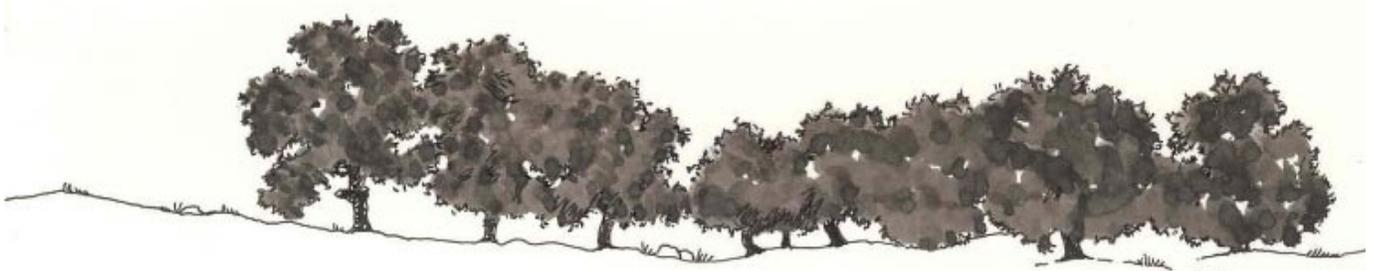


Trees in Trouble -

Sudden Oak Death

A Resource for Educators
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California's native oaks offer serenity, beauty, and so much more to our landscape. Oak woodlands profoundly affect the variety and abundance of wildlife, providing food, water, cover, and space for approximately 350 vertebrate species. Oak woodlands are also the basis for watersheds that protect drinking water for millions of Californians. The oaks face a new threat to their existence - Sudden Oak Death.



The Oak Community

California's native oak landscapes are very diverse and widespread, covering nearly 11 million acres statewide. From the Pacific shore to high desert slopes, mingling with redwood trees to the north and cactus to the south, oaks are included in many kinds of forests, woodlands, and chaparral communities. Oak woodlands provide forage for grazing animals, habitat for hundreds of wildlife species, and protection for water quality. Oaks give our state its character - golden hills dotted with deep green trees.

Trees in Trouble

Despite growing attention by Californians toward protecting individual oaks, California's oak woodlands remain a community at risk. In many areas of the state, oak populations are experiencing little or no tree replacement. Without regeneration, the sustainability of oak woodlands are in jeopardy. This decline, as well as concerns about loss of habitat and open spaces, are prominent reasons for studying oak communities. An especially timely concern is the recent advent of the disease Sudden Oak Death that has already killed tens of thousands of oaks and tanoaks and threatens the larger oak community.

What is Sudden Oak Death?

Sudden Oak Death is a forest disease that kills black oak, canyon live oak, coast live oak, Shreve's oak, and tanoak and also infects many other plant species. The disease is caused by a recently discovered pathogen (disease causing agent) called *Phytophthora* ("Phy-TOFF-thoruh") *ramorum*. It was originally named "Sudden Oak Death" due to the rapid color change from green to brown of the leaves of infected oaks and tanoaks.

Counties currently known to have Sudden Oak Death:

Alameda	Napa
Contra Costa	San Mateo
Humboldt	Santa Clara
Marin	Santa Cruz
Mendocino	Solano
Monterey	Sonoma



Plants in California confirmed to be affected:

bay laurel	coast redwood	manzanita
black oak	coffeeberry	rhododendron
bigleaf maple	Douglas-fir	Shreve's oak
buckeye	honeysuckle	tanoak
canyon live oak	huckleberry	toyon
coast live oak	madrone	Western starflower

What causes this disease?

In July 2000, University of California researchers discovered the cause of this disease: a previously unknown species of *Phytophthora* (a fungus-like organism). *Phytophthora* species are known for causing plant diseases around the world (the name itself is Greek for "plant destroyer"). This new species was named *Phytophthora ramorum* because of its tendency to cause infection on branches ("ramus" is Latin for branch). These aggressive pathogens attack and kill healthy plant tissue, often causing the death of the plant.

How are oaks affected?

Infection may produce a "bleeding" or oozing symptom on the trunks of oaks and tanoaks called cankers. As the disease progresses, the canker may extend all the way around the trunk ("girdling" the tree). Weakened trees are susceptible to attack by beetles and decay fungi, which often invade trees infected with *P. ramorum* and may hasten the death of trees.

How does the disease spread?

Researchers have found abundant spores on the leaves and twigs of hosts such as bay laurel trees and rhododendron after rainy periods. These spores may be naturally dispersed through wind-blown rain. "Artificial" or human-mediated spread can occur through movement of infected plants, plant parts, and possibly soil.

STUDENT ACTIVITIES

Getting Ready

These activities provide your students the opportunity to learn more about healthy native oaks and ways they can help stop the spread of the Sudden Oak Death (SOD) pathogen.

Acorn Planting

Grades: grades 3-8

Subjects: science, math

Skills: observing, organizing, comparing and contrasting, measuring, evaluating, analyzing information

Materials: 100+ acorns, 4-gal. potting soil, 3 plastic flower pots (very clean), kitchen scales, plastic bags

Time: 2-3 class periods



At this time, we recommend that you plant acorns of oak species that are not known to be hosts for the pathogen, such as valley and blue oak. Collect enough acorns (at least 100 for a class of 30

students) so that each student can have an opportunity to complete these activities. Harvest or collect acorns from healthy trees during the months of August-October. Choose acorns that are greenish-brown, firm, and plump. Include a few that are damaged or appear to have insect holes. Set aside at least one acorn per student to be used for Part C. Rinse the acorns and store them in a plastic bag in a cool place (or refrigerate).

Part A.

Give each student an acorn and ask them to describe what can be found inside this seed. After all ideas are shared, explain that acorns are baby oaks surrounded by all the nutrition they need to grow into a seedling. Pose additional questions such as:

- What happens if the acorn doesn't have enough food for the young plant to germinate (grow)?
- How can we tell if the seed is healthy without cracking it open?
- What will you need for your seed to grow? (soil, water, sunlight)

Part B.

Either as a whole group or independently, have students draw a picture of their acorn, describe what it looks like (size, color, shape, distinguishing marks), then weigh it and measure its length. Record this information for individual acorns, then create a class chart and calculate an average length and weight.



Have students form a hypothesis about whether an acorn placed in a cup of water will sink or float. Acorns that are unhealthy or have been damaged by insects will usually float to the top. Place each acorn in a cup of water and determine if it sinks or floats. Choose an acorn with a pinhole to open and inspect it for insect larvae activity.

Organize the students into three teams. Have each team place their acorns in an unsealed plastic bag and record its weight. Team #1 will refrigerate their acorns, Team #2 will leave their bag of acorns at room temperature, and Team #3 will place theirs next to a heater or under a lamp. After one week, each team will reweigh and record the weight of their bag of acorns and calculate the amount of weight change. Compare and discuss these results. This activity will help illustrate the importance of acorn storage conditions.

Part C.

This activity will help students gain an understanding that each seedling needs enough soil, water, sunlight, and space to survive. Give each team 2-3 containers (gallon size flower pots work well) with potting soil. In one container put only one acorn and in the others, crowd in the rest of the acorns. Place the containers in an area with sunlight. Have the students hypothesize about what will happen. (After the acorns germinate, students may want to "thin-out" seedlings from one of the crowded containers to see what will happen.) Make weekly observations and finally, ask students to draw conclusions about growing conditions and healthy seedlings.

Sudden Oak Death Activities

Visit the California Oak Mortality Task Force website (<http://www.suddenoakdeath.org>) for more information about SOD and *Phytophthora ramorum*, as well as to obtain photographs and pamphlets to use in the following activities.

Sudden Oak Death ...On the move

Grades: 3-8

Subjects: science

Skills: observing, comparing and contrasting, evaluating, analyzing skills

Materials: photographs, pamphlets on SOD, white paper, hand lenses

Time: one class period

Background Information: So far, we know that the pathogen is spread through plant material, and even wind-blown raindrops! Use this activity to demonstrate how humans can unknowingly assist in moving the pathogen to unaffected areas and how we can help stop this spread.

Obtain photo-cards or information sheets that illustrate the symptoms of the pathogen on oaks and other host plants. Arrange these for students to view. Describe how it impacts trees and especially how rain splash and movement of soil may affect the spread of the disease.

Place white paper on the floor and ask some or all students to take off one of their shoes and tap it over the paper. Even on the cleanest shoes, there will be some "dirt" that falls onto the sheet. Discuss with students how cleaning our shoes, car and bike tires, and dog's paws after walking in the forest can help stop diseases such as SOD from spreading.

SOD Experts

Grades: 4-8

Subjects: science, language arts

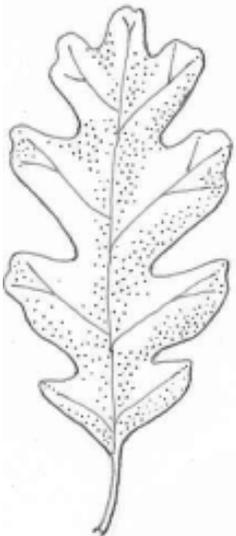
Skills: gathering and analyzing information, hypothesizing, formulating questions, drawing conclusions, communicating

Materials: access to the Internet, list of websites about SOD

Time: 2-3 class periods

In the short time since scientists have identified and begun to understand *Phytophthora ramorum*, a lot of interesting and new information has been learned about this plant pathogen. Nevertheless, a great number of research questions have yet to be answered.

Have students search the Internet sites listed in this handout. Have them choose one site to look at in detail, and ask them to download information or take notes on the topics covered.



Once they have become familiar with SOD information, ask them to imagine that they'll contact a SOD "expert" to ask questions about the disease. Ask them (as individuals or in pairs) to make a list of questions they have about this disease and share these questions with the class. A follow-up option is to invite a "guest expert" or send the list of questions to the contact listed on the website they visited.



Resources

For more information on the oak community, visit the following sites:

California Oak Foundation
www.californiaoaks.org

UC Integrated Hardwood Range Management Program
danr.ucop.edu/ihrmp

For up-to-date information on SOD, go to the California Oak Mortality Task Force website:

www.suddenoakdeath.org

Trees In Trouble - Sudden Oak Death

This bulletin was produced by the California Oak Mortality Task Force
<http://www.suddenoakdeath.org>

Artwork provided by Jo Smith

Sources:

"Investigating the Oak Community: A Curriculum Guide for Grades 4-8," Kay Antunez de Mayolo for the California Oak Foundation, 2000. 510-763-0282
<http://www.californiaoaks.com>