

## Chestnuts in the Classroom: Compare and Share



**Teacher Background:** The image on the left, taken in the mid- to late 19th century, shows us just how large and abundant the American Chestnut was in Eastern U.S. Forests. (Photo courtesy of TACF.) The image on the right, taken in 2015 at [Natural Lands Mariton Wildlife Sanctuary](#) in PA shows the state of the American Chestnut more recently.

### Compare and Share

#### **Part 1: Compare**

1. Show students the 2 images without context. First, ask students to jot down what they notice about each individual picture (make observations; perhaps they can come up with 5-10 things.)
2. Then have students compare/contrast the two images and develop a list of similarities and differences between the two images.
3. Ask students to jot down at least one question they have about the observations they made between the two images.

#### **Part 2: Share**

4. Once students have had a few minutes to process the information in the images on their own, have students share with a partner the different things they observed and any similarities and differences that stood out.
5. Ask the partners to develop an additional question together about what they noticed.
6. Student groups can share out with the larger group any observations or questions that came up during small group discussion and teacher can record these visibly for further investigating.

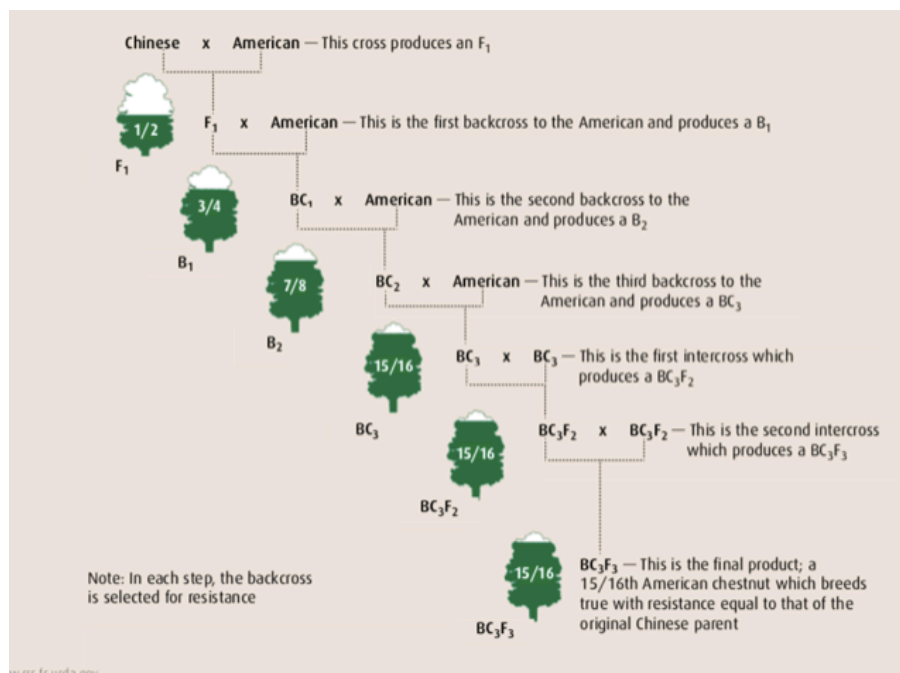
### Connections to Biology and Environmental Science

After students' curiosity has been sufficiently sparked, use the resources listed on the following pages to help students learn about the story of the American Chestnut tree. Then return back to these two phenomenal images and have students 1) explain what is now going on in the two images and 2) answer any of the questions that they are able to answer with the information they have gathered from the lesson.

An additional lesson for the American Chestnut can be found [here](#).

## Data Play: Breeding a Blight-Resistant Chestnut

The graphic featured below is courtesy of [COMPASS Issue 11](#), the U.S. Forest Service Magazine. (This magazine contains dense information on the American Chestnut for further study.) This graphic is demonstrating how breeding the blight-resistant Chinese Chestnut with the non-blight-resistant American Chestnut through a series of breeding events could infuse the genetic material of blight resistance into the American Chestnut genome while maintaining most of the American Chestnuts genes. The green color represents American Chestnut genome whereas the white represents Chinese Chestnut genome.



Have students employ the [12 strategy](#) for analyzing data from BSCS. This strategy involves heavy annotations all over the graphic so give your students ample room or sticky notes.

- **Identify:** What do you see? Students annotate what they see in the figure/data set. They can mark and describe at least three observations (Ex: the  $F_1$  tree has 1/2 Chinese genes and 1/2 American genes; the  $B_1$  has 3/4 American genes)
- **Interpret:** What does the data mean or what “could” the data mean? Students annotate the trends they see occurring or compare/contrast data points to explain similarities and differences. (Ex: the backcross with the American chestnut increases the amount of American Chestnut DNA)
- **Caption:** Students use all of their observations and interpretations to write their own caption for the figure. This is written in complete sentences, in their own words, using what they see in the data and how they interpret it.

## The Mighty Giant: Educational Resources for the American Chestnut

### The American Chestnut Foundation

TACF has produced a variety of [educational resources](#) to help citizens understand the historical importance of the American Chestnut tree, what caused its drastic decline, and what science is doing to help bring the great American Chestnut back into our ecosystems on the East Coast. They even include a [children's book](#) written by high school students to educate young readers about the story of the American Chestnut.

This 4-page, full color publication ([From the Woods: The American Chestnut](#)) tells the history of American chestnut, the blight that wiped it out, and research on blight resistant chestnut trees. Use this article with students to hone in on the economic, ecological, and cultural implications of the American Chestnut tree through the ages. The following guide includes ideas for use in the classroom:



#### *Part 1: The Incredible Tree*

1. Read the Introduction and the section titled “The Incredible Tree.”
2. Why is the American Chestnut considered “the Mighty Giant?” What information from the text supports this nickname?
3. Why was the American Chestnut so important to the American economy? Cite at least three textual examples in your explanation.
4. What do you think the forests on the east coast would look like without the American Chestnut? How would humans and other animals be affected if there were no more American Chestnut

#### *Part 2: The Blight*

5. Read the section titled “The Blight.”
6. What is the blight?
7. How does the blight affect the American Chestnut? Be specific in your description using information from the text.
8. Why do you think scientists are trying to bring the American Chestnut back?



#### *Part 3: Today and Tomorrow*

9. Read the section titled “Today and Tomorrow.”
10. The last sentence of the article states, “If the tree can be restored to even part of its former range and glory, it will be a major accomplishment, and one certainly worth pursuing.” Do you agree or disagree with this statement? Use evidence from the text to support your opinion.

## Further Research on Restoring the American Chestnut: A Blight Resistant Future

After students have gathered information about the American Chestnut before and after the blight, they can learn more about what is currently being done to restore the great tree. This article, [Restoring the American Chestnut with a Virus and Biotechnology](#) from the *American Society of Microbiology* dives deep into the cell biology and molecular biology research being done to genetically modify the American Chestnut to be blight-resistant.

Will the blight end the chestnut?  
The farmers rather guess not.  
It keeps smouldering at the roots  
And sending up new shoots  
Till another parasite  
Shall come and end the blight.

This [very recent article](#) in The New York Times Magazine, fills readers in on the long road toward creating a transgenic chestnut tree. Bill Powell, the primary researcher responsible for discovering the blight-resistant gene and developing the blight-resistant chestnut describes the ups and downs of the research process and his “eureka moment.”



Bill Powell, a State University of New York scientist, holding genetically modified American chestnut tree plantlets. Shane Lavalette for The New York Times

## The Almost Perfect Tree: Evidence-Based Arguments

In the article cited above, the American Chestnut is referred to as “the almost perfect tree” - almost because it is not, on its own, resistant to blight. The perfect tree, in Bill Powell’s opinion, would be 100% American Chestnut + blight tolerance. Present students with this statement and have them use the information they have gathered from all the previous resources to argue whether or not they agree with this statement.

### A Metaphor to Ponder

Geneticists use different methods to produce species with new traits that are better adapted to the changing world and all of its environmental pressures. Two such methods are breeding and genetic engineering. In Bill Powell’s video chat, we learn that breeding is like combining two books that are in two different languages, whereas genetic modification is like adding one sentence to a book, or a few words to a sentence within that book.

1. What is the scientific difference between the process of breeding and genetically modifying organisms?
2. Do you think this metaphor is an accurate summation of the difference between the two processes? Explain your reasoning.
3. How might there be negative aspects to traditional breeding methods?
4. Have your opinions or thoughts on genetic engineering been altered as a result of this information?