

STAR HERO
2nd Edition, Second Draft
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INTRODUCTION<SECTION-HEADER>

"Command to search party," said Captain Bohannon. "Have you found it, Hodge?"

"We're on Deck Six, Adrienne," said the ship's security chief. "We don't have a visual, but it's easy to track. It's leaving a trail of bodies covered in green --"

A piercing screech came over the intercom. "Hodge! Dammit, what's going on down there!?"

The search party couldn't hear her. They were clapping their ears in pain from the continuous shrieking. They were barely aware of the massive, furry tentacles reaching for them now.

Only Ensign Cink-Yoi could react. Holding one hand over each ear, he tossed a stun grenade with his remaining hand. The creature yelped at the explosion and fell back into a doorway. Cink-Yoi yelled "Computer! Shut that door!" and the bulkhead slammed closed.

Back on the bridge, Bohannon said "Did you hear that? That's an Arcturian Banshee! The only thing more illegal than killing them is transporting them! Who brought it on board?"

"We did," said First Officer Castillan. "I've been tracking it. It must have come out of Cargo Hold 2."

"Ischigarg!" said Bohannon. "He did this. He hid that thing in our cargo so we'd do his smuggling for him!"

"Calm down, boss," said Castillan. "They've trapped it in the airlock. Once we space it, who's to know?"

"This is Lieutenant Stone of the Galactic Corps," blared the radio. "We've received your distress call and we're at your airlock..."

WHAT IS A STAR HERO?<C-HEADER>

Welcome! This Campaign Book contains the Hero System rules and source material for the genre of science fiction. A Star Hero is anyone in science fiction, the literature of ideas. In Star Hero, you can be an asteroid miner, an alien telepath, a cybernetic bounty hunter. You can visit underwater cities, dingy space stations, and mysterious black nebulae. You can sip Capellan ginbeer, dance through hyperspace, and set your disintegrator rifle to maximum.

HOW TO USE THIS BOOK<C-HEADER>

This is a supplement to the Hero System Rulebook, not a complete game. If you have the Champions rulebook (4th edition) instead, that also contains the complete Hero System rules. It is hoped that you will use this supplement to run a Hero System Star Hero campaign. If this is the case, the Gamemaster should naturally read the entire book. Players should read the Character Creation, Combat, and Technology Sections and may read everything else if the Gamemaster doesn't indicate otherwise (the sample scenarios, for example, may be off limits). The Gamemaster should then turn to the checklist in the Campaigning section to start building his campaign, and the players should proceed with character design.

There are other ways to use this book, however. Characters and technology from this book may be used in a Champions campaign, and races or worlds designed with these guidelines may be encountered by superheroes. Crossover campaigns or scenarios may use these rules along with Cyber Hero, Fantasy Hero, Western Hero, or other Hero System genre book -- see "Crossover Campaigns".

WHAT'S INSIDE<C-HEADER>

Inside this book, the Genre section lays the ground rules for what Star Hero is about. It defines the campaign styles and character types that are typical of science fiction, as well as the sf component of multi-genre crossover campaigns.

The Campaigning section explains step by step the procedures for building a science fiction campaign. This includes the usual steps of choosing tone, realism, and morality, but also such genre-specific decisions as technology level, alien races, and the history of the future. New genre rules pertaining to science fiction are in this section. A few sample creatures are included, but space limitations require us to postpone a more comprehensive collection until later supplements.

The Character Creation section explains how character abilities and Characteristics are used differently in Star Hero from the standard description in the Hero System Rulebook. Some abilities have expanded uses. Powers and a very few Skills or

Talents may not be allowed by the Gamemaster, as explained in the text. If the Gamemaster wishes to allow certain unusual character types, rules are included for designing psionics, aliens, and artificial beings.

The Combat section presents rules for handling new combat situations that will come up in a science fiction setting, including piloting spaceships, fighting other spaceships, and coping with alien anatomies.

The Technology Sourcebook and the Space Sourcebook provide the elements of setting -- weapons and devices, stars and planets, environments and civilizations.

ACKNOWLEDGEMENTS<B-HEADER>

Sam Bowne and Paula Woods for Star Hero First Edition. The character archetypes were written by Craig Knight. The zero-gravity combat rules were developed by Aaron Allston for Ninja Hero. The Power Advantage, Variable Lethality was invented by David Breuning and Jennifer Williamson. Doug Clowe and Tony Dobro reviewed the astronomy.

Playtesters (round one)<E-HEADER>

Ron Glass, Mike Hernandez, Craig Knight, Ken Leon, Will Tharp

Playtesters (round two)<E-HEADER>

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John Keller, John Brown, Melissa Reed, John Conlon, Mike martin, Judy Whittle, Patti Norwood

Donald McKinney

THE SCIENCE FICTION GENRE<SECTION-HEADER>

Science fiction is the genre of interesting places and situations. It is the genre of choice for players who want to leave boring old Earth behind, rewrite history, or abandon the human race altogether. A Star Hero campaign should work best with players who want to play "What If?" with setting and society. Having said this, Star Hero admittedly concentrates on space travel and alien races. Future Earth, time travel, and alternate dimensions, which are all a part of science fiction, are much less well represented. Perhaps other genre books will follow.

STORY TYPES<A-HEADER>

Science fiction starts with the story. All classical story types are possible in sf role-playing, sometimes with characteristic twists. Following are some of the story formats that the Gamemaster can choose. Some of these are categorized by the type of plot, some by tone, and some by internal elements.

MAN AGAINST MAN<D-HEADER>

Story requires conflict, and the basic conflict is people vs. people. Within a game, the Player Characters could be traders fighting a rival merchant, fugitives fleeing a bounty hunter, or gamblers looking for a mark. In science fiction, there are other possibilities as well. Man against Man is supplemented by Man against Alien, Man against Sentient Machine, and so on. Adversaries in a Star Hero plot may have motivations or behavior patterns that would never be held by a human being.

MAN AGAINST SOCIETY<D-HEADER>

This story format pits the Player Characters against the customs and laws of society. This includes bureaucratic tangles, legal problems, and social demands. Customs and laws among the stars may take any form that generates story potential.

MAN AGAINST NATURE<D-HEADER>

Man against Nature comes into its own when the life support system fails. As other possibilities, how do the Player Characters handle a rogue asteroid, an alien epidemic, or a search-and-rescue?

SCIENCE PUZZLE<D-HEADER>

A common story in science fiction is the science puzzle, as for example, why did a particular colony fail? A science puzzle can also be a minor story element that fits into a larger picture, as when talking with aliens requires figuring out how they communicate among themselves.

CONFLICT RESOLUTION<D-HEADER>

Conflict resolution is usually a simple bashing-of-heads, but it can be more subtle when the conflict is over ideas.

PROCEDURAL<D-HEADER>

A procedural story focuses on the step-by-step of how things get done. The paradigm is a trial in which the Player Characters or someone else has to prove his innocence. On a planet heavy with bureaucrats, buying a box of fuses for the autodoc can also turn into a whole procedural story.

WHODUNIT<D-HEADER>

Given the campaign existence of psionics, other alien abilities, and advanced technology, a whodunit requires some care. Players investigating a crime must be informed by the Gamemaster of anything relevant in these areas. Of course, an odd use for a future device can form the basis of a crime, and the Gamemaster doesn't need to spell things out precisely, as long as the PCs have enough information to go on.

DRAMA<D-HEADER>

Drama is a role-playing story. Character interactions are emphasized. For example, a character and her sister live out the twin paradox (see "Relativity").

TRAGEDY<D-HEADER>

This is a form of drama in which a character meets his downfall because of personal flaws. A tragedy should explore Character Disadvantages, particularly Psychological Limitations, and

test them in a tense situation. DNPCs and Hunteds can be the subject of tragedy as readily as the Player Characters.

COMEDY<D-HEADER>

Comedy is appropriate relief between serious stories. Sometimes comedy in the role-playing context is unscheduled, as when a failed Skill Roll leads to inconvenience and additional challenges. Or, deliberate comedy can be built into a society or alien race.

ALLEGORY AND FABLE<D-HEADER>

Allegories and fables have a larger symbolic meaning. This may make no difference to the Player Characters, but the actual players may enjoy an added layer of richness. In an allegory, the characters and situations symbolize more general truths, besides being themselves. A fable teaches a larger lesson. The easiest way to do either kind of story is to steal from another source and change the details. For example, Aesop's ant and grasshopper can become two planets facing a future disaster.

CONVENTIONS OF SCIENCE FICTION<A-HEADER>

This section presents story elements that turn the Hero System into Star Hero. Science fiction has a multitude of sub-genres, many of which are described below. The Gamemaster can scan the list, or he may have a particular approach in mind already. Alternatively, some discussion is given of crossover campaigns to, for example, combine Star Hero with Champions. These choices will all dominate the style of campaign. This section also lists some typical bits and plot elements commonly found in science fiction. Even a Gamemaster who knows what to present overall may find something of them to include for flavor. When making such choices, however, the Gamemaster should also solicit input from his players and see what kind of game they want to play in.

SUB-GENRES<B-HEADER>

The varieties or sub-genres of science fiction are many. Following is hardly an exhaustive list of the kinds of Star Hero that can be played, but it is a good variety. Additional possibilities may be found in the next section on Crossover Campaigns.

POST-HOLOCAUST<C-HEADER>

DESCRIPTION<D-HEADER>

The Earth has been ravaged by thermonuclear war, plague, or alien invasion. The Player Characters attempt to survive and rebuild civilization while avoiding cannibals, mutant animals, and surviving aliens. Optionally, this kind of campaign can be set on a colony world that failed, the PCs being some of the few survivors.

CHARACTERISTICS<D-HEADER>

Morality: not Black and White; Dramatic Realism: Realistic to Very Realistic; Outlook: Pessimistic; Attitude: Serious or Grim; Scientific Realism: Plausible; Continuity: any style. Tech Level is mostly Medieval with some remnants of Modern to Advanced.

EXAMPLES<D-HEADER>

The Postman by David Brin, Lucifer's Hammer by Larry Niven & Jerry Pournelle, Mad Max movie trilogy.

WAR/ESPIONAGE<C-HEADER>

DESCRIPTION<D-HEADER>

The characters are members of the Space Navy and there's a war on, or the characters work for an intelligence organization prior to or during an interstellar war. The enemy may be human colonies revolting against Earth or it could be an alien star empire.

CHARACTERISTICS<D-HEADER>

Morality: any; Dramatic Realism: Realistic to Very Realistic; Outlook: Optimistic unless the war is going badly; Attitude: Action-Adventure or Serious; Scientific Realism: Appropriate; Continuity: usually Serial or Long Stories. Any Tech Level is appropriate.

EXAMPLES<D-HEADER>

Starship Troopers by Robert Heinlein, The Forever War by Joe Haldeman, Lensman series by E. E. Smith, The Man-Kzin Wars books

edited by Larry Niven, Star Wars movies.

NEAR-FUTURE<C-HEADER>

DESCRIPTION<D-HEADER>

This is the exploration and development of the Solar System before any interstellar flight. The characters may actually be exploring unknown portions of the outer system or they may have some job such as mail delivery or search and rescue within the inner system.

CHARACTERISTICS<D-HEADER>

Morality: any; Dramatic Realism: Neutral to Very Realistic; Outlook: Very Optimistic to Optimistic; Attitude: any; Scientific Realism: Appropriate to Real Science; Continuity: any. Tech Level is Modern to early Advanced.

EXAMPLES<D-HEADER>

The Men in the Mirror by Ross Rocklynne, Lucky Starr novels by Isaac Asimov, A Fall of Moondust by Arthur C. Clarke. Also see the NASA films for our various manned space missions.

CYBERPUNK<C-HEADER>

DESCRIPTION<D-HEADER>

This is near-future, confined to the Earth or Solar System. Society is economically stratified and the Player Characters will have plenty of contact with its underprivileged underbelly. Computer technology, software piracy, and cyborg body enhancement are emphasized.

CHARACTERISTICS<D-HEADER>

Morality: Shades of Grey; Dramatic Realism: Realistic to Very Realistic; Outlook: Pessimistic or worse; Attitude: Serious or Grim; Scientific Realism: Appropriate to Real Science; Continuity: any. Tech Level is Modern to Advanced. Cyborgs and artificial characters are not only allowed, but common.

EXAMPLES<D-HEADER>

Neuromancer by William Gibson; Blade Runner movie, Max Headroom movie and TV series. Refer to the sub-genre book Cyber Hero.

SPACE OPERA<C-HEADER>

DESCRIPTION<D-HEADER>

Space opera is a grand, sweeping melodrama about the exploration and conquest of space. Everything is portrayed on a large scale: ships, weapons, civilizations, emotions. This is the subgenre of mile-long spaceships and pangalactic empires.

CHARACTERISTICS<D-HEADER>

Morality: Black and White or Clear Cut; Dramatic Realism: Very Romantic to Romantic; Outlook: Very Optimistic to Optimistic; Attitude: any but Grim; Scientific Realism: Big Words Science; Continuity: any. Tech Level is high or super.

EXAMPLES<D-HEADER>

Lensman series by E. E. "Doc" Smith, Star Trek original TV series, Cyberiad stories by Stanislaw Lem, Cities in Flight series by James Blish.

EXPLORATION AND CONTACT<C-HEADER>

DESCRIPTION<D-HEADER>

In the days of mature interstellar space travel, the Player Characters operate at the fringes of explored space. They investigate unknown planets, contact new alien races, and try to survive when they encounter nasty surprises.

CHARACTERISTICS<D-HEADER>

Morality: Clear Cut to Little Distinction; Dramatic Realism: any; Outlook: Optimistic to Mixed; Attitude: any but Grim; Scientific Realism: Appropriate; Continuity: any. Tech Level is advanced to high. Alien races and FTL travel are given.

EXAMPLES<D-HEADER>

Hooded Swan series by Brian Stableford, various novels by Andre Norton, many novels set on a single unusual world, such as Mission of Gravity by Hal Clement.

CITY OF THE FUTURE<C-HEADER>

DESCRIPTION<D-HEADER>

This is advanced technology confined to Earth. It is usually a utopia or dystopia, but it can be given a balanced presentation. The emphasis is on the effects of advanced technology, for good or ill, on human lifestyle without addressing space travel.

CHARACTERISTICS<D-HEADER>

Morality: usually extreme; Dramatic Realism: Romantic (utopia) or Realistic (dystopia); Outlook: depends on society; Attitude: any; Scientific Realism: Fantasy to Appropriate; Continuity: Long stories to entirely serial. Tech Level is advanced or beyond. Space travel and aliens are nonexistent. Psions or artificial characters may exist.

EXAMPLES<D-HEADER>

The City and the Stars by Arthur C. Clarke, 1984 by George Orwell, Brave New World by Aldous Huxley, Logan's Run by William Nolan (though a bit of space travel does appear).

GALACTIC EMPIRE/EMPIRE OF MAN<C-HEADER>

DESCRIPTION<D-HEADER>

Humanity has spread among the stars and lives under one or many governments. Other races may share equally in this society or the galaxy may be entirely human. The distinction between this approach and Space Opera is mainly the degree of realism.

CHARACTERISTICS<D-HEADER>

Morality: Clear Cut or Crossover; Dramatic Realism: Romantic to Realistic; Outlook: Very Optimistic to Optimistic; Attitude: any; Scientific Realism: Appropriate; Continuity: any. Tech Level is advanced to high. Fast space travel is a must. Alien races may or may not exist.

EXAMPLES<D-HEADER>

Foundation series by Isaac Asimov, Uplift novels by David Brin, Humanx Space novels by Alan Dean Foster.

INTERSTELLAR TRADERS<C-HEADER>

DESCRIPTION<D-HEADER>

This subgenre is similar to Exploration and Contact except that the characters work within the perimeter of civilized space. Commonly, they operate a trading ship which they pay for by taking funny cargoes to odd destinations.

CHARACTERISTICS<D-HEADER>

Morality: Crossover to Shades of Grey; Dramatic Realism: any but Very Romantic; Outlook: Very Optimistic to Mixed; Attitude: often comedy; Scientific Realism: Appropriate to Plausible; Continuity: any. Tech Level is advanced or high. FTL travel is not necessary, but keeps the travel time down.

EXAMPLES<D-HEADER>

John Grimes novels by A. Bertram Chandler, Fusion comic book series.

PSIONICS<C-HEADER>

DESCRIPTION<D-HEADER>

Humanity among the stars is the backdrop. The key to this subgenre, though, is that psionically gifted humans are a small but critical component of society. Psions may be necessary as hyperspace pilots or navigators, interstellar communicators, or military tacticians. To an extent, psions take the place of superheroes in Champions. Consequently, they may be worshipped, despised, enslaved, or outlawed.

CHARACTERISTICS<D-HEADER>

Morality: Crossover to Shades of Grey; Dramatic Realism: Very Romantic to Neutral; Outlook: any; Attitude: Action-Adventure or Serious; Scientific Realism: Fantasy or Big Words; Continuity: any. Tech Level is Advanced or beyond. Psionics exist, of course, and some or all of the Player Characters should have these abilities.

EXAMPLES<D-HEADER>

Psion by Joan Vinge, Galactic Milieu novels by Julian May, The Rowan by Ann McCaffrey.

ALTERNATE EARTH<C-HEADER>

DESCRIPTION<D-HEADER>

This is modern or near-future role playing on an Earth with a different history, possibly even a different geography. Role playing in earlier time periods also qualifies.

CHARACTERISTICS<D-HEADER>

Morality: any; Dramatic Realism: Romantic to Realistic; Outlook: any; Attitude: Serious; Scientific Realism: Plausible; Continuity: Long Stories to Entirely Serial. Tech Level is modern or earlier. New history is required prior to the twentieth century.

EXAMPLES<D-HEADER>

Eden trilogy by Harry Harrison, SS/GB by Len Deighton.

DETECTIVE/MYSTERY<C-HEADER>

DESCRIPTION<D-HEADER>

This is the detective/police/mystery genre with a science fiction twist. The Player Characters operate a detective agency on a near-future Earth and may have to contend with robots, AIDs, or psions. They certainly have to contend with laser rifles and hovercars. This style of play can also be set in any other traditional science fiction location, such as an alternate Earth, a stellar empire, and so on.

CHARACTERISTICS<D-HEADER>

Morality: Black and White or Clear Cut; Dramatic Realism: any; Outlook: Optimistic; Attitude: any; Scientific Realism: Plausible to Real; Continuity: Episodic or mostly so. Tech Level is modern or as appropriate (the higher the technology, the harder mystery stories get to write).

EXAMPLES<D-HEADER>

Solar Pons stories by Frederick Pohl (?), Robot Detective novels by Isaac Asimov, Space for Hire by William Nolan (this is the comedy approach).

INVASION/REVOLT<C-HEADER>

DESCRIPTION<D-HEADER>

This is a particular form of war campaign in which humans of Earth are being invaded by aliens. Alternatively, the invasion was successful and the Player Characters are part of a revolt.

CHARACTERISTICS<D-HEADER>

Morality: Black and White; Dramatic Realism: Realistic or Very Realistic; Outlook: Pessimistic or worse; Attitude: Action-Adventure or Grim; Scientific Realism: Appropriate or Plausible; Continuity: Mostly Serial. Tech Level is modern, but the aliens are usually more advanced than the humans.

EXAMPLES<D-HEADER>

War of the Worlds by H. G. Wells, War Against the Chtorr series by David Gerrold, V TV series, Tripods TV series.

TERRAN COLONY<C-HEADER>

DESCRIPTION<D-HEADER>

Adventures in the sub-genre are set entirely on one human world, but it isn't Earth. Often this is a lost colony cut off from the rest of humanity, but it may simply be a world whose history isn't stated. The scenarios involve expanding the colonized area, dealing with the planet's wildlife, and sometimes negotiating with an indigenous intelligent race.

CHARACTERISTICS<D-HEADER>

Morality: Clear Cut or Crossover; Dramatic Realism: any; Outlook: Optimistic; Attitude: any; Scientific Realism: Appropriate or Plausible; Continuity: any, but a single big mystery or challenge may underlie the whole campaign. Tech Level is usually advanced. Space travel is either absent or not important. A complete planetary ecology should be designed for this kind of campaign.

EXAMPLES<D-HEADER>

The Right Hand of Dextra by David J. Lake, Pern novels by Ann McCaffrey.

ALIEN SOCIETY<C-HEADER>

DESCRIPTION<D-HEADER>

This is science fiction without humans, or if humans exist, it is presented from an alien point of view. The setting is generally the worlds visited by an expanding spacefaring race.

CHARACTERISTICS<D-HEADER>

See "Exploration and Contact" or any other sub-genre to be used. The Gamemaster must design an alien race in detail, including history and technology. This style of campaign is a real challenge.

EXAMPLES<D-HEADER>

Dragon's Egg by Robert Forward, The Gods Themselves by Isaac Asimov, Albedo comic book series (anthropomorphic animals).

CROSSOVER CAMPAIGNS<B-HEADER>

Star Hero is an ideal vehicle for a Hero System crossover campaign, one that combines science fiction with a few elements or the entirety of a second genre. Some promising possibilities are given below. It is also possible, though, to slip a crossover scenario into an otherwise straight campaign. The characters may, for one adventure, find themselves on a planet where magic works or in a dimension with different physical laws or visiting a Western Hero society.

GALACTIC SUPERHEROES<C-HEADER>

DESCRIPTION<D-HEADER>

This is Champions in space. The characters are superheroes within a stellar society. They travel from planet to planet fighting crime much as a traditional superhero group would patrol a city.

CHARACTERISTICS<D-HEADER>

This is a Superheroic campaign. The characters either have unusual powers or they have alien abilities that are the equivalent of superpowers. Tech Level is advanced or greater and opposing agents are so armed. Characters without FTL travel will need some form of interstellar transport. For characters without appropriate Life Support, the Gamemaster will have to decide what to do about pressure suits in combat: does damage pass through them or are they immediately destroyed by a hit? Use the Megahex scale in space when superbeings fight starships (and maybe always).

EXAMPLES<D-HEADER>

The Legion of Superheroes and Green Lantern comic book series.

TIME TRAVEL<C-HEADER>

DESCRIPTION<D-HEADER>

Player Characters are part of a time traveling organization or they have private ownership of a time vehicle. Most scenarios will take place in various eras of Earth's past. One popular format is for the characters to have to locate and thwart members of a rival (evil) time traveling organization.

CHARACTERISTICS<D-HEADER>

Continuity is Episodic or Mostly Episodic. Tech Level is advanced or high, disregarding the time travel technology itself. Rules for designing the various cultures of Earth's past may be found in other Hero System genre books. Time travel paradoxes are usually ignored to the extent that they affect the heroes, though history for everyone else may or may not be alterable.

EXAMPLES<D-HEADER>

Time Patrol stories by Poul Anderson, The End of Eternity by Isaac Asimov, Voyagers TV series, Quantum Leap TV series.

SCIENCE AND MAGIC<C-HEADER>

DESCRIPTION<D-HEADER>

For whatever reason, both science and magic exist in a society of the future. The setting is usually restricted to Earth plus various fantasy realms such as the fairy world. This sub-genre can also be approximated either with an appropriate style of psionics or by inventing a new branch of science that works like traditional magic.

CHARACTERISTICS<D-HEADER>

Use the "City of the Future" guidelines plus a magic system designed according to Fantasy Hero. Another possibility is to use the "Post-Holocaust" setting with magic having been rediscovered. Aliens from the stars do not exist, but elves and other traditional fantasy races may be included. Normally, technology and magic are equally strong so that, for example, a mystic shield will stop a blaster bolt.

EXAMPLES<D-HEADER>

Incarnations of Immortality and Apprentice Adept series by Piers Anthony, Magic, Inc. by Robert Heinlein; The Case of the Toxic Spell Dump by Harry Turtledove.

DIMENSION WARS<C-HEADER>

DESCRIPTION<D-HEADER>

Realms with entirely different physical laws exist side by side. This normally leads to strife and war. The different realms may be from alternate dimensions somehow abutting, or they may be distinct time periods, or the underlying reason may be technological.

CHARACTERISTICS<D-HEADER>

Effectively, societies representing two or more genres coexist. Player Characters may therefore be designed according to any of a number of Heroic level genre books. When characters cross into the realm of another genre, their unusual character abilities and advanced technology may or may not continue to work.

EXAMPLES<D-HEADER>

"Sidewise in Time" by Gordon Dickson, Well World novels by Jack Chalker.

SPACE WESTERN<C-HEADER>

DESCRIPTION<D-HEADER>

The culture of America's Old West lives on in some frontier star colony. Replace six-shooters with blasters, add a few aliens, and go to it. Some elements of the Western may also be found in a Post-Holocaust campaign.

CHARACTERISTICS<D-HEADER>

See Western Hero for the appropriate genre elements, but design the technology, setting, and races according to Star Hero.

EXAMPLES<D-HEADER>

Outland movie, Westworld movie.

CHARACTER TYPES<A-HEADER>

Science fiction allows for a wide variety of character types. This is certainly true in Star Hero, as demonstrated by the following list. Rules for building all of these may be found under Character Creation.

Any given campaign will admit only some of these kinds of character, of course, depending on the campaign assumptions. For example, androids and cyborgs imply a certain level of technology. Aliens and variant humans require well-developed space travel. Psionics is not suitable for a campaign with scientific realism.

HUMANS<D-HEADER>

A game universe doesn't have to contain humans, but it's convenient to include the baseline. Standard human characters may have Skills, Talents, and Perquisites, but no Powers.

VARIANT HUMANS<D-HEADER>

Variant humans have drifted genetically from standard human stock, usually for environmental reasons. Thus, a heavy gravity world, a freefall space colony, and an underground city may each be populated with a different kind of variant human. Variant humans are represented by a racial Package Deal, which may contain Powers.

ALIENS<D-HEADER>

Aliens are sentient races other than human. They can be as similar to or different from humans as the campaign warrants. Aliens have a racial Package Deal, and exceptional members may purchase additional Powers and Talents as well.

ARTIFICIAL BEINGS<D-HEADER>

Artificial characters include robots and androids, among others. They purchase Powers appropriate to what they can do.

CYBORGS<D-HEADER>

Cyborgs are usually humans with implanted equipment, represented by Powers with the Focus Limitation.

PSIONS<D-HEADER>

Psions are humans with peculiar abilities usually represented by Mental Powers.

CAMPAIGNING<SECTION-HEADER>

THE GAMEMASTER'S CHALLENGE<C-HEADER>

The Gamemaster in Star Hero is responsible for designing everything, and "everything" here means more than it does in most Hero System genres. The Gamemaster creates not only the campaign world, but potentially the entire universe. He designs the worlds, the races, the technologies, and the organizations that Player Characters will encounter. He gives suggestions on PC concepts and approves their final forms. And then, when all of this preliminary work is complete, he creates and runs every last scenario.

This is a daunting task, taken as a whole. Nevertheless, the billowing uncertainties of the campaign can be pinned down the way the Lilliputians pinned down Gulliver, one strand at a time. The following sections break down the tasks of designing and running a campaign into discrete manageable steps. Guidelines are given for creating a universe, populating it, and handling scenarios. The control sheets in Appendix C will also be of use and should be referred to. Additionally, if the Gamemaster has access to other Hero System genre books, such as Champions or Fantasy Hero, some of the Gamemastering advice therein is general enough to be useful here.

DESIGNING A CAMPAIGN<A-HEADER>

DESIGN CHECKLIST<B-HEADER>

To help the Gamemaster get started with a Star Hero campaign, here is a checklist of procedures. The rest of the Campaigning section expands upon these steps and gives examples, where appropriate. These steps do not necessarily have to be followed in the order given. The Gamemaster probably has certain notions of what he wants to do with selected aspects of the campaign, such as a particular tone, technology level, or plot focus. If so, then these elements can be filled in on the Campaign Ground Rules Sheet (see Appendix C) and the remaining entries on the checklist can be addressed in order.

Choose the Tone<E-HEADER>

Choose the degree of morality for the campaign, the level of dramatic realism, the outlook and attitude. Check the appropriate boxes on the Campaign Ground Rules Sheet.

Choose a Level of Scientific Realism<E-HEADER>

There is an entry for this choice on the Campaign Ground Rules Sheet.

Choose a Tech Level<E-HEADER>

Technology levels are defined in the Technology Sourcebook. The predominant Tech Level for the campaign is filled in on the Campaign Ground Rules Sheet.

Choose a Genre<E-HEADER>

The subgenre of science fiction to be played must be consistent with the campaign choices made previously. If the Gamemaster and players do not yet have a choice in mind, several traditional subgenres are explained below.

Design the Society<E-HEADER>

Creating the dominant society in the campaign involves several elements, as expanded upon below. The Gamemaster should identify the size of the society in terms of number of planets, etc., rough out a history back to the 20th century, and create some prominent organizations, places, technologies, and so on. A thumbnail sketch of this dominant society should be entered on the Campaign Ground Rules Sheet, and it should be described in fuller detail on a Society Control Sheet.

Design Major Races<E-HEADER>

Important alien races, human variants, and such exotics as cyborgs should be designed, particularly if they are to be available as Player Characters. Each race warrants a Package Deal and a Race Control Sheet. Advice on these races may be found in the sections on Alien Races and Artificial Characters.

Create Campaign Guidelines<E-HEADER>

Campaign Guidelines include details of what is and is not allowable for Player Characters in terms of Skills, power levels, and character backgrounds. These guidelines should be consistent with the genre, with the Package Deals for available races, and with future scenarios. Information is entered on the Campaign Ground Rules Sheet but may also have to be written down in greater detail. Players receive the guidelines.

Review Character Designs<E-HEADER>

This is a feedback step in which players tender proposed character concepts or first draft designs, and the Gamemaster reacts. The Gamemaster may modify or expand elements of the campaign in reaction to player wishes.

Design Specific Technologies<E-HEADER>

With character designs in place and approved, players will wish to purchase equipment. The Gamemaster must turn Tech Level and genre information into lists of specific existing hardware. Many examples are given in the Technology Sourcebook.

Approve Starting Characters and Begin<E-HEADER>

Naturally, the Gamemaster makes the final call on characters, including their equipment. The first scenario may be considered the final step of the design process and should introduce everybody to everybody else and the situation in general.

CAMPAIGN TONE<B-HEADER>

The campaign tone is a set of attitudes that the players have about the campaign universe and how sympathetic it is to their characters. Most subgenres of science fiction have a specific identifiable tone. If the Gamemaster wants to play one of these, then the tone is given. Otherwise, the Gamemaster must choose the individual elements that make up the campaign tone he will use. The elements of campaign tone are morality, dramatic realism, outlook, and attitude.

Campaign tone should greatly influence Player Character designs. For example, if morality is clearly black and white, most of the PCs should have heroic Psychological Limitations such as Code vs. Killing or Always Answers Appeals for Help. If the outlook is pessimistic, then relatively many of the PCs may have unpleasant, ugly personal histories.

Campaign tone is not a straitjacket. Once the Gamemaster has made a choice, then most of the scenarios should be consistent with that choice, but variety adds interest. An occasional comedy will make serious drama that much more intense. Alternatively, the Gamemaster can start with one choice and effect a slow change over the course of the campaign -- pessimism to optimism, for example.

MORALITY<C-HEADER>

The degree of morality in the campaign refers to how clear cut the choices are between good and evil. Are the Player Characters' opponents truly evil? Or are their deeds understandable, maybe even justifiable, and merely in opposition to PC goals? In a world with black and white or clear cut morality, the PCs may be forced to do something questionable or choose between two evils, but the players should feel uncomfortable and should expect later penalties for their actions. In a world with blurred morality, the PCs will expect to be rewarded for pragmatism and expediency, and the players should feel this is normal.

BLACK AND WHITE<D-HEADER>

In this style of play, the heroes are always heroic and the villains are always dastardly. Player Characters are expected to be heroes, and the few who slip a little are chided by their peers. Likewise, their opponents are always evil. Good deeds are always rewarded and bad ones will eventually be punished. This absolute degree of morality may easily be played as melodrama, in which emotions become close to absolute as well. Example: Lensman series by E. E. "Doc" Smith.

CLEAR CUT<D-HEADER>

Clear cut or mostly clear cut morality means that the PCs will normally be facing opponents whom they will want to stop. Most antagonists will be demonstrably evil, although some may be acting for personal survival, out of callousness, or from a similarly less reprehensible motivation. Incidental deeds by the PCs will not be rewarded or punished, but significant good or ill works will. Example: Star Trek: The Next Generation TV series.

CROSSOVER IN MORALITY<D-HEADER>

Crossover between good and bad means that the PCs are generally good with a few bad qualities. Likewise, their antagonists will have some redeeming features and may occasionally be encountered doing good. Occasional scenarios may force the characters to choose between two evils, but they will not be hit with karmic penalties later in the campaign. Example: The Stainless Steel Rat by Harry Harrison.

LITTLE DISTINCTION<D-HEADER>

If there is little distinction between good and bad, then the characters are a mixed bag. Characters have a mixture of qualities, but most of them are on balance good. The lot contains a few bad eggs, however. Characters will face a lot of scenarios in which no good can be done; the best they can do is extricate themselves from the situation. Nevertheless, it is generally understood that good is better than evil, if this is not readily apparent in practice. Example: The Four Lords of the Diamond novels by Jack Chalker.

SHADES OF GREY<D-HEADER>

The campaign has protagonists, but it doesn't really have

heroes. The morality of the characters is, on the average, little different from that of their antagonists or anyone else they meet. Heroic Player Characters are still permissible, but they are regarded as odd and quixotic, and they face an uphill struggle. Example: Mad Max trilogy of movies.

DRAMATIC REALISM<C-HEADER>

Dramatic realism in a campaign, or its opposite, romanticism, describes the relationship between cause and effect. In a realistic campaign, consequences are similar to those in the real world. For example, a character who gets lost in a desert will wander around for a while, find nothing of interest, and eventually die. In a romantic game, the favored consequences are those that further the story. A character lost in the desert will discover a forgotten civilization, a thieves' hideaway, or at least an oasis, and will expect eventually to be saved.

Characters will behave differently depending on the degree of realism. In a very realistic game, characters who are shot at will duck for cover and crawl away. Characters in a romantic game will take big chances to try to rescue hostages. The Gamemaster should decide which sort of behavior he wants to encourage. The degree of dramatic realism in the game should be similar to the degree of scientific realism, and may be related to the outlook of the campaign.

VERY ROMANTIC<D-HEADER>

In a Very Romantic campaign, intentions are always rewarded with results. If a character crashes through a glass window to attack the villain, he won't suffer a scratch. But, if he hurls that same villain through a window as punishment, the nefarious one's face may be scarred for life. Similarly, characters who wear garish uniforms and adopt outlandish titles (Solar Sally, Three-Gee Gordon) are respected rather than ridiculed. Good guys never ever die except in acts of ultimate sacrifice. Example: Flash Gordon.

ROMANTIC<D-HEADER>

A romantic campaign is like the Very Romantic campaign described above, but less extreme. Bold, dramatic schemes are likely to succeed over cautious, meticulous ones, but the difference is not absolute. Characters caught in a firefight can't simply charge the opponents, but will need the cover of some distraction. Heroic characters only die heroically, and rarely at that. Example: Star Wars movie trilogy.

NEUTRAL<D-HEADER>

In a dramatically Neutral or balanced campaign, Player Characters are best served by devising grand schemes to thwart their opponents, but they have to get the details right. For example, the characters may gain access to the villain by crashing their shuttle into his space cruiser, but any enemy crew or prisoners at the point of impact will die. Player Characters can generally only die from stupidity or very bad luck and will often be given one last chance to live. Example: Planet of the Apes movies.

REALISTIC<D-HEADER>

Characters in a Realistic campaign are encouraged to design plausible tactics to defeat their opponents. They must be careful in what they do, for the universe is a dangerous place. Anyone ejected from an airlock dies. However, the odds are tilted in the Player Characters' favor, if only slightly. Given an otherwise even situation, the good guys will beat the bad guys, although they may suffer losses. Example: Rama trilogy by Arthur C. Clarke.

VERY REALISTIC<D-HEADER>

A Very Realistic campaign is unforgiving. A character who steps into a nonfunctional grav lift will hit bottom and die. (Though this is not by fiat; the Gamemaster will roll dice and count BODY, and then the guy dies.) If the Player Characters are trying to track down a bad guy, they will have to do it the hard way, step by step. Informants will have to be found, possible hideouts should be scouted before being attacked, and dramatic license will not save the PCs if they underestimated the opposing forces. Example: Starship Troopers by Robert Heinlein.

OUTLOOK<C-HEADER>

Outlook refers to the campaign environment more than it does to individual Player Character experiences. If the outlook of society is pessimistic, there is probably a lot of strife and plenty for the heroes to set right. The effects of good deeds, however, may not last long. An optimistic society may have less wrong with it, but strangers will be more encouraging of the heroes, who will find it easier to develop a sense of triumph.

VERY OPTIMISTIC<D-HEADER>

If the world view is Very Optimistic, Non-Player Characters regard society as utopic. (Objectively, they may or may not be correct.) Most of the Player Characters should share this attitude as well. NPCs will expect all wrongs to be righted and PCs will believe that they can do this. Any good that the PCs do will have a lasting effect. If the society really is a utopia, however, major problems may be hard to think of. Example: Barbarella movie.

OPTIMISTIC<D-HEADER>

An Optimistic society knows that it has problems, but life slowly improves. Player Characters will encounter a few sources of evil or hardship and they will expect to be able to handle them. Example: The Moon is a Harsh Mistress by Robert Heinlein.

MIXED<D-HEADER>

If the outlook for the future is Mixed, life goes on. Difficulties are discovered, and some of them can be handled, but new problems maintain quality of life as it is. In a campaign with this sort of outlook, any lasting effects of the Player Character actions will be on a small scale. Example: John Grimes novels by A. Bertram Chandler.

PESSIMISTIC<D-HEADER>

When society is Pessimistic, there is usually a reason. Resources may be scarce, or good sapients may be dying in a war somewhere. Player Characters will find plenty to do, but their successes will have only local and temporary effect. Non-Player Characters will not be eager to help their efforts. Example: Dune by Frank Herbert.

VERY PESSIMISTIC<D-HEADER>

A Very Pessimistic society is probably a dystopia; that is, people despair for a reason. Disaster scenarios, post-holocaust worlds, and monster-hunting campaigns may fit this category. Player Characters will find few if any allies, but will be able to choose problems of any scale. Example: "A Boy and His Dog" by Harlan Ellison.

ATTITUDE<C-HEADER>

Attitude refers to the emotional content of scenarios, as opposed to their dramatic content. Favorite attitudes include comedy, seriousness, and action thrill. Whatever the most common attitude chosen by the Gamemaster, however, it should probably be varied from time to time to hold the players' interest.

COMEDY<D-HEADER>

Comedy has a lot of potential in science fiction, arising from silly gadgets, odd alien customs, and unfamiliar settings. Comedy should probably not be imposed on the players, but it may be what they want to do. Example: Retief novels by Keith Laumer.

LIGHT-HEARTED<D-HEADER>

A Light-Hearted campaign emphasizes humor and other good feelings while stopping short of slapstick. Normal scenarios that could be done seriously can be presented in a light vein without too much effort. For instance, if the characters have an old and unreliable ship to try to maintain, a failure of the air plant would be life-threatening and serious. But, if the food synthesizer started giving everything a licorice taste, that is Light-Hearted. Example: Callahan's Saloon stories by Spider Robinson.

ACTION-ADVENTURE<D-HEADER>

Action-Adventure emphasizes fast-paced events and player decisions. If the Player Characters have to spend game time searching for information, little actual time is devoted to role-playing the outcome, and the camera quickly cuts to the outcome. Example: James Bond movies.

SERIOUS<D-HEADER>

A Serious campaign presents challenges to the players in a respectful manner. Non-Player Characters behave as they might in real life. Often, failure by the Player Characters will have major consequences in people's lives. Example: Lucifer's Hammer by Larry Niven and Jerry Pournelle.

GRIM<D-HEADER>

In a Grim setting, life is nasty, people are nasty, situations are nasty. The outlook may be Pessimistic as well, or perhaps the Player Characters expect to be able to change things. Example: Aliens movie.

SCIENTIFIC REALISM<B-HEADER>

The question of scientific realism is unique to the science fiction genre. Champions most typically uses comic book science, Danger International probably uses real science, and in Fantasy Hero, the issue never arises. Scientific realism is distinct from dramatic realism. The former concerns, for example, what gun designs work. The latter determines whether someone dies when shot with said gun.

The authenticity of the science in the campaign will be determined by the sub-genre being played, if that has already been decided. It will also be influenced by the Gamemaster's own scientific training and what the players are interested in. However, certain concepts are obvious fantasy, and the characters may be presumed to know their science even if the players don't.

FANTASY<D-HEADER>

Fantasy makes no concessions to realistic science. This approach to a campaign can include obvious absurdities such as sailing ships in space, or it may combine magic with space travel. Example: Fantastic Planet movie.

BIG WORDS SCIENCE<D-HEADER>

In this style of campaign, fantastic notions are labeled with Big Words to give them a veneer of authenticity. Some forms of faster-than-light travel are described (if that is the right word) with Big Words. Example: Cities in Flight series by James Blish.

WHAT SEEMS APPROPRIATE<D-HEADER>

If the rule for scientific authenticity is Appropriateness, then the Gamemaster judges devices by how they fit with the prevailing Tech Level. Often, technology that is in the background of society without being described in detail is based on Appropriate science. Example: Star Trek: The Next Generation TV series.

PLAUSIBLE SCIENCE<D-HEADER>

Plausible science must be explained in terms of current knowledge, although, strictly speaking, it may violate current knowledge. A hand blaster is an example of plausible science if it is described convincingly ("broadband electromagnetic radiation") without the Gamemaster checking if its batteries can hold enough energy for more than one shot. Example: "Nerves" by Lester del Rey.

REAL SCIENCE<D-HEADER>

Real Science is just what it sounds like. Devices designed by the Gamemaster or players must adhere to known physical law. There is usually no faster-than-light travel at all in such a campaign, a truth that may itself lead to interesting scenarios. Most such campaigns are confined to the Solar System, although suspended animation, time dilation, or colony ships could all be used to travel between stars. Example: Marooned by Martin Caidin.

CREATING SOCIETIES<A-HEADER>

Potentially, the most interesting feature of science fiction is the strange societies. Any alien race and any human planet, or collection of planets, needs a culture. The combination of culture, its members, and its environment makes a society.

WHAT IS A CULTURE?<C-HEADER>

Speaking academically, a culture is the collection of activities undertaken by a people or race. The description of the culture details how activities are undertaken at particular times, at particular places, by particular members.

Sometimes, but uncommonly, two or more cultures will coexist. Usually, though, slaves and masters or workers and consumers or tree people and ground people are all part of the same culture. The distinction lies in how much they depend on each other for existence and whether they share the same set of beliefs and values. Distinct cultures will usually speak different languages, be physically separated, and interact with outsiders by choice rather than real need. There are exceptions and close calls, of course, and the main point is really to understand the cultural dynamics sufficiently.

DESIGNING SOCIETIES<B-HEADER>

This section describes the whys and hows of designing a society. The details are in the next section.

DESIGN GOAL<C-HEADER>

Any society is designed for a reason and to fill a need. Thus, what the Gamemaster finally comes up with had better answer that need. Here are some of the likely reasons for needing a society.

Long-term Campaign Feature<E-HEADER>

The society is a major part of the campaign and will be around long-term. It may be the Player Characters' home planet, for example, or it may be the main culture of the galactic empire. In this case, the society must be designed in particular detail with care to avoiding inconsistencies (see "Fitting it in").

Player Character Race<E-HEADER>

The society as a whole may not be used much in the campaign, but Player Characters may arise from it. Slightly less detail is needed than as for a long-term campaign feature. Obviously, a Package Deal will be necessary, and it should be reasonably compact. The culture of the society should encourage adventurers to appear. Counterexamples would be a race of cowards, or xenophobes, or a people who believe space travel is blasphemy. A PC out of such a culture would have to be a renegade or an aberant.

Story Need<E-HEADER>

The society is needed for a single story. Maybe the society is the setting for the adventure, or a kidnapped individual comes from there, or information can be gained there. Inconsistencies and lack of detail are more tolerable. If the Player Characters ever go back or if the players ask embarrassing questions, the society can be fleshed out at need. The salient point is that the society, as designed, must enable or enhance the story.

GETTING IDEAS<C-HEADER>

A society is a race and its culture in a particular environment. Ideas for alien races are found in the Character Creation section, and ideas for planets and such are treated in Space. Where does the idea for a culture come from?

AN EARTH CULTURE<D-HEADER>

A distinctive Earth culture, such as the Mongols or Polynesians, can be reused somewhere else. Usually, the culture can be exaggerated slightly to emphasize differences.

EARTH HISTORY<D-HEADER>

Historical events or peoples can be borrowed. Cultures of lower Tech Levels from Neanderthal to medieval can be transplanted to space. Unique episodes of history, such as the Conestoga wagon migrations of North America, might become a permanent feature of some other planet.

AS WITH ALIEN RACES<D-HEADER>

Most of the suggestions found under "Designing Alien Races" are also appropriate for cultures. For example, animal behavior patterns might easily recur among aliens.

FITTING IT IN<C-HEADER>

A culture that is not smoothly blended into its society, or a society that is not merged skillfully with its setting, will be an obvious contrivance. Following are a few points to watch for.

Consistency With the Race<E-HEADER>

The culture must make sense for the race. There is fortunately some leeway here -- witness all of the known human cultures -- but some conjunctions are at best unlikely. Warlike vegetarians and leisurely mayflies are inherently contradictory. If an alien race is modeled after a particular earth animal, then the culture should also be inspired by the same source. One way to assure this consistency is to identify the one most different feature of the aliens physically and design their culture to take advantage of it.

Consistency with Environment<E-HEADER>

The culture is a product of its environment. Whatever occurs frequently in the environment and has great power will have great significance in the culture. Earth examples include volcanoes among Hawaiians and bison in early North America. Any recurring danger will be handled in a ritualized manner. Finally, the ideas available to the culture will be found as words in the language and unknown concepts will not have words.

Interaction with Neighbors<E-HEADER>

Related to environmental consistency is the way a society adapts to finding any neighbors. A low tech planet may be splintered into several cultures. At a higher tech, two distinct environments or even two intelligent races are required to support multiple cultures. And, spacefaring races from different planets may always come in contact.

In any case, societies that interact will reach some equilibrium that makes sense. A peaceful culture that finds a violent culture will probably be conquered. Two military cultures will engage in hot or cold war. And so on.

COMPONENTS OF A CULTURE<B-HEADER>

Every culture contains ways of addressing most of the following needs and functions. This may be considered a checklist for fleshing out a culture once the Gamemaster has his initial idea.

DEMOGRAPHICS<D-HEADER>

Demographics studies the distribution of variations within a society, or what a census reveals. The demographics of a culture include population distributions by location, by age, by internal variations (such as ethnic). Questions to be answered in designing the society include, is the society more rural or urban? Is the birth rate (death rate) high or low? What is the average household size (or how many individuals live together)?

Transportation<E-HEADER>

The speed of transport within a society is determined by its Tech Level, but the kind of transport is up to the Gamemaster. A planet's geography (sorry, planetography) will determine whether boats or wagons or balloons are in order. Additionally, is travel common and cheap? Or do most individuals stay in one place?

Major Institutions<E-HEADER>

Governmental bodies are covered below. Other major institutions may exist, however, that Player Characters will encounter. These could include merchant cooperatives, travel agencies, guides, or legal services. The Gamemaster should design any organizations that the Player Characters will need. To emphasize strange features of the culture, a prominent organization should deal with the activity.

ECONOMICS<D-HEADER>

Societies exist primarily because people that band together can specialize in labor and do much better than individual families. Now, this is entirely anthropocentric thinking, but similar reasoning should apply to beings with other biologies. It follows, then, that different parts of society will want to

swap the results of their labor. Hence, the need for money.

Economics addresses questions such as, what is money? What is considered valuable by the culture? Who has the wealth? How do the wealthy get that way?

Production of Goods<E-HEADER>

The production of goods, and food in particular, is an important part of society. Is labor, in fact, specialized? Is production centralized or distributed? (This will also depend on transportation.) Is it efficient or do goods get produced that nobody wants?

Consumption of Goods<E-HEADER>

How do goods, including food, get distributed for use? Is it first-come, first-serve, or by rationing or by a market economy? Is everyone happy with the method?

Money<E-HEADER>

The actual unit of currency can be an opportunity for humor (scent sacs, helium, limericks) and it can make the Player Characters immediately rich or poor (steel or niobium) depending on what the Gamemaster wants.

COMMUNICATIONS<D-HEADER>

Communications will depend upon the Tech Level, the size of the society, and the structure of the society. Information theoretically originates everywhere within the culture, including news of disasters, orders for goods, and directives from above. Flow of information can be centralized or distributed and it can be open (everything gets through) or restricted. The question of open versus restricted is the difference between everyone having a telephone and everyone having a radio, and so touches on many other questions.

Public Opinion<E-HEADER>

How much do members of the society know about themselves and the universe out there? And how accurate is their information? Player Characters are going to want to learn about this society. Obviously, they will talk to individuals. They will use news outlets if such exist, as well as books, and may be objects of interest themselves.

Actual public opinions should be decided for a number of topics including aliens, technology, and the desirability of change. Also, any society has at least a few completely irrational taboos, and these can be booby traps for the players. Perhaps the color orange is considered obscene or no one appears in public who is not soaking wet.

Language<E-HEADER>

The Gamemaster should think about the society's language. First, the medium of the language will depend on physiology (voice versus tail flicks or scent codes). Second, vocabulary tends to increase with Tech Level, though this may again be anthropocentrism. Third, the complexity of the language may depend on the richness of society and the number of ideas that have to be expressed. Fourth, a simpler trade tongue often exists or develops where needed. See the discussion of languages in the Character Creation section.

DECISION MAKING<D-HEADER>

There are many forms of government, some yet to be invented. Decision making can be local or centralized and the deciders can be permanent or temporary. Communications and transport capability will obviously enter into this. If the number of leaders is small, the Gamemaster may want to create their character sheets individually.

Laws<E-HEADER>

With regard to this topic, are the decisions of society considered inviolate, or are they merely advisory? Laws must be announced and available (communications again) except in a very despotic culture. Thought should be given to the nature of punishment, since the Player Characters will undoubtedly violate some law somewhere.

Weights and Measures<E-HEADER>

An example of a kind of social agreement that may or may not

carry the weight of authority is the nature of the measuring system. A primitive society will be very sloppy about this, but at higher Tech Levels conventional units are almost mandatory. The characters may have constant trouble with this unless they carry around hand computers or have Lightning Calculator. Odd measuring units are another way to emphasize alienness.

VIOLENCE AND EMERGENCIES<D-HEADER>

Likely there are designated groups for handling various forms of danger. Emergencies include fires, quakes, and whatever threats arise from the features of the planet. Odd planetary orbits may produce extreme weather, for example. Note that the locals will probably be used to something that the Player Characters consider extremely dangerous.

Military and Police<E-HEADER>

Often there is little distinction between these two, which is why they are lumped together. The nature of the armed forces will depend on the perceived threat. A planetary culture will be defending itself from internal rebellion only, unless another planet threatens it. Two cultures at war will have defenses for each other's weapons, if the war has gone any length of time.

Player Characters may be particularly interested in the local police, since our heroes are likely to break the law or be considering it. Weapons and character abilities should probably be worked out, therefore.

MAINTENANCE AND GROWTH<D-HEADER>

In a general sense, the Gamemaster should decide if this society is static like medieval Europe or dynamic like the Persian Empire. The general nature of society may also determine the members' attitude toward strangers and new technology.

Reproduction and Care of Young<E-HEADER>

This aspect of society depends rather obviously on biology. If the young need little care after birth, they may have no special status. If they need years of care, then special institutions may exist to serve them. The Gamemaster should decide how numerous the young are, whether they are collected together or distributed, and how their attitudes toward the Player Characters may differ from everyone else's.

Health<E-HEADER>

The nature of medicine will depend on Tech Level but also on the importance of individual lives. A hive society with little distinction between members will not value medical care. (It may still have medical science in the sense of genetic engineering, though.)

Recreation<E-HEADER>

Alien people will have alien forms of play. Their physiology and the environment will suggest possibilities. For example, tree folks are likely to do gymnastics. Often, recreation is a variation of something done seriously by some part of society. The Gamemaster may wish to work up at least one game or contest in detail and have the Player Characters try to participate.

TECHNOLOGY<C-HEADER>

This is a good point to think about the technology of the campaign. Technology affects society. (See "The Effects of Technology on Society", below.) Conversely, each society has a level of technology. Star Hero calls these Tech Levels. Tech Levels are defined separately for several areas of know-how, as defined in the Techbook.

Thus, each society needs a Tech Level assigned for six areas of technology: Transportation, Weaponry, Armor, Medical, Communication, and Power. Usually, these areas should be close to each other. The Techbook lists equipment available in each technology category at each Tech Level.

One other set of Tech Levels is very important, and that is the campaign Tech Level. The campaign Tech Level in each area is defined as the highest technology available to the Player Characters. Presumably this is the technology of their homeworld, or the best among all planets in easy reach. If the PCs have higher technology than anyone they meet, then they may be hard to control. They may appear god-like to others if the difference is very large. The Gamemaster has to decide if this is appropriate

to the campaign.

ALIEN RACES<A-HEADER>

What is more characteristic of science fiction than alien races? Designing aliens can be hard work, but it can also be much fun. If the players contribute by, say, running a member of the race, it can also be very rewarding. Some sample alien races and nonintelligent beasts are given at the end of this section.

DESIGNING CREATURES<B-HEADER>

The design of an alien lifeform requires several steps. An initial idea must be expanded into a description and then transferred to a character sheet. Intelligent aliens should be assigned a Package Deal (or two, one racial and one cultural). A culture and possibly a technology must be developed.

DESIGN APPROACHES<C-HEADER>

CENTRAL CASTING<D-HEADER>

Central casting aliens are popular in movies and TV shows. They resemble humans very closely with slight differences such as green skin or protruding brows. In other words, they can be portrayed by members of Central Casting. They may still have a very alien culture. Some of their other characteristics include:

Life Support<E-HEADER>

Central casting aliens breathe oxygen and eat almost the same foods as humans.

Crossbreeding<E-HEADER>

Central casting aliens can crossbreed with humans, producing stories about biracial families.

STORY-BASED ALIENS<D-HEADER>

Story-based aliens are used in campaigns with less scientific realism. They may have any appearance, any abilities, and any culture. The key is that their abilities drive the story. So, if the story requires a race of fire-breathing shapeshifters, they exist. With this design philosophy, an alien race is created using Normal Characteristic Maxima and Champions powers.

REALISTIC ALIENS<D-HEADER>

Realistic aliens are designed according to the laws of biology and plausible theories of alien life. They are not too difficult to create, but there are constraints on the imagination. Realistic aliens should adhere to most of the following rules:

Survivability<E-HEADER>

Aliens should be able to survive in their own environment. Note, though, that humans survive in the Arctic even though our native environment is tropical Africa. Also, if aliens have polluted or destroyed their native planet, they may now only be able to survive elsewhere.

Aliens should be able to reproduce and have some method of ingesting energy (eating, photosynthesis, etc.). Evolution will be at work with these aliens if the reproduction process is even slightly imperfect. If so, they should be "fit" in Darwin's sense, though not necessarily "fittest".

Composition and Complexity<E-HEADER>

Self-reproducing life is a complex process and intelligent life must be even more complex. Earth life is chemically based on proteins and nucleic acids, both of which are extremely complex carbon-based families of molecules. Alien life would have to be based on some equally complex understructure, such as other long-chain molecules, crystal doping, or gas turbulence.

Human intelligence actually comes from a completely different complex design, the neural network of the brain. Brain cells are relatively simple units that can link together in many, many ways. This is another approach to complexity.

Complexity may also conceivably arise from interactions among many simple but self-sufficient organisms. This would be a colony intelligence.

Size<E-HEADER>

Lifeforms have to be large enough to hold enough complexity for self-reproduction. On Earth, bacteria are the minimum size. (Viruses are smaller but need help in reproduction.) If complexity representing life is based on something smaller than mole-

cules, such as electron shell energies, then the minimum size is smaller yet. At some size larger than the minimum, life becomes complex enough to be self aware, then intelligent. Thus, cats are probably self aware; primates and dolphins are probably intelligent. Intelligent beings based on completely different principles can be extremely small, as with the natives of Robert Forward's Dragon's Egg.

The size of an organism also depends on its environment. They will be larger with plenty of food or other energy sources around. They will be smaller in heavier gravity (assuming we are talking about planet-bound critters). It is theorized as well that an intelligent creature shouldn't be the biggest thing around. That way, brains become a survival trait.

Shape<E-HEADER>

Based on Earth life, growth patterns, and cell division, most life would be either radially symmetric (like a starfish) or bilaterally symmetric (like all vertebrates). This is not gospel, however. Completely amorphous life (like a slime mold) is possible.

The square-cube law refers to the differences between tiny and huge creatures that come simply from scale. A spider can lift many times its weight and gets about on pipecleaner legs. A ten-foot creature of exactly the same shape couldn't support itself. Elephants have thicker legs than horses. Thus, realistic aliens cannot be based on real creatures of a very different size without extensive modification.

Tool Using<E-HEADER>

Most intelligent life will use tools or otherwise manipulate its environment. This is not a great definition, though; after all, beavers manipulate their environment. Tool-users will have some means of holding or steering those tools. Life that cannot use tools (dolphins) may have reached a threshold of minimal intelligence with no way for evolution to increase it.

Language<E-HEADER>

Intelligent creatures are expected to communicate among themselves. This assumes that creatures that communicate cooperate or otherwise share useful information. Recall, however, that bees communicate as well, so this rule must be applied cautiously.

ANTHROPOMORPHICS<D-HEADER>

Anthropomorphic designs may be applied humorously or seriously. In essence, this approach humanizes some Earth animal. So, the result can be dog aliens, cat aliens, lobster aliens, or whatever. In a humorous campaign, the cat aliens would probably look just like two-legged upright cats. In a serious campaign, they would look only vaguely catlike but would have a recognizably feline culture. This is a simple method of creating a very alien, but consistent culture.

VARIANT HUMANS<D-HEADER>

Variant humans are not aliens at all, but rather, different branches of humanity that can still interbreed. Variant humans may be of unusual size, have unusual strength or reflexes, or be able to tolerate some trace poison such as titanium. In a less scientifically realistic campaign, they might have odd powers. Psions would be a form of variant human (see the separate section on psionics). Pure variant human populations usually occupy small colonies or nonterrestrial, but livable, environments. The most common origins for variant humans are as follows:

Genetic Manipulation and Breeding<E-HEADER>

A small group of humans was deliberately bred for the unusual trait, such as size. Alternatively, germ cells were altered genetically so as to produce offspring with the trait. Slave races may be created this way. Colonists who know they are going to a hostile environment might create children who can survive there.

Evolution and Adaptation<E-HEADER>

On a slightly hostile world, evolution killed the colonists least likely to survive. The offspring of the survivors have the trait. Tolerance for ultraviolet light or strength to fight heavy gravity are good traits to achieve this way.

Genetic Drift<E-HEADER>

A very small group of colonists grew into a large population with some unusual trait simply because the handful of ancestors did not represent average humanity. For example, if most of the founders were red-haired, most of the later population will be. Traits derived this way are usually neither directed nor useful. In a more dramatically romantic campaign, though, the original population might be unusually psionic or prophetic. Nearly all members of the later colony would then share a useful trait that is rarely found in humanity at large.

PHYSICAL ATTRIBUTES<C-HEADER>

The physical attributes of the aliens should be imagined, including size, build, and appearance. Characteristics, Skills (including Everyman Skills), and Powers (if any) possessed by the average alien must be specified. For intelligent aliens, a culture must be defined, as discussed below. After this, everything should be reevaluated for consistency.

BUILD AND APPEARANCE<D-HEADER>

To an outsider, all life on a planet will probably share many similarities. Thus on Earth, plants, arthropods, and vertebrates would each be very similar looking. Not that an alien couldn't tell a man from a dog, but both obviously share a common ancestor. As on Earth, so among the stars. If a planet's intelligent beings and animals are both to be designed, they should have some underlying commonality, such as number of limbs and placement of the eyes.

Beyond this, any appearance is probably fair game. Story-based aliens don't even need to sound viable. The Gamemaster should give details about the alien race on the following subject:

Size and Mass<E-HEADER>

Animals on a planet come in a range of sizes, as on Earth. Assuming standard gravity, an animal's size can be estimated by comparing it to the nearest equivalent among real animals. In light gravity, dense atmosphere, or oceans, everything will be bigger. In heavy gravity or high winds, everything will be smaller.

Big creatures weigh more than little creatures, unless filled with buoyancy sacs as a jellyfish. Bigger usually means more BODY. Also, big creatures tend to have a lower metabolism and move more slowly, but there are many exceptions.

Shape and Structure<E-HEADER>

One design will normally dominate a planet's animals, but the details will depend on lifestyle. Thus, the Gamemaster may decide that all of a planet's animals have five limbs. Arboreal creatures may then have long arms for reaching and clinging, whereas big land animals will have stocky legs and limited hip movement. Flyers and swimmers tend to be streamlined. Small creatures have skinnier legs than big creatures. Metallic bones and hollow bodies would also thin the legs.

Hide<E-HEADER>

Among Earth creatures, the original purpose of skin was to hold our water in. Beyond that, a skin can be a heat insulator, armor, and camouflage. The hide of an alien creature will depend on the threats in its environment. If the predators use radar, the prey may need to be radar-absorbing. If the soil is radioactive, then animal hide may contain lots of barium. Intelligent creatures are less dependent on environment, but carry traces of their ancestry. They also fashion animal skins into clothing.

Sometimes, an animal hide is valuable because of what it is made of or because of what it does (e.g., reflect radar).

LIFE CYCLE<D-HEADER>

Designing an animal's life cycle should start with the broadest categorization, such as herbivore, predator, or scavenger. Then, the creature should be well suited to whatever it does. Details are given below.

Habitat<E-HEADER>

A creature should survive in its own habitat. Thus, it should live close to whatever it eats, and it should be comfortable with the temperature, lighting, etc., of its own domain. Of course, an ill-fitting animal can be a clue to former migration or ecologi-

cal disruption.

Often, the Gamemaster will design the habitat before populating it. Thus, the gas world or volcanic moon comes first, and only then does the Gamemaster think about whether it supports life. Unless the campaign is heavily realistic, the answer should probably be yes, in the interest of story material. Gravity, atmosphere, and so on will have to be considered in creating the actual animals.

Food<E-HEADER>

Generally speaking, if something can be eaten for food energy, it will be. The bottom of the food chain comes first. There, life eats something that isn't alive. On Earth, this is plants taking in sunlight. This will be a common answer. The alien features of another world should be exploited, though, for other possibilities. Reactive chemicals, volcanic vents, and strong magnetic fields might all support strange forms of life.

Higher up on the food chain, predators need to be able to find and catch their prey, without wiping them out. They need to be able to eat their catch, which may mean strong jaws for getting through shells, or alkaline saliva to neutralize acidic blood.

Reproduction<E-HEADER>

Immortal beings do not need to reproduce. Others do. On Earth, the key to reproduction is the self-replicating molecule DNA. Other chemistry-based creatures will develop similar solutions. On the visible level, reproduction requires ingesting enough food energy and mass. If food is scarce, reproduction will be infrequent or by some low-energy means such as spores. Gestation requires time and effort and is more likely with larger creatures having a social structure (as with an elephant herd).

Sexual and asexual reproduction are both likely. More than three sexes is probably infeasible, because it makes procedures that much more difficult. Story-based aliens can be designed with any mechanism, of course.

Creatures that tend to die young or in large numbers will have large litters. Long-lived creatures reproduce infrequently and have one at a time. Intelligent aliens will have different attitudes toward family and young depending on where on this scale they fall.

ABILITIES<D-HEADER>

Story-based aliens may start with an idea for an ability. Otherwise, such will depend on the needs of the environment. See the respective ability sections. Sometimes, though, abilities are just a matter of chance in the evolutionary process. So, the Gamemaster can slip in the occasional animal with an odd Power even if nothing obviously justifies it.

Most abilities can be put into one of three categories, describing how an animal attacks, defends, and moves. Claws and high STR are common attacks. Armor plates and high DEX are examples of defense. Movement modes will depend on the environment.

Characteristics<E-HEADER>

Characteristics of alien animals can be determined by comparing them to earth animals with similar functions and by deciding how dangerous the animal is to a normal man. Intelligent aliens that can be player characters should not have characteristics very different from normal, because that locks in too many of the available points. See the Characteristics section for reasons why particular values should be high or low.

Skills<E-HEADER>

Animals will have certain Skills, but not too many, reflecting their lifestyles. Common Skills include Climbing, Stealth, and Survival. Predator and prey normally have similar CV values, which means that one or the other may need a Level or two. Alien beings will have Everyman Skills appropriate to their culture and technology. One of the lists in the Hero System Rulebook or in this book should be chosen and modified slightly as appropriate. Very rarely will all members of a race have a full Skill rather than a Familiarity. Of course, the various hunters and herders that characters meet will have Skills appropriate to their professions.

Powers<E-HEADER>

Animals can have almost any wild ability represented by a Power; see the Power section and the Alien Bestiary for ideas and examples. Movement modes, defenses, and Enhanced Senses will be the most common Powers. Certain dangerous features of the environment will cause the animals to develop Life Support. All of this is true of intelligent aliens as well. Races available as player characters should have very few points in Powers by default, but rather, just enough to make them distinctive.

CULTURAL ATTRIBUTES<C-HEADER>

Suggestions for designing cultures are found elsewhere in this section. Here is just a reminder that culture and physiology should match. Herbivores don't usually form a militaristic society, and sea dwellers don't worship a fire god. Of course, they do if it's an important part of the story.

RACIAL AND CULTURAL PACKAGES<B-HEADER>

The following Package Deals represent human cultures and human racial variants resulting from our spread among the stars and adaptation to new environments. For a reminder of the distinction between cultural and racial packages, see the Hero System Rulebook.

HEAVYWORLDER<C-HEADER>

Humans born on high-gravity worlds tend to have high strength, short lives, and either good reflexes or tough skin (or both). Actual average strength will depend on the specifics of the home world, for example, natives of a 2-g world will average STR 15, up to STR 20 for a 4-g world. Anything higher will cause problems even for the natives, as the human body can adapt only so far.

RACIAL PACKAGE<D-HEADER>

Cost Powers
26 Increased Char Maxima: STR 25, CON 23, BOD 23, PD 10, ED 10, END 60
0+ DISADVANTAGES
0 Package Bonus
2 Decreased Char Maxima: INT 18, COM 16
10 DF: Heavyworlder
14 Package Cost

CULTURAL PACKAGE<D-HEADER>

Cost Skills
2 AK: Heavy gravity environment
1 Familiarity w/Mechanic
1 PS: Laborer
0+ DISADVANTAGES
0 Package Bonus
4 Package Cost
This package is for a young colony where everyone has to take a hand in fixing things. Any heavyworlder can pick up manual labor when off-planet; hence, the PS.

HIGHRIDER<C-HEADER>

The natives of space stations, born in free fall, are tall and thin. They learn the high-tech skills needed to keep themselves alive in their artificial environment.

RACIAL PACKAGE<D-HEADER>

Cost Powers
10 Increased Char Maxima: DEX 23, COM 22, ED 10
3 Immunity to radiation
0+ DISADVANTAGES
Package Bonus
8 Decreased Char Maxima: STR 16, BOD 18, PD 6, STN 45
5 DF: Highrider
2 Package Cost

CULTURAL PACKAGE<D-HEADER>

Cost Skills
2 AK: Space environment, 11-
1 Familiar w/Mechanic, 8-
1 PS: Vacc suits, 8-
3 PS: Zero-gee operations, 12-
3 Survival, 11-
0+ DISADVANTAGES
2 Package Bonus

8 Package Cost

MARTIANS<C-HEADER>

No, not that kind of Martian! Mars is an early colony and a light-gravity world with hostile environment.

RACIAL PACKAGE<D-HEADER>

Cost Skills
4 Increased Char Maxima: DEX 21, COM 22
0+ DISADVANTAGES
0 Package Bonus
3 Decreased Char Maxima: STR 18, BOD 18
1 Package Cost

CULTURAL PACKAGE<D-HEADER>

Cost Skills
2 KS: Martian weather, 11-
1 PS: Vacc suits, 8-
1 PS: Miner, 8-
3 Survival, 11-
0+ DISADVANTAGES
1 Package Bonus
6 Package Cost
Mining is a plausible reason for being on Mars.

SAMPLE ALIEN RACES<B-HEADER>

The races presented here represent a range of scientific and dramatic realism. The Tribesmen are Central Casting aliens appropriate to any television show. The Hardrockers are implausibly humanoid silicon life suitable to a comic book or highly dramatic campaign, in other words, story-based aliens. The Ting'ri are completely unique in form and function. Some notes on the races:

NAME<D-HEADER>

An intelligent race will have its own name for itself. A polite Gamemaster will choose something pronounceable. In the interest of verisimilitude, however, the race can call itself by some difficult set of phonemes with Humans assigning a nickname. This is the case here with both the Na!zalla (Tribesmen) and the Kuruin (Hardrockers).

PACKAGE DEALS<D-HEADER>

Altered Characteristic Maxima in Package Deals, as described in the Hero System Rulebook, present a conceptual problem. Specifically, the player gets no cost break for raising maxima in the package and is, in fact, penalized for having to pay points early. To evade this problem, none of the packages here contain Characteristics or Characteristic Maxima.

TRIBESMEN<C-HEADER>

This alien race is properly referred to as the Na!zalla (the exclamation point denotes a click of the tongue). Because many Humans find this name difficult to pronounce, they call the race "Tribesmen", after the official name of their stellar empire, the Realm of the Thousand Tribes. The Realm is a rough sphere perhaps 200 ly in diameter, and overlaps the fringes of the Terran Alliance Treaty Exploration Zone (the Frontier).

DESCRIPTION<D-HEADER>

The Tribesmen are roughly humanoid (two-armed bipeds). They are native to chilly (by Human standards) worlds which orbit close to cool red dwarf stars. (The fact that red dwarfs seem to be the most common variety of star in the galaxy may explain the Tribesmen's broad expansion.)

Tribesmen wear garments of animal hide and large, heavy plant leaves (or their synthetic reproductions); but contrary to expectations, the clothes are not rough cut or ragged, but are surprisingly well-tailored. Common adornments include animal tusks, teeth, feathers, etc. Tribesmen dress lightly on Human worlds, which seem warm to them, but in their own habitats they wear the equivalent of full outfits.

Na!zalla starships are always painted to resemble fur, feathers or scales, and are decorated with large replicas of tusks, horns, feathers. Na!zalla hate streamlining, and hulls have various pleasing shapes that don't necessarily cleave the air efficiently. (This is possible with a big enough propulsion system; in space, of course, who cares?)

Among the Na!zallas' more "human" qualities is their preference for dealing with those similar to themselves and their tribal culture. They like Humans who can rattle off extended-family histories, and many Human traders and diplomats have seen the advantages of introducing themselves as "Suzanne Crow of the Apache Nation" or "Connor MacLeod of the Clan MacLeod."

The Tribesmen culture has a sort of "Chinese master" attitude: they are reluctant to start fights or wars, but combat training is seen as very important, and they are uncommonly good fighters and tacticians.

RACIAL PACKAGE<D-HEADER>

Cost Skills
5 IR Vision
3 LS: Cold
0+ DISADVANTAGES
3 Package Bonus
5 DF: Tribesman
3 Package Cost

CULTURAL PACKAGE<D-HEADER>

Cost Skills
1 Tactics, 8-
1 Sc: Game theory, 8-
0+ DISADVANTAGES
0 Package Bonus
2 Package Cost

Note: Typically for Central Casting aliens, these packages are small and diverge the characters only slightly from Humans.

KURUIN<C-HEADER>

Also known as Hardrockers or Rockers, this race is the first known sentient silicon lifeform. When they were contacted by Humans, they had just developed their own FTL space drive and had explored just four nearby star systems. Rocker space is entirely contained in the Terran Alliance sphere. By necessity, the Rockers have a good relationship with Humanity.

Rockers get their nickname from their natural armor, which resembles crushed stone.

Just as Humans named their homeworld with the word for "ground," the name of the Kuruin homeworld has a similar origin. "Grrethd" literally means bedrock, which to the Rockers has more stable connotations than mere dirt. Humans call it Bedrock.

RACIAL PACKAGE<D-HEADER>

Cost Powers
13 Density Increase, 2 levels, End 0, Persistent, always on [20]
9 Armor (3/ 3)
5 LS: High-carbon atmosphere
3 Simulate Death
0+ DISADVANTAGES
0 Package Bonus
15 DF: Kuruin
15 Package Cost

Note: A typical Hardrocker will have high BODY and low DEX in addition to the adjustments indicated here.

CULTURAL PACKAGE<D-HEADER>

Cost Skills
3 Survival, 11-
2 AK: Volcanic environment, 11-
1 PS: Miner, 8-
0+ DISADVANTAGES
1 Package Bonus
5 Package Cost

TING'KI<C-HEADER>

The name "Ting'ki" is a Human approximation of the wind-chime sound referring to this very rare nonhumanoid crystal lifeform.

DESCRIPTION<D-HEADER>

Ting'ki evolved on Ting, a low-metal world with shallow seas high in mineral content. An individual is a collection of cubic crystals made of an impure pizeoelectric ceramic. Four 1-meter cubes float in an arrangement that is electromagnetically suspended and locked together. Six 1/4-meter cubes are positioned between the various pairs of larger crystals. A very old individual will have grown a set of twelve tiny crystals as well.

A Ting'ki sees by absorbing photons through the translucent faces of its larger cubes. It hears by the electrical charges that a sound compression wave induces. The reverse of this process generates musical sound. The individual can manipulate nearby objects directly by creating static electrical forces. This won't work on completely nonconducting materials (no Limitation taken on the TK). Note that certain electromagnetic weapons mimic this process in a destructive manner. The Ting'ki also uses its smaller crystals in the manner of hands, grasping objects between two cubes or pressing buttons with a corner.

Ting'ki eat by soaking in a mineral bath approximating the homeworld oceans. If an individual suffers destruction of one of its large crystals, it will unconsciously grow one of its small cubes to the larger size. A lost small cube is regrown from a seed crystal. Reproduction uses a related process in which two individuals each contribute two small crystals toward forming a new entity.

CULTURE<D-HEADER>

Compared to humans, Ting'ki are very orderly and deliberate. The governmental decision-making body is very slow and thorough. Both government and individuals tend to respond to emergencies with previously set plans and are very bad at improvising.

Ting'ki will use equipment fitted with electrostatic pads at the various contact points such as triggers, switches, and so on. Doorways, passenger spaces, and so on have unpredictable shapes because the entities can arrange their bodies as desired. This is a great inconvenience for visiting Humans.

RACIAL PACKAGE<D-HEADER>

Cost Powers
10 TK, STR 10, no range [15]
3 LS: Eat minerals
5 Stretching 1"
5 Extra Limbs (6 total)
0+ DISADVANTAGES
0 Package Bonus
5 x3/2 BODY from masers
15 DF: Ting'ki (nc)
3 Package Cost

CULTURAL PACKAGE<D-HEADER>

Cost	Skills
2	KS: Minerology, 11-
1	Bureaucratics, 8-
1	Sc: Electronics, 8-
1	Perk: Protected species

0+ DISADVANTAGES

1	Package Bonus
4	Package Cost

Note: "Protected species" is a presumption based on the species' rarity among Humans.

THE ALIEN BESTIARY<B-HEADER>

VORE<C-HEADER>

Val	Char	Cost	Combat Stats			
25	STR	10	OCV: 5			
16	DEX	18	DCV: 5			
18	CON	8	ECV: 4			
11	BODY	2	Phases: 4, 8, 12			
3	INT	-7				
12	EGO	4	Costs			
18	PRES	8				
12	COM	1	Char:	51	Base:	50
9	PD	4		+		+
7	ED	2	Powers:	63	Disads:	64
3	SPD	4		=		=
8	REC		Costs:	114		114
30	END	-3				
33	STUN					

Cost	Powers	END
7	Density Increase, 1 Level, 0 End, Persistent, always on	
[10] 0		
10	1D6 RKA (acid), 0 Range [15]	1
15	+5D6 HA, 0 END, only vs grabbed (-1/2) [22]	0
5	Damage Resistance (5 PD/ 5 ED)	
6	+3" Running (9" total)	1
9	Climbing, Contortionist, Stealth, 12-	
6	Concealment, Tracking 10-	
5	1 Level Hand-to-Hand	
50+	DISADVANTAGES	
15	Berserk if grabbed prey escapes 11-, 14-	
10	Fear of water	
15	No fine manipulation	
24	Beast bonus	

Description<E-HEADER>

The vore is a large shaggy omnivore resembling a bowed X covered in fur, or a four-legged tarantula with no body. The underside of the junction point conceals a mouth that can spit digestive acid a short distance.

The vore is normally encountered running stealthily at top combat speed, for it is faster than most prey and even climbs trees. It instinctively avoids water, however, since it would sink. When it closes with prey, it wraps it between all four legs and uses its powerful contraction muscles to crush the victim. The acid will only be used if a victim or victim's companion that hurts it. The vore will continue to crush a dead victim for a while to make the job of masticating easier.

LIAR'S FERN<C-HEADER>

Val	Char	Cost	Combat Stats		
15	STR	5	OCV: 3		
9	DEX	-3	DCV: 3		
13	CON	6	ECV: 3		
10	BODY		Phases: 6, 12		
5	INT	-5			
8	EGO	-4	Costs		
17	PRES	7			
8	COM	-1	Char:	13	Base: 50
8	PD	5		+	+
5	ED	2	Powers:	80	Disads: 43
2	SPD	1		=	=
6	REC		Costs:	93	93
26	END				
25	STUN				

Cost	Powers	END
22	1D6 HKA, Penetrating (1 1/2D w/STR)	2
5	Damage Resistance (6 PD/ 4 ED)	
5	Stretching 1"	
-10	-5" Running (1" total)	
20	Targeting Hearing (Passive Sonar)	
25	Shapeshift, any plant, 1/2 END	1
5	Extra Limb (many, many limbs)	
3	Concealment, 11-	
2	+1 Hearing	
3	Survival, 11-	
50+	DISADVANTAGES	
10	x3/2 STUN vs. fire	
25	No sight	
3	No defense vs. chemicals in soil	
5	Reputation, 8-	

Description<E-HEADER>

Liar's Fern is a carnivorous plant that is normally dangerous only to the unwary. In its natural form, it resembles a clump of chives or round grass blades 3 meters tall and perhaps 22 cm across. The tough blades are various shades of green and brown, or whatever the usual plant coloration on the world. A Per Roll vs. Concealment may detect bones or traces of blood about its base. Liar's Fern is found in savannah and light woods.

The plant is not normally seen in its natural form. It has imprinted on its genes the shapes of several other indigenous plants. It can also detect the shapes of nearby plants by their shadows falling on it at various angles. The Liar's Fern instinctively arranges its blades, folded and twisted as necessary, into the outline of one of these plants. Blades of the correct coloration are outermost.

Liar's Fern feeds on sunlight, but gets its phosphorus from animals. Thus, it Grabs any large moving object within reach and slowly slices it to pieces. Note that the DEX and SPD of the plant are such that only someone taken unawares is in any real danger. The plant can also pull up its shallow roots and move very slowly if necessary.

LOVEBIRDS<C-HEADER>

Val	Char	Cost	Combat Stats		
3	STR	-7	OCV: 3		
10	DEX		DCV: 7		
13	CON	6	ECV: 3		
6	BODY	-8	Phases: 4, 8, 12		
3	INT	-7			
10	EGO		Costs		
8	PRES	-2			
14	COM	2	Char:	-5	Base: 50
2	PD	1		+	+
3	ED		Powers:	83	Disads: 28
3	SPD	10		=	=
4	REC		Costs:	78	78
26	END				
15	STUN				

Cost	Powers	END
8	1D6 Mind Control, NND vs non-mammal or 10 pt LS, Area 2" r.	
	per die, Usable Selective by Others, End 0, Persistent, no range,	
	always on, specific command only (-1) [23]	0
27	Shrinking, 2 levels, End 0, Persistent, always on [40]	0
30	Flight 15"	3
3	Seduction, 11-	
3	Survival, 11-	
3	Acrobatics, 11-	
9	3 Levels with Flight	
50+	DISADVANTAGES	
10	Gregarious	
15	No manipulatory appendages	
3	Beast bonus	

Description<E-HEADER>

Lovebirds are cute flying menaces. Not true birds, they are pill-shaped, 1/2 meter in size, and covered in bright fuzz of varying hues. A lovebird flies by inhaling and expelling large amount of air and by exploiting its lifting-body shape. The creature feeds on insects caught with each breath.

Lovebirds inhabit fields and mountain valleys in flocks of 3D6 individuals. Their danger lies in the protective pheromones that are mixed into their exhaust streams. These chemicals will act on any mammalian creature who breathes them as a Mind Control with a single command. The command is always something gentle that will deter potential predators: relax, sleep, giggle. Groups of lovebirds effectively add their Mind Controls together, doing attacks of 1D6 per creature.

Flocks of lovebirds will swoop to investigate groups of Humans. They are not easy to catch because of size and maneuverability, but will not normally be driven off by a single failed lunge. Humans have been known to collect them as pets, particularly those kinds with aphrodisiac scents.

ROCK WORMS<C-HEADER>

Val	Char	Cost	Combat Stats		
15	STR	-5	OCV: 4		
11	DEX	3	DCV: 6		
13	CON	6	ECV: 3		
8	BODY	-4	Phases: 6, 12		
5	INT	-5			
8	EGO	-4	Costs		
12	PRES	2			
8	COM	-1	Char:	-5	Base: 50
5	PD	2		+	+
5	ED		Powers:	137	Disads: 82
2	SPD	-1		=	=
4	REC		Costs:	132	132
26	END				
20	STUN	2			

Cost	Powers	END
16	EC -- Corundum teeth	
15 a	1D6 HKA (2D6-1 w/STR), AP, 1/2 END	1
16 b	1" Tunneling through DEF 10	0
13	Density Increase, 2 levels, END 0, Persistent, always on	
[20]	0	
13	Shrinking, 1 level, END 0, Persistent, always on [20]	0
24	Armor (8 PD/ 8 ED)	
25	Ranged Targeting Taste	
5	LS: eat rock, doesn't sleep	
7	Contortionist, 13-	
3	Survival, 11-	
50+	DISADVANTAGES	
10	1D6 STUN, BODY per minute from immobility	
25	Blind	
15	No fine manipulation	
5	Reputation, 8-	
27	Beast bonus	

Description<E-HEADER>

Rock worms are an ecological hazard to colonists. They are meter-long worms seemingly made of rock. Rock worms live to burrow, and only armor plating or chemical repellents can stop them. They have even been known to tunnel into a spaceship's landing fins and thus spread to other worlds.

ASTROSQUID<C-HEADER>

Val	Char	Cost	Combat Stats		
303	STR	-7	OCV: 3		
8	DEX	-6	DCV: -37		
93	CON	166	ECV: 2		
70	BODY		Phases: 6, 12		
8	INT	-2			
5	EGO	-10	Costs		
80	PRES	70			
4	COM	-3	Char:	253	Base: 100
23	PD	22		+	+
23	ED	4	Powers:	1110	Disads: 1263
2	SPD	2		=	=
50	REC	60	Costs:	1363	1363
100	END	-43			
119	STUN				

Cost	Powers	END
400	Growth, 60 levels, 1 Mhex long, -40 DCV, 100 kton mass, -60 Knb, End 0, Persistent, always on [600]	0
356	15D6 Suppress all technological Enhanced Senses +2, Area 28 Mhex r., Personal Immunity, 1/2 End	16
23	Damage Resistance, 23 PD & ED	
45	Armor (12 PD/ 12 ED), Hardened	
19	LS: breathe, vacuum, radiation, cold	
53	75% Damage Reduction, Physical and Energy, STUN only -1/2	
[80]		
45	Flight 20 Mhex, x4 NCM	4
16	FTL, 16 LY/year	
60	Telescopic Sight to Mhex scale	
5	4 Extra Limbs	
75	1/2 END for STR	30
10	2 Levels HTH	
3	Navigation, 11-	
50+	DISADVANTAGES	
15	Immobile in gravity field	
25	Distinctive Looks (NC, extreme)	
10	Reputation (extreme), 8-	
15	Hunted by galactic police, 8-	
1198	Beast bonus	

Description<E-HEADER>

The Astrosquid is an example of the extreme space monster design necessary to create something that can fight a spaceship. It is also not appropriate for a realistic science campaign. Chances are, however, that it is not precisely balanced for the Gamemaster's particular campaign, so defenses and Flight at a minimum should be modified to suit.

The astrosquid actually has 8 tentacles, so it looks like a 1-Mhex octopus. Its strength is great enough to move large asteroids, which is what it normally eats. Spaceships emit a lot of energy, though, so the astrosquid takes them to be something worth eating. It takes a while to enter a system, so the inhabitants usually have enough time to put out a warning.

Powers<E-HEADER>

The astrosquid moves on a Megahex scale, with suitable Perception modifiers, just like ships. It can grab and strike ships or throw asteroids (normally only one would be in reach during an entire combat). The astrosquid absorbs interplanetary hydrogen and uses this for reaction mass in flight. It can also expel a large cloud of impure hydrogen that interferes with electronics. This could be handled as Darkness on a Mhex scale, but for dramatic reasons, it instead Suppresses all capabilities of a ship's sensors. Effectively, characters will have to resort to looking out the window for targeting.

GAUSSLION<C-HEADER>

Val	Char	Cost	Combat Stats		
20	STR	10	OCV: 6		
18	DEX	24	DCV: 6		
18	CON	16	ECV: 2		
13	BODY	6	Phases: 3, 6, 9, 12		
5	INT	-5			
7	EGO	-3	Costs		
20	PRES	10			
10	COM		Char:	80	Base: 75
10	PD	6		+	+
8	ED	4	Powers:	113	Disads: 118
4	SPD	12		=	=
8	REC		Costs:	193	193
36	END				
32	STUN				

Cost	Powers	END
7	Telekinesis, STR 10, only vs metal (-1) [15]	1
24	2D6 HKA, Reduced Penetration (2x 1 1/2D6 w/STR) [30]	3
2	Damage Resistance (2 PD/ 2 ED)	
10	2D6 Energy Absorption to STUN	
10	Sense magnetic sources at Range	
10	Sense metal at Range	
15	Telescopic +10 for both Senses	
10	Tracking scent with magnetic Sense	
9	+3 Perception	
6	+3" Running	1
3	Stealth, 13-	
3	Survival, 11-	
3	Concealment, 10-	
1	Contortionist, 8-	
75+	DISADVANTAGES	
15	Territorial and possessive (irrational)	
15	No fine manipulation	
88	Beast bonus	

Description<E-HEADER>

The gausslion takes its name from a lifestyle similar to that of the lion on Earth's African veldt. Physically, though, the male resembles a stout monitor lizard with a cobra hood and a forward-projecting horn. This creature dominates an area of about 1 square kilometer and rules a pride of about 5-10 females, which lack the hood and horn.

The gausslion lives on a world poor in iron and other life-sustaining trace metals. An unusual sense can locate metal deposits and other magnetic anomalies at long distances (roll of 9- at 1 km). Concentrations of metal in its horn, and a cluster there of high-amperage nerves, allow it to actually project a magnetic attraction/repulsion ray. The gausslion never uses this important organ to attack physically, relying instead on its semimetallic claws. For defense, it has semimetallic scales and a nervous system capable of absorbing energy from electromagnetic attacks (essentially all energy attacks except, perhaps, cold).

BEAR PAWS<C-HEADER>

Val	Char	Cost	Combat Stats		
8	STR	-2	OCV: 5		
14	DEX	12	DCV: 7		
13	CON	6	ECV: 4		
7	BODY	-6	Phases: 3, 6, 9, 12		
8	INT	-2			
11	EGO	2	Costs		
13	PRES	3			
16	COM	3	Char:	42	Base: 50
8	PD	6		+	+
7	ED	4	Powers:	59	Disads: 51
4	SPD	16		=	=
5	REC		Costs:	101	101
26	END				
18	STUN				

Cost	Powers	END
8	Penetrating on STR 8 and M. Throw	1
13	Shrinking, 1 Level, Persist, 0 END, always on [20]	0
4	+2" Running (8" total)	0

Skills

Pummeling Martial Art:

3 a	Martial Throw	+0/+1, 3 1/2D6 Penetrating + v/5
4 b	Nerve Strike	-1/+1, 3D6 NND1
4 c	Martial Disarm	-1/+1, STR 28
8	+2 DC with MA	
6	Breakfall, Stealth, 12	
6	Tactics, Tracking, 11-	
3	Survival, 11-	

50+ DISADVANTAGES

10	Pack instincts
15	No fine manipulation
26	Beast bonus

Description<E-HEADER>

Bear paws roam the woods and valleys of another world like the wild dogs packs of Earth. In appearance, they are fuzzy balls 1 meter across and studded with tiny mouths, eyes, and other sensory organs. Under the skin is a loose skeletal frame and many local clusters of very powerful muscles. When these muscles are flexed just so, the bear paw bounds along or thumps into its chosen prey with a numbing blow to a joint or other sensitive spot.

Attacking in packs of 2D6, bear paws can trip, pummel, and eventually exhaust creatures thirty times their individual mass. They can knock guns out of hands and do Penetrating damage, but men in armor or pressure suits are immune to the NND strike. The NND attack is also unusable against invertebrates with their completely different internal structures.

CREATING DEVICES<A-HEADER>

Characters in science fiction use interesting gadgets and whole new areas of technology. The Gamemaster will want to emulate these, either exactly or in spirit. Unfortunately, researching and building advanced devices such as those in the Technology Sourcebook is a little harder than poring over contemporary mail order catalogues. This section discusses how to go about this.

This section is divided into four parts. The first three principally discuss original designs, gadgets copied from literature, and how to realize either one in the Hero System. Actually, though, some of the ideas in each part will apply to any design. The Gamemaster should always look over the entire section, then, for pertinent advice and restrictions. The last part of this section is a review of the ramifications of technology on society and how to make the two consistent.

CREATING ORIGINAL DEVICES<B-HEADER>

When creating a device or technology area from an original idea, the Gamemaster should first ask, why does this device exist? Alternatively, why should it exist? Following is an examination of why technology is invented in the first place.

TO SUPPLY A NEED<D-HEADER>

The most direct reason for an invention is that it is needed. A planet or society with unusual features will probably have unusual needs. For example, if a city is surrounded by mud flats, it will need ground effect vehicles, monitoring equipment to predict mud eruptions, and perhaps mud-resistant clothing.

TO EXPLOIT A TECHNOLOGY<D-HEADER>

Discoveries and breakthroughs are normally first of a scientific or abstract nature. Only later are devices built that take advantage of the new technology. Hertz's discovery of radio waves led to Marconi's radio receiver and eventually to masers, radar, and microwave ovens. In other words, when the Gamemaster designs a society, its older technologies should be well represented by a number of devices. The newest, most advanced technologies may be represented in only a few ways. These areas are most ripe for invention (and for story possibilities).

TO EXPAND EXISTING TECHNOLOGY<D-HEADER>

Existing ideas tend eventually to be transplanted to new and unanticipated domains. The steam engine, for example, was first used as a pump in coal mines before it was applied to transportation. The Gamemaster might, then, examine technology of the previous Tech Level and see what other applications can be developed. Even if the Gamemaster doesn't do this, the players probably will at some point. Weapons will be used as cooking gear, and vice versa. Surgical equipment may be applied to lock-picking. The Gamemaster should at least be prepared for these possibilities and assemble some guidelines for what is a reasonable reapplication.

TO SUPPLY A STORY POINT<D-HEADER>

This justification for devices is most appropriate to more romantic games. If a story needs a certain device, or aliens become more interesting if they have some odd form of transportation, then the Gamemaster may create it. Once the device exists, however, the Gamemaster will still have to think through the consequences (see below, Effects of Technology).

RECREATING CLASSIC SF GADGETS<B-HEADER>

A good source of ideas on gadgets and technology is literature. Certain devices are common and widespread in science fiction (blasters, slidewalks). Others are uniquely the product of a single writer (James Blish's spindizzies). Since none of these come attached to a Hero System writeup, the Gamemaster will have to do some work to make such a writeup possible.

IDENTIFY SALIENT FEATURES<D-HEADER>

The original source should be examined for the ways in which this device is used. Range of effect, power requirements, and any limitations should be noted (does it work in the rain?). Numbers of any kind are invaluable. In their absence, though, the Gamemaster should estimate how fast a vehicle flies, how fatally a weapon kills someone, how quickly a tool performs its function.

ESTIMATE THE TECHNOLOGY LEVEL<D-HEADER>

The technology level of the device can be estimated by referring to the chart of examples in the Technology Sourcebook, and comparing it to something similar in degree of sophistication. The original source might indicate that this device has been around for a long time, though, in which case it might be called an improved model of the next Tech Level. Prototype equipment might be a late example of the previous Tech Level.

With a Tech Level identified, the Gamemaster then has to compare the Tech Level of his own campaign. In the common case where they don't match, he can modify the gadget or he can discard it. If a gadget is too advanced for the prevailing Tech Level, the Gamemaster can design a larger, less efficient version of it or build in extra shortcomings. Or, he can leave it at its accurate Tech Level and call it the product of some outside civilization. Equipment properly belonging to a higher Tech Level may also simply be a lucky invention.

A device estimated to be of a lower Tech Level than that which prevails in the campaign is less of a problem. Useful equipment stays around for a long time, at least in niche applications, if there is no obvious substitute. We still use steam engines for certain purposes. The Gamemaster should shrink the size of the device and perhaps remove some Limitations.

DETERMINE AVAILABILITY<D-HEADER>

Just because a device exists, doesn't mean that it is available and affordable to the common citizen. Three factors should determine availability and price: the description in the original source, the device Tech Level compared to the prevailing one, and what the device will do to the campaign. The last of these three is, of course, the deciding factor.

A device will be cheap and very commonly available if it has been around since one or two Tech Levels ago. If the device is small or very useful, it will also actually be owned by many people. (Unicycles are pretty easy to buy, but who wants one?) More recently developed technology will be available first of all to its inventor, and then to those who are rich or have the greatest need.

If the Gamemaster can't reconcile what he wants with the logic of what must be, there are also a couple of escape clauses. Certain technologies get snapped up by the military and stamped Classified. These would, then, be hard to get despite everything said above. Also, fads will sweep the populace and simply everybody will want his own whatever-it-is. This will make a device more common than expected.

ENVISION THE GADGET<D-HEADER>

Whatever the Gamemaster lifts from literature, it should be described to the players. (This is true of original concepts as well.) The Gamemaster should envision or get from the source a size, weight, appearance, and composition. If different cultures use the same device, they may have exactly the same Hero System attributes, but different appearances. In fact, various pieces of equipment used by a particular culture may look very similar to an outsider.

BUILDING THE DEVICE<B-HEADER>

Once the Gamemaster has mustered a text description of a particular device, it must be realized in Hero System terminology. The various steps of this process are familiar to some with previous exposure to the Hero System and are given below.

IDENTIFY A POWER<D-HEADER>

The gadget must be based on one Power, Skill, or Talent. Often, the correct choice will be obvious. Otherwise, some additional guidelines can be applied:

Use the Right Kind of Power<E-HEADER>

Offensive devices should be based on offensive Powers. Similarly, defensive devices should be based on defensive Powers, movement enhancers on Movement Powers, and so on.

If a Device Has Two Uses<E-HEADER>

In this case, the device may need multiple writeups based on different Powers. For example, a disintegrator ray can kill people and it can drill holes in objects. It might, then, best be

based on Killing Attack (as a weapon) and Tunneling (for making holes). True, an RKA can punch through an object, but this may be too slow or unreliable to be useful. The second writeup then becomes necessary for clarity.

Don't Strain<E-HEADER>

Make the simplest choice possible. This point will come up when players offer their own designs and try to get away with doing something cheap. It may also arise just from a lack of insight. For example, artificial gravity could be done as Telekinesis, Area Effect, but Change Environment is a much more direct approach.

DETERMINE A POWER LEVEL<D-HEADER>

The power representing the device in question must be assigned a definite Base Cost. If the device comes from literature, then any hard numbers discovered earlier (see above) will be of use. The speed of a vehicle, the range or lethality of a weapon, and so on, can all be translated into a Base Cost. If this information is not available, the Gamemaster will have to compare the device to similar existing equipment and determine a value that way.

ADD POWER MODIFIERS<D-HEADER>

The intended operation of a new device rarely imitates exactly the Power it is based on. Advantages and Limitations will have to be applied. The Gamemaster should also consider how a device is powered. Items that run off of internal power or are recharged infrequently should be bought at zero Endurance. Some gadgets will use Charges and a very few will have an Endurance Reserve. Additionally, devices meant to be used in space often require Range Skill Levels or Increased Range to make them function at a useful distance.

TECH LEVEL ADJUSTMENTS<D-HEADER>

The standard mass for most equipment is defined in the Technology Sourcebook. If a device does not originate at the current Tech Level, then its size and mass should be modified at this point.

FINAL STEPS<D-HEADER>

Finally, every device has DEF and large pieces of equipment have BODY. These should be determined for personal equipment from the Focus rules and for bulkier objects from their mass and composition. Most devices should be assigned a price as well. The default price is based on the Active Cost (Active Cost x 100), but might be adjusted by the Gamemaster to change the availability.

THE EFFECTS OF TECHNOLOGY ON SOCIETY<B-Header>

The technology of your universe will affect the game because of the ways it affects the society. When creating your game world, decide which technologies have been invented or discovered, and be aware of how they will affect the characters' lives.

Try to imagine the logical uses to which an invention would be put, and possible advantages and problems of the discovery. Let this influence the rest of the game world. (For a good example of how to do this, read Larry Niven's "Exercise in Speculation: The Theory and Practice of Teleportation", in his collection All the Myriad Ways.)

You may want to solicit the players' suggestions on this. If they come up with a world-shaking use for the left-handed blivatron, you may decide that someone in the game world must have thought of that already, and adjust the world accordingly before you sit down to play. If, on the other hand, a PC thinks of this idea during the game, you may have to let the player reap whatever benefits he can before the rest of society catches on, possibly blitzing your whole campaign in the process.

Don't let the following examples scare you; afterward we'll see ways to keep technology from running amok.

Artificial Intelligence<E-HEADER>

A basic legal and moral tenet says that sentient beings are not to be exploited. What happens, then, when computers become so intelligent that we can't be sure if they are sentient or not? Are they self-aware, or are they just programmed to think so? Do

androids have rights? Free will? Goals? Affections? Feelings? (Would Shylock's soliloquy in Merchant of Venice make sense in the mouth of your android?) If killed, is it murder? If an AI is programmed to enjoy being exploited, is it still slavery? In short, when is an artificial brain a tool, when is it a person, and must it be one or the other?

Androids in your universe may be considered fully sentient with all the rights as natural sentients, or as very elaborate machines, or as something in between. Biodroids and clones may be considered the property of the person from whose cells it they were grown. Until a society has resolved this problem for itself, there will be excited controversy and prejudice on both sides.

You can't get around this problem by saying "Well, if it has an EGO score it's sentient, otherwise it's an Automaton..." EGO is an abstraction, and NPCs never read character sheets.

Force Screens, Hard<E-HEADER>

Such a screen (Force Wall) would be useful to defend spaceships, but is also good for protecting air and ground vehicles, buildings, installations, etc. With Life Support powers, they make good emergency shelters: they take only a second to erect, and weigh only what the base unit weighs, but last only as long as the batteries hold out.

A screen need not be a wall. Laid sideways, a screen can form an instant, temporary bridge, fire escape, cargo ramp, or safe path across quicksand or a minefield. Police would use them to form instant roadblocks. Criminals would use them to drive over roadblocks.

There's no reason that a force screen cannot be moved and used to move other objects. (This would be Telekinesis, most likely Area Effect, based on Force Wall.) A force screen tractor beam combines the standard TK uses (see below) with those of a force screen. The players may prefer the image of huge glowing cages made of Force Walls to that of plain tractor beams.

Force Screens, Soft<E-HEADER>

Personal screens (Force Fields) will replace armor, if the generators are less encumbering and the batteries last a long time.

FTL Communication<E-HEADER>

If it takes longer to beam a message across space than it does to fly the same distance in a spaceship, those ships will start carrying mail.

Gravity Manipulation<E-HEADER>

This permits many advantages for spaceflight. Travelers on a ship equipped with artificial gravity (Change Environment) need not worry about the long-term health effects of weightlessness. In addition, they may accelerate at any rate the engines allow, without being crushed.

Planetside, gravity manipulation may allow characters to visit worlds with a much higher gravity than they could normally stand. "Gravity traps" could be planted throughout a building for security; intruders would find themselves too heavy to move.

If there is powerful and fine control over gravity, expect people to plan a round-trip beneath the event horizon of a black hole.

Anti-gravity is often a form of Telekinesis (see below).

Longevity<E-HEADER>

People are notoriously selfish about prolonging their own lives. Should a medical breakthrough extend people's lifespan, it's likely to become very popular despite cost, pain, rarity, or any other inconveniences. If everyone's useful lifespan increases, population pressure will increase. Birthrates will have to be curbed.

Long life may change one's attitudes toward time. People will concentrate more heavily on long-range business and political goals. Slow space voyages seem more practical if the astronauts expect to be alive at their destination.

Matter Transmutation<E-HEADER>

Machines able to turn waste material (or air or sunlight or other limitless fuel) into useful items, food, etc. At extreme levels of efficiency, a transmuter can make copies of its own source material.

Transmutation endangers the cargo industry: if the process is cheap and the copies are precise, then the only cargo that needs to be carried anywhere will be transmutation machines...unless the transmuters are able to make more transmuters, in which case cargo hauling will become a lost industry. Only passenger vehicles will be built.

Counterfeiting makes tangible currency worthless; electronic banking takes over. The hobby of Collecting may become obsolete: how can you tell if you have a fake? Perhaps the public's attitude changes: what's the point in spending a fortune for a rare baseball card if anyone can have one just like it? (Then again, the reverse might come true: if everyone has a copy, then it makes the original seem that much rarer.)

Psionic Devices<E-HEADER>

If you can read a person's mind to learn the truth about a crime, does that constitute invasion of privacy? What about searching a neighborhood with a telepathic device to find an individual suspect? Does this society care if a criminal's rights may be violated?

If there are natural psions around -- say a telepathic alien race -- non-psis will appreciate personal Mental Defense gadgets or drugs. Telepaths are likely to be viewed with suspicion.

Spacecraft<E-HEADER>

If starships are comparable in cost and complexity to aircraft, then they will be owned by the same people who own aircraft: passenger lines, the military, corporations, and very rich people. Likewise, a few individuals will have small craft, but these owners will be a bit wealthier than most, and skilled pilots as well. Conversely, if starships are cheaper and simpler, like automobiles, everyone will have one.

Speed of travel is also important. Individuals are willing to commute 30 minutes to 2 hours to get to work; can they get to Luna, Mars, or Alpha Centauri in that time?

Telekinesis<E-HEADER>

Devices which can move objects at a distance are common in SF; they are best known as "tractor beams". Possible special effects include anti-gravity, magnetism, force fields, and mental energy (i.e., psychokinesis, which would most likely be innate, not a gadget.)

Spaceships use tractor beams to tow or capture other craft. Pirates use them to waylay ships. Docking facilities use them to safely guide spaceships into a berth; ocean ports may use them instead of tugboats.

Tractor-beam cranes would become common, and small TK units would be useful to load cargo onto trucks. If these units are man-portable, they would replace trucks. TK devices could make it easier to use heavy equipment -- a rocket pack, TV camera, mortar cannon, a sousaphone in a marching band, etc. Bulky Foci would no longer exist -- perhaps not even Immobile ones.

Law enforcement agencies would find tractor beams make some tasks easy, such as crowd control and capturing a running suspect. Also kidnapping and grand theft.

If your telekinesis doesn't obey Newton's Third Law, then the same special effect can be used for non-aerodynamic flying vehicles. Such flyers need not maintain a particular speed to stay aloft, nor reach a particular speed to reach orbital or escape velocity. Flying cars are possible.

Other Technologies<E-HEADER>

Other potentially world-changing technologies are teleportation, cryogenic suspension, invisibility, weather control, genetic engineering, and everyone's favorite, cloning.

LIMITING TECHNOLOGY IN YOUR CAMPAIGN<B-HEADER>

The GM is not required to allow a certain technology in the game universe just because it's real high-tech. Remember that typical SF force fields aren't even a real-life theory at present, and will probably never be invented. Many space-SF stories show man conquering the solar system or even the galaxy without ever discovering how to go faster than light. Having a gadget that solves every problem eliminates the possibility of conflict, mystery, tension...in short, reasons to be an adventurer.

If you do allow a potentially exploitable discovery, there are ways you can prevent it from becoming too common or too

powerful. These limitations also apply to improvements in existing technology, such as a new FTL drive thirty-two times faster than what everyone else has.

If a device, drug, or process is rare, expensive, or difficult to make, some people will find theft a much simpler way to get one of their own. PCs may be victims of piracy -- or become pirates themselves.

Expense<E-HEADER>

Only governments, corporations, and very rich individuals can own this technology. Normal people can use it under the right circumstances; anyone can buy an airplane ticket or rent a limousine for a night.

The technology may be expensive to use, as well as to buy. Porgo the Pitiless' worldwide weather-control device requires immense amounts of high-voltage electricity and a crew of twelve on double overtime.

In a superheroic game where points are paid rather than money, the GM can require a PC to spend a minimum number of points for a device.

Legality<E-HEADER>

The government only permits the military, official research groups, etc. to use certain devices. This may be for the public's safety, or for the government's own safety. The devices in question may be available on the black market, or on frontier worlds where the government's influence is weak.

The technology may be partly legal; that is, a device may require an owner's or operator's license (a 1- or 2-pt. Perk). Powerful drugs, if legal, must be prescribed by a physician.

Limited Effectiveness<E-HEADER>

Perhaps transmuters can't turn anything into anything; they must begin with a similar substance, such as organic material to make food. Or, the created objects dissolve into a soggy mess after 24 hours. Or the objects are useful but "smudged" like a bad photocopy; everyone can tell that it's not an original.

In James Blish's Cities in Flight stories, antigravity works better on large masses than smaller ones. As a result, whole cities become self-contained space colonies, and leave Earth to roam the galaxy looking for work.

Rare Materials<E-HEADER>

Certain materials required to build or fuel the device are difficult to find, obtain, reproduce, or hold on to. (Neutronium is all four.) Or, getting the material takes an eight-month journey by the fastest ships. Rare materials are expensive, but not even a rich person can get them easily.

Secret<E-HEADER>

The knowledge behind the technology is held by the government, an elite group, alien race, industrial monopoly, or a single inventor (who thus can't patent the thing). The secret may be discovered independently by someone else, but there are legal and illegal means to suppress it.

Side Effects<E-HEADER>

A fast FTL drive causes gravity too high for humans. A Mind Link radio causes brain dysfunction: only people with EGO of at least 15 can use it safely. Ultrasonic weapons cause gradual hearing loss to the user; police forces and other regular weapon users won't buy these guns, but a person who wants a sonic derringer for personal defense may not expect to need it often.

Taboo<E-HEADER>

An immortality drug requires repeated doses of extracts from the glands of infants. It's legal (with parent's permission), and it doesn't hurt the children much, but anyone who is visibly getting younger is looked on by the public as an exploiter of babies. (Some hotshot PCs don't give a hang about social convention -- but just wait until they try getting a job or a date. Roleplay it!)

Too Advanced<E-HEADER>

At any Tech Level there's always something that still can't be reproduced. This could be an artifact found in million-year-old ruins, or obtained from an alien race during an infrequent

contact. Perhaps it was invented by a genius who recently carried the secret to the grave. (Example: Dr. Noonian Soong, creator of Lt. Commander Data.)

Unreliability<E-HEADER>

Let's say that brainscanners are never more than 3d6 Telepathy, so they only work half the time on the typical guy. Other ways to do this are with mandatory Activation Rolls or Skill Roll Required. Just remember: if a character uses a gadget (and it isn't an urgent situation such as combat), and the device doesn't operate that one time, he'll just keep trying it until it does.

Unwieldiness<E-HEADER>

Operating this device requires several people, very specific skills, or (if built for an insect race) two pairs of arms and 360-Degree Vision. Alternatively, the gadget is a Bulky or Immobile Focus. This keeps some guy from running around with a 12d6 RKA laser cannon which is normally mounted in a starship.

Example: A "hard" force screen is made by a generator which interacts with the planet's magnetic field. Once in place, it must be carefully calibrated -- a lengthy and complicated process -- and if moved, the process must be repeated. Such a screen is useless on board a vehicle (or, for that matter, on a planet without a magnetic field), but is often used to protect buildings or whole cities from attack.

REALITY CHECK<C-HEADER>

Although the GM will attempt to be thorough in describing his technology (or alien biology and societies), the players will doubtless see aspects he hadn't thought of. (You know, the same way they find annoying shortcuts through your best scenarios.) Because building a universe is a such a big job, the GM may find it useful to enlist the players comments.

This can even happen during a game session. Example: The PCs' ship encounters an alien ship using a "neutrino drive" -- it flies by shooting off a thrust of neutrinos rather than hot gas or plasma.

"Excuse me: Reality Check," says a player politely. "The thrust is neutrinos, right? Did you know that a rocket flies because the thrust is directed backward through a hole in the engine chamber?"

"Yes..." says the GM.

"Well, did you know that neutrinos pass through ordinary objects without stopping?"

"Well..." He sees what the player is getting at: neutrinos would pass through the engine chamber like smoke in all directions, not just one.

Another player says: "Maybe the engine chamber is lined with a force field. Neutrinos couldn't pass through that."

"Okay, that works," says the GM, since such a detail doesn't affect the scenario. Later, the PCs board the ship and inspect its cold-fusion power plant.

"Pardon me," says a player courteously. "They never did prove that cold fusion is possible."

"Don't care," says the GM, and the game continues.

The Gamemaster should only allow Reality Checks about minor aspects of the campaign, and as always, the players can make only suggestions, not demands, no matter how much they know.

SETTING PLAYER LIMITS<A-HEADER>

The Gamemaster must set limits for his players on their character designs. Otherwise, a player whose character concept has him average or particularly strong in some area, won't know how to put that into numbers. Furthermore, certain aspects of the Hero System, such as Combat Value, are such that if two characters differ by not all that much, say four points of CV, the outcome is almost predetermined. Naturally, a good Gamemaster would avoid this in the interest of dramatic tension. Also, scenarios are much easier to create and run fairly when the Player Characters are similar in ability. Entries are provided for most player design limits on the Campaign Ground Rules Sheet.

BASIC LIMITS<B-HEADER>

Basic limits are those guidelines common to almost every Star Hero campaign. Some of the following limits and rules are not called out specifically on the Campaign Ground Rules Sheet. If not, and the Gamemaster makes an unusual choice, this should be noted at the bottom of the sheet.

A Superheroic campaign crossing over with Champions should ignore all of this section and make the choices recommended in that genre book.

HEROIC CAMPAIGN<D-HEADER>

Most Star Hero campaigns will be Heroic campaigns. Characters will start with a 75 pt. base plus at most 75 pts. in Disadvantages, no more than 25 from any single category. Characters will take Normal Characteristic Maxima for no points. They do not pay points for normal equipment.

COMBAT RULES<D-HEADER>

The recommended choices are listed.

Hit Location Chart<E-HEADER>

Use the chart unless the campaign is heavily romantic or especially nonlethal.

No Knockback<E-HEADER>

A Heroic level campaign should not use the Knockback rules.

Endurance<E-HEADER>

The Endurance cost for Powers except movement is 1/5 Active Points. Limited Pushing is recommended. Long Term Endurance loss is up to the Gamemaster's discretion.

CHARACTER ABILITIES<B-HEADER>

Character abilities for which guidelines should be set include Characteristics, Skill Rolls, attacks, and defenses. Equipment should also be controlled, both directly and by limiting Wealth (see Wealth under Perquisites).

The Ability Range Table suggests value ranges for various qualitative levels of character abilities. Here, "Heroic" signifies character abilities that are average for a Heroic campaign. The "Normal" line represents a skilled Normal. "Powerful" refers to an above-average Heroic campaign, and the ranges on the "Superhero" line should generally be reserved to a Champions-level campaign. The categories are to be scaled individually. That is, the Gamemaster may want average (Heroic) Combat Values in the campaign, but attacks with "Powerful" Damage capability.

ABILITY RANGE TABLE<C-HEADER>

	DAMAGE	CV	SKILL ROLLS	RESIST DEFENSE	TOTAL DEFENSE	SPEED
Normal	3-5 DC	3-4	12-	3-5	6-11	2
Heroic	6-8	5-6	13-15	6-9	12-17	3-4
Powerful	9	7	16-17	10-12	18-24	3-5
Superhero	10+	8+	18+	13+	25+	5+

DAMAGE<D-HEADER>

Damage from attacks, rated in Damage Classes, refers to both innate abilities, such as Martial Maneuvers or psionics, and melee or ranged weaponry. The choice made by the Gamemaster will actually depend on the Tech Level of the campaign as much as anything else; higher Tech Levels tend to have more powerful weapons available (see the Technology Sourcebook). Naturally, the magnitude of the average attack will also influence the range of

recommended defenses.

COMBAT VALUE<D-HEADER>

The listing for Combat Value in the Ability Range Table refers to a character's Dexterity and any Combat Skill Levels. Levels built into a weapon, heads-up displays, and other equipment can be expected to add 2-3 points of OCV. Force shields, Combat Maneuvers, and Range Modifiers will add 0-6 points of DCV. Thus, characters may be allowed to have OCVs about 2 points higher than their DCVs without destroying rough parity.

It is desirable, after all modifiers, to see an attacker's OCV and a defender's DCV within about 3 points of each other. This way, the attacker's number to hit falls in the range of 8- to 14- (25% to 90%) and is uncertain enough to be interesting. If the Gamemaster intends to design opponents according to this criterion, then the Player Characters should themselves have similar (modified) CVs differing by, say, no more than four points. If this is not the case, then some PC will have an unusually difficult or easy time of hitting the opponents. Both the Gamemaster and the player involved should be clear on this.

SKILL ROLLS<D-HEADER>

The listed numbers are suggested ranges for the majority of a character's important Skill Rolls. In addition, a character may be allowed to have one Skill at a higher level. For example, a skilled Normal with a doctorate degree will have a roll of 13- or better in some subject. Players who wish higher rolls for their characters' Skills should not campaign for looser limits, but should instead purchase associated Skills in order to gain Complementary rolls.

DEFENSES<D-HEADER>

The listed ranges for Resistant and total defenses refer to a character's natural PD or ED plus normal Armor and Force Field equipment. Available equipment is also limited by the Tech Level of the campaign (see the Technology Sourcebook). The Gamemaster should also consider the level of attacks to be permitted.

As listed, if the attack range and defense range are taken from the same line of the Ability Range Table, a character will suffer Body damage from Killing Attacks. For example, a Heroic attack will do 2-2 1/2 dice of Killing Damage for 7-10 points minus 6-9 points of defense. Thus, one or two points of Body will go through. The Stun damage will be on the order of 10-12 points, barring a lucky hit, which will not Stun but will knock a character unconscious after 2-3 hits. If all of this is as the Gamemaster wishes, then so be it. Otherwise, the adjustments to the player limits should be clear.

SPEED<D-HEADER>

Speed determines how often a player gets to make decisions in combat, and thus, to an unfortunate extent, it determines the player's enjoyment of the combat experience as a whole. In a Heroic level game, Player Character Speeds should generally be kept within two points of each other, as 2-4 or 3-5. As a practical matter, most players do not give their characters SPD 2, so that the actual range in an average campaign is 3-4.

WEALTH<D-HEADER>

Not listed in the chart, Wealth is also an important contributor to character capability in a science fiction campaign. As mentioned in the Perquisites section, the character with the biggest bankroll is often the one with the most firepower. So, after setting ability guidelines, the Gamemaster should then check the Technology section for the price of equipment that will meet those guidelines. This will suggest a limit on character Wealth. Further suggestions may be found in the Perquisite entry.

OTHER LIMITS<B-HEADER>

The numerical limits on player designs described previously do not tell the whole story. The careful Gamemaster will more than likely also find reason to forbid or require certain combinations of character abilities without regard to numbers. First, though, since some Gamemasters live and die by Hero System point totals, a word on that subject is in order.

WHY SOME THINGS DON'T DEPEND ON POINTS<C-HEADER>

Certainly, points are a good start for comparing Hero System

capabilities. A character built on a base of 150 pts. can do more than one built on 75 pts. A laser rifle with a 60 pt. Active Cost is probably more dangerous than one with a 45 pt. Active Cost, but only if the Limitations are similar. Point totals can be both inconclusive and misleading for several reasons.

INTERNAL DETAILS<D-HEADER>

When two characters or two devices have similar cost totals, their internal details have to be compared. A 150 pt. character with no Disadvantages is less restricted than a 75 pt. character with 75 pts. of Disadvantages and may be better off than a 120 pt. character with those same Disadvantages. Armor Piercing and Penetrating are both +1/2 Advantages, but which is better in a weapon depends on who is on the other end of the barrel. Thus, the Gamemaster should always be willing to examine the components of a writeup, particularly if a player proposes something unusual and bristling with Power Limitations.

SIDE EFFECTS<D-HEADER>

Abilities and devices may sometimes have side effects disproportionate to their costs. FTL Travel may be the best example of this. For +2 Base Cost, possibly less in terms of Real Cost, the speed of travel is doubled. This effectively halves the dimensions of explored space. The Gamemaster who wants to preserve the vast reaches of space will probably want to impose an absolute limit on FTL technology. Similarly, if the campaign is to emphasize mysteries or espionage, psionic Telepathy and devices for Sense Blood Pressure at Range will have to be discouraged.

INAPPLICABILITY<D-HEADER>

Not all capabilities are actually measured in points. Certainly, once player and Gamemaster have agreed on an income level for the player's character, he is free to buy anything in the department store. The Gamemaster will have to ensure that the only items for sale are those he can permit in the campaign.

Combinations of abilities can create entirely new effects. Eidetic Memory, already tricky to police, may be too versatile if coupled with Cramming or Speed Reading.

Synergistic combinations between players can also be overly useful. A robot character will be much more viable if someone has purchased Mechanics and KS: Robot repair. And watch out for that character with Inventor!

CAMPAIGN DETAILS<D-HEADER>

The nature of the intended campaign may induce a Gamemaster to encourage or discourage certain character abilities beyond their nominal point costs. Some Skills may actually be required (see below), but adjustments of a lesser nature may be in order. For example, the existence of psionics may make thought screens cheaper in price or, conversely, illegal.

FINE RESTRICTIONS<C-HEADER>

Every campaign being unique, the distinctive features of the one in question will likely reflect themselves in the list of available character abilities. If the Gamemaster foresees much of this, he should create a list for the players of common, uncommon, and forbidden abilities much as the one found in the Skills section. Advice on Characteristics, Skills, etc., may be found throughout the Character Creation section.

CHARACTER TYPES<D-HEADER>

The Gamemaster must state whether unusual character types such as artificial characters, mutants, variant humans, psions, or aliens are available. Many of these will need a Control Sheet and a Package Deal.

SKILLS<D-HEADER>

Particularly likely to change from campaign to campaign are the Languages and Transport Familiarities. The players should be made aware of the detailed descriptions of the various technological Skills (Computer Programming and so on).

PERQUISITES<D-HEADER>

As stated at the head of the Perquisites section, some costs are open to Gamemaster discretion. The list of Fringe Benefits will also change with the campaign.

TALENTS<D-HEADER>

Most campaigns will allow at least a few Talents. The Gamemaster should indicate desired frequencies.

POWERS<D-HEADER>

Which characters may purchase Powers, if any, must be indicated by the Gamemaster. If any will be in use, say for psionics, then a list of approved and disapproved Powers will be needed.

DISADVANTAGES<D-HEADER>

The Disadvantages section describes how appropriate various ones are to the standard Star Hero campaign. The Gamemaster should list any deviations for the players.

PACKAGE DEALS<D-HEADER>

Available cultures and professions should be listed for the players.

DESIGN REQUIREMENTS<C-HEADER>

The nature of the campaign may require all Player Characters to share certain abilities or Disadvantages. Naturally, the Gamemaster will inform the players of any such requirements. Some of the likeliest situations are listed below.

REQUIRED SKILLS<D-HEADER>

The nature of the campaign may require all characters to have a set of common Skills, for example, PS: Spaceman. The Gamemaster may ask nicely for everyone to share a common language. Or, for character survival, the Gamemaster may dictate Skills such as PS: Vacc suit.

SKILL POOLS<D-HEADER>

If the characters comprise, say, a starship crew, they may be asked to furnish amongst themselves a pool of Skills. In this case, the requirements would include a pilot, a navigator, an engineer, and a ship's doctor.

REQUIRED DISADVANTAGES<D-HEADER>

Characters all employed by the same organization would probably share a Watched. Humans among aliens, or vice versa, would have Distinctive Features.

COMMON PACKAGE DEALS<D-HEADER>

Characters belonging to the same organization may actually share enough to warrant a Package Deal. For example, in a war or espionage campaign, they would all have certain Skills from common training, certain Perquisites due to rank, and Disadvantages such as Watched, Hunted, or Reputation.

MANAGING SCENARIOS<A-HEADER>

Congratulations to the new Gamemaster, for the campaign is in place. Worlds and future history are written, Player Characters are designed and approved. Now all that is needed is scenarios. Lots of them. As many as can be thought of, perhaps.

This section describes how to think up scenarios and how to plot them. Also addressed is how to run them, keeping scenarios interesting and fair. Further advice on scenarios may be found in the Champions supplement, Challenges for Champions. The section closes with Gamemaster tips on two important aspects of science fiction role playing, Sciences and space combat.

CREATING SCENARIOS<B-HEADER>

A scenario starts with an idea. That idea must be expanded into a full plot with details interesting to the players.

GETTING IDEAS<C-HEADER>

Some people can think of story idea after story idea with seemingly no effort. Others have to strain and reach to find any meager excuse for an adventure. For those people, discipline and hard work will eventually produce something, given a program to follow. So, where do ideas come from?

BOOKS AND MOVIES<D-HEADER>

The easiest way to get a plot idea is probably to steal it from somebody else. Print and visual fiction hold plenty of ideas. It is best not to be too faithful, though, in the translation, if for no other reason than to prevent the players from guessing the ending. If the original source is outside of science fiction, then some conversion is almost unavoidable. Cities can become planets, desert islands can become uncharted asteroids, and so on. A good adaptation is one that works for the players even after they recognize the underlying source material.

CAMPAIGN ELEMENTS<D-HEADER>

Something in the Gamemaster's original campaign layout may merit further expansion. Perhaps an interesting alien race should be investigated more; the players can visit the home world. Perhaps some feature on the star charts was casually given an odd name; the Gamemaster can now think of a reason for it. And, there are always, of course, the characters' campaign Disadvantages. Hunters, Dependents, and Watchers can furnish scenarios or pad very thin plots.

INTERESTING SITUATIONS<D-HEADER>

Inspiration for a plot may stem from a single scene that catches the Gamemaster's fancy. An alien dreadnought swallows the characters' ship. The characters try to talk to intelligent grass. A meteor strike interrupts the diplomatic conference. The Gamemaster should take this scene, decide what leads up to it and what follows, and build a plot. Because are Player Characters never predictable, however, the Gamemaster should be emotionally prepared for the unpredictable in case this favored situation never comes about during play.

CHARACTER ABILITIES<D-HEADER>

Possibly one or more characters have abilities the Gamemaster would like to see used. A plot can be built by figuring out the appropriate situation and expanding from there. Perhaps a character speaks Armenian -- an Armenian colony could be created, or old Armenian scriptures could be the target of a theft. Peculiar Transport Familiarities can be used in an obvious way. Professional Skills can be exercised during undercover work or to get a job close to someone important. A fringe benefit of this approach to plot construction is that the player who purchased the unlikely Skill will be pleased at being the key to success.

PLAYER REQUESTS<D-HEADER>

It is possible that one or more characters have abilities that the players would like to see used. Or, players may request to have Hunted situations resolved, or an opportunity to learn TF: Large spaceship. Even if no one says anything, the Gamemaster should eventually solicit requests, for the campaign belongs to the players as well. Given the request, then, a situation should come to mind and be expanded into a full plot.

OLD SCENARIOS<D-HEADER>

After a campaign has run for a while, follow-ups to old scenarios may be in order. Non-Player Characters can return with new problems. Old situations may flare up again. Here, getting an idea is as simple as recollecting the previous scenario and deciding what the NPCs have been doing between then and now.

STRUCTURING SCENARIOS<C-HEADER>

A lone idea does not a scenario make (but it's a great start). As with any other narrative writing, the scenario has to be given a beginning, a middle, and an end. The necessary components will be examined in order.

INTRODUCTION<D-HEADER>

The first task is to introduce one or more characters to the problem: A distress call whispers on the ether. A long-lost relative bursts in, dodging blaster fire. A technetium strike is made in the Boreus Belt. If the plot has multiple parts, or competing bad guys, or some other separable aspect, different characters can be introduced to different elements of what's going on. Not everyone has to be involved in the introduction if it's kept short, but it will save time later if all of the players listen.

HERO ROUNDUP<D-HEADER>

The Player Characters have to be brought together and made aware of what's going on. If everyone belongs to the same group, no problem. Otherwise, it may be as simple as mailing out free tickets to Elysium, the resort planet. Characters who do not normally work together can be brought to the site of the plot in many different ways as well. They can be hired by a Non-Player Character, they can fail a Navigation Roll and fly there by mistake, they can make a Streetwise Roll and hear rumors. Occasionally, though, some contrivance is necessary, particularly if this is the first scenario of the campaign. If so, the players should realize the necessity of what is being done and cooperate.

THE MIDDLE<D-HEADER>

The middle of the story has the bulk of the action and can be paced many different ways. Two situations crop up frequently. In the first, the Player Characters have to gather information to find out what's going on or where the villain is. If this is the format, the middle portion is simply a sequence of PC encounters with information sources. If the characters divide up into small teams, care must be taken to move the plot briskly so that no one sits around for too long (though this also depends on the temperament of the players).

In the second frequently-occurring situation, the PCs have as much information as they need and are simply involved in a chase or bait-and-capture attempt. This will require more work by the Gamemaster to choreograph. Complete success should be divided up into several steps, saving the best for the climax. The heroes should be allowed to win one or two and lose one or two before the end. For example, if bad guys are trying to pull off a theft, the Gamemaster can have small groups of them fail or partially succeed in, effectively, rehearsals before the showdown. Or, in a tried-and-true formula, the items to be stolen can be located on different planets with the heroes protecting them sequentially.

TROUBLESHOOTING<D-HEADER>

Occasionally, i.e., 80% of the time, a scenario will not go as planned. Either the heroes will do something completely unexpected, such as finger an innocent planetary governor, or bad luck will intervene with a failed 16- Demolitions Roll. The carefully prepared plot collapses or is totally irrelevant. The harried Gamemaster has three choices. Possibly he prepared an alternate plotline for critical turning points. Or, he might be able to improvise the rest of the way.

The last possibility is to write contingencies into the script to shove it back on track. These are such stratagems as a spare opponent to spring the main bad guy when he gets captured too early, or a revision of the plot schedule when the Player Characters take too much or too little time. If the PCs go flying off into space in entirely the wrong direction, a carelessly leaked radio broadcast, a police report, or a lucky sighting can bring them back. The only certainty is that some form of damage control will be needed at least once during the adventure. If

things get too messed up though, the best bet may be to stall for time and correct things during the next gaming session.

FINALE<D-HEADER>

The finale wraps up the conflict. Ideally, it should be exciting and challenging and give everybody something to do. A big fight with the villain is always a good bet. Sometimes, the climax involves Skill Rolls by multiple people, such as simultaneous attempts to defuse a warhead, reprogram the missile, and warn the target city. The Gamemaster should usually be prepared for the Player Characters to either succeed or fail and know how to follow up either one.

DENOUEMENT<D-HEADER>

The denouement or resolution ties up loose ends. Captured opponents are interrogated to find out minor plot points. Government officials hand out rewards. Paramedic Rolls save wounded heroes. The Gamemaster may also want to introduce at this point the beginning of the next scenario.

FLESHING IT OUT<C-HEADER>

The skeleton of a scenario represents a lot of work accomplished, but details are required to flesh it out. In essence, this involves adding a lot of facts concerning people, places, and things. Also, a careful Gamemaster writes everything down, at least in condensed form.

CHARACTERS<D-HEADER>

All characters in the script should have names, minimal descriptions, and some kind of personality tag (nervous, brusque, etc.). All major characters should get the full treatment - character writeups, Disadvantages, physical appearance, and personal history. Some Gamemasters choose to draw a face or refer to a famous person for each character's likeness. Whatever will make these people seem real to the players is what works.

Character Sheets<E-HEADER>

Important characters in the plot should actually be written down on character sheets, with Characteristics, Skills, and Disadvantages. The points don't need to balance, but an honest effort should be made. If agents are involved, one sheet will cover them all, with a companion list of equipment carried and any Skills that may differ among them.

LOCATIONS<D-HEADER>

All places in the script should be sketched crudely by the Gamemaster so that he can describe them to the players without wasting time. Brief descriptions should be prepared that will fix these places in the players' minds. The type of architecture, the smell of the air, and the level of background noise are all good details.

Maps<E-HEADER>

Any location where the Gamemaster expects a fight will have to be mapped more carefully. Since the area will be transferred to a hex grid for combat, it should probably be drawn on one to begin with. The Gamemaster should decide the dimensions of buildings, locations of exits, and important features such as trees and furniture. The Body and DEF of walls and doors should be noted on the original map.

ITEMS<D-HEADER>

Important props will have to be described to the players. Even unimportant ones may need descriptions; the Player Characters don't necessarily know what a door key looks like on this planet. Unusual-looking objects that are completely functional go a long way toward establishing an alien or futuristic atmosphere.

Drawings and Writeups<E-HEADER>

Major items, such as the ancient artifact everyone is trying to steal, should be sketched for the players' benefit. Anything important that actually does something will also need a Hero System writeup. At a minimum, objects should be assigned Body, DEF, and Active Costs.

DETAILS<D-HEADER>

Extra details beyond the necessary minimum spelled out above

will serve several functions. First, they will disguise the important features. The Gamemaster may know that a neutron time bomb has been concealed in the space marshall's desk, but that room should be given other furniture as well. Extraneous details are entertaining in their own right and will come in handy when the Player Characters start asking unlikely questions or go off to visit unlikely places. Finally, those details may be a starting point for future scenarios.

SIDEPLOTS<D-HEADER>

Sideplots are brief storylines that run consecutively with the main action and are resolved before the end of the adventure. If left unresolved, they may turn into subplots, described below. Sideplots should be kept simple as with, for example, a brief romantic interest or a non-player detective working on the same case. Character Disadvantages can be used as sideplots, and sideplots can be recurring themes rather than people. If someone suffers acrophobia, then all of the buildings on the planet can be placed on stilts and given transparent floors.

SUBPLOTS<D-HEADER>

Subplots are similar to sideplots except that they persist for several adventures. One form of subplot is a foreshadowing and buildup to the next adventure.

Example: Say that the next adventure will feature Mad Mbilli, the Zulu space pirate. During Session 1 of the current adventure, the characters get word from the street that six-foot-plus thugs of African ancestry are being hired in unusual numbers. During Session 2, someone they are interviewing mentions that her brother, the antique spear carver, does not answer his vidphone. During Session 3, news reports describe a ship found drifting, its crew speared to death. The stage is set for the next adventure.

Subplots may also develop the relationship between a character and his Hunted or Dependent. With greater effort, a relationship may be established with someone completely different, instead. Players will make their own requests for subplots, as when a PC wishes to learn a new skill and goes searching for a teacher. Players normally enjoy subplots, but only one or two should be given significant time during any single adventure. Naturally, players should be given turns as the focus of a subplot.

[DAVE: SOMEWHERE I WROTE ABOUT WHAT I CALLED "SIDELINES". THIS IS A SORT OF AN OPEN-ENDED SUBPLOT WHOSE PURPOSE IS TO JUSTIFY ADVENTURES -- EXAMPLE, THE PCs HAVE A SHIP AND THEIR CURRENT SIDELINE IS TO TAKE THE LONDON SYMPHONY ORCHESTRA ON A CONCERT TOUR OF THE SECTOR. THAT'S JUST AN EXCUSE FOR THE GAMEMASTER TO GET THEM ON A DIFFERENT PLANET EACH WEEK AND HAVE ADVENTURES THERE. I KNOW I WROTE ABOUT IT BEFORE, I JUST CAN'T FIND THE FILE YET.]

CLASSIC BITS<C-HEADER>

There is a multitude of recurring story elements in science fiction, some of which are listed below. The Gamemaster should look for opportunities to include these recognizable bits when designing or running a scenario.

THE TRAMP FREIGHTER<D-HEADER>

This is a cargo ship held together by glue and wire. It may be the Player Characters' own ship on which things are continually breaking, or it may be the only ship available in port when they have to escape the authorities fast.

EMERGENCY TAKEOFF<D-HEADER>

It's usually the tramp freighter that is called upon to do this. Characters have to run through their takeoff checklist faster than normal (perhaps with a penalty to Navigation) while the authorities approach, fighter ships scramble, and guns come to bear.

PRECURSOR RACE<D-HEADER>

This is a mysterious, very advanced alien race which has long vanished, but whose influence can still be found throughout explored space. Called the Ancients, Preservers, Seeders, etc, their legendary powers include the crafting and distributing of other races (like us), terraforming worlds, and inventing incom-

prehensible technology. Gamemasters will find such a race useful because it provides a simple explanation for why many worlds support Earth-type life, or why so many races resemble humans or Earth animals. They also provide adventure plots by leaving all those age-old, unfathomable artifacts and ruins lying around. And what if these aliens aren't all dead after all?

DERELICT SPACECRAFT<D-HEADER>

The PCs' ship encounters a drifting, apparently abandoned spacecraft. It could be of alien origin, a relic from the character's own civilization, or could even date back to a precursor race. It's guaranteed to contain something of value: a previously unseen lifeform, a new automated weapon system, an unusually intelligent AI -- but it also holds hidden dangers: a previously unseen lifeform, a new automated weapon system...

ALIEN RUINS<D-HEADER>

Dead worlds often have mysterious alien ruins just where the Player Characters choose to land. On a human colony world, the presence of alien ruins may provide an important clue to the colony's own survival.

SPACESTATION BAR<D-HEADER>

Bars in spacestations are filled with the riffraff of a hundred worlds and possibly as many species. All sorts of contacts and enemies turn up just when they are needed (or not wanted). Space bars can be handled in many ways the same as they are in western movies.

CUTE ALIEN PETS<D-HEADER>

Usually picked up on an uninhabited world by someone who should know better, this pet will blend into the characters' lives for a while. Eventually, though, it will be revealed as a danger to the ship/the crew's only hope/a carrier of plague/actually intelligent.

RISKY PILOTING<D-HEADER>

When our heroes' ship is being chased, they may need a close approach to a planet/star/black hole to throw off pursuit, or a fast course through a crowded asteroid field, or entry to hyperspace from much too far into the gravity well. The pilot chooses what penalty to accept on his Combat Piloting Roll, and any pursuers must accept the same penalty.

FIGHTS ON SHIP<D-HEADER>

Sooner or later the characters will be fighting on shipboard (hopefully under gravity -- another issue entirely). They may have to repel pirates or hunt down a monster, all while worrying about stray blaster shots holing the hull.

AIRLOCKS<D-HEADER>

You can't sneak aboard a ship using an airlock; it takes time to cycle and there are indicator lights. Characters may need a distraction, or they can blow open the lock while wearing space suits. Being sucked out an airlock is another form of excitement. The Gamemaster should decide what kind of roll to give a character to let him hang on inside.

LANGUAGE<D-HEADER>

Space Opera has its own set of interjections: "Great galaxies!", "By the moons of Jupiter!", "Comet dust!". More serious equivalents also exist for other campaign styles. There is also casual reference to fictional planets and lifeforms. Finally, units of measure are usually metric in science fiction.

ALIEN SKIES<D-HEADER>

Alien skies are seldom completely normal. They may be green or purple, depending on the air pressure (Mars has pink skies). Too many moons of the wrong size are usually floating around. And, the primary star itself may be red or orange and larger or smaller than Sol.

RUNNING SCENARIOS<B-HEADER>

A properly planned scenario is not difficult to run. There are, of course, good ways to run a scenario as well as other ways. The advice given here is more a list of techniques and caveats than it is a series of instructions.

PREPARATIONS<D-HEADER>

Character sheets, maps, and scenario notes should be ready and available at the start of the session. If some players arrive early, they can remind each other of what happened last time, with the Gamemaster fielding any lingering questions.

PACE<D-HEADER>

The scenario should move at a good pace, particularly when not everyone is participating and during intervals when the players are exploring unproductive options. Since so much of the effort and detail is often put into the climax, enough time must be allowed for it to be executed properly.

DETAILS<D-HEADER>

Situations can be interesting in proportion to the quality of detail used in their descriptions. Descriptions should be consistent with the style of the campaign. In space opera or romantic sf, pressure doors hiss softly. In realistic, pessimistic mode, airlocks groan and clang. The lighting is bright or shadowy, the air is crisp or dank, the hyperspace engines hum or howl. It is the responsibility of the Gamemaster to set the mood with the right choice of words.

FAIRNESS TO ALL<D-HEADER>

Everyone should get a piece of the action. Depending on the structure of the plot, players may act sequentially on different problems, or simultaneously during one big emergency. With the first structure, the Player Characters ideally are allowed to divvy up the tasks themselves. If not, the Gamemaster should try hard to give them tasks that are equally challenging based on their particular abilities. During the big emergencies, some protocol may have to be established to determine who speaks first. (The Speed Chart will handle this during combat.) Ideally, every PC will have something appropriate to do. To make this happen, the Gamemaster may have to throw in extra victims to be rescued or make suggestions (based on a Deduction Roll) to those not doing anything.

QUICK JUDGMENTS<D-HEADER>

Situations will come up that the Gamemaster didn't anticipate and may not even know the rules for. Rules questions can be looked up. If the plot is drifting, though, or the bad guys have the wrong power level, the Gamemaster will have to make a judgement of another kind and change the prepared script. Enemy agents may need to suddenly lose half of their Stun points or, alternatively, the second wave of agents may need to be tougher and more accurate. If the players are following an investigation but simply not getting the answer, some NPC may have to offer a clever suggestion. In other words, the scenario has to be monitored constantly for adjustments less drastic than full damage control.

MAINTAIN AUTHORITY<D-HEADER>

What the Gamemaster decides, is truth. He may entertain appeals if desired, but situational and rules questions to be established for the future are best held until after the game.

REFER TO NOTES<D-HEADER>

Those scenario notes made before the game should be followed unless a good reason says otherwise. With luck, some of the odd questions that players ask will even be anticipated there.

MAKE NOTES<D-HEADER>

Notes should be made about what happens to NPCs, about new characters introduced on the fly, and about the resolution of the plot. Rules interpretations should also be recorded. All of this will be more than helpful when writing and running new scenarios.

GAMEMASTERING SCIENCES<B-HEADER>

Sciences are important in realistic science fiction, obviously. This section discusses some Gamemastering techniques that will help the players feel as though their Science Skills are meaningful. First, however, some distinctions should be made:

Science Skill<E-HEADER>

A Science is a collection of facts, procedures, and theo-

ries concerning a particular topic, usually an aspect of nature. This information is logically ordered in such a way that the character can gain new information and increase his Skill Roll by working with it, either deriving new theories from old or by performing experiments.

Engineering Science<E-HEADER>

This is a true Science that is more applied than a theoretical one. It is a collection of facts, procedures, and applications in a single area, usually a kind of hardware or software. The character may improve his Skill Roll by working in his field and testing new designs. Almost every engineering Science has a corresponding theoretical Science, and vice versa.

Knowledge Skill<E-HEADER>

This is a body of knowledge about a particular topic. The knowledge is not necessarily interrelated, and the way the character increases his knowledge is by reading more books or spending time in the area he knows about. A Knowledge Skill may be used to represent a Professional Skill or Science that the character has read about but never had direct experience with.

Professional Skill<E-HEADER>

This is some skill that the character can perform other than the standard Hero System Skills and which is not properly represented as a Science. This is often an employable skill. When purchased for a scientific occupation, this Skill represents everything about the job other than the actual scientific work; that is, it represents knowing who is prominent in the field, what publications are available, and which organizations hire such people.

USING SCIENCES<C-HEADER>

When should a character be able to use a Science? The following circumstances are the most likely:

The character wishes to answer a technical question<E-HEADER>

The character wants to know why something is as he sees it; whether something is unusually large, small, noisy, etc., for its type; which star is likely to live longest; where he is likely to find a deposit of corundum. These are questions in the realm of a theoretical science.

The character attempts to work on a design, device, or procedure<E-HEADER>

The character attempts to design a weapon; the character creates a map of a city; the character adjusts a set of fuel flow valves for optimum performance. These are tasks within some engineering discipline.

PRACTICAL CONSIDERATIONS<C-HEADER>

In some cases, a Knowledge or Professional Skill may be Complementary to the Science. If the task is such that additional raw facts will help the character, then a Knowledge Skill will contribute. For example, if a character is attempting to determine what is unusual about a particular river, then KS: rivers would be complementary to Geology or Hydrology. If an attempt is being made to impress one's colleagues or outsiders with the quality of result, then a Professional Skill will help. However, if a Skill already exists within the Hero System for doing something, then the Science is Complementary to it and may not be the base roll. For example, the design of a device will require an engineering Science Roll, but attempts to build most things will use Electronics or Mechanics.

The purpose of the optional Science Chart is to permit the Gamemaster to require Science Skill Rolls as he feels appropriate, even if the players have not purchased many Sciences for their characters. With the chart, the player group collectively need only purchase one Science from each tree; this amounts to four Skills. Then, at least one character will be able to attempt a roll, no matter what specific discipline is called for. The Skills section explains what the derived default rolls are.

The Gamemaster should be cautious of requiring unreasonably specific Sciences to perform a task, especially those below the third level of any tree. After all, any particular use of Astronomy will be for some specific purpose. Just because the character is trying to analyze a gas giant doesn't mean that Planetary

Astronomy, Jovian is the required Skill. If a character has a Science that is more specific than the Gamemaster would have required, then either it becomes a complementary Skill to the derived roll or it can be the base Skill at a bonus of +2.

Example: the character wishes to design a mechanical heart. The required Science is either Heart Cybernetics or a combined Skill, Cybernetic Cardiology. Either of these shares 4 points of similarity with Cybernetics (general). So, a character with that Science would have a derived roll at -2 to which he could add Cybernetics as a Complementary Skill. Cardiology also has 4 points of similarity with Cybernetic Cardiology or 3 with Heart Cybernetics, depending on which of the two the Gamemaster rules is the base Skill. Therefore, a character with only Cardiology could also attempt the task using a derived roll based upon the appropriate degree of similarity. Now, because the Gamemaster would allow either of these cases, a character who actually has Heart Cybernetics should receive a bonus to his roll.

It is likely that a player will want a Science that is not listed on the tree. It should not be difficult, though, for the Gamemaster to locate the correct major branch of the correct tree. Beyond this, placing the Science is just a matter of comparing how specific it is in relation to the given Sciences. It is possible that a character will think of a Skill that can be treated as a Science under the above guidelines, but cannot be placed on any of the existing science trees (Numismatics, possibly, or Astrology). The Gamemaster will have to judge these cases individually and start a new tree if it is warranted.

CHOREOGRAPHING SHIP COMBAT<B-HEADER>

How to keep everyone busy during spaceship battles? Ship-to-ship combat is potentially very exciting and compelling, but not if most of the players aren't involved. Some hints as to what to do can be found in the Spaceship Combat section, but possibly things need to be listed in detail.

ASSIGN CREW FUNCTIONS<C-HEADER>

A crew of four to six can all have distinct roles in combat, depending on the design of the ship. Optimally, this is handled during the campaign design stage. Players design their characters to be the ship's pilot, engineer, etc., and the Gamemaster ensures that the PC ship is complex enough to keep them all busy.

PILOT<D-HEADER>

The pilot uses his Phases to move the ship and perform the Combat Maneuvers described under Spaceship Combat. If the character's SPD is higher than the vehicle's SPD, he should use the in-between Phases to recover from bad Combat Piloting Rolls and to communicate with the rest of the crew.

Desired Skills: Combat Piloting, Transport Familiarity, and DEX/SPD at least equal to the vehicle's.

SENSOR OPERATOR<D-HEADER>

The ship's sensors make Perception Rolls based on the operator's Systems Operation. The same Skill is used for ECM vs. opposing ships' Perception Rolls. Both of these can be performed in the same Phase, though the character operating the equipment will have to split any Skill Levels between the two functions.

Ship's sensors will be unopposed sometimes. Any opposing ship may not be using ECM, or the PC ship may be using its weapons to shoot passive targets such as asteroids. In this case, the same character can also perform as communications officer.

Desired Skills: Systems Operation, appropriate Knowledge Skills.

COMMUNICATIONS<D-HEADER>

The communications post includes ship-to-ship and intraship communications as well as damage assessment. Tactical analysis may be assigned to this position as well, since it may be the only station with all the information. This is not a high-demand post, so the communications officer may be given something else to do as well. Command, tactics, sensors, and a minor weapon are all possibilities.

Desired Skills: Systems Operation, Tactics, and support skills such as Computer Programming or Security Systems.

ENGINEER<D-HEADER>

The ship's engineer allocates reserve power to various functions each Phase as described elsewhere. He should work closely with the pilot to determine what will do the most good. The engineer is also an auxiliary damage control officer.

Desired Skills: Mechanics, PS: Engineer, appropriate Knowledge Skills and Sciences.

DAMAGE CONTROL<D-HEADER>

This is a standby position, so the character assigned may have another responsibility as well. The damage control officer attempts repairs in combat to systems that have been damaged, and attempts to patch or circumvent problems such as hull breach.

Desired Skills: Electronics, Mechanics, Weaponsmith, appropriate Knowledge Skills, and extra Running.

MEDICAL OFFICER<D-HEADER>

This is another standby position, ready to do to people what the damage control officer does to equipment.

Desired Skills: Paramedic, appropriate Sciences, PS: Doctor.

WEAPONS<D-HEADER>

Each weapon should be manned by a different person. If the ship has a large crew, then multiple weapons is the way to keep them all busy. Ship weapons are generally limited as to arc of fire, and this should be established during ship design.

Desired Skills: Weapon Familiarity and high OCV.

PROVIDE MULTIPLE SHIPS<C-HEADER>

The obvious appeal to having multiple PC ships is that it requires more pilots, more engineers, and so on. This situation may come about after the characters' ship defeats its first pirate (you are going to run a pirate scenario, aren't you?) and decides to keep their vehicle as booty. An odd alternative is to make the Player Characters all fighter pilots aboard a space carrier as in Battlestar Galactica. More simply, the main PC ship can have a combat-worthy shuttlecraft that takes a one- or two-man crew.

RUN SIMULTANEOUS PERSONAL ACTION<C-HEADER>

Characters will be kept busier than they ever wanted to be if things are happening aboard ship at the same time that it is being shot at. This plan may require two maps, one at Megahex scale for the ship engagement and the other at personal scale for the in-ship entertainment. In any case, the Speed Chart is tracked simultaneously for everybody.

BOARDING PARTY<D-HEADER>

This can be run both ways, with hostiles trying to enter the PC ship or Player Characters boarding one of the opposing ships. A variation on this is escaped prisoners trying to gain control in combat. The introductory scenario "Brain Trust" contains a different twist on this idea.

ANOTHER PLOT THREAD<D-HEADER>

Ship combat may be just the time to spring something else that has been waiting in the wings. That alien pet may get loose in the commotion, for example, or a Hunted may have sabotaged the cleaning robot.

ENVIRONMENTAL HAZARDS<D-HEADER>

Hazards such as decompression and exploding machinery may happen even without planning, and might be tracked at personal scale rather than being abstracted. Other exciting events can be planned ahead of time, perhaps contingent on the right Ship Hit Location Rolls. These include fire and leakage of hazardous cargo.

GENRE RULES<A-HEADER>

Science fiction embraces a wide variety of people, places, and situations. So it's not surprising that some extra rules are needed beyond the Hero System Rulebook, which covers the general case. Differences in Skill usage are in the Skills section under Character Creation. New combat rules are in the Combat section (of course). These include spaceship combat and alien Hit Locations. Most everything else is collected right here, if we did things right. Here are character rules for Skills and Perks, high and low gravity rules, and rules for surviving environments from the inconvenient to the very dangerous. Enjoy this section.

TIME CHART<C-HEADER>

This is the expanded Time Chart for use with very long periods of time.

1 Segment	
1 Phase	
1 Turn	(Post-Seg 12)
1 minute	
5 minutes	
1 hour	
5 hours	
1 day	
1 week	
1 month	
1 season	(3 months)
1 year	
5 years	
20 years	2 decades; 1 generation
1 century	1 lifetime
5 centuries	
2 millennia	recorded history
10 millennia	
50 millennia	
200 millennia	1 ice age period
1 million years (MA)	existence of Man
5 MA	
20 MA	
100 MA	existence of mammals
500 MA	existence of vertebrates
2 billion years (GA)	age of Earth
10 GA	age of universe; lifespan of Sun

RANGE MODIFIERS<C-HEADER>

For the very long ranges encountered in space, an extended Range Modifier Chart is needed. These modifiers are used for Perception Rolls and combat at ordinary Personal Scale. At KiloHex Scale add +20, at Megahex Scale add +40, and if you dare to use Gigahex Scale add +60. (See the space combat design rules, below, for what all these scales are.)

EXTENDED RANGE MODIFIER CHART<D-HEADER>

HEXES	MOD	DISTANCE
4	-0	8 m
6	-1	12 m
8	-2	16 m
12	-3	24 m
16	-4	32 m
24	-5	48 m
32	-6	64 m
48	-7	96 m
64	-8	128 m
95	-9	190 m
125	-10	250 m
187	-11	375 m
250	-12	500 m
375	-13	750 m
500	-14	1 km
750	-15	1.5 km
1000	-16	2 km
1500	-17	3 km
2000	-18	4 km
3000	-19	6 km
4000	-20	8 km
6000	-21	12 km
8000	-22	16 km
12,000	-23	24 km
16,000	-24	32 km
24,000	-25	48 km
32,000	-26	64 km
48,000	-27	96 km
64,000	-28	128 km
95,000	-29	190 km
125,000	-30	250 km
187,000	-31	375 km
250,000	-32	500 km
375,000	-33	750 km
500,000	-34	1000 km
750,000	-35	1500 km
1 million	-36	2000 km
1.5 million	-37	3000 km
2 million	-38	4000 km
3 million	-39	6000 km
4 million	-40	8000 km
6 million	-41	12,000 km
8 million	-42	16,000 km
12 million	-43	24,000 km
16 million	-44	32,000 km
24 million	-45	48,000 km
32 million	-46	64,000 km
48 million	-47	96,000 km
64 million	-48	128,000 km
95 million	-49	190,000 km
125 million	-50	250,000 km
187 million	-51	375,000 km
250 million	-52	500,000 km
350 million	-53	750,000 km
500 million	-54	1 million km
750 million	-55	1.5 million km
1 billion	-56	2 million km
1.5 billion	-57	3 million km
2 billion	-58	4 million km

Example: The Earth-Moon distance is 400,000 km. A character on Earth thus suffers a Perception Roll modifier of -52 for range to see a character on Luna. A ship built for Megahex Scale and parked in low Earth orbit would be sensing the character on

Luna at essentially the same range, but would only incur a modifier of -12.

PERCEPTION IN SPACE<B-HEADER>

Backgrounds: black, starry (nite in country), very starry (milky way), extremely starry (core). Dark on light. Light on dark. As relative distance doubles, increase magnitude by 2.5, PER-2.

Sensor use: when is it trivial to spot something? What size/range? (Systems Operation replaces PER Roll.) planets: detection modifiers (mass, size, albedo). Remember, nothing you see more than a light-second away is happening anymore! Even with telescopic vision and beaucoup Perception Levels, what you're looking at is simply a perfect Image. Psionics may miss!

BUYING WORLDS AS BASES<B-HEADER>

"There's the Brande estate - it's a small planet!"
"Why doesn't he buy a large one?"
"What do you think he is - a showoff?"

- Legion of Super Heroes, _____(date)

Don't be surprised if your space explorers find a wonderful uncharted planet (or an asteriod, abandoned space station, etc.) - and want to keep it . Should you let them? Probably.

OBTAINING A PLANET<C-HEADER>

There are a number of ways to get your own planet.

PAY FOR IT<D-HEADER>

In cash. If the society allows planets to be owned, then the characters can pay the previous owner (probably the government). The cost will depend on how common planets are, accessibility, desirability, and ease of access - just like any real estate. If your galaxy is crisscrossed by a public teleportation net, and millions of usable worlds have been discovered, then a deed to a world may go for less than a billion credits. Any country - or large organization - could have one.

PRIOR CLAIM<D-HEADER>

The world goes to the person who locates, or first lands on, the planet and says "It's mine," as long as he registers his claim. This may apply to previously unknown worlds, or those that the government has designated "public land." This is the way the Homestead Act worked in 19th Century U.S.; although, as in the Act, it is more likely that homesteaders would be allowed to claim part of a planet. A claim may not be honored by hostile governments, aliens unaware of your civilization's existence, native inhabitants, or claim jumpers. Which brings us to:

SECRET CLAIM<D-HEADER>

If you happen upon a planet that no one else knows about, you can do pretty much what you want with it. If a planet is very sparsely populated - say a new colony with only one city - a separate party could land and set up a base thousands of kilometers from anyone else without being spotted (depending on the other guy's sensors). The city may suspect that they share their world with dozens of claim jumpers - pirate's safe haven and the like - and not have the resources to catch them.

POINT COST AND OTHER LIMITS<C-HEADER>

In a Heroic game, you never pay points for a base, no matter how big it is. In a Superheroic game, characters pay points for their base and its grounds. A whole planet costs surprisingly few points, but most characters will still only be able to purchase part of the world. Your players may want some justification as to why they can only have one small section of a wilderness light-years from anyone.

A "base" is something with walls - a building, fort, cave. The "grounds" are the area that the character has control over. It's where he can go out at night and feel safe from intruders and wildlife. It's the area he builds a fence around or a force-field over (see the "Grounds" rules in the Hero System Rulebook), or has well mapped, or is monitored by cameras, and is known to be free of intelligent and hostile life.

What if you have claimed the whole planet - and have the points for it - but you have no building, or a very small one

such as a tent? Pay the points as if you had an 8-hex base, the minimum size. (The GM should let you defend that small an area, even without walls).

What if the GM doesn't want the PC to be the only person on the planet - and doesn't want him to know it? Give the base a Mystery Disadvantage (Hunted, Unluck, or something else). Eventually the PC will have to deal with the claim jumpers, make a treaty with the natives, explain his presence to the secret military outpost...

MISCELLANEOUS RULES<C-HEADER>

Area Effect vs. Planets: see the chart. A big bomb only need cover the surface, not destroy the world.

SPACESHIPS AND SPACE COMBAT<B-HEADER>

To a certain group, SF role-playing means space combat. Space combat, though, is a slippery concept with many variables. Nimble fighters and missile racks contend in literature with mile-long spaceships and spinal-mount beamcasters. In other words, the look and feel of space combat in any particular Star Hero campaign are up to its Gamemaster. Here, we go through the choices involved. The time and distance scales are both up for grabs, and the ship components influence everything else. Perhaps the Gamemaster has in mind a particular book or movie where space battles work the way he wishes. If so, that example should be kept at hand when reading the following sections.

COMBAT RANGE<C-HEADER>

At what range do ships open fire? Typically, fighter craft can reach a few hundred meters, while huge battleships slug it out at planetary distances or greater, depending on Tech Level. In Star Hero, four scales are available for space battles.

Personal Scale<E-HEADER>

Personal scale is the familiar scale of 1 hex = 2 meters. Small fighters, low-tech vehicles, and spacesuited individuals are likely to fight at Personal Scale.

KiloheX Scale<E-HEADER>

At kiloheX scale, 1 hex = 2000 meters, or what would be 1000 hexes at Personal Scale and a Range Modifier of -20. KiloheX scale is appropriate for battles that cover several miles. This includes larger and better fighters, planetary defense batteries, small space stations, and near-future projectile weapons. KiloheX scale is usually best for Advanced Tech campaigns.

MegaheX Scale<E-HEADER>

MegaheX Scale is defined as 1 hex = 2 million meters or 2000 kilometers. This is one million hexes at Personal Scale for a Range Modifier of -40. At MegaheX Scale, planets can be represented by counters (Earth is 6 MegaheXes across). Very powerful or advanced spaceships use this scale, as do arrays of defense satellites, mega-artifacts, and huge space monsters. MegaheX Scale is usually appropriate for High Tech and Super Tech campaigns.

GigaheX Scale<E-HEADER>

GigaheX Scale means that 1 hex = 2 million kilometers, another factor of a thousand beyond MegaheX Scale. This distance at Personal Scale bears a Range Modifier of -60. Outlandish Space Opera campaigns may use this scale, in which planets themselves are in range of each other. (Earth-Mars distance can be as low as 120 GigaheXes.) But, GigaheX Scale only makes sense if combat can take place at faster-than-light speeds, otherwise ships will be limited to moving one or two hexes per Turn.

USING DISTANCE SCALES<D-HEADER>

The Gamemaster selects a particular distance scale to use for all space combat in the whole campaign. If the choice is anything but Personal Scale, this expanded scale should be used only in space, interpreted as a consequence of vacuum, free fall, and very open lines of sight. It is used automatically and the necessary Power Advantages are assumed to be built into all equipment. Examples of use can be found in the Combat section.

This rather carefree attitude toward equipment design works because characters don't pay points for items. If this is unacceptable, then details can be worked out as follows: The major pieces of ship equipment affected by the combat scale are ship's sensors and the weapons.

Ship's Sensors<E-HEADER>

The Techbook lists sensors appropriate to each distance scale. For combat purposes, the distinction is an extra +20 Range Levels for all Perception at each step. In other words, at Megahex Scale, a ship needs 40 Perception Range Levels to suffer no range penalty at 4 Megahexes.

Weapon Ranges<E-HEADER>

When point costs matter, weapons require a combination of Power Advantages to function at larger scales. Character Creation lists the Power Advantage for each combat scale, repeated here -

KiloheX Scale: +1 Advantage

MegaheX Scale: +2 Advantage

GigaheX Scale: +3 Advantage

Technically, each of these is a combination of Extended Range, No Range Modifier, and the Limitation that Range Modifiers cut in again at a certain distance. The weapons in the Techbook do not explicitly display these Power Advantages.

TIME SCALE<C-HEADER>

Space combats can be lengthy, drawn-out affairs. Fighter battles may sensibly be resolved second by second, but Phases aren't necessarily appropriate for capital ships. As a comparison, World War II battleships only fired a few shells per minute per barrel. Similarly, capital ships in some Star Hero campaigns may have weapons with a 1-Turn rate of fire or slower. Turn Scale would be best for handling such battles. Another reason for Turn Scale would be engine technology. Particularly with Advanced Tech, accelerations may be too small for ship positions to change Phase by Phase.

DEFENSES<C-HEADER>

How do spaceships defend themselves? How do they accumulate damage? The Gamemaster's choices here will determine how long (in player time) a battle takes and how many pieces were blown off of the losing hull.

Armor and BODY<E-Header>

To emulate WWII battleship action, spaceships should have significant Armor and even more Body. With less Armor than the average weapon damage, ships will blow big holes in each other and still keep fighting. Advanced Tech military vessels could be built this way. So could a ship made from a hollowed-out asteroid.

Ablative Screens<E-Header>

Often in SF literature, spaceships are protected by energy screens that absorb energy. Eventually, they reach their limit and the ships die. In Star Hero, absorbing screens are represented by Force Field with the Ablative Limitation. Examples are shown in the Techbook. Normally with this approach, battles last a long time with no actual damage registering, then an Activation Roll is failed and someone loses (or hurts bad).

Standard Screens<E-Header>

Ships may be protected by energy screens, that don't overload from excess damage, but merely pass the extra through. These are represented by standard Force Fields. In an early High Tech campaign, when energy screens are new, military ships may have Armor in addition to their screens.

Exotic Defenses<E-Header>

Stranger forms of ship defense may be found here and there in literature. Fighters rely mainly on DCV, of course. An organic ship may simply heal faster than it is damaged (Regeneration). Absorbing screens may feed the acquired energy into something useful (Ablative FF with Absorption). Point defenses can take care of missiles and occasionally beam weapons (Missile Deflection). Let the original source be a guide to what is appropriate.

WEAPONS<C-HEADER>

How do ships go about killing each other? The three main ways are guns, beams, and missiles, with the inevitable addendum of "other" methods.

Guns<E-Header>

Projectile guns shoot bullets and mass drivers fire high-velocity pebbles. These are generally low technology weapons built as physical RKAs, possibly with Autofire or Armor Piercing. Charges may or may not be an issue in game terms. Within the game, obviously, the ship has to restock ammo eventually. At higher tech levels, ships accelerate too well and fly too close to lightspeed for guns to remain practical.

Beams<E-Header>

Beam weapons go by many names: lasers, particle beams, primary rays, blasters. Most of these are energy RKAs with their own distinctive Power Modifiers. Beam weapons other than lasers become more available at higher tech levels. They have a lot of advantages over physical weapons, starting with the elimination of ammunition. When energy weapons are common, though, ship defenses may emphasize ED over PD.

Missiles<E-HEADER>

Missiles are projectile weapons that travel slowly enough to be represented by a counter on the tactical map. Missiles are not necessarily only low tech devices, but they do have to travel faster than the ships they are chasing. If ship acceleration or maneuverability is high enough, only FTL missiles can catch up. Missiles, like shells, are usually physical Killing Attacks.

Exotic<E-HEADER>

Odd attacks crop up in space battles as they do in personal battles. A particular genre or literary source may manifest weapons that are best represented by Telekinesis (induction beams), Flash (radar jamming), Drain (energy leeches), and so on. Check equivalent personal weapons to see if the technology is consistent with the prevailing Tech Level, and think about the degree of Scientific Realism.

SHIP SIZES<C-HEADER>

The feel of space combat changes with the size of ships. When combat begins, does each character hop into his own personal fighter and go? Or are the Player Characters important crew on a star dreadnought with a complement of thousands? Every military in the campaign may use the same ship size because it works so well, or the choice could be a racial thing, or fleets could be a mixture of escorts and capital ships. The following are typical descriptions of various ship sizes. As always, the Gamemaster should ignore anything that doesn't work in his campaign.

FIGHTERS<D-HEADER>

A fighter is a small one- or two-being ship with a DCV Modifier of about -4. Fighters may carry two light weapons (referring to the Techbook descriptions) or one medium weapon. If exclusively fighters are used, the recommended scale is Kilohect. Fighters with guns or missiles usually have serious ammo limits. (Larger ships often don't care.) The optional Pilot Maneuvers (see Combat) should be used.

SMALL SHIPS<D-HEADER>

Small ships include military scouts and pleasure yachts having a crew of 10-20 and a DCV Modifier of as much as -8. Civilian small ships might be armed as a fighter unless modified. Military craft could have one or two medium weapons. All ships larger than fighters should fight at Kilohect Scale using Advanced Tech or Megahex Scale at higher technologies.

MEDIUM SHIPS<D-HEADER>

This is a wide range of civilian and military vehicles with a DCV Modifier of -10 to -12. Medium civilian craft could include freighters with a skeleton crew or explorer ships with up to a hundred crew. Defenses and armaments depend on where the ship expects to be. Military medium-size ships are called destroyers and cruisers and hold crews of one to five hundred. A destroyer carries perhaps one heavy weapon and four medium to small weapons. Double these numbers for a cruiser.

LARGE SHIPS AND CARRIERS<D-HEADER>

Battleships are the large military ships. Large civilian ships include really big freighters, expansive yachts, and cruise liners. All have DCV Modifiers of about -16. Civilian craft at this size don't increase in armament unless someone is expecting big trouble. They have crews of one to several hundred plus any paying passengers. Battleships, though, need a crew of a thousand or more to handle their one dozen heavy weapons and dozens of smaller weapons.

Carriers are large ships that (surprise) carry fighters. Carriers have sizes, crews, and defenses, similar to those of battleships, but are lightly armed. They depend on their fighters for protection. The number of fighters depends on relative sizes of the two hulls, but can range from dozens to hundreds.

VARIATIONS<C-HEADER>

These combat nuances are explained in detail where they belong, under Combat. However, since they also have an effect on the flavor of combat, they are listed here.

NEWTONIAN MOVEMENT<D-HEADER>

Newton said that an object in motion tends to keep going. This isn't true with standard Hero vehicle rules. The optional Newtonian flight rules, though, are reasonably simple and keep old Isaac happy. These rules are best suited to games with Real or Plausible Science.

PILOT MANEUVERS<D-HEADER>

Pilot maneuvers do the opposite of Newtonian flight rules. A ship can stop suddenly or make a U-Turn at any speed, if the pilot is good enough. These rules are appropriate to fighter combat or possibly small (sturdy) ships.

UNMAPPED COMBAT<D-HEADER>

Advanced Tech ships don't have high acceleration because of the absence of artificial gravity. Consequently, their counters on the tactical map will hardly move, especially at Megahex Scale or larger. Unmapped combat turns space combat into a more theoretical experience and a faster one, for games that emphasize other activities.

THREE-DIMENSIONAL MOVEMENT<D-HEADER>

3-D movement does the opposite of unmapped combat. It slows combat by adding another element of realism. This option is most meaningful when ship accelerations are high.

HYPERSPACE COMBAT<D-HEADER>

Can ships fight in hyperspace or at FTL speeds? If so, the mapping scale should probably be larger than it otherwise would. Allowing fights at trans-light speeds gives the Gamemaster a chance to change the laws of physics for hyperspace - perhaps beam weapons are slower than the ships, so missiles are the way to go.

EXAMPLES<C-HEADER>

So, now the various tools for building space combat have been laid out. Here are some examples of how to use them to emulate combat as described in different stories.

TO BOLDLY GO<D-HEADER>

This is a Super Tech campaign with medium ships and Megahex scale. The Player Characters are officers among a crew of many. Ships use energy weapons with a 1-Turn warmup, ablative screens, and may possibly fight in hyperspace.

SPEAKING OF BOSKONE<D-HEADER>

This describes a Space Opera, Super Tech campaign in which the Player Characters operate one ship of a navy or perhaps advise the navy as specialists. Use Gigahex Scale, a mixture of energy and physical weapons, plus any wild and weird attacks that come to mind: sun beams, flung planets, black hole generators, and so on. FTL combat and Pilot Maneuvers are allowed.

A RAG-TAG FLEET<D-HEADER>

This is a fighter/carrier campaign. Player Characters fly fighters in pairs or singles off of a mother ship. Use Kilo-hex Scale, late Advanced Tech, and Pilot Maneuvers. Fighters may use guns or energy weapons, but ammunition should be a consideration. Ships defend with armor or perhaps standard screens.

THE NEW FRONTIER<D-HEADER>

This is a good choice for an exploration campaign in which combat is not emphasized. The Player Characters fly a single small or medium ship in which they are the entire crew. Arm it appropriately and give it standard screens. Use High Tech, Megahex Scale, and if brave, Newtonian movement. No fighting at FTL speeds.

NEAR-EARTH DEFENSE<D-HEADER>

Here is an oddity to show what can be done with the space combat rules: The characters fly fighters based on Earth, defending against alien flying saucers who use advanced technology. Use Advanced Tech and either Personal or Kilo-hex Scale. Fighters are armed with guns and missiles with ammo limitations. They use Pilot Maneuvers in atmosphere, but Newtonian movement in space. Fighters are armored. The flying saucers, on the other hand, use energy weapons and standard screens. They move by standard Hero vehicle rules.

HIGH AND LOW GRAVITY<B-HEADER>

Nonstandard gravities are everywhere in science fiction.

Alien planets, spinning spacestations, and ships under thrust all have gravity of some sort. Gravity affects the way a character moves and defends, and changes some of his END costs. Most of the effects are summarized on the Gravity Effects Table. To use this table, find the listed gravity closest to the actual gravity of the current environment (extending the table as necessary to higher gravities). The appropriate DEX Roll and DCV Modifiers and the effective STR adjustment will then be found. The DEX/DCV mods are different for characters native to a gravity other than 1.0g. See the sections that follow for details. Weightlessness (zero gravity) is handled specially in a separate section.

GRAVITY EFFECTS TABLE<C-HEADER>		
GRAVITY	DCV/ DEX ROLL	EFFECTIVE STR
0	special	special
	/-3	
1/4	-2	+10
1/2	-1	+5
1	0	0
1.5	-1	-3
2	-1	-5
3	-2	-8
4	-2	-10
6	-3	-13
8	-3	-15

STANDING<C-HEADER>

For simplicity, characters of at least STR 0 may stand up in any gravity. (There are enough other effects to worry about.) However, the character may have to pay END for Encumbrance and may be taking damage in high gravity (see below).

LEAPING<C-HEADER>

The way gravity affects leaping is by adjusting for character weight as described in the Hero System Rulebook, p. 172. For example, a normal person on a 2g world weighs 200 kg. The same result can be obtained by adjusting the character's Strength by the amount on the Gravity Effects Table (but he spends END according to his true Strength).

OTHER MOVEMENT<D-HEADER>

Movement other than leaping is not affected by gravity.

LIFTING AND THROWING<C-HEADER>

Since an object's weight is different when the gravity changes, it may be easier or harder to lift. Use the modified weight for this purpose. For throwing, though, use the object's normal weight and adjust the character's Strength according to the Gravity Effects Table. This is because of the difference between weight and mass (inertia). By this rule, a character on a light gravity world may end up spending more END for his STR than he normally could.

ENCUMBRANCE<C-HEADER>

The Encumbrance Table in the Hero System Rulebook is appropriate for other gravities as well. Merely adjust the weight of what is carried (x2 for a 2g world, etc.). The DCV and DEX Roll Modifiers are in addition to those on the Gravity Effects Table.

FALLING<C-HEADER>

Sooner or later, someone is going to take a spill on another world. Two effects are at issue: the falling acceleration rate and terminal velocity. Terminal velocity also involves atmosphere effects.

FALLING ACCELERATION<D-HEADER>

The rate of acceleration while falling on Earth is 5" per segment per segment. For another gravity, simply multiply this number by the local gravity (round halves down). As usual, the damage on impact is 1d6 per 1" of velocity. The special case of falls under 10" in height must also be modified. Scale the 10" height limit by the local gravity as well.

TERMINAL VELOCITY<D-HEADER>

Terminal velocity is the fastest falling velocity that a character can attain on a world with atmosphere. It is affected

by the local gravity, atmospheric pressure, and the character's density. The basic formula is

$$\text{terminal velocity} = (30 + \text{Density}) \times \text{gravity} / \text{pressure}$$

with levels of Density Increase, air pressure in atmospheres, and gravity in g's. See World Generation for representative air pressures corresponding to thin and thick atmospheres.

KNOCKBACK<C-HEADER>

If Knockback or Knockdown rules are in use, then other gravities give characters various Knockback modifiers. Every x2 gravity is -1" KNB and every halving is +1".

DCV AND SKILL MODIFIERS<C-HEADER>

Strange gravities just don't feel right to a character, and his reflexes are all wrong for it. Consequently, a character in a gravity other than his own suffers penalties to his DCV, DEX Rolls, and all DEX-based Skills as listed on the Effects of Gravity Table. The penalty can be read off directly for a character from a 1g world. For other characters, the modifier should be -1 for every x2 difference in gravity levels, with a limit of -3.

Example: a character from a 3g world on Mars (1/3 gravity) is off by a factor of 9, or more than 3 doublings. He receives the maximum penalty of -3.

A character with the appropriate Professional Skill can negate these penalties. Every Phase that a character with PS: High gravity maneuvers or PS: Low gravity maneuvers makes his Skill Roll in the appropriate environment, the penalties are negated. Area Knowledges would be Complementary to this roll.

DAMAGE FROM ACCELERATION AND HIGH GRAVITY<C-HEADER>

Acceleration is the act of changing speed or direction of travel. When a spaceship performs large accelerations, the characters inside may suffer damage. Similarly, a character in a steady high-gravity environment may suffer continual damage. In either case, the presence of artificial gravity will protect the characters.

The maximum gravities (g's) of acceleration possible with the standard spaceships are listed among the ship characteristics. This number represents adding the ship's full Combat Flight to its velocity in one Phase, or subtracting from. Changing by half its velocity requires half the acceleration, and so on.

For original ship designs, the drive acceleration can be calculated. The formula is

$$g = V \times \text{SPD} / 120 ,$$

where V is inches of Combat Flight, SPD is the vehicle Speed, and g is the acceleration in gravities. On Megahex scale, remember to multiply by one million. (Technically, the acceleration caused by a change of facing should use a different formula, but that is ignored here.)

FIGURING THE DAMAGE<D-HEADER>

The base damage suffered is 1d6 per gravity per Phase. This is normal Stun and Body. Characters resist this damage with their Strength. They may subtract 1d6 of damage for every 5 full points of STR. Characters use their full STR even if not paying END for it and even if not conscious. A character may Push his Strength to take less damage, but in that case has to pay END on the full STR. Finally, subtract natural PD from the damage, but no PD from equipment other than cybernetic armor (use average DEF in this case). To summarize,

$$\text{Damage} = (\text{gravities} - \text{STR}/5)d6 - \text{natural PD}$$

Modifiers<E-HEADER>

Subtract 3d6 if character is lying in an acceleration couch (no modifier for lying on a hard surface). Subtract 5d6 if character is in a fluid bath (sometimes called an acceleration tank). Characters in suspended animation take no damage. The Immunity Talent and Life Support will also cancel part or all of the damage.

HIGH GRAVITY<D-HEADER>

Characters in a high-gravity environment will take damage as from a steady acceleration. Thus, a STR 10 character on a 4g

world will take 2d6 damage per Phase.

ZERO GRAVITY<B-HEADER>

Zero gravity is also referred to as weightlessness and free fall. In the absence of artificial gravity, free fall prevails on ships coasting through space and on orbiting stations not under spin. Zero gravity rules should also be used on any asteroid with a gravity less than 0.1g.

MOVEMENT<C-HEADER>

Normal movement modes are unavailable in free fall. The available choices are crawling and leaping, and characters with the proper equipment may also walk or fly.

CRAWLING<D-HEADER>

Crawling is a form of Climbing. The character moves along a ladder or uses other handholds. Climbing Skill is not required except for difficult maneuvers. The base movement rate is 1" with a x2 Noncombat Multiple.

LEAPING<D-HEADER>

A character in free fall may leap from spot to spot separated by his normal leaping distance. If the character leaps to a location farther than this, he uses Noncombat Movement, moving at a constant speed each Phase until arriving.

CONVENTIONAL MOVEMENT<D-HEADER>

In certain cases, more normal movement is possible. A character with magnetic or sticky shoes can walk on appropriate surfaces (buy as Clinging). A thruster pack will permit Flight and a character wearing large wings will be able to glide.

THROWING<C-HEADER>

An object thrown in zero gravity will travel indefinitely until it strikes something. The maximum distance that a character can throw something accurately (full OCV) is the same as it would be in 1/4 gravity (see above). If an object is thrown farther than this, it is a "noncombat throw". The object travels the same distance each Phase until it strikes something.

ENCUMBRANCE<C-HEADER>

Do not use Encumbrance modifiers in zero gravity.

SKILL ROLLS<C-HEADER>

The penalty for all DEX Rolls and DEX-bases Skills is -3, as shown on the Gravity Effects Table. The appropriate Skill for negating these penalties is PS: Zero-gravity maneuvers. Otherwise, use the same rules as for high and low gravity.

COMBAT<C-HEADER>

Modifiers for zero-gravity combat fall into three categories: OCV/DCV penalties, damage modifiers, and Knockback.

OCV/DCV PENALTIES<D-HEADER>

A character floating in free fall is 1/2 DCV. Anchored and flying characters have normal DCV. Certain Hand-to-Hand attacks take a -3 OCV modifier: kicks, foot sweeps, and others that require the character to have his feet planted. The OCV penalty, but not the DCV penalty, may be negated with a successful roll of PS: Zero-gravity maneuvers.

DAMAGE<D-HEADER>

All Hand-to-Hand strikes, thrown objects, and other Strength-based attacks suffer a -1 DC penalty in free fall unless both the attacker and the defender are anchored. This penalty does not apply if the two characters are grappled.

KNOCKBACK<D-HEADER>

Always use the Knockback rules in free fall. Also, if the defender is not anchored, roll 1d6 less subtraction as for flying. As a special rule, if the attacker is not anchored, then he is also affected by Knockback. Split the Knockback result in half and apply it to both parties, in opposite directions. Knocked-back characters continue to drift at the same speed on the attacker's SPD and DEX until something changes or interrupts their motion.

Example: Lupus Shade and Gina are arguing in a free fall

spacestation. Lupus throws a handy ammunitions case at Gina, hitting her. He rolls 4d6, getting 16 STUN and 4 BODY. He rolls 1d6 for Knockback subtraction, rather than the normal 2d6 because both individuals are floating. The die is a 2, for 2" of Knockback. Both characters move back at 1" per Phase until they strike something.

A floating character can use this as a clumsy form of movement.

HYPERSPACE<B-HEADER>

VACUUM<B-HEADER>

SPECIAL EFFECTS<C-HEADER>

EXPLOSIVE DECOMPRESSION<C-Header>

This occurs when a pressurized room takes Body in combat.

All the air leaves the room in a number of segments equal to the size in hexes of the room. Loose objects are sent flying out into space, and characters who wish to hold on to something must make a DEX Roll and then a STR Roll to hold on to a solid object. GM's may wish to be nice and let any character who is unconscious hit an object on a 8- and become entangled rather than fly out.

Unprotected characters (not in a Vacc Suit) take 6d6 Normal Damage from shock immediately. Only natural or cybernetic PD protects and not Body Armor (Treat as an AVLD does Body). Once the air is evacuated, unprotected characters take 2d6 NND STUN damage from cold, low pressure, and suffocation. Characters may lower their SPD in order to suffer damage more slowly, just as drowning characters may. Once a character is unconscious, that character takes NND BODY as well as STUN. The average character operating at SPD 1 will therefore take 2 Body and 7 Stun each Turn in vacuum, and will die in about 2 minutes.

WEIRD ENVIRONMENTS<B-HEADER>

LIVING IN A DANGEROUS UNIVERSE<A-HEADER>

RADIATION<B-HEADER>

The word radiation has been applied to any number of dangerous energies, not necessarily related to each other. Radiation can be classified by source, so that we have nuclear radiation, thermal radiation, stellar radiation. In Star Hero, though, we are going to classify by kind of radiation, because kind determines effects. Most of the phenomena that are called radiation are described here. The game effect of most of them is "radiation damage", defined below. Some of the forms (microwaves, light, often ultraviolet) do normal or killing energy damage instead.

PARTICLE RADIATION<C-HEADER>

Particle radiation consists of atomic fragments or subatomic particles. Particle radiation always does physical damage, so any defenses that apply will be physical ones. Particles have to travel at less than the speed of light, so if they come from a long distance, as with a stellar flare, there might be some visual warning.

ELECTRONS<D-HEADER>

Electrons are also known as beta radiation in this context. Electrons are emitted by certain radioactives, by particle accelerators (e.g., the Van de Graffe generator), and in cathode ray tubes (TV tubes, computer monitors). Electrons will penetrate a few millimeters into the human body, causing skin burns and cancer. Being lightweight charged particles, they are not difficult to stop. Double all defenses versus electrons.

ALPHA PARTICLES<D-HEADER>

Alpha particles are bare helium nuclei, two protons and two neutrons without any electrons. As radiation particles go, they are very heavy and can do a lot of tissue damage. Alpha particles are emitted by radium and certain other radioactives and can be made artificially by ionizing helium. They are not very penetrating, though. A person will absorb any alpha radiation in his skin, which can cause skin cancer. Any resistant Armor or FF will stop all alpha particles, and treat any point radiation source (such as a lump of radium) as a No Range attack.

COSMIC RAYS<D-HEADER>

Cosmic rays are highly energetic protons (hydrogen nuclei). They can be produced by a particle accelerator, but are best known as the radiation that saturates all of space. Solar wind is cosmic rays of moderate energy. Solar flares (see Flares) produce higher energy rays. The most energetic cosmic rays, though, are thrown out by supernovae (see Supernovae) and caught up by the galaxy's magnetic field. These exist everywhere, in all directions, except under the magnetic field and atmosphere of a planet, or underground. Cosmic rays cause internal cancers and genetic damage.

(Also see "Cosmic Energy" below.)

NEUTRONS<D-HEADER>

Neutrons are neutral particles normally trapped within an atom, but emitted by certain radioactive elements and any nuclear reactor or bomb. Neutrons are the most dangerous form of radiation, because they penetrate deep within the body and are not stopped by electromagnetic effects. Neutron radiation can cause cancer, genetic damage, and actually leave residual radiation. Neutrons ignore any Force Field defenses.

ELECTROMAGNETIC RADIATION<C-HEADER>

All electromagnetic radiation is related, from radio and microwaves, through visible light, to the more dangerous forms. All EMR travels at the speed of light and obeys Maxwell's equations. The less energetic forms are treated as normal energy attacks and the high energy forms do radiation damage versus energy defenses.

MICROWAVES<D-HEADER>

Microwaves can be felt as heat, but are invisible to normal sight. They are emitted by broadcast antennas, radar dishes, and copiously by reddish stars. Microwaves are absorbed strongly by water and so cause internal burns to lifeforms (a normal attack). A maser is a coherent microwave beam that does Penetrating

damage.

LIGHT<D-HEADER>

Visible light can cause burns and blindness if intense enough. Steady light radiation will upset the circadian rhythms of humans and others whose bodies expect cycles of day/night and summer/winter. This will interfere with sleep and recuperation. A laser is a coherent light beam that does Armor Piercing damage.

ULTRAVIOLET RADIATION<D-HEADER>

Ultraviolet radiation is invisible to normal sight. It is emitted by G-type stars and hotter and by sun lamps or weapons designed for the purpose. UV is absorbed by glass and atmospheric ozone. It can cause burns and blindness in moderate intensities and has a weak potential for radiation damage, leading to skin cancer.

X-RAYS<D-HEADER>

X-rays are very energetic electromagnetic waves, invisible to sight. They are produced by the hottest stars, by pulsars, by nuclear weapons, and by machines designed for the purpose. X-rays are very penetrating and cause genetic damage and burns.

GAMMA RAYS<D-HEADER>

Gamma rays are the most energetic of electromagnetic waves and the most penetrating. They are invisible to normal sight. They are emitted by various radioactives and are also produced by black holes, by antimatter explosions, and by synchrotron accelerators. Gamma rays are so penetrating that they deposit only a portion of their energy in tissue, resulting in distributed genetic damage. Gamma rays are Armor Piercing radiation attacks.

WEIRD RADIATION<C-HEADER>

Following are less traditional forms of radiation. Some of these are theoretical at best; others are real, but their effects are conjecture.

GRAVITY WAVES<D-HEADER>

Gravity waves fall out of Einstein's equations, but have never actually been observed. Gravity waves of dangerous magnitude probably have to be artificial. They can be generated by a set of two or more micro-black holes orbiting each other or by gravity technology. Gravity waves will spread out in all directions or can be focused as a beam. Their effect is to stretch and compress space at right angles to the direction of propagation. Treat as Telekinesis, Area Effect, stretch or compress only (-1).

ELECTRIC AND MAGNETIC FIELDS<D-HEADER>

Any high voltage electrical equipment will generate electrical and magnetic fields. Oscillating fields (as from alternating current) might heat tissue as microwaves do. Steady fields will confuse creatures with natural direction senses. Robots and other electronics might malfunction. There is speculation that long-term exposure could cause radiation damage.

MOLECULAR RESONANCE<D-HEADER>

Electromagnetic bursts could be tailored to decompose particular substances or molecules. For example, radiation that breaks up ATP, the energy-bearing molecule, in the blood stream could be represented as an END Drain. Molecular resonance is a good explanation for the various story-based forms of radiation found in science fiction.

CHRONONS<D-HEADER>

Chronons are hypothetical particles of time. Exposure to chronons might make one experience deja-vu or actually jump in time.

COSMIC OR PRIMAL ENERGY<D-HEADER>

In comic book science fiction or space opera, this is the fundamental universal force that touched off the Big Bang. It is possibly equivalent to the strong nuclear force, but is not to be confused with cosmic rays. Elder races that evolve beyond Super Technology use cosmic energy for transmutation, teleportation, and pretty much anything they want to.

REPRESENTING RADIATION EFFECTS<C-HEADER>

Radiation damage is bought as Transform (15 pts); Cumulative (+1/2); Visible only to Radio and Special Sense Groups (+1/2); AVLD: varies with type of radiation (+11/2). Effects are Instant or Continuous (+1) depending on the source. The defense versus most radiation is Armor plus FF, but check the descriptions above. Inhaled or ingested radiation sources will not be stopped by any defenses. Life Support vs. Radiation will allow one to ignore Continuous sources of 1d6 or less. The Transform result is described below.

MEASURING RADIATION<D-HEADER>

The effects of radiation absorption on tissue are measured in rems. Some reference works will quote the strength of radiation absorption itself, in rads. Fortunately, for most sources, 1 rad = 1 rem. Alpha radiation and neutron sources, though, produce about 10 rems per rad.

CALCULATING RADIATION DAMAGE<D-HEADER>

One rem of radiation will do 1d6 of Transform. Radiation sources are either Instant or Continuous. Instant source are such things as nuclear explosions and x-ray exams. Continuous sources are such things as stellar radiation, cosmic rays, and unshielded nuclear reactors. An Instant source will do +1d6 of Transform for every x2 amount of radiation (see the Radiation Dice of Damage Table) and no damage if the amount is less than one rem. A Continuous source that is at least 1 rem/second will do this amount every Segment. If the source is weaker than this, as many are, the damage is 1d6 per time it takes to accumulate 1 rem. This can be adjusted to fit a step on the Time Chart if desired.

RADIATION DICE OF DAMAGE TABLE<D-HEADER>

RADIATION (REMS/SEC)	RADIATION (REMS/YEAR)	TRANSFORM (d6)
<3x10e-7	<10	no damage
4x10e-7	12	1 per month
1.6x10e-6	50	1 per week
1.2x10e-5	365	1 per day
5.6x10e-5	8800	1 per 5 hours
2.8x10e-4	44000	1 per hour
3.3x10e-3	105	1 per 5 minutes
0.017	5x105	1 per minute
0.083	2.5x106	1 per Turn
0.33	107	1 per Phase
1	3x107	1 per Segment
2		2
4		3
8		4
16		5
32		6
64		7
125		8
250		9
500		10

Example: 250 milligrams of radium put out 0.250 milligram of radium put out 0.21 rads/hour of alpha radiation, equivalent to 4.1 rems/hour of effect. This is 1 rem per 15 minutes. The Gamemaster can roll 1d6 per 15 min or he can roll 3 dice per hour, the next highest step on the Time Chart.

The intensities of various radiation sources are given on the Radiation Source Strength Table.

RADIATION SOURCE STRENGTH TABLE<D-HEADER>

SOURCE	STRENGTH	DICE	NOTES
Carbon-14 (6kg)	0.01 rem/y	-	Beta radiation
Cobalt-60 (1g)	24 rem/min	1d6/Phase	Gamma radiation
Iodine-131 (1g)	7 rem/s	3.5d6/Seg	Gamma radiation
Plutonium (1g)	0.5 rem/h	2d6/5 h	Alpha radiation
Potassium-40 (6kg)	0.1 rem/y	-	Beta radiation
Radium (1g)	16 rem/h	1d6/5 min	Alpha radiation
Radon gas (1g)	50 rem/h	2d6/5 min	Alpha radiation
Uranium-238 (1kg)	1.5 rem/mo	1d6/mo	Alpha radiation
X-ray photo	1 rem	1d6	Instant
Radioactive soil	0.3 rem/y	-	Typical (gamma rays)
Cosmic rays	0.3 rem/y	-	Sea level, Earth
	28 rem/y	2d6/month	40,000 ft altitude

	100 rem/y	2d6/week	Earth orbit
	180 rem/y	3d6/week	Luna
Van Allen Belt	10000 rem/y	1d6/5 hr	cosmic rays
Solar flare	1000 rem/h	1d6/Phase	cosmic rays

TRANSFORM EFFECTS<D-HEADER>

Characters will slowly heal Transform damage as it accumulates. (This is why less than 10 rems/year is not worth accounting for.) A character who reaches x2 BODY is Transformed. Any further radiation dice do BODY damage rather than more Transform.

A character who has taken x2 BODY in radiation damage immediately loses half his CON, REC, and BODY (which might be lethal). These can be healed, as can the Transform damage, at a rate determined by the reduced Recovery. Such a character is suffering from radiation sickness. The damage can be ruled localized in one Hit Location if appropriate, or distributed.

In real terms, the character is more susceptible to disease. His hair may fall out and his blood cell count drop. (This is bone marrow damage.) The eyes may develop cataracts. Temporary or permanent sterility will result from genetic damage to the gonads. General genetic damage will have effects similar to aging. Cancers may appear months or years later. Children are more susceptible to radiation than adults, and other races may be less susceptible than humans.

DAMAGE TO EQUIPMENT<D-HEADER>

Equipment will suffer radiation damage as well. The difference is that equipment doesn't heal, so any dosage that exceeds its DEF has permanent effect. At x2 BODY, metal fatigues, plastics partially decompose, and computer memory alters.

TREATING AND PREVENTING RADIATION<C-HEADER>

The best preventions against radiation are distance and heavy armor. Certain drugs will boost resistance. Treat these as Armor with Limitations or as Aid to Recovery.

After exposure, proper medical assistance can double one's healing rate. Blood and bone marrow transfusions are the best treatment, aided by drugs.

DISTANCE<D-HEADER>

The radiation dosage from a small source should drop off with distance. To calculate this adjustment, figure the Perception Modifier for seeing the source from where a character is standing, based on the object's distance and size. Every -1 to PER will halve the radiation received (or remove 1d6). A cruel Gamemaster can increase the radiation for positive modifiers.

Example: An outcropping of uranium ore is 1 hex across (PER +2) and 10 hexes away (PER -4). A net modifier of PER -2 means that radiation is quartered.

Another way to look at this is that damage from radiation source begins to drop at a distance of eight diameters.

DETECTION<D-HEADER>

Most radiation sources are visible only to the Radio and Special Sense Groups. Ultraviolet radiation is also visible to UV Vision, of course. Bombs and weapons may produce visible and audible side effects, though. In any case, the equipment to measure most forms of radiation is pretty simple (electroscopes and geiger counters) and requires a simple Electronics or Mechanics Roll to construct. A dosimeter can be rigged to turn black after receiving a cumulative 1 rem. Detecting neutrons and gamma rays requires some intermediate medium such as boron or lead. The Skill Roll to build these detectors is at -3.

Radiation effects of at least 1 Rem/second trigger light flashes on the retina of the eye. A Perception Roll at -3, adjusted for quantity of radiation, will spot this.

The existence of Transform damage from radiation can be detected before the onset of radiation sickness. A simple Skill Roll in Sc: Medicine or Paramedic at -3 is required.

TEMPERATURE<B-HEADER>

Dangerous temperatures may be encountered on a planet's surface, near a star's surface, or when the life support equipment goes bad. Sometimes extreme "temperatures" are quoted for very rarified environments, such as the near-vacuum of space. In this case, the temperature is just a convenient measure of the atomic motion involved. Such a small amount of matter has almost

no energy content and thus doesn't pose any danger. In other words, when a spaceship is in a star's corona (millions of degrees of temperature, but very low density), it takes damage from the nearby photosphere (thousands of degrees and appreciable density).

DAMAGE FROM HEAT<C-HEADER>

Stars are hot. The heat from a star, lava flow, or anything hot enough to glow comes mainly from radiated light and micro-waves. A character or spaceship near enough to a hot body will take Killing damage every Segment according to the object's temperature. The base damage is listed on the Temperature Damage Table. The actual damage decreases with distance in the same way that radiation does: Figure the Perception modifier for seeing the hot body based on its size and distance. Every -1 to PER is -1 Damage Class. Add +1 DC for touching, +2 DC for immersion.

TEMPERATURE DAMAGE TABLE<D-HEADER>

TEMP (K)	DAMAGE CLASSES	DAMAGE (kdice)	NOTES
500	8	3d6-1	red hot
750	10	3d6+1	
1000	12	4d6	
1500	14	5d6-1	lava
2000	16	5d6+1	
3000	18	6d6	M5 star
4000	20	7d6-1	K5 star
6000	22	7d6+1	Sol
8000	24	8d6	A8 star
12000	26	9d6-1	B8 star
16000	28	9d6+1	B4 star
24000	30	10d6	B1 star, Jupiter core
32000	32	11d6-1	O8 star

Examples: Ten diameters out from Sol, a spaceship will take 7d6 K per Segment. Eight diameters out (7 diameters from the surface), the damage rises to 7d6+1 K and increases no further with proximity. If the ship touches the surface of the photosphere, the damage goes up one Damage Class, and if it submerges, the damage becomes 8d6 K. By contrast, a ship exploring the outer layers of Betelgeuse, an M3 supergiant, would only suffer 7d6-1 per Segment.

These temperatures are well beyond the solid state of any substance. (Tungsten melts at about 3000 K). Therefore, treat any Armor as Ablative above 2000 K. Contrary to the standard rules, though, a ship's hull is still protected by its screens and does not have to be the first line of defense.

Life Support vs. heat conveys immunity to the first 2000 K of temperature.

TURBULENCE<B-HEADER>

Turbulence is random eddies within a agitated fluid, just the place where a spaceship shouldn't be. Of course, it doesn't happen this way. Pilots take their ships into nebulae, gas giants, and stars, all of which are turbulent environments (among other hazards).

Turbulence is described by an average fluid velocity and a turbulence length scale. A pilot will have control problems if he flies faster than one length scale per Turn. A Combat Pilot Roll is needed, with penalty for speed (see Spaceship Combat).

COLLISIONS<B-HEADER>

What happens when your spaceship hits a meteor, or flies through a ring and gets unlucky? Find the mass of the colliding object and the combined speed of impact. Meteors will be going at orbital velocity for their location. Ring particles are likely traveling across the ship's path, so use ship velocity.

Figure Move-Through damage for a 100 kg object, add or subtract 1d6 per x2 mass different from this. Never use a mass greater than the ship's mass (special free fall rule). This can be a whole lot of dice, but remember that BODY from the impact has to get through the ship's defenses.

Example: The largest objects in Saturn's rings are 5m across. This is 64 tons of ice, or +9d6 damage. A ship traveling at 40 Mhexes will take 13d6 + 9d6, or 22d6 damage, only enough to get through its screens.

A glancing blow can do Move-By damage instead. This same formula can be used if a character in space is hit by a meteor (a strikingly unlikely event). Use the lesser of the character's mass and the object's mass for the dice modifier.

ASTEROID BELTS<D-HEADER>

Flying through an asteroid belt at high speeds is comparatively safe - at least in our Solar System, where the asteroids are _____ apart. Several Voyager and Pioneer spacecraft have flown blind through the belt with no damage. If the Gamemaster wants an exciting chase through an asteroid field, he can make the belt denser (as it would be in a younger solar system).

RINGS<D-HEADER>

The danger of flying through a ring depends on its particle density. For a dense ring like those of Saturn and Uranus, a ship is all but certain to be struck once (roll 17-). For Neptune's partial rings, the chance is 8-. Even in a dense ring, though, the resonance gaps are a better bet. Rings are thin enough that a ship will never collide with more than one particle unless the pilot loses control. To generate a random size for the colliding object, figure the damage for a maximum size object and subtract 0-5 dice. (Saturn or Uranus: +9d6, Neptune: +3d6, Jupiter: -16d6)

VACUUM<B-HEADER>

Vacuum (see Explosive Decompression). Life Support vs. Pressure is only good up to 50 atmospheres (a suggested technology limit; see Powers). Humans require 0.2 atm pressure and oxygen pressure of 0.05-0.4 atm.

PRESSURE<B-HEADER>

Pressure extremes are found at the bottoms of dense atmospheres and inside gas giants and stars. A spaceship in a high pressure region will take crushing damage based on the pressure difference in atmospheres between inside and outside. Dice of normal damage are figured on the Pressure Damage Table.

PRESSURE (atm)	DAMAGE (d6)
1	1
2	2
4	3
8	4
16	5
32	6
64	7
125	8
250	9
500	10
1000	11
2000	12
4000	13
8000	14
16,000	15
32,000	16
64,000	17
125,000	18
250,000	19
500,000	20

Dice of damage are theoretically rolled every Segment, though the Gamemaster can use expected results instead. Damage through defenses is applied to the Body of the vehicle only.

Example: A craft that touches down on Venus (90 atmospheres) must be able to withstand 7d6. If the hull has 7 DEF, it will take damage every other second or so. If it has a DEF of 10, it will take about one point every two Turns.

Pressure damage also applies to submarines, where ocean pressure increases by one atmosphere every ten meters, and to characters in hazardous environments. Life Support versus pressure conveys immunity to the first 50 atmospheres (a suggested technology limit). Otherwise, characters may use defenses from body armor and force fields only if they are airtight. Roll the dice and count BODY. Damage through defenses is applied to whatever is maintaining the pressure difference (such as a pressure suit). When that goes, further damage, BODY and STUN, is

applied to the character's PD.

Gravity. Light. Other hazards.

CHARACTER CREATION<A-HEADER>

INTRODUCTION<A-HEADER>

Before the campaign begins, players will need characters. Anyone new to the Hero System may want to start playing with one of the sample characters at the end of this section, but one of the tremendous strengths of the system is the ability to design exactly the character you want. So, eventually everyone will want to design characters.

This sections describes how designing Star Hero characters is different from the basic guidelines in the Hero System Rulebook, which you should already have. Typical appropriate character conceptions are discussed. Some of the standard Hero Skills, Perks, and Talents are used differently in Star Hero or are more or less common, and this is also explained. Finally, the Gamemaster may allow certain nonstandard character types, such as aliens, psionics, and robots. Such characters may have Powers, and the rules for these are given.

More than in any other Hero System genre, designing characters for Star Hero depends on what the Gamemaster has designed for his world or universe -- see the Campaigning section. The Gamemaster will decide the technology level, what planets and races are available, and in general the envelope of possible character backgrounds. Players should cooperate with the Gamemaster in designing their characters, particularly in determining character concepts and backgrounds. A player may have an idea for a concept that the Gamemaster hasn't thought of yet but can work into the campaign setting.

The Gamemaster will also decide the usual aspects of character design, such as starting points, maximum Disadvantages, and power levels. Most Gamemasters will probably run a Heroic level campaign. Characters will start with 75 power points plus a maximum of 75 Disadvantage points, no more than 25 from any particular category. Characters will use these points to buy Characteristics, Skills, Talents, and Perks. Certain character types, as noted above, may also be allowed to purchase Powers. As usual, all final character designs require the approval of the Gamemaster.

CHARACTER CONCEPT<A-HEADER>

Character design starts with a character concept: what makes this Star Hero character an individual? What kind of character does the player want to be? There are several ways to arrive at an answer to these questions.

Sometimes the Gamemaster will want players to cooperate in designing a group, such as the crew of a starship. In this case, the player may feel especially inclined to take one of the several positions that are open and turn that position into a character.

Whether or not the player is picking from a list in this way, he may have certain abilities in mind that he wants his character to have. A rogue, a merchant, a soldier are all identified by their abilities. Maybe one of the Skills in Star Hero looks particularly interesting, or maybe the player wants to try the spaceship pilot rules.

If abilities don't suggest a character, perhaps attitude does. Why is this character interacting with the other player characters? Motivation may imply certain Skills, Characteristics, and the rest of the design.

A character may also be suggested by the Gamemaster's campaign environment. A certain planet or alien race be interesting to the player and is sure to be fleshed out further if the player's character is a part of it.

If these techniques do not lead to a character concept, the player can always look to examples elsewhere. The player may want to try to recreate a character from science fiction, or transplant a character concept from another Hero campaign, or even play himself and his own reactions to a future society.

The sections below describe in more detail how to apply these various techniques.

GROUP CHARACTER DESIGNS<D-HEADER>

Frequently, a Gamemaster for Star Hero may ask the players to design characters who are all part of the same group. This makes it easier to move the characters from planet to planet, for example, and introduce them to new adventures. A player in this case may obtain the beginning of a character concept by inspecting the slots available within that group.

For example, the Gamemaster may be running a future war or espionage campaign and the characters will all be part of the same military organization. The group will then need a leader, a heavy weapons expert, and a forward observer, or perhaps it will need a pilot, an electronics expert, and a disguise artist. Which does the player wish to be?

Or alternatively, the Gamemaster may ask that the players be the crew of a small ship. They will need to produce among themselves a pilot, an engineer, and a doctor among other skill areas. The player may be particularly intrigued by one of these.

Regardless of whether the Gamemaster takes this approach or not, however, players who already have a character concept should not feel straitjacketed. The pilot should probably have high DEX, Combat Pilot, and TF: small ship, but that leaves plenty of points to spend. The pilot may be cocky, unsure, businesslike, drug-addicted, or whatever the player can conceive. Players who are still looking for a conception at this point can combine this technique with those that follow.

ABILITY-BASED CHARACTERS<D-HEADER>

A player may obtain his conception by considering what he would like that character to be able to do. This may be a Skill category such as "Sciences" or "Martial Arts", it may be an occupation such as "politician", or it may be an aspect of the Hero or Star Hero rules such as spaceship piloting.

Depending on the campaign, occupations that make good Star Hero characters include those that make good modern adventuring characters. Examples include detective, doctor, entertainer, explorer, lawyer, playboy, politician, reporter, rogue, scholar, scientist, writer. Other occupations unique to Star Hero include alien contact specialist, clone broker, hyperspace engineer, planetary ambassador, and starship pilot.

A character conception may also derive from certain Hero System Skills that the player wants to use. Some are particularly appropriate in a Star Hero campaign, as noted in the Skills section. A player may wish to have a lot of Sciences, for example, to help in exploring new planets. Or the player may want his character to be particularly good at Conversation, Persuasion,

and the other social interaction Skills. If the player takes this approach, he should then think of an occupation that would be appropriate for the character and a motivation that would make him want to use those Skills in the way the player wishes.

Another category of abilities is the set of rules unique to Star Hero. Perhaps, for example, the player wants to try out Martial Arts in zero gravity, possibly even working with the Gamemaster to design a new weightless Martial Arts style. Or, the player may want to be able to do limb grafting and other advanced medical techniques. And there are always the spaceship piloting rules.

MOTIVATION-BASED CHARACTERS<D-HEADER>

A player looking for a character conception may ask himself, why is my character prone to adventure? What character attitude does the player wish to portray? Careful exploration of these questions may lead to a full character design, with the Characteristics, Skills, and Perks necessary to fulfill that motivation.

Star Hero adventuring typically involves a lot of travel. In choosing character motivation, then, a player should be looking for reasons why this character would want to travel. Some suitable motivations common to science fiction include:

Wanderlust<E-Header>

The character can't stay anywhere for more than a few months without itching to see new places. This is a more acute condition than it is in modern adventuring; even a whole planet isn't sufficient for the character with wanderlust. It helps satisfy wanderlust if a character has his own ship or is at least wealthy.

Curiosity<E-Header>

Similar to wanderlust, curiosity drives a character to find out everything possible about new places, new cultures, and new inventions. Characters with curiosity are often reporters or scientists. Curiosity can be a very useful handle for Gamemasters; the Gamemaster has only to mention the newly discovered Skull Nebula for that character to want to visit it.

Duty<E-Header>

Patrolling the fringes of the Star Empire is a lonely job, but somebody has to do it. The character driven by duty typically works for a larger organization that sends him into adventures. He may be a lawman, a thingie salesman, or a missionary.

Greed<E-Header>

Steering a greedy character can be as simple for the Gamemaster as providing a treasure map or mentioning the location of ancient alien artifacts. If the Gamemaster keeps his players strapped for cash, then milder forms of greed become motivations. Characters may seek wealth simply to keep their spaceship and cybernetic parts operating. The one problem for the Gamemaster is that greed probably cannot be allowed to be fulfilled or it ceases to be a motivation. See Wealth in the Hero System Rulebook.

Idealism<E-Header>

The character has a personal code that lures him into adventure, and this code has elements of romanticism. A scientist may be looking to advance the frontiers of knowledge, a social worker may be bringing culture and aid to deprived aliens, or a poet may wish to experience the grandeur of space. Idealistic characters are often amenable to accompanying others on their particular quests, but usually want to convert those others to their thinking.

Revenge<E-Header>

Somebody did the character wrong and he is driven to avenge himself. If the campaign has a main bad guy, then that person or organization may have wiped out the character's family/colony/finances. Otherwise, the character is probably searching for the responsible party and the search itself leads to adventure.

Self-Preservation<E-Header>

The character is adventuring to keep himself alive. Perhaps someone else is motivated by revenge and the character is trying

to stay one jump ahead. Or, more exotically, the character has a rare alien disease that will kill him in one year if he doesn't find a cure.

Once a player has selected a motivation for his character, he will likely find Skills and Perks to help pursue it. For example, a character driven by revenge may want weapon Skills, Bugging, or Contacts, depending on how the player wishes to achieve that revenge.

CAMPAIGN-BASED CHARACTERS<D-HEADER>

The Star Hero Gamemaster will have indicated what kind of campaign he plans to run. Something in the background, a particular planet or alien race, for example, may suggest a character concept.

A player looking for a character concept should examine the Gamemaster's preliminary campaign description for interesting elements. Possibilities include:

Race or Culture<E-Header>

The player may decide that he wants to be a representative of some interesting race or culture. Likely, then, the Gamemaster has designed an appropriate Package Deal (q.v.) or will upon request. Equally likely, the Gamemaster has not yet developed everything about that culture or race that the player will want to know. The player should engage in a dialogue and help fill in the missing details. If no other members of the culture or race are likely to appear in the campaign, then it may be enough for the player to design and run a typical member. Otherwise, the player will have to do some additional individualization of his character for the benefit of the other players when they meet others from the same background.

Setting<E-Header>

The character may come from an unusual place or have spent time there. This is more general and less defining than belonging to a particular culture. For example, the character may have been employed on a large space station or by a noteworthy interplanetary corporation.

Other PCs<E-Header>

The other PCs are also part of the campaign. This approach may take some cooperation by another player in obtaining his character conception, but linked histories can be enjoyable. If another player has a rich character, perhaps he needs a personal lawyer or bodyguard, or perhaps the Gamemaster would like him to have a business rival. If one player is designing an alien or cyborg, another may want to design the doctor who can put him back together after combat.

TRANSPLANTED CHARACTERS<D-HEADER>

If a player needs a character concept, cannot devise a suitable original idea, and is not inspired by the campaign background, another source of character ideas may be necessary. Possibilities include fiction, other Hero System games, and the player himself.

Fictional characters are usually presented as fairly complete, so that the player has a history, appearance, and set of motivations available. The Skills, Characteristics, and other elements simply have to be translated into Hero System terms. A less direct approach is to design the fictional descendent of a modern character, retaining most of the personality but with Skills appropriate to the era. When translating characters, the player should remember that the result still has to fit the Gamemaster's campaign concept. This means that the character may not be allowed to have as high a Skill Roll as the original source may indicate, or certain Perks may have to be dispensed with. Finally, the player should give his character a different name out of courtesy to the original writer and to allow the Gamemaster freedom to shape this character's future.

If the player has played other Hero System games, he may have a character concept ready to hand. How would that Fantasy Hero thief be different in a high-tech environment? What sort of skills would that Western Hero doctor have in a galaxy full of aliens? More than likely, the Characteristics and 90% of everything else translate directly. The player should honestly try to individualize this character, though, and look for appropriate modifications. Once again, the player should choose a new name.

Some players enjoy playing themselves as characters in a future setting. This will normally require the player to imagine himself born into that society, but with the Gamemaster's permission can actually involve time travel from the 20th century. The player will have to judge his own Characteristics, Skills, and Disadvantages in Star Hero terms. No doubt, other players will offer advice if this seems difficult. A player who chooses to base his character on himself should always remember that the character is not the player. Bad fortune visited on the character is not a personal attack by the Gamemaster and, no matter what happens, the player can always start over with a new character design.

BRINGING IT ALL TOGETHER<D-HEADER>

No matter where a player begins with his character conception, he is going to have to do some thinking to devise a complete person. If the player begins with motivation, then he will need a character history that accounts for the motivation. If the player starts with character history, then he should create a psychological profile consistent with it. And in either case, physical appearance should not be forgotten.

Once the character concept is more or less complete, the player should continue with the process of character creation. (See the checklist, p. 12 of the Hero System Rulebook.) The more thorough the conception, the easier should be the task of picking appropriate Characteristics, Skills, Perks, and Talents. This process should include selecting less obvious Professional Skills and Knowledges implied by the character background. Such minor skills may not seem very useful, but they can be occasionally invaluable and they will win respect from the Gamemaster for the overall character design.

CHARACTERISTICS<A-HEADER>

Most characters in Star Hero are presumably human and subject to Characteristic Maxima. For these characters, Characteristics function exactly as they do in other Heroic level campaigns.

STRENGTH<D-HEADER>

Strength is important for characters who do physical tasks without machine assistance or for explorers and such who spend time roughing it away from civilization. High-gravity natives will have high STR; low-gravity natives will not. Low Strength characters get by quite easily, however, in a world of automation and robotics.

DEXTERITY<D-HEADER>

Unusually high Dexterity should be given to people who need it for their professions, such as dancers and ship's gunners. Variant humans from high- or low-gravity environments will also develop high DEX to cope with their surroundings.

CONSTITUTION<D-HEADER>

With weather control, machine assistance, and advanced medicine, high Constitution is difficult to justify. Superior diet and health care might produce it. Characters who expose themselves to pain or hardship will certainly have high CON. This includes athletes and colonists, among others. Once the campaign starts, of course, most PCs will find themselves exposed to pain and hardship, like it or not.

BODY<D-HEADER>

Arguments for Body follow the lines of those for high CON. Additionally, large characters and those with unusually strong will to live can have high BODY. (And what Player Character doesn't have a strong will to live?)

INTELLIGENCE<D-HEADER>

Some intelligence is required to do almost anything creative in a science-fiction setting. Computer Programming and Systems Operation are INT-based Skills as necessary to some occupations as literacy is today.

EGO<D-HEADER>

High Ego will be crucial to psionic characters, if allowed, or to anyone wishing to defend against psionics. Strength of will may be important to characters in certain solitary professions or in the public spotlight.

PRESENCE<D-HEADER>

High Presence is appropriate for those who want to dominate others and who expect to be in social conflicts. This obviously includes characters designed around the Presence-based Skills. Characters who wish to resist being pressured socially should have at least moderately good Presence.

COMELINESS<D-HEADER>

Comeliness describes how members of the same species view each other. Comeliness is of less significance between members of different species (Distinctive Features covers this). Nevertheless, humans expecting to deal only with aliens and aliens expecting to live among humans should not automatically buy low COM. Comeliness will help smooth relations during layovers between adventures when a character is trying to pick up information or companions. And, good Comeliness may help crew morale on long voyages.

PHYSICAL DEFENSE<D-HEADER>

Most of the populace enjoys a machine-assisted, weather-controlled, and downright coddled existence in a high-tech society. For the masses, then, high PD is difficult to justify. Athletes, colonists, high- and low-gravity natives can expect occasional bruises and will have better defenses. In fact, though, most Player Characters have unusual backgrounds and should be able to find some excuse for buying more PD. Since exposure to dangerous weapons is a fact of life in Star Hero, the PD will be used.

ENERGY DEFENSE<D-HEADER>

Energy attacks are as common as physical attacks in science fiction, so a character shouldn't ignore his ED while buying lots of PD, or he may live to regret it. At least, let us hope he lives.

SPEED<D-HEADER>

Pilots, bounty hunters, amateur grav-ball players all need high Speed. Characters who expect to do their best work at a computer input or making the cocktail circuit can get by with less, as long as they are fast enough to at least duck and cover in time when it becomes necessary.

RECOVERY<D-HEADER>

Recovery gives a character good healing and second wind, both of which may be useful when the blaster bolts start flying. High Recovery may be a result of superior genes if there are no occupational reasons.

ENDURANCE<D-HEADER>

Not a lot of tasks require much exertion in the society of the future, so most characters can probably get by on their base END value. However, if the ship gets holed while accelerating at 4 g's, characters may need to push STR to reach their spacesuits ...

STUN<D-HEADER>

Stun is not an important Characteristic until the shooting begins, when it may become the most important Characteristic. Anyone who expects to get hit at least once and wants to do something about it should seriously consider buying Stun.

SKILLS<A-HEADER>

Skills in Star Hero work essentially as they do in other Hero System games. A very few Skills are not available to characters, generally because they are obsolete, and several others should be treated differently in the science fiction genre. Those cases are described in this section. Any Skill without detailed explanations should be assumed to be available and working its normal way.

EVERYMAN SKILLS<B-HEADER>

Certain minimal Skill Rolls are available to everyone for free as explained in the Hero System Rulebook. These Skills differ from genre to genre and, unless otherwise stated, are at the Familiarity or 1 pt. level. For a standard science fictional high-tech society, the Everyman Skills are:

Computer Programming
Concealment
Conversation
Deduction
Paramedic
Shadowing
Stealth
Systems Operation
KS: Native area or city
KS: Native culture
1 Language, native with literacy
1 Professional Skill
TF: Personal vehicle
A native gravity

These Skills will vary by culture. For characters from a rural or frontier background, replace Systems Operation with Climbing. Alien cultures may also have a different set of Skills, as determined by the Gamemaster. The Transport Familiarity will be with the most common local form of personal transport is. (See Combat and Adventuring for information on native gravity.)

SKILL AVAILABILITY<B-HEADER>

The following table indicates how common various Skills are in a standard science fiction setting, in terms of their availability to player characters rather than to the public. In general, the Gamemaster should allow any character to take a "Common" Skill, assuming it can fit the character's background. "Uncommon" Skills should each be allowed to only a few characters in the player group, and then only if their backgrounds justify it. Skills listed as "Not Available" and selected uncommon Skills that the Gamemaster might indicate should only be allowed in very unusual cases, as with a 20th century character being projected into the future. Such a character might know Lockpicking or TF: camel even though the Skill may never come up in the campaign.

As an aid to the Gamemaster, the table also indicates the standard time interval required to use each Skill (p=Phase, t=Turn, m=minute, h=hour, d=day, w=week). In many cases, advanced tools and materials are assumed to be commonly available (Disguise, for example), so that the times are shorter than they would be in a modern campaign. The minimum time required may be less than the standard time for some Skills in the opinion of the Gamemaster. In these cases, the character may take less time than the chart indicates at a penalty of -1 for every level up on the Time Chart. The nuances of several Skills are described in more detail following the table. In some cases, the time required may be open-ended and the time is marked with a "+". Players and Gamemaster should both read how these Skills are to be treated in Star Hero.

Skill	Availability	Time
Acrobatics*	Common	1/2p
Acting	Common	5m
Animal Handler*	Uncommon	1w
Breakfall*	Common	1/2p
Bribery	Common	1m
Bugging	Common	1h
Bureaucratics	Common	1d
Climbing	Uncommon	1p+
Combat Driving	Common	1/2p
Combat Pilot	Common	1/2p
Combat Skill Levels	Common	-
Computer Programming*	Common	1h
Concealment	Common	1p
Contortionist	Uncommon	5m
Conversation	Common	5m
Criminology	Common	1h
Cryptography	Common	5h
Deduction	Common	1p
Demolitions	Uncommon	1h
Disguise	Common	5m
Electronics	Common	5h
Familiarity	Common	-
Forensics	Common	1d
Forgery	Common	5h
Gambling	Common	1h
High Society	Common	1h+
Interrogation	Common	1h
Inventor	Uncommon	1w
Knowledge*	Common	-
Languages*	Uncommon	-
Lipreading*	Uncommon	1t+
Lockpicking*	Not Avail	1t
Martial Arts*	Uncommon	-
Mechanics	Uncommon	5h
Mimicry	Uncommon	1p
Navigation*	Common	1h
Oratory	Common	5m
Paramedic*	Common	1p
Persuasion	Common	1m
Professional Skills*	Comm\$	-
Range Skill Levels	Common	-

Riding	Uncommon	1/2p
Sciences*	Common	-
Security Systems*	Common	5m
Seduction	Common	5h
Shadowing	Common	5m+
Skill Levels	Common	-
Sleight of Hand	Uncommon	1p
Stealth	Common	1p
Survival	Uncommon	1h
Systems Operation*	Common	5m
Tactics	Common	1t
Tracking	Uncommon	1m
Trading	Common	5m
Transport Familiarity*	Common	-
Ventriloquism	Uncommon	1p
Weapon Familiarity	Common	-
Weaponsmith	Common	var

*See text

SKILL DESCRIPTIONS<B-HEADER>

ACROBATICS<D-HEADER>

Acrobatics is an appropriate Skill for a romantic, swash-buckling approach to science fiction. John Carter, born on Earth, was able to perform acrobatic leaps in the lesser gravity of Barsoom. In a more realistic game, Acrobatics is useful primarily when maneuvering in free fall (weightlessness).

ANIMAL HANDLER<D-HEADER>

This Skill is possessed by merchants, entertainers, and the like who deal with exotic alien pets. Training an alien animal is normally no more difficult than training a terrestrial one, although providing the proper diet could be difficult. Modifiers of -1 to -3 could be imposed depending on how different the animal finds a human environment to be.

Additional negative modifiers could be imposed by the Gamemaster for an animal with a completely different biology or mentality. Often in science fiction, an animal trainer dealing with such an animal seems to succeed, only to face a delayed surprise under the right conditions. For example, the animal might become berserk during mating season. The Gamemaster could simulate this by making the Animal Handler Skill Roll secretly and, if it fails by the amount of this modifier, something happens later on.

BREAKFALL<D-HEADER>

This is another Skill acquired by characters in free fall. Additionally, heavy gravity worlders need this Skill for personal safety.

COMPUTER PROGRAMMING<D-HEADER>

Computers in science fiction are usually powerful, versatile AIDs that anyone can use merely by telling it what he wants. For such computers, no Computer Programming Skill Roll is required for routine data requests, accessing communications and data networks, and other normal tasks. A Skill Roll is needed only if the request is unusually specific or technical, or is outside the computer's programming. For instance, trying to predict the next solar eclipse by examining cave paintings made by primitive sky-watchers requires a knowledge of both astronomy and anthropology. If your computer is programmed for one but not the other, then a Computer Programming roll is needed to carry out the task. (In either case the computer will need to make Sciences Skill Rolls.)

A Skill Roll is required if the computer was programmed for alien concepts; appropriate Knowledge Skills are Complementary. The Gamemaster also may decide that any use of a non-AID computer requires a Skill Roll.

A computer operator may need a Skill Roll for other uses, no matter what computer he is using. With a Skill Roll, he can write original programs or do complex data searches and retrievals. Note that very large databases are useful only if the information to be retrieved is specified very precisely or narrowly. Otherwise, a character is likely to end up with many times as much information as he can sift through himself.

With Computer Programming, a character without authorization may also attempt to access or modify data, rewrite computer systems and architectures, and plant viruses or monitoring programs. The attempt is resolved as Skill vs. the Security

Systems Skill of the computer system operator. If the character is attempting to overcome programming tricks rather than formal security safeguards, the opposing skill is Computer Programming. In any case, Security Systems is Complementary. (If the system operator has both Skills, one of them is Complementary, also.)

A character with this Skill knows how to phrase accurate orders to robots and computers, although subtle or complex orders may require a roll. If the Gamemaster so indicates, a character may use Computer Programming to modify the minds of AIDs and mechandroids, which have Ego. The Skill Roll is made as above versus the designer of the system. Additionally, however, an uncooperative target makes an Ego Roll as Complementary to the opposing Skill. Memories may be altered in this way at the various depths defined on the Telepathy table, commands may be planted as per the Mind Control table, Skills and Psychological Limitations may be added or changed, but the target may not increase in point value. Some modifiers for this procedure:

Per level on Telepathy or MC table	-1
Per 10 Active Points modified	-1
Attempt to keep target unsuspecting	-2

KNOWLEDGE<D-HEADER>

Knowledges are useful. Knowledges validate a character's background and provide useful Complementary Skill Rolls. In a standard science fiction setting, with large databases and fast travel available, with automation providing ample leisure time, anyone may have picked up a few Knowledge Skills. Potential areas of knowledge include:

Cultures: academic, AIDs, alien races, artistic, bars, business, criminal, frontier, military, nobility, psionic, religious, spaceports, specific dominions, specific planets, terrain types (e.g., desert culture)

Groups: alien races, crime cartels, governments, interstellar corporations, law enforcement organizations, military organizations, nobility, political factions, religions, research groups, starlines, trade guilds, universities

People: administrators, alien ambassadors, bartenders, criminals and smugglers, famous explorers, historical figures, inventors, local law officials, merchants and traders, nobles, outstanding scientists, rulers, ship captains

Places: bars, border zones, cities, moons, nebulae, planets, space sectors, space stations, starports, starships, star systems, trade routes

Things: alien physiologies, banking codes, big corporations, communications protocol, computer systems, history, landing procedures, lifeforms, military procedures, pilot regulations, planetary ephemerises, ship timetables, spaceship emergency procedures, starship designs, terrain types, warp networks

LANGUAGES<D-HEADER>

It is generally assumed in science fiction that in a society at Modern Tech Level or higher, one language dominates on any planet. Various human planets may have been colonized from different regions of Earth, though, so that, for example, Norwegian prevails on St. Olaf and Hebrew on New Zion. Alternatively, the Gamemaster may assign one language to all of human space (usually a descendent of English), and the Hero System Language Chart is thereby of little use.

Alien languages always have 0 points of similarity with human languages or those of other races. Different languages of the same race have 1 point of similarity. If two alien species actually share a common history, such as the Vulcans and Romulans of Star Trek, then those languages may also share 1 point of similarity.

Note that 0 points of similarity force a character without Linguist to pay extra to learn an alien language. However, things are even worse than that. The Gamemaster may decide that certain computer-synthesized tongues or alien pheromone codings cost even more to learn, assuming the character can emit the right scent signals or whatever in the first place. It may be impossible for a character without Mimicry or mechanical assistance to speak some of these languages without accent.

A character in Star Hero should be assumed literate with his own race's languages, but will have to buy literacy separately for each alien writing technique. Some written forms (scent

spots, ultraviolet phosphors) may require specialized equipment to produce, but should still only cost 1 point for literacy.

A character may choose to learn the written form of a language instead of the spoken form at the normal (0 points of similarity) cost. Speaking and listening ability may then be purchased later for 1 additional point. This is a good option for dead languages no longer spoken.

LIPREADING<D-HEADER>

It is possible to use this Skill with an additional -3 modifier to follow alien speech that cannot be heard. The character must know the alien language; this rule is intended for situations such as a language normally spoken in infrasonic tones. Complementary Skills would include KS: Alien culture.

LOCKPICKING<D-HEADER>

Mechanical locks are all but absent in most science fiction, replaced by electronic devices. The proper skill for bypassing those is Security Systems. Old-fashioned tumbler locks might be encountered in museums and on low-tech alien planets, but characters other than archaeologists will barely recognize them. If characters have to deal with such things, the Gamemaster can have someone attempt a Security Systems Roll -5 or a Mechanics Roll -3. Near future and gritty realistic campaigns will still have plenty of locks and this skill would then be available.

MARTIAL ARTS<D-HEADER>

Martial Art maneuvers and forms can be designed that take advantage of nonhuman physiologies or nonstandard gravities. For example, a tailed species might develop a Sweep maneuver that a human could only learn or use if he strapped on an artificial tail.

NAVIGATION<D-HEADER>

This Skill allows a character to plot a course for a journey and it allows him to determine where he is if he is lost. Navigation can be used for travel in one, two, three, or four dimensions. In one dimension, this would be timing a trip along a highway. Two-dimensional travel includes sailing, driving, and flying over a planet's surface. Examples of travel in three dimensions are SCUBA diving, spelunking, space flight, and exploring the atmosphere of a gas giant. Time travel and warp or hyperspace travel use four dimensions.

When navigating a trip, the player generally makes one Navigation Roll at the beginning and periodic rolls thereafter to check for course corrections. Daily rolls are recommended. A successful first roll will modify subsequent ones. Other modifiers include maps, travel through or near hazards, and uncertain knowledge of the destination. Complementary Skills include AK: travel area, KS: navigation instruments, and related Sciences such as oceanography or orbital mechanics. Driving and Piloting are not complementary, however. A character may plan a route that is optimal in some way, such as being the fastest or the most fuel-efficient, and this also entails a modifier.

A failed Navigation Roll means that the character is off course and may be lost. The amount of drift should be taken from the Time Chart. For daily rolls, the suggested amount is five hours of travel off course for every point the roll is failed by. A character may use Navigation when lost to find his location from available information. Between an hour and a day may be required to gather these clues, which could include the appearance of the stars, the local vegetation, and prominent landmarks. In the absence of such clues, say under a cloudy sky or in hyperspace, the character may estimate his position using dead reckoning. Some common modifiers:

One-dimensional travel	+1
Two-dimensional travel	+0
Three-dimensional travel	-1
Four-dimensional travel	-2
First roll successful	+2
Plot optimal course	-1
Dead reckoning	-2
Navigating while driving	-1

PARAMEDIC<D-HEADER>

A character with this Skill can treat one race without

penalty, usually his own race, usually humans. He may attempt to use Paramedic Skill on other lifeforms with various negative modifiers, depending on how different they are from what he has learned. Some modifiers for a human treating other lifeforms are:

Variant human	-0 to -1
Near-human bioandroids	-1
Other Earth mammals	-1
Other Earth animals	-2
Humanoid mammalian aliens	-1
Other humanoid aliens	-2
Nonhumanoid organic aliens	-3
Nonorganic aliens	-5
Biological damage to cyborgs	-0

The general rule is that the modifiers are the same whether the creature is an animal or intelligent, natural or artificial. The Gamemaster may allow a character to purchase this Skill with additional lifeforms at +1 point each. If not, then the character can offset penalties using Complementary Skills such as KS: Alien species or SC: Alien physiology. These Complementary Skills cannot increase the Paramedic Roll above its unmodified value.

PROFESSIONAL SKILLS<D-HEADER>

Science fiction professions can only be listed by example, since specifics will vary by campaign. In general, professions requiring creativity can be expected to survive automation better than drudgery jobs, especially if given a cybernetic or alien twist. Possibilities include asteroid miner, artist (gravity sculpture, holoscenes, alien songs), astrogator, big game hunter, body sculptor, bounty hunter, computer programmer, cyberdoctor, exotic pet dealer, fashion designer, fusion engineer, gravball champion, gun runner, holovid reporter, hydroponics farmer, interstellar lawyer, lightsail racer, private investigator, space pirate, spaceport dockhand, starship officer, warp engine inspector, xenobiologist.

A character may also purchase certain Professional Skills to represent practical knowledge or things the character can do, where a Knowledge Skill would represent academic understanding and a Science is not appropriate. The character may use the Skill when the Gamemaster imposes negative situational modifiers.

Examples:

Zero-gee maneuvers, high- and low-gravity maneuvers: The character is comfortable operating in such an environment, knows what to expect, and can offset penalties to DCV and Skill Rolls.

Vacc suit: The character can maintain a pressure suit, is comfortable wearing it, and can offset penalties to DCV and DEX Rolls.

SCIENCES<D-HEADER>

Sciences should be an important part of any Star Hero campaign that aims for realism. Sciences can be useful Complementary Skills for a character who wishes to be good at some other Hero System Skill such as Navigation or Systems Operation. An appropriate Science will be the primary Skill commonly enough, such as when characters wish to decipher an alien culture or figure out what chemical is eating through their pressure suits. Almost any Science a player can think of is available in Star Hero; the only likely exceptions would be obsolete applied sciences such as steam hydraulics or midwifery. Of course, the character still has to have some degree of education in his background.

As an aid to helping the Gamemaster use Sciences, the optional Science Chart is presented. The chart has three skill trees, representing the physical sciences, life sciences, and social sciences. A fourth tree, not shown, contains the engineering sciences and is discussed below. The most general sciences are at the top of each tree, with more and more specific subdivisions underneath. Many specialized sciences exist, of course, that are not listed. If a player wishes to purchase a Science that is not listed, or if a Skill Roll calls for such a Science, it should be straightforward for the Gamemaster to decide which more general skill it would go under. The four most likely forms of specialties are as follows:

Specialties by domain (Selenology under Geology, Pediatrics under Medicine, Xenobiology)

Specialties by topic (Stellar Astronomy, Cardiology, History of Transportation)

Specialties by process (Freudian Psychiatry, Experimental Economics)

Specialties by combination (Biochemistry, Forensic Archaeology)

If the Science in question is specialized in two ways from a listed Science, then it goes two steps below. A combination Science is placed directly beneath both of its parent Skills. Note that some sciences are already listed in two places.

Sciences are related in the same sense as languages. Sciences connected directly to each other in a parent/child or sibling/sibling relationship have 4 points of similarity. A character with one such Science may make a roll at -2 in place of any connected Science that he doesn't have. Thus, a character with Cosmetic Surgery may attempt Corrective Surgery at -2. Two Sciences connected to the same Science have 3 points of similarity. A character attempting a roll in a Science that he doesn't have may use a Science having 3 points of similarity and the better of a roll -4 or 8-. Thus, a character with Microbiology may attempt Organic Chemistry (tracing through Molecular Biology) with a roll no worse than 8 or less. Two Sciences located anywhere under the same major division, say anywhere under Physics, have 2 points of similarity. A character may use a Science with 2 points of similarity to make a roll at -4 (with no minimum) in a Science he doesn't have. Thus, a Dietetics Roll -4 may substitute for Psychiatry. Two Sciences located anywhere on the same tree have 1 point of similarity; the character may substitute a roll at -4 with a maximum skill of 8-. To summarize:

4 points of similarity: roll -

3 points of similarity: best of roll -4 or 8

2 points of similarity: roll -

1 point of similarity: worst of roll -4 or 8

There are a few additional guidelines to using these rules. Familiarity with a Science may never be used to derive a roll. A derived roll may not be used as a Complementary Skill, but an actual Science may be Complementary to a derived one. It is suggested that only Sciences with 4 points of similarity be Complementary. It is also suggested that all Sciences be general rather than characteristic-based, as a realistic representation of the educational process.

Finally, the engineering tree is not listed. It can be assumed for simplicity that there is one engineering specialty corresponding to each academic science listed on any of the trees, and that they are connected in the same fashion except for all having at least 1 point of similarity. Thus, Fluids Engineering corresponds to Fluid Dynamics. Some of the less obvious correspondences are:

Sociology	Civil Engineering
Meteorology	Weather Control
Ecology	Environmental Engineer
Zoology	Animal Husbandry
Botany	Agriculture
Bionics	Cybernetics

In the medical field the engineering skills include such subjects as cloning, organ synthesis, and android engineering. Corresponding academic and engineering skills have 4 points of similarity. This is not a breakdown of the field of engineering that an actual engineer would necessarily agree with, but it is a workable one. Further guidelines for using Sciences may be found in the Campaigning section.

SECURITY SYSTEMS<D-HEADER>

A character with this Skill may design, install, program, arm, disarm, and bypass security devices. All of these require a roll except for disarming the character's own mechanisms. Actually building or coding the security system will require a different Skill, usually Computer Programming or Electronics. Security systems are often placed across doorways, around areas, or on computer and communications networks. The fundamental purpose of a security system is to detect surreptitious entry. Systems are also commonly used to bar access altogether, although sufficient brute force will disable a hardware mechanism (see below) in a very obvious way, even without a Skill Roll.

Hardware security systems include devices that detect a person's identity, such as retinal scanners and palmlocks, passkey systems, and cipher systems, which accept a code word or number. Mechanical locks would also be hardware systems, but are

considered obsolete in much science fiction (see Lockpicking). Hardware security may be placed on computer equipment to prevent turning it on or it may be placed anywhere to prevent physical access. If hardware security is programmable in any way, say, to change the code word or list of authorized individuals, then it contains local memory storage or it is linked to a computer database. Hardware security may signal its results to a software system, either to allow access or to record activity.

Software security is almost always password-based and is placed on an information network of some kind. Software security is generally much more flexible than hardware for indicating who is authorized access and under what conditions (such as time of day).

A character may be able to bypass some security devices without a Skill Roll. For example, the character may obtain a passkey or code word. Otherwise, a Security Systems Roll is required, often with another Skill allowed as Complementary. For fooling identity checks, Mimicry or Disguise may be Complementary; for passkey systems, Forgery; and for code locks, Cryptography. Software security is bypassed with Computer Programming and Security Systems is Complementary. In all cases, the roll is Skill vs. the Security Systems Skill of the security designer. A player's clever design suggestion or method of bypass will earn a bonus of +1 to +3 to the respective roll. In rare cases, a roll to bypass or disable security may not be possible. For example, if a door is designed to be unlocked only from one side, the lock may be completely inaccessible from the other side. Similarly, a character can't make a Computer Programming Roll if he has failed to defeat hardware security to turn on the computer terminal. Finally, a character cannot phone up a computer and sort through its data if it isn't connected to the telephone network in the first place.

SYSTEMS OPERATION<D-HEADER>

A character with this Skill may operate radio receiving, search, and remote sensing devices. With a Skill Roll, he may operate broadcast equipment or use sensors such as radar, sonar, and visual monitors to locate targets that are either deliberately or incidentally concealed. A character may also use a Systems Operation Skill Roll to operate jamming or ECM devices.

Locating targets with ship's sensors or other sensing equipment uses the same procedure as a Perception Roll, with the same modifiers for target range and size. Spaceship sensors usually have additional Range Skill Levels or ordinary Skill Levels built into them as well. An additional modifier of +3 applies to spotting anything in open space, +1 spotting targets in planetary orbit or within asteroid belts, and +0 or worse only in unusually crowded situations, such as a space junkyard. If an attempted roll fails to spot an inert, unconcealed target, then the target is automatically spotted with that roll anyway after enough time passes beyond 1 Phase. (This assumes the sensors are operated and monitored continuously.) For example, if a character misses his roll by 1, he will notice the object in one Turn.

Sensing equipment is either passive or active. Passive equipment includes listening devices, telescopes, and radio receiving dishes. Active equipment includes radar, sonar, and other systems that send out a signal and listen for an echo. Passive equipment may have Range Skill Levels built into it. Active equipment may also have ordinary Skill Levels, but can be detected with the proper instruments anywhere in the search area.

Jamming and ECM systems are either fixed or variable. Fixed systems subtract a set amount from a searcher's Systems Operation Roll if the equipment operator makes his own roll. With a variable system, the searcher makes a Skill vs. Skill Roll instead.

TRANSPORT FAMILIARITY<D-HEADER>

The various Transport Familiarities are modified slightly to reflect the needs of science fiction, as shown below. Animal TFs embrace all beasts of burden, including pack animals and those that pull vehicles. The Gamemaster may decide that Familiarity with an animal, rather than Riding Skill, gives a character the ability to care for the animal. If so, a separate category exists for each planet's animals (e.g., Terrestrial Animals, Martian Animals) or possibly for each class of animal (mammals, reptiles, etc.).

Ground effect vehicles are capable of rising no more than a meter or so off the ground and can travel over flat ground, calm

water, snow, and mud. The Transport Familiarity is listed twice, within both the Ground and Water Categories. The Recreational Category is slightly expanded. It includes most one-man transports and may include additional alien or futuristic forms.

A vehicle may have multiple modes of travel or propulsion and operate differently in different media. For example, a space vehicle may have wings or auxiliary air-breathing engines and operate as a plane in atmosphere. In this case, two Familiarities are required to pilot the vehicle under all conditions or a character may buy a special 1 point combined TF. Note that merely being able to voyage through different environments is not enough. If a spacecraft flies normally in air or water, then no combined Familiarity is needed, nor is one needed for incidental operation such as taxiing an airplane.

A character with a Transport Familiarity may operate a radio-controlled vehicle remotely with no additional penalty if the character can see the vehicle or is receiving images from it. Control of a vehicle over planetary distances or greater will involve a time lag based on the speed of light. Maneuver rolls suffer a -1 penalty for a one-second time lag, -1 per additional step on the Time Chart, assuming the circumstances allow a roll at all.

A character with a Transport Familiarity may encounter alien vehicles that have odd controls or displays marked with unreadable script. Assuming the character can manipulate the controls at all and they don't, for example, require four hands and a tail, he can drive the vehicle after one hour's practice, but is -3 with maneuver rolls. He would regain +1 at the end of each of the first day, week, and month of use. An instructor or proper vehicle operation manual would move each of these times up one line on the Time Chart.

Beasts of Burden<E-HEADER>

- Small animals: dogs
- Medium animals: horses, camels
- Huge beasts: elephants
- Flying beasts
- Swimming beasts

Ground Vehicles<E-HEADER>

- Small wheeled: cars, motorcycles, small trucks
- Large wheeled: large trucks, construction equipment
- Tracked: tanks, APCs, construction equipment
- Ground effect: hovercraft
- Legged: powered armor, giant robots
- Ski: snowmobiles

Water Vehicles<E-HEADER>

- Boats: any that touch the top of the water
- Ground effect: hovercraft
- Submersibles: submarines, bathyscaphes

Air Vehicles<E-HEADER>

- Winged: planes, jets, gliders
- Vertical thrust: helicopters, anti-gravity
- Lighter-than-air: balloons, airships

Space Vehicles<E-HEADER>

(includes starships)

- Small: fighters, scouts, shuttles, yachts
- Large: freighters, passenger liners, most military

Recreational Vehicles<E-HEADER>

(cannot be purchased as a category)

- Diving: SCUBA, personal propulsion
- Skis: water, snow
- Skates and boards: skates, surfboards, skateboards
- Parachutes
- Rocket packs

SKILLS AS DEVICES<C-HEADER>

Devices with Skills are common in science fiction. Some examples may be found in the Technology section.

PERQUISITES<A-HEADER>

Perks work normally in Star Hero for the most part. Some alternate possibilities particular to science fiction are presented in this section. On a general note, if the players want a lot of Perks having planetary influence or greater, these are going to rapidly become expensive under the standard guidelines for cost. A Gamemaster who wants to encourage Perks may decide instead that a planetary lawman in Star Hero has the power of a modern state trooper (2 points rather than 5 for either a Contact or a Fringe Benefit) and that a magistrate for the star empire is equivalent to a modern federal judge (3 points). This works if a player never actually attempts to draw on the enormous amount of resources that multiple planets full of people represent. For example, a player's law officer couldn't be allowed to charge everyone on a planet with loitering and collect the fines. The suggested cost break is simply to avoid the parochial sense that is engendered by worrying about individual nations.

PERQUISITE DESCRIPTIONS<B-HEADER>

CONTACTS<D-HEADER>

Contacts designed by the players or met during the campaign will potentially have a wide range of levels of influence. The Gamemaster will have to carefully decide how far-reaching each Contact is in terms of nations, planets, or stellar federations, and how many points that is worth. (See the discussion above.) See the list under KS: People for a list of suggestions on good Contacts.

FAVORS<D-HEADER>

Favors awarded at the end of an adventure are a good way to prove to the players that they have done something meaningful. Besides, if the characters have helped someone important, they are going to go back to him later for help whether the Gamemaster has formally awarded a Favor or not. The general discussion on costs of Perks and the notes under Contacts apply to Favors as well.

FOLLOWERS<D-HEADER>

In addition to the usual sorts of Followers, characters in Star Hero may conceivably have robots, AIDs, and more peculiar conceptions (a symbiotic organism?). The Gamemaster must approve all such proposals, of course. See the sections on Aliens and Artificial Characters for guidelines.

FRINGE BENEFITS<D-HEADER>

The general discussion on costs of Perks applies to Fringe Benefits. All Fringe Benefits that a player wants should be carefully worked into his character's background. Exactly what is available will depend on the specifics of the Gamemaster's campaign. For example, in a dystopian or repressive society, a gun permit might be almost unobtainable (which is not the same thing as the gun itself being unobtainable). On the other hand, a high tech society may have no specific concealed weapon regulations. Miniaturization, sophisticated materials, and the huge range of actual weapon designs may make such a concept unenforceable. To give the Gamemaster somewhere to start, though, and using the normal cost guidelines, here are some Fringe Benefits available in a standard Star Hero campaign:

Access to a private data network	1
Multiple ID's (legal or not)	1
Spaceship pilot, private	1
Spaceship pilot, commercial	2
Starship owner's license, small	1
Starship owner's license, medium	2
Starship owner's license, huge (Death Star)	3
Weapon permit	1
Licensed professional (doctor, lawyer, p.i., press, warp engineer)	1
Local influence (administrative, aristocracy, police)	2
National influence	3
Planetary influence	5
Interplanetary influence	6

MONEY<D-HEADER>

Income levels for a character with wealth are in terms of the local monetary unit and probably only exist electronically, hard currency being a thing of the past. In a heroic campaign with high technology, the greatest firepower belongs to the guy with the biggest bankroll -- even now, players everywhere are poring over the Technology section and figuring what they can afford. The players will want wealth. Possibly every player will want to be Well Off or better. To handle this, the Gamemaster must first decide the power level of the campaign and what equipment is available, particularly weapons and equipment. Beyond this, there are three approaches:

If the characters belong to an organization, they simply require the allowed equipment. Anything they could actually buy on their meager salaries would be inferior, so they don't bother.

The Gamemaster calculates what wealth is needed to buy the allowed equipment and forbids any income level beyond that.

Players are given all of the money and equipment they ask for consistent with their character histories. The Gamemaster merely ensures that the bad guys are always just as well armed. (Also see "Limiting Technology in Your Campaign" in the Campaigning section for more approaches.)

To help the Gamemaster make precise amounts of wealth available, some additional income levels are introduced:

1 pt. Money	\$100,000/year
2 pt.	200,000/year
3 pt.	300,000/year
4 pt.	400,000/year
5 pt.	500,000/year
6 pt. Money	\$1 million/year
7 pt.	2 million/year
8 pt.	3 million/year
9 pt.	4 million/year
10 pt.	5 million/year

VEHICLES AND BASES<D-HEADER>

Vehicles include spaceships and bases include space stations in Star Hero. If the entire player group wants to pool points for a vehicle, it can become the basis of the campaign. The Gamemaster might want to modify the limit on vehicle points in this case. See the Starships section for examples of vehicles. See Campaigning for buying an entire world as a base.

TALENTS<A-HEADER>

Unless the Gamemaster is running an extremely realistic campaign, characters can safely be allowed to purchase most Talents without disrupting either atmosphere or game balance. Technology, alien abilities (if any), and great cultural diversity will provide counterbalance. Talents in Star Hero work, for the most part, as they do in other heroic games. Those Talents that might require special consideration are described below.

TALENT DESCRIPTIONS<B-HEADER>

ABSOLUTE TIME SENSE<D-HEADER>

If a character with this Talent travels at very high speed less than the speed of light, he will be affected by relativistic time dilation. At the end of the trip, the character will find that his internal clock is running slow with respect to the rest of the universe. This should have no actual game effect, but may be disturbing to the character. Time dilation is a calculable effect, so can be compensated for in devices.

BUMP OF DIRECTION<D-HEADER>

The Gamemaster may allow a character with this Talent to sense the location of his home planet from any other star system. Jump warp technology and teleportation, if used in the campaign, will disrupt this Talent. Hyperspace travel, however, will not. This should have little actual game effect, but may be disturbing to the character.

FAST DRAW<D-HEADER>

This Talent is particularly appropriate in gritty science fiction such as post-apocalypse Earth or adventures set on a penal colony.

IMMUNITY<D-HEADER>

A character may have an immunity because of gene-tailoring or a long-duration drug implant. This Talent may be given to slightly variant humans to represent their response to an alien environment. For example, humans on a world high in beryllium may have genetically tailored beryllium immunity (1 Character Point unless much adventuring is done on that world).

In conjunction with the acceleration damage rules in Combat and Adventuring, a character may buy Immunity to high gravity damage. For 1, 2, or 3 points, the character can ignore the first 5, 10, or 15 gravities of damage. This Talent would be appropriate for a veteran fighter pilot, for example, whose ship does not have artificial gravity.

The Gamemaster may designate other forms of damage discussed in Star Hero as suitable subjects for Immunity.

LIGHTNING CALCULATOR<D-HEADER>

Many so-called lightning calculators actually cultivate this ability by learning arithmetic shortcuts. It is possible that in a world of computers, arithmetic has become a lost art and that this Talent be very rare. It may even be regarded as mystical by the uninformed.

A character with Lightning Calculator and Navigation can calculate warp maneuvers and orbital parameters without a computer.

SPEED READING<D-HEADER>

A Star Hero character with this Talent can read text off a monitor almost as fast as the computer can display it, a page per second or the contents of a book in five minutes. Without Eidetic Memory, the character will not actually remember all of that information, but can certainly scan for particular items in a very short time.

UNIVERSAL TRANSLATOR<D-HEADER>

Unrestricted use of this Talent is not good in realistic Science Fiction; it shortcuts and sabotages the Gamemaster's efforts to portray other cultures as alien. Languages are a much more realistic and interesting mechanism for interacting if the players are willing to cooperate. This Talent is perfectly acceptable in space opera or supertechnology, although occasional alien concepts or whole languages may still prove indecipherable.

Restricted versions may be acceptable in other campaigns. The Gamemaster may or may not allow an actual Power Limitation. A

good restriction is to allow the Talent to work with a group of related languages, for example, all human languages or all synthetic languages. This may represent that a character actually knows all those languages from, say, massive injections of memory RNA or because he is simply old enough.

TALENTS AS DEVICES<C-HEADER>

Certain science fictional devices are best represented with Talents. Normally, the Gamemaster draws up a list of equipment that is available in his Star Hero campaign at the Tech Level he has chosen to play (see Campaigning). If the Gamemaster wishes, this list may include Talent devices. They are designed with the Base Cost of the Talent, the Focus Limitation, and any other appropriate Power Modifiers.

Talents that work particularly well as devices include Absolute Time Sense (clock), Bump of Direction (compass, gyroscope), Cramming, Eidetic Memory (camera), Find Weakness, and Perfect Pitch. Immunity, Lightsleep, Resistance, and Simulate Death could be acquired temporarily through drug doses. These would be purchased with Continuing Charges of some duration.

Universal Translator can be a device under the same restrictions as the Talent itself. For example, a computer may be programmed to speak a group of related languages -- simply "Translator" would be a better name in this case. A device capable of general translator duties should be found only in Super Tech.

POWERS<A-HEADER>

Powers are used in Star Hero to represent a great variety of special effects, from equipment to alien abilities to natural forces. The basic costs and uses of Powers are detailed in the Hero System Rulebook. The Gamemaster must decide, though, which effects and Powers are right for his Star Hero campaign. To this end, a degree of appropriateness is given here for each power, in the context of science fiction and for various special effects. Also, certain Powers are described in more detail.

POWER AVAILABILITY<B-HEADER>

There are five general uses for Powers in Star Hero, and the Power Availability Chart indicates which of four of these uses are appropriate for each Power. Cybernetics are devices implanted in a human or other being and controlled by the nervous system. Androids and robots should also use this column. Gadgets include handheld tools, vehicles, and freestanding equipment. Lifeforms means natural abilities of variant humans and intelligent or unintelligent aliens. Psionics, if available, are natural mental abilities. The fifth category would be natural forces, described under "Living in a Dangerous Universe".

In the chart, Powers are identified as Common (C), Uncommon (U), Not Available (N/A), and Gamemaster decision ([MAGNIFYING GLASS] and [STOP SIGN]). Common Powers may be permitted to anyone who desires them, without endangering either game balance or game flavor. Uncommon Powers should be used only infrequently, perhaps by one Player Character per group. Not Available means just that. Availability of the [MAGNIFYING GLASS] and [STOP SIGN] Powers will depend on the fundamental assumptions of the Gamemaster's particular campaign. For example, if alternate dimensions do not exist, then obviously Extra-Dimensional Movement is not available. Decisions about these Powers should be recorded on the Campaign Guideline Sheet, unless doing so gives away vital information.

The column for availability of cybernetics contrasts with the one in Cyber Hero. The major reason for this is the different setting that is assumed. The cyberpunk setting of Cyber Hero is a near-future, urban, and probably earthbound campaign. Star Hero emphasizes more advanced technology and a greater variety of environments.

For brevity, Adjustment Powers, Mental Powers, and Movement Powers each appear as a single entry in the chart. In general, Powers of the same category share a level of availability, but the Gamemaster should consider whether there are exceptions in his game.

POWER AVAILABILITY CHART<C-HEADER>

POWER	CYBERNETICS	GADGETS	LIFEFORMS	PSIONICS
Adjustment Powers	U	U	U	U
Armor	C	C	C	N/A
Change Environment	U	C	U	U
Characteristics	C	C	N/A	N/A
Clairsentience	N/A	U	U	C
Clinging	U	C	C	U
Damage Reduction	U	U	U	U
Damage Resistance	C	C	C	N/A
Darkness	U	C	U	U
Density Increase	U	U	C	U
Desolidification	U	U	U	U
Dispell	U	U	U	U
Duplication	N/A	U	U	U
END Reserve	C	C	U	*
Energy Blast	C	C	C	C
Enhanced Senses	C	C	C	U
Entangle	C	C	C	U
Extra-D Movement	N/A	*	N/A	*
Extra Limbs	U	U	C	U
FTL Travel	N/A	C	U	N/A
Flash	U	C	U	U
Flash Defense	C	C	U	U
Force Field	U	C	U	C
Force Wall	U	U	U	C
Growth	U	*	C	U
HTH Attack	C	C	C	U
Images	U	U	U	C
Instant Change	U	U	U	U

Invisibility	U	C	U	C
Killing Attack - HTH	C	C	C	U
Killing Attack - Ranged	C	C	C	U
Knockback Resistance	U	U	U	U
Lack of Weakness	U	N/A	U	U
Life Support	C	C	C	U
Mental Defense	U	U	U	C
Mental Powers	U	U	U	C
Mind Link	U	U	U	C
Missile Deflection	U	U	U	C
Movement Powers	C	C	C	*
Multiform	U	U	U	U
Power Defense	U	U	U	U
Regeneration	U	U	U	U
Shapeshift	U	U	U	U
Shrinking	U	*	U	U
Skills	C	C	N/A	N/A
Stretching	U	U	U	U
Summoning	N/A	*	*	*
Telekinesis	U	C	U	C
Transform	U	U	U	U

POWER DESCRIPTIONS<B-HEADER>

CHANGE ENVIRONMENT<D-HEADER>

Certain life support functions in enclosed environments are represented by Change Environment, including lights, temperature, and artificial gravity.

DENSITY INCREASE<D-HEADER>

Massive cybernetic implants and heavily armored pressure suits may confer Density Increase, Always On.

DESOLIDIFICATION<D-HEADER>

Technological Desolidification can be a molecular dispersal device, but only at super technology (see Technology Sourcebook).

DISPEL<D-HEADER>

Dispel can represent almost any device or effect designed to disrupt another. Likely special effects to target include electronics, cybernetics, and psionics.

DUPLICATION<D-HEADER>

Duplication as a technological effect is another feat of super technology. Possible approaches include fast cloning or a variation of the Star Trek transporter device.

ENHANCED SENSES<D-HEADER>

Range of Radio Senses<E-HEADER>

Most Powers have a maximum range of Active Points x 5 hexes (Megahexes in space, see Space Combat). The various radio senses (Radio Hearing, Radio Listen and Transmit, High Range Radio Hearing) are instead assumed in Star Hero to have a maximum range of Active Points x 5 in kilohexes (1000 hexes = 2 km), or Megahexes in space. For two radios to communicate, either the transmitter or the receiver must be able to reach the other.

FTL Radio<E-HEADER>

Faster-than-light communication, when an available technology, is purchased as a combination of High Range Radio Hearing and Faster-Than-Light Travel. For +10 Points, High Range Radio will propagate at the speed of light with no range limitation. This propagation speed can be doubled for every +2 points; see the chart under FTL Travel. The Gamemaster should set a technology limit on propagation rate.

FTL Radio is not limited by a maximum range. Rather, the useful range of FTL Radio depends on the round-trip lag time for communication. If the lag is measured in days, then this becomes a form of mail. Awkward conversations can be held if the lag is a Turn or less. Natural speech requires a delay of less than a Phase.

EXTRA-DIMENSIONAL MOVEMENT<D-HEADER>

The existence of Extra-dimensional Movement, including time travel, is obviously a campaign decision. Besides the obvious possibilities, other dimensions could include hyperspace and cyberspace (as described in Cyber Hero).

FASTER-THAN-LIGHT TRAVEL<D-HEADER>

As a device, FTL Travel is built exclusively into vehicles (but see FTL Radio). Even rarer are space creatures that travel FTL.

GROWTH<D-HEADER>

Technology-based Growth can take two different forms. One is the Always On version represented by large robots and armored suits. The other, not allowed in all campaigns, is a drug-induced metabolic change such as certain comic book characters undergo.

INSTANT CHANGE<D-HEADER>

Instant Change can represent mood-sensitive fabrics that vary their appearance, as well as subdermal melanin reservoirs and other cybernetic devices to change one's appearance.

LIFE SUPPORT<D-HEADER>

Life Support may be applied for 3 pts to various environmental hazards including pressure, radiation, temperature, and gravity. The Gamemaster should set technological and physiological limits, though, on how much protection is offered; he may decide that aliens from a desert world cannot withstand the same heat as a solar probe, despite paying the same 3 points for LS vs heat.

Some suggested technological limits are:

Pressure	0 to 50 atmospheres
Temperature	0 to 2000 K
Gravity	1 million g's

These limits can be waived at Super Tech.

MIND LINK<D-HEADER>

Mind Link in a device can represent various unusual forms of communication. One possibility is interplanetary FTL communication. Another is person-to-person speech via brain implants.

MOVEMENT POWERS<D-HEADER>

The only Movement Powers that are normally available by psionics are Flight and Teleportation.

MULTIFORM<D-HEADER>

Since Multiform is the only way to change one's Disadvantages, Multiform can represent a hormonal or drug-induced personality change (Robert Louis Stevenson's "The Strange Case of Dr. Jekyll and Mr. Hyde"). By extension, physiological changes also become possible. Multiform is also appropriate for transforming giant robots or for lifeforms with metamorphic life stages.

SHAPESHIFT<D-HEADER>

See the discussion under Multiform. As in other genres, Shapeshift can describe a more temporary and superficial change than Multiform; for instance, the giant robot which changes to a jet fighter (Multiform) can also disguise itself as a oil derrick without losing any of its abilities (or being able to pump crude, either).

SHRINKING<D-HEADER>

In a campaign with less scientific realism, the drug-induced changes described under Growth may also produce Shrinking. Certain robots may be designed to diminish their size.

SUMMONING<D-HEADER>

The appropriateness of Summoning will, to an extent, depend on whether dimensions exist from which creatures may be obtained. A society at Super Tech may use a pocket dimension to store useful objects for recall (e.g., Arthur Clarke's The City and the Stars).

A more mundane Summoning will bring natural creatures from the surrounding environment. The special effects can be a psionic beckoning, a skilled mimic who knows the animal's mating call, a pheromone grenade, and so on. The power must have certain limitations (animals must be within 100", animals must reach character by normal movement, etc). [THEY USED THIS IN ONE OF THE PSIONIC SOURCEBOOKS: THAT LITTLE GIRL WHO CALLED NEIGHBORHOOD ANIMALS TO HER AID.]

POWER MODIFIERS<A-HEADERS>

Power Modifiers include Power Advantages, Power Limitations, and Power Frameworks. The basic rules are described in the Hero System Rulebook.

POWER ADVANTAGES AND LIMITATIONS<D-HEADER>

The availability of Advantages and Limitations can be based upon common sense. If Desolidification is available, for example, then Affects Desolidified should also be available. If a technology is new or unreliable, then the Limitations should reflect it. Any device built with the guidelines in "Creating Devices" will probably have a proper combination of Power Modifiers.

The following new Power Advantages may be available in a game in which space combat uses an expanded tactical scale. The Advantages are appropriate if the Gamemaster requires strict cost accounting for equipment or Powers. For example, in a Champions campaign, abilities intended for use in space may be assigned the Megahex Advantage.

KiloheX Advantage<E-HEADER>

This Advantage makes a Power operate at KiloheX Scale as a standard Power does at regular Personal Scale. At KiloheX Scale, one tactical hex represents 2000 meters. Thus, the Power has a maximum range of 5 x Points in KiloheXes, a Range Modifier of -2 at 5-8 KiloheXes, and so on. A Power with KiloheX Advantage may be given other Advantages that concern distance and area. In combat at Personal Scale, a Power with this Advantage will either function normally or, at Gamemaster discretion, it will function as a Power with No Range Penalty and unlimited range.

KiloheX Advantage: +

Megahex Advantage<E-HEADER>

This Advantage makes a Power operate at Megahex Scale as a standard Power does at regular Personal Scale. At Megahex Scale, one tactical hex represents 2000 kilometers. Thus, the Power has a maximum range of 5 x Points in Megahexes, a Range Modifier of -2 at 5-8 Megahexes, and so on. A Power with Megahex Advantage may be given other Advantages that concern distance and area. In combat at Personal Scale, a Power with this Advantage will either function normally or, at Gamemaster discretion, it will function as a Power with No Range Penalty and unlimited range.

Megahex Advantage: +

Gigahex Advantage<E-HEADER>

This Advantage makes a Power operate at Gigahex Scale as a standard Power does at regular Personal Scale. At Gigahex Scale, one tactical hex represents 2 million kilometers. Thus, the Power has a maximum range of 5 x Points in Gigahexes, a Range Modifier of -2 at 5-8 Gigahexes, and so on. A Power with Gigahex Advantage may be given other Advantages that concern distance and area. In combat at Personal Scale, a Power with this Advantage will either function normally or, at Gamemaster discretion, it will function as a Power with No Range Penalty and unlimited range.

Gigahex Advantage: +

POWER FRAMEWORKS<D-HEADER>

In general, Power Frameworks are not available. There are a few exceptions.

Elemental Control<E-HEADER>

Occasional creature designs (but never Player Character aliens) will have Elemental Controls. This is really just a book-keeping device and has no effect other than to encourage the Gamemaster to think about related Powers. Psionics and equipment should not use ECs.

Multipower<E-HEADER>

Certain pieces of equipment are properly designed as a Multipower, e.g., a gun that shoots two different kinds of ammunition. Psionic abilities and Player Character races should not use Multipowers. Cybernetic enhancements should not either, generally speaking, although the Gamemaster may identify exceptions.

Variable Power Pool<E-HEADER>

Variable Power Pools may be encountered on very rare occa-

sions, especially in a space opera campaign (see Subgenres in Campaigning). Elder races advanced beyond Super Tech are living examples of Clarke's Third Law ("any sufficiently advanced technology is indistinguishable from magic") and are best represented with Variable Power Pools.

If Player Characters must pay Character Points for their equipment, then a Character may have a Gadget Pool.

CHARACTER DISADVANTAGES<A-HEADER>

The right Character Disadvantages contribute greatly to a proper science fictional atmosphere for Star Hero. Motivations and attitudes that recur in the literature can be represented as Psychological Limitations, planetary governments and interstellar corporations can be Hunters or Watchers, and alien physiological differences can crop up as Physical Limitations, Susceptibilities, and Distinctive Features.

This section points out some of the ways in which the right Disadvantages can be chosen for a Star Hero character. If a type of Disadvantage is not listed, assume that it is treated as in a standard Hero System campaign. Most of the discussions apply to normal humans -- aliens can be exceptions to a lot of these guidelines. See the section on alien design for more advice.

ACCIDENTAL CHANGE<D-HEADER>

This is principally a comic book device and is normally inappropriate in Star Hero. It is conceivable, however, that certain alien races may have multiple forms for which this Disadvantage would apply.

AGE<D-HEADER>

Age is a permissible Disadvantage in Star Hero. Brain and nervous tissue do not regenerate without super technology, so humans will inevitably grow old and die. However, because human lifespan is expected to increase with medical advances, a character who takes the 5 pt. Disadvantage may easily be 80 or 150 years old rather than 40. Alien races will have their own distinct lifespans, and the Characteristic Maxima may change differently as well (though this is not recommended).

BERSERK<D-HEADER>

Berserk and Enraged are normally not appropriate Disadvantages, although as states of mind they could conceivably be induced through drugs or brainwashing. One notable exception is the Pon Far (rutting madness) experienced by Vulcan males on Star Trek.

DEPENDENCE<D-HEADER>

In a campaign with advanced medical technology, this Disadvantage should be used to represent only very nontraditional problems. Deficiencies such as diabetes can be handled with implanted 6-month insulin capsules or a whole pancreas transplant. Physical addictions to normal drugs can be assumed curable with routine care, and mental addictions are better represented by Psychological Limitations.

Use of Dependence requires some imagination, therefore. Some synthetic drugs may be extremely addicting, to the point of overwhelming even advanced medicine. Newly discovered alien substances may not pose a problem once analyzed, but can be Dependencies until then. Technology may create unusual needs that are not tractable by traditional methods. Examples might be direct pleasure center stimulation (Larry Niven's "wireheading") or a mechandroid who needs periodic degaussing.

DISTINCTIVE FEATURES<D-HEADER>

Racial and individual Distinctive Features crop up repeatedly in science fiction. Distinctive Features should only be taken for being a member of a particular species if the character's race is really going to be unusual. That is, a human can take Distinctive if he will almost always be among aliens in the campaign and there won't be many humans around. In a cosmopolitan interstellar empire with dozens of alien races, no one's particular appearance is going to arouse attention.

A character may also take Distinctive Features if he is a member of a race or group that is subject to prejudice by most of society. Depending on the campaign, prejudice may be directed at all aliens, certain alien races, androids, clones, cyborgs, psionics, or robots. Being visibly a member of such a group would be worth +5 points for Always Noticed, Major Reaction.

Individual Distinctive Features are mainly a matter of personal choice. Hair and skin tone, birthmarks, and tatoos can likely all be added and subtracted routinely using future cosmetic surgery. Mannerisms and occupational indicators are also valid features under the same guidelines as for a modern campaign. Again, though, a feature is only distinctive if members of

society will note and remember it.

HUNTED AND WATCHED<D-HEADER>

These can be enjoyable Disadvantages for the Gamemaster, but he has to think big. Even an entire planet has to be considered a "limited geographical area" in Star Hero, and anything smaller is probably of no consequence. Single people and small groups as Hunters should be wealthy and very mobile or hooked into a good information network (really extensive non-combat influence).

PHYSICAL LIMITATIONS<D-HEADER>

The player may have to think to justify any Physical Limitations. Little advance is required beyond modern-day medicine to allow transplanting intact eyes and entire limbs (regenerating organs is a bit further along).

However, all is not lost. Physical Limitations can be used to represent slight human variations that do not warrant a full Package Deal (q.v.). For example,

Eight feet tall: Human character comes from a low-gravity world where they grow 'em tall. Character won't fit normal doors or chairs and may not fit in the autodoc. Infrequently to frequently, slightly: 5-10 pts.

Light-sensitive: Character comes from a world without sunlight and is -3 to sight PER in bright light. Infrequently, slightly: 5 pts.

Physical Limitations may also be used to represent certain handicaps unique to an advanced technology, as for instance,

Computer Illiteracy: The character is almost completely unable to phrase coherent orders to computers or robots. Skills such as Computer Programming may only be used at the Familiarity level.

The character may come from a low-tech society or may simply use too many metaphors and slang phrases. Always, greatly: 20 pts.

No Electronic Records: This limitation applies to fully computerized societies with electronic wealth and no hard currency. In such a society, the character has no government ID number, credit rating, or bank account. The character may come from a previously unknown alien planet, he may be an illegally created clone, or he may be the victim of malice or ill fortune. The character will encounter hassles and confusion whenever he interacts with bureaucracy, law enforcement, or financial institutions (-5 on appropriate Skill Rolls). The character is not required to be poor, however, if he has some other access to wealth, such as a patron or a nonpersonalized debit card. Rogues and technophobes may be lining up to take this Disadvantage, so the Gamemaster should be prepared to play up its inconveniences. Frequently, greatly: 15 pts.

Space sickness: The character becomes physically ill in free fall. Dexterity drops by 15 to a minimum of 1 and the character gets no free post-Segment 12 Recovery. A plastic bag is recommended. Infrequently, fully: 15 pts.

PSYCHOLOGICAL LIMITATIONS<D-HEADER>

The right Psychological Limitations can set the tone of Star Hero better than almost anything else. Here are some that are common to science fiction stories:

Absent-Mindedness: The character becomes engrossed in his own interests to the exclusion of potentially life-saving details. He forgets to close his space helmet, doesn't take a weapon on landing expeditions, wanders into crumbling alien ruins. It is stereotypical of scientists to have this Disadvantage. Common, irrational: 15 pts.

Agoraphobia: This is a combination fear of open spaces and crowds of strangers. Characters raised on space stations and ships or deriving from underground races might have this Disadvantage. Uncommon, irrational: 10 pts.

Gunslinger Mentality: The character is the fastest draw or toughest fighter on seventeen planets and will so boast in every bar. The character must accept challenges. Common, irrational: 15 pts.

Law-Abiding: The character respects all local laws, no matter how silly or irrelevant to humans. Diplomats and sessile bureaucrats might have this Disadvantage. Common, total commitment: 20 pts.

Neatness Fetish: The character must spend measurable time cleaning compartments and replacing tools and will berate anyone who

does otherwise. This behavior might be seen shipboard, where weightlessness or sudden accelerations can turn loose objects into hazards. Uncommon, 5 pts.

Prejudice: A character may discriminate against certain others. See Distinctive Features. This is not a particularly heroic Disadvantage for player characters, but it is permissible regardless of whether society in general behaves the same way or opposes discrimination. Uncommon to very common: 5-15 pts.

Sanctity of Life: The character will not kill any living thing and tries hard to eat only synthetic foods. Very simple lifeforms such as bacteria are exempt. Common, total commitment: 20 pts.

Technophilia: The character loves flashy technology. He buys the latest model of everything, surrounds himself with automation, and owns the only known voice-activated gauss pistol. The character tends to trust devices more than people and becomes lost or confused during a power failure. Common, strong reaction: 15 pts.

Technophobia: The character fears/hates (player specifies) technology more advanced than two levels below the current prevailing tech level, or as established with the Gamemaster. The character avoids what he considers dangerous and experimental transportation, keeps records on real paper, and probably mistrusts robots. Very common, strong reaction: 20 pts.

Thrillseeker: The character seeks excitement. He flies fast skimmers close to the ground, sneaks into forbidden alien temples, and breathes strange atmospheres without a respirator. Common, irrational: 15 pts.

Wanderlust: Wherever the character is, he yearns to be somewhere else. Greater adventures or more exotic cultures are sure to be found in the next star cluster. If the character wishes to stay in one locale for more than a day, he must make an Ego Roll on the second day and at every additional step on the Time Chart. Common: 10 pts.

Xenophilia: The character is fascinated by all things alien and will go out of his way to sample alien customs, alien foods, etc., in preference to human ways. Common, irrational: 15 pts.

Xenophobia: The character fears/hates (player specifies) alien experiences. Alien sky colors nauseate him, alien fashions repel him, and so on. Common, irrational: 15 pts.

SECRET IDENTITY<D-HEADER>

This Disadvantage might be appropriate in its traditional sense to space opera or other romantic campaigns. Otherwise, it can represent a character (clone, alien, android) passing himself as human, a spy for another government, or someone operating under a fake ID.

SUSCEPTIBILITY<D-HEADER>

Robots may be susceptible to masers and certain aliens to various common substances (salt, lead), but standard humans should not normally have Susceptibilities.

VULNERABILITY<D-HEADER>

Comments on Susceptibility apply to Vulnerability also. In a campaign based on gritty realism, however, a player may give his character a Hit Location Vulnerability as detailed in Ninja Hero.

PACKAGE DEALS<B-HEADER>

Package Deals are primarily a means of simplifying character design. Characters can certainly be designed without any Package Deals at all. As explained in the Hero System Rulebook, a Package Deal is given to members of the same race, culture, or profession, or who would otherwise share common Skills. Sample racial Package Deals are given in the Aliens section. The examples below are chiefly occupational.

SOLDIER<D-HEADER>

Cost Skills

- 2 WF: Small arms
- 2 WF: choose from
Common Melee, Heavy Weapons, or 2 Uncommon
- 3 Concealment
- 3 Systems Operation
- 1 KS: Military procedures
- 1 KS: Enemy forces
- 6 Choose 2 Skills (+1 w/Weapon Group, Bureaucratics, Climbing, Combat Driving, Computer Programming, Demolitions, Electronics, Mechanics, Paramedics, PS: Zero-G Operations, PS: Vacc Suit, Security Systems, Stealth, Survival, Weaponsmith)

0+ DISADVANTAGES

- 3 Package Bonus
- 5 DF: Soldier
- 10 Watched by military, 8-
- 0 Package Cost

Soldiers are pretty much alike from culture to culture. They all work for someone else doing nasty jobs for little pay. Even the food jokes tend to be the same.

FIGHTER PILOT<D-HEADER>

Cost Skills

- 3 WF: Small arms, ship to ship
- 3 Combat Pilot
- 3 Navigation
- 3 Systems Operation
- 1 KS: Military procedures
- 2 PS: Vacc suits
- 3 Choose 1 Skill (Bureaucratics, Combat Driving, Computer Programming, Electronics, PS: Zero-G Operations, Mechanics, Survival)

0+ DISADVANTAGES

- 3 Package Bonus
- 5 DF: Military pilot
- 10 Watched by military, 8-
- 0 Package Cost

Fighter pilots are highly skilled elitists who tend to die young.

SCOUT<D-HEADER>

Cost Skills

- 2 WF: Small arms
- 3 Navigation
- 3 Survival
- 1 TF: Spaceships, one size
- 2 AK: Frontier space
- 1 KS: Military procedures
- 1 PS: Vacc suit
- 4 Choose 2 Sciences
- 6 Choose 2 Skills (Climbing, Combat Driving, Combat Pilot, Concealment, Electronics, Mechanics, Paramedic, PS: Zero-G Operations, Stealth, Systems Operation, Tracking, WF: Ship-to-ship)

0+ DISADVANTAGES

- 3 Package Bonus
- 5 DF: Scout
- 5 Reputation, 8-
- 10 Watched by other scouts, 8-
- 0 Package Cost

Scouts make their living hopping from one unexplored system to another, selling the results of their surveys. Scouts are infamous for overlooking dangerous problems later found by would-be colonists.

COMMANDER<D-HEADER>

Prerequisite of Soldier, Fighter Pilot, or Scout Package

Cost Skills

3 Tactics
2 KS: Famous strategies
3 Perk: Commander rank
3 Choose 1 Skill (+1 w/Weapon Group, Bureaucratics, High Society, Interrogation, Oratory, Paramedic, Persuasion, Survival)
0+ DISADVANTAGES
3 Package Bonus
5 Reputation, 8-
3 Watched by military, 11-
0 Package Cost

BOUNTY HUNTER<D-HEADER>

Cost Skills
4 WF: Small arms, common melee
3 Criminology
3 Shadowing or Tracking
3 Stealth
2 KS: Wanted criminals
6 Choose 2 Skills (Bribery, Combat Driving, Combat Pilot, Concealment, Conversation, Disguise, Forgery, Interrogation, Lockpicking, Navigation, Paramedic, Security)
0+ DISADVANTAGES
3 Package Bonus
10 Reputation, extreme, 8-
8 Watched by local authorities, 8-
0 Package Cost

PRIMITIVE<D-HEADER>

Cost Skills
4 WF: Common melee and missile
3 Survival
3 1 Level with Weapon Group
2 AK: Home terrain
2 KS: Homeworld flora and fauna
9 Choose 3 Skills (Acrobatics, Animal Handler, Breakfall, Climbing, Mimicry, Navigation, Paramedic, Riding, Shadowing, Stealth, Tracking)
0+ DISADVANTAGES
3 Package Bonus
5 DF: Primitive
15 Technical illiterate
0 Package Cost
This is a general package for members of a pre-technical society.

LAW ENFORCEMENT AGENT<D-HEADER>

Cost Skills
4 WF: Small arms, Common melee
3 Criminology
2 KS: Criminal law
2 KS: Agency specialization
6 Perk: Interplanetary police powers
6 Choose 2 Skills (Bugging, Bureaucratics, Combat Driving, Combat Pilot, Computer Programming, Concealment, Conversation, Deduction, Forensic Medicine, Persuasion, Shadowing)
0+ DISADVANTAGES
3 Package Bonus
10 Upholds the law
13 Watched by agency, 11-
0 Package Cost

EXPLORER<D-HEADER>

Cost Skills
2 WF: Small arms
3 Navigation
3 Systems Operation
1 TF: Spaceships, one size
2 AK: Frontier space
1 PS: Vacc suit
1 Perk: Spaceship pilot's license
6 Choose 2 Skills (Bureaucratics, Climbing, Combat Driving, Combat Pilot, Concealment, Electronics, Mechanics, Paramedic, Persuasion, Stealth, Survival, Trading, WF: Ship-to-ship)
0+ DISADVANTAGES
3 Package Bonus
5 Reputation, 8-
12 Watched by patron, 14-
0 Package Cost

SPACESHIP PILOT<D-HEADER>

Cost Skills
2 WF: Ship to ship
3 Navigation
3 Systems Operation
1 TF: Spaceships, one size
2 AK: Space routes
2 PS: Vacc suit, Zero-gee operations
1 Perk: Spaceship pilot's license
3 Choose 1 Skill (Bribery, Bureaucratics, Combat Pilot, Concealment, Electronics, KS: Black Market, KS: Military Procedures, Mechanics, Trading)
0+ DISADVANTAGES
3 Package Bonus
13 Watched by employer, 11-
0 Package Cost

CON MAN<D-HEADER>

Cost Skills
9 Acting, Conversation, Persuasion
2 KS: Confidense scams
6 Choose 2 Skills (Bribery, Disguise, Forgery, Gambling, High Society, Language fluent w/accnt, Lip Reading, Mimicry, Oratory, Seduction, Sleight of Hand, Streetwise)
0+ DISADVANTAGES
3 Package Bonus
15 Hunted by authorities, 8-
-1 Package Cost

PIRATE

Cost Skills
5 WF: Small arms, common melee, ship to ship
5 Streetwise +1
1 AK: Safe haven
1 PS: Vacc suits
6 Choose 2 Skills (Combat Driving, Combat Pilot, Concealment, Demolitions, Electronics, Gambling, Mechanics, Navigation, Paramedic, Systems Operation, Weaponsmith)
0+ DISADVANTAGES
3 Package Bonus
15 Hunted by authorities, 8-
0 Package Cost

SMUGGLER<D-HEADER>

Cost Skills
3 WF: Small arms, ship to ship
3 Combat Pilot
3 Navigation
3 Systems Operation
3 AK: Smuggling routes
2 KS: Black market
3 Choose 1 Skill (Bribery, Concealment, electronics, Forgery, Mechanics, Persuasion, Seduction, Trading)
0+ DISADVANTAGES
3 Package Bonus
15 Hunted by authorities, 8-
5 Reputation, 8-
0 Package Cost

THIEF<D-HEADER>

Cost Skills
2 WF: Small arms
6 Concealment, Security Systems
3 Stealth
3 Streetwise
1 PS: One type of crime
2 Contact: Fence
6 Choose 2 Skills (Bribery, Bugging, Climbing, Contortionist, Conversation, Demolitions, Disguise, electronics, Forgery, Gambling, High Society, Lip Reading, Seduction, Shadowing, Sleight of Hand, Streetwise)
0+ DISADVANTAGES
3 Package Bonus
15 Hunted by authorities, 8-
5 Reputation, 8-
0 Package Cost

DOCTOR<D-HEADER>

Cost Skills
3 Paramedic
2 KS: Medical specialty
2 PS: Doctor
4 Sc: Medicine and specialty
1 Perk: Licensed doctor
3 Choose 1 Skill (Bureaucratics, Computer Programming, Deduction, Forensic Medicine, Inventor, Oratory, Systems Operation)
0+ DISADVANTAGES
3 Package Bonus
12 Watched by medical board, 11-
0 Package Cost

SHIPS' ENGINEER<D-HEADER>

Cost Skills
6 Electronics, Mechanics
3 Systems Operation
2 KS: Ship design aspect
2 Sc: Engineering specialty
2 TF: Spaceships
0+ DISADVANTAGES
3 Package Bonus
10 Watched by employer, 11-
2 Package Cost

SCIENTIST

Cost Skills
3 Computer Programming
3 Scientist
2 KS: Field of science
2 Sc: Primary specialization
2 Choose 2 related Sciences
3 Choose 1 Skill (Bureaucratics, Deduction, Electronics, Inventor, Oratory, Systems Operation)
0+ DISADVANTAGES
3 Package Bonus
12 Watched by patron, 11-
0 Package Cost

BUREAUCRAT<D-HEADER>

Cost Skills
3 Bureaucratics
2 KS: Organizational regulations
1 KS: Politics
1 Contact
3 1 Presence Skill
1 1 Presence Skill Familiarity
3 Choose 1 Skill (Acting, Bribery, Computer Programming, High Society, Oratory, PS: Speech writer, Persuasion)
0+ DISADVANTAGES
2 Package Bonus
13 Watched by organization, 11-
-1 Package Cost

DIPLOMAT<D-HEADER>

Cost Skills
12 Bureaucratics, Conversation, High Society, Persuasion
2 KS: Diplomatic procedures
2 KS: Host culture
2 PS: Diplomat
2 1 Language, fluent
5 Perk: Diplomatic immunity
0+ DISADVANTAGES
3 Package Bonus
10 Watched by own government, 8-
0 Package Cost

MERCHANT<D-HEADER>

Cost Skills
9 Conversation, Persuasion, Trading
1 Familiar w/Concealment
2 KS: Trade demands
0+ DISADVANTAGES
2 Package Bonus

8 Watched by local authorities, 8-
2 Package Cost

SECRET AGENT<D-HEADER>

Cost Skills
2 WF: Small arms
3 Concealment
3 Conversation
5 Shadowing +1
2 KS: Espionage techniques
4 KS: Own organization, enemy organization
3 Choose 1 Skill (Acting, Bribery, Bugging, Bureaucratics,
Climbing, Combat Driving, Computer Programming, Cryptography,
Demolitions, Disguise, High Society, Interrogation, Language
fluent w/accnt, Lockpicking, Mechanics, Perception, Persuasion,
Resistance, Security Systems, Seduction, Stealth, Streetwise,
Survival, Weaponsmith)
0+ DISADVANTAGES
3 Package Bonus
10 Watched by own agency, 8-
10 Watched by enemy agency, 8-
-1 Package Cost

ARTIFICIAL CHARACTERS<A-HEADER>

These are characters who originated in a workshop or laboratory, including androids, robots, and genetically constructed lifeforms. In Star Hero such a character may be created as an Automaton with an AI brain, but it is much simpler to build one as a typical PC with specific properties.

Artificial beings may have any Powers, Skills, and Talents allowed by the GM and the campaign's technology, including the Automaton Powers: Cannot Be Stunned, Does Not Bleed, and Takes No Stun (Beware of letting the PC wear armor!). The GM must decide whether artificial characters have no Everyman Skills, the same Everyman Skills as other characters, or a special set of Everyman Skills for each type of construct. An artificial being may have an appropriate Package Deal for the purpose it was created (such as Soldier). If the campaign uses psionics, the GM must decide whether artificial characters can have or be affected by psionic abilities.

See Power Limitations and Character Disadvantages for some properties of artificial beings.

TYPES OF ARTIFICIAL BEINGS<C-HEADER>

Robots in futuristic SF are usually mobile AI computers, such as the Cylons of Battlestar Galactica and those in Asimov's robot stories. These should be written as regular characters with conspicuously mechanical bodies (Distinctive Features).

An android is an artificial being resembling a real one, usually human ("android" means "manlike"). Androids may look like other lifeforms; nonhuman races are likely to have "androids" built in their image. Mech-androids are machines; human-looking robots. Some are so lifelike that they secretly pass for human.

Bio-androids are grown or assembled from organic materials, and mimic living beings in their life functions. An untrained observer cannot tell some bio-androids from a human even by looking at its internal structure. Biodroids are usually created with genetic alterations so as to have improved abilities such as high STR or tolerance to hostile environments, or a low INT or EGO so as to be easily controlled. (The word "robot" was actually coined for biologically-created humanoids in the play R.U.R. Others include the replicants in Blade Runner and Frankenstein's monster.)

A clone is a bio-android grown from natural genetic material. It has the same genetic code and Racial Package Deal, if any, as the original being. Identical twins are, in fact, naturally-occurring clones of each other.

A clone is nearly, but not quite, identical to the individual creature it was grown from. Like identical twins, the two are exact only in genetic details such as facial structure and hair color. They differ in randomly-created details such as fingerprints and retina patterns.

The clone will not automatically have the memories and skills of its progenitor, nor (as sometimes happens in SF) need it have a Mind Link with its "parent" or co-clones. A clone intended as a replacement or exact duplicate of a person must somehow have the memories of the original transferred into it, as well as fingerprints altered and scars reproduced.

A clone normally takes as long to grow as a normal creature does from the time of conception, but SF clones are often force-grown to the desired age. Others develop at an accelerated rate as a side-effect of the cloning process, and die of old age while still comparatively young. While still only a few cells big, a clone may be genetically altered (like a biodroid) so that it will have a different appearance or characteristics from its sire, or even have its sex reversed.

A cyborg is a person whose body parts have been replaced by mechanical devices. Technically this includes anyone with a pacemaker or Teflon hip-joint, but SF cyborgs are often as much machine as man. Mentally, a cyborg may be as human as he was before his conversion, or he may suffer from feelings of inhumanity, or his cyborg systems may include a computer which imposes AI Disadvantages on him (as per Robocop).

A biot is an organic/mechanical construct with an artificial brain, such as the flesh-covered Terminator or the biots in Rendezvous with Rama, which originated the term.

CHARACTER DISADVANTAGES<B-HEADER>

HARD-CODED PROGRAM<D-HEADER>

This is a Psychological Limitation bought as a Physical Limitation. Usually used for robots and androids, it represents a behavior or belief which is literally built-in and cannot be changed by an EGO Roll, by Mind Control, nor even by reprogramming. This Limitation can only be removed by the equivalent of major surgery, like other Physical Limitations.

Because Psychological and Physical Limitations both depend on the frequency of occurrence and the degree of impairment, Hard-Coded Programs cost the same as the corresponding Psychological Limitations.

COMMON PSYCHOLOGICAL LIMITATIONS<C-HEADER>

ARTIFICIAL CHARACTERS<D-HEADER>

Curiosity: Common, total commitment (20 points)
Secretly hates organic lifeforms: Common, serious (15 points)
Considers mission goals more important than crew: Common, total commitment (20 points)
Secret programmed goals: Uncommon, total commitment (15 points)
Wishes to be human: Common, total commitment (20 points)
Doesn't know he's an android/clone: Common, total commitment (15 points)
Refuses to believe he's an android/clone: Common, total commitment (20 points)
Emulates humans: Very common, serious (20 points)
Feels superior to humans: Common, serious (15 points)
Total commitment to programmed purpose: Common, total commitment (20 points)
Helpful to humans: Common, serious (15 points)

Isaac Asimov's "Three Laws of Robotics":<E-HEADER>

Code vs Killing humans: Common, total commitment (20 points)
Must obey humans: Common, total commitment (20 points)
Self-preservation instinct: Common, serious (15 points)

COMMON PHYSICAL LIMITATIONS<C-HEADER>

ROBOTS AND MECH-ANDROIDS<D-HEADER>

Hard-coded Program: (see above)
Obvious deactivation switch (instantly renders robot unconscious): Frequently, fully impairing (20 points)
Hidden deactivation switch: Infrequently, fully impairing (15 points)
Deactivation code (robot may be turned off by communication signal and Security Systems skill): Frequently, fully impairing (20 points)
Does not heal BOD; must be repaired: Frequently, greatly impairing (15 points)
"Eats" only silicon maintenance compound: Frequently, greatly impairing (15 points)
No emotions: All the time, greatly impairing (20 points)
Naive and ignorant: No life experiences: All the time, greatly impairing (20 points)

BIO-ANDROIDS AND CLONES<D-HEADER>

Limited life span: Infrequently, somewhat impairing (5 points)
Unusual Physiology, -1 to Medical Rolls: Infrequently, somewhat impairing (5 points)
Very Unusual Physiology, -3 to Medical Rolls: Infrequently, greatly impairing (10 points)
No emotions: All the time, greatly impairing (20 points)
Naive and ignorant, no life experiences: All the time, greatly impairing (20 points)

OTHER DISADVANTAGES<C-HEADER>

CLONES<D-HEADER>

Distinctive Features: Looks like progenitor and co-clones
Secret ID: Clone, not a human being
Reputation: Same as that of progenitor
Owned Property, no legal rights: see Discrimination

ROBOTS AND MECH-ANDROIDS<D-HEADER>

Vulnerable x2 BODY from electricity and masers: see Cybernetics.
Additionally, individual Powers may have the - 1/4 Limitation.

ALIEN RACES<A-HEADER>

Alien races are bought in two steps. First, the Gamemaster designs or approves a Racial Package Deal, which the alien character must purchase. Second, this is repeated for a Cultural Package Deal if the alien grew up within his own culture. Guidelines and examples are found in the Campaigning section.

CYBERNETICS<A-HEADER>

Cybernetics are artificial, nonbiological implants that replace a character's normal organs or give him new capabilities. Usually, cybernetic devices are hooked into the character's own nervous system. Cybernetics are discussed well in Cyber Hero. The information here and the examples in the Technology Sourcebook are a minimal treatment, including the specific design criteria for the realm of Star Hero.

BUYING CYBERNETICS<B-HEADER>

The Gamemaster may indicate that Player Characters can have cybernetic devices. If so, this is how it is done.

CYBERNETICS COST POINTS<D-HEADER>

Players pay Character Points for cybernetic implants. See Designing Cybernetics for how to figure the cost, and the Technology Sourcebook for examples.

CYBERNETICS COST MONEY DURING PLAY<D-HEADER>

A starting character does not pay money for his cybernetics. New devices implanted during play cost money as well as points. Replacement systems cost money, but no new points. Monetary costs are based on the Active Points of a device and the Tech Level. See the Technology Sourcebook for examples.

SURGERY<D-HEADER>

Cybernetics that are Inaccessible or have no Focus Limitation require surgery to install. Exceptions include skillsofts and weapon clips, which slide into existing cybernetic systems. Surgery costs money unless the character is just starting. The cost of surgery is found by determining which locations on the Hit Location Chart are affected. Add up the Stun Multipliers for these locations. Then,

$$\text{Surgery Cost} = (\text{Sum of Stun Multipliers}) \times 1000.$$

If only one arm or leg is to be done, halve the cost. Thus, installing a single artificial hand costs 500, one head location (a chipjack, for instance) costs 5000, and armoring both chest locations costs 6000.

It is possible that Player Characters will be under a medical plan offered by either the government or their employer. In this case, certain surgeries will be considered necessary rather than optional and be free of charge. Any cybernetic device that exactly replaces a normal organ is installed free. This includes, for example, a replacement eye or hand. The equipment itself still costs money.

DESIGNING CYBERNETICS<B-HEADER>

Cybernetic devices are normal commodities and easily available to an advanced culture. Ideally, the Gamemaster should design all cybernetics and give a list to the players. The design guidelines that follow assume that cybernetics is a mature, reliable technology. This is not appropriate for all genres. Cyberpunk and other near-future campaigns may want to use the rules in Cyber Hero instead.

CYBERNETIC ABILITIES<C-HEADER>

Many or most Characteristics, Skills, Talents, and Powers can be put into cybernetics. The individual descriptions will suggest when this is appropriate.

CHARACTERISTICS<D-HEADER>

Characteristics in cybernetic devices add to a character's normal attributes and are not affected by Characteristic Maxima. If the Gamemaster fears this is unbalancing, he should play up the Power Limitations of the device. Most devices with Characteristics will have the No Figured Characteristics Limitation. Many will have Limitations such as Strength for One Limb Only -1. Artificial glands and drug ampules should use Aid instead.

SKILLS<D-HEADER>

Skills based on a Characteristic must have a base roll of 9, as stated in the Hero System Rulebook. Skill Levels must be 5 point levels or greater. Skills can be permanent abilities coded into nonremovable ROM, or they can be interchangeable skillsofts

as described in Cyber Hero.

POWERS<D-HEADER>

The Power Availability Chart indicates which Powers are appropriate as cybernetic devices. All such Powers share the common special effect, cybernetic.

POWER LIMITATIONS<C-HEADER>

There are several related considerations here.

CYBERNETICS<D-HEADER>

This - 1/4 Limitation is required for all cybernetic equipment. It means, first of all, that the equipment shares a common special effect. Second, cybernetics are vulnerable to electricity, microwaves, and masers and take x2 Body from these sources. Thus, a cybernetic arm will take extra damage if Hit Location 7 or 8 comes up. Consider the Vulnerability when checking for Impairment or Disabling. If a cybernetic device is not a Focus, then the character takes the extra damage instead. If cybernetics are common in society, then this Limitation will be well known.

FOCUS<D-HEADER>

Nonremovable systems will not have a Focus Limitation. These would be such things as artificial nerves and muscles. Otherwise, the specific Limitation will vary.

Visibility<E-HEADER>

Cybernetics may be Obvious or Inobvious to suit the taste of the consumer. Inobvious devices are covered with artificial skin or otherwise look normal. Obvious devices look artificial; they are covered with flexible plastic or metal, they whirr, and so on. If cybernetics are rare or invite prejudice, then characters with Obvious Foci may take Distinctive Features.

Accessibility<E-HEADER>

Most cybernetics are Inaccessible Foci. They can be disabled or destroyed with a Turn of effort. To actually remove an artificial eye or limb, though, may require a Skill Roll with Mechanics or PS: Cybernetic doctor. Accessible Foci include skillsofts and certain attachments such as interchangeable fingers for a mechanical hand. Equipment with external controls (generally a poor engineering concept) is also Accessible.

Applicability<E-HEADER>

Cybernetics are usually Personal Foci, meaning that they have been fit to a particular bone joint or nerve network. However, a cybernetics specialist should be able to rework any such device so that it can be installed in someone else.

NOT INDEPENDENT<D-HEADER>

Cybernetic devices are never built Independent. They can be replaced if broken with no extra cost in Character Points.

OTHER LIMITATIONS<D-HEADER>

Other Power Limitations will be appropriate, depending on the device being designed. Burnout and Activation Roll represent unreliable technology just introduced in the current Tech Level. A device that suffers Burnout can normally be repaired with a few minutes of noncombat time. Particularly noisy equipment may be Visible.

ENERGY<C-HEADER>

Cybernetic devices can be powered in various ways. If the system does not use END, then a lifetime battery can be assumed, or it runs off of body heat. Otherwise, there are several options.

PERSONAL END<D-HEADER>

A limb is hooked to the character's tendons at the attachment joint, or an artificial organ uses the body's chemical energy store. The character's own END powers the device.

END RESERVE<D-HEADER>

This is a large capacity battery of the current Tech Level. Each limb and organ cluster may have its own End Reserve or everything may run off of a single power source in the character's abdomen. In the latter case, surgery is required to run

artificial nerves from the battery to each cybernetic device.

An END Reserve may recharge itself slowly by using body heat, motion, or trace amounts of the body's ATP. Buy Recovery for it. Otherwise, it has a convenient socket for external charging.

CHARGES<D-HEADER>

Normally, only weapon clips and drug ampules will represent Charges, but other systems may use Charges with a good explanation. New charges will cost small amounts of money unless the cost of the device is high to begin with.

COST<C-HEADER>

The monetary cost of a cybernetic device is figured as for any other equipment. Obviously, the device must have already been invented. Most devices cost Active Points x 100 at the Tech Level of introduction and are cheaper later on. See Cost Rationale in the Technology Sourcebook for specific rules.

PSIONICS<A-HEADER>

The Gamemaster's campaign may allow psionic characters. Indeed, psionics may be the theme of the campaign. This section advises the Gamemaster on defining psionic abilities and the player on designing psionic characters.

DEFINITIONS<D-HEADER>

Psionics is a set of Powers, and sometimes Talents, with a mental special effect and sharing certain Power Limitations. A psion is a character in a Heroic level game who has psionic abilities.

FOR MORE INSIGHT<D-HEADER>

Refer to Mind Games and other psionic sourcebooks. Psionics in a SF setting bears a relationship to magic in a medieval setting. After reading the information here, the Gamemaster might turn to Fantasy Hero for more suggestions, in the section on designing magic and magic casters.

PSIONS IN SOCIETY<B-HEADER>

The relationship between psions and society is usually special in some way. The Gamemaster's decision on this point will hinge on how important psionics will be in the campaign. If psionics are to be allowed, but only one player is interested, then his character will probably have the same status as any uncommon alien race. On the other hand, if all PCs are psions, then this had better be significant in the campaign setting.

PSIONS AS A SELECT GROUP<C-HEADER>

Typically, psions are a small fraction of the populace. Often, they are special and either especially respected or especially abused.

APPEARANCE<D-HEADER>

Psions are often visibly distinctive. Their eyes glow, they have bulging foreheads, or they belong to a known psionic race. (Larry Niven's Kzinti psions have bad grooming habits.) Psion Characters have Distinctive Looks with an appropriate degree of concealability.

OPPRESSED PSIONS<D-HEADER>

Psions may be feared, hated, or enslaved for their powers. (Example: Zenna Henderson's The People.) Player Character psions will have to disguise themselves or hide their powers. Characters have Distinctive Looks, Causes Prejudice.

ELITE PSIONS<D-HEADER>

Psions may be especially respected, they may have high-paying consulting jobs, or they may even be the ruling class. (Example: The Rowan by Ann McCaffrey.) Being psionic is a Perk worth 1-3 points, depending on how much privilege is conferred (compare with medieval nobility). Elite psions will have a guild or school and will not like renegades and mavericks.

ASSIMILATED PSIONS<D-HEADER>

In a universe filled with odd races, human variants, and expanding technology, psions are just one of many marvels. (Example: Alien Legion by Epic Comics.) This is the best approach if most players don't want to be psions.

PSIONICS AS LEARNED<D-HEADER>

When psions are rare, they often seek out their own kind and provide training, if not protection. In a campaign dominated by psionics, such a group could recruit the Player Characters to start things off. In a campaign where psionics is incidental, a psionic school could be a source of information.

Psions may have their own lifestyle and culture (including a Culture Knowledge). They usually have a jargon to describe various psionic abilities and techniques (e.g., a telekinetic person is a "teek", telepathic communication is "mindspeak"). A set of such terms will help flesh out a psionic campaign.

PSIONS AS A SPECIFIC RACE<C-HEADER>

Often in literature, entire races are presented as psionic. When this is so, most or all members have the same abilities, which are commonly rather weak and few in number (telepathy

alone, for example). Races with psionics may have more customary alien abilities as well, of course.

Variant humans from a particular planet may also be psionic. In this case, psionics is probably their only difference from standard Humanity.

A psionic culture will often be different in ways similar to what technology produces. (See "The Effects of Technology on Society.")

TECHNOLOGY AND PSIONICS<C-HEADER>

Star Hero emphasizes technology, and the Gamemaster should decide how technology and psionics interact. There are several choices.

PSIONICS ARE MYSTERIOUS<D-HEADER>

Nobody knows what causes psionics or how it works. Meters can't measure the energy it uses and force shields won't stop it. There are no thought screens for sale at department stores. This option is not actually recommended; it's more appropriate for Justice Incorporated pulp and horror.

EQUAL FOOTING<D-HEADER>

Technology and psionics are both well understood and can perform similar functions, perhaps in different ways. The best generator of psionic energy is the human brain, but devices can measure this energy and amplify it. Technology may even be able to duplicate psionic abilities, less efficiently.

TECHNOLOGICAL CRUTCH<D-HEADER>

Everyone has psionic abilities, but in uselessly small amounts (less than 1 Active Point). Functional psions require a technological device (or some other Focus, see below) to boost themselves to operant levels. Psions start with higher levels of abilities (up to 5 Active Points) to begin with, though. Most people can't even be amplified. Example: The Saga of the Pliocene Exile by Julian May.

WHAT PSIONICS IS NOT<C-HEADER>

Psionics is a distinctive concept in science fiction. It is not mysticism, magic, or enhanced normal abilities. If presented with the right flavor, it should feel different from all of these.

PSIONICS IS NOT MYSTICISM<D-HEADER>

Mystical phenomena are produced by outside forces and entities, such as nature and the spirit world. Psionics comes from within. Religious miracles, which come from higher beings, are also a different effect. Ghosts are not psionic manifestations, although a ghost who was a psion might conceivably retain its psionic abilities.

PSIONICS IS NOT MAGIC<D-HEADER>

Magic is understood to be completely disjoint from science and natural laws. Psionics, on the other hand, is potentially subject to study by nonpractitioners. The energy of magic is obtained from other planes or from elemental forces within nature. Psionics is powered by the psion or by conventional means.

PSIONICS IS NOT MORE OF THE SAME<D-HEADER>

Martial arts, meditation, and biofeedback can all lead to the discovery of amazing abilities. These, however, are all recognized as supremely developed physiological functions: enhanced senses, pain suppression, hysterical strength, and so on. Psionics is a new effect, and is found only in intelligent minds.

PSIONIC POWERS<B-HEADER>

Psionic characters will purchase Powers with Character Points. This section describes how to design these Powers.

NUMBER OF POWERS<D-HEADER>

Often, only a small number of Powers are available to psions. That is, there may only be 5-10 recognized psionic abilities. For this style of campaign, limit psions to the Powers identified under Power Availability as "Common". In any case, a single psion normally has no more than three different Powers.

(Minor Powers and Talents, as described below, can be in addition.)

POWER LEVEL<D-HEADER>

The two options here are comparable-to-technology or weak. We suggested that psionics be equal in Active Points and Damage Classes to available man-portable weaponry (see Weapons). Alternatively, psionics can be weak, limited to about 4 DC.

Normal psionics should be considered to travel at lightspeed and be limited to planetary ranges (for such Powers as Mind Scan and Mind Link). Faster propagation will allow interplanetary communications. For this effect, buy extra propagation speed the way the FTL radio is purchased in the Technology Sourcebook.

SINGLE SPECIAL EFFECT<D-HEADER>

"Psionics" is a single special effect. Psionic energy can thus be Detected, Suppressed, etc.

VISIBILITY<D-HEADER>

Psionic Powers are always visible to the Mental Sense Group. The Gamemaster must decide if they are otherwise invisible or visible. If visible, psionics should share a common appearance, such as ectoplasmic tendrils or a distinctive light pattern. Depending on the campaign decision, some Powers will either require Invisible Power Effects or the Visible Limitation.

ENDURANCE<D-HEADER>

All psionic Powers must cost Endurance (but see Talents and Minor Powers) and no Power may have the Advantage, Reduced Endurance Cost. As a campaign decision, either all Powers use the psion's personal END or all Powers use an END Reserve.

POWER LIMITATIONS<B-HEADER>

Power Limitations will do the most work in generating a proper feel to psionics. The basic concept is that psionics should be hard to do. As an exception, aliens with racial psionic abilities might use them easily if this does not hurt play balance.

ENDURANCE<D-HEADER>

Psionic abilities come from within. Thus, as stated above, all Powers that normally do not cost END must have that Limitation.

STANDARD LIMITATION<D-HEADER>

Psionic Powers may be Limited in some standard way that is common to all psionics. The magnitude of the Limitation will, of course, depend on how limiting it is. Some examples:

Stopped by Some Substance<E-HEADER>

Such as water, or platinum, or enough rock.

Conditional<E-HEADER>

Such as only in day, only at night, or only on a planet. (Only on a particular planet could be a large Limitation.)

Reciprocal<E-HEADER>

Only with other psions, -1. Ordinary people are immune to Telepathy and other effects. Powers such as Clairsentience that are not targeted will not have this Limitation.

SKILL ROLL<D-HEADER>

Being difficult and requiring training, psionic Powers may have to take Requires a Skill Roll. The Skill is called "Psionics", is based on Ego, and is purchased like Gadgeteering, Magic Skill, or any Control Skill for 3 points, +1 per 2 points.

SIDE EFFECT<D-HEADER>

Failing that Skill Roll could have annoying consequences, which would be mental or psychosomatic. The psion could give himself a pounding headache, go into shock, or lose the ability he was using (STUN, END, or Power Drain).

FOCUS<D-HEADER>

Natural psionic ability is really a puny thing and must be boosted to do any good. With this option, psions require a boost: a technological device, a focusing crystal, or special drugs. A

technological device should be Obvious and probably worn on the head. A crystal may be Obvious or Inobvious but is definitely a Personal Focus and requires an hour of meditation to attune. Drugs are Inobvious and Expendable.

MINIMUM LIMITATION<C-HEADER>

All psionic Powers must have at least a total -1 Limitation taken from Limitations on this list:

Activation
Concentrate
Extra Time
Incantation
Increased END Cost
Limited (in the standard way)
No Conscious Control
Requires Skill Roll
Side Effects

TALENTS AND MINOR POWERS<B-HEADER>

Psions may have certain minor abilities that are appropriate to the genre but are easy, perhaps even automatic, rather than difficult. With the Gamemaster's permission, any of the following may be purchased by a psion without the normally required Power Limitations.

TALENTS<D-HEADER>

Psions have an unusual number of the mentally-oriented Talents. These abilities must still fit the guidelines in the general Talents section.

ENHANCED SENSES<D-HEADER>

Appropriate Senses include Mental Awareness and Detect Psionics. Other senses, such as N-Ray and Spatial Awareness, are appropriate as well, but should take the normal Limitations.

MENTAL DEFENSE<D-HEADER>

Can be effortless or cost END at the Gamemaster's discretion.

MIND LINK<D-HEADER>

Can be effortless.

OTHER CHARACTER ABILITIES<B-HEADER>

Psions are less distinctive in their other abilities, but a few points should be made.

CHARACTERISTICS<C-HEADER>

Characteristics other than those mentioned here follow the normal design guidelines.

EGO<D-HEADER>

Psions should have a high EGO, certainly 13+ and probably 15+. The Gamemaster should decide what the desired range of ECV values is for his campaign.

PRESENCE<D-HEADER>

If psions are leaders of society or well-respected, they should have higher PRE scores. Otherwise, design as normal.

END<D-HEADER>

With all Powers costing END, characters may wish to invest in this attribute.

SKILLS<C-HEADER>

Just a few Skills pertain to psionics, although quite a lot of them could be enhanced by it: Interrogation by Telepathy, Seduction by Mental Illusions, and so on.

CULTURE KNOWLEDGE<D-HEADER>

This Skill lets the character know what the power groups are within psionic society. The character knows the etiquette of using Telepathy, spying with Clairvoyance, and so on.

KNOWLEDGE: PSIONICS<D-HEADER>

This Knowledge tells the character what the various psionic powers are, how they work, and what their common limitations are. The character knows the jargon of psionics.

PSIONICS<D-HEADER>

This Ego-based Skill is the Control Skill for psionics when a Skill Roll is required. As usual, it subtracts 1 per 10 Active Points in the Power. If the character takes extra time, PS: meditation might be a Complementary Skill.

DISADVANTAGES<C-HEADER>

To a large extent, the Disadvantages taken by psions will depend on how they fit into society. Some suggestions are given.

DEPENDENCE<D-HEADER>

If psionics requires a booster drug, then a Dependence is foreseeable.

DISTINCTIVE FEATURES<D-HEADER>

As mentioned earlier, psions are often physically distinc-

tive in some way. Prejudice by society is worth +5 points.

HUNTED AND WATCHED<D-HEADER>

Quite possibly, some people don't like psions and are out to do them in. Psions may be Watched by the government or by the Guild of Psionics.

PSYCHOLOGICAL LIMITATIONS<D-HEADER>

Psions may have odd behavior and beliefs as a side effect of their abilities or because they know they can get away with it. Psions may have a code of behavior concerning the use of their abilities. They may be arrogant toward normals, and so on.

REPUTATION<D-HEADER>

This is appropriate if many people in society know the limitations of psionics or are aware of how psions are trained.

SAMPLE PACKAGE DEAL<B-HEADER>

If multiple characters will be psions, it is appropriate for the Gamemaster to design a Package Deal. Following is an example. The guidelines for magic schools in Fantasy Hero are also useful.

Cost	Skills
2	KS: Psionics, 11-
3	Psionics
10	10 pts in Powers
0+	DISADVANTAGES
1	Package Bonus
5	DL: Psion
9	Package Cost

COMBAT<SECTION-HEADER>
SPACESHIP COMBAT<A-HEADER>
DISTANCE SCALE<B-HEADER>

Space combat takes place over vast distances. Consequently, mapped combat at High Tech and Super Tech is preferably displayed at Megahex Scale. At Megahex Scale,

one Megahex = 2 million meters = 2000 km.

Velocities and accelerations at Advanced Tech are lower because of the absence of artificial gravity. Therefore, it is recommended that Advanced Tech use KiloheX Scale. At KiloheX Scale,

one KiloheX = 2 thousand meters = 2 km.

Alternatively, unmapped combat is a good choice. Super Tech/Space Opera campaigns should use Gigahex Scale, which is one thousand times Megahex Scale. The other scale used in Star Hero is the familiar Personal Scale, in which one hex is 2m. Most of the rules discussions in Star Hero assume Megahex Scale.

To emphasize, Megahex Scale or other expanded scale should be used only in space, a consequence of vacuum, free fall, and very open lines of sight. It is used automatically without any special Power Advantages being put on equipment. Powers act at Megahex Scale the way Powers normally do at Personal Scale. That is, Range Modifiers start at -2 from 5-8 Megahexes, Flight speed is 1 Megahex per 2 points, max range is 5 x Active Points in Megahexes, and so on.

Example: A small freighter buys the minimum 5" of Flight for 30 pts. When it takes off from a planet, it leaves the atmosphere slowly at 10" per Phase, Noncombat, at Personal Scale. After it gets 2000 km out (1 Megahex), it switches to Megahex Scale and flies a million times faster (this change of speed is assumed to take a few Turns). It can buy additional Flight or Noncombat Multiples. The freighter must be unmanned or have artificial gravity (see the rules on acceleration damage).

MIXING DISTANCE SCALES<D-HEADER>

Megahex Scale is appropriate for every Power and piece of equipment in a combat. For example, a bow shot from the hull of a ship should not have a range measured in Megahexes. Alternatively, personal combat on the same ship's hull may take place around weapon emplacements capable of Megahex range.

Consequently, if lesser-scale Powers are used in combat at a larger scale, they should be treated as though having the No Range Limitation. Powers or equipment built for a larger range scale used at the smaller scale should be treated as having the No Range Modifier Advantage and unlimited range.

APPLYING SPACESHIP SCALE TO CHAMPIONS<D-HEADER>

Spacefaring superheroes and vehicles in Champions also operate at Megahex Scale. The one exception is that personal perception (e.g., eyes) still uses Personal Scale. To counter this, characters must purchase enough Perception Range Levels (+40) to be effective.

Gamemasters who dislike this arbitrary transition may require Champions Powers designed for space to include the special Power Advantages defined in Character Creation.

RANGE MODIFIERS<C-HEADER>

For ship's sensors at Megahex Scale, Perception Rolls and Attack Rolls take the normal subtractions (-2 at 5-8 scale hexes, and so on). Extreme modifiers are compared on the Extended Range Modifier Chart. Measurements in terms of tactical hexes are listed in the left-most column next to the appropriate Range Modifiers. Equivalent distances in real-world terms are given for Personal Scale, KiloheX Scale, and Megahex Scale. Gigahex Scale would use distances one thousand times the Megahex values. The table can be also be extended downward in multiples of one thousand. Every x1000 range is an additional -20 Range Modifier.

EXTENDED RANGE MODIFIER CHART<D-HEADER>

HEXES	MOD	Personal	KiloheX	Megahex
4	-0	8 m	8 km	8000 km
6	-1	12 m	12 km	12,000 km
8	-2	16 m	16 km	16,000 km
12	-3	24 m	24 km	24,000 km
16	-4	32 m	32 km	32,000 km
24	-5	48 m	48 km	48,000 km
32	-6	64 m	64 km	64,000 km

48	-7	96 m	96 km	96,000 km
64	-8	128 m	128 km	128,000 km
95	-9	190 m	190 km	190,000 km
125	-10	250 m	250 km	250,000 km
187	-11	375 m	375 km	375,000 km
250	-12	500 m	500 km	500,000 km
375	-13	750 m	750 km	750,000 km
500	-14	1 km	1000 km	1 million km
750	-15	1.5 km	1500 km	1.5 million km
1000	-16	2 km	2000 km	2 million km
1500	-17	3 km	3000 km	3 million km
2000	-18	4 km	4000 km	4 million km
3000	-19	6 km	6000 km	6 million km

SAMPLE RANGES<D-HEADER>

MOD DISTANCE
-41 Diameter of Earth
-51 1 light second
-52 Earth-moon distance
-63 1 light minute
-69 1 Astronomical Unit (AU)
-74 1 light hour
-81 Solar System diameter
-83 1 light day
-101 1 light year (ly)
-104 1 parsec
-124 1 kiloparsec
-135 100,000 ly
galaxy diameter
-141 1 million ly
distance to Andromeda
-144 1 Megaparsec

PERCEPTION IN SPACE<B-HEADER>

Starships make Perception Rolls with their ship's sensors. The base roll is a Systems Operation Skill Roll by the sensor operator with appropriate modifiers. Of course, characters may make their own Perception Rolls if looking out of a porthole or space walking or such. Ship's sensors always use Megahex Scale for detecting things in space. Characters always use Personal Scale, and so do ships when on a planet or examining its surface or when within 1 Megahex of it.

Perception in space can be subject to extreme modifiers. Possibilities include size, range, and brightness. Long-distance range modifiers are detailed above.

SIZE<D-HEADER>

Large objects can be seen at extreme distance. For vehicles, the Perception Modifier is equal to its DCV modifier (with sign change). For a natural object, find its largest dimension on the Extended Range Modifier Chart; the corresponding Range Modifier +4 becomes the Perception Modifier (again, with change of sign). For example, the Andromeda Galaxy is one million ly away (-141 Perception at personal scale), but is 100,000 ly across (+135+4 Perception). The net modifier to see it is therefore -2.

BRIGHTNESS<D-HEADER>

Brightness in space is measured in apparent magnitude, as described in the section on Space. If the apparent magnitude of an object is known, subtract it as a Perception Modifier. As a simpler approach, objects can be classified as very bright, normal, or dim. The only things likely to be very bright are the stars and major planets in the current system (+3 to +5). Distant or small stars are dim (-3 and worse). Other objects are somewhere in between.

COMBAT PERCEPTION<C-HEADER>

A ship in combat must make a successful Perception Roll to see its target before firing. If the target doesn't have ECM, the roll needs to be made only once. Most ship's sensor packages include ECM, though, and a sensor operator with Systems Operation may resist being detected from Phase to Phase. There are two kinds of ECM, fixed and variable. Fixed ECM subtracts a set amount from the attacker's sensing roll if the ECM roll is made. Attempting to detect a target with variable ECM is resolved as Systems Operation Skill vs. Skill with the range and target size modifiers applying to the sensing ship.

Attempting a ship detection roll is a half Phase action and applies to all potential targets. Operating ship's ECM is also a half Phase action and applies to all sensing ships.

SPACESHIP MOVEMENT<B-HEADER>

Spaceships move through space at Megahex Scale (or other expanded scale) the same way that smaller Hero System vehicles fly in atmosphere. Each 1" of Flight gives one scale hex of movement with normal Turn Mode. If velocity-derived DCV is in play, then the Megahex speed should be used in the calculation. At Personal Scale, spaceship velocities can get extremely large, such when a ship overflies an airless moon. If necessary, use the Extended DCV from Velocity table.

EXTENDED DCV FROM VELOCITY<C-HEADER>

Velocity Inches/Turn	DCV	Velocity Inches/Turn	DCV	Velocity Inches/Turn	DCV
32-	1	32 thousand	21	32 million	41
64	3	64 thousand	23	64 million	43
125	5	125 thousand	25	125 million	45
250	7	250 thousand	27	250 million	47
500	9	500 thousand	29	500 million	49
1 thousand	11	1 million	31	1 billion	51
2 thousand	13	2 million	33	2 billion	53
4 thousand	15	4 million	35	(speed of light)	
8 thousand	17	8 million	37		
16 thousand	19	16 million	39		

COMBAT OPTIONS<B-HEADER>

PILOT MANEUVERS<C-HEADER>

These rules are used when dramatic flying skill is appropriate. Usually, Pilot Maneuvers are available to space fighter pilots and possibly to pilots of slightly larger craft.

Every Phase during space combat, the pilot of a spaceship must choose a maneuver from the Piloting Maneuvers Table. The default maneuver is Cruise, which requires no Skill Roll. Any other maneuver is a half Phase action and requires a Combat Piloting Skill Roll at the listed penalty, with an additional penalty for the current ship speed taken from the Speed Penalty Table. This table is easily extended, but remember that the speed of light is 150 hexes/second at Megahex Scale or 2 hexes/Turn at Gigahex Scale.

SPEED PENALTY TABLE<D-Header>

Speed	4-	8	16	32	64	125	250
Maneuver Penalty	0	-1	-2	-3	-4	-5	-6

PILOTING MANEUVERS<D-Header>

Maneuver	Roll	OCV	DCV	Range	Mod
Cruise	-	+0	+0	+0	
Evade	+2	-2	+3	+0	
Hold Steady	+2	+2	-2	+0	
Swerve	+0	-3	+4	-2	
Target	+0	+3/+0	-2	+2/+1	
Hit the Brakes	-1	-2	+3	-2	
Hard 60	-1	-1	+2	-1	
Hard 120	-2	-2	+4	-2	
Immelman 180	-4	-4	+6	-4	
Loop 360	-8	-8	+8	-8	

FAILING A MANEUVER ROLL<D-HEADER>

On a failed roll, the ship's OCV, DCV, and Range Mod are reduced by the amount the roll was failed by. To regain control of the ship, the pilot must make a roll at -1/2 the amount he failed on his next phase.

Example: Morgan is trying a Hard 60 at a speed of 60". The total penalty to his Combat Piloting Roll is -5, -4 for his speed and -1 for the maneuver. His Piloting Roll is 16-. Rolling a 13, he fails the roll by 2, the result being a -2 to the ship's OCV and DCV, and -2 to the ship's RMod. To regain control, he must roll his Piloting Skill at a -1.

DESCRIPTION OF MANEUVERS<C-HEADER>

CRUISE<D-HEADER>

This is the default maneuver for an unpiloted ship or a pilot without Combat Piloting. The ship may move normally. OCV, DCV, and Range Modifiers are as normal.

EVADE<D-HEADER>

The ship follows a course that is deliberately slightly erratic. This is a defensive maneuver.

HOLD STEADY<D-HEADER>

The ship's course and speed are made more stable than usual. Opposing ships are easier to hit, but so is the pilot's own vessel.

SWERVE<D-HEADER>

The ship's course is made very erratic so that it is hard to hit. The ship's gunners, however, do not love the pilot for this, for their OCVs and Range Modifiers suffer.

TARGET<D-HEADER>

This is the equivalent of a Set in personal combat. Target works on one opponent, against which the higher OCV and Range Modifier bonuses apply. The second set of numbers applies to all other targets.

HIT THE BRAKES<D-HEADER>

The pilot uses emergency thrusters to decelerate the ship by more than its Combat Flight, to a complete stop if desired.

HARD 60, HARD 120, IMMELMAN, LOOP <D-HEADER>

These maneuvers allow the pilot to turn suddenly and by more than 60 degrees once during the Phase, even when the ship has not satisfied its Turn Mode. The number after the maneuver name indicates the allowed change of facing. The ship must still travel one hex between turns.

COMBINED MANEUVER<D-HEADER>

If the pilot performs two maneuvers in the same Phase, combine the Roll Modifiers for a single roll (apply the speed penalty once). The ship has the worst OCV, DCV, and Range Modifier out of the two maneuvers, with an additional -2 to each.

NEWTONIAN MOVEMENT<C-HEADER>

Standard Hero vehicle movement does not represent real physics, especially in space. These optional rules allow spacecraft to operate on the tactical map according to Newton's Laws of Motion. For visual reference on what this looks like, watch the movie 2001 or the television series Babylon 5.

The basic rule for Newtonian movement is that ships are always considered to use combat movement. Any noncombat multipliers are ignored. Nevertheless, vehicle velocity builds up from Phase to Phase, this extra velocity just doesn't figure into Turn Modes, DCV from Velocity, or any other secondary effects.

PREPARATION<D-HEADER>

A large tactical map is a good idea, because ship's don't turn around quickly. Each vehicle requires two markers to represent it, the ordinary ship counter and a separate velocity marker. The Gamemaster also needs one additional placeholder marker to use when moving ships.

Place all ships on the map at their initial positions and headings. Decide their initial speeds or where they were last time they moved. The velocity marker for each ship then goes where it was last time it moved. At the end of every ship's move during combat, its velocity counter will again be put where it was the last time it moved.

MOVING A SHIP<D-HEADER>

A ship moves according to its DEX and SPD as usual. When a ship is to move, put the placeholder marker under its velocity marker and transfer that marker to under the ship counter. Now look at how the placeholder marker and the ship are separated. Before the ship pilot does anything, the ship counter should be moved that same direction and amount. For example, using the Scatter Diagram, say the ship counter is 5 hexes in direction 1 away from the placeholder and over 1 hex in direction 2. Move the ship counter 5 hexes more in direction 1 (that's away from the placeholder) and 1 hex in direction 2. Don't change the ship facing. Leave the velocity marker where it is.

All done? Now pick up the placeholder. The pilot gets to do his thing. As usual, he may fly the ship at any speed from 0 to its maximum combat velocity. As usual, he is limited by the Turn Mode of the speed he chooses. And that's all there is to it.

Notice when using this method that the ship's facing may have nothing to do with where it moves. To speed up, the pilot should fly away from his velocity marker. To slow down, he should fly toward it. If he ends a move parked on the velocity marker, then the ship has come to a dead stop.

RESTRICTIONS<D-HEADER>

There is a slight drawback to this simple approach. Specifically, the path that the ship counter takes to get to its final position each

Phase isn't "really" the path the ship would have taken. More accurately, the movement would be broken up into half-moves or quarter-moves, with the pilot making decisions after each increment. But that probably isn't worth it.

Keeping the simple approach, then, just remember that the ship counter can't fly through obstacles in this method any more than it can with standard movement rules. One more restriction:

No attacks may be made while the ship is doing automatic movement away from its velocity marker.

All attacks by the ship or at the ship must be made after the pilot takes over from nature.

THREE-DIMENSIONAL MOVEMENT<C-HEADER>

Three-dimensional spaceship movement adds very little complexity. Use the standard Hero System rules for Turn Modes of flying characters. By these rules, a spaceship still must have one of six discrete facings on the tactical map. It also has an altitude and one of three pitches, though: climbing, level, or diving. A ship that is climbing or diving must satisfy its Turn Mode before flying level, and a ship in level flight must satisfy its Turn Mode before climbing or diving.

ENGINEER FUNCTIONS<C-HEADER>

Every Phase during combat, the ship's engineer may use his skills to tinker with the engines and route reserve power as desired. The appropriate Skill is PS: Ship's engineer or Sc: Power plant engineering or something similar (but not a KS, TF, or Mechanics). This requires a full Phase and is not modified. The options after success are listed on the Reserve Power Usage Table.

RESERVE POWER USAGE<D-HEADER>

+1 Piloting
+1 Turn Mode
+1 Sensors
+1" Flight
+1 Ablative system
-1d6 Acceleration Damage
+1 END Battery Recovery

The bonuses to Piloting, Turn Mode, and Sensors are used as Skill Levels by the crew members performing those functions. The Flight bonus is an increase in velocity (Inches/Phase). [WOULDN'T IT BE SIMPLER FOR THE ENGINEER'S SKILL ROLL TO BE COMPLEMENTARY TO THE PILOTING AND SENSOR ROLLS? MAYBE NOT SIMPLER, BUT THE EFFECT WOULD BE GREATER. WHAT IF SOMEONE NOTICES THAT AND WANTS TO DO THAT INSTEAD? The Ablative bonus applies to one system with Ablative Limitation, such as shields or damaged life support, and will not raise the Activation Roll above 15-. The other two options are a reduction in acceleration damage (see below) and a better REC for all END Batteries aboard, if any.

Effects last until the engineer's next Phase. The engineer must be located where he can control the ship's engines or power plant.

OTHER CREW FUNCTIONS<C-HEADER>

Further advice on crew functions may be found in the Gamemastering section. Naturally, each weapon should be assigned to a different crew member. The engineer or some other character may perform damage control, which includes field repair of damaged equipment (see below).

DAMAGE<B-HEADER>

If a ship is hit and takes BODY, roll on the chart below for impairment or disability to the ship, instead of the chart on page 192 of the Hero System Rulebook.

SHIP HIT LOCATION CHART<D-Header>

3d6	Location	OCV Mod
3	Sensors Hit	-8
4	Control Room	-7
5	Other Rooms (Galley, Crew Quarters, Passenger Rooms)	-6
6	FTL Engines (-Damage in d6 Power Drain to FTL)	-5
7	Weapons	-4
8	STL Engines (-Damage in d6 Power Drain to DEX)	-3
9	Landing Gear	-2
10	Cargo	-1
11	Cargo	-1
12	Equipment	-2
13	STL Engines (-Damage in d6 Power Drain to SPD)	-3
14	STL Engines (-Damage in d6 Power Drain to Flight)	-4
15	Shield Generator (-Damage in d6 Power Drain to Force Screen)	-5

- | | | |
|----|--|----|
| 16 | Computer Hit | -6 |
| 17 | Communications Hit | -7 |
| 18 | Life Support (Ablative Burnout: 15- from first hit, 14- from second, etc.) | -8 |

EFFECTS OF DAMAGE<C-HEADER>

DAMAGE TO PEOPLE<D-HEADER>

If the compartment hit contains a character (control room, other rooms, possibly cargo), then a random character in that room is hit on a roll of 8 or less. Use average defenses versus the Body that exceeded the vehicle's DEF. Otherwise, damage that gets through the hull of a ship is explosive at the point of impact - roll normally for Stun Multiplier.

COMBAT REPAIRS<D-HEADER>

Damage may be fixed in combat by the ship's tech at -2 to the roll per Body Point done. Each piece of equipment is Light (4 Body), Medium (6 Body), or Heavy Machinery (8 Body), depending on the size of the ship and the opinion of the GM. If over 1/2 the Body is gone, the item cannot be repaired in space; it must be replaced in spacedock.

[THIS MIGHT BE A GOOD TIME TO REMIND EVERYONE THAT IF THE SHIP HAS ANY EQUIPMENT BOUGHT AS AN ACCESSIBLE FOCUS, IT IS NOT PROTECTED BY THE SHIP'S DEFENSES. WHICH BRINGS UP ANOTHER TOPIC: TARGETING SPECIFIC AREAS OR EQUIPMENT ON THE TARGET SHIP.]

DAMAGE AND RECOVERY<A-HEADER>

ALIEN HIT LOCATIONS<B-HEADER>

How to handle Hit Locations for aliens with tails, wings, extra arms, and whatnot? The basic rule is: use the standard Hit Location Table wherever possible, but reinterpret the locations as necessary.

REASONABLY SIMILAR ALIENS<C-HEADER>

Aliens that are not very different from the humanoid model use normal Hit Locations relabeled. This includes bipeds and quadrupeds with any combination of tails, wings, and extra limbs. Tips on relabeling follow.

LOCATIONS 7-8, 15-16<D-HEADER>

These four locations should be distributed among limbs, tentacles, and wings as appropriate.

LOCATIONS 6,17-18<D-HEADER>

These locations should be distributed among hands, legs, hooves, and tentacle tips.

LOCATIONS 3-5<D-HEADER>

In the case of a creature without a head, treat this as an exposed sensory cluster, if any - eyes, antennae, or whatever will hurt the most if hit. If nothing is appropriate, interpret as especially severe Vitals hits.

LOCATIONS 9-14<D-HEADER>

These locations remain core body hits of various kinds.

FORMLESS CREATURES<C-HEADER>

Some creatures have little in the way of limbs or other obvious body parts. So for living sponges, giant amoebae, and so on, roll a Stun Multiplier.

NORMAL HEALING<B-Header>

At Advanced Tech, a character normally recovers his REC in BODY per month. At High Tech, he recovers REC in BODY per week, and at Super Tech, per day. This assumes normal medical facilities for the time period. There are faster ways to recover using cutting edge technology. Refer to the Technology sourcebook.

TECHNOLOGY SOURCEBOOK<A-HEADER>

Use the following equipment in your Star Hero game. But, for galaxy's sake, don't use all of it! Equipment is limited, first, by the Gamemaster, and second, by the concept of Tech Level, as described below. More advice on using equipment may be found in Gamemastering.

TECH LEVELS<B-HEADER>

Technology is divided for game purposes into ten Tech Levels, as shown on the Technology Levels Chart. These historical and projected stages of development are defined mostly by example - that is, by what happens when.

STONE AGE<D-HEADER>

The most primitive toolmaking capability, characterized by stone (later, copper) implements, wheeled carts, and firemaking. Among primates, the hunter-gatherer society is little different from that of their animal ancestors. Aliens would have a lifestyle patterned analogously. Remote parts of the Amazon basin and Melanesia can still be considered Stone Age.

BRONZE AGE<D-HEADER>

Bronze, a combination of tin and copper, is the most easily smelted hard metal. Tools get better. Agriculture creates cities and the beginnings of writing. Animal husbandry makes leather and wool available. In Asia, the Bronze Age began about 5000 B.C.

IRON AGE<D-HEADER>

In the Iron Age, more of the same gets better. Iron replaces bronze, writing replaces hieroglyphs, and sailing improves upon riding. The first iron users may conquer well all of their neighbors, producing the first large empires. The Iron Age began in Turkey about 1500 B.C.

MEDIEVAL<D-HEADER>

The Medieval period in Christian and Moslem culture, roughly 500-1400 A.D., was a period of dissemination and refinement of previous discoveries. Medicine and astronomy were two notable areas of investigation. Large empires are common. On another planet, the details of this era will depend on quirks of history.

RENAISSANCE<D-HEADER>

The important characteristic of the Renaissance (1400 A.D. in Europe) for Star Hero purposes, is that research and scientific theory are formalized for the first time. Combined with the invention of printing, universities become possible. Certain projects begin that are possible only with good logistics (such as circumnavigating the globe). Standing armies become common late in this period.

INDUSTRIAL<D-HEADER>

The two dominant inventions of the Industrial Age are abundant power (from steam) and instantaneous communications (telegraph, then radio). The world becomes a smaller place and machines start to free up manpower. On Earth, the Industrial Age began in 19th century Britain.

MODERN<D-HEADER>

This name identifies Western culture as of the 20th century. Electricity, radio, and aircraft give the world a more homogeneous society. Large numbers of professional scientists and engineers, aided by calculating machines, make technological discovery explosively fast. The first weapons of mass destruction are created (gas, diseases, fission).

ADVANCED<D-HEADER>

This is the era of spaceflight before FTL transport. Civilization spreads from one planet to fill its entire star system. Fusion power and widespread automation (computers, robots) create a large leisure class. In a dark campaign, overpopulation and pollution are serious problems.

HIGH TECH<D-HEADER>

The High Tech era is marked by one huge discovery: Faster-Than-Light travel. This era begins perhaps a hundred years after the end of the Modern Age, depending on whether FTL is a lucky discovery or a product of diligent research. Civilization spreads among the stars and probably meets other races. Colony planets evolve separate cultures. Reliable cybernetics and other man/machine interfaces may turn humans themselves into something different.

SUPER TECH<D-HEADER>

This is the most advanced technology that can be projected, short of magic. FTL travel is not only possible, it's convenient. Teleportation, regeneration, and antimatter manipulation are all a reality.

TECHNOLOGY LEVELS CHART<C-Header>

Age	Transport	Weapons	Armor<D-Header>
STONE AGE	Feet	Stone Weapons	none
BRONZE AGE	Horse	Bronze Swords	Leather
IRON AGE	Galley	Iron Swords	Scale Armor
MEDIEVAL	Sailing	Steel Weapons	Plate Mail
RENAISSANCE	Hot Air Balloon	Muskets	
INDUSTRIAL	Zeppelin	Repeating Handgun	
MODERN	Aircraft	Machine Gun	Kevlar
ADVANCED	Spaceship	Laser	Reflect/Duralloy
HIGH	Starship	Blaster	
SUPER	Teleportation	Disintegrator	Personal Force Fields

Age	Medical	Communication	Power<D-Header>
STONE AGE		Language	Animals
BRONZE AGE	Herbology	Pictographs	Water Wheel
IRON AGE	Bleeding	Writing	Windmill
MEDIEVAL	Amputations		
RENAISSANCE		Printing	
INDUSTRIAL	Anesthetics	Telegraph	Steam Engine
MODERN	Antibiotics	Telephone	Electricity
ADVANCED	Suspend Animation	Visiphone	Nuclear
HIGH	Cybernetics	FTL Mail Delivery	Solar
SUPER	Autodoc	FTL Communication	Antimatter

USING TECH LEVELS<C-HEADER>

Any particular culture has a Tech Level, which defines what is available. The Gamemaster assigns one Tech Level to the campaign, which applies to planets of "civilization". Other planets will have other Tech Levels. Not all discoveries are made according to schedule, though, so if disintegrator pistols are wanted at High Tech, they can be moved there.

EXPLANATION OF EQUIPMENT<B-HEADER>

Equipment is divided by use into several sections. Each item has several properties.

TECH LEVEL<D-HEADER>

The level at which the item is introduced. All equipment of the current Tech Level and most previous ones is normally available. Many items are improved at later Tech Levels; see the individual sections. For these, the listed values are those for the earliest model.

ACTIVE POINTS AND REAL COST<D-HEADER>

For use in Superheroic campaigns, for targeting Adjustment Powers, and for figuring the DEF of an item.

MONETARY COST<D-HEADER>

Here, the default formula is Active Cost x 100, modified by Tech Level. Exceptions have been made, though, in certain cases.

MASS<D-HEADER>

No formula was used; instead, real or realistic values were assigned.

WEAPONS<A-Header>

All weapon damage, mass, and prices are based on the Tech Level of introduction. For each level above introduction increase damage by 1DC, and reduce mass and cost by 1/4, to a maximum of two steps of bonus.

Example: a laser pistol at Advanced Tech (introduction level) does 2d6 damage, masses 1.0 kg, and is priced at Active x100. At High Tech it does 2d6+1, masses 0.75 kg, and is priced at Active x75. At Super Tech it does 2 1/2d6, masses 0.5 kg, and is priced at Active x50.

ADVANCED TECHNOLOGY<C-Header>

CHEMICAL SLUGTHROWERS<D-Header>

This weapon fires a projectile using a chemical propellant (gunpowder) causing a penetration wound.

MODEL	OCV	RMod	Damage	STUN	STR	Shots	Act	Real	Mass
				Mod	Min		Pts	Cost	(kg)
5mm Autoloading Pistol	+2	+0	1d6-1K	+0	7	16	20	10	0.5
8mm Autoloading Pistol	+1	+0	1d6K	+0	7	16	20	10	0.7
9mm Autoloading Pistol	+1	+0	1d6+1K	+0	8	16	25	12	1.0
10mm Autoloading Pistol	+1	+0	1 1/2d6K	+1	10	12	45	20	1.5
11mm Autoloading Pistol	+1	+0	2d6K	+1	12	8	52	21	1.8
13mm Autoloading Pistol	+1	+0	2d6+1K	+1	13	6	60	22	2.0
9mm Submachine Gun (A)	+2	+0	1d6+1K	+0	5/10	32	52	26	2.0
11mm Submachine Gun (A)	+2	+0	2d6K	+1	8/13	32	90	45	3.0
13mm Submachine Gun (A)	+2	+0	2d6+1K	+1	10/15	32	101	50	4.0
5mm Assault Rifle (A)	+2	+1	2d6-1K	+0	8/13	32	66	33	4.0
8mm Assault Rifle (A)	+2	+1	2d6+1K	+1	11/16	32	108	54	5.0
5mm Sniper Rifle	+2	+4	2d6+1K	+1	14	16	85	42	5.0
8mm Sniper Rifle	+2	+4	2 1/2d6K	+1	16	12	93	41	8.0
13mm Sniper Rifle	+2	+4	3d6K	+1	17	1	100	25	15.0
Pump Shotgun (RR,RP)	+2	+0	2d6+1K	+1	10	12	67	24	5.0
Autofire Shotgun (A,RR,RP)	+2	+0	2d6+1K	+1	10/15	12	90	33	5.0
5mm Machinegun (A)	+1	+2	2d6K	+1	9/14	64	102	51	3.0
8mm Machinegun (A)	+1	+4	3d6K	+1	11/16	125	170	85	6.0
10mm Machinegun (A,*)	+1	+4	4d6K	+1	-	250	231	92	12.0
13mm Machinegun (A,*)	+1	+4	5d6K	+1	-	500	299	120	25.0
25mm Lt Cannon (A,N,*)	+1	-	6d6K	+1	-	1000	380	152	50.0
50mm Md Cannon (A,N,1,*)	+1	-	7d6K	+1	-	2000	522	209	100.
100mm Hy Cannon (A,N,2,*)	+1	-	8d6K	+1	-	4000	687	275	200.

GAUSS WEAPONS<D-Header>

This weapon is essentially a portable rail gun. It uses magnetics to fire a projectile at hyper-velocity, causing a small but devastating penetration wound.

MODEL	OCV	RMod	Damage	STUN	STR	Shots	Act	Real	Mass
				Mod	Min		Pts	Cost	(kg)
5mm Derringer	+0	+0	1d6K AP	+1	5	4	30	10	0.5
5mm Autoloading Pistol	+1	+0	2d6K AP	+1	7	16	70	35	1.0
5mm Assault Rifle (A)	+1	+2	2d6K AP	+1	5/9	32	113	56	2.0
8mm Light Machinegun (A)	+1	+4	3d6K AP	+1	11/16	64	186	93	4.0
10mm Medium Machinegun(A,*)+1		+4	4d6K AP	+1	-	125	250	100	8.0
13mm Heavy Machinegun(A,*)	+1	+4	5d6K AP	+1	-	250	322	129	16.0
25mm Lt Cannon (A,N,1,*)	+1	-	6d6K AP	+1	-	500	451	180	32.0
50mm Md Cannon (A,N,2,*)	+1	-	7d6K AP	+1	-	1000	605	242	64.0
100mm Hy Cannon (A,N,3,*)	+1	-	8d6K AP	+1	-	2000	781	312	128.

INCINERATORS<D-Header>

Incinerators are flame/plasma throwers and are perhaps the most feared portable weapons known to man.

MODEL	Area	OCV	RMod	Damage	STUN	STR	Shots	Act	Real	Mass
	(hex)				Mod	Min		Pts	Cost	(kg)
Pistol	9	+0	+0	2d6K E	+1	5	16	120	34	1.5
Lt Rifle	15	+0	+0	3d6K E	+1	5	32	191	54	3.0
Med Rifle	21	+0	+0	4d6K E	+1	10	64	270	77	6.0
Hvy Rifle	28	+0	+0	5d6K E	+1	15	125	356	102	12.0
Lt Cannon (*)	36	+0	+0	6d6K E	+1	-	250	450	112	25.0
Med Cannon (*)	45	+0	+0	7d6K E	+1	-	500	551	138	50.0
Hvy Cannon (*)	54	+0	+0	8d6K E	+1	-	1000	660	165	100.

Notes: Uncontrolled (+1/2), Continuous (+1), Area Effect Any Area (+1), Uncontrolled Continuous Attack has a Speed of 1 (-1/2), No Range (-1/2), Not underwater or in vacuum (-1/2)

LASERS<D-Header>

LASER (Light Amplification by Stimulated Emission of Radiation) weapons became practical when small, extremely efficient power sources were developed. The laser beam is coherent monochromatic light, and is less effective against countermeasures to refract or disperse it, such as smoke or fog. Each shot discharges an internal capacitor, so these weapons fire short pulses rather than a continuous beam.

MODEL	OCV	RMod	Damage	STUN Mod	STR Min	Shots	Act Pts	Real Cost	Mass (kg)
0.25kw Derringer	+1	+0	1d6KAPE	+0	5	16	30	13	0.5
2.0 kw Pistol	+1	+0	2d6KAPE	+0	7	32	61	27	1.0
2.0 kw Assault Rifle (A)	+1	+2	2d6KAPE	+0	5/9	64	102	45	2.0
16 kw LMG (A)	+1	+4	3d6KAPE	+0	11/16	125	170	75	4.0
128 kw MMG (A,*)	+1	+4	4d6KAPE	+0	-	250	231	84	8.0
1.0 Mw HMG (A,*)	+1	+4	5d6KAPE	+0	-	500	299	109	16.0
8.0 Mw Lt Cannon (A,N,1,*)	+1	-	6d6KAPE	+0	-	1000	427	155	32.0
64 Mw Med Cannon (A,N,2,*)	+1	-	7d6KAPE	+0	-	2000	577	210	64.0
500 Mw Hvy Cannon (A,N,3,*)	+1	-	8d6KAPE	+0	-	4000	750	273	128.
-1DC per 2" of Fog or Smoke (- 1/4)									

MASERS<D-Header>

The MASER (Microwave Amplification by Stimulated Emission of Radiation) was discovered before the better known laser. It generates and amplifies coherent electromagnetic waves of precise frequency by using the excess energy of an atomic system. Like all advanced-tech energy weapons, it fires a pulse rather than a continuous beam.

MODEL	OCV	RMod	Damage	STUN Mod	STR Min	Shots	Act Pts	Real Cost	Mass (kg)
0.25kw Derringer	+1	+0	1d6KPENE	+0	5	16	30	13	0.5
2.0 kw Pistol	+1	+0	2d6KPENE	+0	7	32	61	27	1.0
2.0 kw Assault Rifle (A)	+1	+2	2d6KPENE	+0	5/9	64	102	45	2.0
16. kw LMG (A)	+1	+4	3d6KPENE	+0	11/16	125	170	75	4.0
128 kw MMG (A,*)	+1	+4	4d6KPENE	+0	-	250	231	84	8.0
1.0 Mw HMG (A,*)	+1	+4	5d6KPENE	+0	-	500	299	109	16.0
8.0 Mw Lt Cannon (A,N,1,*)	+1	-	6d6KPEN	+0	-	1000	427	155	32.0
64 Mw Med Cannon (A,N,2,*)	+1	-	7d6KPENE	+0	-	2000	577	210	64.0
500 Mw Hvy Cannon (A,N,3,*)	+1	-	8d6KPENE	+0	-	4000	750	273	128.
1/2 Damage vs. Metal (Steel) Armor (- 1/4)									

TANGLERS: ADVANCED<D-Header>

This weapon fires a stream of synthetic silk threads that entangle a man-sized target from head to toe. A relaxer spray is included with each clip bought.

MODEL	OCV	RMod	Damage	STUN Mod	STR Min	Shots	Act Pts	Real Cost	Mass (kg)
Derringer	+0	+0	3d6 Entangle	-	5	8	30	12	0.5
Pistol	+0	+0	3d6 Entangle	-	5	16	30	15	1.5
Rifle	+0	+2	3d6 Entangle	-	5	32	45	22	3.0

ULTRASONICS: ADVANCED<D-Header>

This weapon fires a pulse of ultrasound that disrupts the inner ear and central nervous system. Note that it does not have to be aimed at a target's ear.

MODEL	OCV	RMod	Damage	STUN Mod	STR Min	Shots	Act Pts	Real Cost	Mass (kg)
Derringer	+1	+0	4d6 NND	-	5	16	50	20	0.5
Pistol	+1	+0	5d6 NND	-	5	32	67	27	1.0
Rifle (A)	+1	+2	6d6 NND	-	5/9	64	164	66	2.0
LMG (A)	+1	+4	7d6 NND	-	7/12	125	221	88	4.0
MMG (A,*)	+1	+4	8d6 NND	-	-	250	256	85	8.0
HMG (A,*)	+1	+4	9d6 NND	-	-	500	294	98	16.0
Lt Cannon (A,N,1,*)	+1	-	10d6 NND	-	-	1000	330	110	32.0
Med Cannon (A,N,2,*)	+1	-	11d6 NND	-	-	2000	405	135	64.0
Hvy Cannon (A,N,3,*)	+1	-	12d6 NND	-	-	4000	487	162	128.

Note: No Normal Defense (Sound Flash Defense, CON Roll-5) (+1), Not in vacuum (-1/2)

HIGH TECHNOLOGY<C-Header>

BLASTERS<D-Header>

This energy weapon projects a bolt of charged particles carried along a laser beam.

MODEL	OCV	RMod	Damage	STUN Mod	STR Min	Shots	Act Pts	Real Cost	Mass (kg)
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2.0 kw Derringer	+0	+0	6d6N E	-	5	16	30	15	0.5
16. kw Pistol	+1	+0	9d6N E	-	12	32	62	31	1.0
16. kw Assault Rifle (A)	+1	+2	9d6N E	-	9/14	64	112	56	2.0
128 kw LMG (A)	+1	+4	12d6N E	-	16/21	125	173	86	4.0
1.0 Mw MMG (A,*)	+1	+4	15d6N E	-	-	250	230	92	8.0
8.0 Mw HMG (A,*)	+1	+4	18d6N E	-	-	500	294	118	16.0
64 Mw Lt Cannon (A,N,1,*)	+1	-	21d6N E	-	-	1000	440	176	32.0
500 Mw Med Cannon (A,N,2,*)	+1	-	24d6N E	-	-	2000	594	238	64.0
4 Gw Hvy Cannon (A,N,3,*)	+1	-	27d6N E	-	-	4000	770	308	128.

NEEDLER: HIGH<D-Header>

This weapon has a tank filled with a drug which it flash-freezes into the shape of a needle as it shoots at a target at high velocity. Besides its obvious use as a non-lethal weapon, field medics have found it useful in delivering medicines to their own troops without leaving a protected position. Ammunition tanks may be switched to supply different drugs, and persons with chemistry skills often create their own varieties.

Needle Pistol<E-Header>

Abilities: Needler Multipower, All Stats (+2), 64 Charges (+1/2), Recover per 5 Minutes (+1/2), Ranged (+1/2), No Range Penalty (+1/2), Must divide dice between stats affected (-1), OAF Needler, Not vs. 3PD+ Resistant Defense (-3/4), Takes 1 Phase to change Multipower (- 1/4)
 .1- (u) 4d6 Drain
 .2- (u) 4d6 Aid
 Active Cost: 230 Real Cost: 57 Mass: 0.5 kg.

Needle Rifle<E-Header>

Abilities: Needler Multipower, All Stats (+2), 250 Charges (+1), Recover per 5 Minutes (+1/2), Ranged (+1/2), No Range Penalty (+1/2), Must divide dice between stats affected (-1), OAF Needler, Not vs. 3PD+ Resistant Defense (-3/4), Takes 1 Phase to change Multipower (- 1/4)
 .1- (u) 5d6 Drain
 .2- (u) 5d6 Aid
 Active Cost: 287 Real Cost: 71 Mass: 1.0 kg.

SUPER TECHNOLOGY<C-Header>

DISINTEGRATORS<D-Header>

This weapon fires a continuous beam that breaks down the molecular bonds that hold matter together.

MODEL	OCV	RMod	Damage	STUN	STR	Shots	Act	Real	Mass
				Mod	Min		Pts	Cost	(kg)
2.00kw Derringer	+2	+0	2d6K	+1	-	16	210	105	0.5
8.00kw Pistol	+2	+0	3d6-1K	+1	-	32	275	137	1.0
16.00kw Assault Rifle	+2	+1	3d6K	+1	-	64	333	166	2.0
64.00kw LMGx6	+2	+2	4d6-1K	+1	-	125	426	213	4.0
128.00kw MMG (*)	+2	+4	4d6K	+1	-	250	492	197	8.0
1.00Mw HMG (*)	+2	+4	5d6K	+1	-	500	625	250	16.0
8.00Mw Lt Cannon (N,1,*)	+2	-	6d6K	+1	-	1000	775	310	32.0
64.0 Mw Med Cannon (N,2,*)	+2	-	7d6K	+1	-	2000	977	391	64.0
500 Mw Hvy Cannon (N,3,*)	+2	-	8d6K	+1	-	4000	1202	481	128.

All Disintegrators are: Continuous (+1), AVLD Does Body: Defense is Force Field (+2 1/2), and Variable Lethality (+ 1/4)

New Advantage (Variable Lethality): This allows a person to alter the Body amount in an attack; i.e., when the character fires his 3d6 Killing Attack he can declare whether he did full Body, one-half Body, or no Body. The Stun is still figured on the full Body of the attack. Again in our example above, if the character scored a 12 on the Body and a 4 on the Stun Multiplier the possible damage combinations would be: 12 Body, 48 Stun or 6 Body, 48 Stun or 0 Body, 48 Stun. The Gamemaster may choose to require a half Phase for changing settings. Variable Lethality is a + 1/4 Advantage.
 [I THOUGHT WE MOVED THIS TO "NEW ADVANTAGES"?]

GENERAL NOTES<C-HEADER>

All weapons are OAF unless otherwise indicated
 (A) Autofire - 5 shot (+1/2)
 (N) No Range Penalty (+1/2)
 (1) Increased Range x125 (+1/2) (Active x125)
 (2) Increased Range x3,125 (+1) (Active x3,125)
 (3) Increased Range x78,125 (+1 1/2) (Active x78,125)
 (*) Bulky Focus, must be mounted on a tripod or vehicle (-1/2)
 Note that STR Min is -10 With Bipod (minimum STR min is 5).

MELEE WEAPONS<B-Header>

ADVANCED TECHNOLOGY<C-Header>

MONOFILAMENT BLADE: ADVANCED<D-Header>

This is a taut thread, one molecule wide, affixed to the edge of a metal blade.

Damage	OCV	STUN	STR	Shots	Act	Real	Mass
		Mod	Min		Pts	Cost	(kg)
1 1/2d6K PEN	+1	+0	11/9	0 End	60	30	1.0
+2 DC per 15 STR over STR Min							

STUN BATON: ADVANCED<D-Header>

This is a baton with a electrically charged tip that stuns the target.

Damage	OCV	STUN	STR	Shots	Act	Real	Mass
		Mod	Min		Pts	Cost	(kg)
3d6 NND	+0	-	5	64	37	18	1.0
NND: Defense is CON Roll -3 (+1)							

VIBRO-BLADE: ADVANCED<D-Header>

This is a high-tech sword whose blade vibrates rapidly with a high frequency hum. When the blade senses an impact it vibrates even faster, allowing it to shear through most matter.

Damage	OCV	STUN	STR	Shots	Act	Real	Mass
		Mod	Min		Pts	Cost	(kg)
1 1/2d6K AP	+1	+0	11/9	64	60	30	1.0
+2 DC per 15 STR over STR Min							

HIGH TECHNOLOGY<C-Header>

ENERGY SABER: HIGH<D-Header>

This is beam sword of variable length that is wielded like a katana or sabre. The beam may be adjusted in length from a wakizashi (short sword) to a no-daichi (great sword), though the weapon damage doesn't change.

Damage	OCV	STUN	STR	Shots	Act	Real	Mass
		Mod	Min		Pts	Cost	(kg)
1 1/2d6K Energy	+1	+1	11/9	64	60	30	1.0
+2 DC per 15 STR over STR Min							

SHOCK GLOVES: HIGH<D-Header>

The wearer of these gloves must touch the target with both hands. This creates an oscillating charge field between the two that stuns the individual.

Damage	OCV	STUN	STR	Shots	Act	Real	Mass
		Mod	Min		Pts	Cost	(kg)
1d6 HKA Energy	+0	-	5	64	22	15	0.5

SUPER TECHNOLOGY<C-Header>

GRENADES<D-Header>

Grenades are explosive effect weapons that must be either thrown (special effects bypass the "No Range" Limitation), or fired from launchers, which are listed after the grenades. The Reduced Penetration Limitation is applied differently at the 1/2 level than at the 1/4 level; at the higher level it applies to Stun as well.

Example: Lupus Shade is in a fight when a foe throws a concussion grenade. The GM rolls damage (7 1/2d6 + 7 1/2d6) and gets 26 Stun, 7 Body and 27 Stun, 8 Body; he rolls Hit Location 5 (ouch). Lupus isn't wearing a helmet (OUCH!) and has 4 PD. He takes 45 Stun, 7 Body through defenses. With the Hit Location mods, this becomes 90 Stun and 14 Body. Maybe he'll wear a helmet next time.

A fragmentation grenade in the same example would have done damage as follows: the GM rolls damage (2 1/2d6 + 2 1/2d6), say 9 and 8 Body, and again rolls Hit Location 5. Lupus is still not wearing a helmet and so has no protection vs. Killing Damage. After Hit Location mods he takes 85 Stun and 34 Body.

ADVANCED TECHNOLOGY<C-Header>

Concussion Grenades<E-Header>

Ability: 15d6 Energy Blast, Explosion (+1/2), -1 DC per 5" (+1), No Range (-1/2), Reduced Penetration (-1/2), 1 Charge, OAF
 Total Active Cost: 187 Real Cost: 27 Mass: 0.5 kg.

Fragmentation Grenades<E-Header>

Ability: 5d6 RKA, Explosion (+1/2), -1 DC per 5" (+1), No Range (-1/2), Reduced Penetration (-1/2), 1 Charge, OAF
 Total Active Cost: 187 Real Cost: 27 Mass: 0.5 kg.

Sleep Gas Grenades<E-Header>

Ability: 6d6 Energy Blast, AE 7" Radius (+1), NND (+1), Time Delay (+ 1/4), No Range (-1/2), 1 Continuing Charge of One Minute (-1), OAF (-1)
Active Cost: 105 Real Cost: 30 Mass: 0.5 kg.
Note: No Normal Defense (LS: Self Contained).

Tangle Grenades<E-Header>

This grenade sprays a compound of sticky, quick-drying plastic fibers.
Ability: 5d6 Entangle, AE 6" Radius (+1), Time Delay (+ 1/4), No Range (-1/2), 1 Charge (-2), OAF (-1)
Active Cost: 112 Real Cost: 25 Mass: 0.5 kg.

Tear Gas Grenades<E-Header>

Abilities:
1: 5d6 Energy Blast, AE 7" Radius (+1), NND (+1), Time Delay (+ 1/4), No Range (-1/2), 1 Continuing Charge of One Minute (-1), OAF (-1)
2: 7" Radius Darkness, Time Delay (+ 1/4), No Range (-1/2), 1 Continuing Charge of One Minute (-1), OAF (-1), Linked to Above (-1/2)
Note: No Normal Defense (LS: Breathing)
Active Cost: 184 Real Cost: 50 Mass: 0.5 kg.

Ultrasonic Grenades<E-Header>

Ability: 6d6 Energy Blast, AE 7" Radius (+1), NND (+1), Time Delay (+ 1/4), No Range (-1/2), 1 Continuing Charge of One Minute (-1), OAF (-1), Not in Vacuum (-1/2)
Note: No Normal Defense (LS: Sound Flash Defense)
Active Cost: 105 Real Cost: 26 Mass: 0.5 kg.

Grenade Launcher<E-Header>

Ability: Cancels No Range Limitation and 1 Charge Limitation on up to 200 Active Points (Becomes 16 CH [+0]) and adds No Range Penalty (+1/2), OAF OR
Ability: Cancels No Range Limitation and 1 Continuing Charge for 1 Minute Limitation on up to 200 Active Points (Becomes 6 CH of 1 minute [+0]) and adds No Range Penalty (+1/2), OAF
Active Cost: 220 Real Cost: 110 Mass: 3.5 kg.

FLARE GUN<D-Header>

Flare guns are used for illumination and very rarely for damage; however, just in case, the damage is listed below.

Flare Gun<E-Header>

Table with columns: Effect, OCV, RMod, Damage, STUN Mod, STR Min, Shots, Act Pts, Real Cost, Mass (kg). Rows include 1: Light, 2: Burning if hit, 3: Light if hit, and Totals.

Advantages<E-Header>

*6 continuing charges of 5 minutes 1/4 +

Limitations<E-Header>

OAF: Flare Gun -1
RKA Linked to Change Environment -1/2
Flash Linked to RKA -1/2
6 CH (For RKA And Flash) -3/4

NUCLEAR MISSILE LAUNCHER<D-Header>

This launcher is modified from a Heavy Gauss Cannon.

8 Kiloton Nuclear Missile Launcher PRICE: 6,450,000<E-Header>

Abilities

1: 10d6 RKA (Radiation Burst), AVLD Does Body (+2 1/2), AE x1000 Radius, 82,500" (82.5 Kilohexes) (+3 1/2), 64ch (+1/2), Increased Max Range x78,125 (+1 1/2) 105,468,750" (211,000 Kilometers) (+8), OIF (-1/2), Bulky (-1/2), 180deg firing (-1/2), Loses 1d6 per 5000 Hexes/5 Kilohexes (-1) (-2 1/2)
2: 40d6 ED Energy Blast, (Heat Flash), AE Rad x1000 Radius, 60,000" (60 Kilohexes) (+3 1/2), 64ch (+1/2), Increased Max Range x78,125 (+1 1/2) 101,562,500" (203,000 Kilometers) (+5 1/2), OIF (-1/2), Bulky (-1/2), 180deg firing (-1/2), Loses 1d6 per 1000 Hexes/1 Kilohex (-1) Linked to Above (-1/2) (-3)
3: 40d6 PD Energy Blast, (Concussion Blast), AE Rad x1000 Radius, 60,000" (60 Kilohexes) (+3 1/2), 64ch (+1/2), Increased Max Range x78,125 (+1 1/2)

101,562,500" (203,000 Kilometers) (+5 1/2), OIF (-1/2), Bulky (-1/2), 180deg firing (-1/2), Loses 1d6 per 1000 Hexes/1 KiloHex (-1) Linked to Above (-1/2) (-3)

4: 20d6 Flash, (Light Burst), AE Rad x1000 Radius, 60,000" (60 KiloHexes) (+3 1/2), 64ch (+1/2), Increased Max Range x78,125 (+1 1/2) 101,562,500" (203,000 Kilometers) (+5 1/2), OIF (-1/2), Bulky (-1/2), 180deg firing (-1/2), Loses 1d6 per 2000 Hexes/2 KiloHex (-1) Linked to Above (-1/2) (-3)

5: 10d6 Major Transform (Sighted Person into Blind Person), AVLD (+1 1/2) (vs. Flash Defense), AE Rad x1000 Radius, 67,500" (67.5 KiloHexes) (+3 1/2), 64ch (+1/2), Increased Max Range x78,125 (+1 1/2) 93,750,000" (187,500 Kilometers) (+7), OIF (-1/2), Bulky (-1/2), 180deg firing (-1/2), Loses 1d6 per 5000 Hexes/5 KiloHexes (-1) Linked to Above (-1/2) (-3)

Active Cost: 6450 Real Cost: 1761 Mass: 128kg <D-Header>

HIGH TECH<C-Header>

Energy grenades are studded with miniature beam conduits (lenses, collimators, etc.) of the same type as their firearm counterparts. The grenade itself does not explode, but sprays the area with energy.

Blaster Pulse Grenades<E-Header>

Ability: 12d6 Energy Blast, AE 7" Radius (+1), Time Delay (+ 1/4), No Range (-1/2), 1 Charge (-2), OAF (-1)

Active Cost: 135 Real Cost: 30 Mass: .5 kg.

Laser Pulse Grenades<E-Header>

Ability: 3d6 RKA, AE 8" Radius (+1), AP (+1/2), Time Delay (+ 1/4), No Range (-1/2), 1 Charge (-2), OAF (-1), Not In Fog or Smoke (-1/2)

Active Cost: 124 Real Cost: 25 Mass: .5 kg.

Maser Pulse Grenades<E-Header>

Ability: 3d6 RKA, AE 8" Radius (+1), Penetrating (+1/2), Time Delay (+ 1/4), No Range (-1/2), 1 Charge (-2), OAF (-1), 1/2 Damage vs. Metal Armor (-1/2)

Active Cost: 124 Real Cost: 25 Mass: .5 kg.

SUPER TECH<C-Header>

Disintegration Grenades<E-Header>

Ability: 3d6-1 RKA, AE 15" Radius (+1), AVLD does body (+2 1/2), Time Delay (+ 1/4), No Range (-1/2), 1 Charge (-2), OAF (-1)

Active Cost: 190 Real Cost: 42 Mass: .5 kg.

ANTI-MATTER TORPEDOES/MINES<D-Header>

These spaceship weapons can be programmed to detonate when a large mass comes within a set range, or after a set time has elapsed, or simply fired at a target. AMTMs use a trickle of powdered anti-lead in a tank of water to provide propulsion, then dump the whole charge into the water to explode.

Light Torpedoes PRICE: 91,100<E-Header>

9d6 RKA, AE Rad 43,875" (44 KiloHexes) x1000 Radius (+3 1/2), 32ch (+ 1/4), Time Delay (+ 1/4), Trigger: Proximity Fuse (+ 1/4), Increased Max Range x78,125 (+1 1/2) 71,171,875" (142,344 Kilometers): (+5 3/4), OIF (-1/2), Bulky (-1/2), 180deg firing (-1/2), Loses 1d6 per 5000 Hexes (1d6 per 5 KiloHexes) (-1) (-2 1/2)

Active Cost: 911 Real Cost: 360 Mass: 3.2T Volume: 0 CuHexes

Medium Torpedoes PRICE: 126,000<E-Header>

12d6 RKA, AE Rad 64,000" (64 KiloHexes) x1000 Radius (+3 1/2), 64ch (+1/2), Time Delay (+ 1/4), Trigger: Proximity Fuse (+ 1/4), Increased Max Range x78,125 (+1 1/2) 98,437,500" (196,875 Kilometers): (+6), OIF (-1/2), Bulky (-1/2), 180deg firing (-1/2), Loses 1d6 per 5000 Hexes (1d6 per 5 KiloHexes) (-1) (-2 1/2)

Active Cost: 1260 Real Cost: 360 Mass: 3.2T Volume: 2 CuHexes

Heavy Torpedoes PRICE: 168,700<E-Header>

15d6 RKA, AE Rad 90,000" (90 KiloHexes) x1000 Radius (+3 1/2), 125ch (+3/4), Time Delay (+ 1/4), Trigger: Proximity Fuse (+ 1/4), Increased Max Range x390,625 (+1 3/4) 65,894,375" (1,317,969 Kilometers): (+6 1/2), OIF (-1/2), Bulky (-1/2), 180deg firing (-1/2), Loses 1d6 per 5000 Hexes (1d6 per 5 KiloHexes) (-1) (-2 1/2)

Active Cost: 1687 Real Cost: 482 Mass: 12.8T Volume: 8 CuHexes

Extra Heavy Torpedoes PRICE: 216,000<E-Header>

18d6 RKA, AE Rad 121,500" (121.5 KiloHexes) x1000 Radius (+3 1/2), 250ch

(+1), Time Delay (+ 1/4), Trigger: Proximity Fuse (+ 1/4), Increased Max Range x1,953,125 (+2) 421,875,000* (8,437,500 Kilometers): (+7), OIF (-1/2), Bulky (-1/2), 180deg firing (-1/2), Loses 1d6 per 5000 Hexes (1d6 per 5 Kilohexes) (-1) (-2 1/2)
 Active Cost: 2160 Real Cost: 617 Mass: 64T Volume: 28 CuHexes

INTEGRATED DAMAGE CLASS TABLE<B-Header>

The following Integrated Damage Class table is for use with real world information about weapons and energy output. For example, if you know the energy output of a gun in foot-pounds, check the energy column of the chart, cross reference to DC, and round up. For example, a .44 Magnum produces 1200 FP. On the chart, that cross references to 2d6, as 1200 is less than 2000 and greater than 1000, rounding up. Energy output is listed in Joules, foot-pounds, and Watts, all of which are numerically equivalent for this purpose.

The Explosives column is the amount of TNT that will produce the indicated Damage Classes. Other explosives are more or less powerful for the same mass, as indicated in the separate Relative Explosives Power table.

INTEGRATED DAMAGE CLASS TABLE<C-HEADER>

DC	Killing Damage	Explosives	Energy Output (Joules/Foot-Pounds/Watts)	
1	1 pip	.016 gram	64	
2	1/2d6, 1d6-1	.032	125	
3	1d6	.064	250	
4	1d6+1	.125	500	
5	1 1/2d6, 2d6-1	.250	1	Thousand/Kilowatt
6	2d6	.500	2	
7	2d6+1	1.000 gram	4	
8	2 1/2d6, 3d6-1	2.000	8	
9	3d6	4.000	16	
10	3d6+1	8.000	32	
11	3 1/2d6, 4d6-1	16.000	64	
12	4d6	32.000	125	
13	4d6+1	64.000	250	
14	4 1/2d6, 5d6-1	125.000	500	
15	5d6	250.000	1	Million/Megawatt
16	5d6+1	500.000	2	
17	5 1/2d6, 6d6-1	1 Kilogram	4	
18	6d6	2	8	
19	6d6+1	4	16	
20	6 1/2d6, 7d6-1	8	32	
21	7d6	16	64	
22	7d6+1	32	125	
23	7 1/2d6, 8d6-1	64	250	
24	8d6	125	500	
25	8d6+1	250	1	Billion/Gigawatt
26	8 1/2d6, 9d6-1	500	2	
27	9d6	1 Ton	4	
28	9d6+1	2	8	
29	9 1/2d6, 10d6-1	4	16	
30	10d6	8	32	
31	10d6+1	16	64	
32	10 1/2d6, 11d6-1	32	125	
33	11d6	64	250	
34	11d6+1	125	500	
35	11 1/2d6, 12d6-1	250	1	Trillion/Terawatt
36	12d6	500	2	
37	12d6+1	1 Kiloton	4	
38	12 1/2d6, 13d6-1	2	8	
39	13d6	4	16	
40	13d6+1	8	32	
41	13 1/2d6, 14d6-1	16	64	
42	14d6	32	125	
43	14d6+1	64	250	
44	14 1/2d6, 15d6-1	125	500	
45	15d6	250	1	Quadrillion/Petawatt
46	15d6+1	500	2	
47	15 1/2d6, 16d6-1	1 Megaton	4	
48	16d6	2	8	
49	16d6+1	4	16	
50	16 1/2d6, 17d6-1	8	32	
51	17d6	16	64	
52	17d6+1	32	125	
53	17 1/2d6, 18d6-1	64	250	

54	18d6	125	500	
55	18d6+1	250	1	Quintillion/Exawatt
56	18 1/2d6, 19d6-1	500	2	
57	19d6	1 Gigaton	4	
58	19d6+1	2	8	
59	19 1/2d6, 20d6-1	4	16	
60	20d6	8	32	

RELATIVE EXPLOSIVE POWER<C-Header>

Substance	DC Modifier
Black Powder	-2
Homemade Chemical	-2
Dynamite	-1
TNT	+0
Blasting Gelatine	+1
Plastique	+2
Nitroglycerine	+2
Nuclear	+0
(in TNT equivalents)	
Antimatter	+35

Note: Nuclear and antimatter explosions produce many additional effects and have extended range. See the Nuclear Missile Launcher for an illustration.

PERSONAL DEFENSE<A-Header>

ARMOR<B-Header>

Armor is a character's last defense against the damage of an attack. The Defense of a piece of armor is fully Resistant and adds to both the character's PD and ED. The armor's DEF is subtracted from the BODY of any Killing Attacks. The armor's DEF plus the character's PD or ED is subtracted from the STUN of all attacks.

ARMOR ENCUMBRANCE<C-Header>

Most characters will wear some armor, though heavy armor will add to a character's encumbrance. Refer to the Encumbrance section of the Hero System Rulebook (Page 150) to find the DCV modifiers for carrying a heavy load. Encumbrance normally includes everything a character is carrying, but the GM may simplify this by only counting the armor itself.

The Encumbrance and armor mass rules were designed for a standard 100 kg character. For characters who are very large or very small, multiply their armor mass and their Encumbrance break points by their mass multiple. This means that very large characters will have heavier armor, but it will not slow them down any more than a standard character in similar armor. Alternatively, to get the DCV modifier simply, you can ignore the mass multiplier and just look up the standard armor mass on the Encumbrance Chart, noting the effects.

ARMOR DESCRIPTIONS<C-Header>

Transparent armors are normally colorless. They are often tinted or painted opaque so as not to be vulnerable to laser fire.

Light Plastic<E-Header>

A transparent lightweight polymer that is the lightest form of armor.

Acrylic Plastic<E-Header>

A stronger, lightweight polymer, also transparent.

Syntheleather<E-Header>

A lightweight synthetic material that resembles leather.

Woven Kevlar<E-Header>

A synthetic fiber material that is very flexible and is indistinguishable on the surface from ordinary clothes. Versus cutting attacks it is worth only 1/2 value (1/4 vs. AP) (- 1/4 Limitation).

Reflect<E-Header>

A highly reflective lightweight coating that is applied to armor or clothing to help offset the advantage that energy weapons give. Reflect is Hardened vs. Energy weapons such as lasers and beam swords (+ 1/4). Reflect is Ablative when hit by Physical attacks (-1/2 Limitation) in the location hit as the coating is chipped away or scuffed.

Fiberglass<E-Header>

A spun glass that is useful for armor and lightweight weapons.

Resin Bonded Kevlar<E-Header>

This is Kevlar that has been resin bonded. It improves on the effectiveness of the woven kevlar.

Ablative Foam Armor<E-Header>

This armor comes in an applicator and has the Ablative Limitation (-1). In a campaign that uses Hit Locations, the armor ablates in that location, which is no longer protected. That is, if a character is hit in location 4 and then is hit in location 4 again, the armor no longer protects him there. Ablative foam may be used over other armors and is one of the few cases with which stacking armor is allowed.

Steel<E-Header>

This is a mediumweight iron alloy. Steel is cheap; when damaged beyond repair, it can always be reforged; and stainless steel does not rust. These advantages somewhat outweigh the jokes users hear about medieval suits of armor. [WHAT ARE THE TRADEOFFS BETWEEN STEEL AND CERAMIC PLATE?

Ceramic Plate Armor<E-Header>

Graphite ceramic plates inserted into a jumpsuit.

Heavy Reflect<E-Header>

A heavier version of the armor above.

Ceramic Bonded Kevlar<E-Header>

Graphite ceramic plates bonded to kevlar.

Polysteel<E-Header>

This is a mediumweight transparent armor made of polymer with a tensile strength higher than steel.

Diamondsteel<E-Header>

This is an opaque crystalline metal alloy as hard as diamond.

Duralloy<E-Header>

A transparent memory polymer-and-crystal compound. Components are pretensioned to resist changes in shape, hence "memory".

Crysteel<E-Header>

This is a single transparent crystalline molecule matrix grown in the shape of piece of armor. The way it is created makes it one of the toughest materials known.

Faceplates<E-HEADER>

Transparent armors are used for the faceplates (location #3) of armors. When tinted, they provide Flash Defense at GM's option.

SF ARMOR TABLE<C-Header>

Armor	Resistant DEF
Light Plastic	1#
Acrylic Plastic	2#
Syntheleather	3#
Woven Kevlar	3#
Reflect	+3 ED*
Fiberglass	4#
Resin Bonded Kevlar	5#
Ablative Foam Armor	+5 DEF*
Steel	6#
Ceramic Plate Armor	6#
Heavy Reflect	+6 ED*
Ceramic Bonded Kevlar	7#
Polysteel	7*
Diamondsteel	8*
Duralloy	9*
Crysteel	10*

#1/2 Listed mass in the Hero System Rulesbook. pg204

* 1/4 Listed mass in the Hero System Rulesbook. pg204

Each type of armor can be expanded to include a "light" version and a "heavy" version. The light style is -1 DEF, and is correspondingly lighter. The heavy style is +1 DEF, and is appropriately heavier. For example, Heavy Ceramic Plate Armor is DEF 7 and a full suit masses 14 kg.

SECTIONAL DEFENSE<C-Header>

Armor need not cover a character completely; each location on the Hit Location Chart can be armored individually. The mass of the piece of armor for each Hit Location is listed in the Sectional Armor Mass Table. Remember that the total mass of a character's armor is important. The player should total the armor mass and figure his DCV and END Encumbrance modifiers.

PIECES OF ARMOR<C-Header>

Most named pieces of armor cover several hit locations. Not all named pieces of armor historically were used with all types of armor, but nearly any type of armor can be used to cover any of a character's Hit Location. The Sectional Armor Defense Table lists a number of different pieces of armor, their coverage, and the base mass in kilograms. Remember to adjust the mass for material used. If the armor is Hardened multiply the mass by the advantage.

Example: A Crysteel Helm covering locations 3-5 masses 3.69 kg.

The same Helmet Hardened masses 4.6125 kg.

If you are using Superheroic rules, use the Armor Coverage and Cost Table and apply the Limitations based on the number of locations the armor covers. Remember that each DEF of armor is PD and ED and so costs 3 points. Most armor is OIF.

SECTIONAL ARMOR MASS TABLE IN KILOGRAMS<C-Header>

Hit Location	Name (roll)	Armor Base Defense									
		1	2	3	4	5	6	7	8	9	10
Full Suit	(3-18)	3.50	5.00	7.00	10.00	14.00	20.00	28.00	40.00	56.00	80.00
Head	(3)	.02	.02	.03	.05	.06	.09	.13	.18	.25	.36
Head	(4)	.05	.07	.10	.14	.19	.28	.39	.56	.78	1.11

Head	(5)	.10	.14	.19	.28	.39	.56	.78	1.11	1.56	2.22
Hands	(6)	.16	.23	.32	.46	.65	.93	1.30	1.85	2.59	3.70
Arms	(7)	.24	.35	.49	.69	.97	1.39	1.94	2.78	3.89	5.55
Arms	(8)	.34	.49	.68	.97	1.36	1.94	2.72	3.89	5.45	7.78
Shoulder	(9)	.41	.58	.81	1.16	1.62	2.32	3.24	4.63	6.48	9.26
Chest	(10)	.44	.63	.88	1.25	1.75	2.50	3.50	5.00	7.00	10.00
Chest	(11)	.44	.63	.88	1.25	1.75	2.50	3.50	5.00	7.00	10.00
Stomach	(12)	.41	.58	.81	1.16	1.62	2.32	3.24	4.63	6.48	9.26
Vitals	(13)	.34	.49	.68	.97	1.36	1.94	2.72	3.89	5.45	7.78
Thigh	(14)	.24	.35	.49	.69	.97	1.39	1.94	2.78	3.89	5.55
Leg	(15)	.16	.23	.32	.46	.65	.93	1.30	1.85	2.59	3.70
Leg	(16)	.10	.14	.19	.28	.39	.56	.78	1.11	1.56	2.22
Foot	(17)	.05	.07	.10	.14	.19	.28	.39	.56	.78	1.11
Foot	(18)	.02	.02	.03	.05	.06	.09	.13	.18	.25	.36

SECTIONAL ARMOR DEFENSE<C-Header>

Hit Location		Armor Base Defense									
Name	(roll)	1	2	3	4	5	6	7	8	9	10
Faceplate	(3)	.02	.02	.03	.05	.06	.09	.13	.18	.25	.36
Full Helmet	(3-5)	.16	.23	.32	.46	.65	.93	1.30	1.85	2.59	3.69
Coif	(4-5,9)	.55	.79	1.10	1.57	2.20	3.15	4.41	6.30	8.82	12.59
Helm	(4-5)	.15	.21	.29	.42	.58	.83	1.17	1.67	2.34	3.33
Cap	(5)	.10	.14	.19	.28	.39	.56	.78	1.11	1.56	2.22
Gauntlets	(6-7)	.41	.58	.81	1.16	1.62	2.31	3.24	4.63	6.48	9.25
Gloves	(6)	.16	.23	.32	.46	.65	.93	1.30	1.85	2.59	3.70
Brassards	(7-8)	.58	.83	1.17	1.67	2.33	3.33	4.67	6.67	9.34	13.33
Vambraces	(7)	.24	.35	.49	.69	.97	1.39	1.94	2.78	3.89	5.55
Rerebraces	(8)	.34	.49	.68	.97	1.36	1.94	2.72	3.89	5.45	7.78
Pauldrons	(9)	.41	.58	.81	1.16	1.62	2.32	3.24	4.63	6.48	9.26
Hauberk	(7-14)	2.85	4.07	5.70	8.15	11.40	16.30	22.80	32.60	45.64	65.18
Corselet	(9-15)	2.43	3.47	4.86	6.94	9.72	13.90	19.40	27.80	38.89	55.55
Byrnie	(9-14)	2.27	3.24	4.54	6.48	9.07	13.00	18.20	25.90	36.30	51.85
Cuirass	(9-13)	2.03	2.89	4.05	5.79	8.10	11.60	16.20	23.20	32.41	46.30
Vest	(10-13)	1.62	2.31	3.24	4.63	6.48	9.26	13.00	18.50	25.93	37.04
Breastplate	(9-11)	1.28	1.83	2.56	3.66	5.12	7.32	10.20	14.60	20.48	29.26
Skirtplate	(12-13)	.75	1.06	1.49	2.13	2.98	4.26	5.96	8.52	11.93	17.04
Chausses	(14-18)	.57	.81	1.13	1.62	2.27	3.24	4.54	6.48	9.07	12.94
Leggings	(14-17)	.55	.79	1.10	1.57	2.20	3.15	4.41	6.30	8.82	12.58
Skirt	(14)	.24	.35	.49	.69	.97	1.39	1.94	2.78	3.89	5.55
Greaves	(16-17)	.15	.21	.29	.42	.58	.83	1.17	1.67	2.34	3.33
Boots	(17-18)	.06	.09	.13	.19	.26	.37	.52	.74	1.03	1.47
Knee Cops	(15)	.16	.23	.32	.49	.65	.93	1.30	1.85	2.59	3.70
Demigreaves	(16)	.10	.14	.19	.28	.39	.56	.78	1.11	1.56	2.22
Anklets	(17)	.05	.07	.10	.14	.19	.28	.39	.56	.78	1.11
Shoes	(18)	.02	.02	.03	.05	.06	.09	.13	.18	.25	.36

ARMOR COVERAGE AND COST<D-Header>

Covers # of Locations	Activates	Limitation
1 or 2	8-	-2
3	9-	-1 1/2
4	10-	-1 1/4
5 to 7	11-	-1
8 to 12	12-	-3/4
13 or 14	14-	-1/2
15	15-	- 1/4
16		-0

EXAMPLE ARMOR LIMITATIONS<D-Header>

Name	(Locations)	Limitation
Full Helmet	(3-5)	-1 1/2
Coif	(4-5,9)	-1 1/2
Face Plate	(3)	-2
Helm	(4-5)	-2
Cap	(5)	-2
Gauntlets	(6-7)	-2
Gloves	(6)	-2
Brassards	(7-8)	-2
Vambraces	(7)	-2
Rerebraces	(8)	-2
Pauldrons	(9)	-2
Hauberk	(7-14)	-3/4
Corselet	(9-15)	-1
Byrnie	(9-14)	-1
Cuirass	(9-13)	-1
Vest	(10-13)	-1 1/4
Breastplate	(9-11)	-1 1/2
Skirtplate	(12-13)	-2

Chausses	(14-18)	-1
Leggings	(14-17)	-1 1/4
Skirt	(14)	-2
Greaves	(16-17)	-2
Boots	(17-18)	-2
Knee Cops	(15)	-2
Demigreaves	(16)	-2
Anklets	(17)	-2
Shoes	(18)	-2

AVERAGE DEFENSES<C-Header>

If a character is wearing different armor on different parts of his body, and the campaign is not using the Hit Location rules, he should calculate the average value of his armor. It is also appropriate when the character is hit by an attack that is not concentrated against a single area.

There are two methods of calculating the Average Armor Value. In the first, the player should total the Armor Defense covering hit locations 9-14, add the Armor Defense covering the head, and then divide the total by 7. This is the equivalent of wearing a byrnie and a helm. The armor covering the head must cover at least two of the head hit locations to count toward the Average Armor Value.

This Average Armor calculation is a simplification, but it takes into account about 70% of a character's hit locations, and all hit locations that have a x1 or x2 BODY multiple on the Hit Location Chart.

The calculation is only accurate if the character has some armor covering even those locations that are not included in the calculation; but it does represent the way many characters in literature are depicted. If the GM feels that a character is abusing the average armor rule by heavily armoring the locations in the calculation, but leaving the other locations undefended, the GM may reduce the Average Armor Value by 1 or 2 to compensate.

A more comprehensive, but more easily abused, method is to add up the character's defenses in all 16 hit locations and divide by 16. This tends to give big bonuses to characters who wear armor on their hands, arms, legs and feet, but it does take all the armor a character is wearing into account. If a character has a reasonable distribution of armor when the GM is using hit locations (heavy armor covering x1 and x2 BODY locations) then using all 16 hit locations is a more comprehensive calculation of the character's Average Armor Value and Encumbrance.

PRICE OF ARMOR<C-Header>

The starting price for armor should be 500 CR per kilogram before mass reduction for material used. For example a complete suit of Crysteel (80 KG before mass reduction) costs 40,000 CR. Even more than weapons, armor comes in a dizzying array of options. The GM should consider the calculated price and adjust for common sense. Extremely light armor, like boots, should have increased cost.

PERSONAL SCREENS<B-Header>

SUPER TECH<C-Header>

FORCE FIELD<D-Header>

A force field casts a field of energy which protects the character. It cannot fully form around heavy armors because of secondary electric fields (and playability).

Force fields are designed as if they were a full suit of armor, up to 10 DEF, and they are priced 2,500 per equivalent kilogram, so a 5 DEF force field which "masses" 14 kg would be priced at 35,000.

A force field may be Hardened with the same increases in cost and equivalent mass as Armor. In the example, above the same force field would "mass" 17.5 kg and be priced at 43,750.

Example Force Field:

Ability: 5 PD / 5 ED Force Field, 0 End (+1/2), Persistent (+1/2)
 Hardened (+ 1/4), OIF: Force Field device (-1/2), -1 PD / -1 ED
 per 1 DEF of Armor Worn (- 1/4), Power Cell Lasts for One Hour (-
 1/4)
 Active Cost: 22 Real Cost: 11 Mass: 1 kg.

Force Shield PRICE: 2000<E-Header>

This is a wrist device that when activated forms a disk of force in front of the character that behaves like a shield.

Ability: +4 DCV, OIF: Force Shield Device (-1/2), Power Cell lasts for 1
 Hour (- 1/4)
 Active Cost: 20 Real Cost: 11 Mass: .5 kg.

LIFE SUPPORT EQUIPMENT<A-Header>

Skin Suit PRICE: 1000<E-Header>

This is a vacuum suit that is put on in case of emergency. It is essentially a plastic bag vaguely shaped like a person which, when donned, fills with heated air and shrinks to proper size. One size fits all.
Ability: LS: Self Contained, Vacuum/High Pressure, Intense Heat/Cold, Immune to Disease, Immune to High Radiation; OIF: Spacesuit (-1/2), Fragile (- 1/4), Power Cell lasts for one hour (- 1/4)
Active Cost: 22 Real Cost: 11 Mass: 2 kg.

Space Suit PRICE: 5000<E-Header>

This suit is used for short excursion into hostile environments. Its major advantage over primitive space suits is the ease of movement it allows.
Ability: LS: Self Contained, Vacuum/High Pressure, Intense Heat/Cold, Immune to Disease, Immune to High Radiation; OIF: Spacesuit (-1/2), Power Cell lasts for one day (- 1/4)
Active Cost: 22 Real Cost: 13 Mass: 4 kg.

Deep Space Suit PRICE: 10000<E-Header>

This is a full environmental space suit.
Ability: LS: Self Contained, Vacuum/High Pressure, Intense Heat/Cold, Immune to Disease, Immune to High Radiation, Need not Eat/Excrete, OIF: Spacesuit (-1/2), Power Cell lasts for one week (-0)
Active Cost: 27 Real Cost: 18 Mass: 10 kg.

GENERAL RULES<D-HEADER>

All suits (Except the skin suit) must be armored up to a minimum 3 DEF. Use the rules for creating a suit of armor and all locations must be armored; simply choose the armor you want and add its cost and masses to the above cost and mass.

Example: Albert has a character in a Advanced Tech campaign and wants a normal space suit with armor:

Fiberglass Helmet, DEF: 4; (3-5): 0.23 kg

Woven Kevlar Bodysuit, DEF: 3; (6-18): 3.925 kg

Add the costs and mass for Life Support (Space Suit) for a total of 9.155 kg and -2 DCV.

TRANSPORTATION<A-Header>

VEHICLE LIST<C-Header>

AIR VEHICLES<D-HEADER>

Name	SIZE	DCV	Mass	Knb	STR	DEF	BODY	DEX	SPD	MOVE	MAX
Aircycle	1.25x.64	-0	200	-1	15	5	11	20	4	30x4	480
Aircar S	2x1	-2	800	-3	25	5	13	20	4	30x4	480
Aircar M	2.5x1.25	-2	1.6T	-4	30	5	14	15	3	25x4	300
Aircar L	3.2x1.6	-3	3.2T	-5	35	5	15	15	3	25x4	300
Airvan	3.2x1.6	-3	3.2T	-5	35	5	15	15	3	25x4	300
Airbus	4x2	-4	6.4T	-6	40	5	16	15	3	25x4	300
Helicopter	3.2x1.6	-3	3.2T	-5	35	5	15	20	4	25x4	400
Jet S	4x2	-4	6.4T	-6	40	5	16	20	4	50x8	1600
Jet L	8x4	-6	50.0T	-9	55	5	19	20	4	50x8	1600

LAND VEHICLES<D-HEADER>

Name	SIZE	DCV	Mass	Knb	STR	DEF	BODY	DEX	SPD	MOVE	MAX
Motorcycle	1.25x.64	-0	200	-1	15	5	11	20	3	40x4	480
Car S	2x1	-2	800	-3	25	5	13	20	4	30x4	480
Car M	2.5x1.25	-2	1.6T	-4	30	5	14	15	3	25x4	300
Car L	3.2x1.6	-3	3.2T	-5	35	5	15	15	3	25x4	300
Van	3.2x1.6	-3	3.2T	-5	35	5	15	15	3	25x4	300
Bus	4x2	-4	6.4T	-6	40	5	16	15	3	25x4	300
Maglev Train	4x2 (Car)	-4	6.4T	-6	40	5	16	20	4	50x4	800
Rail Train	4x2 (Car)	-4	6.4T	-6	40	5	16	15	3	25x4	300
Hovercraft	5x2.5	-4	12.5T	-7	45	5	17	15	3	25x4	300

WATER VEHICLES<D-HEADER>

Name	SIZE	DCV	Mass	Knb	STR	DEF	BODY	DEX	SPD	MOVE	MAX
Aquasled	1.25x.64	-0	200	-1	15	3	11	15	3	10x4	120
Hovercraft	5x2.5	-4	12.5T	-7	45	5	17	15	3	25x4	300
Submersible	32x16	-10	3.2KT	-15	90	10	19	15	3	25x4	300
Ocean Liner	80x40	-12	50KT	-19	105	7	29	10	2	20x4	160

POWERED ARMOR<D-HEADER>

Name	SIZE	DCV	Mass	Knb	STR	DEF	BODY	DEX	SPD	MOVE	MAX
Loader	1.25x.64	-0	200	-1	50	5	11	15	3	3x2	36
Man-sized	1.25x.64	-0	200	-1	30	10	11	20	4	10x4	160
Walker	2.5x1.25	-2	1.6T	-4	30	10	14	15	3	15x4	180

HIGH TECH<C-Header>

ANTI-GRAVITY EQUIPMENT<D-Header>

Anti-Gravity Chair PRICE: 4000<E-Header>
 Ability: 10" Flight, 0 End, Persistent, OAF, Bulky
 Active Cost: 40 Real Cost: 16 Mass: (20kg)

Anti-Gravity Backpack PRICE: 200<E-Header>
 Abilities: +10 STR vs. Encumbrance only (-2), 0 End, Persistent, OAF
 Active Cost: 20 Real Cost: 5 Mass: (2kg)

SUPER TECH<C-Header>

ANTI GRAVITY EQUIPMENT<D-Header>

Anti-Gravity Belt PRICE: 40,000<E-Header>
 Abilities: 10" Flight, 0 End, Persistent, OIF
 Active Cost: 40 Real Cost: 27 Mass: (2kg)

Anti-Gravity Modules PRICE: 400<E-Header>
 Abilities: +20 STR vs. Encumbrance only (-2), 0 End, Persistent, OAF
 Active Cost: 40 Real Cost: 10 Mass: (2kg)

TELEPORTATION<D-Header>

Interstellar Teleporter PRICE: 2,000,000<E-Header>
 Most of the Fixed Locations in this transportation network will be on important worlds (sometimes more than one per world). Some will be on new colonies, and some will be in a warehouse waiting for an enterprising crew to deliver and install it on a distant planet. (Note that this device makes it possible to have wide-ranging adventures without the characters owning a spaceship. It also makes it possible to have a space campaign in which spaceships no longer exist.)
 Abilities:
 1: 10" Teleportation (20), x8 quadrillion NC (+265) 80 quadrillion inches (256 Light-years), 0 End (+1/2); OAF (-1), Immobile (-1), Must use at non-combat only (- 1/4), Only to and from Fixed Locations (-1/2)
 2: 250 Fixed Locations, OAF (-1), Immobile (-1)
 Active Cost: 677 Real Cost: 197

MEDICAL TECHNOLOGY<A-Header>

ADVANCED TECH<C-Header>

Airhypo<E-Header>

Abilities:

Airhypo Multipower, All Stats (+2), 16 Charges (+0), Recover per 5 Minutes (+1/2), Must divide dice between stats affected (-1), OAF Airhypo, Stopped by 3PD+ Resistant Defense (-3/4), Takes 1 Phase to change Multipower (- 1/4)

.1- (u) 6d6 Drain

.2- (u) 6d6 Aid

Active Cost: 241 Real Cost: 59 Mass: 1.5 kg. <E-Header>

DRUGS<D-Header>

Artificial Adrenaline<E-Header>

3d6 STR Aid, 3d6 CON Aid

Amnesia Drug<E-Header>

6d6 INT Drain

Anger Inducing<E-Header>

6d6 INT Drain

Death Simulation<E-Header>

6d6 STUN Drain

Hallucination Drug<E-Header>

6d6 INT Drain

Healing Drug<E-Header>

6d6 AID

Hypnotic Drug<E-Header>

3d6 INT Drain, 3d6 EGO Drain

Paralyzer Drug<E-Header>

6d6 STR Drain

Poison<E-Header>

6d6 Body Drain

Stimulant<E-Header>

3d6 DEX Aid, 3d6 SPD Aid

Medkit

PRICE: 50<E-Header>

Ability: +3 to All Medical Rolls, OAF, Fragile

Active Cost: 15 Real Cost: 7 Mass: 1kg

Diagnosis Table

PRICE: 33,000<E-Header>

Abilities:

1: +5 To All Medical Rolls, OIF, Bulky

2: Detect: Medical Condition, Discriminatory, OIF, Bulky

Active Cost: 33 Real Cost: 16 Mass: 100kg

Cryosleep Chamber

PRICE: 11,000<E-Header>

Ability: LS: Immune to Age, Disease, No Sleep/Eat/Excrete; Target must be unconscious (- 1/4), OAF, Bulky

Active Cost: 11 Real Cost: 4 Mass: 250kg

HIGH TECH<C-Header>

Medical Bed

PRICE: 175,000<E-Header>

Ability: 10d6 AID, All Reduced Stats (+2), 0 End (+1/2), Gradual Effect 5 hours (-2 1/2), OIF, Bulky

Active Cost: 175 Real Cost: 87 Mass: 250kg

Brainwiper

PRICE: 175,000<E-Header>

Ability: 3d6 Major Transform into mindless person, Cumulative (+1/2), AVLD (+1 1/2) vs. Mental Defense, 0 End (+1/2), OIF, Bulky

Active Cost: 157 Real Cost: 78 Mass: 500kg

Medical Detector

PRICE: 2,300<E-Header>

Ability: Detect: Medical Condition, Discriminatory, Range, 360 Degree, OAF

Active Cost: 23 Real Cost: 7 Mass: 1kg

Artificial Skin PRICE: 1,000<E-Header>

While the main use of this product is to protect wounds while they heal, there are others.

Abilities:

1. +5 to All Disguise Rolls, OAF, Independent, 16ch
2. 2d6 Entangle, No Range, OAF, 16ch, limited locations (Hands, Mouth, Ankles Etc. (-1/2))

Active Cost: 20 Real Cost: 8 Mass: 1kg

Personal Autodoc PRICE: 10,000<E-Header>

This device may be worn on the wrist, belt, etc.

Ability: 3d6 Aid to all reduced Stats (+2), Trigger when any stat is reduced (+ 1/4), OAF, 8ch (-1/2)

Active Cost: 49 Real Cost: 20 Mass: 1kg

Neural Inhibitor PRICE: 24,000<E-Header>

Ability: 3d6 Entangle, Stops All Senses (+50), takes no damage (+1/2), Based on ECV (Must use EGO for STR: +1), 0 End, OAF, No Range

Active Cost: 240 Real Cost: 96 Mass: 1kg

SUPER TECH<C-Header>

RNA Recording PRICE: 100,000<E-Header>

Abilities:

- 1: 15d6 Telepathy; 0 End (+1/2), must attempt to read subconscious (-1/2), OIF, Bulky
- 2: Eidetic Memory, OIF, Bulky, linked to Telepathy (-1/2)

Active Cost: 122 Real Cost: 49 Mass: 2kg

Regeneration Chamber PRICE: 100,000<E-Header>

Ability: 1 Body Regeneration per Hour (-3/4), OAF, Bulky

Active Cost: 10 Real Cost: 3 Mass: 500kg

Stasis Chamber PRICE: 1,000,000<E-Header>

Ability: Extra-Dimensional Movement, transport through time (Special Effect: The object in the chamber is frozen in space for the length of time desired. Because the object has been figuratively sent through time, it cannot be affected in any way by the outside world), 0 End, OAF, Bulky

Active Cost: 60 Real Cost: 24 Mass: 500kg

ROBOTS<A-Header>

Robots are one of the staples of SF; who could forget Robbie the Robot, C-3PO, R2D2, and the robot from Lost In Space? This section discusses NPC robots, the rules governing PC robots are given in Character Creation under Artificial Characters. These robots may be taken as followers at the given costs.

COMBAT ROBOT PRICE: 175,000<D-Header>

40 STR 14 DEX 0 CON 5 BODY 5 INT
 -- EGO 15 PRE 0 COM 8 PDr 8 EDr
 3 SPD 0 REC 0 END -- STUN 37 Cost

Powers and Skills<E-Header>

Takes no Stun & Does Not Bleed (Automaton); 60 End 6 Rec End Battery; LS: Full but Age; 9d6 Energy Blast; Radio Listen And Transmit; English (Vocal Circuits), Literate; UV Vision; +2 Level w/Combat; 178 Cost

175 +Disadvantages<E-Header>

x2 Body Electricity; x2 Body Microwaves; DF: Robot (Not Con, Major React)

Follower Cost: 35<E-Header>

UTILITY ROBOT PRICE: 75,000<D-Header>

15 STR 14 DEX 0 CON 5 BODY 10 INT
 -- EGO 5 PRE 0 COM 6 PDr 6 EDr
 3 SPD 0 REC 0 END -- STUN 0 Cost

Powers and Skills<E-Header>

Takes no Stun & Does Not Bleed (Automaton); 0 End on STR; LS: Full but Age; Radio Listen And Transmit; English (Vocal Circuits), Literate; UV Vision; Computer Programming 12-; Demolitions 11-; Electronics 11-; Lockpicking 12-; Mechanics 11-; Security Systems 12-; Systems Operation 12-; Scholar; KS: Starship Mechanics 11-; KS: Custom Program 11-; KS: Custom Program 11-; KS: Custom Program 11-; KS: Custom Program 11-; 140 Cost

75 +Disadvantages<E-Header>

x2 Body Electricity; x2 Body Microwaves; DF: Robot (Not Con, Major React), Physical Limit: 3 Laws of Robotics

Follower Cost: 15<E-Header>

VALET ROBOT PRICE: 95,000<D-Header>

15 STR 11 DEX 0 CON 5 BODY 15 INT
 -- EGO 15 PRE 0 COM 6 PDr 6 EDr
 3 SPD 0 REC 0 END -- STUN 9 Cost

Powers and Skills<E-Header>

Takes no Stun & Does Not Bleed (Automaton); 0 End on STR; LS: Full but Age; Radio Listen And Transmit; English (Vocal Circuits), Literate; UV Vision; Bureaucratics 12-; Conversation 12-; High Society 12-; PS: Valet 13-; Universal Translator 17-; 151 pts.

95 +Disadvantages<E-Header>

x2 Body Electricity; x2 Body Microwaves; DF: Robot (Not Con, Major React), Physical Limit: 3 Laws of Robotics

Follower Cost: 15<E-Header>

COMPUTERS<A-Header>

Computers are purchased as Followers (see Perks); they are the size and mass of a character (2m, 100 kg). If a unit is to be smaller, it must have Shrinking. Computers can take damage and the damage that they can take is based on the weight of the unit as detailed in breaking things. All computers may be AIDs.

Levels of Shrinking for Computers: All Shrinking has been bought at 0 End, Persistent, Always On.

STANDARD COMPUTER SIZES<D-HEADER>

Microcomp: 5 Levels, .064m, .0032 kg, 66 pts.
Pocketcomp: 4 Levels, .125m, .025 kg, 53 pts.
Portacomp: 3 Levels, .25m, .2kg, 40 pts.
Deskcomp: 2 Levels, .5m, 1.6kg, 27 pts.
Minicomp: 1 Level, 1m, 12.5kg, 13 pts.
Mainframe: 0 Level, 2m, 100kg, 0 pts.

COMPUTER CHARACTERISTIC MAXIMA<D-Header>

Modern Tech: INT 20, EGO 20, DEX 20, SPD 4
Advanced Tech: INT 25, EGO 25, DEX 25, SPD 4
High Tech: INT 30, EGO 30, DEX 30, SPD 5
Super Tech: INT 35, EGO 35, DEX 35, SPD 6

EVERYCOMPUTER/EVERYROBOT TALENTS<D-HEADER>

Absolute Time Sense
Eidetic Memory
Lightning Calculator
Speed Reading

Mind Link<E-HEADER>

AID Computers may have Mind Link with other Robots and Computers. (This may be considered a tight beam electronic signal).

Price of a Computer<E-HEADER>

The price of a Computer is equal to the Base Points multiplied by the level of Shrinking +1 and divided by the Tech Level (Advanced being 2, High being 3, and Super being 4) x10 for non-AIDs, x10,000 for AIDs.

Example: The price of the sample Pocket Computer below is 85 for the Base Points multiplied by 5 for the Shrinking, divided by 2 for Advanced Tech, x10 for a non-AID Computer.

POCKET COMPUTER PRICE: 2,125<D-Header>

This Advanced Tech Computer is the size of a deck of cards. It has a lifetime battery.

10 INT 10 DEX 2 SPD 0 EGO Cost: 0

Powers<E-Header>

4 Levels Shrinking, 0 End, Persistent, Always on (0.125 meters, 0.025 kg)

Skills<E-Header>

Paramedic 11-; Scholar; KS: Medicine 11-; KS: General Math 11-; KS: General Science 11-; English (Vocal Circuits, Literate); five 3pt Skills to be added by purchaser

Talents<E-Header>

Absolute Time Sense; Eidetic Memory

Programs<E-Header>

Search Database; Record Information

Cost: 85

Follower Cost: 17<E-Header>

SHIP'S COMPUTER (AI) PRICE: <D-Header>

This computer is appropriate for a small military craft.

30 INT 20 DEX 20 EGO 4 SPD Cost: 70

Skills<E-Header>

Bureaucrats 11-; Combat Pilot 11-; Conversation 9-; Computer Programming 15-; Demolitions 11-; Electronics 11-; English, Literate; High Society 11-; Mechanics 11-; Navigation 14-; Security Systems 15-; Systems Op 15-; Scholar; KS: Military Vehicles 12-; KS: KS: Pilot Protocols 12-; KS: Popular Entertainment 12-; KS: Ship Layout 12-; WF: Ship to ship

Talents<E-Header>

Everycomputer Talents; Universal Translator 17-

Programs<E-Header>

Search Database; Record Information; Control Robot; Control environment; Diagnose malfunction; Scan space; Pilot ship A to B;

Scan vehicle and display; Maintain security

100+Disadvantages

Code vs. Killing; Must obey authorized personnel; Self-preservation

Follower Cost: 5<E-Header>

CYBERNETICS<A-Header>

First the rules that govern cybernetics:

Cybernetics that replace the body part with no enhancement are bought with money.

Cybernetics that enhance the body part that they replace cost Character Points and money. Remember that cybernetic parts don't have to cost double points for going above the Characteristic Maxima.

All cybernetics (including non-removable types) must be bought with the Limitation: Cybernetic - 1/4.; This means if it is hit with masers (microwaves) or electricity, the body part takes 2x damage for purposes of Impairment or Disablement.

All removable cybernetics may be bought as Inaccessible Foci (Obvious or Inobvious), and Cybernetic.

For more information on cybernetics, see Character Creation and Cyber Hero. Note that the cybernetics in Cyber Hero are equivalent to early Advanced Tech and are generally less reliable than those described here.

CYBERNETIC ENHANCEMENTS<C-Header>

The Cybernetic enhancements below are examples.

Cybernetic Arm PRICE: 60,000<E-Header>
Ability: 25 STR for the arm only (-3/4), 25 DEX for the arm only (-3/4)
IIF, Cybernetic (- 1/4)
Active Cost: 60 Real Cost: 27

Normal Replacement (One) PRICE: 1,500<E-Header>
Ability: Pays off Physical Limitation: No Arm (Frequently, Greatly impairing); IIF, Cybernetic (- 1/4)
Active Cost: 15 Real Cost: 10

Normal Replacement (Both) PRICE: 2,500<E-Header>
Ability: Pays off Physical Limitation: No Arms (All the time, fully impairing); IIF, Cybernetic (- 1/4)
Active Cost: 25 Real Cost: 17

Cybernetic Ear PRICE: 17,000<E-Header>
Radio Hearing, Telescopic Hearing +4, Ultrasonic Hearing, Flash Defense 5 pts, IIF, Cybernetic (- 1/4)
Active Cost: 17 Real Cost: 11

Normal Replacement (1 Ear) PRICE: 500<E-Header>
Ability: Pays off Physical Limitation: Hard of Hearing (Infrequently, Slightly impairing); IIF, Cybernetic (- 1/4)
Active Cost: 5 Real Cost: 3

Normal Replacement (2 Ears) PRICE: 1,500<E-Header>
Ability: Pays off Physical Limitation: Deaf (Frequently, Greatly impairing); IIF, Cybernetic (- 1/4)
Active Cost: 15 Real Cost: 10

Cybernetic Eye PRICE: 39,000<E-Header>
Infrared Vision, x100 Microscopic, +4 Telescopic, Ultraviolet Vision, +4 Level with Range Mods, Flash Defense 5pts, IIF, Cybernetic (- 1/4)
Active Cost: 39 Real Cost: 26

Normal Replacement (1 Eye) PRICE: 500<E-Header>
Ability: Pays off Physical Limitation: One Eye (Infrequent, Slightly impairing); IIF, Cybernetic (- 1/4)
Active Cost: 5 Real Cost: 2

Normal Replacement (2 Eyes) PRICE: 500<E-Header>
Ability: Pays off Physical Limitation: Blind (All the Time, Fully Impairing); IIF, Cybernetic (- 1/4)
Active Cost: 25 Real Cost: 17

Cybernetic Hand PRICE: 60,000<E-Header>
Ability: 25 STR for the Hand only (-3/4), 25 DEX for the Hand only (-3/4)
IIF, Cybernetic (- 1/4)
Active Cost: 60 Real Cost: 27

Normal Replacement (One) PRICE: 1,500<E-Header>

Ability: Pays off Physical Limitation: No Hand (Frequently,
Greatly impairing); IIF, Cybernetic (- 1/4)
Active Cost: 15 Real Cost: 10

Normal Replacement (Both) PRICE: 2,500<E-Header>
Ability: Pays off Physical Limitation: No Hands (All the time,
fully impairing); IIF, Cybernetic (- 1/4)
Active Cost: 25 Real Cost: 17

Cybernetic Legs PRICE: 75,000<E-Header>
Abilities:
1: 25 STR for the Legs only (-3/4), 25 DEX for the Legs only
(-3/4) IIF, Cybernetic (- 1/4)
2: +5" running at 0 End, IIF, Cybernetic (- 1/4)
Active Cost: 75 Real Cost: 37

Normal Replacement (1 Leg) PRICE: 1,500<E-Header>
Ability: Pays off Physical Limitation: No Leg (Frequent, Greatly
impairing); IIF, Cybernetic (- 1/4)
Active Cost: 15 Real Cost: 10

Normal Replacement (2 Legs) PRICE: 2,000<E-Header>
Ability: Pays off Physical Limitation: No Legs (Frequent, fully
impairing); IIF, Cybernetic (- 1/4)
Active Cost: 20 Real Cost: 13

Cybernetic Vehicle Linkage PRICE: 2,500<E-Header>
Ability: +5 to all Piloting/Driving Rolls, OAF Cable, Cybernetic
(- 1/4)
Active Cost: 25 Real Cost: 11

Cybernetic Implant Skills PRICE: 3,000<E-Header>
Ability: One 3 pt Skill, IIF, Cybernetic (- 1/4)
Active Cost: 3 Real Cost: 2

Cybernetic Implant Communicator PRICE: 5,000<E-Header>
Ability: Radio Listen And Transmit, IIF, Cybernetic (- 1/4)
Active Cost: 5 Real Cost: 3

Cybernetic Gland PRICE: 6,000<E-Header>
Ability: 1d6 Aid to any one Stat (+ 1/4), 16ch, IIF, Cybernetic
(- 1/4)
Active Cost: 6 Real Cost: 4

Cybernetic Gill PRICE: 500<E-Header>
Ability: LS: Underwater, IIF, Cybernetic (- 1/4)
Active Cost: 5 Real Cost: 3

Cybernetic Claws PRICE: 3,000<E-Header>
Ability: 1d6 HKA AP at 0 End, IIF, Cybernetic (- 1/4)
Active Cost: 30 Real Cost: 20

Cybernetic Subdermal Armor PRICE: 90,000<E-Header>
Ability: Armor +3PD/ +3ED, IIF
Active Cost: 9 Real Cost: 7

Cybernetic Subdermal Armor PRICE: 150,000<E-Header>
Ability: Armor +5PD/ +5ED, IIF
Active Cost: 15 Real Cost: 12

EQUIPMENT<A-Header>

ADVANCED TECH<C-Header>

COMMUNICATORS<D-Header>

Earphone Communicator PRICE: 50<E-Header>
This is a comm unit small enough to go unnoticed by all but the
most stringent of inspections. It has a lifetime battery.
Ability: Radio Listen & Transmit, IIF, Fragile
Range: 5 x Active Cost in Khexas in Atmosphere: 25,000" (50 KM)
Range: 5 x Active Cost in Mhexes in Space: 25,000,000" (50000 KM)
Active Cost: 5 Real Cost: 3 Mass: 1gm

Hand Communicator PRICE: 150<E-Header>
This is a comm unit the size of a walkie-talkie. It has a life-
time battery.
May be scrambled / encoded with a Cryptography Roll
Ability: High Range Radio Listen & Transmit, Increased Maximum
Range: x25 (+1/2), OAF
Range: 125 x Active Cost in Khexas in Atmosphere: 1,875,000"
(3750 KM)
Range: 125 x Active Cost in Mhexes in Space: 1,875,000,000"
(3,750,000 KM)
Active Cost: 15 Real Cost: 7 Mass: 1kg

Wrist Communicator PRICE: 90<E-Header>
This is a comm unit small enough to fit on your wrist. It looks
like a watch and even has that function. It has a lifetime
battery.
Abilities:
1: Radio Listen & Transmit, Increased Maximum Range: x5 (+ 1/4),
OIF
2: Absolute Time Sense, OIF
Range: 25 x Active Cost in Khexas in Atmosphere: 150,000" (300KM)
Range: 25 x Active Cost in Mhexes in Space: 150,000,000" (300,000
KM)
Active Cost: 9 Real Cost: 6 Mass: .1kg

Telemetry Communicator PRICE: 1,500<E-Header>
This is a comm unit small enough to fit on your wrist. It has a
lifetime battery.
Abilities:
1: Detect: Sense, Discriminatory: Medical Condition (10), OIF
2: Radio Transmit (3), Increased Maximum Range on Radio: x125
(+3/4), Radio only transmits Detect (-1/2), OIF
Range: 125 x Active Cost in Khexas in Atmosphere: 375,000" (187.5
KM)
Range: 125 x Active Cost in Mhexes in Space: 375,000,000"
(187,500 KM)
Active Cost: 15 Real Cost: 9 Mass: .1kg

DETECTORS<D-Header>

Motion Detector PRICE: 2,300<E-Header>
Ability: Detect Motion; Range, Discriminatory, 360 Degree, OAF
Active Cost: 23 Real Cost: 11 Mass: 1kg

Radiation Detector PRICE: 2,300<E-Header>
Ability: Detect Radiation; Range, Discriminatory, 360 Degree, OAF
Active Cost: 23 Real Cost: 11 Mass: 1kg

REPAIR KITS<D-HEADER>

Robot Repair Kit PRICE: 150<E-Header>
Ability: +3 to all Robotics Rolls, OAF
Active Cost: 15 Real Cost: 7 Mass: 4kg

Electronic Repair Kit PRICE: 150<E-Header>
Ability: +3 to all Electronics Rolls, OAF
Active Cost: 15 Real Cost: 7 Mass: 1kg

Mechanical Repair Kit PRICE: 150<E-Header>
Ability: +3 to all Mechanics Rolls, OAF
Active Cost: 15 Real Cost: 7 Mass: 10kg

Computer Security Kit PRICE: 150<E-Header>
Ability: +3 to all Computer Rolls, OAF
Active Cost: 15 Real Cost: 7 Mass: 1kg

SPY GADGETS<D-Header>

Bug Detector PRICE: 2,500<E-Header>
Ability: Detect Listening Devices; Sense, Range, Discriminatory,
360 Degree, OAF
Active Cost: 25 Real Cost: 12 Mass: 1kg

Bug Killer PRICE: 7,500<E-Header>
Ability: 10d6 Dispel Listening Devices, AE Radius, 0 End, OAF
Active Cost: 75 Real Cost: 37 Mass: 1kg

Digital Recorder PRICE: 10<E-Header>
Ability: Eidetic Memory, OAF, Fragile
Active Cost: 10 Real Cost: 4 Mass: .5kg

Electronic Lockpicks PRICE: 1,500<E-Header>
Ability: +3 to all Security Rolls, OAF
Active Cost: 15 Real Cost: 7 Mass: 1kg

Hypno-Teacher PRICE: 450<E-Header>
Ability: Cramming x5, OAF, Extra Time: 5 Hours (-3)
Active Cost: 45 Real Cost: 9 Mass: 2kg

Laser Listening Device PRICE: 2,500<E-Header>
Ability: 500" Clairsentience Sound, OAF
Active Cost: 25 Real Cost: 12 Mass: 2kg

Listening Device (Bug) PRICE: 500<E-Header>
Ability: 5000" Clairsentience Sight and Sound, IAF, Fragile, may
be destroyed at listening point (-1/2)
Active Cost: 50 Real Cost: 22 Mass: .1g

SURVIVAL EQUIPMENT<D-Header>

Anti-Glare Goggles PRICE: 50<E-Header>
Ability: +5pts. Flash Def, OAF
Active Cost: 5 Real Cost: 2 Mass: 10gm

Artificial Gill PRICE: 500<E-Header>
Ability: LS: underwater, IIF
Active Cost: 5 Real Cost: 4 Mass: .1g

Base Camp Security Sensor PRICE: 2,500<E-Header>
Ability: Detect Intruders; Sense, Range, Discriminatory, 360
Degree, OAF, Bulky
Active Cost: 25 Real Cost: 10 Mass: 10kg

Decontamination Spray PRICE: 5,000<E-Header>
Ability: 5d6 Minor Transform into non radioactive material, 16ch,
OAF
Active Cost: 50 Real Cost: 25 Mass: 1g

Electro-Binocs PRICE: 3,100<E-Header>
Abilities:
1: Telescopic +12, OAF
2: Detect Range; Range, Discriminatory, OAF
Active Cost: 31 Real Cost: 15 Mass: 1kg

Environmental Cage PRICE: 11,800<E-Header>
Abilities:
1: 6d6 AE 1 Hex Entangle, OAF, Bulky, 1 CH Recoverable (-1 1/4)
2: 1" Change Environment, Variable (+1), 0 End, OAF, Bulky,
Linked to Entangle (-1/2)
3: LS: Self Contained, High Radiation, Intense Heat/Cold, OAF,
Bulky, Linked to Entangle (-1/2)
Active Cost: 118 Real Cost: 33 Mass: 50kg

Environmental Survival Kit PRICE: 150<E-Header>
Ability: +3 to all Survival Rolls, OAF
Active Cost: 15 Real Cost: 7 Mass: 1kg

Filter Canteen PRICE: 500<E-Header>
Ability: 5d6 Cosmetic Transform into Pure Water, OAF, 16ch
Active Cost: 25 Real Cost: 12 Mass: 1kg

Flight Pack PRICE: 4,500<E-Header>
Ability: 10" Flight, x8 Non-Combat, 0 End, OIF, Power cell lasts
for 1 day (- 1/4)
Active Cost: 45 Real Cost: 25 Mass: 2kg

Habitat PRICE: 4,300<E-Header>
Ability: LS: Self-Contained, Immune to Disease, High Radiation,
Intense Heat/Cold, Usable by 8 Others (+1 1/4): OAF, Bulky
Active Cost: 43 Real Cost: 18 Mass: 20kg

Heat Suit PRICE: 300<E-Header>
Ability: LS: Cold, OIF
Active Cost: 3 Real Cost: 2 Mass: 1kg

Inertial Compass PRICE: 30<E-Header>
Ability: Bump of Direction, OAF
Active Cost: 3 Real Cost: 1 Mass: 1gm

IR Vision Goggles PRICE: 50<E-Header>
Ability: IR Vision, OAF
Active Cost: 5 Real Cost: 2 Mass: 10gm

Laser Torch PRICE: 1,840<E-Header>
Abilities:
1: 1" Tunneling through 15 DEF, 0 End, AP, OAF, Extra Time 1 Turn
(-1)
2: 3d6 RKA AP, 0 End, No Range, OA
Active Cost: 184 Real Cost: 67 Mass: 2kg

Microscopic Goggles PRICE: 1,800<E-Header>
Ability: Microscopic x1,000,000, OAF
Active Cost: 18 Real Cost: 9 Mass: 1kg

Monowire Netting PRICE: 1,100<E-Header>
Ability:
1: 6d6 Entangle, OAF, 1 CH Recoverable (-1 1/4)
2: 1d6+1 RKA Penetrating, Damage Shield, 0 End, OAF, Linked
(-1/2)
Active Cost: 110 Real Cost: 38 Mass: 1kg

Multi-Goggles PRICE: 1,500<E-Header>
Ability: IR Vision, UV Vision, 5Pts Flash Defense, OAF
Active Cost: 15 Real Cost: 7 Mass: 20gm

NBC Filter PRICE: 1,600<E-Header>
[IS THIS SOMETHING YOU WEAR, WRAP AROUND YOUR TENT, OR POUR
SEAWATER THROUGH? IT SOUNDS LIKE A KIND OF KIT...]
Ability: LS: Self Contained, Immune to Disease, High Radiation,
OIF
Active Cost: 16 Real Cost: 11 Mass: 1kg

Rations PRICE: 20/day<E-Header>
Standard rations are universally bad-tasting.

Respirator PRICE: 50<E-Header>
Ability: LS: Breathe other environment, OAF
Active Cost: 5 Real Cost: 2 Mass: 1g

Rocket Grapnel PRICE: 1,000<E-Header>
Ability: +5 to all Climbing Rolls, OAF
Active Cost: 10 Real Cost: 5 Mass: 3kg

Rope PRICE: 60<E-Header>
Ability: +3 to all Climbing Rolls, OAF
Active Cost: 6 Real Cost: 3 Mass: 1kg

Scuba Suit PRICE: 1,300<E-Header>
Ability: +3" Swimming, +1 Non-Combat Multiple, LS: Underwater,
OIF
Active Cost: 13 Real Cost: 9 Mass: 1kg

Sleeping Bag PRICE: 300<E-Header>
Ability: LS: Heat/Cold, OAF
Active Cost: 3 Real Cost: 1 Mass: 1kg

Stillsuit PRICE: 3,000<E-Header>
Ability: LS: Heat/Cold, Need not eat / excrete, OIF
Active Cost: 8 Real Cost: 5 Mass: 2kg

Ultrasonic Watchguard PRICE: 1,350<E-Header>
Ability: 6d6 NND AE 7" Radius, 0 End, Continuous, OAF, Bulky, No
Range (-1/2)

Defense is Sound Flash Defense

Active Cost: 135 Real Cost: 45 Mass: 50kg

Ultraviolet Vision Goggles PRICE: 50<E-Header>

Ability: Ultraviolet Vision, OAF

Active Cost: 5 Real Cost: 2 Mass: 10gm

Vapor Canteen PRICE: 500<E-Header>

Ability: 5d6 Minor Transform water into pure water, OAF, 16ch

Active Cost: 50 Real Cost: 25 Mass: 1kg

WEAPON ACCESSORIES<D-Header>

Articulated Weapon Harness PRICE: 150<E-Header>

Ability: +10 STR for STR Min of a weapon only (-2), 0 End, OIF

Active Cost: 15 Real Cost: 4 Mass: 2kg

HUD (Heads Up Display) PRICE: 2400<E-Header>

Ability: +2 RMod, +1 OCV Ranged, Telescopic +2, IR Vision, UV Vision, OIF

Active Cost: 24 Real Cost: 16 Mass: 3kg

Laser Spotting Sight PRICE: 80<E-Header>

Ability: +1 RMod, +1 OCV Ranged, OIF

Active Cost: 8 Real Cost: 5 Mass: .5kg

Scope PRICE: 110<E-Header>

Ability: +2 RMod, +1 OCV Ranged, OIF, Must Be Braced (- 1/4)

Active Cost: 11 Real Cost: 6 Mass: .5kg

MISCELLANEOUS<E-Header>

Drop Capsule PRICE: 5,600<E-Header>

Abilities:

1: LS: Self-Contained, High Radiation, Intense Heat/Cold: OAF, Bulky

2: 10" Gliding, OAF, Bulky

3: 10 PD / 10 ED Armor, OAF, Bulky

Active Cost: 56 Real Cost: 22 Mass: 100kg

HIGH TECH<C-Header>

DETECTORS<D-Header>

Bio-Detector PRICE: 2,300<E-Header>

Ability: Detect Bio-organisms; Range, Discriminatory, 360 Degree, OAF

Active Cost: 23 Real Cost: 11 Mass: 1kg

Chemical Detector PRICE: 2,300<E-Header>

Ability: Detect Chemicals; Range, Discriminatory, 360 Degree, OAF

Active Cost: 23 Real Cost: 11 Mass: 1kg

Energy Detector PRICE: 2,300<E-Header>

Ability: Detect Energy; Range, Discriminatory, 360 Degree, OAF

Active Cost: 23 Real Cost: 11 Mass: 1kg

Mass Detector PRICE: 2,300<E-Header>

This device contains two dumbbells linked at the center of the bars and rotating about that point. Sensors measure the change in angle between them.

Ability: Detect Mass; Range, Discriminatory, 360 Degree, OAF

Active Cost: 23 Real Cost: 11 Mass: 1kg

Pheromone Detector PRICE: 2,300<E-Header>

Ability: Detect Pheromones; Range, Discriminatory, 360 Degree, OAF

Active Cost: 23 Real Cost: 11 Mass: 1kg

SPY GADGETS<D-Header>

Disguise Kit PRICE: 150<E-Header>

Ability: +3 to all Disguise Rolls, OAF

Active Cost: 15 Real Cost: 7 Mass: 2kg

Hacker Jack PRICE: 6,000<E-Header>

This is a small jack to interface with computers.

Ability: 2d6 Transform computer into friendly computer, Cumulative, 0 End, OAF

Active Cost: 60 Real Cost: 30 Mass: .5kg

Holobelt PRICE: 40,000<E-Header>

Abilities:

1: Eidetic Memory, OIF,
2: 1" Images, Sight and Sound, -5 to PER Rolls, OIF, No Range
Active Cost: 40 Real Cost: 22 Mass: 2kg

Holographic Recorder PRICE: 3,200<E-Header>

This small holographic recorder can also project the image in the air. It has a lifetime battery.

Abilities:

1: Eidetic Memory, OAF
2: Images 1 Hex Sight/Sound at 0 End, No range, OAF
Active Cost: 32 Real Cost: 13 Mass: .5kg

Silence Field PRICE: 3,000<E-Header>

Ability: 1" Radius Darkness to Sound Group, 0 End, Powercell
Lasts for 1 day (- 1/4), OIF, No Range
Active Cost: 30 Real Cost: 13 Mass: 2kg

Thought Screen PRICE: 10,000<E-Header>

This is a skull cap worn under normal hats or Helmets. It has a lifetime battery.

Ability: 10 Pts Mental Defense, Not vs. Ego Attacks (-1/2), IIF
Active Cost: 10 Real Cost: 6 Mass: .1kg

Universal Solvent PRICE: 1,840<E-Header>

Typically stored as a binary compound in two containers.

Abilities:

1: 1" Tunneling through 15 DEF, 0 End, AP, OAF, Extra Time 1 Turn (-1)
2: 3d6 RKA AP, Gradual effect of 1 Minute (-1), 0 End, No Range, OAF
Active Cost: 184 Real Cost: 56 Mass: 2g

SURVIVAL EQUIPMENT<D-Header>

IR Vision Contacts PRICE: 500<E-Header>

Ability: IR Vision, IIF
Active Cost: 5 Real Cost: 4 Mass: 1gm

Ultraviolet Vision Contacts PRICE: 500<E-Header>

Ability: Ultraviolet Vision, IIF
Active Cost: 5 Real Cost: 4 Mass: 1gm

Survival Foam PRICE: 30<E-Header>

Ability: LS: Immune to Disease, OAF, Tube lasts for 1 week (-1/4)
Active Cost: 3 Real Cost: 1 Mass: 1g

SUPER TECH<C-Header>

COMMUNICATORS<D-Header>

Tachyon (FTL) Communicator PRICE: 32,000<E-Header>

This is a comm unit the size of a briefcase. It has a lifetime battery.

Ability: High Range Radio Hearing, FTL Capable (64 LY/Y, +22 Pts), OAF
Active Cost: 32 Real Cost: 16 Mass: 3kg

DETECTORS<D-Header>

Omni-Detector PRICE: 2,300<E-Header>

This is a hand-held all-purpose analysis device.

Ability: Detect Age, Bio-Organisms, Chemicals, Energy, Mass, Molecular Composition, Motion, Radiation, and Structural Integrity; IR and UV Vision; 5 Pts Flash Defense all Senses; Range and Discriminatory on all Detects and IR/UV; 360 Degree all Senses; +10 Perception; Microscopic Vision x1000; OAF
Active Cost: 171 Real Cost: 85 Mass: 1kg

SPACESHIPS<A-Header>

Spaceships and starships will vary from campaign to campaign according to the rules of space combat. So, spaceship construction is modular. To build a spaceship, choose a hull of the desired size. Add engine, sensors, defenses, weapons, and special equipment. Serve with a pinch of crew. Or, pick from among the sample complete spaceships at the end of this section.

All volumes and prices are based on the Tech Level of introduction. For each level above introduction, reduce volume and price by 1/4, to a maximum of two steps of bonus.

EXTRA EQUIPMENT<D-HEADER>

Normally, all equipment chosen for a spaceship must fit inside the hull. Extra equipment may be attached to the outside, however, and designated as Accessible Foci. Accessible Foci are not protected by any of the defenses of the ship. Furthermore, a ship with extra equipment on the outside may not enter atmosphere or strong gravity fields.

PARTIAL COVERAGE<D-HEADER>

Many pieces of equipment have a price and size based on the Volume (VOL) of the hull. Some of these, for example Life Support, may be limited to covering only a portion of the ship. In this case, multiply price and size only by the volume actually covered. A few pieces of equipment (e.g., artificial gravity) will also reduce their Real Cost.

USING EQUIPMENT AT SPACE SCALE<C-HEADER>

Ships in space fight and move at an expanded scale chosen by the Gamemaster. This scale change is automatic in space; see Combat. All ship sensors, engines, and weapons in the Techbook are built for this scale.

STARSHIP HULLS<B-HEADER>

The hull is the starting point for building a starship. The ship can be of any shape or configuration as long as the volume does not exceed what is listed. A Hull comes with decking and metal skin and conduits, etc., plus basic controls. It is partitioned by bulkheads and decks into compartments. In game terms, the hull defines the vehicle STR, BODY, and SIZE and all Figured Characteristics (Mass, Knb Mod, etc.).

STARSHIP HULLS		PRICE: 400 x VOL<C-Header>						
COST	SIZE	VOLUME	DCV	MASS	KNB	STR	BODY	DEF
(LxWxH)	(CuHex)				MOD			
0	1x0.5x0.5	0.25	0	0.1T	0	10	10	2
15	1.25x0.64x0.64	0.5	0	0.2T	-1	15	11	5
20	1.6x0.8x0.8	1.	-1	0.4T	-2	20	12	5
25	2x1x1	2.	-2	0.8T	-3	25	13	5
30	2.5x1.25x1.25	4.	-2	1.6T	-4	30	14	5
35	3.2x1.6x1.6	8.	-3	3.2T	-5	35	15	5
40	4x2x2	16.	-4	6.4T	-6	40	16	5
45	5x2.5x2.5	32.	-4	12.5T	-7	45	17	5
50	6.4x3.2x3.2	64.	-5	25T	-8	50	18	5
55	8x4x4	125	-6	50T	-9	55	19	5
60	10x5x5	250	-6	100T	-10	60	20	5
65	12.5x6.4x6.4	500	-7	200T	-11	65	21	5
70	16x8x8	1000	-8	400T	-12	70	22	5
75	20x10x10	2000	-8	800T	-13	75	23	5
80	25x12.5x12.5	4000	-9	1.6KT	-14	80	24	5
85	32x16x16	8000	-10	3.2KT	-15	85	25	5
90	40x20x20	16000	-10	6.4KT	-16	90	26	5
95	50x25x25	32000	-11	12.5KT	-17	95	27	5
100	64x32x32	64000	-12	25KT	-18	100	28	5
105	80x40x40	125000	-12	50KT	-19	105	29	5
125	100x50x50	250000	-13	100KT	-20	110	30	10
130	125x64x64	500000	-14	200KT	-21	115	31	10
135	160x80x80	1000000	-14	400KT	-22	120	32	10
140	200x100x100	2000000	-15	800KT	-23	125	33	10
145	250x125x125	4000000	-16	1.6MT	-24	130	34	10
150	320x160x160	8000000	-16	3.2MT	-25	135	35	10
155	400x200x200	16000000	-17	6.4MT	-26	140	36	10
160	500x250x250	32000000	-18	12.5MT	-27	145	37	10
165	640x320x320	64000000	-18	25MT	-28	150	38	10

EXPLANATION OF TERMS<D-Header>

Cost<E-Header>

Cost of the basic hull in terms of Character Points, for games in which this is an issue.

Size<E-HEADER>

This is listed in hexes as length x width x height. The height will have to be divided into decks. A standard deck is 2 hexes tall with 1.5 hexes inside and .5 hexes for equipment between decks.

Volume (VOL)<E-Header>

The ship volume available for additional equipment, in units of 2-meter tall hexes (a cubic hex or CuHex). All crew, living space, and equipment other than armor must fit within the hull. When all the space is allocated, it's time to stop buying equipment. Many pieces of equipment have a base price and size that is multiplied by the VOL to produce a final price and size.

DCV<E-HEADER>

This is the DCV Modifier of the vehicle based on its size.

Mass<E-HEADER>

This is the mass of the fully loaded vehicle. Vehicles can generally carry half their fully loaded weight in passengers and cargo.

KNB Mod<E-HEADER>

This is the Knockback Modifier of the vehicle based on its mass.

STR, BODY<E-HEADER>

These are standard Hero System characteristics for the vehicle.

DEF<E-HEADER>

This is the Resistant Defense of the vehicle's hull before addition of any armor or screens.

DEFENSES<B-HEADER>

Most spaceships will have additional protection beyond their intrinsic DEF. The kind of defense is campaign-specific and at the discretion of the Gamemaster. Normally, only one of the following categories is available.

ARMOR<D-Header>

Armor is the simplest form of defense and the only one available at Advanced Tech.

ARMOR	DEF	COST	Price /VOL
Light	+5	15	1500
Medium	+10	30	3000
Heavy	+15	45	4500

Hardened Armor price is multiplied by the Advantages.

ABLATIVE ARMOR<D-Header>

Ablative armor, available at Advanced Tech, consists of cheap overlapping hull plates backed up by redundant internal structural members. In game terms, ablative armor is extra BODY.

ARMOR	BODY	COST	Price /VOL
Light	+15	30	300
Medium	+25	50	500
Heavy	+35	70	700

DEFENSE SCREENS<D-Header>

Defense screens, introduced at High Tech, are Force Fields always on at +5 DEF. These are the navigation shields that prevent damage from space hazards, micro-meteorites, or the ravages of space travel. Military ships and large civilian ships have screens with higher settings as well. Each screen generator protects one hex side. If combat is three-dimensional, additional screens cover the top and bottom of the ship.

SCREEN	DEF	ACTIVE COST	REAL COST	Base Volume	Price /VOL
Navigational	+5	32	21	0.05	1020
Medium	+10	50	27	0.10	2100
Heavy	+15	67	32	0.15	3120

Advantages: 0 End (+1/2), Hardened (+1/4)

Limitations: Bulky OIF (-1), 60 degrees (-1)

Additions: 6 Total Shield Projectors (One on Each Hex Face) +15 pts.

Volume: Base Volume times VOL in CuHex

ABLATIVE SCREENS<D-Header>

Ablative screens are similar to defense screens and also available at High Tech. They use the standard Ablative Limitation from the Hero System Rulebook.

SCREEN	DEF	ACTIVE COST	REAL COST	Base Volume	Price /VOL
Navigational	+5	32	19	0.05	510
Medium	+15	67	28	0.15	1050
Heavy	+20	82	32	0.20	1560

Advantages: 0 End (+1/2), Hardened (+1/4)

Limitations: Bulky OIF (-1), 60 degrees (-1), Ablative (-1)

Additions: 6 Total Shield Projectors (One on Each Hex Face) +15 pts.

Volume: Base Volume times VOL in CuHex

ENGINES<B-Header>

Most ship engines are reaction drives of one kind or another and are represented in game mechanics by a combination of Flight, DEX, and SPD. Most engines are rated for dual use in space and atmosphere. The primary consideration in choosing an engine is acceleration, measured in G's. This determines cost and size. Hero System vehicles do not normally use END for movement, but for added realism they may (-1/2 Limitation) and draw off an END Reserve representing fuel tanks.

Cost	DEX	SPD	Flight	NCM	MAX	G's	Price
							/VOL
30	15	3	5	x2	30	0.25	120
40	15	3	10	x2	60	0.50	240
50	15	3	15	x2	90	0.75	360
65	15	3	20	x4	240	1.00	960
90	15	3	30	x8	720	1.50	2880
110	15	3	40	x8	960	2.00	3840
135	15	3	50	x16	2400	2.50	9600
70	20	4	15	x2	120	1.00	480
105	20	4	30	x4	480	2.00	1920
140	20	4	45	x8	1440	3.00	5760
170	20	4	60	x8	1920	4.00	7680
205	20	4	75	x16	4800	5.00	19200
84	25	5	12	x2	120	1.00	480
101	25	5	18	x4	360	1.50	1440
113	25	5	24	x4	480	2.00	1920
125	25	5	30	x4	600	2.50	2400
142	25	5	36	x8	1440	3.00	5760
183	25	5	54	x16	4320	4.50	17280
219	25	5	72	x16	5760	6.00	23040

Introduced: Advanced Tech

Volume is G's x 0.30 x VOL of ship

ION DRIVE<C-HEADER>

An ion drive is a low-thrust engine designed only for space. It is cheap and uses little fuel to achieve enormous velocity (see Space Travel).

Cost	DEX	SPD	Flight	NCM	MAX	G's	Price
							/VOL
63	8	1	6	2 million	12 million	0.1	8

Limitation: not in a gravity well -1/2

Introduced: Advanced Tech

Volume: 0.004 x VOL

LIGHT SAIL<C-HEADER>

A light sail is an enormous reflective surface made from the lightest available synthetic. It produces thrust from light pressure and solar wind near a star. A light sail is huge (the radius is the DCV Mod of the vehicle in kilometers) and fragile (although a few holes won't matter). It takes hours to deploy or stow and is useless in atmosphere or interstellar space.

DEX 5, SPD 4; 1d6 Absorption to Flight, +6 to maximum, 0 END, only absorb light or solar wind -1, bulky OAF

Active Cost: 22 Real Cost: 3 Internal Volume: 1 CuHex Price: 80 x VOL

Introduced: Advanced Tech

FTL DRIVES<B-Header>

How ships move faster than light depends on the campaign. See Space Travel for a list of possibilities. In game terms, though, there are only four basic categories: FTL, Extra-Dimensional Movement, Teleport, and really fast Flight. The last of these is obvious, and examples of the first three are included below.

WARP DRIVE<C-HEADER>

A warp drive wraps the ship in a bubble of space with different physical laws so that it can exceed lightspeed. A ship in warp drive might be considered Desolidified, only subject to gravitational effects, or it might be vulnerable to the whole range of physical phenomena.

Cost	FTL Speed	Price	Volume<D-Header>
	(LY/Year)	/VOL	/VOL
22	64	256	0.04
24	125	500	0.08

26	250	1000	0.12
28	500	2000	0.16
30	1000	4,000	0.20
32	2000	8,000	0.24
34	4000	16,000	0.28
36	8000	32,000	0.32
38	16,000	64,000	0.36
40	32,000	128,000	0.40
42	64,000	256,000	0.44
44	125,000	500,000	0.48
46	250,000	1,000,000	0.52
48	500,000	2,000,000	0.56
50	1,000,000	4,000,000	0.60

Introduced: High Tech

HYPERDRIVE<C-HEADER>

Hyperdrive puts the ship in another space continuum in which the ship's normal engines somehow take it farther, faster. A ship in hyperspace is detectible by special equipment only, if at all.

Extra-Dimensional Movement, to/from hyperspace, 0 End, Navigation Skill Roll -1/2, Not within 100 AU of massive body -1/2, Bulky OIF

Active Cost: 40 Real Cost: 13 Volume: 0.08 CuHex x VOL Price: 1000 x VOL

Introduced: High Tech

JUMP DRIVE<C-HEADER>

Jump Drive creates a field of quantum instability around the ship that instantaneously transports it over many lightyears to a potential energy minimum, a jump point. A jump drive is tricky to calibrate and use; a failed Navigation Roll will move the ship to a random jump point (range of 16 ly at Megahex Scale). Catalogues of known jump points are readily available.

1. Teleport 10", x 233 NCM (16 ly range), Extra Time 1 hour -2 1/2, Only to stored locations -1/4, Skill Roll required (without the -1/10 Active) -1/4, Bulky OIF

2. 100 Fixed Locations, Bulky OIF

Active Cost: 285 Real Cost: 96 Volume: 0.12 CuHex x VOL, min 50 CuHex Price: 10,000

Introduced: High Tech

CREW AND PASSENGERS<B-Header>

Seats and living space are required for all passengers and crew. The numbers below take into account people, living quarters, and community facilities.

REQUIRED CREW<D-Header>

Ships don't run themselves. The absolute minimum crew for a ship is equal to the magnitude of its DCV Modifier. Thus, a 12 ton ship with a DCV Modifier of -4 requires at least 4 crew to run everything. For larger ships, a more reasonable crew is one per 25 CuHexes. Otherwise, what crew there is spends all its time pushing buttons and hauling gear, with no opportunity to wait on passengers or do maintenance. A ship's computer counts as its INT/5 in number of crew.

SEATING SPACE FOR SHORT FLIGHTS<D-HEADER>

Crew (Includes controls and Acceleration couches): 1 CuHex per 6 People

Passengers (Seated): 1 CuHex per 9 people

LIVING QUARTERS FOR LONG FLIGHTS<D-HEADER>

Crew (Includes controls and Acceleration couches): 3 CuHex Each

Passengers (Low Passage): 1 CuHex each

Passengers (Medium Passage): 2 CuHex each

Passengers (First Class): 4 CuHex each

Passengers (Luxury): 8 CuHex each

BASIC LIFE SUPPORT PRICE: 400 x VOL of Ship<D-Header>

Life support is highly recommended for manned ships. Basic life support, available at Modern Tech, includes pressurization and climate control. There are no recycling facilities, however, so food and water must be stored for each voyage.

Life Support: Self-contained breathing, Pressure, Radiation, Temperature

Active Cost: 19 Real Cost: 19 Volume: 0.005 CuHex x VOL

CLOSED LIFE SUPPORT PRICE: 600 x VOL of Ship<D-Header>

Closed life support, introduced at Advanced Tech, improves upon the basic version by adding water and waste reclamation facilities. The drawback if no one aboard has cooking skill is that the food machinery

produces nothing but flavored food bricks.
Life Support: Self-contained breathing, Eat/Excrete, Pressure, Radiation,
Temperature
Active Cost: 24 Real Cost: 24 Volume: 0.006 CuHex x VOL

ARTIFICIAL GRAVITY<D-Header>

Artificial gravity prevents those nasty side effects of extreme acceleration. Without it, manned ships can't maneuver effectively at MegaHex Scale or larger. Artificial gravity is bought as Change Environment with an Area Effect big enough to cover the longest dimension of the ship's hull. The gravity of individual rooms can be adjusted from zero to 3g. A flat gravitational field such as this is much easier to achieve in a large volume (large ship) than a small one, hence the price.
Introduced: High Tech

Radius (hex)	Active Cost	Real Cost
1	27	11
2	41	16
4	55	22
8	69	28
16	82	33
32	96	38
64	110	44
125	124	50
250	137	55
500	151	60
1000	165	66

Note: Change Environment (Gravity), 0 End, Variable Effect (+1), Selective Area +1/4, No Range -1/2, Bulky OIF -1
Volume: 0.004 CuHex x VOL
Price: Active x 1000

SENSOR PACKAGE<B-Header>

Ship's sensors include a wide variety of instruments to gather information on space phenomena. For convenience, ship communication gear is also included in this sensor package. At Advanced Tech, the standard package relies on radar and spectroscopy for most of its results. In other words, the approach is essentially realistic. Higher Tech Levels add more abstract devices, however, such as "Life Sensors". These advanced sensors are convenient for storytelling, but they become difficult to describe in terms of modern science. Remember when using this equipment that a Perception Roll with sensors is based on a character's Systems Operation Skill.

ADVANCED TECH<D-HEADER>

Abilities: Infrared Vision; Ultraviolet Vision; 360 Degrees all Senses; HR Radio Hearing; Radar; +10 PER; +40 Telescopic all Senses; Detect, Discriminatory (Energy, Light, Mass, Motion, Radiation); Range on all Detects; Variable ECM; Bulky OIF
Active Cost: 220 Real Cost: 110
Volume: 0.005 CuHex x VOL
Price: 22000

HIGH TECH<D-HEADER>

New Abilities: Radio is FTL Capable (1 LY/Year); Spatial Awareness; +10 Telescopic all Senses (+50 total); N-Ray Vision, Not through Hardened DEF; Detect, Discriminatory (Age, Force Field, Life Forms, Molecular Composition, Structural Integrity)
Active Cost: 335 Real Cost: 167
Volume: 0.005 CuHex x VOL
Price: 16750

SUPER TECH<D-HEADER>

New Abilities: FTL Capable is (4 LY/Hour); +10 PER (+20 total)
Active Cost: 395 Real Cost: 197
Volume: 0.005 CuHex x VOL
Price: 19750

FIXED ECM<D-HEADER>

Fixed ECM is less effective than the results of variable ECM in the hands of a skilled operator, but it has the advantage of requiring no supervision.
Ability: -5 to opposing PER Rolls, Cost 15.
Available: Advanced Tech.
Price: 1500.

EXTENDED RANGE SENSOR PACKAGES<C-HEADER>

These packages convert a ship's sensors from Personal Scale to the extended space combat scale. Normally this conversion is implicit, but for games in which characters pay points for equipment, here are the details.

KILOHEX SENSORS<D-HEADER>

+20 Range Levels for all abilities, only in space (-1/4), Bulky OIF, Active Cost 60, Real Cost 27
Available: Advanced Tech
Price: 6000

MEGAHEX SENSORS<D-HEADER>

+40 Range Levels for all abilities, only in space (-1/4), Bulky OIF, Active Cost 120, Real Cost 53
Available: High Tech
Price: 10500

GIGAHEX SENSORS<D-HEADER>

+60 Range Levels for all abilities, only in space (-1/4), Bulky OIF, Active Cost 180, Real Cost 80
Available: Super Tech
Price: 13500

TRACTOR BEAMS<B-Header>

Introduced: High Tech

Tractor beams are a spinoff of gravity technology. A tractor beam is a tight gravitational ray that can pull or move an object. It cannot squeeze, damage, or do fine work.

Abilities: Telekinesis, 0 End (+1/2), Increased Max Range x78,125 (+1 1/2), Bulky OIF (-1), 180 degree firing (-1/2), Cannot squeeze or punch (-1/2)

Capacity	STR	Range (km)	Active Cost	Real Cost	Volume CuHex	Price
6 Ton	40	28,000	180	60	0.1	72,000
50 Ton	50	35,000	225	75	0.5	90,000
100 Ton	60	42,000	270	90	1	108,000
1600 Ton	80	56,000	360	120	16	144,000
2500 Ton	100	70,000	450	150	250	180,000

MISCELLANEOUS<B-HEADER>

COMPARTMENTALIZATION<D-Header>

The interior bulkheads of a spaceship are normally 2 DEF, 2 BODY. This can be increased at a cost of +1 DEF for 3 points and +1 BODY for 1 point. If the DEF is at least 5, interior doors are assumed to be airtight.

CARGO<D-HEADER>

Cargo requires at least 1 CuHex of storage space per 8 tons.

POWER PLANT<D-Header>

Vehicle movement in the Hero System doesn't use END, but other onboard equipment might. Power plants, which supply END, are described in the Hero System Rulebook.

<Description of each>

Chemical Fuel
Fuel Cells
Capacitors
Solar Panels
Fission Plant
Fusion Plant
Antimatter
Conversion

COMPUTERS<D-HEADER>

Computers can be programmed with Skills the crew doesn't have or is too busy repelling boarders to use. A computer can take the place of its INT/5 in required crew. A standard computer is 0.5 CuHex (see Computers), but may be designed smaller.

LABORATORIES<D-HEADER>

The basic rules for laboratories are found in the Hero System Rulebook. A laboratory at any Tech Level occupies 1 CuHex of space, plus 1 CuHex per +1 bonus the laboratory has. The price is Active Cost x 100.

AUXILIARY CRAFT<D-HEADER>

Space can be allocated within the hull to hold auxiliary craft (lifeboats, shuttles, fighters). A vehicle requires hanger and landing bay space equal to twice its own volume.

Example: A fighter has a volume of 32 CuHex. A carrier for fighters must therefore contain 64 CuHex for each of its fighters.

WEAPONS<D-HEADER>

All weapons of the same size category (light, medium, heavy) take the same space at their introductory Tech Level. A light cannon or torpedo requires 5 CuHex of space; medium, 50 CuHex; and heavy, 500 CuHex. If a weapon has Charges, then the ship must take on new supplies to restore those Charges once expended.

Example: An 8 Mw laser light cannon takes 5 CuHex and costs 426 x 100 at Advanced Tech. At High Tech, the space requirement is 3.75 CuHex and the price is 426 x 75. At Super Tech, 2.5 CuHex is the volume and 426 x 50 is the price. An 8 Mw laser is good for 1000 shots, after which certain internal elements must be replaced.

ADVANCED TECH<C-HEADER>

Umbilical Tube PRICE: 4700<D-HEADER>

An umbilical tube is a pressurized corridor to be extended between the airlocks of two ships that rendezvous in space. This permits people to pass between the vehicles without spacesuits.

Life Support: Breathe, Pressure, Radiation, Temperature; Area 32" Line +1 1/2; Bulky OAF -1 1/2; 1 Turn to deploy or stow -1/4
Active Cost: 47 Real Cost: 17

Chemical Duplicator PRICE: 4,300<E-Header>

(Note: use only if Closed Life Support is not used)

<description>

Sd6 Minor Transform: Refuse into Food (+1/4), 0 End, Bulky OIF

Active Cost: 87 Real Cost: 43 Volume: 1 CuHex/200 persons

HIGH TECH<C-HEADER>

Virtual Reality Room PRICE: 120,000<E-Header>

A VR Room does not shrink in size with Tech Level.

Abilities:

1: Images: Sight Group (+10), Sound Group (+10), Smell/Taste Group (+10), -15 PER (45pts), 0 End, 4" Radius (+1/2), Fragile Bulky OIF

2: 20 STR Telekinesis w/Fine Manipulation, AE Selective (+1 1/4), Invisible to all senses but tactile (+3/4), Fragile Bulky OIF, Linked to Images (-1/2)

Active Cost: 290 Real Cost: 120 Volume: 64 CuHexes

SUPER TECH<C-HEADER>

Cloaking Device PRICE: 13,200 x VOL<E-Header>

<Description>

Invisibility to all Sight, Radar, Spatial Awareness, and Unusual Senses, 0 End, IIF, Bulky, Not with Force Field (-1/4), Cannot fire weapons while invisible (-1/4)

Active Cost: 67 Real Cost: 33 Volume: 0.4 CuHex x VOL, min 1 CuHex

Molecular Duplicator PRICE: 93,000<E-Header>

<description>

Sd6 Major Transform: Into Anything (+1), 0 End, Bulky OIF

Active Cost: 187 Real Cost: 93 Volume: 1 CuHex/200 persons

Teleporter PRICE: 110,000<E-Header>

<description>

Abilities: 10" Teleportation, x8,000,000 NC, 80,000,000" (160,000 Kilometers), 60 STR (100 ton), Usable Against Others, AE 2 Hex Radius Selective, Ranged, Increased Max Range x78,125 (+1 1/2) 86,718,750" (173,437 Kilometers), 0 End, Indirect (+1/2), Fragile Bulky OIF, Must use at

Noncombat only (-1/4), Requires System Operation Roll (without the minus 1/10 Active) (-1/4)
Active Cost: 1110 Real Cost: 404 Volume: 1 CuHex

SAMPLE SPACESHIPS<B-HEADER>

This section contains premade spaceships classified by civilian or military use and by Tech Level. Each ship has defenses, engines, sensors, life support, computer, and crew. Some have weapons, artificial gravity, and FTL as well.

SHIP TYPES<D-HEADER>

There are only a few standard hull designs among the sample ships. Most are available in several sizes, in which case the base name is followed by an "L" for Light, "M" for Medium, "H" for Heavy, or "X" for Extreme.

Escape Pod<E-Header>

This is not really a ship, but a life boat for one with minimal controls. Think of it as a big garbage can with a motor.

Carrier<E-Header>

A carrier is much like a destroyer with a huge fighter hanger in the rear. Those listed as "passengers" are the flight crews, whose bunks are near the hangers. The regular ship's crew is all forward.

Cruiser<E-Header>

The largest common military vehicles are cruisers. A cruiser is oval like a destroyer, but longer. All important equipment is in the interior. Even the bridge is inside, away from the hull, so there is no big viewport up front. Cabins, storage rooms, and hangers line the sides. Weapons and sensors are up front and engines are aft.

Destroyer<E-Header>

A destroyer is a smallish military vessel with an oval shape. Except for engines and bridge, the important equipment and rooms are inboard, allowing crew quarters a view of the outside.

Explorer<E-Header>

This is an all-purpose civilian ship designed to operate on its own for a long period of time. It is somewhat boxy, with cabins and workrooms alternating throughout the ship. There is a small cargo hold in the belly and a machine shop within the rear engine room.

Fighter<E-Header>

As a military vehicle, a fighter is all engines and weapons wrapped around one or two claustrophobic individuals. Fighters are usually slender with cantilevered engine mounts to either side, plus wings if the vehicle is designed for atmospheric flight. Some fighters are heavily customized with special equipment and distinctive paint jobs. A fighter has no warp drive.

Freighter<E-Header>

A freighter is built to carry things, so much of it is empty space. The squarish freighter hull places all of its living space up front, with bridge and quarters located over the engine room. Decks in the hold are built with twice the standard spacing, so there will be half as many aft decks as listed. Freighter holds also have movable bulkheads and big cargo doors. To save expense, only one-fifth of the interior is fitted with life support and gravity.

Miner<E-Header>

A miner is designed to locate, process, and carry raw materials of a particular kind - common choices are ice, hydrogen, and metal ore. A miner is triangular with a flat belly containing the cargo doors and hold. Control rooms are up front, except for the engine room in back, and living quarters run along both sides.

Scout<E-Header>

The smallest military vehicle other than fighters, a scout is meant to see without being seen. The hull is a low-profile needle shape with the engines in the center if possible, to reduce its electromagnetic signature. A heavy scout carries specialists to analyze the information it collects.

Shuttle<E-Header>

A shuttle is a transport for a larger ship and may not have on-board accommodations for a long flight. Think of it as a bus with a spacedrive.

Shuttles have no warp drive.

Starliner<E-Header>

The space equivalent of an oceanliner, a starliner is rotund but beautiful. Generally, the crew areas are isolated fore and aft, with the central half reserved for the paying passengers.

Yacht<E-Header>

A yacht is a pleasure vehicle for private use. The hull shape is often beautiful and distinctive, with no set design. It has a bridge and a few state rooms up front connected to the engine room in the back by one main corridor. Limited hold space is underneath.

COMMERCIAL SHIPS<D-HEADER>

NAME	SIZE (LxWxDecks)	DCV	MASS	KNB	STR	DEF	BODY	DEX	MOVE	Crew	WEAPONS
	(T) MOD						/SPD	xNCM	/Pas		
Escape Pod	1.6x0.8x1	-1	0.4	-2	20	2	12	15/3	20x4	1/0	-
Shuttle L	3.2x1.6x1	-3	3.2	-5	35	10	15	15/3	15x2	2/4	1L
Shuttle H	10x5x3	-6	100	-10	60	10	20	15/3	20x4	10/110	2L
Shuttle X	16x8x4	-8	400	-12	70	10	22	15/3	30x8	40/400	2L
Yacht L	4x2x1	-4	6.4	-6	40	10	16	15/3	15x2	1/1	1L
Yacht H	6.4x3.2x2	-5	25	-8	50	10	18	15/3	20x4	3/3	1L
Yacht X	12.5x6.4x4	-7	200	-11	65	10	21	15/3	20x4	20/20	1L
Starliner	160x80x40	-14	400K	-22120	15		32	15/3	20x4	50k/50k	4L
Explorer L	25x12.5x6	-9	1.6K	-14	80	10	24	20/4	30x4	200/40	1M
Explorer H	100x50x25	-13	100K	-20110	15		30	20/4	30x4	10k/400	2M
Freighter L	4x2x1	-4	6.4	-6	40	10	16	15/3	5x2	1/0	1L
Freighter H	40x20x10	-10	6.4K	-16	90	10	26	15/3	15x2	100/0	4L
Freighter X	400x200x100	-176.4M	-26140	15			36	15/3	15x2	1k/0	4M
Miner L	20x10x5	-8	800	-13	75	10	23	15/3	30x8	40/0	1L
Miner H	64x32x16	-12	25K	-18100	10		28	15/3	30x8	1k/0	4M
Miner X	100x50x25	-13	100K	-20110	15		30	15/3	30x8	15k/0	4M

MILITARY SHIPS<D-HEADER>

NAME	SIZE (LxWxDecks)	DCV	MASS	KNB	STR	DEF	BODY	DEX	MOVE	Crew	WEAPONS
	(T) MOD						/SPD	xNCM	/Pas		
Fighter	5x2.5x1	-4	12.5	-7	45	10	17	20/5	30x4	2/0	1L
Scout L	8x4x2	-6	50	-9	55	15	19	20/4	30x4	6/0	2L
Scout H	32x16x8	-10	3.2K	-15	85	15	19	20/4	45x8	200/5	2M
Destroyer L	40x20x10	-10	6.4K	-16	90	20	26	15/3	30x8	400/200	4M
Destroyer H	80x40x20	-12	50K	-19105	20		29	15/3	40x8	8k/4k	9M
Cruiser L	160x80x40	-14	400K	-22120	25		32	15/3	30x8	50k/50k	6H,16M
Cruiser H	320x160x80	-16	3.2M	-25135	25		35	15/3	50x1680k	50k	8H,16M
Carrier L	100x50x25	-13	100K	-20110	20		30	15/3	40x8	10k/2k	4H, 9M, 500F
Carrier H	400x200x100	-176.4M	-26140	25			36	15/3	40x8	50k/40k	18H,32M, 10kF

EXPLANATION OF TERMS<D-Header>

DEF<E-Header>

The DEF of the vehicle includes the hull's intrinsic value plus armor at Advanced Tech or screens at higher Tech Levels.

MOVE<E-HEADER>

This is listed as #x#: the first number is the vehicle's maximum combat move (Flight), and the second number is the vehicle's non-combat multiple. Movement is in hexes in atmosphere or Megahexes in space.

Crew/Pas<E-Header>

This is the number of crew and passengers. "Passengers" in the case of a military vessel often refers to ground troops or fighter pilots.

Weapons<E-HEADER>

These are indications of the kind of weapons carried, where L means a Light weapon, M is Medium, and H is Heavy. F refers to the fighters onboard a carrier.

TECH-VARIANT ASPECTS<C-HEADER>

Certain aspects of the sample ships vary by Tech Level, particularly points and price. Equipment also differs. Ships at Advanced Tech use armor for defense. They have no artificial gravity or FTL drive. High Tech ships and later use screens in place of armor. They have closed life support and artificial gravity. The sensors are upgraded. Space constraints are most severe in designing High Tech ships, in the sense that one can usually be converted up or down in Tech Level with interior space left over.

COMMERCIAL SHIPS<D-HEADER>

NAME	ADVANCED TECH			HIGH TECH			SUPER TECH		
	PTS	PRICE	CARGO	PTS	PRICE	CARGO	PTS	PRICE	CARGO
Escape Pod	214	23.7k	0	276	184k	0	306	11k	0
Shuttle L	229	42.4k	0	313	75.3k	0	343	53.4k	0
Shuttle H	269	812k	22	365	746k	27	395	535k	49
Shuttle X	304	5.1M	10	400	4.17M	67	430	2.92M	195
Yacht L	234	62.9k	0	344	109k	0	374	78.1k	0
Yacht H	259	224k	0	375	305k	0	405	220k	7
Yacht X	274	1.6M	80	396	1.91M	30	426	1.38M	90
Starliner	344	3.16G	40k	488	3.64G	40k	518	2.65G	160k
Explorer L	329	16.5M	835	456	17.5M	730	486	12.6M	1510
Explorer H	374	1.03G	66k	512	1.09G	59k	542	781M	108k
Freighter L	214	55.3k	6	319	84.2k	5	349	60k	5
Freighter H	284	37.1M	12k	406	43.4M	10k	436	31.8M	11.8k
Freighter X	349	37.1G	12M	493	43.4G	10M	523	31.8G	12M
Miner L	309	10.2M	950	436	8.22M	900	466	5.75M	1140
Miner H	334	325M	31k	466	325M	27k	496	231M	37k
Miner X	359	1.27G	90k	497	1.27G	75k	527	901M	114k

MILITARY SHIPS<D-HEADER>

NAME	PTS	PRICE	CARGO	PTS	PRICE	CARGO	PTS	PRICE	CARGO
Fighter	314	169k	2	404	191k	6	434	135k	12
Scout L	319	725k	20	426	752k	11	456	543k	36
Scout H	384	75.7M	20	502	66.7M	10	532	46.9M	2270
Destroyer L	349	64.7M	2400	462	57.6M	1220	492	41.5M	2680
Destroyer H	389	1.13G	16k	508	988M	700	538	708M	28k
Cruiser L	349	8.08G	28k	474	7.18G	123k	504	5.18G	306k
Cruiser H	459	118G	2M	589	97.8G	2M	619	68.3G	3.9M
Carrier L	394	1.89G	29k	523	1.72G	10k	553	1.22G	62k
Carrier H	439	145G	5M	569	126G	3M	599	90.6G	6.9M

PTS AND PRICE<D-HEADER>

The Real Cost and price of the vehicle. Weapons, computers, and fighters must be purchased separately, although the space has been allocated.

CARGO<D-HEADER>

Unallocated space in the hull for cargo or additional equipment.

MATERIALS<A-HEADER>

DEGENERATE MATTER<D-HEADER>

White dwarf matter: teaspoon weighs a ton (10^9 kg/m³).
Sirius B has the same mass as the sun and 9000 times the density.
(6000 * platinum - REMEMBER, IT HAS TO STAY UNDER PRESSURE.)

NEUTRONIUM<D-HEADER>

Neutron star matter (10^{16} kg/m³). Star is max ten miles diameter; a million times denser than white dwarf. Neutronium is shiny like mirror. Neutronium resembles a big atomic nucleus.

OTHER<D-HEADER>

How about black-dwarfium? What's a black dwarf made up of, if it's a star with no nuclear fuel left? HEAVY METAL. How dense is it? DENSER THAN REGULAR METAL, BUT LESS THAN WHITE DWARF (I.E. ABOUT 100 G/CC). REMEMBER, IT HAS TO STAY UNDER PRESSURE. Anti-matter. Buckyballs (Popular Science August 91, Discover a few months before)

(antimatter; crysteel, molecule wire, memory plastic, superconductors, kevlar, duralloy, polysteel)

[NOTE TO SELF: LIFE STAGES OF STARS AND NEBULAE ARE INTERESTING BUT NOT IMPORTANT. TREAT THEM THAT WAY: WITH A MENTION, NOT AN OUTLINE. NOTE TO SELF: MOST OF THESE ARE TOO LONG.]

SPACE<SECTION-HEADER>

THE UNIVERSE<A-HEADER>

The universe began at least 15 billion years ago in an all-encompassing explosion we call the Big Bang. Thermal echoes of that first event linger as cosmic background radiation at a temperature of 3 K. The matter that condensed from the expanding cloud was almost entirely hydrogen, with probably a little helium. Even now, after the formation of galaxies and stars, small amounts of hydrogen are found everywhere. Its interstellar density is 1 atom every few centimeters and, in intergalactic space, 1 atom every few meters.

GALAXIES<A-HEADER>

The radius of the universe is about 15 billion ly. (Beware: values prior to 1984 are wrong.) All of the matter that we can see within that distance has contracted into spinning disks called galaxies.

Our galaxy is the Milky Way Galaxy. It is about 100,000 ly or 30 kpc across and 1000 ly thick. Earth and the Solar System are about 30,000 ly from the center. With about 200 billion stars, the Milky Way is well above average in size, although the largest galaxies are hundreds of times bigger. The much commoner dwarf galaxies are only 10,000 ly in diameter.

Distances on the scale of galaxies are extreme by any civilization's standards. Nearest-neighbor galaxies are usually about a Megaparsec apart. Our nearest "satellite galaxies" are the tiny Magellanic Clouds, about 175,000 ly away. The distance to the nearest big galaxy, the Great Galaxy in Andromeda is about 2 million ly (0.7 Mpc). Suppose your civilization has an FTL drive that can cross the Milky Way - a 100,000 ly distance - in the blistering time of ten years. Flying from one star to the next would essentially be teleportation, but you would still need two centuries to reach the Andromeda Galaxy. Therefore, intergalactic travel is too far to use as a campaign scale.

STRUCTURE<D-HEADER>

Most galaxies share certain features. The central region, the core or nucleus, has the densest packing of stars, and they thin out toward the rim. For example, in the neighborhood of Sol, there's one star per 300 cubic ly. But at 10000 ly from the center, there is roughly one star per 55 ly³. The core may have a giant black hole or cosmic string, which would explain why some galaxy cores emit violent jets.

A big galaxy like ours is surrounded by a collection of globular clusters (see Stellar Associations). Both the clusters and the stars of the galaxy proper revolve around the core. At the distance of Sol, a galactic "year" is 5 million Earth years.

CLUSTERS<D-HEADER>

Galaxies are bound together by gravity. For example, the Magellanic Clouds orbit the Milky Way with a period of about a hundred million years. On a larger scale, galaxies form clusters. Ours is called the Local Group. It contains two major galaxies and at least 28 smaller ones.

Clusters form superclusters (also by gravity) of hundreds of hundreds of clusters, separated by vast distances. Ours is called the Local Supercluster. Superclusters are not smoothly distributed in the universe, but form walls and strings. This means that there are intergalactic voids hundreds of Megaparsecs across containing almost no galaxies.

CLASSIFICATION OF GALAXIES<C-HEADER>

ELLIPTICAL<D-HEADER>

The dwarf elliptical galaxy is the most common kind, though bigger ellipticals exist. An elliptical galaxy is oblong or round with little structure and looks like a vast globular cluster. Ellipticals contain old Population II stars (see Star Generations) and very little dust, so any new stars must form from the remains of old ones.

SPIRAL<D-HEADER>

A spiral galaxy such as ours has a core of any size plus two

or more arms winding around it of various tightness-winding. The result is the familiar pinwheel design. These arms are the result of density waves propagating through the galaxy. Most star formation occurs in these arms, both the bright short-lived ones and the dim long-lived ones. The bright stars are burnt out by the time the density wave moves on, so they always mark where star formation is occurring. Thus, spiral arms contain more gas and dust clouds than the so-called rifts in between. They contain almost all of the young stars, the hot blue stars, and the open clusters.

In our galaxy, the arm toward the center from us is called the Sagittarius Arm, and the one away from center is the Perseus Arm. Sol is actually between the Perseus and Sagittarius arms, on a bar called the Orion bridge or spur. These arms are all about 1 kpc wide and so are the rifts in between.

BARRED<D-HEADER>

The barred galaxies may be thought of as a variant of spirals. The core is crossed by a bar of stars from which come two or four pinwheel arms.

IRREGULAR<D-HEADER>

Irregular galaxies include everything else. They are generally asymmetrical and may be distorted because of close passes or collisions. A few are in the process of colliding - actual stellar close passes are still very rare, and time scales are long.

The Large and Small Magellanic Clouds are good examples of irregular galaxies. In a satellite galaxy such as the Clouds, the big spiral would dominate the night sky and give an unmistakable view of typical galactic structure.

QUASARS<B-HEADER>

Quasar is short for quasi-stellar object. These things are point sources of light like stars. They are the furthest things ever seen and must be incredibly bright (i.e., emitting vast quantities of energy) even by galactic standards. The best theories say the only thing that could create such energy is the gravitational collapse of a galactic core (100,000,000 suns) or two cores, from a pair of colliding galaxies.

The closest quasar, Arp 220, is 230 million ly away. Since distance equates to time, we are seeing this object as it was 230 million years ago. Most quasars are farther away, with distances in the billions of lightyears. The absence of nearby quasars means that they are characteristic of the early universe, when galaxies were much closer together and more likely to collide.

Being so far away, quasars are used as reference points for the most accurate navigational systems.

Quasars look like point sources from far away, but up close they actually have a complicated structure. The typical quasar is embedded in an irregular galaxy formed from the collision of two spirals. Gas, dust, and a lot of stars are pulled into a massive black hole at the center. This infall generates huge amounts of energy, much of which emerges in cosmic jets along the galactic poles.

STARS<A-HEADER>

A star is a massive globe of gas which generates immense quantities of energy. Stars are made primarily of hydrogen, which is converted to helium by nuclear fusion reactions. They also contain traces of many other elements in vapor form.

The most obvious feature of a star is the light it emits, but stars also emit plenty of energy in other forms. All stars are powerful radio sources and emit ultraviolet light as well. The hottest stars are x-ray sources, as are neutron stars and black holes.

In a Star Hero campaign with FTL travel, stars are the landmarks. Planets are much, much closer to their stars than the stars are to each other. Therefore, societies tend to be identified by their stars, even though they really live on planets. Very unusual stars will be known far and wide, much more so than unusual planets.

STAR PROPERTIES<B-HEADER>

Stars can be characterized by two attributes: mass (which is closely linked to brightness) and spectral class. Most of the star's other properties can be figured out from these two.

SPECTRAL CLASS<C-HEADER>

This one-letter designation describes the color and temperature of the star. The common spectral classes are, from hottest to coolest: O, B, A, F, G, K, M. Originally these classes were arranged alphabetically, according to the proportion of hydrogen in the stars, but when stellar chemistry proved to be very complex, some classes were dropped and the others rearranged according to decreasing temperature. Astronomers use mnemonics to remember the order. One favorite is "Oh, Be A Fine Girl, Kiss Me".

Class O, B, and A stars are the hottest, and are white or blue-white in color. Class F and G are yellow and medium temperature; these are the most likely to have Earthlike planets. K and M are red and only a few thousand degrees cool. (By the way, white-hot is hotter than red-hot, opposite of the "cool" and "hot" known to decorators.)

Several other stellar classes are very rare: Class W, or Wolf-Rayet stars, are white-hot, more than twice the temperature of O stars. R, N, and S are giant stars which are so cool that they cannot support Earth-type life in their vicinity. R and N - nowadays classed together as C - are dim red, and S is an even dimmer reddish-brown.

Spectral classes are further broken down into ten numerical subclasses, 0 (hot) through 9 (cool). Thus our sun, a G2 star, is hotter than a G5 and cooler than a G0, which in turn is slightly cooler than an F9 or F8.

TEMPERATURE<C-HEADER>

The surface temperature of a star follows directly from its spectral class, and is thousands of degrees or more. Being too close to a star causes damage; see Living in a Dangerous Universe.

MASS<C-HEADER>

Stars must be at least 0.085 solar masses; protostars which are smaller fail to ignite and become brown dwarfs or gas giants (see Brown Dwarf, Protostar). There may be no upper limit to the mass of a star, but there are very few which are more than 50 solar masses, and it is doubtful that any star is more massive than the star HD 93250, which has the mass of 120 suns! Very large stars have short lifetimes and are usually unstable.

The size of a star is designated by a roman numeral:

CLASSIFICATIONS OF STARS BY SIZE<D-HEADER>

Number	Type	Diameter
Ia, Ib	supergiant	Hundreds of Solar diameters
II, III	giant	Tens of Solar diameters; 100 is typical
IV	subgiant	Intermediate; a few Solar diameters
V	Main Sequence	(see "Main Sequence")
VI	subdwarf	Less than 1 Solar diameter
VIII	white dwarf	5000 km

These terms are further defined below. Sol is a very average G2 V star, a yellow Main Sequence dwarf. Type R, N, and S stars

are always red giants or supergiants.

BRIGHTNESS<C-HEADER>

Brightness of a star is closely related to its mass. The larger and more massive a star is, the brighter it is. brightness of a star is measured by its magnitude. Astronomers have traditionally compared stars by apparent magnitude - the brightness of a star as seen from Earth. Yet even before the advent of interstellar travel they saw the need to know the actual brightness of stars. For this they use absolute magnitude, which is the magnitude of any star as if viewed from a distance of 10 parsecs. In this book we use the term brightness to mean absolute magnitude.

The

Each magnitude is 2.5 times brighter than the next highest one. The important thing to remember is that the lower the number, the brighter the object, and that negative values are the brightest of all. The Sun has a brightness of 4.7; a brighter star may have a 1 or even a -1 or -3. The brightest star known, S Doradus in the Large Magellenic Cloud, is a brilliant -9.5. (The naked eye can barely see an apparent 6th magnitude. The Sun is apparent magnitude -26.8.)

[Perception Modifiers for brightness, see Combat and Adventuring. Visual damage for being up close. UV blinds you. Assume the brightness modifiers are the same for different wavelengths (x-ray, radio, UV, IR) unless specifically say so.]

TYPES OF STARS<B-HEADER>

The above star properties cause all known stars to fall into 3 basic categories: Main Sequence, Giants, and White Dwarfs (and a few other unusual, but significant types). It used to be that most MS stars were called just plain dwarfs. This is unofficial, but still in common usage.

MAIN SEQUENCE<C-HEADER>

In these stars, brightness (and size and mass) are closely linked to spectral class (color and temperature). Hot, white Main Sequence stars are always huge and bright, and cool red ones are always small and dim. Sol, a yellow G2 V sun, sits right in the middle of the sequence in temperature, size, and brightness.

A star spends most of its multi-billion-year lifetime as a Main Sequence star; because of this, nearly all (90%) stars belong to this group. (For the origin of the term, see Formulae for Math Lovers.) This makes the spectroscope an extremely useful tool for astronomers: because of the frequency of Main Sequence stars, an observer who determines the spectral class of a typical star will also know its size, mass, temperature, and brightness. Furthermore, by comparing its brightness with its apparent magnitude, he can approximate its distance as well. And all this from Megaparsecs away! For Main Sequence stars the relationship is precise: cooler=more time on Main Sequence.

PROPERTIES OF MAIN SEQUENCE STARS<C-HEADER>

SPEC TYPE	TEMP (1000 K)	ABS MAG	MASS (Sun)	RADIUS (Sun)	LUMINOSITY (Sun)
O5	40	-5.8	40	18	500,000
B0	28	-4.1	18	7.4	20,000
B5	15.5	-1.1	6.5	3.8	800
A0	9.9	0.7	3.2	2.5	80
A5	8.5	2.0	2.1	1.7	20
F0	7.4	2.6	1.7	1.3	6.3
F5	6.6	3.4	1.30	1.2	2.5
G0	6.0	4.4	1.10	1.05	1.26
G5	5.5	5.1	0.93	0.93	0.79
K0	4.9	5.9	0.78	0.85	0.40
K5	4.1	7.3	0.69	0.74	0.16
M0	3.5	9.0	0.47	0.63	0.063
M5	2.8	11.8	0.21	0.32	0.008
M8	2.4	16.	0.10	0.13	0.0008

GIANTS & SUPERGIANTS<C-HEADER>

Giants stars are 10-50 times the size of our sun. These are mostly old stars which have burned up most of their hydrogen fuel and are expanding into old age. Giants are most often red, but there are orange and yellow giants as well.

Supergiants are even larger - twenty diameters to several hundred. A really large one can reach the size of Jupiter's orbit or even Saturn's. At this size they are extremely bright (Abso-

lute Magnitude -8 or -7) and serve as signposts in the galaxy. Supergiants can be any spectral class, but are usually K or M. Being old, they are short-lived and even rarer than giants. They have extremely low densities: Betelgeuse is about a ten-millionth the density of Sol. A well-shielded spaceship could fly into its low-temperature outer layers.

Supergiants differ from giants in more than just size. A giant is small enough to end its life quietly as a white dwarf. A supergiant will become a supernova and then a neutron star.

PROPERTIES OF GIANT STARS<C-HEADER>

SPEC TYPE	TEMP (1000 K)	ABS MAG	MASS (Sun)	RADIUS (Sun)	LUMINOSITY (Sun)
G0	5.6	1.1	2.5	6.3	32
G5	5.0	0.7	3.2	10	50
K0	4.5	0.5	4.0	16	80
K5	3.8	-0.2	5.0	25	200
M0	3.2	-0.4	6.3	43	400
M5	3.0	-0.8			1000

PROPERTIES OF SUPERGIANT STARS<C-HEADER>

SPEC TYPE	TEMP (1000 K)	ABS MAG	MASS (Sun)	RADIUS (Sun)	LUMINOSITY (Sun)
O5		-6.6	160		
B0	30	-6.4	50	20	250,000
B5		-6.2	25	32	80,000
A0	12	-6.2	16	40	20,000
A5		-6.	13	50	13,000
F0	7	-6.	12.5	63	8000
F5		-5.0	10	79	6300
G0	5.7	-6.	10	100	6300
G5	4.9	-6.	12.5	125	6300
K0	4.1	-5.	12.5	200	8000
K5	3.5	-5.	16	400	16,000
M0		-5.	16	500	32,000

WOLF-RAYET STARS<D-HEADER>

Wolf-Rayet stars (Type W) are supergiants which have become unstable to the point of casting off their outer layers. The exposed helium-burning region makes these stars extremely bright and hot. About 1/5 of planetary nebulae (see Nebulae) contain a Type W star. Their color is greenish-white.

SUBGIANT AND SUBDWARF<C-HEADER>

These are intermediate sizes of star that are not of special interest in Star Hero.

WHITE DWARF<C-HEADER>

Any star from 1-4 solar masses, towards the end of its fuel-burning life, gives off a shell-cloud of hydrogen, shrinks, and cools to a white dwarf. Thus, a white dwarf represents a very old star. White dwarfs are more numerous than any other group except Main Sequence. They are dim - about 10 magnitudes below MS, cool, about solar mass, but much smaller/denser; a teaspoonful weighs a ton (this is degenerate matter: see Materials). Sirius B, for example, has the same mass as the Sun and 9000 times the density. A white dwarf cannot mass more than 1.4 Suns and be stable. (If Sirius B absorbs too much mass from its primary, it will supernova.) Typical radius is 5000 km, Earthsize. A typical temperature is 5000 K. When it eventually cools, a white dwarf grows very dim and then becomes black dwarf.

BINARY<C-HEADER>

More than half of all star systems are binary or multiple; that is, there are two or more stars gravitationally bound. Binary stars let you compute their mass by watching orbits. The average separation is 10 AU, but the range is anywhere from contact binary to hundreds of AU. Division in mass between the stars is nearly random.

Planets in a binary system can orbit one star, the other, or both. Widely separated stars will have separate planetary systems, each reaching to about 1/5 the separation. In a close binary system, the planets will orbit both stars. Planetary orbits are likely to be eccentric, though, and the chances for life are dubious.

The stars of a binary system are normally born together, but if they are of different sizes, they will age at different rates. This allows for many possibilities later on. An aging red giant

may accompany a young yellow dwarf, both stars may be fast-living blue giants, and so on.

Stars in a binary system affect each other. Most obviously, contact binaries touch and exchange gas. This can result in a flare star, nova, or supernova. The supergiant Betelgeuse actually contains a companion star orbiting within its outer layers. Close binaries don't touch, but exchange material through the solar wind and heat each other as well. If one star goes nova or ejects nebular material, the other star can be rejuvenated by an infall of material, or it can be driven unstable itself.

MULTIPLE STARS<C-HEADER>

A multiple star system is simply a system with more than two stars, all gravitationally bound. This is rarer than a binary system, but most of the same concepts apply. The usual case is a double orbited by a single or another double. Castor, however, is actually 6 stars!

UNUSUAL STARS<B-HEADER> NEUTRON STAR/PULSAR<C-HEADER>

When a star tears itself apart as a supernova, the remaining stellar fragment is usually a neutron star. There may be other ways to produce a neutron star, but this is the one known. A neutron star is between 1.4 and 3 solar masses, but because of its phenomenal density, it is only ten miles across. A neutron star is made of neutronium (see Materials), a million times denser than white dwarf material. So, it is essentially a solid ball of neutrons.

A neutron star no longer performs nuclear fusion, so it generates comparatively little heat and light. However, it retains all of the angular momentum of the original star, but in a much smaller object. What does this mean? A neutron star spins extremely fast, perhaps a thousand times a second when first born, slowing down to once a second later on. The neutron star also contains the magnetic field of its progenitor, highly concentrated. Lastly, it emits copious quantities of x-rays. These three elements - spin, magnetism, and x-rays - are the ingredients that produce a pulsar.

The key to a pulsar is the magnetic field. X-rays from the neutron star can only escape in the direction of its magnetic poles. Magnetic poles are almost never exactly at the spin poles - consider Earth. So, two beams of intense x-rays reach into space and spin with the star. If one of the beams points toward Earth, we see an x-ray source flashing many times a second. If we can't see the x-rays, the neutron star is close to invisible. So, a pulsar is a point-of-view phenomenon.

VARIABLE STAR<C-HEADER>

These are stars off the Main Sequence that fluctuate in brightness over time periods ranging from half a day to over a year. Variable stars are thought to be a very brief stage in the normal lifetime of a star.

A variable star may be pulsating or eruptive, regular or irregular, short- or long-term, and often fluctuates in the radio wavelengths as well as the visual. Pulsating variables expand as they get hotter and brighter, and contract as they dim. Eruptive stars give off sudden, explosive blasts of energy. A star is short-term or long-term depending on whether its pulsation cycle is longer or shorter than 80 days. Irregular variables have no distinct period, and varies in the amount of brightening as well. The class of a variable star is named after the best-known star of that type. A few types are:

CEPHEID<D-HEADER>

(After Delta Cephei) are admirably regular short-term pulsators, F- and G-type giants and supergiants with brightnesses of 0 to -6 and periods of 1-60 days. The brighter a Cepheid is, the longer the period; this relation is so precise that the star's absolute magnitude can be determined by the duration of its cycle. In turn, one can compare this brightness to its apparent magnitude and calculate the distance to the star. (The distances to many galaxies were computed by observing their Cepheids).

A Cepheid varies in size 10-20% as it pulsates, and its light output fluctuates by about one magnitude. There are also slight changes in temperature and spectral class.

FLARE STARS<D-HEADER>

(or UV Ceti stars) are eruptive short-period stars. These are cool red M-type dwarfs that have solar flares like Sol, but which overwhelm the regular light output. (That is, a Sol-type flare on a much dimmer star.) In just a few minutes - or a few seconds - the star grows 1-2 magnitudes brighter, then fades more slowly. This can happen as often as twice per day. See Flares for the basic rules, except: the warning period is only one minute, the duration is 1d6 minutes, and the intensity is 1/2d6 times as much.

NOVA<D-HEADER>

Novae are so named because they were thought to be "new" stars. Actually they had flared up so brightly that they briefly became visible to the naked eye on Earth. A nova is a close binary star in which the larger member dumps material into the other, a small, hot blue or white star. These excess gasses accumulate until they burn explosively, causing a sudden optical/radio outburst that increases the brightness 10-13 magnitudes in a few hours, and a slow, months-long fade to its original level. "Recurrent" novae repeat this pattern every few decades; it is possible that all nova repeat over thousands or millions of years. [DAMAGE. WARNING. ANY PLANETS?] It may be possible to predict a nova explosion (a successful Astronomy Roll) if the binary can be seen clearly. [HOW COMMON ARE NOVA CANDIDATES AMONG BINARY STARS?]

REVERSE NOVA<D-HEADER>

(R Coronae) is an irregular short-term variable with an unusual twist: it suddenly gets dimmer, not brighter, for several days at a time. These F-, G-, or K-type supergiants drop 5-10 magnitudes in brightness at unpredictable intervals.

EXTRINSIC VARIABLE<D-HEADER>

This is any star which only appears to fluctuate. The most common example is the eclipsing binary: a pair of stars whose mutual orbit causes them to periodically block each other from the observer's point of view.

JETSTAR<C-HEADER>

A binary where a compact star (white dwarf, black hole, pulsar) is drawing matter into a pancake-like accretion disk. Infalling gas is heated up and ejected in 2 jets perpendicular to disk, channelled by star's magnetic field. Jets are hot electron gas of ____ density and ____ temperature. Jets go on for ____ distance, are visible to radio. Examples: SS443 (seems to be coming and going) and Scorpius X-1. [HOW COMMON ARE JETSTARS AMONG BINARY STARS? BINARY STAR/BLACK HOLES?] "Ghostly searchlight beams". [HOW LONG AND WIDE ARE JETS? WHAT IS TEMPERATURE?] [ARE JETSTARS PROHIBITED FROM BECOMING NOVA CANDIDATES?]

STAR GENERATIONS<B-HEADER>

The first stars, born 15 billion years ago, have all exploded or faded away. But in their furnaces, the heavier elements beyond helium were first forged. Today's stars can be roughly identified as second generation (called Population II) or third generation (Population I). The two star populations and their star systems are found in different places and have different characteristics.

POPULATION II STARS<D-HEADER>

These old stars form the cores of spiral galaxies, the entirety of elliptical galaxies, and the globular clusters (see below). Being ten billion years old in general, they are cooler. In fact, surviving members consist entirely of G and K spectral types plus white dwarfs and other stellar remains.

Population II stars formed from gas clouds that were poor in heavy elements compared to now. Consequently, any terrestrial planets must be tiny and metal-poor. Such star systems will show their age in other ways as well. Many bodies will be face-locked, their geology quiet, and their atmospheres thin. Asteroids and comets will be thinned out. These are the systems where the "elder races" of the galaxy evolved.

POPULATION I STARS<D-HEADER>

Sol is a Population I star. Population I forms the arms of spiral galaxies and the open clusters (see below). Type O and B stars, those with short lifespans, are all Population I, with

perhaps a few fourth generation specimens.

Stars of these later generations formed from clouds containing plenty of the heavy elements. Consequently, rich star systems are possible. Metals exist all the way up to the radioactive elements. Most star systems encountered in a campaign should be Population I.

STAR FORMATIONS<B-HEADER>

Any civilization that can see the sky will notice that stars form groups. Much later, the civilization's astronomers will conclude that the star formations they see are not necessarily the real formations. Constellations and optical binaries are merely point-of-view artifacts. Clusters are real. Stellar associations are real but hard to detect. And being in the disk of the galaxy distorts everything.

ASTERISMS AND CONSTELLATIONS<C-HEADER>

The attractive patterns we see in the stars are called asterisms. The Big Dipper, Orion's belt, and the teapot in Sagittarius are all asterisms. But encompassing these are 88 official constellations that cover the sky. Among these, Ursa Major and Orion are distinctive, but Camelopardis is dim and obscure. Our constellations look the same anywhere in the Solar System, but begin to change as we move farther away. As an approximation, every 1 lightyear of travel will change the star patterns by 1 percent. So at Alpha Centauri, 4 ly away, the biggest differences are a missing star in Centaurus and an extra one (Sol) in Perseus. Distant signposts such as bright Deneb and Rigel will not have moved perceptibly.

Elsewhere in the galaxy, the constellations are completely different. If developments on Earth are reflected elsewhere, the most prominent features in the night sky have deep significance for a young culture on any planet. Constellations, bright stars, and visible planets are identified with religious figures, later mythological. Any nearby nebula, globular cluster, or other unusual feature can be expected to have cultural meaning.

STAR NAMES<C-HEADER>

The vast majority of stars seen from Earth have no name or identifier of any kind. Only the brightest and nearest do. They are named by many schemes, and will likely be named anew if humans come to live near them. These new names are appropriate for fictitious settlements in Star Hero.

A very few stars have proper names. If humans settle a planet circling Altair or Achird, they will likely use that name. They may also call it "The Sun". Our sun will be referred to as Sol for clarity. On the other hand, settlers in the nearest star system to Sol will have a choice of calling their star Rigel Kentaurus or Alpha Centauri. Neither is particularly convenient, so they might end up calling it Kent. Other stars positively demand renaming. There is, for example, 107 Piscium, the 107th brightest star in Pisces. Gliese 183 is the 183rd entry in Gliese's Catalogue of Nearby Stars. And the euphonious BD+50deg1725 is identified by its sky position in another standard catalog.

The earliest human colonies will possibly continue current tradition of using Earth mythology. Later, explorers with different interests or backgrounds will get in on the act. Name assignments farther from Sol will become more varied. Don't forget that the planets and major moons in a system need names as well. Usually, these names share a theme. Thus, if a star is called Sherwood, its planets might be named Robin, Marian, and Tuck.

STAR CLUSTERS<C-HEADER>

Clusters are stellar assemblages held together by mutual gravitation. The stars are physically related through a common origin. A cluster is a good place for adventure because the stars are so close, moderate FTL speeds are more effective than usual. Stars in a cluster are of similar ages, so multiple civilizations will mature at about the same time. In other words, if the cluster holds one life-bearing system, it is likely to contain several.

OPEN CLUSTERS<D-HEADER>

Open (formerly called galactic) clusters are nearly all found in the spiral arms. These are irregular groups containing ten to hundreds of young stars. The cluster is the end product of

a single star-forming cloud. Open clusters differ in size, density, and type of star. Commonly, a cluster is 5-75 ly in diameter and its stars are more densely packed than average. Being a part of the galactic disk, a cluster is subject to the pull of surrounding stars. Eventually it will be pulled apart into individual stars and become unrecognizable.

Some open clusters in our galaxy include the Pleiades and Hyades (in Taurus), Praesepe (Cancer), and Coma Cluster (Coma Berenices). The variety of known clusters suggests that a Game-master can invent one having almost any properties (as long as it is full of young stars).

GLOBULAR CLUSTERS<D-HEADER>

Globular clusters are clumps of stars found above and below the disk of a galaxy in a roughly spherical region called the galactic halo. A cluster contains ten thousand to a million stars in a region 15 to 300 ly across. The shape of the cluster is approximately spherical and denser near the center. In fact, that region may hold several stars per cubic lightyear. These are Population II (older) stars, red to yellow dwarfs and red giants. (All of a galaxy's globular clusters are very old and formed early in the galaxy's history.)

A globular cluster is the place to put a Star Hero campaign or story that is set outside of the galaxy. However, planets will be few among these metal-poor stars.

STELLAR ASSOCIATION<C-HEADER>

This is a very loose grouping of stars of similar spectral type and origin, its chief feature. An association contains fifty to a few hundred stars in or near the galactic disk. It is slowly expanding (moving at 5-10 km/sec) and probably disperses in only 10 million years. An association is actually less dense than the surrounding starfield, and thereby differs from an open cluster. The stars formed at same time in the same region from a single nebula, but all are moving too fast to be held together by gravity. Star creation takes time, so some associations are at a point such that the massive stars are complete (an OB association) but the less massive ones are still protostars (in contraction phase). Associations sometimes have open clusters at the center. These are extremely young stars, of course.

An OB association has large numbers of hot blue giant stars O and B. An example is the Orion Association. T (or T Tauri) associations consist of cooler "dwarf" irregular variables (T Tauri stars) with strong solar winds. Associations are of many types; these are only two.

In a campaign, an association is an excuse for spreading stars with a common origin over an appreciable volume of space. A rare star type can thus be made more common, or previously close planets can be spread more widely. Perhaps these planets contain a rare mineral or the ruins of an ancient race.

STAR SYSTEMS<A-HEADER>

As of this writing, no one knows for sure how many stars have planets orbiting them. Current theory suggests that worlds are very common, although not necessarily habitable. One speculation is that when a star has a disk of material orbiting it, the material will coalesce either into a single large body - another star - or a group of much smaller bodies - planets. This may mean that solar systems are as common as binary stars - which make up about half of those in the sky!

SOLAR SYSTEM BOUNDARIES<C-HEADER>

PLANET BOUNDARIES<D-HEADER>

A star system can be defined by three circular boundaries around the star. The innermost circle is the inner planet boundary which lies close to the star. At this distance, the temperature is 2000K, at which rock melts. No worlds will be found closer to the star than this. The ice boundary lies further out from the star. At this distance the temperature is 273K, the freezing point of water. The outer planet boundary is the maximum distance at which planets may be found, roughly 50 AU.

STELLAR ROCHE LIMIT<D-HEADER>

This is a spherical region around each star. Natural worlds which come within this limit are broken up by stellar tides. Planetesimals (primordial asteroids) within the Roche Limit never coalesce to form worlds, as they do in the rest of the system, and remain a belt forever. The Roche Limit's radius is 1.25 times the star's diameter.

INNER STAR SYSTEM<D-HEADER>

This is the region between the inner planet boundary and the ice boundary. Most terrestrial worlds will be here. This is the only area in which liquid water can form, which is required for all forms of life known to us.

OUTER SOLAR SYSTEM<D-HEADER>

This region extends from the ice boundary to the outer planet boundary. Gas giants are found in this large zone. Ice which forms here is permanent.

COMETARY HALO<C-HEADER>

This is a very large, spherical region in which comets originate. The halo begins about 40,000 AU from the star, and is about 10,000 AU wide. Comets here are too far from the star to have tails (see "Comets" below), and are so far apart from each other that it would be very difficult for a space traveler to tell that he's in a cometary halo.

ORBITS<B-HEADER>

At a given star, most of the planets' orbits lie in a plane (called the ecliptic) and orbit in the same direction. Occasionally a planet's orbit is substantially inclined to the ecliptic.

Most orbits are not quite circular; the distance between the planet and its sun will vary at different points in its year (but not enough to influence the world's climate). Some worlds have highly eccentric (elongated) orbits; these include captured rogues (see below), worlds of a multiple star systems, those which have survived a close pass with another body, and others with some unusual gravitic event in their past. Eccentric orbits are usually inclined as well. Worlds with eccentric orbits will indeed have extreme temperature variations. (Note that these variations need not coincide with the local seasons, which depend on axial tilt; see below.)

In rare instances, two worlds in adjacent orbits come close to each other on a regular basis (say, every second or third orbit). If this orbital conjunction is close enough, the worlds will affect each other gravitationally. This has the same effect as a mild close pass (see "Catastrophes"). Such conjunctions are more likely if one of the worlds has an eccentric orbit. Conjunctions are also possible between a planet and a comet or asteroid.

In very rare instances, two planets of different sizes may share the same orbit, sixty degrees apart. Orbital mechanics keep these co-orbital worlds from colliding. In campaigns not sticking to Real Science, the GM can state that the worlds are diametrically opposed and hidden from each other by the sun. Actually, the fluctuating velocity of an orbiting planet would keep this from happening.

WORLDS<A-Header>

TERRESTRIAL<B-HEADER>

As the name suggests, these worlds are comparable to Earth in size and composition. As a naming convenience, we term a planet any body at least 1000km in diameter; smaller bodies are termed asteroids (see below).

Terrestrial planets in the inner part of a star system are composed primarily of rock; those larger than 6000 km have cores of molten iron which give them a magnetic field and radiation belts. Rocky terrestrials include Earth (the largest known), Venus, and Earth's moon, Luna.

Terrestrial worlds in the outer solar system are often a rock core surrounded by a thick layer of frozen water, ammonia, or methane (or a rock/ice mixture with little structure). Others are pure ice, with no rock core. In fact, a terrestrial world may have any composition from 100% rock to 100% ice. In Star Hero, an "ice world" is one whose ice layer is more than a quarter of its radius or half its volume, as opposed to the thinner crust on an ice-covered planet. Ice worlds are rarely over 1800 km in diameter and, because of the low density of ice, less massive than all-rock worlds. The larger moons of Jupiter and Saturn are ice worlds, as is Pluto.

PLANETARY CHARACTERISTICS<B-Header>

All of these characteristics are common to terrestrial worlds, and they generally apply to other types as well. Use common sense. Normal gas giants do not have terrain, for instance.

YEAR<C-HEADER>

A planet's year or period of revolution is directly calculated. See Formulae for Math Lovers.

DAY<C-HEADER>

Planets rotating in more than 4 days probably have temperature extremes inimical to life. (Certain atmospheres might change that back.)

FACE-LOCKED<D-HEADER>

Terminology: face-locked = tidally locked = synchronous.

All planets slow down over time, until eventually the day matches the year. Face-locking is likely for an old world - much older than Earth (say, a type K or M star, or Population II) - or one close to its primary. Earth may be so in 45 billion years, or it may become locked to Luna's period.

Most satellites are face-locked unless very young and far away (because tidal effects depend so strongly on distance). (A rare exception is Saturn's moon Phoebe, which is probably a captured rogue.) None of Sol's planets actually are, not even Mercury (as discovered 1965), but rumors persist!

Twilight Zone<E-HEADER>

A face-locked body has a permanent day side and night side, or (like Luna) near side and far side. Drastic climate differences prevail. The boundary is called the twilight zone. Natives stay on their own side; human colonists will settle in the twilight zone where temperatures are more moderate, unless they somehow prefer one side or the other.

Five or ten degrees of longitude is a typical width for this zone, but the it depends on orbital eccentricity. A body in a noncircular orbit will rock back and forth slightly during an orbit. This is called libration, and produces a wider twilight zone.

AXIAL TILT<C-header>

The axis of rotation of a planet may not be perpendicular to its orbital plane. The difference is axial tilt. High tilt is more likely when the orbit is highly inclined or eccentric. Tilt is a major determinant of seasons and climate.

VERY HIGH<D-HEADER>

Drastic seasons (high temperature variation), smaller polar caps due to temperature variation. Trans-hurricane winds in winter and summer (away from dayside). Season-long day and night.

HIGH TILT<D-HEADER>

High winds, icecaps, growing season, midnight sun effect.

LOW TILT<D-HEADER>

Weak seasons, weak weather. Glaciers and icecaps are permanent and large.

NO TILT<D-HEADER>

No seasons. Bigger icecaps, colder at icecaps, hotter at equator, but big temperate zone with little variation.

MAGNETIC FIELDS<C-HEADER>

When a world has a magnetic field, it mostly (but not completely) protects against solar wind and flares. Worlds with weak or no magnetic fields are susceptible to radiation from the sun. Worlds with strong fields are well protected. (See Radiation, below.) Earth's and Saturn's are medium, Mercury's is weak (although stronger than expected from its slow rotation); it must have a massive metal core. Jupiter's is strong (30,000,000 km across); Venus' & Mars' are very weak (because Venus rotates slowly, although its heavy upper atmosphere stops solar wind, and Mars has the wrong kind of core); Luna's is very weak or none. Pulsars have very, very, very strong fields; this causes the beacon effect described earlier.

The field is teardrop shaped, being pushed by the solar wind. Size of field: Does not depend on planet's size. World must have a fluid, conductive core (metallic hydrogen or iron/nickel) and be rotating. <FIELD SIZE DEPENDS ON STRENGTH?>

On a world with a magnetic field, native lifeforms sometimes develop magnetic senses. Compasses are possible; natives may have discovered them. WHAT STRONG FIELDS DO TO YOUR TECHNOLOGY. Ionosphere, aurorae, bounding radio waves> See "Living in a Dangerous Universe".

GRAVITY<C-HEADER>

<DEFINE CATEGORIES FROM NONE TO HEAVY. WHAT ARE EFFECTS ON PEOPLE? DEFINE EFFECTS AS DIFFERENCE IN CATEGORIES (E.G. HEAVY GRAVITY AFFECTS A MEDIUM-G NATIVE THE SAME AS MEDIUM-G AFFECTS A LIGHT-WORLDER). THE EFFECTS ON CARDIOVASCULAR SYSTEM. FOR GAME EFFECTS ON STR, LIFTING, THROWING, ETC., SEE COMBAT AND ADVENTURING.

FOR LONG AND SHORT TERM GRAVITY EFFECTS, SEE RINGWORLD GEMMASTERS BOOK P.27-8.

ATMOSPHERE<C-HEADER>

When a world coalesces from its primordial cloud, some of its components are gaseous. These become the atmosphere if not lost to space or broken down by solar radiation. Later meteor bombardments may add other ingredients.

Gas giants are essentially all atmosphere. Terrestrial worlds even in the inner system may start with abundant hydrogen, but its early escape is only one of a number of changes expected as a world evolves. The later mix should be a chemically stable function of the local orbital temperature. Examples include Mars' carbon dioxide and nitrogen or Titan's nitrogen and methane.

Oxygen, though important to us, is an unstable component, because it reacts with so many things. Oxygen in Earth's atmosphere signifies that something unusual is going on. What's going on is life, of course.

PRESSURE<D-HEADER>

The average pressure in atmospheres is equal to surface g's, but extreme variants are not uncommon. At high pressure, many "gases" will be liquid or solid on surface. Humans require 0.2 atm pressure and oxygen pressure of 0.05-0.4 atm.

Type<E-HEADER>

Type of atmosphere is a reflection of surface pressure (trace, very thin, thin, medium, heavy, very heavy, massive). Gas giants are always "massive" deep down. If there is no atmosphere or only trace atmosphere, the world will be heavily cratered. Conversely, a thick atmosphere promotes erosion.

ABSORPTION AND OPACITY<D-HEADER>

Atmosphere (Earth's, anyway) absorbs or reflects all but visible, microwave, a little IR, and radio EMR. Clouds block visible. Other gases absorb different wavelengths.

COMPONENTS<D-HEADER>

See Random World Generation for ideas. Contaminants, caused by industry, volcanoes; aliens must use filters or oxygen. What is the effect of various components/contaminants, and where do they come from?)

WATER PRESENCE<C-HEADER>

Depends on average temperature, atmospheric pressure.

<ANYTHING ELSE?>

TERRAIN<C-HEADER>

ALBEDO<C-HEADER>

<CLOUDS, ICE, OCEANS AFFECT IT. CALCULATE.>

TEMPERATURE<C-HEADER>

Planets rotating in more than 4 days probably have temperature extremes inimical to life. (Certain atmospheres might change that back.) Those with greatly elongated orbits also have temperature extremes.

ORBITAL TEMPERATURE<D-HEADER>

The temperature range of a planet is based first of all on its orbital temperature. This is the the heating effect of the star at that range. For main sequence stars, selected values are listed in the Main Sequence Orbital Temperatures chart. See Formulas for Math Lovers for the equation.

<DOUG'S FORMULA: $T = T_o * (R_o/r)^{2/7}$

<Ro and r in same units. Or use exponent of 1/2

<TONY'S FORMULA: $T = T_o * (R_o/2r)^{1/2}$

<TONY'S WORKS THE BEST SO FAR - BUT GETS THE WRONG ANSWER AT THE STAR'S SURFACE.>

MAIN SEQUENCE ORBITAL TEMPERATURES<C-HEADER>

Sp	Star	Surf	ORBIT RADIUS (AU)									
Cl	Radius	Temp	0.4	0.7	1	1.6	2.8	5.2	9.5	19.2	30.639.4	
	Color	(sun)	(K)									
O3												
O5		20	35300	--	--	--	--	--	--	1735	13751211	
O7		0	0	0	0	0	0	0	0	0	00	
O9		5.9	0	0	0	0	0	0	0	0	00	
B0	BlueWhite	10	21000	--	--	--	--	1912	1403	1038	730	578510
B2		5.1	17000	--	--	1849	1462	1105	811	600	422	334295
B3		4.8	15000	--	1892	1583	1251	946	694	514	361	286252
B5		3.7	13500	1978	1495	1251	989	747	549	406	285	226199
B8		2.7	11500	1439	1088	910	720	544	399	295	208	165145
A0	Blue-White	3.2	9700	1321	999	836	661	499	367	271	191	151133
A2		2	8700	937	708	593	469	354	260	192	135	10794
A5		1.8	8100	828	626	523	414	313	230	170	119	9583
A7		1.7	7800	775	585	490	387	293	215	159	112	8978
F0	White	1.7	7200	715	540	452	357	270	198	147	103	8272
F2		1.3	6900	599	453	379	300	226	166	123	86	6960
F5		1.4	6500	586	443	370	293	221	162	120	85	6759
F8		1.1	6000	479	362	303	240	181	133	98	69	5548
G0	Yellow	1.03	5800	448	339	284	224	169	124	92	65	5145
G2		1	5600	426	322	270	213	161	118	88	62	4943
G5		0.91	5400	392	297	248	196	148	109	81	57	4540
G8		0.87	5300	376	285	238	188	142	104	77	54	4338
K0	Orange	0.9	4900	354	268	224	177	134	98	73	51	4036
K2		0.78	4830	325	246	205	162	123	90	67	47	3733
K5		0.56	4100	234	177	148	117	88	65	48	34	2724
K8		0.67	3900	243	184	154	122	92	67	50	35	2824
M0	Red	0.54	3670	205	155	130	103	78	57	42	30	2321
M1		0.56	3500	199	151	126	100	75	55	41	29	2320
M2		0.36	3400	155	117	98	78	59	43	32	22	1816
M3		0.29	3300	135	102	86	68	51	38	28	20	1514
M4		0.21	3200	112	84	71	56	42	31	23	16	1311
M5		0.35	2800	126	95	80	63	48	35	26	18	1413
M9		0.2	2300	78	59	50	39	30	22	16	11	98

SURFACE TEMPERATURE<D-HEADER>

The orbital temperature is also the temperature of the daytime surface if the planet doesn't rotate and has no atmosphere. (The nightside will be near 0 K.) Rotation evens out the two sides. A thin or standard atmosphere will decrease the average temperature. A thick atmosphere will increase it.

RESOURCES<C-HEADER>

Rock? Ice? Soil? Terrain? Metals? A strong magnetic field or a high density (because rock is density 3 and metal is density 8) on a terrestrial world means heavy metal core, probably high in metal resources.

RADIATION (VAN ALLEN) BELTS<C-HEADER>

These are layers of the magnetic field in which solar wind particles are trapped, forming a high radiation zone. Earth's are 2000-5000 km high (mostly protons) and 13000-22000 km high (mostly electrons). Obviously, this requires a magnetic field, with ions coming from the atmosphere, solar wind, or cosmic rays. Since all planets receive radiation from at least two of these sources, this means that all planets have to put that radiation somewhere. Earth is the only terrestrial with radiation belts. Mars collects radiation in its upper atmosphere, and the airless worlds expose their surfaces directly to it.

SOLAR RADIATION<C-HEADER>

Exactly how it affects temperature, native vision, anything else interesting.

Dangerous radiation from Sol at 1 AU amounts to 6 rad/year of protons, plus an additional 12 from galactic cosmic rays. The solar portion of this is attenuated as the square of the distance from the Sun. For another star, multiply by its luminosity. (Properly, though, hot stars should put out even more radiation).

BACKGROUND RADIATION<C-HEADER>

Figure the sum of solar radiation and cosmic rays at planet's position (see above). An atmosphere will block some of this (see the Atmospheric Attenuation of Radiation table). A magnetic field will block some as well (about half for an average field). Multiply by both factors. Finally, there may be high background radiation from radioactive minerals in the crust or old nuclear holocaust. This causes high mutation rate, if any life exists at all. Radiation is always a danger to non-natives. See "Living in a Dangerous Universe".

ATMOSPHERIC ATTENUATION OF RADIATION<D-HEADER>

TYPE	FACTOR
Trace	x1
V Thin	x0.3
Thin	x0.01
Medium	x0.003
Heavy	x0.001
V Heavy	x0.0001
Massive	x0

VULCANISM<C-HEADER>

All young worlds are likely volcanic. Small ones cool fastest so that among terrestrials, Earth is still active, Mars is somewhat active, and Luna is dead. Tidal forces from an oversize moon will also promote vulcanism. Primitive life only (if young world). Earthquakes common, likely sulphur dioxide and other volcanic gases in air.

GAS GIANTS<B-HEADER>

Gas giants, or Jovian planets, orbit the sun in the outer part of their star systems. Gas giants are huge: the smallest are at least 10 times the mass of Earth, and the largest, the mass of 800 Earths (about 2.5 Jupiters). Astronomers consider larger bodies to be brown dwarfs (q.v.). The known Jovians are made of hydrogen and helium, and there may be small ones composed of methane and ammonia.

Trace elements in the clouds of a gas giant often give it bright colors and make visible the climatic zones and violent winds on the planet. The Great Red Spot on Jupiter is a hurricane three times the size of Earth, which has endured for at least three hundred years. There is turbulence at 1000 km scale; see Space Travel. The upper edge of the atmosphere, just above the cloud tops, is considered the world's "surface" when determining its size, gravity, etc.

Below the immensely deep atmosphere, the pressure turns the world's gases into liquid. Gas giants have no solid surface (unless you count the Earth-size core, which lies at the center many Earth-diameters beneath the cloud tops).

The atmospheric pressure at the cloud tops is very low -

about 0.1 bars (1/10 atm). If a spaceship were to plunge into the planet, it would find the pressure doubling with every 10 kilometers of depth. Patchy clouds occur down to the 1 bar level, which is the deepest that visible light will penetrate. At a depth of ____ km, the pressure exceeds 100 kbars, and the consistency of the gases is closer to liquid. The ship must have Swimming if it is to proceed further. At a pressure of 3 Megabars is the metallic hydrogen ocean.

The temperature at the cloud tops is a few degrees warmer than that of nearby outer space (see "Orbital Temperature" in "Solar System and Planet Generation"), because gas giants give off heat. The temperature rises 5-10 K with every kilometer of depth. At the fluid level, the temperature is in the neighborhood of 2000 K.

All known gas giants have both moons and rings.

ASTEROIDS<B-HEADER>

These rocky objects are also called "minor planets" because several hundred thousand of them circle Sol in a wide belt between Mars and Jupiter, although others have been found in erratic orbits. They are most frequently found in the inner solar system. Asteroids are small; Ceres, the largest, is about 1000 km across; only two others are larger than 500 km. Smaller asteroids are more common, and the smallest - which are essentially boulders - are probably the most common.

Asteroids smaller than 400km diameter have irregular, usually potato-like shapes. Larger objects are round. Small asteroids may be hollowed out and used as spacecraft hulls, or even as space habitats. (See "Starships", and use the cost for a hull of equivalent size.)

Asteroids are useful for their mineral content. Most are made of stone, iron, or carbon (coal). Many space stories concern "Belters," a space-bound community of asteroid miners in Sol's asteroid belt. Likely minerals include iron, nickel, cobalt, and aluminum, but it can be supposed that almost anything exists in at least one rock, somewhere.

Ice asteroids also exists, in the outer solar system. They are made of frozen water, methane, and other ices found in that part of the system. These bodies are perhaps ten times smaller than rock or stone asteroids, but not much is really known about them. They may in fact be identical to comets.

SATELLITES<B-HEADER>

A satellite is an object which circles a world - normally a planet, although a large moon or asteroid may have its own satellite. (The body which a satellite orbits is called its primary, just as a star is the primary of its planets.) Moons are the most familiar kind of satellite, but many planets have rings as well.

MOONS<C-HEADER>

A moon is a world (planet or asteroid) in itself. It will have all the appropriate characteristics of other worlds in that part of its solar system. Some moons have atmospheres and the potential for life. By definition, a moon is less than half the mass of the planet; if larger than this, the pair is called a double planet.

The terrestrial planet with the most known satellites is Mars, with two, but planets may someday be found with quite a few more. Earth's moon may certainly be called The Moon for the rest of human history, but in many SF stories (as well as Star Hero), it is called by its Latin name Luna to avoid confusion.

Gas giants routinely have one to two dozen moons. Most of them are essentially asteroids, both rocky and icy, less than 20 km across. Of the rest of the moons, 7-12 are a few hundred kilometers across, and 1-4 are small terrestrials 1000-2000 km in diameter - usually ice worlds. In rare cases, a Jovian may have a moon larger than this, or even one which is a small gas giant itself.

A world's moons normally circle the planet around its equator, in the same direction. (A captured rogue world may orbit at a different angle and in a different direction). The orbits of the moons lie between 1.25 and 250 times the diameter of the planet. (Planets, like stars, have a Roche limit 1.25 diameters from the planet.) If a moon or other object more than a kilometer across should orbit closer than this to the primary, the force of the planet's gravity will break the moon up into small pieces which eventually become a ring.

The gravitational interactions among a planet's moons force them into related orbits. One moon's period will be related to another's by simple ratios, most commonly 2:1, 3:1, 4:3, 3:5, 2:3, and 1:1 (this last means the moons are co-orbital). For instance, if a moon orbits the planet in 20 days, the moon in the next orbit out may orbit in 40 days, 60 days, etc. A moon may belong to more than one pair, so its period may be three times that of one moon and twice that of another.

TIDES<D-HEADER>

<when do satellites cause drastic TIDES?>

RINGS<C-HEADER>

A ring is made up of millions of small fragments of rock, dust, or ice which orbit their primary like individual moons, above its equator and in the same direction as any actual moons. Rings are typically just a few kilometers wide, but a world may have so many such rings that they appear from a distance to be a few very broad ones. Saturn, for example, has thousands of rings that form a band 100,000 km wide.

On the planet's surface, rings are best viewed from the temperate-zone latitude, where - seen from an angle - they will resemble a huge arch crossing the sky from east to west. At the equator, they will be a thin, barely-visible line passing directly overhead, and at the poles, the rings will be so low in the sky that they may be hidden by the horizon. A highly reflective ring will light up the sky every night - the world will never have the equivalent of a "dark, moonless night."

Ring particles are dust-sized in some rings (Jupiter) and up to house-sized in others (Saturn). Rings also vary widely in number, reflectivity, and concentration. No one knows why Saturn's thousands of rings are spectacular, made of shiny water ice, while Jupiter's single ring is so faint that it was only discovered - by a spacecraft camera - when backlit by the Sun.

All known rings are within the Roche limits of their planets. They either began as moons which wandered too close (likely), or (less likely) as particles which never coalesced into moons when the planet was born, because they were inside the Roche limit. If an existing moon is somehow pulverized, the debris will spread out in its current orbit; it won't move down into the Roche limit.

The Roche limit only applies to natural orbiting bodies. A large artifact, such as a kilometer-long starship, need not worry about breaking up the same way, because of the internal strength given it by basic engineering principles. However, there may be problems with long antennae or booms snapping off. (Note also that this breakup immunity applies only to bodies orbiting planets. Orbits around black holes and other high-gravity objects behave differently. See Black Holes.)

Rings are apparently not permanent features. The larger pieces collide and fragment into smaller particles which are eventually lost to other forces. Ring particles also drift inward and outward from their original orbits and either burn up in the atmosphere or get swept up by moons. This can be prevented by the gravitational influences of "shepherd" satellites that define each edge with their orbits. It is not currently obvious how rings can be apparently both common and ephemeral.

GAS TORUS<C-HEADER>

A gas torus is much like a ring not composed of solid particles. The only known gas torus is the thin sulphur dioxide cloud in Io's orbit. Under extreme conditions, though, the gas might be much higher density, perhaps approaching one atmosphere.

A gas torus is inherently unstable, but there are at least three ways to make it last. The first is to place a world (such as Io) that continually outgases in the same orbit. The second is to flank the torus with a pair of shepherd satellites. Around a world with a magnetic field, the third is to place the torus at the synchronous orbit. Charged particles will then be held in place as an especially dense radiation belt.

OTHER BODIES<B-HEADER>

COMETS<C-HEADER>

A comet is a frozen ball which orbits a sun and, under certain conditions, leaves a visually striking tail - or two - millions of kilometers long.

Comets have extremely eccentric orbits, usually high off the

ecliptic and always very elongated. A comet's closest pass to the sun (called "perihelion") is often less than 1/2 AU. Short-term comets fly out to a maximum distance (aphelion) of about 5 AU (Jupiter's orbit), and orbit the sun in 20 years or less. Long-term comets reach out to past Neptune's orbit and take more than 60 years to orbit. A "non-period" comet takes millenia - sometimes eons - to orbit, or it may spin away into interstellar space for good after its first perihelion.

The comet nucleus is a lump of frozen water, methane, and ammonia, and silicate dust and rocks. No more than 10 km across, the nucleus is all there is of the comet when in the outer solar system. The nucleus also contains traces of carbon, hydrogen, oxygen, and nitrogen, in the same proportions found in only one other source in the universe: living beings. It has been speculated that comets have some connection to the rise of life on Earth, but the chemical similarity may be mere coincidence.

APPROACHING THE SUN<D-HEADER>

When the comet enters the inner solar system, solar radiation causes dramatic changes. Ice boiling off the nucleus becomes a fuzzy, luminous cloud called the coma, which may be 100,000 to 1 million km in diameter and obscures the tiny nucleus.

Ultraviolet radiation and solar wind cause a fluorescent ion tail to stretch away from the coma for tens of millions of kilometers - occasionally as long as 1 AU. Light pressure also pushes dust particles off into a reflective dust tail. These particles move slower and are "left behind" by the comet, so the dust tail is typically curved. The two tails always point away from the sun, not behind the comet's direction of travel, and because they normally overlap they are hard to distinguish. Occasionally, the relative positions of the comet, sun, and observer allow him to see the tails pointing in separate directions.

Larger comets also have a hydrogen envelope, invisible to the eye, which is typically a million kilometers across and surrounds the coma.

LIFE CYCLE<D-HEADER>

The coma and tail(s) are evidence that each pass of the comet close to the sun causes it to lose material. After perhaps a thousand orbits, the ices and much of the rock will be exhausted. All that remains is a group of asteroids which follows the comet's old orbit forever.

Comets are thought to originate in the cometary halo (or Oort Cloud), spherical region of icy asteroids lying 40,000-50,000 AU (0.6-0.8 ly) from the star. The asteroids - comet nuclei - are remnants of the creation of the solar system. They are perturbed from the Cloud by the gravity of planets and the nearest stars, fall towards the sun, and are sometimes captured into their elongated orbits.

COMET FOLKLORE<D-HEADER>

Comets visible in the night sky have traditionally been considered harbingers of evil, plague, and bad luck. Other worlds may have more benign legends about these stellar wanderers. In truth, Earth has passed through comet's tails with no effect whatsoever, yet an impact with a comet may be disastrous as any cosmic collision (see "Catastrophes").

UNUSUAL WORLDS<C-HEADER>

Some planets will have features unique in all of explored space. Certain ideas are presented here, but obviously the possibilities are open-ended.

EXTREME SHAPE<D-HEADER>

No world is precisely round; its rotation makes it bulge slightly at the equator and flatten at the poles. A world which is very massive or rapidly spinning may be visibly "squashed." A world which is face-locked and close to its primary's Roche limit may bulge into an egg shape with one end pointing at the primary. Flattened portions of such worlds may be hundreds of kilometers closer to the planet's center than the "highlands", hence the gravity will be much higher and the atmosphere much denser. The highlands may rise right out of the world's atmosphere.

Small worlds and moons - those close to asteroid size - will sometimes have asteroid-like irregular shapes. These too may have projections which stick out of the atmosphere.

TERRAIN FEATURES<D-HEADER>

A world can have a huge or distinctive terrain feature, such as a canyon many miles deep, or Mars' Olympus Mons, the largest volcano in the Solar System. Such features have great environmental effects. Imagine a range of mountains crossing the center of a continent. If the range is so high and wide that upper-atmosphere winds can't get across, then the two regions can have different climates and separate biospheres; flora and fauna on either side have no contact with each other.

A world with unusual or distinctive weather patterns makes an interesting setting. On Ray Bradbury's Venus, the constant, oppressive rainstorms could drown a man in the open ground. On James Tiptree Jr.'s planet Tyree, the everpresent high winds give rise to flying creatures who spend their whole lives in the air.

MASSIVE BODY<D-HEADER>

A "planet" may not be a planet at all, but a brown dwarf or protostar in what would have been a double-star system had conditions been different. Such a massive body could have very many satellites, including gas giants: a "solar system" of its own.

GHOST WORLD<D-HEADER>

A ghost world is one which once supported life and has since been rendered uninhabitable. The disaster could have been a close pass, a nearby nova or supernova, a nuclear or pollution holocaust, or an event which caused it to "go rogue" from its original orbit or system.

If the planet has had a civilization, explorers might find remaining artifacts, possibly hidden in vaults designed to survive the holocaust. If any lifeforms remain, they will most likely be mutations, and very tough.

Explorers might instead find a dying world which barely survived a past disaster, or whose environment is slowly becoming hostile (as from increased radiation from its sun). This will become a ghost world within a few generations.

ROGUE PLANET<D-HEADER>

This is a planet, moon, or large asteroid which has been cast out of its star system, either by a close pass with another body or by its star going supernova. It may be found in interstellar space, the only case in which a planet does not have a star. Such a world will be a cold, desolate place, any atmosphere it once had now deep layers of ice (unless, of course, the supernova blew the atmosphere away). The world's original surface will be far below the frozen atmosphere.

If a rogue is found wandering through another star system, explorers are likely to mistake it for a native world with an odd orbit until they can carefully plot its course. While visiting this new system, the rogue might pass into regions as warm or warmer than those it began in. If the explorers are lucky they can land when the atmosphere has thawed, to see if any quick-frozen, million-year-old ruins exist.

While in this new system, the rogue world may pass close to or collide with another world. It might even become captured by the star's gravity and take up residence as its newest planet (see below).

CAPTURED ROGUE<D-HEADER>

This planet originated somewhere else. It became a rogue world for a time and settled down into its new orbit as a planet. The most likely type of captured rogue is a moon of a gas giant, which has become itself a planet in the same system.

Worlds with eccentric and highly inclined orbits are usually suspected of having been captured. (Pluto is a likely candidate.) The surface of the planet may show evidence that it had a different climate: the afore-mentioned frozen atmosphere, dry ocean beds, etc.

MULTIPLE-STAR WORLD<D-header>

This is a planet whose orbit encloses two or more stars. It is rare that such an orbit is stable - the planet must be far enough from both suns (3 times the separation). Even then, there is a high chance of eccentric orbits or planets going rogue. Days and nights will have uneven lengths, and seasonal heating differences will come as much from the number of visible stars as from the axial tilt. If the central stars are of different types, odd color shifts will play across the landscape as they rise and set.

TERRAFORMED<D-HEADER>

Terraforming is the science of engineering a planet's surface as desired. In its most basic form, it includes the creation of dams and canals, but in SF it usually refers to the changing of an entire climate, atmospheric composition, or continental terrain. It may not be obvious that a world has been terraformed. Evidence will exist in the rock strata and fossil record. Finding a force-beam cannon capable of digging a river may be a giveaway as well.

The environment of a fully terraformed world is perfect - for the builders. The temperature, atmosphere, fauna, and even gravity will have been changed if the builders were capable - unless they liked a particular aspect just the way they'd found it. The world may be an ages-old relic, or may be currently inhabited. SF usually assumes terraforming to be carried out with sound ecological principles in mind, but a terraformed world may be one on which so much heavy construction has been done that little trace of its original biosphere remains.

SITUATIONAL<D-HEADER>

A world where it has no business being is good material for a story: a life-bearing world around a flare star, a large terrestrial around a Population II star, an unstable orbit in any system. A world might orbit a mini-black hole or cosmic string fragment or other unlikely gravity-bearing object.

OTHER<D-HEADER>

Other unusual planets include those with characteristics far at the end of the possible scale, such as a terrestrial twice the radius of Earth, or a gas giant that gives off so much heat that its nearest moons can support life. Combinations of the above types are quite possible.

VERY UNUSUAL WORLDS<C-HEADER>

These are worlds which are unlikely to be found outside of science fiction. Some of these worlds require an extremely high level of technology; others simply need high levels of imagination.

ARTIFICIAL WORLD<D-HEADER>

This may be an immense constructed satellite, a series of linked space stations, a large asteroid hollowed out to serve as a habitat, and so on. Like a terraformed world (a type of artificial environment), this world will be perfectly suited to its creators, whether inhabited or not. Old artificial worlds may suffer from lack of maintenance.

MEGA-ARTIFICIAL WORLD<D-HEADER>

<CONDENSE "BIGGER THAN WORLDS" HERE. RINGWORLD, DYSON SPHERE (originally planned as disconnected, not a shell) COSMIC MACARONI, MOONBOW, RECORD WORLD> This will be the only "world" in its solar system.

WORLDSHIP<D-HEADER>

This is a powered rogue, a planet with engines powerful enough to push it. The engines may be solely to move the world to a desired orbit, a type of terraforming. Starship engines could move the planet to another star system, to rescue an entire biosphere from a disaster in its home system. In any case, the engines may have been built for just one journey.

A worldship seems a clumsy way to evacuate a solar system, but it guarantees that everyone - that means everyone - can be moved. It is unlikely that a starship fleet of any size could evacuate billions of people from a world faster than they reproduce. Worldships may be built for other reasons: the Death Star was a small artificial worldship.

LIVING WORLDS<D-HEADER>

Such notions offer an interesting surprise to explorers. The planet itself has a mind, or is even intelligent, as is Marvel Comics' Ego the Living Planet (who has worldship capability to boot). More scientific is a single, huge organism that covers the world, such as the sentient ocean in Stanislaw Lem's Solaris. Another type is a group mind comprised of all the world's life-forms.

World-creatures are usually capable of sensing events

anywhere on the planet. Some can control the weather and seismic processes and can terraform themselves, sometimes with great speed. Many have mental powers. Some can control native life-forms, alter their evolution, or give birth to a unique individual overnight.

OTHERS: HOLLOW. SQUARE. EGG OF SOME COLOSSAL BIRD. FRAGMENTS (KIND OF AS ASTERIOD BELT). STEPS: MULTIPLE/GRAVITY FIELDS. MACRO-STARGATE. HUGE PERMANENT FORCE-FIELD "CONTINENTS" (LIKE ZOO WORLD IN MAN-KZIN WARS.)

NEBULAE<A-Header>

A nebula is a cloud of gas and dust, large or small. Some nebulae contain embryonic stars and solar systems, and one kind contains an aging star at its center.

DIFFUSE NEBULAE<B-HEADER>

Diffuse nebulae are large masses of primordial dust within the spiral arms of the galaxy, or else are ancient supernova remnants long past the compact stage. These irregularly shaped clouds are often named for their distinct outlines: the Horsehead Nebula looks like a chess knight in profile, and the North American Nebula resembles that continent. Of course the outline appears different from other points of view, so inhabitants of various systems may have different names for the same cloud.

A typical diffuse nebula is about 30 ly across, but may be as much as 200 ly in its largest dimension. A nebulae can block the view of a whole region of space, making long-range scans difficult or impossible. Interesting objects may therefore be lurking nearby, just beyond the next dust cloud. Of course, these clouds are dense only in a relative sense. Interstellar space contains one atom every few centimeters, and a diffuse nebula is only about two hundred times denser. On Earth, we would call this a good vacuum.

The boundaries of a diffuse nebula are not sharp or obvious except at long distance. A spaceship may fly into one and not even notice at first. Any effect on the ship's flight depends on what kind of drive is in use. A slower-than-light ship will be slowed slightly and a ramscoop will find more fuel to collect. So, any civilization in or near a large nebula may prefer to use ramscoops.

An FTL ship will be affected if it flies FTL through normal space, as with a warp drive. A ship flying through a cloud at speeds faster than about 1000 ly/year will encounter heavy turbulence (Piloting Roll with speed penalty, see Combat and Adventuring) and skin friction.

Diffuse nebulae are further characterized by how they look, as described below. A nebula obstructs visible light and IR frequencies. Seeing into or through 30 ly of diffuse nebula incurs a -2 PER roll penalty, -4 for 60 ly, -6 for 120 ly, and so on.

LUMINOUS NEBULAE<D-HEADER>

Also called emission nebulae, these diffuse nebulae glow with brilliant colors. Hot, type O or B stars (or an OB association) near or inside the cloud give off ultraviolet light which ionizes the gas, causing it to glow like a neon tube. The M42 Nebula in Orion, for instance, is lit by a four-star constellation called the Trapezium. (Absolute Magnitude typically 0-3. This could light a planet within a couple of parsecs.)

The colors in a luminous nebula are caused by the different chemicals which compose it. The cloud is mostly hydrogen with some helium and trace elements such as nitrogen, neon, carbon, and even oxygen. The spectrum of a nebula can be analyzed to determine the precise composition, just like that of a star.

These nebulae are as large as other diffuse nebulae, but only the regions within about 3 parsecs of the O and B stars actually glow. The rest is normally invisible, and should be treated as a dark nebula.

REFLECTION NEBULAE<D-HEADER>

These are the same as the luminous kind, but the star nearby is cooler (nearly always a bright B2) and doesn't produce enough UV light to ionize the hydrogen. Instead, dust particles in the nebula reflect starlight, like a cloud reflecting sunlight at nightfall. (Dust - even black dust like graphite - can be nearly as reflective as snow under the right conditions.) The spectrum of the nebula will appear to be the same as that of the stars whose light it reflects.

Note that a reflection nebula may be a luminous one seen from a different point of view, or that one section may be luminous while another is reflective.

DARK NEBULAE<D-HEADER>

Some dark nebulae are simply diffuse nebulae without any stars to light them. Dark nebulae are also the smaller dust clouds, 1-25 ly in diameter, found in the arms of spiral galax-

ies. Against a black sky with few star, a dark nebula is nearly impossible to see optically; doing so requires a Perception Roll at -6. Because such a nebula can dim or block the light of stars behind it, it may be clearly visible against a background of a dense starfield (as is the Coalsack Nebula), or another, brighter nebula (as is the Horsehead Nebula).

COMPACT NEBULAE<B-HEADER>

"Compact nebula" is a convenient term for a wide variety of objects that are smaller and much denser than diffuse nebulae. A typical compact nebula is only the size of a single star system, either because it was created by a single star, or because it will coalesce into a single star. The statements made about flying through a diffuse nebula apply to these phenomena as well, with more extreme effects. Use a safe speed limit of 10 ly/year.

PLANETARY NEBULAE<C-HEADER>

Planetary nebulae are not planets and aren't truly nebulae either. So named because they resembled planets when viewed through small telescopes, they are actually the remnants of old red giant or supergiant stars.

As a red giant begins to pass to the next stage in its life - collapse into a white dwarf - it blows its outer layers of unburnt hydrogen off into space. The star in the center of this round shell of gas - an unusually hot specimen of about 100,000K - lights up the shell in the same manner as a luminous nebula. (Sol will reach this stage eventually.) The luminous gas forms a cloud no more than a light-year in diameter, having a sharp outer boundary and often a sharp inner one also, giving the cloud a ringlike appearance (and, in the case of the Ring Nebula, its name as well).

A planetary nebula is much denser than a luminous one (1000-10,000 atom/cm³) and a thousand times brighter (total magnitude -1). Space travelers will find the front of the cloud expanding at about 25-50 km/sec. Like luminous nebulae, a planetary nebula is made of hydrogen with traces of elements such as carbon and nitrogen.

After 10,000 years of expansion, during which the star shrinks down to a white dwarf, the gas thins out and becomes invisible, and the nebula as such no longer exists. Planetary nebulae form about once a year in our galaxy, but they seem rare because of their comparatively short lifespans.

SUPERNOVA REMNANTS<C-HEADER>

Many years after a supernova has occurred, the layers of gas which made up the bulk of the star continue to expand into space. Over time this gaseous shell breaks up into giant, irregular arcs which fly away from the center at thousands of kilometers per second. The neutron star left by the supernova's explosion is usually at the center of the nebula, but if the explosion was asymmetrical it might have been hurled out of the cloud.

Supernova remnants may be "dark" and essentially invisible, but many (such as the Crab and Vela nebulae) are illuminated by their central neutron star. In older, more distended remnants, the gas glows as it collides with interstellar matter. This type is much easier to detect in the radio and X-ray spectra than with the eye or optical scanners.

A supernova remnant has a diameter of 8 ly after 60 years, and 100 ly after 20,000 years. The Vela Nebula is the largest known supernova remnant, with a diameter of 2300 ly.

BOK GLOBULES<C-HEADER>

These are very small, opaque dark nebulae. They are notable as the birthplace of protostars and cocoon nebulae, which in turn become stars and solar systems. Bok Globules are 1-2 ly in diameter, spherical in shape, and less than 15K in temperature. Perception Roll -2 to see through or into one.

COCOON NEBULA<C-HEADER>

A cocoon nebula (or "stellar nursery") is the dark cloud of dust which surround a protostar or the star recently born from a protostar. In its early stages, the nebula is 250 AU across.

A later-stage cocoon, as it evolves into a solar system, is more disklike in shape. There's a protostar in the center for fragments to whirl around. The fragments, called planetesimals, range in size from dust particles to asteroids and will grow bigger as, over millions of years, gravity makes them collide and

come together, eventually forming planets. The solar wind blows away the remaining gas and dust - as if throwing off a cocoon - and leaves the new solar system.

Cocoon nebulae are of interest to astronomers wishing to see new stars and worlds being born. The dust obscures visible light as in other dark nebulae - but it also converts that light to infrared radiation, so some detail can be seen with IR sensors.

PROTOSTARS<D-HEADER>

Protostars and cocoon nebulae are, by definition, always found together. A protostar is basically a large gas giant. The environment is starless, so treat it as a large, hot gas giant in the furthest possible zone of a solar system.

It spends several million years coalescing, but only a few 1000 years collapsing (if you look closely you might see it shrink 50% over 1000 years) and getting hotter (over a century you might see the temperature rise a few thousand degrees C).

OTHER SPACE PHENOMENA<A-HEADER>

BROWN DWARF<B-HEADER>

A brown dwarf is a "failed" star (less than 0.08 solar masses, less than 2500 K, the minimum for red star). This is insufficient mass to ignite fusion. Brown dwarfs are made of hydrogen/helium, like gas giants and stars. There is no real distinction between a brown dwarf and a gas giant. A brown dwarf could be ignited by the addition of more hydrogen, if its mass is increased above threshold. It may have planets like a white dwarf. It produces 1/5 the Sun's heat, and all radiation is in the infrared with no visible magnitude.

[Mass: 800 Earths to 0.08 solar. Diameter: Brightness (Magnitude, Per Modifier): Surface Temperature: Damage:] [COLOR, EVOLUTION NOTES.]

BLACK DWARF<B-HEADER>

This is a dead star, a old and inert remnant of a white dwarf, or a very-low-mass Main Sequence star, which has exhausted the last of its fuel. It is now a lump of very dense iron, possibly cool enough to land on, but with a surface gravity of about .2 gravities and a trace hydrogen atmosphere. SIZE: smaller than white dwarf (1/3?). Density: ABOUT 100 G/CC. Surface temperature: anywhere between 2500 K and interstellar space. Escape velocity.

Note the difference between a black dwarf and a brown dwarf, which was never a star in the first place.

BLACK HOLE<B-HEADER>

(Or collapsar) is a former very massive star which had collapsed with age and became so dense that its surface escape velocity became greater than the speed of light. Around the collapsar is a perfectly spherical region called the event horizon. At this distance from the center, the escape velocity is exactly light-speed. No object moving slower than light (that is, no real-life object) can pass beneath this barrier and return. Because photons are affected by gravity, the black hole can trap light beams (and radio waves, x-rays, etc.) as well as matter; hence the term "black". Nothing inside can be seen from without.

Size of a black hole is best measured by the location of its Schwarzschild radius or event horizon. This equals the mass in Suns x 3 km. The original star has at least 40 solar masses, and the black hole has at least 6.

DETECTING BLACK HOLES<D-HEADER>

Despite popular belief, black holes are not hard to detect. Sure, they should be black on the black background of space, but there are several indirect ways to tell where one is. They glow like a hot body, and the smaller they are, the more they glow (photons and neutrinos) and the easier to detect. They emit particles and radiation (called Hawking radiation), and the smaller the mass, the higher the temperature. (Actually, particles and rads come from just outside the event horizon.) Unfortunately a black hole with a mass of a few suns has a temperature less than that of the universal background radiation.

Larger black holes can be detected by x-rays as well. A black hole is surrounded by an accretion disk of infalling material. This is superheated gas that is hot enough to give off x-rays. Matter can be drawn in and pushed out by the magnetic field into a jetstar. A black hole in a binary system with a star wukk have an especially rich accretion disk of matter pulled from companion star. A strong jetstar results.

There are multiple star systems in which one star can't be seen. It could be a dim star, but if it gives off x-rays, it's likely that matter is being drawn off one star and spiraling into the other. This spiraling heats the matter, giving off x-rays. From the motion of the visible star you can determine the minimum mass of the unseen. At Cygnus X-1, 8000 ly away, this other is about 16 solar masses, which is too big to be anything else dim than a black hole.

The only other good black hole candidate known is the binary system A0620-00, 3000 ly from Sol. But, considering how many candidates there must have been since the lifetime of the universe, there may be more than there are visible stars. (Collapsar mass would explain why some galaxies rotate at the speeds they do; the visible mass is insufficient). There's evidence of a black hole of about 100,000 solar masses at the core of our galaxy. Stars ripping up and spiralling in may account for the radio waves and

infrared (not x-rays) observed at the center.

A galactic core can also undergo gravitational collapse to become an enormous black hole. This may be a quasar. In fact, any sufficiently compressed mass would become collapsar.

CREATING BLACK HOLES<D-HEADER>

In the very early universe, pressure was high enough to create very small black holes. These are very rare. The smaller ones have all "evaporated" from Hawking radiation. Primordial black holes of 1 billion tons or more would still be around and would be giving off x-rays and gamma rays at about 10,000 Megawatts. (A primordial hole only a billion tons is the mass of a mountain and the size of an atomic nucleus.)

A black hole of this size might be manufactured by advanced enough technology. It grows by acquiring protons and electrons. If it is fed more of one than the other, it will get a charge and could be held safely in place by electrical forces.

Can't you turn garbage into energy (x-rays) by dumping it into a black hole? Yes, perhaps as high as 40% efficient (10x more than solar nuclear fusion).

ENTERING A BLACK HOLE<C-HEADER>

If an object falls in, the mass of the hole goes up and event horizon increases. Eventually the energy equivalent of that extra mass will radiate back into space.

GOING CLOSE<D-HEADER>

Time slows down close to the event horizon, compared to the outside world. This is functionally a type of suspended animation. Actually, this effect happens near any large mass, but only a black hole makes noticeable effects.

Flying past a black hole requires a parabolic orbit, with careful steering and very little power since the gravity does most of the work. A failed Navigation Roll will have especially dramatic consequences.

GOING IN<D-HEADER>

What happens to an object (spaceship, unlucky astronaut, etc.) that falls into a black hole? After passing the event horizon, the object falls at increasing speed towards the exact center, a point called the singularity. The gravity pulls more strongly parts nearest to it - perhaps several million gravities more - so the object is stretched into a wire one atom wide, then ripped into separate atoms which fall into the singularity, where all matter is compressed to one point. Nothing is sturdy enough to avoid this doom.

ESCAPE<D-HEADER>

This may not be the only possible fate inside the event horizon, according to current theory, speculation, and the whim of the Gamemaster.

If, you may wonder, your ship falls below the event horizon where the escape velocity is faster than light, why not just turn on your FTL? The GM may allow this, provided that 1) the special effects of the FTL drive allow it to be activated close to a gravity source, 2) the ship is still too far from the singularity to be stretched to pieces, and 3) the ship's artificial gravity (if any) can compensate for the increased Gs caused by the violent trajectory.

However accomplished, an escape from a black hole would not be a quick one. The same time dilation that occurs near the event horizon is even more pronounced inside. The collapsar explorer can see the universe speed up around him, because the event horizon does not block incoming light.

A current theory on black holes suggests that a ship inside the event horizon may be able to avoid hitting the singularity and fall through a wormhole (see below) first. The theory also states that the very presence of the ship changes the conditions in the hole, making it impossible to avoid the singularity - but who knows?

In SF, sometimes there's a way to go through them like a worm hole. Hypothetically, matter comes out elsewhere as a white hole or into another dimension. And you may be able to go into the past close to a singularity!

NAKED SINGULARITY<B-HEADER>

A rotating black hole contains a ring-shaped singularity

with no event horizon. It is just barely possible to navigate past the ring, come out the other side in a different universe or part of our universe. This is easier to do with bigger black holes (such as a galactic core collapsar).

WORMHOLES<B-HEADER>

A wormhole is the conjectured bottom end of a black hole, but one could conceivably stand alone. A standalone wormhole might be natural or artificial, or even a natural object enlarged and stabilized by technology. The major advantages of a wormhole by itself are that it permits two-way travel and it avoids the many problems of approaching a black hole.

A natural wormhole terminus is a difficult thing to locate. Its gravity and radiation are very local phenomena and it is nonluminous unless the other end emerges inside a star. Natural wormholes are apparently unstable creatures at best: One or both ends might jump around, the interior cross section can grow or shrink, and the whole thing might just fade away someday.

An artificial wormhole would be constructed with gravity technology or black hole manipulation. The ends can be anchored with gravity or electromagnetic forces, and the interior is probably lined with some unreasonably strong material.

A wormhole can potentially lead to almost anywhere. Possibilities include elsewhere in the same universe, somewhere in a different universe, or through time to past or future.

WHITE HOLES<B-HEADER>

This is the far end of a wormhole that connects to a black hole. It appears to be a single point (singularity) spewing matter and energy. Radiation and temperature will be high. Most of what comes out will be single dissociated atoms, but if something survives the fall into the black hole, it will reemerge intact. A white hole can be detected from far, far away.

COSMIC STRING<B-HEADER>

This is a hypothetical defect in time and space. It resembles a band of matter a few atoms thick forming a loop billions of kilometers around. In fact, a string is not matter; it is a distortion or "crack" in spacetime, and can best be described as a kind of force field. The string has the same effect as a great concentration of mass: a gravitation field as strong as that of a black hole. A cosmic string will cause many of the same phenomena as well: an event horizon, accretion disks spaced at random along its immense length, and so on.

Another strange property is the string's radiation field. This radiation is so strong that it can actually repel matter, effectively clearing out billion-mile channels of space as the string wanders through space at the speed of light.

Cosmic strings have never been seen; any that may exist are incredibly rare remnants of the beginning of the universe.

DANGEROUS PHENOMENA<A-HEADER>

SUNSPOTS AND FLARES<B-HEADER>

Sunspots are cool areas on the Sun and other stars where magnetic flux is concentrated and the solar wind escapes into space. Sol is a slightly variable star with a twenty-two year period. Twice during any period, sunspots, radio emissions, and solar wind are all enhanced.

A sunspot, up close, is not particularly more dangerous than any other part of a star. A solar flare is another matter. This spectacular event is an eruption on the star's surface after a buildup of magnetic energy. Plasma and cosmic rays are spewed into space.

A flare is preceded by five minutes to an hour of agitation in the star's photosphere. An observer can thus predict the flare with a successful Science Roll. These predictions should be less accurate than meteorology at the prevailing Tech Level. The flare itself begins with a tongue or arc of plasma reaching outward as much as a stellar radius. This emits a burst of x-rays of moderate radiation intensity (100 rems - see "Living in a Dangerous Universe"). Since x-rays travel at the speed of light, there will be no further warning of their arrival.

The flare also discharges enhanced levels of cosmic rays (1000 rems/hour) continuously for 1d6 hours. These travel at 1/60 the speed of light and thus reach one AU (eight light minutes) in eight hours. Close to the star, this is a beam of radiation, but the particles quickly diffuse throughout the star system. People on a planet with radiation belts will simply notice bright aurorae and radio static. Anyone in space without protection will probably die.

During enhanced sunspot periods, flares might follow one upon another for several days.

NOVAE<B-HEADER>

Atlas says: all novae are binary stars in which the white dwarf is drawing matter off the bigger star. Is this proven or widely accepted? Can smaller star be neutron, black hole? How long do they take to occur? How much warning? How much damage?

SUPERNOVAE<B-HEADER>

A supernova is the most dramatic of all endings for a star. A supernova is similar in effect to a nova, but very different in cause. In fact, they can't happen to the same stars. For our purposes, there are two kinds of supernova. A Type Ia begins as a white dwarf with a close companion star. A Type II is a very massive old star. (The other kinds of supernova, Type Ib and Ic, are variations on Type II. We won't get into why and thus embarrass astronomers.)

To take the second case first, a red supergiant (rarely, a blue) having at least 8 solar masses will eventually reach a point where the internal pressure from fusion no longer offsets gravitational attraction. The same effect creates white dwarfs (see above), only this star is too big to become a white dwarf. The star will probably oscillate in size for a few thousand years to let folks know what is going to happen. Eventually, and within the space of a second, the stellar interior collapses completely. It rebounds and expands again. The shock wave moves slowly through the star, reaching the surface in an hour. At this point, it tears the star apart in an explosion that can be seen galaxies away.

A Type Ia supernova begins as a large white dwarf, say 1 solar mass, in a close binary system. When the companion star ages and expands, the dwarf draws off much material. Now, a white dwarf cannot be larger than 1.4 Suns. If it absorbs too much matter, then, it becomes unstable and explodes as a supernova.

The visible stage of a supernova explosion occupies from 1-5 seconds. The surface of the star heats to 50,000 K and emits large amounts of radiation. At these temperatures and pressures, new elements form. (Supernovas are responsible for almost all elements in the universe heavier than iron.) The outer layers of the star expand into space as a shell of superheated gas. Eventually, they will be designated a new nebula. The exposed core of the star has increased in magnitude by as much as +20. It can be seen in daytime on planets within its own galaxy and can be identified Megaparsecs away. Peak brightness lasts for a few weeks, then the star fades. The stellar core of a type II event will ultimately become a neutron star. A type Ia supernova tears

itself completely apart. There is nothing left.

Neither type of supernova can be predicted precisely. They are rare, fewer than one per year per galaxy. A Sc: Astrophysics Roll with access to good data can identify stars having no more than a few hundred years of life left. But, the explosion itself will come with almost no warning. A neutrino or gravity detector will sense the collapsing core an hour or so ahead of time. Both neutrinos and gravity waves move at the speed of light, so this warning will always precede the dangerous effects.

THE EFFECTS OF A SUPERNOVA<D-HEADER>

Those dangerous effects are of three types: high temperature, the shockwave, and lethal radiation. Temperatures around 50,000 K will do 11d6 Killing Damage within the star system. This, combined with the force of the expanding gas cloud, will strip gas giant planets in the system down to their rocky cores (if any) and will destroy anything else.

The shockwave is a physical Killing Explosion doing 30d6 at the star's surface and decreasing by the largest 1/2DC for every x2 distance. Its initial speed is 24,000 kps (0.08c). At one light year distant, it has lost 7d6. Beyond this point, as the shock passes through other systems, it diffuses some. The shock front becomes up to a year in thickness and any damage it would do is spread over time.

The third danger of a supernova explosion is radiation. (See "Living in a Dangerous Universe.") The x-ray component of the initial flash travels at the speed of light, an hour behind the neutrino pulse. This is instantaneous radiation doing 1d6 at 40 AU. Additionally, a supernova creates large amounts of radioactive cobalt-56 within the residual star core. This Co-56 decays into iron with a half-life of 77 days, releasing lethal levels of gamma radiation (45d6 at 10 AU) into the system. One year after the explosion, the surrounding gas cloud becomes transparent to gamma rays, and the rest of the galaxy is briefly exposed. At this stage, radiation will do 1d6/second of Transform at a distance of 12 ly, decreasing by half every 77 days. Three years after the supernova, radiation output drops to typical neutron star levels.

WHAT THE RESULTS MEAN<D-HEADER>

Dice of Transform damage and so on may be hard to grasp. If a supernova happened 8 ly away from Earth it would shine as brightly as the daytime sun. X-rays would flood nearby systems, followed a few months later by gamma rays. This would destroy the ozone layer and the resulting increase in radiation would end all life. Even at 80 ly, there would be considerable damage to the biosphere; this may cause mass extinctions.

A civilization with FTL capability may detect a supernova in time to save nearby star systems. After all, a star only 4 ly from the blast has 4 years to prepare. Planets can be evacuated, or asteroids can be blown up to provide a dust screen.

CATASTROPHES<B-HEADER>

<DOES IT CAUSE EXTREME VULCANISM, EXTREME TILT, AND EARTHQUAKES?>
SPACE STORMS<B-HEADER>

LIFE<A-HEADER>

CIVILIZATIONS<B-HEADER>

("Star wars are unlikely"...Carl Sagan. A conflict will usually be won by the higher dev-level, especially in weaponry & warfare support.)

Government by one: Monarchy (limited or total), dictatorship (for life or cyclic), rule by machine.

Government by select group: Oligarchy, republic, feudal nobility.

Government by a specific organization: Military rule, theocracy, corporate, perpetual bureaucracy, one-party rule, miscellaneous.

Diffuse government: true democracy, destructive anarchy, cooperative anarchy, city-states, tribal, active war.

Divided planet: by geography, by environs, by clan, by occupation, by lifestyle.

Interplanetary/Interstellar Society: Spacebound nomads, asteroid mines, star empires, planetary confederation.

Tech levels.

Economic systems. Money

Terraforming. Globular cluster worlds: implications of metal-poor.

SOCIETIES (p.104+ of the how-to-write-SF book).

Based on social/mental characteristics. (usually not far from human).

Try answering these questions: Is life sacred? For all sexes and races? Slavery. Territorial drive (rootlessness). Aggressive? (war, violence). Is man perfectable? (No: power corrupts. checks and balances.)(Yes, but society must be perfect: communism) (Yes, but society must be unrestrained: anarchy). Are sexes equal? (Women too valuable to be in army). Are they different? Casual sex. Technology: cheap and plentiful energy? what if everyone has what they want? Laws. Law enforcement: citizens or police. Police cannot be "incompetent buffoons". social order must have passive support of most citizens and active support of police.

About Socio/political Development levels: are civilizations really a progressive thing? Karl Marx thought so, and look where he ended up.

SPACE TRAVEL<A-HEADER>

APOLOGIA<C-HEADER>

The principles of spacecraft motion were worked out a very long time ago by Isaac Newton, as modified by Einstein's Special Theory of Relativity in 1905. So, the informed reader will have anticipated the contents of this section. Game mechanics are another matter, however. There are two significant obstacles to using Real Science in the spaceship combat rules, although an approximation was presented as an option. One is playability, and the other is the existing vehicle movement rules, which make no concession to Newton's First Law of Motion. The way things really work is described in this section. The Hero System rules are found in Combat and Adventuring, and where differences occur, these are the reasons.

SLOWER-THAN-LIGHT TRAVEL<A-HEADER>

CONVENTIONAL SPEEDS<B-HEADER>

Conventional speeds are those much less than the speed of light, say one percent of c or less. At higher speeds, relativity begins to take effect, although it doesn't dominate until about $0.85c$.

THRUST<C-HEADER>

An object in motion will stay in motion until acted on by a force. That simple rule governs spacecraft motion. In flat space away from planets, a ship will thrust (accelerate) toward its destination for a while, then coast. It keeps moving until it thrusts forward to cancel that velocity at the end of the journey. The duration of the journey is shortened by using more thrust or coasting for less of the distance.

Most spaceship engines are reaction engines, which means that they move the ship by throwing mass out the back. This requires fuel tanks, and realistic fuel tanks are big - at least half the volume of the ship. Unrealistic fuel tanks can be a lot smaller, as can tanks for a very weak engine. Fuel tanks usually contain chemicals to burn, but these can be solids as easily as liquids. If the engines get their energy from some other source such as solar power, then the "fuel" tanks simply hold throw mass, which can be rocks, ice, or water.

All of which goes to show that there are many kinds of spaceship engine. Here are some common types:

REACTION ENGINE<D-HEADER>

The most common and realistic reaction engine burns some fuel or fuel combination. The hot gases expand out the stern of the ship and double as throw mass. Reaction engines require big fuel tanks. If the fuel is naturally occurring, then the ship can refuel at the appropriate asteroids or gas giants.

FUSION ENGINE<D-HEADER>

Fusion is simply one way to power a reaction engine. This kind of engine runs on hydrogen, fusing it into helium. The hot helium acts as the throw mass. Hydrogen is cheap and plentiful, and fusion provides much more energy than chemical reactions, all of which makes this an attractive choice.

ORION DRIVE<D-HEADER>

An Orion Drive is an extreme reaction engine: thrust comes from exploding nuclear bombs! The ship in question has to be massive, backed by a thick pressor-plate and good shock absorbers. Orion Drive can be used to take off from a planet, but no reasonable government will permit this.

ION DRIVE<D-HEADER>

An ion drive is a very weak reaction drive that requires little fuel. Ions, charged atoms, are emitted by hot matter and radioactives among other sources. The throw mass is tiny and so is the acceleration, but any thrust will generate a large velocity after enough time. Ion drives are used where cost and weight are more important than maneuverability, such as a generation ship. An ion drive cannot be used to lift off of a planet.

LINEAC<D-HEADER>

An object doesn't need to have it's own engine at all. Just throw it at the destination. A linear accelerator, lineac, or

rail gun is a track or tunnel pointed at the horizon. The payload is accelerated to escape velocity by magnetic induction or some other convenient means. A lineac works best from an asteroid or moon, but a big enough one can fling objects off of a planet. Ships with low thrust engines (ion drive, etc.) might rely on a lineac to get them started.

A ship itself might include a lineac as its means of expelling throw mass. This results in a slow ship, but one that is cheap and easy to build.

LIGHTSAIL<D-HEADER>

Starlight and solar wind both carry momentum. A ship with a lightsail can use these to maneuver, slowly. ("Slowly" means low thrust, of course, not low speed. Speed can be anything.) A typical lightsail is a huge aluminized square of lightweight material, kilometers across, but weighing only kilograms. Naturally, it is fragile.

A lightsail spaceship maneuvers much like a sailing ship on an ocean. Thrust comes from the local star. The spaceship can also sail by means of artificial light, if laser cannons are trained on it. This is the only way to develop thrust in deep space. Obviously, a lightsail cannot be used in atmosphere.

MAGNETIC OR GRAVITY DRAG<D-HEADER>

Magnetic drag is another low-thrust drive system for use between stars. The ship extrudes wires and charges itself up. It can then steer, a little, on the galactic magnetic field. A hypothetical variation of this is the gravity drag. With this device, a spaceship can latch onto the gravity field of a nearby massive body and be pulled into it. Neither drive is suitable for taking off from a planet.

REACTIONLESS DRIVE<D-HEADER>

A reactionless drive is for anyone who doesn't want to bother with the nuisances of real physics. A reactionless drive converts fuel into momentum without needing throw mass. Since it doesn't use exhaust tubes, it can sit protected in the center of the ship. If the reactionless drive uses fusion or some other efficient energy source, then it doesn't need large fuel tanks, either.

ORBITS<C-HEADER>

When a spaceship isn't thrusting, it's in an orbit, unless it is sitting on the ground. Spaceships obey the same rules of orbital mechanics as planets and moons (see Space) with a couple of exceptions: they can take up unlikely or unnatural orbits, and they can change orbits.

In flat space between the stars, a pilot can just point his ship and go, without worrying about the law of gravity. Within a star system though, he can only get along without a navigator if he's willing to waste fuel in seat-of-the-pants flying. The following various kinds of orbits require a successful Navigation Skill Roll. Failure means that the ship has entered a different orbit (wrong altitude or inclination) with results ranging from inconvenience to actual danger.

STANDARD ORBIT<D-HEADER>

In spacer language, a standard orbit is a circular orbit above a planet's equator. The spaceship orbits in the same sense that the planet rotates (prograde). The orbit is high enough above the atmosphere that air drag is not an issue, but low enough for sensor sweeps and convenient shuttle missions. Above Earth, a good altitude would be 500 km.

SURVEY ORBIT<D-HEADER>

A survey orbit is much like a standard orbit, but tilted 30 degrees or so to the planet's equator. This puts much of the planet under the ship's sensors within a few orbital periods.

RETROGRADE ORBIT<D-HEADER>

A ship in a retrograde orbit travels against the rotation of the planet. The advantage of this is that terrain passes more quickly under the ship. The disadvantage for a ship launching from the planet is that much more fuel is used canceling the velocity of rotation of the planet's surface.

POLAR ORBIT<D-HEADER>

A polar orbit passes over both poles of the planet. As the planet rotates underneath, the ship eventually passes over every part of it. This is ideal for exhaustive search and survey missions, but a ship launched from the surface requires more fuel than normal to cancel the planet's rotation.

LOW ORBIT<D-HEADER>

A low orbit is positioned in the top of the atmosphere (100-200 km above Earth) for high-resolution photography. Atmospheric drag will cause such an orbit to decay in a matter of weeks or years. Regular engine corrections will delay this.

SYNCHRONOUS AND STATIONARY ORBITS<D-HEADER>

Synchronous orbit is high enough that the orbital period equals the planet's day. This means that the ship passes over any particular spot at the same time of day. A stationary orbit is a synchronous prograde orbit in the plane of the equator. The ship seems suspended above a single point on the surface. Earth's stationary orbit (35,000 km radius) is crowded with communications satellites.

FORCED ORBIT<D-HEADER>

A forced orbit is usually a low orbit. The ship orbits much faster than usual by using its engines to develop additional inward thrust. A forced orbit is usually used in a dangerous situation, such as above a turbulent gas giant. The reason is that as soon as the engines are cut, the ship swings out to a higher orbit.

TRANSFER ORBIT<D-HEADER>

A transfer orbit is a way of getting from one permanent orbit to a higher or lower one. The transfer orbit is elliptical and touches both of the other ones. To use a transfer orbit, a ship makes one maneuver entering it and another to leave it at the altitude of its new permanent orbit. The ship does not normally stay in the transfer orbit for an entire period.

OPTIMAL ORBITS<D-HEADER>

A ship usually has a choice of several transfer orbits. In picking one, the navigator usually optimizes fuel efficiency, time, or some other factor. The fastest orbital transfer can burn a lot of fuel. Conversely, a minimal-fuel orbit can take a lot of time. For example, an orbit from Earth (1 year period) to Mars (2 year period) can itself take up to two years, depending on the relative positions of the planets.

LAGRANGE POINTS<D-HEADER>

The 18th century mathematician Lagrange examined the case of a small body orbiting a larger one (as a moon around a planet). He found five positions at which a relatively tiny third body could be placed and stay. Three of these are on the line connecting the two centers of mass and turn out to be not very stable. The fourth and fifth Lagrange points (L-4 and L-5) are in the orbit of the moon, 60deg ahead of and behind it. These positions are indeed stable long-term.

The Lagrange points of any body tend to collect dust, boulders, and even asteroids, depending on the size of the orbiting body. Jupiter's Lagrange points contain several asteroids, which have been named after heroes of the Trojan War. Hence, the other name for these positions, Trojan points.

The Trojan points of a planet-moon system are a good place to park space stations. Also, because they contain lots of debris, they may be good locations for a spaceship to lurk unseen when it wants to spy.

ESCAPE VELOCITY<D-HEADER>

A ball thrown upward on Earth will fall back down. But, if it's thrown fast enough (12 km/sec - quite a throw!), it will leave the Earth's gravity well permanently. Atmospheric drag increases this escape velocity somewhat, but the principle stands. A spaceship that breaks away from a planet by accelerating and coasting must reach escape velocity to do so. A ship that thrusts continually can use slower speeds.

Larger bodies have larger escape velocities, and the necessary velocity is smaller from far orbit than from the surface. A satellite has an escape velocity just as any world, though it will be lower than that of its primary. Remember that in order to

leave the planet/moon system from the moon, a ship must be going fast enough to break orbit from both bodies.

PARABOLIC AND HYPERBOLIC ORBITS<D-HEADER>

When an object falls toward a massive body, whips around it, and leaves, its path is a parabolic orbit. The object is everywhere moving at escape velocity. At higher speeds, it follows a hyperbolic orbit, though a Navigation Roll is required to tell the difference. Highly eccentric cometary orbits are almost indistinguishable from parabolic orbits.

RELATIVITY<B-HEADER>

QUOTE: [FROM THE LYRICS OF "'39" BY QUEEN ON THE ALBUM A DAY AT THE RACES]

Relativity is the change of physical quantities and measurements when observed in various states of motion. Relativistic effects happen all the time, but unless objects are moving very fast - near the speed of light - the effects are much too small to be detectable. The effects below have been proven by examining swiftly-moving subatomic particles. Other relativistic effects that have yet to be proven are the existence of black holes and gravity waves. See "Black Holes" and "Radiation".

INVARIANCE OF LIGHTSPEED<D-HEADER>

Imagine a train moving at 90 km/hour. A passenger walks from the back of the train to the front at 3 km/hr, relative to the train. To a stationary viewer watching from outside the train, the passenger seems to be moving $90+3 = 93$ km/hr. His speed depends on the frame of reference from which he's viewed.

Surprisingly, the same does not hold true of light. If you watch a spaceship coming at you at one-half the speed of light (or $0.5c$), and it fires a searchlight beam (which moves at c) at you, you would expect the beam to reach you at $1.5c$ - but it does not. You will see it moving at c - lightspeed. The pilot of the spaceship also sees it reach you at lightspeed.

In short, all electromagnetic phenomena - light, radio waves, gamma rays, etc. - always appear to be moving at the speed of light, even to people viewing the same rays while moving at different speeds.

BLUESHIFT AND REDSHIFT<D-HEADER>

The relative speed of the viewers does have a noticeable effect on light, however. In the example above, we would see the wavelengths compressed as the beam approached us. Wavelength translates to color, so the colors of the beam would be blueshifted - red becomes orange, orange becomes yellow, green becomes blue - all the colors are shifted towards the blue/violet end of the spectrum. Violet light falls off the end into the ultraviolet. (The pilot would see us blue-shifted as well).

A similar redshift occurs when you watch objects moving away from you at high speeds. Yellow stars behind your spaceship will appear orange or red, or even infrared, as you race away from them. The faster the viewer moves toward or away from the object, the greater the blue- or redshift.

This effect, called the Doppler shift, also affects "invisible" wavelengths. X-rays or radio waves may even be shifted into the visible range. Doppler shifting can be measured, and the relative speeds computed. The expansion of the universe was discovered when astronomers noticed the redshifted spectra of distant galaxies, and realized that they are all moving away from us and each other.

MASS INCREASE<D-HEADER>

Objects moving near lightspeed also increase in mass when viewed from rest. At $0.1c$ (10% the speed of light), the additional mass is only 5%, but at $0.85c$ the mass is double that at rest. At one billion trillionth below lightspeed, a small spacecraft will mass as much as a medium-sized asteroid; should it approach a world at such speeds, it will wreak the same gravitic havoc as a close pass with such an asteroid.

Were an object to actually reach the speed of light, it would have infinite mass and would shortly cause the universe to collapse in upon it. Fortunately, it requires infinite energy to accelerate a mass to lightspeed, which is why c is the ultimate speed limit of the universe.

See Formulae for the precise mass increase.

LORENTZ-FITZGERALD CONTRACTION<D-HEADER>

To stationary viewers, an object moving near lightspeed appears to become shorter in its direction of movement. A ship moving at 85% of the speed of light will appear half its normal rest length. At 99.99999999% of c, a 200-meter ship would appear as a disk a millimeter thick.

TIME DILATION<D-HEADER>

The most dramatic effect is the slowing of time when moving at near-light speed. On board a spaceship moving at 0.85c, time passes only half as fast as it does for the outside universe. If a space journey at 0.99c takes 30 years, only four years will have passed for the crew.

Time dilation also occurs when close to very large masses. If your spaceship passes close to the event horizon of a black hole and survives the gravity, you will spend the next lifetime or so in a kind of suspended animation until your ship falls away again. This is the outside observer's view, of course.

WHAT YOU'D SEE<D-HEADER>

You hop into your ship, aim it toward Betelgeuse, crank up the drive and hit the hyperburners. You accelerate - zero-point-seven c, point-eight, point-nine. Betelgeuse burns dead ahead of you, but not its normal red color. Your velocity has blueshifted it: it turns orange, then dull yellow. In your rear monitor, the opposite has happened to Sol: its gotten red.

But it's the other stars that get your attention. They're moving. The stars in the front half of your sky are slowly migrating to an area directly in front of you. You know it's an illusion caused by your great speed, but it's still unsettling.

Now all the stars you see crowd around Betelgeuse. For a while you could make out moving constellations - you think of flying Swans and charging Bulls - but not anymore. The stars in their courses have occupied a spot smaller than that of Luna seen from Earth, and brighter - a tenth the brightness of Sol on a sunny day.

On a hunch, you check your rear monitor - yes. Sol is surrounded by its own halo of stars, those that used to be in the rear half of your sky. All else is blackness.

If you could reach lightspeed, you would see only two infinitely bright spots, one fore and one aft. You never will, of course, but there are compensations.

There's nothing in the universe like the view you'll be seeing next.

Ready for hyperspace...

FASTER-THAN-LIGHT TRAVEL<A-HEADER>

Current scientific thinking is that faster-than-light travel is impossible by any means. However, FTL makes for great science fiction stories, so everybody assumes it. You will probably do the same in your game. The details of FTL, though, are certainly open to choice. There are many possibilities, as discussed in this section. How it works in your game will determine who has it, how convenient it is, and in general, what stories are possible.

TYPES OF FTL TRAVEL BY GAME MECHANIC<B-HEADER>

Here we discuss how FTL travel can work in terms of Hero System game mechanics. Game mechanics are what get written on the vehicle sheet or, rarely, the character sheet. Flight, Teleportation, and other Powers are all legitimate bases to use. A few implications of each are given, with references to the next section, in which FTL special effects are examined.

EXTRA DIMENSIONAL<D-HEADER>

Ships that travel using Extra-Dimensional Movement will have no contact with normal space. Possibly they will have contact with each other or with beings and objects in hyperspace. The amount of time that passes during travel may be different from the time experienced in normal space. Examples include hyperdrive, inverse mass, and tachyon conversion.

FTL TRAVEL<D-HEADER>

Ships using FTL Travel will go through normal space, but will normally not interact with it, as though Desolidified. As with Desolidification, though, the ship may be affected or even disrupted by select phenomena. Typically, ship's sensors still work, and strong gravity gradients are dangerous. Examples include warp drive, and jump drive if it takes time.

FLIGHT<D-HEADER>

Ships using Flight have normal rules of engagement for sensing and encounters, just at very large scale and speed. Examples include warp and stutterwarp.

TELEPORT<D-HEADER>

A ship using Teleport has no contact with areas between points and never actually has speed. Examples include teleport travel, jump points, and warpgates.

TYPES OF FTL TRAVEL BY SPECIAL EFFECT<B-HEADER>

This section discusses FTL travel by special effect, the way a ship's engineer would. Dozens and dozens of variations may be found in science fiction, and they all have impact on the kind of stories that can be told. How expensive/convenient/reliable is FTL travel? Where can the characters go? Can they travel secretly? Can they get out of danger fast? Pick a form that will work in your campaign, and then individualize your choice with the twists and limitations suggested later. Note that if you like more than one selection, different races or empires can use different forms of travel.

HYPERDRIVE<D-HEADER>

In this form of travel, a ship flies through another dimension, called hyperspace, inverspace, or subspace. This works because

- 1) there is a 1-to-1 correspondence between spaces, and the spaces are closer together in hyperspace; or
- 2) the speed of light is not a limiting factor or is higher; or
- 3) objects sent into this dimension are converted to tachyons and must travel faster than light; or
- 4) there is a 1-to-1 correspondence of points, but distances between points vary (i.e., three stars all 10 ly from each other in real space are not necessarily all the same distance in hyperspace).

There may be objects in hyperspace, even planets, even life. Hyperspace may be used for convenience, but poorly researched in and of itself. Sometimes (with certain versions) hyperspace can be affected by normal space. A common case is for gravity wells to be barriers, so that FTL cannot be used within a star system. In this case, uncharted neutron stars could be hazardous.

Hyperdrive ships may or may not be able to communicate with each other. If so, piracy is a possibility (assuming some kind of weapon works in hyperspace). Can pirates establish a permanent base in hyperspace, or do they have to come out after a short time?

Typically, a ship in hyperspace is cut off from the universe. The navigator makes his calculations, the pilot pushes a button, and only at the end of the journey do they know that they are in the right place. Also, since travel takes time, things may have happened in the meantime so that a whole different situation prevails by the time the ship drops back into normal space.

"WARP" DRIVE<D-HEADER>

[Let's call it something descriptive and non-gurpsian/trekkian. The Warp Envelope is a special effect; FTL-in-normal-space is the mechanic. "Field Drive"?]

This form of drive permits FTL travel in normal space by wrapping an envelope of hyperspace around the ship. Different laws of physics apply within the field, hence, FTL. Ideally, only the speed of light is different, but there may be side effects. Sensors may or may not be reliable, ship's crew may suffer headaches or have to take special drugs, and so on. Remember that the ship is actually in normal space, so stray asteroids and even pebbles are a lethal hazard if they can't be swept aside.

JUMP DRIVE<D-HEADER>

This is long range teleport with limitations. You can jump

- 1) from any jump point to any other jump point; or
- 2) from a jump point to one other "related" jump point; or
- 3) from a jump point to a group of "related" jump points; or
- 4) from any jump point to anywhere else; or
- 5) from anywhere to any jump point.

A jump point is a place where teleporting is possible. This assumes that you can't teleport to or from anywhere else (except for Types 4 and 5 above). Depending on special effects, a jump point may be immobile or may drift through space. Usually the machinery is all in the ship; it's called a "jump drive".

Jump points may be natural, artificial, or both. Natural ones are valuable natural resources, usually guarded and often fought over. Artificial ones have a space station nearby; presumably, they can be built anywhere, but would be very expensive. Prior mapping of points is required, or they can be predicted.

Note that it is hard to get between jump points. Other backup drives may be necessary to explore uninhabited areas, or those between points. A civilization that uses jump points tends to overlook the areas it can't get to easily. Undiscovered races, overlooked jump points, and interesting natural phenomena may lurk in the corners.

The mechanics of jumping are of interest. Jumping may take a long time to initiate or a lot of calculation. There may be physical or psychological side effects. And, since the jump is normally to or from civilization, someone is keeping a record of the ship's movement.

WARPGATES<D-HEADER>

This is long range teleport with some of the machinery located outside the ship. You can jump

- 1) from any warpgate to any other warpgate; or
- 2) from a warpgate to one other "related" warpgate; or
- 3) from a warpgate to a group of "related" warpgates; or
- 4) from any warpgate to anywhere else; or
- 5) from anywhere to any warpgate.

A warpgate (or stargate) is a two-dimensional jump point shaped like a hole in space. Any ship (or any object small enough) can enter and emerge at its new destination, without a special drive. SF Warpgates are usually of Type 3. The "wormhole" phenomenon is a hypothetical natural warpgate (albeit too small to pass electrons: Just make it bigger). Warpgates may always be open, or may close periodically (or randomly). Depending on special effects, a warpgate may be immobile or may drift through space.

All of the discussion about jump points applies to warpgates. Warpgates may be natural, artificial, or both. Natural ones are valuable natural resources, usually guarded and often fought over. Artificial ones are expensive and always guarded. Warpgates may be relics of a lost civilization or lost technology.

Perhaps ships need a special drive or force field to use a warpgate safely (or at all). This puts some of the hardware onboard the ship.

Warpgate travel may not be instantaneous from the point of view of the travelers. In this case, it resembles hyperspace travel.

TELEPORT<D-HEADER>

A ship just jumps from one point to another with this form of travel. If it is efficient enough, you may not need spaceships to travel to known worlds; just teleport passengers and cargo "naked". If ships are still necessary, teleport is very much like unrestricted jump point travel. Commonly, lengthy calculations are required before each jump, else a ship can just disappear at the first sign of trouble.

REPEATING TELEPORT<D-HEADER>

The ship can teleport short distances with a fast cycle time. With repeat-teleport, the effective velocity = teleport distance/cycle-time. If teleport distance is less than the length of the ship, it can't teleport through objects and you might as well call it Flight. If cycle-time is faster than once per second, it can't be used on the Speed Chart as Teleport and you might as well call it Flight anyway.

A repeat-teleport ship may need safety interlocks or deflector beams to keep it from jumping into space debris. Even if this is taken care of though, there is another problem: The ship jumps on top of photons emitted by surrounding stars. In plain language, the walls look transparent. Passengers may suffer agorophobia, and pilots may strain to read their instruments.

PSIONIC<D-HEADER>

Psionic powers haven't been mentioned yet. This form is like any other, but it requires a psion to propel you (FTL is a Mental Power) or initiate FTL, or navigate it. FTL as a Mental Power may be bought with extra mass as Teleport. A psion needed to navigate or initiate FTL buys a Skill instead. If psions are rare, then they are either highly paid or treated like slaves.

OTHER<D-HEADER>

There is always a "miscellaneous" category. If magic exists in the campaign, it provides yet another way to circumvent Einstein's limit. And, of course, there is the Big Words science approach: make up something and don't explain the details. In practice, though, you still have to decide if the ship flies around obstacles or through them, whether piracy is possible, and so on.

TWISTS AND FEATURES<B-HEADER>

No two forms of FTL are exactly alike. Therefore, you should personalize your choice in some way, if only in the appearance and name of the machinery in use. Actually, what is really needed is limitations on the usefulness of FTL.

The reason for limits on the utility of FTL is to guide and control the stories. First, FTL travel should feel special in most campaigns. Characters should regard it more as a charter air service in our time (infrequent and expensive) than as a bus. Second, the characters should probably be restricted in how often they move from planet to planet. Creating a planet, life form, government, etc. is hard work, and there may be several stories lurking in each star system. If the characters can fly away on a whim, much of that work is wasted. Third, the characters should not have an easy time out of danger. If they get too close to a black hole, space squid, or enemy navy, they should not be able to disappear at the push of a button without confronting the situation.

A typical limitation for FTL travel is to be at least 100 AU from a solar mass, or any big gravity source. This means that travel within a star system is by conventional drive. Indeed, travel within a system may take more time than the FTL portion did.

If hyperdrive FTL does not have precise 1:1 correspondance with the normal universe, it might vary by a good Navigation Roll (giving the navigator some responsibility), or be completely random, or might be approximate. In fact, Navigation Rolls are always a good idea, with the standard -2 penalty for 4-dimensional travel and perhaps more, depending on the technology. It is

also common for preparations, including the calculations, to take a half hour or more.

Speed effects are a consideration: FTL may be available at only at one speed. Or, perhaps, only at top speed. In this case, a ship can't slow down, but it can have more than the next ship. With this option, the characters are limited as to where they can visit, but select enemies can hunt them down and catch up to them. Note that speed determines the amount of space that a single government can handle. Anything more than a couple of months travel from the capital is mostly on its own.

Other limits besides speed include max distance and max mass. Distance limits ensure that there is always unexplored space. Mass limits make the speedy space scout more viable than the cargo ship or passenger liner.

FTL COMMUNICATIONS<C-HEADER>

Once the details of FTL travel are settled on, it's time to decide about faster-than-light radio. Specifically, does it exist? FTL radio allows for regular news updates from other planets. Characters can call ahead when approaching a star system and they can call for help when they run into deep-space problems. Law enforcement can easily put out bulletins on them.

If FTL radio doesn't exist, information flows no faster than the mail ships. News updates from other planets will be days or weeks old. Characters entering a star system may be surprised by new developments. On the other hand, they can run away from old enemies. And deep-space rescue is a matter of luck.

Whether FTL radio makes sense depends greatly on the choices made in designing FTL travel. Hyperspace allows for hyper-radio, but warp drive and jump points require physical engines. If warp gates let light through, well, radio is a form of light. Psionic travel implies psionic communication, though not necessarily at interstellar scales. If you have decided that small ships are faster or more efficient than big ships, then FTL communication beams represent the smallest ships of all and should work.

STL TO THE STARS<B-HEADER>

Visit the stars without FTL! It's perfectly possible, although not nearly as convenient. If you don't want to offend Einstein or the science purist in your group, try one of these methods:

TIME DILATION<D-HEADER>

A ship traveling close enough to lightspeed without exceeding it will seem to take little time between systems. For example, a ship at 85% of c will cover two lightyears every year, from the point of view of the crew. The outside world has a different opinion, of course. Thus, mail will be slower than radio, but passengers have no other choice.

The drawback to this method, other than true passage of time, is that the ship requires lots of fuel. One workaround is for the ship to be accelerated by linear accelerator or laser in the starting system. Another choice is the Bussard ramjet: the ship projects a magnetic field ahead of it that collects interstellar hydrogen. Some arrangement may be needed on the far end to slow the ship down when it arrives.

People who use time dilation to make round trips will discover that their siblings have grown old in their absence. In extreme cases, everyone they know is long dead.

GENERATION SHIP<D-HEADER>

A generation ship simply accepts the reality that travel from star to star takes a long time. The ship goes at a more attainable speed, say 0.01c, and people grow old and die during the trip. They raise kids and train them to be the new crew. A generation ship is usually very large and is really a campaign setting in and of itself. If machinery breaks down, spare parts are hard to come by. The kids may have different ideas from their parents as to where to go or what to do. And a slow-moving ship has a better chance of noticing strange asteroids that it passes.

If a generation ship is not the campaign setting, it can also be the source of a story if a more advanced civilization having FTL encounters one sent out by someone else. Or sent out by themselves long ago, for that matter. Note that the generation ship may be moving faster than the FTL ship can when it is in normal space, so that catching up is a problem.

SUSPENDED ANIMATION<D-HEADER>

Also called cryosleep or hibernation, this involves putting people in big tanks and slowing down their metabolisms for the trip. Drugs and cold are the usual approaches. There may be a skeleton crew on watch, in shifts, or the whole ship may be computer controlled. (This is bad when the computer malfunctions and even worse when something unexpected shows up, such as borders.) Remember that the ship is traveling in normal space, so a long time passes, as with a generation ship.

LONGEVITY<D-HEADER>

If the characters live long enough, they can go anywhere they please. They may be robots, or even vampires. Obviously, this requires a certain amount of patience and detachment, especially if the rest of civilization is on a normal schedule. Fashions will change, and whole governments will rise and fall as the characters fly about. As the only beings with long-term memories, they may be a corps of specialists to do social troubleshooting. One advantage to this method over cryosleep is that the characters can be in radio contact at all times. They thus don't face the shock of absorbing all changes at once.

THE FTL QUESTIONS OF YOUR UNIVERSE<B-HEADER>

Here are some questions to answer in individualizing the FTL travel in your universe. Not all of the answers have significant game effects, but they will give the players a better feeling of being there.

Can FTL ships detect each other? Can they detect/be detected from n-space? Is piracy possible? Can an FTL body affect or be affected by one in n-space? Can they sense gravity wells (i.e. celestial mass) only? Is it unsafe to use FTL too near a gravity well?

What does it look like out the windows? Blind Spot? Swirling vapors or energies? Do people go insane looking at hyperspace? Can hyperspace affect flight like ocean currents & storms? Can you see the stars?

If you use warp gates or jump points, how are they discovered? Who controls them? Does travel between points seem to take time? (And what does it look like out the window?)

Is FTL good for sending mail? Bulk cargo? Passengers? Do you have FTL radio? Fast or instantaneous?

How many forms of FTL are there in your universe? Is the scientific "loophole" you use obvious, so that anyone will discover it? Or was it a lucky accident by one person/race?

Can everyone use FTL travel? Do a few people or one race get sick? Or can only an elite few survive? Can anyone become a pilot/navigator? What modern transportation method most closely resembles it?

GRAVITY<A-HEADER>

Human beings need gravity. The observed problems with long-term exposure to free fall include diminished muscle tone and loss of calcium from the bones. Children who grow up in free fall may never develop strong hearts. In space, though, there isn't any gravity unless it's somehow manufactured. There are four basic ways to do this.

THRUST GRAVITY<B-HEADER>

A spaceship under thrust has internal gravity naturally, which is why ship drive systems are rated in g's. For example, if a ship is increasing its speed by 60 hexes (not Megahexes) per Turn every Turn, passengers can't tell the difference from standing on Earth. This gravity has the same strength in every part of the ship, and "down" is the same as aft. If the ship turns, passengers will be pulled toward the outside wall. Violent maneuvers could hurt people, then, especially at Megahex scale.

SPIN GRAVITY<B-HEADER>

A ship that rotates (usually about its longest axis) creates centrifugal force inside, which is indistinguishable from gravity. The "floor" is the inside of the hull, and the spin axis appears to be "up". Spin gravity is commonly used by space stations, but may also be used by a ship if it's coasting or drifting. Spin is a low-energy and low-tech solution to the problem of gravity, but there are a few disadvantages.

A space station built for spin will be wheel shaped or have long arms with many floors. Gravity increases away from the spin hub, so the rate of spin is usually designed to produce one gravity at the rim. The formula is

$$\text{Gravity (g's)} = 8 \times \text{radius} / (\text{period})^2 ,$$

where the radius is in hexes and the spin period is in seconds.

The ship or station must continue to spin to maintain the gravity. If the ship must accelerate forward, it must do so gently or thrust gravity takes effect as well. If a small craft uses spin gravity, sensitive people will complain of motion sickness. Also, maneuvering jets are tricky to use during spin. The oddest drawback to spin, though, is the coriolis force, a sideways drift of objects moving inside the craft or station. This force is tiny enough to ignore in game terms, but it may be a subliminal annoyance.

NEUTRONIUM<B-HEADER>

The only real-life way to make true gravity is with matter: all matter produces gravity, and the more mass, the more gravity. Deck plating made of neutronium or other hyperdense material is a rather extravagant solution to the problem. It requires advanced force field engineering to keep the material under pressure and it requires an absence of actual gravity technology. A sheet of neutronium produces a flat gravity field. Both sides can be used, but the field drops with distance, so only an extremely large artifact, such as a discworld, can have significant gravity to a great height.

Variations of this idea include building a space station around a micro-black hole and putting neutronium ceilings on a planet to produce low-gravity.

ARTIFICIAL GRAVITY<B-HEADER>

Actual artificial gravity is still science fiction, but may fall out of a Unified Field Theory. As described in SF, gravity generators have all of the conveniences with none of the drawbacks of other approaches. The generators described in the Technology Sourcebook are typical. They infuse a spaceship with a field that can be adjusted in individual hexes to produce different levels of gravity.

APPENDIX A: RANDOM UNIVERSE GENERATION<A-HEADER>

Do not feel constrained by the die rolls. Ignore or select any results you like - the most interesting places are usually the most uncommon. Also, unless you're basing a large part of your campaign in a particular star system, you don't need detailed information about each planet.

Unless otherwise noted, the following units are used:

Quantity	Units used	To Convert, multiply by:
Star Mass	Sun = 1	2×10^{30} kg or 328,000 Earth masses
Star Diameter	Sun = 1	696,000 km or 435,000 mi
Planet Mass	Earth = 1	6×10^{24} kg
Density	Earth = 1	$5.5 \text{ gm/cm}^3 = 5.5$ water units
Planet Diameter	Earth = 1	12,800 km or 8,000 mi
Orbit Radius	AU	150,000,000 km or 93,000,000 mi

INTERSTELLAR OBJECT CREATION<A-HEADER>

Roll 2d6:

- 2) Giant or Supergiant
- 3-9) Main Sequence Star
- 10-11) White or Brown Dwarf
- 12) Unusual Object

Unusual Object (2d6):

- 2-3) Protosun
- 4-6) Variable Star
- 7-8) Black Dwarf
- 9-10) Nebula
- 11) Neutron Star/Pulsar
- 12) Black Hole

Chance of Multiple Objects: (3d6)

- 3-10) Single Star
- 11-15) Binary Star
- 16-18) Multiple Star. (Start with two stars; for each, roll again on this chart. Maximum of six stars).

$$\text{Orbital Period} = P = (d^3 / (M1 + M2))^{1/2}$$

Check type of object separately for each star.

CLASS OF STAR<B-HEADER>

MAIN SEQUENCE<D-HEADER>

Spectral Type (3d6):

- 3-12) M
- 13) K
- 14) G
- 15) F
- 16) A
- 17) B
- 18) O, W

GIANT AND SUPERGIANT<D-HEADER>

Spectral Type (3d6):

- 3-8) M
- 9-10) K
- 11-12) G
- 13) F
- 14) A
- 15-16) B
- 17-18) O

Roll subclass 0-9.

Magnitude, temperature, luminosity, size follow from charts.

Companions: determine orbits (close is more common than distant). The average separation is 10 AU, but the range is anywhere from Contact Binary to 100's of AU. Division in mass is nearly random.

Chance of Planets (0 is too young to have planets, but may have a wide belt of planetesimals (asteroids) [ARE B AND A TOO YOUNG? (2300 VS. LSH). CAN M,R,N,S HAVE PLANETS?])

White Dwarfs have same planets that survived the red giant stage. [GURPS SAYS: GENERATE A SYSTEM FOR THE RIGHT KIND OF STAR. TURN ANY GG INSIDE 80 AU TO A TERRESTRIAL; TURN ANY PLANET INSIDE 40 AU TO ROCKBALL WITH NO ATMOSPHERE, AND ANY PLANET WITHIN 1 AU TO A FOND MEMORY.]

Unusual stars (variable, nova, jetstar, pulsar)

NOTES

rogue star, planet, gas giant

separate chart: encounters

Binary: About 5% of the time the mass ratio is 1:20, and under these circumstances a solar system might form.

Perhaps 10^8 stars could have bona fide planets. Population II stars are the stars in glob clusters, galactic core

[PUT BIGGER-THAN-SUN ARTIFACTS IN "STARGEN". (RINGWORLDS, DYSON SPHERE, VERY LONG COSMIC MACARONI, RECORD WORLD)]

<Suggestion: for each paragraph, do a simple and a long version. Explain that you can do whichever you need for your campaign or that particular world.>

STAR SYSTEM GENERATION<A-header>

If you haven't chosen a star from Interstellar Object Creation, go do it. You will need its mass, luminosity, surface temperature, and diameter for this section.

For giant and supergiant stars, you may want to know the star's diameter in AU as well as Sol units. To get this, divide the diameter by 215.

For worlds orbiting two or more suns, use the combined mass or luminosity of the suns where mass or luminosity are asked for.

ORBITS<B-header>

INNER PLANET BOUNDARY<D-HEADER>

The closest that any body can orbit the sun is where the temperature reaches 2000K. Closer than this, rock melts. This boundary is:

$$(Star\ Temperature)^2 \times Star\ Diameter / 11.5$$

in kilometers from the center of the sun. The surface temperature of the sun is in Kelvin. If the planets are circling both members of a binary system, the inner boundary must be at least three times the separation between the stars.

ROCHE LIMIT<D-HEADER>

This is a spherical region around each star. Natural worlds which come within this limit are broken up by the sun's gravity. Planetesimals (primordial asteroids) within the Roche Limit never collect together to form worlds, as they do in the rest of the solar system, and remain a belt forever.

For most stars the Roche Limit is too narrow to affect any of its worlds; you aren't likely to need it unless the star's diameter is greater than 45.

The Roche Limit's radius is 1 1/4 times the star's diameter. In AU, the Roche Limit is:

$$RL = Star\ Diameter / 172$$

ICE BOUNDARY<D-HEADER>

Where temperature drops below 273K. This boundary is:

$$Star\ Diameter \times (Star\ Temperature / 3980)^2$$

in AU, and separates the outer star system (where permanent ice can form) from the inner star system. For multiple-star combined temperature, use: $D^2 T^4 = D1^2 T1^4 + D2^2 T2^4 + \dots$ where D means effective star diameter.

OUTER PLANET BOUNDARY<D-HEADER>

50 AU x Star diameter. If the planets are orbiting one of a binary pair, the maximum planet boundary is at most one-third the separation distance.

COMETARY HALO<D-HEADER>

A spherical region which begins about 40,000 AU from the star, and is about 10,000 AU wide.

GENERATE ORBITS<C-HEADER>

The first orbit is $2d6 \times 0.1$ AU in radius. For all subsequent orbits, the orbital multiplier is:

$$(Orbit\ Number + d6 + 10) \times 0.1$$

Multiply this times the radius of the previous orbit to get the radius of the new orbit. The maximum multiplier is 2.5. Determine the orbits until you've reached the Outer Planet Boundary.

Because the radius of the planetary orbits is measured from the center, not the surface, of the sun, the first few orbits may fall inside the inner planet boundary, or even inside the star itself (quite possible in the case of giant stars). Consider these orbits empty and continue.

Remember also that the orbit radius is the average distance from the sun. Most orbits are slightly eccentric, although not enough to influence the world's climate.

PLANET TYPE<C-HEADER>

Determine which orbits have planets in them, and what type. For each orbit, roll 2d6.

- 2-4) Empty orbit.
- 5) Terrestrial: Rock World.

- 6-7) Terrestrial: Ice World (outer system) or Rock World (inner system)
- 8-9) Gas giant (outer system) or Asteroid Belt (inner system).
- 10) Asteroid belt.
- 11) Unusual world.
- 12) Very unusual world.

Any orbit within the inner planet boundary is, of course, empty. Any non-empty orbit within the Roche Limit must contain an asteroid belt or artificial body. From here on, orbit numbers don't include empty orbits. Renumber them.

<TONY DISPUTES THIS WHOLE PARAGRAPH. VERIFY.>

Type O, B, and A stars are too young (less than 3 billion years) to have many planets, but may have belts of "planetesimals" (asteroids which will someday form worlds). For these stars, roll on the chart above, but count any planet result as an asteroid belt. If you roll a 12 for a Type O or B star, or 11-12 for a Type A, roll again normally.

<DAVE SAYS THE ORBIT JUST INSIDE FROM THE FIRST GAS GIANT CANNOT BE TERRESTRIAL IF TOO CLOSE, BUT MUST BE EMPTY OR ASTEROID BELT. "TOO CLOSE" MEANS RATIO OF ORBITAL RADII WITHIN A FACTOR OF 2. THIS IS A THEORY; NOBODY REALLY KNOWS IF ITS THAT SIMPLE.>

UNUSUAL ORBITS<C-HEADER>

For each occupied orbit, roll a d6. On a 1, roll for (or select) an Unusual Orbit. (Add +1 to this roll if in a binary/multiple star system):

- d6 Unusual Orbit
- 1 Co-orbital.
- 2 Orbital Conjunction.
- 3 Highly inclined orbit.
- 4 Highly eccentric orbit.
- 5 Highly inclined and eccentric orbit.
- 6+ Doomed Planet.

CO-ORBITAL<D-HEADER>

Two worlds orbit sun at same distance. Gravitational effects keep them from colliding. (In a less scientific campaign, the GM can state that the worlds are diametrically opposed, and hidden from each other by the sun. Actually, the fluctuating velocity of an orbiting planet would keep this from happening.)

ORBITAL CONJUNCTION<D-HEADER>

Planet periodically comes near to comet, large asteroid, other planet, or other orbiting body. (see "Catastrophes: close passes" for possible effects.)

HIGHLY INCLINED ORBIT<D-HEADER>

Planet orbits high out of the ecliptic.

HIGHLY ECCENTRIC ORBIT<D-HEADER>

This orbit is very elongated and off-center. Orbit actually goes from (for example) one-half the average distance at perihelion (closest approach to the sun) to three-halves (1 1/2) that distance at aphelion (furthest distance from the sun). If orbit dips into the Roche limit, the "planet" is now a highly eccentric asteroid belt (and quite a navigation hazard).

DOOMED PLANET<D-HEADER>

Planet will eventually collide with comet or other body, be flung from its orbit by a close pass, or spiral into its primary's Roche limit. Event may occur within days, months, or years, depending on dramatic effect. (See "Catastrophes")

ORBITAL TEMPERATURE<C-HEADER>

This is the temperature of "space" at a given distance from a particular sun. The orbital temperature will be needed later to determine the climate of the planet.

The formula for orbital temperature is:

$$\text{SQRT}\{ \text{SQRT}(\text{Luminosity}) / \text{orbit-radius} \} \times 374 \text{ K}$$

- or look it up on the chart.

ORBITAL TEMPERATURE CHART<C-HEADER>

LUMINOSITY	Orbit Radius				
	0.5	1	2	4	8
0.0001	53	37	26	19	13
0.002	112	79	56	40	28
0.01	167	118	84	59	42
0.05	250	177	125	88	63
0.2	354	250	177	125	88
0.2	354	250	177	125	88
0.3	391	277	196	138	98
1	529	374	264	187	132
5	791	559	395	280	198
10	941	665	470	333	235

Most worlds interesting to PCs will be in the orbits having orbital temperatures between 185 and 550. (Earth's orbit has an orbital temperature of 374 K.) Worlds with high albedos will be cooler, and those with low albedos and high greenhouse effects will be warmer. Some worlds may thus have orbital temperatures near the ends of the scale and still be tolerable to humans.

A world with a highly eccentric orbit may have very different orbital temperatures at different points in its orbit. You may find it useful to determine the orbital temperature for the world's closest, furthest, and average distances from the sun. Similarly, worlds orbiting a variable star will have varying orbital temperatures at different times in the star's cycle.

PLANETS<B-HEADER>

GENERAL CHARACTERISTICS<C-Header>

TERRESTRIAL WORLD: ROCK<D-HEADER>

Diameter: $(3d6-2) \times 0.08$
Density: $2d6 \times .1$
Surface Gravity (in g's) = Density x Diameter.

TERRESTRIAL WORLD: ICE<D-HEADER>

Diameter: $(2d6+8) \times 0.008$
Density: $1d6 \times .1$
Surface Gravity (in g's) = Density x Diameter.

GAS GIANT<D-HEADER>

Diameter: $4d6 \times 0.8$
Average Density: $1d6 \times 0.05$
Cloud Top Gravity (in g's) = Density x Diameter.

ALL WORLDS<D-HEADER>

Mass = Gravity x Diameter².
Geosynchronous orbit radius = $(\text{Day}^2 \times \text{Mass})^{1/3} \times 35,700\text{km}$
Surface Escape velocity = $\text{Density}^{1/2} \times \text{Diameter} \times 11.2$
km/sec

ASTEROID BELT<D-HEADER>

The thickness of the belt is $(1d6+4)/10$ times the orbit radius. The belt has thousands of asteroids, of which 3d6 are of significant size. Large rock asteroids are $(1d6+4) \times 100$ kilometers in diameter. Large ice asteroids, found only in the outer star system, are $(1d6+4) \times 10$ kilometers. Otherwise, treat these as terrestrial worlds with no atmosphere.

All asteroids in a belt have the same orbit type (normal, unusual) and year.

UNUSUAL WORLDS<D-HEADER>

Pick type or create one:
Planetary characteristic (size, albedo, etc.) outside of typical range.
Oblate, egg-shaped, or irregular.
Huge or distinctive terrain feature.
Unusual or distinctive weather patterns.
Brown Dwarf or Protostar.
Dying or Ghost World.
Captured. (There is a 4:6 chance that the orbit is Unusual.

Roll $1d6+1$ to determine type of orbit).

Terraformed.
Steps (varying levels/gravities/atmospheres).
Retrograde motion.
Other/Combination.

VERY UNUSUAL WORLDS<D-HEADER>

Pick type or create one:

Artificial World.
Mega-Artifact (ringworld, Dyson sphere, etc.)
Worldship.
Living world.
Smoke ring.
Stargate.
Hollow.
Cube.

LENGTH OF YEAR<D-HEADER>

Planet year (in Earth years) = $\sqrt{\text{orbit radius}^3 / (\text{Mass of Star})}$

Orbit radius is in AU; the mass of the star is in Solar masses.
If planet is orbiting both stars of a binary system, use the combined mass of the two stars.

LENGTH OF DAY<D-HEADER>

Starting at "5 minutes" on the Time Chart, move 1d6 levels down the chart. Multiply that value (e.g. "5 hours") by 6d6 for the approximate length of day.

Worlds generally cannot spin much faster than once in 10 hours.

For worlds with an orbit radius less than 10 times the star's radius, see if the world is face-locked to the sun. Roll 3d6. Modifiers: -2 if star is Population II, -2 if it is Type K or M <VERIFY!!>, and -2 if you previously rolled a length-of-day longer than 70 hours. If result is 8 or less, the day is the same length as the year.

Note that the day and year of any world may be the same by coincidence.

AXIAL TILT<D-HEADER>

Roll 2d6. Add +2 if the orbit is Inclined, and +2 if world is Captured. Note tilt category (slight, standard, etc.) for future reference and, if you wish, decide on a precise value.

- 2-5) Very little (0-5 deg)
- 6-8) Slight (5-20 deg)
- 9-10) Standard (Earthlike) (20-35 deg)
- 11) High (35-50 deg)
- 12) Extreme (50-90 deg)

MAGNETIC FIELD<D-HEADER>

Roll 1d6:

- 1) none
- 2) weak
- 3-4) medium
- 5) strong
- 6) very strong

Ice worlds have no magnetic field. If the planet's day is more than an Earth week long, -2 from the roll. Add +1 each if density is more than 1, or if day is shorter than an Earth day.

TERRESTRIAL PLANET CHARACTERISTICS<C-header>

ATMOSPHERIC PRESSURE<D-HEADER>

The base surface pressure of a terrestrial world equals the Gravities of the world, expressed in atmospheres. For each world with an atmosphere roll 2d6. On a 2, the atmosphere is unusually thin; on a 12 it is unusually heavy. Roll 3d6 to get a number from 3-18, then roll that number of dice. For an unusually heavy atmosphere, multiply the base atmospheric pressure by this number. For a unusually thin one, divide by this number instead. Note the pressure category for future reference:

Pressure	Category
0 - .01	None
.01 - 0.5	Trace
0.5 - 0.8	Thin
0.8 - 1.2	Standard (Earthlike)
1.2 - 1.5	Thick
1.5+	Heavy

ATMOSPHERIC COMPOSITION<D-HEADER>

A terrestrial world's atmosphere usually has a few dominant components plus almost any mixture of additional ingredients. So, major components will be defined as those being 10% of the atmo-

sphere or more. Minor components are a few percent each, and any gases in the parts per thousand range (ppt) are trace components. Select an atmospheric composition from the Atmospheric Components Table or use the following procedure.

First, roll for major components. Roll 1d6 on the table, modifying for orbital temperature according to the Temperature Modifier Table. (Explanations follow the tables.) This first major component will have an abundance of $(1d6+1) \times 10\%$. Keep rolling components, each of which has an abundance of $1d6 \times 10\%$. (Any reroll of the same substance merely adds to its percentage.) The component that goes over 100% becomes the first minor one instead. If you hit 100% exactly, skip the minor components.

Roll 2d6 for each minor component, modified for orbital temperature. (Remember that the first minor component was just rolled as a major.) The abundance of each minor component is $1d6 \times 1\%$. When a minor component pushes the total over 100%, it becomes the first trace component.

The first trace component was just determined. Others are automatic. Certain major components will cause other substances to be present in at least traces: Check the Mandatory Trace Elements table. If desired, you can roll for 1d6-1 additional trace elements on the Atmospheric Components Table. Precise abundances are not important, but everything adds up to 100%.

ATMOSPHERIC COMPONENTS TABLE<D-HEADER>

COMPONENT	MAJOR (1d6)	MINOR (2d6)	TRACE (2d6)
Metal vapor	8	14+	14+
Sulfur	-	13	13
Irritant gases	-	-	12
Halogens	-	12	11
Water	6-7	11	-
Carbon monoxide	-	10	10
Carbon dioxide	4-5	9	-
Noble gases	-	7	9
Particulates	-	-	8
Other	3	6	7
Oxygen	2	8	-
Nitrogen	1	5	-
Helium	-	4	6
Complex organics	-	-	5
Ammonia	-	-	4
Methane	0	0,3	0,3
Hydrogen	-	1-2	1-2

TEMPERATURE MODIFIER TABLE<D-HEADER>

ORBITAL TEMPERATURE	DIE ROLL MODIFIER		
	MAJOR	MINOR	TRACE
0-200 K	-1	-2	-2
200-350	0	0	0
350-450	+1	+2	+2
450+	+2	+4	+4

MANDATORY TRACE ELEMENTS<D-HEADER>

IF	THEN
MAJOR:	TRACE:
H2O	CO2
CO2	H2O
O2 or N2	Irritant gases
Metal vapor	Particulates

Other<E-HEADER>

If rolled as a major component, reroll on the minor component column. If rolled as a minor component, reroll as a trace component. If rolled as a trace component, pick something not otherwise listed.

Metal Vapor<E-HEADER>

These are bare ions of the metals potassium (K), sodium (Na), iron (Fe), and magnesium (Mg). Requires a young world or high temperature.

Sulfur<E-HEADER>

Various sulfur compounds, such as sulfur dioxide (SO2) and hydrogen sulfide (HS). Usually accounted for by vulcanism, and stable only at high temperature.

Irritant Gases<E-HEADER>

These include ozone (O₃), nitric oxide (NO), and nitrous oxide (NO₂). Sunlight will form these from O₂ and N₂, or they can result from pollution.

Halogens<E-HEADER>

These are the most reactive gases other than oxygen. This category includes fluorine (F), chlorine (Cl), and bromine (Br) as well as their acid forms (HF, HCl). The presence of any of these gases might indicate some form of life.

Water (H₂O)<E-HEADER>

Water is very common. Its form (solid, liquid, gas) depends on the temperature. Abundance as a gas goes up with temperature.

Carbon Monoxide (CO)<E-HEADER>

Carbon monoxide usually results from sunlight dissociating CO₂ or from pollution. Stable only at high temperature.

Carbon Dioxide (CO₂)<E-HEADER>

A very common stable compound, produced by volcanoes and plants, absorbed by animals and weathering rocks.

Noble Gases<E-HEADER>

The gases neon (Ne), argon (Ar), krypton (Kr) and xenon (Xe) are not common in the universe, but they are essentially chemically inert. This means that however much is present in the primordial cloud will eventually make its way into the planetary atmosphere. Radon (Rn) is also chemically inert, but more importantly, it is a radioactive breakdown product from radium. Radon in the atmosphere would be an interesting challenge to explorers.

Particulates<E-HEADER>

Particulates in the atmosphere include volcanic dust, silicon sand, and biological products such as pollen. Pollution can be particulate. A low gravity world with a moderate or heavy atmosphere might suffer severe dust storms.

Oxygen (O₂)<E-HEADER>

Highly reactive and thus unstable. Its presence on Earth is accounted for by plant life. Intense amounts of sunlight, lightning, or another energy source could also generate oxygen (from H₂O or CO₂). To be breathable, its partial pressure (% oxygen times atm. pressure) must be 0.05 - 0.4.

Nitrogen (N₂)<E-HEADER>

Nitrogen is stable and common, but at higher temperatures reacts with other substances and is less likely to be found in its elemental form. At high concentrations, N₂ causes narcosis and "the bends."

Helium (He)<E-HEADER>

Helium is the second most common element in the universe, and every planet starts with some. Being lightweight and inert, however, it normally escapes easily from the atmosphere. Heavy gravity and low temperature will help hold onto helium, but its presence in small amounts is commonly a result of breakdown of radioactive ores.

Complex Organics<E-HEADER>

Larger organic molecules may or may not result from life. Possibilities include cyanogen, formaldehyde, and alcohols. An old, polluted planet will have plenty of organics in its atmosphere, as will a young planet in the first stages of evolution.

Ammonia (NH₃)<E-HEADER>

Ammonia is very common at low temperatures, but breaks down easily in warmer environs. Ammonia is extremely soluble in water, though, and might saturate water oceans if present at all in the atmosphere.

Methane (CH₄)<E-HEADER>

One of the commonest small molecules, but unstable at high temperature.

Hydrogen (H₂)<E-HEADER>

The commonest element in the universe will rarely be a big

component of terrestrial atmospheres. High gravity and cold temperatures might be enough to retain significant amounts of a planet's primordial allotment of hydrogen. Measurable amounts of H2 are more likely, though, to be a result of continual resupply. Additional primordial hydrogen might be slowly outgassing from the interior, or be coming from a heavy solar wind.

WATER PRESENCE AND CLOUD COVER<D-HEADER>

If the world has an orbital temperature of 185-485K and the atmosphere contains at least trace water, then water or ice covers this percent of the surface:

$$8d6 - 8 + (\text{Gravities} \times 40\%)$$

If the world is in the outer system, subtract 20%.

Cloud cover equals the water surface covered minus 20%.

Trace atmospheres and atmospheres with trace water have at most 20% cloud cover.

<DO SOME KINDS OF ATMOSPHERES GIVE MORE OR LESS COVER DUE TO COMPOSITION OR PRESSURE? WHAT ABOUT VENUS?>

GREENHOUSE EFFECT<D-HEADER>

Note Greenhouse Factor for future reference.

Atmosphere is	Greenhouse Factor
None	1.0
Trace - Thin	1.05
Standard	1.1
Thick - Heavy	1.15

If the atmosphere contains the following gases, add the modifier shown to the Greenhouse Factor. <VENUS ADDS 1.85, and is 96% CO2. Tony suggests +0.01 per percent of greenhouse gas.>

Gas	Modifier
Carbon dioxide	_____
Water vapor	_____
Methane	_____
Ammonia	_____
_____	_____

TERRAIN<D-HEADER>

Begin by deciding on the size and shape of the continents and oceans, using the percentage of water cover to determine relative size. Worlds without oceans may still have "continents." Large, elevated land masses, such as on Venus and Mars.

Icecaps<E-HEADER>

On worlds with much surface water, icecaps cover about 10% of the planet surface. This ice may be several kilometers thick, and can cover a polar land mass or a polar ocean. (Earth has one of each type.) Icecaps may also exist on cold, waterless worlds: Mars' icecaps are carbon dioxide which freezes out of its atmosphere. If cold enough, oceans or icecaps may be nitrogen, ammonia, or methane. See Bodies of Water, below.

Choose terrain types for each area of interest:

Contour types<E-HEADER>

Flat - desert, plains, swamp

Hilly - undulating but passable.

Rough - cliffs, canyons, many craters. (Cratering is very common on worlds with no atmosphere.)

Mountainous - includes same features as Rough.

Vegetation<E-HEADER>

Desert - very dry, little or no life. May be sand, rock, dust, or all three. All types of terrain. Worlds with no atmosphere are typically all desert.

Grassland - Few or no trees. Includes prairie (temperate), steppes (flat and arid; areas of extreme temperature range), savannah (tropical and subtropical), tundra (permanently frozen ground near icecaps).

Forest - Dense vegetation, temperate zone.

Jungle - very dense vegetation. More common in warm/hot climates.

Wetlands - Low-lying, wet areas such as marsh and swamp. Vegetation common.

Bodies of Water<E-HEADER>

Rivers - drain water from an area, flow from higher to lower elevations. Feed into lakes, seas, oceans, or larger rivers.

Lakes - Freshwater, in comparatively low areas. May feed into large rivers.

Seas - High mineral content (saltwater), are usually inland and have no river outlets. Coastal sections of ocean are sometimes named seas. (Warning: This terminology is sometimes used inconsistently. By these definitions, the Great Salt Lake is a sea, and the Sea of Galilee is a lake.)

"Bodies of water" could be a different liquid instead under the right temperature conditions and given an atmosphere (see table). Dissolved impurities will stretch these ranges.

Ocean Temperature Ranges

Type	Range (K)
nitrogen	63-77
methane	90-110
ammonia	175-140
water	273-373
sulfur	385-720

Other features<E-HEADER>

Glacier - A large, deep body of ice in mountainous regions near the icecaps. Pressure makes the ice flow down slopes or valleys like water - but very slowly (meters per year <???)>).

Archipelago - a group of islands formed by the tops of underwater hills or mountains.

ALBEDO<D-HEADER>

The reflectivity of a planet may be approximated: Earth's albedo is 0.30, cloud-covered Venus' is 0.76, and Mercury and Luna are about 0.06. If you wish a precise figure for albedo, determine the percentage of clouds, oceans, land, and ice. Multiply the albedo of each component by the fraction which each component makes up. Add the results: the total should be a number between 0 and 0.99.

The albedos of typical components are:

Vegetation	.10
Dust or Sand	.20
Water	.02
Snow	.85
Ice	.55

Clouds	.40 - .80
Bare Rock	.05
Polished Metal	.8 - .99
Perfect Mirror	1.0

Example: The world Chinook is 80% ocean, 16% prairie (vegetation), and 4% desert. At any time, 50% of the world is covered by clouds - that is, 50% of each terrain is exposed. As a result, we can see 40% ocean, 8% vegetation, 2% desert, and 50% clouds. Multiplying each terrain by its albedo, we get ocean: $.8 \times .02 = .16$; vegetation: $.08 \times .1 = .008$; desert: $.02 \times .20 = .004$; and clouds (average albedo = .60): $.50 \times .60 = .3$. Adding these results, we get $.16 + .008 + .004 + .3 = .472$. Chinook reflects 47%, almost half, of its sunlight.

TEMPERATURE<D-HEADER>

This system is primarily for worlds whose orbital temperatures are between 185-1000K. Those higher or lower are likely to be too cold or too hot for a precise value to be useful.

Average Temperature<E-HEADER>

The day/night average temperature in spring or fall at 30 degrees latitude is:

$$T = (\text{Greenhouse Factor} \times (1 - \text{Albedo}) \times \text{orbit temp.}) - 273$$

G is greenhouse factor, and A is the Albedo. The result is in degrees Celsius.

Use this chart to find the climate category:

Average Temperature		Climate
F	C	Type
0	-20	Freezing
15	-10	Cold
45	7	Cool
75	23	Standard (Earth)
90	30	Warm
105	40	Hot
120	50	Very Hot

The temperature in a given climate can vary as much as 10deg C from the average. The range of human comfort is 0 to 30deg C. The "pioneer" range - the limits of human habitability - is -20 to 50deg C.

Other factors affect temperature, giving the Gamemaster leeway in choosing a climate. A high concentration of radioactive minerals makes the surface warmer. Moons of a gas giant are warmed by tidal flexing (an effect of the primary's gravity) and by the heat radiated by larger gas giants.

On worlds with a highly eccentric orbit, the temperature will be very different at the points closest and furthest from the sun (which do not necessarily coincide with local summer and winter). The Gamemaster can recompute the orbital temperature at aphelion, perihelion, and the average orbital distance, or he can approximate. If the planet is twice as far from the sun at aphelion as at perihelion, the temperature (in K) will be 1.4 times higher.

Temperature Variations<E-HEADER>

The temperature at any given point can vary widely from the world's average. Earth's temperature changes one level on the chart about every 15 degrees latitude. Daily and seasonal variations may also be important (see tables, below). If Day is longer than an Earth day, add one level to the daily variation. If the world has no oceans, increase the daily and seasonal variations by a level each.

Variation between Day and Night<E-HEADER>

If the Atmosphere is	Variation from Average:
None, Trace	2 levels
Thin	1 level
Standard	Less than 1
Thick	A few degrees
Heavy	None

Variation between Summer and Winter<E-HEADER>

If the Axial Variation from Average

Tilt is:	Summer	Winter
Very Low	None	None
Slight	<1	None
Standard	1	None
High	1	1
Extreme	1-2	1-2

PLANET COMPOSITION AND MINERAL RESOURCES<D-HEADER>

<ANY IDEAS, OTHER THAN STEALING DIRECTLY FROM GURPS?> <WHAT ABOUT ICE WORLDS?>

A strong magnetic field, or a high density, on a terrestrial world means heavy metal core, probably high in metal resources.

If metal-rich: +1 to magnetic field strength.

SURFACE RADIATION<D-HEADER>

Roll 1d6 and add the category numbers for Atmosphere Pressure and Magnetic Field (Trace atmosphere = 2, Strong magnetic field = 5, etc.) Subtract 2 if world is high in radioactives. Subtract 2 if the world is a moon orbiting less than five planetary diameters from a gas giant with a Strong magnetic field.

- 3-8 high (1 rad/day or more)
- 9-14 medium (1 rad/month)
- 15-18 low (<1 rad/year)

GAS GIANT CHARACTERISTICS<C-header>

ATMOSPHERIC PRESSURE AND DENSITY<D-HEADER>

The pressure at the cloud tops is very low, about .1 atm. The density at the cloud tops is _____. The pressure and density increase as you go deeper into the planet, doubling about every 10 km until pressure reaches 100,000 atm. After that, density rises slowly.

Typically, this scheme will not account for all of a planet's density, as determined earlier. If not, the planet has a rocky core of sufficient size to make up the extra mass.

COMPOSITION<D-HEADER>

A gas giant is at least 90% hydrogen, the rest helium with less than 1% other gases. These trace gases include hydrogen compounds such as ammonia and methane. Small, cold gas giants - less than 20 Earth masses - have larger amounts of ices deep in the atmosphere.

ALBEDO<D-HEADER>

The albedo of a gas giant is 1d6 x 0.1.

TEMPERATURE<D-HEADER>

The temperature at the cloud tops is 10% above orbital. Temperature increases with depth, about 5-10 Kelvin per kilometer, to a maximum of 10,000 K or so.

RADIATION<D-HEADER>

Roll 1d6 and add the category number for Magnetic Field (Strong magnetic field = 5, etc.)

- 3-8 high (1 rad/hour or more)
- 9-14 medium (1 rad/day)
- 15-18 low (<1 rad/month)

This is the radiation at the 0.1 bar level. Radiation decreases with increasing pressure and depth as described in the section on Space. <HOW FAR OUT DO RADIATION BELTS GO?>

ASTEROID CHARACTERISTICS<C-header>

Asteroids are created as airless terrestrial worlds, but the largest (at least 800 km diameter) have a small chance of a Trace atmosphere. (A roll of 6- on 3d6 indicates so.)

ASTEROID COMPOSITION, MINERAL RESOURCES, AND ALBEDO<D-HEADER>

Roll 3d6 for each significant asteroid:

die roll	Type	Albedo
3-12	C-Type (Carbonaceous)	2d6 x .01
13-14	S-Type (Iron & Magnesium Silicates)	1d6 x .1 (max .4)
15-18	M-Type (Iron/Nickel)	1d6 x .1 (max .4)

The brightness of a rotating asteroid appears to fluctuate because of its irregular surface.

SATELLITES<C-HEADER>

For a terrestrial planet, roll d6-3 for the number of moons.

(A die result lower than one means the planet has no moons.) For a gas giant, roll 5d6.

Satellites are created as terrestrial planets or asteroids, depending on size, except as noted here:

ORBITS<D-HEADER>

The interaction of gravity between orbiting satellites forces them into orbits whose diameters are related to each other. Three to five satellites form each group of related orbits; a world may have any number of satellite groups.

For each group: First determine the base orbit of that group. Multiply the planet's diameter by 5d6 (or by 5 and then by 1d6). Then roll a die; on an 1-2, multiply this number by 10; on a 5-6, divide it by 10. This is the radius of the base orbit, and will have a moon in it.

For each of the other moons in the group, multiply this base orbit radius by the number on this chart (Roll 2d6):

Roll	Multiplier
2	0.5
3	0.6
4	0.7
5	0.75
6	0.8
7	1
8	1.2
9	1.3
10	1.4
11	1.6
12	2.1

(co-orbital)

Repeat this process for each group of moons until you've found orbits for all the planet's satellites.

SATELLITE TYPE<D-HEADER>

Roll on chart:

Roll 2d6	Type
2-6	Terrestrial: rock
7-8	Terrestrial: rock (inner system) or ice (outer system)
9-10	Ring
11	Unusual
12	Very Unusual

Any satellite inside the planet's Roche limit (1.25 x planet's diameter) becomes a tiny ring shepherd (see below and also "Rings" in the Space section).

UNUSUAL SATELLITES<D-HEADER>

Unusual satellites can be of the same type as unusual worlds. In addition, moons may be unusual in the following ways:
Double planet: a moon which is more than half the mass of the planet it orbits.

Unusually large: the moon is more than 2000 km in diameter. If the planet is a gas giant, the moon may be a smaller gas giant.

Not face-locked: Unlike most moons, this one does not have a day equal to its orbital period.

Satellites: The moon has a moon or moons of its own. This is most likely in the case of unusually large satellites.

Captured: This was once a rogue world. Such moons are rarely face-locked, and are sometimes unusually large.

For each moon, check to see if its orbit is Unusual in the same manner as for planets. Although co-orbital planets are rare, co-orbital moons are not. Replace each result of "1" (Co-orbital) with "Non-resonant: no other satellites in group."

ORBITAL TEMPERATURE<D-HEADER>

The same as that of its planet.

DIAMETER<D-HEADER>

For moons of a terrestrial world, roll 2d6-1. (If the roll is 11, then roll again and add the two rolls.) Divide the diameter of the planet by this number to get the diameter of the moon.

Of the moons of a gas giant, 1d6+6 are 100-600 km, 1d6-2 are 1000-2000 km, and the rest are 3d6 km. One in six is a rocky terrestrial, and the rest are ice or rock/ice bodies.

LENGTH OF ORBITAL PERIOD<D-HEADER>

$P = \{ (\text{Orbit radius}/200)^3 / \text{Mass of planet} \}^{1/2} \times 30 \text{ Earth days.}$

The orbit radius is in Megahexes. Note that you need the mass of the planet (not the moon).

LENGTH OF DAY<D-HEADER>

Most satellites are tidally locked, so its day is the same as its orbital period.

AXIAL TILT<D-HEADER>

Because moons are usually face-locked to their planet, the tilt is None with respect to that world. Because moons are usually in the planet's equatorial plane as well, the moon's tilt with respect to the sun (which determines seasons) is the same as that of the planet.

MAGNETIC FIELD<D-HEADER>

<WHAT IF MOON IS IN PRIMARY'S FIELD? IF ITS IN THE OUTER EDGES, CAN IT BE AFFECTED BY THE PRIMARY'S RADIATION BELTS? OR IS IT PROTECTED BY PRIMARY'S FIELD?

TEMPERATURE<D-HEADER>

<SOME LARGE GAS GIANTS MAY RAISE IT A LITTLE.>

RADIATION BELTS<D-HEADER>

See Magnetic Field.

RINGS<C-HEADER>

Almost all gas giants have a ring, unless the planet is very young or very old. The ring system will stretch from about 10,000 km above the atmosphere out to the Roche limit. Roll 1d6 for particle size and again for ring density:

ROLL	PARTICLE SIZE	RING DENSITY (COLLISION CHANCE)
1	dust	No ring
2	up to 1 mm	Partial ring (8-)
3-4	0.01-1m	Sparse ring (11-)
5	0.1-5m	Dense ring (14-)
6	0.1-10m	Very dense ring (18-)

Composition can be rock, ice, gas, or a mixture. Albedo as appropriate to composition.

Ring gaps are swept out by resonance with all close or major moons. Generate the moons first, then each pertinent resonance group will create two gaps.

Rings are usually thin (less than 10m), but any highly inclined moon will spread the particles vertically.

OTHER BODIES<C-HEADER>

Short-period comets, long-period comets currently within the planetary boundaries, and lone asteroids have highly eccentric and inclined orbits. There may be dozen or hundreds of these; place as many as you feel are important.

Earth's Oort cloud has 2 trillion comets (estimated). Short period comets: 50. Long period: One million.

LIFEFORMS<B-HEADER>

All forms we know require liquid water. It's possible to have ammonia-based instead of water-based. Silicon life is a stretch. Sulfur? Boron? See Bodies of Water, above.

APPENDIX B: STAR AND PLANET DATA<SECTION-HEADER>

STARS IN THE NEIGHBORHOOD OF SOL<A-HEADER>

Following is a list of known stars within 30 light years of Sol, for those who want to set a Star Hero campaign in known territory. It's a long list and full of tiny red stars, so feel free to trim it. Stars can be added as well, with discretion. Anything brighter than K class should be placed as far as possible from Sol or directly behind another system on the same line of sight.

No	Name	SpCl	Mv	Dist	NB	X	Y	Z
1	Gliese 915	WD	13.5	26.7		7.0	-4.2	-25.4
2	Gliese 1	M4	10.3	14.5		3.1	-0.9	-14.1
3	Groombridge 34A	M1	10.4	11.2		-4.6	9.6	-3.5
	Groombridge 34B	M4	13.4	11.2	f			
4	Zeta Tucanae	F9	5.0	23.1		8.0	-10.9	-18.7
5	Beta Hydri	G2iv	3.8	20.5		8.3	-13.1	-13.4
6	HR 222	K2	6.5	22.8		-6.4	10.6	-19.1
7	Van Maanen's Star	WD	14.3	13.8		-3.9	6.4	-11.6
8	Achird A	G0	4.6	18.5		-9.5	15.8	-1.5
	Achird B	M0	8.7	18.5				
9	Wolf 47	M5	13.9	29.4	f	-15.8	24.8	0.0
10	Ross 318	M4	10.3	28.6		-15.0	23.9	4.6
11	Vys 2	K5	9.8	29.9		-16.1	25.2	0.0
12	Marfak A	G5	5.6	25.1		-13.9	20.7	-3.2
	Marfak B	G5		25.1				
13	Gliese 54	K	11.5	28.9		8.3	-16.2	-22.4
14	Rho Eridani A	K0	6.0	21.3		3.0	-10.1	-18.5
	Rho Eridani B	K0	6.8	21.3				
15	Luyten 726-8 A	M6	15.5	8.4		-2.4	0.4	-8.1
	UV Ceti	M6	16.0	8.4	f			
16	107 Piscium	K1	5.9	27.4		-15.5	14.0	-17.7
17	Vys 93	M2	11.2	28.6		-13.5	9.1	-23.5
18	Tau Ceti	G8	5.7	11.4		-3.6	0.8	-10.8
19	BD+63 238	K0	5.9	28.6		-17.4	22.7	1.1
20	LFT 171	M5	13.9	15.3	f	-8.9	5.9	-10.9
21	Gliese 84	M3	10.5	28.6		-10.3	-0.5	-26.7
22	LFT 193	M	10.4	29.4		-6.3	-7.3	-27.8
23	Gliese 102	M6	15.4	24.5		-17.9	10.7	-12.8
24	HR 753 A	K3	6.6	25.3		-16.5	5.3	-18.4
	HR 753 B	M4	12.4	25.3				
25	Ross 556	M4	11.1	26.1		-19.9	10.9	-13.0
26	Vys 857	K2	6.6	27		-14.8	-2.0	-22.5
27	96 kl Ceti A	G5	5.0	30.2	v	-22.4	1.3	-20.2
	96 kl Ceti B			30.2				
	96 kl Ceti C			30.2				
28	82 Eridani	G5	5.3	20.3		-4.4	-10.5	-16.8
29	Epsilon Eridani	K2	6.1	10.8	p	-7.2	-1.6	-7.9
30	Rana	K0iv	3.8	28.9		-20.0	-5.1	-20.2
31	Keid A	K1	6.0	15.6		-12.0	-3.8	-9.3
	Keid B	WD	11.2	15.6				
	Keid C	M4	12.3	15.6				
32	1 Pi3 Orionis	F6	3.6	23.8		-21.7	-3.7	-9.0
33	EG 45	WD	15.6	19.6		-16.8	-9.0	-4.5
34	Gliese 183	K3	6.4	29.9		-25.0	-10.0	-12.9
35	Vys 112 A	M1	8.9	18.7		-12.3	-10.0	-9.9
	Vys 112 B		11.3	18.7				
36	Kapteyn's Star	M0	10.8	12.7		-4.2	-9.4	-7.4
37	Ross 41	M5	12.8	28.4		-27.0	-6.1	-6.2
38	Vys 9	M1	9.1	19.2		-16.7	-7.4	-5.9
39	Vys 465	M2	10.1	27.9		-25.0	10.8	6.2
40	Ross 47	M4	12.7	19.6		-17.5	7.6	4.4
41	Gamma Leporis A	F6	4.1	25.5		-16.9	-16.3	-10.1
	Gamma Leporis B	K2	6.6	25.5				
	Gamma Leporis C		16.0	25.5				
42	Alpha Mensae	G6	5.4	27.9		5.0	-23.9	-13.5
43	Vys 471	M2	9.3	18.7		-12.6	-12.7	-5.5
44	Ross 64	M6	13.6	27.9		-27.5	-3.6	2.9
45	Ross 614 A	M6	13.1	13.1		-11.3	-6.5	-1.1
	Ross 614 B	M	16.8	13.1				
46	Sirius A	A1	1.4	8.6		-6.1	-5.9	-1.1
	Sirius B	WD	11.2	8.6				
47	Wolf 294	M4	11.0	19.4		-18.6	-0.4	5.4
48	Gliese 257 A	M4	11.1	28.4		-8.5	-25.8	-8.3
	Gliese 257 B	M4	12.0	28.4				
49	Ross 986	M5	12.6	19.3		-18.0	0.8	6.9
50	Luyten's Star	M4	12.0	12.1	b	-10.2	-6.1	2.4

51	Procyon A	F5	2.6	11.4	-9.4	-5.9	2.7
	Procyon B	WD	11.9	11.4			
52	LFT 543 A	WD	13.8	23	-14.2	-18.0	1.4
	LFT 543 B	M	18.7	23			
53	YZ Canis Minoris	M4	12.3	19.5	f -15.6	-10.7	4.8
54	Luyten 97-12	WD	15.7	18.9	2.1	-17.7	-6.1
55	Ross 619	M6	13.7	21.6	-16.9	-10.7	8.1
56	Gliese 300	M	15.0	19.1	-9.7	-16.2	2.7
57	LP 425-140	M	19.3	23.5	-17.9	-8.6	12.6
58	LFT 598	M	13.5	28.1	-11.8	-24.8	5.9
59	Luyten 532-81	WD	12.3	28.9	-9.1	-27.2	3.5
60	BD+53 1320 A	M0	8.7	19.6	-13.6	4.1	13.5
	BD+53 1321 B	M0	8.8	19.6			
61	CD-59 1362	M0	11.4	24	3.1	-23.6	-2.9
62	Vys 26 A	M4	10.3	29.7	-11.4	-23.7	13.8
	Vys 26 B	M4	11.0	29.7			
63	11 Leonis Minoris	G8iiii	5.6	29.9	-19.6	-2.4	22.5
64	Gliese 357	K	13.1	26.7	-16.3	-8.6	19.3
65	LFT 682	M4	10.8	29.9	-0.1	-29.7	3.6
66	BD+50 1725	M0	8.3	14.7	-8.5	2.4	11.8
67	LFT 698	M0	11.1	28.1	-10.5	-16.7	20.0
68	Gliese 386	K	11.4	29.9	-7.5	-22.5	18.2
69	AD Leonis	M4	11.0	15.8	f -7.3	-5.2	13.0
70	Ross 446	M2	10.2	25.1	-7.5	-15.3	18.5
71	Wolf 358	M5	12.4	23	-6.1	-11.6	18.9
72	CN Leonis	M6	16.7	7.7	f -1.9	-3.8	6.4
73	Ross 104	M3	10.9	21.6	-7.3	-5.3	19.6
74	Lalande 21185	M2	10.5	8.2	b -3.3	-0.2	7.5
75	Vys 35 A	M2	10.2	17	-7.2	1.7	15.3
	WX Ursae Majoris	M8	16.0	17	v		
76	Alula Australis A	G0	4.3	23.8	-7.8	-2.0	22.4
	Alula Australis B	G0	5.3	23.8			
	Alula Australis C	B0		23.8			
77	SZ Ursae Majoris	M1	9.7	27.4	-12.5	12.7	20.8
78	61 Ursae Majoris	G8	5.6	27.4	-7.4	-0.3	26.4
79	Ross 909	M3	11.0	28.9	-6.3	-3.7	28.0
80	LFT 839	K0	11.3	27.2	9.3	-25.0	5.1
81	Luyten 145-141	WD	13.1	15.8	6.4	-14.4	-0.5
82	Gliese 445	M4	12.4	16.7	-7.4	10.7	10.4
83	Ross 128	M4	13.5	10.9	0.0	-5.5	9.4
84	Groombridge 1830 A	G8	6.7	30.5	II -7.8	1.9	29.4
	Groombridge 1830 B				f		
85	Ross 695	M4	11.9	29.7	8.4	-19.5	20.7
86	Wolf 424 A	M4	14.3	14.1	1.5	-4.3	13.3
	Wolf 424 B	M7	15.2	14.1			
87	Chara	G0	4.5	27.9	-4.5	5.0	27.1
88	LFT 930	M3	11.1	27	12.9	-23.0	5.8
89	Wolf 437	M4	11.6	29.4	4.7	-7.7	28.0
90	AC+66 3955	M4	11.1	28.1	-8.9	15.0	22.0
91	Wolf 457	WD	16.1	30.2	7.7	-9.7	27.5
92	Beta Comae Berenices	G0		26.3	2.0	1.4	26.2
93	61 Virginis	G6		27.9	13.2	-15.1	19.4
94	Ross 490	M1	9.6	24.9	7.5	-3.9	23.4
95	Wolf 489	WD	15.3	24.2	9.3	-5.6	21.6
96	Wolf 498	M4	10.0	15.9	5.0	-0.8	15.1
97	BD-11 3759	M4	12.4	20.4	13.8	-5.6	14.0
98	Rigel Kentaurus A	G2	4.4	4.4	3.1	-3.1	0.0
	Rigel Kentaurus B	K1	5.7	4.4			
	Proxima Centauri	M5	15.5	4.2	f 2.9	-3.0	-0.1
99	Xi Bootis A	G8		20.9	9.6	3.7	18.2
	Xi Bootis B	K4		20.9			
100	HR 5568 A	K4	7.1	19	14.8	-6.1	10.2
	HR 5568 B	M2	9.3	19			
101	Wolf 562	M5	11.5	21.3	16.3	-1.7	13.7
102	Gliese 588	M4	11.2	19.3	16.6	-9.0	3.9
103	LFT 1218	M5	11.9	29.4	25.6	-5.3	13.5
104	Gliese 618 A	M4		24.9	23.3	-7.8	3.8
	Gliese 618 B	M7	16.5	24.9			
105	Vys 163	M3	11.0	23.6	5.1	16.3	16.3
106	Wolf 1061	M5	10.1	13.1	12.0	0.6	5.2
107	Wolf 629	M4	12.8	19.3	17.8	3.1	6.8
108	Vys 782 A	M3	10.0	20.9	f 19.3	3.4	7.3
	Vys 782 B	M4	10.8	20.9			
	Van Biesbroeck 8		17.6	20.9			
109	Vys 165 A	M3	10.3	21.3	6.2	16.2	12.4
	Vys 165 B	M3	11.2	21.3			
110	36 Ophiuchi A	K1	5.7	17.3	17.2	-0.7	2.0

36 Ophiuchi B	K0	6.5	17.3				
LFT 1332	K5	7.6	18.3	18.2	-0.6	1.9	
111 HR 6426 A	K3	6.6	23.1	22.9	-3.3	0.6	
HR 6426 B	K5	7.9	23.1				
HR 6426 C	M2	10.9	23.1				
112 41 Arae A	G8	6.1	24.9	23.5	-7.8	-2.4	
41 Arae B	K0	9.3	24.9				
113 Wolf 718	K7	8.1	24.7	21.5	9.1	8.1	
114 Gliese 1351	M4	11.0	15.1	14.3	-4.4	-1.8	
115 LFT 1358	M5	12.8	15.3	4.9	12.2	7.9	
116 Vys 322	M3	10.8	15.2	-1.4	12.8	8.1	
117 Vys 169	M1	10.1	25.9	18.1	15.3	10.3	
118 Mu Herculis A	G5iv	4.0	24.5	14.1	17.1	10.4	
Mu Herculis B	M4	10.3	24.5				
Mu Herculis C	M4	10.8	24.5				
119 UC 48	M	14.1	19.2	16.7	-8.1	-5.0	
120 Barnard's Star	M4	13.2	6	g,II 5.1	2.8	1.4	
121 Vys 176	M2	10.1	23.6	21.5	9.2	3.3	
122 70 Ophiuchi A	K0	5.8	16.2	14.0	7.5	3.0	
70 Ophiuchi B	K4	7.3	16.2	b			
123 Chi Draconis A	F7	3.6	25.5	-4.4	22.0	12.1	
Chi Draconis B	K1	12	25.5	v			
Chi Draconis C	WD	13.5	25.5				
Chi Draconis D			25.5				
124 Vega	A0	0.6	24.5	p 9.6	21.1	7.9	
125 Struve 2398 A	M3	11.2	11.6	0.5	10.6	4.7	
Struve 2398 B	M4	11.9	11.6				
126 Ross 154	M4	13.1	9.4	9.1	1.8	-1.7	
127 Gliese 745 A	M2	11.1	27.4	16.9	21.4	2.6	
Gliese 745 B	M2	11.1	27.4				
128 17 Lyrae C A	M4	12.2	26.7	12.2	23.2	4.9	
17 Lyrae C B	M5	12.5	26.7				
129 Vys 65	M3		19	14.7	11.9	-1.3	
130 VanBiesbroeck's Star	M6	19.3	19				
131 LFT 1469	M7	14.9	18.6	16.8	-2.3	-7.7	
132 Alsaifi	K0		18.4	-2.8	16.8	6.9	
133 Altair	A7	2.3	16.1	11.0	11.5	-2.7	
134 Delta Pavonis	G6	4.8	18.5	13.2	-8.1	-10.2	
135 LFT 1532	M0	9.0	19.9	16.4	-1.9	-11.1	
136 HR 7707 A	K3	6.6	18.2	15.3	1.2	-9.8	
HR 7707 B	M5	12.7	18.2				
137 HR 7722	K0	6.1	26.3	22.0	5.6	-13.3	
138 Vys 820	M3	11.0	25.7	-3.5	24.6	6.7	
139 Gliese 799 A	M4	10.6	26.7	20.9	4.0	-16.1	
Gliese 799 B	M4	11.5	26.7	f			
140 Vys 824	M0	8.8	30.5	23.6	5.0	-18.6	
141 Vys 199	M2	9.2	23.5	-2.8	22.9	4.6	
142 61 Cygni A	K5	7.6	11.1	v 1.8	10.9	-1.2	
61 Cygni B	K7	8.4	11.1	g			
143 Cordoba 291-91	M1	6.7	12.7	8.9	0.7	-9.0	
144 Gamma Pavonis	F6	4.5	27.6	17.4	-11.3	-18.3	
145 Gliese 775	M4	11.3	21.2	7.1	18.0	-8.6	
146 Wolf 922	M4		24.3	13.4	13.0	-15.6	
147 LFT 1640	M1	10.3	15.2	10.1	-1.7	-11.2	
148 Epsilon Indi	K5	7.0	11.2	6.6	-2.9	-8.5	
149 Vys 73	M3	10.7	29.1	11.3	17.1	-20.6	
150 Krueger 60 A	M3	9.8	13.1	-3.0	12.8	0.0	
Krueger 60 B		11.2	13.1	f			
151 Luyten 789-6	M7	14.5	11.2	4.1	4.5	-9.4	
152 Vys 336 A	M2	9.3	29.9	11.7	9.7	-25.7	
Vys 336 B	M4	11.6	29.9	f			
153 EV Lacertae	M4	11.5	16.7	f -2.6	16.1	-3.7	
154 Ross 780	M5		15.6	4.7	6.2	-13.5	
155 LFT 1747	K	12.1	26.7	13.1	-15.4	-17.5	
156 GC 31978	K4	7.0	25.5	10.0	3.2	-23.2	
157 Ross 671	M2	9.5	22.3	1.1	17.5	-13.8	
158 Fomalhaut	A3	2.0	21.9	p 8.3	3.5	-20.0	
159 Vys 339	M1	8.5	25.1	8.3	6.7	-22.7	
160 Lacaille 9352	M1	9.6	11.7	4.5	0.6	-10.8	
161 HR 8832	K3	6.4	22.3	-7.0	21.1	-1.1	
162 EQ Pegasi A	M4	11.3	21	f -2.2	16.2	-13.2	
EQ Pegasi B	M6	13.5	21				
163 CD-73 2299	K3		29.4	12.9	-16.2	-20.9	
164 Ross 248	M5	14.8	10.4	-3.2	9.4	-3.0	

No<D-HEADER>

The numbering indicates star systems. When a system has

multiple components, it receives one number in the list and the coordinates are only listed once. The existence of dim companion stars is sometimes in doubt, so numbering the systems ensures that adding or subtracting stars doesn't disrupt the list.

Name<D-HEADER>

Some stars have many names or appear in several catalogues. For example, Rigel Kentaurus is also called Alpha Centauri and CN Leonis is also Wolf 359. References to the same star in a different source may therefore use another name.

SpCl<D-HEADER>

Spectral Class, where known. ("WD" is simply white dwarf). The dimmer companions in multiple systems are often uncertain (witness the several blanks in their entries).

Mv<D-HEADER>

Absolute Magnitude, where known.

Dist<D-HEADER>

Distance from Sol, in lightyears.

NB<D-HEADER>

Note Bene. Notes are as follows:

b Has brown dwarf companion
f Flare star
g Has probable gas giant
II Population II
p Has protoplanet dust cloud
v Variable star

X,Y,Z<D-HEADER>

The (X,Y,Z) coordinates refer to a three-dimensional reference frame in which X is toward the galactic center, Z is toward galactic north, and Y is in the plane of the galaxy with its rotation. The units are lightyears and Sol is at the origin.

SOLAR SYSTEM STATISTICS<A-HEADER>

This table is for Gamemasters who would set a campaign in the Solar System or at least visit it. Bodies that orbit the Sun are in bold type, with their major satellites in normal type. The statistics here are those that should be useful for game purposes. Some of the values for satellites of the outer planets are questionable, but they are at least ballpark figures. Remember, however, that the majority of these worlds (possibly excepting the moons of Mars) are not just rocks of the appropriate size. The several unmanned probes sent out by JPL/NASA have brought us pictures and other data that show how each world is unique. Any Gamemaster should look up this information for the benefit of his players.

PLANETS AND MOONS OF THE SOLAR SYSTEM<C-HEADER>

Body	Mass (Earth)	Diam (Mhex)	Grav (g)	Day	Orbit (Mhex)	Period	Temp (K)
Mercury	0.056	2.5	0.37	59 d	28 G	88 d	600/95
Venus	0.82	6	0.91	243 d	54 G	223 d	750
Earth	1.0	6.5	1.0	1 d	75 G	1 y	290
Luna	0.012	1.5	0.16	=	192	30 d	370/120
Mars	0.11	3.5	0.39	25 h	112 G	23 mo	220
Phobos	2x10 ⁻⁹	-	-	=	4.5	8 h	315
Deimos	3x10 ⁻¹⁰	-	-	=	12	20 h	315
Vesta	2x10 ⁻⁶	-	-	5h	177 G	3.6 y	
Juno	3x10 ⁻⁶	-	-	7h	200 G	4.4 y	
Ceres	10 ⁻⁵	0.5	-	9h	207 G	4.6 y	168
Pallas	3x10 ⁻⁶	-	-	8h	207 G	4.6 y	
Asteroid (typical)	2x10 ⁻⁸	-	-	4-12 h	142 G	2.7 y	
Jupiter	318	69	2.6	10 h	390 G	12 y	100
Io	0.012	2	0.18	=	210	42 h	130
Europa	0.008	1.5	0.14	=	340	3.5 d	140
Ganymede	0.026	2.5	0.14	=	540	7 d	140
Callisto	0.016	2.5	0.12	=	975	17 d	155
Saturn	95	57	1.1	10 h	710 G	30 y	100
Mimas	6.4x10 ⁻⁶	-	-	=	=	90	22 h
Enceladus	1.4x10 ⁻⁵	-	0.5	=	=	120	33 h
Tethys	1.3x10 ⁻⁴	-	0.5	=	=	150	41 h
Dione	1.8x10 ⁻⁴	-	0.5	=	=	190	2.7 d
Rhea	4.2x10 ⁻⁴	-	1.0	=	=	260	4.5 d
Titan	0.023	2.5	0.14	=	615	16 d	105
Hyperion	2.9x10 ⁻⁶	-	-	=	=	740	21 d
Iapetus	3.1x10 ⁻⁴	-	0.5	=	=	1780	79 d
Phoebe	6.7x10 ⁻⁷	-	-	=	=	6480	550 d
Uranus	15	26	0.92	17 h	1400 G	84 y	64
Miranda	1.2x10 ⁻⁵	-	-	=	=	65	34 h
Ariel	2.1x10 ⁻⁴	-	0.5	=	=	97	60 h
Umbriel	2.2x10 ⁻⁴	-	0.5	=	=	133	4.1 d
Titania	5.8x10 ⁻⁴	-	0.5	=	=	217	8.5 d
Oberon	5.1x10 ⁻⁴	-	0.5	=	=	292	13.5 d
Neptune	17	25	1.2	16 h	2200 G	165 y	59
Larissa	-	-	-	=	37	13 h	
Proteus	-	-	-	=	59	26 h	
Triton	3.6x10 ⁻³	-	1.5	0.1	=	180	5.9 d 38
Neireid	-	-	-	=	2760	360 d	
Pluto	0.017	1.0	0.07	6.4 d	2900 G	248 y	50
Charon	0.002	0.5	-	=	8	6.4 d	50

BODY<D-HEADER>

The accepted name of the world (pronunciation is sometimes debatable).

MASS<D-HEADER>

Mass of the world in Earth masses.

DIAM<D-HEADER>

The diameter of the world in Megahexes. A dash indicates a value less than 0.25 Megahexes (500 km).

GRAV<D-HEADER>

Surface gravity of the world in g's. This is not necessarily a useful number for gas giants (where it refers to the cloud tops). A dash indicates a value less than 0.1g.

DAY<D-HEADER>

The period of revolution for the world. Abbreviations here and for orbital period are h=hour, d=day, mo=month, y=year. A "=" indicates that the world is tide-locked, with its day equal to its orbital period.

ORBIT<D-HEADER>

The mean radius of the world's orbit in Megahexes. (Mercury, Pluto, and Neireid have significantly eccentric orbits, though.) The notation "G" indicates that the value is actually in Gigahexes (thousands of Megahexes).

PERIOD<D-HEADER>

The period of revolution for the world; its year, if it is a planet. Triton and Phoebe orbit retrograde.

TEMP<D-HEADER>

The mean surface temperature in kelvins. If two values are present, they represent day and night. Other worlds show temperature cycles as well, of course, but these are the important cases where the information was available.

[DAVE: IF YOU NEED MORE SPACE, CUT THE ENTRIES FOR ETERNITY SMITH, QUANTUM LEAP, STRIKEFORCE MORITURI, TRANSMUTATION OF IKE GARUDA, OPEN SPACE, FUSION, 2001 NIGHTS. LET'S NOT MAKE THEM TRACK DOWN CANCELLED COMICS AND TV SHOWS. IF YOU NEED MORE ROOM, DELETE ENTRIES WHICH AREN'T FUTURISTIC, DON'T TAKE PLACE IN OUTER SPACE, ETC. ANOTHER ALTERNATIVE IS TO DELETE ANY REFERENCE YOU MADE IN THE GAMEMASTER'S SECTION (REMEMBER ALL THOSE EXAMPLES FOR EACH GENRE CHOICE?)

[IF YOU DON'T HAVE A SPACE PROBLEM, I'D LIKE TO INCLUDE SOME SOFTWARE SUCH AS SIM-EARTH, SIM-CITY, SIM-LIFE, CERTAIN ASTRONOMY PROGRAMS, THE ULTIMATE ROBOT...ISN'T THERE SOME PROGRAM THAT LET'S YOU CREATE CREATURES?]

APPENDIX E: BIBLIOGRAPHY AND FILMOGRAPHY<A-Header>

Good science fiction may be found on nearly any theme or topic. By no means is this a complete list! Additional suggestions are scattered throughout Star Hero as examples.

EXPLORATION<D-Header>

"Surface Tension" (short story by James Blish). Microscopic humans in a puddle discover "outer space."
The Man in the Maze (novel by Phillip K. Dick). Example of a weird alien city.
Gateway (novel by Frederik Pohl). Humans find collection of alien starships with preset coordinates. First in his Heechee series.
Daedalus Mission series (novels by Brian Stableford). Recontact ship Daedalus visits lost colonies.

Alien Artifacts<E-Header>

The Tar-Aiym Krang (novel by Alan Dean Foster). About an alien artifact, to be sure, but also part of his Humanx series.
Rogue Moon (novel by Algis Budrys). Deadly underground installation found on Luna.
Rama series (novels by Arthur C. Clarke and Gentry Lee). Alien space colony wanders through Solar System - is it inhabited?

Unusual Worlds<E-Header>

Neutron Star (anthology by Larry Niven). A "Known Space" collection including "Flatlander" and "Grendel", which describe the worlds Jinx, Gummidgy, and Cannonball Express.
Mission of Gravity (novel by Hal Clemens). Oblate world with hundreds of gravities at the poles.

Very Unusual Worlds<E-Header>

See "Aliens" below for samples of living worlds and stars.
The Integral Trees and The Smoke Ring (novels by Larry Niven). Humans live in a habitable cloud of gas surrounding a star.
Ringworld and The Ringworld Engineers (novels by Larry Niven). A belt-shaped artificial world. A classic and its excellent sequel. Mr. Niven invents some of the most memorable worlds.
"Bigger Than Worlds," (article by Larry Niven). Fun discussion about constructing mega-artificial worlds such as Ringworld. Appears in A Hole in Space collection.
"And Lo! The Bird" (short story by Nelson Bond);
"Born of the Sun" (short story by Jack Williamson). Science fantasies which tell the truth about the Earth.
Orbitsville and Orbitsville Departure (novels by Bob Shaw);
Farthest Star and Wall Around A Star (novels by Fredrick Pohl and Jack Williamson, collected as The Saga of Cuckoo). Discovery and exploration of Dyson spheres.

Rogue Worlds and Worldships<E-Header>

Worlds in Collision (non-fiction by Immanuel Velikovsky). Describes how Venus originated as a rogue world, made close passes with Earth, and then settled into its current orbit. This book is non-fiction, but Velikovsky's theories are universally dismissed by modern scientists.
A World Out of Time (novel by Larry Niven);
Lifeboat Earth (novel by Stanley Schmidt). Earth is relocated to orbit around Jupiter (Niven) and a distant star (Schmidt).
When Worlds Collide (novel by Phillip G. Wylie and movie 1951). Classic tale about people escaping Earth's collision with another world.
Cities in Flight (four novels by James Blish). New York City roams the galaxy looking for work.
Star Trek: "For the World is Hollow and I Have Touched the Sky" (television episode). The Enterprise encounters a space

colony disguised as an asteroid.

Space 1999 (television series). Luna is blown out of orbit and wanders the universe. The science is imprecise, to say the least.

Star Wars (movie, 1977). "Look at him - he's heading for that small moon."

"That's no moon. It's a space station."

"It's too big to be a space station..."

Meteor (movie 1979). Asteroid collides with Earth. Based on an MIT disaster research scenario.

GENETICS<D-HEADER>

The Andromeda Strain (novel by Michael Crichton; movie, 1970).

Investigation of bizarre plague virus.

The Wild Cards series (shared world stories, edited by George R. R. Martin; comic miniseries, Epic comics, 1992). Genetic virus causes super-powers and unique deformities.

The Seedling Stars (short story collection by James Blish).

Humans colonize other worlds by genetically changing their offspring.

The Uplift series (novels by David Brin). Humans engineer intelligent apes and dolphins. Includes Sundiver, The Uplift War, and Startide Rising.

Brave New World (novel by Aldous Huxley). Genetic caste system created on Earth.

VIRTUAL REALITY<D-Header>

"Semper Fi" (short story by Damon Knight);

"Baby, You Were Great" (short story by Kate Wilhelm). Full-sensory fantasy entertainment.

Dream Park series (novels by Larry Niven and Stephen Barnes). What good holography could do for Disneyland.

Total Recall (movie, 19__). Either Arnold Schwarzenegger is experiencing an implanted-memory adventure, or people really are trying to kill him. Based on Phillip K. Dick's short story "We Can Remember It For You Wholesale", and also reminiscent of his novels UBIK, Time out of Joint, Do Androids Dream of Electric Sheep?, and Martian Time-Slip.

Star Trek: The Next Generation (television episodes) "The Big Goodbye," "Elementary, My Dear Data," "Identity Crisis," and "Ship in a Bottle". Interesting uses for the holodeck, and even more interesting ways in which it can get you into trouble.

TELEVISION<D-Header>

Bug Jack Barron (novel by Norman Spinrad).

The Running Man (short novel by Stephen King as "Richard Bachman"); movie, 1987). A game show where winning contestants get to stay alive.

Looker (movie, 1981). Making commercials is easy once you've got the actors backed up on disk.

Max Headroom (movie, 1985; television series). A savvy series about a computer-generated TV personality.

CYBERPUNK<D-Header>

Check the Bibliography in Cyber Hero.

Clockwork Orange (novel by Anthony Burgess; movie, 1971) This is more properly "punk" than "cyberpunk" since it predates the latter concept. But it has the attitude.

Neuromancer, Mona Lisa Overdrive, Burning Chrome (novels by William Gibson)

Tron (movie, 1982)

Comics: Batman: Digital Justice (graphic novel, DC Comics); Iron Man: Crash (graphic novel, Marvel Comics); Strikeforce Morituri: Electric Undertow (comic miniseries, Marvel Comics)

Other Books: Mirrorshades: The Cyberpunk Anthology (edited by Bruce Sterling); The Ophiuchi Hotline (novel by John Varley); Hardwired (novel by Walter Jon Williams); Street Lethal (Steven Barnes); Nova (Samuel Delany).

ALIENS<D-Header>

Star Surgeon and Hospital Station (novels by James White). About Sector General, a space hospital with diverse alien patients - and doctors.

Barlowe's Guide to Extraterrestrials (book by Wayne D. Barlowe and Ian Summers). Biologically believable illustrations of

aliens from a large selection of SF stories.

- Sentenced to Prism (novel by Alan Dean Foster). Organosilicate ecology of crystalline lifeforms. A Humanx novel.
- The Black Cloud (novel by Fred Hoyle). A space-dwelling, cloud-like entity threatens to block out the sun.
- Corona (novel by Greg Bear). Star Trek novel #15; the Enterprise encounters an energy being unique even by Trek standards.
- 2001: A Space Odyssey, 2010: Odyssey Two, and 2061: Odyssey Three (novels by Arthur C. Clarke; movies 1968, 1984, and maybe someday). A mysterious race alters human evolution and makes an astronaut something more than human.
- Whipping Star (novel by Frank Herbert). What is the transdimensional alien that calls itself Fannie Mae?

Living Worlds<E-Header>

- Solaris (novel by Stanislaw Lem; movie 1972). Surreal novel of human exposure to a sentient ocean.
- The Gaea Trilogy (novels by John Varley). The novels Titan, Wizard, and Demon, about a moon-sized alien with control of her biosphere.
- Short Stories: "Lonely Planet" (Murray Leinster); "Process" (A.E. van Vogt); "The Forest of Zil" (Kris Neville); "Vaster than Empires; and More Slow" (Ursula K. LeGuin).

Living Stars<E-Header>

- The Starchild Trilogy (novels by Frederick Pohl and Jack Williamson). The Reefs of Space, Starchild, and especially Rogue Star.
- The Dosadi Experiment (Frank Herbert). A Caleban - an intelligent star - puts a barrier around the planet Dosadi.
- "The Living Galaxy" (short story by Laurence Manning)
- "If the Stars are Gods" (Gregory Benford and Gordon Eklund). Aliens come to the Solar System to worship our sun.

First Contact<E-Header>

- "First Contact" (short story by Murray Leinster). The short story that defined the term.
- The Mote in God's Eye (novel by Larry Niven and Jerry Pournelle). Modern epic about encounter with asymmetrical extraterrestrials.
- Dragon's Egg and Starquake (novels by Robert Forward). Intelligent race on the surface of a neutron star.

Precursor Races<E-Header>

- World of Ptaavs, Protector, "Down in Flames" (novels and an article by Larry Niven). "Known Space" pieces about the Slavers, the Pak, and the tnuclipun, respectively. ("Flames" appears in the collection N-Space. Read it last.)
- Saga of Pliocene Exile series (novels by Julian May). Psionic exiles and time-exiled humans.
- The Well World series (novels by Jack Chalker). Many races, all designed by one precursor race.

HUMOR<D-Header>

- Of course, humor is just an approach taken with any other category.
- The Hitchhiker's Guide to the Galaxy (novel by Douglas Adams; television series syndicated on PBS; radio series; record album). Cult favorite about a group that wanders time and space after the Earth is destroyed to make way for a hyperspace bypass. The novel has three sequels; much of that material appears in the other versions.
- Star Smashers of the Galaxy Rangers (novel by Harry Harrison). Spoof of pulp SF adventure novels. Two square-jawed young heroes and their friends ply the starways in a homemade starship: a converted 747 that runs on cheese.
- How Much For Just the Planet? (novel by John M. Ford). Star Trek novel #36. If Kirk didn't know better, he'd swear that people on this world are doing their best to make his crew and the Klingons look ridiculous.
- Red Dwarf (television series, syndicated on PBS; series of novels). British sitcom about a genial slob, a nitpicking hologram, and a humanoid cat, the only survivors aboard an immense starship.
- Q-In-Law (novel by Peter David) Star Trek: The Next Generation novel #18. Guess who's dating Lwaxana Troi?

FTL COMMUNICATION<D-Header>

The Quincunx of Time (novel by James Blish). Interstellar society is shaped by an FTL radio with a strange side effect: it tells the future. An expanded version of Blish's short story "Beep."

PSIONICS<D-Header>

Mental powers form a major subcategory of SF; only the briefest sample can appear here. These are sources in which psionics are a major element; such powers are very common in other SF.

Books: Dune (Frank Herbert); The Demolished Man (Alfred Bester); More Than Human (Theodore Sturgeon); The Midwich Cuckoos (John Wyndham); Dr. Bloodmoney (Philip K. Dick); The Dream Master (Roger Zelazny); Jack of Eagles (James Blish); Dying Inside (Robert Silverberg); Firestarter (Stephen King); 14 Great Tales of ESP (edited by Idella P. Stone).

Movies: Dreamscape (1984); Firestarter (1984); Scanners (1980).

TELEPORTATION<D-Header>

"Exercise in Speculation: The Theory and Practice of Teleportation" (article by Larry Niven). Niven explains how different types of teleportation would affect the world (and stories about that world). An excellent, methodical approach that may be applied to any futuristic gadget. Read this if your game world has any type of influential technology. Appears in the collection All the Myriad Ways and elsewhere.

The Stars My Destination (novel by Alfred Bester). Teleportation as a mental power.

The Transmutation of Ike Garuda, (comic miniseries, _____ 1991-2,). Interstellar travel is by teleport, not starships.

Cluster (novel by Piers Anthony). Interstellar teleport requires that an empty body be waiting for you at your destination.

The Fly (movies, 1958 and 1986). Research into teleportation can yield horrifying results. The details are interestingly different in these two versions, but the remake is not for the squeamish.

ROBOTS, CYBORGS, & ANDROIDS<D-Header>

Star Trek: The Next Generation (television episode) "The Measure of a Man". Neatly states the arguments for and against whether an android - Lt. Cmdr. Data - has the same rights as an organic being.

He, She and It (novel by Marge Piercy). A programmer falls in love with her project, and android "golem".

Do Androids Dream of Electric Sleep? (novel by Phillip K. Dick) and Blade Runner (movie, 1985) A cop chases renegade artificial humans that are so realistic, not even they always know that they aren't "real." Director Ridley Scott's visually stunning version of the novel takes many liberties, but is a masterpiece of atmosphere.

Man Plus (novel by Frederick Pohl). Conversion of a man to cyborg who can explore Mars.

The Cyborg series (novels by Martin Caidin). Original of television's The Six Million Dollar Man.

Robocop (movie 1987). Black-humored hit about a cyborg policeman.

SCIENCE FICTION<D-Header>

The Science Fiction Encyclopedia (edited by Peter Nichols).

Allows you to look up SF concepts (e.g., time travel, aliens) as well as authors and movies. The only drawback is that it hasn't been updated since 1977.

HUMAN EVOLUTION AND MUTANTS<D-Header>

Books: Slan (novel by A.E. van Vogt); Childhood's End (novel by Arthur C. Clarke); Stranger in a Strange Land (novel by Robert Heinlein); Hellstrom's Hive (novel by Frank Herbert); The Nexus (novel by Mike McQuay);

Movies: Videodrome (1982); Planet of the Apes (1968); Village of the Damned (1960); Day of the Dolphin (1973); Phase IV (1973)

UTOPIAS AND DYSTOPIAS<D-Header>

We (Eugene Zamaitin); 1984 (George Orwell); Fahrenheit 451 (Ray Bradbury); New Atlantis (Sir Francis Bacon); Utopia (Sir Thomas More)

Movies: Barbarella; Brazil; 1984; Logan's Run; Zardoz

WAR<D-Header>

Books: The Forever War (novel by Joe Haldeman); Space Cadet and Starship Troopers (novels by Robert Heinlein); Mercenary (novel by Jerry Pournelle); Bolo (collection by Keith Laumer); the Hammers Slammers series (by David Drake); Ender's Game (novel by Orson Scott Card); the Dorsai series (by Gordon Dickson).

Movies: Aliens (1986); War of the Worlds (1953); Enemy Mine (1985); The Last Starfighter (1984);

Television: Battlestar Galactica; V; The Invaders

BUSINESS<D-Header>

The Space Merchants (novel by Fredrick Pohl); The Trouble Twisters series (novels by Poul Anderson); Rollerball (movie,)

DIPLOMACY & POLITICS<D-Header>

The Retief series (novels by Keith Laumer). Humorous adventures of a star-travelling diplomat.

Other Books: The Foundation series (novels by Isaac Asimov); Bio of a Space Tyrant series (novels by Piers Anthony); The Dispossessed (Ursula K. LeGuin).

POLICE WORK AND ESPIONAGE<D-Header>

The Robot Detective novels (by Isaac Asimov). An android cop and his human partner. The books are The Caves of Steel, The Naked Sun, and The Robots of Dawn.

Other Books: The Stainless Steel Rat series (Harry Harrison); The Cool War (Frederick Pohl); Friday (Robert Heinlein); the Ensign Flandry series (Poul Anderson)

Movies: Escape from New York (1981); Outland (1981).

SPACE OPERA<D-Header>

The Centuri Device (novel by _____). Grand space opera.

Nova (novel by Samuel Delany). Space Opera in the SF "new wave" style.

Galactic Empires (edited by Brian Aldiss). Anthology of short stories on a galactic scale.

The Lensmen series (novels by E.E. "Doc" Smith). Interstellar wars, psionic cops, evil races, and the biggest arms race you'll ever read about...

Comics: Pirate Corps; Fusion (defunct); Open Space (ditto); Legion of Super-Heroes (newest version); 2001 Nights

Other Books: Skylark of Space (novel by E.E. "Doc" Smith); Family D'Alembert (series of novels by E.E. "Doc" Smith); The Future History stories (Robert Heinlein); The Left Hand of Darkness (Ursula K. LeGuin); The Time Wars saga (Simon Hawke); A Rebel in Time (Harry Harrison); The Crosstime Engineer (Leo Frankowitz).

ALTERNATE AND PARALLEL WORLDS<D-HEADER>

Alternate worlds are stories of Earth as it might be, had history somehow been altered. Parallel worlds are universes or "dimensions" which exist side-by-side. These stories often involve travel from one dimension to another.

Alternate Worlds<E-HEADER>

The Difference Engine (novel by William Gibson and Bruce Sterling). The computer revolution begins in the 19th Century.

The Man in the High Castle (novel by Phillip K. Dick). The Axis won WWII.

SS/GB (novel by Len Deighton). The Axis won WWII again.

The Iron Dream (novel by Norman Spinrad). A novel is written by science-fiction author Adolf Hitler.

Eye in the Sky (Phillip K. Dick); A group of people travel through a series of alternate Earths.

Tunnel Through the Deeps (novel by Harry Harrison). Centuries after the failed American Revolution, a major engineering project is performed by a descendent of the traitor George Washington.

Watchmen (comic trade paperback, DC comics) also in trade paperback edition). Only one of the superheroes has real powers, and he changes the world.

West of Eden (trilogy by Harry Harrison). Cavemen are ruled by intelligent dinosaurs.

Journey to the Far Side of the Sun (movie, 1969). Co-orbital world of Earth is our mirror image in every way.

Batman: Holy Terror (graphic novel, DC Comics, 1991). America is

run by a corrupt church, and a priest named Bruce Wayne has a way to deal with it.

Captain Confederacy (comic series Steeldragon Press, 19__; comic miniseries, Epic Comics, 1991-2). Superheroes in the world where the South didn't lose the War Between the States.

Parallel Worlds<E-HEADER>

The Paratime Police stories, (novels <????> by H. Beam Piper).
Transdimensional spy stories, including Lord Kalvan of Otherwhen.

The Number of the Beast (novel by Robert Heinlein). Travel to other Earths, other Heinlein novels, and the kingdom of Oz in a flying Buick. <????>

The Gods Themselves (novel by by Isaac Asimov). A new power source threatens two entire universes.

Roadmarks (novel by Roger Zelazny). A gun-runner and a talking copy of Whitman's Leaves of Grass travel a highway with exits into the past and future.

"Random Quest" (short story by John Wyndham); Quest for Love (movie version, 1971). Man falls into a parallel earth and into love.

(The Adventures of) Buckeroo Banzai Across the Eighth Dimension (movie, 1984). Gonzo adventure about a rock-star scientist and an invasion from the 12th Dimension.

TIME TRAVEL<D-Header>

Millennium (John Varley)

Lest Darkness Fall (L. Sprague De Camp) and the book that inspired it, Mark Twain's A Connecticut Yankee in King Arthur's Court.

Dr. Who (television series, syndicated on PBS). Adventures in time and space with the immortal hero.

The Time Machine (novel by H.G. Wells; movie, 1960). The first SF book on the subject.

Time After Time (movie, 1980). However, if Wells really did have a time machine, and traveled to San Francisco in 1980...

Star Trek IV: The Voyage Home (movie, 1986) Better yet, what if Cpt. Kirk and crew came to Twentieth Century San Francisco?

Star Trek: The Next Generation (television episode) "Time's Arrow." Data goes back to 19th century San Francisco.

Back to the Future (movie 19__). Comedy employs every time-travel cliché in the book at least once -- and does a fun job of it, too. Two sequels were pretty good also.

Quantum Leap (television series, NBC). A new riff on the wandering-hero theme as a man bops around to a new year and identity each episode.

Eternity Smith (comic, Renegade Press, 1986-7 and Hero Comics, 1987-8). A scientist hero returns from the future.

POST HOLOCAUST<D-Header>

Day of the Triffids (novel by John Wyndham; movie, 1962). Humanity is decimated by giant mobile plants. Much better than it sounds.

Lucifer's Hammer (novel by Larry Niven & Jerry Pournelle). Comet strikes earth.

Make Room, Make Room (novel by Harry Harrison); and Soylent Green (movie 1973). Overpopulation decimates the world. The movie is a rather loose version of the book.

The White Plague (novel by Frank Herbert). A scientist creates an epidemic which kills only women.

Other Books and Movies:

The Wanderer (novel by Fritz Leiber). Aliens arrive at Earth, but not in a ship...

Alas, Babylon (Pat Frank); The Postman by David Brin; A Canticle for Leibowitz (Walter M. Miller); War Day and Nature's End (Whitley Strieber); A Boy and His Dog (Harlan Ellison, movie 1976); the Mad Max movie trilogy; On The Beach (movie 1959); Night of the Comet (movie 1984)

SCIENCE MAGAZINES <D-HEADER>

These are good ways to get ideas on new gadgets and fun concepts, as well as keeping your game's science background up to date and prevent you from introducing "futuristic" technology that will actually be in the stores in the next two years and obsolete in five. Browse through magazines such as Discover, Omni, PC Magazine, and anything with "science" in its title.

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