Ethics in Synthetic Biology

...

Synthetic Biology Module 7
University of Rochester iGEM 2020

Checklist for Module #7

- ❑ Read the article “From Corgis to Corn: A Brief Look at the Long History of GMO Technology”
- ❑ Open Google Form #7

Module Overview

- The Dual-Use Dilemma
- Ethical Themes in Synthetic Biology
- Popular Topics for Ethical Discussion
- Ethics: It's not so black and white
- Activity #7: Is this ethical?

What ethical concerns in science have you heard from friends, family or the media?

Dual-Use Dilemma

Miller, 2007

Image: PNG ALL

Key Themes

How can GMOs affect individual health?

How can GMOs affect society and human rights?

How can GMOs affect economics and power?

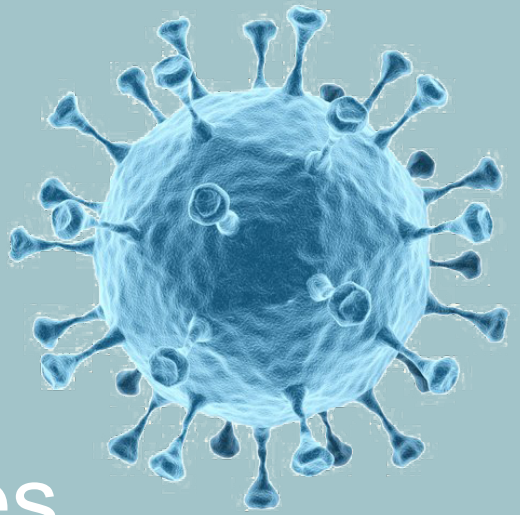
GMO = Genetically Modified Organisms

Popular Topics

Agriculture

Chow, 2016
James, 2018
Images: NON GMO Project
USDA Bioengineered Symbols

Popular Topics



Bacteria and Viruses

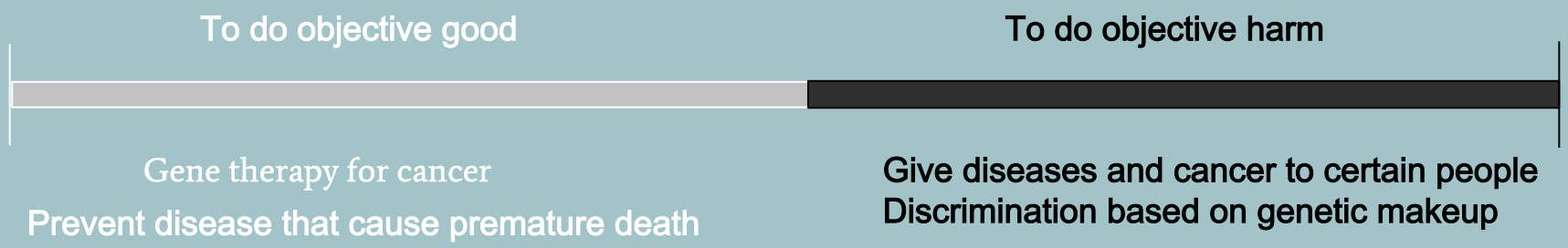
McLeod, 2017
Riglor, 2018
Ristanovic, 2018
https://igem.org/Main_Page
Images: PNG Mart
The Eighteenth Elephant

Popular Topics

Humans

Brokowski, 2019
Image: 23andMe

It’s not so black and white



What should we consider things like changing eye color?

Review

- The Dual-Use Dilemma describes technology that can do both good and harm
- There are three key themes in ethics regarding synthetic biology
- Agriculture, Bacteria and Virus, and Human gene editing are popular topics
- What should we do when it's not so black and white?

Activity: Is this ethical?

Scenario #1: *Nutrition Content and Labelling GMOs in Food*

As mentioned in the module, crops can be genetically modified to have increased nutritional content. According to the Office of Disease Prevention and Health Promotion, over 80% of Americans' diets are insufficient in vegetable intake and about 70% of Americans' diets are insufficient in fruit intake. Fruit and vegetables are an important source of nutrients. Fruits and vegetables can be genetically modified to contain *even more* nutrients than they naturally do. This would be beneficial to people who don't or can't eat the recommended amount of fruits and vegetables. Oliver thinks that all fruits and vegetables should be genetically modified to have a higher nutrition content. He also believes that since all fruits and vegetables should be genetically modified, there is no point in labelling these genetically modified foods. Do you agree with Oliver? Should *all* fruits and vegetables be genetically modified to have a higher nutrition content? Should genetically modified fruits and vegetables be labelled? Why or why not?

To learn more about current eating patterns in the U.S., visit health.gov

Scenario #2: *Celiac Disease and Human Gene Modification*

Celiac Disease is a non-life threatening disease where the body has an inappropriate response to gluten (a protein in wheat). The body's reaction to gluten leads to diarrhea and poor nutrient absorption. The severity of these symptoms range between individuals and can be mild to severe. The current treatment for Celiac Disease is to eat a gluten-free diet. Most people experience relief from eating a gluten-free diet. Recently, genes associated with Celiac Disease have been identified. While almost all people with Celiac Disease have at least one of these genes, approximately 30% of people who **do not** have Celiac Disease also have these genes. Cecilia thinks we should use genetic modification to ensure no one gets Celiac Disease. Do you agree with Cecilia? Should we use genetic modification to ensure humans do not get Celiac Disease? Why or why not?

To learn more about Celiac Disease, visit: [ghr.nlm.gov](ghr.nlm.gov)

Thank you!

Email us at uofr.igem@gmail.com

Sources

23andMe DNA Genetic Testing & Analysis. (n.d.). Retrieved May 25, 2020, from https://www.23andme.com/

Bioengineered Symbols. (n.d.). Retrieved May 25, 2020, from https://www.ams.usda.gov/rules-regulations/be/symbols

Brokowski, C., & Adli, M. (2019). CRISPR ethics: moral considerations for applications of a powerful tool. *Journal of molecular biology*, *431*(1), 88-101.

Chow, S., Norris, J. F., & Benjamin, G. (2016). Insight into the genetically modified foods: from the concerns of safety to development. *Science Insight*, 1-6.

International Genetically Engineered Machine. (n.d.). Retrieved May 25, 2020, from https://igem.org/Main_Page

James Jr, H. S. (Ed.). (2018). *Ethical Tensions from New Technology: The Case of Agricultural Biotechnology* (Vol. 6). CABI.

McLeod, C., Nerlich, B., & Mohr, A. (2017). Working with bacteria and putting bacteria to work: the biopolitics of synthetic biology for energy in the United Kingdom. *Energy research & social science*, *30*, 35-42.

Miller, S., & Selgelid, M. J. (2007). Ethical and philosophical consideration of the dual-use dilemma in the biological sciences. *Science and engineering ethics*, *13*(4), 523-580.

The Non-GMO Project. (n.d.). Retrieved May 25, 2020, from https://www.nongmoproject.org/

Parthasarathy, R. (2015, April 26). Slammed! (Why do bacteria care about physics?). Retrieved May 25, 2020, from https://eighteenthelephant.com/2015/04/26/slammed-why-do-bacteria-care-about-physics/

PNG ALL. (n.d.). Retrieved May 25, 2020, from http://www.pngall.com/balance-png

Bacteria Transparent PNG image. (n.d.). Retrieved May 25, 2020, from http://www.pngmart.com/files/7/Bacteria-PNG-Transparent-Image.png

Rangel, G. (2015, August). From Corgis to Corn: A Brief Look at the Long History of GMO Technology. Retrieved May 25, 2020, from http://sitn.hms.harvard.edu/flash/2015/from-corgis-to-corn-a-brief-look-at-the-long-history-of-gmo-technology/

Riglar, D. T., & Silver, P. A. (2018). Engineering bacteria for diagnostic and therapeutic applications. *Nature Reviews Microbiology*, *16*(4), 214.

Ristanovic, E. (2018). Ethical Aspects of Bioterrorism and Biodefense. *Defence Against Bioterrorism* (pp. 255-270). Springer, Dordrecht.