

Lesson Plan: Genetically Modified Organisms (GMOs)

A teacher-contributed lesson plan by Dr Sneha Bhogale, Pune, India.

As a **high school** or **undergraduate Biological Sciences** teacher, you can use this set of computer-based tools to teach about **Genetically Modified Organisms (GMOs)**, their genetic make-up and application in agriculture and industry.

This lesson plan will explain what GMOs are, describe how they are constructed and will introduce the question of whether GM crops could be one possible mechanism to address food and livelihood security in the face of global climate change.

Thus, the use of this lesson plan allows you to integrate the teaching of a climate science topic with a core topic in **Biological Sciences**.

Use this lesson plan to help your students find answers to:

- What are Genetically Modified Organisms (GMOs)? How are they used in agriculture and industry?
- What is the difference between GMOs and gene edited organisms?
- Describe how GMO crops are created.
- Are GMO crops one possible solution to food and livelihood security in the wake of changing climatic conditions?

[About the Lesson Plan](#)

Grade Level: High School, Undergraduate

Discipline: Biological Sciences

Topic(s) in Discipline: Genetically Modified Organisms (GMOs), Genetic Engineering, Gene Editing, GMO Crops

Climate Topic: Climate Adaptation and Mitigation, Climate and the Biosphere, Climate and the Anthroposphere

Location: Global, Africa

Access: Online, Offline

Language(s): English

Approximate Time Required: 70-90 mins

1 Contents

1. A set of videos (8-10 min each) and associated readings (5-7 min each)

A set of video interviews of plant scientists to introduce what GMOs are, explain how genetic engineering techniques are used to introduce/regulate desired traits or remove/regulate undesirable factors in organisms, and the application of GMOs across different fields like agriculture and the pharmaceutical industry. Explore various topics using separate tabs to discuss whether GMOs affect human health, plant and insect ecosystems, and how are they regulated.

This can be accessed at:

<https://ag.purdue.edu/GMOs/Pages/WhatareGMOs.aspx>

2. Video (~10 min)

A video that describes how GMO plants are created by genetic engineering techniques.

This can be accessed at:

<https://www.youtube.com/watch?v=JtkhHIG3nx4>

3. Reading (10 min)

A reading that explains how GMO seeds could help African farmers deal with the adverse effects of climate change on crops.

This can be accessed at:

<https://allianceforscience.cornell.edu/blog/2019/03/african-farmers-want-gmo-seeds-help-weather-climate-change/>

4. Suggested questions/assignments for learning evaluation

- What are Genetically Modified Organisms (GMOs)? How are they used in agriculture and industry?
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2 Step-by-step User Guide

Here is a step-by-step guide to using this lesson plan in the classroom/laboratory. We have suggested these steps as a possible plan of action. You may customize the lesson plan according to your preferences and requirements.

1. Topic introduction and discussion

Use a set of videos and associated readings, '[The Science of GMOs](#)' by Purdue University, to introduce the topic of GMOs to your students. Navigate through the tabs at the bottom of the webpage to explain various topics concerning GMOs, as listed below:

1. What are GMOs?
2. Why do we use GMOs?
3. Do GMOs harm health?
4. How do GMOs affect insects?
5. How does the regulation process work?
6. What about GMOs and weeds?
7. What's the story on GMOs and labeling?
8. What is gene editing?

Use each section to enable discussions regarding the different aspects of the creation and usage of GMOs in agriculture and industry. Finally, discuss the difference between genetically modified crops and gene edited crops.

This can be accessed at:

<https://ag.purdue.edu/GMOs/Pages/WhatareGMOs.aspx>

2. Extend understanding

Use the video, '[How to Make a Genetically Modified Plant](#)' by the National Center for Case Study Teaching in Science, to explain how genetic engineering techniques are used to modify the genetic material in plants to introduce, remove or regulate certain traits. Discuss, using the examples given in the video, the rationale for modifying certain traits in these plants. Describe, using the video, the molecular components (gene of interest, plasmid, promoter sequence, origin of replication (ORI), regulatory sequences, antibiotic selection gene), techniques (gene-transfer, plasmid selection), and strategies employed to create GM crops.

This can be accessed at:

<https://www.youtube.com/watch?v=JtkhHIG3nx4>

3. Discuss further

Use the reading, '[African farmers want GMO seeds to help weather climate change](#)' by John Agaba, Alliance for Science, Cornell University, to explain to your students how GM crops could possibly bolster food security in several Sub-Saharan African countries that are dealing with failed crops due to climate change. Use the text to emphasize to your students how the GM seeds could be the solution to growing crops that are more resilient in changing climatic conditions. Discuss the various case studies mentioned in the text to explain to your students the different approaches adopted by several African countries to improve their crop yield and crop resilience.

This can be accessed at:

<https://allianceforscience.cornell.edu/blog/2019/03/african-farmers-want-gmo-seeds-help-weather-climate-change/>

4. Questions/Assignments

Use the tools and the concepts learned so far to discuss and determine answers to the following questions:

- What are Genetically Modified Organisms (GMOs)? How are they used in agriculture and industry?
- What is the difference between GMOs and gene edited organisms?
- Describe how GMO crops are created.

- Are GMO crops one possible solution to food and livelihood security in the wake of changing climatic conditions?

3 Learning Outcomes

The tools in this lesson plan will enable students to:

- understand what GMOs are and describe their applications across different fields
- describe how GMOs are created and how they differ from gene-edited organisms
- discuss how GMO crops could be used as a climate adaptation strategy to ensure food and livelihood security

4 Additional Resources

If you or your students would like to explore the topic further, these additional resources will be useful.

1. Reading; 'Scientists Say GMO Foods Are Safe, Public Skepticism Remains'

A National Geographic article by Tamar Haspel that summarizes a 2006 comprehensive report on GMO crops by the National Academy of Sciences, USA.

This can be accessed at:

<https://www.nationalgeographic.com/culture/food/the-plate/2016/05/17/scientists-say-gmo-foods-are-safe-public-skepticism-remains/>

2. Reading; 'Frequently asked questions on genetically modified foods'

A document by the World Health Organization (WHO) that addresses the FAQs about GMOs and GM food.

This can be accessed at:

https://www.who.int/foodsafety/areas_work/food-technology/faq-genetically-modified-food/en/

3. Reading; 'Impact of Climate Change on Crops Adaptation and Strategies to Tackle Its Outcome: A Review'

A 2019 review by Ali Raza et al., in 'Plants' by Multidisciplinary Digital Publishing Institute (MDPI), Basel, about the climate adaptation strategies in agriculture, including GMO and gene-edited crops, against climate change.

This can be accessed at:

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6409995/>

5 Credits/Copyrights

All the teaching tools in our collated list are owned by the corresponding creators/authors/organizations as listed on their websites. Please view the individual copyright and

ownership details for each tool by following the individual links provided.

We have selected and analyzed the tools that align with the overall objective of our project and have provided the corresponding links. We do not claim ownership of or responsibility/liability for any of the listed tools.

1. A set of videos and associated readings; 'The Science of GMOs'

By [College of Agriculture, Purdue University](#).

2. Video; 'How to Make a Genetically Modified Plant'

By the [National Center for Case Study Teaching in Science](#), University at Buffalo, State University of New York.

3. Reading; 'African farmers want GMO seeds to help weather climate change'

By John Agaba for [Alliance for Science, Cornell University](#).

4. Additional Resources

A [National Geographic](#) article by Tamar Haspel.

A document by the [World Health Organization \(WHO\)](#).

A 2019 review by Ali Raza et al., in '[Plants](#)' by Multidisciplinary Digital Publishing Institute (MDPI), Basel. Hosted by [National Centre for Biotechnology Information \(NCBI\)](#).