GURPS® Fourth Edition

BIO-TECH™

BY DAVID MORGAN-MAR AND DAVID PULVER

STEVE JACKSON GAMES

THE FUTURE IS ALIVE

"Who needs chrome, pal? Meat is where it's at. Mother Nature always did it best – she just needed a little help. Get down to the black clinic, old-timer, and you can be 15 again. If you still want to be human at all."

It's the technology of the posthuman age: biotech! Upgrade your old body with steroids, smart drugs, transplants, and viral nano . . . or get a new one. Improve on nature with eugenics and gene-fixing. Or go parahuman – if you love cats, become one! You have time to explore the possibilities – death is only a temporary inconvenience with cryonics and immortality drugs. And who needs silicon? Vatbrain biocomputers are where it's really at!

But biotech isn't just the future. ***GURPS Bio-Tech*** includes a full range of medical equipment from the 19th, 20th, and 21st centuries, from early vaccines to surgical robots, along with game stats for the world's deadliest diseases.

GURPS Bio-Tech also includes character templates for biotech professions, rules for biotech magic, and two original mini-settings: an alternate Earth ruled by a clone of Alexander the Great, and a living starship on its way to colonize an alien world!

Say goodbye to your old body. Have you upgraded your genes this year?

GURPS Bio-Tech *requires the* ***GURPS Basic Set****, Fourth Edition. You can use the campaign settings and information on technology in any game.*

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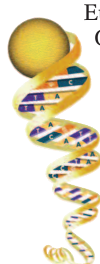

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Introduction

Genetic engineering and other biomedical technology are starting to change the world in ways we can only begin to guess at.

Can we resist the temptation to tinker with our genes when the potential rewards include immortality? Will exotic wonder drugs soon be produced in cows and goats? Could natural or artificial plagues wipe us out, or will biotech conquer disease or transform us into posthuman superbeings? And just how do genetic engineering and cloning work, anyhow?

GURPS Bio-Tech explores these and other questions, examining the promise and perils of medical and biotechnologies real and imagined, and their effects on characters and societies. The answers may surprise you . . .

Using This Book

Biotechnology breeds its own jargon. While most technical terms are explained as they are introduced, if you run into an obscure term, check the Glossary (p. 231).

Fictional quotes introduce many sections of this book. Capsule biographies of our "commentators" appear in Chapter 8 (p. 216).

Publication History

This is the second edition of ***GURPS Bio-Tech***; it has been revised to the ***GURPS*** *Fourth Edition* rules and expanded to cover medicine, drugs, magic, and new technologies. Some variant races and wonder drugs were introduced in ***GURPS Space*** (by William Barton and Steve Jackson). The biological android (bioroid) and proteus virus rules originated in ***GURPS Robots*** (David Pulver). The first edition of ***GURPS Bio-Tech*** (by David Pulver) was 144 pages long and focused on modern and future technology. Some of its fictional vignettes established ideas that would later be expanded in the ***Transhuman Space*** series. In turn, a few biotech and variant races in this edition are derived from material introduced in ***Transhuman Space*** (David Pulver) and its supplements ***Deep Beyond*** (David Pulver), ***Fifth Wave*** (Jon F. Zeigler), and ***Under Pressure*** (David Morgan-Mar, Kenneth Peters, and Constantine Thomas). The biotech spells are based on those in David Pulver's ***Bio-Tech*** Designer Notes in *Pyramid*. The medical care flowchart and some advanced medicine rules are adapted from a *Pyramid* article by Eric Funk.

About the Authors

David L. Pulver is a freelance writer and game designer who lives in Victoria, Canada. He has written or co-authored numerous ***GURPS*** books, including ***GURPS Basic Set Fourth Edition***, ***Transhuman Space***, and the original ***Bio-Tech.***

David Morgan-Mar is a research engineer who lives in Sydney, Australia. He is the author of ***GURPS Update*** and co-author of ***Transhuman Space: Under Pressure,*** and has contributed to several ***GURPS*** books including ***Monsters*** and ***Steam-Tech.***

About *GURPS*

Steve Jackson Games is committed to full support of ***GURPS*** players. We can be reached by email: **info@sjgames.com**. Our address is SJ Games, P.O. Box 18957, Austin, TX 78760. Resources include:

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Pyramid (**pyramid.sjgames.com**). For 10 years, our PDF magazine *Pyramid* included new rules and articles for ***GURPS,*** plus systemless locations, adventures, and much more. The entire 122-issue library is available at Warehouse 23!

Internet. To discuss ***GURPS*** with our staff and your fellow gamers, visit our forums at **forums.sjgames.com**. You can also join us at **facebook.com/sjgames** or **twitter.com/sjgames**. Share your brief campaign teasers with #GURPShook on Twitter. Or explore that hashtag for ideas to add to your own game! The ***GURPS Bio-Tech*** web page is **gurps.sjgames.com/bio-tech**.

Store Finder (**storefinder.sjgames.com**): Discover nearby places to buy ***GURPS*** items and other Steve Jackson Games products. Local shops are great places to play our games and meet fellow gamers!

Bibliographies. Bibliographies are a great resource for finding more of what you love! We've added them to many ***GURPS*** book web pages, with links to help you find the next perfect element for your game.

Errata. Everyone makes mistakes, including us – but we do our best to fix our errors. Errata pages for ***GURPS*** releases are at **sjgames.com/errata/gurps**.

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

Artificial Life

The ultimate expression of biotechnology is to *create* life from non-living matter. At a reductionist level, there seems to be no barrier to this; if we can line up all the molecules in the right configurations, it would be impossible to distinguish a natural organism from a created one. This would take superscience technology, as the number of molecules to be arranged will defeat anything less. There are shortcuts, though.

Tissue Engineering

Tissue engineering is the first step in producing artificial organisms. It uses stem cell cultures (p. 22) grown on biodegradable scaffolds in a suitable biochemical environment to produce organs without having to grow an entire clone body.

Transplant Organs (TL8)

Tissue engineering can be used to grow organs suited for transplantation (p. 141). The patient donates a sample of DNA, which is then used to grow the required organ. At TL8, organs must be grown attached to a living animal so they are supplied with the required nutrients, but smaller versions of cloning tanks may ultimately replace them at TL9. Cosmetic tissue such as ears and noses is the simplest to grow (TL8), followed by simple organs such as kidneys and livers (TL9). These would take four weeks to grow. Entire limbs and complex organs like hearts, lungs, and eyes would become available later, and take up to eight months to grow.

Fauxflesh (TL9)

NAPANEE (AP) – Acting on an anonymous tip, Ontario Provincial Police raided a factory building on the outskirts of Napanee. They found what one officer called a "disgusting scene, right out of the 20th century": live pigs and chickens being slaughtered and packed by modified agribots for the black-market meat trade. "I thought I'd seen everything in my 10 years on the force," said OPP officer Bill Mackenzie, "but this really turns your stomach, eh?" Police made six arrests.

Gengineered cells from livestock are cultured in growth tanks and supplied with nutrients. This creates a continuously growing biomass of lean meat tissue, which is harvested whenever food is required or it gets too big for its vat. Fauxflesh meat comes in oddly regular shapes, but is otherwise indistinguishable from natural meat.

Initially there is likely to be consumer resistance to fauxflesh as "unnatural," but this may be overcome by relative cheapness, concerns for animal welfare, or a population outpacing its food supply. Once established, fauxflesh may ultimately make raising animals for meat socially unacceptable or illegal.

Mimicking Biology

For most of our scientific history, we've thought of life as plants and animals and, more recently, microbes. These provide plenty of patterns on which we could base artificial living organisms.

Biogenesis (TL10)

Biogenesis is tissue engineering (above) taken to the point where biological molecules can be assembled into a viable organism. Nanomachines lay down a polymer or carbon composite scaffolding and assemble bone, muscle, nerves, and other tissues on this framework. The cells are controlled by artificial chromosomes, designed to produce the proteins and enzymes needed by the resulting organism. Often the designers will take shortcuts, using clusters of nanofactories to produce required proteins that couldn't be coded into the genes, either because of lack of understanding or development time. The result is that the organism is a mixture of biological parts and artificial components.

Biogenetic organisms come in all sizes, from insect-sized up to building-sized or larger. Since construction throughout the organism is simultaneous, they all take around the same time to build: four to six weeks. Larger organisms require more nano and raw materials, however, and thus are proportionately more expensive. Biogenesis can be used to create a wide variety of organisms, including copies of animals, designer lifeforms such as the skullcat (p. 96), and biogadgets (p. 95).

Any biogenetic organism will have Unusual Biochemistry (p. B160).

Bioroids (TL10)

Bioroids (short for biological androids) are humanoid beings created using biogenesis. Although they can be made to resemble humans, deep differences will be apparent if the cells are examined. Baseline bioroids are designed to accept artificial chromosomes, with "slots" into which genetic engineers can easily plug specific modules of genes. Much redundant material, such as introns, is left out of bioroids.

A basic bioroid design is similar to a genetically upgraded human. Initially they will be sterile, though some female models will be able to act as surrogate mothers. This limitation can be overcome with implanted or *in situ* tissue-engineered reproductive organs grown from human DNA.

Early bioroids will have limited intelligence, restricted to instinctive actions, but as the technology matures designers will be able to produce learning and reasoning capability. Since bioroids are produced in a fully grown form without passing through childhood, they will require intensive learning programs to achieve human levels of intelligence in a reasonable time; they would be ideal candidates for deep learning technology (p. 143).

Polymers

Not traditionally associated with biological materials, polymers can nevertheless be produced from proteins, forming horny materials like keratin and chitin. Gengineers may design proteins that polymerize into plastics with desirable properties, then put genes to produce them into various plants and animals. An advantage of protein-plastics is that they are biodegradable, allowing easy recycling rather than polluting the environment.

Ceramics

Bone, silica, and calcium carbonate are some of the ceramic materials produced by organisms. Others could be crystallized out of raw chemicals by biological processes. Gengineered organisms could be designed to grow everything from ultra-pure crystals for use in precision electronics up to bulk construction material. They could also be used to synthesize artificial gemstones, both crystalline such as diamond and amorphous such as opal. Other ceramics with properties based on precise microscopic structure, such as light refraction, could also be grown organically.

Biological Control

Humans have been fighting pest species since prehistoric times. We pull up weeds in our gardens, spray insecticides on our crops, lay traps for mice, and scrape floating plants off our waterways. These labor-intensive and sometimes unsafe methods are never effective for long.

Biological control uses organisms to do the work of fighting pests for us. (Another method of controlling pests is to modify the pests themselves; see *Genetically Defective Vermin*, p. 87.)

The cost of species used for biological control is highly variable. They may be released en masse by government programs, or purchased by individual farmers or residents. A box of common insect agents such as ladybugs or lacewings costs $20-$100. Each contains a few thousand eggs or a few hundred adults, suitable for treating up to an acre of land. Engineered species would cost more.

Control Using Extant Species

The ancient Egyptians practiced biological control when they realized that keeping cats could hold mouse populations down. Some early Asian farmers encouraged ants to live amongst their crops, to protect them from other insects. Modern biological control began in 1762 when colonists successfully transported a species to a foreign location specifically to reduce vermin: mynah birds to control locusts on Mauritius. Scientists of 19th-century Europe controlled several crop-eating insects using parasitic wasps and predatory mites, and developed the principle of transferring native predators to control pests introduced into new areas. This technique has since been used many times to control both plant and animal pests, using agents as varied as insects, internal parasites like nematode worms, and fungi.

Using existing species as biological controls is attractive for a number of reasons. It is relatively cheap, as the animals breed themselves in the wild and spread to cover nearby infested areas. It also avoids the use of chemicals, which avoids any problems of toxicity in the environment or final product, and makes the products more attractive to consumers.

Discovering a suitable biological control agent takes more than just finding a naturally occurring predator on the pest organism. If released into a new ecosystem, such a creature could wreak havoc on the local native species as well – or instead of! – the desired target. Several attempts over the years have backfired in exactly this way: mongooses introduced to Hawaii to control rats have exterminated many bird species. Ideally, a control species will not prey on any species other than its intended target, and die off as the pest is brought under control. Nowadays, exhaustive testing is undertaken before releasing a control species to ensure this. The problem is, most candidates don't measure up.

Gengineered Control Species

Gengineering is an obvious way to produce species more satisfactory as biological control agents. Usually the trait needing modification will be the tendency to attack species other than the one to be controlled. This might be achievable with purely behavioral modifications, but a more reliable approach is to engineer a reliance on the target species or an aversion to other potential targets. The first method relies on finding some protein or nutrient supplied only by the target organism, and engineering the control species to die without it. The second method is more difficult as it requires finding substances in all other possible targets and engineering them to be poisonous or distasteful to the control organism.

Control Using Microorganisms

All of the principles discussed above can also be applied to biological control using microbes. There are additional considerations, however. The naturally occurring disease myxomatosis was used to control rabbits in Australia, until the remaining rabbits spread myxomatosis-resistant genes throughout the population. The next stage was to be a controlled release of rabbit calicivirus, but the virus escaped a highly secure experimental quarantine area on an offshore island in 1995 and spread to every state on the mainland within a few months, before anyone knew if the virus could affect native mammals.

Sample Insect Agents

These are just some of the possibilities for gengineered insects.

Smart Mosquito (TL10)

Among the most common insects to be modified are female (bloodsucking) mosquitoes. A mosquito's ability to fly, its small size, its excellent sense of smell, and, most of all, its ability to be modified to deliver chemicals into the blood make it a highly useful organic platform for covert operations.

A smart mosquito has the usual mental and physical modifications common to insect agents. It also has a pheromone gland that allows it to mark objects with a distinctive scent so that it can find them later. It will always mark its owner.

The insect can fly at about 2 mph (Move 1). It has an effective Tracking skill 10, which can be used to find objects or people it has been programmed to recognize. It can be programmed to scent-mark an object it has found. Provided that target is not behind a sealed barrier or more than a mile or so distant, this gives the mosquito +3 on any Tracking rolls to find it later on.

The mosquito can be programmed to perform one of several tasks if it finds its target:

Payload: The mosquito cannot carry anything heavier than a few grains of sand, but sometimes that can be enough! Useful payloads include pinhead-sized listening devices and messages that are coded as microdots ($1 each). These can also be deposited somewhere – or on some*one* – and scent-marked for later retrieval.

Sampler: The mosquito can draw blood from a subject and retain it without consuming it for up to six hours. This can provide a blood sample for analysis.

Target Marking: Mark the object with a pheromone marker. This can be combined with any other task.

Vector Attack: The insect can carry and transmit a dose of a germ-warfare agent or proteus virus (designed not to affect the mosquito). It may also carry a drug or poison, but as it can only carry a small dose, HT rolls to resist are at +4. Delivery is by biting. This won't penetrate armor, but many people won't even notice a mosquito bite (make a Perception roll at -2 to do so).

A target being stalked by a smart mosquito should get a Hearing roll to notice it. A mosquito-sized insect has SM-16, but any hit will kill it.

A smart mosquito costs $8,000; it can be carried in a matchbox-sized carrying case. They live only two months. Drugs that extend the mosquito's life span by one month per dose cost $100 per dose. They are effective on a roll of 15 or less; roll each month. Mosquitoes can also be bought as dried eggs, which remain viable for 20 years and hatch after a day in water. Smart mosquitoes are LC3.

Smart Bug (TL10)

A smart ant or small spider uses the same rules as a smart mosquito, except that it is limited to moving on the ground at Move 1, cannot act as a blood sampler, has Tracking-7, and can carry a little more (gives only +2 to resist any drug or poison). While it can't fly, it can walk up walls, and is silent so it's hard to notice; a Per-4 roll is required to spot an ant or spider sneaking up on you. On the other hand, it's easy to kill – just step on it.

Smart ants or spiders are slightly easier to construct than mosquitoes, and cost $5,000. They can be equipped with two additional biological modifications:

Hardened Mandibles (TL10): These bioceramic jaws allow the bug to perform sabotage, chewing tiny holes in ducts, slicing wires, or biting for 1 point of damage per minute. A swarm of at least 100 is needed to do 1 HP of injury per second and will be dispersed after losing 6 HP; see p. B461. Add $1,000.

Vacuum Adaptation (TL11): The insect's body has been surgically adapted to survive for a short time (up to an hour) in space, or other high- or low-pressure environments. Add $10,000.

Gengineered Animals

Larger animals – such as fish, dogs, or cows – can be bioengineered, often by adding genes from other species. Just like humans, animals can be modified with germline gengineering or a biomod operation. The former has the potential to create a race of modified animals (if a breeding pair is modified). The latter only modifies a single individual, but can usually be performed at an earlier TL.

So why would someone want to gengineer animals? Some possible objectives are described below.

Companions and Working Beasts

Pet owners already enjoy exotic breeds. If laws don't get in the way, we may see dogs with pink fur or strange hybrids like a cat-rabbit. Even if they are illegal, there may still be a black market for radically altered pets. While society may frown on giving rabbit ears and a semi-intelligent brain to a cat, genemods designed to enhance the intelligence of working beasts like sheep dogs, police dogs, or horses may be acceptable. At high TLs or in cyberpunk worlds, customized "super pets" could be created by finding a freelance genehacker and having him make a pet to order.

Some societies may even permit the design of "guardbeasts" or "warbeasts" with enhanced combat abilities, derived from deadly animals. These might also be used in ecological warfare. Most such beasts are LC2-3; those that can breed rapidly might be LC1.

Anti-Material Bacteria

Halfway between killer germs and exotic industrial bacteria, these are microorganisms designed to attack nonliving things rather than animals or plants. Some types that are already under development (making them TL8) include:

Explosive-Eating Bacteria: Usually targeted at a specific chemical explosive; e.g., TNT, RDX, Plastex-B, etc. These will knock out explosive warheads and chemical propellants.

Petroleum-Eating Bacteria: Based on bacteria used to clean up oil spills, these are designed to eat hydrocarbon-based lubricants and fuels such as gasoline, diesel and jet fuel.

Rubber-Eating Bacteria: These could destroy tires, fuel lines, valves, boots, etc., disabling vulnerable equipment.

Other Types: At TL9+, more exotic types of bacteria (or nanomachines that work like bacteria) may become available that can rapidly degrade plastics, various biotech materials and even silicon chips. However, bacteria won't have much chance against metal, stone or most advanced composites and ceramics. Other types of microbes may also be used.

If equipment or supplies that are vulnerable to a particular anti-material bacteria are in an area that is contaminated, or come into contact with infected material, check for infection. Use the Contagion rules (p. B443) as guidelines to see if the bacteria infect particular material. Ignore modifiers for eating flesh, but "intimate contact" would be direct physical contact with contaminated material – e.g., topping off an uninfected fuel tank with contaminated gasoline, or spraying the bacteria directly into a mechanism. If the HT of the material (or its container) is unknown, use HT 10 for machines, 12 for solid objects.

Anti-material bacteria work slowly. Generally, infected material will show initial signs of rot or contamination after 24 hours and become useless (eaten away, turned to goo, etc.) within 48 hours. During this time, the bacteria can infect other material it contacts. A roll against Hazardous Materials skill (with appropriate equipment) can detect contamination early enough to treat it (using disinfectant bleaches, etc.). A fully airtight container or seal will protect against anti-material bacteria. In the case of sealed vehicles or bases, GMs can require occasional rolls vs. Hazardous Materials skill, with a failure or indicating that some sort of mistake was made (e.g., a seal left open), which will allow a chance of contamination. Of course, saboteurs can always open up machinery and spray the bacteria into it!

In general, anti-material bacteria are devastating against unprepared targets (especially at TL7 or less) but will be of limited use against targets equipped with countermeasures, such as ultra-tech military forces. See also *Cleanup* (p. 114).

Anti-Nano Bacteria (TL10)

One of the primary applications of nanomachines is to seek and destroy cells of various types. Turning this around, it is possible to gengineer microbes to seek and destroy nanobots. This is a trickier task for the developers, as they need to equip the bacteria with the ability to detect nanomachines – which can come in a wide variety of physical shapes – and the ability to damage them.

At TL11 it becomes possible to engineer bacteria to *reprogram* nanobots. Reprogramming bacteria would cost at least as much as the purchase price of the reprogrammed nanobots, but the advantage is that the original nanobot controller may be unaware of the reprogramming, and might even be fed false information.

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