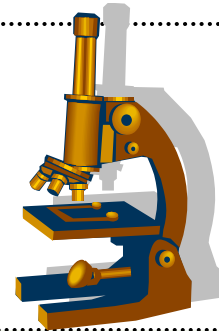




Plant Breeding Ethics

What are the pros and cons of genetically modified plants?



Skill Level: Intermediate (11-13 years old) or 6-8th grade

Learner Outcomes:

Understands that ethics are intertwined in science.

Education Standard(s):

NSES: Science in Personal and Social Perspectives

NETS: Digital Citizenship

Sunshine State Standards:
SC.7.L.16.4; SC.8.N.4.2;
SS.8.A.4.6

Success Indicator:

Can explain the positives and negatives of genetically modified plants.

Can recognize that ethical decisions are based on personal viewpoints in addition to scientific data.

Life Skill(s):

Communication and Critical Thinking

Tags: GMO, Bioethics

Time Needed: 90-120 minutes

Materials List: Agree and Disagree signs, flip chart paper, markers, four copies of scenario and viewpoints

A *genetically modified organism* (GMO) is one that has been transformed by the addition of a gene or genes from one organism to another. Sixty percent of all processed foods in the United States contain crops that have been genetically transformed. Since the 1990s, geneticists have been taking genes from plants and microorganisms and inserting them into a crop plant's DNA. Before this time, most new crop cultivars were produced by conventional breeding, taking the pollen from one plant and crossing it with a plant that had a desirable trait. While conventional breeding is still the workhorse of plant breeding, transgenic breeding is increasingly used. The results can create plants with traits normally not found in nature. One example is a blue carnation flower. Through genetic transformation, a breeder can pick specific genes (or groups of genes) that contain only one trait at a time to create an improved plant type, known as a *cultivar*. Crops are genetically transformed to help fight disease, produce their own pesticide, be tolerant to an herbicide, or to be more nutritious.

Conventional breeding is still used widely to produce improved varieties but it has some drawbacks. Plants bred conventionally usually need to be related. This may limit what traits can be bred into a new cultivar. Also, with this type of breeding, the breeder may be crossing to get disease resistance genes but many other genes may "come along for the ride" bringing unwanted traits with them. Another drawback is the time it takes to get a new crop cultivar to market with conventional breeding. It takes 8-15

Learn More

Food: How Altered?
<http://environment.nationalgeographic.com/environment/global-warming/food-how-altered/>

Virtual Fun

Create your own genetically modified crop in this online game:

<http://www.pbs.org/wgbh/harvest/engineer/transgen.html>.



years to develop an improved cultivar through classical breeding. By genetically transforming a plant (creating a GMO), breeders can produce a new crop cultivar in only 6-8 years. Transgenic breeding is not only speedier but has several other advantages that we'll look at shortly. What else may happen when you take traits from unrelated organisms and put them in a crop plant? This has rightly caused many questions to be asked. Just because we can genetically transform a plant, is it right to do? What are the risks and benefits? Questions like this are addressed in *bioethics*, the study of the ethical and moral implications of new biological discoveries.

What to Do:

The following two activities were adapted from Macer's Moral Games with his permission. These games will help youth think about the facts surrounding GMOs and help them form and express their own options on the topic. Ahead of time, select one or two of these games to conduct with the group both before your discussion on GMOs and then again afterwards.

Donuts- This exercise works well as an icebreaker, and provides an opportunity for youth to clarify their thinking on the question being asked. Make two circles of people with pairs facing each other. In the case where there is insufficient room for circular donuts, the exercise can be done by forming two lines of persons facing each other, to make pairs, and to shift one line each cycle. The pairs discuss a moral question for one minute, then the outside circle shifts so that new pairs are made. The new pairs repeat the exercise with the identical question. After two or three times, you can ask a different question. Once the outside circle has made the full rotation, have everyone go back to their seats. At the end of the exercise, ask students how their views have developed over the course of the exercise. They also will have been able to listen to others' views and describe what others said.

Sample Questions:

1. Is it ethical for plant breeders to continue to develop food that grows faster/cheaper/more nutritious when the world's population continues to grow?
2. What would you like to do to help solve world hunger?
3. Is it ethical for US plant breeders to develop better food crops and not share them with developing countries that do not have good relationships with our government?

Agree or Disagree- This game involves asking people whether they agree or disagree with a statement. It is a simple form of values clarification in which each learner is asked to show their opinion, and develop their opinion as a result of sharing their opinion and listening to others. Ahead of time, place signs "I Agree" and "I Disagree" around the room. Explain to the youth that when the statement is read, if they strongly agree with the statement, they should stand by the "I Agree" sign; if they are unsure, they should stand somewhere between "I Agree" and "I Disagree." Those who disagree should stand near the "I Disagree" sign. Select a sample of participants to explain why they chose to take a particular position. People may change positions if convinced by other's explanations, and they can be asked to explain why they changed their position.

Did You Know?

Sixty percent of all processed foods in the United States contain crops that have been genetically transformed.

Glossary Words

Cultivar
Genetically modified organism
Bioethics

Related Activities

(Link to Activities in the 4-H Directory of Materials)



Sample Statements:

- Genetically modified plants are better because they can be developed faster and they can use less pesticides and be more nutritious.
- Scientists should not mess around with nature because we don't know what the long term effects are.
- Plant breeders do not need to worry about producing more or more nutritious food because the world's population is already too large.
- Plant breeders need to work to develop better plants to help starving countries.
- If it is alright to change plant's genes, then it is alright to change human genes.

Case Study on Golden Rice

Case studies can be a teaching tool to get youth involved in group discussion, teamwork, and problem solving. The purpose of this case study is to provide youth the opportunity to discuss the risks and benefits of genetically modified plants in a debate format. Students read the case, about Golden Rice, and role play the different viewpoints of the people involved.

To begin, take a few moments to review what the youth learned from "The Art and Science of Plant Breeding." Next divide the group into four smaller groups. Assign each group a viewpoint. Advise them that they are to represent the viewpoint of that person, not their personal viewpoint. Give each group a scenario and viewpoint description. Allow the groups 10 minutes to read through the scenario and viewpoints. Ask the groups that are representing the Human Activist and the Pediatrician to list the pros and cons of Golden Rice on newsprint or flip chart paper. Remind them that their list should reflect the viewpoint of the person their group is assigned. Ask the group who is representing the Government Official to discuss the following questions and try to come to a consensus about them:

- How might Golden Rice positively affect the quality of society, family, and economics in this country?
- How might Golden Rice negatively affect the quality of society and economy in this country?
- What is the likelihood of Golden Rice being allowed in this country and why?

Ask the group representing the Parent Group to list their worries and concerns.

Assemble the group and begin the debate:

- Start with the group representing the Government Official and ask them share the answers to the questions they have been working on.
- Next have the groups representing the Human Activists and the Pediatrician, one at a time, state their case and try to persuade the government official group to share their viewpoint.
- Next, introduce the parent group and ask them to share their concerns and worries.
- Finally, have the group that represents the government Official have a quick discussion to decide whether or not to allow Golden Rice into the country.
- To close the exercise, review the general steps in producing a genetically modified plant to clear up any questions or misconceptions.



Case Study on Golden Rice

Scenario:

You are part of a medical relief team that is visiting a small third world country where there is little food available. One of the main foods that they grow is rice, but it does not have all the vitamins needed for a well-balanced diet. Malnutrition is rampant, and many children are dying or going blind because they are not getting the nutrients they need to be healthy. One of the human activists on your team wants to teach the people how to grow Golden Rice, genetically modified rice which is rich in beta-carotene, a nutrient that can help fight disease and blindness. However, one of the pediatricians on the team is against the idea because he is unsure of the long term effect this genetically modified crop will have on the children. The parents of the children are unsure. The government officials are concerned about the cost to grow this new rice and what the long term effects on the environment will be.

Viewpoints:

Human Activist- is appalled at the number of sick and dying children in this country and the lack of healthy, nutritious food that could easily make this problem go away. She wants to make a difference and end the suffering of the people who live in this country, and feel that the families should be able to grow this rice if they choose to do so- it should not be a government regulated issue.

Pediatrician- the pediatrician has dedicated his life to helping children and is also saddened by the number who are in bad health due to lack of proper nutrition. Although he badly wants to solve this problem, he is not convinced that Golden Rice is the answer because he is afraid that there might be long term effects of this genetically modified plant that scientists do not yet know about.

Parents- the parents love their children and want desperately to help them but certainly do not want to do anything that may potentially harm them more.

Government Official- the government official also wants to help, but concerned about the effects GMOS have on the environment. He also is not sure about the political effects Golden Rice will have on his country and his country's relationship with other countries. He wants more information before making a decision



Share . . .

- What did you like about discussing the ethics involved in plant breeding?
- How did you decide on your own viewpoints?
- What did you observe about the way groups agreed or disagreed?

Reflect. . .

- What did you learn about yourself by doing this activity?
- What did you learn as a group that you might not have learned alone?

Generalize. . .

- What other situations have you experienced like this?
- Why is it important that each person have his/her own point of view?

Apply. . .

- Describe a time when you might need the skills/knowledge that you learned today.
- How can you apply the thinking process you used today to evaluate or explore other issues in your school or community?

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