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Introductions from your WHO Dais

Hello Delegates,

My name is Maya Nelson, and I will be your Chair for the WHO committee at StuyMUNC. I am a junior and have been an active member of Stuyvesant's Model UN team since the beginning of my Freshman year. I knew immediately when I started going to Stuyvesant that I wanted to join Model UN, and have learned so much since then. I've met so many amazing people, my confidence has grown tremendously, and I've become more knowledgeable about the world around me and public speaking while being a part of this team. I was co-director for the UNHRC committee at last year's StuyMUNC, but this is my first time as Chair. I'm so excited to be able to meet all of you, and I know that you will have a great time at StuyMUNC 2022!

Whether this is your first committee or you've been doing Model UN since infancy, I encourage you to actively participate in committee and do your research. Try to enter committee prepared and ready for discussion. Don't be afraid to speak – it's the only way you'll learn something and improve yourself. I know in my first couple of conferences it was terrifying to raise my placard, and I'd be lying if I said my heart rate didn't still increase when doing so today. It helps to know that in the grand scheme of things, no one will remember if you accidentally say "crispy" instead of "CRISPR."

While researching, be sure to look into your country's position as well as other countries actions' on this issue. It's helpful to have an idea of who you want to work with before entering committee. Also, if you are not already familiar with the WHO be sure to look into its history, powers, and functions. This background guide is a great place to start, but I encourage you to go further in your research. Position papers are not required but are highly recommended, and they're a great way to establish your country's position and get a headstart on brainstorming solutions. Most importantly, have fun and don't be afraid to reach out to me or any of the other dais if you have any questions!

Sincerely,

Maya Nelson

mnelson30@stuy.edu

Hello Delegates,

Nice to meet you! My name is Simone Raleigh, and I am very excited to be your director for the WHO committee at StuyMUNC. I am a sophomore, and have been part of Stuyvesant's Model UN throughout this year, attending both online and in-person conferences. Although I was originally hesitant to join after an unconventional remote school-year, Model UN has allowed me to develop confidence in my public speaking, understand the importance of networking, practice researching skills, and become a more effective leader through diplomacy. I am delighted to be a part of this team, and I really hope that you all enjoy the committee–I look forward to meeting all of you at StuyMUNC 2022!

Regardless of your capacity of prior knowledge and CRISPR mastery, I encourage you all to go into this conference ready to learn. Spend time doing research, and more importantly be open to learning from each other–whether that be in formal debate, or unmoderated conversations. Do not be afraid to get a little creative! Although this is a committee rooted in a complex scientific topic, try to think outside of the box with your speeches–it keeps the committee fun and engaging. Additionally, do not underestimate the power of notes. Communication is key in committee, so sending some secret messages to your fellow delegates is always a great way to get ahead.

I understand that sometimes getting up in front of a large audience of essentially strangers seems jarring, but your MUN skills will only improve with practice. It's perfectly fine and normal to slip up in a speech, or perhaps get slightly lost during committee, but if you prepare–I suggest writing position papers to have a general idea of your goals–and try your best in committee, small mistakes will not really matter. If you do slip up, no worries! It's a great learning experience, and will help you become a better delegate in the future. If you have any questions about the committee, background guide, or just planning in general, please feel free to reach out to me or any other dias for questions–we are more than happy to help!

See you all soon,

Simone Raleigh

sraleigh40@stuy.edu

Committee Information

The World Health Organization (WHO) is an agency of the United Nations dedicated to promoting health and world safety. Its specific responsibilities include shaping the health research agenda, setting norms and standards, articulating policy options, providing technical support to countries, and monitoring and assessing health trends.

In this committee, we will be focusing on the controversy surrounding genome editing, a form of genetic engineering in which DNA is altered, removed, replaced, or added inside the genome of a living organism. There is a strong opposition to this with critics arguing that CRISPR and related methods are not fully safe to use, and the idea of creating a more “desirable” gene pool through artificially altering the human genome can give rise to eugenics. In addition, many countries already have laws and restrictions in place that limit gene editing, while some have gone so far as to completely ban the practice. With this topic generating much controversy, delegates will discuss the pros and cons of gene editing for the unborn and the potential implications this can have on society, and whether this is a goal worth pursuing and if so, how it can be implemented.

This committee will function as a General Assembly; standard parliamentary procedure will be followed. During committee, delegates will vote on motions to discuss topics related to the main issue. They will form blocs with countries that share similar views to pass a comprehensive resolution that provides solutions to this issue.

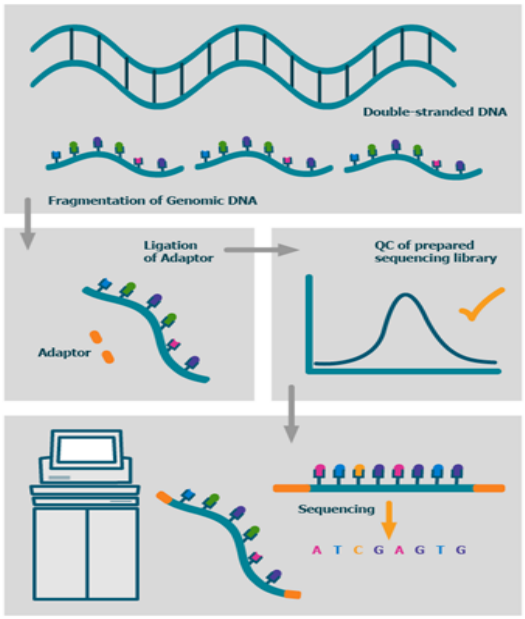
StuyMUNC does not require position papers, but we do **highly recommend** and encourage them. Position papers should be one page single-spaced and cover your countries relation to and stance on the issue and possible solutions. Position papers are a great way to compile your research and solidify your country's stance on this issue. They should be titled YourCountry_WHO_YourName_YourSchool. All delegates should email their papers to mnelson30@stuy.edu. If you would like feedback on your paper, be sure to mention so in your email and send it by [DATE]. Position papers will officially be due the day of committee, but feedback cannot be guaranteed past that date.

Committee Background

History of Genome Sequencing

The Three Generations

Despite being such a crucial part of human anatomy, the double-helix structure we call DNA wasn't actually discovered until 1953[1] by a group of four scientists. Progress in its isolation wasn't made until 1965, when Robert Holley sequenced the first tRNA (which helps decode messages sent by RNA into amino acids). However, the first official DNA sequencing method, called the "chain termination method," was coined by Fredrick Sanger in 1977.



This method would continue to be the dominant tool for sequencing for the next 30 years, making a Sanger revolutionary figure. It works by using polymerase to extend a primer binding on the region of interest, and bringing the reaction to a stop in order to identify the base of the DNA sequence[2] — the equivalent of throwing a wrench into a gear. Afterward, simply use reactive dye to identify the chain terminating nucleotide. The molecules are placed in an electric current with polymer which separates it base by base.

The second generation of genome sequencing began in 1996, when Mostafa Ronaghi, Mathias Uhlen and Pål Nyŕen invented pyrosequencing. This method detects luminescence from the pyrophosphate on nucleotide incorporation into the strand[3]. This was later automated in 2005.

It's more difficult to identify when the "third generation" of genome sequencing began, as dozens of biotech companies using unique methods were founded in the 2000s. It's largely agreed that Pacific Biosciences

[1]https://the-dna-universe.com/2020/11/02/a-journey-through-the-history-of-dna-sequencing/

[2]https://www.thermofisher.com/blog/behinddthebench/how-does-sanger-sequencing-work/

[3] https://www.sciencedirect.com/topics/neuroscience/pyrosequencing

Inc (PacBio) is the ultimate pioneer of this generation, though, due to their use of zero-mode waveguide (ZMW) in sequencing. Each nucleotide is identified with a different fluorescent dye, and the signal that is emitted during incorporation is immediately recorded by detectors attached below the ZMW[4]. These technologies have drastically reduced in size and increased in efficiency to this day.

However, others mark 2003 as the year when genome sequencing was revolutionized forever. The sequencing of the first human genome based on Sanger's method began the technologies of next-generation sequencing (NGS).[5] Currently, NGS has modernized to adapt Sanger's method by running multiple reactions at a time and automatically gathering that data.

Use Cases over Time

Initially, data collection was the primary motive for genome sequencing, as different organizations aimed to build databases on plant, animal, and human genome data. Since the technologies were still relatively new and underdeveloped, real world application was largely limited to research. A major example of this was the Human Genome Project[6] which was launched in 1990 and sought to find the genome order, or 'genetic blueprint', of humans.

In the late 2000s, focus shifted to disease research in order to find cures or methods of eradication for major viruses and infections. In 2008, studies into leukemia[7] using genome sequencing helped identify the source of mutations and allowed for more personalized

medical treatment. Modern day genome sequencing methods have been used to identify COVID-19[8], which played a major role in mapping characteristics and predicting the spread of the virus early on in the pandemic.

The most controversial modern use case involves the genetic modification, rather than sequencing, of human genomes. This has two different purposes — medical genome editing or

[4]https://the-dna-universe.com/2020/11/02/a-journey-through-the-history-of-dna-sequencing/

[5] Ibid

[6]https://www.nature.com/immersive/d42859-020-00099-0/index.html

[7]https://www.nature.com/articles/d42859-020-00106-4

[8]https://www.cdc.gov/coronavirus/2019-ncov/variants/genomic-surveillance.html

heretic genome editing. The first is used to treat a patient's medical conditions through cell editing[9]. While some processes are approaching clinical use, most remain too expensive for the average patient. The second, and far more controversial, use involves the modification of a human egg, sperm, or embryo to control the traits of a future child. Both of these practices are in their infancy stage, using CRISPR as the primary method of genome editing.

Timeline of Genome Sequencing Milestones[10]

1977: Frederick Sanger develops his revolutionary genome sequencing method and sequences the first full genome.

1983: The location of the genome for Huntington's disease is discovered by James Gusella.

1985: Genome profiling is invented.

1990: The Human Genome project is created.

1992: Technique for identifying certain diseases in embryos is developed.

2002: The full genome of a mouse is completed, the first mammal to be fully genetically sequenced.

2003: The Human Genome Project is completed.

2008: The 1000 Genomes Project is launched, aiming to sequence the genomes of 2500 unique individuals.

2009: First comprehensive analysis of cancer genomes is published.

2013: US Supreme Court rules that naturally occurring DNA cannot be patented.

2018: 100k Genomes Project is completed, aiming to help patients affected by cancer and other rare diseases.

2020: COVID-19 Genome is sequenced.

[9]https://www.geneticsandsociety.org/topics/human-genetic-modification

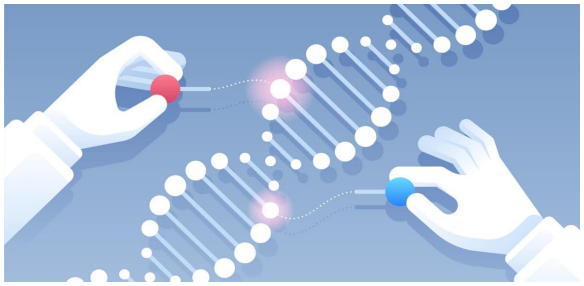
[10] https://www.yourgenome.org/facts/timeline-history-of-genomics

Let's Talk about CRISPR

To avoid confusion, let's clarify this right away: CRISPR technology is not a form of genome sequencing, it is a method of gene editing, which is why its history was absent from the previous section. CRISPR itself only refers to a family of DNA sequences found in Bacteria and other prokaryotic organisms, standing for Clustered Regularly Interspaced Palindromic Repeats. While there are several associated technologies, CRISPR is the dominant buzz-word of the gene editing debate and is the most widely used method of human genome editing, which is why it'll be the central focus of this section.

History of CRISPR

Francisco Mojica is known as the first researcher of CRISPR[11], leading a decade-long research project that began in 1993 (though the name CRISPR was first used in 2002). In the early 2000s, further research labeled CRISPR as an adaptive immune system, rather than a DNA repair system as had been the early hypothesis. It wasn't until 2013 that CRISPR-Cas9 was officially harnessed for gene editing, where it was used to repair eukaryotic cells. It was soon applied to mammal cells from both humans and mice. Since then, the technology has rapidly developed to perform targeted epigenome editing, which modifies, rather than replaces, a certain genomic region[12].



Current Applications

Studies have already shown that CRISPR can be effectively used to to correct genetic defects, including cystic fibrosis and cataracts[13]. It is currently in early stage trials as a method of cancer therapy and a treatment for blindness. A research team in China attempted to cure a patient's HIV using CRISPR, and while this was unsuccessful, the treatment had no harmful side effects.

The other application involves the creation of gene drives, which increases the chances of passing down a particular

[11] https://www.broadinstitute.org/what-broad/areas-focus/project-spotlight/crispr-timeline

[12] https://bitesizebio.com/47927/history-crispr/

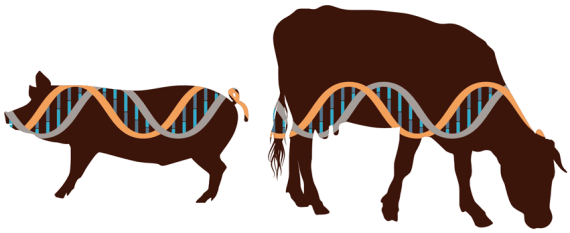
[13] https://www.livescience.com/58790-crispr-explained.html

trait to an offspring. This could be used to eradicate invasive species, reverse pesticide resistance in crops, and of course, modify humans, though the latter has yet to be successfully implemented.

CRISPR with Animals

Genetic Modification of Mammals

Genetically modified animals are animals that have been genetically modified for a variety of purposes including producing drugs, enhancing yields, increasing resistance to disease, etc. The vast majority of genetically modified animals are at the research stage while the number close to entering the market remains small. A number of techniques are available for inserting the isolated gene into the host genome. With animals DNA is generally inserted using microinjection, where it can be injected through the cell's nuclear envelope directly into the nucleus, or through the use of viral vectors.[14]



Domestication of Animals

Humans have domesticated animals since around 12,000 BCE, using selective breeding or artificial selection (as contrasted with natural selection). The process of selective breeding, in which organisms with desired traits (and thus with the desired genes) are used to breed the next generation and organisms lacking the trait are not bred, is a precursor to the modern concept of genetic modification.[15]

Benefits in Medicine

Mammals are the best models for human disease, making genetic engineered ones vital to the discovery and development of cures and treatments for many serious diseases. Knocking out genes responsible for human genetic disorders allows researchers to study the mechanism of the disease and to test possible cures. Genetically modified mice have been the most common mammals used in biomedical research, as they are cheap

[14] https://www.efsa.europa.eu/en/topics/topic/genetically-modified-animals

[15] https://www.nationalgeographic.org/encyclopedia/domestication

and easy to manipulate. Pigs are also a good target as they have a similar body size and anatomical features, physiology, pathophysiological response and diet. Nonhuman primates are the most similar model organisms to humans, but there is less public acceptance towards using them as research animals.

Genome Editing of Plants

GMOs

The majority of GM crops have been modified to be resistant to selected herbicides, usually a glyphosate or glufosinate based one. Genetically modified crops engineered to resist herbicides are now more available than conventionally bred resistant varieties; in the USA 93% of soybeans and most of the GM maize grown is glyphosate tolerant.

Golden rice is the most well known GM crop that is aimed at increasing nutrient value. It has been engineered with three genes that biosynthesize beta-carotene, a precursor of vitamin A, in the edible parts of rice. It is intended to produce a fortified food to be grown and consumed in areas with a shortage of dietary vitamin A, a deficiency which each year is estimated to kill 670,000 children under the age of 5 and cause an additional 500,000 cases of irreversible childhood blindness.[16]

Editing for Aesthetics

Some genetically modified plants are purely ornamental. They are modified for lower color, fragrance, flower shape and plant architecture. The first genetically modified ornamentals commercialized altered color. Carnations were released in 1997, with the most popular genetically modified organism, a blue rose (actually lavender or mauve) created in 2004. The roses are sold in Japan, the United States, and Canada.[17]

[16] https://pha.berkeley.edu/2021/02/20/crispr-and-gmo-the-unlikely-hero-for-the-world/

[17] https://bmcplantbiol.biomedcentral.com/articles/10.1186/s12870-018-1539-3

Editing for Conservation

It has been proposed to genetically modify some plant species threatened by extinction to be resistant invasive plants and diseases, such as the emerald ash borer in North America and the fungal disease, Ceratocystis platani, in European plane trees. The papaya ringspot virus (PRSV) devastated papaya trees in Hawaii in the twentieth century until transgenic papaya plants were given pathogen-derived resistance.

However, genetic modification for conservation in plants remains mainly speculative. A unique concern is that a transgenic species may no longer bear enough resemblance to the original species to truly claim that the original species is being conserved. Instead, the transgenic species may be genetically different enough to be considered a new species, thus diminishing the conservation worth of genetic modification.

Ethical Debates/Current Policies

Recent CRISPR Events[18]

In July 2018, the ECJ ruled that gene editing for plants was a subcategory of GMO foods and therefore that the CRISPR technique would henceforth be regulated in the European Union by their rules and regulations for GMOs.

In February 2020, a US trial safely showed CRISPR gene editing on three cancer patients.

In October 2020, researchers Emmanuelle Charpentier and Jennifer Doudna were awarded the Nobel Prize in Chemistry for their work in this field. They made history as the first two women to share this award without a male contributor.

In June 2021, the first, small clinical trial of intravenous CRISPR gene editing in humans concluded with promising results.

In September 2021, the first CRISPR-edited food went on public sale in Japan. Tomatoes were genetically modified for around five times the normal amount CRISPR was first applied to in tomatoes in 2014.

In December 2021, it was reported that the first CRISPR-gene-edited marine animal/seafood and second set of CRISPR-edited food has gone on public sale in Japan

[18]https://www.sciencedaily.com/news/plants_animals/crispr_gene_editing/

Ethical Concerns of CRISPR

If genetic edits are made to embryos, or to egg and sperm cells, these changes will be inherited by all future generations. This is perhaps one of the greatest ethical concerns of this type of gene editing: any edits will have a ripple effect and will be passed down to generation after generation. Eventually, the entire human species could bear the marks of genetic editing.

The radical alteration of ecosystems using gene editing technologies like CRISPR is another potential issue that cannot be overlooked. Some argue that we have a duty to protect the planet's biodiversity, but this raises the question of whether we should be taking advantage of our newfound ability to alter the genetic composition of species in nature. Many of the alterations made could potentially lead to mutations that destroy or radically change the species we originally sought to protect.

Questions to Consider

During committee and in your research, keep these questions in mind.

1. What are your country's current policies regarding genetic modification?

2. What scientific developments are being pursued in your country? Are they supported by the government or private institutions?

3. How would the implementation impact your country economically?

4. How would it affect global relations?

5. What is the general public consensus regarding genetic modification in your country?

6. How would these technologies be implemented in your country? Would there be an agricultural focus? A disease research one?

Committee Positions

Africa

Due to the prevalence of tropical diseases and pests, public health, medicine, and agriculture would benefit greatly from the introduction of CRISPR technology. Among tropical diseases, malaria ranks first for prevalence and is responsible for about half a million deaths yearly. Mosquitoes transmit malaria and other diseases, but controlled efforts have continued for decades with little success, owing to the complex biology of mosquitoes and limitations of existing strategies. Recent laboratory successes indicate the strong potential of CRISPR-based GDs for the elimination of malaria whose strains could spread antimalarial genes or suppress generations of wild populations. [19]

Asia

Asia has become the forefront of CRISPR technology, with China becoming a world leader in genome editing. Amid controversies surrounding creating genomically edited babies, governments continue to pour resources into work with plants and animals. As a whole, South-East Asia, a major agricultural region with a regulated approach to genetically modified (GM) crops, faces debate on whether the relatively new technique of genome editing should be subject to the same safety and labeling regulations as GM organisms.[20]

EU

Currently, CRISPR plants face strict GM laws throughout the EU. The court decided that gene-edited plants face the same restrictions as GMO affected plants are covered by the GMO directive because they are still able to alter the genetic material of an organism in a way that does not occur naturally. This decision is very controversial, as some researchers argue that to classify gene-edited crops as GMOs and equivalent to transgenic crops is completely incorrect by any scientific definition.[21]

North America

The now popular North America market for CRISPR has been separated into animal genetic engineering, plant

[19]https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6378648/

[20]https://www.science.org/content/article/its-crispr-revolution-china-becomes-world-leader-genome-editing

[21]https://allianceforscience.cornell.edu/blog/2021/04/europe-is-reviewing-its-stance-on-crispr-crops/

genetic engineering, and cell line engineering. Canada has been displaying an upsurge in the number of research activities and technological breakthroughs in the area of gene editing throughout the past few years. For instance, in October 2020, the results of a petri dish study revealed that CRISPR/ Cas9 can potentially be used for altering a particular gene in nerve cells in the human brain, thereby slowing down the production of beta-amyloid protein which is responsible for triggering Alzheimer's disease. Government-supported research initiatives have also led down a smooth path for the progression of the North American gene editing market.[22]

Oceania

Following global trends, investigations on CRISPR-Cas have been thriving in Australia, especially in agriculture sciences. Importantly, CRISPR-edited plants have been given a green light in Australia, with regulatory bodies indicating they will not be classified as a genetically modified organism (GMO) if no foreign DNA is present in an edited plant. As a result, genome-edited products would not attract the extensive regulation required for the introduction of a GMO, which could lead to more rapid deployment of new varieties and products that could be traded freely in Australia, and potentially to export markets.[23]

South America

Within South America, farmers are partnering with scientists to create new crop varieties using gene-editing techniques in a move to help the region realize its potential as a world power in food production. This potentially addresses issues associated with a growing global population, sustainability concerns, and possibly help address the effects of climate change which negatively affect agriculture.[24]

[22]https://www.nature.com/articles/s41436-019-0482-5

[23]https://www.frontiersin.org/articles/10.3389/fmars.2021.763470/full

[24]https://research.ncsu.edu/ges/research/idb-crispr/