will usually be 300-600 miles in diameter, and there are likely to be hundreds or thousands in the 30-60 mile range. In our own solar system,

The Oort cloud provides some of the same plot hooks as the Kuiper Belt, although in this case the question of *finding* any Oort cloud object becomes very difficult. In the dark fringes of a star system, any object is hard to see by reflected light – and in the Oort cloud, comets are likely to spend most of their time billions of miles apart. There may be Pluto-sized objects in the Oort cloud as well; Earth-bound astronomers have found none in our own solar system, but this may only be because such objects are almost impossible to detect.

ARTIFICIAL STRUCTURES

Any star system can contain *artificial* structures – objects that were built or placed in the system by sapient beings.

Asteroid Habitats

People living in deep space can build a home for themselves, turning an asteroid or comet into a habitat. Most of the techniques for building asteroid habitats appear at TL9, when extensive deep-space travel and industry are possible. There are several varieties of asteroid habitat.

Beehive habitats are three-dimensional mazes of tunnels and chambers, burrowed into the body of an asteroid or comet. Beehive habitats usually have some surface installations, such as landing pads, airlocks, vents, tool sheds, and antenna farms. They are almost indefinitely extensible, as the inhabitants continue to carve out new tunnels and chambers. Their major disadvantage is that they are hard to provide with gravity. Asteroids are rarely symmetrical, so tunnels are driven in any convenient direction and “spin gravity” will rarely be perpendicular to the floor. If super-science gravity generation is available, this may not be a problem. Of course, inhabitants that are genetically adapted to microgravity will be able to live comfortably.

Cole habitats are built out of metallic (M-type) asteroids, melted with stellar heat and reshaped to create a hollow metal-hulled shell. A Cole habitat is usually cylindrical, and is rotated on its long axis to provide spin gravity. Nuclear power or stellar mirrors can be used to light the interior. The interior surface can be terraformed with soil, water, and plants, permitting “natural” agriculture and a pleasant lifestyle.

Artificial Habitats

With or without a convenient asteroid to use for building material, artificial habitats can be built in space. Aluminum, steel, and titanium can be mined and launched into space with mass drivers. Power is provided by solar panels or nuclear plants,

Who Needs Planets, Anyway?

Human beings evolved on the surface of a planet, and are dependent on several aspects of the planetary environment for their survival. They need air to breathe, water to drink, and a pleasant temperature to live in. Even the planet's gravity is important.

Still, none of these requirements *have* to be met by living on the surface of a ball of rock and metal massing sextillions of tons. Living on a planet has its disadvantages – most of its mass is buried and inaccessible, and in the meantime it's very difficult and expensive to get off!

Many science fiction writers have speculated about civilizations that make almost no use of planets at all. Instead, they can use found materials – the results of asteroid or cometary mining – to build artificial habitats. They can even settle the asteroids and comets themselves, tunneling into the stone or ice and carving out habitable spaces.

Asteroids and comets can provide all of the raw materials for breathable air, drinkable water, and edible food. If there is no space for arable land, agriculture can use hydroponics or outright food synthesis instead. Fusion power can be fueled by hydrogen liberated from volatile ices. Metals can be used to drive industrial production, including the industries needed to build spaceships or more habitats.

The major difficulty with deep-space settlement is *gravity*, or rather the lack of it. Humans who live in microgravity for a long time suffer progressive loss of health. The immune system declines, muscles and bones atrophy, and the cardiovascular and renal systems suffer problems.

To overcome this obstacle, a habitat can be spun, providing an artificial substitute for gravity through centrifugal “force.” Alternatively, it's possible for genetic engineering to produce a human body that doesn't suffer degradation in microgravity. Of course, superscience “artificial gravity” can provide a healthy environment for human life too. Any of these advances can give rise to a society that regards planets as *inconveniences* rather than homes.

artificial gravity is provided by spin. A thick shell of slag, left over from the manufacturing process, provides radiation shielding.

O'Neill Cylinders: These are the largest and most expensive space habitats. A giant cylinder, as much as several miles in length and a mile or more in diameter, rotates on its axis to provide spin gravity. Inside is a complete terraformed environment, complete with park and urban zones. If more living space is desired, cylinders can be paired, rotating in opposite directions – this also makes docking easier. An O'Neill cylinder can house up to several million people.

Stanford Torus: Smaller than the O'Neill cylinder, the Stanford torus is shaped like a bicycle wheel, with spin gravity and landscaping on the outer

rim. The spokes serve as elevators, leading to a microgravity environment at the hub where special manufacturing processes can be run. A Stanford torus can house about 50,000 people.

Bernal Sphere: A sphere, up to a mile in diameter, with several smaller cylinders attached. The sphere rotates, providing spin gravity in a strip around its equator, but the cylinders are left unrotating to house microgravity manufacturing. The sphere is easy to build, but the lack of spin gravity across most of its inner surface can be inconvenient. A Bernal sphere can house several thousand people.

Smaller Stations: These range from the classic wheel-shaped space station that spins for gravity and has plenty of radiation shielding, down to the much more basic “work shack” that lacks

much of either. Work shacks are usually cylinders or spheres, 30 to 300 feet in diameter and (if cylinders) up to five times as long. Some of these crude stations are made from old fuel tanks or cast-off cargo containers. The only radiation shielding may be a cramped “storm cellar” that the crew uses to ride out solar storms.

MEGASTRUCTURES

The light source was small and brilliant white, very like a view of Sol as seen from the general neighborhood of Jupiter. The ring was huge in diameter, wide enough to stretch half-across the darkened surface of the dome; but it was narrow, not much thicker than the light source at its axis. The near side was black and, where it cut across the light, sharp-edged. Its further side was a pale blue ribbon across space.

If Louis was growing used to miracles, he was not yet so blasé as to make idiotic-sounding guesses. Instead he said, “It looks like a star with a ring around it. What is it?”

Chiron’s reply came as no surprise.

“It is a star with a ring around it,” said the puppeteer. “A ring of solid matter. An artifact.”

— Larry Niven, *Ringworld*

A truly advanced civilization will be able to perform engineering on a grand scale, literally rebuilding star systems to suit their own purposes. Some of the possibilities are as follows.

Rosettes

Objects in space are never motionless, so a civilization that can move large masses around has the problem of making sure they stay where they’re put. One solution is the *rosette*. A rosette is composed of equal masses (large habitats, asteroids, moons, planets) that are placed at the points of an equilateral figure and given equal velocities around the system’s center of mass. The resulting system is dynamically stable. The components will continue to orbit their common center of mass, maintaining their separation as long as they’re not disturbed by any outside gravitational influence.

A rosette is useful primarily as a convenience – the components are guaranteed to remain close to each other at a fixed distance. A civilization that builds many space habitats may use rosettes to keep them in order. A much more advanced society might place whole *planets* in a rosette configuration, possibly with a star at the center of mass.

Macropower Stations

Many objects in space can be tapped for power. Luminous stars, brown dwarfs, and even massive gas giants all have powerful magnetic fields, which can be used to generate electric power. Electrically conductive material is stretched through the magnetic field, carrying massive currents whenever the star or planet’s field fluctuates.

Macropower stations can be used for a variety of purposes. Lasers can transmit power across great distances, powering ships or industrial installations. Particle accelerators can produce antimatter in bulk, to be used in power plants across a star system.

Ringworlds

A *ringworld* takes the notion of a “torus habitat” to the largest possible scale. A ringworld is a large, ribbon-shaped ring, the flat surface turned inward, rotated at high speed to provide spin gravity. The inside surface is sculptured and terraformed to provide an Earthlike environment. The edges of the inside surface have high rim walls, holding in the atmosphere. Light can be provided by a nuclear power plant at the axis of the ring, or by a nearby star. If the ring is *very* big, it can be placed *around* a star.

Ringworlds are mathematically simple, but actually *building* one safely can be a terrible challenge. A ringworld the size of Earth’s orbit would need to rotate at hundreds of miles per second to provide Earthlike gravity; the ring’s foundation structure would need to have more tensile strength than is theoretically possible for normal matter. Ringworlds are also vulnerable to meteor impacts. Any penetration of the ringworld floor will spill all the air into space

unless the hole is patched quickly. Finally, a ringworld is dynamically unstable; if it has a star at its axis, there are no forces tending to keep the star centered, and eventually it may collide with the ringworld.

Even with these disadvantages, a ringworld may be one way for an advanced civilization to get *lots* of living room. If the engineering challenges of an Earth-orbit-sized ringworld can be met, it will provide *millions* of times as much habitable space as a typical Earthlike world. Even a much smaller ringworld can house billions of people without crowding, and can be designed to avoid some of the concept’s drawbacks.

Ringworlds were invented by SF author Larry Niven, who used the concept in a series of novels attached to his “Known Space” universe. The author Iain Banks uses smaller ringworlds, called “Orbitals,” in his “Culture” novels. The videogame *Halo* is also set on a small, ringworld-like structure.

Dyson Spheres

Solar power is abundant and effectively inexhaustible. Its main disadvantage is that only a miniscule amount of it is available on an Earthlike planet. If *all* of the energy output of a sunlike star could be intercepted and used, it would be enough to support a civilization millions of times as powerful as our own.

Of course, to intercept all of a star’s output, a hollow shell has to be built around it. This can be done with millions of individual artificial habitats, orbiting the star in belts and shells of varying size, blanketing it in all directions. Alternatively, a solid sphere can be built at a fixed radius, with habitable surface on the inside. Either of these structures is called a *Dyson sphere*, after the astronomer who first proposed them.

Dyson spheres are among the most *detectable* megastructures. As one is built, it cuts off the visible light from a star, replacing it with the infrared radiation of the sphere’s waste heat. A Dyson sphere could probably be detected by alert astronomers from many parsecs away.

CHAPTER SIX

ALIEN LIFE AND ALIEN MINDS

I emptied the magazine of my gauss rifle into the charging myrmidon. Most of the shots glanced off its thick exoskeleton, but a few found vital spots between plates and it went down twitching. I reloaded, then scanned the area with my hand analyzer, checking for the unique electrical signature of the myrmidons' nervous system. Nothing.

Then I heard a noise from the edge of the jungle and swung my gun up. Had they somehow learned to mask themselves from detection? The myrmidons were incredibly adaptable, but how could they know what we were using to find them? My finger tensed on the trigger.

"Don't shoot! It's us!" I recognized Captain Panatic's voice. A moment later, he and Toshio stepped into the cleared space around the perimeter fence, waving cheerfully. They had some ugly-looking cuts and one of Panatic's arms was in a crude sling, but they were both alive and in good spirits.

"You're alive! How? I saw those myrmidons drag the three of you into their tunnels."

"It's all right," said Captain Panatic. "Toshio here shot the queen with a grenade launcher. Blew her all to bits. The hive's destroyed."

The feeling of relief at seeing them alive was cut by a cold pang of fear. "Captain, do you know what happens in a swarm-mink when the queen dies? It doesn't kill the hive – it just stops the pheromones she produces to keep the soldiers from being fertile. If these creatures work the same way, you've just replaced one queen with thousands!"

"Oh." He looked crestfallen. "I guess we'll have to evacuate the colonists and go nuclear."

"As I recommended from the start." Military men. They just don't understand that sometimes overkill is the efficient option.



ALIENS IN THE CAMPAIGN

Alien life in a space campaign can fill a vast number of roles. The social and political categories for alien species noted in Chapter 1 are pretty much independent of biology – it doesn't usually matter if the dominant species are carbon-based or silicon-based, aquatic or aerial.

From a *dramatic* standpoint, however, alien beings can fit into four categories, and their biology and appearance do affect which one they belong to. In science-fiction stories and films, alien beings seem to naturally clump into types: people, beasts, things, and monsters.

PEOPLE

Aliens as people are probably the most common in modern science fiction. They don't have to *look* like humans – Poul Anderson created many fascinating alien “people” with very unusual shapes – but a humanoid appearance does make it easier to view them as “folks like us.” People-aliens have understandable motives and rational goals. If they are in conflict with humans, the fight is likely to be about something like resources or living space.

They don't have to act exactly like Earth humans, though. Often people-aliens have one or more human traits cranked up to an inhuman degree. Some of these caricature traits are so common in fiction as to be standard types: the warrior Race, the mystics, the ultra-rationalists. Their societies can also parody an aspect of modern human life.

Some readers have criticized people-aliens as being just “humans in funny suits” but others like the idea that a mind is a mind no matter what body it wears. The issue will no doubt remain in dispute until humans actually meet aliens and find out.

BEASTS

Beast aliens make use of archetypes drawn from human perceptions of Earthly animals. They can fit many of the same roles as people-type aliens, but their behavior and culture reflect

their animal models. If people aliens tap into ancient travelers' tales about exotic lands, beasts come from fairy tales and fables about talking animals. Larry Niven's Kzinti are beast aliens based on Terran cats. Genetically modified animals provide a rigorously “hard SF” way to use beast archetypes even in a game universe without any aliens at all.

Beasts are very effective because they come with a ready-made and fairly consistent set of assumptions. Eagles are fierce and solitary, so eagle-like aliens make good “proud warrior” cultures. Some of those assumptions about the relationship between ecological role and personality inform the alien-design rules in this chapter.

Game Masters can also make use of the mythical and legendary associations of Earth animals when creating beast aliens. Snakes aren't evil, but because they have long been used as icons of evil in many Terran mythologies, a civilization of serpent-men aliens make natural campaign villains. Lions aren't particularly noble, but their association with royalty make lion-aliens good candidates for honorable aristocrats.

THINGS

“Happy b-b-birthday, you thing from another world, you.”

– Porky Pig, *Duck Dodgers in the 24 1/2th Century*

The most alien aliens are perceived as “things” – icky and creepy, possibly not even really alive. They draw on our nearly reflexive reactions to things that sting and bite or spread decay. For a long time SF used alien things simply as monsters, as when H.G. Wells used octopuses as the model for his bloodsucking Martian invaders of Earth. But things don't have to be automatically hostile; they may simply be mysterious and incomprehensible to humans. Things are intrinsically *alien*. If humans ever learn how they think, things can turn into funny-looking people.

While things often use “creepy-crawly” animals like spiders and squids for a model, they can also take

on attributes of inanimate or non-living things. Plasma-beings that look like living flames are things, as are cyborg races that have turned themselves into machines.

MONSTERS

Aliens as monsters are probably the oldest role of all – consider Grendel in *Beowulf* or the gorgons of Greek myth. They are menaces, pure and simple. Recent films like the *Aliens* series show the trope is alive and well.

Monsters may or may not be intelligent. If they are, their cleverness only adds to the threat they present. The whole point of a monster is that it's dangerous. If the monster can be negotiated with or placated, it ceases to be a monster and turns into some other kind of alien. The process of “reclassifying” monsters is an old and highly useful science-fiction plot.

Purely animal monsters may be “only” dangerous predators, or may have some other reason for hunting or attacking the heroes. Again, discovering the reason behind an animal monster makes a good adventure. Sometimes, though, a monster is just a monster.

In appearance monsters may be terrifying “things,” or beasts drawing on monstrous archetypes like Terran wolves, or deceptively human-seeming “people” with a deadly secret nature. In cinematic settings, monsters may even look like demons or undead.

WORKING BACKWARD

The bulk of this chapter is concerned with how to create realistic alien species from scratch. There are even tables for randomly generating things like ecological niches and mating styles. Given that humans won't be able to choose or predict what kind of creatures we meet out there, random creation or just doing what sounds cool is a reasonable and even realistic way to create aliens.

But GMs may have a particular role in mind when creating an alien species, and sometimes the random results won't match. It's a pain when the planned "aggressive conquering menace" turns out to be a species of peaceful, sessile filter-feeders.

When you know what kind of alien you want, the solution is to work backward. Consult the alien personality trait tables (see the box *Alien Creation X*) to select a proper mindset. Consult the modifiers for those tables and assign ecological niches, mating habits, and other details that encourage those mental traits. From there, go through the process and either select or randomly generate other features of the species.



Example: Sean wants his alien Andromedans to be a civilization of "evil masterminds" for his campaign. He consults *Alien Creation X* and decides he wants them to be Chauvinistic, Single-Minded (to let them devise grandiose master plans), Curious (to encourage ethically-challenged weird science research), Selfish, Callous, Imaginative, and Paranoid. Consulting the modifiers, he sees that they should have a small-group social structure in which males keep harems, be pouncing carnivores, have strong K-strategy, and be fairly small in size. At this point, Sean could choose to make them beast-aliens modeled on Terran cats, but he wants something more exotic

and distinctive. He decides to give them lots of body segments and an exoskeleton like Terran insects, with long legs for fast sprinting and a poison-tipped tail. Since they're K-strategists, he chooses live birth

over egg-laying. To make them more formidable he assigns them superior senses, including Night Vision and Acute Taste/Smell. There are still some details to be filled out, but the Andromedans are definitely taking shape.

Some Common Aliens

Aliens in SF often fit into a standard type, and when used wisely those types can add a lot of resonance to a space campaign. Some common alien stereotypes include:

Comic Aliens

Foreigners are funny. *Alien* foreigners must therefore be even more funny. Certainly SF writers have gotten a lot of comic mileage out of aliens with bizarre and silly customs or their laughable incomprehension of our *entirely normal* and *reasonable* habits. Often comic aliens are physically cute or funny-looking, typically unthreatening beast archetypes like teddy bears, ducks, penguins, or otters. Comic Things are also common.

Primitives

Aliens that are much less technologically advanced than humans (at least at the time of contact) are often "noble savages," living lives untainted by the corruptions of civilization. Or they can be just plain savages who want to eat visiting space travelers. Either way they fit into many of our stereotypes about "primitive" humans. They are often people-aliens or beast-aliens. In appearance they tend to either fragile beauty or menacing ugliness.

Superminds

Superhuman intellects can be mystical philosophers or ultra-advanced technologists, and sometimes are both. They are usually benevolent (if a bit patronizing), but may be dangerous opponents if they think they're being threatened. In appearance superminds are often physically frail with huge brains; disembodied brains supported by machinery may be things. Superminds may also be completely immaterial beings of "pure thought."

Warriors

Warrior aliens are very aggressive, either from natural combativeness or a militarized society. Sympathetic warriors may be bound by honor and duty, while enemy warriors are often faceless hordes to be mowed down. Beast-aliens based on carnivores are often warrior races.

LIFE

LIFE AS WE KNOW IT

The simplest way to define life is to say that it's "like life on Earth." This has been the operating theory behind

most real-world searches for life on other planets. If it's made of the same chemicals as Terrestrial life and does the same things, it's alive.

Life on Earth is based on nucleic acids – enormously long molecules like RNA and DNA. They in turn are

Clashing Definitions

Defining life has been a troublesome part of the search for living things beyond Earth. Some scientists take a narrow definition: life must be based on DNA in a water matrix, using proteins and getting energy from photosynthesis or the breakdown of organic molecules. Earth life, in other words. This may sound restrictive, but it has its advantages. We know a lot about Earth life, and we can design experiments to detect it, even across interstellar distances. When you're building a multi-billion-dollar space probe, that's an important consideration.

Other scientists, especially those who have studied "extremophile" organisms on Earth, are willing to allow for some weirdness in alien life. They postulate life that gets its energy from sulfur or iron compounds, like some bacteria found in ocean volcanic vents. But they still assume those organisms will be based on DNA and liquid water.

Researchers fond of wild speculation have adopted much looser standards. They postulate that life is any system that can locally increase the level of organization, or that life is any system capable of undergoing evolution. These definitions allow for just about any kind of life – including plenty of types nobody has imagined yet.

For the purposes of this book, we're going to split the difference. We're defining life broadly, including everything from energy-based organisms living in interstellar nebulae to nearly human creatures on nearly Earthlike planets. But we're also assuming that Earthlike life is the most common form, or at least the type most characters are going to spend their time interacting with.

made up of smaller units called nucleotides. Three interesting features make nucleic acids the fundamental molecules of life. The first is that they can replicate themselves. A DNA helix can pull apart into two strands, which can then each assemble new matching strands out of free-floating nucleotide molecules. When the first nucleic acids started doing that in the primordial seas of Earth, one can say that life began. In a very real sense, everything done by living things on Earth since then simply reflects more and more complex and sophisticated ways for nucleic acids to replicate themselves.

The second useful ability of nucleic acids is their ability to encode information, in the form of nucleotide chains. This is important because different chains of nucleotides can encode the formulas (known in the trade as "sequences") for building protein molecules. That ability to "remember" information and build "tools" let the nucleic acids alter their environment – membranes to surround themselves for protection, organelles to process organic molecules for energy, and so on.

Which brings up the third useful ability of nucleic acids. Because DNA is a long chain of units, parts of the strand can change without destroying the rest of the molecule. So DNA can *mutate*. Environmental factors and replication errors can create different daughter chains, which encode different proteins. This lets DNA molecules

evolve. Ultimately the nucleic acids evolved to the point where they encased themselves inside billions of cells organized into huge mobile complexes controlled by powerful brains capable of writing and playing RPGs.

Carbon and Water

Earth life is based on complex carbon compounds for several reasons, and those reasons make it likely that living things elsewhere in the universe may do the same. First, carbon is one of the four most common elements in the universe, so just about any world is likely to have a substantial supply. Second, the electron structure of the carbon atom makes it capable of forming large and complex molecules. No other element known can do that as well as carbon.

Liquid water is also considered crucial for life. On Earth, life formed in water, and just about all Earth life uses water as a solvent and circulatory fluid. Water has some properties that make it especially suited for use by living things. It is liquid over a fairly broad temperature range (180 degrees Fahrenheit), so a planet can have large amounts of liquid water without an unreasonably uniform climate. Second, water has a large heat capacity. This is important on several levels. It means a planet with large water oceans will have a fairly stable climate, and it means that active organisms won't easily boil themselves with metabolic heat.

Alternate DNA

The DNA and RNA molecules used by Earth life aren't the only ones possible. Scientists have discovered several nucleotide molecules (the building-blocks of a DNA helix) that don't occur normally, but which can plug right into DNA and function just fine. So even life very similar to Earth life, based on DNA, might use a different "alphabet" at the molecular level. Extending that metaphor, it's also possible to use the same nucleotides but encode proteins using entirely different sequences – the same "letters" but a different "language."

The double-helix form is also not the only way to organize a DNA molecule. Scientists have created complicated branching nucleotide chain structures, and alien life might use something like that instead.

Proteins are extremely complex and versatile molecules themselves. It's entirely possible that some type of carbon-based life uses giant self-replicating protein molecules instead of nucleic acids as the carrier of genetic information.

Finally, water has an unusual property: when it freezes it expands, so ice floats. Most liquids get denser when they freeze. This means a water ocean develops an insulating cover of ice when it gets cold, whereas a freezing sea of ammonia would chill from the bottom up. Living things can survive in a water ocean even when the air temperature is below freezing. This advantage of water also has its drawbacks – when an Earth organism freezes, the expanding water crystals rupture its cells, killing it. (Some fish and frogs have evolved natural “antifreeze” chemicals to avoid this.) Organisms using a different solvent might survive freezing with no ill effects.

Metabolism

Originally, Earth life did not breathe oxygen, because billions of years ago there was no oxygen to breathe. Early life on Earth was anaerobic, getting energy by fermentation and related processes. Even today there are whole kingdoms of anaerobic bacteria to which free oxygen is pure poison.

Humans breathe oxygen because plants and cyanobacteria produce it as a waste product of photosynthesis. In effect, we’re breathing pollution. If green plants and algae did not constantly renew the supply, Earth’s atmosphere would lose its oxygen, becoming a mix of nitrogen and carbon dioxide. (Any other world that has highly reactive atmospheric gases is a good candidate for life, since something has to be making them.) Oxygen is very reactive, and oxygen-breathers can support a very active lifestyle. Aliens from a world with a different atmosphere might not be able to sustain the level of activity found on Earth.

Chlorine is quite reactive, and would serve as a good oxygen replacement, on a world where the local plants use photosynthesis to break up salts and store energy in sodium compounds. The result would be a chlorine-laced atmosphere and oceans of bleach. Because chlorine is a much less abundant chemical than oxygen, such worlds are probably vanishingly rare, but chlorine-breathers have a long history in science fiction.

Organisms that breathe a gas other than oxygen use the same rule as water-breathers as described under Gills (p. B49): it’s a 0-point feature that balances their need for life support with the ability to breathe something toxic to humans. If humans normally *can* breathe the organism’s native atmosphere but it contains some trace element missing from Earth-standard air, that would qualify as a Dependency, typically at the -25 or -50 point level.

OTHER CHEMISTRIES

While carbon molecules in water are the most plausible basis for life, they are by no means the only possibility. And in a sufficiently big universe, even unlikely forms of life may find congenial conditions. Just about all aliens with variant chemistries should take the Unusual Biochemistry disadvantage in human-centered campaigns.

There are several ways in which life could have a different chemical basis from Earth life. It could use different solvents, like ammonia or hydrocarbons in place of water. It could use different molecules to store genetic information, like silicate chains or complex nitrogen compounds. It could use an entirely different family of compounds for metabolism, genetics, and tissues.

Hydrogen Chemistry

Hydrogen is the most abundant element, and giant planets like Jupiter are essentially big balls of hydrogen. If hydrogen-based life is possible, the Universe holds a *lot* of potential places for it to arise. In extremely dense hydrogen (near the core of a gas giant, for instance) crystals of solid hydrogen could store “genetic” information in a lattice structure.

At more normal pressures and very low temperatures (-250° F or below) lipid molecules (akin to fats found in Terran life) could be the basis of life in a medium of liquid hydrogen. Hydrogen-chemistry organisms would use “reduction” reactions to release energy by combining organic molecules with hydrogen. (The

organics would have to be manufactured by photosynthesis.)

Hydrogen life from a low-energy environment (like a supercold Pluto-type world) would probably be sluggish compared to humans, with Decreased Time Rate and a reduced Basic Speed. However, astronomers have identified gas giants orbiting quite close to some stars where energy is plentiful, so the possibility of very active hydrogen-based organisms from a high-pressure environment exists.

Ammonia Chemistry

Ammonia could replace water as a medium for life. Ammonia has a narrower liquid temperature range than water, so it would require a planet with a very stable climate between -108° Fahrenheit (-78° C) and -27° F (-33° C). In that cold environment, it’s possible for something like Terrestrial nucleic-acid chains to function, or for complex chains of nitrogen or carbon and nitrogen to serve the same purpose. Since complex nitrogen molecules become highly unstable at liquid-water temperatures, ammonia-based organisms could be made of living high explosive! (This does not require the Explosive disadvantage, however, because the temperatures involved would kill the being long before its molecules became unstable.)

Ammonia-based life could conduct photosynthesis if it evolved on a cold Earth-type planet, or might tap the heat differential between layers of a gas giant world’s atmosphere. Such creatures probably would not be oxygen-breathers, since the chief source of oxygen molecules for Earth-type life (carbon dioxide) is a solid at ammonia-life temperatures. Instead, ammonia-based organisms might breathe free hydrogen, either in a gas giant atmosphere or liberated from methane molecules on a cold Terrestrial world.

Living creatures based on ammonia should define their Temperature Tolerance range as centered somewhere between -100° F and -25° F; they are *not* automatically Cold-Blooded in the sense defined by the disadvantage of that name, however. Hydrogen-breathers may take the

disadvantage Fragile (Combustible) if they spend lots of time in oxygen environments, as their “air” can catch fire. Since chemical reactions are slower at ammonia temperatures, either a low Basic Speed or Decreased Time Rate might be appropriate.

Hydrocarbon Life

The Huygens probe found signs of ancient methane lakes on Titan, and one might imagine larger worlds with seas of heavier molecules like octane – gasoline oceans, in other words. Life on a “petrochemical planet” could make use of the fantastic versatility of carbon in ways Terran life has only begun to explore. Organisms made of complex polymers (“plastic”) or lipids (“fats”) could swim in those oily seas. Instead of oxygen respiration, organisms on a hydrocarbon world would probably make use of the “reduction” reaction, breathing hydrogen.

Hydrocarbon-based organisms are likely to be Fragile (Combustible), if not Fragile (Flammable) or even Fragile (Explosive), but only when adventuring off-planet in oxygen environments. As with ammonia-based life, hydrocarbon organisms from a cold environment might have low Basic Speed or Decreased Time Rate.

Silicon and Silicones

On hot planets, silicon-based life becomes a possibility. Silicon is chemically similar to carbon, though it has no gaseous forms. Large silicon objects on Earth are known as rocks, but interesting chemistries become possible when the silicon atoms alternate with oxygen to form silicate chains, or combine with carbon to make the class of molecules known as silicones.

Oxygen respiration is barely possible for silicate or silicone life, but in the hot environment of a world like Venus or Mercury, silicon-based organisms could also get energy from sulfur metabolism or reactions involving fluorine. Silicon life using iron chemistry for metabolism and liquid rock as a solvent might thrive in places like the Earth’s mantle, hundreds of miles below the crust. (For all we know the Earth’s mantle is home to a busy ecosystem that is



equally ignorant of the flimsy water-based life hugging the cold outer surface of the planet.)

Silicon-based life would naturally set its comfortable temperature much higher than humans: somewhere around 300° F for sulfuric acid/silicon creatures, 500° F for silicon/liquid sulfur organisms, and 2500° F or higher for silicon/liquid rock beings. Silicon-based fluorine-breathers adventuring in an oxygen environment should take the Combustible disadvantage, and possibly Increased Life Support to reflect the extraordinary difficulty of handling fluorine gas.

Since high temperatures speed up chemical reactions, silicon beings might live faster than us cold and sluggish humans. This can mean either an increased Basic Speed, or the advantages Altered Time Rate or Enhanced Time Sense.

Sulfur-Based Life

Sulfur-based life could use liquid sulfur as a solvent much as we use water. On Jupiter’s moon Io, volcanos pour out large amounts of sulfur, indicating the possibility of an

underground “ocean” of liquid sulfur. In the absence of free oxygen, sulfur-based life could use carbon-sulfur compounds, fluorocarbons, or silicates as the basis of life. They could breathe hydrogen sulfide (the gas that makes the “rotten egg” smell) or free hydrogen.

Another possible solvent for sulfur-based life is sulfuric acid. On Venus, the clouds contain fairly large amounts of sulfuric acid, and it’s not impossible to imagine a slightly cooler Venusian world with lakes or small seas of acid on the surface. Since a strong acid like sulfuric acid can dissolve rocks, sulfuric acid would also be a good medium for silicon-based life using sulfur chemistry for metabolism. Civilization on such a world might never develop metal-based technology, as only “noble metals” like gold would be able to resist the fantastic corrosion of an acid-laced atmosphere for very long. Instead one can imagine silicon-based organisms developing a combination of “biological” ceramics and silicones as their primary materials for tools and machinery.

Sulfur-based life probably should take the Increased Life Support disadvantage among oxygen-breathers, to reflect the difficulty of handling large amounts of sulfuric acid or molten sulfur. It's possible that a sulfurous organism would have a Bad Smell among oxygen-breathers, since protective suits might not be able to eliminate the rotten-egg odor. Sulfur-based life from a high-temperature environment might have Altered Time Rate.

Non-CHEMICAL LIFE

All of the “weird life” we’ve discussed involves various chemicals used to store energy and information. But there are other ways to do those things.

Plasma Life

Organisms made of hot ionized plasma (within the photosphere of a star, or in a dense and highly

“I haven’t seen anything like that except, uh, molecular acid.”

“It must be using it for blood.”

– Dallas and Brett, *Alien*

energetic nebula) can store energy and information in the form of electric charges and magnetic fields. A self-replicating pattern of electromagnetism could function as the “DNA” for plasma-based life. The plasma organisms could get energy by tapping the hotter layers lower down in the star’s interior.

A “cell” of plasma-based life would be larger than its chemical analogue, because all the processes of life would be happening at nearly the speed of light. The fundamental units of plasma-based life would probably be on the order of a centimeter in size, which means that highly complex organisms big enough for intelligence

would be tens of kilometers long. Of course, living on a star would certainly provide enough room.

Plasma life would be “immaterial” compared to solid creatures like humans. This would best be modeled by the Body of Fire meta-trait. It would require Increased Life Support outside its native environment (as it would need something like a fusion reactor containment torus to live in comfortably).

Magnetic Life

On a neutron star, matter is incredibly compressed by the gravity and the intense magnetic fields. Atoms take on new shapes, their electron orbitals squeezed into rod shapes by magnetic field lines. In those conditions, normal chemical laws break down, and it becomes possible for chains of single atoms to behave like DNA. The intense magnetic fields also provide an energy source, leading to the possibility of an entire ecosystem.

Life made of “degenerate matter” like this would be extremely different from Earth life. It would be much smaller – a creature containing as many atoms as a human would be compressed down to microscopic size. The smaller size and tremendous supply of energy allows a much faster pace. The physicist Robert Forward wrote a fascinating novel, *Dragon’s Egg*, about life on a neutron star; in the course of the story a civilization arises on the star, develops science and technology, and finally goes exploring the stars, all during the course of a few days while bemused human scientists look on!

Magnetic-based life on a neutron star would be certain to have Enhanced Time Sense and several levels of Altered Time Rate; they would also require four levels of Increased Life Support to duplicate neutron-star conditions.

Alien Creation I

Throughout this chapter there are boxes detailing how to create alien life in **GURPS** terms. They are set up so the user can either make decisions based on the game setting and the needs of the campaign, or roll randomly. This system can also be used to create non-sentient creatures.

Chemical Basis

Select the alien’s biochemistry based on the climate of its homeworld, or roll randomly on 3d. GMs should feel free to disallow certain types of life or adjust the probabilities to suit a given game universe.

Roll (3d) Type of Life

3-5:	Hydrogen-Based Life (Frozen worlds below -250° F or Gas Giants)
6-7:	Ammonia-Based Life (Frozen worlds between -100° F and -30° F)
8:	Hydrocarbon-Based Life (Cold to Cool worlds)
9-11:	Water-Based Life (Cold to Hot worlds)
12:	Chlorine-Based Life (Cold to Tropical worlds)
13:	Silicon/Sulfuric Acid Life (Warm to Infernal worlds between 50° F and 600° F)
14:	Silicon/Liquid Sulfur Life (Infernal worlds between 250° F and 750° F)
15:	Silicon/Liquid Rock Life (Infernal worlds above 2500° F, or mantle)
16:	Plasma Life (Infernal worlds or stars above 4000° F)
17-18:	Exotica (Nebula-dwelling life, Machine life, Magnetic life)

Artificial Life

An extremely plausible kind of non-biological life is machine life. Humans are close to being able to build machines capable of creating copies of themselves, and some scientists have proposed launching self-replicating space probes toward other stars. Each probe would create copies of itself and send them further off into space. In time the whole galaxy would be infested with probes, all for the cost of a single launch. Others have proposed similar techniques to create asteroid mining robots or terraform other planets. Author Fred Saberhagen imagined "Berserkers" – self-replicating robot spaceships dedicated to annihilating all life they encounter.

Machine life need not have any physical existence at all: there could be entire civilizations of artificial-intelligence organisms living entirely within the memory of complex datanets. Such "virtual life" could be descended from organic life if it becomes possible to "upload" an organic intelligence into data form.

Mechanical intelligence could develop from sub-intelligent machinery. One can easily imagine cosmic rays inducing "mutations" in the programming of a

self-replicating machine, erasing its original purpose and leaving it no goal other than that of creating as many offspring as possible. Mutations (or conscious design changes) in the offspring machines could eventually create an entire mechanical "ecosystem" of predators, parasites, and prey. If the machines aren't intelligent to begin with, evolution might eventually produce sentience.

Alternately, artificial intelligence machines might deliberately set out to create their own civilization apart from organic life. In an advanced civilization with "uploading" technology (like that presented in *Transhuman Space*), the distinction between bio-life and machine life might seem as unimportant as the difference between acoustic and electric guitar music.

Whatever its origin, machine life can thrive in a much broader range of environments than biological life. Machine life may or may not have the Machine meta-trait, as highly evolved machines based on nanotechnology could appear to be living things even at the microscopic level.

ECOLOGIES AND NICHES

An ecology is the sum of all living things in a given area. By definition, all living things are part of an ecology. A creature's place in its native ecology determines a great deal about it.

ENERGY FLOW

Life can't exist without energy. Every ecosystem is based on a flow of energy from some non-living source. Certain organisms (called autotrophs or primary producers) tap that energy and change it into forms that life can use.

Energy Sources

On Earth, the chief source of energy is sunlight, and plants are the primary producers. On other worlds there might be different energy sources.

Chemosynthesis is the process of extracting energy from available non-living chemicals. On Earth chemosynthetic organisms are mostly found near active volcanic sources, as those provide a steady flow of energetic chemicals. Iron and sulfur are the most common bases for chemosynthesis on Earth.

In environments with a strong heat gradient, organisms might live by thermal energy. Humans are very familiar with this; it is the basis of just about all our technology. Living things might tap heat differential in a kind of "engine" like a boiler, or could use the electric current flow in heated metal dipoles. Whatever the method, heat-based life must have one end in the heat source and one end at a heat sink – there must be a flow to make things work properly. Plasma-based beings living on the surface of a star could do the same.

Radioactive minerals give off energy. To most Earth life radiation is hazardous, but some organisms might evolve to make use of low-level radiation. Gamma rays may be too energetic, but beta particles could be a useful source of energy. The trick would be finding enough radioactive material to keep alive. On Earth it is thought that a combination of volcanic activity and water-concentrated radioactive minerals at sites in Africa, creating natural nuclear reactors that endured for centuries. On an alien world this might be more common, especially with radiation-eating organisms helping the process along.

In a science-fiction setting with superscience power sources like "cold fusion" or "zero point energy," some organisms may have evolved to make use of them. This could allow for creatures that can make use of incredible amounts of energy, without needing to eat anything at all.

Nutrient Sources

In addition to energy, living things need a reliable supply of chemical building blocks. For plants and other autotrophs, the important nutrients are the basic chemical elements in forms they can use. Plants on Earth, for instance, use nitrogen but they don't get it from the air; they require nitrogen compounds in the soil or dissolved in groundwater, and those compounds have to be produced by bacteria. Less abundant elements like phosphorus, potassium, and others can limit biological activity even when energy is abundant. In the oceans, the water at great depth is often nutrient-rich, but the environment is low in energy, while surface water is nutrient-poor. Upwellings where currents bring up nutrients are apt to be places of spectacular abundance.

Consumers

One good way to get energy is to steal it. As soon as a population of organisms exists that extract energy from the environment, other organisms are going to start extracting energy from them. And then in turn other creatures will start to eat the eaters, and so on. Eating other living things has the advantage that the food is very concentrated, so consumers – carnivores and herbivores – can be large and active.

Environment Types

The **GURPS** rules distinguish among 16 different types of environments: eight each for land and sea (p. B224). These environments are obviously based on an Earthlike setting, but they have analogies on every kind of world.

Arctic environments are any place where the temperature hovers around the low end possible for that type of life. For Earth life, it's places where it's often below freezing. For silicon-based life it's a chilly 200° F!

Desert environments are any place where the necessary solvents or nutrients for life are scarce. There's often plenty of energy, just no stuff to use. Deserts also tend to extremes of temperature. Life tends to be scarce, clustered around oases.

Island/Beach environments are an interface between land and sea, and as such are especially suited for amphibious beings. The "sea" can be any kind of fluid, obviously. Islands in particular can support isolated micro-ecologies where species evolve in unusual ways.

Jungle settings are lush, dominated by huge autotrophs (trees, on Earth). They support lots of life, but often that life has evolved an array of defenses. Jungles offer many specialized niches for life to exploit.

Mountain environments are often poor in resources for life, simply because fluids drain away downhill and erosion scours away the soil. At very high altitudes, even *air* is scarce! Mountains often support lots of "micro-ecologies" specialized for a particular altitude.

Plains are wide-open regions with fairly abundant life, dominated by small area producers (grass, on Earth)

and the grazers that feed on them. Because plains are so open, the things that live there are often highly mobile.

Swampland environments are another interface, where land and water (or whatever the local fluid is) meet, but there is protection from the mechanical force of waves on the shore. They support abundant life, especially amphibious life.

Woodlands, like jungles, are mature "climax" environments of large, slow-growing primary producers. Unlike jungles, woodlands are subject to greater climate variation, usually tied to the seasons. Food is abundant at certain times of the year, but scarce at other times, and everything in the environment must be able to cope with the cycle. On planets with extreme climate variation, there may be no jungles, only woodlands. By contrast, on a planet with little climate change, woodlands would be rare (replaced by something akin to a temperate or cool jungle-like, high-altitude tropical forests).

In the ocean, *Banks* are coastal waters where nutrients are abundant. They can support a great deal of life; on Earth they are the great fisheries. One can call banks the marine equivalent of plains, since they have lots of food but most of the animal life is quite mobile.

Deep Ocean Vents are isolated places where nutrients and chemical energy are abundant, but the organisms that live there must be highly specialized. Because they are isolated, each vent site is an entirely separate ecosystem with unique species. On ice-covered worlds like Europa, vents may be the most thriving ecosystems.

Fresh-Water Lakes are full of energy and nutrients, but they are isolated from each other and from the ocean. They are also short-lived, geologically speaking, which means life doesn't have a whole lot of time to evolve to exploit a particular lake. Instead, most lake organisms enter via rivers and adapt to local conditions. On alien worlds, lakes are any isolated but thriving aquatic environment that exists for only a few thousand years. There are some similarities between island environments and lakes, as both are typically colonized by life from other regions.

Open Ocean is kind of like a desert full of water: there's plenty of energy but no nutrients, so life is sparse. Isolated reefs serve as "oases" where living things cluster.

Reefs are similar to jungles in the ocean. They are places of abundant life, often dominated by large plants or colony creatures (coral). Living things are abundant and the local food web is complex.

River/Stream environments are another interface, like beach or swamp, but have some unique features of their own. A river flows through different environments, creating lots of micro-ecologies along its course. The water level in a river depends on rainfall, so it usually goes through an annual cycle of high water and drought. The creatures that live in a river environment must be able to cope.

Salt-Water Seas are isolated bodies of water where the salt level is concentrated by evaporation. Ordinary aquatic life has trouble handling the high-salt conditions, so they are the aquatic equivalent of desert regions.

Tropical Lagoon environments are the counterpart of beach or swamp-land: a coastal zone *under* the water. Lagoons in particular are sheltered and shallow, and can host a great variety of organisms. As in the other coastal zones, many lagoon species are amphibious.

Alien Environments

Many possible alien environments are not found on Earth. Most of them can be modeled by analogy with one of the types described above. In a gas giant's atmosphere, upwellings of material from deep layers might correspond to reefs or banks in an ocean. A seafloor away from vents or reefs would be like open ocean. Subterranean environments might map well to oceans, with banks or lagoons where magma currents provide lots of nutrients. A system of caves with native life would resemble freshwater lakes or deep ocean vents in terms of ecology.

More exotic settings can work by analogy, based on how abundant energy and nutrients are, and how easy the environment is to move around in. Plasma-beings on the

Alien Creation II

Habitat

First decide where in space the organism lives. Space-dwelling life requires no planet. Planet-bound life comes in two types: those native to gas giant atmospheres, and those living on more or less terrestrial planets. Since we're assuming the GM has already created the home planet of the aliens, those details should be obvious.

For terrestrial planet life, determine if it lives primarily on land or in water. Decide, or roll 1d: on a 1-3 it is land-dwelling, 4-6 it is water-dwelling.

Modifiers: -1 if the planet's surface is 50% ocean or less; -2 if it is 10% or less; +1 if it is 80% ocean or more; +2 if it is 90% ocean or more. On planets that are entirely water, the only land environment available is Island/Beach. Worlds with 0% ocean coverage can only have Salt-Water Sea, Fresh-Water Lake, or River-Stream aquatic environments. Gas giant life uses the water table.

Then determine the specific habitat type. Roll 3d:

Roll (3d)	Land Habitat	Water Habitat
3-7	Plains	Banks
8	Desert	Open Ocean
9	Island/Beach	Fresh-Water Lakes
10	Woodlands	River/Stream
11	Swampland	Tropical Lagoon
12	Mountain	Deep-Ocean Vents
13	Arctic	Salt-Water Sea
14-18	Jungle	Reef

Trophic Level and Strategy

Now determine or decide how the organism gets its energy. There are two tables, one for a random animal in the environment, the other for potentially intelligent life. Note that Deep-Ocean Vent autotrophs cannot be photosynthetic. Some beings may use two methods.

Ordinary Animals: Roll 3d.

Roll (3d) Trophic Level

3	Combined Method: roll twice.
4	Autotroph (1-3: Photosynthetic, 4-5: Chemosynthetic, 6: Other)
5	Decomposer
6	Scavenger
7	Omnivore
8-9	Gathering Herbivore
10-11	Grazing/Browsing Herbivore
12	Pouncing Carnivore
13	Chasing Carnivore
14	Trapping Carnivore
15	Hijacking Carnivore
16	Filter-Feeder (becomes Trapping Carnivore in Arctic or Desert)
17-18	Parasite/Symbiont

Sapient Organisms: Roll 3d, no modifiers.

Roll (3d) Trophic Level

3	Combined Methods (roll twice)
4	Parasite/Symbiont
5	Filter-Feeder (becomes Trapping Carnivore in Arctic or Desert)
6	Pouncing Carnivore
7	Scavenger
8-9	Gathering Herbivore
10	Omnivore
11-12	Chasing Carnivore
13	Grazing Herbivore
14	Hijacking Carnivore
15-16	Trapping Carnivore
17	Decomposer
18	Autotroph (1-3: Photosynthesis, 4-5: Chemosynthesis, 6: Other)

surface of a star might be like sea creatures, with "banks" in nutrient-rich regions. The fact that the nutrients are upwellings of helium from the stellar interior or concentrated magnetic field loops doesn't change the logic of the ecosystem.

AUTOTROPHS AND DECOMPOSERS

Autotrophs are organisms that tap directly into primary energy sources like sunlight or reactive chemicals. By far the most common autotrophs on Earth are plants, which use sunlight to

conduct photosynthesis. One can imagine other autotrophs that use solar power via the photoelectric effect, or which heat up a kind of "solar boiler" for power.

Photosynthesis has an efficiency of roughly 1%, so on Earth could produce about one calorie per hour per square foot of collecting area. Since humans need some 2,000 calories per day, a plant-person would need to have huge "solar panels" with an area of at least 200 square feet. On a planet with more intense sunlight, the required area naturally goes down, so mobile autotrophs get more likely. A more efficient form of

photosynthesis would also help, allowing either less collecting time or smaller collecting area, although a practical maximum would be around 50%. Photosynthesizers might have to remain nearly immobile during the day, giving them the Nocturnal disadvantage.

Some microorganisms live by chemosynthesis, and if suitable sources of energetic chemicals were available they might evolve into larger multicellular forms. The *source* of those energetic chemicals would be hard to explain, however. Volcanic vents are one good possibility.

Decomposers

Decomposers get their energy from breaking down organic materials. On Earth, fungi and many microorganisms are decomposers. They aren't primary producers like autotrophs – they don't bring energy into the system – but they do tend to resemble them in "lifestyle."

Both autotrophs and decomposers are usually static beings, since it's hard for a plant or a fungus to accumulate enough energy to be active. Some slime molds can move about, and some plants (like Venus flytraps or orchids) have structures that can react to stimuli, but you don't see them striding across the landscape. All autotrophs and decomposers would probably qualify for either the Sleepy or Slow Eater disadvantages, and might have No Legs (Sessile) as well.

For autotrophs or decomposers to be as active as animals, they would need a very concentrated source of energy, and a *need* to be mobile. On a world with vastly more intense sunlight than Earth, plants could move – but why? Plants would need to be mobile only if they depended on some resource that moved about (like intermittent water sources in a desert, perhaps). Chemosynthetic autotrophs might have to move around to find new sources of energetic chemicals. Decomposers obviously need to be able to seek out new sources of rotting material, but the energy released by breaking it down is limited.

One possibility is autotrophs or decomposers that are active only during a certain life phase. Imagine a plant whose "fruit" are like small animals, using stored energy to roam in search of the ideal place to put down roots and take up life as a new plant. Another possibility is an autotroph or decomposer that can "moonlight" as a consumer, especially if the environment has large seasonal changes in availability of energy. Maybe when the winter days get short, the trees can get *hungry*.

HERBIVORES

In this discussion, "herbivores" refers to any creatures that eat essentially unresisting food. On Earth, herbivores are plant-eaters, but one might define the baleen whales as being the

equivalent of herbivores, since the prey they hunt (krill) are about a thousand times smaller than they are. From a whale's point of view, krill might as well be plants. Aliens that consume nonliving food (like active chemosynthetic organisms or machine life that mine what they eat) are functionally herbivores. One can further subdivide herbivores by how abundant their food is and how much work they must do in order to get it.

Filter Feeding

Filter-feeders live in a fluid environment that is so rich in food they can just drink it in. They don't even have to move – many Terran filter-feeders live rooted to a single spot for most of their lives. They simply sit and suck in material, sifting out the good parts. In an abundant environment, like shallow tropical seas, filter-feeders can get quite big; some sponges and giant clams weigh hundreds of pounds. In environments like deep ocean vents, the distinction between a chemosynthetic autotroph and a filter-feeder may be too subtle to notice. Because filter-feeders typically have to process a lot of mass, they take the Slow Eater disadvantage.

Grazing

Grazing organisms eat low-energy food that is very abundant. The chief problem is just eating it fast enough. Often their food has defensive chemicals, which the herbivore's digestive system must be able to handle. Grazers can get quite large, especially if there is never any food shortage. Standing around and eating all day doesn't require much in the way of brains, but many grazing animals live in large groups, and can develop complex social and communication abilities. (These concepts also apply to any organism or machine that lives by processing large amounts of material.) Grazers typically take the Slow Eater or Increased Consumption disadvantages.

A related type of herbivore are *Browsers*. Like grazers they eat lots of low-energy food, but where Terran grazers eat grass and similar plants, browsers eat leaves from trees and shrubs. They may be tall (to reach

what they eat), and can get quite large. Browsers and grazers can have a tremendous effect on the environment, preserving or even expanding the area covered by grassland. In this chapter, browsers and grazers are lumped together.

Gathering

Gatherers consume high-energy food. Often this means they must go to a lot of trouble to find it. Some gatherers specialize in a single food, and develop highly specialized organs to locate and harvest it. Others prefer to generalize. Gatherers tend to be smaller than grazers and have excellent senses. Their digestive systems can generally cope with a variety of toxic chemicals. They are often fairly intelligent, especially if they live in social groups. Some gatherers supplement their plant diet with smaller animals, scavenged remains, or eggs. (Gathering is analogous to machine or physical life that must seek particular resources that are sometimes hard to find, but which are fairly rich or rewarding.) Specialized gatherers may have the Restricted Diet disadvantage, while gatherers that consume lots of toxic plants can have the advantage of Resistant to poison, Reduced Consumption (Cast Iron Stomach), or both.

CARNIVORES

Carnivores are meat eaters. That is, they consume other animals, or at least something that can try to run away or fight back. Herbivores in an environment with mobile plants would effectively be carnivores, because of the need to subdue dinner. Animal food is high in energy, so carnivores don't have to eat as often, but this is offset by their frequent failures to get a meal. They come in several types, based on how much effort they put into getting their food.

Scavengers

Scavengers prey on the creatures that are easiest to catch – dead ones. They devour the remains of other predators' kills or animals dead of disease and accident. Usually they have impressive resistance to disease and decay toxins because much of their



food is half-rotted. Their senses must be good to find carcasses. Many scavengers also hunt small game if they can get it, and some double as gathering herbivores. They generally operate alone or in small groups, although often quite a crowd can gather when one finds a carcass. Scavengers usually have the advantage Resistant to Intestinal Disease and Spoiled Food, or Reduced Consumption (Cast-Iron Stomach). Among non-carrion-eaters, their diet can also qualify as an Odious Personal Habit.

Omnivores

Omnivores eat both plant and animal food. As plant-eaters they tend to function like gatherers, concentrating on high-energy food, while as meat-eaters they are usually pouncing predators, seldom investing a lot of energy in hunting. They are often fairly clever, as they have to be able to recognize a wide variety of potential food items. While some Terran omnivores work in groups, they are more likely to be solitary.

Trappers

Trapping carnivores are almost like filter-feeders: they sit in one place and let their prey come to them. Many help the process along by building

traps – spiders spin webs, and ant lions dig pits. They must be patient, since they have no control over how often something will stumble close enough to catch, and the investment involved in building a trap is often considerable. Though the traps can be quite sophisticated, they are usually built by instinct, and waiting for prey doesn't require much intelligence or keen senses. Trappers are usually solitary, since too many traps close together can't support their makers. They often have an advantage connected to their trap mechanism, like Binding or Tunneling, and frequently have a fast-acting Innate Attack or Affliction to subdue victims (on Earth this is usually poison, but aliens might use electric shocks, acid, or psionics). They may have racial skill in Camouflage, or some form of Chameleon ability.

Pouncers

Pouncing hunters catch prey with swift attacks, often from ambush. They may have to make several attempts for each success, but the investment in a given attack is fairly small. Pouncers nearly always go after smaller prey, so that the kill is easy. Sometimes pouncers combine their efforts, with one or more driving prey

toward a waiting ambush; this can involve a high degree of social communication and planning. Others are solitary.

Pouncing hunters are usually very fast, with excellent senses and formidable natural weaponry. Pouncers that specialize in a particular kind of prey can have elaborately specialized hunting mechanisms: woodpeckers hunt beetles under tree bark, and their whole skull and beak form a highly developed chisel mechanism. Other pouncers may use venom to subdue their prey quickly (a Toxic Attack). Typical pouncer advantages include increased Move (possibly with the Costs Fatigue limitation) or Super Jump, improved Perception or specific senses, weapons like Teeth or Claws, and possibly an Innate Attack. They may have racial skill levels in Brawling, Jumping, or Stealth.

Chasers

Chasing hunters go after larger prey and invest a lot of energy in making sure they get a successful kill. Often they work in groups and coordinate the hunt by well-developed communication methods. Chasers must have good stamina and senses, to keep up with a big prey animal until it falls from exhaustion. Solitary chasers are especially impressive in this regard: a Komodo dragon can hunt a deer for days. Appropriate advantages include Fit or Very Fit, high racial HT, increased Move or Enhanced Move, and at least one improved sense. Racial skill at Tracking is likely.

Hijackers

If you're really big and fierce, you may not have to do your own hunting. Just find someone else who's made a kill and chase them away. That's what hijackers do. They are frequently powerful pouncing hunters picking on smaller pouncers or chasers, although a big omnivore could do just as well. Hijackers have to be large enough to be scary, and may have racial skill levels in Intimidation and Brawling. They probably have natural attacks to back up their threats. Since most hijackers also hunt their own food, they can have all of the abilities of a pouncer or chaser.

Parasites and Symbionts

A great many organisms have found that the best place to live is inside another living thing. They let the host organism do all the work of getting food or energy and keeping away predators. Parasites have several ways to live off their hosts. Some drink blood, others simply live in the host's digestive system and eat its food, and some eat the host's own tissues.

Parasites need to be able to resist the host's natural defenses, and often must go to great lengths to reproduce, since it's hard to mate with a partner that is inside another large animal. Many parasites have an active and mobile form when young, becoming nearly immobile once they've got a cushy spot in a host. Other creatures are parasitic only as larvae, becoming free adults once they emerge. (In science fiction the most spectacular parasitic larva is of course the monster in the film *Alien*.)

Symbionts differ from parasites in that they provide a benefit for the host; in effect they "pay rent" in exchange for food or protection. Potential benefits include fighting off parasites or other hostile organisms,

disposing of waste products, or even helping the host digest certain foods. (All large organisms on Earth use symbiotic bacteria or fungi to help digest food.)

Parasites may have the advantage of Possession (Parasitic) if they can control the host's actions (this isn't entirely cinematic; on Earth there are many parasites that at least influence the behavior of the host creature). They may also have an Innate Attack or Affliction making it possible for them to get into or attach to the host. Parasites are likely to have a whole suite of physical disadvantages, including Blindness, No Manipulators, No Legs, Invertebrate, and Restricted Diet.

Symbionts may be Resistant to whatever defenses the host creature puts up, and possibly have a Restricted Diet if they depend on a specific substance produced by the host. Based on relative point values, symbionts and their hosts may count as Dependents, Allies, or Patrons for one another. In extreme cases, the symbiont and host pair may be simpler to model as a single organism.

ALIEN ANATOMY

It's highly unlikely that creatures from an alien environment will look much like Earth life. There are a few basic features that result from simple physical laws: anything that moves is likely to have something like a head at the front end, with sensory organs grouped near the brain. Anything above a certain size on land must have some kind of structural support. All organisms must have a way to get food or nutrients, and all must have a way to reproduce.

MOBILITY

Most animals have some way to move around. Even sessile creatures like oysters generally have a mobile stage before settling down.

Walking

For land animals, walking is the method of choice for getting around. On Earth there are walking animals with any number of legs, from two to dozens. Though many SF writers have assumed that animals on high-gravity worlds would need extra legs to hold

up their weight, it's noteworthy that some large dinosaurs like *Tyrannosaurus rex* managed to carry many tons of weight on only two legs. A creature's walking speed depends on the length of its legs and the local gravity. Specifically, speed is proportional to the square root of leg length times gravity. This means that one can generally run *faster* in high gravity, because the higher gravity makes you take faster steps. To convert this to **GURPS** terms, Move for aliens equals 5 times the square root of $(L \times G)$, where L is the aliens' height or length divided by human height of 6 feet, and G is the local gravity in gees. So for a creature from a planet with a gravity of 0.5 G, standing 10 feet tall, basic Move should be about 4.5 yards per round, rounded down to 4; the same creature on a planet with 1.2 G would have a basic Move of 7! (This is only as a guideline for creatures that evolved in a particular gravity; visiting a high-G world doesn't automatically make one move faster.)

Note that really big animals like elephants or the larger dinosaurs never move faster than a walk or a

trot, because would put too much stress on their bones. That doesn't matter because they can walk pretty fast anyway because of their long legs. Creatures optimized for running can add the Enhanced Move (Ground) advantage.

Many creatures have specialized feet with Hooves or Blunt Claws for traction or protection against wear. Others get by with just tough soles. On present-day Earth, hooves are found among herbivores, but this is purely a historical accident. Alien worlds might well have hoofed meat-eaters.

Slithering and Sliding

If you don't have legs, you can't walk. But you can still get around by slithering – undulating your body or the surface of a special foot to move yourself along. Slithering is slower than running, and for large creatures it gets quite inefficient because it does not store the energy of motion as walking does. Slithering creatures get the No Legs (Slithering) disadvantage. When figuring movement rates, be sure to take extra encumbrance into

account, which can slow down large, heavy creatures considerably.

On low-friction surfaces like water, ice, or loose sand, creatures can slide along. This is especially useful if one can get help from gravity and thereby achieve high speeds without expending any energy. This would be Terrain Adaptation (by terrain), or a 1-point perk (built-in skates), which would then require a racial skill level in Skating or Skiing. Sliding can be combined with sailing (below), and probably requires walking or some other form of locomotion as a backup.

Climbing

In forests or other environments that offer a lot of handholds, creatures can specialize in climbing and leaping from branch to branch. This saves a lot of time getting down to the ground and climbing up again, and it keeps the animal out of reach of non-climbing predators. Some Earth creatures, like gibbons, are specialized for efficient, long-distance locomotion by swinging from branches; this is called brachiation and it takes advantage of the same pendulum effect used in walking. The drawbacks to brachiating are that eventually one runs out of trees, and that a failure means a painful landing. Climbers should get Super Climbing advantage, and possibly others like Brachiator, Catfall, Clinging, and Perfect Balance. Racial skill levels in Acrobatics and Climbing are also appropriate.

Digging

In any environment with sand, snow, or loose dirt, digging provides a way to get at prey hiding underground, or to lurk in hiding and attack things on the surface. It's also a good way to hide, and provides insulation against dangerous temperatures in the desert or winter. Magma-dwelling silicon creatures might dig or swim in liquid rock. Because diggers have to move through a dense medium, size becomes a problem. On Earth nothing larger than an armadillo lives underground full-time. For most digging animals, Digging Claws would be a 1-point perk, equivalent to having a built-in shovel. When tackling harder materials they simply "attack" it,

breaching the material by doing damage. Diggers use the standard *Digging* rules based on their Basic Lift (p. B350). Space opera aliens that can move through the ground as easily as a fish through water can take the Tunneling advantage. Burrowing creatures are likely to have poor vision and smell, but can have extremely good hearing and the Sensitive Touch advantage. Vibration Sense is also very useful.

Swimming

Swimming works in any fluid medium of about the same density as the organism. Naturally, just about all aquatic organisms swim. Even bottom-dwelling walkers like lobsters can swim when they want to move fast. Because of the properties of a fluid environment, swimming gets more efficient as the swimmer gets bigger. Tiny organisms struggle through water while whales can comfortably cruise at speeds of up to 20 knots and sprint up to 30. Since water also helps support large creatures, this means that swimmers can get massive indeed.

A very different type of aquatic movement is *sailing*, using the power of wind for motion. This has the tremendous advantage that the energy

for locomotion *doesn't* have to come from the organism itself, but requires fairly specialized wind-catching structures, and the winds may not always be blowing where the creature needs to go. On Earth, the Portuguese man-o-war is a sailing organism. Sailing qualifies an organism for the No Legs (Aquatic) disadvantage at the -10-point level. Creatures with IQ 1 simply go with the breeze, but more intelligent beings could have racial skill levels at Boating (Sailboat) to allow them to tack. Navigation would be another useful innate skill. While oceans or large lakes are the best places for sailing, one could also imagine land-dwellers in deserts, grasslands, or ice-caps that use sailing in conjunction with natural skis or wheels.

Finally, some aquatic creatures just literally go with the flow. *Floating* is about the easiest way to get around there is, if you don't care where you're going or how long it takes to get there. Aquatic filter-feeders or trapping carnivores can do quite well just bobbing along, waiting for food to arrive, and of course autotrophs can just soak up sunlight. Many floaters have some swimming ability to avoid predators, but may just rely on size (large to deter attackers, small to avoid notice) or poison for protection.



Flying

Flying requires an atmosphere. There are several methods of staying aloft.

Buoyant flight uses hot air or a lifting gas less dense than the surrounding atmosphere to create a living balloon. Balloons have to be very big to produce enough lift to get off the ground, and all their tissues must be as light as possible. Buoyant flight also becomes feasible for extremely tiny organisms, which can "swim" in the air. A swarm-type being might use this kind of particulate buoyancy.

Hot air requires a heat source, which in turn requires a very abundant source of energy. Lifting gas requires some metabolic process to make the gas. Many such gases are also flammable, depending on the type of gas and the atmosphere. Buoyant flyers get the Flight advantage with the Lighter Than Air limitation and a greatly reduced Move.

Small creatures like spiders or plant seeds can get carried by the wind. Movement rates will be at whatever the local wind speed is, and there is no control over direction. Windborne organisms have Flight (Gliding; -50%; Lighter Than Air, -10%) [16]. Some windborne organisms take flight only once during their lives (typically as young); in that case it's a 0-point feature.

Jet propulsion uses Newton's Third Law: by expelling gas in one direction, the flyer propels itself in the other. Pushing the gas requires a lot of energy, making it fairly inefficient unless the creature can tap something like combustion for power. Some organisms use jet propulsion as an "emergency getaway" method, when efficiency becomes less important than speed. Jet flying is Flight with the limitations Cannot Hover and either Costs Fatigue or Limited Use.

Winged flight uses large flat surfaces to push air down, driving the flyer upward. This can be used in conjunction with gliding, which uses the flyer's forward motion to generate lift. Especially skilled gliders can use winds and thermals to gain altitude without a lot of flapping, and some (like albatrosses) can stay aloft for days at a time. Winged flyers can cover very large distances, making it

possible to migrate with the seasons, or find food in desert or arctic environments. Winged flight is Flight with the limitation Winged, or possibly Controlled Gliding.

Wingspan for flying creatures depends on their weight and the atmospheric density. For a rough rule of thumb, divide weight (in local gravity) by 30 lbs. and take the square root, then multiply by 10 feet. This can vary by as much as 25% depending on what kind of flyer the creature is – long-range ocean flyers have long, narrow wings, while fast and maneuverable flyers have shorter ones. Wingspan goes down in denser air and up in thinner. Very long wingspans are difficult to make with biological materials; among birds the record is 17 feet for the Pacific albatross, and for fossil pterosaurs the widest known span is 35 feet for *Quetzalcoatlus*. That's probably about the maximum possible for Earthly bone and flesh. Note that flyers that *never* land could have better-designed wings and a span of perhaps 50 feet.

Immobile Creatures

Some organisms just don't move. It saves a lot of energy, and if they don't have to roam around in search of food it's a fine strategy. On Earth, autotrophs like plants and aquatic filter-feeders are all immobile. However, reproduction poses a problem. For sexual creatures, getting together is difficult when you're rooted in place, and even asexual organisms don't want all their offspring crowding around competing for resources. Sessile organisms often have elaborate mechanisms for dispersing gametes or larval young. Since they can't run away from predators, immobile creatures need good protection, often in the form of thick shells, spines, or poison.

Immobile organisms have an appropriate form of the No Legs disadvantage, depending on whether they are truly rooted in place or can drag or roll themselves along.

Space Travel

Space-dwelling creatures must be able to move around. The obvious method is some kind of rocket propulsion, but that brings up the problem of fuel. Unless the space life has a very

reliable source of new reaction mass, rockets are too costly. Solar sailing is more likely, as space life is likely to be large in any case, and could use itself as a solar sail to change orbit. Plasma-based life could spin a "plasma sail" or use magnetic fields to catch the solar wind. Game Masters who have superscience reactionless drives or psionic powers may wish to give space life one of those as a method of moving about. Most space dwellers get Flight with the Newtonian Space Flight limitation, though superscience beings may be able to have Space Flight alone.

SIZE

Compared to most living things, humans are extremely large – the vast majority of life on Earth is single-celled organisms. On the other hand, the existence of whales and huge fossil dinosaurs show that creatures can get very large indeed. Gravity and the strength of materials place some absolute limits on size, and ecology restricts size by limiting the food a large organism can get.

The Square-Cube Law

A very important rule in biology governing animal size is the square-cube law. It is a simple consequence of geometry. If you increase something in one dimension, it increases in all dimensions unless you change its shape. Mass is a function of volume, which increases as the cube of the organism's linear size. Since the strength of bones and muscles (or their alien equivalents) depends on cross-sectional area, those elements increase as the square of the size. Consequently, doubling a creature's height means its muscular and structural strength increases by a factor of four (two squared). So far, so good. But its mass increases by a factor of eight (two cubed), so it is proportionally only half as strong. This is why ants can heft leaves many times their size, but humans have to strain to lift objects even half their weight. In **GURPS** terms, this is why a creature's Basic Lift is based on the *square* of ST, which in turn scales with length.

The square-cube law has other interesting effects. Warm-blooded creatures must cool themselves to regulate temperature; cooling occurs

Alien Creation III

Primary Locomotion

Determine primary locomotion. Roll 2d on the list below and apply the appropriate modifiers based on lifestyle. Methods with an asterisk (*) indicate a secondary mode of locomotion. "Special" includes buoyant or jet-powered flight, sliding, wheeled locomotion, or whatever bizarre means of transport the GM prefers. Add +1 for pouncing and chasing carnivores, omnivores, gathering herbivores, and scavengers.

Arctic: **2**, immobile; **3-4**, slithering; **5-6**, swimming*; **7**, digging*; **8-9**, walking; **10-11**, winged flight*; **12-13**, special.

Banks/Open Ocean: **2-3**, immobile; **4**, floating; **5**, sailing; **6-8**, swimming; **9-11**, winged flight*; **12-13**, special.

Deep-Ocean Vents/Reef: **2-5**, immobile; **6**, floating; **7**, digging*; **8-9**, walking*; **10-13**, swimming.

Desert: **2**, immobile; **3-4**, slithering; **5**, digging*; **6-8**, walking; **9-11**, winged flight*; **12-13**, special.

Gas Giant Planet: **2-5**, swimming; **6-8**, winged flight; **9-13**, buoyant flight.

Island/Beach: **2**, immobile; **3-4**, slithering; **5**, digging*; **6-7**, walking; **8**, climbing*; **9**, swimming*; **10-11**, winged flight*; **12-13**, special.

Lagoon: **2-4**, immobile; **5**, floating; **6**, slithering*; **7**, walking*; **8**, digging*; **9**, swimming; **10-11**, winged flight; **12-13**, special.

Lake/Salt-Water Sea: **2-3**, immobile; **4**, floating; **5**, walking*; **6**, slithering*; **7-9**, swimming; **10-11**, winged flight*; **12-13**, special.

Mountain: **2**, immobile; **3-4**, slithering; **5**, digging*; **6-7**, walking*; **8**, climbing*; **9-11**, winged flight*; **12-13**, special.

Plains: **2**, immobile; **3-4**, slithering; **5**, digging*; **6-8**, walking; **9-11**, winged flight*; **12-13**, special.

Planetary Interior: **2-6**, immobile; **7-13**, digging.

River/Stream: **2-3**, immobile; **4**, floating; **5**, slithering*; **6**, digging*; **7**, walking*; **8-9**, swimming; **10-11**, winged flight*; **12-13**, special.

Space-Dwelling: **2-6**, immobile; **7-11**, solar sail; **12-13**, rocket.

Swampland: **2**, immobile; **3-5**, swimming*; **6**, slithering; **7**, digging*; **8**, walking; **9**, climbing*; **10-11**, winged flight*; **12-13**, special.

Woodlands or Jungle: **2**, immobile; **3-4**, slithering; **5**, digging*; **6-7**, walking; **8-9**, climbing*; **10-11**, winged flight*; **12-13**, special.

Secondary Locomotion

For any method marked with an asterisk (*) on the Primary Locomotion table there is a chance of a secondary method of locomotion. Roll 2d and check the primary mode to determine the secondary method. Some secondary methods are also marked with an asterisk, indicating the chance of a third method of locomotion.

Climbing: **2-6**, slithering; **7-11**, walking; **12**, no secondary.

Digging (land): **2-6**, slithering; **7-11**, walking; **12**, no secondary.

Digging (water): **2-5**, slithering*; **6-7**, walking*; **8-11**, swimming; **12**, no secondary.

Slithering (in water): **2-10**, swimming; **11-12**, no secondary.

Swimming: **2-6**, slithering; **7-9**, walking; **10-12**, no secondary.

Walking (in water): **2-8**, swimming; **9-12**, no secondary.

Winged Flight: **3-5**, climbing*; **6-7**, swimming*; **8-10**, walking; **11**, slithering or sliding*; **12**, no secondary.

Aliens on Wheels

One method missing from the list of locomotion methods is the wheel. This may seem strange because wheels and rollers are a major element of human technology. Why aren't they found in nature?

There are two main reasons. First, any kind of axle or roller is hard to connect to the rest of the organism, since it is turning. Possibly a species might evolve non-living wheels made of some substance like shell, turned by muscles within the creature. Other creatures could roll into a ball or wheel shape and roll downhill for fast getaways.

Second, environments suitable for wheels aren't that common. On Earth there are few places with large extents of smooth, hard, level ground, and most of those are the work of humans for the convenience of their machines. Other worlds might have some environment that is good for driving where a wheeled species might evolve.

Wheeled organisms get the No Legs (Wheeled) disadvantage, worth -20 points.

across the body surface. As a creature gets bigger, the ratio of heat-generating mass to cooling surface goes up. This often requires big organisms to develop radiators (like an elephant's ears). On the other hand, it means that

big warm-blooded creatures can easily survive in cold climates as long as there is enough food – whales swim comfortably in Arctic waters where an unprotected human would die in minutes of hypothermia. Large warm-blooded creatures also don't have to

eat as much as small ones in proportion to their size. Birds and small mammals eat more than their own weight each day, whereas whales consume only a few percent of their mass.

Gravity and Buoyancy

Local gravity is likely to have a tremendous effect on the size of organisms. Lower gravity reduces the stress on bones and muscles and allows creatures to support a bigger mass. The equation works out as follows: $L=1/G^{2/3}$, where L is the linear dimension (height or length) and G is the local gravity.

This assumes that the creature must support itself against gravity. Weightless organisms can be arbitrarily large, limited only by food supply. This applies to aquatic creatures, buoyant floaters in a gas giant atmosphere, or spaceborne life.

Any creature that cannot support itself should probably get an Increased Life Support disadvantage to reflect that if it's going to be spending time among humans. Being aquatic is a 0-point disadvantage because it is compensated by the advantage of being able to swim (see *No Legs*, p. B145). A spaceborne organism should probably take a Weakness to gravity forces.

Size and Ecology

Gravity isn't the only limit on a creature's size – otherwise everything on Earth would be as big as dinosaurs. Another important limit is the ecology. Some environments simply can't support large creatures. Evolution forces a tradeoff: do you get as big as you can and hog all the resources you can get, or do you stay small and breed quickly? When conditions are unstable, evolution favors the smaller creatures, since they can adapt more quickly and survive in more marginal environments.

The ideal habitat for large creatures is a grassland or water, where there is plenty of food to eat (either plants or plant-eaters) and room for such a creature to move around. Woodlands, jungles, mountains, and swamps are simply too difficult for big animals to get through, unless they have a long, narrow body plan optimized for the environment. Deserts, islands, and mountains may not have enough food. Arctic environments are a special case: food is very scarce, but the square-cube law means that large creatures have an advantage over small ones in surviving. The result is that arctic environments tend to

support very few creatures, but those few are often quite large.

BODY PLAN

Once you know how big the creature is and how it gets around, you can start determining how it is arranged. You can either design the aliens or use the random-generation tables in the box text.

Symmetry

An organism's symmetry refers to how its body is laid out. There are several possibilities.

The simplest body plan is *asymmetric*. Either the creature changes its form as it moves, or the growth of limbs and body systems is fairly free-form. Terrestrial plants are often asymmetric.

A common form of organization is *bilateral symmetry*. Humans are bilateral, as are most animals on Earth. Bilateral organisms have matching organs and systems on each side, at least externally.

Unknown on Earth but popular in science fiction is *trilateral symmetry*, in which the organism has all its parts in sets of three, arranged around the body. This is really just a special case of radial symmetry, but gets its own listing because it shows up so often in fiction.

Organisms with *radial symmetry* have more than three matching "sides." Starfish are an example of five-sided radial symmetry.

Spherical symmetry takes organization a step further. Instead of being radial about an axis, the organism is symmetrical about a point, like a multi-sided die. Some tiny single-celled organisms on Earth are spherically symmetrical, but it is unknown among larger creatures.

Number of Limbs

While humans think two arms and two legs are plenty, we are actually rather deprived in the limb department. Insects get six legs plus wings and antennae, while millipedes have dozens of body segments. Our small number of limbs is a historical accident, due to the number of fins our fish ancestors had when they began moving onto the land.

Multicellular organisms tend to develop in segments, based on their body symmetry. For bilateral, trilateral, or radial organisms, the number of body segments can range from one to dozens. Each segment has a number of limbs equal to the body's sides. (Limbless segments are certainly possible, but we ignore those here.) Some of these limbs can get modified to serve as sense organs, jaws, fins, wings, reproductive organs, or whatever. Radial-symmetry beings can have multiple segments piled up like a stack of starfish. Spherical organisms are likely to have a single limb per face or per vertex.

Obviously, creatures with more than two arms and legs get the Extra Arms or Extra Legs advantage. Limb-derived structures like wings, antennae, fins, or eating mandibles don't count as Extra Arms or Legs.

Asymmetrical or bilateral organisms with four or more legs get the Horizontal disadvantage. Trilateral and radial organisms are Horizontal if they have only one body segment; otherwise they are likely to be upright.

Tails

Nearly every vertebrate on Earth has a tail, and many invertebrates have them as well. Humans, sadly, don't have them. Tails have a variety of uses, although they tend to be specialized for a single purpose. On trilateral or radial-symmetry beings, the tail would be any limb emerging along the being's central axis. Spherical beings cannot have tails.

Tails often figure in a creature's mobility. Creatures with only two legs sometimes use their tails for balance. Balancing tails can be fairly massive, to offset the weight of the head and torso, and are usually not very flexible. Swimmers or amphibious organisms frequently use tails for propulsion in water. Swimming tails can either be moved from side to side (like a fish tail) or up and down (like a whale's flukes). Either way, a swimmer's tail tends to be large and flat for maximum surface area to react against the water. Winged flyers on Earth use their tails as extra control surfaces. They need a fairly large area to interact with the air. Climbers like monkeys or pythons use tails as extra limbs to grip branches.

Alien Creation IV

Size Category

Determine general size category using on the following table.

Modifiers: -4 if Magnetic life; +3 if space-dwelling; +2 if 0.4 G or less, +1 if 0.5 G to 0.75 G, -1 if 1.5 to 2 G, -2 if greater than 2 G; +1 if any water habitat, +1 if Open Ocean or Banks habitat, -1 if Tropical Lagoon or River/Stream habitat, +1 if Plains habitat, -1 if Island/Beach, Desert, or Mountain habitat. +1 if Grazing herbivore, -4 if Parasite; -1 if Slithering, -3 if Winged Flyer; Plasma life multiplies Size in yards by 1,000.

Roll (1d)	Size Class
2 or less	Small (up to 12")
3-4	Human-Scale (18" to 3 yards)
5 or more	Large (5-30 yards)



Size and Mass

Once the basic size category is determined, roll below to get the actual size. For a given size, weight can be anywhere from half to twice the listed value, based on build. For silicon-based life, double the weight for a given size; for magnetic life, determine size and mass normally, then divide size (but *not* mass) by 1,000. For hydrogen or plasma-based, divide mass (but *not* size) by 10; for space-dwelling, divide by 5. For a more precise determination of weight (or for huge organisms), divide height (in yards) by two, cube the result, and multiply by 200 to get weight in pounds. Note that weight is in a standard 1 G environment; adjust by local gravity to determine weight in the creature's native habitat.

Roll (1d)	Size (size modifier)	Weight
Small		
1	0.05 yards (-10)	0.003 lbs (0.05 oz.)
2	0.07 yards (-9)	0.01 lbs. (0.16 oz.)
3	0.1 yards (-8)	0.025 lbs. (0.4 oz.)
4	0.15 yards (-7)	0.08 lbs. (1.25 oz.)
5	0.2 yards (-6)	0.2 lbs. (3 oz.)
6	0.3 yards (-5)	1 lb.

Roll (1d) Size (size modifier) Weight

Human-Scale		
1	0.5 yards (-4)	4 lbs.
2	0.7 yards (-3)	9 lbs.
3	1 yards (-2)	25 lbs.
4	1.5 yards (-1)	80 lbs.
5	2 yards (0)	200 lbs.
6	3 yards (+1)	600 lbs.

Large		
1	5 yards (+2)	3,000 lbs.
2	7 yards (+3)	4 tons
3	10 yards (+4)	12 tons
4	15 yards (+5)	40 tons
5	20 yards (+6)	100 tons
6	Extremely Large: 2d x 10 yards or bigger	

Gravity Effects

Modify for gravity. Multiply the size by the modifier on the following table based on local gravity. This applies to all land-dwelling life, amphibians, or winged flyers, but not aquatic creatures or buoyant flyers. Once the final size is figured, recalculate weight based on final size (applying all the modifiers for body chemistry, etc.), then multiply that weight by local gravity to get the creature's weight in its native environment.

Gravity	Size Multiplier
5	0.3
3.5	0.4
2.5	0.5
2	0.6
1.5	0.75
1.25	0.9
1	1
0.9	1.1
0.8	1.2
0.7	1.3
0.6	1.4
0.5	1.6
0.4	1.8
0.3	2.2
0.2	2.9
0.1	4.6

Strength

Strength varies depending on body plan and musculature, but a rough guideline follows the square-cube law: ST equals 2 x the cube root of mass in pounds. (This uses the cube root of mass as a way to get a common "length factor" that doesn't depend on body plan. Since in *GURPS* a character's Basic Lift is proportional to the square of ST, it all works out.)

A tail can also be a weapon. The most fearsome were the giant spiky maces and clubs of some dinosaurs, although anyone who has been stung by a scorpion's tail might have a different opinion. Weapon tails are Strikers (p. B88), typically with the limitations Clumsy and Limited Arc. A long heavy tail may get the Long enhancement, but that isn't mandatory. Most tails do simply crushing damage, but with spikes or blades could certainly be cutting or piercing. Prehensile tails count as Extra Arms (see *Manipulating Limbs*, below).

Many creatures use their tails for communication. This is usually a basic "semaphore" to convey a single message like "run away" or "I'm ready to mate." Other creatures (like dogs and cats) have more elaborate tail-based communication. Tailed creatures that use gestures for communication will almost certainly employ their tails.

Manipulating Limbs

For intelligent life forms, having limbs to manipulate and carry objects

is of great importance. There may be dozens of worlds out there with inhabitants just as smart as humans, but helpless to make or use tools.

Not all species have manipulators. Four-legged walking creatures can carry things in their mouths, but that's all. Birds can use their claws and beaks, but again with difficulty. The "default" for most organisms is the disadvantage No Fine Manipulators. Animals with good paws may have Bad Grip instead. Creatures that use their mouths combine Bad Grip and One Arm.

While just about anything might develop a manipulating appendage, there are some guidelines to follow. Brachiators tend to have them as a side effect of being able to climb and swing from branches; they have at least two and may supplement them with a prehensile tail. Flyers sometimes have them for perching (Earth bats and birds are handicapped by having only one pair of legs, which means they have to be used as feet instead of hands.) Omnivores or gathering herbivores often need them to

get at hard-to-reach food; these are usually paws or part of the feeding mechanism. Some large grazers (elephants come to mind) have manipulators to let them reach food; in the case of an elephant's trunk, there is only one limb. Very few land carnivores have good manipulators. They tend to be specialized for chasing and killing.

In the sea, there are a lot of creatures with manipulating limbs. This is partly an accident of history: many sea creatures have more than four limbs, so they can spare some for other purposes. Bottom-dwellers, in particular, seem to go in for quite good manipulating limbs; these are often short arms, but there can be multiple pairs.

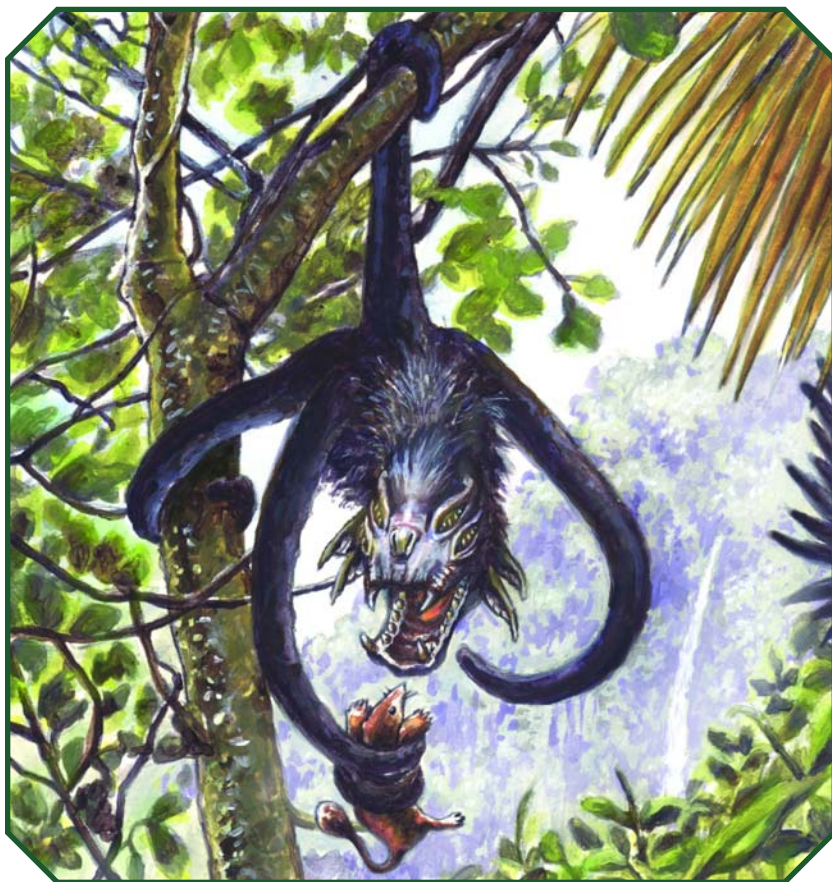
Tentacles are manipulating limbs beloved of science fiction writers. Like elephant trunks, they are muscular hydrostats. Buy them as Extra Arms with the Extra-Flexible enhancement. For just two tentacle arms, the Extra-Flexible advantage costs 10 points.

Prehensile tails count as Extra Arms (possibly Long or Extra-Flexible). If a tail is the creature's *only* manipulator, then it obviously gets the One Arm disadvantage and may also have Bad Grip. See *Modifying Beings With One or Two Arms* on p. B53 for an example.

Placement of Senses

Any organism that moves about will want its senses in its front end. Determining where the front is becomes tricky if the creature is radial or spherical, so those types may instead space redundant senses all around the body, or at the ends of limbs.

Senses usually show up where they do the most good. Taste and smell are either near a creature's feeding apparatus or in its manipulator arms so it can tell what is and isn't edible. Sight should be in front, often placed high up for a better field of view. Climbers and hunters put multiple eyes together to get the advantages of binocular vision, while prey animals space them far apart to watch for danger. Wide-spaced eyes give the Peripheral Vision or even 360° Vision advantages, but they often combine those with Bad Sight and No Depth Perception (see p. B145).



Where there is a lot of information coming in, something is needed to process it. A brain, or at least a major nerve nexus, is usually located near the main sense organs.

Structural Support

All organisms have some kind of structure. Some designs may seem floppy or flimsy to us, but they allow the creatures to move or affect their environment.

No Skeleton means the organism has no structural members of its own. It either flows about constrained only by its skin, or makes use of the environment when it needs to exert force. Very few organisms above microscopic size have no skeleton, and those tend to be immobile.

An *External Skeleton* uses a shell made of some rigid material that can be jointed to allow movement. This is a very successful design, as the hard shell protects the soft interior of the organism. However, growth is difficult because the organism must shed its old skeleton to grow a bigger one, leaving it vulnerable during the change. Aliens with exoskeletons may have evolved a way to grow without molting. Without a buoyant medium for support, large external skeletons can become very heavy and cumbersome.

An *Internal Skeleton* uses rigid or semi-rigid units (bones), often connected with joints. Internal skeletons place no limits on the growth of the creature, except the upper limit of what the bones can support. However, they offer little protection to the organism's soft parts.

A *Hydrostatic Skeleton* uses no rigid parts at all, relying instead on internal pressure and the strength of the outer membrane to maintain shape. They are used by many "boneless" creatures like cephalopods and jellyfish, and by many plants as well. Hydrostatic skeletons are limited in size by the tension on the skin, but clever design can offset that to some extent. Hydrostatic organisms can take the Invertebrate disadvantage.

Combinations of skeleton types are common. An elephant has an internal skeleton and uses a flexible muscular hydrostat for its trunk. Plants often combine rigid and hydrostatic support structures.

Metamorphosis

Many creatures on Earth go through dramatic changes in form during their lives – caterpillars becoming moths, tadpoles becoming frogs, and so forth. Alien creatures might well do the same. This can be particularly interesting if they go from sapient to non-sapient (or vice-versa), or if they shift from a harmless or cuddly creature to something powerful and deadly. "Life Changes" of this type are a 0-point feature. Game Masters can get plenty of dramatic mileage out of a metamorphosing PC or NPC if the change is predictable and will have major effects on the character's personality.

Some creatures change more often. This can be as minor as a rabbit's pelt turning from brown to white as winter approaches, or as major as a rainy season browser turning into a dry season carnivore. Minor changes are also 0-point features anyway. Major periodic changes are Alternate Forms, with the limitations Limited Use, Trigger, and Uncontrollable, capping out at -80%.

Finally, there may be some creatures that can *consciously* change form. That's Shapeshifting or Morph as described in the **Basic Set**, and probably should have a very long preparation time or concentration period as a nod to realism. (See the notes on "Blob Monster" powers, p. 165.)

Multiple Bodies

There are several ways an organism can have multiple bodies.

Colony organisms are made up of several different life forms living in symbiosis. The component organisms reproduce on their own, but don't normally live apart. In effect, they form a single super-creature. For **GURPS** creatures, being a colony creature is simply a 0-point feature.

Connected creatures have multiple bodies that are physically connected. Some plants live this way – sometimes a whole grove is actually a single tree, joined underground by roots and runners. Obviously, this option works best for immobile life forms, although floaters or buoyant flyers might also have multiple connected bodies. In general, connected bodies can survive if the link is severed. In **GURPS** terms, connected bodies can be modeled in two different ways. If the several bodies can work together as a single being, this is simply a 0-point feature of being large and having lots of extra limbs. If the organisms can operate independently, then this is a group of Allies, Constantly present.

Swarm bodies have an enhancement of the advantage Injury Tolerance (Diffuse). A swarm is a collection of tiny creatures. By taking a Concentrate maneuver, the swarm can

scatter into its component parts. The outer perimeter of a swarm travels at the being's best Move, up to a maximum radius of 1/2 mile. (Area Effect can change the size of a swarm.) While scattered, only area-effect, cone, and explosion attacks can injure the swarm being, and only do damage in proportion to the total area they blanket. (So an attack that covers 5% of the swarm's area does 5% of normal damage.) A swarm being can focus its senses on any point within its area; changing viewpoints requires the Ready maneuver. Swarm bodies when dispersed have a form of the Insubstantiality advantage (p. B62): they cannot pick up normal objects, nor can they make physical attacks. A swarm can penetrate solid objects like a fluid, creeping through holes and cracks. To resume normal form, a swarm body must contract to the body's original size (at normal Move rate), then Concentrate to reunite. Cost of having a swarm body is a +160% enhancement of Injury Tolerance (Diffuse) for a being that can switch between a compact solid body and a swarm, or +80% points for a being permanently in swarm form. A Swarm under sufficiently intelligent control might be able to purchase Shapeshifting or similar advantages.

Alien Creation V

Symmetry

Roll 2d to determine body symmetry.

Modifiers: +1 for immobile organisms, spaceborne life, or buoyant flyers.

Roll (2d) Symmetry

2-7	Bilateral
8	Trilateral
9	Radial (roll 1d+3 to determine how many sides)
10	Spherical (roll 1d: 1: 4 sides, 2-3: 6 sides, 4: 8 sides, 5: 12 sides, 6: 20 sides)
11-14	Asymmetric

Number of Limbs

Spherical organisms have one limb per side. Asymmetric organisms have 2d-2 limbs. For Bilateral, Trilateral, and Radial organisms, roll on the following table.

Modifiers: -1 for Trilateral, -2 for Radial.

Roll (1d) Number of Segments/Limbs

1 or less	Limbless
2	One segment (one limb per side)
3	Two segments (two limbs per side)
4	1d segments (each segment has one limb per side)
5	2d segments (each segment has one limb per side)
6	3d segments (each segment has one limb per side)

Tails

Spherical organisms don't have tails; for others roll 1d: on a 5-6 the creature has a tail. Swimmers add 1 to the roll.

For tail features, roll 2d and consult the following table:

Roll (2d) Features

2-5	No features (tail is a 0-point advantage)
6	Striker tail (Striker doing crushing damage)
7	Long tail (Long enhancement)
8	Constricting tail (Constriction Attack)
9	Barbed striker tail (Striker doing cutting or piercing damage)
10	Gripping tail (counts as an Extra Arm with Bad Grip)
11	Branching tail (tail splits according to body symmetry)
12	Combination (roll 1d+5 twice and combine results)

Manipulators

Roll 2d on the table below. The number of manipulators can never be greater than the number of limbs, unless the extras are trunks or tails. A "set" of manipulators equals the body's overall symmetry: two for bilateral, three for trilateral, etc. For Asymmetrical organisms, replace a "pair" of limbs with a single one. If the GM is creating a sentient, tool-using species, roll 1d+6 instead of 2d.



Modifiers: -1 if only two limbs, +1 if more than four limbs, +2 if more than six limbs; -1 if winged or gliding, -2 if open ocean swimmer or gas giant inhabitant, +2 if brachiator; +1 if gathering herbivore.

Roll (2d) Number of Manipulators

6 or less	No manipulators; limbs are locomotive or Strikers only
7	1 set of manipulators with Bad Grip
8	Prehensile tail or trunk (roll 1d: on a 6 check again for other manipulators)
9	1 set of manipulators with normal DX
10	2 sets of manipulators (roll 1d for each pair: 1-4 Bad Grip, 5-6 normal DX)
11	1d sets of manipulators (roll 1d for each pair: 1-4 Bad Grip, 5-6 normal DX)
12-17	1d sets of manipulators (roll 1d for each pair: 1-4 normal DX, 5-6 High Manual Dexterity 1)

Skeleton

Roll 2d to determine what kind of support the organism has.

Modifiers: +1 for Human-scale creatures, +2 for Large creatures; +1 for any land-dwelling creature; -1 for immobile or slithering creatures; -1 for asymmetric organisms; -1 for gravity less than 0.5 G, +1 for gravity greater than 1.25 G.

Roll (2d) Structure

3 or less	No skeleton
4-5	Hydrostatic skeleton
6-7	External skeleton
8-10	Internal skeleton
11-16	Combination

SKIN, HIDE, AND ALTERNATIVES

Every organism needs some kind of barrier between itself and the outside world. It can protect against things trying to eat it, help maintain the proper internal temperature or chemical balance, and generally act as the creature's first line of defense.

Skin can have a lot of functions. Among animals with external skeletons, it acts as armor and structural support. Softer-skinned creatures use it as a sense organ. Warm-blooded organisms put a lot of insulation at the skin layer to regulate internal temperature.

Skin Types

Creatures with *soft skin*, like slugs or jellyfish, have very poor protection against the external environment. In **GURPS** terms, they are Susceptible to chemical irritants (Very Common). Soft-skinned organisms on Earth often secrete a layer of mucus or slime for added protection. This negates the vulnerability to irritants, and may give the creature the Clinging or Slippery advantages.

Humans, toads, and other "naked" creatures have *normal skin*, which is neither an advantage nor a disadvantage (**GURPS** being fairly human-centered). Many mammals have *hide*, a tough skin that gives DR1, bought with the limitation Tough Skin. Elephants and rhinoceroses have *thick hide*, a very tough skin that gives them DR 4, also bought with the Tough Skin limitation.

Aquatic mammals like dolphins or whales have *blubber*, a very thick skin backed up with an even thicker layer of insulating fat. It provides DR 2 (for dolphins) to DR 4 (for whales), with the Flexible limitation. Blubber also provides Temperature Tolerance 2-4. Dolphin blubber also functions as an elastic energy-storage system to make swimming more efficient.

Skin cells can do other things besides just acting as a barrier. In cephalopods and some reptiles, skin cells can change color, giving the creature a few levels of the Chameleon advantage. Among the former, this may also function as a means of communication. Some

mammals (including humans) have skin that can sweat, providing cooling to allow sustained effort in hot conditions or possibly some levels of Temperature Tolerance to resist heat. And some creatures like desert toads have skin that secretes a noxious venom to poison enemies on contact. This is an Affliction with the limitations Touch Only, Always On, and Takes Recharge.

Most land mammals cover their skin with a layer of hair or fur. Hair cells are specialized skin cells that produce strands of stiff dead protein. It is a good insulator, allowing warm-blooded mammals to survive even in arctic conditions. Short fur protects against sunburn but does little else; long hair provides DR 1 and up to Temperature Tolerance 4. Extremely large cold-climate creatures, like the extinct mammoth, might combine long hair and blubber. See the perk Fur, p. B101.

Porcupines have hair that is extremely thick and stiff, giving them the Spines advantage. Other spiny creatures use specialized scales (see below), or extensions of their vertebrae.

Reptiles and fish have specialized skin cells that produce plates of protein instead of strands; these are called scales. As noted in the **Basic Set**, scales provide DR 2 (for snake or lizard scales) up to DR 4 (for heavy alligator scales).

Turtles, along with some dinosaurs and mammals, have plates of bone in the skin forming a hard shell. This can be very tough but also quite heavy. Giant tortoises or armored dinosaurs could have DR 5, but might also suffer the Numb disadvantage.

Birds have an even more elaborate kind of specialized skin cell that produces branching protein structures called *feathers*. Feathers help birds fly by giving them a larger wing surface than the living tissue of their limbs can provide. They are also first-rate insulation, and can even keep diving birds like penguins warm in arctic waters. Feathers can provide DR 1 and up to Temperature Tolerance 5.

Insects and other arthropods cover their bodies with a rigid *exoskeleton* made of chitin (a complex sugar). It has joints and hinges to allow movement. On small insects this is not

much different from skin, but (as anyone who has eaten boiled lobster can attest) in large invertebrates it functions as armor, typically DR 1 or 2. Armored creatures also get the disadvantage Numb.

Sea-dwelling immobile invertebrates like oysters have *shells* made of calcium carbonate. Aliens might use silica compounds or even metals. This is essentially like having an outer covering of rock. It provides very good protection – up to DR 5 for a thick-shelled giant clam – but at the cost of being almost completely inflexible. When open, the oyster has soft skin (see above). When closed, it has the Numb disadvantage.

Plants also use complex sugars, especially cellulose, to form *bark*. Large plants can have very tough bark, providing DR of up to 10. Any creature with bark suffers from the Numb disadvantage.

Alien organisms could have versions of all these skin types, mixing and matching in ways unknown on Earth. Mammals never evolved feathers or bark, but those are accidents of history. Aliens could use cellulose instead of protein, feathers instead of hair, or combinations unknown on Earth.

Alternate Materials

There are also some potential outer coverings that Earth life doesn't use. Metal is the most obvious absence from the arsenal of biological materials. Alien life, especially silicon-based life on a dense, metal-rich world like Mercury, could incorporate metal into its tissues, creating armored skin with very high DR and the Hardened enhancement.

Carbon-based life like ourselves can create very strong materials. Spider silk is one, with a tensile strength greater than steel. It's not hard to imagine alien organisms with the equivalent of Kevlar instead of collagen in their skin (although it's a little harder to imagine why they would need to be naturally bulletproof).

Hydrocarbon life could take advantage of the great versatility of carbon polymers, leading to living things with plastic skin. This could have most of the same properties as protein skin, but might take the Fragile (Combustible) disadvantage.

Silicon-based organisms living in liquid rock or molten sulfur could have an outer skin made effectively of rock or ceramic. This would have to be jointed, just like an insect's exoskeleton, but could provide tremendous Damage Resistance. Similarly, on cold worlds, organisms might make use of ice as a structural material, covering themselves with jointed shells of solid water. Rock or ice skin would have a high DR (10 for ice, 20 for rock) with the Semi-Ablative limitation for rock and Ablative for ice.

METABOLISM

This section delves into how organisms keep alive. How do they breathe? How do they eat and how do they use the food they eat?

Breathing

Any organisms that use atmospheric gases to support chemical reactions breathe. Fish breathe, although the oxygen they take in is dissolved in water rather than free in the air. But in stagnant water, a fish can drown as easily as a human.

Breathing must cope with several problems. The first is surface area. Small organisms can simply exchange gases across their skin. But large active creatures can't do that. A human, for instance, needs a much larger area for gas exchange than our total skin surface. How do we do it, then? Our lungs are filled with branching passageways, so that each lung has a huge internal surface area. Fish use stacked layers of gills to produce the same effect. Smaller invertebrates like lobsters just have lots of external gills.

The second problem is protection. All that surface area is fragile and makes a good point of entry for diseases and parasites, so the safest place to put it is inside the body. But the gases are outside. This means creatures have to pump air or fluid in and out. Fish let water stream through their gills, a very efficient process, but mammals are stuck with a single opening so they have to constantly puff in and out. It also makes us vulnerable to choking, but reduces the chance of harmful matter getting into

those delicate lungs. Lungs work well with a light fluid like air, but not with dense substances like water. Even if we could properly absorb dissolved oxygen, the effort involved in breathing lungfuls of water in and out would consume more energy than is released by combining that oxygen with food!

Creatures that live in water full-time have either the Doesn't Breathe (Gills) advantage as a 0-point feature or the advantage Doesn't Breathe (Oxygen Absorption). Oxygen Absorption only works for Small organisms because of the surface-area problems already described. A huge but very thin creature like a buoyant flyer might be able to use it as well. Note that this applies equally well to fluids other than water. A swimmer in seas of liquid methane on Titan would have gills to extract dissolved hydrogen, and a magma being cruising through Earth's upper mantle would have something analogous to gills to extract useful chemicals from liquid rock.

Many creatures find it useful to be able to visit another element from time to time. Water-breathers who can come up on land for brief periods (like crabs or cephalopods) have a version of Breath-Holding, or possibly racial skill levels in Breath Control. Air-breathers who visit the water have Breath-Holding. Air-breathing creatures that live in water can have Breath-Holding or Doesn't Breathe (Oxygen Storage) – some marine mammals can stay down for hours! This is often combined with Metabolism Control to reduce consumption.

Alien organisms may be able to breathe air or water equally well; either they have both lungs and gills, or their organs can switch from one to the other. This is the Doesn't Breathe (Gills) advantage at the 10-point level.

Finally, some organisms may not breathe at all. Any non-chemical life probably doesn't need to, and obviously any space-dwelling life must have Doesn't Breathe, either unmodified or with some incredible levels of Oxygen Storage.

Temperature Regulation

Humans and other mammals are "warm-blooded" animals. We

maintain a constant body temperature, often one higher than the environment. This helps birds and mammals to thrive in cold climates. The drawback is that being warm-blooded takes a considerable investment of energy. Mammals and birds have to eat a lot more than cold-blooded creatures of comparable size. However, in hot environments we also have to worry more about *cooling* – elaborate mechanisms like sweating, panting, radiator organs, and insulation.

Cold-blooded creatures don't have to worry so much about temperature regulation, but the drawback is that they can get very sluggish in chilly weather. There are ways around this problem. Size is one: a sufficiently large cold-blooded organism can stay warm simply by sheer thermal mass. Another is using radiating or heat-absorbing organs to make use of external heat. There are also chemical tricks – incorporating "antifreeze" in the blood or bodily fluids to withstand low temperatures.

Many cold-blooded organisms get the Cold-Blooded disadvantage, but it isn't mandatory. In particular, any cold-blooded creature with a mass above 100 lbs. can probably store enough heat to avoid it. And any cold-blooded creature that routinely lives in a cold climate presumably has chemical methods to counteract that disadvantage.

Taking in Food

Eating is essential for staying alive, unless you're an autotroph. What creatures eat determines a lot about how they eat.

Grazers usually have mouth parts suitable for cutting and grinding (though some grazers do the grinding in their stomachs). In game terms these are usually 0-point Blunt Teeth. Filter-feeders, or aquatic grazers like baleen whales, have no teeth at all, but instead have a sieve or filter arrangement to separate food from water. Gathering herbivores may have quite specialized mouthparts, as they often eat well-protected seeds or tough-skinned fruit. They may have Sharp Teeth or a Sharp Beak. Carnivores have Sharp Teeth, Sharp Beaks, or Fangs virtually without exception, since their food is usually

Alien Creation VI

Skin

Roll 1d to determine outer covering type.

Roll (1d) Covering

1-2	Skin
3	Scales
4	Fur
5	Feathers
6	Exoskeleton (external-skeleton organisms always have Exoskeleton)

Then roll below for the appropriate type.

Skin: Roll 2d to see what sort of skin the creature has.

Modifiers: +1 for arctic, +1 for aquatic, -1 for desert; +1 for herbivore; -5 for flyer.

Roll (2d) Covering

4 or less	Soft skin
5	Normal skin
6-7	Hide (DR 1)
8	Thick Hide (DR 4)
9	Armor shell (DR 5)
10-15	Blubber (DR 4 and 1d levels of Temperature Tolerance)



Scales: Roll 2d for the type of scales.

Modifiers: +1 for desert; +1 for herbivore; -2 for flyer; -1 for tunneling.

Roll (2d) Covering

0-3	Normal skin
4-8	Scales (DR 1)
9-10	Heavy scales (DR 3)
11-14	Armor shell (DR 5)

Fur: Roll 2d for fur type.

Modifiers: -1 for desert, +1 for arctic; -1 for flyer; +1 for herbivore.

Roll (2d) Covering

0-5	Normal skin
6-7	Fur
8-9	Thick fur (+1 level of Temperature Tolerance)
10-11	Thick fur over Hide (DR 1 and +1 level of Temperature Tolerance)
12-14	Spines

Feathers: Roll 2d to determine feather type.

Modifiers: -1 for desert, +1 for arctic; +1 for flyer.

Roll (2d) Covering

1-5	Normal skin
6-8	Feathers (+1 level of Temperature Tolerance)
9-10	Thick feathers (+2 levels of Temperature Tolerance)
11	Feathers over Hide (DR 1 and +1 Temperature Tolerance)
12-14	Spines

Exoskeleton: Roll 1d for exoskeleton type.

Modifiers: +1 for aquatic, +1 for immobile, -2 for flyer.

Roll (1d) Covering

2 or less	Light exoskeleton (DR 0)
3-4	Tough exoskeleton (DR 1)
5	Heavy exoskeleton (DR 3)
6-8	Armor shell (DR 5)

Breathing

Aerial or land-dwelling organisms breathe air. Deep Ocean Vent inhabitants always have Gills. For other water-dwellers, roll 2d.

Modifiers: +1 if native to Arctic, Swampland, River/Stream, Island/Beach, or Tropical Lagoon; +1 if walking is primary or secondary locomotion, +2 if flying or climbing is secondary locomotion.

Roll (2d) Breathing

2-6	Doesn't Breathe (Gills)
7-8	Lungs (air-breathing) with Doesn't Breathe (Oxygen Storage)
9-10	Doesn't Breathe (Gills) and Lungs (or convertible organ)
11-16	Lungs

Temperature

Roll 2d to determine body temperature regulation.

Modifiers: +1 for air-breathers, -1 for water-breathers; +1 for Human-scale or larger; +1 for land-dwelling, +1 for Woodland or Mountain environment, +2 for Arctic environment.

Roll (2d) Temperature Regulation

1-4	Cold-blooded (with Cold-Blooded disadvantage)
5-6	Cold-blooded (no disadvantage)
7	Partial regulation (temperature varies within limits)
8-9	Warm-blooded
10-17	Warm-blooded (with Metabolism Control 2)

Continued on next page . . .

Alien Creation VI (Cont'd)

Growth

Roll 2d to determine growth pattern.

Modifiers: -1 for external skeleton +1 for Large size category; +1 if immobile.

Roll (2d)	Growth Pattern
1-4	Metamorphosis
5-6	Molting
7-11	Continuous Growth
12-14	Unusual Growth Pattern (adding segments, branching, etc.)

well protected and often needs killing. Some specialized carnivores, like hunting spiders, may use a kind of siphon to drain the prey of fluids; this could be modeled as a Vampiric Bite without the healing effect.

On Earth, nature has demonstrated many ways of biting and grinding. Arthropods, including insects and spiders, have extremely complicated mouthparts made up of several pairs of limbs. These can be modeled as teeth or beaks, depending on how formidable they are. Ordinary mouthparts are like ordinary blunt teeth. Big sharp mandibles could be either a beak or sharp teeth, depending on how large they are.

Vertebrates have jaws, hinged bone arches that use leverage to exert impressive force through the teeth. On Earth, vertebrate jaws work “up and down,” but on an alien world they could be mounted sideways, or in radial arrangements of three or more. Vertebrate beaks are jaws tipped by sharp keratin instead of teeth. Cephalopods also have beaks, though they are not mounted on jaws. Instead a circle of muscle surrounding the beak pinches it shut.

Growth

How organisms grow determines a lot about their body design. Humans and other vertebrates grow in one piece, remodeling our skeleton and enlarging our organs in a continuous process until we reach full size. Invertebrates do the same with soft parts, but some of their hard parts (like shells or exoskeletons) can't be

rebuilt on the fly. Some of them molt, shedding old shells and growing a new one around their larger body. Others have simple shells (like mussels or snails) that can grow by adding new layers. The study of clam and mussel shells is fascinating for mathematicians because they maintain the same shape even as they add larger and larger layers. Plants, on the other hand, add outer layers around a central core, or grow from the tips of branches and roots.

Some creatures take it a step further, redesigning the body at different points in life. See the section on Metamorphosis (p. 153) for details.

There are other possibilities. Some plants add length and branches but not bulk (this is a gray area between growth and reproduction). While it's beyond the scope of this book to discuss all the possibilities, an unusual growth mechanism is a good way to make a really alien creature. What if they add body segments, becoming gradually longer over time?

REPRODUCTION

All living things reproduce, although they do it in different ways. Some create new individual offspring, some create copies of themselves, and some simply break off pieces that take on independent existence. Beyond Earth, aliens might not reproduce, preferring to live forever and grow indefinitely.

Sex and Genetics

Humans have two sexes for reproduction: males and females. Why we

have two is an interesting question. There are other options.

Asexual organisms don't have “sexes.” Each individual reproduces on its own, either by budding or by parthenogenesis. Budding simply breaks off a part of the organism that grows on its own; this is extremely common among plants. Parthenogenesis, or “virgin birth,” requires the whole apparatus of eggs or live birth, but the organism doesn't need outside fertilization. Self-fertilization is similar; except that the organism is a hermaphrodite and supplies both eggs and sperm.

Sexual organisms with two sexes have several advantages. They exchange and combine genetic material, increasing the diversity of their offspring. Sexual organisms evolve faster, which in the very long term gives them an edge. In humans gender remains constant, but in many other species individuals shift from male to female. This may be due to environmental stimuli (female when food is plentiful, male when it's scarce), or internal (male when you're young and small, female when you've grown), or social (male if you're big enough to chase off other males).

Hermaphrodites have the equipment for both male and female roles, either at the same time or at different times during the life cycle. This is a fairly common arrangement on Earth. Most plants are hermaphrodites, and a great many animals are, too. Plants tend to have both male and female organs simultaneously, while animals change back and forth.

No organisms on Earth have more than two parents. This may be just a historical accident, but given the incredible diversity of life on Earth it does seem to suggest that there is at least no *advantage* to having genes from three parents rather than two – or that any advantage is not worth the added difficulty of locating two mates rather than just one.

An alien world might have conditions that encourage multi-parent reproduction. Since the whole point of sexual reproduction is to speed up evolution, a planet with particularly chaotic conditions might have multi-sex inhabitants. The investment in creating a large gamete (an egg) or bearing a live offspring is

considerable, so it's highly unlikely that more than one parent would do this in a multi-parent arrangement. Three or more sexes would most likely have a "female" and two or more types of "males." Each male might only father males of his type, but either could father females (or perhaps females are produced by parthenogenesis).

Another possibility for multi-sex reproduction would have several different kinds of "males" and different "females," only some of which are compatible. So A-males and B-males can mate with A-females and D-females, but not with B- or C-females. C-males can mate with B- and C-females only, but D-males can mate with all but A-females. In a more

extreme case with less difference between eggs and sperm, a species could have a whole array of different sexes capable of combining with certain others.

It's entirely possible for organisms to combine various methods of reproduction. Plants often do both asexual and sexual reproduction, sending out runners to sprout new individuals nearby and releasing seeds to colonize new locations. It would be easy for a hermaphrodite species to dabble in parthenogenesis. Among some hive insects, unfertilized eggs develop into males (parthenogenesis) while fertilized ones are female (sexual). Others might reverse that approach, with females reproducing other females by parthenogenesis and

males only when fertilized by a male. Many Earth species alternate generations of sexual and asexual reproduction. Reproduction by budding or fission is uncommon on Earth in complex animals, but alien species might manage it.

Strategies

There are two main strategies for reproduction, known to biologists as "K-strategy" and "r-strategy." K-strategist organisms have few offspring, but invest a great deal of resources and energy in rearing them and making sure they survive to adulthood. K-strategists also tend to live a long time, so that they have the chance to have more than one offspring.

R-strategists take the opposite approach: they have large litters and put minimal investment into raising the young. If they survive, good; if not, there are always more. They also tend to mature quickly and die young. Such organisms should definitely take the Short Lifespan disadvantage, possibly living no longer than a year or two.

Obviously, K and r strategies are the endpoints of a whole continuum of behaviors. Some creatures split the difference, having small litters and putting some effort into raising them; some creatures change strategy depending on the situation. Indeed, within a particular species some individuals may choose different strategies – humans in preindustrial societies tended to have a lot of children because many of them were likely to die, whereas nowadays couples in affluent countries have just one or two children.

Fertilizing and Gestation

In addition to numbers of young, there is the issue of how the organism brings them into the world. There are several methods known on Earth.

Spawning is the method used by fish, amphibians, and many invertebrates; and it is analogous to the way plants reproduce. Organisms that spawn release their gametes (eggs or sperm) into the environment, and fertilization and development take place outside the body. Often females can lay thousands of eggs, in the hope that

Lifespan

How long a creature lives seems to depend chiefly on size and metabolic rate. Among Earth mammals, most species wind up having about a billion heartbeats over the course of a life – but a mouse's heart beating at 500 per minute goes through them in three years, while an elephant's heart pumping slowly at 30 beats per minute can go on for 60 or 70 years. Metabolic rate appears to be roughly proportional to linear size, though the animal's specific build and lifestyle can cause quite a bit of variation.

The big joker in the lifespan deck is humanity. For our size we live considerably longer than we should. A human-sized organism should typically last about 30 years, but humans routinely last two or three times that long. It's obvious that our bodies aren't really up to the job, either: humans start losing their adult teeth by age 30, and without modern dentistry one could expect to be toothless by 50. Our joints start to wear out around the same time.

Plausibly, most creatures less than three yards in length/height should have Short Lifespan 1 (half normal human span), those smaller than about 1.5 yards should have Short Lifespan 2, less than 20" get Short Lifespan 3, and less than one foot get Short Lifespan 4. Moreover, only really huge organisms – dinosaur-sized beasts 20 feet or more in length – should be able to have the Extended Lifespan advantage. Of course, as humans themselves demonstrate, intelligence and technology can provide free levels of longevity. Shift any tool-using intelligent species up one increment, so that those with Short Lifespan 2 go to 1, those with Short Lifespan 1 get normal lives, and an intelligent elephant-sized organism would get Extended Lifespan 1.

Metabolic rate also depends on the rate of chemical reactions. Cold-environment organisms (ammonia or hydrogen-based life) should probably be one or two increments more long-lived than their size would suggest, since they would generally live more slowly. Hot-environment organisms might be similarly short-lived. For silicon-based life, move everything down one increment, and for really fast things like magnetic-based neutron star inhabitants, give them Short Lifespan to balance their Altered Time Rate advantage.

some will reach maturity. Obviously, spawning lends itself to r-strategy reproduction, although there are species in which one or both parents remain near the egg mass and do their best to protect and feed the young once they hatch.

Plants use a similar method, pollination, in which they release pollen into the air or water. Some plants enlist the aid of animals, either by stealth or bribery, and get them to carry pollen to a likely mate. The plants develop colorful flowers and sugary nectar to attract pollinators. In some cases, they are specialized for one particular pollinating organism.

Egg-laying creatures have internal fertilization, but then release the young into the world before they develop. This is an extremely common method on Earth. The chief drawback is that the egg has to contain all the food necessary to support the embryo through development to hatching; this can be inconveniently large. Another problem is that the egg must be tough enough to protect the embryo, without being so strong that the little creature can't get out when it's ready.

Live-bearing organisms fertilize internally and carry the young within the parent's body until it is ready to be born. This allows longer development (since the size of an egg is no longer a factor) and better protection, at the cost of putting a greater burden on the mother. Live-bearing organisms often care fairly well for the young after birth. Some, the mammals, have specialized glands to nourish the young.

Marsupials add another wrinkle, bearing the young live through part of their development, then carrying them in a pouch until they are ready to live on their own. This frees up the reproductive tract for another offspring.

Finding Mates

Any sexual organisms put some effort into finding or attracting potential mates. Among spawning creatures, it's usually a matter of tracking down some eggs that need fertilizing. But internal fertilizers have to win a mate by charm, bribery, bullying, or trickery. In an interesting twist, males usually wind up compensating for the relative "cheapness" of their reproductive cells (sperm) by expending a lot of

resources on methods to attract or keep a mate. (A few species reverse this, and in many the sexes show off and compete for mates in different ways.)

In some species this takes the form of advertising – elaborate displays of good health in the form of huge racks of antlers, long iridescent tail feathers, loud singing, or scent markings. Other males show off their resources by grabbing good nesting sites, building bowers, or picking up shiny trinkets (cynics may include humans in this group). Still others take a more direct approach, chasing away rival males by force. Some males become parasites, attaching themselves permanently to a single female.



The sheer variety of mating displays and techniques is impossible to list in a simple table. Game Masters must decide on their own what investment the species makes in mating. Some can be represented as advantages: loud songs or calls could be the Penetrating Voice perk, or even a sound-based Affliction. Males sometimes sport natural weaponry to battle potential rivals, giving them Strikers. Mating displays can also be a disadvantage: sexual behavior can give organisms a Compulsive Behavior, Lecherousness, or even Intolerance (own sex).

Mating strategies can lead to species with very different body forms in males and females. They can have different attributes, advantages, and disadvantages. Some writers have even speculated about alien species in which only one sex is sapient. In any

species with two or more sexes, the GM can either assign sex differences to suit the campaign, or accompany each step in the alien design process (except fundamentals like chemical basis and habitat) with a dimorphism roll on 1d: if the result is a 6, then roll that trait separately for males and females.

Taking Care of the Kids

How long the parents care for the offspring is a function of strategy. Strong r-strategy species invest no care at all. You spawn, you swim away, and the young either survive or not. (In some species, the adults don't even distinguish between juveniles and other prey when they're looking for food.) Other spawners and egg-layers stick around to guard the nest until the young hatch, but then lose interest.

K-strategists devote care to the young after they hatch or are born. Birds feed their offspring until they can fly, mammals nurse them until they are old enough to find food, and some fish dutifully carry their young around in their mouths.

Some organisms may arrange a surrogate parent before abandoning their young; these are known as brood parasites. Cuckoos lay their eggs in the nests of other birds to ensure a proper upbringing. Other parents make their young into genuine parasites – the botfly lays its eggs under the skin of a large animal so the grubs have plenty of food until they're ready to break out and fly away.

Among most intermediate strategists, only one parent does any care (usually the mother). Strong K-strategists (particularly some birds and mammals) have both parents doing their best to raise the young. The most fanatical K-strategists gather in groups to pool child-care. Elephant herds and troops of primates do a fair amount of "day care" for their young. The apex of this is among the hive insects, where nearly all the adults are sterile females who spend all their time finding food and caring for the offspring of their mother; only a handful of males and fertile females are born, and they have thousands of dedicated caretakers making sure they can go out and breed.

Alien Creation VII

Sexes

Roll 2d to determine number of sexes.

Modifiers: -1 if immobile; -1 if asymmetric body plan; -1 if autotrophic.

Roll (2d)	Sexual Arrangement
4 or less	Asexual reproduction or Parthenogenesis
5-6	Hermaphrodite
7-9	Two Sexes
10	Switching between male and female
11	Three or more Sexes (1d: 1-3: three sexes, 4-5: four sexes, 6: 2d sexes)
12	Roll twice and combine; types either alternate or are triggered by conditions

Gestation

Roll 2d for gestation method.

Modifiers: -1 if aquatic or amphibious; -2 if immobile; +1 if warm-blooded.

Roll (2d)	Gestation
6 or less	Spawning/Pollinating
7-8	Egg-Laying
9-10	Live-Bearing
11-13	Live-Bearing with Pouch

Special Gestation

Roll 2d; on a 12 the species uses a special gestation strategy. If so, consult the following table.

Roll (1d)	Special Gestation Method
1	Brood Parasite (young raised by another species)
2-3	Parasitic Young (young implanted in a host)
4-5	Cannibalistic Young (young implanted in parent, fatal to parent)
6	Cannibalistic Young (young consume each other)

Strategy

Roll 2d for reproductive strategy. Multiply the number of young per litter by 2d × 10 for spawning organisms (they may actually lay many, many more, but most of those won't even reach childhood).

Modifiers: -2 if Large, +1 if Small; +2 if Spawning.

Roll (2d)	Reproductive Strategy
0-4	Strong K-Strategy: one offspring, extensive care after birth
5-6	Moderate K-Strategy: one to two offspring per litter, extensive care after birth
7	Median Strategy: 1d offspring per litter, moderate care after birth
8-9	Moderate r-Strategy: 1d+1 offspring per litter, some care after birth
10-16	Strong r-Strategy: 2d offspring per litter, no care, +1 level of Short Lifespan

SENSES

To interact with the world, organisms must be able to perceive it via senses. The simplest senses are chemical receptors. Most creatures add a sense of touch and vibration (hearing). These are nearly universal.

Other senses depend on the environment. If the atmosphere is transparent to light (or other radiation), vision becomes a useful sense. If the creature exists in darkness, echolocation is more important. Creatures that hunt warm-blooded prey may evolve infrared sensors. Migratory organisms or ocean voyagers demonstrate an ability to sense magnetic fields, giving them a built-in compass. More exotic senses are possible. Magma-dwellers might be able to sense radiation. Space-dwelling creatures might "see" using microwave radar.

Information isn't much use if you can't process it. Many species have fairly poor senses, simply because they don't need a higher level of detail. Humans have good vision because we are descended from brachiators (who need depth perception to avoid falling) and evolved to hunt by throwing things. Since we also get food by gathering plants, we can also see colors well. Many carnivores have limited color vision, because it isn't essential to their way of life.

Vision

Vision is only useful if there's any light to see by. On any world with an opaque atmosphere, there isn't much use to having eyes. Deep-ocean creatures either have very bad vision because they use some other sense, or extremely good vision (like the extinct ichthyosaurs) because that's the only way to see in the dark. Underground creatures tend to have very bad vision, and many are completely blind.

Humans have better-than-average vision. Assume the "default" for most creatures with vision is worse than human standard, combining Colorblindness and Bad Sight. Organisms with dark-adapted eyes may have Night Vision up to 9, but may also have Colorblindness or suffer daytime vision penalties.

Sight is extremely constrained by physics. The resolving power of an eye of a given size is in inverse proportion to the wavelength it senses. Consequently low wavelengths – infrared, microwave, and radio – require bigger eyes, and quickly get too big to be practical. The big waves also run into problems because they are bigger than some objects. You can't see a mosquito with radar because the radar waves are bigger than the mosquito is. A creature must be at least Human-sized to have any kind of radio detection sense, and must be Large to be able to use radar.

Infrared "vision" on Earth tends to be more a directional heat detector rather than actual sight. To model this in **GURPS** terms, use Detect (Heat) or Detect (Infrared Light) rather than Infravision. Note that a heat detector must be *cooler* than what it is detecting, making this chiefly useful for creatures with low body temperature trying to spot warm-blooded prey.

There are problems with short wavelengths, too. Many Terran organisms can see in ultraviolet light, including many insects, but nothing we know sees with gamma or X-rays. The trouble with using high-energy photons is that it's very difficult to create a focusing lens for them, and there aren't usually good sources of high-energy particles in the environment to see by. Creatures made of denser material (like silicon-based organisms) might be better able to see by high-frequency light, but only if they live near an active black hole or other "bright" source of hard radiation.

Some organisms on Earth have polarized vision, which helps cut glare and allows them to see better through clouds and haze. Such creatures typically have two to four levels of Acute Vision (Accessibility, Only to compensate for glare and haze, -50%) [1/level].

Hearing

Hearing is an outgrowth of the sense of touch, optimized to pick up air vibrations. Humans have average to poor hearing (partly because we subject ourselves to a lot more noise than most animals). Most organisms can have Acute Hearing sufficient to bring their Hearing roll up to 12. Since sound travels better in a denser

medium, water-dwelling creatures tend to hear quite well, at least underwater, and presumably magma-swimmers would have exceptionally acute hearing.

Echolocation combines superb hearing with specialized processing in the brain to convert echoes from sound pulses into an "image." It can be quite precise – bats can catch small insects using echolocation. However, since it is an active sense, requiring the creature to emit a pulse, echolocation is relatively short-ranged due to the slow speed of sound. The *Sonar* form of the Scanning Sense advantage (see p. B81) gives full details.

Touch

The sense of touch actually incorporates several senses. First is the obvious tactile sense embedded in the skin. Some organisms are more sensitive than others in this respect. Extremely thick fur, scales, armor, or blubber tends to interfere with the sense of touch, so that any organisms with those abilities are likely to have a poor touch sense. Some animals use specialized hairs as touch sensors, like the whiskers of a cat. Touch also has a size component: a small creature can feel textures more easily than a large creature, simply because the bumps are larger in proportion. Game Masters may wish to give Small-sized organisms a bonus for their sense of touch, and impose a penalty on Large ones.

A related sense is proprioception, the mental "image" of the body's position. For creatures like octopuses and squids, keeping track of one's arms takes up a major chunk of the brain's processing power. This sense seems to be more important for creatures with many limbs, and is likely to be more important for land-dwelling organisms, if only because it's a key part of being able to walk. In **GURPS** terms, this sense is the primary component of Dexterity.

The sense of balance is another component of proprioception. More generally, it's the "gravity sense" that any planet-living organism needs. Swimmers have a related ability to keep themselves properly oriented underwater. Brachiators and mountain-living creatures are likely to have

excellent balance, for obvious reasons. The Perfect Balance advantage plus some increase in DX are appropriate for organisms with above-average gravity sense.

Taste and Smell

The simplest one-celled life forms have only one way to perceive their environment: chemical receptors. They taste the world around them, eating anything that tastes good and moving away from anything that tastes bad. Nearly any chemical-based life will have some sense of taste. While humans keep theirs inside the mouth to check food before it is swallowed, other organisms put taste receptors outside, on antennae or skin, to analyze things they encounter.

Smell is a more sensitive form of chemical detection, specialized to pick up airborne molecules. Whales have lost their ability to smell, but they do taste the water they swim in. Vacuum-dwellers can't smell anything, but they might well taste whatever they touch or eat.

Humans seem to have a good sense of taste, which is what one might expect from creatures with gathering herbivore ancestors, but our sense of smell is only about average. Some of us can identify vintages by taste, but you don't see humans tracking by scent. Dogs can track by scent, and identify individuals. Moths can detect one another by smell across miles of distance. Anything up to Acute Taste and Smell 10 is quite within the realm of biological possibility. Game Masters may want to break apart Taste and Smell, giving some creatures a Smell bonus but not Taste, or vice-versa, at 1 point per level.

Because Earth creatures often use scent molecules as a form of communication without conscious control, creatures with very acute sense of smell could easily justify having Animal Empathy or Sensitive.

Other Senses

Creatures on Earth have a remarkable variety of senses, and it's possible to imagine exotic senses unknown to Earthly life. There are, after all, a relatively limited number of ways an organism can perceive its environment.

Electromagnetic waves have already been discussed under vision. In addition to sight, one can imagine senses like Detect (Microwaves) or Scanning Sense (Radar) on huge space-dwelling creatures, or Detect (Gamma or X-Rays) on dense organisms.

Most Earth life uses “passive” electromagnetic senses, relying on the sun to provide illumination to see by. But that’s not strictly necessary. There are some deep-sea creatures that generate their own light, and one can imagine alien organisms capable of generating bright pulses like a strobe light to see in darkness. If a creature could generate coherent light, a form of Ladar (see p. B81) might even be possible. (The drawback to any “active” sense, of course, is that it makes one visible to anyone else with the same sort of sensor.)

Electromagnetic field senses exist already in many Earth animals. Many fish have electric-field detectors, picking up the emissions of other creatures’ muscle impulses. Note that this requires a medium like water that conducts electricity. Air is an insulator, and so blocks electric impulses. This would be Detect (Electric Fields) or possibly Detect (Living Things).

Air doesn’t interfere with magnetic fields, however, and there are several species of birds that apparently have internal magnetic sensors to provide a compass for long-range navigation. This is not normally precise enough to qualify as Absolute Direction; it’s simplest to just call it a 0-point feature, as on p. B34. Alien beings with more precise magnetic sense could have Detect (Magnetic Fields) or possibly Absolute Direction.

Gravity detection is part of balance and proprioception. Space-dwelling creatures might be able to detect gravity fields even in free-fall, or sense mass by the curvature of space. Obviously this would only pick up large masses, the size of asteroids or planets. It would be Detect (Gravity Fields).

Vibration senses are essentially an extension of hearing, and work best in a dense medium that conducts waves easily. Many fish have a “lateral line” – a set of receptors on the skin that pick up faint water movements. This wouldn’t work as well in air, because

air isn’t dense enough to transmit vibrations very far, but any swimmer might have a similar sense. This would be Vibration Sense. Any land-dwelling creatures could have a kind of “seismic sense” to pick up ground vibrations; this would be Vibration Sense with the limitation “Ground Only” (-10%).

Chemical senses are variants on taste and smell, possibly specialized for different kinds of molecules. On Earth most chemical senses are attuned to molecules made by living things, to either help find food or warn of danger from predators. Aliens might be able to smell things humans cannot – minerals, trace atmospheric gases, or poisons. This could be as simple as a very precise Detect added to normal sense of smell, like Detect (Methane) or Detect (Pheromones). Or it could replace Taste and Smell with something like Detect (Minerals).

Exotic senses are weird or super-science abilities that are either based on imaginary science or require bending the rules to function in the real world. This includes nearly all psionic abilities, “X-ray” vision as depicted in comic books, neutrino vision, extra-dimensional or faster-than-light senses, and so on.

COMMUNICATION

Just about all organisms have some way to send signals. Even seemingly passive things like plants are constantly pumping out chemicals to affect each other. Animals make use of their more sophisticated senses to communicate with sound and visual displays, but don’t give up on chemical cues. In general creatures use all their senses for communication to some extent – humans speak to each other, but we also use gestures and facial expressions, and our bodies do respond to scents.

Organisms with no intelligence (IQ 0) tend to communicate by instinctive, “automatic” methods, like scents released in response to certain stimuli. More intelligent creatures (IQ 1) add channels under voluntary control. Organisms without complicated social structures tend to stick to simple “broadcast” communications, like scent sprays or calls to any creature within earshot. Creatures with more elaborate societies may add more selective “person-to-person” communication. Actual *language* only really becomes possible with sapience and IQ 6 or better.



Alien Creation VIII

Sense options marked with an asterisk are possible communication channels. Roll 1d for each marked sense; the highest roll indicates the primary method of communication and the second highest indicates the secondary. Channels marked with two asterisks get a +1 on this roll. If the two highest rolls are the same, the species uses the two together as a single channel.

Primary Sense

Most creatures have a primary sense that is what they rely on to get around and find food. Roll 3d on this table to determine the primary sense. When rolling on the sense tables below, the primary sense gets a +4 bonus.

Modifiers: -2 for aquatic; +2 for autotrophs.

Roll (3d) Primary Sense

1-7	Hearing
8-12	Vision
13-20	Touch and Taste

Vision

Roll 3d; space-dwelling life treats any result of 9 or less as 3.

Modifiers: -4 if Digging is primary locomotion, +2 if climbing, +3 if flying, -4 if immobile; -4 if Deep Ocean Vent habitat; -2 if filter-feeder; +2 if carnivore or gathering herbivore.

Roll (3d) Visual Ability

6 or less	Blindness
7	Blindness (Can sense light and dark, -10%) [-45]
8-9	Bad Sight and Colorblindness
10-11	Bad Sight or Colorblindness*
12-14	Normal Vision*
15-23	Telescopic Vision 4*

Hearing

Roll 3d; space-dwelling life is automatically Deaf.

Modifiers: +2 if Completely or Nearly Blind, +1 if Bad Sight; +1 if aquatic, -4 if immobile.

Roll (3d) Hearing Ability

6 or less	Deafness
7-8	Hard of Hearing
9-10	Normal Hearing*
11	Normal Hearing with extended range (Subsonic Hearing if Large, Ultrahearing otherwise)*
12	Acute Hearing 4**
13	Acute Hearing 4 and either Subsonic Hearing or Ultrahearing**
14-21	Acute Hearing 4 with Ultrasonic Hearing and Sonar**

Touch

Roll 2d for sense of touch.

Modifiers: -2 for external skeleton; +2 for aquatic organisms, +2 for digging organisms, -2 for flyers; +2 if Blind or Nearly Blind; +1 if Trapping carnivore; +1 if Small.

Roll (2d) Touch Ability

2 or less	Numb
3-4	-2 DX from poor sense of touch
5-6	-1 DX from poor sense of touch
7-8	Human-level touch
9-10	Acute Touch 4*
11-18	Acute Touch 4 and either Sensitive Touch or Vibration Sense*

Taste/Smell

Roll 2d for taste and smell ability.

Modifiers: +2 for chasing carnivores, +2 for gathering herbivores, -2 for filter-feeders, autotrophs or trapping carnivores; +2 if sexual reproduction; -4 if immobile.

Roll (2d) Taste/Smell Ability

3 or less	No Sense of Smell/Taste
4-5	No Sense of Smell (can taste, -50%) [-2 points]
6-8	Normal taste/smell
9-10	Acute Taste/Smell 4 (aquatic organisms use Acute Taste only)*
11-16	Acute Taste/Smell 4 and Discriminatory Smell (aquatic organisms use Discriminatory Taste)*

Special Senses

For each sense roll 2d; it is present on a roll of 11 or more unless noted. Modifiers to the roll are listed with each special sense.

*360° Vision**: +1 for plains or desert habitat; +1 for herbivore; +1 for radial or spherical symmetry.

Absolute Direction: +1 for Open Ocean habitat; +1 for flying, +1 for digging.

*Discriminatory Hearing**: +2 if organism has Sonar.

Peripheral Vision (10-12): +1 for plains or desert habitat; +2 for herbivore.

*Night Vision 1d+3**: +2 for aquatic organisms; +2 for carnivores.

*Ultravision**: no for aquatic organisms, no for ammonia-based life.

*Detect (Heat)**: +1 for carnivores; +1 for arctic habitat, no for aquatic life.

*Detect (Electric Fields)**: aquatic only; +1 for carnivores.

Perfect Balance: land-dwelling only; +2 for climbing; +1 for mountain habitat; -1 if gravity 0.5 or less, +1 if gravity 1.5 or more.

*Scanning Sense (Radar)**: no if Small size or aquatic; +2 if space-dwelling.

SPECIAL ABILITIES

Other special abilities are impossible to predict. Why did woodpeckers become specialized to bore holes in trees? Why did electric eels evolve into living capacitors? On alien worlds, things can get even more bizarre, but the basic laws of nature still apply.

What's Plausible

The most plausible special abilities for aliens are those that we know are possible because they already exist. Anything used by existing or extinct Earth species are perfectly defensible. Many special abilities based on Earth life are already described above, but there are more possibilities. Without turning this chapter into a biology encyclopedia, there are some abilities to consider.

Afflictions in the form of chemical defenses are fairly common. Some are ranged sprays, like a skunk's musk or a bombardier beetle's superheated chemical spray. Range tends to be fairly short for spray attacks – typically no more than the animal's ST in yards, up to a maximum of about 10 yards. They take the Limited Use or Takes Recharge limitations, since all

creatures have a finite amount of material to work with.

Hibernation in unpleasant conditions is another common ability. Northern animals do it in winter, when food is hard to find and it makes sense to huddle up and conserve energy. Warmer-climate organisms may hibernate (technically, they are *estivating*, the summer version of hibernation) during droughts. Some creatures can survive in drought mode for extraordinary periods – tardigrades or brine shrimp can be revived after decades in stasis. In **GURPS** terms this is Metabolism Control (Hibernation) as described on p. B68.

While *shapeshifting* in the comic-book sense is not really possible (see below), there are creatures that undergo changes, either seasonally or as part of maturation. Snowshoe rabbits switch between white and brown spotted pelt depending on the season, while many invertebrates completely remodel their bodies as they go through different life stages. These are all simply 0-point features, since they happen either once or according to a predictable schedule.

On Earth there are many *invisible* creatures – undersea organisms whose bodies are exactly as transparent as the water around them. They take

advantage of a specific environment and have adapted to those conditions. It requires a medium about as optically dense as one's body tissues. This would be modeled as Invisibility to sight only, with several limitations – only in water, a slight chance of being seen. It also works best for small organisms, no more than Human-Scale in size.

What's Possible

There are also abilities that are unknown (or nearly so) on Earth but that aren't actually forbidden by the laws of nature.

Projectile weapons (as opposed to sprays) don't show up on Earth but they aren't completely impossible. Medieval folklore and American frontier legends both describe spiny animals capable of throwing their quills; on an alien world a species might combine quills with a chemical organ like the bombardier beetle to produce an actual dart gun. Creatures might have multiple "launchers" but each would be single-shot, taking days or weeks to regrow a new dart. Some kind of "blowgun" arrangement that could use pebbles or seeds as projectiles might be possible, but it would require a reliable source of ammunition – and something to shoot at.

Breath weapons like those of fantasy dragons are also within the realm of possibility, but unlikely. A creature could generate a burning spray, but the energy represented by a large burst of flame is tremendous. The creature either needs an external source of "fuel" or a very long "recharge" time between shots. Poison gas is also unlikely because of the difficulty in generating a large volume of gas.

"Blob monster" abilities like Elastic Skin, Stretching, or Morph would suffer some severe limitations. For Earth animals to change their form generally requires substantial amounts of time. Even small insects undergoing metamorphosis take several days. Among larger animals, "shape changes" in pregnancy take months. Anyone designing alien shape-changers should make the process as slow as possible. (This only applies to evolved "natural" species: an artificial organism or machine life might be able to

Moving in Clades

Humans have speculated about the possibility of genetic engineering and cybernetic augmentation. Advanced alien civilizations could alter themselves using the same methods, creating "daughter species" with new or improved abilities.

One thing to remember in such cases is that new species don't automatically replace old ones. When one species of bird-like dinosaur gave rise to the ancestors of birds, the dinosaurs didn't all disappear; they remained doing the same bird-like dinosaur things they always had, while their ancestral-bird cousins started doing different things. Similarly, a genetically modified subspecies or widespread use of cybernetics won't necessarily replace the original species. They may coexist – and both the new species and the original group can spin off other new "daughter species," which in turn can create variants of their own.

The result is that once a species starts modifying itself, one can expect a tremendous diversification. Unless some strong authority enforces uniformity by force, there are likely to be lots of different populations with different modifications and combinations of traits. Human explorers contacting alien civilizations should expect to find a lot of "multispecies" worlds with wildly varying populations, all descended from a common ancestral type.

do real-time rearrangement of body parts under conscious control.) An exception might exist if the body is actually a swarm of independent creatures (see p. 153).

Having an *Extra Head* is not unknown on Earth, usually the result of a birth defect that conjoins twins. It could be an inherited trait. If the heads share a single “mind” (or don’t contain the brain, as with Larry Niven’s *Puppeteers*) then this is simply a matter of a better arc of vision and an extra mouth. If they do have separate or redundant brains, then use the **GURPS** advantage as described.

Racial Memory is possible, especially for creatures that rely a great deal upon instinct. The memories could be passed only from parent to child, so that a given individual would only have its parents’ memories – but those memories could include the parental memories of its parents, and so on. This is especially likely for creatures that reproduce by budding. Alternately, the species might be able to “write” memories into the genetic

code, giving access to ancestors thousands of generations back.

What’s Impossible

Overtly “paranormal” abilities are impossible under the laws of nature as we understand them. That being said, GMs are free to allow some of them as the result of superscience unknown on Earth.

Duplication violates the laws of conservation of matter. Creatures that reproduce by fission, creating two identical, smaller copies with shared memories aren’t using Duplication because it’s rare, permanent, and there is no further connection between the two offspring.

Mental Influence abilities like Mind Control, Mind Probe, Mind Reading, or Mindlink are superscience – unless the species has a form of radio communication and all members of the species can use the channel. Mind Control by physical or chemical means is definitely possible.

Para-senses like Clairsentience, Penetrating Vision, or Precognition

are in the same situation as teleportation. If creatures could use them, they would confer a tremendous advantage and would quickly become widespread. Note that Precognition opens the whole Pandora’s Box of time paradoxes.

Size changing abilities like Growth or Shrinking are pretty much impossible. They violate the law of conservation of matter, and creatures getting huge or tiny without changing mass run into severe mechanical constraints – how do tiny muscles lift normal-size mass? Best to leave these for “four-color” comics reality.

Telekinesis, Temperature Control, DR (Force Field), and other energetic abilities are another “superscience only” set. They violate more laws of nature than we can conveniently list!

Teleportation fits into the realm of superscience. If it exists, it can be described in a logical, consistent manner. But current science says it can’t happen. This applies to the advantages Warp, Jumper, and Snatcher.

ALIEN MINDS

Just because a creature is intelligent doesn’t mean it will have a mind like ours. The editor John W. Campbell was famous for his dictum: “Show me a creature that thinks as *well* as a man, but not *like* a man.”

BRAINS

Humans have extremely complex brains, allowing us to do things that no other known creature can. Though the behaviors and abilities found among Earth’s living things are amazing, there’s only one species that builds space probes, drills for oil, or writes roleplaying games.

The vast majority of Earth’s living things are quite literally mindless. Plants, fungi, and single-celled organisms have no brains at all (IQ 0). *Alien* plants might be brainier. Among animals, most invertebrates appear to be almost robotic, following “pre-programmed” behaviors refined by long evolution, but with no trace of thought. Maximum IQ for most organisms of this type is 1. They may

qualify for the Cannot Learn disadvantage. (An important exception to this is among the cephalopods – octopuses and squids appear to be as smart as any nonhumans on Earth.)

Vertebrates appear capable of generally more sophisticated behavior, and among the vertebrates mammals and birds are particularly good at learning and inventing new behaviors. Most vertebrates would have IQ of 1-4, with the Bestial disadvantage. Mammals and birds (and possibly cephalopods) can have IQ as high as 5, and are Bestial.

Sapience, or human-level intelligence, is very difficult to define, but most people know it when they see it. Why it arose among humans and why it never appeared among any other species is something of a mystery. We naturally see all the advantages to being smart, but evidently it’s just one method among many as far as evolution is concerned. Sapience eliminates the Bestial disadvantage and allows IQ levels of 6 or more.

The question of whether it is possible for organisms to be superhumanly intelligent is, of course, a matter of complete speculation. One theory holds that natural selection ceases to apply to any species that reaches human-level intelligence, and that this suggests that no species would naturally evolve a higher average intellect. (Some extremely pessimistic thinkers, like SF author Cyril Kornbluth in his story “The Marching Morons,” posit that civilization causes a *decline* in intellect as stupidity ceases to be fatal.)

The opposite idea, familiar to all fans of classic *Star Trek*, is that sentient beings become more and more specialized for intelligence, eventually turning into frail, huge-brained creatures dependent on technology to survive. Even if creatures don’t evolve naturally toward higher intelligence, an advanced civilization could artificially boost its average IQ by genetic engineering, excellent education, or cybernetic augmentation.

NATURE: THE INFLUENCE OF BIOLOGY

Exactly how much of human behavior is derived from our evolutionary heritage is a hotly debated topic. It is also fraught with ideological minefields. If humans act a certain way because we have evolved to do so, does that mean we *should* behave that way? Is what is natural the same as what is right? And what does it say about free will if our personalities are the result of our genes?

Still, it is possible to speculate on how an organism's evolutionary past may affect its psychology. Certainly animals in different niches on Earth behave differently, even when removed from their native environment. Game Masters who don't like that idea can downgrade any personality traits to the level of "racial quirks."

Ecology

The ecological niche a species occupies can affect its behavior quite strongly. Grazing herbivores have abundant food, so can gather in large groups for mutual protection. Gathering herbivores have to compete for scarcer but more rewarding food, so they live in small groups or are solitary. Omnivores are often loners, as are scavengers.

Pouncing predators work either alone or in small groups, but chasing predators sometimes form large packs to bring down really huge prey. Trappers are almost always solitary.

The environment has its effects, too. In harsher environments like arctic or desert conditions there is a greater penalty associated with being in a group (there just isn't enough food or water to support them). However, warm-blooded creatures may band together in those environments to literally share heat! The dense nature of a woodland or jungle environment makes it hard to keep a group together, encouraging smaller bands or solitary organisms.

The Mating Game

Mating patterns come in several types. For many creatures the male and female meet only at fertilization and never see one another again. This is typically linked to strong R-strategy behavior. Males have as many partners as they can get, limited only by competition from other males. If there are any differences between the sexes, they tend to be functional – larger females because it takes more energy to produce eggs or bear young. In many species the males are short-lived, "one-shot" creatures that fertilize and then die.

Other species have a temporary pair-bond, in which the parents remain together until the offspring

hatch or are capable of fending for themselves. (On Earth this usually means one year.) Since these creatures have to attract a new partner each year, they often go in for elaborate mating displays, especially the males. Males may also stake out prime territory or good nesting sites.

If the parents remain together for several seasons, they are said to "mate for life." (A fair amount of cheating goes on even in these arrangements.) The couple rears multiple sets of offspring, and often shares food with each other. This naturally goes well with a moderate K-strategy setup. Life-mating species often have little visible difference between the sexes; if there is a difference it is often the case that males are small or even parasitic.

Males sometimes try to monopolize all the available females by driving away or killing any rival males. This "harem" system is particularly common in species that gather in groups anyway, like plains grazers. The advantage is that the strongest male fathers many children, and the females often cooperate in caring for the offspring. Harem species often have a noticeable difference between the sexes, with males typically large and bristling with weaponry to fight off challengers. In some harem species the males and females live apart except during mating season.

NURTURE: THE INFLUENCE OF SOCIETY

Creatures form social systems, often highly complex ones. Social relations refer to how a creature interacts with others of the same species. Interspecies relationships generally fall into the categories of eating, hijacking food, or running away.

Solitary species live alone, except possibly during mating season. They often have a territory that they defend against interlopers. Large organisms are frequently solitary (simply because big creatures need a big territory for support). Low-intelligence solitary organisms may not even recognize a distinction between their own species and prey.



Alien Creation IX

Intelligence

There are two tables here, one for animals and one for sapient aliens capable of technological civilization. Game Masters who want the possibility of randomly generating a sapient species can assume that a result of 13+ on the first table indicates sapience and IQ 6 or better.

Animals: Roll 2d for intelligence level.

Modifiers: -1 for autotroph, filter-feeder or grazing herbivore, +1 for gathering herbivore or omnivore; -1 for small size; -1 for strong r-strategy, +1 for strong K-strategy; +1 for normal or extended lifespan.

Roll (2d) Animal Intelligence

3 or less	Mindless (IQ 0)
4-5	Preprogrammed (IQ 1 and Cannot Learn)
6-8	Low Intelligence (IQ 1-3 and Bestial)
9-10	High Intelligence (IQ 3-5 and Bestial)
11-15	Presapient (IQ 5)

Sapient Beings: Roll 1d+5 for the average species IQ. The minimum IQ for sapience is 6, so treat any result of 5 or less as a 6.

Modifiers: -1 for autotroph, filter-feeder or grazing herbivore, +1 for gathering herbivore or omnivore; -1 for small size; -1 for strong r-strategy, +1 for strong K-strategy.

Mating Behavior

Roll 2d for mating behavior.

Modifiers: -2 for hermaphrodites, -1 for spawning, +1 for live-bearing; -1 for strong r-strategy, +1 for strong K-strategy.

Roll (2d)

5 or less
6-7
8
9-10
11-14

Mating Behavior

Mating only, no pair bond
Temporary pair bond
Permanent pair bond
Harem
Hive

Social Organization

Roll 2d for social organization. Hive species have a "pregenerated" social organization already and need not roll here.

Modifiers: -1 for carnivores, +1 for grazing herbivores; -1 for large size; +1 for harem mating, -1 for no pair bond.

Roll (2d)

6 or less
7-8
9-10
11
12-14

Social Organization Type

Solitary
Pair-bonded
Small group of 2d members (1-2 Troop, 3-4 Pack, 5-6 Herd)
Medium group of 4d members (1-2 Pack, 3-6 Herd)
Large Herd of 1d x 10 members

Pair-bonded species (as noted above) live in "nuclear family" groups of parents and offspring. They may or may not be able to tolerate the presence of other pairs nearby – some birds live quite happily in huge communal rookeries with thousands of neighbors, while eagles have widely separated nests.

A small group of creatures (four to 10) living together is called a *troop*, (or band, or pride). This often is based on a mating arrangement: several mated pairs or a male and his harem. Troops share child-care and often work a lot of food-sharing into their social arrangements. Any social group larger than a mated pair requires fairly sophisticated communication – even the "mindless" workers in a hive are using complex chemical signals and body movements to communicate.

A larger group is a *pack*, with six to 20 members. This is typical among chasing carnivores on Earth, but

could be used by grazers or gatherers just as well. In a pack there is a hierarchy, with the "alpha male" and "alpha female" as the leaders. They lead in hunting and get a larger share of the food. Alphas mate with other alphas, and prevent low-status members of the pack from mating at all (or at least make sure the young don't survive if they do). The result is that the alphas' offspring benefits from the entire pack's efforts. This is obviously a strong K-strategy setup, and requires constant communication and social jockeying.

Huge groups of animals (10-100 or more) are known as *herds*, schools, or flocks. On Earth they are typically found among grazers, since a huge group requires a huge food supply. Small herds may be a harem, but really big herds are simply too much for even the most ambitious male to monopolize. Herds don't seem to have as much of the hierarchy found in

packs; the biggest or oldest members may be the herd leader, but that seems to be "merit-based" rather than "political."

Hives are a very successful social unit based on a single family. The queen is the only fertile female, and spends her life as an egg-making machine. Most of her offspring are sterile females, who spend their time caring for eggs. A small number of fertile females and males leave the hive in search of mates, in order to start new colonies. In some species, all members of the hive are potentially fertile, but are kept from developing by pheromones given off by the queen; when the queen dies her young compete to take the role. Other hives die with their queen. Hive systems combine the vast numbers of young cranked out by r-strategists with the guaranteed-survival care of K-strategists. The only drawback is the "overhead" of all the sterile workers.

Alien Creation X

There are nine mental qualities that define a species' collective "personality." For species whose mentality is closely coupled to their biology, simply apply the modifiers on each table and use the result. For more variation, roll a die, then roll a second and subtract that result from the first. Add the result (positive or negative) to the sum of modifiers. Do that for each table.

Chauvinism

Chauvinism measures how the species views itself as a group compared to others.

Modifiers: -1 for autotrophs or filter-feeders, -2 for parasites or scavengers; +2 for small or medium groups and hives; -1 for asexual or spawning organisms; -1 for solitary or pair-bonded.

Total	Chauvinism Level
+3 or more	Chauvinistic (quirk) (becomes Racial Intolerance if Empathy is less than +1 or Suspicion greater than -1; becomes Xenophobia if Suspicion is greater than +1)
+2	Chauvinistic (quirk) (becomes Racial Intolerance if Empathy is less than +1 or Suspicion greater than -1)
+1	Chauvinistic (quirk) (becomes Racial Intolerance if Empathy is less than 0 or Suspicion greater than 0)
0	Normal
-1	Broad-Minded (quirk)
-2	Broad-Minded (quirk) (becomes Xenophilia at 15 if Suspicion is less than 0 and Empathy is greater than 0)
-3 or less	Undiscriminating (quirk – considers all intelligence to be one "species") (becomes Xenophilia at 12 if Suspicion is less than 0 or Empathy is greater than 0; Xenophilia at 9 if both are true)

Concentration

Concentration describes how well individual members of a species can focus on a task.

Modifiers: +1 for pouncing or chasing carnivore, -1 for any herbivore; +1 for strong K-strategy.

Total	Concentration Level
+3 or more	Single-Minded and either High Pain Threshold or one 5-point Talent
+2	Single-Minded
+1	Attentive (quirk)
0	Normal
-1	Distractible (quirk)
-2	Short Attention Span (12)
-3 or less	Short Attention Span (9)

Curiosity

Curiosity includes how receptive the species is to new things, and how interested they are in finding them.

Modifiers: +1 for omnivores, -1 for grazing herbivores or filter-feeders; -1 for Blind or Nearly Blind species; -1 for strong r-strategy, +1 for strong K-strategy.

Total	Curiosity Level
+3 or more	Curious (9) (if Concentration or Suspicion is 0 or less, reduce self-control number to 6)
+2	Curious (12) (if Concentration is 0 or less, change self-control number to 9)
+1	Nosy (quirk) (becomes Curious at 12 if Concentration is 0 or less)
0	Normal
-1	Staid (quirk)
-2	Incurious (12) (self-control number becomes 9 if Suspicion is less than 0)
-3 or less	Incurious (9)



Egoism

Egoism is a measure of how personally self-important members of this species are, compared with others. It is the individual counterpart to species Chauvinism.

Modifiers: +1 for solitary, +1 for harem (males only), -1 for hives; +1 for strong K-strategy, -1 for strong r-strategy.

Total	Egoism Level
+3 or more	Selfish (9)
+2	Selfish (12) (control number becomes 9 if Suspicion is more than 0 or Empathy is less than 0)
+1	Proud (quirk) (Selfish at 12 if Suspicion is more than 0; Selfish at 9 if Suspicion is +2 or more or if Empathy is -2 or less)
0	Normal
-1	Humble (quirk)
-2	Selfless (12) (control number becomes 9 if Chauvinism is +2 or more)
-3 or less	Selfless (6)

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Alien Creation X (Continued)

Empathy

Empathy measures how well individuals can sense or care about the feelings of others, both within and outside their species.

Modifiers: +1 for chasing carnivores, -1 for autotrophs, filter-feeders, grazers or scavengers; -1 for solitary or pair-bonded, +1 for small or medium group; +1 for strong K-strategy.

Total	Empathy Level
+3 or more	Empathy (if Gregariousness is more than 0 add Charitable at 12)
+2	Empathy (Sensitive)
+1	Responsive (quirk) (becomes Sensitive if Gregariousness is more than 0 and Suspicion is less than 0)
0	Normal
-1	Oblivious
-2	Callous
-3 or less	Low Empathy (carnivores add Bloodlust at 12)

Gregariousness

This indicates how sociable members of the species are, and how much they need the company of others. It doesn't say how the *species* feels about other forms of life.

Modifiers: -1 for pouncing carnivore, scavenger, filter-feeder, autotroph, or any herbivore; -1 for solitary or pair-bonded, +1 for medium or large group, +2 for hive; -1 for asexual or hermaphrodite, -1 for spawning.

Total	Gregariousness Level
+3 or more	Gregarious
+2	Chummy
+1	Congenial (quirk)
0	Normal
-1	Uncongenial (quirk)
-2	Loner (12)
-3 or less	Loner (9)

Imagination

Imagination indicates how well members of the species come up with new ideas, see patterns, and invent new behaviors.

Modifiers: +1 for pouncing carnivores, omnivores, or gathering herbivores, -1 for autotrophs, filter-feeders, or grazers; +1 for strong K-strategy, -1 for strong r-strategy.

Total	Imagination Level
+3 or more	Imaginative (quirk) (as with +2 below, but if Empathy is less than +1 add the Odious Racial Habit (Nonstop Idea Factory) [-5])

Total	Imagination Level
+2	Imaginative (quirk) (as with +1 below, but adds the quirk Dreamer if Egoism is greater than 0 or if Concentration is less than +1)
+1	Imaginative (quirk) (becomes Versatile if Concentration is 0 or more and Egoism is less than +2)
0	Normal
-1	Dull (quirk)
-2	Hidebound
-3 or less	Hidebound and -1 IQ

Suspicion

This is how distrustful and fearful individuals of the species are about new things or surprises.

Modifiers: -1 for any carnivore, +1 for grazing herbivores; +1 for Blind or Nearly Blind; -1 for large, +1 for small; +1 for solitary or pair-bonded.

Total	Suspicion Level
+3 or more	Fearfulness 2, and Cowardice (if herbivore) or Paranoia (if carnivore)
+2	Fearfulness 1 (becomes Careful quirk if Curiosity is -3)
+1	Careful (quirk) (ignore if Curiosity is -2 or less)
0	Normal
-1	Fearlessness 1
-2	Fearlessness 2 (add Overconfidence if Egoism is +2 or more)
-3 or less	Fearlessness 3 (add Overconfidence if Egoism is +1 or more; Fearlessness becomes Unfazeable if Chauvinism is -3 or less)

Playfulness

Playfulness measures how willing a species is to play – to do things purely for fun rather than for any material benefit. Playful animals may be easier to train, and playful sapients are likely to have a sense of humor. This is one table on which humans may not be “normal,” since we appear to be unusually playful as a species. To reflect this, Game Masters may decide to give all *other* intelligent species an additional -1 modifier, to make humans seem more playful by comparison.

Modifiers: +1 if K-strategy, +2 if strong K-strategy; +1 for IQ 2 or higher; -1 if Solitary; -3 if Cannot Learn.

Total	Playfulness Level
+3 or more	Compulsive Playfulness (9) (becomes Trickster at 12 if species is Overconfident)
+2	Compulsive Playfulness (12) [-5*]
+1	Playful (quirk)
0	Normal (occasionally playful)
-1	Serious (quirk)
-2	Odious Racial Habit (Wet Blanket) [-5]
-3 or less	No Sense of Humor

CHAPTER SEVEN

FUTURE AND ALIEN CIVILIZATIONS

Shiro and Tatsumi walked through the old Imperial Gardens in Tokyo, hand in hand as if they were just another pair of teenage lovers out for a stroll. They really were lovers now, thought Shiro, and he couldn't keep from blushing.

The old palace buildings were completely gone, leveled during the Shahr campaign to erase human history. In their place was the Family of Species Culture and Education Center. The two Alien Fighter Army operatives were hoping the library there would help them figure out the alien tech Shiro had found.

They passed through a security checkpoint under the gaze of a looming Gustrugin soldier in combat armor. Actually, Shiro was glad the huge alien was there – nobody would wonder why his heart was pounding or his mouth was dry. Once inside they followed the signs in Shahr glyphs to the library. Tatsumi had better marks than Shiro in the alien language, so she was going to be the one doing most of the actual research.

They were met at the library entrance by a Tarcaser in a white jacket. It watched them with its top eye while the other two flicked about, scanning the room. "What are your needs?" it asked in slow Japanese.

"We're just looking for some books," said Tatsumi in her best Shahr.

"This facility has millions of works stored on crystals, but no 'books,'" said the Tarcaser, and Shiro decided at that moment that he really hated this alien. The two Alien Fighters had hoped for hardcopy books precisely because nobody would be able to trace what they were researching.

"We're doing a report on industrial design and ergonomics in multi-species equipment," said Shiro as smoothly as he could. "Please, show us how to use the system here."

Suddenly the Tarcaser stiffened, and Shiro realized everyone in the room beyond was staring at them. No – behind them. He turned and found himself looking into the single cloudy eye of a Shahr. A very high-ranking one, if he was reading the insignia on its neckband correctly. There was a little knot of Shuman and Tarcaser flunkies standing four paces behind it.

"It is good for humans to study our technology," said the Shahr. "They will be happy doing their tasks in the Family of Species." It nodded at the Tarcaser and turned to go.

"Please come this way," said the Tarcaser in a much more humble tone.

This chapter covers the business of choosing and designing science-fictional societies for the space-genre campaign. It examines the ways in which advanced technology and alien biology might change how society is structured, and discusses some of the pragmatics of designing a government, its legal structure, and its military forces.



STORY CONCERNS

Roleplaying campaigns are frameworks for stories – the adventures and exploits of the player characters. The purpose of the society is to serve as a story element. Most commonly, societies are simply backdrops, the scenery against which the actors strut and declaim. Occasionally the story focuses on a conflict between the characters and their society, which elevates the society to the status of a “character” in its own right. The role in the story in turn determines elements of the society’s structure and function. Is it an open, free society, or a restrictive culture? Who holds power?

SOCIETY IN THE STORY

It’s up to the GM to determine the purpose of a society. Is it scenery, is it an adversary for the heroes, or a mystery to solve? Sometimes it can be all three, or change over time.

Society as Backdrop

The simplest use for any society in a story or roleplaying campaign is as a backdrop. Making a world or culture alien and exotic reminds the players that this is a science-fiction adventure. An especially well-designed backdrop can provide lots of fun just by letting the characters “play tourist” and explore the setting. Life doesn’t have to be a series of shootouts and bar fights, after all.

A useful thing for Game Masters to keep in mind is that all the people in the backdrop society *don’t know they’re in the background*. Each of them is the main character of his or her own story. Giving the PCs encounters with people who have their own goals and aren’t especially interested in the evening’s adventure will help make the setting seem more real and give it depth.

Society as Obstacle

Of course, a society can be more than just the setting for the heroes, it can be their foe. This can be overt, as

when the PCs are military personnel fighting a hostile alien civilization, spies infiltrating a tightly monitored state, or rebels trying to bring down a tyrannical empire. But characters can come into conflict with a society even if they aren’t trading blaster shots with armored stormtroopers. A merchant trying to make a profit in the face of heavy taxes and trade barriers is at odds with society. So is a lawman bringing justice to a wild frontier. Or lovers in a society that forbids marriage between social classes.

Obstacle societies obviously need features that will put them at odds with the heroes – restrictive laws, aggressive plans for Galactic conquest, widespread corruption, lack of interest in space exploration, or whatever. They also need ways for the heroes to circumvent or overcome those obstacles. Can they change the laws, or halt the conquering fleets? If change is impossible, can they get away to someplace more congenial, or find a way to accomplish their goals secretly? A society that is intolerable and inescapable doesn’t make for particularly entertaining adventures, after all.

A different form of obstacle society is one that presents the characters with a puzzle. This often happens to explorers visiting strange new worlds, but can befall anyone trying to operate in an unfamiliar environment without enough information. A puzzle society is one that seems to not make sense on first examination. The inhabitants behave or think in a way that just doesn’t seem rational. For example, why do the Venusians exile their adults to wilderness preserves when they reach 30 years of age? On the face of it, this is a puzzle, since one would assume people in their prime years would be an asset to society. The puzzle can also create an obstacle if the heroes will suffer some negative effect if they don’t solve it in time (in this case the Venusians insist that all PCs over 30 must also be exiled).

But of course a puzzle must have a solution. In the case of the Venusians, it turns out that their species is infected by a parasitic fungus that gradually

destroys the individual’s intelligence. They send their adults off when they begin to revert to an animalistic state. Puzzles don’t have to be science problems like that one, of course. The Venusian situation could be the result of a strong religious belief (one must “return to nature” in order to achieve enlightenment or salvation), a political struggle (the Youth Party took over and is attempting to eliminate the middle-aged as a class), or economics (Venus has a constantly changing, information-driven economy, and Venusians over 30 just aren’t mentally flexible enough to keep up). Often solving a puzzle presents a new obstacle or puzzle – can the PCs find a cure for the parasite, or will they too begin to lose intelligence? And if they do cure the parasite, then all of a sudden the Venusians are going to be facing some major social changes.

Evolving Societies

Social change causes conflict, and conflicts are the heart of roleplaying adventures. So any society undergoing change will offer many opportunities for heroes to show their stuff. Of course, all societies are changing, all the time, in different ways. Technological change is one potent driver of social transformation; exposure to new ideas from other cultures is another. Economic cycles drive social change – a generation that grew up during a boom era won’t have the same attitudes as one that came of age in a depression. External events like wars or even climate changes can alter societies.

In a game, social changes can be divided into three types: ongoing trends, cycles, and catastrophic shifts. Trends are quiet, gradual changes that often get lost in the “background noise” of everyday events, even though they may turn out to be very profound transformations. Emigration by Europeans to America radically changed the European social and economic system by knocking the economic props out from under the old noble landowners, but it took place over the course of a century and mostly happened “offstage,” in places like

Kansas. In game terms, these changes are likely to be too small to notice on the scale of the characters' adventures.

Cycles include things like business cycles, the "generational personality" model of popular attitudes, the political "pendulum" of liberal and conservative ascendancy, and the rise and fall of civilizations as posited by historians like Spengler and Toynbee. Most of these cycles are beyond the ability of PCs to influence, and many of them happen on such a long time scale they don't really affect the campaign. It can be interesting if the GM wants to posit a "jackpot year" in which several long and short term cycles all peak at once, leading to major economic and political shifts. This can be especially interesting if the PCs (or an NPC) can predict the crisis. Aliens with differing lifespans could have different cycle lengths: very long in the case of beings with Extended Lifespan, blindingly fast for short-lived species.

Catastrophic shifts, unlike the others, can take place almost literally overnight. In the case of wars, stock market crashes, or shocking events like political assassinations, massive changes can happen in a few days. Characters who get caught up in those changes can face all kinds of interesting challenges, and potentially valuable opportunities as well.

Dropping a major shift into the game setting should not be undertaken lightly. It must feel right to the players. If their characters have overcome some initial obstacles and are getting to feel at home in the setting, a major change will feel appropriate: the "second act" of the ongoing drama. But if the campaign has been running for a long time and the GM throws in a massive change just to "shake things up" the result may feel like one of the periodic continuity rewrites in a comic book series – a sign that the writers are running out of ideas.

It's also important to make sure that the post-change setting is as interesting a place to have adventures as the original situation. If the players have been having fun running characters who are space merchants, an interstellar war that brings commerce to a halt and gets them drafted into the Navy may not be what they want to do.

CONTROL AND INTRUSIVENESS

Exactly how much the social background affects the player characters depends in part on how much control that society has over its citizens. In general, the looser the society, the more the characters can ignore it and focus on their own plots and goals. As society becomes more intrusive, it takes up more of the PCs' attention, eventually becoming an obstacle.



Control Ratings

The *GURPS Basic Set* includes the concept of Control Ratings for each society (p. B506). This is an abstract numerical rating of the intrusiveness and oppressiveness of a given state or culture. As with any single-axis description of something as complex as a civilization, it involves some oversimplification. Consider a frontier town on a remote world without many laws, but with summary execution as the only form of punishment. Is that an open society or a restrictive one? If the police can't carry weapons but are allowed to read all your e-mail, is that oppressive?

Game Masters may wish to break down a particular society's Control Rating into distinct sub-ratings for Civil Rights, Social Control, Legal Restrictions, Punishment Severity, and Economic Freedom. The overall Control Rating is the average of these.

Civil Rights are the rights reserved for the citizens that the government may not infringe. The nature and extent of those rights depends on the culture's priorities and history. For instance, many foreigners are baffled by modern Americans' attachment to their Second Amendment right to keep weapons, while Americans abroad are startled by things like government-licensed prostitution or marijuana sales. Typically a low CR in the Civil Rights department means that the citizens have the "upper hand" and will react with anger and indignation when their rights are infringed; a high CR means they are resigned to oppression and know not to complain.

Economic Freedom fundamentally represents how free the people are to buy, sell, and conduct business. Restrictive societies may make it very difficult to do business without government involvement, while open ones may consider commerce to be an entirely separate sphere. Economic Freedom also indicates how heavy the tax burden is (unless there is some unusual situation, like a war to fight raising the tax level or government-controlled resource sales providing a "free" income stream). Game Masters may wish to apply a society's economic CR as a penalty to Merchant skill when non-native characters are trying to do business there, in place of the normal -3 penalty for dealing with foreign cultures.

Legal Restrictions are simply how many things are against the law. Very free societies only ban violence against other citizens (and may even tolerate a certain amount of violence as "private wars"). As CR rises, more things are banned. Typically property crimes come next, followed by laws against fraud and deception, then laws banning reckless acts, then laws governing offensive speech and behavior. Cultures with a high Legal Restrictions CR try to regulate all aspects of behavior, leaving nothing untouched by the laws.

Note that alien or future societies may have very different ideas about what is restrictive and what is free. In a strongly religious culture, casual blasphemy could be a serious crime even at low CR, while in an honor-bound society murder in a “fair fight” could be far less serious than lying.

Punishment Severity is a measure of how harshly the culture treats law-breakers. A low Punishment CR means sentences are light, fines are more common than jail time, and the emphasis may be on treatment or rehabilitation of offenders. High Punishment CR means that the society imposes heavy penalties to punish the guilty or deter future wrongdoers. This also affects how likely law enforcement agents are to use physical or lethal force. A low Punishment CR probably means they don’t go armed, or carry only stunning weapons. High Punishment CR means they can use lethal force to stop fleeing suspects.

Social Control reflects how much of a society’s intrusiveness represents extralegal mechanisms. There may not be any law against carrying a blaster on Aspen Station, but if you try it you’ll find the hotel won’t give you a room, the cantina won’t seat you or sell you a drink, and the repair dock won’t give you credit. Low social CR means that people mind their own business and don’t stick their noses

into other people’s lives. High social CR means that everyone knows what everyone else is doing and lets them know what they think of it. Typically, social control CR is high in small close-knit societies, and low in diverse urban cultures.

AVENUES TO POWER

Characters within a society may wish to gain positions of power and authority themselves. There are at least three ways to do this.

Work the System

All systems of government have a mechanism for choosing who rules. There’s no reason why player characters can’t join in. This can mean running for office in a democracy, getting hired and rising to the top in a corporation, or assassinating everyone with a better claim to the throne in a hereditary monarchy. Rising to the top by working within the system usually takes a while, and may become the focus of an ongoing campaign. Of course, it’s easier for adventurous types to rise in some societies than in others. A feudal culture might reward boldness and cunning with ennoblement, but in a democracy the voters are seldom likely to keep re-electing

someone who spends all his time off having adventures instead of doing his job.

Start Your Own

Characters may get the opportunity to be “Founding Fathers” of a new society as a result of their actions in the campaign. Leaders of a rebellion or independence movement have to create a government to replace the one they’ve overthrown, and entrepreneurs setting up a colony on a distant world can establish the kind of regime they like.

Becoming the new rulers is a good way to retire characters after a successful adventuring career. They may become patrons to new, less powerful PCs, or the whole tone and structure of the campaign can shift from colony-building and rebel heroics to political infighting and diplomatic struggles.

The Cortez Option

Finally, sufficiently aggressive PCs may attempt to simply take over an existing state and make it their own private empire. This requires something to give a small group of characters (and whatever followers or mercenaries they bring along) an edge over the people they’re fighting. In the case of Cortez it was steel weapons and the sophisticated military tactics and command structure the Europeans inherited from the Romans. Empire builders in a space campaign can leverage their firepower by choosing low-tech opponents – even a single TL difference can have a huge effect.

It’s also useful to choose a target society that is ripe for toppling. The Aztec Empire had lots of discontented subject tribes ready to ally with the Spanish. Even gold-obsessed strangers from over the sea were apparently preferable to the Aztecs’ industrial-scale human sacrifice. In Cortez’s case, this was pure luck, but future conquistadors can do careful intelligence-gathering beforehand to find a suitably unstable target regime.

Low-tech cultures may have high-tech protectors. Primitive planets can be guarded by the space Patrol or the rangers. Trading partners or neighbors may get upset if some upstart

Corruptibility

A society’s *Corruptibility* is an index of how easy it is to evade the laws by bribery, connections, or bluffing. Apply Corruptibility as a modifier to Control Rating in appropriate situations. If the Corruptibility index is 0, the laws are enforced equally and fairly, and violators can’t weasel out of a penalty. But if Corruptibility is, say, -5 in a CR 6 culture, then for the “right people” almost anything is permitted.

Exactly how to take advantage of the local Corruptibility index depends on the structure of the society. In status-conscious or feudal societies, a *Savoir-Faire* roll might allow one to act like one of the elite. Almost anywhere *Streetwise* rolls tell one when and how much to bribe (or locate a speakeasy or black market that has already paid off the authorities). In highly bureaucratized societies, an *Administration* roll lets one work the system to avoid arrest or punishment. Politics can be used in oligarchies or one-party states to behave like a high-ranking member of the Party.

Additional skills can help. *Area Knowledge* lets the character know what method to try. *Fast-Talk* can replace one of the other skills, but at a penalty equal to the local CR.

takes control of a nearby world. There may even be bands of bold adventurers on scene willing to help fight for the planet's freedom. A clever conquistador will try to neutralize potential interference beforehand: point out the

instability or awful conditions on the target world so that the new regime seems like an improvement to the interstellar community. Reassure trading partners that existing contracts will be honored (even if they won't).

Buy off adventurers with a promise of a share in the loot. Bribe the rangers to look the other way, or choose a moment when the nebula pirates are occupying all of the Patrol's attention.

SOCIETY AND BIOLOGY

A creature's biology affects the way it thinks and behaves. Exactly how much effect biology has is still in debate: some scientists maintain that "biology is destiny" and most of our behavior is hard-wired, while others insist on free will and the importance of environment. Without another intelligent species to study and compare ourselves to, the debate is likely to continue.

BIOLOGICAL CONSTRAINTS

Setting aside questions of free will for the moment, it is nevertheless true that a creature's physical body and evolutionary history must have an effect on the type of society it builds.

Numbers and Density

Diet and size affect how many beings a given environment can support, which in turn will affect population density and things like the design of cities. Humans can eat plants, which means that agriculture can feed fairly large, concentrated populations. Larger organisms would require more food, reducing the numbers a given region can support. Smaller beings could have much bigger populations. As a rough guideline, divide the creature's mass (unmodified by gravity) by 200 lbs., then take the cube root of that ratio, square it, and divide the population by the result. Thus if an average individual weighs 500 lbs., the species population is only 54% of the normal level.

Carnivores need proportionally more area for support, since they can't eat plants directly. Divide population by 10 if the species are pure carnivores or scavengers. Omnivores can presumably shift to a plant-based diet if necessary. For parasites, figure population based on the species they parasitize.

Metabolic rate also plays a role. Cold-blooded creatures don't need as much food, so can support a bigger population in the same space as warm-blooded ones. Double the population number for a cold-blooded species.

Habitable Environments

Where a species evolved affects where it can live. In general, organisms can't really thrive in an environment that is poorer in food and water than where they evolved. Humans arose in dry African grasslands, so could easily handle forests, jungles, and coasts. We don't do so well in deserts, mountains, or the arctic. Warm-blooded organisms like humans seem to be able to handle cooler climates than their native environment fairly well, while cold-blooded creatures might spread into warmer territories.

Aquatic creatures have similar constraints. Animals with gills can't go between salt and fresh water very easily, although air-breathers can (creatures with gills have problems with salt concentration gradients that air-breathers don't have to deal with). Creatures native to shallow water (lagoon or reef) can colonize other shallows, but probably can't spread into deep water. Deep-ocean organisms

may thrive in the shallows, where energy and nutrients are abundant.

Ultimately a Game Master must decide how much of his home planet a given species can use. Much depends on technology, as with TL6+ equipment beings can live just about anywhere if they must.

PSYCHOLOGICAL CONSTRAINTS

Even if you don't assume all behavior is hard-wired, it's pretty obvious that at least some traits are innate, and those in turn will have an effect on society. In particular, the psychological traits discussed in Chapter 6 will influence how an alien culture develops.

Chauvinism

One can assume that chauvinism also applies within a species as well as in dealings with aliens. Chauvinistic beings probably are loyal to their own social group and dislike outsiders. High Chauvinism translates to a lack of unity in the culture, since it will be hard to bring different subcultures together. Broad-minded or Xenophilic races, by contrast, may have no trouble uniting – but may also feel little loyalty to their own species if an alien culture seems more attractive.

Setting aside questions of free will for the moment, it is nevertheless true that a creature's physical body and evolutionary history must have an effect on the type of society it builds.

Concentration

A race's Concentration level is likely to affect its economic productivity. Single-Minded beings can work harder and thus produce more; their society may have a higher-than-average Wealth. Concentration may also affect the race's ability to undertake long-term projects. Distractible or Short Attention Span creatures will tend to "live in the moment" and have a hard time planning ahead or considering consequences. They may not have any capital assets greater than what one group or individual can build and make use of. They are likely to be poor stewards of a planetary environment, and be limited to low TL.

Curiosity

Science and technology depend ultimately on the curiosity of individual researchers and inventors. A race with high Curiosity is likely to advance quickly, while Incurious species may never achieve much advanced science on their own. Curiosity is a major driving force behind things like exploration and contact with aliens. An Incurious race will probably never leave its home planet unless there's a very good reason to do so. The far-ranging starships will belong to the Curious.

Egoism

Individual ego has its biggest effect on a society's Control Rating and economic structure. Egoistic species won't cooperate easily and will have a healthy sense of their own importance. Control Ratings for Egoistic species societies will tend to be either very low (no more than 2) or very high (5 or more).

Selfless organisms will tolerate high Control Ratings (even if they don't need them), and are more likely to adopt non-market economic systems. A very Selfless species might be able to make socialism work better than egoistical humans have managed.

Empathy

Racial Empathy affects how "nicely" a species behaves, both individually and as a society. Species with

Empathy pay lots of attention to good manners and proper conduct – though it can also mean a very prickly willingness to take offense when others fail to behave properly. High Empathy also implies a fairly high level of Social Control (see above) instead of formal legal structures. Reluctance to give offense may mean the species has trouble stating unpleasant truths.

By contrast, low Empathy encourages a "laissez-faire" attitude, but is also conducive to "brutal honesty" and a sense of individual freedom. Combined with high Egoism it can make it hard to form any kind of society at all. Low-Empathy societies may require elaborate and clearly defined legal codes to avoid a total "war of all against all" situation.

ideas, while a Hidebound race will at least stick with what works. Imaginativeness coupled with Suspicion can create a race of paranoids, sensing dangers that don't actually exist.

Playfulness

Playfulness is connected to imagination and curiosity. Socially, it reflects a culture's willingness to devote resources to nonessentials like art, sports, entertainment, and games. Species with high Playfulness are likely to produce lots of art, literature, and media. They may have elaborate sports. Aggressive but Playful species may channel their warlike impulses into intense competition in athletics

What is the use of a house if you haven't got a tolerable planet to put it on?

– Henry David Thoreau

Gregariousness

A species' Gregariousness will affect its population levels and how urbanized society can become. Chummy or Gregarious species can have a higher population since individuals don't mind crowding. Cities may be huge and packed. This in turn may stimulate economic activity and technological progress, so Gregarious species may well be richer and more advanced than others. Low Gregariousness requires a more dispersed population, which means fewer big cities and more small towns and settlements. A species with a Gregariousness of -3 or below may never form a society at all.

Imagination

This trait is another technology and science driver, and also reflects how willing the species is to try new social structures. A highly Imaginative race may have a great diversity of social patterns and lots of new technologies. Low Imagination reflects a love of stability. Note that an Imaginative culture may try lots of *bad*

or wargames. Low Playfulness suggests a very "utilitarian" species, only doing things for practical reasons. They are likely to value rationalism and measurable results rather than aesthetics or inspiring gestures. It means a lot less waste on frivolity, but that very practicality may mean the culture lacks any sort of "safety valve" for individual or group discontent.

Suspicion

Suspicion has a strong effect on government type. A strongly suspicious race will favor a high CR, but may also insist on protections for civil rights. High Suspicion leads to a strong reliance on following proper procedures and documenting everything. Lack of trust in others does make it hard to organize large-scale operations.

Low Suspicion makes for personal bravery and a certain level of optimism. A low-Suspicion culture is likely to be adventurous and expansionistic; coupled with low Empathy and high Chauvinism it could make for a race of aggressive conquerers.

Oxygen-Breathers Unite!

Some space settings have so many alien species there's no way anyone can keep track of them all. David Brin's "Uplift" series and James White's "Sector General" stories involve incredibly diverse multispecies societies. In such a setting beings may feel kinship with related or similar species.

White and "Doc" Smith both used classification systems for alien species, based on various characteristics of biology and environment. Knowing your proper species code could be a matter of life and death

for interstellar travelers, especially when a mistyped digit could put you in the fluorine-breather section of a starship!

Of course, even species that eat and breathe the same stuff can be radically different in habits and outlook, and there is a lot of dramatic (and comic) potential in having humans lumped together with a hideous or hostile species that happens to share the same classification code.

SOCIETY AND TECHNOLOGY

The technology level has a tremendous effect on any society. Changes like the birth of cities, the industrial revolution, and the modern "information society" all came about because of new technologies. A strongly "technological determinist" view postulates that societies at the same TL will tend to look the same even if they are different species on different planets.

TECHNOLOGY AND DAILY LIFE

Modern readers know perfectly well how much technology affects their lives. But how will it affect the characters in a space game? Here are some social and personal attitudes to consider for a futuristic society.

Dead Without It

Humans can live on Earth without advanced technology. Even the most tech-dependent city-dweller can still breathe the air. On any world without a fully Earthlike environment, that won't be the case, and humans in those environments will be much more aware of the machinery that keeps them alive. Anything that might disrupt the life support will be viewed as a serious crime, and all citizens are likely to know at least some basic damage-control techniques. This could foster either a strongly communitarian culture ("we must all work together") or a certain degree of callousness ("incompetence is its own punishment").

Invisible Tech

In very high-tech societies, devices can be so advanced as to be invisible. Instead of typing commands or pressing buttons, people just speak to the air when they want something to happen. Hidden computers hear and obey. Inhabitants of such a society would have almost godlike control over their surroundings – but might be completely helpless if the machines stop listening. One can see aspects of this already: modern automobiles with computerized engines are more efficient, but there are fewer people who can fix their own cars.

Pictures Do Lie

Already it's possible for a computer-generated actor to steal scenes in a film. In a future setting, *any* recorded or transmitted data could be falsified, and any kind of verification can be forged. Such societies may see a return to reliance on face-to-face transactions and the importance of an individual's word as a guarantee of truth. (Or they could lead to a paranoid society in which everything really *is* a lie and trust is a forgotten concept.)

Safety Uber Alles

Advances in science and technology also make people aware of dangers. Sometimes they are new dangers resulting from technology; but there are also natural dangers that become avoidable. For most of

human history, disease was a "random event," but with modern medicine it is something to control and prevent. Future generations may feel the same way about things we see as normal. Future societies could require people to eat properly, or prosecute makers of "unhealthy" products like chocolate or butter. If computer-controlled cars are safer, it may be illegal for humans to drive themselves. By modern standards, a future world of hyper-safety might seem dull, and its people oddly repressed and unadventurous. (Or a hyper-safe world might breed reckless risk-takers, unaware that bad things *can* happen.)

CONTROLLING TECHNOLOGY

The question of how to control technology and who decides when to do so is a major theme in science fiction. In SF gaming, it has direct effects on the game environment.

Why?

Inhabitants of modern Western civilization may find the whole issue of controlling technology mysterious. Why bother? Technology has been good to Europe and its colonies over the past thousand years. More must be better, right?

Maybe not. There are several good reasons why people might want to control technology.

Social Disruption: New technologies change the playing field. Some people get rich, but those whose fortunes are tied to older ways of doing things sometimes get poor. Usually the economic growth associated with technological change overcomes the disruption, but for the individuals actually affected, things can be rough. They may try to protect their jobs by putting the brakes on technology change.

Technologies also change social structures. The birth control pill and the private automobile led to the Sexual Revolution, which in turn had ripple effects on religious life, family structure, demographics, and people's views of morality. Naturally, many of those who don't like the social changes may wish to ban the technologies that cause them.

In a science-fiction setting, where stellar-level supertech can meet stone-age societies, the possibilities for disruption are immense. Even with entirely good intentions, advanced cultures can destroy primitive ones – and as yet there isn't a technology that can eliminate bad intentions. It should be noted, however, that supposedly "primitive" societies on Earth have sometimes proved very adept at using new technologies and assimilating them into their existing culture. Low-tech doesn't equal stupid or helpless, after all. The "natives" may have very different ideas about whether they are "ready" for advanced technology, and may be very resentful of the arrogant aliens trying to keep it from them.

Danger: Some technologies are just plain dangerous. Nuclear power provides vast amounts of energy, but gives its users the potential to create nuclear or radiological weapons. Space travel lets people explore the Universe, or lob weapons at enemies thousands of miles away. Nanotechnology holds the potential for immortality – and for deadly "gray goo" capable of destroying all life.

Any society may decide that some technology is simply too dangerous to let anyone have free access to. Even the open, technophilic West keeps nuclear weapon designs secret. Exactly how secret depends on how dangerous the technology is (or is perceived to be) and how easily it can be misused. Nuclear weapons are really

dangerous, but they're also really hard to build, requiring resources on the scale of at least a minor nation-state. So people can still study nuclear physics, and the textbooks don't come with a security clearance.

Weapon technology is often restricted, but how it is restricted depends on the situation. During the Cold War, both the United States and the Soviet Union sponsored massive research programs into weapon systems, and trained thousands of engineers, but also tightly limited exports and contact with the other side. Both sides *wanted* new tech, they just didn't want the other guys to share it. By contrast, in the 1890s Great Britain had the world's best battleships, and the introduction of the *Dreadnought* class suddenly made them obsolete. Suddenly, Britain's naval supremacy evaporated because of a ship they themselves built. Many in the Royal Navy would have been perfectly happy if *nobody* had that new technology.

Political Instability: Related to the idea of social disruption is the potential for *political* disruption, especially in tyrannical societies. When the Evil Overlord controls all sources of information, a new channel of communication can threaten his rule. Dissidents can get in touch without being monitored; they can contact supporters abroad and plan how to get rid of the Overlord. Naturally, the Overlord wants to keep that technology out of people's hands. If the new technology is a weapon that can even the odds between the rebels and the Overlord's legions, he'll be even more intent on suppressing it – at least until he can refit his troops.

Getting Out Of Control: Sometimes technologies can literally get out of control, especially biotechnology or artificial intelligences. Computers are powerful and vital to all parts of daily life – what if they stop obeying orders? Compared to most machines, humans are frail and easily damaged, and the technology that makes it possible to support a city of millions means those millions are vulnerable when something goes wrong. Do humans want to create machines smarter than we are?

In the modern world, this is one reason for the alarm about genetically modified foods or human cloning. In science fiction, this fear is often the

root of things, like Asimov's Laws of Robotics or the social stigma suffered by genetically modified creatures. In a sense, science fiction has been grappling with this issue ever since Mary Shelley's Victor Frankenstein brought his monster to life and discovered it had a mind of its own.

How?

Even if people agree that a given technology should be controlled, actually doing so is sometimes quite difficult. There are a variety of methods.

Absolute Ban: Just say no. If society decides that nanotechnology is just too dangerous, then forbid it. No research into the subject, no making nanotech items, no nothing. Anyone who does can be jailed, fined, or torn apart by an angry mob. This method works, but it has its vulnerabilities. In particular, it's hard for one society to enforce its ban on others. The European Community has had mixed success using economic pressure to discourage the use of genetic engineering in other countries. And if a dangerous technology is also powerful, the society that bans it is putting itself at a disadvantage.

If the ban is maintained by force or by some external power (a high-tech civilization trying to keep some worlds low-tech, for instance), then the question becomes how far the external power is willing to go. Will they censor textbooks? Destroy research labs? Assassinate or kidnap scientists? At some point the measures to control the technology may become as disruptive as the effects they are intended to prevent.

Embargo: This can go in either direction. A society might try to maintain its monopoly on a given technology by strict controls on exports, while others might try to keep out "harmful" tech by import restrictions. This works fairly well to control the spread of large items, but it can't stop information very well at all, and no border is absolutely "leakproof." If somebody on one side wants technology that is only available on the other side, then somebody else is going to make money smuggling it across.

In the case of a low-tech society denied access to high tech, an embargo can prevent the import of items,



and might even limit the spread of things like textbooks and schematics, but it's almost impossible to stop *ideas* from getting across. Once the locals have seen firearms, they'll try to build their own. If they succeed, then either the embargo power must try to enforce an absolute ban, or admit that the society has "joined the club" and relax the restrictions.

Licensing: An open society may try to limit the spread of dangerous technology by requiring anyone who uses it to pass rigorous tests, and possibly security checks or psychological exams. This has the advantage of letting society enjoy the benefits of the technology, but it also means the safety of the society depends on how well the licensing exams work at weeding out crooks, fanatics, lunatics, and enemy agents. It's vulnerable to corruption, and won't stop a really determined foe from learning what they want.

Technical Fixes: It's possible to use technology to control technology. The simplest way is to attempt to make devices tamper-proof, so that anyone

trying to find out how they work ends up with useless fragments. A variant on this is to include fingerprint or DNA recognition pads on equipment, and install a self-destruct if anyone who isn't an authorized user tries to activate it.

A brute-force method might employ large electromagnetic pulse generators to fry any electrical technology in use on a given world. Every few months, the Technology Patrol comes through and zaps the planet back to the Steam Age. A more sophisticated version of this might employ nanotech devices built to home in on gunpowder or plastic and break them down into useless dust.

More elaborate "superscience" methods can be used to enforce a tech embargo or an absolute ban. In L. Sprague deCamp's "Planet Krishna" stories, the authorities used sophisticated brainwashing equipment to make sure nobody cheated on the technology embargo – but even then the inventive Krishnans found ways to beat the system.

LOSING TECHNOLOGY

A common trope in science fiction, going well back before even the invention of nuclear weapons, is the decline of modern civilization and the loss of technological capability and scientific knowledge.

There are a couple of reasons why this is such an appealing idea in fiction. First (and simplest), the image of barbarians wandering through the weed-choked ruins of New York and Paris is a dramatic and compelling one. It lets writers comment on things like hubris, mortality, and other Big Topics.

Second, reducing or limiting technology makes for fun adventures. Destroying civilization in a story lets the reader (and the author) experience the vicarious fun of getting away from all the bothersome details of modern life. No IRS audits, no taking the kids to soccer practice, no pesky supervisors at work – just a pure struggle for life against mutant cannibals and psychotic motorcycle gangs.

Limiting technology also lets science fiction dip into the deep wells of historical and fantasy fiction. Cutlasses were good enough for the pirates of the Spanish Main, why can't space pirates use them? And it's much more sporting to fight a dragon without an elephant gun or blaster cannon handy.

Dark Ages can be useful even if the characters aren't living in them. A "Long Night" or "Chaos Years" in the past lets the GM "press reset" on the setting's history. He doesn't have to envision a future society that knows everything known today plus centuries of future scientific and cultural accumulation. He can focus on the period of rebuilding leading up to the campaign date.

A post-Dark Age setting allows for more variety in technology and societies. There can be super-advanced technology from before the Collapse left lying around, and isolated human societies on different worlds can diverge into strange and interesting forms. Explorers can go out to re-establish contact with human worlds, leading to all kinds of cool Planetary Romance possibilities.

How It Happens

Actually losing technical knowledge is difficult. Even during the Dark Ages following the fall of Rome, Europe retained its technology. What it lacked was resources – the sheer wealth needed to finance big construction projects or equip a professional legion to Roman standards. The knowledge was there, just not the money. That being said, there are several ways to reduce the available technology of a culture, even if they have knowledge of more advanced techniques.

The simplest and most brutal is a population crash. Most modern technology works best on a large scale. A silicon chip plant requires a market for millions of chips to be profitable. Reduce the population and the tech level possible goes down. Maintaining TL8 requires a society about as big as a large modern nation-state, like Japan or the United States, with 100 million people or more. A TL7 culture can be smaller – the size of a country like Great Britain or Italy, with a population of 50 million or more people. For TL6, a society can get by with about 20 million. Maintaining TL5 needs at least 10 million, the size of the young United States at the start of

industrialization. (TL5 is also about the highest technology a town-sized community could easily keep running with occasional infusions from outside.)

Lower technology levels require much smaller populations. An Age of Sail ship's crew could fabricate and maintain just about everything they needed on board, except for the cannons. A town of a few thousand could be technologically self-sufficient and self-sustaining at TL4. Given the poor communication and transport available, even small communities of only a few hundred *had* to be self-sufficient at TL3, and TL2 needs about the same population. Bronze Age TL1 cultures can be maintained with even a small village.

These population levels assume reasonable levels of trade and communication. Any disaster that cuts off transportation would effectively make every town a self-contained unit, limiting them to the technology they can support with local resources. Similarly, an interstellar colony that is cut off (by war, or some interference in hyperspace, or whatever) would have to manage with whatever technology its population can maintain.

If you don't want to kill everyone off, another way to reduce technology

is to assume some kind of massive social movement in favor of a low-tech existence. In practice this works out to an absolute ban on high technology, but one enforced as much by popular prejudice as by government action. A voluntarily low-tech society might stockpile advanced weapons for self-defense, leading to unpleasant surprises in store for would-be conquistadors seeking an easy victory over a "primitive society."

Another method is to assume that the society's technology all depends on a single key resource, then cut off the supply. Energy sources are an obvious choice, but there are others. One interesting variant is to assume the society's technology is based on a supply of Precursor artifacts – perhaps all starship drive cores are Ancient tech, and if the supply runs out, there won't be any more starships!

Finally, information itself can run out. A culture that stores all its records in electronic format could lose huge chunks of knowledge to an "infowar" of virus programs or EMP weapons, or to some catastrophic software accident like the much-feared "Y2K bug." This is especially likely for a small colony without a lot of backup libraries and archives.

ECONOMICS

One of the most important aspects of any society is how it generates and distributes wealth. The science of *economics* studies how societies perform this basic function.

ECONOMIC OUTPUT

Any society, even a pre-industrial one with very primitive economic institutions, will produce goods and services. *Economic output* is one way to think of the sum total of all economic activity within a society: food harvested, raw materials gathered, manufactured goods produced, housing erected, professional services used, artistic works created and performed . . . everything that the society's citizens might wish to produce, offer for trade, and use.

Resources

The resources available to a society are one factor controlling its economic output. Resources are *found* items, products of nature that can be turned to productive use once a society applies its available technology to the problem.

Resources become valuable when they are very useful *and* in short supply. If a resource isn't useful, it won't be valuable. For example, uranium ores were nothing but a geological curiosity before technologists learned how to extract power and explosive force from them. Meanwhile, even a useful resource won't be valuable if it is plentiful. Iron is extremely useful in many industries, but since iron ore is common it remains relatively cheap.

Any science-fiction universe needs to make note of what resources are particularly valuable, given the available technology and the needs of society. A resource that is rare and critical to important technologies can be a good plot hook, driving conflicts between characters and between societies.

One trap to avoid, of course, is the invention of a mysterious resource that was completely *unknown* to pre-spaceflight society, but which has somehow become critical to civilization. Many science-fiction stories have postulated such resources, and it's not unreasonable to have one in a space setting, but they shouldn't be multiplied beyond reason. See *Unobtainium* (p. 181) for examples of such resources.

Unobtainium

Here are some examples of special resources not found on present-day Earth, which *are* reasonable to include in a science-fiction universe.

Antimatter

The visible universe is dominated by “normal” matter. Antimatter doesn’t seem to exist naturally in large masses, for a very good reason: if a large quantity of antimatter was produced by some natural process, it would annihilate itself spectacularly the moment it encountered normal matter.

Antimatter is thus likely to be produced only in a laboratory – but if some odd natural process produced large quantities of antimatter, then somehow *confined* it away from contact with normal matter, it could be “mined.” The engineering processes involved would be difficult, but any civilization that already uses artificial antimatter for power distribution will be up to the challenge.

Antimatter, of course, is the basic power source in the *Star Trek* universe. The television series has never established whether antimatter is produced or mined, but given the wealth of other odd materials in that universe, natural production seems possible . . .

Artifacts

Alien or Precursor devices of technology beyond what human civilization can achieve are fabulously valuable. If the super-advanced aliens are still around, getting their artifacts requires finding something they think is worth trading for, and avoiding any restrictions their government may place on giving high tech to primitive humans. If the aliens are extinct (or have “passed on to a higher state of being”) then finding artifacts is a cross between prospecting and archaeology, and the chief dangers are claim jumpers and huge rolling stone balls.

Exotic Biologicals

Living organisms produce a bewildering variety of chemicals even on Earth, where almost everything uses the same basic biochemistry. On alien worlds, where life may be based on other chemical processes, truly exotic substances will be produced.

Any one biochemical is unlikely to be useful, but biologists and pharmaceutical researchers make their living by investigating thousands of them at a time. Any

living world might yield useful, yet previously unknown, industrial chemicals or drugs. Meanwhile, alien organisms will produce other substances, valuable for their rarity or curiosity value: exotic woods, unusual amber-like secretions, and so on.

The classic example of an exotic biological – the basis for an entire series of novels, in fact – is the *melange* spice in Frank Herbert’s *Dune*.

Exotic Matter

Quantum black holes, magnetic monopoles, cosmic string loops, or negative matter could all be valuable in a future society. Even if there’s no industrial use for them, scientists will likely pay good money for samples to study, and some types of weird matter may be essential for antigravity or FTL travel. Most of them are likely to be *very* hard to collect and store.

Transuranic Elements

It’s a common cliché to invent “new” chemical elements that were somehow unknown to pre-spaceflight society, but which are critical to interstellar society. In fact, there are no gaps in the periodic table of the elements; we already know all the chemical building blocks of matter, from here to the furthest star.

There is one set of chemical elements – the stable *transuranic* elements – that have not been found on Earth, but which could conceivably be found in other star systems. As atomic nuclei become heavier, they become more unstable and more radioactive, which is why elements heavier than uranium aren’t found in nature and must be produced in a laboratory. However, there are theoretical “islands of stability,” ranges of atomic weights well beyond that of uranium, in which nuclei might be more or less stable. Tiny amounts of such ultra-heavy metals might be produced in supernova explosions; if some natural process could concentrate them, it might be possible to find and mine them.

What properties do these stable transuranics have? It’s anyone’s guess, since no one has found or produced any of them yet. Perhaps some superscience technologies depend on the unusual properties of these weird substances. Several pieces of classic science fiction, particularly Poul Anderson’s “Polesotechnic League” stories, turn on the rarity and special properties of stable transuranics.

Technology

Advances in technology have a variety of effects on a society’s economy. Every new technology increases the *variety* of goods and services, and creates a demand for items that didn’t even exist before the technology was

developed. New technologies create brand-new industries, each with its own pattern of supply and demand, and this can increase a society’s economic volume.

Another profound effect of new technology is on *productivity*. A worker

who is given better tools will often produce more goods, or more useful services, in the same amount of time. Technological advances can also make the use of resources more efficient, so that more goods can be produced with the same amount of energy and raw materials.



One common theme in science fiction is the economic disruption caused by new technology. It's true that when new technologies change patterns of supply and demand, some industries (and some occupations) will decline in importance. Many stories have described societies in which citizens are being made obsolete by advances in technology.

On the other hand, the economic law of *comparative advantage* suggests that advances in technology will never render human workers completely useless. Even if automated ultra-tech tools can do *everything* more efficiently than human labor, society will still be more productive if humans are permitted to do whatever they do best, trading the products of their work for other goods and services produced by machines. Some recent science fiction envisions societies in which sophisticated computers do most of the administration and industrial production . . . but humans still thrive by producing art, music, philosophy, and other cultural goods!

ECONOMIC DISTRIBUTION

Once an economy produces goods and services, the economic system has to determine how to *distribute* them.

Who benefits – who profits – from manufactured goods and delivered services?

Surpluses

Every society defines a minimum standard of living for its members, often reinforced by moral or political codes. No matter how hard times get, a society's members tend to share their goods and labor so that no one

falls below a certain level. This level can be quite low, of course – either because everyone is facing true deprivation, or because the society regards its poorest members as expendable. Any economic production, beyond what is needed to meet this minimal standard of living for everyone, is an economic *surplus*.

One question that needs to be considered is the source of a society's economic surplus. Which members of society actually do the most to produce the surplus – unskilled laborers, skilled laborers, managers, technologists, or automated machines? What status do these productive classes hold in society? How do they produce the surplus, and what form does it take? Economic surpluses are often generated by a society's newest industries, based on new resources or new technologies that haven't been fully assimilated by the society as a whole.

Economic Equality

Every society must develop mechanisms to *distribute* its economic surplus. The question of who benefits from the surplus is as important as the question of who produces it in the first place . . . and there's no guarantee that they're the same people.

One feature of a distributive system is the degree of *coercion* that it involves. Many societies distribute their economic surpluses coercively.

Money

There's a long tradition of coming up with new names for money in futuristic settings, and one can tell a lot about a society by what its currency is called. "Credits" are a very common currency in science fiction, suggesting a highly abstract money system, possibly with no physical "money" circulating at all. Other societies might prefer a currency with a more objective basis of value: the gigajoule (about \$10), the megabyte (about \$0.20), or grams of various metals. If counterfeiting is a problem, "money" may take the form of one-time cryptographic keys.

Currency names can also reflect the society's history and values. Monarchies may have "Royals" or "Imperials." Any human culture might use "Solars" in honor of the home system, or "Stars" as a more generic unit.

Of course, an especially balkanized setting might not *have* any kind of standard interstellar currency. *All* transactions off-planet must be in barter, and the value of an item shifts wildly depending on who you're negotiating with.

The Leisure Society

Many science-fiction stories have portrayed a *leisure society*, a society in which almost no one is forced to work in order to support a comfortable lifestyle. In a leisure society, even many luxuries (advanced education, luxury goods, wide-ranging travel, and so on) are freely available to every citizen.

A leisure society can happen when industries are so productive that they can easily provide every citizen's needs without requiring them to work. This can be the result of extremely advanced technology, such as automated factories and "magic" nanotech. In effect, so much wealth is available that the minimum standard of living for every citizen can be placed very high.

Naturally, even in a leisure society some people will have more leisure than others. Just because the minimum standard of living is high doesn't mean there isn't an economic surplus, which may be distributed very unequally. In fact, in a world where no one is suffering real starvation or deprivation, it may be easier to justify vast differences in wealth.

Of course, another way to generate a leisure society is to have an underclass of non-citizens who do all the necessary work. This is an extreme example of an unequal system of distribution – the luxurious standard of living of a few citizens is supported by the labor of many non-citizens. If the relationship is very coercive, the society holds slaves or serfs. If the system is only mildly coercive, the laboring class may be "migrant" or "guest" workers. If the laboring class has the Slave Mentality disadvantage, then no coercion may be needed at all!

In science fiction, leisure societies can be a useful way to examine a variety of social or philosophical issues. When no one needs to struggle to survive or enjoy life, does life still have meaning? If the leisure society is supported by non-citizen labor, what moral obligations exist between citizens and non-citizens? Do the answers change if the non-citizens are themselves products of advanced technology (robots or artificial life forms)?

hands, leading to strong inequalities of wealth. Such inequalities often encourage the formation of an elite social class – administrators, entrepreneurs, high priests, or military leaders who use wealth, social position, and political power to reinforce each other. Other systems tend to spread the economic surplus more widely, permitting more of a society's members to benefit.

There are many societies in which wealth means more than money or goods. Prestige, religious merit, or political influence are immaterial forms of "wealth" that might be as valuable as cash in some settings.

Coercion and equity are almost "independent variables," only loosely correlated with each other. A despotic or feudal society will be both strongly coercive and very unequal in its distribution of wealth. A communistic or hive-mind society may be very coercive, but also very egalitarian. A capitalistic society may be very free, while still permitting wealth to concentrate in the hands of a property-owning or entrepreneurial class. Finally, a communitarian or "natural communist" society may be very free while still distributing the economic surplus almost equally across the population. Super-intelligent AI computers might be able to make central planning work in a way that humans have not been able to achieve.

The surplus is gathered in the form of taxes, fees, tribute, or other enforced contributions, and is then distributed by the conscious action of an administrative or governing class. Other societies use some form of "free market" to distribute an economic surplus. In a free market, ownership of goods and services is assigned to the people who produce them, who are then permitted to offer them freely to anyone who can meet a reasonable price. Most societies use some mix of these methods, using some level of coercive taxation to support the government's operations, and permitting other economic activity to take place in a free market.

Another important feature of any distributive system is its level of *equity*. In some systems, the economic surplus is concentrated into very few



The coerciveness of a distributive system is related to the Control Rating of a society (p. B506). A society in which wealth is coercively distributed will almost always have a high Control Rating. The equity of a distributive system doesn't have a

simple measure in the **GURPS** rules – but it will have an effect on how many people have Wealth (p. B25) far above or below the average. A strongly unequal society will have some people with several levels of the Multimillionaire advantage, and

a lot of Dead Broke people to balance them out. An egalitarian society will have few Multimillionaires and relatively few Dead Broke or Poor people. The *average* wealth will remain the same.

LAW AND JUSTICE

Of course, governments aren't really governments without laws. A despot may rule by whims and decrees, but any stable society requires a set of known and consistent rules. Otherwise any kind of planning for the future becomes impossible.

SOURCES OF LAW

Laws can come from a variety of sources, and the source of law must ultimately be something that makes the law legitimate in the eyes of the people who obey them.

Common Law

Many English-speaking countries on Earth follow a system of common law, based on tradition and precedent. While sometimes unwieldy, it has the weight of tradition and the powerful concept of “because we’ve always done it that way” to lend legitimacy. Nowadays all countries supplement that with laws enacted by legislatures, but on another world or in an alien civilization, tradition could be the only true source of law. Such a system gives a lot of power to the judges who interpret the law and make decisions that get enshrined as precedent. Common law systems are sometimes slow to adapt to changing conditions and unexpected situations. They can often preserve odd quirks and remnants of the past. In organized, literate societies, common law can amass a huge database of precedents and decisions, while in low-tech cultures it may only include what the judges can remember.

Religious Law

When you can't trust other humans to make the laws, who can you trust? God, that's who. Many societies on Earth still use legal systems based on

religion. Islamic law combines the principles laid down by Muhammad with what amounts to a common-law system of precedents and interpretations; ancient Jewish law was very similar. Religious law has the advantage of divine authority to lend legitimacy, but that can break down if the populace changes its beliefs or abandons the religion. Like common law, religious law is very slow to change, especially since the divine revelations simply *cannot* be wrong.

In science-fiction settings, there is the possibility that genuine “higher powers” might actually exist. A super-intelligent AI, or aliens with vast intellects, might give a culture a set of laws to follow, then either move on to another world or lose interest in the project. Colony founders might give their descendants a legal code that acquires mythical status after civilization collapses.

Legislated Law

Law codes are systems of rules drawn up by a government. An absolute ruler can draw up a code to suit himself and impose it by fiat (as Justinian or Napoleon did); democratic states have legislatures to make and amend laws. Code law depends on respect for the government for its legitimacy, although an especially well-crafted set of laws can be accepted for their sheer functionality. In a monarchy the legitimacy of the laws is the same as the ruler's claim to the right to rule. In a democracy it is often codified in a constitution (which is really nothing more than a “meta-law” to define the system for making and changing the rules). The same authority that drafts the laws can change them, so that a law code system can adapt to changing conditions; however there is no guarantee the changes will be wise ones, and the ease of

amendment makes it easy to follow a disastrous course.

In many Earth nations law codes exist uneasily with other systems. In the Anglophone democracies, acts of the legislatures can supersede common law, but in Islamic lands conflicts between religious law and secular law can erode the legitimacy of the civil authority.

Fiat Law

In some situations, the law is simply what the people in power say it is. What they say can change from day to day, and it's up to the population to stay informed. On Earth this sort of rule by edict is usually confined to dictatorships, emergency governments, military occupation authorities, and any other situation where there is power to enforce order, but no established rules. But in a future society with AI computers, a legal system that adapts moment-to-moment, taking all factors into account and judging each situation on its merits, might be highly enlightened and efficient.

Other Systems

Science-fictional societies can add all kinds of new wrinkles to the idea of making laws.

Consensus systems use the input of everyone in the society, or at least all adults. In low-tech societies this only works in small groups, and often requires a lot of discussion. But an information-age society could link up its citizens in an “online democracy.” It can either enact codified law as a kind of super-legislature, or apply fiat law to situations as they occur.

Instinct is seldom a basis for law among humans (though consider the ancient tradition sanctioning a man killing his wife's lover). Alien creatures might have much more of their

behavior determined by hard-wired instinct, and use that as the basis for law and administering society.

Prestige might give an individual's statements or opinions the force of law in some societies. This assumes that prestige comes from some source other than brute force or religious authority. On Earth this sometimes works in democratic societies, when prominent individuals can urge legislation and sway public opinion.

Participation could be the source of law in a utopian anarchy or a laissez-faire free enterprise system. Individual laws or sections of legal code could be made available to the public, and if the public adheres to those laws, they remain in force. This is akin to common law, but with the built-in "sunset" policy that if enough people break the law it ceases to apply.

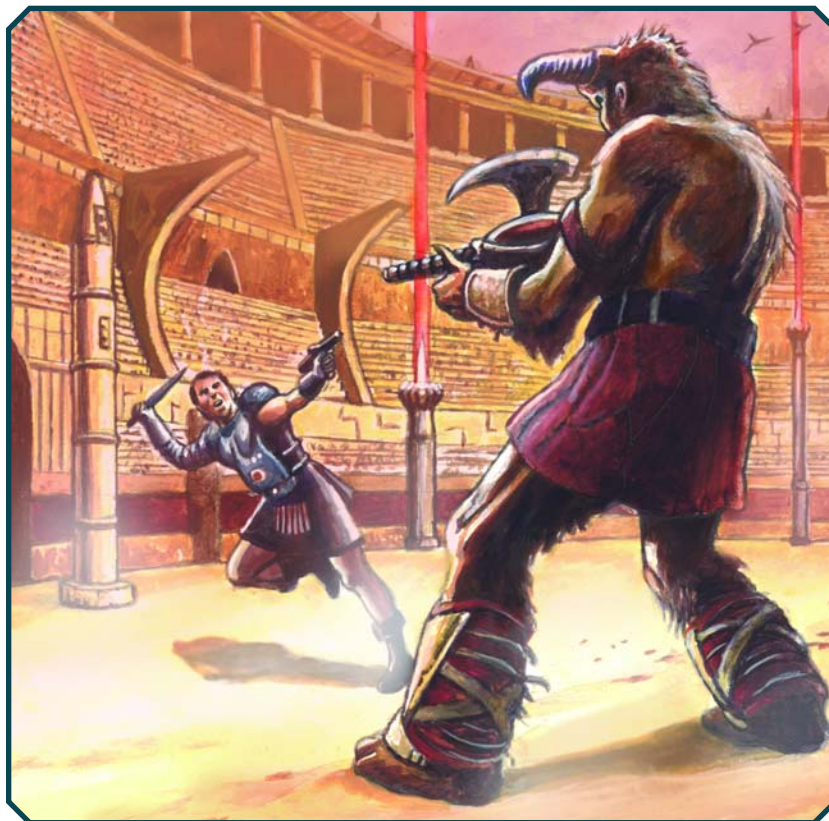
RESOLVING DISPUTES

One of the reasons to have laws is to resolve disputes between people or groups. When there is no mechanism for dispute-resolution, the only recourse available is fighting. On Earth, dispute-resolution is handled by the courts, through the whole system of civil law and litigation. Other cultures might do things differently.

Augury seeks the will of the Gods through omens, and has been used on Earth as a means of dispute-resolution. If reading omens requires a priest, then in effect the priests are the civil judges. But if anyone can read the omens, then this is essentially justice by random die rolls. Clever operators will learn to "game the system" by choosing situations so that the omens favor their side. In some settings, the omens may be picking up the will of some superhuman being.

Democracy means that the whole society gets to resolve disputes, probably through some kind of Athenian democracy vote. Even in modern America people talk about the "court of public opinion" and note that the judges follow the election returns. This requires either a small, close-knit society or a very efficient communication system.

Mediation is used in some cases in modern society, but another culture



might use it for *all* dispute resolution. Mediation seeks to work out a "compromise position" that both sides can live with, instead of the more familiar "winner and loser" outcome. Mediation helped by psionics or super-intelligent computers might try to achieve the goal that is best for *everyone*, including the participants and society.

Ordeals are an old method, similar to augury, in which the disputants go through an ordeal like submersion, holding a burning coal, handling poisonous snakes, or other unpleasantness. The theory is that whoever is in the right will be protected by divine power and so will be unharmed. If the ordeals are dreadful enough, people will only demand a trial when they are *sure* they are right!

Telepathy lets a skilled psi discover the true right or wrong based on the memories of those involved in a dispute. This makes psis into arbitrators, and means that privacy is impossible for anyone who wants justice. This is an obvious choice for a society ruled by psis.

Trial by Combat has an old history on Earth, and is based on the idea that Fate or the Gods will uphold justice by

giving victory in a fight to the one who is right. A culture that values martial prowess might retain trial by combat even in a high-tech society. There may be limits on weapons one can use, rules about hiring a champion to fight in one's stead (in which case skilled champions can become very well-paid), and so on. It's quite likely that a society with trial by combat as a legal mechanism will also have a *lot* of informal duels and fistfights.

Verification by supersophisticated lie detectors or completely reliable truth drugs could make the whole question of dispute resolution a technical matter. This would reflect a society in which getting at the truth is more important than privacy.

CRIMINAL DETECTION

Criminal law can be considered a special case of civil law, in which the society as a collective entity considers itself wronged by one person's actions. Again, the major purpose in having criminal laws is to make society the agent of justice rather than letting individuals carry on personal vendettas.

How a society deals with crime reflects both its ideals and the practical realities the law enforcers must face. In the United States we insist that the police read the accused their rights (idealism) and allow minor criminals to plea-bargain in exchange for testifying against major ones (practicality). These two are often buckets in a well, changing relative importance depending on how serious the crime problem is. When crime is running rampant, "get tough" policies are enacted, shifting the balance to practicality. When things are under control or there are outrageous abuses, the idealists demand reforms.

In modern Western societies the police are a distinct agency, separate from the military, the courts, and fire/rescue services. Other cultures may combine elements – a frontier marshal might be both police and magistrate, authorized to track criminals and mete out punishments on his own authority. In a society facing serious violent crime, the army may take over some or all law-enforcement tasks. Conversely, a very peaceful culture might view policing as just an extension of fire and rescue, dealing with all threats to the safety of the citizens.

New Crimes

New technologies and new societies mean new ways to break laws. In just the past couple of decades computer crime has gone from a curiosity to a major concern of law enforcement. Some possible future crimes include:

Illegal Insentiation: Creating a computer system with free will, contrary to the rules governing AIs.

Irreversible Murder: Killing a person in such a way as to preclude easy recreation or revival.

Mindraper: Mind-reading or mental manipulation without consent.

Personality Theft: Stealing an individual's mind record.

Social Tampering: Influencing a low-tech or alien civilization for personal gain. The most common method would probably be the "God Grift" (impersonating a divinity for criminal purposes).

Unlicensed Cloning: Making a genetic duplicate of someone (probably someone famous) for exploitation

in various ways. This could range from making copies of famous actresses for bordellos to something as relatively benign as cloning great athletes and then seeing how much teams pay to hire a legend "reborn."

PUNISHMENT

While the details of law enforcement and dispute resolution get short shrift in most science fiction, writers and filmmakers get really creative when it comes to punishments. Just regular jail never seems to be enough. Over the years, they have come up with lots of imaginative ways to punish evildoers.

Brainwashing

Mind control, either through psionics, hypnotic conditioning, or brain surgery, lets society try to "cure" criminals. The simplest level just makes it impossible for a convict to perform violent or criminal acts. The film *A Clockwork Orange* shows one technique and its effects. Sometimes clever crooks can find ways to beat the conditioning.

More elaborate brainwashing may "kill" the criminal's personality and replace it with a new person who doesn't remember the crimes he committed. The brainwashers may or may not tell the reprogrammed person what he did. This kind of treatment lends itself to complications when the treatment goes wrong. Is the mass murderer's personality starting to resurface in his new mind? What if a mindwiped person runs into a victim of his former personality – a victim who wants revenge?

Exile

If space travel is easy, then criminals can be exiled to another world, either for a limited term or for life. A relatively humane society may simply use this as a form of "compulsory colonization" intended to let troublemakers and tough guys fight a hostile planet instead of peaceful citizens. A tyrannical or sadistic culture may use convicts as slave labor, or ship them to an especially nasty "hell planet" where only the toughest can survive.

Internal Exile requires some kind of preserve or "prison zone" where

criminals are sent to serve out their sentences. Often the Zone's borders are sealed by some kind of ultra-tech barrier. Violent criminals tend to build their own vicious anarchy, while political prisoners may use internal exile as a chance to put their ideals into action.

Finally, a criminal could be exiled by simply becoming "invisible." In a high-tech culture this means being Zeroed, but with no chance to acquire a temporary identity. Cut off from computer networks, bank terminals, and communication, the exile lives in society but can't participate.

Organ Banks

Larry Niven was probably the first author to suggest that capital punishment becomes a lot easier for people to stomach if they know that all the criminal's usable organs will go to help sick and dying people get a new lease on life. Niven also speculated that if living a long and healthy life depends on lots of executions, people might start imposing the death sentence for more and more offenses. So far, no government has connected the same dots, but it may only be a matter of time. In a space campaign, many high-CR societies may fill organ banks with parts of condemned criminals.

With sufficiently advanced medicine, the criminal doesn't even have to die. A particularly cruel culture might remove organs for transplant from a *live* felon, condemning him to an existence tied to life-support machines but helping others. Cordwainer Smith's hell-planet Shayol took this to an even more baroque extreme, as convicts were sentenced to life on a world where local microorganisms stimulated the growth of extra organs!

Virtual Prison

One complaint about modern jails is the expense. It costs money to house a criminal in even minimally decent standards. It would be so much simpler if they could be just stacked up like cordwood in a warehouse somewhere until their sentences are up. Suspended animation offers a way to do just that. Crooks get frozen for the length of their sentence. No muss, no fuss.

Of course, some might object that freezing felons means they aren't getting punished for their crimes. They enter jail, go to sleep, and wake up free men. Virtual reality technology can solve that problem: the prisoner's body sleeps, but his mind is awake in a simulated environment. The nature of that environment depends on how cruel the prison system planners want to be. It could be educational, merely tedious, or actively horrific. One idea that is just sadistic enough to be plausible is for the criminal to spend his

sentence experiencing all his crimes from the viewpoint of the victims.

Alien Punishment

A nonhuman culture could use very different penalties, based on alien psychology or anatomy. For instance, a species of gregarious herd creatures might consider exile the equivalent of the death penalty, while a society of solitary carnivores would hardly consider it a punishment at all. A species that regrows limbs might use amputation as a penalty for minor offenses.

For some beings, the question of *how* to punish them becomes important. A teleporting psionic can't be kept in jail, and a superintelligent AI could simply "upload" its personality to a different computer brain. Would an immortal even mind spending a few years locked up? In any society where these things are normal, the laws and courts must have ways to deal with them. Perhaps the psionic gets an implanted "inhibitor chip," while the computer is isolated from all networks.

MILITARY FORCES

Almost every society maintains military forces – institutions designed to use force to defend the society from attack or impose the society's will on its enemies. The nature and organization of these forces can have a big effect on how a society works, so it's an important thing to consider when designing an alien or futuristic society.

MILITARY TYPES

Throughout history, military forces have been organized in a variety of different ways. Many of these institutional forms may be resurrected in the future, as military technology (and the political environment) change.

Standing Armies

The concept of a *standing army* – a permanent military force manned by trained professionals – is relatively new in human history. Although military forces can be economically productive, as when they're used for public-works projects or humanitarian aid, they're usually a net drain on a society's wealth. As a result, a society needs to have a significant economic surplus before it can maintain permanent military forces. Societies without standing armies have used a variety of techniques to maintain a military force for use in wartime.

Militias

Many societies use a *militia* instead of a standing army. A militia is drawn from the civilian population, and can be called up when an emergency

threatens. Depending on how much time and money is spent on training and organization, a militia can be an untrained rabble, or it can be a highly trained near-professional force. Some societies require every citizen to undergo basic military training, providing a large pool of people who can take up arms immediately when needed.



Militias are found most often in frontier societies, or in small "city-state" societies that have only limited manpower. They are more common in democratic societies, where the common citizen is encouraged to feel that

he has a stake in the society's military success. Even very advanced and prosperous societies often use militias; for example, most modern industrial states maintain "national guard" units to supplement their relatively small standing armies.

Both standing armies and militias can be made up of volunteers or conscripts. Conscript armies can be vastly larger, but tend to have lower overall morale and training levels. Some nations have a volunteer standing army in peacetime and expand it through conscription when war breaks out. Being a volunteer soldier gives characters a *Duty* to the service, while conscripts have an *Involuntary Duty*.

Mercenaries

Some societies make heavy use of *mercenaries*. Mercenaries are professional soldiers who are not dedicated to the service of one ruler or state; instead, they temporarily serve whatever ruler or state pays them. Mercenaries can be very effective, because they are professional soldiers. Mercenaries also have the advantage that they don't need to be kept on the payroll during peacetime. On the other hand, both of these advantages can turn against a mercenary force's employers. Mercenaries will rarely take great risks in battle, because their interest is in surviving long enough to collect their pay and move on to the next assignment. Mercenaries can also be dangerous if they don't get paid on time . . .

Mercenary forces are common in aristocratic societies, where the rulers may prefer to rely on professional soldiers but can't afford to maintain a standing army (or are reluctant to arm the common citizenry, for fear of revolution). Mercenaries are also more common in situations where warfare is considered to have "rules" limiting its destructive potential.

MILITARY UNITS

Military units are usually organized in a hierarchical fashion, with smaller units being used as building blocks for the larger ones. Historically, the number of small units that make up the next larger one is often quite consistent. This is because of the concept of *span of control*: a single human commander can only deal with so many subordinates before being overwhelmed by the stream of information and needed decisions. Military officers deal with this problem by delegating some of their authority to other officers of lower rank, who command smaller units.

This section describes a fairly "generic" system of military organization, based on modern Western models. This system may be useful for a wide variety of science-fiction settings, especially in the "military SF" genre where many authors draw on their own experience of military life to flesh out their description of futuristic military institutions.

GMs who want something more exotic may wish to research alternative military models – although the hierarchical organization of military units is likely to be a constant for *any* human military force.

Aliens, or other beings not subject to human limitations, may organize their military forces quite differently. One simple variant is to change the span of control: beings descended from herd or hive animals might be able to manage larger numbers of subordinates, leading to bigger units at each level of the organization scale. Conversely, solitary aliens might prefer a more "hands-on" style with fewer subunits. Proud, solitary beings might not be able to organize into hierarchies at all, and could retain more of a "heroic warrior" model for armed forces – devastatingly effective special ops squads, but no armored divisions.

Army Organization

"Ground forces" military units (an army, a marine corps, and so on) will usually be organized in the following hierarchy. *Teams* of two to four individuals are the smallest tactical unit. *Squads* are composed of two to three teams (more in a high span of control culture), or are the crew of a single large fighting machine. *Platoons* are formed of three to five squads under an officer, and may include some support personnel outside the combat squads. A *Company* consists of three to five platoons, a command or headquarters element, and some additional support vehicles and personnel. It is normally commanded by an officer of Rank 4. Artillery companies are called *batteries*, while cavalry or armored companies are *troops* or *squadrons*.

A *battalion* consists of two to five companies, with a headquarters element and a significant number of extra support vehicles and personnel. A battalion is usually the smallest unit to have extensive "rear echelon" support elements, such as a medical field hospital, a motor pool, or a military-police unit. *Regiments* consist of two to three battalions, normally commanded by a colonel (Military Rank 5-6). Regiments are often composed of battalions and companies of different types, and can exchange these smaller units to fit changing circumstances. Some armies use regiments as a purely administrative unit, while others dispense with them entirely, but they were the primary unit for the British Army during the colonial era, so they show up in Kiplingesque space settings often.

A *brigade* consists of two regiments or three to five battalions. Like a regiment, a brigade is usually composed of a variety of smaller unit types, and may exchange smaller units as needed. *Divisions* are the smallest self-contained military units, with all their administrative and support functions "in-house." A division consists of a variable number of regiments or brigades, usually averaging about 20 battalions in all. It is normally commanded by a major general or lieutenant general (Military Rank 7). Above the division are a variety of units – the *corps*, the *army* or *field army*, the *army group*, and so on. These are rarely standardized, and are

usually assembled and reassembled as needed. Units above the division level are usually commanded by full generals (Military Rank 8+).

Navy Organization

In science fiction, "space forces" (the navy, the Patrol, and so on) are usually organized along the lines of a present-day oceangoing or "wet" navy. Since space navies are organized around spaceships of varying size and complexity, they won't use the simple hierarchy to be found in a ground-based army.

Note that a "space navy" doesn't have to use "wet-navy" ranks and titles. A space force derived from the air force would have ships commanded by majors and colonels, and fleets led by generals. Alternately, the spacers might come up with their own set of titles – astronaut, specialist, mission commander, etc.

Team: A team is the smallest organized unit, and consists of two to six crewmen who work together to support some common function. A team will usually be led by an experienced crewman (Military Rank 0-1), although a team with a particularly important function may be led by a senior NCO or even an officer. On a very small vessel, a "team" may consist of only one crewman, in which case the team isn't considered part of the command structure.

Department: A department (sometimes called a *section*) is a group of teams that work together to take care of one function aboard a vessel or naval base. A department is usually referred to by its function: the *command* department, the *communications* department, the *engineering* department, and so on. A department head is often called a *chief*, a *department officer*, or a *commander*. He may be a senior NCO for a small department, or an officer for a medium-sized or large one. His Military Rank depends on the number of people in department.

Crew: A single ship's crew consists of all the departments and individuals who work on board the ship. A ship and its crew are commanded by an officer, who is always called the *captain* as a job title regardless of his actual rank. Ship's captains usually have Military Rank 3-6, depending on the

size of the ship and its crew. Small bases are organized much like a single ship.

Task Force: A task force is a group of ships of varying sizes, organized for a specific purpose. They are also known as squadrons or battle groups. The exact makeup is determined by what the mission is and what ships are available. Typically the most powerful combat unit is the flagship of the force commander, though some fleets may have specialized command ships with extra communication and data-handling capacity. A task force's commander is usually Rank 7, or at least one level above the highest-ranking ship commander in the force. A large base is the equivalent of a task force in terms of size and command rank.

Fleet: A fleet is more of an administrative division than a combat unit. It typically has responsibility for operations within a given region, and includes not only ships but bases and support facilities. Fleet commanders are always Rank 7 or higher, but the number of people they command can vary. A military could have a "fleet" assigned to a quiet or empty sector with almost no ships or people, but a fully active headquarters.

Logistics

There's an old saying, "Amateurs talk tactics and strategy, professionals talk logistics." No military unit can fight without supplies, and that dependence only increases as units become more technologically advanced. The soldiers of Napoleon's *Grand Armée* could get by with little beyond ammunition and hardtack, but a modern force needs fuel, spare parts, medical supplies, *lots* of ammunition, electronics – a whole shopping list. It's likely that future armies will need even more.

Having a logistical "tail" stretching across interstellar space makes warfare very difficult. Assume 10 lbs. of supplies *per day* for each soldier in the field, and at least 100 lbs. of fuel per vehicle. If all that has to be hauled by starship, interstellar war will be very expensive. That's not a bad thing for gaming purposes: expensive wars will rely on fast-moving, hard-hitting teams of highly trained soldiers – the perfect environment for PCs.

Alternate Armies

Many science-fiction writers have imagined future armies without any soldiers at all – or at least no *human* soldiers.

Robot soldiers would be hard to kill, easy to replace, and never complain. But it's proving to be very hard to make robots smart enough to act as soldiers, and machinery always seems to need maintenance. Modern armies are beginning to field robots as remote surveillance units or remote-controlled guns, but so far nobody's willing to take the human finger off the trigger button. One possible solution is to use humans safe in the rear "teleoperating" robot soldiers in combat. Jamming the control channels would be a primary goal of the enemy.

If you can't make robots into soldiers, make the soldiers into robots. Partly, anyway. Cyborg soldiers would be strong, fast, possibly armored and equipped with built-in weaponry, but still human. Finding volunteers willing to become cyborg-soldiers might be difficult; a tyrannical state might use prisoners or conscripts – though that runs the risk of having alienated, angry super-soldiers turning mutinous.

Finally, genetic engineering could produce combat bioroids or uplifted animal troopers. They could have animal ferocity and human intelligence, and with a few scavenger genes could live off almost anything – including enemy casualties. As with cyborg soldiers, there could be serious problems if the genetically engineered super-soldiers decide they don't like the society that made them.

How Much Military Rank?

There's a useful rule of thumb when deciding what Military Rank a given soldier or spacer should have. Each level of Military Rank means that the character has about four to five times as many *subordinates* under his direct command. This number has to do with the span-of-control concept – most humans can deal with about that many subordinates before becoming overwhelmed and needing to delegate authority. So someone with Rank 0 has no subordinates, Rank 1 has four to five people, Rank 2 commands 16-25 men, Rank 3 has 64-125 troops, and so on.

This rule of thumb often breaks down across the transition between senior enlisted rank and officer rank; a very junior officer may have Military Rank 3 while still only commanding a section or platoon. Also, a serviceman in a *staff* position, with no one under his direct command, will usually have lower Military Rank than his position in the hierarchy would otherwise indicate. Characters on staff might add levels of Courtesy Rank to reflect their anomalous position of great influence but no subordinates.

The rule of thumb for Military Rank may be extended to other forms of Rank as well, since the span-of-control concept works for every human institution!

The more units can "live off the land" the bigger armies can be in a space war. Automated factories could produce spares in the war zone, and destroying an enemy's autofacs would be a key goal for commando raids. Fusion or cosmic power sources could

eliminate the need for fuel, drastically improving an army's supply situation. Nanotech "food fabricators" could turn local air and dirt into rations – though the troops will probably still gripe about the taste.

Mobility

Related to the issue of logistics is the question of how mobile military units are. If it takes weeks or months to move a battalion from one world to another, then units won't relocate often. There will be semi-permanent garrisons on frontier worlds, big enough to hold off an attack until reinforcements can arrive. Offensives

against other advanced military powers will be very difficult, and borders will be stable.

Fast but expensive travel will force militaries to use small forces with as much offensive power as possible – high-tech battlesuit troopers, super-tanks, or transforming mecha. This is a good environment for PCs. Instead of big wars there are lots of commando raids, and “special warfare” troops

working with discontented citizens to start rebellions in enemy territory.

Fast *and* cheap transport, equivalent to modern air transport, lets powerful military units move about easily. This lets states centralize their military forces, reacting quickly to crises. However, since *other* states can do the same, large-scale wars become possible.

INTERSTELLAR GOVERNMENTS

In any campaign extending beyond a single world, there is likely to be at least one interstellar government. There may be several contending powers, or even a vast patchwork of states. The nature of those states reflects and influences the nature of the campaign setting. Most of the notes on governments in this section can also be applied to states at planetary or national scale, but for simplicity the descriptions assume a multiplanetary interstellar government.

ANARCHY

Anarchy is a state that isn't a state at all. There is no government, at least not in the sense we know today. Anarchies come in three main types.

Patchwork States

It's possible to have an interstellar civilization with no government above the planetary or even the continental level. This simply mimics the situation in the modern world, just on a vastly larger scale. This arrangement is likely if interstellar transport is very slow and difficult, so that colonies have to be independent if they can survive at all, and there is no way for one world to exert military force against another. In this situation, space beyond the claims of planetary governments could be a dangerous haunt of pirates or bandits, but worlds could cooperate in patrolling deep space, forming the basis of an alliance (see p. 191). Conflict among patchwork states is likely to be localized, pitting a few worlds against each other, and rebellions will be directed against specific planetary governments (often with the help of unfriendly neighbors). Trade

can be as free or restricted as individual worlds wish, and companies with operations on many worlds can grow rich enough to become independent powers in their own right.

Failed States

Contemporary news readers are probably familiar with what happens when the government of a country can no longer maintain any order. Law disappears, and society returns to a state of nature, in which the strong do what they want to the weak. On an interstellar scale, there could be entire star systems in which order is maintained by a local regime, but in deep space or on remote planets the law of the jungle prevails. This is also the situation in a frontier zone with little or no control by the central government.

An interstellar failed state can remain in anarchy until either some external force imposes order (which may unite the quarrelling natives to resist the invaders), or until one world sets up an empire or several enter into an alliance to dominate the rest. If the new rulers can suppress or co-opt the local bosses, the new state may survive, but often the civil war drags on through several more cycles.

Anarchist Utopias

Very different from the thugs-with-guns style are stable anarchies deliberately set up as states without a government. These can be quite large, even galactic in scale, but recognize no sovereignty above the level of individual beings. The Culture in Iain Banks' series of novels is a huge anarchy that is the dominant civilization in the galaxy. Anarchies on an interstellar

scale must either be the only society there is, or else must be wealthy and powerful enough to defend themselves against aggressive neighbor governments. Social arrangements are either fiercely “libertarian capitalist” setups, with contractual agreements and payment for all services, or “true communist” societies in which automated labor and superintelligent computers have really made it possible for everyone to have what they need without money.

Government

While the whole point of an anarchy is that there is no government, any society has some way of making decisions. In patchwork anarchies there are the local governments, and in failed states there is whoever has the biggest gun at the moment. Utopian anarchies may have no official government, but citizens can form ad-hoc “working groups” to undertake projects or deal with crises.

The Military

In patchwork anarchies, individual worlds can have as much armed force as they can afford (see p. 187). This means that in aggregate, a patchwork anarchy can have more military force than an empire – it's just that there's no central command to point it all in the same direction. There's little distinction between the Patrol and the navy, and planetary armies are most likely configured for defense. Mercenaries are a prime method of foreign intervention, and thrive in this kind of system.

In failed state areas, no formal military exists. Instead there are people

with whatever hardware they can get their hands on. Space forces consist of a few battered old ships, and there's no distinction between the Patrol and pirates. Armies are simply the local goon squad. Failed state militaries can't go toe-to-toe with any kind of organized opposition, but are lethally effective at low-level terrorism and guerrilla warfare.

An anarchist utopia won't have a formal military either, but in a sufficiently wealthy and advanced society, the ad-hoc groups formed for military operations can be quite powerful. The Patrol and the navy alike consist only of ships built and manned by volunteers, and fleets form for specific missions. Defense against invaders is the most likely, but there's nothing to prevent citizens of an anarchy from mounting an offensive to topple an unfriendly state or spread the anarchist ideology at blaster point.

Law and Order

Patchwork anarchies have law at the planetary or national level, and enforcement can be as efficient or lax as the citizens tolerate. Beyond planetary orbit there is *no* law, and unless a pair of worlds have specific treaties of friendship and commerce, *all* spacecraft will be viewed as potential raiders by the planetary navy. Extradition treaties may exist between specific worlds, but otherwise all law enforcement is concerned only with local crimes.

*Mere anarchy is loosed upon the world,
The blood-dimmed tide is loosed,
and everywhere
The ceremony of innocence is drowned . . .*

– William Butler Yeats

A failed state has no law at all. The strong do what they want and the weak suffer what they must. Some warlords may maintain order among their followers or in a given territory, but that just makes them tempting prey for raiders. Bounty hunters may venture into a failed state's territory in search of particularly valuable fugitives.

Utopian anarchies also have no laws. Nevertheless they may have fairly strict non-legal methods of social control. Custom and tradition can be as powerful as law, or there may be technical fixes like monitor robots to zap anyone attempting violence. Free-enterprise police services could protect subscribers.

Origin

A patchwork anarchy originates when there are several inhabited worlds but no power capable of imposing a government and no desire among the planetary rulers to unite. It

is, in effect, the "state of nature" from which other interstellar governments arise.

Failed states, on the other hand, are the endpoint of a society's collapse. There has to be some kind of organization that has broken down. Fallen empires, based on the Roman model, are the most common in fiction, but the real world has seen republics and other systems collapse. A corporate state might go bankrupt leading to anarchy.

Anarchist utopias are generally founded by groups with a specific ideology, and are designed to be functioning societies. Anarchists might simply be from a species that needs authority to get along, or could be reformers or exiles from an oppressive state.

ALLIANCE

An alliance is a loose affiliation of several sovereign states for mutual benefit. In the modern world, NATO and the North American Free Trade Agreement are military and economic alliances. The European Community is an example of an alliance moving toward federation (see p. 193). The structure of an alliance can be formal and tightly organized (like NATO), an ad-hoc arrangement like the Escobar alliance in Lois McMaster Bujold's "Vorkosigan" series, or just a loose and general "we're on the same side" agreement like the human worlds in Niven's "Known Space" stories.

If the members of an alliance continue to improve their ties and work together, it can become a federation, but if one member predominates, it can take on qualities of an empire. Conflict within an alliance can be forbidden or strictly limited, as any major war would shatter it into two or more smaller alliances. Since the

Macro-Life

An especially interesting form of interstellar anarchy is "Macro-Life." This concept was invented shortly after the idea of space colonies independent of planets. If a space colony is self-sufficient, then it's essentially a giant spaceship. It can move about the Solar System or venture to other stars. It can build "daughter" colonies and spread its culture and heritage. In short, it can act like a really huge living organism. The humans within the colony act as its DNA.

A civilization consisting of mobile, self-sufficient, advanced city-states is very difficult to subject to any sort of central authority, so a macro-life society would be anarchic by default. Some "clans" of cityships might form temporary alliances, or build "empires" in certain star systems, but their influence would be limited. The GSVs of Iain M. Banks' "Culture" series are effectively macro-life vessels, controlled by superintelligent AIs.

members are trying to remain friends, open war is much less likely than espionage, political meddling, and covert operations. Rebellions will oppose specific members of the alliance, and can cause serious conflict when allies whose ideals they may actually agree with. In a trade alliance, commerce is free and easy – within the borders, anyway. A free-trade pact may well include very tough tariff walls against non-members.

Government

The governing body is a council of delegations from each member world. If a world has multiple governments, all must be represented in the delegation. In some cases, an alliance may give special power to important members – extra votes or veto power.

Normally, the Council may only pass laws affecting relations among its members, and seldom intrudes on its members' internal affairs. A majority of the Council – usually two-thirds – must favor any measure before it can be voted into law. A world can disregard alliance laws by seceding or by becoming an associate member – giving up its vote on the Council to gain full freedom in interstellar policy, yet retaining many benefits of membership.

The council also acts as a court or mediator among member worlds.

When it comes to politics, an alliance is wide open. Member worlds can practice assassination, war among themselves, bribe alliance officials – and until the council comes up with a two-thirds majority, the alliance will be powerless to stop it. Each member world, protective of its own sovereignty, is loathe to allow the extra police powers – including counterespionage or expanded military forces – that would allow the alliance to maintain order among its members. Only an outside threat is likely to unify the council to legislate the needed action.

The Military

Alliances typically maintain a small interstellar navy, while member worlds maintain their own defense forces. If member worlds are stingy, the alliance military may be desperately underfunded until actual war breaks out; if not, they can be small but formidable forces.

Navy operations beyond routine patrols must be approved by the council. Alliance military forces may not intervene in a member's internal affairs without permission from that member. In extreme cases – if conflict on a world or between member worlds is a clear threat to the alliance and its

other members – the council may send in a peacekeeping force.

During peacetime, planetary fleets usually restrict themselves to their own star systems. They may also take turns performing border patrols or other routine duties at the request of the alliance. In wartime, the council can request members to mobilize their fleets to supplement the Alliance Navy. Even then, officers may challenge the nominal authority of the alliance admiral, especially when their homeworlds are threatened.

Ground combat forces might consist of a small core group – a “Marine Corps” or “Presidential Guard” – supplemented in wartime by member worlds' armies. Mercenary organizations thrive in the loosely regulated climate of an alliance, and are always available to aid with the defense . . . for a price.

Law and Order

There will be an interstellar police force, usually called the Space Patrol (see p. 203). From a 20th-century perspective, the Patrol is a combination of state police and coast guard. It may be the only permanent armed space force an alliance maintains. The Patrol has full judicial and legal powers within the alliance and outside the member worlds' borders. Anyone arrested by the Patrol is tried in a Patrol court.

Since alliance laws deal only with interstellar matters, adventurers will not be bothered by alliance law except when operating in space. Within the political boundaries of a member world – which usually extend throughout its solar system – they are subject to local laws and ordinances, which can vary widely from member to member! One world could be a liberal democracy where citizens enjoy great personal freedom, while others might be dictatorial, tribal, theocratic, corporate . . .

Extradition of criminals from member worlds is possible, but never certain. Once a criminal is on a world, he is under its jurisdiction – the alliance legal system only has jurisdiction in interstellar space between member borders.

The Patrol seldom interferes in commerce between member worlds –



restrictions are more likely to be imposed by the members themselves. Exceptions may be made if the Patrol is after terrorists or pirates, or if a ship is acting suspiciously, but the Patrol must be careful not to offend member worlds – and delaying cargoes or disturbing tourists is often offensive.

The Patrol exerts more control over travelers from beyond alliance borders. Patrol ships and border stations carefully screen incoming traffic, even if the destination worlds protest such scrutiny. Passengers are checked against lists of wanted criminals. Cargoes are checked for contraband, dangerous animals, or illegal weapon shipments, and routine tests are made for disease or pests. Leaving alliance territory, on the other hand, is usually simple.

Certain goods may be taxed or banned, either because they're dangerous or to protect the industry of member worlds. Enforcement is up to the Patrol. Taxation of individuals is a power strictly held by member worlds, not by the alliance. The alliance is funded by tariffs, fines, and contributions from member worlds for protection and services. Payment may be made in kind rather than in cash. Worlds that cannot pay their "dues" may be subject to coercion by other worlds or by alliance forces.

Terrorist and fanatic groups may exist. If they do, the limited authority of the alliance may make them hard to root out. Member worlds might secretly shelter terrorist bases, letting them train beyond the reach of the Patrol.

Origin

Alliances may form in response to external threats, or from the weakening of a more controlled society. This is a natural first stage for interstellar government. Often, the original members have ties besides geography – common ancestry, trade ties, or similar histories.

FEDERATION

A federation is a union of sovereign states, preserving a fair amount of power for member states but surrendering certain areas to federal control. The most famous federations in

The United Galaxy

As on 21st-century Earth, nearly all worlds or civilizations in the galaxy may be enrolled in an alliance to preserve peace among them. How well this alliance actually works depends on how it is structured and what the member states think of it. A "United Galaxy Organization" could be the last best hope for peace, or nothing but a glorified debating society where career bureaucrats from minor states can lord it over the representatives of the galactic great powers. If some great peril threatens, getting the United Galaxy to recognize the danger and respond to it can be a daunting task for even the most heroic characters. A minor civilization threatened by aggressors might desperately try to get the United Galaxy to intervene, while a civilization devoted to personal freedom might try equally desperately to prevent United Galaxy interference.

science fiction are *Star Trek's* United Federation of Planets and the Federation in H. Beam Piper's book of the same name.

At the weak end, federations are like close-knit alliances combining military and free trade pacts. Stronger federations give more power to the central government, like the modern-day United States or Germany, and a very strong federation puts all power into the central government, leaving the member states as little more than administrative regions. If one member of a federation dominates the others and interferes in their domestic affairs, the federation becomes more like an empire.

Even a fairly weak federation can keep order in space – that may be all the members allow it to do – so trade and travel thrive. Member worlds may or may not be allowed to maintain their own military forces, but the Patrol and any exploration service are probably federal operations. If the members distrust central government, then the federal armed forces are stretched thin and need to call in member militaries for backup. Mercenaries won't find much work within a federation, but member states or the federal government may use them for "deniable" operations beyond the border. Rebellions may arise when a member wants to withdraw but the central government won't let it go, or when a very powerful group of members try to turn the federation into an empire with themselves as the center.

Laws can vary from place to place within a federation, and in a weak one criminals from one member world can find sanctuary on others. This makes lots of business for bounty hunters. Federal law enforcement probably focuses on crimes outside planetary jurisdiction, and on really dangerous criminals who are too mobile for any single member's police to catch.

Government

The exact structure of a federation's government can vary. Most have been republics of some sort, with representatives of the member states voting in a council or parliament. Some federations, like the old German Empire of the Kaisers, were federations of monarchies with a supreme monarch over all. The modern United States is a federation in which the central government is chosen directly by the citizens, rather than the governments of member states. The governments of the members can vary. One can imagine an interstellar federation that includes planets governed by republics, monarchies, one-party states, and theocracies.

A typical legislative body is a Federation Congress, elected by individual worlds (delegation size depends on world population); it is usually responsive to the will of the citizens. There is usually a separate judicial branch. The Patrol is responsible for enforcing federation law, but offenders are tried by a federation court at the appropriate level.



When a world joins the federation, it agrees to abide by the federation charter. For this reason, sector or planetary government and law are much more homogeneous than those of an alliance's member worlds – divergence is prevented by swift federation action, including economic blockade and military invasion.

Secession usually isn't an option for members of a federation, unless several worlds secede at once or outside military protection is available. Planetary nationalists favoring secession may become rebels or terrorists. In rare cases, politics will allow a peaceful evolution to "special autonomous status" and finally independence.

There may also be frontier districts. These are similar to member systems, except that their populations are new (mainly colonists or the newly conquered) or scattered (a blighted region of space). The district government and officials are appointed by the federation.

The Military

Federation politics recognize that military and political power are linked. The Federation Navy is the only group authorized to have interstellar warcraft. Member worlds must surrender their navies upon joining. Harkening back to the days of independence, however, naval vessels may be named after and manned by a particular world – the cruiser *Lotvik*, for instance, is crewed largely by native Lotvikians. Size of the fleet depends on the political will and wealth of its citizens. If the people will tolerate the

cost of a major fleet, a federation can be as militant as any society.

With federation permission, individual worlds may establish planetary guard units. These include ground troops and possibly atmospheric and sublight warcraft, but no significant armed starships.

The Interstellar Marine Corps is the federation's military ground force. Planetary guard troops and draftees supplement the marines in wartime, but it is the experienced, well-trained marines who handle the dirty work – planetary invasions and defenses, commando raids, etc. If there is a continuing threat to the nation, federations may institute a draft, requiring young citizens to serve terms in the armed forces.

Mercenary companies are rare except in frontier sectors, as the government distrusts independent military forces in central areas. In times of upheaval, mercs may be called in, but liaison officers will be assigned to ensure that they remain under strict control. A federation may form its own legion of mercenaries. These troops are useful for prosecuting politically unpopular wars, especially if they are recruited solely from frontier or foreign worlds – which have no representation in Congress and cannot easily complain about combat losses.

Law and Order

Unlike an alliance, which is concerned with the rights of its member worlds, a federation guards the rights of its citizens. Federation laws are designed to protect the individual citizen and to provide security and unity

for the society. On the whole, federation citizens get more benefits, services, and protection than citizens of an alliance.

Police functions may be handled by planetary or sector law-enforcement organizations or by the Space Patrol. The Patrol has full authority anywhere in federation territory, but must cooperate with planetary police – it cannot investigate and arrest independently of local authorities, unless they are obstructing justice.

Extradition of accused criminals between worlds is mandatory under federation law, provided the requesting world can guarantee a fair trial. Otherwise, the accused will be tried in a federation court. Federation authorities (such as the Patrol) carry out the extradition process.

Terrorists may be present, but bases must be well-hidden to survive. Any world known to be harboring terrorists can expect swift reprisals.

Federations keep tabs on interstellar trade within their borders, routinely inspecting cargoes and travelers. Traffic entering and leaving the nation will be more restricted than that of an alliance. Passports will be required – especially if the federation has hostile neighbors – but the emphasis will be on the right of the average citizen to travel, limited by the security needs of the society.

The Space Patrol is on hand to combat pirates or terrorists and to conduct rescue operations when needed. It will also ensure that unscrupulous transport companies do not take advantage of citizens.

Interstellar trade involving federation worlds is regulated by the Interstellar Trade Commission (p. 202). Congress may ban some goods – usually harmful drugs, proscribed weapons, dangerous animals, etc. Tariffs and duties may exist to control imports that might harm world economies. This means there may be a lucrative business for smugglers in some areas, but that's what the Patrol is for. Customs offices are maintained at all starports in federation space. Starports are considered federation territory, and local police do not have jurisdiction there. The Patrol operates these ports, plus any additional posts needed at jump points or along trade routes.

Free news services thrive, restricted only in the name of federation security.

Taxes may be collected by federation, sector, and local governments. There may be a personal income tax, taxes on commerce, or both. Merchants and entrepreneurs will do their best to beat any such tax!

Origin

A federation often evolves when an alliance is forced by some threat to strengthen its central government. Federations last longer than alliances because their society can quickly meet and deal with external threats, and often has the power and authority to deal with internal ones as well.

CORPORATE STATE

Ever since the rise of large commercial corporations, people have worried about them becoming powerful enough to rival governments. In history, it has even happened from time to time: the British East India Company was the government of India for nearly a century. In science fiction, corporate governments come in several different flavors, depending on how the corporations are structured and how they exercise power.

In history, corporations often exercise power indirectly. In Central America before World War II, for instance, the United Fruit Company was effectively the ruling power, even

though each of the countries in which it operated had a sovereign government. The company paid heavy bribes to the government leaders to keep them agreeable, and could sometimes call upon the United States military when bribery wasn't enough. Powerful corporations ruling indirectly are a standard feature of cyberpunk science fiction.

If a setting has multiple corporations, the dynamic changes. Competition among companies can give the people a great deal of leverage (see *The Free Enterprise Society*, p. 196). Of course corporations can band together to avoid competition, forming a cartel. If there is no higher power to prevent it, the result is an interlocked group of companies that function as a single operation.

Corporate-ruled societies are likely to be awful places for independent traders to operate in, because naturally the ruling company or companies will monopolize all the lucrative trade routes. Mercenary soldiers, on the other hand, can often do quite well since a corporate state might prefer to hire military forces only when there's a war to fight, then downsize during peacetime. Spies can be agents of rival companies seeking trade secrets, and explorers can be "trade scouts" looking for new markets and business opportunities.

Government

A corporate state is "managed" rather than governed. Leadership follows standard business practice – the CEO directs day-to-day affairs, appointed and supervised by the Board of Directors. As long as the CEO has the support of the board, he has dictatorial powers, and may hire and fire all other executive officers.

The Board of Directors is elected by the company stockholders. Directors have no responsibility for the day-to-day operation of the company, but act as a policy council to advise and direct the CEO. The directors elect one of their number as Chairman. The Chairman is the single most powerful person in the corporate state, though he operates behind the scenes.

Minor rules and regulations are set by corporate bureaucrats at all levels.

Major policy decisions are made by the board. The board also decides the amount of stock available on the market, and possibly its current cost.

The relative benevolence of the corporate state depends on how the stockholders are organized. Citizenship is defined as owning stock in the company. Sometimes a stock certificate is issued along with a birth certificate; sometimes citizenship must be earned. More stock means more voting power; in a malevolent corporate state, the board is dominated by a wealthy minority. But sometimes the "poor" stockholders can band together into "blocs" of common interest, similar to political parties in a democracy. If they have the numbers, they can vote their own representative to the board.

Stock ownership is power. If a few wealthy magnates control the board, society will be managed for their benefit and individual rights will suffer. If other voting blocs gain power on the board, interests will be protected; as more blocs gain power, rights are gradually extended to all citizens.

Stockholders also receive dividends, as long as the corporation makes money. Militant stockholders may demand profits, steering CEOs away from long-term investments and toward short-term gains. After an unusually profitable period, the board may declare a jubilee year – paying extra dividends and sponsoring celebrations.

Individual worlds are run by corporate middle managers, many of whom are working hard to show a profit and earn a promotion. Local management styles may vary from enlightened to dictatorial, and don't have to match overall corporate policy if the board is far away.

The Military

The company has a monopoly on armed might, from local police to interstellar fleets. Local forces will be controlled by planetary directors. Major operations may be ordered by the CEO and must be approved by the board. There may also be an elite security force – possibly a secret police in all but name – under the direct command of the Chairman of the Board.

The Free Enterprise Society

A variant of the corporate state is the free enterprise society. This is simply a government run entirely on business principles, with the overriding ideal of open competition for everything. Military forces are entirely staffed by mercenaries, all services are contracted out to private firms, and instead of political parties there are competing government management companies. In extreme versions, individual citizens can contract with different governments, the way they now do business with rival insurance carriers or long-distance phone companies. The good thing about a free enterprise society is that there is tremendous freedom and opportunity – as long as you can pay for it.

Free enterprise states are usually not expansionist or aggressive, and are open to all kinds of trade – but competition is fierce and sometimes violent. Multiple planets with free enterprise government may merge into a kind of libertarian federation.

Law and Order

Company regulations have the force of law. Many rules exist to insure that individuals put company concerns over any of their own.

Personal freedoms are often allowed only to the point where they interfere with job performance. Failure to follow regulations, meet quotas, or get along with one's supervisor can result in demotions and salary cuts (and loss of social status), criminal sentences, or firing. Firing is the ultimate punishment, since there is no other employer – shopping at the company store, banking and credit rights, and health benefits are lost along with employment.

Rebels aren't acknowledged as such. They are instead saboteurs, pirates, socialists, communists, or – worst of all – unionists, and are to be rooted out at all costs. The losers of a takeover bid could decide on armed resistance instead of golden parachutes.

There is no judicial branch. Local executives conduct hearings and trials in their localities. There may be a "corporate ombudsman" to see that workers get fair treatment and fair trials. The power of the ombudsman depends on the stockholders. If the company is repressive, the ombudsman is helpless, or a pawn of management; in a benevolent society, the ombudsman has enough influence

that middle management must respect his views.

Travel between worlds is controlled by the company. Travel for corporate reasons is easily arranged. Individual citizens are also free to travel, using their own time and money, though they may be "bumped" from scheduled flights by business travelers. Productive employees are often rewarded with paid vacations to pleasure worlds. Most employees, however, rarely get to leave the worlds on which they are employed – unless their skills are temporarily needed on another planet.

News is handled by the corporation's public relations or communications department, and reflects the company line. There are many stories about corporate success and happy employees. Failures are seldom reported.

Trade is company-regulated. Company employees must obtain all their goods at the local company store, paying whatever prices the company sets. With the company in control of all commerce, there's no competition and no chance of getting bargains somewhere else. Of course there's a black market, but it's grossly illegal.

Specific taxes in a corporate state are not necessary, since the company makes a "profit" on everything that is bought or sold. Occasionally, in a profitable year, the corporation will even pay bonuses to its workers.

Origin

A corporate state may evolve from the conflict between a super-corporation and a weak government, or when government gives too much authority to business.

If world colonization and exploitation is run by private enterprise, then single-company settlements may result. If corporate rule is unchecked by government, the corporation can expand its power base until it is the government on the colonies, while controlling trade with the mother world.

In a far-flung society, corporations may be allowed to form private fleets for defense in remote areas – similar to the East India merchant ships in Earth history. Such military power can allow total despotism in colonial regions, and may give the force needed (perhaps in alliance with other corporations) to secede from or take control of the society.

A corporation may also control a technology so valuable – FTL travel, for instance – that it can do whatever it likes!



Why People Support Rotten Empires

It's nice to think that a government that Goes Too Far will eventually cause the citizens to rise in righteous wrath and throw the rascals out. It's also convenient when all the defenders of the Evil Empire wear uniforms (except for the occasional Secret Police spy). Unfortunately, we know from centuries of experience that it doesn't really work this way. The worst tyrannies imaginable have been enthusiastically supported by people no worse than you or me.

Without going deeply into psychology, here are some of the reasons why citizens support tyrannies. You can use these to make your fictional Evil Empire and its people something more than laser fodder.

Citizens fear that the unknown will be worse than the known: a foreign philosophy, a strange religion, or perhaps society breaking down to anarchy. They may fear and hate an enemy population, especially if they are a different religion or race, let alone species: Do you hate the Bug soldiers because they are cruel and ruthless, or because bugs are icky? Many people fear that a new government would cost them their jobs or personal power; in a corrupt regime, they may have good reason to be afraid of justice. A clever regime's propaganda will play on all these fears, constantly portraying the foe as inhuman, the rebels as terrorist killers.

People who are used to obeying the law often have a hard time changing their habits when the law becomes oppressive. They still believe that "the police only arrest criminals; honest people have nothing to fear." When the rebels break into an armory to get guns, these people see only that a robbery was committed. Enough of this and patriotic citizens may volunteer for the army to fight the wicked rebels. Obviously, rebellions find more support on worlds that were free until the empire conquered them. But even there, some citizens may hate the occupier but doubt the rebels would be any better. You can fight for "freedom" – but once you win, you have to set up a government.

And people may be loyal to the idea, or to the ideals, of a nation or empire, even when the reality is tarnished. "My country, right or wrong . . ."

It is not evil, or even cowardly, to be afraid of starvation, torture, and death. Any successful rebellion must overcome these fears . . . to convince the people that anything is better than slavery. Meanwhile, the government is telling them that anything is better than anarchy. Which is why rebellions have a hard time of it.

– John M. Ford

EMPIRE

When historians or political scientists speak of an empire, they mean a system in which one state controls the internal and external affairs of one or more other states. If this is a legally recognized situation, it's a formal empire; if it's done by ad hoc arrangement or under the cloak of some other structure, it's an "informal" empire.

Many empires in history have been combinations of both. The rulers of Rome had a formal empire of provinces under Roman governors,

but they also had an informal empire of client states and allies. Sometimes it was necessary to take over the administration of a client state and shift it from informal to formal empire. Sometimes a province can get more autonomy, as when the British government granted dominion status to its colonies in Canada and Australia, recognizing that they were capable of self-rule – and capable of fighting for it if Britain refused.

All empires tend to expand even when the central government has no

desire to annex more territory. To safeguard the border, the empire's rulers naturally want friendly states as neighbors. To ensure that they stay friendly, the empire starts to take an interest in their internal affairs. Eventually, some crisis provokes intervention by the empire and what was formerly a neighbor becomes a conquered province. Naturally, to protect this province, the empire has to make sure there are no hostile states on the border, and the cycle begins all over again. Commercial interests and religious or ideological missionaries can accelerate the process.

The process of expansion can continue until the empire bumps up against a power strong enough to resist. If they border directly on each other, the situation may be quite tense, with constant patrols along the line, "incidents" provoked by hotheaded commanders, and a clampdown on trade. Alternately, the empires may agree to back off and sponsor a neutral zone or buffer state in between. The action shifts from military to diplomatic and political as each empire strives to exert influence in the buffer region and prevent its rival from doing the same. This sort of thing can happen even when the empires are nominally friendly.

Government

Any kind of government can have an empire. Rome gained its first imperial possessions as a republic, and expanded them as a monarchy; the British Empire was acquired as Britain itself moved from absolute monarchy to parliamentary democracy. Republican France had a large formal empire in Africa, and the United States had a substantial informal empire in Latin America.

In science fiction, empires are usually based on the Roman model, with an actual emperor as the absolute ruler. If there is a senate or other legislature, it is distinctly secondary to the monarch's power. Monarchical empires in fiction are usually evil and oppressive, as in the *Star Wars* movies, but some stories like Niven and Pournelle's *The Mote in God's Eye* or Poul Anderson's tales of Dominic Flandry depict empires that are reasonably well run and humane.



States with a single ruler have all the advantages and disadvantages of extremely centralized power. If the emperor wants something done, it gets done – but if the emperor can't be bothered, a problem can fester. And if the emperor is foolish, or crazy, or just plain mean, a lot of *bad* things can get done.

The feel of a monarchical empire depends a lot on how the ruler gained power. Dictators or emperors who seized power by their own efforts tend to build strong but paranoid regimes, with lots of secret police, censorship, and murder of potential rivals. On the other hand, they do tend to be personally very competent rulers. But even the competent ones often make the mistake of assuming that being good at gaining and holding political power makes them experts at economics, military strategy, and city planning. This is seldom true. In human history only a handful of dictators have been competent, sane, and humane all at the same time. Few self-made dictators die natural deaths. Some empires have no set rule of succession, so all the rulers are essentially self-made dictators.

By contrast, a ruler who has inherited power has a lot more legitimacy in the eyes of the people and can afford to be more tolerant. However, with hereditary rulers there is a great deal of random chance involved: will this one be a lunatic? Or just an idiot? It's rare for a dynasty to win the lottery of genetics and upbringing even twice in a row, so a strong ruler is usually followed by one or more weak ones. Sometimes the weak rulers are at least wise enough to recognize their limits

and rely on competent ministers and generals, but sometimes they're so incompetent they don't even realize it. Since the chaos of civil war is sufficiently unpleasant, most people are willing to put up with hereditary rule if the only alternative is warlords fighting to become the next dictator.

Some of the Roman emperors chose their own successors, which combines the legitimacy of inheritance with a merit-based choice. Unfortunately, some rulers can be swayed or tricked when picking an heir. High-tech societies might leave the choice of a new emperor to super-intelligent computers, or design the next monarch from scratch using genetic engineering and sophisticated psychological manipulation.

Of course, sometimes it doesn't matter who the emperor is, if he's just a figurehead. This can be a constitutional monarchy like modern European kingdoms, or a puppet ruler dominated by powerful ministers or generals. In some cases a weak figurehead emperor can regain authority if the ministers or warlords fail spectacularly.

The Military

Most monarchical empires, hereditary or new, rely on military power. (Theocracies or especially beloved monarchies may be able to get by without overwhelming power.) Some rulers are content to do nothing more than stamp out dissent, letting the army and the fleet rot and exposing the empire to threats of invasion. Others (particularly self-made dictators) want to expand their dominions

and crush all possible foreign enemies as well as domestic ones. Historically, this encourages other states to band together in alliances to crush the dictatorship.

In most space empires, the navy is the dominant service, with fleets of huge starships. Being an admiral is a stepping-stone to the throne, which means senior officers are watched very carefully. Shrewd emperors divide the navy into entirely separate fleets, so that the admirals can keep each other under control. If there is a separate Patrol at all, it is subordinate to the navy. The marines are the navy's integral ground-combat arm, spearheading planetary invasions. The army does a lot of pacifying conquered worlds and suppressing dissent. Mercenaries can take service with local imperial governors to supplement the thin-stretched imperial forces, and in an informal empire situation they may be the primary instrument of policy.

Law and Order

The word of the emperor is law. Some emperors rule by personal decree, but others are happy to let a huge bureaucracy make all the "boring" decisions. Imperial laws take precedence over all other laws.

Empires are restrictive by nature. In some cases there is a drastic difference in personal freedom between inhabitants of the ruling state and those of the provinces. Frustration with that difference is often the motive for rebellion.

The Space Patrol has police powers. Routine trials are held by local

Alternate Empires

There are a number of variant types of empires, depending on the exact details of their government and organization.

Feudalism

In a feudal system, political, military, and economic power are combined in a pyramidal arrangement. At each level the rulers are also the military commanders, and are also the largest landowners (or other resource owners in a science fiction setting). They hold their lands as fiefs, granted by the lord at the next higher level, and in exchange owe that lord support and allegiance. Feudal arrangements can get very complicated when a low to medium level lord nevertheless acquires vast wealth and power, or when two lords owe each other allegiance. Feudal lords tend to be rebellious and quarrelsome, hard for the central government to control; on the other hand, invaders have their hands full fighting against an endless series of local rulers who know the territory. In practice, a feudal society functions like a loose federation, or a cartel-based corporate state. Mercenaries can do very well in a feudal system, and can look forward to being awarded fiefs of their own.

Imperium

A really huge or widespread empire may be so big that the ruler can't directly control the whole thing, and consequently delegates power to governors or proconsuls in the provinces. The governors have absolute power themselves, but can be removed or reshuffled at the emperor's whim. The result functions like a federation or alliance of monarchies, as the various governors may or may not cooperate with one another in a crisis. Naturally, governorship is a good stepping-stone to the imperial throne, which means the emperor's chief worry is keeping his underlings under control.

Theocracy

In a theocracy, rule is through a religious hierarchy rather than a civil government. The ruler is the head of the church, and may have divine status. If the head of the church can rule absolutely, the result is like a hereditary monarchy with much more ritual (and probably an inquisition instead of secret police). A church that has more input from the lower members of the hierarchy may resemble a republic or a corporate state. As recent Earth history shows, a democratic theocracy is possible if the people are sufficiently devout and elect rulers with a religious agenda, but once in power the theocrats tend to dig in and resist changes in the will of the people.

governors, or by the Patrol for offenses in space, but important matters must come before an Imperial Magistrate. Punishments include prison, forced-labor camps, slavery, torture, and impressed military service.

An autocrat may tolerate protest against his policies, but never against his rule. At the first hint of any actual threat, dissension is crushed.

In tyrannical empires travel is tightly regulated and requires the right

documents. Common citizens find it next to impossible to obtain permission to travel beyond the borders. One of the Space Patrol's duties is to police the borders for refugees attempting to escape.

Interstellar trade may still flourish, but heavy regulations and duties make it difficult to prosper without buying influence in the imperial court. Nearly all empires have a system of tariffs and monopolies to reward certain merchants and

exclude others. Small traders may turn to smuggling to survive.

The empire will ban commerce it deems a threat, including military supplies; gunrunning to rebels carries an automatic death sentence. Traffic in drugs and vices may be prohibited by a puritanical emperor or encouraged by a decadent one. But the Imperial Trade Commission is notoriously easy to bribe.

Taxes are numerous and burdensome, although some empires tax the subject provinces heavily to keep rates low in the home country.

Origin

Empires can come about in various ways. An expanding frontier of settlement and colonization can create a very tight-knit empire. Both Russia and the United States eventually absorbed their areas of settlement into the mother country. Britain's settlement colonies have become independent nations. Alliances can develop into empires when the most powerful member of the alliance starts meddling in the internal affairs of its partners, as happened when the Greek city-states banded together against the Persians and then the Athenians turned the league into an empire. A state that is home to many vigorous commercial enterprises can develop an informal empire based on trade. And of course, an aggressive military power can deliberately go out and conquer weak states.

ALIEN GOVERNMENTS

The list of governments above is naturally based on arrangements devised by humans, for humans. But in a science-fiction universe there are other possibilities suitable for alien civilizations.

Hive Minds

Humans have long been fascinated by the unity and activity of insect colonies, and it's interesting to imagine how a hive would function on a human scale. The term "hive mind" has two meanings, one from classic science fiction, the other from biology and information science.

Alternate Names

Each type of interstellar government can go by a variety of names, depending on specific details of history, ideology, and political thought. Sometimes names can be misleading. Many “people’s democracies” aren’t democratic at all, and the United Kingdom of Great Britain is functionally a parliamentary republic that just happens to have a Royal Family. Alternate names for the various governments described here include:

Anarchy: Anarchate, Free State, Frontier Zone, Libertarian Republic, Post-Polity, Unorganized Territory, Wild Space.

Alliance: Axis, Bloc, Coalition, Community, Commonwealth, League, Pact, Sphere.

Federation: Concordium, Confederation, Regime, Union, Unity.

Corporate State: Cartel, Combine, Conglomerate, Consortium, Hansa, Keiretsu, Partnership.

Empire: Dominion, Hegemony, Imperium, Kingdom, Monarchy, Principiate, Realm, Reich.

In science fiction, hive minds are societies in which all the individuals are linked together into a single super-organism. This is usually done via telepathy, although it can be natural telepathy or some kind of artificial “brainlink” device. The Borg of *Star Trek* are one well-known SF hive mind. Such hives usually exist to contrast their destruction of individuality and regimentation with human free will and personal liberty. A hive might even duplicate the specialized types found in ant colonies, with castes of workers, warriors, breeders, and so on (SF usually adds a huge-brained “thinker” caste). Hives may be limited in the range across which members can link up, so a multiplanet hive civilization might function as a federation of planetary hives.

An equally interesting type of hive can be based on the “emergent properties” of behavior in actual insect hives. If one thinks of an ant colony as a single organism composed of ants, it’s interesting to note how the colony seems capable of more sophisticated behavior than any individual ant could ever manage. Since ants don’t have any kind of “thinking ants” in the nest, the clever behavior arises out of the interactions among individual ants. One can imagine a hive big enough to have human-level intelligence arising from its billions of nearly mindless members. Vernor Vinge’s Tines in *A Fire Upon the Deep* are close to this concept. Such “hive

individuals” could either interact with one another as rational beings the way humans do, or they could combine into a super-hive, a vast single intelligence. As above, this kind of hive would have trouble operating across large distances.

Hive civilizations can be military powers, with inexhaustible armies of purpose-bred warriors. In fiction they tend to be better at ground combat than space battles. Trade, if hive cultures can even grasp the concept, is handled entirely by government representatives.

Machine Civilizations

Another SF standby is the idea of a society either ruled by machines or entirely made up of mechanical beings. Often this is presented as a nightmarish, dystopian society, in which “human” qualities like imagination, freedom, or love are subordinated to mechanical efficiency. The alternate universe codenamed “Steel” (p. B528) is one particularly nasty machine society. Often, machine civilizations take on aspects of a hive mind, with specialized units for each task coordinated by a giant “master computer.” (This has the advantage of giving the nightmarish dystopia a single neck to sever.)

Other writers have envisioned civilizations of numerous independent machines, usually united by some pre-programmed obsession. Usually that

obsession is highly unpleasant, like the life-destroying goal of the Berserkers in Fred Saberhagen’s stories, or the imperial ambitions of the Daleks or Cybermen on *Dr. Who*. Even if they aren’t actively hostile, a machine civilization could simply treat humans and other organic life as a nuisance to be tidied up, as in Gregory Benford’s *Great Sky River* and sequels.

But other SF writers have speculated that a government by superintelligent, incorruptible machines might be exactly what people need. Isaac Asimov’s supercomputer “Multivac” and positronic robots secretly ruled humanity and created a utopian society. More recently, Iain M. Banks’ “Culture” stories depict a civilization ruled by extremely powerful computers in partnership with humans. Of course, Jack Williamson’s “Humanoids” stories explore the dark side of humanity under the thumb of machines that only want to protect and serve us.

And the ideas of transhumanists include, among other things, blurring or completely removing the dividing line between humans and machines. When it’s a matter of personal taste to run your mind on computer hardware or living “meatware,” government by superintelligent AI will seem not only desirable but inevitable, about as controversial or utopian as automating telephone switchboards. Such societies might take the form of prosperous libertarian anarchies, or (oddly enough) something resembling a secular theocracy, with supercomputers in place of the church leaders and robots for priests.

Dystopian machine civilizations are best used as the setting for rebels fighting for human survival or to reclaim humanity’s dominion over machines. More pleasant settings with humans and machines working together allows for just about any adventure type, although since utopian societies run by superhuman intelligences tend to be peaceful and a little bit boring, the really fun adventures can be found across the border.

Machine cultures can have very impressive armies of steel soldiers, fleets of superintelligent robot battle-ships, and highly efficient factories to replace losses quickly. Berserker-type machines may wage constant war

against living things, so that the entire civilization is on a constant war footing.

Trade with machine cultures is often difficult. The aggressive, dangerous ones take what they want, and the super-efficient utopian ones are often post-economic cultures of abundance.

PLANETARY GOVERNMENTS

Of course, planets have to have their own governments. There is a lot more variability in the style of planetary government than in interstellar societies.

Individual planets in a space campaign can use the interstellar government types, though obviously with smaller constituent units. Exactly how large the units are can dramatically affect how a planet is run.

Anarchy on a planetary level, as in an interstellar society, can reflect either a utopian absence of government or a dystopian absence of order. If there are organized states but no planetary government, the term *balkanized* is sometimes used. Contemporary Earth is either a balkanized world or a very weak alliance.

Alliances are common on balkanized planets, and it's entirely possible for one alliance to effectively dominate the whole planet. During the era of the colonial empires, when most of Earth was controlled by a handful of European great powers who often acted in concert to keep order, one could describe Earth's planetary government as a loose alliance.

Federations are a very likely form of planetary government. Many supporters of the United Nations have hoped that it can evolve into a kind of "Federation of Earth." The exact details of the federation's government can dramatically affect its politics. An American-style republic with direct election of federal officials by the citizens is very different from a European-style union in which the central authority is selected by member state governments.

Corporate government of a single planet is likely to be an offworld megacorporation that owns the whole planet (or at least has a

monopoly on trade). A corporate-ruled planet that is not part of an interstellar economy is more likely to have a cartel-style government, if only because a single corporation wouldn't have anyone to do business

with. *Free Enterprise* planets might be fairly common, especially in the case of colony worlds settled by libertarian idealists. How long those societies endure depends on the GM's opinion of libertarian ideas.

History and Government

The structure of a planet's government will depend in part on the world's history. A world with a native intelligent species will have lots of unique cultures in different parts of the planet, multiple languages, and probably many different religions. Uniting a large, diverse population like that may be best accomplished by one of the looser government types like a federation or alliance. A colonial-style empire might impose unity by force! Either the various parts of the planet come together, or one region imposes its rule on the rest.

By contrast, most colony planets will often begin with a government already in place. The founding settlers draft a constitution, or the Colonization Authority imposes its rules. Colony worlds may tend to more idealistic systems, sometimes highly impractical ones. They may also allow for growth by setting up a federation structure or keeping the whole planet as a single unitary government.

A colony world with multiple colonies planted by different groups may wind up in the same situation as a world with native inhabitants: multiple diverse populations with no great desire to unify. They may function as an alliance, unite in a federation, or one colony may be able to simply annex the others. The growing pains of colonial societies can make for interesting adventures, as PCs get involved in political struggles or decide to carve out their own realms.

Setting History

Everyone and every place has a history, and history affects the way people react to new situations. America and Russia both fought in the world wars, but came away with radically different attitudes. Russia sought to hold all possible enemies at arm's length by controlling Eastern Europe; America wanted to prevent future aggressors from dominating the continent. Those attitudes, stemming from very different histories, locked the two nations in conflict for half a century after World War II.

The simplest way to design the history of the setting is to work forward from the present, extrapolating trends, while throwing in "random events" like scientific breakthroughs or unexpected wars. Sometimes past history makes a good model: base the growth of the Interstellar Federation on the expansion of the United States, while the Trade Alliance mirrors the history of the Venetian Republic. Most of it can be glossed over in generalities (like summarizing the whole 20th century as "a time of technological progress and social change marred by wars among competing ideologies"). The period to describe in detail is the century or so before the campaign's timeline, especially events that would have happened during the lifetimes of the PCs.

Game Masters are allowed to "stack the deck" and create a history that leads to interesting conflicts in the campaign's present. If the game is to take place in a time of "cold war" tension between two evenly matched empires, sow the seeds of that enmity a couple of generations back.

Empires on a planetary scale are certainly possible, even at low technology levels. The Mongols, Romans, Spanish, and British all ruled substantial fractions of the world at one time or another, and one could imagine a more aggressive or durable empire finishing the job. On a planetary scale, empires can have any kind of internal structure. At low tech levels monarchy is likely, and the examples above all show a monarchical empire can be very successful at world conquest.

Alternate Planetary Governments

Some government types are more common at the planetary level than on the interstellar scale. This includes many of the types listed on pp. B509-510, especially Athenian democracy (which pretty much *can't* exist across interstellar distances unless there's some form of very fast interstellar communication), and clan/tribal. The variant forms colony, cybercracy (as opposed to machine civilizations), sanctuary, and subjugated are also single-planet types.

New kinds of planetary administrations include:

Codomination: Rule by two different governments at once. This typically occurs in a colony or "neutral zone" region, either in dispute or a joint project of two states. The functions of government are divided between two administrations, sometimes even with different laws applying to citizens of the two governments. Things can get interesting when the two governments are very different and have different Control Ratings! CR variable.

Conscription: Typically a republic or meritocracy, but one in which the rulers are chosen to serve *whether they want to or not*. Essentially government service is like jury duty in modern America – something you do because it's your responsibility. Conscript governments are usually CR2-4.

One-Party State: A subtype of oligarchy, using the forms of a democracy but with only one legal political party. Power goes to those who can rise within the party hierarchy. Often the party grows to have millions of members, but the rank and file have little control over decision-making. On

Earth they are typically socialist, as that allows the party substantial control over the economy to reward followers. CR3+.

Plutocracy: Rule by the rich, often through direct purchase of government offices. Usually the officeholders expect a good return on their investment, leading to massive corruption. This differs from a corporate state in that power is held by wealthy *individuals* instead of companies, making it similar in some ways to a feudal system. CR2-4, with bribery common and accepted.

Psionocracy: A form of caste system or meritocracy, but the key qualification is psionic talent. This gives the government remarkable power, since the rulers can do things ordinary citizens can't. A psionocracy might come about if psis are oppressed and decide they aren't going to take it anymore, but it could also represent an enlightened culture that uses psionics as a tool for the benefit of all. CR3+, sometimes with real "thought police!"

ORGANIZATIONS

Below is a representative collection of organizations likely to exist in a space campaign. The details given are only suggestions – the GM will want to modify them or use different organization names as he adapts them to his universe. None of these organizations has to exist – some may not be appropriate for some civilizations, and other nations may combine multiple functions into a single organization. All of these organizations can also exist in campaigns without interstellar travel – in that case, just replace references to "interstellar" with "interplanetary."

The scale of organizations varies depending on the campaign. For example, Game Masters who want to make life challenging for rebel and smuggler PCs can put a Patrol base on every inhabited world, while GMs who want to make sure Patrol characters can't depend on easy backup can make them scarce and far apart.

GOVERNMENT ORGANIZATIONS

Government bureaus that affect the lives of PCs may not be the most important parts of the government. In the grand scheme of things, the off-stage Imperial Revenue Service is far more vital than the Mercenary Regulatory Agency.

Diplomatic Corps

The importance and style of the diplomatic corps depend on what kind of other states or civilizations exist and how the society interacts with them. A powerful empire with no real rivals would have diplomats who act more like viceroys, bossing local rulers around on behalf of the all-powerful emperor. An all-human federation dealing exclusively with alien cultures would have a diplomatic corps specializing in xenology and

alien languages, as much scientists as diplomats. Envoys to a species that still practices dueling and ritual combat might be ex-commandos skilled in mayhem. All diplomats have some intelligence-gathering and propaganda functions.

On Earth, foreign embassies are considered "sovereign territory," inviolate by local authorities. Other civilizations might not follow this standard. Differences in how civilizations view and treat diplomats can lead to comic misunderstandings – or endless interstellar war.

Interstellar Trade Commission

The ITC regulates trade, operates the customs stations at all starports, and cooperates with the Patrol (p. 203) against interstellar smuggling. The size and power of the ITC mirrors how much the government controls

the economy. It will be a huge bureaucracy in states with a high economic CR, and an underfunded licensing agency in low-CR cultures that value free trade. In a corporate state, the ITC is the Auditing Department, making sure that shipments and payments go to the right places.

Mercenary Regulatory Agency

In cultures that don't use mercenaries, this agency is simply part of the police, tasked with cracking down on illegal private armies. Where mercenaries are permitted, they set the ground rules.

Regulatory agencies almost always prohibit biological, chemical, or "dirty" nuclear warfare within the nation's borders. Clean tactical nukes are sometimes allowed. Mercs must not go to a troubled world unless hired by someone on the scene, and must leave when the fighting is over.

The MRA may also try to level the technological playing field to prevent high-tech offworlders from completely dominating local forces. Agency inspectors get very good at spotting concealed high-tech gear. Some latitude may be allowed; in certain civilizations the MRA can juggle restrictions on both sides of a fight to make it an "even match." (This is especially true if the MRA works closely with media organizations to make wars a good show for the folks back home.)

The MRA maintains a central office on the capital world. Other offices may be opened if local business makes it worthwhile. Regulators are assigned to each merc outfit. Some are self-righteous and obnoxious; some can be bought; some do their jobs.

The MRA is also a clearinghouse for licensed mercenary outfits seeking work. When contracts are negotiated, the employers place half the agreed payment on bond with the MRA. If there is a dispute later between the mercs and their boss, the MRA arbitrates – paying the mercenaries from the bond fund if necessary. Societies like informal empires that use mercenaries may subsidize them during long periods of peace.

Navy

The space navy is generally the dominant military force in any interstellar society, if only because soldiers can't fly from planet to planet without a spaceship. The Navy's job is to control space and deny it to enemy forces. Spaceships can also make devastating strikes against planets and bases, but aren't much good at taking and holding territory. Between wars, the navy maintains readiness by carrying out mock battles – often in barren, remote systems where it can use live ammunition.

Large naval bases are maintained at strategic locations, often on airless moons or navy-controlled worlds. Small bases – mostly for refueling and repairs – are attached to many larger starports. The navy also has an intelligence branch, responsible for gathering current information on enemy military forces.



In an alliance or other loose society, the navy may be the professional core of the fleet, supplemented in wartime by regional forces of varying ability. Where the navy is the sole military arm, tight control must be maintained or the admirals may seize command and declare an empire.

During peacetime, governments often find other things for the Navy to do. Navy ships may conduct science missions, provide aid at disaster sites, or support colony projects. Ships may be detached for tours with the Patrol, or may simply *be* the Patrol.

Office of Colonial Affairs

The Office of Colonial Affairs oversees colony ventures. In an expanding society with lots of colonies, the OCA may rule dozens or hundreds of star systems, making it very powerful. One or two obscure clerks in an office in the capital city may decide the fate of whole sectors. New colonies may be planted on resource-rich worlds, or to secure a contested sector, or on deliberately harsh worlds as dumping-grounds for prisoners and dissidents. If colonization is typically a private enterprise, the OCA may serve as "referees" to decide which group of settlers gets control of a given planet.

Settings with very few habitable worlds may replace the OCA with the Terraforming Authority, in charge of modifying planets and seeding them with life. The staggering cost of terraforming means that colonies will only be allowed with government approval, and illegals may be hunted down and deported.

Patrol

The primary responsibility of the Space Patrol is law enforcement: anti-piracy and anti-smuggling patrols, and police duty on small or remote colonies. They also regulate and inspect starships and space stations, assist vessels in distress, and generally keep space peaceful and orderly.

Typically, the heaviest Patrol ship will be a light cruiser, but crews are likely to be elite. Patrol vessels get put under navy command during wartime, but at all times there's a rivalry between the two services. Patrolmen consider the navy a bunch of overequipped glory hogs who spend all their time in training, while navy spacers look down on the Patrol as "orbital crossing guards" who can't handle *real* threats.

Patrol bases are attached to many starports; even minor starports are likely to have a Patrol office. The Space Patrol also has separate operation bases, away from the commercial starports, from which major anti-piracy and other missions are launched. The Patrol usually maintains a covert-operations office; its agents infiltrate

criminal organizations. (In a repressive society, they are secret police.) The Patrol is known for rigorous adherence to the letter of the law and rigid interpretation of those laws.

Postal Authority

The Postal Authority is responsible for the mail. Mail between vital worlds is carried by official courier ships. Mail service for minor worlds is contracted out to private trade ships. This is profitable – many independent traders depend on mail runs for steady cash – but PA standards are high! Other interstellar communications may also be controlled by the Postal Authority, depending on technology.

Control of interstellar communications makes the Postal Authority *extremely* powerful. In any high-CR society, the PA *reads* the mail and forbids distribution of “treasonous” publications.

In some settings, the PA may be a huge private company or nonprofit entity. It may be galaxy-wide, using the threat of cutting off communications to keep governments from interfering. And whoever *does* control the post office can rule the galaxy!

Security and Intelligence Agency

Just about all governments want to keep some things secret, and just about all of them want to find out what everyone *else* is trying to hide. This task can be divided into three main categories: foreign intelligence (spying on other governments), domestic intelligence (spying on the government's own citizens), and counterintelligence (catching or fooling enemy spies).

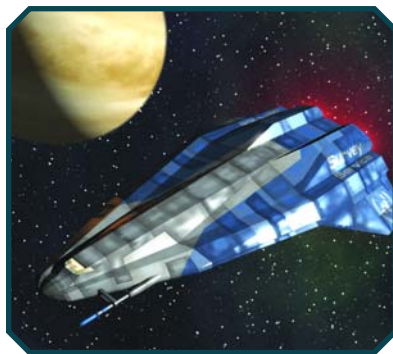
Foreign intelligence agencies spend most of their time reading news reports, census data, and other public information in order to get a comprehensive picture of what other governments are doing. Their chief concern is identifying military or terrorist threats, though some governments use their intelligence agencies to spy on foreign corporations to help domestic firms compete. They also make use of electronic signal interception, and of course hire spies.

Domestic intelligence is part of law enforcement, but focuses on people who might commit crimes instead of those who have actually done something. In particular, domestic spies seek terrorists and organized crime. In tyrannical states, domestic intelligence also rounds up dissidents, critics of the regime, and anyone who looks like they might be one.

Counterintelligence works on uncovering foreign spies, and on spreading disinformation to make it harder for the other guys to get accurate information.

The three types of espionage are often combined with covert operations forces – secret military or paramilitary units trained to be stealthy, fast-moving, and well-hidden. Covert ops do the things the government needs to do secretly.

A state may have different agencies for each job. Or it may have multiple agencies, each of which does a few of those tasks. Given the nature of the secret world, that means they often wind up spying on each other.



Special Justice Group

The Special Justice Group controls large corporations. Its precise role varies depending on the society. Where there are few restrictions, it is simply a “referee” focused on keeping a level playing field. In societies more suspicious of big business, the SJG monitors corporations closely, scrutinizing ads for subliminal messages and analyzing tax data in search of “financial anomalies.”

Of course, in some societies the government runs the corporations, either directly (in a Corporate State or socialist system) or indirectly (through “crony capitalism” or state-granted monopolies). In those situations the SJG acts as a liaison office, or

directs its attentions at corporations that *don't* have the favor of the government.

The Special Justice Group is likely to keep its base of operations wherever businesses are most concentrated, with branch offices in all the major financial hubs. Field investigators must rely on civilian transport or call in the Patrol to assist on raids.

Survey Service

The Survey Service is in charge of discovering new worlds and maintaining accurate information about known ones. Discovering new worlds is the task of the Scout Service or Exploration Division. Maintaining data on known worlds falls to the Survey Division, sometimes known as the Grand Survey or the Astrographic Division.

First-in scouts are a quirky lot, solitary and temperamental. Often using one- or two-man craft, they visit unexplored systems. If they find a potentially habitable world, they make the best report they can, landing for close inspection if there are no apparent hazards. First-in scouts especially watch for signs of intelligent life. If an intelligent species is detected, they may avoid contact – that's a job for specialists. In some settings, first-in scouts may be freelance explorers, ranging into unknown space in second-hand ships looking for valuable worlds, and then selling their data to the Survey Service.

When the scouts make a favorable report on a new world, the survey team goes in. A survey team may be a single ship or a full expedition; it includes xenobiologists, planetologists, xenoarchaeologists, and first-contact specialists. They begin by making an exhaustive orbital study, landing only when the planet is judged safe. Survey scouts certify worlds as suitable for colonization, and make recommendations about relations with new alien societies. Survey scouts are more intellectual than their first-in brethren, but they are still adventurous survivors.

Survey stations, manned by exploration division personnel, may be set up for the long-term scientific study of planets or interesting space phenomena (e.g., black holes) and major

archaeological finds (like Precursor sites). Covert survey stations may be established if a planet has a low-TL native race deemed worthy of study but “unready” for contact. In an interplanetary campaign with no FTL travel, most worlds will have been explored already, so manning such projects may be the scouts’ main role.

During wartime, scouts are attached to the navy. First-in scouts perform long-range reconnaissance, while survey scouts are attached to naval intelligence, often acting as fleet intelligence forces.

PRIVATE ORGANIZATIONS

Alien Rights League

The Alien Rights League is an altruistic group dedicated to promoting equality for all sapient beings. In societies that respect individual rights, the ARL focuses on fighting prejudice among the citizens, and works closely with government legal agencies.

But in societies that legally oppress aliens, the ARL must work *against* the government. Sometimes it exists underground, operating safe houses and secret transport routes for aliens fleeing oppression.

In any setting the ARL is likely to be a perennial thorn in the side of the Office of Colonial Affairs, standing up for the rights of low-tech or presapient natives the OCA wants to displace. Often the xenologists of the scout service are the ARL’s best allies in government.

As a private organization, the ARL likely maintains a modest office near the seat of power in the society, and a network of supporters (both open and secret) throughout the galaxy.

Corporations

Big business can’t be bigger than the society that supports it. In a free-market society that prevents monopolies and encourages competition, even a huge corporation won’t be bigger than 1d% of the society’s total economic volume (see p. 95). Monopolies that control an entire industry can be bigger, up to 2d%. A corporate state would consist of several monopolies

joined into a single conglomerate, controlling the lion’s share of an entire economy.

Multistellar corporations operate across many worlds or star systems. The quickest way to figure the size of a multistellar is to add up the economic volume of all the worlds where it operates and roll one or two dice to determine its share of the economy. A more detailed approach would consider how much of a share it has on each world separately: on some planets GalactiCo is merely a big company among many, but on others it has a monopoly in its industry, and on a few worlds it dominates the local economy.

A typical corporation has one employee per \$100,000 to \$500,000 in sales (at lower TLs this may be higher). This doesn’t count things like private armies, spies, goons, bribes, or secret black-technology projects, of course. Following the usual rule for military budgets, a corporation probably won’t spend more than 1% of its sales on such “nonessentials.” Of course, a multiplanet corporation can concentrate its forces and overwhelm the military of a small planet, and use advanced technology as an advantage against primitive societies.

Free Trade League

At first, it was little more than an association of independent traders that met at market worlds to swap information. As interstellar competition – and regulation – grew, the Free Trade League became a lobbying group for the rights of independent traders. It now has offices everywhere that traders gather.

The league is a clearinghouse for market information. An independent trader who has valuable information he can’t use will pass it to the league – which brokers the data to other independents before the big corporations get the word. The original trader gets a 5-10% royalty; the League itself takes a percentage as well.

The league also arbitrates grievances among members and operates as a bank, facilitating transactions between races and cultures. Traders down on their luck can apply for a loan – but if they can’t pay it back, they’ll be pariahs in the trade community.

Governments that want to control trade (or are chummy with big corporations) may view the Free Trade League as a nuisance, but others may support it as a valuable aid to maintaining free markets and competition.

Mercenary Companies

Mercenary units are simply small to mid-size corporations who deal in mayhem. They may use euphemisms like “private security firms.” Merc outfits are typically small in size – generally not more than 1,000 troops, and often fewer. Companies can be contracted for specific missions or hired by the month. Sensible mercenaries know that a company’s reputation is its biggest asset, so they fulfill contracts and keep up high standards of training and off-duty behavior. Other mercs may be more interested in getting a quick profit by looting, betrayal, or seizing power. Mercs can be the equalizer when a remote colony comes into conflict with a major power or megacorporation, or they can be the “deniable assets” used by the big guys.

Mercenary space fleets are rarer, due to the immense cost of warships and the understandable reluctance of governments to have them in private hands. Where they do exist, they are generally called “privateers” rather than mercenaries.

News Services

News services can be either private corporations or government-controlled media. Which type depends on the Control Rating of the home society. Each one requires reporters or stringers to gather news, who may or may not be the same as the people who present it to the public. News services are extremely important in any society: in tyrannies they are one of the chief methods the government uses to maintain control, and in open societies they are the battleground where ideas are presented.

The available technology determines what the news services will look like. If messages have to be carried by starships, then interstellar news will be more like a newspaper or magazine in presentation, with no “breaking news” coverage because of the lag times in transit. Interstellar

“broadcasting” in real time allows something like network television news. Interstellar computer networks make it possible to have decentralized, ad-hoc volunteer news services. In general, the more difficult it is to send messages, the easier it would be for someone to control the spread of information and manipulate what people know.

Governments and corporations hate news services when they run stories revealing embarrassing secrets. Activist groups love them because they can “leverage” a small organization’s influence.

The Organization

The Organization (if it really exists) can only thrive in a middle ground of legal strictness. In high-CR societies, police monitoring makes it too hard to operate. In very low-CR cultures, there’s too much legitimate competition for what the Organization has to sell! What the Organization prizes are planets with moderate to strict laws and lots of corruption.

The Organization is effectively a multiplanet corporation, with a near-monopoly in its chosen field. As such it’s comparable in size to a big multi-stellar company and has similar assets. On the rare occasions when it’s been necessary, the Organization can even hire mercenary armies and pirate ships for full-scale military operations.

On many worlds, *all* criminal activities require the approval of the Organization – with a piece of the action going to the syndicate. And on any world with a population of more than a few hundred, there’s an Organization contact. Organization VIPs live like royalty, often on syndicate-controlled worlds where crime bosses are feudal lords. The Organization also sponsors sanctuary worlds beyond the reach of police.

Should the PCs want to find an Organization contact on a new world, the best place is a startown or similar port area. Roll against Streetwise, minus the Control Rating of the local government (see p. 94). Each attempt takes two days of barhopping and hint dropping. As a rule, about the time the searcher gives up, he’ll be tapped on the shoulder and escorted to Mr. Big’s office. A critical failure will lead to

unwelcome interest by either the Organization or the local authorities.

Psionic Studies Institute

The PSI is a research foundation dedicated to the study of psionics, but there’s more to it than that. It is a secret psionic society that offers aid and training to psis. The institute has branches on major worlds, particularly those with large universities. PSI members constantly search for promising candidates for training. Some are willing recruits, rescued from death at the hands of anti-psionic mobs. Others get a mysterious “scholarship award” and learn what’s going on only after they’re already enrolled. And there are rumors that some PSI members were abducted and brainwashed . . .

In worlds where psionics are widely known and at least marginally accepted, PSI is the semi-official training and licensing organization for psionics. There will still be some crackpots who think it’s a conspiracy – and sometimes the crackpots are right! Where psis are oppressed, PSI helps them avoid vivisection or conscription into the government’s

psi-force. Where psionics don’t exist, PSI is a group of crackpots and frauds. (Or is that just what they *want* you to think?)

Universities and Scientific Foundations

Scholarly organizations can be huge and influential, and very long-lived. In a wealthy interstellar society, a university might be “endowed” with a whole planet! Healthy, growing societies have academies that develop young minds and expand the frontiers of knowledge. Decadent cultures have universities devoted to nothing but rehashing the work of past scholars and savage infighting over academic privileges.

Scientific foundations can range in size from giant government research agencies to tiny groups funded by one or two wealthy enthusiasts. Either end of the spectrum can produce cutting-edge research or monumental quackery. In tyrannical societies, scholars tend to “discover” results that conform to official ideology (or the emperor’s whims).

Startown

A long-standing trope in space fiction is the rough-and-tumble “startown” district near the spaceport. On all but the most xenophobic worlds, the authorities realize that offworlders will have strange customs, may not understand local rules, and need to “cool their jets” after a long voyage. So most planets have a small area (often no more than a few city blocks) near the spaceport where officials turn a blind eye to strange behavior. Assume the CR in Startown is one or two levels lower than the norm for that world.

In addition to visitors, startowns attract locals with unconventional tastes or ideas. Some just drop in to gawk at the offworlders, but a few move in and settle down. Add to them a few spacers permanently “between berths” and an assortment of crooks and opportunists, and you’ve got startown.

On some worlds, startown is legally defined, perhaps even lying within the port’s perimeter fence under control of the spaceport authority. It may even be an entire city, a “treaty port” like old Shanghai, the only place on the planet where offworlders and locals can mix.

While the cops may tolerate some violations of local mores in startown, that doesn’t mean the place is a free-fire zone. Violence, especially violence involving weapons, will bring an appropriate response. Crimes committed against locals are investigated as usual. (Crimes against offworlders may not be such a big deal.) The regulars in startowns understand this, and try to do their part to keep the peace.

CHAPTER EIGHT

ADVENTURES



The cabin of the old fishing boat was crowded and smelly, but Shiro tried to look cool and unconcerned. Inside he was practically bubbling. Here he was, surrounded by genuine resistance fighters, planning to strike at the alien overlords!

The old Russian captain coughed quietly and everyone fell silent. He unrolled a sheet of coarse paper on the chart table. "This is our target: the cosmodrome at Narita. Each of you and your organizations will have an important job to do."

Shiro listened, memorizing everything, as the captain outlined each resistance group's role in the plan. As the briefing went on, he began to feel a little crestfallen. What was the Alien Fighter Army going to do? After all the trouble they'd gone to just getting in touch with the resistance, it would be terrible if the Alien Fighter Army wasn't allowed to help.

"Shiro – still with us? Good. Your people are in charge of creating a diversion. You need to cause chaos all through

central Tokyo, beginning around sunset. That should draw the police away from Narita."

"What kind of chaos?"

"It should look serious. Could you start a riot?"

Shiro thought desperately, then beamed as an idea came to him. "Comics!"

"Eh?" The old Russian looked skeptical.

"The Shahr banned comics and had all the old ones destroyed because there were too many alien bad guys. If I pass the word that a big cache of old comics has been found, I can get thousands of fans to show up! When they find out there's nothing, you'll get your riot."

The captain looked off into the distance for a moment, then smiled a little. "Very well, comics it is. We use every weapon we can get."



Having set up the campaign, the Game Master needs to create some adventures for the players to run their characters through. This, ultimately, is where “the rubber hits the road.” No matter how much planning and work went into the campaign, if the adventures aren’t interesting and fun, nobody’s going to know or care about the setting.

Any roleplaying adventure has certain key features: there is a *hook* which gets the PCs involved, a *goal* for them to pursue, and *obstacles* to overcome. The precise nature of all these things depends on the characters and the setting.

Your Mission, Should You Choose to Accept It . . .

Heroes who have a duty to some agency can simply be assigned missions that will lead to adventures – although often the mission doesn’t *seem* particularly exciting when it’s assigned. This applies to military personnel, explorers working for the survey service, police, spies, and possibly diplomats. Some freelance character

The Default Adventure

A useful concept in designing a campaign is to think of the “default adventure.” This is simply what the characters are expected to do. In classic *Dungeons & Dragons*, for instance, the default adventure is exploring an underground complex full of monsters and treasure. In *Call of Cthulhu*, the default adventure is investigating an ancient cosmic horror. The default adventure and the campaign concept tend to be closely linked – one is simply an application of the other. So for a band of tough space mercenaries, the default is a military operation – attacking an enemy force. For explorers, it’s finding a new planet and solving its mysteries.

Not all the adventures have to fit the same template – in fact it would be deadly dull to make them all the same. The default adventure serves as the point of departure, the “zero setting” on all the knobs before you start to twiddle them. Characters can enter new and different adventures once they have “mastered” the default scenario. So after the space mercenaries have run a few basic military operations, the GM can start throwing curve balls: betrayal by allies, a natural disaster which interrupts the battle, maybe even the discovery of an underground complex full of monsters and treasure. The explorers could be called upon to conduct a military operation because the rest of the fleet is mysteriously absent, or find clues on a new planet that lead to an ancient cosmic horror.

The GM can use default adventures to play up different aspects of the game and the setting. One mercenary operation might wind up being mostly negotiation, as a besieged garrison bargains for honorable terms of surrender. Another could turn into an investigation as the soldiers realize there is a traitor among them. The GM can drop default adventures into different crossover genres, so that the explorers face a horror story scenario on one planet, a swashbuckling adventure on the next, and a tense thriller on a third.

THE HOOK

The hook for an adventure is what gets the characters involved in the situation. Some campaigns have hooks built into their structure, while others allow the heroes to blunder into situations on their own.

types are also good for mission-style adventure hooks. Bounty hunters, independent scouts, or mercenaries are essentially “adventurers for hire” and the latest client can send them on a mission of danger and excitement.

The useful thing about this kind of “assigned adventure” is that there’s little chance the characters will turn it down and go bowling instead. If you’re a space marine and the colonel says go attack that pirate base, well, that’s what you’re going to do. The emphasis is on *how* the characters accomplish the mission rather than what they’re going to do. This approach works very well with “set-piece” adventures, and appeals to players who want to get straight to the crunchy bits of tactical plans, blowing

stuff up, and infiltrating through the air ducts. The chief drawback is that it may be hard to surprise the players or get the characters into unusual situations. It may also be hard to create much continuity from adventure to adventure.

Going Fishing

Other characters aren’t looking for adventure, and their ostensible jobs don’t normally lead to mysteries and shootouts. Merchants, asteroid miners, colonists, and some scientists require hooks that are at least vaguely related to the job they’re supposed to be doing. For merchants the canonical adventure hook is the weird cargo or mysterious passenger; prospectors and colonists can run across strange

things in the wilderness, and scientists discover something that becomes the focus of an adventure.

For this kind of campaign, it's often best for the GM to toss out lots of potential adventure hooks and let the characters follow up whichever ones interest them. (To save on effort, the GM can have several hooks lead to the same scenario.) So the merchants hear a rumor in the spaceport bar about a lost treasure, bump into an old spacer who's trying to get revenge on the pirates who killed his family, see a news item offering a reward for a hijacked ship, and are offered a good price on a cargo of alien artifacts. Any one of these can lead to an adventure, and they give the feeling of a vibrant universe full of mysteries and excitement.

Drawbacks to this approach is that players may get kind of scatterbrained – pursuing one adventure hook and then dropping it to take up a different one. Game Masters who like to create detailed scenarios in advance may wind up with a lot of unused material.

Let me make this abundantly clear. I do the job, and then I get paid.

–Mal, Firefly

And if *every* option leads to a mystery or a battle, the PCs may start to feel a little put-upon – “Can’t we ever haul a *normal* passenger?”

A Date With Destiny

Any characters can simply have the bad luck to get caught up in a strange or dangerous happening. The marines are on leave, the merchants are buying new reactor parts, or the colonists are building a new wind turbine – when suddenly the kidnapped princess begs for help! Or the aliens attack! Or whatever.

This is a very good approach to use for an introductory adventure, when the characters may not know one another and the players are still learning about the setting. It also works well for “change of pace” adventures – getting the marines into a romantic comedy situation or the merchants into a technothriller. The chief drawback is that adventures by chance don’t happen very often. If “one in a million chance” things happen to the heroes every few weeks it starts to erode the sense of realism in the campaign (unless, of course, there’s something *causing* all these weird things).

Metaplot

“Metaplot” is a term used to describe the ongoing storyline within a game world. Many published role-playing games, especially those tied to a specific setting, have a metaplot that is gradually revealed in new supplements and sourcebooks. Here, we use the term to describe the unfolding history of the game world, which may or may not have any connection to the actions of the heroes. So in a campaign involving archaeologist-astronauts digging up alien ruins on Mars, the metaplot might have growing international tension between the United States and China explode into war. America and China are a long way from Mars, and it’s unlikely anything the PCs did had anything to do with the start of the war, but it will affect how the Chinese and American characters interact.

Why have a metaplot? Three reasons. First, a game world which changes and evolves helps make it all seem more real. Players may find themselves getting interested in the unfolding history of the setting. In a small-scale campaign, the sense that this is a big world full of things going on helps make things more exciting. A newspaper or “Galactic Action News” report at the start of each session makes a nice transition from mundane reality to the world of the game.

Second, a metaplot is a great source of adventure hooks, especially if large-scale conflicts are underway.

Characters in a military campaign will be greatly affected by wars and changing alliances. Merchants may profit – or lose their shirts – as a result of large-scale events. The introduction of new technologies can change everything, giving some the chance to benefit and forcing others to struggle to adapt.

Finally, metaplots make a good scale indicator or “scorecard” for the player characters. When their actions *do* start to affect the course of events, they know they’ve made it to the big time.

Before the Game Master hurries off to start planning half a dozen world-shaking events for the campaign, there are some things to keep in mind. First, players have limited time and attention to devote to the game, and expecting them to keep up with a barrage of in-game current events may be asking too much. Keep the amount of information down to maybe half a dozen “news bulletins” per game session. Second, be sure that the changes don’t destroy the appealing features of the campaign. If the players are happily building up a thriving little commercial empire as star merchants, wrecking everything with a massive alien invasion can provoke resentment – aimed at the Game Master, not the aliens.

GOALS

The *goal* in an adventure is simply what the characters are trying to accomplish. Very often the goal and the hook are the same thing: you're hired to find the killer androids, so tracking them down is the goal. But it can be interesting when the hook *isn't* the real goal. This comes about either because the heroes have been misinformed about the true nature of the mission, or because something unforeseen happens along the way.

As an example, suppose the heroes are mercenaries hired to do a simple strike mission against a remote corporate research lab. The mission goes off flawlessly, but it turns out the lab was doing biowarfare research and some of the troops are now infected with a virus causing compulsive cannibalism. So now instead of a straight up shootout, the heroes are caught in a nightmare of paranoia and horror.

Goals that diverge from the original hook are a good way to throw some variety into mission-driven adventures, and are practically required in hard-boiled, grim-and-gritty scenarios in which nobody tells the whole truth and there are wheels within wheels at work. They are also a good way to challenge players who tend to over-plan things in advance. As with "date with destiny" adventures, they can be done too often – if every

adventure involves some unexpected challenge, the players may get restive.

TYPES OF GOALS

There is a limitless range of possible goals, but most of them can be generalized into three types.

Go Someplace

The characters have to get to a place. But of course they can't just walk in. Perhaps the place is hidden, so they have to find it. Maybe they have to evade traps and alarms to get in. The place can be defended by force fields and an army. Or maybe it's very exclusive and they have to get an invitation. It could simply be very far away. If getting there isn't the problem, maybe the heroes have to arrive before something happens, or before someone else does. Sometimes going someplace really means getting *out* of someplace.

Get Something

The heroes have to get their hands on a particular thing (or person, or information). The Something may be inside a Someplace, but there are other ways to make it hard to get. Something that is hidden must be

located. Mobile or intelligent beings may not *want* to be found, and may even fight the PCs when discovered. The heroes may be trading for the thing in question, and must be able to meet the price. Having gotten it, the heroes must keep the thing, even though others may have the same goal. Often getting *the reward* (money, prestige, the handsome prince) is the ultimate goal which lies behind all the others in an adventure.

Do Something

The PCs wish to make a change in the world. This can be as peaceful as building a new colony, or as violent as destroying the emperor's flagship. It may mean preventing someone else from achieving a particular goal. Survival is probably the most basic thing to accomplish. Often one must go Someplace in order to do something, and there may be things to acquire to ensure success.

Goals can be nested or linked, so that the heroes must repair the starship in order to travel to an unexplored system in order to penetrate the pirate fortress in order to steal the crystal nanocomputer in order to counteract the gray-goo plague that is destroying New Earth.

OBSTACLES

The obstacles faced by the heroes are the true meat of the adventure. Without obstacles, there's really not much of a story. Obstacles are either internal or external. Internal obstacles are situations where a character's personality or desires (mental disadvantages, in *GURPS* terms) conflict with what they must do. External obstacles are the various threats, barriers, puzzles, and enemies the heroes have to overcome.

PUZZLES AND MYSTERIES

Science is all about solving mysteries. Some of them are big mysteries

like "What is the origin of the universe?" while others are smaller mysteries like "What is the effect of hydrolyzation on this particular protein?" Part of the fun of science-fiction roleplaying is that the players get to experience some of the same thrill of discovery that scientists get from their work. Giving the heroes a puzzle to solve is always an interesting obstacle.

Conventional Puzzles

A conventional puzzle is a mystery or question with an answer based on human motivations or the mundane details of the setting, rather than science or fantastic elements. This doesn't make them any less interesting or

potentially important. Conventional puzzles can be things like "Why is the port commander refusing to let us unload our cargo?" or "How can our squad get past that guard tower without being seen?" or "Who murdered Dr. Fortunato?" Solving them may require roleplaying and information gathering, physical action and combat, or a combination. Sometimes what seems to be a conventional mystery turns into a science puzzle. Conventional puzzles have the advantage that they don't require a lot of background knowledge, either of real or imaginary science, which makes them especially suitable when the players don't know a lot of science



even though their characters do. Solving non-scientific puzzles can give them the same feeling of discovery.

Scientific Puzzles

A science puzzle is one where the answer specifically lies in the realm of undiscovered scientific facts. This does not mean they must be dry or unimportant: finding the vaccine to a deadly plague is a science puzzle, as is coming up with a way to prevent an asteroid impact, or working out the purpose of an ancient alien device.

Fiction and roleplaying games add the possibility of “rubber science puzzles” in which the science involved is imaginary or at least highly speculative.

A problem with science puzzles is that they require a very good level of science knowledge on the part of both players and Game Master. The GM has to know enough to set up a fair and interesting problem, and the players must be able to at least partly figure it out themselves. Science problems which are solved entirely by die rolls against the characters’ science skills are pretty boring, so it helps if the players can at least figure out the broad outlines of the answer, then do the die rolling to fill in the details.

Even when the Game Master is using an imaginary science as the basis for an adventure, he must be absolutely clear about how that imaginary science works, so that clever or

merely inquisitive players can’t poke holes in his creation by asking the wrong questions.

ADVERSARIES

Adversaries are people or other beings who function as obstacles in an adventure. They must be defeated, subverted, evaded, or otherwise dealt with. One of the chief ways science fiction differs from other genres is its emphasis on rationality. The underlying assumption is that we can understand the universe. This is reflected in the nature of enemies in many SF stories.

Good and evil certainly have their place, and there are no shortage of stories, especially older ones, in which the heroes are good guys and the villains are bad guys and that’s that. Adventures that try to duplicate the classic pulp feel may do likewise. But a more common approach (reflecting some of the basic optimism of the field) is to redefine Evil as Ignorance. Enemies are enemies because either they don’t understand the heroes, or because the heroes haven’t discovered the key piece of data that lets them understand the enemies. This applies to “monsters” as well as people – the alien creature is only a danger until the scientists can figure out how to communicate with it or control its behavior (though sometimes the only way to do that is to kill it).

Monsters

Monsters in space adventures can be any sort of dangerous alien creature, deadly robot, or genetically engineered horror. The important thing about monsters is that they have to be a credible threat. Because futuristic weaponry packs a big punch, science-fiction monsters need some special abilities to keep from getting fried.

Some creatures may be immune to the effects of laser pistols or plasma guns. Plasma-based life might shrug off (or even enjoy) shots from energy weapons. Well-armored silicon-based organisms or beings with tough exoskeletons might be able to withstand a few hits. Swarms are not very vulnerable to a narrow beam.

You can’t hit what you can’t see. Monsters can use stealth and camouflage to remain hidden until it’s time to

Alien Psychology

A fertile source for mysteries in science fiction is in the behavior and motivations of aliens. Especially when communication is difficult or impossible, working out what an alien creature is doing and why can be an excellent mystery for players to solve. The tone and style of the campaign determine exactly what the mystery is and why they need to solve it: if the alien is devouring the brains of Terrans, the heroes probably want to find out what it’s hungry for in order to stop or destroy it. Conversely, if the aliens are just building huge crystal towers on a distant asteroid, the mystery is what the towers are for.

Sometimes an alien-behavior puzzle is the result of biology. (“It’s trying to learn about us by eating brains!”) Other mysteries result from quirks of alien culture. (“We eat the brains of strangers to demonstrate our oneness with all life.”) Finally, the alien motives may be all too understandable, and the problem is simply coming up with a way to resolve conflicts. (“I convinced him that ice cream is better than brains, at least on a hot day like this.”)

To make an alien puzzle, the GM obviously has to have a very good understanding of the made-up aliens. Since the GM is the one making them up, that shouldn’t be too hard. The other important element is to make sure there’s a good reason the PCs don’t already know the answer to the mystery. (“It says in the guidebook that these guys like to eat brains, so never take your hat off in a restaurant.”) Are the aliens recently discovered? Are they keeping this a secret on purpose? Has something changed in the environment causing new behavior? (“The brain mines are running out!”)



strike. Burrowers can lurk underground. Psionic monsters could even use “psychic invisibility” to stroll right up to their victims in plain sight. Speed and size modifiers can also help monsters survive and remain a viable threat. Fast-moving flyers or small fast-running creatures could be very difficult to hit.

Monsters also need believable motivations. Few creatures on Earth attack humans without provocation. Suitable motives include hunger (even if they can’t eat humans, the alien animals won’t know that until it’s too late), protecting young (especially if the humans don’t recognize what the

young are), or guarding territory against rivals. *Trained* animals, of course, might be taught to attack funny-looking two-legged creatures, and could even be fitted out with cybernetic enhancements to make them into very dangerous living weapons.

Villains

Villains are those who oppose the heroes. They can be enemies, working directly to prevent the heroes from succeeding; or they can be rivals, who simply want to succeed at their own goals even if that thwarts the heroes. A vengeance-crazed

ex-lover who wants to kill one of the PCs is an enemy, while a greedy merchant who steals the last available shipment of dronberries is a rival.

Motivation is important for a convincing villain. In space opera settings, villains can be motivated by a love of evil for its own sake, but other science fiction subgenres tend to emphasize rational villainy. Characters can have extremely logical motives and still not be nice (greed is logical). Alien villains may have motives that initially appear to be nothing but senseless evil, but which on closer examination turn out to have an entirely reasonable cause.

To be a credible opponent, a villain must also be powerful enough to challenge the PCs. That doesn’t necessarily mean all villains must be unstoppable combat monsters; merely that in the specific context of the adventure, they have enough power to be a threat. If the PCs need to get into a formal party to speak with the ambassador, the ambassador’s protocol-obsessed social secretary is a powerful foe, even if he’s frail and unarmed, because in that situation he has tremendous clout that the heroes lack.

Adventure Seeds

Bounty Hunters

Lee Kang wiped out a whole space station full of people to collect on an insurance scam. He’s been on the run for years, but now someone’s spotted him: he’s in neutral space, living very well on a world ruled by a corrupt oligarchy. The price on his head is big, but is it worth sneaking him off a well-defended world to earn?

Colonists

A band of space pirates have crash-landed near the only settlement on a remote world where the Patrol seldom ventures. The raiders claim they just need time to make repairs and then they’ll leave, but they seem to be making a big effort to make friends among the colonists. Someone needs to stand up to them before the colony becomes a pirate hideout.

Criminals

Someone has skipped out on a loan, and the Boss wants to make an example of him to keep anyone else from getting ideas. The deadbeat is a scientist, who needed the money to fund an expedition to some far-off planet to study the local primitives; she claims they

once had some kind of big-deal civilization. The Boss wants you to go there and ice the scientist. If you mess up, don’t bother coming back.

Diplomats

Your government has sent you to arrange a treaty of friendship with a newly discovered space-capable civilization. Not much is known about them, but several scout ships did disappear in this part of space before contact. Adding urgency to the mission is the presence of envoys from a rival power, trying to win the aliens over to their side.

Explorers

The heroes have made a very interesting find: a star system that has been completely converted into a “Dyson swarm” of giant space habitats, absorbing all the energy of the central sun. Mysteriously, the swarm appears to be completely abandoned. What could destroy a civilization powerful enough to dismantle planets?

Continued on next page . . .

Goons

One thing that makes villains impressive is that they usually come with a big horde of obedient goons. They're usually humans, but can also be big tough aliens, robots, or cyborgs.

Goons, like their masters, need to be a credible threat to the heroes. If a small band of PCs can wipe the floor with the cream of the galactic tyrant's legions, the question arises, "How did those wimps conquer the galaxy, anyway?" Of course, a large force of competent goons will defeat the heroes in short order. Balancing the two factors is tricky.

The Aim maneuver is one useful technique, giving the heroes the chance to duck for cover or fast-draw their own weapon, while still leaving the goons a chance to do some serious damage. Another method is to make sure that encounters with large forces of goons only happen in constricted areas where they can't make their numbers effective. Finally, GMs can encourage (and reward) attempts by heroes to sneak, bluff, or use disguise to avoid combat with the goons. If the heroes have had one tough battle with just a few goons

early in the adventure, they'll have a healthy respect for them later on.

Credible goons shouldn't be too dumb. Bluffing through a checkpoint should require a hero who is highly skilled at Fast-talk or Acting, and there should still be some tense moments when it seems the goons may not be falling for the charade. It also helps maintain believability if the goons follow sensible tactics. If one guard fails to check in (because he's been taken out by surprise), a whole team of other troops should arrive to see what's the matter.

Adventure Seeds (Continued)

Mercenaries

Here's the job: two multistellar corporations are trying to get control of a world rich in rare minerals. The native sapient is low-tech and balkanized, but know about interstellar civilization. A revolution just broke out in the biggest kingdom, and the two corps are backing different factions. Your job is to make sure your employers' faction wins. (Of course, if you want to get all idealistic, you could side with whoever's going to give the natives the best deal.)

Merchants

It sounded like a simple contract: some aliens hired you to haul a consignment of eggs to a new colony world. What they forgot to mention is that the eggs are genetically engineered predators to help control pests on the new colony. They also forgot to mention that they're going to start hatching midway through the voyage. They certainly won't pay for any predators damaged in shipment.

Navy

A band of rebels have stolen the plans for a key defense installation. The ships of the star fleet have spread out to recover the plans before the rebels can use them to mount a surprise attack. But the heroes discover that someone within the government is passing information to the rebels – is the rebel scare merely part of something bigger?

Patrol

There's a new wrinkle in piracy on the frontier, and it's pretty ugly. Raiders have been hitting poorly defended settlements and carrying off the inhabitants to sell as slaves. The Patrol has to locate and infiltrate the slave market in order to find out who's buying the slaves and where they're being sent. Then they can shut the whole operation down with extreme prejudice.

Prospectors

The Golconda Trojans are a rich asteroid cluster where many prospectors operate. But now a big mining company is moving in, buying out or scaring off the independents. They recently took over the only station in the Golcondas where prospectors could get their ships repaired. Some of the guys are cashing in and retiring, others are heading out to find a new belt to work. But others are organizing; they're going to stay and fight back. What about you?

Scientists

The Ikana were a civilization that spanned this part of the galaxy when humans were still hunting mammoths. They were wiped out in a huge war with some unknown enemy. Now excavations on a remote Ikana outpost world have turned up traces of active machinery deep underground. Are there still Ikana surviving in hibernation? Or is it their destroyers, ready to emerge?

Soldiers

A Patrol investigation has found the home base of a slaver operation: a well-defended space station. Now it's time for the marines to go in and take the place, without getting all the captives killed. The Patrol is providing a couple of disguised merchant ships to get the marines into the docking bay. The enemy will be pirates and slavers – well-armed, not very well-trained, and willing to fight to the death to avoid capture.

Spies

Someone in Stellardyne is passing information on cutting-edge weapon technology to rival powers. It's your job to infiltrate the company's research station and find the spy. Of course, Stellardyne may have its own secrets to hide – and just who is the spy working for, really?

CHAPTER NINE

CHARACTERS

"Recovering that disk's not going to be easy."

"Thank you for pointing out the obvious, Captain," I snapped. "Kervan Kang didn't get to be the galaxy's leading crime lord by making it easy for people to steal from him."

"We're going to need help. I can fly a ship, and you know as much as anyone about how to find the tablet once we get into Kang's private museum. I figure we'll need some specialists: a tech who can shut down or spoof Kang's security web, and a couple of guys who can hold off Kang's guards during the raid. Can you think of anyone else?"

"A medic, I suppose – somebody's liable to catch a few blaster shots during this whole operation. Maybe someone to provide a distraction. Can we afford to hire three or four experts?"

"Not really. We could offer shares," he suggested, but my glare ended that speculation. I wasn't going to all the trouble of acquiring the Fomalhaut Disk only to sell it! The sole record of an entire civilization would be enough to restore my scientific reputation a dozen times over.

"So we just have to find one super-agent who'll work cheap," I said bitterly, and then stopped. "That's it!"

"You know someone like that?"

"As a matter of fact, I do. Zelia Meff. She's a xenobiologist, but before she got her degree, she spent a few years working for the Federation Intelligence Agency, in the Anomaly Correction Office."

"What did she do?"

"Corrected anomalies, of course. She said only four people in the galaxy are cleared to know about her history, and that two of them have to be kept sedated because of what they know. I do know she catches Vreeba lizards for her research by shooting them with tranq darts from a kilometer away." I didn't tell Panatic about the time she'd inadvertently broken a would-be mugger's spine after a late night at the lab. No sense in intimidating the good Captain, after all.

"Can we hire her?"

"Hire? I'm not going to hire her! I've got something much more valuable to offer: I'm going to make her my co-author!"



GROUP STRUCTURES

One important way in which role-playing adventures differ from film or written fiction is that they are team efforts. A typical gaming group has from three to six players, each of whom has at least one character. Each one of those characters is (to that player, at least) the star of the story. When creating characters, it's useful to think of ways to connect them, and set up plausible situations for a team of adventurers to keep hanging around together.

MILITARY TEAM

The exploits and adventures of a team of soldiers have a long history in fiction, both in SF and outside the genre. A squad or fire team is the right size for a gaming group, and explains why these particular soldiers are always together. Fighter pilots can be in the same squadron, and tank or mecha crews may be aboard one or two vehicles, depending on crew size. In a military team, the characters have

a lot of overlap in skills and training, especially if they're all in the same branch of service. They're all "combat monsters" by definition. Making them individuals is a matter of choosing vivid disadvantages and quirks, and some distinctive non-military skills. Nicknames and regional or ethnic traits verging on caricature are common in fiction.

A variant military team is the Special Forces or commando squad. The troops have to be quick to adapt

to unexpected situations, which means the characters get a lot more initiative than the average grunt in the ranks. Special Forces teams can also include some highly trained specialists in unusual fields, giving room for more diversity among the characters.

SPACESHIP CREW

On a small vessel the PCs can make up the entire ship's complement, while on larger ships they can be the senior officers. For an interesting variant, the PCs might be low-ranking crew, perhaps part of a special "contact group" or the ship's security troops. Another possibility is to let each player have two or more PCs: one senior officer who seldom leaves the ship, and a low-ranking crewman or space marine for planetside adventures.

EXPLORATION TEAM

A group of scientists or explorers makes for a somewhat different type of campaign. Whether they are planet-based or aboard a spaceship, explorers are likely to be much less rigidly disciplined than a military unit. The characters can be more quirky and diverse, especially if it's a privately funded expedition. An exploration team can contain scientists, experts on outdoor survival, journalists or video-camera operators, linguists, traders, missionaries, and bodyguards. The

potential for personality clashes within such a group does mean that the GM and players should enjoy that kind of roleplaying before undertaking the campaign.

THE PROFESSIONALS

A team of expert crooks assembled for the Big Score is an old favorite in crime fiction, and the same situation can be dropped into a science fiction

setting. Characters can be from a wide variety of backgrounds, with odd and flawed personalities. The only requirement is the necessary skills for the job, at suitably high levels. Niche protection (see the box) is especially important in this arrangement, and the GM needs to be ruthless about making sure the characters have the right abilities. To inject a note of paranoia and mistrust, characters can have hidden agendas – secrets, hidden patrons, or personal enemies.

Niche Protection

It's always a good idea to make sure that each character has a "niche" – some particular area of expertise in which no other character has higher effective skill levels. In general, the character's niche should match the concept – if someone wants to play a "two-fisted space marine," then that character should have the best brawling skill in the party. (Sometimes it's fun to play with those assumptions, and have the party's best fighter be the shy astrogator who just happens to be a martial-arts champion.)

Niche protection ensures that all the characters get something to do. If one of the heroes is a good all-around character but someone else is better at any specific task, then the good all-around guy will always be standing around while someone else takes on the tricky jobs. This doesn't mean that every character should be absurdly specialized and only able to do one thing; having a backup on hand if one person is taken out of action is only prudent.

Character niches also make sure none of the *players* are sitting idle too much. The GM can give each person's character a chance to shine during each play session by creating adventures that play to each niche. (Sometimes the situation simply doesn't allow for this, but it's a worthy goal to aspire to.)

CHARACTER CONCEPTS

Once the Game Master has designed the campaign setting, the players need to come up with characters.

ASTRONAUTS

Space voyagers are almost the "default" character type for a space campaign. Science fiction has shown a great variety of possible models. The earliest fictional space travelers reflected the Victorian milieu of stories like Wells' *The First Men in the Moon* or Verne's *From Earth to the Moon*. They were a mix of brilliant-but-eccentric scientists, gentlemen explorers, and the occasional virtuous sweetheart.

Many of the interwar pulp magazines kept the same blend, with a few lower-class mechanics for comedy relief or gangsters as villains. But tales set in the future introduced a new concept: space explorer as a profession. The Legion of Space in Jack Williamson's stories, the Galactic Patrol of E.E. Smith's "Lensman" series, and Edmond Hamilton's Captain Future became the new models.

Beginning with Yuri Gagarin, space exploration became a real-world career path, and writers began to adjust their stories to reflect new realities. Heroes became less two-fisted and trigger-happy, and shed their jodhpurs and jackboots for jumpsuits. In the 1980s gritty

realism took another giant step with the appearance of blue-collar space heroes like those of the film *Alien*.

Whatever the character's specific background, an astronaut needs certain basic skills: Spacer (p. B185), Piloting (spacecraft type) (p. B214), Free Fall (p. B197), and Vacc Suit (p. 192) are mandatory. G-Experience (p. B57) or Improved G-Tolerance (p. B60) allow them to be at home in a variety of gravity levels.

SPACE KNIGHTS

The idea of a superhuman warrior for justice is surprisingly common in science fiction. From the Lensmen of E.E. Smith to the Jedi of George Lucas,

orders of elite, highly trained Space Knights have been defending the galaxy and fighting for justice. In comics they merged with superheroes to become the Green Lantern Corps. Space knights are more than just superior fighters – they have powers unavailable to lesser mortals, and often they serve a higher purpose rather than simply drawing a paycheck from the government. That's what distinguishes a space knight from, say, a galactic Green Beret or even the stalwart officers of *Star Trek's* starfleet.

Of course, space knights, like real feudal aristocrats, can have a dark side. In past centuries, millions of people fought to be free of rule by hereditary elites; aristocrats with superhuman powers could create an unshakable tyranny. And again, history shows that the worst tyrants of all are those who think they are doing good.

Space knights must naturally be highly competent (even the bumbling novices are merely less supercompetent than the veterans). If they are truly noble heroes, their disadvantages should only be heroic ones – Code of Honor, Sense of Duty, and the like – although it can be fun to play a tarnished hero with one serious flaw. In a darker campaign, the space knights may be less noble, adding Bully, Intolerance, and Fanaticism.

The nature of the knights' skills depends on the technology and setting. If elite warriors duke it out with energy swords, then Force Sword skill and martial arts are most important. Settings where mecha jockeys or fighter aces are the "knights" require Piloting or Driving skills and Gunner. Often knights have access to hidden or secret lore unknown to the rest of society.

TRAMP FREIGHTERS AND MERCHANT PRINCES

Merchant characters can be just as wide-ranging as knights, and can get into a much wider range of trouble. They need a good array of skills: Law, Merchant, and Administration to run the business side, social skills to make contacts and close deals, space-piloting skills to get from market to market,

and combat skills to deal with bandits, pirates, and hypercompetitive rivals.

In a ship crew, the characters can specialize. The captain can focus on the trading side, the pilot on spacecraft operation, and the engineer on keeping the old girl running. Combat can be the responsibility of the marine veteran security officer (or maybe just the cook), or all the crew can have at least minimal competence with blaster or fists.

More high-powered campaigns may involve individuals who run whole trading companies. This doesn't mean they can't get into trouble (Poul Anderson's Nicholas Van Rijn did his share of field work when he wasn't managing his empire), but it does change the necessary skill mix. Social skills and Administration become vastly more important, along with Area Knowledge and Current Events to stay abreast of developments.

MODIFIED HUMANS

Humans have always wished to be better than they are. The ancient Greeks told stories of super-strong Herakles and invulnerable Achilles. Science fiction allows realistic characters with superhuman abilities. While early stories such as Philip Wylie's "Gladiator" postulated giving chemical treatments to a developing fetus to create a superman, modern writers rely on either genetic modification or advanced cybernetic implants to give characters special abilities. **GURPS Bio-Tech** covers biological modifications and technology.

Tailored Genes

Genetic engineering has tremendous potential. Think of all the amazing things that real living organisms already do. Early stage genetic engineering would likely focus on removing genes for undesirable traits (and the definition of "undesirable" is still a huge seething can of giant mutant worms for society to resolve). The next stage would be to pick and choose among the best of the human genome to create people with at least the potential to be great at everything. Beyond that, engineers could start importing

genes from other primates, then other mammals, and finally any Terran life. By then they could even start inventing new genes, and human capabilities would be limited only by the physical laws of nature.

In **GURPS** terms, first-stage genetic engineering (late TL8 to TL9) would simply remove most of the inborn physical Disadvantages from play. With widespread gene selection, nobody would be born color-blind or hemophiliac. Depending on the society, even below-average looks would become rare.

Second-stage engineering (TL9-10) drastically widens the range of possibilities. Borrowing abilities from the animal kingdom makes it quite feasible to create amphibious people, people with Night Vision or echolocation, people with fur or armor skin, people with wings, or people with incredible attribute levels. Chapter 6 includes useful guidelines for biological superpowers that don't violate any natural laws. Game Masters can (and should) set limits on how many points characters can spend on genetic modifications.

Metal and Flesh

Another way to make people superhuman is simply to bolt advanced machines onto them, or implant devices inside their bodies. One might call this the "Tin Woodman" solution, after L. Frank Baum's character who gradually replaced lost body parts with tin until he was all metal. Martin Caidin's novel *Cyborg* (which inspired the TV series *The Six Million Dollar Man*) envisioned a man with super-strong "bionic" limbs. A decade later the cyberpunk authors took the idea to baroque excess, imagining just about every possible combination of human and machine. More recently, as the possibilities of nanotechnology have become more celebrated, the old ideas of cold metal attached to living flesh have given way to new images of a merging at the cellular level – bodies laced with tiny machines that are themselves almost alive.

Detailed rules about body modifications are covered on p. B294. In a **GURPS** campaign there are three

ways to handle cybernetics. Implants and bionic limbs can be treated as part of the character – in which case they cost character points based on effect, can't easily be removed, and don't count against the character's starting wealth. This kind of cybernetics is effectively a "special effect," and the character shouldn't get disadvantage points for missing the parts the bionics replace. This is probably the best method for invisible internal systems and full-body nanotech upgrades.

The second way is to treat bionics as possessions, which just happen to be attached to the person's body. They cost money rather than points (although for really expensive systems the character may wind up trading points for wealth to afford them), and can be stolen or removed about as easily as any other possession. The character does get the disadvantage points for any missing limbs or organs that the bionics replace, though the Mitigator limitation still applies. This method encourages players to "trade up," constantly upgrading their characters' systems just as they buy new guns and gadgets. Obviously this works best for external hardware like mechanical hands or legs.

Finally, the GM may elect to do both, charging points *and* money for cyberware. This is a bit rough at character creation, since the PCs are getting hit both for the Wealth they need to afford stuff and the point value of the bionics, but it does keep things under control in play. Players can offset the point cost with disadvantages based on missing body parts, and can limit the cost of cybersystems with limitations like Takes Recharge. Individuals with cybernetic systems can take the Maintenance disadvantage to reflect the need for periodic overhauls.

The price in dollars of cyberware varies with the campaign world and the tech level. If implants or mechanical arms are common fashion accessories, mass-produced by the million, then they'll be cheap – though the cheap ones may have built-in glitches due to hasty manufacturing and poor quality control. In settings where cybertech is rare or secret, the cost can run to millions.

UPLIFTED ANIMALS

If genetic engineering can improve humans, it can do the same for other species as well. People could make animals stronger, healthier, faster – and smarter. Possibly as smart as humans themselves. David Brin's "Uplift" series depicts a whole galactic civilization based on species boosting others to intelligence, and gives us the name for the process, but the idea has been around much longer. Olaf Stapledon's novel *Sirius* focuses on an intelligent dog, and Cordwainer Smith wrote of animal-derived "Underpeople."

The best candidates for such improvement are naturally the animals that already show great natural intelligence, language ability, or tool use. Chimpanzees are an obvious choice, with dolphins and dogs as runners-up. Other possible uplift subjects include cats, raccoons, elephants, octopuses, bears, gorillas, parrots, ravens, killer whales, and coyotes.

The most important change for an uplifted animal is to raise IQ to 6 or more and buy off the Bestial disadvantage. This creates an intelligent creature, but with severely limited ability to communicate or manipulate items. For species without natural hands the designers may either try to modify the animal's paws to give them manipulating ability, or simply create tools that overcome the lack of hands. The dolphins in Brin's "Uplift" stories use sophisticated robot arms controlled by cybernetic implants.

As to communication, the engineers have three options. They can modify the animals to approximate human speech (though probably with the Disturbing Voice disadvantage); they can go for a technical fix by providing them with voice-synthesizer boxes or translation computers (the Cannot Speak disadvantage with a Mitigator); or they can create a language which the animals can speak but humans can understand.

Exactly how much modification is possible depends on the animal and the campaign background. Raising a dog's intelligence would probably be easier than modifying its entire anatomy and posture to give it hands and bipedal locomotion. Making a dolphin

into a humanoid would be about as hard as creating a new species from scratch (and would negate most of the dolphin's natural advantages anyway).

In many fictional worlds and campaign settings, engineered animals are second-class citizens, considered inferior to their human creators. Cordwainer Smith's "Underpeople" were animal-derived humanoids who served as slaves to humans. This would be a combination of low Status and Social Stigma.

PSIONIC MUTANTS

Humans with psionic powers have been around in science fiction since at least the days of Edgar Allen Poe, who wrote about mind-controlling hypnotists and psychic phenomena. The exact nature of psi powers depends on the campaign, of course. Traditional abilities include telepathy, clairvoyance, and telekinesis. More exotic psi powers allow teleportation, time-jumping, world-jumping, probability alteration, and reality manipulation. Old-time "steampunk" psychic powers are closer to magic, with abilities like spirit medium, psychometry, and animal communication. For details on particular powers and abilities, see pp. B254-257.

Psionic mutants became a fixture in SF during the 1940s and 1950s, when public fears of nuclear war met the legendary editor John W. Campbell's interest in psionic experiments. Writers began using post-apocalyptic mutations as a way to explain the growth of powerful psionics.

Unlike comic-book mutants, SF psionics tend to have a single ability, like mind reading or telekinesis, often with interesting limitations. Larry Niven wrote about Gil the ARM, a future police officer whose telekinesis and ESP manifest themselves as an "imaginary arm" which is no stronger than an ordinary limb but can reach through walls or even video screens! Player characters may require psi-booster drugs or cybernetic implants to activate their powers – or to shut them off! Game Masters should feel free to limit the points characters can spend on psionics, and encourage them to come up with limitations to make their powers unique and interesting.

The rarity of psionic powers determines how much of an Unusual Background the character should have. In some settings, *everyone* can have psionics, so it isn't unusual at all! Alfred Bester's novels *The Demolished Man* and *The Stars My Destination* both feature worlds of universal psychic ability. If psionics is a secret from everyone without powers, then having psi powers is worth 20 points or more. If powers are known to secret government agencies and underground psionic conspiracies but are considered a myth by the general public, which would be worth about 10 points. In worlds where psionics are known but are limited to those born with the talent, it's a 5-point Unusual Background.

Psionics may also suffer a Social Stigma, especially if their powers result from mutation. Normal humans may view them as inhuman, unnatural, or dangerous. Marvel Comics' X-Men titles show this attitude among the general public. The level of stigma depends on the campaign: in some worlds it may be a minor one, equivalent to Social Stigma (Second-Class Citizen); other societies may oppress or even seek to exterminate psionics! Some governments may draft psionics to use their powers "for the greater good," imposing an Involuntary Duty on psis.

By contrast, a society that accepts and respects psionics may give levels of Social Regard based on the character's power level. Details will vary depending on the campaign, but a good guideline is 1 level of Social Regard just for being psionic, 2 if the character has an ability powerful or useful enough to use professionally, and 3 or more if the character's powers are notably strong or impressive. This Regard may be either respect or fear!

ROBOTS AND AIs

One of the earliest SF stories, Mary Shelley's *Frankenstein*, is all about the creation of an artificial intelligence and the consequences of it. Shelley's scientist used biological and alchemical methods instead of electronics, but the "Frankenstein theme" has remained a key part of science fiction for two centuries and shows no sign of disappearing.

There have been several reinterpretations of the idea. Most early stories treated the idea of creating life or intelligence as a blasphemy. Karel Capek's play *R.U.R.* used androids as a way to comment on the exploitation of workers by industrial society, and depicted their destruction of humans as a natural and perhaps desirable result. Isaac Asimov rejected the whole concept of conflict by positing robots programmed with the "Three Laws of Robotics." The three laws made robots ethical, possibly even morally better than humans, and Asimov suggested rule by beings who are made to be ethical could be superior to rule by flawed and fallible humans. Jack Williamson's stories of the "Humanoids" showed a possible flaw in that reasoning, as his robots deprived humans of all freedom in the drive to protect them.

Parallel to the idea of the robot is the concept of the computer. Where robots were in some way "people" – a way to comment on how humans act and how they treat each other – the giant super-intelligent computer rapidly took on the qualities of a god. D.F. Jones' Colossus and Asimov's Multivac were both titanic thinking machines in fiction, so vastly intelligent that humans often had trouble understanding their motives.

As computer technology has become more powerful and widespread in recent decades, depictions of artificial intelligence have become more realistic and sophisticated. Modern stories tend to focus on intelligent *programs* that can run on any sufficiently powerful machine. A humanoid metal body or a giant box with blinking lights are just the "platform" now for the AI.

Giant computers and realistic-style AIs should take the Digital Mind advantage, but old-style robots and androids may not; their intelligence is bound to a particular robot brain. On the other hand, robots do take the Machine meta-trait, while an AI program living entirely in cyberspace would not.

As with psionics and uplifted organisms, robots and AIs get a Social Stigma in many settings. Often they are considered property, or lack certain legal rights enjoyed by humans (the right to reproduce, for instance).

Of course, in some settings (like the *GURPS Reign of Steel* world) computers are the masters and it's *humans* who are the victims of oppression!

ALIENS

The first speculations about alien beings are nearly two thousand years old. The Roman satirist Lucian of Samosata wrote of a ship being carried by a whirlwind to the Moon, where the crew encounters strange vegetable-people. Johannes Kepler imagined more scientific Moon creatures in his *Somnium*, and H.G. Wells' *The War of the Worlds* introduced that dependable SF cliché, the tentacled space monster.

Chapter 6 includes plenty of material on creating alien species, but it's also important to keep in mind the *role* the alien will play in the campaign. There are several possibilities. If humans are the "default species," then alien characters are *outsiders*. They are not human, and so their attitudes and behavior can comment on the things humans take for granted. Tales of outsiders interacting with humanity can replay or comment on human contacts with "alien" human cultures – the conquest of the Americas, the slave trade, and the Boxer rebellion. In early episodes of *Star Trek*, Mr. Spock filled the role of alien outsider. Outsiders may have a Social Stigma, depending on how tolerant the majority culture is of aliens. They also can have disadvantages like Clueless, Low TL, or Unusual Biochemistry, reflecting how little they know of the majority society and how little it knows of them.

A campaign in which humans are roughly equal to several alien civilizations can have aliens as *rivals*. They aren't outsiders – indeed they may be embarrassingly well informed about human culture and psychology – but they don't have the same goals as humans. Their ambitions may be opposed to those of humans (in which case they are likely to be enemies), or they may simply be unrelated. In that sort of universe, the focus is often on coming to terms with the aliens and avoiding violent conflict. The various squabbling civilizations of *Babylon 5* are good examples of alien rivals. Rival aliens may get a Social Stigma

or a racial Reputation among other civilizations. Multispecies settings typically ignore the problems of incompatible biochemistries or food, assuming that spacecraft and starports are set up to handle at least the members of known or important alien species.

If humans are the outsiders in an alien-dominated civilization, then the aliens are the *insiders*. Insider aliens naturally lend themselves to adventures in which learning about the alien civilization or forming social ties with aliens are the goal. The aliens of *Farscape* are insiders. Insider aliens

may or may not know much about humans, but the difficulty is in making them *care*. Since theirs is the majority culture, they don't suffer any disadvantages simply because they are aliens.

Finally, aliens can be simply *monsters*. This is an old role that springs from, and can be used to comment on, human xenophobia and racism. Alien monsters are destructive and dangerous. Communication with them is either impossible, or is the key to stopping their rampage. This is perhaps somewhat "unenlightened" but it's a

dependable SF standby. The predatory alien of *Alien* or Wells' Martians are examples of alien monsters. Monsters get a severe Social Stigma, and may also have Horrific appearance, Cannot Speak, and various Odious Racial Habits reflecting their monstrous behavior.

It is possible for one alien species or civilization to occupy several of these roles at different times. A species encountered first as a monster may reappear later in the outsider role, before joining the community of spacefaring cultures as another rival.

ADVANTAGES, DISADVANTAGES, AND SKILLS

The **GURPS** rules are extremely flexible, but creating characters for far-future or alien settings may require a few adjustments or special interpretations.

ADVANTAGES

A science-fiction campaign makes some advantages very useful, while others become less important.

3D Spatial Sense

see p. B34

This advantage becomes quite important in any campaign in which the heroes spend a lot of time in zero gravity. It's also good for space pilots and navigators. Game Masters should decide if 3D Spatial Sense works in hyperspace or "jumpspace," and whether or not a person with the advantage can retain his direction sense even through an interstellar jump.

Alternate Identity

see p. B39

One useful limitation characters can take on an Alternate Identity is to limit it to a specific world. So if Captain Templeton of the Space Patrol has an alternate identity on the pirate station Port Royal as the smuggler Captain Notelpmet, that reduces the cost. Exactly how much reduction depends on how much time the

characters are in the area where the alternate identity is valid. An identity valid during half the campaign would be a -20% reduction, a fourth of the time is -30%, and a particularly obscure or secret place would be -80%. Note that this only applies to seemingly valid, "legal" identities with all the associated paperwork. Captain Templeton can always *call* himself something else when he visits a new world.

Charisma

see p. B41

The Game Master must decide in advance if advantages like Charisma or Empathy work on different species. The default assumption is that they *do* work on aliens, but appearance and Voice do not. If the GM decides that Charisma and Empathy don't affect aliens, reduce the point value by applying the limitation "Humans Only," worth -20%.

Cultural Adaptability

see p. B46

At the 10-point level this makes a character familiar with all cultures of his race. If he is native to a "multiracial" civilization (like *Star Trek's* Federation), this includes all "member species" cultures but not those beyond the border.

At the 20-point level, the character is familiar with all cultures – but of

course this only applies to *known* cultures. It doesn't mean the character knows anything about undiscovered civilizations!



Cultural Familiarity

see p. B23

Those who lack familiarity with an alien civilization will be fish out of water. PCs should not be allowed to start with familiarity with newly discovered (or *undiscovered*) civilizations. Robots and AIs are likely to have their own cultures, different from those of humans or aliens, and will be similarly unfamiliar with human ways.

Digital Mind

see p. B48

This is the standard advantage for any robot or AI character. Humans may take this advantage (indicating some kind of computer brain implant) but should probably pay an Unusual Background cost of 5-10 points.

G-Experience

see p. B57

This advantage is likely to be quite common in any game that involves interplanetary travel. Characters are assumed to have experience in their native gravity level for free. Game Masters may allow characters to buy familiarity with several different gravities at 1 point each, then “trade up” to familiarity with all gravity levels once they’ve spent 10 points.

High TL

see p. B23

The issue of what constitutes “high TL” can be tricky in a game universe that includes civilizations at different technology levels. A character has the High TL advantage if he can *legally acquire* equipment which otherwise would not be available to other PCs in the game setting. Getting a super-tech weapon from the body of an alien assassin doesn’t make one High TL; knowing where the assassin got his weapon and being able to shop there does.

Improved G-Tolerance

see p. B60

This advantage is an alternate way to model characters who can function on a variety of different worlds without penalty. Unlike G-Experience (see above), it is an innate ability (possibly genetically engineered) rather than something one might pick up as a result of travel.

Languages

see p. B23

In a setting that includes aliens, members of some races might be unable to learn the languages of other races at better than Broken or Accented level – or at all! This is a 0-point racial feature, and cannot be bypassed with Language Talent.

Magery

see p. B66

Magical ability is obviously a fantasy concept rather than science fiction, but writers and gamers love to blur the distinction between the two. If magic

is a known effect in the campaign, then use the listed value for Magery. If magic is secret or unknown, there are two approaches possible: either charge an Unusual Background to let a PC use magic, or declare that since magic is hidden, learning about magic is very difficult. Characters can only learn spells in play from NPCs, who are likely to charge a stiff price or demand services.

Racial Memory

see p. B78

This ability may actually exist among certain alien species, especially those that reproduce by budding. It can also be used to represent the pre-loaded files and memories of an artificial intelligence character.



Resistant

see p. B80

An important type of the Resistant advantage in a space campaign is the ability to withstand acceleration; this is especially common among astronauts and pilots who have to withstand high-gee maneuvers in planes and spacecraft. Resistant to Acceleration (+3 to HT to resist sudden acceleration) is worth 1 point, and Resistant to Acceleration (+8) is worth 2 points. See p. B434 for more on acceleration effects.

Social Chameleon

see p. B86

As with advantages like Empathy and Charisma, the GM should decide if this advantage works in alien societies. If not, apply the -20% limitation “human cultures only.”

Status

see p. B28

Status only gives a benefit or disadvantage if the people you’re dealing with recognize it. Characters from alien or exotic civilizations adventuring in galactic society may wish to buy “courtesy Status” at 1 point per level; if you want to call yourself Baron of Callisto, the natives of Rigel VII won’t argue, but it won’t affect their reactions, either.

Talents

see p. B89

Some new Talents appropriate for SF campaigns include:

Alien Friend: Anthropology (any alien culture), Diplomacy, Expert Skill (Xenology), History (any alien specialty), and Psychology (any alien race). *Reaction bonus:* aliens. 5 points/level.

Cyberneticist: Computer Hacking, Computer Operation, Computer Programming, Computer Programming (AI), and Electronics Repair (computers). *Reaction bonus:* other computer professionals, AI systems, and robots. 5 points/level.

Hot Pilot: Gunner (any), Navigation (Air or Space), Piloting (all types). *Reaction bonus:* other pilots. 5 points/level.

Zeroed

see p. B100

In a far-flung campaign with slow communications, planetary datanets may not be able to share information very well. Individuals may be Zeroed on one world but not another. Game Masters may wish to let PCs be Zeroed on a given world (or star system) with an Accessibility limitation based on how often the characters go there.

DISADVANTAGES

Addiction

see p. B122

A science-fiction setting offers new possibilities for addiction, including virtual reality, psionic contact, or electric stimulation of the pleasure center.

Virtual Reality is Cheap, Incapacitating (in that one can’t do anything

else while using it), and is likely to be Legal, giving it a value of -10 points. *Psionic Contact* is Cheap (assuming one is psionic), likely to be incapacitating, and probably is illegal, for a value of -15. *Direct Pleasure Stimulation* is Cheap, Incapacitating, Totally Addictive, and probably Illegal, for a cost of -25 points.

Amnesia

see p. B123

A setting with advanced brain-hacking or mind manipulation could add another type of Amnesia: *Selective Amnesia*. The victim knows who he is and knows most of his skills and background, but there are certain periods that are “missing” because those memories have been blocked or erased. It’s quite likely that those missing periods included some important events, since otherwise nobody would go to the trouble of erasing them. *Selective Amnesia* is worth -5 points.

Appearance

see p. B21

In any culture that has contact with alien races (or at least knows they exist), simply looking like an alien is not necessarily enough to give an Appearance penalty. Unless species have notably similar standards of beauty, Appearance modifiers don’t cross over from one race to another.

Bad Sight

see p. B123

Given the present-day availability of laser eye surgery and the prospect of genetic engineering to prevent vision problems, Bad Sight may become a forgotten disadvantage in future societies.

Cannot Speak

see p. B125

Aliens with different mouth structures may be unable to pronounce human languages, effectively giving them the Cannot Speak disadvantage. Others may actually be mute, unable to produce sounds. In any society above TL7, this can be mitigated by a computer speech synthesizer, at a -60% cost reduction. See *Mitigator*, p. B112.

Code of Honor

see p. B127

Science fiction opens up a whole universe of possible Codes of Honor for aliens and other forms of intelligence. Some possible new codes include:

Asteroid Miner’s Code: Don’t jump someone else’s claim. A handshake is as good as a contract. Help other prospectors in distress. -5 points.

Ethical Psionic’s Code: Never use your powers on someone without their consent. Always help out another psi. Show restraint and self-control in front of the mundanes. Always stand up for your rights and the rights of other psis. -10 points.

Hacker’s Code: Never steal money. Share information. Don’t use your skills to harm people. Clever work is better than brute force. -5 points.

Mercenary’s Code: A merc should look out for his buddies, take care of his gear, and fight for the honor of the unit. Obey the rules of engagement. Don’t poach on another unit’s contract. Do the job you’re hired for. -10 points.

Dependency

see p. B130

Breathing a different atmosphere is a common Dependency in science fiction. Assume the right air mix for a known species is Very Common, while a more obscure race’s air would be Common. Only really unusual atmospheres (vaporized metal, for instance) would be Occasional or Rare, if only because no space traveler would ever leave home if there was no reliable source of stuff to breathe! All air Dependencies are Constant, so this is a -25 point disadvantage for most species, and -50 points for races that breathe obscure gases.

This disadvantage only applies if the alien is spending all his time in an environment that is hostile to him but in which other characters can operate normally. A team of explorers on the Moon all need air, so it doesn’t matter if one of them has tanks of methane on his back while the others carry oxygen.

Most other requirements of life don’t qualify as a Dependency. Alien food is better modeled as a Restricted

Diet, and medical needs fit Unusual Biochemistry. The need for a different temperature range is a form of Increased Life Support, since the actual vulnerability to different temperatures is balanced by the tolerance for extreme conditions.

Disturbing Voice

see p. B132

In general, an alien’s way of speaking should not qualify as a Disturbing Voice. An individual alien may have a Disturbing Voice, but the way a species communicates should probably be subsumed into any Social Stigma they suffer as aliens.

Electrical

see p. B134

This is a very common disadvantage for robots, computers, and “weird life” aliens based on electric fields or ionized plasma. It doesn’t apply to androids formed by “synthetic life,” or to steampunk-style Babbage engines.

Enemies

see p. B135

In a society with widespread human cloning or cheap and easy plastic surgery, having an Evil Twin Enemy may not be so unlikely or even unusual. If “my clone did it” is a valid excuse in a setting, then the disadvantage of having an Evil Twin is reduced by 5 points. Characters with “off-the-shelf looks” (see Appearance, p. B21) can’t take this form of the Enemy disadvantage at all, because everyone *knows* they look like a lot of other people.

Fragile

see p. B136

A science-fiction setting adds a new variation on Fragile for beings whose bodies are made of gas or a swarm of tiny objects: *Tenuous*. Any critical failure on the HT roll for a major wound from an explosive attack means your body is dispersed, instantly reducing you to -10×HP and killing you. -15 points.

G-Intolerance

see p. B137

Beings who cannot function without penalty in *any* gravity level other than their native one can take a higher value of disadvantage, *Total G-Intolerance* (-25 points). Those with Total G-Intolerance suffer the ill effects of different gravity as if their G-Increment were 0.05G, but always add one *extra* increment in any gravity but their home gravity. In addition, they cannot take G-Experience for other gravity levels.

Increased Life Support

see p. B139

Aquatic creatures require flooded living quarters and water-filled environment suits. This makes their life support Massive, worth -10 points. Organisms from different atmospheres (chlorine-breathers, methane-breathers, or hydrogen-breathers) require Pressurized quarters; -10 points.

Some aliens may require new forms of Increased Life Support. Extremely large beings (4 or more meters in height/length) take the *Large* life support requirement, which doubles the minimum space for bunks, quarters, and airlocks. For each additional doubling of height, add another level. -5 points/level, to a maximum of -30.

Space-dwelling organisms need vacuum and zero gravity, which combines the Massive and Pressurized requirements (assuming artificial zero gravity is possible at all) for -20 points.

Lecherousness

see p. B142

In a realistic (or even semi-realistic campaign), characters with Lecherousness will not be attracted to aliens, even attractive ones. Lecherous characters who also have Xenophilia will be attracted to aliens normally. (And for -20% they can be Lecherous only toward aliens.) In less realistic campaigns, in which cross-species liaisons are common, apply the Physiology Modifiers (p. B181) as a *negative* modifier to the lecher's self-control roll.

Lifebane

see p. B142

While this is normally a supernatural disadvantage, it can be used to model the lethal effect of aliens who are intensely radioactive, or whose tissues exude toxic gas. If a protective suit can reduce or prevent the effect, take the standard -60% limitation. See *Mitigator*, p. B112.

Pacifism

see p. B148

All forms of pacifism normally treat other intelligent beings as "people." Someone might be a Pacifist toward members of his own species, but be willing to use violence against aliens. This assumes that aliens are relatively common. "Single species" pacifists get a -20% reduction in the value of the disadvantage.

Phobias

see p. B148

Some new phobias that are particularly appropriate in a space campaign include:

Radiation (Radiophobia): You are terrified of invisible, deadly radiation or radioactive contamination. You must make a self-control roll to approach or touch something labeled "radioactive" or bearing the radiation trefoil, and must roll once per turn to remain near a source of radiation, even if the level isn't harmful. You will constantly monitor the rad level in your surroundings. -5 points*

Robots (Cyberphobia): You are afraid of intelligent machines, or machines which act intelligent. You must make a self-control roll when encountering any seemingly sentient machine. There is a -3 penalty on the roll whenever you must entrust your life or safety to a "friendly" machine (like an autodoc or a robot pilot), and a -6 penalty when you face a hostile robot or computer intending harm. You will also react at -1 to people with cybernetic implants. -15 points* if *sentient machines are common in the setting*, -5 points* if *they are rare*.

Space: You cannot stand being away from a real solid planet. Aboard a space station or spaceship, make a self-control roll to avoid complete

panic during any stressful situation (with a penalty of -2 if you can see out a window at the time). Any time you must go outside into space wearing only a suit, a roll is required *each turn* to avoid panic. -10 points* if *space travel is common*, -5 if *it is rare*.*

Restricted Diet

see p. B151

In a strictly realistic campaign, all aliens should take this disadvantage when adventuring away from their home planets. The value depends on what they eat. DNA-based creatures who breathe oxygen would have the -10 point level, exotic-chemistry organisms would have it at -20, and non-chemical life would have it at -30. Multispecies civilizations or high-tech societies that have contact with many alien races are assumed to have facilities and food for known species, so this disadvantage doesn't apply in those circumstances unless the characters are from an undiscovered or obscure race. This advantage could also be used to model robots or androids with "nonstandard components," so that all repairs require custom-built parts at 10 times normal cost, for -10 points.

Social Stigma

see p. B155

Several forms of Social Stigma occur frequently in science-fiction campaigns.

Aliens are outsiders, considered funny-looking, possibly dangerous, and certainly inferior to humans. Aliens get -2 on reaction rolls made by humans (or whatever race is the majority in the culture), but a +2 from members of their own species (at least in human-dominated areas). -10 points.

Psionics are often considered not quite human, with abilities that make them potentially dangerous. They get a -2 on reaction rolls from normals, but +2 from other psionics in situations where they are a minority. In some cultures, psionics may require a license to use their powers at all! -10 points, -15 if a license is needed to use *psi powers*.

Robots are typically considered "valuable property" just like slaves or

animals. Some robots or AIs are “free machines” with legal rights but a -1 reaction penalty from humans. -10 points for property machines, -5 points for free ones.

Uplifted Animals are often second-class citizens, with restricted rights and privileges. They get a -1 on reaction rolls from humans, but not from other uplifts. -5 points.

Stress Atavism

see p. B156

This disadvantage may be common among uplifted animals or synthetic organisms with animal genes. Some alien species may have a form of Stress Atavism if they shift into an animalistic state under certain conditions. One likely condition is mating season: Accessibility (Mating season only) is a -80% limitation.

Supernatural Features

see p. B157

No alien features are considered Supernatural Features, unless by a strange coincidence they match up with another species’ legends about magical creatures. Since that would be for a single culture, it would be worth a -40% limitation on the Supernatural Feature disadvantage.

Susceptible

see p. B158

Aliens may be immune to poisons or allergens that affect humans, but are likely to have their own suite of things to be susceptible to. Uplifted animals, robots, or bioroids may have built-in susceptibilities as a method of social control. For animals and bioroids it could take the form of a specific poison or a tailored disease – which law-enforcement agencies probably stockpile. For robots there might be a particular gas mix or liquid (treat as a poison) with devastating effects.

Unusual Biochemistry

see p. B160

In a realistic campaign, *all* aliens should have Unusual Biochemistry, since even oxygen-breathers based on DNA would likely use very different

hormones, blood chemicals, and proteins. In a less realistic campaign, assume all “humanoids” have similar biochemistry, but anything based on different chemicals (chlorine-breathers, hydrogen life, etc.) would still get this disadvantage. In a multi-species civilization, no member race’s biochemistry would qualify as “unusual,” since presumably doctors and pharmacists would be trained in how to treat them.

Vulnerability

see p. B161

Some aliens, especially those with very different chemistries, may be vulnerable to certain types of attack. In particular, a nitrogen-based organism would probably take $\times 3$ or $\times 4$ injury from any kind of incendiary attack, as it would cause a chain-reaction in the molecules of the organism’s body!

Robots may be designed with vulnerabilities to allay human fears of them. Microwave or electrical attacks might get a multiplier of $\times 2$ or more, and in a setting with robots as part of society microwave or electrical weapons are likely to be common.



Weakness

see p. B161

This might be quite common in a science-fiction campaign, both for humans on other planets and aliens visiting Earth. Any alien biosphere is likely to have chemicals or particulates that irritate or harm organisms that aren’t used to them. There are several levels of sensitivity.

Allergens are irritants in the atmosphere or local food that cause an immediate reaction. This is typically Occasional in frequency, although a particularly nasty atmospheric gas (like oxygen for non-breathers) would

be Very Common. The frequency is typically 1d per 5 minutes or 1d per 30 minutes, and most allergies do Fatigue damage only.

Heat or even room temperature might be harmful to aliens whose body tissues can melt (this is in addition to the effects of temperature above the comfort zone). The exact temperatures depend on the chemistry; see Chapter 6 for some numbers on freezing and boiling points. Above the melting temperature you suffer 1d damage per turn, and damage from melting cannot be healed or regenerated. This is Weakness (any significant heat; Very Common, 1d per minute) [-60].

Slow Poisons are trace elements in the environment that accumulate in a body, gradually killing the organism. This is Common, and does 1d per 30 minutes. The body can probably flush out the toxins in a few hours as long as there isn’t new exposure.

In all cases, a Weakness only applies to something that affects one character or race, but which is otherwise harmless. On a world with a lethal atmosphere that kills just about everyone, there’s no point in taking a Weakness, any more than one would take a Weakness to bullets! Similarly, the GM should rigorously enforce the frequency of occurrence modifiers – an effect that occurs on a single planet is an adventure hook or a setting detail, not a disadvantage. Only if the campaign spends a lot of time in that environment should characters get points for a Weakness there.

Weirdness Magnet

see p. B161

In a science-fiction setting, many “weird” elements become fairly mundane. Getting visited by aliens isn’t “weirdness” if you can see aliens down at the mall every weekend buying used CDs. (If *nobody else* can see them, that’s another matter entirely. . .) The Game Master should adjust the effect of this disadvantage to reflect what is really weird in the campaign. This may mean paranormal events and psionics in a hard-SF campaign, or magic and Fortean in a space opera setting. In a *really* weird campaign, the GM may disallow this disadvantage altogether because *everyone* has it!

Planet Types Revisited

Biology (p. B180), Geology (p. B198), and Meteorology (p. B209) require you to specialize by “planet type,” as does the “Physical” specialty of Geography (p. B198). The six types listed represent a middle ground in the quest for realism. For real hard-SF accuracy, all those sciences should specialize by individual planet – so a researcher can be an expert at Mars geology, Earth geology, or Pluto geology.

Players may also wish to broaden the list of options by using the list of planet types in Chapter 4, so that one could be a specialist in Large Hadean meteorology or Standard Garden World biology.

Xenophilia

see p. B162

If an alien species is a well-known part of the setting, then it probably doesn't count as “strange and exotic,” so Xenophilia would not apply. (If there is a Rigelian neighborhood in every city on Earth, then a human attracted to Rigelians only has a 1-point Quirk.) Xenophilia only applies to unusual, unfamiliar, or exotic aliens.

SKILLS

Acrobatics

see p. B174

Game Masters may wish to add a new specialty: *Zero-Gravity Acrobatics*, sometimes known as “Astrobatics.” It requires Free-Fall as a prerequisite, and defaults to Aerobatics at -2, other forms of Acrobatics at -6. Perfect Balance gives no benefit, but 3D Spatial Sense does give a +2 bonus.

Animal Skills

Different planets will require new and exotic specialties of Animal Handling, Riding, and Teamster, with no defaults to Earthly specialties. Also, remember to apply Physiology Modifiers (p. B181) to Veterinary skill.

Bioengineering

see p. B180

Characters with Bioengineering skill can invent biological modifications or even entire new species at TL9+. Use the rules governing

inventions to determine cost and time required. Note that for things like new animals, the creature still has to actually grow up at the normal rate. GMs may require would-be bioengineers to take the Gadgeteer advantage as well.

Boating/TL†

see p. B180

Add the new specialty *Hydrofoils*, which governs the use of powered vessels that ride on underwater hydrofoils rather than floating. Hydrofoils are experimental at TL6, begin to come into use at TL7, and are a mature technology at TL8+. It defaults to Large Powerboat-2 and Motorboat-3.

Environment Suit/TL

see p. B192

Add a new specialization: *Hydrosuit*. This is the skill of wearing a water-filled suit when moving about in air or vacuum. It is learned by aquatic beings who want to explore other environments. Just about all hydrosuits include some kind of powered exoskeleton. The skill defaults to DX-5 or Battlesuit-2.

Erotic Art

see p. B192

This skill (and Sex Appeal) is *entirely* limited to a particular species. Extremely broad-minded or Xenophilic characters may study alien Erotic Art techniques, but there is no default and they only work on the species that invented them.

Explosives

see p. B194

Add the new subspecialty *Nuclear Demolition*, the use of nuclear charges to demolish structures or excavate rock and soil. As with Nuclear Ordnance Disposal, setting the charges requires a double critical failure to cause a spontaneous detonation. However, a critical failure in placing the charge can have catastrophic effects after detonation, in the form of landslides, shockwave damage, flying debris, and radioactive contamination. Nuclear Demolition defaults to conventional Demolition at -2, to Engineer (Mining) at -3, and to Nuclear Ordnance Disposal at -4.

Hypnotism

see p. B201

Alien brains may not be affected by Hypnotism the way human brains are. There are several possibilities. The least realistic is to assume the same skill works on all species. Alternately, human Hypnotism is at a skill penalty on aliens (see *Physiology Modifiers*, p. B181). Human hypnotists could learn hypnosis for a specific alien race to offset the penalty.

More realistically, there may be no default between human-style Hypnotism and alien hypnosis, but humans could still learn alien hypnotic methods to use on individuals of another species. Hypnotism (species) is thus a separate skill with no cross-defaults.

Finally, it may be that humans are unique in the galaxy in being vulnerable to hypnotic effects. Hypnotism *only* works on humans, never affects aliens, and is probably a secret humans don't talk about much off-world.

Linguistics

see p. B205

Linguistics is another skill that requires specialization in a multi-species campaign setting. Each species has its own form of Linguistics, and the study of all languages across species lines is Linguistics (Comparative). The Game Master should decide the default levels. In a hard-SF campaign there may be *no*



default between Linguistics skills for different species, and a -5 default between any species' Linguistics and Linguistics (Comparative). A less realistic campaign may improve the default, putting it at -5 for different species in a moderate-realism game, or -2 in a space opera setting.

When studying the language of a species that communicate in a way very different from human speech (radio pulses, or consuming memory RNA), Linguistics skill gets an additional penalty of -3 to -5 depending on just how alien the method is.

Lip Reading

see p. B205

Since Lip Reading depends on an understanding of how a being shapes sounds, use the *Physiology Modifiers* (p. B181) when trying to read the lips of an alien being. Of course, some aliens may communicate by methods that don't involve any physical motion at all, in which case Lip Reading is simply impossible for them.

Medical Skills

Medical skills naturally concentrate on a particular species, and there are penalties when using medical skills on alien creatures. Use the *Physiology Modifiers* (p. B181) to determine how hard it is to treat an alien.

Mimicry

see p. B210

Add a new specialization in campaigns with alien civilizations: *Alien*

Speech. This skill lets a character imitate the sound of a particular alien race's speech. It may involve the use of handclaps, musical instruments, or other sound effects. As with mimicry of human speech, it doesn't give one the ability to speak an alien language, but it would fool another non-speaker. Obviously this only works with alien languages that use sound!

Paleontology

see p. B212

As with other natural sciences, this should include a subspecialization by planet, or the "comparative" speciality, which concentrates on similarities across alien biologies. The techniques of paleontology are quite similar, so a character doing field work is at no

penalty on an alien world, but background knowledge and interpretation default across world specializations at -2 for similar planet and biology types, -4 for similar worlds with different biologies, and -6 for entirely alien environments.

Piloting/TL†

see p. B214

Depending on the setting, there may be new specializations of Piloting skill for a space game. If Hyperspace is an unusual environment, then Piloting (Hyperspace) is important for any star pilot. Hyperspace piloting defaults to other space piloting at -4 (or more).

Warp drives or other methods of going faster than light in normal space require the Piloting (FTL) specialization. It defaults to High- or Low-Performance Spacecraft at -3.

Savoir-Faire

see p. B218

Instead of the normal -3 penalty for an unfamiliar culture (see p. B23), Game Masters may wish to apply the modifiers described under *Alien Psychology* (see below) to reflect the greater difficulty in trying to master the social rules of an alien mentality. Halve (or ignore) the normal status modifiers when dealing with aliens, since they may not understand differences among humans very well.

Alien Psychology Modifiers

Each alien species requires its own specialty of Anthropology (p. B175) and Psychology (p. B216). Defaults between such specialties are at -2 for species with similar mentalities ("rubber suit" humanoids, members of a multi-species civilization, etc.) or -5 for species with different but comprehensible mentalities (most other naturally evolved sapient species). Specialties dealing with utterly alien species (hyper-dimensional intelligences, machine entities, etc.) would default to "normal" specialties at -6 or worse!

If the default between two cultures is -5 or worse, members of those species should use this penalty *instead* of the usual -3 for unfamiliarity when they interact using the skills listed under *Culture* on p. B23. This is why Cultural Familiarity with an alien culture costs 2 points.



Social Sciences

Skills that deal with the study of cultures and their products – Anthropology, Archaeology, History, Literature, Occultism, and Sociology – must specialize by civilization. Defaults are nonexistent across species lines, since knowing about Terran societies tells you nothing useful about Rigellian cultures, and vice versa. This specialty does not reduce the point cost; the basic skill already assumes it. To make a character who really does know about all the galaxy's literatures, take the specialization Galactic, or possibly Comparative. Local culture skills default to Galactic or Comparative ones at -4 for most places, -3 for important worlds that have had a lot of influence on the grand scheme of things, and -8 for obscure or remote planets. Undiscovered planets get *no* default

on local cultural skills from Galactic ones. Obviously a student of Galactic history won't know nearly as much about events on a particular planet as students of that world's history would.

Spacer

see p. B185

This is an essential background skill for characters who grew up in an orbital habitat or other space station. Just about any character who spends a fair amount of time aboard spacecraft or space stations should have at least some familiarity with Spacer skill.

Submarine

see p. B223

Aquatic civilizations make extensive use of the specialty *Free-Flooding Sub*, as that is the most common vehicle type among undersea dwellers. Ignore the Diving Suit or Scuba prerequisites for any species that can breathe underwater.

Tactics

see p. B224

Available weapon technologies can affect the tactical environment. Game

Masters may wish to define Tactics as a "TL" skill, especially in settings with different technology levels. The usual tech level penalties apply.

Urban Survival

see p. B228

Cities on other worlds are likely to have important differences in services and physical layout. Until characters are familiar with a particular environment (spending at least a week in a city on a given world type or in an alien civilization), impose a -2 penalty to Urban Survival for an alien culture, -2 for an unfamiliar world type, or -4 for both.

Weird Science

see p. B228

In a rigorously hard-SF game, this skill is effectively the skill of *bogus* science, and represents familiarity with pseudosciences and crank theories. In settings with incomprehensible alien or Ancient tech, Weird Science is a fairly serious discipline, the study of sciences that lie beyond human understanding.

CHARACTER TEMPLATES

Players can use these templates as a guide when creating characters; Game Masters can use them when making up NPCs. Both should feel free to alter details to fit the campaign or the character concept.

Astronaut

100 points

Astronauts are officers or crew aboard space vessels. They command and run the ship, operate sensors and weapons, and make sure the passengers and cargo get where they are going without mishap. There are numerous variations on the type in science fiction: low-tech Astronauts, bold Starship Captains, swaggering Fighter Jocks, miracle-working Engineering Officers, and grungy blue-collar merchant crews.

Attributes: ST 10 [0]; DX 12 [40]; IQ 12 [40]; HT 10 [0].

Secondary Characteristics: Damage 1d-2/1d; BL 20 lbs.; HP 10 [0]; Will 12 [0]; Per 12 [0]; FP 10 [0]; Basic Speed 6 [10]; Basic Move 6 [0].

Advantages: 20 points chosen from among 3D Spatial Sense [10], Acute Vision 1-5 [2-10], Ambidexterity [5], Fearlessness 1-5 [2-10], G-Experience [1-10], High Manual Dexterity +1 [5], Immunity to Space Sickness [5], Improved G-Tolerance (1 or 2 increments) [5-10], Perfect Balance [15], Rank 1-4 [5-20], Security Clearance [5], Single-Minded [5], +1 HT [10], and +1 to +4 Per [5-20].

Disadvantages: -35 points chosen from among Duty [-2 to -15], Honesty [-10*], Jealousy [-10],

Loner [-5*], No Sense of Humor [-10], Oblivious [-5], Overconfidence [-5*], Post-Combat Shakes [-5*], Sense of Duty (Comrades) [-5], Squeamish [-10*], Stubbornness [-5], and Workaholic [-5].

Primary Skills: Mathematics (Applied) (H) IQ-1 [2]-11, and 8 points chosen from: Artillery (any) (A) IQ [2]-12, Electronics Operation (any) (A) IQ [2]-12, Electronics Repair (any) (A) IQ [2]-12, Freight Handling (A) IQ [2]-12, Gunner (any) (A) DX [2]-12, Leadership (A) IQ [2]-12, Mechanic (spacecraft type) (A) IQ [2]-12, Navigation (Space or Hyperspace) (A) IQ [2]-12, Piloting (spacecraft type) (A) DX+1 [4]-13, Shiphandling (Spaceship or Starship) (H) IQ [4]-12.

Secondary Skills: Astronomy (H) IQ-1 [2]-11, Free Fall (A) DX [2]-12, Physics (VH) IQ-2 [2]-10, Spacer (E) IQ+2 [4]-14, Vacc Suit (A) DX [2]-12.

Background Skills: Computer Operation (E) IQ [1]-12, First Aid (E) IQ [1]-12, and one of: Beam Weapons (Pistol) (E) DX [1]-12, Carousing (E) HT [1]-10, or Smuggling (A) IQ-1 [1]-11.

Engineering Officer (120 points): Add Computer Programming (H) IQ [4]-12 and Engineer (spacecraft type) (H) IQ [4]-12; add 1 level of Artificer [10]; add +1 level to Physics skill [2].

Fighter Jock (120 points): Must take Piloting as a Primary Skill and either Beam Weapons or Carousing as Background. Add one of: Danger Sense [15], Daredevil [15], Luck [15], or Serendipity [15]; add +1 level to Piloting skill [4]; add +1 to either Carousing or Beam Weapons [1].

Present-Day Astronaut (120 points): Add Fit [5], Research (A) IQ [2]-12, Survival (any) (A) Per-1 [1]-11, and one of the following: Biology (any) (H) IQ+2 [12]-14, Geology/TL8 (any) (H) IQ+2 [12]-14, Physician (H) IQ+2 [12]-14, or Physics +3 [10] and +1 Math (Applied) [2].

Starship Captain (120 points): Must take Navigation and Shiphandling as Primary Skills. Add +2 Rank [10]; choose 10 points from among: Diplomacy (H) IQ [4]-12, Law (Space) (H) IQ [4]-12, Leadership (A) IQ [2]-12, Merchant (A) IQ [2]-12, Market Analysis (H) IQ [4]-12, +1 level to Navigation [2], Savoir-Faire (Military) (E) IQ+1 [2]-13, +1 level to Shiphandling [4], Tactics (H) IQ [4]-12.

* Multiplied for self-control number; see p. B120.

Bounty Hunter

120 points

In many science-fiction stories and films, easy interplanetary travel and limited jurisdiction for police means criminals can escape offworld. Bounty hunters catch fugitives and bring them back in exchange for a hefty reward. In

some stories (like Mike Resnick's "Widowmaker" series), bounty hunters are tough but usually honorable, while in the *Star Wars* films the sinister bounty hunter Boba Fett is enigmatic and ruthless. PCs may be bounty hunters themselves, or may find themselves pursued by them if they commit crimes or do something the authorities don't like. A variant on the standard bounty hunter is the Repo Man, who specializes in recovering starships when the owners have defaulted on their bank payments.

A bounty hunter's Legal Enforcement Powers are a *license*, not police authority, and are very limited; essentially they are civilians performing "citizens' arrests" on fugitives or repossessing private property. They tend to operate in places where formal law-enforcement is spotty or nonexistent.

Attributes: ST 11 [10]; DX 12 [40]; IQ 11 [20]; HT 10 [0].

Secondary Characteristics: Damage 1d-1/1d+1; BL 24 lbs.; HP 12 [2]; Will 11 [0]; Per 12 [5]; FP 10 [0]; Basic Speed 6 [10]; Basic Move 6 [0].

Advantages: Legal Enforcement Powers [5] and 25 points from among the following: Combat Reflexes [15], Cultural Adaptability [10], Danger Sense [15], Enhanced Dodge [15], Fearlessness 1-5 [2]-10], Gizmos [5]-15], Gunslinger [25], Hard to Kill 1-5 [2]-10], High Pain Threshold [10], Indomitable [15], Intuition [15], Photographic Memory [10], Rapid Healing [5], Single-Minded [5], Social Chameleon [5], Unfazeable [15].

Disadvantages: Choose total of -35 points from among: Bad Temper [-10*], Bully [-10*], Callous [-5], Code of Honor (Pirate's or Professional) [-5], Greed [-15*], Jealousy [-10], Obsession (capturing specific person) [-5*], Post-Combat Shakes [-5*], Selfish [-5*], Status -1 [-5], Stubbornness [-5], Trademark [-5], Vow (bring in specific person) [-15].

Primary Skills: Criminology (A) IQ+1 [4]-12, Law (region) (H) IQ+1 [8]-12, and Streetwise (A) IQ+1 [4]-12.

Secondary Skills: Intimidation (A) WILL [2]-11, Research (A) IQ [2]-11, Shadowing (A) IQ+1 [4]-12, and any two of the following: Beam Weapons (Pistol) (E) DX+2 [4]-14, Brawling (E) DX+2 [4]-14, Fast-Draw (weapon) (E) DX+2 [4]-14, Guns (Pistol or Shotgun) (E) DX+2 [4]-14

Background Skills: Computer Operation (E) IQ+1 [2]-12, First Aid (E) IQ+1 [2]-12, and either Acting (A) IQ [2]-11 or Fast-Talk (A) IQ [2]-11.

Repo Man (130 points): Add Free Fall (A) DX [2]-12, Lockpicking (A) IQ [2]-11, Navigation (Space or Hyperspace) (A) IQ-1 [1]-10, Piloting (spacecraft type) (A) DX [2]-12, Spacer (E) IQ [1]-11, Vacc Suit (A) DX [2]-12.

* Multiplied for self-control number; see p. B120.

Colonist

50 points

The people who settle on untamed new planets or build space habitats need to be tough, resourceful, and persistent. Some encounter unexpected dangers on their new home world, while others find settled life too boring and constantly move on ahead of the frontier looking for adventure.

This template is priced fairly low so that it can be combined with others to reflect a character's background on a colony world.

Attributes: ST 10 [0]; DX 10 [0]; IQ 11 [20]; HT 11 [10].

Secondary Characteristics: Damage 1d-2/1d; BL 20 lbs.; HP 12 [4]; Will 12 [5]; Per 11 [0]; FP 11 [0]; Basic Speed 5.25 [0]; Basic Move 5 [0].

Advantages: G-Experience (colony world gravity) [1] and any two of: Absolute Direction [5], Animal Empathy [5], Fit [5], Plant Empathy [5], Rapid Healing [5], Resistant (one hazard of colony world) [5], or Single-Minded [5].

Disadvantages: A total of -10 points from among: Debt 5 [-5], Hidebound [-5], Honesty [-10*], Loner [-5*], Low TL 1 [-5], Miserliness [-10*], Pacifism (Reluctant Killer) [-5],

Post-Combat Shakes [-5*], Selfless [-5*], Sense of Duty (Fellow colonists) [-10], Shyness (Mild) [-5], Social Stigma (Uncultured rube) [-5], Stubbornness [-5], Struggling [-10], Truthfulness [-5*], Workaholic [-5].

Primary Skills: One of: Animal Handling (any) (A) IQ+1 [4]-12, Farming (A) IQ+1 [4]-12, Mechanic (vehicle or system type) (A) IQ+1 [4]-12, Merchant (A) IQ+1 [4]-12, or Prospecting (A) IQ+1 [4]-12.

Secondary Skills: Either the pair Driving (any) (A) DX-1 [1]-9 and Survival (colony environment) (A) Per [2]-11, or the pair Free Fall (A) DX-1 [1]-9 and Vacc Suit (A) DX [2]-10.

Background Skills: First Aid (E) IQ [1]-11, Scrounging (E) Per [1]-11, and either Beam Weapons (any) DX [1]-10 or Guns (any) (E) DX [1]-10.

Separatist or Utopian (40 points): Add one of Fanaticism [-15], Pacifism (Self-Defense Only) [-15] or Xenophobia [-15*]; add Public Speaking (A) IQ-1 [1]-10, and either Philosophy (colony ideology) (H) IQ [4]-11 or Theology (colony religion) (H) IQ [4]-11.

* Multiplied for self-control number; see p. B120.

Con Man

75 points

Likeable rogues have a solid history in science fiction, dating back to Jack Williamson's Giles Habibula, if not earlier. Sometimes they are merchants, more shrewd than honest, and sometimes they are outright crooks bilking the unwary. Fictional con men often conceal a heart of gold, putting their talents to work in order to deceive humorless aliens or tyrannical regimes. Real ones tend to be callous or self-deluding, and can often be surprisingly gullible themselves. A variant con man is the Gambler, who often supplements his skill with a marked deck or loaded dice.

Attributes: ST 10 [0]; DX 10 [0]; IQ 13 [60]; HT 10 [0].

Secondary Characteristics: Damage 1d-2/1d; BL 20 lbs.; HP 10 [0]; Will 13 [0]; Per 13 [0]; FP 10 [0]; Basic Speed 5 [0]; Basic Move 5 [0].

Advantages: 30 points' worth from among: Attractive [4], Alternate Identity (Illegal) [15], Charisma 1-3 [5-15], Courtesy Rank 1-6 [1-6], Cultural Adaptability [10], Daredevil [15], Eidetic Memory [5], Intuition [15], Luck [15], Pitiable [5], Rapier Wit [5], Social Chameleon [5], Smooth Operator 1 [15], Status 1 [5], Unfazeable [15], Versatile [5], or Zeroed [10].

Disadvantages: A total of -35 points from among: Addiction (cheap, legal stimulant or Tobacco) [-5], Bully [-10*], Callous [-5], Chummy [-5], Cowardice [-10*], Greed [-15*], Jealousy [-10], Laziness [-10], Loner [-5*], On the Edge [-15*], Overconfidence [-5*], Pacifism (Reluctant Killer) [-5], Paranoia [-10], Post-Combat Shakes [-5*], Reputation (Crook) [-5], Secret [-5 or -10], Selfish [-5*], Slow Riser [-5], Social Stigma (Criminal record) [-5], Struggling [-10], Trickster [-15*].

Primary Skills: Streetwise (A) IQ+1 [4]-14; one of Acting (A) IQ+1 [4]-14, Fast-Talk (A) IQ+1 [4]-14, or Sex Appeal (A) HT+1 [4]-11.

Secondary Skills: 8 points from among the following: Accounting (H) IQ [4]-13, Beam Weapons (Pistol) DX [1]-10, Computer Hacking (VH) IQ-1 [4]-12, Computer Programming (H) IQ [4]-13, Disguise (A) IQ [2]-13, Forgery (H) IQ [4]-13, Guns (Pistol) (E) DX [1]-10, Merchant (A) IQ [2]-13, Propaganda (A) IQ [2]-13, Public Speaking (A) IQ [2]-13, Savoir-Faire (E) IQ [1]-13, or Sleight of Hand (H) DX-1 [2]-9.

Background Skills: Carousing (E) HT [1]-10, Computer Operation (E) IQ [1]-13, Law (region) (H) IQ-1 [2]-12.

Gambler (100 points): Add High Manual Dexterity +2 [10], Lightning Calculator [2], Area Knowledge (any) (E) IQ [1]-13, Gambling (A) IQ+1 [4]-14, and Sleight of Hand (H) DX+1 [8] -13**.

Scientific Fraud (80 points): Add Weird Science (VH) IQ-3 [1]-10, and any two of: Archaeology (H) IQ-1 [2]-12, Astronomy (H) IQ-1 [2]-12, Biology (any) (H) IQ-1 [2]-12, Chemistry (H) IQ-1 [2]-12, Geology (H) IQ-1 [2]-12, Mathematics (any) (H) IQ-1 [2]-12, Paleontology (any) (H) IQ-1 [2]-12, Physician (H) IQ-1 [2]-12, Physics (any) (H) IQ-1 [2]-12, or Psychology (H) IQ-1 [2]-12.

* Multiplied for self-control number; see p. B120.

**Includes bonus for High Manual Dexterity.

Detective

110 points

Detectives perform criminal investigations, usually as agents of a law-enforcement agency. In large agencies they often specialize in a particular kind of crime. Exactly what constitutes a crime varies from culture to culture, and detectives serving a repressive regime may focus on rooting out political dissidents rather than thieves or murderers. At high tech levels, detective work involves a lot of science, though many prefer to rely on intuition and personal interviews with witnesses and suspects.

Private detectives have no official sanction, but by the same token have greater independence of action. Their job may overlap with that of bounty hunters, especially if they must pursue a culprit beyond the reach of police forces.

If psionic powers exist in the game world, they will have a dramatic impact on law enforcement. Psionic detectives may fight mundane crime, or concentrate on bringing in rogue psis who abuse their powers.

Brian Stableford's "Emortality" series includes several stories of police investigating crimes in a future society where death is optional and genetic engineering is an art form. Alfred Bester's *The Demolished Man* is a classic murder story in a world of psionics.

Attributes: ST 10 [0]; DX 11 [20]; IQ 12 [40]; HT 10 [0].

Secondary Characteristics: Damage 1d-2/1d; BL 20 lbs.; HP 12 [4];

Will 12 [0]; Per 13 [5]; FP 10 [0]; Basic Speed 5.25 [0]; Basic Move 5 [0].

Advantages: Legal Enforcement Powers [5], Police Rank 1 [5] and 25 points from among the following: Combat Reflexes [15], Danger Sense [15], Eidetic or Photographic Memory [5 or 10], Fearlessness 1-5 [2-10], Hard to Kill 1-5 [2-10], High Pain Threshold [10], Indomitable [15], Intuition [15], Legal Enforcement Powers [+5], Police Rank +1-3 [5-15], Rapid Healing [5], Single-Minded [5], Social Chameleon [5], or Unfazeable [15].

Disadvantages: Duty (police department, 12-) [-10], and choose a total of -25 points from among: Addiction (legal stimulants or Tobacco) [-5], Alcoholism [-15], Bad Temper [-10*], Bully [-10*], Callous [-5], Cannot Harm Innocents [-10], Code of Honor (Professional) [-5], Curious [-5*], Greed [-15*], Honesty [-10*], Intolerance (choose group) [-5], Jealousy [-10], Obsession (capturing specific person) [-5*], On The Edge [-15*], Paranoia [-10], Post-Combat Shakes [-5*], Sense of Duty (Fellow officers) [-5], Sense of Duty (Civilians) [-10], Stubbornness [-5], or Workaholic [-5].

Primary Skills: Criminology (A) IQ+2 [8]-14, Forensics (H) IQ [4]-12, Interrogation (A) IQ [2]-12, Law (region) (H) IQ [4]-12, Observation (A) Per+1 [4]-14, Research (A) IQ [2]-12,

Secondary Skills: Area Knowledge (jurisdiction) (E) IQ [1]-12, Driving (Auto or Hovercraft) (A) DX [2]-11, Electronics Operation

(Security or Surveillance) (A) IQ [2]-12, Forced Entry (E) DX [1]-11, Search (A) Per [2]-13, one of Beam Weapons (Pistol) (E) DX+1 [2]-12 or Guns (Gyroc, Pistol or Shotgun) (E) DX+1 [2]-12.

Background Skills: Computer Operation (E) IQ [1]-12, First Aid (E) IQ [1]-12, Savoir-Faire (Police) (E) IQ [1]-12, Streetwise (A) IQ [2]-12, and one of Brawling (E) DX+1 [2]-12 or Fast-Draw (weapon) (E) DX+1 [2]-12.

Private Detective (110 points): Delete Legal Enforcement Powers, Police Rank, and Duty.

Psionic Detective (125 points): Increase Will by 1 [5]; add Electronics Operation (Psychotronics) (A) IQ [2]-12, Expert Skill (Psionics) (H) IQ [4]-12, and Mind Block (A) Will+1 [4]-14. Add psi powers as appropriate for campaign.

Secret Police Inspector (122 points): Improve Legal Enforcement Powers [+5], add Security Clearance [5] and Intimidation (A) Will [2]-12.

* Multiplied for self-control number; see p. B120.

Doctor

90 points

Future medical technology holds amazing promise, but no gadgets are effective without someone who knows how and when to use them. This template represents a physician with a medical degree, who presumably has access to state-of-the-art medical equipment.

Field medics, on the other hand, must emphasize fast response and treating patients on the spot with

minimal equipment. They usually have other training, as rescue workers, police, military personnel, or vehicle crew.

Xenomedical specialists, like the doctors in James White's "Sector General" stories, treat aliens, and consequently must be able to operate in a variety of environments, often dealing with patients who can't communicate with them.

Attributes: ST 10 [0]; DX 10 [0]; IQ 13 [60]; HT 10 [0].

Secondary Characteristics: Damage 1d-2/1d; BL 20 lbs.; HP 10 [0]; Will 13 [0]; Per 13 [0]; FP 10 [0]; Basic Speed 5 [0]; Basic Move 5 [0].

Advantages: 20 points from among: Comfortable Wealth [10], High Manual Dexterity 2 [10], Healer [10], Intuition [15], Status 1-2 [5-10], Unfazeable [15], Versatile [5].

Disadvantages: Choose -35 points from among: Code of Honor (Hippocratic Oath) [-5], Charitable [-15*], Combat Paralysis [-15], Duty (12-, nonhazardous) [-5], Honesty [-10*], Overconfidence [-5*], Pacifism (Cannot Kill or Self Defense) [-15], Workaholic [-5].

Primary Skills: Diagnosis (H) IQ+1 [8]-14, Physician (H) IQ+1 [8]-14, and either Bioengineering (any) (H) IQ+1 [8]-14 or Surgery (any) (H) IQ+1 [8]-14.

Secondary Skills: Electronic Operation (Medical) (A) IQ [2]-13, Hazardous Materials (any) (A) IQ [2]-13, Law (Medical) (H) IQ-1 [2]-12, Pharmacy (H) IQ-1 [2]-12, Physiology (H) IQ-1 [2]-12, Psychology (H) IQ-1 [2]-12.

Background Skills: Biology (any) (H) IQ [4]-13, Chemistry (H) IQ-1 [2]-12, Computer Operation (E) IQ [1]-13, Research (A) IQ-1 [1]-12, Savoir-Faire (High Society) (E) IQ [1]-13.

Field Medic (14 points): Choose any other template and add the following skills: Diagnosis (H) IQ [4], Electronics Operation (Medical) (A) IQ [2], First Aid (E) IQ+2 [4], Hazardous Materials (any) (A) IQ [2], and Surgery (VH) IQ-2 [2].



Xenomedical Specialist (120 points): Add the following: Biology (alien world specialization) (H) IQ-1 [2]-12, Expert Skill (Xenology) (H) IQ+1 [8]-14, Physiology (alien species) (H) IQ [4]-13, Vacc Suit (A) DX+2 [8]-12, and Veterinary (H) IQ+1 [8]-14.

* Multiplied for self-control number; see p. B120.

Explorer

150 points

Explorers venture into unknown territory to find out what's there. They must be adaptable and tough if they want to get home and tell anybody what they've discovered. This template is for a planetary explorer whose skills are optimized for travel and survival in hostile environments. Explorers who spend most of their time aboard spacecraft should use the Astronaut template instead. Scientist-explorers who wish to perform detailed studies of their new finds should use the Scientist template.

Some explorers venture into regions with intelligent inhabitants, and so must be experts in establishing peaceful contact and learning to communicate with aliens. They use the "Contact Specialist" lens below.

Attributes: ST 12 [20]; DX 12 [40]; IQ 12 [40]; HT 12 [20].

Secondary Characteristics: Damage 1d-1/1d+2; BL 29 lbs.; HP 15 [6]; Will 12 [0]; Per 12 [0]; FP 15 [9]; Basic Speed 6 [0]; Basic Move 6 [0].

Advantages: 20 points chosen from among Absolute Direction [5], Combat Reflexes [15], Cultural Adaptability [10], Danger Sense [15], Fearlessness 1-5 [2-10], Fit [5], G-Experience [1-10], High Pain Threshold [10], Improved G-Tolerance [5-10], Language Talent [10], Luck [15], Outdoorsman [10], Rank 1-4 [5-20], Rapid Healing [5], Serendipity [15], Single-Minded [5], and Unfazeable [15].

Disadvantages: -35 points chosen from among Curious [-5*], Honesty [-10*], Jealousy [-10], Loner [-5*], Miserliness [-10*], Obsession (reaching a particular place) [-5*], Overconfidence

[-5*], Pacifism (Cannot Kill or Self-Defense Only) [-15], Post-Combat Shakes [-5*], Sense of Duty (Comrades) [-5], Stubbornness [-5], Workaholic [-5], or Xenophilia [-10*].

Primary Skills: Cartography (A) IQ [2]-12, Geography (Physical, choose planet type) (H) IQ [4]-12, Navigation (Sea, Air or Land) (A) IQ+2 [8]-14, and any two of the following: Boating (any) (A) DX [2]-12, Driving (any) (A) DX [2]-12, Hiking (A) HT [2]-12, Piloting (any) (A) DX [2]-12, Scuba (A) IQ [2]-12, Submarine (any) (A) DX [2]-12, or Vacc Suit (A) DX [2]-12.



Secondary Skills: Biology (choose planet type) (VH) IQ-2 [2]-10, Survival (any) (A) Per [2]-12, and either Electronic Operation (Communication, Scientific, Sensor, or Sonar) [A] IQ [2]-12 or Photography (A) IQ [2]-12.

Background Skills: Computer Operation (E) IQ [1]-12, First Aid (E) IQ [1]-12, Swimming (E) HT [1]-12, Writing (A) IQ [2]-12,

and one of the following: Beam Weapons (any) (E) DX [1]-12, Brawling (E) DX [1]-12, Crossbow (E) DX [1]-12, or Guns (any) (E) DX [1]-12.

Contact Specialist (170 points): Delete Cartography, Geography and Survival skills [-8]; add Diplomacy (H) IQ+2 [12]-14, Expert Skill (Xenology) (H) IQ+2 [12]-14, and Linguistics (H) IQ [4]-12.

* Multiplied for self-control number; see p. B120.

Merchant

75 points

Merchants must often go far afield to find goods or markets. Far, of course, is a relative term – on a low-tech colony world the local merchant may have to travel a hundred miles over bad roads to the spaceport, while the space merchant he does business with travels hundreds of light-years. This template assumes a "hands-on" merchant who does a lot of traveling and negotiating in person. For a more desk-bound sort, use the Executive lens.

A more specialized merchant is the Antiquities Dealer, who sells rare and possibly alien-made items that may or may not be legal. Antiquities dealers must be fairly knowledgeable about what they sell, even if what they're selling is bogus.

Attributes: ST 10 [0]; DX 10 [0]; IQ 12 [40]; HT 10 [0].

Secondary Characteristics: Damage 1d-1/1d+2; BL 20 lbs.; HP 10 [0]; Will 12 [0]; Per 12 [0]; FP 10 [0]; Basic Speed 5 [0]; Basic Move 5 [0].

Advantages: 30 points chosen from among Business Acumen [10], Comfortable or Wealthy [10 or 20], Courtesy Rank 1-5 [1-5], Cultural Adaptability [10], Cultural Familiarity [1 or 2/culture], Eidetic Memory [5], G-Experience [1-10], Improved G-Tolerance [5-10], Independent Income 1-5 [1-5], Language Talent [10], Lightning Calculator [2], Luck [15], Rank 1-4 [5-20], Serendipity [15], Status 1-2 [5-10], Unfazeable [15], or Versatile [5].

Disadvantages: -35 points chosen from among Bad Temper [-10*], Callous [-5], Chummy [-5], Code of Honor (Professional) [-5], Debt 1-10 [-1-10], Duty (to employer, 12-, nonhazardous) [-5], Greed [-15*], Honesty [-10*], Jealousy [-10], Miserliness [-10*], Overconfidence [-5*], Pacifism (Reluctant Killer) [-5], Post-Combat Shakes [-5*], Stubbornness [-5], or Workaholic [-5].

Primary Skills: Administration (A) IQ [1]-12**, Accounting (H) IQ [4]-12, Current Affairs (Business) (E) IQ+2 [4]-14, Finance (H) IQ [4]-12, Law (Trade) (H) IQ [4]-12, Market Analysis (H) IQ [3]-12**, Merchant (A) IQ+2 [8]-14.

Secondary Skills: Either Leadership (A) IQ [2]-12 or Propaganda (A) IQ [2]-12; and any three of the following: Driving (any) (A) DX [2]-10, Freight Handling (A) IQ [2]-12, Navigation (any) (A) IQ [2]-12, Packing (A) IQ [2]-12, Piloting (any) (A) DX [2]-10, Shiphandling (any) (H) IQ-1 [2]-11, Spacer (E) IQ+1 [2]-13, or Teamster (A) IQ [2]-12.

Background Skills: Computer Operation (E) IQ [1]-12, First Aid (E) IQ [1]-12, one of the following: Beam Weapons (type) (E) DX [1]-10, Brawling (E) DX [1]-10, or Guns (any) (E) DX [1]-10; and one of either Carousing (E) HT [1]-10 or Savoir-Faire (E) IQ [1]-12.

Antiquities Dealer (85 points): Add connoisseur (art) (A) IQ [2]-12, Forgery (H) IQ [4]-12, and either Archaeology (H) IQ [4]-12, Expert Skill (Xenology) (H) IQ [4]-12, or Hidden Lore (Lost civilizations) (A) IQ+1 [4]-13.

Executive (80 points): Delete all the secondary skills except Propaganda [-6], increase Computer Operation to IQ+2 [+3], delete combat background skills and First Aid [-2], increase Administration to IQ+2 [+6], add Leadership (A) IQ [2]-12 and Public Speaking (A) IQ [2]-12.

* Multiplied for self-control number; see p. B120.

**Bought from Merchant default.

Scientist

75 points

Scientists gather knowledge about the universe. In the modern world they tend to be specialists in a particular field or topic, but fictional scientists are often generalists to a ridiculous degree. Contrary to stereotype, modern scientists are usually quite adept at practical tasks like building apparatuses, catching specimens, and surviving in the wild while on field season.

Fictional uber-scientists should use the Cinematic Scientist lens, possibly combined with the Inventor template below. Science officers aboard spaceships use the Science Officer lens.

Attributes: ST 10 [0]; DX 10 [0]; IQ 13 [60]; HT 10 [0].

Secondary Characteristic: Damage 1d-2/1d; BL 20 lbs.; HP 10 [0]; Will 13 [0]; Per 13 [0]; FP 10 [0]; Basic Speed 5 [0]; Basic Move 5 [0].

Advantages: 20 points chosen from among Eidetic Memory [5], Fit [5], G-Experience [1-10], High Manual Dexterity 1-2 [5-10], Language Talent [10], Lightning Calculator or Intuitive Mathematician [2 or 5], Mathematical Ability 1 [10], Reputation +1 (among scientists in field) [1 per level], Security Clearance [5], Serendipity [15], Single-Minded [5], Status 1-2 [5-10], Tenure [5], Unfazeable [15], Versatile [5] or +1 to +2 Per [5-10].

Disadvantages: -35 points chosen from among Absent-Mindedness [-15], Clueless [-10], Code of Honor (Professional) [-5], Combat Paralysis [-15], Curious [-5*], Gullibility [-10*], Honesty [-10*], Indecisive [-10*], Jealousy [-10], Loner [-5*], Miserliness [-10*], Obsession (solving a particular problem) [-5*], Overconfidence [-5*], Pacifism (Cannot Kill or Self-Defense Only) [-15], Post-Combat Shakes [-5*], Reputation -1 (among scientists in field, as a sloppy researcher or crackpot) [varies], Shyness [-5 or -10], Stubbornness [-5], Truthfulness [-5*], Workaholic [-5], or Xenophilia [-10*].

Primary Skills: Research (A) IQ+1 [4]-14, and any two of: Anthropology, Archaeology, Astronomy, Bioengineering (any), Biology (any), Chemistry, Computer Programming, Economics, Expert Skill (any), Engineer (any), Geography, Geology, Mathematics (any), Metallurgy, Paleontology (any), Physics (any), Psychology, or Sociology – all are (H) IQ+1 [8]-14.

Secondary Skills: Teaching (A) IQ-1 [1]-12, Writing (A) IQ-1 [1]-12; one of: Cartography (A) IQ-1 [1]-12, Electronic Operation (Scientific, Sensor, or Sonar) (A) IQ-1 [1]-12 or Photography (A) IQ-1 [1]-12; and one of: Hazardous Materials (any) (A) IQ [2]-13, Scuba (A) IQ [2]-13, Survival (any) (A) Per [2]-13, or Vacc Suit (A) DX [2]-10.

Background Skills: Computer Operation (E) IQ [1]-13, First Aid (E) IQ [1]-13, Public Speaking (A) IQ-1 [1]-12, Scrounging (E) Per [1]-13, Swimming (E) HT [1]-10.

Cinematic Scientist (100 points): Delete primary science skills [-16], add Science! (W) IQ [24]-13 and Weird Science (VH) IQ-1 [4]-12; add Independent Income 3 [3], High TL 1 [5] and Gizmo [5].

Science Officer (120 points): Add Duty [-5 to -15] to disadvantage options, increase DX to 11 [20], add Rank 3 [15], Beam Weapon (Pistol) (E) DX+1 [2]-12, Electronics Operation (Scientific or Sensor) (A) IQ [2]-13, Free Fall (A) DX+1 [4]-12, Spacer (E) IQ+1 [2]-14.

* Multiplied for self-control number; see p. B120.

Secret Agent

100 points

Spies and secret agents have a long history in science fiction, from the one-man guerrilla movement of Eric Frank Russell's *Wasp* to the starkly incredible Lensmen of E.E. Smith. At the fringes of the genre, where SF meets technothrillers and political novels, spies are everywhere. Certainly many of James Bond's cinematic exploits have SF elements.

Science-fiction secret agents come in two main types: the grittily realistic operatives and the dashing Bondian heroes. Superspies have a natural niche in space opera fiction, while bleak, paranoid spies hang out in cyberpunk stories – often working for megacorporations instead of government agencies. The template depicts a realistic spy, while lenses present a cinematic Superspy and a “Military Advisor” suitable for covert warfare.

Attributes: ST 10 [0]; DX 11 [20]; IQ 12 [40]; HT 10 [0].

Secondary Characteristics: Damage 1d-2/1d; BL 20 lbs.; HP 12 [4]; Will 12 [0]; Per 13 [5]; FP 10 [0]; Basic Speed 5.25 [0]; Basic Move 5 [0].

Advantages: Security Clearance [5] and 25 points from among the following: Combat Reflexes [15], Cultural Adaptability or Xeno-Adaptability [10 or 20], Cultural Familiarity [1 or 2/culture], Danger Sense [15], Eidetic or Photographic Memory [5 or 10], Fearlessness 1-5 [2-10], High Pain Threshold [10], Indomitable [15], Intuition [15], Language Talent [10], Legal Enforcement Powers [5-15], Legal Immunity [5-20], Rank (Military or Administrative) 1-4 [5-20], Security Clearance +1 [5], Single-Minded [5], Social Chameleon [5], Unfazeable [15], Versatile [5].

Disadvantages: Duty (agency, 12-) [-10], and choose a total of -25 points from among: Addiction (legal stimulants or Tobacco) [-5], Alcoholism [-15], Bloodlust [-10*], Callous [-5], Code of Honor (Professional) [-5], Curious [-5*], Loner [-5*], On The Edge [-15*], Paranoia [-10], Post-Combat Shakes [-5*], Secret (Undercover agent) [-20], Sense of Duty (Fellow agents) [-5], Stubbornness [-5], or Workaholic [-5].

Primary Skills: Area Knowledge (any) (E) IQ+2 [4]-14, Current Affairs (any) (E) IQ+2 [4]-14, Law (international) (H) IQ [4]-12, and one of: Acting (A) IQ+2 [8]-14, Observation (A) Per+2 [8]-15, or Research (A) IQ+2 [8]-14.

Secondary Skills: Choose 12 points from among the following: Beam Weapons (Pistol) (E) DX+1 [2]-12, Computer Programming (H) IQ [4]-12, Computer Hacking (VH) IQ-1 [4]-11, Cryptography (H) IQ [4]-12, Detect Lies (H) Per-1 [2]-12, Diplomacy (H) IQ [4]-12, Driving (any) (A) DX [2]-11, Electronics Operation (Communications, Security or Surveillance) (A) IQ [2]-12, Expert Skill (Political Science or Xenology) (H) IQ [4]-12, Fast Talk (A) IQ [2]-12, Forgery (H) IQ [4]-12, Guns (Gyroc, Pistol or Shotgun) (E) DX+1 [2]-12, Holdout (A) IQ [2]-12, Intelligence Analysis (H) IQ [4]-12, Interrogation (A) IQ [2]-12, Lockpicking (A) IQ [2]-12, Propaganda (A) IQ [2]-12, or Shadowing (A) IQ [2]-12.

Background Skills: Computer Operation (E) IQ [1]-12, First Aid (E) IQ [1]-12, Savoir-Faire (E) IQ [1]-12 or Streetwise (A) IQ-1 [1]-11, and either Brawling (E) DX [1]-11 or Fast-Draw (weapon) (E) DX [1]-11.

Superspy (150 points): DX 12 [20]; add 20 points from among: Gizmos 1-3 [5-15], Hard to Kill 1-5 [2-10], High TL [5], Luck [15], Rapid Healing [5], Security Clearance +1 [+5], Smooth Operator 1 [15]; add Overconfidence [-5*] and Trademark [-5] to disadvantage options; add Disguise (A) IQ [2]-12, Judo (H) DX [4]-12, Stealth (A) DX [2]-12, and either Connoisseur (any) (A) IQ-1 [1]-11 or Fast-Draw (any) (E) DX [1]-12.

Covert Military Advisor (165 points): DX 12 [20], ST or HT 11 [10], and 20 points from among Fit [5], High Pain Threshold [10], and Military Rank 1-4 [5-20]; add Code of Honor (Soldier's) [-10], Duty (Extremely Hazardous) [-15] to disadvantage options; add Soldier (A) IQ+2 [8]-14, either Beam Weapons (Rifle) (E) DX [1]-12 or Guns (Rifle) (E) DX [1]-12; and 6 points from among: Camouflage (E) IQ [1]-12, Explosives (Demolition) (A) IQ

[2]-12, Forward Observer (A) IQ [2]-12, Gunner (any) (E) DX [1]-12, Knife (E) DX [1]-12, Stealth (A) DX [2]-12, Tactics (H) IQ [4]-12.

* Multiplied for self-control number; see p. B120.

Security Officer

115 points

They're known as guards, police officers, goons, and rent-a-cops. They spend most of their time watching for trouble and being bored. When something happens, they're the guys on the spot.

This template assumes a fairly ordinary “beat cop.” For professional investigators, use the Detective template. On the frontier, the local Marshal may be the only law enforcement available, requiring more investigative skills. Space station or shipboard security add appropriate skills.

Attributes: ST 11 [10]; DX 12 [40]; IQ 10 [0]; HT 12 [20].

Secondary Characteristics: Damage 1d-1/1d+1; BL 24 lbs.; HP 12 [2]; Will 11 [5]; Per 11 [5]; FP 10 [0]; Basic Speed 6 [0]; Basic Move 6 [0].

Advantages: Legal Enforcement Powers [5], Police Rank 0 [0], and 25 points from among the following: Combat Reflexes [15], Danger Sense [15], Fearlessness 1-5 [2-10], Fit [5], Hard to Kill 1-5 [2-10], High Pain Threshold [10], Indomitable [15], Intuition [15], Legal Enforcement Powers [+5], Police Rank 1-2 [5-10], Rapid Healing [5], Security Clearance [5], Single-Minded [5], or Unfazeable [15].

Disadvantages: Duty (Police Department, 12-) [-10], and choose a total of -25 points from among: Addiction (legal stimulants or Tobacco) [-5], Alcoholism [-15], Bad Temper [-10*], Bully [-10*], Callous [-5], Code of Honor (Professional) [-5], Flashbacks [-5], Gluttony [-5*], Greed [-15*], Honesty [-10*], Intolerance (choose group) [-5], Loner [-5*], On The Edge [-15*], Overconfidence

[-5*], Paranoia [-10], Post-Combat Shakes [-5*], Secret (Corrupt) [-10], Sense of Duty (Fellow officers) [-5], Sense of Duty (Civilians) [-10], Stubbornness [-5], or Workaholic [-5].

Primary Skills: Criminology (A) IQ [2]-10, Law (Local Police) (H) IQ [4]-10, and Savoir-Faire (Police) (E) IQ+2 [4]-12.

Secondary Skills: Brawling (E) DX+2 [4]-14, Detect Lies (H) Per-1 [2]-10, Driving (any) (A) DX [2]-12, Fast-Draw (weapon) (E) DX [1]-12, Forced Entry (E) DX [1]-12, Forensics (H) IQ-1 [2]-9, Search (A) Per [2]-10, Stealth (A) DX [2]-12, Tonfa (A) DX [2]-12, and either Beam Weapons (Pistol) (E) DX+2 [4]-14 or Guns (Pistol or Shotgun) (E) DX+2 [4]-14.

Background Skills: Carousing (E) HT [1]-12, Computer Operation (E) IQ [1]-10, First Aid (E) IQ+1 [2]-11, and Streetwise (A) IQ [2]-10.

Frontier Marshal (135 points): Improve IQ to 11 [20]; delete Savoir-Faire [-4], add Survival (local environment) (A) Per [2]-12, and either Beam Weapons (Rifle) (E) DX+1 [2]-13 or Guns (Rifle) (E) DX+1 [2]-13.

Rescue Squad (145 points): Improve IQ to 11 [20]; add Climbing (A) DX [2]-12, Explosives (EOD) (A) IQ [2]-11, Hazardous Materials (any) (A) IQ [2]-11, Liquid Projector (Sprayer) (E) DX [1]-12, NBC Suit (A) DX [2]-12; improve Forced Entry to DX+1 [+1].

Starship Security (125 points): Add G-Experience (5 other gravity levels) [5], Free Fall (A) DX [2]-12, Spacer (E) IQ [1]-10, Vacc Suit (A) DX [2]-12.

* Multiplied for self-control number; see p. B120.

Soldier

70 points

The Poor Bloody Infantry. The Leathernecks. Tommy Atkins and G.I. Joe. Stories about soldiers have been around as long as there have been stories. Over time, soldiers have changed from big guys with swords to tech-savvy men and women with an arsenal

of gadgets at their fingertips. This template represents a basic soldier with no special training. As is, it can represent a trainee or a green trooper from an underfunded army, or can be combined with other templates to create a combat medic or a military technician. Add one of the specialization packages to create a skilled front-line combatant. Officers add the Officer package to the specialization. Veterans add the Veteran package, and elite soldiers the Elite package. It is possible to be a Veteran Elite Officer.

Attributes: ST 11 [10]; DX 12 [40]; IQ 10 [0]; HT 11 [10].

Secondary Characteristics: Damage 1d-1/1d+1; BL 24 lbs.; HP 11 [0]; Will 10 [0]; Per 10 [0]; FP 11 [0]; Basic Speed 6 [5]; Basic Move 6 [0].

Advantages: Military Rank 0 [0], and 20 points chosen from among Ambidexterity [5], Combat Reflexes [15], Fit or Very Fit [5 or 15], High Pain Threshold [10], Rank 1-2 [5-10], Rapid Healing [5], +1 to ST or HT [10], +1 to +5 to HP [2-10], and +1 to +4 to Per [5-20].



Disadvantages: Duty (15 or less) [-15] and -20 points chosen from among Alcoholism [-15], Bad Temper [-10*], Bloodlust [-10*], Code of Honor (soldier's) [-10], Compulsive Carousing or

Spending [-5*], add Extremely Hazardous to Duty [-5], Fanaticism [-15], Flashbacks (Mild) [-5], Gullibility [-10*], Honesty [-10*], Impulsiveness [-10*], Lecherousness [-15*], Overconfidence [-5*], Post-Combat Shakes [-5*], Sense of Duty (Comrades) [-5].

Primary Skills: Soldier (A) IQ+2 [8]-12, and either Beam Weapons (any) or Guns (any) (E) DX+2 [4]-14.

Secondary Skills: Driving (any) (A) DX [2]-12, Explosives (any) (A) IQ [2]-10, Scrounging (E) Per [1]-10, and either Brawling (E) DX [1]-12 or Knife (E) DX [1]-12.

Background Skills: Computer Operation (E) IQ [1]-10, First Aid (E) IQ [1]-10.

Armored (90 points): Improve Driving to DX+2 [+6]. Add Electronics Operation (any) (A) IQ [2]-10, Forward Observer (A) IQ [2]-10, Mechanic (vehicle type) (A) IQ+1 [4]-11, Navigation (Land) (A) IQ [2]-10, and either Artillery (any) (A) IQ+1 [4]-11 or Gunner (any) (E) DX+2 [4]-14.

Battlesuit Trooper (100 points): Battlesuit (A) DX+2 [8]-14, Camouflage (E) IQ+2 [4]-12, Electronics Operation (any) (A) IQ [2]-10, Forward Observer (A) IQ [2]-10, Gunner (any) (E) DX+2 [4]-14, Mechanic (Battlesuit) (A) IQ+1 [4]-11, Navigation (land) (A) IQ+1 [4]-11, Throwing (A) DX [2]-12.

Engineer (110 points): Increase IQ to 11 [20]; add Camouflage (E) IQ+1 [2]-12, Electronics Operation (any) (A) IQ-1 [1]-10, Engineer (Combat) (H) IQ+2 [12]-13, Gunner (any) (E) DX+1 [2]-13, Mathematics (Applied) (H) IQ-1 [2]-10, Navigation (Land) (A) IQ-1 [1]-10.

Infantry (90 points): Add Camouflage (E) IQ+2 [4]-12, Electronics Operation (any) (A) IQ [2]-10, Forward Observer (A) IQ [2]-10, Gunner (any) (E) DX+2 [4]-14, Hiking (A) HT+1 [4]-12, Navigation (Land) (A) IQ [2]-10, and either Survival (any) (A) Per [2]-10 or Urban Survival (A) Per [2]-10.

Ranger (130 points): Increase IQ to 11 [20]; add Camouflage (E) IQ+2 [4]-13, Climbing (A) DX+1 [4]-13, Electronics Operation (any) (A) IQ [2]-11, Forward Observer (A) IQ [2]-11, Gunner (any) (E) DX+2 [4]-14, Hiking (A) HT+1 [4]-12, Navigation (Land) (A) IQ+1 [4]-12, Stealth (A) DX+1 [4]-13, and Survival (any) (A) Per+3 [12]-14.

Space Marine (95 points): Add Free Fall (A) DX+2 [8]-14, Spacer (E) IQ+2 [4]-12, Vacc Suit (A) DX+2 [8]-14, add one of the following: G-Experience 5 [5], Immunity to Space Sickness [5] or Improved G-Tolerance 1 [5].

Elite Trooper (+60 points): Increase ST by 1 [10], DX by 1 [20], and IQ by 1 [20], increase Will by 1 [5], improve Soldier skill to IQ+3 [4], add Savoir-Faire (Military) (E) IQ [1]-11.

Officer (+55 points): Increase IQ by 1 [20]; raise Rank by 3 [15]; add Administration (A) IQ+1 [4]-12, Law (Military) IQ-1 [2]-10, Leadership (A) IQ+1 [4]-12, Savoir-Faire (Military) (E) IQ+1 [2]-12, Tactics (H) IQ+1 [8]-12.

Veteran (+40 points): Increase IQ by 1 [20], add either Danger Sense or Luck [15], increase Soldier skill to IQ+3 [4], increase Scrounging to Per+1 [1].

* Multiplied for self-control number; see p. B120.

Space Knight

150 points

You're an elite warrior, trained with secret martial arts and equipped with super-technology to be a defender of galactic society. More than a mere soldier, you fight for honor and out of a sense of duty to all sentient life. The exact nature of your training depends on the weapons available, but whatever they are, you're a master.

Attributes: ST 11 [10]; DX 13 [60]; IQ 12 [40]; HT 11 [10].

Secondary Characteristics: Damage 1d-1/1d+1; BL 24 lbs.; HP 11 [0]; Will 12 [0]; Per 12 [0]; FP 11 [0]; Basic Speed 6 [0]; Basic Move 6 [0].

Advantages: Social Regard (Feared or Respected) 2 [10] or Status 2 [10], and 30 points chosen from



among Ambidexterity [5], Combat Reflexes [15], Danger Sense [15], Fit or Very Fit [5 or 15], High Pain Threshold [10], Luck [15], Rank 1-2 [5-10], Rapid Healing [5], Trained by a Master [30], Weapon Master (Knights Weapons) [30], +1 to ST or HT [10], +1 to +5 to HP [2-10], and +1 to +4 to Per [5-20].

Disadvantages: Either Code of Honor (chivalrous) [-15] or Duty (to Order, 15 or less) [-15], and -20 points chosen from among adding Extremely Hazardous to Duty [-5], Fanaticism [-15], Flashbacks (Mild) [-5], Gullibility [-10*], Honesty [-10*], Impulsiveness [-10*], Overconfidence [-5*], Pacifism (Cannot harm innocents) [-10], Selfless [-5*], Sense of Duty (Nation or All Life) [-10 or -15], Truthfulness [-5*], Vow [-5 to -15].

Primary Skills: Any two of the following: Battlesuit (A) DX+1 [4]-14, Broadsword (A) DX+1 [4]-14, Driving (any) (A) DX+1 [4]-14, Force Sword (A) DX+1 [4]-14, Gunner (any) (E) DX+2 [4]-15, Judo (H) DX [4]-13, Karate (H) DX [4]-13, Piloting (spacecraft type) (A) DX+1 [4]-14, Rapier (A) DX+1 [4]-14.

Secondary Skills: Beam Weapon (Pistol) (E) DX+1 [2]-14,

Electronics Operation (any) (A) IQ [2]-12, Law (Galactic) (H) IQ [4]-12, Leadership (A) IQ [2]-12, Navigation (any) (A) IQ [2]-12, Savoir-Faire (Dojo, High Society, or Military) (E) IQ [1]-12, Stealth (A) DX [2]-13

Background Skills: Computer Operation (E) IQ [1]-12, First Aid (E) IQ [1]-12.

* Multiplied for self-control number; see p. B120.

Space Worker

75 points

Some people explore space, and some people just work there. They build space colonies, mine asteroids, salvage wrecked spaceships, and do all the other tough jobs the star pilots and eggheads are too busy for. Space workers can be independent prospectors or salvagers; or they can get a regular paycheck.

Attributes: ST 11 [10]; DX 11 [20]; IQ 11 [20]; HT 11 [10].

Secondary Characteristics: Damage 1d-1/1d+1; BL 24 lbs.; HP 11 [0]; Will 11 [0]; Per 11 [0]; FP 11 [0]; Basic Speed 5.5 [0]; Basic Move 5 [0].

Advantages: G-Experience (choose gravity) [1], Immunity to Space Sickness [5], and two of: +1 Per [5], Fit [5], Improved

G-Tolerance [5], Rapid Healing [5], Single-Minded [5].

Disadvantages: A total of -35 points from among: Addiction (cheap, legal stimulant or tobacco) [-5], Debt 5 [-5], Honesty [-10*], Loner [-5*], Miserliness [-10*], Pacifism (Reluctant Killer) [-5], Post-Combat Shakes [-5*], Sense of Duty (work crew) [-5], Shyness (Mild) [-5], Stubbornness [-5], Struggling [-10], Truthfulness [-5*], Workaholic [-5].

Primary Skills: Free Fall (A) DX+2 [8]-13, Vacc Suit (A) DX+2 [8]-13.

Secondary Skills: Any three of: Electrician (A) IQ+1 [4]-12, Explosives (Demolition) (A) IQ+1 [4]-12, Freight Handling (A) IQ+1 [4]-12, Hazardous Materials (any) (A) IQ+1 [4]-12, Machinist (A) IQ+1 [4]-12, Mechanic (system type) (A) IQ+1 [4]-12, Prospecting (A) IQ+1 [4]-12.

Background Skills: Brawling (E) DX [1]-11, Carousing (E) HT [1]-11, First Aid (E) IQ [1]-11, Piloting (spacecraft type) (A) DX-1 [1]-10, Scrounging (E) Per [1]-11, Spacer (E) IQ [1]-11.

* Multiplied for self-control number; see p. B120.

Technician

55 points

Just about everyone in a SF setting can use the advanced devices available, but technicians are the ones who understand how they work, and can repair, improve, or build them. Contemporary stereotypes assume all technicians are geeky and shy, but in some settings being a tech wizard could be glamorous. This template is fairly low-priced in order to allow players to combine it with others.

Attributes: ST 10 [0]; DX 10 [0]; IQ 11 [20]; HT 10 [0].

Secondary Characteristics: Damage 1d-2/1d; BL 20 lbs.; HP 10 [0]; Will 11 [0]; Per 11 [0]; FP 10 [0]; Basic Speed 5 [0]; Basic Move 5 [0].

Advantages: Choose 20 points from among: Artificer 1-2 [10-20], Eidetic Memory [5], Gizmos [5-15], High Manual Dexterity 1

-2 [5-10], Intuitive Mathematician [5], Lightning Calculator [2], Mathematical Ability [10], Security Clearance [5], Serendipity [15], Single-Minded [5], Versatile [5] or +1 to +2 Per [5-10].

Disadvantages: A total of -10 points from among: Addiction (cheap, legal stimulant or tobacco) [-5], Absent-Mindedness [-15], Clueless [-10], Code of Honor (professional) [-5], Combat Paralysis [-15], Curious [-5*], Gullibility [-10*], Honesty [-10*], Indecisive [-10*], Loner [-5*], Miserliness [-10*], Overconfidence [-5*], Pacifism (Reluctant Killer) [-5], Post-Combat Shakes [-5*], Shyness (Mild or Severe) [-5 or -10], Stubbornness [-5], Truthfulness [-5*], or Workaholic [-5].

Primary Skills: Any two of: Armoury (any), Electrician, Electronics Repair (any), Explosives (any), Lockpicking, Machinist, or Mechanic (any) – all are (A) IQ+2 [8]-13, or Computer Programming (H) IQ+1 [8]-12.

Secondary Skills: Electronics Operation (any) (A) IQ [2]-11, Hazardous Materials (any) (A) IQ [2]-11, and either NBC Suit (A) DX [2]-10 or Vacc Suit (A) DX [2]-10.

Background Skills: Computer Operation (E) IQ [1]-11, First Aid (E) IQ [1]-11, Scrounging (E) Per [1]-11.

Inventor (100 points): Increase IQ to 12 [20]; add Gadgeteer [25].

* Multiplied for self-control number; see p. B120.

Thief

75 points

Crime won't go away just because humans travel to the stars, but the crooks will have to get more clever to defeat high-tech locks and security systems. Famous thieves in SF include Slippery Jim diGriz, or the crack team of operatives in Iain M. Banks' *Against a Dark Background*. Cyberpunk SF introduced a new kind of thief, the cyberspace decker, a freelance hacker who steals information or money.

Attributes: ST 10 [0]; DX 11 [20]; IQ 12 [40]; HT 10 [0].

Secondary Characteristics: Damage 1d-2/1d; BL 20 lbs.; HP 10 [0]; Will 12 [0]; Per 12 [0]; FP 10 [0]; Basic Speed 5.25 [0]; Basic Move 5 [0].

Advantages: 20 points' worth from among: Alternate Identity (illegal) [15], Artificer 1-2 [10-20], Daredevil [15], Gizmos [5-15], High Manual Dexterity 1-2 [5-10], Luck [15], Serendipity [15], Single-Minded [5], Versatile [5], +1 to +2 Per [5-10], or Zeroed [10].

Disadvantages: A total of -30 points from among: Addiction (cheap, legal stimulant or tobacco) [-5], Callous [-5], Cowardice [-10*], Greed [-15*], Jealousy [-10], Laziness [-10], Loner [-5*], On the Edge [-15*], Overconfidence [-5*], Pacifism (Reluctant Killer) [-5], Paranoia [-10], Post-Combat Shakes [-5*], Reputation (crook) [varies], Secret [-5 or -10], Selfish [-5*], Slow Riser [-5], Social Stigma (Criminal Record) [-5], Struggling [-10], or Trademark [-5 to -10].

Primary Skills: Any two of: Electronics Operation (Security) (A) IQ+2 [8]-14, Electronics Repair (Security) (A) IQ+2 [8]-14, Explosives (Demolition) (A) IQ+2 [8]-14, Forced Entry (E) DX+3 [8]-14, or Lockpicking (A) IQ+2 [8]-14.

Secondary Skills: Any three of: Acting (A) IQ [2]-12, Beam Weapons (Pistol) DX+1 [2]-12, Disguise (A) IQ [2]-12, Driving (any) DX [2]-11, Fast-Talk (A) IQ [2]-12, Forgery (H) IQ-1 [2]-11, Guns (Pistol) (E) DX+1 [2]-12, Law (region, criminal) (H) IQ-1 [2]-11, Merchant (A) IQ [2]-12, Stealth (A) DX [2]-11.

Background Skills: Computer Operation (E) IQ [1]-12, Streetwise (A) IQ [2]-12.

Cyberspace Thief (75 points): Change primary skills to Computer Hacking (VH) IQ+1 [12]-13 and Computer Programming (H) IQ [4]-12.

* Multiplied for self-control number; see p. B120.

BIBLIOGRAPHY

NONFICTION

Asimov, Isaac. *The Universe* (Avon, 1966). Clear, readable survey of science by an SF writer. Dated, but still very informative.

Asimov, Isaac. "Not As We Know It" in *View From a Height* (Avon, 1963). One of the few studies of possible alien biochemistries.

Bova, Ben, and Lewis, Anthony R. *Space Travel* (Writer's Digest Books, 1997). A handy guide to space drives, orbits, and delta-V for aspiring SF writers.

Bretnor, Reginald (editor). *The Craft of Science Fiction* (Barnes & Noble Books, 1976). A collection of useful essays on creating SF settings and stories.

Carroll, Bradley W., and Ostlie, Dale A. *An Introduction to Modern Astrophysics* (Addison-Wesley, 1996). A solid introduction to how planets and stars work.

Clark, Stuart. *Life on Other Worlds and How to Find It* (Springer, 2000). Solid, readable introduction to astrobiology.

Clute, John, and Nicholls, Peter (editors). *The Encyclopedia of Science Fiction* (St. Martin's Griffin, 1995). Massive and massively useful overview of the entire field.

Cohen, Jack, and Stewart, Ian. *What Does a Martian Look Like?* (Wiley, 2002). Wide-ranging and interesting exploration of possible types of alien life, by a scientist who designs aliens for writers.

Cox, Arthur N. (editor). *Allen's Astrophysical Quantities*, Fourth Edition (Springer-Verlag, 2000). Highly useful encyclopedia of data and equations about the universe.

Darling, David. *The Extraterrestrial Encyclopedia* (Three Rivers Press, 2000). Another useful compendium of information about other worlds and star systems.

Diamond, Jared. *Guns, Germs, and Steel* (Norton, 1997). Examines the growth of civilizations and technology; very useful for anyone creating alien civilizations or alternate histories.

Dozois, Gardner, et al. (editors). *Writing Science Fiction and Fantasy* (St. Martin's, 1991). Another collection of

"how-to" essays, including an extremely useful piece by John Barnes on extrapolating future trends.

Feinberg, Gerald, and Shapiro, Robert. *Life Beyond Earth: The Intelligent Earthling's Guide to Life in the Universe* (Morrow, 1980). Fascinating if occasionally over-cute study of alien biology, which inspired a decade of SF stories by authors cribbing ideas.

Gillett, Stephen L. *World-Building* (Writer's Digest Books, 1996). Very useful guide to planet design.

Goldsmith, Donald, and Owen, Tobias. *The Search for Life in the Universe* (Cummings, 1980). Actually a basic science textbook, using the question of alien life as a unifying theme. Slightly dated, but a useful reference.

Henbest, Nigel, and Couper, Heather. *The Guide to the Galaxy* (Cambridge University Press, 1994). As the title says, a guide to the galaxy, with fairly up-to-date information and lots of maps.

Heppenheimer, T.A. *Colonies in Space* (Warner, 1977). A cheerleading book about O'Neill habitat colonies, somewhat dated now but a good source of ideas and background for space habitat settings.

Kaku, Michio. *Visions* (Anchor, 1998). An exciting look at future prospects in science and technology, by a theoretical physicist.

Langford, David. *War in 2080* (Morrow, 1979). Study of possible future evolution of weapons and defenses, from a strictly hard-SF perspective. Some of its predictions have been overtaken by events.

McGowan, Christopher. *Dinosaurs, Spitfires, and Sea Dragons* (Harvard University Press, 1991). Interesting study of animal size and engineering, very useful for its information on flight and locomotion.

Regis, Ed. *Great Mambo Chicken and the Transhuman Condition* (Perseus Books, 1990). Fun, irreverent guide to transhumanism, space colonization, nanotech, cryonics, and general wackiness.

Sagan, Carl, and Shklovskii, I.S. *Intelligent Life in the Universe* (Dell, 1966). Very dated now, but this was the first scientific study of the topic in half a century.

Schmidt, Stanley. *Aliens and Alien Societies* (Writer's Digest Books, 1995). A nuts-and-bolts "how-to" guide for aspiring SF writers.

Vogel, Steven. *Life's Devices* (Princeton, 1988). An introduction to the mechanical engineering of living things, essential for designing alien life.

Zuckerman, Ben, and Hart, Michael H. (editors). *Extraterrestrials: Where Are They?* (Cambridge University Press, 1995). Wide-ranging collection of pieces on SETI, alien intelligence, methods of star travel, interstellar colonization, and terraforming.

FICTION

Many of these works are classics which have gone through dozens of editions. Publishers and dates listed are for the most recent versions.

Comedy

Adams, Douglas. *The Hitchhikers Guide to the Galaxy* (Ballantine, 1995). The first book in a series of very popular SF comedies.

Ford, John M. *How Much for Just the Planet?* (Pocket Books, 1999). A slapstick *Star Trek* novel which generates very strong reactions from readers.

Crime and Mysteries

Bester, Alfred. *The Demolished Man* (Vintage, 1996). Murder mystery set in a society of telepaths.

Delany, Samuel R. "Time Considered as a Helix of Semi-Precious Stones." This novella won the Hugo and Nebula awards in 1969, but still seems fresh and cutting-edge more than 30 years later.

Gibson, William. *Neuromancer* (Ace, 1995). Hugo and Nebula winning novel which was the template for much cyberpunk to come. It has two sequels, *Count Zero* and *Mona Lisa Overdrive*.

Niven, Larry. *The Long ARM of Gil Hamilton* (Del Rey, 1977). A collection of stories about a future policeman battling organleggers and technological criminals.

Hard Science Fiction

Benford, Greg. *In the Ocean of Night* (Warner Aspect, 2004). First volume of

an epic series following humans trying to survive in a galaxy dominated by hostile machine intelligences.

Bova, Ben. *Privateers* (Eos, 2000). Red-blooded entrepreneurial adventure, an example of the technothriller genre in space.

Clarke, Sir Arthur C. *The Fountains of Paradise* (Warner Aspect, 2001). Heroic Engineering at its finest, as the protagonist struggles to build a space elevator.

Clarke, Sir Arthur C. *Rendezvous With Rama* (Bantam, 1990). One of the great First Contact stories and a seminal Big Dumb Object novel as well. Human astronauts explore a vast alien ship which has entered the Solar System. Avoid all sequels.

Forward, Robert. *Dragon's Egg* (Del Rey, 2000). Following a suggestion by Shapiro and Feinberg (see above), this novel examines life on a neutron star.

Heinlein, Robert. *The Moon Is a Harsh Mistress* (Orb, 1997). Lunar colonists rebel against a tyrannical Earth, aided by an AI computer.

Landis, Geoffrey. *Mars Crossing* (Tor, 2001). Astronauts struggle for survival on Mars after their ship is crippled. Landis is also a NASA scientist.

Robinson, Kim Stanley. *Red Mars* (Bantam Spectra, 1993). First volume of a trilogy (*Red Mars*, *Green Mars*, *Blue Mars*) chronicling the terraforming of Mars and the new society which develops there.

Steele, Allen. *Orbital Decay* (Warner Books, 1990). Gritty stories of life among blue-collar workers building space habitats.

Sterling, Bruce. *Schismatrix Plus* (Ace, 1996). A novel and short stories set in a hard-SF world of genetic engineering, cybernetic enhancement, and space colonization.

Varley, John. *Red Thunder* (Ace, 2003). Amazingly talented teenagers build a miraculous rocket in a Florida warehouse.

Military SF

Haldeman, Joe. *The Forever War* (Eos, 2003). Perhaps it would be better to call this anti-military SF, as its depiction of a slower-than-light interstellar war is vicious in its condemnation of military stupidity.

Heinlein, Robert. *Starship Troopers* (Ace, 1987). The seminal work of military SF, chronicling one soldier's life in

the armored Mobile Infantry as they fight an interstellar war. Avoid the film.

Pournelle, Jerry. *Mercenary* (Baen, 1986). A mercenary commander fights for the collapsing CoDominium.

Saberhagen, Fred. The "Berserker" series. A long-running series of books and stories about humans battling implacable robots programmed to destroy all life.

Weber, David. *On Basilisk Station* (Baen Books, 2002). The first of the long-running "Honor Harrington" series of space opera war stories with a strong flavor of Nelson's navy.

Wells, H.G. *The War of the Worlds* (Tor, 1993). The original alien invasion story, and still the greatest. First published in 1898.

Planetary Romance and Big Dumb Objects

Brackett, Leigh. *The Book of Skaith* (Doubleday, 1976). Tough guy Eric John Stark penetrates the mysteries of the dying planet Skaith.

Niven, Larry. *Ringworld* (Del Rey, 1985). One of the original Big Dumb Objects, *Ringworld* inspired several sequels and a Chaosium roleplaying game.

Vance, Jack. *Planet of Adventure* (Orb, 1993). The four Tschai novels are classic Planetary Romance, and the stories inspired *GURPS Planet of Adventure*.

Varley, John. *Titan* (Berkeley, 1984). First of a trilogy of novels exploring the giant sentient space habitat Gaea, orbiting Saturn.

Space Opera

Banks, Iain M. *The Player of Games* (HarperCollins, 1997). One of several novels set in "The Culture," a spaceborne transhuman civilization. The best of the new wave of "postmodern space opera" from the UK.

Brin, David. *Sundiver* (Spectra, 1985). The first of the "Uplift" series, chronicling humanity's struggle to survive in a galaxy of ancient civilizations which uplift other species to sentience. Inspired *GURPS Uplift*.

Bujold, Lois McMaster. *Shards of Honor* (Baen, 1991). The first of her ongoing Barrayar series, chronicling the adventures of Cordelia Naismith and her son, Miles Vorkosigan. Unapologetic old-school space opera.

Herbert, Frank. *Dune* (Ace, 1996). Transformed the classic space opera

genre with a generous helping of mysticism and ecological awareness. Spawned several sequels by Herbert and a recent series by his son; quality varies.

Niven, Larry, and Jerry Pournelle. *The Mote in God's Eye* (Pocket Books, 1991). Excellent fusion of space opera and first-contact story; the sequel is much less successful.

Resnick, Mike. *Santiago* (Tor, 1992). Bounty hunters and space pirates on the lawless Galactic frontier. Resnick has written many other books and stories using the same general setting.

Reynolds, Alastair. *Revelation Space* (Ace, 2002). The first of a loosely-connected series of novels exploring nanotech plagues, ancient alien civilizations, and crazed starship captains. Postmodern hard-SF space opera.

Smith, E.E. *Triplanetary* (Old Earth Books, 1997). The first book in the "Lensman" series. The ultimate Golden Age space opera series, with all its faults and virtues turned to 11. Inspired the book *GURPS Lensman*.

Wright, John C. *The Golden Age* (Tor, 2003). Space opera set 10,000 years in the future, when humans have godlike powers.

FILM

Aliens (James Cameron, 1986). Straddling the border between action and horror, this film features Marines battling alien predators on a distant world.

Blade Runner (Ridley Scott, 1982). The cyberpunk film, based on the Philip K. Dick novel *Do Androids Dream of Electric Sheep?* Tells of a future cop hunting rogue androids.

Star Wars (George Lucas, 1977). The original film is now Episode 4 in the series, which has proved markedly uneven in quality. One of the most successful films in history.

TELEVISION

Babylon 5 (Warner, 1993-98). Excellent old-school space opera, centered on a vast space habitat.

Firefly (Fox, 2002). A short-lived but superb spaceship drama, with clear Old Western inspiration.

Star Trek (Paramount, 1966-69). The original series has spawned nine films and four more television series. For most non-fans, this is what science fiction is.

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