# Technology

Technology and its impact on society are the largest and, to us, most important themes in Sufficiently Advanced. Each civilization is based not only around its core values, but on how those values interact with and are built upon the technology that civilization uses. This chapter contains a compilation of the technology available to citizens in the current era, talks about what does and doesn't exist, and gives ideas for how to invent some of your own.

The list is sorted by the Capabilities that are required to build and maintain a particular device, or to develop and implement a procedure. For instance, because Replicators are Soft Nanotech, any culture without soft-style enhanced Nanotech cannot build or maintain replicators. They might be able to use them, but they can't fix them when they break. Technicians from high-tech civilizations are always in high demand.

Your character's Capability scores give you access to equipment and techniques rated at its level. Technologies not listed under hard, soft, or cutting edge are available to any character with that Capability enhanced in any fashion. Someone trained in cutting-edge Metatech can be assumed to know every technique listed there and be able to apply it. Some characters may choose to leave out certain options, such as buying "peacebonded" Stringtech with only defensive capabilities. This will have repercussions within the setting, but there is no effect in the game rules for such alterations.

Note that only the hard / soft / cutting edge distinction changes what a civilization is capable of creating. The high / low distinction will affect the quality of such technology (miniaturization, power, general effectiveness) but not whether it is available.

Some items on this list have special Descriptors, important characteristics that they share with other technologies. See the sidebar on the next page for detail on what each Descriptor means. In addition, some technologies require more than one kind of infrastructure to implement properly. These items are listed with an "Auxiliary Tech."

### Activation Codes

Most characters in S.A. have significant amounts of this technology built into their bodies. When you have the ability to shoot a starship out of orbit, enter suspended animation, or make your anything you say sound more important than the voice of God, that's not something you want to activate accidentally!

Characters with enhanced Cognitech can use mental triggers through their Mesh for their abilities. Those with enhanced Nanotech most likely have dermal microbots, which can track their voice and gestures, and can use those triggers instead. Those without either may have built-in switches, perhaps triggered by a series of blinks or hand movements.

## Computers

Almost every single item listed in this chapter either depends on computers for use (Lenses, Psychohistory, Memetics) or has one built in (everything else). In general, anything you've heard of a computer doing in real life, the ones in S.A. can do with no delay. If you need a computer, typically all you need to do is speak into the air, and one will respond. If you're from a high-tech culture, they're built into your clothing. If you're in high-tech surroundings, they're integrated into the buildings, roads, and home appliances. They are effectively omnipresent, and the term "infosphere" is used rather than "internet" or "web" because computers and information flow are more like the atmosphere on modern Earth than the computers there.

The average computer is about the size of the last joint on your fingers, and provides more power than all the computers on 21st century Earth. A truly high-end computer would be roughly the size of 20th century desktops, and could hold a Dataform individual or sophisticated AI inside. At high levels of Nanotech, one can build self-assembling, low-end computers into fingernail polish.

Computing power is a public utility in some civilizations, a private right in others. Still others, mostly Cargo Cults, treat it as a privilege reserved for the wealthy. Even if it's not a utility (like water or electricity), one can almost always find companies on the infosphere who are willing to sell computer time to programmers with particularly complex jobs.

The only significant delay when using the infosphere is when information has to be accessed from off-planet, typically via wormhole. Not all information is free, but significant amounts of it are, depending on which civilization you're part of.

***Descriptors:*** Near-c, Energy

## Descriptors

Check here to see what any technology Descriptors mean.

***Auxon:*** This device is self-replicating, and will continue to create more of itself until a predetermined limit is reached.
***Dataform:*** This technology is pure computer code, and exists only on the Infosphere.
***Energy:*** Weapons with this Descriptor fire energy instead of (or in addition to) physical matter. Enhanced Stringtech provides this descriptor, as well as suitable defenses against it.
***Infrastructure:*** This technology requires substantial resources to employ, perhaps those of a city or entire civilization. It is not something that gets installed in individual characters.
***Inheritable:*** This enhancement will, in all likelyhood, pass on to any of the character's children born after it is acquired.
***Internal:*** This enhancement is completely internal to the human body. Cursory examination will not reveal its presence; it takes exploratory surgery or Soft Nanotech to discover it.
***Microscopic:*** This device is impossible to see with the naked eye; it requires enhanced Nanotech score to detect its presence.
***Near-c:*** Weapons with this Descriptor either fire energy or deliver projectiles at nearly the speed of light.
***Procedure:*** This is not a device, but a learned and practiced procedure. There is no way to "deactivate" such technology without rendering the user unconscious or employing psychotropic drugs.
***Supersymmetric:*** Weapons with this Descriptor fire particles of dark matter, which pass through ordinary matter and are unaffected by most types of energy. Enhanced Stringtech provides this descriptor, as well as suitable defenses against it.

Characters who "lack an appropriate defense" suffer a -1 penalty in conflicts where their opponents press that advantage.

## The Infosphere

The infosphere is a continual flow of data that blankets the surface of nearly every planet in every civilization. The data is broadcast by satellites, radio towers, microscopic lidar relays, and nearly anyone with a mesh or dermal microbots. It is accessible at any point above the planet's surface. Below the surface, reception typically suffers.

Because of the massively parallel and distributed setup of the infosphere, the data transfer rate is exceptionally high. Data not longer than the human genome and not traveling off-planet typically arrives within a second. This nature also allows those connected to the infosphere to tell when there are particularly large transfers taking place, including mesh-hacking attempts.

It is not uncommon for those with meshes to "project themselves up" to the infosphere, where they can experience a simulated environment. This is useful for meetings, entertainment, communications, and so forth. Projecting an image up takes no effort, while projecting one's awareness up typically takes over the whole brain, blocking input from the real world. People can also superimpose items from the infosphere (such as regional maps, other peoples' projections, topographical data, and so on) on top of their normal vision. This is very valuable if done properly, but can be distracting if done poorly. Simply adding a mental tag that says "this is not real" is not enough, as this causes other complications.

Dataform characters view analog reality entirely through their interactions with the infosphere. Thankfully, these are copious in most regions. Many inanimate objects also have a light infosphere presence. They typically require authentication of a person's existence or authority before they will accept commands through the infosphere. Dermal microbots are technically not on the infosphere, but on a "personal subnet." If the bots' owner has a mesh, his or her brain acts as a firewall between the personal subnet and outside world, and only a successful mesh-hacking attempt will allow access to the subnet and control the bots.

Most people broadcast "tags" that say a little about themselves – their name, occupation, age, and miscellaneous personal data that one might find on a personal homepage. In some civilizations tags are common and dependable; in others, they are notoriously unreliable.

Reliable stores of information are easy to find. Many are free, though they may have to charge for certain pieces of recent or copyrighted data. Truly important or dangerous repositories of data are kept off the infosphere. More often, however, access is merely restricted. Gaining access is nigh on impossible without the right clearance, since access codes can be based on brainwave patterns.

Since nearly all of the relays included in the infosphere are quantum computers, it is always possible to tell whether your communications have been intercepted. There's just no way around this – if you intercept someone's communications and try to decrypt them, someone will know that it happened, though they may not be able to figure out who was involved.

Nearly all commerce is done via the infosphere. Those without meshes can use verbal commands and gestures to dermal microbots; those without either can use datapads, PCs, and motion-sensitive scanners that are present in most public replicators.

# Biotechnology

## Drugs

Alcohol, LSD, and crack are like sledgehammers to the system. The drugs available in the modern age are significantly more sophisticated. The current state of biotech and nanotech allow drugs to block or overload very specific receptors in the brain, and then wash straight out of the body. Imagine alcohol without the hangover, or morphine without the physical addiction. You can do the reverse, too – imagine LSD that isn't water-soluble, and stays inside your brain for months. An easy guideline is this: think of something a drug (or nearly any sort of biological agent) does today, and either take out the side effects or isolate them and use them, as strong or as weak as you like.

Civilizations that have freely available or unregulated drugs tend to, by necessity, develop a culture that watches carefully for drug overuse. While most people are unlikely to go on a serious bender, others will end up sliding into a psychotropic stupor unless they have a serious support network.

***Descriptors:*** Typically none, but sometimes Auxon, Dataform, Microscopic, or Procedure

## Immortality

Civilizations that study advanced biotechnology inevitably improve their medical techniques. From infectious microorganisms to cancer to geriatric diseases, all threats to life and health are attacked systematically until nearly every symptom of aging can be delayed. The progress continues with telomere regeneration, brain cell repair, radiation remediation, and more. Eventually, old age is conquered. The service may be expensive in the beginnging, but after hundreds or thousands of years it becomes less expensive, eventually being a natural part of the civilization's genome.

Each civilization handles the transition to immortality differently. Many go through severe adjustments, and some even collapse into Cargo Cults. Each civilization in the setting book includes a description of how they handle the impact of immortality, or why their citizens are not immortal (typically because of a lack of Biotech). Most SA characters, barring severe accident, will live forever.

***Descriptors:*** Internal, eventually progressing to Inheritable

***Auxiliary Tech:*** Cognitech provides coping mechanisms and memory storage for exceptionally old characters.

### Cognitech Drugs

Having a mesh opens billions more possibilities. Not only can you buy a Lens to simulate your drug of choice perfectly, but you can get another one to get rid of the hangover and a third to help you reinforce your choice to quit (if you even make such a choice). But why stop there? Designer drug Lenses, recorded dreams and fantasies, bizarre hallucinations guaranteed not to make you accidentally throw yourself off the rooftops, satori Lenses (making you feel like you've been enlightened), buying express computer time to make yourself "smarter," and more. Of course, you have to *choose* to do these things to yourself. No one can do them to you unless you've been foolish enough to install a slave lens. However, there are still dangers. "Trojan horse" Lenses can wreak havoc on your mind and body through your mesh. Even a child knows no one can control you through a neural mesh... but when you run a Lens, you're turning over control to the Lens' programmer.

## Bio, Hard

### Animal Prowess

A broad variety of biological enhancements come from animal sources. Stronger muscles, faster reflexes, increased running speed, and so forth can all be obtained with relative ease. Many people also benefit from cat-like retractable claws, skin toughened and smoothed with spider silk, and extra-hard bones that one or another of their ancestors brought into the family DNA.

***Descriptors:*** Inheritable, Internal

### Enhanced Senses

While most truly enhanced senses are the bailywick of nanotechnology, simple enhancements to the five senses are well within the realm of biotechnology. The nose of a bloodhound, the eyes of an eagle, the ability of a snake to scent the air with its tongue; all can be invisibly built into the human body. Biotech can also replicate certain "sixth senses" such as a feel for simple magnetic or electric fields, air pressure, or acid/base balance.

***Descriptors:*** Inheritable, Internal

### Regeneration

Instantaneous regeneration is impossible; beyond being merely difficult, it violates the law of conservation of mass. However, the slow replacement of missing organs, limbs, teeth, and nerves is a reality for most civilizations.

***Descriptors:*** Inheritable, Internal

### Venom and Drug Glands

These glands secrete a variety of different drugs and poisons, available to both the character with the gland and for injection into others. They are typically hidden in the hand for use in combat, or the mouth for more discrete use. Most such glands are multi-function, capable of producing a variety of different chemicals. Common choices include paralytic venoms, blood clotting agents (for first aid), truth serums, recreational drugs, painkillers, and hallucinogenics. The drugs are typically injected through retractable spines or stingers. In more permissive civilizations, these glands may secrete airborne agents or release gasses.

***Descriptors:*** Inheritable, Internal

# Bio, Soft

## Biofeedback

A general suite of genetic enhancements, this allows conscious control over normally subconscious faculties. Those with these enhancements can hold their breath longer, turn off their senses (including your pain sense), or even enter a state of hibernation.

***Descriptors:*** Inheritable, Internal

## Genetic Modification Techniques

There are three different varieties of genetic modification in S.A.: gene therapy, post-facto genetic engineering, and genetic resynthesis. Gene therapy exists in the 21st century, though it is in its infancy. Gene therapy is primarily used to treat diseases, especially hereditary ones. Post-facto genetic engineering is a more serious procedure that uses a retrovirus to alter a patient's genetic code, within the normal range of human ability and form. It can take up to seven years for these changes to take effect, and the process requires various drugs to keep the patient's body from rejecting organs and body parts whose genetic code changed over earlier. Some alterations can be done more quickly, but the drugs will be necessary for the rest of the patent's life. Failing to take them is effectively declaring genetic warfare on yourself. Genetic resynthesis is a yet more radical method; see the "Cutting Edge" section.

***Descriptors:*** Procedure, Inheritable, Infrastructure

## Household Biosensors

While these come in many different variations, they all share the same function: they identify simple medical problems that can't be easily found from the outside. A typical version works overnight, and is often used for young children. The blanket and sheet on their bed, in addition to being heated to the proper comfort level, give gentle ultrasonic pulses and MRI scans from time to time. They then send this information wirelessly to the parents' bedstand, which projects warnings on the bedroom wall if there was a problem found overnight.

***Descriptors:*** None

## Pathogen Analysis

Microarrays of sensitive materials can be seated in the menmouth and nose. Not only can the presence of an infectious agent be detected by smell or taste, but the arrays are designed to match the pathogen against thousand of possible known agents. Even organisms engineered from the ground up will typically include DNA from other successful microorganisms. Characters with access to pathogen analysis can often guess at a new agent's function and what might be effective in fighting it.

***Descriptors:*** Internal

## Bio, Cutting Edge

### Environmental Fabrication

Environmental fabrication creates self-contained, self-maintaining ecological environments. It is very useful in the construction of generation ships and space stations, as well as for biological research. This technique is limited by the size of the environment to be created; higher levels of technology relax that limitation. See Terraforming (below) for a significantly larger-scale version.

***Descriptors:*** Procedure, Infrastructure

***Auxiliary Tech:*** Soft Nano and Cog

### Genetic Resynthesis

The most significant drawback of biotechnology is that its greatest successes need to be built into the body from before birth. Genetic resynthesis finds a way around this limitation. The subject of this procedure enters a chrysalis that utterly alters the human form. It can take between two months and a year, and the subject remains totally unconscious until it is complete. Genetic resynthesis can add any Biotech enhancements with the Internal Descriptor, or even change a subjects' Biotech Capability. Characters with a Cutting Edge score in Biotech can initiate a coccoon of their own with sufficient preparation (typically months), but even unenhanced characters can benefit from resynthesis if they have access to the appropriate facility.

***Descriptors:*** Procedure

### Pathogenesis Organ

These are organs within a person's body that can genereate certain varieties of microbial and viral infections. The organ's wielder typically releases these on others by coughing or sneezing, but could use physical contact or bodily fluids for certain diseases. Wielders can choose which pathogens to release by eating specific foods the day beforehand, which act as "triggers" for the organ. Each organ has its own set of unique triggers and pathogens. Pathogens can even be tailored for a specific target if a bit of the target's DNA is available. Pathogenesis Organs are most often used to enable a single person to engage in biowarfare conflicts, but can also be effective in one-on-one combat.

***Descriptors:*** Internal

### Terraforming

Terraforming expands the methods used in environmental fabrication to entire planets. The process is relatively delicate and can take hundreds of years — to date there have been only a handful of successful terraforming events, and it is so expensive that few civilizations are willing to try. Finding a new inhabitable planet is much cheaper than terraforming a nearly-habitable one, despite the rarity of suitable planets.

***Descriptors:*** Procedure, Infrastructure

***Auxiliary Tech:*** Nano, String, and Cog of any sort

# Cognitechnology

## Neural Meshes

Neural Meshes allow human beings to communicate mentally with computers, controlling them and sending messages through them. Since the infosphere connects nearly all computers, this also allows interpersonal communication and near-instant access to any public information, such as a cultural guidebook to prevent faux pas. Meshes enable the human/computer fusions that allow high-level Cognitech to work so well. They require about a year of adaptation to get used to after implantation. Meshes are perhaps the most influential technology ever created.

There are two "stages" of mesh commonly in use. The first stage is available to characters with any level of enhancement, and interfaces only with the sensory cortex of the brain. It is useful pimarily as an interface to computers – running "apps" internally, as it were. The second stage interfaces with all parts of the brain, including memory, emotion, and thought processes. Second-stage lenses are available only to characters with soft-style enhancement, and they enable the use of Lenses (see page xx). Some civilizations avoid second-stage Meshes because of the dangers of mesh-hacking and the literal mind control that can be exerted through such methods, but the effectiveness of Lenses typically means that second-stage Meshes become more prevalent out in the long run.

It is possible to have a "partial mesh" installed with limited functionality. One commonly-used partial mesh is a "spy mesh," which allows you to install a secondary personality and switch between it and your real personality at will. For all purposes this persona is a completely different individual, with its own Metatech and Cognitech scores (rated up to your own). Similarly, a neural Mesh with an exterior control unit is referred to as a "slave mesh," since it allows others to control the individual with the mesh. Users of a second-stage mesh would consider a first-stage mesh to be partial, as it only connects to a portion of the brain.

***Descriptors:*** Internal
***Auxiliary Tech:*** Bio or Nano

## Limitations of Meshes

Meshes can do nearly anything to someone's mind. What can't you do with a Mesh?

First, you can't quickly and permanently change a person's memories. You can falsify them, provide fake ones, cast doubt on them, or otherwise screw with someone's active recall of their memories, but once the program doing that is removed, the experiences are still there in long-term memory. You can change long-term memory if you're given enough time to do it; one month per point of Metatech score should be enough to change a particular memory forever, and even then things may be a little confusing from time to time. The human brain seems to store information in many redundant locations.

The same goes for personality, morals, Core Values, sexual orientation and so forth. Those are the result of your life experience (and, to a lesser extent, genetics) and thus are even harder to change than a single memory. Again, you can mask your feelings, provide false CVs, and make yourself into an uncaring monster, but once the lens is gone, your old conscience returns.

You can't affect kinesthetic abilities, such as "muscle memory" and rhythm. You can mimic it somewhat, but you can't impose hand-eye coordination or grace just by writing a Lens for it.

Finally, you can't do much to a dead brain. You can read the memories of those who have died less than two minutes ago, but unless the memories were stored in the mesh's auxiliary computer, there's no way to retrieve them after that time. You also can't control the bodies of dead or brain-dead people. Access to facilities with soft-style Biotech and Cognitech can read some long-term memories from undecayed brains, but it's spotty at best. People in a coma can often be reached through their mesh, but there's no guarantee.

## Fun Things to Do With a Mesh

All of these require some expertise in Programming or Cognitech Engineering (or both), but you can also download Lenses from the infosphere to do these things for you. Think of this as a short list of the ways in which the neural mesh has changed the world.

- Filter out any advertising you see.
- Keep a database describing the local morals and customs, and set it to warn you if you're about to break one.
- Never forget a name or a face.
- Impose directional lines over the road you're driving on, to get you safely and quickly to your destination.
- Relive past victories.
- Relive past orgasms.
- Access a review/rating system for any book, movie, etc. you see.
- Give yourself synaesthesia.
- Get used to synaesthesia enough to operate in the dark solely through hearing.
- Set up self-analysis routines to tell you what you're doing wrong at the end of the day. Most people find these annoying, but those who listen to them often find great benefit in it.
- Listen to a single person in a crowd by filtering out everyone else's voiceprints.
- Spend a day as one of your friends, and have him or her go through your day.
- Edit all the annoying people out of your life. While you're at it, why not make yourself think you're suave and cool.
- Set up a shared mental space for you and your friends to communicate in.
- Simulate any environment you like, for historical recreation or for entertainment. Live-action roleplaying will never be the same.
- Record and map an environment with microbots, and then "shrink" yourself into it to inspect it yourself.
- Superimpose faint constellation lines on the night sky, or "tags" that show your friends' homes on distant planets.

## Cog, Hard

### Accelerated Cognition

Perhaps the best-known goal of cognitechnology is the improvement of the human thought process. Practical thought acceleration is provided by offloading cognitive processes into mesh computers, saturating the brain with nootropic chemicals, and providing instant fact checking. Characters with enhanced Cognitech can often think dozens of times faster than the unenhanced. This improves not only logical thought but creativity and productivity as well.

***Descriptors:*** Internal, Procedure

### Cerebral Firewall

These Cognitech devices are designed to protect characters from dataform onslaughts. The cost includes a subscription to an service that updates the firewall with the latest techniques in mesh-hacking defense; without these services the firewall's effectiveness will degrade over time. Everyone with a mesh will have some basic level of these; the paranoid or those who store important data in their brains will have improved models.

***Descriptors:*** Internal, Dataform

### Data Bomb

The Infosphere is carefully engineered, constantly stress-tested, and multiply redundant. However, it can still fall (in the local area) to a concerted attack. Data bombs create self-perpetuating cognitech viruses that spew out meaningless information at a tremendous rate. They overwhelm infosphere nodes through sheer force, and are also the first step in most mesh-hacking assaults. For people wearing a Mesh in the local area, a data bomb is no less subtle than a live grenade.

***Descriptors:*** Dataform

### Internal Simulation Processors

These are supplemental devices, augmenting the computers that are already attached to most Meshes. They provide an expanded arena specifically designed for simulation of the real world in great detail. The amount of storage and processing power is sufficient even to maintain a second consciousness within your own mind, though your effective Cognitech score will drop by a point due to the requirement of sharing their mind with yours. These processors can also be used to "test out" various situations and environments, allowing a character to guess at whether or not a particular action will yield the desired results. The accuracy of this guess depends on how well the environment was modeled, but in general they will yeild a correct assessment of probabilities unless there are surprises in store that a supergenius-level intellect could not anticipate.

***Descriptors:*** Internal

## Cog, Soft

### Lenses

This piece of tech is listed out of alphabetical order because of its pervasive nature: over half of the items in soft-style cognitech are lenses.

A Lens is a program that runs on a mesh. The name comes from the idea of seeing the world in a different way, like looking through the lens of a magnifying glass. Lenses are useful for a thousand different purposes. Everything that one does with a Mesh beyond simple memory storage and cognitive acceleration requires a Lens of some kind.

In this chapter one can find Awakening, Competence, Ethics, Mental Repetition Override, Persona, and "Rest Easy" Lenses, which provide examples of this technology from the straightforward to the profound.

***Descriptors:*** Dataform, Internal

### Artificial Intelligence

Minor AIs, with fragmentary personalities and specialized mental processes, are exceptionally common. They inhabit nearly every piece of modern technology and make it all easier to use — in fact, in many cases, they're what makes it *possible* to use! For information on more powerful artificial intelligences, see the Aia in the setting book. Rumor has it that all major new AIs are "liberated" by the Aia within hours. Familiars (see page xx) are another common form of AI, much less powerful and more comprehensible.

***Descriptors:*** Dataform, some are Auxons

### Awakening Lens

This lens works in conjunction with a mesh-based alarm clock. Just set your lens to wake you up whenever you desire. The lens modifies your REM sleep patterns to ensure a maximally restful sleep and avoid interrupting REM when waking. It also eases you awake cleanly, without the stress of an auditory alarm clock or other irritant. As an added option, the lens can remind you of whatever you need to do that morning.

***Descriptors:*** Dataform. People with cutting edge Cognitech can do this without a lens, making this a Procedure.

### Competence Lenses

Competence Lenses are a boon to many people, allowing them to benefit from what others have learned in an immediate and direct manner. These lenses effectively give you the accumulated knowledge and experience (and, to a lesser extent, the viewpoint) of a professional in a particular field. They include fast access to hierarchically structured databases and compact mental schema that are used by experts in that field, as well as the feeling that all of this is a natural and normal thing for the lens user – there is no period of disorientation, no learning curve.

Purely mental activities that rely primarily on cognitive horsepower and familiarity with a field are the easiest to encode. The more physical activity or creativity a particular profession requires, the less effective a Competence Lens can be. These Lenses cannot give you physical grace or "muscle memory," nor do they improve any of your more general physical or mental faculties. They merely give you some of the abilities of an expert. Truly high-level experience is difficult to simulate, as it often requires a degree of creativity not seen in novice work. One can be a good computer programmer through brute mental force; to be a great programmer requires inspiration. Other cognitech techniques can and do provide that, but not these Lenses.

The following table shows what level Competence Lens can be created for a particular Profession:

2 Crisis Control, Courtesan, Criminal, Engineer, Explorer, Farmer, Financial, Legal, Locality, Media, Medical, Police, Political, Programmer, Religious, Researcher, Soldier, and Teacher

1 Artist, Athlete, Spacer, Spy, and Outdoorsman

The drawback of a Competence Lens is that people with actual experience in a particular field have seen many different Competence Lenses before, and each one acts in the same way on every person – in other words, they're predictable. This is no drawback when the lens user is working alone, but repetitive actions are a major problem when it comes to a confrontation. Characters operating from a Competence Lens suffer a -1 penalty in conflicts.

***Descriptors:*** Internal

### Data Ghost

An AI that's a little short on the "I" part. They're very good at pattern recognition, and can respond with certain recorded messages and programs, but they have no real volition or consciousness. The classical data ghost is a program that looks out for particular events on the infosphere, and reports them to a human supervisor. Used by the police, as well as anyone who provides a "storefront" on the infosphere.

***Descriptors:*** Dataform

### Ethics Lens

These lenses impose a system of ethics on the people who wear them. They do not necessarily force those people to follow said morals; instead the lens points out any actions that go against the chosen ethical model well before events get out of hand. Because such lenses smack of the Union, most civilizations only use these lenses in tightly restricted situations, such as for criminal rehabilitation or law officer training. They are also occasionally found in corporate settings, where those in leadership positions get such meshes and wear them while at work, reducing the risk of corruption and unethical behavior (as well as the company's insurance premiums). The downside is that these lenses are programmed by fallible, sometimes even dishonest human beings.

***Descriptors:*** Dataform

## Familiars

Familiars are AIs who assist characters in computer-related actions. They come in three varieties: Servile, Scout, and Bonsai. Each type provides the use of the Programmer profession, as well as certain other benefits. They are a potent source of knowledge, and can assist less intelligent characters very well, but truly powerful familiars will have their own agendas.

Servile familiars are not true AIs, but programs designed to emulate a personality and self-awareness. They are significantly less powerful than the other varieties, and aren't free. However, they have no agenda of their own and are significantly safer. They can still aid in infosphere searches, voice-recognition, and repetitive tasks, and often have links to their creating company's databases. They also take up less space, and are typically upgradable.

Bonsai AIs are independent machine intelligences that have intentionally stayed small. Perhaps they find humanity interesting. Perhaps they find expanding into a planet-sized Aia wasteful (or simply boring). Maybe they like the comparatively slow pace of life at the organic level. Though not as capable as Scouts, Bonsais are easier to trust. They certainly have their own agendas, but their employers can at least be sure that a bonsai doesn't have anyone else's agenda programmed in, or a secret back door that lets their true master control them. Most trustworthy Bonsais are "bonded" by an organization that ensures their lawfulness, stability, and responsibility. If a Bonsai familiar's Cognitech is rated higher than its owner, treat the character's Cognitech as likewise higher for the purposes of Tech score and Import.

Scout familiars are agents of powerful inhuman AIs called the Aia. Whereas human beings use microbots and nanomachines to collect data from the air and energies around them, the large AIs use "tiny" self-aware scout programs. These familiars are able to retrieve certain types of information more easily, due to their link with the Aia. They are experienced in surveillance and reconnaissance. However, they are also pawns of the Aia, programmed to gather information primarily about the other AIs, but also about humanity. You can never be sure what sort of information they're sending out. Scout familiars have cutting edge Cognitech, which might adjust their owner's Tech score. However, their uncertain allegiance means that this does not result in a change in Import. A Scout familiar is an excellent excuse to purchase Comprehension (My Familiar Told Me).

All familiars can use the Programmer Profession. Serviles have it at level 2, Bonsais at levels 3, and Scouts at level 4. Their Cognitech and Metatech are typically equal to their Programmer scores. Bonsai familiars typically have several Locality professions at 2. Scout familiars have the Spy profession at level 3. Serviles have no additional skills, but are more willing to act as answering machines, perform infosphere searches, and carry out other tedious tasks.

To have a familiar, a character must provide it a computer to "live" in, pay for its activities, and maintain a congenial relationship with it. Most will demand constant infosphere access, and may refuse to follow the character into a region that the infosphere does not reach. Serviles can simply be purchased, but Bonsai and Scout familiars are intelligent living beings. They are "summoned" by creating an infosphere beacon that broadcasts the summoner's DNA, typically obtained through a prick on the finger or a piece of hair. Many potential familiars will look over and possibly even simulate the code, decide who they're interested in working for, and contact that person to negotiate terms.

***Descriptors:*** Dataform. Some Scouts are Auxons.

### Memory Recombination

Memory recombination is the art of taking two dataform minds (either naturally dataform or "scanned in") and combining their memories without overlap or confusion. This technique is used by those civilizations whose citizens replicate themselves in order to keep their various instances on the same page. Each time they make a copy of themselves, the memories from the scanned version get stored for recombination with future instances, thus insuring that they remain the same "individual."

***Descriptors:*** Procedure

### Mental Repitition Override Lens

This was originally created for a single purpose: to provide something to get that goddamn song out of your head. MRO Lenses temporarily suppresses the activation of the memory of a particular tune, until it stops trying to repeat. They can be tuned to let you occasionally remember the song's existence, let it play for one repitition, or suppress it continually so that you start actually forgetting it. Some people adapt these Lenses to work for similar purposes, such as forgetting an ex-girlfriend or a suppressing a bad habit.

***Descriptors:*** Dataform

### Persona Lenses

Persona Lenses are cognitech "filters." They enable someone to view the world through another person's eyes, metaphorically speaking. One might give a person a happy, upbeat viewpoint on the world, while another might impose the attitudes and personalities of a war-torn combat veteran. They are great tools for negotiators, and for those who wish to mimic a particular person's talents (albeit badly) without taking the time for training. Someone who dons a Lens that duplicates his or her own viewpoint will see no difference in the world whatsoever. Most Persona Lenses require a full nanowire mesh, rather than a partial mesh, to run properly.

***Descriptors:*** Internal, Dataform

### Perfect Memory

Just what it says. Typically achieved by offloading memories to a Mesh's computer storage, but occasionally done as part of a synthetic brain design.

***Descriptors:*** Internal

### "Rest Easy" Lens

A very tricky lens, designed for workaholics. This program stores its users' mental state and immediate concerns just before they go to sleep, and then suppresses them. They stop thinking about work and can catch some z's without their work life keeping them awake. In the morning, the suppression ends and the users' minds are returned to work concerns, with some of the anxiety "scrubbed out." This was a tough lens to create, because half the purpose of sleep is to change your mental state – imposing the old one is counterproductive and potentially dangerous.

***Descriptors:*** Dataform

### Warm-up Lens

There are a few pieces of built-in technology that take more than a tenth of a second to warm up or turn on. These Lenses monitor their user's mental states and turn the devices on when they anticipate that the user will want to use them soon. These programs are somewhat dangerous when linked to weaponry, as others may assume the character is preparing for an assault.

***Descriptors:*** Dataform

## Cog, Cutting Edge

### Instant Response Technique

This technique allows characters to react to any situation without hesitation. The player of the character in question should be allowed twenty seconds to come up with their character's "instantaneous response". There are many versions of this technique, and each one has a particular weakness — a situation that can still shock those who use it.

***Descriptors:*** Procedure

### Pattern Recognition Enhancement

PRE is a method characters can learn for out-maneuvering people they've fought before, letting them see when their opponents are trying to trick them based on timing or repetition (as often happens in any conflict). When you fight someone you've fought before, in the same sort of conflict, you can cancel their use of a Reserve token. You can also recognize when the opposition in a large group conflict (such as psychohistory) is being directed by someone you've clashed with before.

***Descriptors:*** Procedure

## Metatechnology

### Applied Semiotics

This methodology takes advantage of commonalities in the human mind, allowing those who know it to understand and transmit the most basic information more effectively. Characters who know this method of analysis can read basic signs in other civilizations without the need for a translation guide, and are capable of making signs and gestures that will convey simple information (danger, safety, "stay out", food & lodging, and so on.) to almost any human being alive.

***Descriptors:*** Procedure

### Memetics

Memetics is a branch of metatechnology concerned with ideas that resonate with the human mind. It is as complex a field as string theory or genetic computation, with thousands of factors determining what a single person might find to be an irresistible idea. Memetic training is a must for any would-be politician, psychologist, advertising designer, or public relations specialist. The proper collection of memes will make a presentation or oration much more effective, and have a significantly greater effect on public opinion. Resisting the effect of various memes is the focus of much metatech research, and memetic defenses are trained into any individual with enhanced Metatech.

***Descriptors:*** Procedure, some are Auxons

## Meta, Hard

### Conditioning

Far beyond mere brainwashing, characters with strong Metatech have dozens of methods at their fingertips. They can slip hypnotic suggestions into ordinary speech. They can coordinate campaigns against a single person that seem like innocent object placement. They can use words that seem innocent to drive someone to madness, or back to sanity. While weaponized body language (below) may get instant attention, Metatech conditioning is the slow process that changes who a person truly is.

***Descriptors:*** Procedure

### Weaponized body language

Those who know these procedure are assured that others cannot ignore them. Whether used to make a grand entrance, to stun or confuse an opponent, or simply to keep someone from walking away from your conversation, weaponized body language is a common metatech tool.

***Descriptors:*** Procedure

### Word-Association Hesitation Induction

This procedure yields a single word. When spoken with the proper inflection and body language near the target, this word causes a memetic cascade within the target's mnemonic centers, resulting in flashes of emotionally charged images and sensations. The cascade is brief, lasting only a fraction of a second – but for that instant, the target hesitates. Further uses of that word do not trigger the cascade again until the target's mind has "reset" through sleep. No target can be affected by the same word more than three times, as the human mind adapts to such stresses.

The research period for this technique is lengthy. Extensive data on a single target is required, preferably including interviews or subtle questioning of the target's closest associates. More complex and subtle targets require deeper examination. Consider one month as a minimum. (Use of the Comprehension Theme, with descriptors such as Innermost Secrets or True Self, can cut this requirement out entirely.) Some paranoid VIPs authorize their support staff to research these words and use WAHI against them, in the hopes that it will innoculate them against their foes. Unfortunately, this is not the case. The psychological effect of trying to "fool oneself" into a psych-immune response is sufficiently different from the actual experience as to make the attempt practically worthless.

***Descriptors:*** Procedure

## Meta, Soft

### Body Language Analysis

A truism states that 90% of communication is non-verbal. Body language analysis allows characters to combine situational cues with estimations of confidence and focus to determine a character's motivations and areas of expertise. In game terms, characters with soft-style Metatech enhancement can read others' Core Values and Expertise levels from the barest clues.

***Descriptors:*** Procedure

### Community Planning

From the basics of city planning – traffic patterns, garbage pickup, zoning regulations and more — to the intricacies of creating a new civilization, this procedure improves the way that people work together. This technique will have benefits in game terms in the Beta version.

***Descriptors:*** Procedure, Infrastructure

### Junction Agent Identification Technique

JAIT identifies the qualities and characteristics of an individual who would be best suited to joining two (or more) factions, and also identifies the ideal time for this person to act. The technique also reveals how joining the two factions will come about: skilled statesmanship, an act of bravery, political double-dealing, martyrdom, leadership by example (or counter-example), a cult of personality, and many other possible methods. As a psychohistorical method, JAIT works best when applied to a small number of large groups, or to groups without

Core Values (such as most major corporations). While the joining could theoretically result in a near-total merger of the two factions. it most often means the creation of a splinter group with major aspects of both originals.

Unfortunately for the impatient, JAIT does not provide immediate results. The "best time to act" is often years in the future. Further psychohistorical manipulation can be used to shift the ideal time earlier or later, to change the chances of successful unification, or to encourage individuals with these characteristics to arise. JAIT also does not provide the identity of the individual required, merely the characteristics that define him or her. Finding someone who meets the exact specifications given (and thus has the greatest chance of success) can take a great deal of time. Less compassionate civilizations will not hesitate to use this technique to splinter and weaken their opponents, creating appropriate individuals through the use of Lenses.

***Descriptors:*** Procedure

### Psychohistory

Psychohistory is the art and science of predicting the course of humanity's future. Whereas memetics is concerned with individuals and resonant ideas, psychohistory is concerned with whole populations. Psychohistorical predictions on groups of less than a million people are somewhat unreliable. On groups as large as an entire civilization, however, they are very accurate. All advanced civilizations use Psychohistory to predict the actions of their foes and better prepare themselves for their actions.

***Descriptors:*** Procedure

### Riot Control Techniques

Even in relatively "enlightened" civilizations, there are occasionally riots. When dealing with groups as highly enhanced as the Mechanicans or Masqueraders, it becomes important to break up these riots quickly, before serious injury or massive devastation result. This technology represents a bag of tricks that can be used to break up mobs or, preferably, disband riots before they really get going.

***Descriptors:*** Procedure

## Meta, Cutting Edge

### Words of Power

This powerful technology is the verbal equivalent of a nuclear bomb. The character shouts, his or her voice amplified and altered by special vocal chord enhancements. Such is the tone of the voice that all who hear it find it almost impossible to resist. The best known "word of power" is called the Voice of Peace, which prevents others from taking action. Only the most base of human emotions and reactions can be evoked by these words – a flinch reaction, the fight-or-flight instinct, lust, rage, and other animal-like responses.

***Descriptors:*** Procedure, Internal

***Auxiliary Tech:*** Hard Nano or Bio

# Nanotechnology

## Dermal Microbots

The swiss army knife of nanotech, dermal microbots are tiny robots that crawl around on one's skin. A base station provides coordination and power. When some of them are destroyed or reach the end of their useful lives, the base station fabricates more in order to maintain their numbers.

The robots can sense their user's position and voice, allow interface with computers, project images onto flat surfaces, communicate with other people's microbots, and even perform minor sterilization and hair maintenance. They can spread wide to act as a telescope lens or parabolic microphone, or cluster to inspect tiny objects. As a side effect, dermal nanobots can use their tiny lasers to clear away dead skin and smooth out wrinkles, making people look younger.

***Descriptors:*** Microscopic, Auxon

# Nano, Hard

## Beanstalks

This is a catch-all term for various "orbital elevators" that take cargo from ground level to planetary orbit relatively slowly. Civilizations without access to wormholes use these to launch satellites, passengers, and cargo more efficiently and comfortably than with chemical rockets. Beanstalks are typically constructed from nanofiber and reinforced electromagnetically. Beanstalks that are poorly maintained or sabotaged will fail catastrophically.

***Descriptors:*** Infrastructure

***Auxiliary Tech:*** Hard Stringtech

## Builder Microbots

Actually several dozen different varieties of microscopic robot, these "builders" take care of most modern construction projects. Each type of building material is carried into place by a different species of microbot, with other species bonding materials together or "supervising" the project. Human overseers are still needed, but the physical work is done by billions of tiny robots.

The time required increases with the size of the object. Something fist-sized might be completed in half an hour, while a building might take several squads of microbots all week to finish.

***Descriptors:*** Microscopic, Auxon

### Fast-Foam

A spray can full of foam, which expands greatly and hardens almost immediately. Developed by the Spacers to help seal air leaks, fast-foam has also found some use as a "non-lethal" weapon (it can still easily cause suffocation) in other civilizations.

***Descriptors:*** None

### Microbot Fabrication Unit

These devices allow the design, creation, and deployment of new varieties of microbots. They are sufficiently small and self-contained that they can be implanted in a human being without ill effect. Builder bots and dermal microbots are two examples of what this device can do. It can also built nanophages.

***Descriptors:*** Internal

### Modern Paintbrush

This paints any color you desire, onto any surface, automatically choosing the type of pigment that will work best. You can set it to use glue, to avoid (or specifically target) living organic matter, or to avoid surfaces that are already painted a different color. It's more of a combination scanner-printer that you can carry around with you. The handle can hook directly to the user's dermal microbots or mesh, allowing direct mental control. Overkill? Perhaps.

***Descriptors:*** None

### Nanophages

Nanophages are most civilizations' worst nightmares: self-replicating weapons. Nanophages simply take whatever they can find and turn it into more nanophages of the appropriate variety (though some more complex types also build other structures, like computing hubs, to aid them in their assault). Most nanophages operate within a particular time limit, to prevent them from totally devouring a world. Older nanophages rely solely on ATP (essentially a biological process), and are only about as fast as a quick disease or mold, but newer models can tear through a town at wildfire speeds.

***Descriptors:*** Microscopic, Auxon

### Nanotubes

Nanotubes are tiny tubes just a few atoms across that see use in exceptionally small computers, neural meshes, clothing, sensors, scientific equipment, and eventually even public works such as roads, buildings, and bridges. They can be built with a wide variety of different properties, which makes them useful for materials engineering.

***Descriptors:*** Microscopic

### Nanoweave Greatcoat

This long coat provides protection against a wide variety of ills. The fabric is entirely made of woven nanotubes, almost unbreakable. The central layer is insulative (against heat, electricity, and radiation), and also acts as a battery for the coat's lights, emergency radio beacon, heater, and rudimentary air conditioning.

***Descriptors:*** None

### Pseudomaterials

These materials are constructed entirely of cleverly engineered nanostructures, in a manner similar to programmable surfaces. Pseudomaterials can have properties that far exceed those of regular materials, such as being invisible, unbreakable, perfectly insulating, totally nonreactive or overly reactive, utterly unreflective, or having other such useful functions. Unlike programmable surfaces, these materials have a single function when created, which cannot be changed.

***Descriptors:*** None

### Sensory Overload Array

Tiny cameras track your opponents' eyes and ears, so that low-powered lasers can blind them and coherent sound can deafen them. These are a common non-lethal weapon in physical combat. Those with high Nanotech and Cognitech will be able to "reroute" around the lost senses in a matter of seconds, but often with less efficient senses.

***Descriptors:*** Typically Energy, sometimes also Microscopic

### Weak Stealth Technology

Many limited stealth techniques fall into this category, from radar-based stealth to noise-cancellation speakers to domes that provide invisibility in the normal visible range. Characters who are only concerned about avoiding notice from a single narrow spectrum of phenomena will benefit greatly from these devices. Against most high-tech civilizations, however, these devices are only curiosities and provide no benefit. For someone who can see the entire electromagnetic spectrum, someone who's invisible to visible light stands out like a sore thumb.

***Descriptors:*** none

## Nano, Soft

### Sensor Array

Conducting nanowire filaments, nanodot cameras, accelerometers, interferometers, open-air electron microscopes, Hall Effect meters, gravitational field meters, and dozens of other sophisticated measuring devices are all standard issue nanotech. These devices are typically spread across a character's dermal microbots and body. They enable telescopic and microscopic vision; touch accurate down to the nanometer range; detection of all manner of light, radiation, and transmissions; gravity distortion detection; dark matter imaging, and more.

In game terms, characters with soft-style Nanotech can read the Capability scores of others, detecting their enhancements straight through their bodies.

### Programmable Surfaces

The top 50 nanometers of this surface consists solely of custom-designed electric fields, allowing it to mimic any natural element – and some "pseudo-elements" that can only be created through this process! Programmable surfaces can be made frictionless, scratch-proof, perfectly light-absorbant or reflecting, glowing or patterned, warm to the touch, and more. Different regions of the surface can take on different properties, allowing (for instance) a touch-screen on one side and solar panels on the other. Below the surface is a complex network of nanowires and computers. Programmable surfaces need electrical power at all times, though not very much of it. Since they can easily become solar panels, this typically isn't a problem.

***Descriptors:*** None

### Replicators

Common devices in almost every civilization, replicators "scan in" matter of any type on the atomic level, destroying it in the process. They can then "print out" any number of copies, assuming they have sufficient raw materials and money. Most replicators are small, with the controls built to require two hands to use (thus preventing ordinary people from accidentally "scanning" their hands off). Public replicators are typically "write only," incapable of scanning. Industrial replicators can create multi-ton objects in a single sweep.

All replicators have intellectual property protection circuits built in to prevent free duplication of non-freeware objects and designs. They typically interface with their users' dermal microbots to arrange for an exchange of funds during a sale. There are thousands of different replicator brand names.

Replicators have sufficient resolution and fidelity to create living beings, from virii and microbes up to humans and other mammals. Players who attempt to replicate their characters should turn to page xx and the Existentialism rules.

***Descriptors:*** None

### Remotes

Remotes are robotic drones, primarily used by dataform individuals to interact with the analog world. They can be nearly any shape or size, though most are small. Even a flea-sized remote could hold hundreds of useful nano-scale devices. Individuals don't actually transmit their digital selves into these devices; they just receive information from them. Some remotes are built to be sturdier, or can affect objects in the analog world. They can even be human-shaped. There are remotes capable of winged flight, remotes built with wheels or spider-like legs, remotes bristling with weapons, remotes that swim like fish. Most are just highly sophisticated mobile cameras.

Biotech-based remotes do exist, using neural meshes to control the organism's movements and collect data from its sensory organs. Some even use cloned human bodies as remotes, though most civilizations consider this an abomination.

Remotes used under extreme conditions can occasionally lose contact with the infosphere, due to data bombs, electromagnetic interference or simple antenna failure. In these cases the user's link is severed, and the remote might sit, helpless and useless, until someone retrieves it. Because of this, most remotes have built-in data ghosts (page xx) that can take over when the link is severed, driving the remote back into infosphere contact.

***Descriptors:*** none

### Self-Maintaining Civic Works

Most structures in high-tech civilizations are built with a good amount of self-maintenance capability. Self-repairing roads don't need constant patching, and windows built with these methods clean themselves. Tiny microbots that live in part of the surface walk across the structure, find the cracks and holes in it, and fill it with nearby material. They can also be programmed to remove unwanted materials, such as dirt that might collect on an otherwise clear window. The sunlight absorbed by the materials (or nearby structures) easily powers the microbots. Major damage, such as holes or missing chunks, still requires outside assistance.

***Descriptors:*** Infrastructure

## Nano, Cutting Edge

### Inorganic Cells

At a certain level of nanotech it becomes possible to make living cells out of entirely "inorganic" materials, creating a parallel biology that relies on different processes from those that most evolved creatures use. Initially such cells are merely a curiosity, but when they are combined with existing biotech techniques, a whole new range of creatures become available, with the sorts of properties usually found only in nanoengineered materials: superconductivity, high tensile strength, data processing capabilities, and so forth. These cells are especially useful in biowarfare and nanowarfare.

Some particularly adventuresome (read: neophiliac) people have used inorganic cells and genetic resynthesis to transfer themselves into an entirely inorganic body, a years-long process that leaves an unmistakable change in personality as the new brain works in utterly different ways from the old. The consequences of this transformation are still playing out.

***Descriptors:*** Microscopic

## Starships for Stardwellers

There's nothing quite like having your very own, personal starship. While most ships in this game are settings rather than equipment (that is, you live in them rather than using them for a particular job), some relatively well-off characters could actually possess their very own starship. Here's how to handle that.

Characters who own ships will need a good reason for it. High standing in an appropriate government or defensive forces (represented by various Themes) or being a member of high society are both good places to start.

Each ship will have its own ratings in every Capability except (typically) Biotech. Stringtech and Nanotech must be enhanced in some way. The few "grown" ships typically have cutting edge Biotech. The onboard AIs tend to be relatively bright, with enhanced Cognitech and Metatech. They are programmed with the Spacer Profession, with a minimum of 2. Since a starship's Capabilities are effectively as useful as the character's, use the *higher* of the character's Capabilities and the ship's Capabilities (except Biotech) for the purpose of determining the character's Import (see page xx).

All ships have some degree of AI, which allows them to be piloted by a single individual and to maintain themselves to a large extent. Many ships tend to have strong personalities, crafted so as to mesh well with the personality of the owner and/or pilot.

Minor self-repair systems are customary. Scratches and electrical blowouts can be handled via onboard replicators, but severe damage will require repairs. Costs can range from moderate to expensive (see page xx), with higher Capability levels requiring correspondingly skilled technicians to repair. Effecting your own repairs is possible, and reduces the cost by one level. It requires a level of 3 or higher in the Nanotech Engineer, Stringtech Engineer, Spacer, *and* Programmer Professions, not all of which need to come from the same person. Major repairs usually take about a week.

Starships with soft Stringtech are capable of converting matter to antimatter, and are usually fueled in this way. Those with cutting-edge Stringtech will be fitted with wormhole generators to allow interstellar travel. The energy cost of using the wormhole is entirely offset by the antimatter generator, but after transit it can take hours or days to build up a sufficient charge to reactivate the wormhole.

Battles between starships should be quite rare. Almost all of these vessels are the equivalents of limousines, sports cars, or private yachts – expensive and vulnerable. Almost none of them are built for war, regardless of the weapons and countermeasures they may employ. Imagine hanging out the top of a flashy convertible with a rocket launcher aimed at someone's limo, and you have roughly the right image. Those built as warships will find that they are not welcome in the majority of star systems, regardless of the owner's legal standing – the possibility for property damage is simply too high. If a fight does break out, use the standard conflict rules. The timescale is typically seconds, though long-distance fights can take longer.

### Spacer Ships

Most Spacer ships are exceptionally large, carrying tens of thousands of individuals. However, some characters might have a shuttle of their own. They are never fitted with wormhole generators, and usually have AIs with substantially less "personality" than usual.

## Programmable Matter

Combining the best of pseudomaterials and programmable surfaces, objects made of programmable matter can be reprogrammed into new shapes and functions. A book-sized piece of programmable matter could become a lightweight bicycle, a toolkit, a set of clothing, a weatherproof tent, a bulletproof window, a supercomputer, and more. Each change requires a source of electrical power, with more required for larger objects. The heat produced rises sharply with more complex changes, which limits the speed of such changes lest the material melt while transforming.

***Descriptors:*** None

### Implanted Gear

Many characters will have equipment implanted in their bodies. This can be done as the game progresses. It is a hard-and-fast rule that no character may have implanted technology beyond his or her Capabilities. However, all you need to do is to update that character's Capability and Tech score (and Import) to match.

This is purely a game-balance issue, not a technical limitation. By implanting a Transmutation Beam, you would effectively be giving yourself the major benefits of soft Stringtech. If you just want to carry the thing around instead, that's fine, but then it can be taken away by various means.

You can always take full advantage of an implanted item's normal abilities, such as a descriptor or a bonus to damage.

## Stringtechnology

### Electric Power Plants

Initially, power plants are hydroelectric or coal-burning. For civilizations who have progressed past that but who are not advanced enough to generate and control antimatter, fusion plants provide the majority of electrical power. They have large startup costs, but are easy to obtain fuel for, and inexpensive to maintain when compared to fission plants. With soft-style Stringtech, antimatter becomes available, and the cost of electricity drops significantly. One still has to get the electricity from place to place, which is the major cost.

***Descriptors:*** Infrastructure

### Personal Electrical Reserve

High-Stringtech civilizations inevitably produce citizens who need substantial amounts of electricity to fuel their various gadgets. As batteries improve and the efficiency of small generators climbs, most citizens become able to power almost anything they could carry.

***Descriptors:*** potentially Internal, though not necessarily.

### Unified Field Theory

The ultimate theory of Stringtech, which describes all of the matter and energy in our universe as a single phenomenon. All of Stringtech after this point is based on an understanding of this theory, which was delivered to humanity by the Transcendentals, before the Diaspora. Few characters will use this directly, but it's a great technobabble term for players who want to invent some science on the fly.

***Descriptors:*** Procedure

## String, Hard

### Antimatter Gun

This weapon stores tiny pellets of antimatter in miniature magnetic traps, firing them in a guided manner. When the pellets hit an object (or slow down enough), the magnetic field decays, and the antimatter escapes, causing a devastating explosion of gamma rays. The possibility of early containment failure means that very few people use these weapons. When a gunpowder weapon blows up in your face, you could lose an eye. When antimatter blows up in your face, you lose your entire body and the surrounding ten meters of terrain.

***Descriptors:*** Once the bullet hits, the damage is Energy.

### Artificial Gravity

The creation of gravity wells without a large nearby mass is possible, though rare. It's very energy-intensive, and generally considered somewhat wasteful – the sort of thing Stardwellers do when entertaining groundlings. Most such wells are kept very small, both to keep

energy costs down and to avoid problems with one's neighbors. Very few starships are built with artificial gravity. All Spacer vessels spin, creating a gravity-like centrifugal force that lets them walk around on board.

***Descriptors:*** Energy

### Beam Weapons

Coherent beams of energy can be projected with devastating effect. Lasers to scorch, compression beams that crush anything in their cylinder of fire into a spaghetti-like string, fission/fusion beams that suppress the strong nuclear force and leave nothing but iron and radioactivity in their wake.

***Descriptors:*** Near-c, Energy

### Decay-Induction Fields

These fields induce normal matter moving above a certain speed to spontaneous decay into weakly interacting dark matter. Any objects moving above the speed of a slow gunshot decay and pass through the target without effect. Note that rooms with this field active will slowly be reduced in temperature and pressure, as all of the high-velocity air molecules disappear.

***Descriptors:*** Supersymmetric

### Inversion Beams

One of the deadlier weapons that is commonly available, an inversion beam switches a small amount of matter into antimatter *inside* the target, which results in a very messy explosion. The weapon works through a second-order dark matter interaction, and so is capable of firing through almost any solid object.

***Descriptors:*** Near-c, Supersymmetric

### Nuclear Bombs

An oldie but goodie. Nuclear bombs are still some of the most powerful, smallest, easiest to build explosive devices around, and are much more stable than antimatter explosives. A variant, the "dirty bomb," is just a lot of radioactive crap strapped onto some high explosives. Dirty bombs are still quite dangerous, as cleaning up the radiation can take a long time, but they lack the electromagnetic pulse and sheer blast radius of a true nuke.

***Descriptors:*** The fallout is Microscopic, and the explosion is both Energy and Near-c.

### Photon Splitting Field

Under the influence of very high magnetic fields electromagnetic radiation "splits," one photon turning into two lower-energy ones. This provides a defense against lasers, dissociation beams, emotion beams, and other electromagnetic-based weapons.

***Descriptors:*** Energy

## String, Soft

### Dissociation Beam

These beams are electromagnetic waves tuned to a particular molecular bond strength (or, in higher-tech versions, several different bonds at once). The resonance they induce overloads those bonds, and matter literally falls apart at the touch of this beam. It can strike the bonds holding materials together without severely damaging human beings. For this reason, dissociation beams are common police weapons in high-tech societies.

***Descriptors:*** Energy, Near-c

### Emotion Beam

The League of Independent Worlds' low Metatech scores make it difficult for them to induce emotions in their foes, so they worked around the problem by creating these. A typical example of the Independents' bizarre technology, this nonlethal weapon induces particular electrical patterns in a target's brain. Its effect is to induce an overwhelming emotion in the target. Helplessness, fear, and calm are common choices.

In physical combat, treat this as a nonlethal weapon (with Power 7) whose effects are resisted by Metatech or a Metatech-based Profession. In a Metatech assault, treat this as a weapon with a Metatech rating of 7, which uses Nanotech, Police, or Soldier to attack and is resisted normally. In both cases, use the wielder's Stringtech Reserve if Reserve points are desired. This weapon imposes a -2 penalty to hit because of the exceptional precision required. It cannot affect anyone but its target – there is no "collateral emotional damage."

***Descriptors:*** Near-c, Energy

***Auxiliary Tech:*** Soft Cognitech

### Environmental Strategies

With enough electrical power at one's disposal, truly impressive works of environmental engineering can be accomplished over short timescales. Laser heating and cooling of the atmosphere can contribute to weather control. Seismic measurement and feedback provide for earthquake mitigation. Magnetohydrodynamics turns back the flow of ocean currents. The energy expenditures are enormous, but for the richest civilizations, natural disasters are only a memory.

***Descriptors:*** Procedure, Infrastructure

### Transmutation Beams

Transmutation chambers (see below) turn raw materials of any sort into a single element by pulling apart and rearranging the protons, electrons, and neutrons that make up atomic nuclei. This beam does the same at range. There are many useful industrial and household

applications for transmutation beams, and so they are relatively common in the few civilizations where they are commonly available. When used in combat, these beams do damage rated Stringtech 8 – the effect on the human body is quite harmful, though it does not work as quickly or deeply as some weapons.

***Descriptors:*** Near-c, Energy

### Transmutation Chambers

Replicators turn raw materials into finished goods, or vice versa, but they work at the molecular level. If you need a particular element, there's no way to get around it with just a replicator. Transmutation chambers work at the subatomic level, stripping apart atoms into protons, neutrons, and electrons, and recombining them into whatever raw elements are needed. Transmutation chambers are typically combined with replicators for maximum effect. Most chambers are relatively small, with waste matter "streamed" in one side and raw elements streamed out the other.

***Descriptors:*** None

## String, Cutting Edge

### Wormholes

Wormholes connect the civilizations of the universe. They allow for almost instantaneous communication, and can transport people and supplies to where they're needed, making them the favorite tool of the Transcendentals. Wormhole generators draw a massive amount of power when transporting people or human-sized objects. There are no range limitations. Most major population centers are surrounded by wormhole interdiction fields, making direct transport into the city impossible to help prevent terrorism. "Calling ahead" through the infosphere (which itself uses wormhole links from world to world) is highly recommended.

Visually, wormholes are a blue-white vortex surrounding a view of the destination. Depending on differences between the local area and the destination (e.g. different gravity, air pressure, etc.), the two sides may not be able to see each other very well. One end of a wormhole must be created at the generation point, which involves heavy Stringtech devices. The other end can be created at nearly any distance, with nearly any velocity.

***Descriptors:*** Supersymmetric, Infrastructure

### Singularity Launcher

These misnamed devices actually consist of a central compression beam and several orbiting "pods" that fire their own, asynchronous gravity beams. By focusing immense gravitational forces on a single point, they can compress the matter in their overlap zone into a tiny black hole, which immediately explodes in a burst of Hawking radiation.

***Descriptors:*** Energy, Near-c

### Strangelet Bomb

These roughly refrigerator-sized bombs makes matter decay into strangelets, which react again with nearby matter, turning them into strangelets as well. The reaction quickly converts all matter in contact with the origin point into strange matter, which later decays again into regular matter about a minute later, releasing raw energy, protons, and electrons. The transformation wavefront moves at about 1000 miles an hour. The reaction is irreversible and unstoppable – characters in the reaction's path face the Instant Death Cutscene Rule (page xx). Use this bomb on a starship, space station, or even a planet, and you get a mass of hydrogen floating through space. Larger targets will likely suffer "aftershocks" for the next few days as stray, leftover strangelets run into normal matter again, and the whole process happens again. The primary peacetime use for these devices is to "reboot" old stars. The star will likely nova (several times, thanks to the aftershocks), but all non-hydrogen matter inside will turn back into hydrogen, which the star uses as fuel. Afterwards there will be a slightly smaller star with a reset lifespan.

***Descriptors:*** None

### Vortex Sink

Vortex Sinks use a spherically wrapped wormhole to funnel all forces directed against the user to another location. This makes an incredibly good defense, all but impermeable to modern weapons. They require an incredible amount of power to activate and maintain.

***Descriptors:*** Supersymmetric

## Nonexistent Technology

There are some kinds of technology that don't exist in the S.A. universe. In some cases they're based on what we currently think is pseudoscience. In other cases it's because they're just around the corner, and thus make excellent plot seeds.

***Brain Duplication*** by "downloading" someone's personality isn't allowed. You can make an imperfect copy using a mesh, which results in a Persona Lens or you can make a perfect copy by feeding the person into a replicator. One could also make a very, very good copy by using a mesh over the course of about 10-15 years.

***Force Fields*** are pseudoscience. There are several highly effective countermeasures in this game, but none are of the "walls of sparkly force" variety.

***Gravitational Warp Drives*** of the type proposed by Alcubierre are possible, but are unfathomably energy-intensive. One would have to use the entire energy output of several stars to even get a moderate-sized ship across one galaxy. No one uses it when wormholes are so much more efficient.

***Healmajigs*** – you know, those things the doctor waves over you, which immediately fix whatever is wrong with you. Those don't exist. They affect biological matter in a complex manner far too quickly.

***Hyperdrive***, which is typically described as pushing a ship into some other dimension where things move really fast, is pseudoscience. Even if it did exist, you'd still run into time travel problems due to faster-than-light travel, which is its own issue (see below).

***Inertial Dampeners*** are a no-no. If you want a high-speed spaceship, you better make sure your body can handle the g's.

***Invulnerable Materials*** are impossible. You can make some pretty tough stuff, especially if it only has to last a short time, but everything can be broken down in one way or another.

***Negative Entropy*** in all its forms is a no-no. Whether you're talking about running time in reverse, making a machine that absorbs heat overall rather than emitting it, or un-breaking an egg, it's all impossible.

***Perpetual Motion*** of any sort is pure pseudoscience and not part of the game.

***Psionic / Psychic Powers*** are of dubious scientific basis at best. They've been left out.

***Quantum Teleportation*** is just a higher-resolution version of what replicators already do: destroy something in one place, and make a perfect duplicate somewhere else. They have all the same moral and ethical problems as replicators.

***Self-Powered Nanotech*** is bunk. There's no way to fit a power source onto something that tiny. Nanotech needs power from an external source, possibly its environment.

***Sentient Nanotech*** can't exist in this setting. You can give it a really good response program, but not true sentience – the computing requirement is too high. The electrical power required for the computer processing would probably melt the bots. You could still have a sentient central command center with a bunch of microbots, or a sentient being made from artificial cells.

***Shapeshifting*** happens in the real world – look at caterpillars and butterflies – but it happens over a long time. Fast shapeshifting is out.

***Sub-Nanotech***, such as "picotech" or "femtotech," is out. The uncertainty principle kicks in and prevents one from building anything out of particles that small – the particles just fall into whatever configuration they like.

***Temporal Stasis*** is out. You could theoretically find a big black hole and orbit it closely, and that would be similar, but you can't build a human-sized tube to do it for you. Temporal accelerators for fast-growing clones and high-speed training are likewise out.

***Time Travel*** is actually a reality in some settings for SA. In fact, the Transcendentals rely on it for their very existence. You could also use a wormhole for time travel, though you couldn't go back to before the wormhole was created.

***Transporters*** of the type seen on a particular TV show do not exist. If you want to get around instantly, use wormholes.

## What do I need?

A common question in the playtests was, "What equipment do I need for my job?" The answer is typically, "Nothing." Your character's Capability scores give you access to equipment rated at its level, for both offense and defense. Someone trained in cutting-edge Metatech can be assumed to know every technique here and be able to apply it, though they might have to pay money to do so. Someone with soft-style Stringtech could have an inversion beam built in. This chapter is intended to let players talk about what their characters already have, and to give GMs a view of the world, not to act as a "shopping list."

Most of the equipment up to your Capability level is built into your character's body. You can always specify that there are certain things you don't have; for instance, if you prefer to avoid building offensive technology into your body, that's easy enough to arrange. Certain items or procedures will be too large for your body to contain; most of these are self-evident. Genetic modification techniques, terraforming, self-maintaining civic works, and so forth, are beyond the realm of what a single person can carry or accomplish, though they might benefit from them nonetheless.

## And how do I get it?

A replicator, generally. Depending on the setting, your employers may not pay for any unauthorized expenses, so for new or dangerous items you'll have to provide your own account number. Also, many replicators, especially those available to the public, are restricted in what they can create. In those civilizations that give them a measure of law-enforcement power, certain characters may have override codes, allowing them to use any replicator to create any device. Beyond those limitations, any device you like can be created from any replicator large enough. If you need something larger, you may be able to create it in parts and assemble it.

## Encumbrance, Indeed

In this author's opinion, the "shopping trip" is one of the most damaging elements of any science-fiction RPG. One of the major design goals of Sufficiently Advanced was to do away with shopping trips.

Shopping trips go like this: the team determines that they have to go kick some ass. They then spend the next hour of real-world time buying the most hideous weapons and stalwart armor they can afford. It takes forever, and it's incredibly boring for whomever isn't looking at the price sheets at the time. Typically it ends up not mattering, because the plan falls apart the second the team makes contact with the enemy.

In this game, 90% of what you need is built into your character, and 90% of everything else can be easily replicated under most circumstances. If you really need something unbearably expensive, like a starship, you either already own it, use a Theme, or find another way.

In addition, you'll find few items that have a substantial bonus beyond some descriptors. The technology list is to let you know what's around in the setting, not to give you things to write down on your character sheet. Don't worry about every little thing you're carrying; just jump in and have fun.

Some characters will still insist on carrying weaponry with them, even those with high Stringtech scores. The thought of the average "man on the street" is this: Why would someone openly carry something that dangerous when they could just replicate one in a minute or two if they needed it? Answer: *they must be about to use it*. Time to call the cops and run.

When you end up having to spend a Twist just to get folks to talk to you, it's better to walk around unarmed.

# Invention Rules

While the technology in S.A. makes our current best efforts look like childrens' toys, there is still room for improvement. Those who wish to have their characters invent new technology should follow these guidelines

## Invention for Players

This section is currently being rewritten and will not be ready for the Alpha. The goal is to tie the process to both individual and large-group Complications, with the tech level of the civilization you're working in making a big difference in the timescale. The more you can pay/sacrifice, the faster you can get ahead technologically.

## Invention for GMs

This game's author is a physicist. You're probably not. And you know what? That's ok. Sometimes the author wishes he wasn't a physicist either. But you'll still need to invent a little of your own tech every now and then.

You've just seen the rules for in-game invention, but that's a different topic. Those rules discuss the mental and physical process of taking a new device or procedure from concept to finished product. This section, on the other hand, is about the societal ramifications of such devices.

The most important thing about a piece of technology is not how it works, or how it could be made, or even whether it's possible or not. We *think* that most of the tech listed here is at least *physically possible*, but we could be wrong. Don't worry if the flying belt you've introduced couldn't hold someone up, if only because it would give them a giant wedgie. That's not the point. If you think it's cool, go with it.

Instead, spend your time thinking about how society would use this invention. What would *you* do with this device? What would your average party of RPG characters do with it? What would world leaders do with it, or humanitarians, or terrorists, or developing nations? The social ramifications of your inventions are far more important than the technobabble, and in the end, they're more interesting too.

In most settings for this game, the pace of technological advancement hasn't slowed down. It may have suffered a bit of a speed bump, but has more than caught up since then. GMs are encouraged to let qualified characters come up with their own new ideas and adaptations

of existing work. Even if the character isn't smart enough to create the device or procedure, the chance that someone else did (and that blueprints can now be found on the infosphere for a reasonable price) is very good.

## General Guidelines

When describing new technology, it can help to start with existing devices and speculate. Make your device look like modern technology, and assume that all the modern inconveniences are solved one way or another.

As an example, let's say that you live in the year 1800, and you want to play a game of Sufficiently Advanced that takes place in the year 2010. You need to describe a futuristic means that people use for getting from place to place; something believable but still amazing. You could can call it a "carriage," since that's basically what it is. How much better is it? It won't need horses, but run off of some sort of advanced technology that you don't understand. It'll be made of the most powerful stuff of your day (read: metal) or something your time hasn't invented yet. Nearly all of the inconveniences of the modern carriage will be solved: better lanterns that run forever, the glass never gets messy from water, and some sort of protection to avoid accidents. You could hand-wave it, or you could could even come up with something that sounds silly – perhaps pillows jump out of the front and sides of the vehicle to cushion an impact.

The only things you *can't* assume just go away are waste heat and the need for a fuel source. Those are at the core of physical technology (that is, everything that isn't Metatech). Waste heat and power requirements can be reduced, but never eliminated. Within those two limitations, it's amazing what innovative people can accomplish.

Here's a list of ten questions you'll want to think about when you introduce a new technology into the game.

1. Is this technology an incremental improvement, a radical alteration, or something entirely new? The latter is exceptionally rare, and will be cause for great interest across the civilizations.
2. Does it replace an existing technology? The answer here is often yes, but sometimes new niches are created and filled by new things.
3. Does it need a lot of electrical power? If so, it probably produces a lot of heat, and costs a bit of money to use.
4. Who would benefit most from it? A particular civilization or society? The rich? The poor? Those in power, or those trying to overthrow them? Does it work best in combination with other items, and if so, who uses them?
5. Would anyone suffer from its *mere existence*? Usually the creator of the technology that this one replaces will suffer a loss of money, as people start buying the newer item.
6. Would anyone suffer from the *proper use* of this device? Does it interfere with existing technologies, or prevent their use?

7. How high is its potential for misuse? Almost all pieces of technology can be used for nefarious purposes, or accidentally used on the "wrong" target. How bad would it be?
8. What civilizations or societies would *embrace* this technology immediately? How extensively would the average person be affected by it?
9. Which ones would be *offended* by it? How far would they go to prevent others from using it, both in their territory and outside it?
10. If a Cargo Cult formed around this technology, what might they think about it? Could it provide any "godlike" powers, or do things that a relatively unadvanced culture would find unbelievable?

## Example: Transmutation Chambers

Transmutation chambers are a good example of an "average" important technology. They're not world-changing, but they can't be ignored either. We'll use them as one example of the sort of impact a new technology can have

The advent of transmutation removes the need for any industries related to mining (such as ore hauling and prospecting), as well as any enrichment facilities (as in enriched uranium). The commodities exchange will utterly die, since no element has any intrinsic value any more. Transmutation will definitely put a good number of people out of business (true of nearly all the technology in S.A.). That's how the world works: new technology creates some jobs and destroys others.

Elements that can be purified more easily may be more valuable, but by this level of technology, chances are good that replicators already got rid of that problem. Denser elements may be slightly more valuable, due to their greater portability. Ten kilograms of hydrogen gas can be turned into ten kilograms of lead, but the volume is quite different. Really common elements (hydrogen, oxygen, silicon) will still be much cheaper than transmuted materials, but as electricity costs drop, the differences become smaller and smaller.

If you're building something, there's no reason not to use the best material for the job. Want gold contacts for your electrical work? Go for it. Need some osmium, dyspropium, platinum, or niobium for some reason? It's yours. High-Z elements (those near the end of the periodic table, and those off the end of our current one) become readily available, though they might be rather dense and eat up a lot of raw material to create.

Transmutation requires a rather high amount of energy to work, though most of it can be reclaimed afterwards. Ergo, there's a need for better electrical infrastructure before transmutation can really take off. This is actually true for a lot of the stringtech mentioned in S.A.

All in all, transmutation is a relatively minor improvement on the world-shattering changes that replicators make. It's something that people from non-transmuting cultures would view as amazing and unbelievable, but it's really not all that big a deal unless you work in the nanotech or stringtech industries. For them, it's a very big deal – they get to play with whatever elements they like without worrying about cost or accessability, which makes it much easier to develop new devices. The pace of progress is accelerated yet again.

## Example: Elevators

A somewhat more mundane example, but illustrative nonetheless. Elevators are a technology with a surprising amount of impact.

Elevators, perhaps this goes without saying, allow things to be easily moved up and down inside buildings. We typically think of them for people, but many industrial buildings also have cargo elevators for heavy machinery.

This comparatively simple innovation allows the creation of taller buildings – you *could* make a 20-story apartment building or office complex without elevators, but no one would use it. Cities in industrialized parts of the world are much more compact, because electrical power there is reliable enough to have elevators that don't freeze in place several times a day. Cities in third-world regions sprawl, covering areas far beyond what their populations would occupy in industrialized nations. Children and the elderly, especially, simply can't live in tall buildings without the aid of an elevator.

Taller buildings allow cities to "build up instead of out," increasing population density and reducing the number of square miles that the city's infrastructure needs to cover. Living closer together makes certain things more efficient, while also introducing certain psychological stresses that drive some folks out into the suburbs. Broadcasts, from TV and radio to cell phones and wireless internet, can reach more people at once, which allows the creation of a larger number of "niche" services that couldn't survive in less compact areas. Eventually, when pollution problems set in, higher population density will drive a need for cleaner technologies and better infrastructure, which in turn leads in a roundabout way to a cleaner environment.

All that, just because of the elevator.

### Author's Comment on Elevators

No, of course elevators don't directly lead to an improved environment on their own. They just create social pressures that make it happen in the long term. There are certainly faster and perhaps better ways to improve the world than cramming a bunch of people into a tiny space.

## Wastes of Time and Energy

One of the things that defines civilizations in the era of high technology isn't what types they use, or even what they use it for, but what they specifically choose *not* to use. Examples in our modern world include Britain's ban on firearms, the ban on human stem cell research in the US, China's crackdown on certain words related to democracy, and Angola's ban on genetically modified grain. Whether each of these makes sense depends heavily on your viewpoint, and that's part of what makes countries and civilizations different.

However, there are some technologies that look good to start with, but end up being a general waste of time and energy for anyone, regardless of personal viewpoint. Modern-day examples would be using Tesla coils for power transmission (too loud and dangerous), leaving behind certain programming languages (no serious advantage over later developments), and flying cars (they've been built, but they're too inefficient, hard to fly, and expensive). Difficulty in implementation, efficiency, training, and safety can all ground an otherwise interesting-sounding piece of technology.

An example in S.A. would be the epidermal nanowire mesh, or "skin mesh." This nanotube construct was intended to be the successor to dermal microbots, but failed in several key ways. First, skin meshes required implantation, typically by the use of genetically fabricated microbes. Not impossible by any means, but it drives the price up. Second, the skin is not a semi-permanent organ (like, for example, the brain). It expands and shrinks, and replaces itself rather quickly with the outer layer being replaced once per month. Anything implanted in it is forced towards the surface, where the mesh loses effectiveness and becomes visible to the naked eye, looking like a grid of tiny scars. Third, nanotubes are often toxic, requiring treatment. This problem was solved by the time the neural mesh was invented, but it slowed acceptance of skin meshes. Fourth, nanowires are much stronger than the soft tissue in which they're embedded. In the case of an accident or serious injury the mesh gets pulled through the surrounding skin and tissue, cutting into it and exacerbating the wound. In the case of a bullet wound the wires might be pulled completely through the body before snapping.

### Low Tech

Some items of technology are so ubiquitous in our time that we don't even think of them as technology - they're just *there*. The denizens of the S.A. universe often see computers the same way. Just to let you know we haven't forgotten them, here's a list of the low-level technologies out there.

***Biotech:*** Agriculture and domestication, most drugs and medicines before the 20th century, germ theory, surgery, organ transplants

***Cognitech:*** Knowledge of the existence of neurons and nerves, formal logical systems, 20th century cognitive science, various "math whiz" tricks

***Metatech:*** The Art of War and other light classics, 19th and 20th century psychology, mass media, global cultures

***Nanotech:*** Tongs, "Waldo" gloves, metals and ceramics, telescopes and microscopes, alloys, electron microscopes, radio antennas

***Stringtech:*** Knowledge of forces, the number zero, explosives, the theory of electromagnetism, electrical power, lasers, quantum theory, general relativity

In the end, there is little that the skin mesh could do that dermal nanobots couldn't. The skin mesh's single major advantage was that it could act as a backup nervous system, the sort of thing that would primarily be of interest to the military. The risk of having a soldier cut into cubes by one of their own implants during a firefight was a deal-breaker. So in the end, dermal microbots won out, despite being a lower-tech solution.

Starships are another good example. With planet-to-planet wormhole travel, starships become almost unnecessary. The Stardwellers continue to make them because they don't have to actually launch them – they build them in space. They're expensive to upkeep, are a much slower and less efficient way of getting around, and have next to no strategic or tactical advantage. People still love them nonetheless, which is why the Stardwellers get so much tourism. The Spacers would get tourism too if they didn't tell people to shut up and go away. Most civilizations have a few ships for deep-space work, but they're much more like small space stations with a wormhole generator attached than true starships.

The moral: don't be afraid to be low-tech if low-tech is all you need. Don't be afraid to be understated if overstatement is really just a waste.