Sujay Rao

Dr. Gingrich

Advanced Placement Language and Composition

12 February 2019

Do Humans Have the Right to Play God? An Examination of the Implications of Human Genome Editing

For the hundreds of thousands of years that humans have been on this planet, we have had to sit back and simply accept the way our bodies function. We may have diseases which run in our families, but our only option is to wait and try to stay healthy to avoid getting them. We have no way to predict whether or not those deadly diseases like diabetes or heart disease will take hold of our bodies. But that is starting to change. New technologies are beginning to allow humans to have a say in our genes, a say in our bodies. We no longer need to simply sit back and "deal" with how our bodies work. Just as we may go to the doctor's office to get medication for a sickness, we may soon go to a genetic specialist to remove diabetes or cancer genes from our genomes to avoid the deadly effects of those dangerous diseases that once plagued our ancestors.

Additionally, as parents, we will have the ability to choose the exact genes our children will inherit and eliminate those they won't. In addition to the factors concerning medical health, parents may even have the ability to choose exterior traits of their children – whether they are tall, have blonde hair, have blue eyes, and so on. But when genetic editing is used for purposes other than medical, the question of ethics comes into play. Do we really have the right to change what nature has bestowed upon us? And for those of us who believe in a higher power, do we have the right to play God? This question has come up in recent years, and has led to controversy in the scientific community. But the answer is, if we have found a way to save human lives, we must utilize the technology to its full potential to save as many people as possible.

Gene editing has not been around for very long, but several ground-breaking discoveries have been made that explain how our genes work and how to change them. Deoxyribonucleic acid, or DNA, is the genetic material contained in all living things. It makes up the chromosomes in our cells and stores genetic information that is passed on to us from our parents. A DNA molecule is made up of hundreds of thousands of pairs of the nucleobases adenine, thymine, guanine, and cytosine. The sequence in which these bases are arranged determine the composition of our body's proteins. Those proteins that are made form our cells, tissues, organs, and systems, and make us who we are. Strands of DNA can be several feet long, but they are very tightly coiled up in chromosomes. Though their length may be long, the diameter of a DNA molecule's double helix structure is only about 2 nanometers wide, or $2x10^{-9}$ meters. Therefore, new techniques needed to be developed to operate on a miniscule scale to add and remove information in genes. So far, the most innovative technique is the CRISPR-Cas9 method. In short, a CRISPR molecule, Cas9 in this case, searches for a specific nucleotide in the human genome. Once it finds the correct pair of bases, it uncoils the double helix and "snips" the unwanted sequence out of the strand of DNA. Then, it inserts new genetic information and reconnects the strand. After this, a new attribute is added to the individual, or an unwanted attribute is removed. This method has enabled scientists and genetic engineers to target and edit specific parts of a DNA sequence, rather than having to edit an entire strand. Physical changes are not observed instantly, but will begin to occur gradually as new proteins are produced according to the new genetic information. Using this technique, humans' lives can be saved.

After humans developed gene editing technology, we inherited great power – the power to save lives. For example, in 2015, a little girl named Layla was diagnosed with a type of leukemia which was killing her as the days went by. Her family did not have much hope she would survive, as chemotherapy and blood transfusions were not curing the sickness. Left with few options, her family turned to a new gene editing technology that seemed promising. The treatment involved injecting edited immune cells into her blood stream to counteract the cancerous cells that plagued her body. Soon after the treatment was administered, all signs of the leukemia in her blood were eliminated. Although her treatment was a one-off procedure, the experience gained from treating Layla's leukemia can be extended to help treat other diseases. For example, CRISPR technology has been used to cure HIV in human cell cultures, and research is being done to administer the procedure to living and breathing human cells. CRISPR does this by simply removing viral genes that HIV viruses inject into healthy DNA. Additionally, previously incurable genetic diseases, like Duchenne's muscular dystrophy, can be eliminated in families that the disease once plagued. Despite the potential that gene editing technologies give to science and medicine, there are still opponents to the implementation of the technology.

The opponents of human genome editing are several and very outspoken. They have two major arguments against gene editing and why developments in the technology should be halted.

First, they argue that editing one gene in a sequence can have unprecedented implications on other vital genes. Though this concern may have been valid in the past, it no longer has a place in today's genetic engineering landscape. Technology has advanced to the point where singular nucleobase pairs can be replaced without affecting other pairs, rendering this widespread concern invalid. Second, opponents say that genome editing can get out of hand and be used to create genetically engineered humans. This concern is probably the most pressing issue in the world of genetic engineering, but the likelihood of that happening is quite low. In most countries that have the capability of editing human embryonic cells, legislation has not been passed that allows for it to be practiced. The reason that this legislation has not been passed leads into the ethical argument over gene editing. This argument has presided over the study of gene editing since its inception, and questions whether it is really within our right to edit human genome sequences for reasons apart from medical purposes. The general consensus is that creating humans who are stronger, faster, or smarter leaves other humans at a disadvantage. This belief has been the main deterrent to the creation of altered humans for so long, and it seems that it will prevent the creation of a "new race of superhumans" for a very long time to come. In conjunction with scientists, most lawmakers have expressed distaste towards the usage of genetic engineering to create a stronger race of humans, rendering it unlikely that pro-embryonic editing laws will be passed. Lawmakers, like most people, want the benefits of gene editing to be limited to medical usage, where it will do good to all.

Gene editing has come a long way since it was first introduced, and it has been proven to save lives. Where traditional medications have failed, genetic engineering has succeeded in saving patients' and families' lives. Better yet, gene editing has almost no downsides. New methods like the CRISPR-Cas9 technique have been developed to easily change what is in our genes. However, advances cannot occur without innovation, and innovation often involves moving away from what we are comfortable with. Although gene editing may seem foreign to us now, it will soon become just as normal as taking medicine for a fever. Having gene editing technology gives us the chance to decide whether our family members will have a fever or not, get diabetes or not, get cancer or not, live or not. So, with the capabilities we have now, the question is no longer whether we have the right to edit human genes, but rather whether it is our right to not.

Mentor Texts and Evaluation

https://blogs.scientificamerican.com/observations/human-gene-editing-great-power-great-responsibility/

https://blogs.scientificamerican.com/guest-blog/we-re-all-x-men-as-far-as-genetic-mutations-go/

The editorialist E. Paul Zehr is a writer who produces editorials for the Scientific American. Oftentimes, his editorials relate comic book characters from Marvel and DC to real world issues. One of the major topics he writes about is gene editing and genetic mutations, and he relates the unknown scientific concepts of his writing to various fictional comic book characters, which are universally known to Americans. Although he does not have references to comic book characters in his editorial about human gene editing, he uses an extended relationship between X-Men and natural mutations in his editorial about genetic mutations to relate the topic to the reader.

In the first editorial, Zehr discusses the pros and cons of gene editing. As a scientist, he leans toward supporting genetic editing, but he is still wary of the potential implications that an improperly done procedure can have on a person. Throughout the editorial, he maintains a relaxed tone, and uses colloquial word choice, avoiding using excessive complicated vocabulary. The topic he is discussing is quite a complicated topic, and he manages to keep the topic simple and comprehensible. While he sometimes uses technical terminology that only a genetic engineer would know, he makes sure to explain to the reader what each term means. Zehr's writing style carries on to his other editorials and makes them easy reads. I incorporated Zehr's simple writing style into my editorial to avoid confusion on the reader's part, especially for a reader uneducated in genetic engineering. I also made sure to thoroughly explain topics that may be unfamiliar to the reader.

In the second editorial, Zehr explains what genetic mutations are, how they form, and why we should not think of them as strange and foreign. To explain his point, he uses references to the X-Men movies. In those movies, the characters each have superpowers that came about because of a genetic mutation. He uses this scenario of gaining superpowers to contrast with real-world human gene mutations, which are little more than something that changes your skin color or hair color. Although he also talks about how a mutation can lead to sickle cell anemia or cancer, he continues to contrast it with the fictional powers that X-Men characters have, like claws that extend from their hands or the ability to read someone's mind. Like his other editorials, Zehr maintains a relaxed tone and makes them easy to read. I made sure to incorporate his relaxed tone into my editorial to be sure that readers understand the topic I am relating to them. Because gene editing and genetic engineering as a whole is a complicated subject, papers written about it must be written to make sure that readers can understand the concepts in simple terms.