

## Building the Staircase of Life: Farmers Were the First Genetic Engineers

We've been genetically engineering for over 10,000 years, taking advantage of random genetic mutations and exerting human selection in agriculture. Only in the last 50 years have we developed the tools to exert greater control and speed onto the process.

With a technique discovered in the 1970s and reliably patented just this year, we can now cut and past DNA, albeit still with very high error rates. You definitely would not want to try designing your baby - at least not yet.

Outside of science fiction and in real time, the market is now making rapid advancements in gene therapies for cancer and diseases like cystic fibrosis.

### The Original Genetic Engineers: Ancient Farmers

Before we knew that genes were made of deoxyribose nucleic acid (DNA), ancient farmers already knew the concept of genes. In Mexico, for example, they knew that if they planted the seeds of the most fruitful teosinte grain, a type of grass with barely more seed than the grass that grows in your lawn, the grains would over several growing cycles get larger - and larger - until the Aztec society was dependent on maize (corn).

Not to mention that your puppy Fido has also been genetically engineered by human selection. Originally descended from the Asian wolf, aggressive pups were culled (killed) and docile pups were bred - leading to our 300 breeds of our modern day dog, ranging from Great Danes to chihuahuas.

### So What Are Genes, Anyway?

The code that makes us up are made of 4 molecules represented by the letters: G, A, T, and C. These molecules form a helical structure.

Imagine a spiral staircase 750,000 miles long, tied in knots around itself, wrapping around the Earth 5 times. Every time a new cell is created, a new staircase must be built.

In order to create the proteins that make life, a man has to go step-by-step on the staircase - each step being one letter of the very long recipe that creates a specific life. Some parts of the staircase are so treacherous and knotted that the man jumps off and skips to the next part, leaving many portions of the recipe unread.

Each human has 5 billion +/- 5 million steps in their staircase (called **nucleotides** in DNA language). That's a huge range between individual humans, meaning that your neighbor might have 10 million more or fewer nucleotides than you do!

What does this code even do anyway? Does having more of less of it make you less of a human? It turns out that only 5% of our DNA actually codes for proteins, the essential ingredients of life.

The purpose of the rest is a mystery to science. Although this "junk" code is what makes familial DNA tests possible. The endless repetitive patterns in the junk code are very accurate at telling us where we came from, even from many generations ago.

### Genetic Engineering Today: Gene Therapies

Over our lives, our DNA changes and mutates in the process of aging. Our bodies are very protective of our genes, and our immune system exists to detect and destroy any items that don't belong, like viruses or bacteria.

Some people's genes cause disease though, like the BRCA1/2 genes that are highly linked to breast cancer. In many cases of cancer, there is a gene that either causes greater incidence of genetic mutations or allows mutated genes to replicate wildly and out of control into tumors.

In order to bypass the body's natural defense and DNA-repair system, scientists use vectors, Trojan horses that sneak in therapeutic DNA past the defensive walls.

Viruses are common vectors (you'll hear the term **viral vector** a lot). Some therapies today use a modified version of the AIDS virus to inject genetic information, it's like a cellular needle.

Another method is by extracting our own stem cells, the "blank slate" cells which can become almost anything. The problem with this therapy is that stem cells are hard to find in an adult human, found usually in the bone marrow or roots of your teeth - two places where we really don't want doctors to go!

### Up Next: Research in Genetic Engineering

Next week we will discuss the research behind Lamarckian evolution: **epigenetics**, the science of gene regulation.

## What is Compassionate Technologies?

Each Sunday we deliver to your doorstep an inspirational and educational piece describing a certain trend in technology and business.

We go from small to large throughout the year. This month focuses on Genetic Engineering, progressing up to topics in robotics, artificial intelligence, environmental and then space technologies.

Each month has four parts:

**1st Sunday: Trends**  
**2nd Sunday: Research**  
**3rd Sunday: Technology**  
**4th Sunday: Business**

To keep our doors open, fund interviews with top scientists and industry players, and to continue hosting local events, we charge \$150 per year for 52 print weeklies.

While we're getting started, I'm doing free deliveries in my neighborhood for the month of June. Please enjoy and consider joining me on this journey!

Kindly yours,

Olivia Jeffers

Thoughts?

Email me at [olivia@compassionate-technologies.org](mailto:olivia@compassionate-technologies.org)  
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— Anne Frank

"in their own hands."

"The final forming of a person's character lies