ehp

LESSON:
GM Foods: Are the Risks Real?

Summary:	Students rank in order of riskiness various health-related scenarios they may face and discuss what factors influenced their perception of risk. Then they read an article about genetically modified (GM) foods, one of the ranked scenarios, and determine how the information in the article influences their perception of risk. Finally, students try to reach a consensus on the need for labeling GM foods. Lesson type: Extension Lesson—This lesson extends a topic in the *EHP Student Edition* article.
***EHP* Article:**	"Genetically Modified Foods: Breeding Uncertainty" *EHP Student Edition*, November 2005, p. A527–A533 http://ehp.niehs.nih.gov/members/2005/113-8/focus.html
Objectives:	By the end of this lesson students should be able to:

1. identify factors involved in people's perception of risk;
2. describe the pros and cons of GM foods; and
3. formulate and defend a position on whether genetically modified food should be labeled in the United States.

Class Time:	1–2 hours, depending on length of class discussion and whether Step 6 is assigned as homework
Grade Level:	9–12
Subjects Addressed:	Environmental Health, Biology, Health

▶**Prepping the Lesson (15–20 minutes)**

INSTRUCTIONS:

1. Read the article "Genetically Modified Foods: Breeding Uncertainty" and review the Background Information and Student Instructions.
2. Obtain a class set of *EHP Student Edition*, November 2005, or download the article "Genetically Modified Foods: Breeding Uncertainty."
3. Make copies of the Student Instructions and, if necessary, the article.
4. Decide if you want to assign Step 6 as homework or allow time for the task to be completed in class.

MATERIALS: (per student)
- 1 copy of *EHP Student Edition*, November 2005, or 1 copy of the article "Genetically Modified Foods: Breeding Uncertainty"
- 1 copy of the Student Instructions

VOCABULARY:
- genetically modified (GM) food/crops
- risk perception

BACKGROUND INFORMATION:
GM foods have received considerable attention because of their great potential to address world poverty while posing potential or unknown health risks that concern some consumers and governments. North America, Asia, and parts of South America are using GM crops and foods with few controls. Europe, Russia, and Africa are reluctant to allow the use of GM foods and in some cases have banned their use outright. Part of the concern regarding GM foods is the uncertainty associated with health consequences from their use. If GM foods were to cross-pollinate with conventional crops and were found to pose a significant health risk, the results might be irreversible.

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Also associated with the issue is how people perceive the risk. Scientifically, risk is the probability or chance that a situation will cause a health problem. Scientific analysis of risk considers factors like the frequency of death or injury per a given population, the length and type of exposure, and specific behaviors. The perception of risk by individuals or a population is complex and includes other factors besides scientific risk. For example, the more voluntary a risk is, the less risky people see it as being. People see the risks of smoking and driving cars as low, in part because the risk is voluntary or "under their control." People see the risks of industrial pollution and nuclear power as high, in part because the risks are involuntary. There are typically many factors that are simultaneously involved in how people perceive a risk. Table I shows various factors that influence peoples' perception of risk.

Table I: Risk Perception Factors*

Less Risky	More Risky
Voluntary (e.g., smoking)	Involuntary (e.g., land fill)
Natural (e.g., radon)	Industrial (e.g., contaminated drinking water)
Familiar (e.g., lawn mower hazards)	Exotic (e.g., nuclear power plant)
Not Dreaded (e.g., flu)	Dreaded (e.g., cancer)
Chronic (e.g., allergies)	Catastrophic (e.g., air plane crash)
Visible (e.g., hurricane)	Not Visible (e.g., radiation)
Controlled by Me (e.g., driving car)	Controlled by Others (e.g., hazardous waste incinerator)
Fair (e.g., democratic elections)	Unfair (e.g., locating car race track in community—who gets the noise)
Morally Irrelevant (e.g., radon)	Morally Relevant (e.g., hazardous waste)
Trusted Source (e.g., teacher)	Not Trusted Source (e.g., industry)
Not Vulnerable Population (e.g., healthy adults)	Vulnerable Population (e.g., children and elderly)
Immediate Effects (e.g., car crash)	Delayed Effects (e.g., GM foods)
Affects This Generation	Affects Future Generations
Victim Not Known	Victim Known
Risks Can Be Reduced	Risks Can't Be Eliminated
Low Risk–Benefit Ratio	High Risk–Benefit Ratio
Low Media Attention	High Media Attention
Collective Action Difficult	Collective Action Possible
Benefits Understood	Benefits Unclear
No Alternatives Available	Alternatives Available
Risk Shared by Many	Risk Affects Few

*Sandman P. 1993. Responding to Community Outrage: Strategies for Effective Risk Communication. Fairfax, VA: American Industrial Hygiene Association.

One of the concerns about labeling GM foods is people's reaction to the label. Since GM foods have many of the "more risky" characteristics (industrial, exotic, memorable, controlled by others, vulnerable population, delayed effects, affects future generations, risks can't be eliminated, high media attention, benefits unclear, alternatives available), people may simply choose not to buy GM foods even though some believe GM foods are perfectly safe.

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RESOURCES:

Environmental Health Perspectives, Environews by Topic page, http://ehp.niehs.nih.gov/topic. Choose Agriculture/Farming, Food Safety/Regulation.

Agency for Toxic Substances and Disease Registry, A Primer on Health Risk Communication Principles and Practices, http://www.atsdr.cdc.gov/HEC/primer.html.

FDA Consumer Magazine, January–February 2000, "Are Bioengineered Foods Safe?" http://www.fda.gov/fdac/features/2000/100_bio.html.

Human Genome Project Information, U.S. Department of Energy Office of Science, Genetically Modified Foods and Organisms, http://www.ornl.gov/sci/techresources/Human_Genome/elsi/gmfood.shtml.

SCOPE Curriculum Forum, University of California, Berkeley, Genetically Modified Food, http://scope.educ.washington.edu/gmfood/.

The Campaign, Grassroots Political Action "Genetically Engineered Food Right to Know Act," http://www.thecampaign.org/.

National Academies Press, *Safety of Genetically Engineered Foods*, http://www.nap.edu/books/0309092094/html.

National Safety Council, "Odds of Dying," http://www.nsc.org/lrs/statinfo/odds.htm.

Union of Concerned Scientists, Food and Environment, Biotechnology, http://www.ucsusa.org/food_and_environment/biotechnology/index.cfm.

World Health Organization, Food Safety, Biotechnology (GM Foods), http://www.who.int/foodsafety/biotech/en/.

▶ Implementing the Lesson

INSTRUCTIONS:

1. Lead a discussion with the class brainstorming a list of various health-related scenarios encountered in the community.
2. Tell students that they will now rank some health-related scenarios in terms of the level of concern about these scenarios. Then you will look at one of these scenarios in more depth.
3. Hand out the Student Instructions and the article "Genetically Modified Foods: Breeding Uncertainty."
4. In groups or as individuals, ask students to follow the Student Instructions and read the article.
5. As a class, discuss what influence the article had on the perception of risk and try to reach a consensus of whether GM foods should be labeled.

NOTES & HELPFUL HINTS:

- As an alternative, students could be divided into the following five groups: agrocompany representatives, consumers, African farmers, environmentalists, and university scientists. Ask each group to research, prepare, and conduct a presentation on GM foods from the perspective of the groups they were assigned. Groups could also be asked to prepare a poster representing their group's perspective.
- The "Scenario Survey" could be expanded to include scores or data from other classes.

▶ Aligning with Standards

SKILLS USED OR DEVELOPED:

- Communication (note-taking, oral, written—including summarization)
- Comprehension (listening, reading)
- Critical thinking and response
- Experimentation (conducting, data analysis)
- Observation
- Research

SPECIFIC CONTENT ADDRESSED:

- Risk
- Risk perception
- Genetically modified foods

NATIONAL SCIENCE EDUCATION CONTENT STANDARDS MET:

Unifying Concepts and Processes Standard

- Systems, order, and organization
- Evidence, models, and explanation
- Change, constancy, and measurement
- Form and function

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Science As Inquiry Standard
- Abilities necessary to do scientific inquiry
- Understanding about scientific inquiry

Life Science Standard
- The cell
- The molecular basis of heredity
- Biological evolution
- Energy in the earth system

Science and Technology Standard
- Abilities of technological design
- Understanding about science and technology

Science in Personal and Social Perspectives Standard
- Personal and community health
- Population growth
- Natural resources
- Environmental quality
- Natural and human-induced hazards
- Science and technology in local, national, and global challenges

▶Assessing the Lesson

Step 4: As a class, discuss what factors are important in why some scenarios are ranked as riskier than others.

Responses will vary, but refer to the Background Information section for points of discussion. Where possible, separate the scientific risk from the risk perception factors so students understand the complexity of the issues. You could provide risk examples to highlight points about the difference in scientific risk and risk perception. For example, the estimated risk of dying from a plane crash is 1 in 440,951 per year or 1 in 5,704 over a lifetime. The odds of dying in an automobile accident is 1 in 17,625 per year or 1 in 228 over a lifetime. How did the students rank car crashes compared to plane crashes?

Step 5: Read the article "Genetically Modified Foods: Breeding Uncertainty," *EHP Student Edition*, November 2005, p. A527–A533. As you read the article, make a running list of arguments for and against genetically modified (GM) foods on the "Pros and Cons of GM Foods" form.

See sample responses in the table on the next page

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Pros and Cons of GM Foods

Arguments For GM Foods	Arguments Against GM Foods
Creates crops resistant to pests	Environmental risks are unknown
Creates crops resistant to herbicides	Current testing methods do not adequately assess safety
Increases crop yields	Concentrates food production into the hands of a few multinational companies
Reduces need for agrochemicals	May cross-pollinate with other plants, threatening the purity of local crops
Allows crops to be grown in depleted soils	Restricts sale of crops since many countries have banned GM food
Increases nutritive value of crops	More surveillance of consumers is needed to ensure safety
Creates crops resistant to environmental stresses such as cold	May increase allergic reactions among consumers
Creates crops that may reduce the risk of disease	There was one case of a GM soybean that was found to be a serious health risk because of its allergenic potential
No apparent health effects in current consumers	Safety testing of GM foods is not mandatory by the FDA
Companies take adequate steps in development of GM crops to ensure they are not allergenic	Labeling GM food should be mandatory so consumers have a choice
Labeling of GM food is unnecessary because GM food is no different from conventional food	There is no way to adequately separate GM foods from conventional foods in the food chain
Scientists' consensus of GM food is that it is not inherently dangerous	There was one case where GM food accidentally got in the food supply of both the United States and Europe
May help feed world's poor and reduce famine	

Step 6:   Now that you have read the article, look at the "Scenario Survey" again and determine your level of concern about the GM foods.

A) Has your level of concern gone up, gone down, or remained the same? Explain your answer and use examples from the article to support your answer.

There is no predetermined answer to this question. Assess responses based on the quality of students' explanations. Refer to the Background Information section and *EHP Student Edition* article.

B) Do you think GM foods should be labeled in food stores in the United States so that you could distinguish them from conventional foods? Explain your answer and use examples from the article to support your answer.

There is no predetermined answer to this question. Assess responses based on the quality of students' explanations. Refer to the Background Information section and *EHP Student Edition* article.

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Step 1: Complete the "Scenario Survey" below assessing your level of concern about 20 different health-related scenarios.

Scenario Survey

Hazard	Not Concerned 1	Slightly Concerned 2	Moderately Concerned 3	Very Concerned 4	Extremely Concerned 5	Don't Know	Class Average	Class Rank
1. Tornados								
2. Hurricanes								
3. Flu								
4. Cancer								
5. Improper disposal of hazardous waste								
6. Outdoor air pollution								
7. Contaminated drinking water								
8. Global warming								
9. Car crashes								
10. Terrorism								
11. Genetically modified (GM) food								
12. Plane crashes								
13. Indoor air pollution								
14. Violent crime								
15. Radon in your house								
16. Volcanoes								
17. Building catching on fire								
18. Cigarette smoke from other smokers								
19. Radiation leakage from nuclear power plants								
20. Nuclear warfare								

Step 2:   As a class, average the number score for each scenario and record it on your Scenario Survey. Do not include the "Don't Know" responses when calculating your average. This means if there are 30 people in your class and 5 answer "Don't Know" for #1 "tornados" and the remaining 25 answer "Not Concerned," you will divide by 25, not 30.

Step 3:   Based on the averages, rank the scenarios from 1 to 20 with 1 being of the greatest concern and 20 being of the lowest. If some of the risk rank scores tied, then negotiate the score priority as a class.

Step 4:   As a class, discuss what factors are important in why some scenarios are ranked higher in concern than others.

Step 5:   Read the article "Genetically Modified Foods: Breeding Uncertainty," *EHP Student Edition*, November 2005, p. A527–A533. As you read the article, make a running list of arguments for and against genetically modified (GM) foods on the "Pros and Cons of GM Foods" form.

Step 6:   Now that you have read the article, look at the "Scenario Survey" again and determine your level of concern about the GM foods.

A) Has your level of concern gone up, gone down, or remained the same? Explain your answer and use examples from the article to support your answer.

B) Do you think GM foods should be labeled in food stores in the United States so that you could distinguish them from conventional foods? Explain your answer and use examples from the article to support your answer.

Step 7:   As a class, average everyone's level of concern score again for GM foods. As a class, has the ranking of the concern for GM foods gone up, gone down, or remained the same?

Step 8:   As a class, discuss what influence the article had on the perception of risk and try to reach a consensus of whether GM foods should be labeled.

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Pros and Cons of GM Foods

Arguments For GM Foods	Arguments Against GM Foods

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