Program	**Natural Selection vs. Selective Breeding: Food Production**
Two	Teacher's Guide

Tomatoes and cabbages, like many other living things, come in a variety of shapes and sizes. Evidence of this can be found both in our gardens and at the supermarket. Some tomatoes are big, sweet and so soft, you can barely touch them without leaving a mark and others are nearly as hard as an apple.

How does this happen? Is it purely by accident, as with natural selection, or is it a planned outcome involving the selective breeding of two tomatoes -- two fruits, both with desirable traits, combined to produce a new and unique variety?

Today's harvests often travel thousands of miles to arrive at their destination. Their ability to arrive at their destination with a fresh and healthy appearance is a characteristic prized by grocers. These prized characteristics are often a result of selective breeding.

This piece will address the importance of plant differentiation and the ways it is beneficial to the process of food production.

Program Objectives

Students will learn that:

- Science and scientists are at work in northwest Ohio solving the problems posed by feeding an expanding population.
- Businesses and governments routinely apply the process of scientific investigation to access risk and cost to the community and environment.
- Natural selection and selective breeding are being used by crop scientists in northwest Ohio to improve the production and processing of food.

Ohio Science Standards

Life Science

Benchmark J

Summarize the historical development of scientific theories and ideas, and describe emerging issues in the study of life sciences.

Indicator 26, Grade 10

Use historical examples to explain how new ideas are limited by the context in which they are conceived. These ideas are often rejected by the scientific establishment; sometimes spring from unexpected findings; and usually grow slowly through contributions from many different investigators (e.g., biological evolution, germ theory, biotechnology and discovering germs).

Science and Technology

Benchmark B

Explain that science and technology are interdependent: each drives the other.

Indicator 2, Grade 10

Describe examples scientific advances and emerging technologies and how they impact society.

Life Science

Benchmark H

Describe a foundation of biological evolution as the change in gene frequency of a population over time. Explain the historical and current scientific developments, mechanisms and processes of biological evolution.

Indicator 20, Grade 10

Recognize that a change in gene frequency (genetic composition) in a population over time is a foundation of biological evolution.

Materials

- Computer with access to the Internet
- Paper and pen

Pre-Viewing Activity – Prepare to Learn

When you walk through the supermarket, notice the variety of fruit and vegetables. The different types of apples, tomatoes and even lettuce are really quite amazing. The same species of plant can be grown in an array of shapes, sizes and colors. A question to ask your students is, why?

While some of the initial qualities of the fruits and vegetables found on market shelves may be an accident of natural selection, some of these qualities have become prized enough by producers and consumers to be developed and enhanced through selective breeding.

Some of the more evident qualities bred into fruit and vegetables are taste, texture, color and shape, and some of the less evident ones are related to pest resistance and harvesting. What qualities the grower chooses to emphasize are often related to the central purpose of the fruit. In other words, in the case of a tomato, is it going in a sauce or on a salad?

To a grower, how important might be the quality of firmness in a tomato, especially if it is going to be shipped over a long distance? While the

qualities of size, softness and juiciness might suit a garden variety tomato, think about how that same tomato might look after a train ride from California to Ohio, packed with thousands of other tomatoes. It takes a tough tomato to make a long journey and arrive at its destination intact.

Another consideration might be the ability to manage the crop as it is being grown. Some of the qualities are not so evident to the consumer, but important to the grower might be pest resistance, need for water and the ability to harvest. The cost to manage an acre of tomatoes might be several thousand dollars more or less depending on the type of hybrid seed selected.

While a thousand dollars for a pound of hybrid seed might seem expensive, the qualities inherent in that seed might save the grower thousands of dollars in time and material costs over the course of a season.

Vocabulary

- Selective breeding
- Natural selection
- Hand pollinated
- Hybrid plants
- Solids ratio
- Machine harvesting
- pH
- Human interface
- Mouth feel

Related Discussion Items

- What might be some of the advantages associated with bush variety tomatoes vs. vine type?
- Why would a tomato be bred to be very firm, what might be some of the advantages?
- What might be some of the disadvantages?
- The cost of seed, 80 to 1,000 dollars per pound.

Activity

Once the cognitive map is complete, follow up with a short guided discussion of some economic, social and environmental benefits of selective breeding. This discussion might evolve around how cost savings are related to: harvest, firmness and pest resistance.

Quiz

1. Most of the plants used in canning are hybrids.

   True or False

2. Tomatoes have been selectively bred to make them easier to harvest.

   True or False

3. There are very few financial costs associated with the science of selective breeding.

   True or False

4. The science of selective breeding has very little or no benefit for the consumer.

   True or False

5. Plant hybrids have led to a reduction of pesticide use, and as a result have less impact on the environment.

   True or False

Related Lesson Plan

Investigating Natural Selection
(ORC# 426)

How might biological change have occurred and been reinforced over time? This activity, adapted with permission from BSCS Biology: A Human Approach, simulates the principles of natural selection and requires three class periods to complete. Concepts that are developed include: how species evolve over time; natural selection provides a scientific explanation for the fossil record of ancient life forms; and some living organisms have the capacity to produce populations of almost infinite size, but environments and resources are finite.

Modeling Mendel's Pea Experiment
(ORC# 843)

This modeling activity allows students to discover for themselves what Mendel uncovered in his famous pea experiments. It is an excellent introduction to Mendelian genetics which generates discussion and stimulates interest in Mendel's principles. Students are encouraged to use the same observation and critical thinking skills that Mendel used.

Cracking the Code of Life
(ORC# 61)

This site, maintained by the Public Broadcasting System (PBS), is a companion to the NOVA television special, Cracking the Code of Life, which chronicles the scientific race to complete the human genome. A Genetic Future Survey asks viewers to offer their opinions on genetic research, and a

timeline traces the evolution of an understanding of genes from the early days of Pythagoras to the modern Human Genome Project. Animations provide journeys within the double helix and offer a glimpse into what scientists see as they explore stretches of DNA. A sample section, Sequence for Yourself, illustrates the methods involved in the decoding process. Fragmentation using restriction enzymes is discussed, along with the cloning, detection, and assembly stages. Transcripts of interviews with three key scientists in the field--Francis Collins, Eric Lander, and Craig Venter--reveal the critical nature of balancing curiosity about and fear of genetic determinism. A glossary of key terms supports the text, along with links to additional web sites. There is also a teacher's manual that contains suggestions for instruction and inquiry-based activities for concept extension.

Educational Resources

Additional Resources Using: D3A2

DATA DRIVEN DECISIONS FOR ACADEMIC ACHIEVEMENT D3A2

Search String = agricultural machinery
food engineering
fruit and vegetable harvesting

The **D3A2** helps educators analyze data, and then points them to resources such as lesson plans, assessments and activities designed specifically to address the academic need identified by the data. In addition to linking content to data analysis, educators will have general search capabilities to locate education content resources aligned to the Ohio's Academic Content Standards. Examples of the state resources queried are:

INFOhio
http://www.infohio.org/

Ohio Resource Center
http://ohiorc.org/

Other Resources

OSU Fact Sheet: Canning Tomatoes
http://ohioline.osu.edu/hyg-fact/5000/5336.html

OSU Fact Sheet: Growing Tomatoes in a Home Garden
http://ohioline.osu.edu/hyg-fact/1000/1624.html

U.S. Department of Agriculture: Educators and students
http://www.usda.gov/wps/portal/!ut/p/_s.7_0_A/7_0_1OB?navtype=AU&navid=EDUCATOR_STUDENT

California Tomato commission: California Tomato commission
http://www.tomato.org/splash.html