The Features Of Genetic Engineering

The field of genetic engineering and specifically gene editing has grown significantly in the last decade with the creation of Clustered Regularly Interspaced Short Palindromic Repeats - Cas9, or CRISPR, and the emergence of gene manipulation. This technology can be very risky or valuable based on how it is used. Using Gene therapy, all genetic disorders in humans and animals could be nearly eliminated, the growing need for food in agriculture as the population grows could be solved, and cure diseases that were once not thought to be treatable. Gene therapy is a technology that if utilized correctly could push the human race to the next step of evolution.

Recently technologies like CRISPR have created a way to edit genes more efficiently and for less money. This has made gene editing into a very popular topic in recent years. The Process of manipulating genomes by deleting, replacing, or inserting bits of DNA into a specific place in the genome of an organism or cell is called gene editing. Without technologies like CRISPR, the editing of genes would be costly and nonefficient and would cause the area to not be viable. CRISPR is a powerful tool that makes the editing of genes to be possible, because of this extensive research is being done on it. This can be seen by how there are now more research papers into CRISPR than all other methods despite the fact of how new CRISPR is. It has promising applications in numerous fields including the elimination of genetic disorders, the treatment and prevention of diseases, and improving crop yields. These applications are only possible because of CRISPR's efficient ability to allow scientists to modify genes.

Genomes work by encoding their data into instructions and messages within the DNA. Gene manipulation takes each one of those sequences and changes them to change the instructions. One way to do this is by cutting or breaking the DNA in very specific places to trick the DNA fixing structures in the cell to introduce mutation or other changes in the genome. This allows researchers to make certain changes that they want. This is all done using CRISPR. While other Gene manipulation tools exist, newer tools like CRISPR has made gene manipulation a lot more viable than past tools like TALENS.

Although it goes by CRISPR, the research name is CRISPR-Cas9. Cas9 is an enzyme used by CRISPR. This enzyme acts like a pair of extremely small scissors that are able to cut the strands of DNA. The technology was created by analyzing the defense structure of single celled microorganisms and bacteria. These microorganisms use this defense structure to stop attacks by all foreign bodies like viruses. Using the defense mechanisms, the microorganisms are able to destroy the DNA of the foreign invader by using the Cas9 enzyme's ability to chop up the DNA of the foreign invader. These mechanisms can then be moved to more complex multicell lifeforms, like humans, to manipulate or "edit" the genes inside the lifeforms.

CRISPR is a region of the DNA this has two very distinct attributes that set it apart from the rest of the DNA. These two attributes are the presence of nucleotide spacers and repeats. Repeated sequences, the building blocks of DNA, are found spread out the entire CRISPR region of the DNA. These spacers can then be used as memory for CRISPR. This can be seen evidently in the case of bacteria where spacers are taken from the earlier attacks on the bacteria from different foreign invaders. Once a spacer is integrated into the DNA, if the foreign invader were

to ever attack again, a small portion of the CRISPR is written and changed into CRISPR RNA, or “crRNA” . This single stranded RNA sequence acts as a guide to create and construct another corresponding piece of RNA.

The Cas9 Enzyme is utilized like a pair of surgical scissors to cut the foreign DNA. To do this, it binds the two RNA strands, the crRNA and trans-activating crRNA. The two RNA molecules take the Cas9 enzyme to the targeted DNA. It will cut out both strands of the DNA double helix. To prevent the Cas9 enzyme from cutting in the wrong place in the DNA, the creation of a built-in safety feature was done. Protospacer adjacent motifs or PAMs are short DNA sequences that serve as markers and sit next to the targeted DNA location to guide the enzyme. If the Cas9 enzyme is not able to the PAM where the target cut is located, then it will not cut the DNA sequence.

Currently, gene editing is focused on the treatment of the patient’s body cells such as blood cells or bone marrow. With this type of gene editing, the patient will not pass the gene modifications to their children. This will require the modification of each of the patient’s children for genetic diseases that are hereditary. Although using a different technique, gene editing could be used to target the reproductive cells of the patients. This would allow the modifications to pass to the patient’s children and ending the line of hereditary genetic disorders. This type of gene therapy is called germline gene therapy.

Germline therapy has already started being used. In November 2018, a Chinese researcher Jiankui He announced that he had been able to edit tow human embryos. He edited these embryos to disable the gene for CCR5, which would allow the kids to be immune to HIV. Both girls were born in china but both girls still carried working copies of the CCR5 gene alongside a disabled CCR5 gene. While his research was ultimately unsuccessful it shows that ability germline gene therapy has to improve human life.

There are many concerns when it comes to gene therapy. One concern is who decides what is considered a disorder or disability vs what normal is normal. Gene therapy has the ability to change numerous aspects of a person. A decision would have to be made on things like if a child being hyper is a disability or a normal trait for a child. If we remove every single “disorder” what would make people different? The overuse of a technology this powerful could make a world where not being absolutely normal would make you an “outcast” as all traits deemed bad would be removed.

There are more concerns in the specific types of gene therapy. Many types, like germline gene therapy, are under strong scrutiny because of the unknown effects it could have on the next generation. While germline gene therapy could keep the next generation from experiencing the awful effects of hereditary genetic disorders, it could have unintended consequences on the development of a child or other long-term effects on the child that are not yet known. These children will not be able to whether this unproven treatment is the right option for them as they have not been born yet. This puts certain types of gene therapy on hold as there just isn’t enough research into the long-term effect of them to allow them.

While one of its main advantages gene editing’s ability to treat diseases and disorders and nor its only use. It also has the ability to change other attributes of a person such as intelligence, appearance, athletic ability, or even height. This ability to change people could have the unintended consequence of creating a higher social class of people. Currently, the high cost of

gene editing will only allow the richer part of the population to afford this technology. With only a select group having access to this technology, social classes of “non-enhanced” and “enhanced” people would emerge as people start to believe that with the enhancements that they are better than the people without the enhancements. This ability should only be used if it is available to help a significant portion of the population and not just the rich elite.

Gene editing’s ability to edit the DNA of patients offers the ability to treat many illnesses and disorders that were once considered untreatable. In the United States, about one in every thirty-three babies are born with some sort of birth defect. Birth defects are the leading cause of deaths in infants in America, these deaths account for a fifth of all deaths in infants. Gene editing would have the ability to correct the genetic problems of the infants while the infant is still in the womb. Doing this would greatly reduce the number of infant deaths.

While most genetic diseases are not deadly, they hinder a significant portion of the people in the United States. These disorders affect about ten percent of the general population of the United States. That is thirty million people in just America alone. With about eighty percent of the 7,000 different diseases we have discovered being caused by some genetic fault gene therapy provides a great option to numerous people in need. Gene therapy’s ability to edit DNA would create a valid treatment for many genetic disorders and diseases that were once considered untreatable.

While gene editing is a great treatment for genetic diseases, it is not limited to them. It will allow the ability to prevent and treat other diseases and disorders that are also considered untreatable. An example of this is how with the current overuse of antibiotics bacteria are growing an immunity to antibiotics that we currently rely on. These antibiotic immune bacteria, commonly known as super bacteria, pose a danger as people rely on antibiotics to help us from getting sick. Gene editing allows the ability to change the body in a way that would allow it to use its current immune system to fight off bacteria without the continued use of antibiotics. This not just related to just bacterial infections though we could also use gene editing to fight cancer or age-related disease such as Alzheimer’s disease. Genetic engineering already being used to fight cancer using CRISPR . Gene editing allows for a great alternative for current medicine and will allow the treatment of diseases that are not currently treatable.

Gene editing could also improve human life in other ways besides fighting diseases. With a significant portion of the population suffering infertility, gene editing could be modified to allow families that were once not able to have kids the ability to procreate and have their own biological kids. This has been done successfully in mice using CRISPR. This research shows the potential of similar results in humans. Gene editing’s ability to get rid of problems plaguing humanity would improve everyday human life.

Gene editing effect goes far further than just humans. The use of gene editing in veterinary science would not only make it possible to create treatments for diseases in other animals but would also allow the extension of the lifespan and production of many livestock. Longer lifespans would allow livestock like dairy cattle to produce more milk over a longer amount of its life. This would allow the dairy industry to have less maintenance costs for their animals allowing many animal products to be cheaper.

This technology has great applications for the crop sciences industry. Many companies are already creating genetically modified crops. Newer technologies like CRISPR are going to

continue to revolutionize the industry. This will allow crops to be resistant to more types of insects and bacteria while also producing higher yields than non-genetically modified crops. This provides a great answer to the problem of world hunger, as the current population is set to outgrow the world's current agricultural output.

Gene editing is an exciting new field that has been revolutionized in the last decade. New technologies, like CRISPR, have allowed us to edit genes far more efficiently and have created many new opportunities for the field. These technologies have us "poised to deliver upon the promises of the Genomic Revolution to transform basic science and personalized medicine".

While gene therapy presents shows a lot of the good it can do, it can also do a lot of terrible things. The current price of the technology creates a problem where it will only be available to the extremely rich upper class which would create separate classes of people based purely off of who is genetically modified. This divide would be further extended if the use of gene manipulation to enhance basic human traits was allowed. Though these things could happen the good of this technology far outweigh the bad. The agricultural impact of gene editing will help with the ongoing demand for food as the population of the world grows. Gene editing would create a treatment for both genetic diseases and other diseases. Gene editing will revolutionize the health industry in a similar way antibiotics did when they were invented. Gene editing rewards far offset the risks of the technology and it should be implemented to save human lives.

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