

Lesson Title: Genetically Modified Organisms Student Debate**Time:** 40 minutes**Materials:**

- Selective breeding vs. GMO cards
- Student worksheets
 - pro/con
 - debate outline
- Videos
 - Papaya (6 min) <https://youtu.be/2G-yUiqlZ0>
 - Bill Nye (7 min) https://youtu.be/8z_CqyB1dQo
- Two articles:
 - http://www.huffingtonpost.com/eve-turow/you-need-to-know-the-fact_b_5570951.html
 - <http://umm.edu/health/medical/ency/articles/genetically-engineered-foods>
- Powerpoint with questions

Standards:**Standard - 3.1.7.B4**

Describe how selective breeding and biotechnology can alter the genetic composition of organisms.

Standard - 3.1.7.C2

Explain why the extinction of a species may occur when the environment changes.

Explain that mutations can alter a gene and are the original source of new variations in a population.

Objective:

Understand the basic concept of genetic engineering and the potential benefits and harms they could cause. Be able to articulate these points in a debate.

Background:

What are genetically modified foods?

GMOs, also called genetically engineered (GE) foods, have had their genes altered in a way that would not occur naturally or they can contain genes that are inserted from another organism. Those with genes from other organisms are called “transgenic” and represent a large number of GMOs available today, such as Bt corn, so-named because it contains a gene from bacteria (*Bacillus thuringiensis*) that is resistant to the herbicide Roundup commonly used for weed control.

GMOs have been around since 1994, when the Flavr Savr tomato first came to market after FDA approval. GMOs are everywhere and the United States is the largest producer of GMOs in the world. The most common GMO crops that make their way into our food are corn, vegetable oils (like canola), and soybeans, where 85% of soybeans grown in the US are genetically modified. Squash and papaya are also approved GMO crops, with many more grains, veggies and fruits on the way to being approved.

Although this project is funded in part by the Environmental Protection Agency, it does not necessarily reflect the opinion or position of the EPA

The arguments

Pro's: The main argument that proponents of GMOs make is that they will help with global food production and security.

Reduced environmental impact: reduced pesticide and herbicide use on GM-resistant plants

Improved nutrition: foods “bio fortified” with vitamins/mineral like Golden Rice could help solve nutrient deficiencies

Less food waste: food modified for better transportability, less bruising, etc.

Con's: Advocates are concerned that there are too many unknowns surrounding GMOs, and that approvals have been premature and ahead of solid safety evidence.

Gene flow: the possibility of GMOs passing on genes to wild species and interrupting natural processes

Pest resistance: use of GMOs leading to natural selection for pesticide- and herbicide- resistant insects and weeds

Health: limited evidence to support long-term safety of eating GMOs

Ownership over life: in essence, corporations like Monsanto own these specific life forms and have pursued litigation to protect their property

Opening:

Start by asking how many students have heard the term *genetically modified organisms* or GMOs? Ask where they've heard the term and if any already have some idea of what it means. If someone mentions food, explain that GMOs do have to do with how we grow our food. Talk about how it is a technological development for growing food and explain that before we learn about GMOs, we need to learn about selective breeding. Then move into activity 1.

Lesson Plan/Procedure/Activities:

Outline:

1. (Before class) send home articles discussion pros/cons
2. Activity on selective breeding v genetic engineering (10 min)
3. Watch Bill Nye Video on GMOs (6 min)
4. Divide class and start debate (20 min)

Activity #1: Selective Breeding vs. Genetic Engineering (15 min)

Part I: Cut out two cards of same species (corn) and have two students hold them up. Also give each student a pipe cleaner of DNA that is the same color. One corn plant is bigger while the other is tastier. Pull pieces of both their DNA to combine them into a **potentially** bigger, tastier plant.

Cut out a card of corn and one of bacteria that can survive the herbicide Roundup. Give each one a DNA ribbon of different colors. Pull part of the DNA apart and give to corn plant, making it Bt corn that contains a gene from bacteria (*Bacillus thuringiensis*) that is resistant to the herbicide Roundup commonly used for weed control.

*Go over question 1 on the powerpoint

Although this project is funded in part by the Environmental Protection Agency, it does not necessarily reflect the opinion or position of the EPA

Part II: Play a sorting game using cards that describe both GMOs and selective breeding. Have students sort in groups of 4 and review together as a group. This will help solidify the idea of a GMO.

Other talking points on GMOs vs. selective breeding:

Selective Breeding: “Any plant breeder will tell you that. It has been based on very careful observations, good statistics, and large populations, but it still has a certain degree of randomness and weirdness to it. GM technology is quite different in that we know precisely which gene is being used, what that gene does and where it lands in the genome.”

GMOs: Also called genetically engineered (GE) foods, have had their genes altered in a way that would not occur naturally or they can contain genes that are inserted from another organism. Those with genes from other organisms are called “transgenic” and represent a large number of GMOs available today.

Activity #2: Bill Nye Video on GMOs (6 min)

Have students watch this video and fill out a pro/con worksheet at the end.

*Have students answer questions 2 and 3 on the powerpoint.

Activity #3: The Debate (20 min)

Setting it up: Don't give students a side until that day in class during debate. Divide the class into 2 and give them their side (for/against). Give each group a debate worksheet to fill out and let them go!

Debate format:

- 10 minutes to form arguments (2)
- 3 min: side 1 presents arguments
- 3 min: side 2 presents arguments
- 1 min: side 1 rebuttal

- 1 min: side 2 rebuttal

Materials for lesson:

The Genetically Modified Organism (GMO) Debate

Whether or not we should grow crops that have been genetically modified is a topic that many people, including scientists, debate. As a class, we are going to look at the different sides to the argument. Use the table below to list the arguments on each side.

Pros of GMO	Cons of GMOs
1.	1.
2.	2.
3.	3.

Although this project is funded in part by the Environmental Protection Agency, it does not necessarily reflect the opinion or position of the EPA

Selective breeding vs. GM cards:

<p>A farmer takes a corn plant that grows bigger kernels and breeds it with another corn plant with better taste so that she will have a bigger, better tasting plant.</p>	<p>A chicken farmer breeds a chicken who lays many eggs with a rooster whose mother laid bigger eggs so that the offspring will lay many big eggs.</p>
<p>A dairy farmer has a cow that produces 5-6 liters of milk a day, which is how much her calf needs to survive. The farmer breeds this cow rather than the cow that only produces 3-4 liters of milk a day.</p>	<p>A vegetable farmer that grows a lot of tomatoes find one plant with a very strong flavor. He breeds this plant with a tomato plant that produces many tomatoes.</p>
<p>Corn seed is inserted with a gene from bacteria (<i>Bacillus thuringiensis</i>) that is resistant to the herbicide Roundup commonly used for weed control. This new corn, called Bt corn, is now resistant to the chemicals we use to kill weeds.</p>	<p>A pig farmer has his pigs engineered with a small percentage of human haemoglobin in their blood. Now doctors are able to use pig blood for human transfusions.</p>
<p>A potato farmer changes his potato's DNA in a lab so that less of a chemical called acrylamide, which is suspected of causing cancer in people, is produced when the potato is fried.</p>	<p>To create a tomato that could withstand being shipped across the country, scientists inserted an antisense gene into the tomato DNA that interfered with the production of the plant enzyme that causes rotting. This slowed down the rotting process so the tomato stayed ripe longer.</p>

Although this project is funded in part by the Environmental Protection Agency, it does not necessarily reflect the opinion or position of the EPA

<p>A turkey farmer has some turkeys that reach maturity (the age where they can be slaughtered for meat) in 8 weeks instead of 10 weeks. She breeds these turkeys for offspring next season.</p>	<p>A wheat farmer has a field of wheat that gave him a higher number (yield) of plants than another field. He chooses these seeds to save for next growing season.</p>
<p>A soybean farmer had her beans sent to a lab and injected with a gene to make them resistant to weedkiller. The weedkiller can then be applied to the crop, killing weeds without killing the crop.</p>	<p>At a Pennsylvania sheep farm, sheep are being made to produce milk that contains AAT, a medicine which could be used to treat cystic fibrosis and the lung disease emphysema in humans.</p>

Debate outline:

GMO Debate: Building an argument

Now here's why....

Here's what I think....

<i>Argument #1</i>	(For or against GMOS)
<i>Argument #2</i>	<i>Your evidence</i>

GMO Debate: Building a rebuttal

Here's what they think....

(For or against GMOS)

Now here's why they're wrong...

<i>Their argument</i>	<i>Your rebuttal</i>
<i>Their other argument</i>	<i>Your rebuttal</i>