Forum: Commission on Science and Technology

Question of: Defining boundaries of genetic engineering

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I. Description of the Issue

While each life matters, societies will need to make tough choices, considering the opportunity costs of spending millions, if not billions, of dollars of private and public money to treat rare diseases that affect very small population groups. Making a few people better off while ignoring the medical needs of millions will only exacerbate inequities in health outcomes, even in the most developed countries. The rich living longer and healthier, while the poor lack basic healthcare, will further entrench alienation and societal discontent (of and of Affairs 4).

Genetic Engineering as a technique is becoming more and more prevalent in our daily lives, even if we don't notice it directly. However, this process is costly and often only accessible to wealthier nations and individuals. As of today, genetic engineering is used in a wide variety of different fields, from agriculture to medicine. Genetic Engineering has already helped to find and create bacteria that are capable of synthesizing human insulin, human growth hormone, a hepatitis B vaccine, and other medically useful substances (according to Britannica). In 2015, scientists in the UK successfully cloned a sheep. In the same year, Chinese researchers managed to manipulate the genomes of human embryos (Schaefer). However, these developments in Genetic Engineering also pose a risk to the human species, mostly due to mutations in the changed genetics.

The high costs of genetic engineering further divide the world into rich and poor, with the richer farmers and countries being able to afford better technology, more resistant crops, and more yield, while the poorer nations and farmers can not compete with them anymore. To reach the United Nations Sustainable Development Goals (SDGs), these risks have to be mitigated, and regulations should be established. Having strong regulations in place also calms the people of the earth, who are afraid of mutations in the genetic code that could cause a disaster. International cooperation is very important on this part, as a genetic mutation could impact the whole world, not just a single country. A good example is the COVID-19 pandemic. Even though it was probably not caused by a mutation, it shows how

how fast a biological symptom can spread around the globe. International cooperation can set standards to prevent any such scenarios and strengthen the equality, rights, and freedoms of all the people on the planet.

II. Definition of Key Terms

Genetic Engineering

Genetic engineering (also called genetic modification) is a process that uses laboratory-based technologies to alter the DNA makeup of an organism. This may involve changing a single base pair (A-T or C-G), deleting a region of DNA, or adding a new segment of DNA. For example, genetic engineering may involve adding a gene from one species to an organism from a different species to produce a desired trait. Used in research and industry, genetic engineering has been applied to the production of cancer therapies, brewing yeasts, genetically modified plants and livestock, and more (Institute).

Designer Babies/Super Humans

A designer baby is a baby that is modified before it is born to have specially selected traits, which can vary from lowered disease risk to gender selection. The primary aim of creating designer babies is to avoid having heritable diseases coded by mutations in DNA.

Genetically Modified Organisms (GMO)

A genetically modified organism (GMO) is an organism in which one or more genes, called transgenes, have been introduced into its genetic material from another organism using

recombinant DNA technology. For example, the genes may be from a different kingdom, such as from a bacterium to a plant, or a different species within the same kingdom, e.g., from one plant species to another (of and of Affairs 2).

Germ line editing

Germline editing is the process of editing the genome of an individual in such a way that the change is heritable. This is achieved through genetic alterations within the germ cells, or reproductive cells, such as the egg and sperm. Germ line editing is used to try to prevent genetic diseases before they start. Any alterations made to germ line cells will be passed from parent to child, affecting all future generations.

III. Background Information

Genetic engineering offers numerous benefits in the fields of disease diagnosis, control, prevention, and cure. One notable example is its potential to combat malaria, particularly in less economically developed countries in Africa. Through genetic engineering, large regions could potentially eliminate malaria within two decades. However, there are concerns that the increased speed of genetic engineering might lead to unforeseen mutations that could spread throughout the world very quickly.

In agriculture, genetic engineering has the potential to make crops more resistant to various environmental challenges. For instance, the International Rice Research Institute has developed genetically engineered rice that retains its yield even after flooding. Another type of genetically modified rice is golden rice. It was developed by German and Swiss researchers and contains three new genes, including two from the daffodil and one from a bacterium. These genes enable rice to produce vitamin A, addressing the vitamin A deficiency prevalent in low-income groups in 118 countries, particularly in Africa and Southeast Asia. The World Health Organization estimates that 140 million children in these regions suffer from vitamin A deficiency, leading to blindness and death. Golden rice, made available for mass distribution, owes its accessibility in part to the waiver of patent rights by biotechnology companies. In 2017, approximately 80% of the crops planted in the United States were genetically modified organisms (GMOs). However, questions arise regarding the environmental sustainability and safety of GMOs, as well as concerns about their cost. Small farmers in developing countries may struggle to compete with GMO countries such as the US, as the GMO market is dominated by some large farming companies. This concentration

of power can make small farmers vulnerable to market manipulation and less

Figure 1: Global Share of GMO-Planted Croplands in 2017 (of and of Affairs 3)

Furthermore, the cost of genetic engineering is rapidly decreasing, making it more accessible. The price per modified genome has dropped significantly, from nearly $9 million in 2007 to just $1,100 in 2017. This cost reduction encourages competition among countries. Initiatives such as Human Heredity and Health in Africa direct funds from the US National Institute for Health to research sites across Africa, focusing on studying the environmental determinants of common illnesses, disease susceptibility, and drug responses in African populations.

However, genetic engineering and its benefits are not equally accessible to all, primarily due to financial constraints. This disadvantage disproportionately affects small farmers, particularly in less economically developed countries. Additionally, individuals with severe genetic conditions may be deprived of health insurance coverage, as genetic interventions may not be affordable for everyone. Consequently, genetic engineering primarily serves those who can afford to pay, perpetuating inequalities in access to healthcare; only 13 out of 1,223 new drugs introduced between 1975 and 1996 targeted tropical diseases, despite their significant global impact. This divide in spending is further amplified by the percentage of the $70 billion spent worldwide on health research, of which only 10% focuses on the health needs of

of 90% of the world's population.
Another concern regarding genetic engineering is the potential for unintended health

consequences. Modifying genes can have unforeseen effects, raising questions about the long-term safety and ethical considerations of genetic interventions. There is also the risk of genetic research being used to target or harm specific groups of people, exacerbating existing social inequalities.

One of the ethical dilemmas surrounding genetic engineering revolves around consent. How can an unborn baby, whose DNA is modified, consent to a decision that will impact their entire life? This raises complex moral boundaries and questions about the autonomy of individuals affected by genetic interventions.

Furthermore, the implications of genetic engineering extend beyond geographical regions or national borders. Mutations resulting from genetic interventions can spread globally, raising concerns about their potential impact on ecosystems and populations.

In the context of agriculture, genetically engineered plants may present risks such as failure to germinate, harm to beneficial organisms, reduced soil fertility, and the potential transfer of insecticidal properties or virus resistance to wild relatives of crop species. Additionally, the patent system held by private companies can disadvantage farmers in developing nations, as they are forced to buy seeds for each sowing season, perpetuating dependency and limiting their agricultural independence.

IV. Major Countries and Organizations Involved

- The World Health Organization is the parent organization of the International Center for Genetic Engineering and Biotechnology and suggests resolutions for the United Nations General Assembly, as well as creating a global knowledge base of genomes.
- The International Center for Genetic Engineering and Biotechnology (ICGEB) is an intergovernmental organization (IGO), and its operations are aligned to those of the United Nations Common System. It operates as a Center of Excellence for Research, Training, and Technology Transfer to Industry to promote sustainable global development (for engineering and biotechnology).
- The People's Republic of China provides government funding to researchers and is leading in genetic engineering techniques for human embryos (Schaefer).
- The Republic of India was a leading nation in developing legislation for the regulation of genetic engineering as early as 1989 (Ahuja).

• The United Kingdom of Great Britain and Northern Ireland created the Welcome Trust Center (for genetics) and the UK10K (UK10K).

• The United States of America houses many companies that hold patents on GMO crops and seeds. This nation also housed the highest percentage of GMO-planted crops in the world in 2017 (of and of Affairs 3).

V. Timeline of Events

• 1871: Friedrich Miescher publishes his paper identifying the presence of 'nuclein' (now known as DNA) and associated proteins in the cell nucleus.

1950: Erwin Chargaff works out the pairing pattern of the bases A, C, G, and T in the DNA.

• 1953: The double helix structure of DNA is discovered by James Watson and

Francis Crick

- 1977: The first full genome is sequenced (read) for the virus “phiX174”
- 1983: The location of the gene responsible for Huntington’s disease is identified
- 1983: The polymerase chain reaction (PCR) is developed, a technique used for amplifying DNA.
- 1983: The “International Center for Genetic Engineering and Biotechnology” is established.
- 1990: The Human Genome Project is launched to sequence all 3 billion letters of the human genome in 15 years.
- 1996: The first cloned animal, Dolly the sheep, is born.
- 1997: The “Universal Declaration on the Human Genome and Human Rights” is passed in the General Assembly
- 2003: The Human Genome Project is completed
- 2011: The Nagoya Protocol is signed
- 2013: The U.S. Supreme Court rules that naturally occurring DNA cannot be patented
- 2015: Chinese researchers edited human genomes for the first time.
- 2018: The 100K genomes project is complete, sequencing 100,000 genomes from patients affected by a rare disease or cancer.
- 2020: Following the pandemic outbreak of COVID-19, the genome of the SARS-CoV-2 virus is sequenced

VI. Previous attempts to solve the issue

In early 2019, the WHO established a new advisory committee with the task of developing global standards for governance and oversight of human genome editing. The committee concluded that it would be irresponsible at the current time for anyone to proceed with the clinical application of human germline editing. It also suggested the WHO immediately begin working on a central registry of human genome editing research to level the playing field for all nations (of and of Affairs 6).

VII. Possible solutions

Countries will need to find an appropriate balance between incentivizing advances in genetic technologies and managing their intended benefits and unintended consequences. The balance will rest on three pillars:

Consent and privacy;
information sharing and intellectual property rights; and ethical boundaries.

VIII. How to prepare as a Delegate

Please prepare the best you can for our general debates. This includes writing either a position paper and/or a draft resolution on this topic. In total, you should have one draft resolution and two to three position papers. If you don't know how to write any of these, please read through the delegate's booklet or contact me via email (commissiononscienceandtechfordev@gym-meiedorf.de). In your research reports or draft resolution, Wikipedia can be a useful source; however, please use another source to cross-check what it tells you, like the UN, your government websites, or trustworthy newspapers.

I would advise you to first gain some general knowledge of your country. That includes reading the Wikipedia and CIA Facebook pages for your country, NGO, or IGO. After that, read up on the topic that is being discussed in general so that you know what you are talking about. This could also include watching a documentary or reading or skimming a book. In the end, do some research into what your country (and, if time permits, your allied or opposing nations) have already done in this context.

The deadline for the Position Papers is 1/10 as a PDF.

IX. Relevant UN Treaties and resolutions

A/RES/53/152.
Assembly, United Nations General. "Universal Declaration of Human Rights", Dec. 1948,

www.un.org/sites/un2.un.org/files/2021/03/udhr.pdf. Accessed 24 May 24, 2023. Countries that have signed the Nagoya Treaty. www.cbd.int/abs/nagoya-protocol/

Signatories.
Of the Diversity, Secretariat Convention Biological. Nagoya Protocol on Access to Genetic

Resources and the Fair and Equitable Sharing of Benefits Arising from Their Utilization to the Convention on Biological Diversity. Secretariat of the Convention on Biological

Diversity, 2011, www.cbd.int/abs/doc/protocol/nagoya-protocol-en.pdf. Accessed 23 May 2023.

Organization, United Nations Educational Scientific Cultural. “Universal Declaration on the Human Genome and Human Rights”, 11 Nov. 1997, www.ohchr.org/en/instruments-mechanisms / instruments / universal - declaration - human - genome - and - human - rights. Accessed 23 May 2023.

The States, Parties To The Present Statues. ICGEB BG.3 21-E. International Center for Genetic Engineering / Biotechnology, International Center for Genetic Engineering / Biotechnology, Sept. 1983. Accessed 23 May 2023.

X. Useful Links

- If you have, check the resources your public library provides. They often give you a lot of paid services for free, including some of the following. Otherwise, some of the following sides will offer some/all free content.
- Kanopy (https://kanopy.com/): A website that offers a lot of documentaries for free/with a library or school access
- Google Scholar (https://scholar.google.com/): Google’s Search Engine, but focused on academic articles
- JSTOR (https://jstor.org/): A website on which many academic articles about topics are published (might require school/library access)
- CIA Factbook (https://www.cia.gov/the-world-factbook/): Access general information about your country. I strongly advise you to read up here in your country.
- Know how to efficiently use Google: Example article with 20 useful tips: https://www.lifehack.org/articles/technology/20-tips-use-google-search-efficiently.html
- The official UN website (https://un.org/): I sometimes find, the search on this website does not work as well as I wish. You could use Google and add “site:un.org” to your query, to use Google to search the UN website (see the other tips in above’s article).
- The Internet Archive (https://web.archive.org/): When you want to read an article from a newspaper (such as the New York Times), but it is paywalled, maybe try the

Internet Archive with the article’s URL. Sometimes the article is not paywalled there.

Works Cited

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- of, Economic Social, and Department of Affairs. Playing with genes: The good, the bad and the ugly. United Nations Department of Economic / Social Affairs Economic Analysis, United Nations, May 2019, www.un.org/development/desa/dpad/wp-content/uploads/ sites/45/publication/FTQ May 2019.pdf. Accessed 23 May 2023.
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- org/facts/timeline-history-of-genomics. Accessed 23 May 2023.
- If you have any concerns/suggestions/questions or are not sure how to approach certain tasks, please write me an email, and I'll do my best to help you!