

Redwoods and Climate Change Educator Guide

A resource for using QUEST video and audio in the classroom

QUEST SUBJECTS

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| <p>Life Science</p> <p>Earth Science</p> <p>Physical Science</p> | <p>Biology
Health
Environment</p> <p>Geology
Climate
Weather
Astronomy</p> <p>Physics
Chemistry
Engineering</p> |
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CA SCIENCE STANDARDS

Grade 5

Life Sciences

2. (f, g) Plants use carbon dioxide and energy from sunlight to build molecules of sugar and release oxygen; plant and animal cells break down sugar to obtain energy, a process resulting in carbon dioxide and water (respiration).

Grade 7

Cell Biology (Focus on Life Sciences)

1. (d) Mitochondria liberate energy for the work that cells do and chloroplasts capture sunlight energy for photosynthesis.

Grades 9-12

Ecology

6. (b) Students know how to analyze changes in an ecosystem resulting from changes in climate, human activity, introduction of nonnative species or changes in population size.

QUEST MEDIA FOR TEACHING ABOUT REDWOODS AND CLIMATE CHANGE

You may comment on the stories by posting a reply in the box found at the bottom of each of the story pages.

Watch “Redwoods and Climate Change”

<http://science.kqed.org/quest/video/redwoods-and-climate-change/>

- Follow a group of UC Berkeley scientists to the top of a 320-foot redwood in Mendocino County. See how scientists are trying to predict how the remaining ones and their descendants might fare in the face of climate change in the decades to come.

Watch “Science on the SPOT: Measuring Redwood Giants”

<http://science.kqed.org/quest/video/science-on-the-spot-measuring-redwood-giants/>

- Learn how ecologists measure redwood giants and discover how these ancient trees respond to climatic change.

Listen to “California’s Redwoods Face Climate Change”

<http://science.kqed.org/quest/audio/californias-redwoods-face-climate-change/>

- After a century of logging, California’s old-growth redwood forests are only a fraction of what they once were. Today they face a new threat.

TOPIC BACKGROUND

Old-growth redwoods faced intensive logging a few centuries ago. Only about five percent of the trees remain. Today’s redwood forests are confined to a narrow geographical range along the West Coast of North America. Now scientists worry that these ancient giants might be susceptible to recent rapid climate change.

Redwoods can grow to great heights. Researchers must carefully climb to the top of the towering canopy in order to position sophisticated weather-detection equipment. Ecologists are very careful to not damage a redwood while they climb to the canopy to conduct research. With the use of their equipment and computer-modeling software, scientists can monitor many physiological and environmental changes, such as height, girth, surface area and humidity. By analyzing these data, they can better understand how redwoods respond to climate change.

Coast redwoods depend on fog for as much as 40 percent of their water. In Mexico, California and other places, scientists have discovered that nearly a third of the water has disappeared. Moreover, redwood canopies support a diverse ecosystem, a complex network of plant, animal and microbial organisms that mirrors the richness found in tropical forests. Consequently, researchers imagine a future where the redwoods require human help to protect this richness of diversity.

Additional background resources:

NPS: A Quest at Muir Woods <http://www.nps.gov/muwo/forkids/index.htm>

Redwoods Teacher Toolkit <http://education.savetheredwoods.org/kit/index.php>

VOCABULARY

Cambium

a layer of tissue between the inner bark and the wood that forms the annual rings in woody plants

Canopy

the top layer in a forest that is formed by the crowns of trees

Climate change

a long-term, significant change in weather patterns such as temperature or precipitation

Fog

water vapor condensed to fine particles in the air that differ from clouds because they are so near to the ground

Old growth

forest or woodland having a mature or overly mature ecosystem more or less uninfluenced by human activity

PRE-VIEWING

- What do you know about redwoods?
- What do you know about climate change?
- How do you suppose scientists study the effects of climate change on trees?

VIEWING FOCUS

- Where are ancient redwoods located? What are the historical and ecological reasons why these redwoods are confined to such a narrow geographic range?
- Why would scientists choose to study redwoods over other trees in order to study climate change?
- Why are teams of scientists installing equipment at the top of redwood trees? How do they avoid damaging the trees during this process?
- Why is it important to collect and understand redwood measurements such as girth, height, surface area and humidity?
- In what ways is climate change affecting redwood forests? What evidence is there to support these observations?
- What are some possible solutions for reducing the negative effects of climate change on redwood forests?

For all media see:

- Segment Summary Student Sheet
http://science.kqed.org/quest/files/imp/QUEST_SegSum_StudentSheet.pdf
- Personal Response Student Sheet
http://science.kqed.org/quest/files/imp/QUEST_PersResp_StudentSheet.pdf

LESSON PLANS and RESOURCES from QUEST, PBS and NPR

Global Climate Change: Understanding the Greenhouse Effect PBS LearningMedia

http://www.pbslearningmedia.org/content/ess05.sci.ess.watcyc.lp_global1/

In this lesson, students learn about ways in which we study past climate change, and reflect on the present condition of Earth's climate. They explore the effects of greenhouse gases on Earth's atmosphere and begin to consider the human impact on global warming.

Global Climate Change: The Effects of Global Warming PBS LearningMedia

http://www.pbslearningmedia.org/content/ess05.sci.ess.watcyc.lp_global2/

In this lesson, students conduct an experiment to learn about carbon dioxide levels found in four different gases. Then they reflect on carbon dioxide production on a global scale. They also look at evidence of global warming in our environment and consider their own role in contributing to global warming.

Climate Connections Interactive Map NPR

<http://www.npr.org/news/specials/climate/interactive/>

This is an interactive map of a year-long expedition around the world to explore how climate changes people and how people change climate.

Tracking Temperature Trends PBS LearningMedia

<http://www.pbslearningmedia.org/content/87e655a2-3d99-478a-bbf9-49232bed9478/>

Take a look at some data scientists study to see what the numbers tell you. This interactive can be used in connection with the "Tracking Temperature Trends" worksheet.

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The Bay Institute
www.bay.org

California Academy of Sciences
www.calacademy.org

Chabot Space and Science Center
www.chabotspace.org

East Bay Regional Park District
www.ebparks.org

Exploratorium
www.exploratorium.edu

Girl Scouts of Northern California
www.girlscoutsnorcal.org

Golden Gate National Parks Conservancy
www.parksconservancy.org

The J. David Gladstone Institutes
www.gladstone.ucsf.edu

Lawrence Berkeley National Laboratory
www.lbl.gov

Lawrence Hall of Science
www.lawrencehallofscience.org

Monterey Bay Aquarium
www.mbayaq.org

Monterey Bay Aquarium Research Institute
www.mbari.org

Oakland Zoo
www.oaklandzoo.org

Stanford University's Woods Institute for the Environment
<http://woods.stanford.edu>

The Tech Museum of Innovation
www.thetech.org

UC Berkeley Natural History Museums
<http://bnhm.berkeley.edu/>

MORE EDUCATIONAL RESOURCES FOR USING QUEST MULTIMEDIA TO ENHANCE 21st CENTURY SKILLS IN TEACHING AND LEARNING

Why Use Multimedia in Science Education?

<http://science.kqed.org/quest/files/downloads/2011/06/QUESTWhyMedia.pdf>

- Read about the importance of using multimedia in the 21st century science classroom.

How to Use Science Media for Teaching and Learning

<http://science.kqed.org/quest/files/downloads/2011/06/QUESTMediaTips.pdf>

- A collection of tips, activities and handouts to actively engage students with multimedia.

Science Multimedia Analysis

<http://science.kqed.org/quest/files/downloads/2011/06/QUESTMediaAnalysis.pdf>

- Give your students the tools to recognize the purposes and messages of science multimedia.

Create Online Science Hikes with Google Maps

http://science.kqed.org/quest/files/downloads/2011/06/QUEST_ExplorationCreation.pdf

- Do you like the science hike Explorations on the QUEST site? Use this place-based educational guide to create similar science-based maps with youth.

Media-Making Toolkit for Science Education

<http://science.kqed.org/quest/education/media-making-toolkit/>

- Are you interested in integrating media making into your classroom or science education program? Find instructions, worksheets and rubrics for implementing simple media-making projects with students.

OTHER WAYS TO PARTICIPATE IN QUEST

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CALIFORNIA'S REDWOODS FACE CLIMATE CHANGE — QUEST RADIO TRANSCRIPT

NOTES AND QUESTIONS

After more than a century of logging, California's old-growth redwood forests are only a fraction of what they once were. Today, they remain in a narrow coastal band that extends from Monterey Bay to the Oregon border. Most ancient redwoods are protected in parks. But now they are facing a new threat, as Lauren Sommer reports.

Walking into a forest of old-growth redwoods, a person can feel very...small. Coast redwoods are among the largest living things on the planet. The trunks of these trees can grow to 25 feet around.

STEVE SILLETT: You see how this tree has this big burn cavity on the side? The tree's top hasn't died back yet.

My guide is Steve Sillett, a botany professor at Humboldt State University. Redwoods are Sillett's passion. He's been studying them for two decades, but not from where we're standing.

SILLETT: From down here, you can tell that they're tall but you can't tell too much about each tree.

To find the real action, Sillett says, you have to go up.

Now climbing a 360-foot redwood isn't for the faint of heart. This tree in the Montgomery Woods State Reserve in Mendocino County is one of the biggest in the park. It's taller than a 35-story building.

SILLETT: We don't use spikes or spurs. We don't injure the tree in any way when we're climbing it.

Sillett and his research partner, Marie Antoine, clip their climbing harnesses onto long ropes that are fixed high in the tree. They pull themselves up with an ascender—a metal clamp that slides up the rope and provides traction.

Sillett was one of the first scientists to explore the old-growth redwood canopy. These treetops are home to an entire ecosystem of animals, fern thickets as big as a bus and even other trees that grow among the redwood branches.

SILLETT: The most freaked out I have ever been was when we found the first salamander up there. And I am 300 feet up in a tree and there is a salamander cruising around.

Today, Sillett and Antoine are doing a complete structural inventory of the tree.

SILLETT: Let's do our first wrap at 40, so I'll go to 40.

Dangling gracefully from ropes, they stretch a tape measure around the trunk.

SILLETT: 321.7



They'll also measure every branch.

SILLETT: We did have one tree that had 472 branches and 206 segments in it, which took about four days.

Sillett and his team are measuring hundreds of redwoods like this as a part of an unprecedented study funded by the Save the Redwoods League. With the data, he generates a 3D model of each tree. Once they measure them again in three years, the models will tell him how much the redwoods are growing. But the world is changing around these forests.

SILLETT: Some years, there's a lot of growth, and some years there's almost no growth. And sometimes there's dieback and recovery. We suspect that the really tall trees, the tallest trees in the world, are among the most sensitive things to climate change.

Tall trees, Sillett says, are already under a great deal of stress. Simply lifting water hundreds of feet from the roots to the tree tops is difficult. And with the temperature and precipitation changes predicted by climate change models, these tall trees may show impacts first.

But scientists aren't just looking into the future. They're also looking at the past.

TODD DAWSON: So this is one of the tools of the trade.

Todd Dawson is a scientist at UC Berkeley. He's holding a skinny tool that pulls a core sample from a redwood tree. The core shows the tree's growth rings.

DAWSON: You can see there's some very large rings here, so it was clear that when this tree was young, it was putting on a lot of growth every single year.

The rings further from the tree's center—the newer rings—look much smaller, though Dawson isn't sure why.

DAWSON: They respond to changes in rainfall in a wetter year or a drier year in how much wood they put on. But not only the rainfall or the temperature is important; for the coastal redwoods, it's also the fog.

Redwoods get their water from two places—rain and California's notorious coastal fog. Dawson says the trees are giant fog collectors. They actually absorb it through their leaves.

DAWSON: The fog is a very important water subsidy for these trees, and it's been declining over the last 50, 60, 100 years.

Dawson and others are looking into whether there's a link between a warming climate and the decline in fog.



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NOTES AND QUESTIONS

DAWSON: We're quite concerned about what those declines in fog actually mean for the future growth of the redwoods that grow along the coast.

And here's where the tree rings come in. By analyzing the oxygen in the wood, Dawson can tell how much of a tree's water came from fog versus rain in any given year. That gives him a forensic record of how the climate has affected the tree's growth. Given that some of these trees are thousands of years old, it's a long record.

DAWSON: We can then put that into models and predict "What are these trees going to respond to in the future?" We may lose redwoods permanently at the drier, warmer ends of their range.

Dawson says if that happens, what they're learning in this soggy forest will help them protect redwoods. That could mean preserving more forests or even planting trees in new locations that one day may become a better environment for redwood trees.

For QUEST, I'm Lauren Sommer, KQED News.