Genetic Engineering: Promises & Perils

This article is based on **"The dangers of genetic engineering"** which was published in The Hindustan Times on 23/09/2020. It talks about the promises and perils associated with Genetic engineering.

Genetic engineering may be one of the greatest breakthroughs in recent history alongside the discovery of the atom and space flight. However, there are many disadvantages and plausible risks associated with it.

Although a research **report in Nature Medicine** contradicts the likelihood of intentional engineering of **Sars-CoV-2**, genetic engineering could well be the cause of the next pandemic.

Covid-19 have demonstrated how biological pathogens can be as destructive as nuclear missiles. Hence, the world should be cautious of the potential of genetic engineering to develop viruses that can be used for **Bio-terrorism.**

However, the technological advancement through Genetic engineering can also provide its cure and a strong defense against it. Thus, there should be efforts globally in developing bio-defences.

What is Genetic Engineering?

- Through genetic engineering, scientists are able to move desirable genes from one plant or animal to another or from a plant to an animal or vice versa.
- In essence, genetic engineering is a technology wherein a specific gene can be selected and implanted into the recipient organism.
- The process of genetic engineering involves splicing an area of a chromosome, a gene, that controls a certain characteristic of the body. For example:
    - This gene may be reprogrammed to produce an antiviral protein.
    - The enzyme endonuclease is used to split a DNA sequence as well as split the gene from the rest of the chromosome.
    - This gene is removed and can be placed into a bacterial cell where it can be sealed into the DNA chain using ligase.
    - When the chromosome is once again sealed the bacterial cell is now effectively re-programmed to replicate this new antiviral protein.
    - The bacterium can continue to live a healthy life while genetic engineering by human intervention has manipulated it to produce the protein.

Advantages of Genetic Engineering

- **Genetically Modified (GM) Crops:** Genetic engineering made it possible to create crop varieties regarded as "more beneficial" terms of coming up with crops with the desired traits.
    - Examples of genetically-engineered plants (**Bt Cotton**) with more desirable traits are drought-resistant plants, disease-resistant crops, plants that grow faster, and plants fortified with more nutrients.

- **Treatment of Genetic Disorders and Other Diseases:** Through genetic engineering, genetic disorders may also be fixed by replacing the faulty gene with a functional gene.
    - Disease-carrying insects, such as mosquitoes, may be engineered into becoming sterile insects.
    - This will help in curbing the spread of certain diseases, e.g. malaria and dengue fever.
- **Therapeutic Cloning:** It is a process whereby embryonic cells are cloned to obtain biological organs for transplantation.

Challenges of Genetic Engineering

While genetic engineering is beneficial in many ways, it is also implicated in certain eventualities deemed as “unpleasant” or disadvantageous.

- **Irreversible Changes:** Nature is an extremely complex interrelated chain. Some scientists believe that introducing genetically-modified genes may have an irreversible effect with consequences yet unknown.
    - GMO that can cause harmful genetic effects, and genes moving from one species to another that is not genetically engineered.
    - It has been shown that GMO crop plants can pass the beneficial gene along to a wild population which may affect the biodiversity in the region. An example is the sunflowers genetically-engineered to fend off certain insects.
- **Health Issues Related with GMO Crops:** There are concerns over the inadvertent effects, such as the creation of food that can cause an allergic reaction.
- **Bioethics:** Genetic engineering borderlines on many moral and ethical issues. One of the major questions raised is if humans have the right to manipulate the laws and course of nature.

Dangers Associated With Genetic Engineering

- **Rapid Growth of Technology:** Clustered Regularly Interspaced Short Palindromic Repeats **(CRISPR) gene editing**, developed only a few years ago, deploys the same natural mechanism that bacteria use to trim pieces of genetic information from one genome and insert it into another.
    - This mechanism, which bacteria developed over millennia to defend themselves from viruses, has been turned into a cheap, simple, quick way to edit the DNA of any organism in the lab.
    - CRISPR isn’t the only genetic technology we need to worry about. A broader field, “synthetic biology”, is making the tools for genetic engineering widely available.
- **Democratisation of Biotechnology:** As CRISPR is cheap and easy to use, thousands of scientists all over the world are experimenting with CRISPR-based gene editing projects with very little of this research being limited by regulations.
    - The technologies have democratised to such a degree that any country can engineer viruses.
    - Further, the danger comes not only from governments: Non-state actors, rogue scientists and bio-hackers have access to the same tools.
    - Also, researchers have demonstrated that they can recreate deadly viruses such as that of smallpox, which took humanity decades to eradicate

Way Forward

As there have been no checks or balances, and it is too late to stop the global spread of these technologies.The only solution, now, is to accelerate the good side of these technologies and build defences. In this context:

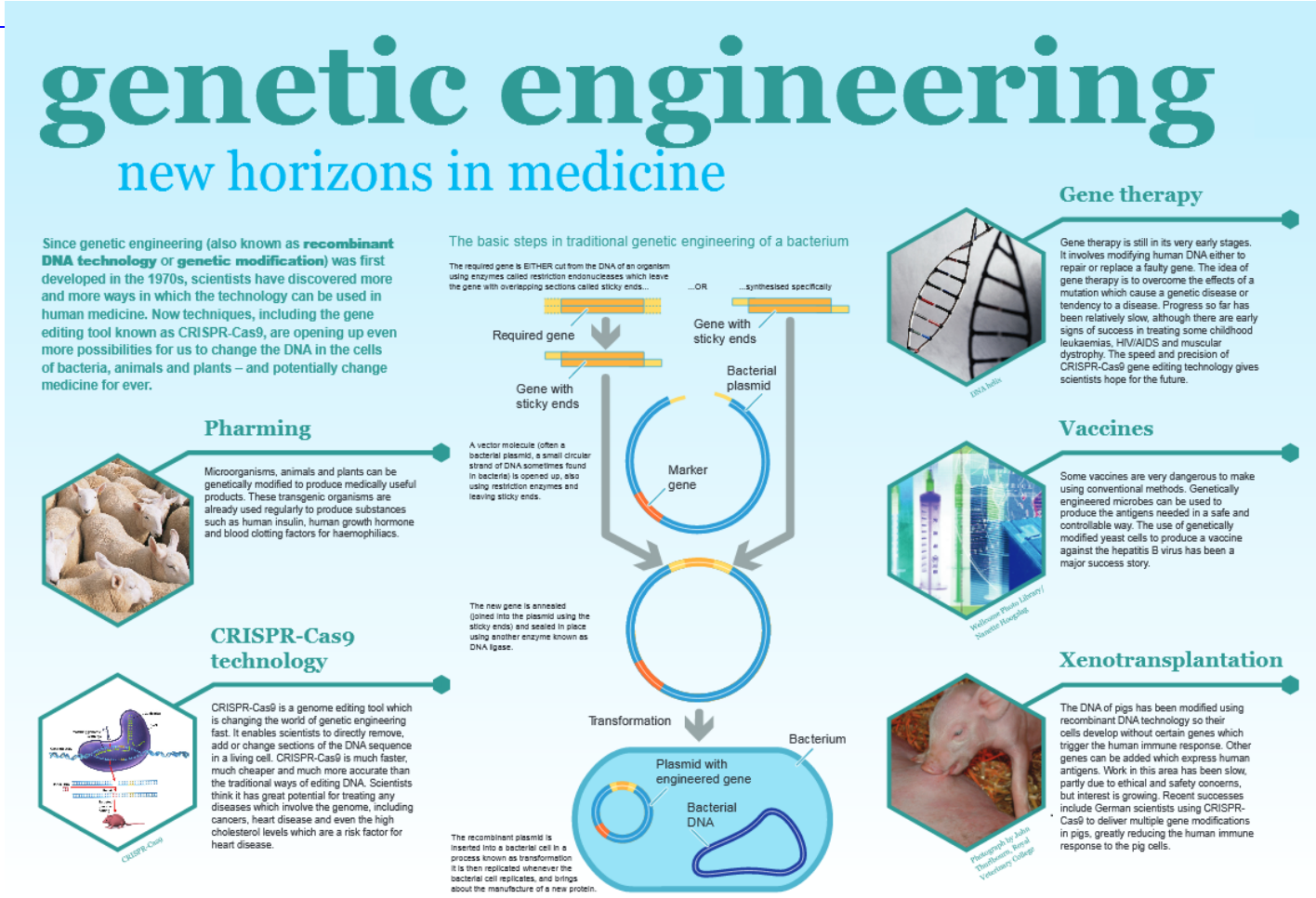
- **Leveraging Artificial Intelligence & Big Data:** With **Artificial Intelligence (AI)** and genomic data, scientists will decipher the complex relationships between DNA and biological processes and

find treatments for diseases.

- **Deploying 3D Printing:** 3-D printing can help develop at home medicines, tissues, and bacteria custom-designed to suit our DNA and keep us healthy.
- **Gathering of Genomic Data:** There is a need to develop genomic blueprints of human and other species, this information can help immensely to defend and develop vaccines against pandemics like Covid-19.

Conclusion

Technologies such as genomics, synthetic biology, sensors, 3D printing, and AI should be leveraged by India to analyse data and develop treatments. Through this, India can lead the world in research and innovation in genetic engineering and lay the foundation for a trillion-dollar medical industry.



Drishti Mains Question

Genetic engineering may be one of the greatest breakthroughs in recent human evolution, but there are many plausible risks associated with it. Discuss.

This editorial is based on **"The vaccine protocol"** which was published in The Hindustan Times on September 21st, 2020. Now watch this on our Youtube channel.