



What is Plant Breeding?

Skill Level: Senior (14-18 years old) or 9-12th grade

Learner Outcomes:

Understands that plant breeders use science to solve problems such as changes in climate.

Education Standard(s):

NSES: Science and Technology; Science in Personal and Social Perspectives; History and Nature of Science

NETS: Creativity and Innovation; Research and Information Fluency; Critical Thinking, Problem Solving and Decision Making

Next Generation Sunshine State Standards:
SC.912.L.17.8; SC.912.L.17.12;
SC.912.N.2.5; SC.912.N.4.2;
SS.912.A.1.6; SS.912.G.5.3;
SS.912.G.5.6

Success Indicator:

Recognizes that plant breeders work to solve problems that affect our world.

Life Skill(s): Decision making, critical thinking, team work, and communication

Tags: plant breeding, crop wild relative, American Chestnut Blight

Time Needed: 90 minutes

Why do we need new varieties of plants?

Plant breeding is both the art and science of changing plant genetics to help humankind. Plant breeders create plant varieties that have higher yields and are more resistant to drought and disease. New plant varieties also often improve plant nutrition and cut costs by allowing farmers to grow more food on less land using fewer resources. These factors are extremely important as our world population continues to grow and as we experience changes in our environments and climate over time.

Ancient farmers used the process of *selection* to find and grow the best and most fruits, grains, and vegetables. Selection was the earliest form of plant breeding. Early farmers helped domesticate many of the fruits, vegetables and grains that we eat today. In fact, the wild relatives of many crops look nothing like their modern descendants. Today, plant breeding is more of a science, and plant breeders use their knowledge of genetics and a range of techniques to produce new and improved varieties of plants. Advances in molecular genetics have allowed plant breeders to be even more precise.

This lesson will introduce the concept of plant breeding and crop wild relatives through two activities:

- Crop Wild Relative PSA
- Case study of the American Chestnut Restoration Project.

Materials List:

access to a word processing or PowerPoint® software, access to the internet to view an online video, MP3 player, digital video camera, flipchart paper and markers, access to a library or internet for research, copies of American Chestnut Case Study

Learn More:

American Chestnut Foundation:
<http://www.acf.org/>.



What to Do:

Introduce the concept of crop wild relatives. Plant breeders have been around for thousands of years. At the beginning of human civilization early farmers picked out the best looking, strongest, and highest yielding plants from of their natural habitats to plant in their gardens, and began to *domesticate* that crop. A domesticated plant is one that has been taken from the wild and had its life cycle, behavior or appearance changed as a result of plant breeding by humans. All the fruits and vegetables in your local grocery store started out thousands of years ago as wild plants growing in the fields and forests of our ancestors. These wild plants are called *crop wild relatives*.

In the "Old World," (Asia, Europe, and Africa) farmers began domesticating plants about 5,000 years ago. In the "New World" (North, South and Central America) domestication of plants began 3,000 years ago. Why do you think New World Farmers started later? Allow youth to discuss reasons why.

All domesticated crop plants have wild relatives related to what you see today in a supermarket. Some of these wild plants look similar to their modern-day, domesticated versions, others do not.

Divide the youth into groups of 3-4 and show them the 6-minute video from Biodiversity International titled, "Unlocking the Secrets for Crop Wild Relatives." This video is located at: <http://www.cropwildrelatives.org/crw.html>. Ask each group to prepare a short (90 seconds or less) public service announcement on how crop wild relatives will help farmers cope with changes in climate. Public service announcements (PSA's) are powerful messages designed to help educate citizens about important topics, such as the benefits of plant breeding, and are only available for non-profit organizations. The National Association of Broadcasters suggests that PSA's "should sound like a cross between a news story and a commercial message." Your PSA's should be brief, well-written in a "conversational" manner, and interesting. Public service announcements can be utilized in three mediums:

- Newspaper (written/print PSA's);
- Radio (audio PSA's); and
- Television (video PSA's).

Students can create their PSA as a PowerPoint© presentation, MP3 player recording, or a U-tube style video. Allow youth 45 minutes to an hour to prepare their presentation and then ask each group to present their presentation. After each presentation, have the youth critique each other. Discuss the strengths of each presentation.

- Which ones were the most effective?
- How could they change their presentation to be a more effective PSA?
- Was one form of media more effective than another (MP3 versus PowerPoint©, for example)?

Did You Know?

American chestnut tree seeds, also called "chestnuts," grow inside "burs." The burs have long sharp spines that protect the seeds until they are fully mature.

Glossary Words

Plant breeding
Selection
Domesticate
Crop wild relatives
American Chestnut

Related Activities

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



Case Study on the American Chestnut Restoration: 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 study about how plant breeders are working to bring back the American Chestnut to the eastern United States. Then students role play the different viewpoints of the people involved.

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, then an additional 20-30 minutes to research their viewpoint either in a library or online. Ask each group to prepare a presentation and flow-chart that includes answers to the following questions:

- What are the problems or issues that your viewpoint is faced with?
- How does your field of expertise relate to the other fields?
- How could you collaborate with the others to help the restoration?
- Are there any potential problems or conflicts that you might encounter while working with the other groups?
- How would your field of expertise been different in 1890? In 1940? Twenty years from now?

After each group has given their presentation, ask them to revise their flowcharts based on any new information that they learned from the other groups. Close by helping the group find commonalities and ways to work together amongst the different viewpoints. The processing questions at the end of this lesson will help.

TALK IT OVER:

Share. . . .

- What were some of the things that were hard to understand when you first started learning about plant breeding and crop wild relatives?
- How did you feel about representing a viewpoint that may be different from your own?

Reflect. . .

- Why is it important for other people to know about plant breeding?
- What did you learn in a group that you might not have learned alone?

Generalize. . . .

- What did you learn about plant breeding as a result of this activity?
- How will learning about plant breeding help you?
- What other kinds of problems do you think plant breeders could help solve?



Apply. .

- Is there anything you will do differently as a result of what you learned today? If so, what?
- How can what you learned today help you in other situations in the future?

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Case Study on the American Chestnut

Scenario:

The American chestnut tree once reigned supreme in the eastern United States. The tree was nicknamed “The mighty giant” because it could grow as tall as 150 feet and its trunk could reach up to 10 feet in diameter. The American chestnut is a fast growing tree that is prized for its valuable wood that is naturally resistant to rot. Until chestnut blight disease killed the tree back, one in four trees in the eastern United States woodlands were American chestnut. The American chestnut is a prolific bearer of delicious nuts, providing food for both humans and wildlife. Around the turn of the 20th century, a fungus (*Cryphonectria parasitica*) was accidentally introduced to America, most likely from imported chestnut wood or seedlings from Japan or China. This fungus, called American Chestnut Blight) spreads rapidly and kills the cambium layer of the bark, rendering the tree unable to mature and make seeds (chestnuts) to reproduce. Plant breeders are on the job and are making significant progress in bringing the American chestnut tree back.

Viewpoints:

Plant breeder- You are the expert on how the breeding program is operating to create blight resistant chestnut trees.

Forest/ plant pathologist- You are an expert on plant and tree disease, especially the chestnut blight.

Timber company manager- Your job is to manage timber sustainably, to make a profit but be environmentally friendly.

Wildlife Ecologist- you will be an expert on how the chestnut tree played and will play a role in the forest ecosystem.

Private landowner- You own a large tract of land and are researching if planting blight-resistant chestnuts makes sense economically and environmentally.

Cartographer- You are map expert. Create a map of the former historical range (where mature American chestnut lived before the blight). Create a second map showing where research and trial plantings have begun on blight resistant chestnut trees. What is the prospect of replanting blight-resistant trees in the former historical range?

Research how your viewpoint relates to the American chestnut restoration, and prepare a 2-3 minute presentation. Remember that you are representing the viewpoint of that person, not your own personal viewpoint. On newsprint paper, prepare a flowchart to demonstrate how your group’s viewpoint related to the other viewpoints. Include the following in your presentation:

- What are the problems or issues that your viewpoint is faced with?
- How does your field of expertise relate to the other fields?
- How could you collaborate with the others to help the restoration?
- Are there any potential problems or conflicts that you might encounter while working with the other groups?
- How would your field of expertise be different in 1890? In 1940? Twenty years from now?