

## SIEMENS STEM DAY ACTIVITY

# GMOS—YAY OR NAY?

## OBJECTIVES

Students will be able to:

- Understand the fundamentals of bioengineering, as related to GMOs.
- Engage in productive argumentation using scientific evidence and reasoning.
- Evaluate, critique, and thoughtfully respond to others' perspectives about the use of GMOs.

## THIS LESSON FOCUSES ON

### Engineering Design Cycle

- Defining the Problem
- Communicating Results

### 21st-Century Skills

- Collaboration
- Communication
- Critical Thinking

## OVERVIEW

Students will learn about different ways that genetic variants can occur and the controversy surrounding genetically modified foods. Additionally, they will explore the benefits and concerns associated with GMOs to understand the complexity of the issues that divide those for and against the use of GMO. Working with a partner, students will prepare claims, evidence, and reasoning to defend their personal stance.

STEM incorporates Science, Technology, Engineering, and Mathematics to focus on real-world issues and problems guided by the engineering design process. This type of instruction supports students in developing critical thinking, collaboration, reasoning, and creative skills to be competitive in the 21st-century workforce.

Each Siemens STEM Day classroom activity highlights one or more components of the engineering design cycle and an essential 21st-century skill.

## MATERIALS

- Understanding **GMO Terminology** Handout—three per person
- **Pre-Seminar Questions** Handout—one per person
- **Socratic Seminar Outer Circle Participation** Handout—one per person
- Computers with internet access

## HAVE YOU EVER WONDERED . . .

How can grapes taste like cotton candy?

## NATIONAL STANDARDS

<p><a href="#">Standards for Technology Literacy</a></p>	<p>Standard 5: Students will develop an understanding of Technology and Society. This includes learning about the effects of technology on the environment.</p> <p>Standard 15: Students will develop an understanding of The Designed World. This includes selecting and using agricultural and related biotechnologies.</p>
<p>Next Generation Science Standards</p>	<p>HS-LS3-2: Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors.</p> <p>HS-LS3-3: Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.</p> <p>SEP1: Asking Questions and Defining Problems.</p> <p>SEP7: Engaging in Argument from Evidence.</p>

## MAKE CONNECTIONS!

### How does this connect to students?

In current society, genetically modified foods are prevalent. It is important for students to understand the science behind GMOs in order to make **informed choices**.

### How does this connect to careers?

A **genetic engineer** is responsible for genetically modifying foods that are produced from plants and animals. This role involves the direct manipulation of DNA of organisms to produce desired traits.

A **biochemist** studies the chemical processes of living organisms at the molecular and cellular levels. This role often collects, analyzes and interprets the secrets of DNA to better understand how organisms function. Biochemists typically work in laboratories as they analyze different factors that affect the development of living organisms.

### How does this connect to our world?

Greater awareness of **sustainable and resilient agriculture** has helped increase food abundance and security worldwide. Research indicates that genetic modification of plants and animals has helped increase food production.

GMOs are reported to have social, economic, and environmental benefits worldwide. **Genetic engineering** has been used to alter crops since the 1990's.

## BLUEPRINT FOR DISCOVERY

1. To engage students in what they will be learning, facilitate a conversation about what students already know about GMOs. Depending upon the familiarity of the group with this topic, you may find it helpful to present the students with some of the basic facts from [Agricultural Biotechnology: Feed Your Mind](#). Additionally, you may choose to share some of the most common concerns related to GMOs, such as environmental and health concerns (especially in regards to nutrition and toxicity).
2. Partner students up and explain that they are going to research GMOs to better understand the fundamentals of bioengineering, also known as genetic engineering. Instruct them to complete the **Understanding GMO Terminology** Handout. Provide each student with 3 copies of the handout. Encourage students to use reputable websites such as information found on [www.fda.org](http://www.fda.org).
3. Next the students are going to conduct research to prepare for a Socratic Seminar. The controversy surrounding GMOs leads to great scientific debate and discussion. Due to this controversial nature of GMOs, the Socratic Seminar is a beneficial instructional technique that requires the students to

engage in the development of their own scientific understanding. This Socratic pedagogy is entirely learner-centered and aides in the development of students' critical thinking and discussion of GMOs. Explain to the students that they will complete the **Pre-Seminar Questions Handout** before starting the seminar discussion using the article "What are GMOs and GMO Foods?" that is found at <https://www.livescience.com/40895-gmo-facts.html>. This is a suggested text; however, feel free to select a different text resource for your students if you'd like. Allow students ample time to prepare for the Socratic Seminar.

4. Use the following presentation to explain the Socratic Seminar format to the students.  
[https://docs.google.com/presentation/d/e/2PACX-1vT4A9uX1rHsX\\_oAMe0LKwxTpe5tnwtcVwWmCzfYaShlRA5fA-8Shh1P\\_E76DVG58F\\_Ka--lrX0plxU2/pub?start=false&loop=false&delayms=3000](https://docs.google.com/presentation/d/e/2PACX-1vT4A9uX1rHsX_oAMe0LKwxTpe5tnwtcVwWmCzfYaShlRA5fA-8Shh1P_E76DVG58F_Ka--lrX0plxU2/pub?start=false&loop=false&delayms=3000)
  - o **Please note:** This is an excellent resource for additional information about Socratic Seminars.  
<https://www.edutopia.org/blog/socratic-seminars-culture-student-led-discussion-mary-davenport>
5. Arrange the chairs into two concentric circles—one inner and one outer circle. Students in the inner circle lead and participate in a discussion, while the outer circle students actively listen and complete the **Socratic Seminar Outer Circle Participation** Handout. This pedagogical approach emphasizes the importance of shared power between the students and teacher. It is important for the teacher to assume a facilitator role which is different from the dispenser of information and more of a guide who supports student debate and understanding. Also, encourage the students to focus on informed discussion and respectful critique of each other's thoughts.
6. Halfway through the Socratic Seminar, instruct the students to switch seats so that they are sitting in the other circle. Students in the outer circle move to the inner circle and vice versa.
7. Upon conclusion of this lesson, instruct the students to write a brief reaction to the Socratic Seminar, and then read and respond to their classmates' reactions. This can be done as digital posts or on paper and shared orally.

## TAKE ACTION!

Students can create an infographic or public service announcement that demonstrates the advantages and concerns related to GM food in order to inform their community.

# UNDERSTANDING GMO TERMINOLOGY

Use the following template to record what you learn about each of the following terms.

- Genetic engineering
- Traits
- Genome
- Hybridization
- Cloning
- Gene splicing
- Transgenic organisms
- Genetically modified food
- Selective breeding

## Understanding GMO Terminology

<b>Definition</b> Write a definition that is specific to the genetic term.	<b>Illustration</b> Include 1–2 labeled pictures that represent the term.
<b>Use word in a sentence</b> Write a descriptive sentence that appropriately uses the term.	<b>Fun facts</b> Select 2–3 fun facts to include.

## Understanding GMO Terminology

<b>Definition</b>	<b>Illustration</b>
<b>Use word in a sentence</b>	<b>Fun facts</b>

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# PRE-SEMINAR QUESTIONS

Using information from the text, complete the following chart according to the benefits and concerns that are raised about GM foods.

Benefits	Concerns

1. Are you personally in favor of genetically modified food or against it? \_\_\_\_\_
2. Do you get a biased perspective from this article? \_\_\_\_\_ If yes, which way \_\_\_\_\_ the use of GMOs.  
*Yes or No for or against*
3. Take a personal pro or con stance on whether GM foods should be labeled. Use evidence from the text to

# PRE-SEMINAR QUESTIONS (CONT.)

support your claim.

- Pick two passages that confuse or interest you and create one question that relates to each passage. In your question include phrases such as “Why do you think...?” and “What do you think is the significance of...?”. Then, propose one possible answer to your question.

Passage:	
Open-Ended Question	Possible Answer
Passage:	
Open-Ended Question	Possible Answer

Do you agree or disagree with the following statement—and why? “The fear-mongering that runs through discussions of GMO foods is more emotional than factual.” Use evidence from the text to support your idea.

What is the current federal status on the labeling of genetically modified foods? Do you agree or disagree with this position? Explain why you agree or disagree.



# SOCRATIC SEMINAR OUTER CIRCLE PARTICIPATION

<p>Agree (what &amp; why)</p>	<p>Ahh Haaa! I never thought of that.</p>
<p>Question(s) to still ask</p>	<p>Disagree (what &amp; why)</p>

**Works Cited**

- <https://www.fda.gov/food/consumers/agricultural-biotechnology>
- <https://www.usda.gov/topics/biotechnology/biotechnology-glossary>
- <https://www.livescience.com/40895-gmo-facts.html>
- <https://www.edutopia.org/blog/socratic-seminars-culture-student-led-discussion-mary-davenport>