Muse

Tree Secrets

American poet Joyce Kilmer wrote "I think that I shall never see, a poem as lovely as a tree." Revered by poets, protected by scientists, and enjoyed by most of the world, trees are more than just beautiful to look at. This issue of MUSE magazine explores how trees are interlinked with each other and with all of humanity.

CONVERSATION QUESTION

What do trees need to thrive?

TEACHING OBJECTIVES

- Students will learn how trees use an underground network to transport nutrients and chemicals.
- Students will learn about the interconnectedness of green redwood trees and albino redwood trees.
- Students will learn about scientific efforts to restore the American chestnut tree population.
- Students will collect evidence to support claims.
- Students will compare and contrast two different types of redwood trees.
- Students will examine solutions to a problem.
- Students will write a persuasive essay.
- Students will complete a classic science experiment demonstrating the function of the vascular system in plants.
- Students will create a map that shows the location of American chestnut trees before and after the blight.



In addition to supplemental materials focused on core STEM skills, this flexible teaching tool offers vocabulary-building activities, questions for discussion, and crosscurricular activities.

SELECTIONS

- The Secret Social Life of Trees Expository Nonfiction, ~960L
- United They Stand Expository Nonfiction, ~960L
- Bringing Back the Giants Expository Nonfiction, ~950L

The Secret Social Life

of Trees

pp. 10–13, Expository Nonfiction This high-interest article will introduce students to the notion that trees are "communicating" through an underground network. Is this simply the exchange of nutrients between fungus and plant or something more?



RESOURCES

• Collect Evidence: Nature's Network

OBJECTIVES

- Students will learn how trees use an underground network to transport nutrients and chemicals.
- Students will collect evidence to support claims.
- Students will write a persuasive essay.

KEY VOCABULARY

- mutualistic (p. 11) a type of relationship between two species of organisms in which both benefit from the association
- allelopathy (p. 13) a biological phenomenon by which an organism produces chemicals to suppress or control the growth of nearby competing species
- superorganism (p. 13) a group of similar organisms that work together in an organized way, such as a bee or ant colony

ENGAGE

Conversation Question: What do trees need to thrive?

Present the title of the article: "The Secret Social Life of Trees." Then ask students to name books and movies in which trees "communicate." (Examples: Tree of Souls in *Avatar*, Whomping Willow in *Harry Potter and the Prisoner of Azkaban*, Grandmother Willow *in Pocahontas*, Treebeard in *The Lord of the Rings*, the apple trees in *The Wizard of Oz*) What traits are usually attributed to trees in fictional stories? How do the trees feel about humans? Why are the trees communicating?

INTRODUCE VOCABULARY

Introduce this as a *Jeopardy***!**-style learning activity. Provide students with only the definitions of the key vocabulary terms. Inform students that they will revisit these definitions after reading and pose the proper question using words from the vocabulary-rich article. (What is mutualistic? What is allelopathy? What is a superorganism?) Have them formulate 17 more answers needing questions, for a total of 20, and share with other classes as a post-reading activity.

READ & DISCUSS

Pose the following questions to prompt meaningful discussion. Students should use complete sentences and details to answer each question.

- 1. How do trees pass information?
- 2. What is the function of the mycorrhizal network?
- 3. Explain Suzanne Simard's sapling experiment.
- 4. How do plants that aren't capable of photosynthesis get energy?
- 5. Why are some scientists skeptical about the cooperation aspect of the wood wide web?

SKILL FOCUS: Collect Evidence

INSTRUCT: This article presents the reader with information about how trees "communicate" through the "wood wide web." Distribute the *Collect Evidence: Nature's Network* organizer. Instruct students to review the article and highlight sentences that provide evidence to support the claims listed in the organizer. After students have collected evidence addressing the claims, they will record the information in the organizer and cite it.

ASSESS: Collect and review worksheets to assess the students' ability to collect supporting evidence.

EXTEND

Language Arts: Remind students that the article describes a debate between scientists based on this question: "Should trees in a network be considered a single organism?" Have students write a persuasive essay taking a stance. Remind students that persuasive essays must include a topic to argue (given), a strong thesis sentence, evidence to support the thesis, rebuttals to disprove opposing theses, and a convincing conclusion.

Nature's Network

Collect Evidence Gather evidence from the article to support each claim below. Include details and examples. Then cite your findings by using page numbers.

Claim: Trees and fungi rely on each other.
Supporting evidence (P)
Claim: Some scientists believe trees are "super-cooperators" who use mycorrhizal networks to beln each
other out.
Supporting evidence (P)
Claim: Nature provides several examples of how plants use mycorrhizal networks to benefit themselves.
Supporting evidence (P)

United They Stand

pp. 20–23, Expository Nonfiction

Concealed beneath the canopy of thousands of coastal redwood trees exists a tiny forest of albino redwoods. Readers will learn how these pale, small trees are interlinked with their dark green counterparts.



RESOURCES

 Compare and Contrast: Out on a Limb

OBJECTIVES

- Students will learn about the interconnectedness of green redwood trees and albino redwood trees.
- Students will compare and contrast two different types of redwood trees.
- Students will complete a classic science experiment demonstrating the function of the vascular system in plants.

KEY VOCABULARY

- conifer (p. 21) a type of tree that produces cones and has needle-like leaves that remain green all year long
- vascular system (p. 22) a network of fibers and tissues that transports water and nutrients between the roots and the leaves of a plant

ENGAGE

Conversation Question: What do trees need to thrive?

Read aloud this information: "Forests of thousands of coastal redwoods cover the mountains of Northern California and Oregon. This Pacific north coast provides the only environment where these trees can grow." Have students locate this region on a map of the U.S. Pose this question: "Based on their location, what can you conclude that redwood trees need to thrive?" (*Answer:* longitude, climate, continual cool moist air, elevation, etc.)

INTRODUCE VOCABULARY

Post the key terms and discuss the definitions. Then display the following questions and have students supply the correct answers.

- 1. Which tree is NOT an example of a **conifer**?
- a) pine tree b) spruce tree c) elm tree d) fir tree
- 2. Which function is the vascular system NOT responsible for?

a) delivering water b) producing chlorophyll c) transporting nutrients Have students share their answers and explain their reasoning.

READ & DISCUSS

Read the article aloud with the class. Have students reread the article in small groups to answer the questions below. Share responses.

- 1. Why can't albino redwoods harness the sun's energy?
- 2. How are the pale, fragile albino redwoods able to survive?
- 3. Explain the root system of redwood trees.
- 4. How do albino needles acquire resources?
- 5. What might explain why albino redwood trees have high levels of heavy metals?

SKILL FOCUS: Compare and Contrast

INSTRUCT: Students will compare and contrast the green redwood tree and the albino redwood tree. Instruct pairs of students to revisit the text and to underline information that will be helpful for this purpose. Introduce the Venn diagram on the *Compare and Contrast: Out on a Limb* worksheet. Have the partners use information from the article to complete the diagram.

ASSESS: Reconvene and review the worksheet with the class. Have students summarize the information from their Venn diagrams in paragraph form. Collect and assess.

EXTEND

Science Use this classic experiment to demonstrate how plants circulate water and nutrients through their vascular system. **Materials:** White carnations, RYGB food coloring, jars of water. **Procedure:** Show students how to make a fresh cut at the bottom of the stem. Fill jars with water. Then add at least 20 drops of food coloring to get a deep color. Place the freshly cut flower into the jar and leave overnight. **Conclusion:** Discuss results and make a connection to the article's content.

Out on a Limb

Compare and Contrast Use information from the article to compare and contrast the green redwood tree and the albino redwood tree.



Bringing Back the Giants

pp. 34–37, Expository Nonfiction In the early 1900s, a fungus invaded the bark of an American chestnut tree. Readers will learn how the blight went on to kill almost 4 billion of these majestic giants and how scientists are working to restore the population.



RESOURCES

 Problem and Solutions: Fight the Blight

OBJECTIVES

- Students will learn about scientific efforts to restore the American chestnut tree population.
- Students will examine solutions to a problem.
- Students will create a map that shows the location of American chestnut trees before and after the blight.

KEY VOCABULARY

- blight (p. 34) a disease, typically caused by fungi, that makes a plant dry up and die
- saplings (p. 34) young trees
- functionally extinct (p. 36) refers to a species whose population has declined to the point where it can no longer play a significant role in the ecosystem and it cannot reproduce

ENGAGE

Conversation Question: What do trees need to thrive?

Guide a discussion about the different symptoms humans exhibit when they get sick and the treatments that are available. Next, have students consider the same question about animals. Lastly, activate prior knowledge by asking, "What happens when trees get sick?"

INTRODUCE VOCABULARY

Post and review the three vocabulary words. Inform students that all the terms can be found in the article, "Bringing Back the Giants." Have them use the title and the vocabulary terms to predict the content of the article. Revisit predictions after reading, and challenge students to write a summary of the article that includes all three words.

READ & DISCUSS

Reinforce comprehension of the concepts presented in the article by using the following questions to direct discussion.

- 1. What caused chief forester Hermann Merkel to be concerned about the American chestnut trees in New York Zoological Park in 1904?
- 2. Why was the loss of 4 billion American chestnut trees especially devastating for the people of the Appalachian Mountains?
- 3. How do scientists think the deadly fungus arrived in North America?
- 4. What does 3BUR stand for? What is their mission?
- 5. Why is it currently illegal to plant transgenic trees outside of test plots?

SKILL FOCUS: Problem and Solutions

INSTRUCT: Inform students that they will be rereading the article with a partner and highlighting passages that depict the primary problem in the article (A blight caused American chestnut trees to become functionally extinct.) and how scientists are attempting to solve it. Distribute copies of the *Problem and Solutions: Fight the Blight* graphic organizer. Tell students they will explain each solution.

ASSESS: Have students peer-review worksheets by sharing completed worksheets with another pair of students. Circulate as they discuss.

EXTEND

Geography: The American chestnut tree once stood 100 feet tall and grew as far south as Alabama, west through Tennessee, and as far north as Maine. Have students use the map on the bottom of page 36 to list the states where the American chestnut thrived before the 20th century. Then have them research where small numbers of these trees grow today. (WV, VA, DE, MD, NY, PA) Provide students with a blank map of the U.S. and have them use this information to create a new map that shows the existence of trees before and after the blight infected the species. Students should include a map key.

Fight the Blight

Problem and Solutions Reread the article and highlight passages that tell how the three processes below are being used to restore the American chestnut tree population. Explain each method using details and examples. (3BUR)

What methods are scientists using to restore the American chestnut tree population?
Breeding:
Biotechnology:
Biocontrol United for Restoration: