

Genetically Modified Plants: Integrated Pest Management Part 3

Brief Description:

Genetically Modified Organisms, or GMOs, are a very hot topic, but how much do you really know about the science behind them? Through science, farmers have been able to reduce the amount of pesticides used, increase yields and improve flavor. This lesson will explore what a GMO is and why we are using them in today's agriculture.

Objective:

Students will:

1. Be guided in a conversation about genetically modified organisms, ethics and decision making, educating themselves on a topic and analyzing the issues.

Time:

Introduction: 30 to 50 minutes

Activity 1: 50 to 75 minutes

Activity 2: 60 to 120 minutes, depending on how much in-class time is given for writing

Vocabulary:

claim, cloning, ethics, fact, genetically modified organism, genetically modified plant as a pesticide, genetically modified plant for higher plant quality and transgenic organism

Background:

What is a Genetically Modified Organism?

From <http://www.bt.ucsd.edu/gmo.html> University of California San Diego

When a gene from one organism is purposely moved to improve or change another organism in a laboratory, the result is a genetically modified organism (GMO). It is also sometimes called "transgenic" for transfer of genes.

There are different ways of moving genes to produce desirable traits. For both plants and animals, one of the more traditional ways is through selective breeding. For example, a plant with a desired trait is chosen and bred to produce more plants with the desirable trait. More recently, with the advancement of technology, another technique has been developed. This technique is applied in the laboratory where genes that express the desired trait are physically moved or added to a new plant to enhance the trait in that plant. Plants produced with this technology are transgenic. Often, this process is performed on

crops to produce insect or herbicide resistant plants, and they are referred to as Genetically Modified Crops (GM crops).

Genetically engineered products are not new. Insulin used in medicine is an example of genetic engineering; the insulin gene from the intestines of pigs is inserted into bacteria. The bacterium grows and produces insulin; this insulin is then purified and used for medical purposes. Thyroid hormones, until recently, were derived only from animals; now the hormone can be cultured from bacteria. Other genetically engineered products include the chemical Aspartame used in sugar-free foods, and the drug used for the hepatitis B vaccine.

Genetically Modified Organisms (GMOs) as pesticides:

The recent public awareness about GMOs and no-label-necessary has sparked many debates. Most GMOs in food crops include inserted genes for resistance to the weed killer (herbicide) Round-up™ or the gene for the *Bacillus thuringiensis* toxin (Bt toxin). Fields of plants containing the "Round-up ready" gene can be sprayed for weeds without harming the crop. This keeps weeds down, which compete with crops and can harbor insects, requiring additional pesticides. Common crops containing the Round-up ready gene are alfalfa, canola, corn, cotton, sorghum, soybeans, sugarbeets and wheat. The Bt toxin is produced naturally from the bacteria *Bacillus thuringiensis*. This toxin affects the ability of caterpillars to digest food and leads to their death. Common crops containing the Bt toxin gene are corn, potato and cotton. Plants containing this gene would not need pesticides that target caterpillars.

Genetically Modified Organisms in plant breeding:

It is common for plant breeders to identify a gene for a desirable characteristic such as flavor, fungal resistance, shelf life, or skin texture in a plant that has other undesirable characteristics that make it a poor choice for growing commercially. For example, the fruit may have a great flavor, but a short shelf life. If the breeder can identify the gene that causes great flavor, and adds it to a fruit with long shelf life, then the result would be a great tasting fruit with a long shelf life. First, the breeder identifies a desirable gene. Next, the breeder isolates the gene and makes copies of the gene. Then, using biotechnology techniques, the breeder can insert the gene into another variety of fruit (transgenic), one that is currently on the market, to improve fruit quality.

*Throughout this lesson reinforce the importance of a science-based, reputable source. There is as much incorrect information as there is correct information. This is a scientific subject, not an emotional one.

Suggested websites for research:

- http://www.nytimes.com/2016/05/18/business/genetically-engineered-crops-are-safe-analysis-finds.html?_r=0
- <http://www.ers.usda.gov/media/1282246/err162.pdf>
- <http://learn.genetics.utah.edu/content/science/gmfoods/>
- <http://isaaa.org/resources/publications/pocketk/1/default.asp>

Introduction:

1. Introduce the topic of genetically modified organisms. Discuss with students what they are and why they are produced, keeping opinion out of the discussion.
2. Introduce the concept of gene insertion with one of the following videos. For an animation of gene insertion, view: <https://www.dnalc.org/view/15476-Mechanism-of-Recombination-3D-animation-with-with-basic-narration.html>. For more information on gene mutation view Bozeman Science video: <https://www.youtube.com/watch?v=eDbK0cxKKsk&t=223s>.
3. After showing the video, explain to students that gene insertion is part of genetically modifying organisms. Ask students, “What are some reasons for modifying a plant?” Possible answers could be: *GMO as a pesticide or GMO in plant breeding.*

Activity 1:

1. Discuss with students the definition of scientific fact and claims. Ask students to give examples of each, and relate them back to the definitions.
2. Separate students into groups of three. Each group will need access to the internet.
3. Each student needs a copy of the *Evaluating Claims about GMOs Worksheet*.
4. Each group will put the phrase “Genetically Modified Organism” into the search field. They will choose five webpages to quote. At least two websites need to be .edu or .gov. Remind students they should find agriculture-related GMO articles or websites.
5. Each group will write down a statement from the website next to Statement 1 and fill out the information below. Repeat for all five websites.
6. Have each group present one statement they think is a scientific fact and one statement they think is a claim. As a class ask, “Was this group correct? Was that a claim or proven fact?”

7. Continue the discussion with students using *Group Discussion Questions*. You can have the students research the answers as an assignment or discuss as a class. The discussion will lead into the essay assignment.

Activity 2:

1. Students will be researching and writing an opinion essay.
2. Each student needs the *GMO Essay Worksheet*. Students will write an essay about their opinion about using GMOs. Students can use the *GMO Essay Worksheet* for guidance.

Activity 3:

1. Students now have a better understanding of how GMOs are used in agriculture and the important role they play.
2. Put students into groups of three and inform them that they are going to be designing a public service announcement campaign.
3. The average American consumer does not understand the science behind GMOs and therefore assumes they are unsafe. You have discovered in Activity 1 that social media and the Internet do not always state fact. Your job is to design a public service announcement to convey truths about GMOs and why they are necessary for our growing population.
4. Once you have designed your approach you will submit it to your teacher for approval. You will redesign it if necessary.
5. As a group you will create a poster that will educate the “average” American and present it to the class.
6. If allowed, the cafeteria is a great place to hang the posters.

Evaluation:

1. Grade groups based on completion of *Evaluating Claims about GMOs Worksheet* and cooperation as a group.
2. Essays are graded by support of the opinion and structure of the essay, not the actual opinion. Encourage students to not worry about right or wrong. They can even write the essay opposing their true opinion.
3. Grade groups based on completion and accuracy of their public service announcement posters.

Evaluating Claims about GMOs Worksheet

Choose Five statements from the web search and evaluate.

Statement 1:

Made by:

Website = .com, .edu, .gov, .org etc.:

Claim or Fact?

What motives may this person or entity have?

Statement 2:

Made by:

Website = .com, .edu, .gov, .org etc.:

Claim or Fact?

What motives may this person or entity have?

Statement 3:

Made by:

Website = .com, .edu, .gov, .org etc.:

Claim or Fact?

What motives may this person or entity have?

Statement 4:

Made by:

Website = .com, .edu, .gov, .org etc.:

Claim or Fact?

What motives may this person or entity have?

Statement 5:

Made by:

Website = .com, .edu, .gov, .org etc.:

Claim or Fact?

What motives may this person or entity have?

Group Discussion Questions

1. What kind of research has been conducted to evaluate the safety of GMO food?
2. What government agencies have approved GMO food and feed for human and animal consumption?
3. Just because we can do something, should we?
4. How can we do it correctly and safely?
5. What are the issues of ethics with respect to GMOs?
6. How do other countries feel about GMOs (European countries, Haiti, China)?
7. What are the conflicts in patenting a gene and the concept of owning life?
8. If GMOs reduce pesticide use, why are people not more supportive?
9. How could GMOs serve to end hunger?
10. What if GMO pollen from Bt plants spread to plants nearby? How do we evaluate the effect on wildlife?
11. Should GMO food be labeled as such?
12. How have GMO vegetables helped supply desirable fruit all year round?
13. Should we value species integrity (the organism is essentially the same species after the new gene is added)?

GMO Essay

1. Using your class notes, make a list of the positive things about GMO crops.
2. Using your class notes, make a list of the negative things about GMO crops. Make sure to separate feeling from scientific evidence. For example, “GMO food is unhealthy” – Is there scientific proof of that, or is that just a feeling. *Answer: Feeling. There is now scientific proof they are just as healthy as non-GMO food.*
3. What do you think? Choose a question to answer:
 - a. Should we create GMO food?
 - b. Should we label GMO food?
 - c. Should we label meat and dairy products that come from GMO-fed animals?
4. Choose a position and support the opinion with three pieces of evidence.
 - Yes, because 1, 2, 3.
 - No, because 1, 2, 3.

Introduction (Five sentences)

“Hook”

Describe GMO crops

Introduce thesis statement

Thesis statement

Support Paragraph 1 (Four sentences)

Topic sentence, 1st support of thesis

Detail

Closing sentence

Support Paragraph 2 (Four sentences)

Topic sentence, 2nd support of thesis

Detail

Closing sentence

Support Paragraph 3 (Four sentences)

Topic sentence, 3rd support of thesis

Detail

Closing sentence

Conclusion (Four sentences)

Restate thesis

Summarize supports

Closing essay

References for Integrated Pest Management Parts 1-3:

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