

# Genetic engineering analysis



**ASSIGN  
BUSTER**

## Genetic Engineering, history and future Altering the Face of Science

Science is a creature that continues to evolve at a much higher rate than the beings that

gave it birth. The transformation time from tree-shrew, to ape, to human far exceeds the time

from analytical engine, to calculator, to computer. But science, in the past, has always remained

distant. It has allowed for advances in production, transportation, and even entertainment, but

never in history will science be able to so deeply affect our lives as genetic engineering will

undoubtedly do. With the birth of this new technology, scientific extremists and anti-technologists

have risen in arms to block its budding future. Spreading fear by misinterpretation

of facts, they promote their hidden agendas in the halls of the United States congress. Genetic

engineering is a safe and powerful tool that will yield unprecedented results, specifically in the

field of medicine. It will usher in a world where gene defects, bacterial disease, and even aging

are a thing of the past. By understanding genetic engineering and its history, discovering its

possibilities, and answering the moral and safety questions it brings forth, the blanket of fear

covering this remarkable technical miracle can be lifted.

The first step to understanding genetic engineering, and embracing its possibilities for

society, is to obtain a rough knowledge base of its history and method. The basis for altering the

evolutionary process is dependant on the understanding of how individuals pass on

characteristics to their offspring. Genetics achieved its first foothold on the secrets of nature's

evolutionary process when an Austrian monk named Gregor Mendel developed the first " laws of

heredity." Using these laws, scientists studied the characteristics of organisms for most of the

next one hundred years following Mendel's discovery. These early studies concluded that each

organism has two sets of character determinants, or genes (Stableford 16).

For instance, in

<https://assignbuster.com/genetic-engineering-analysis/>

regards to eye color, a child could receive one set of genes from his father that were encoded one

blue, and the other brown. The same child could also receive two brown genes from his mother.

The conclusion for this inheritance would be the child has a three in four chance of having

brown eyes, and a one in three chance of having blue eyes (Stableford 16).

Genes are transmitted through chromosomes which reside in the nucleus of every living

organism's cells. Each chromosome is made up of fine strands of deoxyribonucleic acids, or

DNA. The information carried on the DNA determines the cells function within the organism.

Sex cells are the only cells that contain a complete DNA map of the organism, therefore, “ the

structure of a DNA molecule or combination of DNA molecules determines the shape, form, and

function of the organism's offspring ” (Lewin 1). DNA discovery is attributed to the research

of three scientists, Francis Crick, Maurice Wilkins, and James Dewey Watson in 1951. They

<https://assignbuster.com/genetic-engineering-analysis/>

were all later accredited with the Nobel Prize in physiology and medicine in 1962 (Lewin 1).

“ The new science of genetic engineering aims to take a dramatic short cut in the slow

process of evolution” (Stableford 25). In essence, scientists aim to remove one gene from an

organism’s DNA, and place it into the DNA of another organism. This would create a new DNA

strand, full of new encoded instructions; a strand that would have taken Mother Nature millions

of years of natural selection to develop. Isolating and removing a desired gene from a DNA

strand involves many different tools. DNA can be broken up by exposing it to ultra-high-frequency

sound waves, but this is an extremely inaccurate way of isolating a desirable DNA section

(Stableford 26). A more accurate way of DNA splicing is the use of “ restriction

enzymes, which are produced by various species of bacteria” (Clarke 1). The restriction

enzymes cut the DNA strand at a particular location called a nucleotide base, which makes up a

DNA molecule. Now that the desired portion of the DNA is cut out, it can be joined to another

strand of DNA by using enzymes called ligases. The final important step in the creation of a

new DNA strand is giving it the ability to self-replicate. This can be accomplished by using

special pieces of DNA, called vectors, that permit the generation of multiple copies of a total

DNA strand and fusing it to the newly created DNA structure. Another newly developed

method, called polymerase chain reaction, allows for faster replication of DNA strands and does

not require the use of vectors (Clarke 1).

The possibilities of genetic engineering are endless. Once the power to control the

instructions, given to a single cell, are mastered anything can be accomplished. For example,

insulin can be created and grown in large quantities by using an inexpensive gene manipulation

<https://assignbuster.com/genetic-engineering-analysis/>

method of growing a certain bacteria. This supply of insulin is also not dependant on the supply

of pancreatic tissue from animals. Recombinant factor VIII, the blood clotting agent missing in

people suffering from hemophilia, can also be created by genetic engineering. Virtually all

people who were treated with factor VIII before 1985 acquired HIV, and later AIDS. Being

completely pure, the bioengineered version of factor VIII eliminates any possibility of viral

infection. Other uses of genetic engineering include creating disease resistant crops, formulating

milk from cows already containing pharmaceutical compounds, generating vaccines, and

altering livestock traits (Clarke 1). In the not so distant future, genetic engineering will become

a principal player in fighting genetic, bacterial, and viral disease, along with controlling aging,

and providing replaceable parts for humans.

Medicine has seen many new innovations in its history. The discovery of anesthetics

<https://assignbuster.com/genetic-engineering-analysis/>

permitted the birth of modern surgery, while the production of antibiotics in the 1920s

minimized the threat from diseases such as pneumonia, tuberculosis and cholera. The creation

of serums which build up the bodies immune system to specific infections, before being laid low

with them, has also enhanced modern medicine greatly (Stableford 59). All of these discoveries,

however, will fall under the broad shadow of genetic engineering when it reaches its apex in the

medical community.

Many people suffer from genetic diseases ranging from thousands of types of cancers, to

blood, liver, and lung disorders. Amazingly, all of these will be able to be treated by genetic

engineering, specifically, gene therapy. The basis of gene therapy is to supply a functional gene

to cells lacking that particular function, thus correcting the genetic disorder or disease. There

are two main categories of gene therapy: germ line therapy, or altering of sperm and egg cells,

<https://assignbuster.com/genetic-engineering-analysis/>



and somatic cell therapy, which is much like an organ transplant. Germ line therapy results in a

permanent change for the entire organism, and its future offspring.

Unfortunately, germ line

therapy, is not readily in use on humans for ethical reasons. However, this genetic method

could, in the future, solve many genetic birth defects such as downs syndrome. Somatic cell

therapy deals with the direct treatment of living tissues. Scientists, in a lab, inject the tissues

with the correct, functioning gene and then re-administer them to the patient, correcting the

problem (Clarke 1).

Along with altering the cells of living tissues, genetic engineering has also proven

extremely helpful in the alteration of bacterial genes. “ Transforming bacterial cells is easier

than transforming the cells of complex organisms” (Stableford 34). Two reasons are evident for

this ease of manipulation: DNA enters, and functions easily in bacteria, and the transformed

<https://assignbuster.com/genetic-engineering-analysis/>

bacteria cells can be easily selected out from the untransformed ones.

Bacterial bioengineering

has many uses in our society, it can produce synthetic insulins, a growth hormone for the

treatment of dwarfism and interferons for treatment of cancers and viral diseases (Stableford

34).

Throughout the centuries disease has plagued the world, forcing everyone to take part in a

virtual “ lottery with the agents of death” (Stableford 59). Whether viral or bacterial in nature,

such disease are currently combated with the application of vaccines and antibiotics. These

treatments, however, contain many unsolved problems. The difficulty with applying antibiotics

to destroy bacteria is that natural selection allows for the mutation of bacteria cells, sometimes

resulting in mutant bacterium which is resistant to a particular antibiotic.

This now

indestructible bacterial pestilence wages havoc on the human body. Genetic engineering is

<https://assignbuster.com/genetic-engineering-analysis/>

conquering this medical dilemma by utilizing diseases that target bacterial organisms. these

diseases are viruses, named bacteriophages, “ which can be produced to attack specific disease-causing

bacteria” (Stableford 61). Much success has already been obtained by treating animals

with a “ phage” designed to attack the E. coli bacteria (Stableford 60).

Diseases caused by viruses are much more difficult to control than those caused by

bacteria. Viruses are not whole organisms, as bacteria are, and reproduce by hijacking the

mechanisms of other cells. Therefore, any treatment designed to stop the virus itself, will also

stop the functioning of its host cell. A virus invades a host cell by piercing it at a site called a

“ receptor”. Upon attachment, the virus injects its DNA into the cell, coding it to reproduce more

of the virus. After the virus is replicated millions of times over, the cell bursts and the new

viruses are released to continue the cycle. The body’s natural defense against such cell invasion

is to release certain proteins, called antigens, which “ plug up” the receptor sites on healthy cells.

This causes the foreign virus to not have a docking point on the cell. This process, however, is

slow and not effective against a new viral attack. Genetic engineering is improving the body’s

defenses by creating pure antigens, or antibodies, in the lab for injection upon infection with a

viral disease. This pure, concentrated antibody halts the symptoms of such a disease until the

body’s natural defenses catch up. Future procedures may alter the very DNA of human cells,

causing them to produce interferons. These interferons would allow the cell to be able

determine if a foreign body bonding with it is healthy or a virus. In effect, every cell would be

able to recognize every type of virus and be immune to them all (Stableford 61).

Current medical capabilities allow for the transplant of human organs, and even

mechanical portions of some, such as the battery powered pacemaker.

Current science can even

re-apply fingers after they have been cut off in accidents, or attach synthetic arms and legs to

allow patients to function normally in society. But would not it be incredibly convenient if the

human body could simply regrow what it needed, such as a new kidney or arm? Genetic

engineering can make this a reality. Currently in the world, a single plant cell can differentiate

into all the components of an original, complex organism. Certain types of salamanders can re-grow

lost limbs, and some lizards can shed their tails when attacked and later grow them again.

Evidence of regeneration is all around and the science of genetic engineering is slowly mastering

its techniques. Regeneration in mammals is essentially a kind of “ controlled cancer”, called a

blastema. The cancer is deliberately formed at the regeneration site and then converted into a

structure of functional tissues. But before controlling the blastema is possible, “ a detailed

knowledge of the switching process by means of which the genes in the cell nucleus are

selectively activated and deactivated” is needed (Stableford 90). To obtain proof that such a

procedure is possible one only needs to examine an early embryo and realize that it knows

whether to turn itself into an ostrich or a human. After learning the procedure to control and

activate such regeneration, genetic engineering will be able to conquer such ailments as

Parkinson’s, Alzheimer’s, and other crippling diseases without grafting in new tissues. The

broader scope of this technique would allow the re-growth of lost limbs, repairing any damaged

organs internally, and the production of spare organs by growing them externally (Stableford

90).

Ever since biblical times the lifespan of a human being has been pegged at roughly 70

<https://assignbuster.com/genetic-engineering-analysis/>

years. But is this number truly finite? In order to uncover the answer, knowledge of the process

of aging is needed. A common conception is that the human body contains an internal biological

clock which continues to tick for about 70 years, then stops. An alternate “watch” analogy could

be that the human body contains a certain type of alarm clock, and after so many years, the

alarm sounds and deterioration begins. With that frame of thinking, the human body does not

begin to age until a particular switch is tripped. In essence, stopping this process would simply

involve a means of never allowing the switch to be tripped. W. Donner Denckla, of the Roche

Institute of Molecular Biology, proposes the alarm clock theory is true. He provides evidence

for this statement by examining the similarities between normal aging and the symptoms of a

hormonal deficiency disease associated with the thyroid gland. Denckla proposes that as we get

older the pituitary gland begins to produce a hormone which blocks the actions of the thyroid

hormone, thus causing the body to age and eventually die. If Denckla's theory is correct,

conquering aging would simply be a process of altering the pituitary's DNA so it would never be

allowed to release the aging hormone. In the years to come, genetic engineering may finally

defeat the most unbeatable enemy in the world, time (Stableford 94).

The morale and safety questions surrounding genetic engineering currently cause this new

science to be cast in a false light. Anti-technologists and political extremists spread false

interpretation of facts coupled with statements that genetic engineering is not natural and defies

the natural order of things. The morale question of biotechnology can be answered by studying

where the evolution of man is, and where it is leading our society. The safety question can be

answered by examining current safety precautions in industry, and past safety records of many

<https://assignbuster.com/genetic-engineering-analysis/>



bioengineering projects already in place.

The evolution of man can be broken up into three basic stages. The first, lasting millions

of years, slowly shaped human nature from Homo erectus to Homo sapiens.

Natural selection

provided the means for countless random mutations resulting in the appearance of such human

characteristics as hands and feet. The second stage, after the full development of the human

body and mind, saw humans moving from wild foragers to an agriculture based society. Natural

selection received a helping hand as man took advantage of random mutations in nature and bred

more productive species of plants and animals. The most bountiful wheats were collected and

re-planted, and the fastest horses were bred with equally faster horses. Even in our recent

history the strongest black male slaves were mated with the hardest working female slaves. The

third stage, still developing today, will not require the chance acquisition of super-mutations in

<https://assignbuster.com/genetic-engineering-analysis/>

nature. Man will be able to create such super-species without the strict limitations imposed by

natural selection. By examining the natural slope of this evolution, the third stage is a natural

and inevitable plateau that man will achieve (Stableford 8). This omniscient control of our

world may seem completely foreign, but the thought of the Egyptians erecting vast pyramids

would have seem strange to Homo erectus as well.

Many claim genetic engineering will cause unseen disasters spiraling our world into

chaotic darkness. However, few realize that many safety nets regarding bioengineering are

already in effect. The Recombinant DNA Advisory Committee (RAC) was formed under the

National Institute of Health to provide guidelines for research on engineered bacteria for

industrial use. The RAC has also set very restrictive guidelines requiring Federal approval if

research involves pathogenicity (the rare ability of a microbe to cause disease) (Davis, Roche

<https://assignbuster.com/genetic-engineering-analysis/>

69).

“ It is well established that most natural bacteria do not cause disease. After many years of

experimentation, microbiologists have demonstrated that they can engineer bacteria that are just

as safe as their natural counterparts” (Davis, Rouche 70). In fact the RAC reports that “ there has

not been a single case of illness or harm caused by recombinant engineered bacteria, and they

now are used safely in high school experiments” (Davis, Rouche 69).

Scientists have also

devised other methods of preventing bacteria from escaping their labs, such as modifying the

bacteria so that it will die if it is removed from the laboratory environment.

This creates a shield

of complete safety for the outside world. It is also thought that if such bacteria were to escape it

would act like smallpox or anthrax and ravage the land. However, laboratory-created organisms

are not as competitive as pathogens. Davis and Roche sum it up in extremely laymen’s terms,

<https://assignbuster.com/genetic-engineering-analysis/>

“ no matter how much Frostban you dump on a field, it’s not going to spread” (70). In fact

Frostbran, developed by Steven Lindow at the University of California, Berkeley, was sprayed on

a test field in 1987 and was proven by a RAC committee to be completely harmless (Thompson

104).

Fear of the unknown has slowed the progress of many scientific discoveries in the past.

The thought of man flying or stepping on the moon did not come easy to the average citizens of

the world. But the fact remains, they were accepted and are now an everyday occurrence in our

lives. Genetic engineering too is in its period of fear and misunderstanding, but like every great

discovery in history, it will enjoy its time of realization and come into full use in society. The

world is on the brink of the most exciting step into human evolution ever, and through

knowledge and exploration, should welcome it and its possibilities with open arms.

<https://assignbuster.com/genetic-engineering-analysis/>

## **Works Cited**

Clarke, Bryan C. Genetic Engineering. Microsoft (R) Encarta.

Microsoft Corporation, Funk ; Wagnalls Corporation, 1994.

Davis, Bernard, and Lissa Roche. “ Sorcerer’s Apprentice or Handmaiden to Humanity.” USA TODAY: The Magazine of the American Scene GUSA 118 Nov 1989: 68-70.

Lewin, Seymour Z. Nucleic Acids. Microsoft (R) Encarta. Microsoft Corporation, Funk ; Wagnalls Corporation, 1994.

Stableford, Brian. Future Man. New York: Crown Publishers, Inc., 1984.

Thompson, Dick. “ The Most Hated Man in Science.” Time 23 Dec 4 1989: 102-104