COOPERATIVE EXTENSION SERVICE
UNIVERSITY OF KENTUCKY • COLLEGE OF AGRICULTURE

Food Biotechnology Teaching Guide

Land-grant universities and Extension programs have been directed to respond to public concerns about biotechnology issues through outreach and public education programs. The University of Kentucky established the *Biotechnology Research and Education Initiative (BREI)* to respond to the need for integrated programs on campus and in outreach education. To be successful with public education about biotechnology issues, the Kentucky Cooperative Extension Service needs to raise public awareness about benefits and risks and provide basic information about how biotechnology works through programs aimed at a wide range of audiences.

This program is designed to be used with all audiences, including Advisory Councils, community leaders, public officials, health professionals, high school students, and the media. It contains all the elements of a leader training lesson with a teaching guide, visuals, fact sheet, and evaluation tools. Several national and Kentucky surveys of food consumers indicate that concerns about food biotechnology and genetic engineering are not as great as concerns about fat, cholesterol, pesticides, and germ contamination. Today's food consumer is concerned with taste, cost, convenience, and nutrition. Consumers are increasingly concerned about food safety, environmental, and health issues.

Background

The following is a summary of the article "Public Perceptions of Agricultural Biotechnology and Pesticides: Recent Understandings and Implications for Risk Communication" by Robert K.D. Peterson, *American Entomologist*, Spring 2000.

The general public is still in the early stages of forming opinions about the relatively new field of biotechnology. As with any other product, consumers will ultimately decide the fate of products resulting from these new production techniques. The public is currently more concerned with the risks associated with specific products than with the process of genetic manipulation. Perceptions about biotechnology vary by age, gender, income, education, culture, and among types of biotechnology products. Education programs aimed at groups perceiving the most risk should be a priority, as should efforts to raise the level of public education on biotechnology issues. Generally, there is more acceptance of plant biotechnology than of animal or microbial biotechnology. Bioengineered plants that reduce the need for pesticide applications are the most accepted.

In order to educate the general public and the leaders of public opinion, educators will need to frame their communications in terms of relative risks based on consumer and public perceptions. The following are general recommendations for risk communications:

- empathize with and genuinely consider public concerns
- interact with and inform the public
- respond promptly and with complete openness
- respond with simplicity and clarity
- relate to the public that experts are determined to control, limit, and understand medical and environmental risks associated with biotechnology.

When working with the media, try to clearly define technical terms and provide complete information, try to accommodate reporters' deadlines, and organize forums that bring scientists and reporters together for open discussions. Emphasize that you are attempting to build public trust and scientific credibility by communicating completely and openly.

Whenever possible, discuss basic biotechnology information with consistent and clearly defined terms. Discuss benefits and risks as part of an integrated communication program about the food, agricultural, health, economic, moral, and ethical considerations surrounding biotechnology. A risk communications program must include basic concepts of chemistry, biology, genetics, ecology, critical thinking, and the scientific method. This will not be a one-program effort; it will require the use of various communication channels to reach individuals, families, and communities. It is helpful to discuss risks in relative terms and to explain that toxicity is a function of dose and that risk is a function of dose and exposure.

Because most scientific information contains uncertainty, it can be readily misinterpreted based on perceptions. Scientists must openly discuss uncertainties in nontechnical terms and discuss the limitations of current knowledge.

The following are key concerns as outlined in January 2000 in recommendations to the ESCOP/ECOP (Experiment Station Committee on Organization and Policy and Extension Committee on Organization and Policy).

Key Environmental Concerns:

- flow of enhanced genetic material to weed species
- validity of industry data concerning reduced pesticide use
- development of "super" plants that resist control methods
- accelerated spread of antibiotic resistance due to the use of marker genes.

Key Food Safety Concerns:

- unexpected effects produced by transfer of genetic material
- higher toxin levels than in traditional varieties
- different nutrient profile than traditional varieties
- increased allergenic potential
- marker genes that could transfer antibiotic resistance to organisms.

Program Resources

For more information and additional background resources on biotechnology, visit the BREI Web site at <http://www.ca.uky.edu/BREI/>. This site contains facts and information on various aspects of biotechnology, including links to other resources for educators (such as materials from other land-grant universities). The site has information on the following subjects:

- General Biotechnology Information
- Environmental Topics
- Health Topics
- Food Safety
- Farm Impact
- Bioethics
- Research and Science
- Resource Materials
- Teachers
- Just for Kids
- Glossary
- FAQs

Several printed publications are available through Agricultural Communications as part of the BREI series. Agents can order these from the Agricultural Distribution Center:

- *Biotechnology in Our Food System: Frequently Asked Questions and Answers* (BREI-1)
- *Agricultural Biotechnology and the Environment* (BREI-2)
- *Food Biotechnology* (BREI-3)
- *Food Biotechnology Teaching Guide* (BREI-3TG)
- *What Are GMOs?* (BREI-4) (in process)
- *Molecular Biotechnology for Non-Food Applications* (BREI-5) (in process)
- *Biotechnology down on the Farm* (BREI-6) (in process)

Other resources are available from the Biotechnology Research and Education Initiative; to borrow these, contact Valerie Vantreese in the Agricultural Economics Department:

- *Videotapes:*
  –Cloning: How and Why
  –Biotechnology
  –Pick of the Crop
  –BREI on KET
- *CD-ROM*: A Short Course in Biotechnology
- *BREI Display* describing our group and its purpose
- The *BREI Library* also has a collection of slides, presentations, and books available for loan.

Teaching Activities

Use the BREI publication *Food Biotechnology* and the PowerPoint file as the backbone of your presentation. Show participants the glossary of biotechnology terms for handy reference throughout the presentation and activities. Choose from the three activities described below, other resources listed above, and resources on the BREI Web site to enhance your presentation and tailor it to meet the needs of your audience.

"A Brief History of Food" Activity

Using the handout, ask participants to match the list of events with the correct date. When participants have completed the matching activity, review the correct timeline on the back of the handout. Allow time for group discussion about how biotechnology fits into the history and future of agriculture.

8000 BC	First agriculture, crop production, and genetic modification of plants and animals appears.
2000 BC	People learn to use bacteria and yeast for food fermentation and leavening.

1700s	Naturalists identify hybrid plants resulting from spontaneous breeding between plant varieties.
1840s-60s	The field of genetics is founded by Mendel's study of plant characteristics and patterns of heredity.
1860s	Louis Pasteur establishes the science of microbiology and the basis for pasteurized milk.
1900s	Botanists begin to employ genetic knowledge through selective breeding.
1922	Farmers purchase the first hybrid corn, which helps boost U.S. corn production 600% between 1930 and 1985.
1950s	Watson and Crick discover the structure of DNA, the genetic code of life.
1970s	Scientists isolate genes that code for specific proteins, making it possible to identify and move the genes that direct the machinery of life.
1980s	Scientists discover how to transfer pieces of genetic information from one organism to another, something which generally could not have been accomplished with traditional tools. In the first application of biotechnology, insulin is produced for diabetes treatment.
1985	Field testing of genetically engineered plants resistant to insects, viruses, and bacteria.
1986	Agricultural scientists develop herbicide-resistant soybeans using biotechnology techniques.
1990	U.S. government approves the first food product made using biotechnology, a microorganism modified to produce an enzyme needed to make cheese.
1994	The Flavr Savr™ tomato is approved by the FDA for sale in the U.S.
1996	Herbicide-resistant soybeans are approved for sale in the U.S.

"Imagine the Plant Foods of the Future" Activity

Participants will need to be familiar with several terms from the glossary before beginning this activity. For a visual aid, have a large, clear jar filled with Styrofoam packing peanuts and some extra peanuts to scatter around. Use peanuts of different colors to represent genes for various traits. Peanuts work well for this illustration because, just as with genes for desired and unwanted traits, some extra peanuts always seem to stick to the ones you select.

To start the activity:

Imagine that you have a jar full of genes. You know that from one to several of these genes control the plant trait you wish to change. These same genes may control other unanticipated plant features. In the past, you have controlled the genes in the jar by collecting genes only from plant parents with desired features. The total number of genes is limited by the size of the jar. The genes are randomly selected from a prime pool, but inevitably undesirable features are also selected and inherited.

But now, you have the ability to isolate, identify, cut, and paste specific genes. You can even take genes from a fish and put them into a strawberry. In the past, it would have taken many years and many "trial and error" attempts to create a plant with the desired features, but now you can do it in a few years by directly following specific traits.

So, if you could change any plant food with any genetic trait to create a new plant food, what would you make?

Lead participants to complete a handout (as described below) through group discussion. Provide examples of options to help participants complete the activity.

Offer a handout to help participants:
- decide what traits are desired
- identify gene(s) that code for that trait
- insert a new gene
- test for efficacy and safety
- produce
- market.

To end the activity, discuss what concerns this new technology presents to consumers and society.

"Risk Assessment" Activity

Background Resources

Peterson, R.K.D. Public perceptions of agricultural biotechnology and pesticides: Recent understandings and implications for risk communication. *American Entomologist*, Spring 2000.

Lemaux, P.G. From food biotechnology to GMOs: The role of genetics in food production. <http:plantbio.berkeley.edu/~outreach/JPCTALK.HTM> Accessed June 2000.

Bessin, Ric. PowerPoint presentation: "Consumer Perceptions of Genetically Modified Foods." Available on the BREI Web site.

1. Ask the group to think of risky things that they do each day. For example: driving a car, eating an unhealthy diet, investing in the stock market, etc.
2. Discuss different types of risk: health, environmental, economic, ethical. Ask the group to think of a risk of each type.
3. Explain the differences between:
   - "risk" (which can be measured and placed in relative terms)
   - "perceived risk" (what we believe risk to be and what we use to evaluate whether benefits outweigh risks)
   - "safety" (If we believe the benefits are greater than the risk, we choose to do things such as drive cars or fly on airplanes. Government agencies and well-meaning peers also help keep us safe through laws, regulations, and advice.)

Evaluation and Reporting

This program is an integrated (research, instruction, and outreach), multi-disciplinary (Agronomy, Agricultural Communications, Agricultural Economics, Entomology and Specialty Crops, Family and Consumer Sciences, Nutrition and Food Science, Molecular Farming, Molecular Genetics, and Rural Sociology) approach and can be reported as such to meet federal reporting requirements for integrated, multi-disciplinary programs. The following Program Accomplishment Codes (PAC) and priority indicators may be appropriate for reporting the results of this program:

PAC	Priority Indicator
100	Improve the capacity of communities to identify and address critical issues that impact the lives of their citizens.
200	Attain sustainability of agricultural and economic development systems that are globally competitive.
300	Foster development of personal and interpersonal skills, stimulate volunteer leadership, and promote participation in community problem solving.
600	Improve environmental quality by encouraging the implementation of sound environmental practices and the effective stewardship of natural resources.

The following questions may be useful in evaluating the effectiveness of this program:

- Did this program help you understand food biotechnology?
- Did you learn something new about food biotechnology?
- Do you feel better prepared to make informed decisions and to participate in discussions about food biotechnology?

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