Forum: **Environmental Committee**
Issue: **Monitoring and mitigating the potential adverse effects and benefits of modern biotechnology**
Student Officer: **Tommaso Alocci**
Position: **President**

INTRODUCTION

As part of its namesake, biotechnology stems from the field of Biology and is deeply entrenched with living organisms. In essence, biotechnology utilizes cellular and biomolecular processes to advance and create new technologies that aim to ameliorate our health and that of the planet. Biotechnology can be divided into three specific types: medical, agricultural, industrial. Through medical biotechnology, experts have been able to use living biological material such as cells, to find cures to disease as well as being able to prevent diseases. These breakthroughs have major impact on the medicine world yet are the ones that raise many questions of ethics, both of which will be expanded upon later in the guide. Agricultural biotechnology, on the other hand, focuses on the genetic manipulation of plants and crops. This type of biotechnology is used when trying to increase crop yield or providing plants with certain growing advantages and more. Agricultural biotechnology is less ethically controversial, yet genetic manipulation and the usage of artificial products can raise concern on the topic. Industrial biotechnology is related to the cultivation and production of textiles, paper, and other such items. Biotechnology in this sector is useful in increased efficiency as well as the quality of product. However, issues arise when discussing about its harm to customers and the environment. The study guide will revolve around these three main areas of biotechnology and will assess their contribution to their fields but also analyze their negative impacts and aspects in need of mitigation.

DEFINITION OF KEY-TERMS

Biotechnology

Biotechnology is the use of biological systems found in organisms or the use of the living organisms themselves to make technological advances and adapt those technologies to various fields.[1]

Medical Biotechnology

Medical biotechnology is the use of living cells and other cell materials to better the health of humans.[2]

Agricultural Biotechnology

Agricultural biotechnology focuses on developing genetically modified plants to increase crop yields or introduce characteristics to those plants that provide them with an advantage growing in regions that place some kind of stress factor on the plant, namely weather, and pests.[3]

Industrial Biotechnology

Industrial biotechnology is the application of biotechnology for industrial purposes that also include Industrial fermentation. Applying the techniques of modern molecular biology, it improves efficiency and reduces the multifaceted environmental impacts of industrial processes including paper and pulp, chemical manufacturing, and textile.[4]

Environmental Biotechnology

[1] Rinkesh, About. "What Is Biotechnology: Types, Examples, Branches and Applications." *Conserve Energy Future*, 31 Aug. 2020, www.conserve-energy-future.com/biotechnology-types-examples-applications.php#1_Medical_Biotechnology.

[2] Rinkesh, About. "What Is Biotechnology: Types, Examples, Branches and Applications." *Conserve Energy Future*, 31 Aug. 2020, www.conserve-energy-future.com/biotechnology-types-examples-applications.php#1_Medical_Biotechnology.

[3] Rinkesh, About. "What Is Biotechnology: Types, Examples, Branches and Applications." *Conserve Energy Future*, 31 Aug. 2020, www.conserve-energy-future.com/biotechnology-types-examples-applications.php#1_Medical_Biotechnology.

[4] Rinkesh, About. "What Is Biotechnology: Types, Examples, Branches and Applications." *Conserve Energy Future*, 31 Aug. 2020, www.conserve-energy-future.com/biotechnology-types-examples-applications.php#1_Medical_Biotechnology.

Environmental biotechnology is the technology used in waste treatment and pollution prevention that can more efficiently clean up many wastes compared to conventional methods and significantly reduce our dependence on methods for land-based disposal.[5]

Genetics

A branch of biology that deals with the heredity and variation of organisms.[6]

Genetical Engineering

The group of applied techniques of genetics and biotechnology used to cut up and join together genetic material and especially DNA from one or more species of organism and to introduce the result into an organism in order to change one or more of its characteristics.[7]

Genome

A genome is the complete set of genetic information in an organism.[8]

Vaccine

Vaccines are chemicals that stimulate the body's immune system to better fight pathogens when they attack the body.[9]

BACKGROUND INFORMATION

Medical Biotechnology

[5] Rinkesh, About. "What Is Biotechnology: Types, Examples, Branches and Applications." *Conserve Energy Future*, 31 Aug. 2020, www.conserve-energy-future.com/biotechnology-types-examples-applications.php#1_Medical_Biotechnology.

[6] Genetics." *Merriam-Webster*, Merriam-Webster, www.merriam-webster.com/dictionary/genetics.

[7] "Genetic Engineering." *Merriam-Webster*, Merriam-Webster, www.merriam-webster.com/dictionary/genetic%20engineering.

[8] *Nature News*, Nature Publishing Group, www.nature.com/scitable/definition/genome-43/.

[9] Rinkesh, About. "What Is Biotechnology: Types, Examples, Branches and Applications." *Conserve Energy Future*, 31 Aug. 2020, www.conserve-energy-future.com/biotechnology-types-examples-applications.php#1_Medical_Biotechnology.

As the fields of medicine and technology advanced, the combination of the two with the goal to create and develop new drugs, cures, and treatments, biotechnology emerged. Simply put, medical biotechnology re-purposes living cells and cell materials through specific processes to treat and prevent diseases. Through this, biotechnology has been able to help millions of people with health issues, but also foster greater scientific advancements such as the mapping of the human genome.

CRISPR or also known as CRIPSIR-Cas 9 is a molecular "scissor" with the ability to cut through DNA. What this means is that CRISPRs are used to edit genome sequences, allowing doctors and scientists to perform what is known as genetic engineering. This genetic engineering has an overwhelming number of useful applications such as correcting genetic defects, treating diseases, preventing the spread of diseases, improving crops, and more.[10] Needless to mention, there are some serious ethical and medical concerns surrounding the biotechnology of CRISPR. The ability to mutate genes and manipulate the genome raises questions of ethics, as it alters the natural course of biology.

Another, more general, medical advancement with medical biotechnology is the vaccine. Vaccines inject the body with a weaker version of the disease they are intended to protect against, so they allow the immune system to create anti-bodies against that said virus. The attenuated disease is taken using biotechnology such as growing these antigenic proteins in genetically engineered environments. The Biotechnology Innovation Organization claims that recent strides in medical biotechnology have created over 20 new types of vaccines against infectious agents.[11] Rotarix and RotaTeq are two vaccines developed with the help of biotechnology and act as protection for the rotavirus. As a result, in 2009, the deaths from Rotavirus in Mexico depreciated by 65%. [12]

Cancer is another major area within which medical biotechnology can be used. In this area, biotechnology is allowing scientists to develop preventative measures as opposed to treatments. An example can be preventative vaccines from cervical cancer such as Gardasil, and Cervarix.

The rapidity in biotechnology's growth has led to certain concerns and issues with the field. For the creation of new vaccines and drugs they must undergo proper testing to confirm

[10] Western Governors University. "Medical Biotechnology: Advancements And Ethics." *Western Governors University*, Western Governors University, 9 Jan. 2019, www.wgu.edu/blog/medical-biotechnology-advancements-ethics1811.html#close.

[11] "Vaccines." *BIO*, archive.bio.org/articles/vaccines.

[12] "Vaccines." *BIO*, archive.bio.org/articles/vaccines.

their safety. This means that there is a clear risk to human life in these clinical trials. The subjects of the clinical trials tend to be sick patients with hope that the cure or treatment could be found for their disease this burdens doctors and scientists with the responsibility to fully describe any possible side-effects. The transparency between doctors and patients during clinical trials is essential and should be reflected in resolutions. Because biotechnology is a new technology, the cost is very high. The high costs exclude various populations from access to this kind of technology. What this means is that resolutions need to reflect methods to decrease costs and make biotechnology more affordable and available. Lastly, there are some groups of people that simply oppose stem cell research and the re-purposing of living cells and cell materials. The list of ethical issues presented is not exhaustive and there are other ethical issues under this field. Moreover, it is important to mention that ethics play a large role in the medical profession and therefore the handling of these issues should be taken with the utmost importance.

Agricultural Biotechnology

Agricultural Biotechnology and its applications have the primary use to improve crops, by yield and by quality. The way that agricultural biotechnology functions is similar to medical biotechnology by using the characteristics and genes from certain crops to help others. For example, biotechnology has helped the creation of crops with anti-pest capabilities. What this means is that crops are able to grow naturally as opposed to being sprayed with pesticides and other pest-repellant chemicals.

As an example, Bacillus thurnigiensis is a fungus whose genes are being transplanted into crops. The organism delivers a protein (Bt), which is powerful against irritations like the European corn drill. The Bt protein is the ideal trademark researchers might want the plants to have, and consequently, they recognized the quality making Bt protein express in the organism and moved it to crops. The crop then, at that point creates the protein poison normally, bringing down the expense of using an anti-pesticide or any other chemical.

There are little to no side-effects to the proliferation of agricultural biotechnology. This is due to the fact that the main purpose of agricultural biotechnology is to eliminate the negative effects of agriculture such as the usage of pesticides. This means that agricultural biotechnology can introduce more healthy alternatives to growing healthy crops. This can be seen through Genetically Modified Organisms, also known as, GMOs. A GMO is an organism that has its DNA changed, similarly to the aforementioned example of the Bacillus thurnigiensis. Due to the flourishment of agricultural biotechnology, there are a myriad of crops that are

GMOs such as soybeans of which 94% are GMO, and corn of which 92% are GMOs.[13] To conclude, agricultural biotechnology is useful in the production of healthy crop which in turn can create a healthy diet for the population and a healthy indirect effect on the agricultural economy.

Industrial Biotechnology

Industrial biotechnology is quite possibly the most encouraging new way to deal with pollution prevention, resource conservation, and cost reduction.[14] It is frequently alluded to as the third wave in biotechnology. Whenever applied to its maximum capacity, industrial biotechnology may largely affect the world more than healthcare and farming biotechnology.

The use of biotechnology in manufacturing isn't just changing how we manufacture items but on the other hand is furnishing us with new items that couldn't be envisioned a couple of years prior. Since modern biotechnology is so new, its advantages are yet not notable or comprehended by industry, policymakers, or buyers. This means that the lack of regulation allows for its rapid expansion. However, it is important to note that this type of expansion can lead to negative effects, hence, resolutions must reflect the importance of government in a rapidly evolving field such as this one.

Industrial biotechnology includes working with nature to augment and streamline existing biochemical pathways that can be utilized in manufacturing. The industrial biotechnology unrest rides on a progression of related advancements in three fields of investigation of itemized data got from the cell: genomics, proteomics, and bioinformatics. Thus, researchers can apply new procedures to an enormous number of microorganisms going from microscopic organisms, yeasts, and parasites to marine diatoms and protozoa. [15]

The brevity under which this technology has been in existence means that there is the creation of a "Technology Gap."[16] The gap is formed due the difference in availability versus the actual use of the technology. Implementation of Industrial biotechnology must be central to the solutions of resolutions with the goal to reduce the "Technology Gap."

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[13] Center for Food Safety and Applied Nutrition. "Agricultural Biotechnology." *U.S. Food and Drug Administration*, FDA, www.fda.gov/food/consumers/agricultural-biotechnology.

[14] "What Is Industrial Biotechnology?" *BIO*, archive.bio.org/articles/what-industrial-biotechnology.

[15] "What Is Industrial Biotechnology?" *BIO*, archive.bio.org/articles/what-industrial-biotechnology.

[16] "What Is Industrial Biotechnology?" *BIO*, archive.bio.org/articles/what-industrial-biotechnology.

MAJOR COUNTRIES AND ORGANIZATIONS INVOLVED

United States of America (USA)

As the world's technological, and economic leader, the United States has grounded its presence in the biotechnological field. However, they have done so through the private sector. As a capitalist economy, the United States places a lot of focus on the private sector when discussing medicine, healthcare, and technological innovation. The size of the United States in the biotech field is large; as a matter of fact, the United States edges out the second closest spender in R&D by nearly 60%.[17] Furthermore, the United States holds 48.2% of all firms in biotechnology operating out of it.[18] Aside from American firms' contribution to biotechnology per se they have also created jobs in the United States. In the US there 2,349 public and private Biotechnology companies, providing an average annual salary to its workers of up to USD 88,000, more than double the average US wage.[19] Government intervention in biotechnology in the US can be seen in 2013 when the Nation Institutes of Health (NIH) granted subsidized capital funding to private biotech firms to support their research and development. Nowadays, NIH funding for Biotechnology is around 7 billion dollars per annum.[20] Following the idea of research and development, between 2009 and 2013 the biotech field grossly expanded especially medical biotechnology with these technologies being the majority of US Biotechnology patents.

People's Republic of China (China)

China is the leading country in the biotechnology field on the eastern hemisphere. The entrance of biotechnology in its 12th Five-Year Plan (2010-2015). The plan outlined 7 pillars that could transform the Chinese economy and they found that biotechnology was one of them. The next stage of the plan was incentives through research and development. The Chinese government allotted 1.7 trillion USD for this plan's implementation. Furthermore, as China continues to look ahead, its Health minster pledged another 11.8 billion USD for the 13th Five-Year Plan (2015-2020). The 13th Five Year plan divides biotechnology under six sections: pharmaceuticals, agricultural biotechnology including genetically modified crops, biomass

[17] Phillips, Theresa. "Ranking the Top Biotech Countries in the World." *ThoughtCo*, www.thoughtco.com/ranking-the-top-biotech-countries-3973287#ranking-by-total-biotechnology-rd-expenditures.

[18] Beyond borders. Biotechnology Report 2017: Staying the Course

[19] Biotechnology in the United States: Trends and Opportunities." *Alliance Experts*, 16 Feb. 2021, www.allianceexperts.com/en/knowledge/countries/america/chances-in-the-biotech-industry-in-the-us/.

[20] Mikulic, Matej. "Biotechnology Funding by US National Institutes for Health 2013-2021." *Statista*, 4 June 2021, www.statista.com/statistics/716586/total-biotechnology-funding-by-the-national-institutes-for-health/.

energy, environmental protection, bio- services including fertility and reproductive services, and biomedical engineering.[21] The Chinese government places a lot of emphasis on the success of agricultural biotechnology as they see it as a beacon of economic prosperity but also a way to accomplish targets of food and environmental health and safety. Chinese private sector presence is also lively, as five of the last 10 biotech firms offering an Initial Public Offering are based in China. In addition, one can see American firms that are investing to Chinese firms, such as Amgen acquiring a 20% stake in for 3 billion dollars in Chinese BeiGene.[22] As for regulations on biotechnology, the Chinese State Food and Drug Administration (SFDA) has established teams within its organization for quality control, research, and policy. Furthermore, they established a team for consultation with private corporations. As for approval of biotechnological technology China began to expedite these approvals due to their substantial effect on the economy and especially, medical industry.

Biotechnology Innovation Organization

The Biotechnology Innovation Organization (BIO) is the largest organization in the biotech field that is not a firm. It can be seen as an overarching organization that represents member companies, state biotechnology groups, academic and research institutions and related organizations cross the US and other 30+ countries.[23] The BIO was founded under a mission of driving a bio-revolution through education, collaboration, and advocacy; a purpose to cure patients, protect our climate and nourish humanity and a vision of rapid biotech innovation equitably harnessed for health.[24] The BIO follows 5 key strategic pillars to accomplish the aforementioned goals. They aim to "Be a voice of science and for science," stay "united and empower biotech innovators and their ecosystem to improve lives," "remove barriers to innovation," "champion broad access to biotech breakthroughs and scientific equality," and lastly, "catalyze resilient and sustainable bio-based economies."[25] As for methods

[21] Moore, Scott. "China's Role in the Global Biotechnology Sector and Implications for U.S. Policy." *Global China: Assessing China's Growing Role in the World*, Brookings, Apr. 2020, www.brookings.edu/wp-

[22] Moore, Scott. "China's Role in the Global Biotechnology Sector and Implications for U.S. Policy." *Global China: Assessing China's Growing Role in the World*, Brookings, Apr. 2020, www.brookings.edu/wp-content/uploads/2020/04/FP_20200427_china_biotechnology_moore.pdf.

[23] "Biotechnology Innovation Organization." *BIO*, www.bio.org/.

[24] "BIO Strategic Vision." *BIO*, www.bio.org/strategic-vision.

[25] "BIO Strategic Vision." *BIO*, www.bio.org/strategic-vision.

to achieve these aims, BIO implements programs and initiatives with governments and private corporations. An example is The Right Mix Matters. This is an initiative to increase LGTBQ representation in biotech. BIO is an essential organization to the issue, and this should be reflected in the resolutions.

TIMELINE OF EVENTS

DATE	DESCRIPTION OF EVENT
1919	Hungarian Karoly Ereky coined the term "biotechnology" as he was trying to describe the re-adaptation of raw materials into more useful product.[26]
1933	Hybrid corn was first commercialized.[27] One of the first commercialized product of agricultural biotechnology.
1941	Genetic Engineering coined by a Danish Microbiologist. [28]
1980	US Supreme Court approved of the principle of patenting genetically engineering life forms.[29]

[26] "Biotechnology Timeline: Humans Have Manipulated Genes since the 'Dawn of Civilization'." *Genetic Literacy Project*, 19 Sept. 2020, geneticliteracyproject.org/2020/09/08/biotechnology-timeline-humans-manipulating-genes-since-dawn-civilization/.

[27] "Biotechnology Timeline: Humans Have Manipulated Genes since the 'Dawn of Civilization'." *Genetic Literacy Project*, 19 Sept. 2020, geneticliteracyproject.org/2020/09/08/biotechnology-timeline-humans-manipulating-genes-since-dawn-civilization/.

[28] "Biotechnology Timeline: Humans Have Manipulated Genes since the 'Dawn of Civilization'." *Genetic Literacy Project*, 19 Sept. 2020, geneticliteracyproject.org/2020/09/08/biotechnology-timeline-humans-manipulating-genes-since-dawn-civilization/.

[29] "Biotechnology Timeline: Humans Have Manipulated Genes since the 'Dawn of Civilization'." *Genetic Literacy Project*, 19 Sept. 2020, geneticliteracyproject.org/2020/09/08/biotechnology-timeline-humans-manipulating-genes-since-dawn-civilization/.

2008	Chemists in Japan create the first DNA molecule made almost entirely of artificial parts.[30]
2008	First used of CRISPR.
2019	First use of CRISPR on cancer patients

RELEVANT UN RESOLUTIONS, TREATIES AND EVENTS

The Biotechnology promise: capacity-building for participation of developing countries in the bioeconomy

This document is a guide provided by the UN and encompasses the importance of the biotechnology in developing countries.[31]

United Nations Sustainable Development Goals

The UN sustainable development goals are connected to biotechnology insofar as they are goals through with biotechnology can be used to achieve them. This means that they should be kept in mind when writing a resolution.[32]

PREVIOUS ATTEMPTS TO SOLVE THE ISSUE

There have been no previous attempts to solve the issue. This is due several reasons. Firstly, the issue is posed in a way that does not need to be solved but instead regulated as

[30] "Biotechnology Timeline: Humans Have Manipulated Genes since the 'Dawn of Civilization'." *Genetic Literacy Project*, 19 Sept. 2020, geneticliteracyproject.org/2020/09/08/biotechnology-timeline-humans-manipulating-genes-since-dawn-civilization/.

[31] "THE BIOTECHNOLOGY PROMISE: CAPACITY-BUILDING FOR PARTICIPATION OF DEVELOPING COUNTRIES IN THE BIOECONOMY." *UNCTAD*, unctad.org/webflyer/biotechnology-promise-capacity-building-participation-developing-countries-bioeconomy.

[32] "THE 17 GOALS | Sustainable Development." *United Nations*, United Nations, sdgs.un.org/goals.

biotechnology is a field as opposed to an issue that can be solved such as a conflict. Secondly, the issue is relatively recent, and the major advances discussed through the guide are all relatively recent.

POSSIBLE SOLUTIONS

The issue is not one with a solution, however, it is one that necessitates regulation and government oversight. This means that resolutions should be written as legislative guidelines as opposed to a direct, and to some extent, politicized solution. Despite this, there is one "issue" which resolutions should aim to solve, the issue being access to biotechnology in Less Economically Developed Countries (LEDCs).

Guidelines can be segregated into three distinct areas, research and development (R&D), production, and distribution. Regulations surrounding R&D should aim to combat any ethical issues that biotechnology poses. Hence, these guidelines should focus on medical biotechnology, as there are where the most ethical issues persist. Guidelines in this case be on the quantity of stem cells and embryos can be used by a firm per set period of time. Naturally, guidelines on these ethical concerns would mean that they would hinder innovation. Therefore, it is a very important aspect to balance, and where one chooses to balance this is in relation to a country's policy. Secondly, the production of biotechnology. Guidelines in this field would be similar to the ones in the R&D. Quotas on production could be a solution that would be effective in minimizing the use of live genetic material. Lastly, distribution of biotechnology. This part of the process does not need regulation but instead it needs to be equitably distributed. Due to the fact that development of biotechnologies is largely a national dilemma, many countries are not able to afford to develop these technologies are not able to supply them to their people. Hence, it is crucial that a resolution would set up methods for which LEDCs would be able gain access to these technologies. Whether distribution is through direct aid, or through access to R&D but urging direct development, a countries and delegate's policy is where one can draw the line.

BIBLIOGRAPHY

"THE 17 GOALS | Sustainable Development." *United Nations*, United Nations, sdgs.un.org/goals.

"BIO Strategic Vision." *BIO*, www.bio.org/strategic-vision.

"Biotechnology in the United States: Trends and Opportunities." *Alliance Experts*, 16 Feb. 2021, www.allianceexperts.com/en/knowledge/countries/america/chances-in-the-biotech-industry-in-the-us/.

"Biotechnology Innovation Organization." *BIO*, www.bio.org/.

"THE BIOTECHNOLOGY PROMISE: CAPACITY-BUILDING FOR PARTICIPATION OF DEVELOPING COUNTRIES IN THE BIOECONOMY." *UNCTAD*, unctad.org/webflyer/biotechnology-promise-capacity-building-participation-developing-countries-bioeconomy.

"Biotechnology Timeline: Humans Have Manipulated Genes since the 'Dawn of Civilization'." *Genetic Literacy Project*, 19 Sept. 2020, geneticliteracyproject.org/2020/09/08/biotechnology-timeline-humans-manipulating-genes-since-dawn-civilization/.

Center for Food Safety and Applied Nutrition. "Agricultural Biotechnology." *U.S. Food and Drug Administration*, FDA, www.fda.gov/food/consumers/agricultural-biotechnology.

"CRISPR Enables Gene Editing on an Unprecedented Scale." *WhatisBiotechnology.org*, www.whatisbiotechnology.org/index.php/science/summary/crispr.

"Genetic Engineering." *Merriam-Webster*, Merriam-Webster, www.merriam-webster.com/dictionary/genetic%20engineering.

"Genetics." *Merriam-Webster*, Merriam-Webster, www.merriam-webster.com/dictionary/genetics.

Mikulic, Matej. "Biotechnology Funding by US National Institutes for Health 2013-2021." *Statista*, 4 June 2021, www.statista.com/statistics/716586/total-biotechnology-funding-by-the-national-institutes-for-health/.

Nature News, Nature Publishing Group, www.nature.com/scitable/definition/genome-43/.

Phillips, Theresa. “Ranking the Top Biotech Countries in the World.” *ThoughtCo*, www.thoughtco.com/ranking-the-top-biotech-countries-3973287#ranking-by-total-biotechnology-rd-expenditures.

Rinkesh, About. “What Is Biotechnology: Types, Examples, Branches and Applications.” *Conserve Energy Future*, 31 Aug. 2020, www.conserve-energy-future.com/biotechnology-types-examples-applications.php#1_Medical_Biotechnology.

“Vaccines.” *BIO*, archive.bio.org/articles/vaccines.

Western Governors University. “Medical Biotechnology: Advancements And Ethics.” *Western Governors University*, Western Governors University, 9 Jan. 2019, www.wgu.edu/blog/medical-biotechnology-advancements-ethics1811.html#close.

“What Is Agricultural Biotechnology?” *Agricultural Biology*, Cornell University, 2004, absp2.cornell.edu/resources/briefs/documents/warp_briefs_eng_scr.pdf .

“What Is Industrial Biotechnology?” *BIO*, archive.bio.org/articles/what-industrial-biotechnology.