Section IV
LESSONS AND ACTIVITIES FOR TEACHING AND LEARNING ABOUT THE COAST REDWOODS

The following lessons and activities are grouped into four categories; or chapters

Chapter 1: Activities are best done before a trip to the redwoods.
Chapter 2: Activities are intended to be done in the woods.
Chapter 3: Lessons are intended to be used after a trip to the redwoods.
Chapter 4: Lessons and activities that might be done at any time.

Within each chapter, the lessons are arranged alphabetically.

If you do pre-trip lessons, plan how to refer to them while on the trip. If you do post-trip lessons, be aware of ways to prepare the students while on the trip by making observations or asking questions.

While *Redwood Ed* is written for use in teaching about the coast redwoods, most lessons could be used to teach about any kind of tree.

What are “Anticipated Outcomes?”

For each lesson in *Redwood Ed*, I list one or more Anticipated Outcomes. These outcomes are similar to goals or objectives, but are generally not written in the language that teachers would used to write goals or learning objectives. Each user of *Redwood Ed* may have different specific goals and objectives, and may want the students or other learners to demonstrate their understanding in different ways. Classroom teachers may have different goals from docents, who may have different goals from home-schooling parents or park naturalists. The Anticipated Outcomes can help users develop more specific goals to meet their specific needs.

California State Content Standards

Each lesson or activity can help students master one or more of the California State Content Standards in science, math, social studies, or English. In general, these lessons are NOT meant to teach standards to mastery by themselves, but they can be useful in helping students learn the standards.

The California State Content Standards are grouped into "Standard Sets." Each set contains several Content Standards. Some of the lessons in *Redwood Ed* can be used to help teach an entire Standard Set, while others address specific standards within a Standard Set. If an entire Standard Set is addressed by the lesson or activity, that set is indicated with the letters "S.S." If the entire set is not addressed by the lesson, the standard is listed without the "S.S."

Most lessons address more than one standard. Standards (or Standard Sets) that a lesson addresses particularly well are listed as "Focus Standards." Most lessons can

be used to help teach or reinforce additional standards, which are listed as "Other Standards." The Focus Standards are listed by number and paraphrased. The Other Standards are listed only by number. See Appendix I for California State Standards addressed in *Redwood Ed.*

Project Learning Tree has published a series of booklets that correlate the activities in the 2006 *Pre K-8 Environmental Education Activity Guide* with California Content Standards in Science, English-Language Arts, and History/Social Science. See Appendix III: Organizations, and go to < www.plt.org/cms/pages/21_21_43.html > for updated versions.

Environmental Principles and Concepts
In addition to State Content Standards, California has adopted Environmental Principles and Concepts (EP&C). The EP&C are intended to compliment the standards to provide assistance in teaching Content Standards from an environmental perspective. The EP&C are listed in Appendix I, along with California State Content Standards. The lessons in *Redwood Ed* include references, in abbreviated form, to the Environmental Principles and Concepts that the lessons can help address.

Some activities have potential safety issues such as the use of glass. Always warn students of such issues and insist on safe behavior. Watch for the *Redwood Ed* caution icon.

It is very important for the teacher or group leader to try out activities before asking students to do them, especially in the case of experiments. Always test the activities to be sure that your particular equipment will work and that the instructions are understood.

A word about assessment:
In general, assessment tools have not been provided. Different teachers may wish to assess for different things in different ways. In some cases, suggestions are made regarding assessment tools. In others, criteria, or the content for which one should probably assess are suggested. When using these suggestions to develop assessment tools, be sure that the assessments align with the goals and objectives that you have developed for the lesson or activity.

Chapter 1
Pre-Trip Activities

The activities in Chapter 1 are generally best done prior to a visit to a redwood park or forest. They teach concepts and information that will make the visit more beneficial and provide background information that will increase the students' learning.

A Reminder
All activities should be tried out by the teacher prior to having students do them in order to be sure that the directions are understood and that they can be done with your particular equipment and materials. This is important not only to be sure that the activities will work, but to be sure that they can be done safely.

Such details as time estimates are only approximate; as the teacher, you know your students best.

Be sure to consider the activities in Chapter 4: Activities for Any Time.

The Anatomy of a Giant

ACTIVITY SUMMARY
Students learn the basic anatomy of a redwood tree in the classroom. They then study the anatomy of a real redwood tree.

CONCEPTS TO BE LEARNED
1. Plants such as redwood trees have different parts that have different functions.

STANDARDS ADDRESSED

Focus Standards:

Grade 4: Life Sciences 2.a: Plants are the primary source of matter and energy. Science Investigation and Experimentation 6.a: Students make observations and inferences.

Grade 5: Life Sciences S.S. 2: Plants and animals have structures for various life processes.

Grade 6: Ecology (Life Sciences) S.S. 5: Organisms exchange energy and nutrients among themselves and with the environment.

Grade 7: Life Science: Structure and Function in Living Systems S.S. 5: anatomy and physiology

Other Standards:

Grade 7: Life Science…Evolution 3.1
Life Science…Evolution 3.4

Environmental Principles and Concepts

Principle I: Humans depend on natural systems.
Concept a: Humans depend on natural systems for goods and materials.

ANTICIPATED OUTCOMES
1. Students will increase their knowledge of tree anatomy.
2. Students will increase their knowledge of tree physiology.
3. Students will increase their ability to make and record accurate observations.

GROUPING
Individuals

TIME
Part 1: 30-60 minutes
Part 2: Varies. Can be completed over the course of a field trip

MATERIALS
- ❒ Study Guide: "The Anatomy of a Giant" (one per student)
- ❒ Reference books that show basic plant anatomy
- ❒ Drawing materials and paper
- ❒ Optional: samples of redwood branches, cones, bark, seeds

TEACHER PREPARATION

1. Obtain the materials listed on the previous page.
2. Make transparencies of the Study Guide.

PROCEDURE

1. Have the students use reference books and the Study Guide to learn basic plant anatomy and physiology.
2. While on a field trip to a redwood park, have the students compare the idealized plant anatomy drawings from the reference(s) to a real redwood. Have them note any differences.

VARIATIONS, ADAPTATIONS, DIFFERENTIATION

1. If you have a redwood tree on campus, it can be used, but it is better for the students to see the variation found among several trees.
2. You might bring in samples of branchlets, bark, and needles for students to observe in class, or visit a tree on the campus.
3. You might want the students to learn about the xylem and phloem, the sapwood.

ASSESSMENT

1. Can the students identify the major parts of a tree orally in the field and on a diagram?
2. The study guide can be used for assessment.

ANSWERS TO SELECTED STUDY GUIDE QUESTIONS

1. Students should notice such things as burls, misshapen needles, incomplete cones, twisted trunks, spike top trees, flat top trees, and other variations.

Figure 109

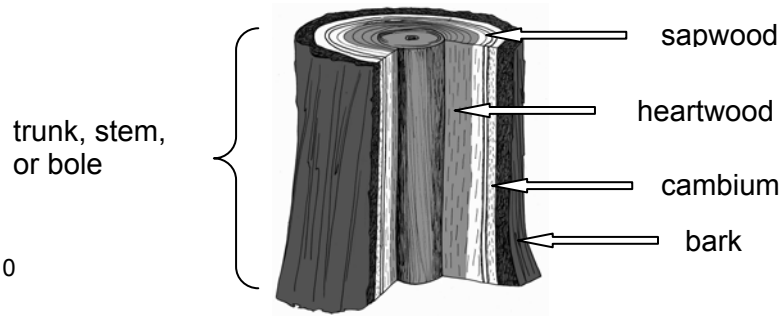


Figure 110

REFERENCES AND RESOURCES

Any basic science text should have information on plant anatomy and physiology.

The Anatomy of a Giant
Study Guide

You already know that plants, including trees, have different parts. They have leaves, stems (trunks or boles), and roots. They may have flowers, or they may produce cones.

Each of those parts has parts, too. A leaf may have a blade and a stem. A flower may have petals and a variety of other parts. Even roots usually have microscopic "root hairs."

If we look at the end of a log, or at a slice of a tree stem, we will see that even the stem of a tree has different parts.

In this activity, you will learn the names of some of the main parts of a redwood tree and what they do to help the tree live.

Procedure:
Part 1: At home or school:

1. Your teacher will provide you with books or other materials that will help you identify the parts of the redwood tree on the diagrams. You might also use resources found on the Internet.

2. As you find out the names of the parts, be sure to find out what they do for the tree (their function).

3. Label the parts of the redwood tree diagrams.

4. As you identify the parts, write their functions (jobs) in the spaces provided. A table has been provided for you.

5. Complete the crossword puzzle.

Part 2: Someplace where you can see some actual coast redwood trees.

You have learned about the main parts of a redwood tree. You have also seen drawings of a "typical" redwood tree. Sometimes actual trees aren't exactly like the "typical" or idealized drawings that we see in books.

Look at actual redwood trees and note (in words and sketches) some ways in which they differ from the idealized drawings that you have seen in books.

Anatomy of a Giant

The diagrams below represent a typical coast redwood tree. Label the bark, cambium, sapwood, heartwood, cone, needle (leaf), branchlet, and stem (trunk or bole).
In the table at the bottom, tell each part's function (what it does to help the tree live).

Figure 111

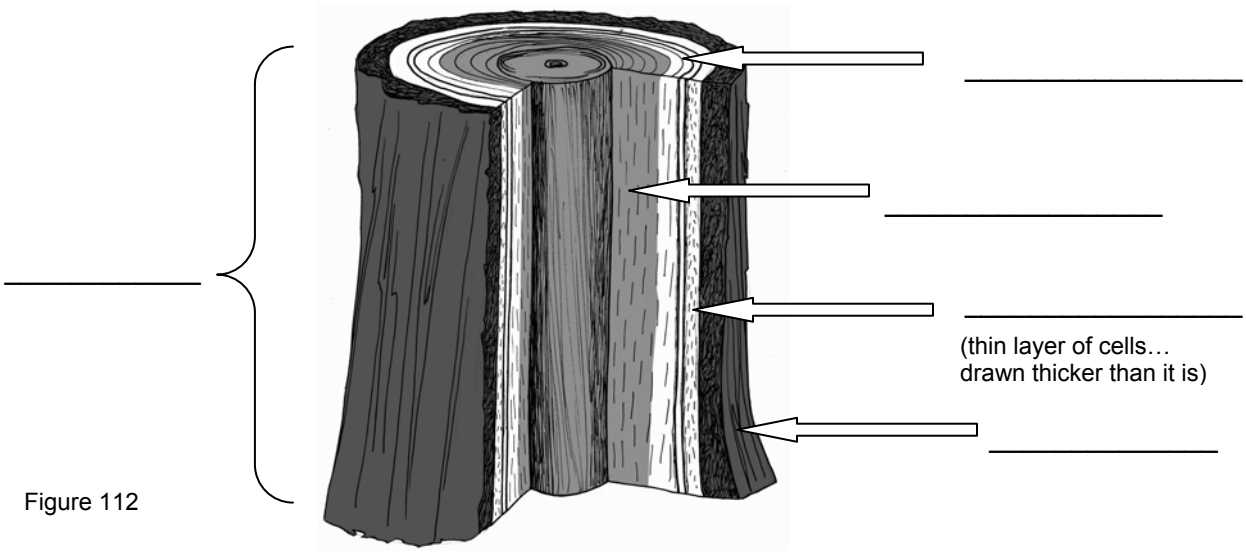
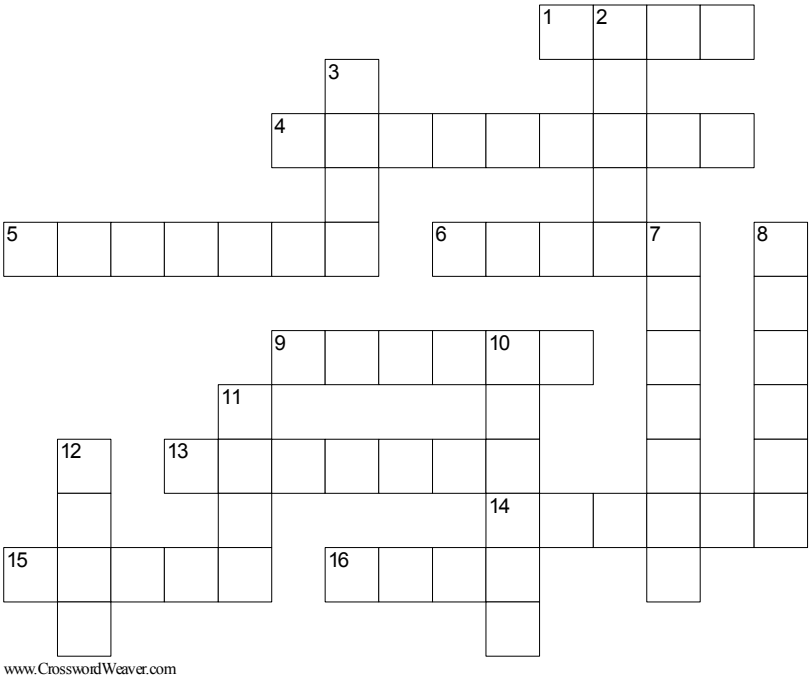


Figure 112

Leaf (needle)	**Branchlet with needles**	**Stem (trunk or bole)**
Cone	**Bark**	**Sapwood**
Heartwood	**Cambium (shown thicker than it really is)**	**Root (not drawn)**

Anatomy of a Giant Crossword Puzzle

Use the words from Anatomy of a Giant and other terms that have to do with the coast redwoods to complete the puzzle below.



Across

1 Fog __ provides water in the summer.
4 non-living center of tree, is dark in color because it has lots of tannins
5 living wood
6 *Sequoia sempervirens* live near the __.
9 redwood leaf
13 produces new wood
14 supports the leaves
15 supports the branches
16 where redwood seeds are produced

Down

2 absorb water and minerals
3 produces a new tree
7 __ are chemicals that help the redwoods resist termites and rot.
8 A __ ring indicates a year's growth.
10 Redwoods provide beautiful __ that is used for building decks.
11 protects redwoods from fire and insects
12 Trees can sprout from this.

Anatomy of a Giant Crossword Solution

The Case of the Runaway Topsoil

ACTIVITY SUMMARY
Students construct stream tables and test the effects of differing slopes and ground covers on erosion rates.

CONCEPTS TO BE LEARNED
1. Running water can erode topsoil.
2. Other things being equal, a greater slope increases erosion rates.
3. Differing types of ground cover can result in different erosion rates.

STANDARDS ADDRESSED

Focus Standards:

Grade 4: Life Sciences S.S. 3: Living organisms depend on one another and their environment.
Science Investigation and Experimentation S.S. 6: Students ask meaningful questions and conduct careful investigations.

Grade 5: Science Investigation and Experimentation S.S. 6: Students ask meaningful questions and conduct careful investigations.

Grade 6: Earth Science S.S. 2: Topography is reshaped by weathering and transportation of sediment.
Science Investigation and Experimentation S.S. 7: Students ask meaningful questions and conduct careful investigations.

Grade 7: Science Investigation and Experimentation S.S. 7: Students ask meaningful questions and conduct careful investigations.

Other Standards:

Grade 4: History 4.1
History 4.3.3

Grade 5: Earth Sciences S.S. 3

Grade 6: History 6.1.3

Environmental Principles and Concepts

Principle II: Humans affect natural systems.

- Concept a: Human populations and consumption affect natural systems.
- Concept b: Human extraction, harvesting, and use of resources affect natural systems.
- Concept c: Expansion and operation of human communities affect natural systems.
- Concept d: Human social systems affect natural systems.

ANTICIPATED OUTCOMES

1. Students will increase their understanding of the causes and effects of topsoil erosion and will understand some ways to reduce erosion.

GROUPING

Two to six students per group, depending on availability of materials

TIME

30-60 minutes

MATERIALS

- ❒ Stream tables: available commercially, or they can be made in a variety of ways with pans approximately 12-16" wide, 16-24" long, 3.5-7" deep (plastic, aluminum, nursery trays lined with plastic, or wooden (caulked and painted)
- ❒ Pieces of wood or bricks with which to create a slope
- ❒ Diatomaceous earth…available from swimming pool supply stores (Diatomaceous earth from garden supply stores may not work as well.) The amount will depend on the size of the stream tables. (It can be dried and used again next year.)
- ❒ Sprinkling can or coffee can with holes punched, or spray bottle
- ❒ Water
- ❒ Towels, sponges for cleaning up
- ❒ A variety of ground cover materials…redwood needle duff, leaves, straw, grass clippings, or? A landscaping company may provide some turf.

TEACHER PREPARATION

1. Obtain materials above.
2. Mix water with diatomaceous earth…

Wearing a dust mask is recommended as diatomaceous earth may irritate your nose. Add enough water so that water sprinkled on the surface runs off, forming a gully, instead of soaking in.

PROCEDURE

1. Always try experiments before having students do them!

2. Prepare the damp diatomaceous earth. Prepare a "hillside" so that the earth slopes towards one end of the pan.

3. Review the water cycle with the students. (See Appendix IV, Sources of Materials, for sources of water cycle posters.)

4. Have students predict what effect different slopes and different types of ground cover will have on the amount of earth that erodes when sprayed with water.

5. Have the students develop data tables that include their predictions, observations, and conclusions.

   Simple data tables might look like the ones below, but it is best if students develop their own for their own experiments.

Slope	Runoff (fast, medium, slow)
Gentle	
Medium	
Steep	

Ground cover	Evidence of erosion (earth at the bottom of the slope…none, a little, lots)
Bare	
Straw	
Live grass	

6. Students use watering cans or spray bottles to create "rain" on the "hillsides." Have them test varying slopes and different types of ground cover.

7. Students look for evidence of runoff or erosion and record their data on the data tables that they developed.

8. While visiting the redwood forest, look for places to point out erosion and hillsides that are and are not eroding.

VARIATIONS, ADAPTATIONS, DIFFERENTIATION

1. Try to find hillsides near your school where you can do similar experiments.

ASSESSMENT

1. Do the students provide accurate and detailed observations, clearly recorded, and are conclusions based on observations?
2. Can students explain the relationship between slope, ground cover, and erosion?

REFERENCES AND RESOURCES

American Forest Foundation: *Project Learning Tree Pre K-8 Environmental Education Activity Guide:* "Water Wonders."

Kaufmann, Jeffrey et al.: *River Cutters.*

Shinkle, Jill: *Creek Watchers: Exploring the Worlds of Creeks & Streams.*

See Appendix IV, Sources of Materials, for sources of water cycle posters.

The Great Tree Cookie Mystery

ACTIVITY SUMMARY

Students examine a variety of rounds ("tree cookies") that show various growth patterns and events in the life of the tree and try to explain the patterns observed.

CONCEPTS TO BE LEARNED

1. Trees grow at different rates during different seasons and under different environmental conditions.
2. One can learn about a tree's growth and life history by studying the annual growth rings.

STANDARDS ADDRESSED

Focus Standards:

Grade 4: Life Sciences 3.a: In any environment, some organisms survive well, some less well, and some don't survive.
Science Investigation and Experimentation 6: Students ask meaningful questions and conduct careful investigations.

Grade 5: Life Sciences S.S. 2: Plants and animals have structures for various life processes.
Science Investigation and Experimentation S.S. 6: Students ask meaningful questions and conduct careful investigations.

Grade 6: Ecology/Life Sciences 5.a: Energy enters ecosystems as sunlight.
Ecology/Life Sciences 5.e: Numbers and types of organisms in an ecosystem depend on abiotic factors.
Science Investigation and Experimentation S.S. 7: Students ask meaningful questions and conduct careful investigations.

Grade 7: Science Investigation and Experimentation S.S. 7: Students ask meaningful questions and conduct careful investigations.

Other Standards:

Grade 4: Mathematics Number Sense S.S. 3.0

Grade 5: Mathematics Number Sense S.S. 1.0, 2.0

Grade 6: Mathematics Number Sense S.S. 1.0, 2.0

Grade 7: Life Sciences 5.b
Mathematics Mathematical Reasoning S.S. 2.0

Environmental Principles and Concepts

Principle I: Humans depend on natural systems.
- Concept a: Humans depend on natural systems for goods and materials.

Principle II: Humans affect natural systems.
- Concept a: Human populations and consumption affect natural systems.
- Concept b: Human extraction, harvesting, and use of resources affect natural systems.

Principle III: Natural systems have cycles on which humans depend and that can be altered by humans.
Concept c: Human practices can alter natural cycles and processes.
Principle IV: The exchange of matter between natural systems and human societies affects the long-term functioning of both.
Concept a: Effects of human activities on natural systems depend on the quantities of resources used and the quantity and characteristics of the byproducts of use.

ANTICIPATED OUTCOMES

1. Students will understand that environmental factors such as sunlight (and competition for sunlight), drought, and fire affect the growth rate of plants.
2. Students will be able to compare the growth rates of trees based on the size of the growth rings in wood samples.
3. Students will describe some possible causes of different growth rates and patterns as indicated by the growth rings.
4. Students will understand some factors that affect the growth of trees and the ways that those factors affect the growth of trees.

GROUPING

Depends on the number of rounds available (preferably 1 or 2 students per round)

TIME

30-60 minutes

MATERIALS

- ❒ Tree rounds that show various growth patterns as described on The Great Tree Cookie Mystery Clue Sheet. The rounds should be numbered by securely stapling a card to them or by a permanent marking pen.
- ❒ Magnifiers
- ❒ Rulers
- ❒ The Great Tree Cookie Mystery Study Guide (one per student or per team)
- ❒ Overhead transparency of The Great Tree Cookie Mystery Clue Sheet (or copies for student teams)
- ❒ The Life Story of a Tree (one per student)

TEACHER PREPARATION

1. Obtain materials listed above.
2. Make a transparency of The Great Tree Cookie Mystery Clue Sheet.
3. Duplicate The Great Tree Cookie Mystery Study Guide and (optional) the Clue Sheet.

PROCEDURE

1. Use a transparency and/or student copies of The Great Tree Cookie Mystery Clue Sheet to explain to students what tree rings are and how to find the age of a round.

2. Use the transparency of the clue sheet, or student copies, to explain some things in addition to age that can be determined by studying tree rounds.

3. Issue the rounds and Study Guides to the students.

4. Have the students complete the Study Guides.

VARIATIONS, ADAPTATIONS, DIFFERENTIATION

1. While on a field trip, look for cut logs or stumps and try to interpret the story told by the rings.
2. Students can make up and illustrate their own stories, including drawing the "cookie."
3. Christmas trees can be cut up to provide rounds that show some of the patterns.
4. See the activity "Slow Growth and Fast Growth in Redwoods."
5. See the activity "Fence Post Study."

ASSESSMENT

1. The activity sheet "The Life Story of a Tree" can be used for assessment.
2. Have students explain orally or in writing what they can deduce from a tree round.
3. The Study Guide can be used for assessment.

ANSWERS TO SELECTED STUDY GUIDE QUESTIONS

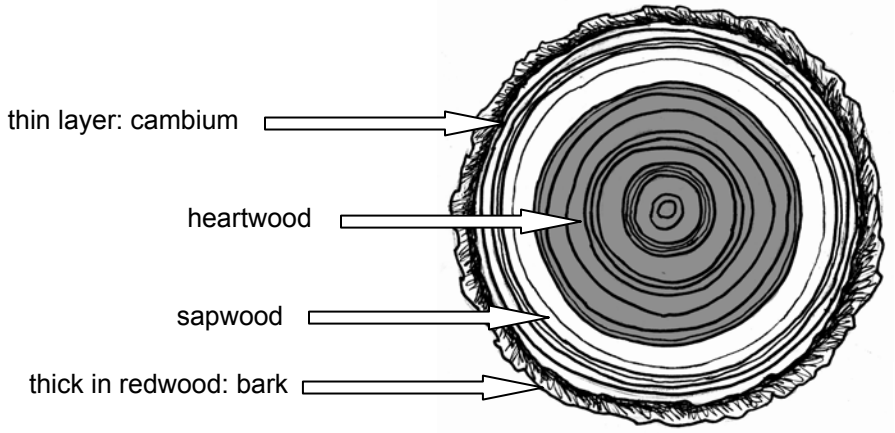
1. Depending on whether cambium is counted, the tree was 18-20 years old when cut.
2. 

Figure 113

3. Average annual growth: With a <u>diameter</u> that was 9 inches achieved in 18 years, 9 inches ÷ 18 years = 0.5 inches average growth in <u>diameter</u> per year. Be sure to point out that this is an average; it doesn't mean that it grew that much <u>each</u> year.

4. Sketches and observations should show the growth patterns, and the explanations should be reasonable and correspond to the information from the Clue Sheet.

REFERENCES AND RESOURCES

Tree cookies can be purchased from various sources. See Appendix IV.

American Forest Foundation: Project Learning Tree: *Pre K-8 Environmental Education Activity Guide*: "Tree Cookies"

The Great Tree Cookie Mystery Clue Sheet

Just like a detective, you can learn to read clues found in evidence. In this activity, you will examine and interpret the evidence provided by "tree cookies," which are slices cut from a tree trunk or branches. Each cookie, or round, provides information about the life of the tree.

As trees grow, a group of cells called the cambium layer produces the cells that become new wood. If the tree is growing rapidly, as it may do in the moist growing season, it produces large cells that form light colored rings. If the tree is growing slowly, as it may do in the late summer and fall, it produces rings of cells that are smaller and darker. A redwood tree will typically produce a light and a dark growth ring each year. Therefore, by counting the rings, you can determine the age of the tree. By measuring the width of the rings, you can tell how rapidly it was growing. (Remember, a year's growth is a light and a dark ring!)

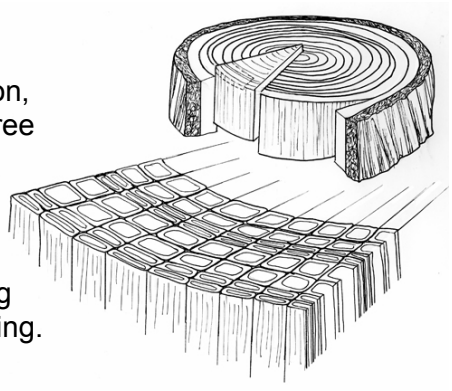
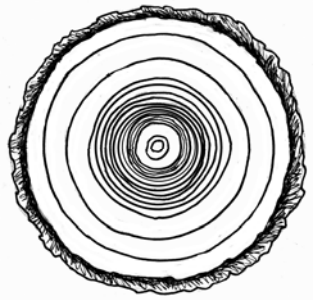
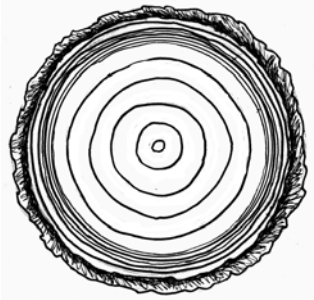


Figure 114

Tree cookies can also tell you about events in the life of a tree. A dark, charred area indicates a fire. A knot is formed when a tree grows around a branch. Sometimes a stub of a broken branch may be found in the cookie, and the tree may have grown over the stub. If a redwood grows on a steep hillside, it may grow more rapidly on the downhill side, which provides extra support. Such a tree will show an asymmetrical growth pattern, possibly forming a "flatiron" shape. Insect attack or drought may slow growth, resulting in suppressed growth with narrow rings. Logging of other trees, a storm, or other factors may open up the forest canopy and result in more sunlight and rapid growth or "release." Some of these growth patterns are shown below.



slow growth, then fast (release)

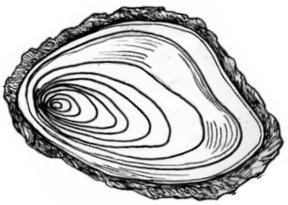


rapid growth, then slow (suppression)

fire scar/rot… healed over

bark damage… healing

parts of branches around which tree grew



buttressing, resulting in a "flat-iron" tree with more rapid growth on the downhill side, resulting in an anvil or (flat) iron shape

Figure 115

The Great Tree Cookie Mystery
Study Guide

1. How old was the tree at the right when it was cut?
2. Identify the following parts of the tree cookie:
   bark, sapwood, heartwood, cambium

   (thin layer of cells): _____

   _____

   _____

   (thick in redwood): _____

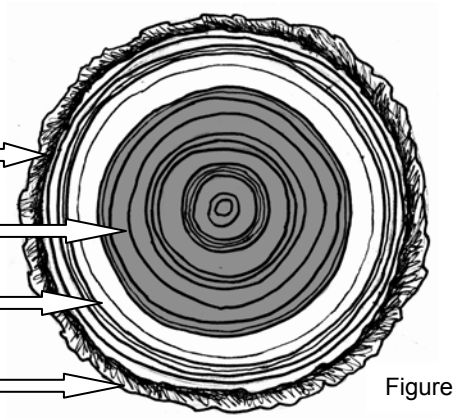


Figure 116

3. If the diameter of the tree drawn above was 9 inches, what was its average annual (yearly) growth rate? Show how you determine the answer.

4. Your teacher will provide you with several "tree cookies." For each one:
   a. Record the number of the cookie.

   b. Sketch the cookie, including any special patterns that it may show. You do not need to sketch every ring, but if some are close together and some are farther apart, show that pattern. Also describe your observations.

   c. Provide an explanation for your observations.

#__ Observation: Explanation:	#__ Observation: Explanation:	#__ Observation: Explanation:
#__ Observation: Explanation:	#__ Observation: Explanation:	#__ Observation: Explanation:

The Life Story of a Tree

A redwood tree's life story is told below. The small circle below represents the tree's first year of growth. Draw rings to indicate the tree's growth pattern. (You might want to draw the rings very lightly in pencil to be sure that you have enough space for 30 annual rings.)

The redwood tree started to grow in a sunny spot near a creek. For the first 5 years, the tree grew very rapidly because there was plenty of sunlight and water and the soil provided plenty of nutrients. Lots of other young redwoods were also growing along the stream, and after 5 years their tops all merged, creating a very shady canopy. The shade slowed down the tree's growth in the crowded forest for the next 7 years. A fire then burned through the forest, but the tree's thick moist bark allowed it to survive with only a scar on the one side where lots of dead branches had piled up. Some of the tree's neighbors, however, were killed, and the forest canopy opened up, allowing more sunlight for the next 4 years. After 4 years of rapid growth, a drought hit the area, and the tree's growth slowed for 3 years. The drought was so severe that more of the tree's neighbors were killed, and when favorable weather returned, the tree started to grow rapidly again. After 6 years of rapid growth, the canopy again closed in, and the tree grew slowly in the shade for the next 3 years. Loggers then came through the area and cut down many of the other trees, resulting in another growth spurt that lasted for 2 years. After 2 years, when the tree was 30 years old, loggers came through the stand again and cut the tree down to make lumber. Before the tree was cut into lumber, though, a tree cookie was cut from the base of the tree and that cookie is drawn below!

The Higher the Fewer

ACTIVITY SUMMARY

By participating in a relay game, students discover that energy and material transferred between organisms in food chains is less than 100 percent efficient.

CONCEPTS TO BE LEARNED

1. As energy passes through a food chain, some is lost to the environment.
2. As material passes through a food chain, some is lost to the environment.

STANDARDS ADDRESSED

Focus Standards:

Grade 4: Life Sciences S.S. 2: All organisms need energy and matter to live and grow.
Life Sciences S.S. 3: Living organisms depend on one another and their environment.

Grade 5: Life Sciences 2.f: Plants use CO_2 and energy from sunlight to build molecules and release oxygen.

Grade 6: Ecology (Life Sciences) S.S. 5: Organisms exchange energy and nutrients among themselves and with the environment.

Environmental Principles and Concepts

Principle III: Natural systems have cycles on which humans depend and that can be altered by humans.

- Concept a: Natural systems have cycles.
- Concept b: Humans depend on and utilize natural cycles and processes.

ANTICIPATED OUTCOMES

1. Students will increase their understanding of food chains, webs, and pyramids.
2. Students will increase their understanding of the impact of their dietary choices.

GROUPING

Whole class in teams of five to seven students

TIME

30-45 minutes, including discussion

MATERIALS

- ❒ Popcorn: about 1 quart per team, plus some to eat after the activity
- ❒ Cones or other objects with which to mark the start and end points
- ❒ Transparencies of the food chain, food web, and pyramid of numbers diagrams from Section I, Chapter 2

TEACHER PREPARATION

1. Obtain the materials listed above.

PROCEDURE

1. It would be helpful if the students have done the food chain activity "Who's for Dinner?," and the food web activity "We're All In This Together" from *Redwood Ed* before doing this activity.

2. Form teams of five to seven students each. If the teams are not equal, have some students run twice.

3. Within each team, assign each student a trophic level such as plant, herbivore, first carnivore, second carnivore, scavenger, decomposer, etc. Assign the student with the largest hands to represent the sun and be first in line.

4. Have the students line up in order behind the sun…sun – plant – herbivore, etc.

5. Discuss the trophic levels represented by each student. Explain that the popcorn represents energy and materials that are to be passed from one level to another.

6. Explain the rules.
   a. The suns will be given as much popcorn as they can hold in their two hands. They may NOT make a pouch out of their shirts, nor may they press the popcorn to their bodies, using their bodies to help hold it.
   b. They are to hold the popcorn only in their hands as they run to the marker or cone, circle it, and return to the next person in the food chain.
   c. The popcorn (energy and materials) is passed to the next person in the food chain, who then runs to the marker, runs around it, returns, and passes the popcorn to the next person in the food chain.
   d. Continue until the entire food chain has completed the relay (including any who need to run a second time because of uneven numbers in the teams).
   e. When the entire team has run the relay, the last person holds the remaining popcorn above his or her head to indicate that the team has completed the relay.
   f. Remind them to run quickly but carefully and not to eat the popcorn that falls on the ground. Tell them that clean popcorn will be provided for eating later.
   g. Discuss the activity. Be sure to relate it to the "pyramid of numbers."
      - Where was most of the "energy" lost? (at exchanges)
      - What would be the effect of having a shorter food chain? (more energy available for the last organism/top carnivore/people)
      - What happens to the energy that is "lost?" (goes into environment, mostly as heat or as chemical energy in waste products)
      - What does this activity imply about people eating as vegetarians? (Vegetarians eat low on the food chain, so agricultural land could support more people eating a vegetarian diet than one that includes meat. Caution the students, though, that a healthy vegetarian diet requires knowledge and careful planning so that it includes the proteins and other requirements of a healthy diet.)

VARIATIONS, ADAPTATIONS, DIFFERENTIATION

1. This activity can be done indoors. Be sure to have cleanup materials ready.
2. Other materials can be used instead of popcorn. Balls are not recommended because they present a hazard to people running.
3. Play another round with uneven teams. This will help emphasize the idea that energy and material are lost at each level, so a shorter food chain results in more energy being available for the last organism… the top carnivore or humans.

ASSESSMENT

1. During the discussion, can students explain what the dropped popcorn represents?
2. Can students tell what happens to the material that is not added to an organism's body?

REFERENCES AND RESOURCES

Roa, Michael. *Environmental Science Activities Kit.*

Ideas for Using Historic Images

ACTIVITY SUMMARY
Ideas for the use of historic photographs in *Redwood Ed* are presented.

CONCEPTS TO BE LEARNED
1. Human activities are undertaken to fulfill wants and needs.
2. Attitudes towards the environment have changed over time and will continue to change.

STANDARDS ADDRESSED

Focus Standards:

Grade 4: History 4.2.1: Describe how the physical environment affects human activities.
History 4.3.3: Analyze effects of the Gold Rush on the physical environment.
Grade 5: History 5.8:Trace settlement patterns with emphasis on the effects of the physical geography.
Grade 6: History 6.1.3: Discuss human modifications of the physical environment.

Other Standards:

Grade 4: Life Sciences 3.a; History 4.2.5, 4.4.2
Grade 6: Earth Science 2; History 6.1.3
Grade 7: Life Science 3.5

Environmental Principles and Concepts

Principle I: Humans depend on natural systems.
- Concept a: Humans depend on natural systems for goods and materials.

Principle II: Humans affect natural systems.
- Concept a: Human populations and consumption affect natural systems.
- Concept b: Human extraction, harvesting, and use of resources affect natural systems.
- Concept c: Expansion and operation of human communities affect natural systems.
- Concept d: Human social systems affect natural systems.

Principle III: Natural systems have cycles on which humans depend and that can be altered by humans.
- Concept c: Human practices can alter natural cycles and processes.

Principle IV: The exchange of matter between natural systems and human societies affects the long-term functioning of both.
- Concept a: Effects of human activities on natural systems depend on quantities of resources used and the quantity and characteristics of the byproducts of use.
- Concept b: Byproducts of human activities affect natural systems.
- Concept c: The ability of natural systems to adjust to human-caused alterations depends on several factors.

ANTICIPATED OUTCOMES

1. Students will understand that human activities have impacts on the environment, and that many of those impacts may be viewed as good or bad, depending on one's perspective, or they may be neutral.

GROUPING

Whole class

TIME

Varies

MATERIALS

- ❒ Illustrations from *Redwood Ed* or other sources of historic photos
- ❒ *Redwood Ed* Compact Disc

TEACHER PREPARATION

Preferably, use the *Redwood Ed* CD and a laser printer to make overhead transparencies of illustrations. Alternatively, you might either photocopy the illustrations from a print copy of *Redwood Ed* or make overhead transparencies from them (or from other historic photos). When printing, use the highest print quality/resolution/number of dots per inch possible.

PROCEDURE…some options:

1. Show the photos, with captions, one at a time and discuss.

2. Show the photos without the captions…ask the students to tell what they see.

3. Discuss wants versus needs.

4. In many old logging photos, the background shows a lot of waste and bare soil that would be susceptible to erosion. In many of those images, the people seem to be proud of their hard work but oblivious to the environmental damage done. Discuss and contrast this to modern attitudes towards the environment. What were the beneficial and harmful consequences of such logging practices? Given the knowledge and equipment available to them, did they have alternatives? How are modern practices and attitudes different? If so, why? Does everybody share the same attitudes and values?

5. If machinery is included in the photograph, ask students to discuss modern machinery and practices.

VARIATIONS, ADAPTATIONS, DIFFERENTIATION

1. When you visit a park or museum, be sure to have the students look at any historic images on display.
2. Consider preparing a worksheet to guide their viewing. The worksheet might include a photocopy of the image (reduced in size) with space for note taking.

3. *Redwood Ed* is available on a compact disc. Obtain the CD and use it to project images.
4. If the images do not photocopy clearly or do not make good overhead transparencies, try tracing around the main parts of the image with a fine pen, either before or after making the transparency.

ASSESSMENT

1. Present a different photograph and ask students to describe what they see, either orally or in writing.

REFERENCES AND RESOURCES

Many of the references cited in Appendix V contain historic images. Local museums, parks, resource companies, and others may also have images. The following books include many historic images:

Andrews, Ralph W: *Glory Days of Logging*
Andrews, Ralph W: *Redwood Classic*
Carranco, Lynwood and John Labbe: *Logging the Redwoods*
Keyworth, C.L.: *The First Americans: California Indians*
Leydet, Francois: *The Last Redwoods*
Nixon, Stuart: *Redwood Empire: An illustrated History of the California Redwood Country*
Schubert, John C.: *Guerneville Early Days: A History of the Lower Russian River*
Williams, Richard: *The Old West: The Loggers*

Making a Forester's Diameter Tape

ACTIVITY SUMMARY
Students make a measuring tape that measures circumference and converts circumference to diameter.

CONCEPTS TO BE LEARNED
1. The relationship between a circle's circumference and its diameter
2. Foresters and scientists use the diameter of a tree when studying stands of trees.

STANDARDS ADDRESSED

Focus Standards:

Grade 4: Mathematics Number Sense 3.0: Solve problems Mathematics Measurement and Geometry 1.0: Understanding perimeter and area Mathematics Statistics 1.0: Organize and represent data Science Investigation and Experimentation S.S. 6: Students ask meaningful questions and conduct careful investigations.

Grade 5: Mathematics Number Sense 1.0: Computation, rounding Mathematics Statistics 1.0: Display and interpret data sets Science Investigation and Experimentation S.S. 6: Students ask meaningful questions and conduct careful investigations.

Grade 6: Mathematics Number Sense 1.0: Solving problems Mathematics Number Sense 2.0: Calculate and solve problems Mathematics Measurement and Geometry 1.0: Measurement, including the use of pi Science Investigation and Experimentation S.S. 7: Students ask meaningful questions and conduct careful investigations.

Grade 7: Mathematics Mathematical Reasoning 2.0: Using estimation Science Investigation and Experimentation S.S. 7: Students ask meaningful questions and conduct careful investigations.

Environmental Principles and Concepts

Principle I: Humans depend on natural systems.
- Concept a: Humans depend on natural systems for goods and materials.

Principle II: Humans affect natural systems.
- Concept a: Human populations and consumption affect natural systems.
- Concept b: Human extraction, harvesting, and use of resources affect natural systems.
- Concept c: Expansion and operation of human communities affect natural systems.
- Concept d: Human social systems affect natural systems.

ANTICIPATED OUTCOMES

1. Students will be able to calculate diameter if given a circumference.
2. Students will make a measuring tape and be able to use it to measure the circumference and diameter of a tree.

GROUPING

Groups of two to three students (or individual)

TIME

30-45 minutes

MATERIALS

- ❒ Light colored ½" - 1" wide ribbon: 15 or more feet per group.
- ❒ (If the ribbon is made of nylon or a similar material, consider using a candle or other heat source to melt the ends to keep them from unraveling.)
- ❒ Fine tip permanent markers: 1 per group
- ❒ Ruler, meter stick, or tape measure (preferred): 1 per group
- ❒ Making a Forester's Diameter Tape Study Guide
- ❒ Optional: an actual diameter tape, available from forestry supply sources such as those found in Appendix IV, or borrow one from a local forester

TEACHER PREPARATION

1. Obtain the above materials. (A parent might be enlisted to melt the ribbon ends.)

PROCEDURE

1. Discuss with the students reasons why a forester or scientist might want to know the diameter of a tree. (to calculate how much wood it contains, lumber it might produce, or to study its growth over time)

2. Review how to calculate the diameter of a circle if the circumference is known.

3. Issue the Study Guide and demonstrate/review how to complete the conversion table. Before students actually use their data, it should be checked for accuracy.

4. After completing the table and having it checked, students use permanent markers to make their own tapes.

5. Have the students use their tapes to measure the circumferences and diameters of trees on campus and/or while on a field trip.

VARIATIONS, ADAPTATIONS, DIFFERENTIATION

1. See the *Redwood Ed* activity "Redwood Pi."
2. The tape could be made using metric units.
3. Students could calculate diameters from given circumferences.

ASSESSMENT

1. The Study Guide can be used for assessment, as can the tape made by the students.

Making a Forester's Diameter Tape
Study Guide

Foresters and scientists want to know the size of trees in the forest. One important measurement is the diameter, which can be used to calculate the approximate amount of wood in a tree. If one is studying a tree or a stand of trees over a period of time, it might be important to know how rapidly the trees are growing, and diameter measurements can be used for this, too.

In order to determine a tree's diameter, foresters use a special tape that measures circumference and diameter at the same time. In this activity, you will make your own Forester's Tape.

When you use the tape to measure a tree's circumference and diameter, you should make the measurement 4.5 feet above the ground on the uphill side of the tree. This is called the "diameter at breast height," or dbh.

Question: Why is it important for all foresters and scientists to measure a tree's diameter in the same way (i.e., 4.5 feet above ground level on the uphill side of the tree)?

Procedure:
1. For each of the following diameters, calculate the corresponding circumference.

2. Use the permanent marker to mark the diameters and circumferences on the tape provided by your teacher. If the tape is wide enough, put both diameters and circumferences on the same side. If the tape is not wide enough, put the diameters on one side and circumference son the other.

Use the formula $c = \pi \times d$ Use 3.14 for π Round to the nearest inch.

Diameter	Formula with values	Circumference (inches)
6 in	C = 3.14 x 6	19
12 in		
18 in		
24 in		
30 in		
36 in		
42 in		
48 in		
54 in		

Diameter	Formula with values	Circumference (inches)
60 in		
66 in		
72 in		
78 in		
84 in		
90 in		
96 in		
102 in		
108 in		

Name That Plant

ACTIVITY SUMMARY
This activity has two parts. In Part 1, students give descriptive names to plants, based on examination of their leaves, and then make up a "dichotomous key" with which the plants can be identified by others. In Part 2, students use commercially available keys to identify plants found in the redwood region.

CONCEPTS TO BE LEARNED
1. The names of organisms may or may not be descriptive of the organism.
2. Identification guides or keys can be used to identify organisms.
3. Different kinds of organisms have different physical characteristics.

STANDARDS ADDRESSED
Focus Standards:
Grade 4: Science Investigation and Experimentation 6.a: observations and inferences
Grade 5: Life Sciences 2.a: Plants and animals have structures for various processes.
Science Investigation and Experimentation 6.a: classify objects
Grade 7: Science Investigation and Experimentation 7.a: Use tools to collect data.

ANTICIPATED OUTCOMES
1. Students will increase their ability to observe and describe anatomical details.
2. Students will be able to use a simple dichotomous key to identify common plants.
3. Students will be able to identify some common redwood region plants.

GROUPING
Groups of two to four students

TIME
Part 1: 30-40 minutes
Part 2: 30-40 minutes

MATERIALS
For each group:
- ❒ Paper and pencils
- ❒ Commercially available keys or guides to redwood region plants (see Appendix IV: Sources of Materials and Appendix V: Resources Cited)
- ❒ Leaves, cones, bark samples from 8-10 plants, either from the school ground or a redwood forest.

TEACHER PREPARATION
1. Obtain the materials listed above.

Leaf specimens might be fresh, or they may be dried specimens mounted on tag board so that both sides of sample leaves are visible. Such dried specimens can be covered with clear plastic shelf liner material.

Fresh specimens are generally preferable. Keep them fresh-looking by storing in a re-sealable plastic bag with damp paper towel until used.

Be sure to include cones, bark samples, or other parts that may be needed in using the guide to identify the plant.

Try out the keys with your specimens to be sure that you have the required plant parts and typical leaves.

PROCEDURE

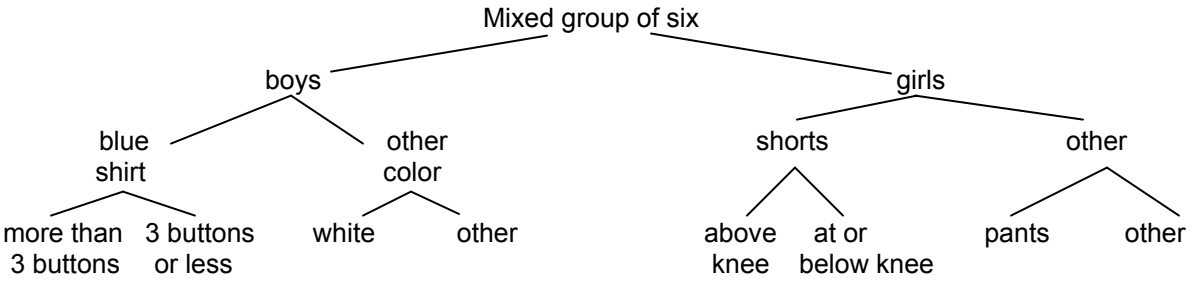
Part 1.

1. Tell students that you are going to describe some animals and that they are to try to identify them from your description. Tell them to write down the words that helped them to identify the animal. Then describe several animals, (using only physical characteristics as opposed to sounds or behaviors) starting with easy ones like zebra, elephant, giraffe and proceeding to ones that may not be so easy such as cow, deer, dog, or others.

Discuss how they were able to identify the organism through descriptive words.

2. Ask for 6 volunteers. Select students with different appearances and clothing. **Avoid selecting students who are sensitive about their appearance or clothing.**

3. Have the class create a "key" for the six students by listing on the board a series of steps that repeatedly divide the group into two groups, for example:



Discuss how such a key might be used to identify someone from the group. Point out the importance of using objective characteristics such as hair color, over 5 feet tall, whether they wear glasses, clothing type, etc., as opposed to subjective descriptors such as tall, thin, smart, etc.

4. Have the students form groups of 2-4 students each. Give each group a set of leaves.

5. Have the students make up names for the leaves. Encourage them to use descriptive names: pointy leaf tree, fuzzy top, circle plant, saw tooth plant, white bottom, arrow leaf, etc.

6. Select a leaf type and discuss what sorts of descriptors might be used to make a key. Emphasize objective descriptors such as overall shape, length, edge shape, vein patterns.

7. Have the students create keys that could be used by someone else to identify each type of leaf.

8. Have groups exchange keys and try to identify each others' leaves. Allow the groups to change their keys so that they can be used by the other students to correctly identify the leaves.

Part 2.

1. Give the students sets of leaves from plants that can be identified using commercially available keys or guides.

2. Use two different types of leaves (e.g., a plant with needles such as redwood or Douglas-fir and a non-needle leaved plant such as black oak or madrone) to demonstrate the use of the key:

   a. Look through the key…point out measuring tools, definitions, maps, etc.
   b. Discuss the importance of being careful when making choices.
   c. Discuss the importance of reading the description after arriving at an "answer." Does their answer match the description?

3. Have the students use the keys to identify their leaf sets.

4. Have the students check themselves by holding up a specimen and asking students to tell what it is. If they make mistakes, go through the keying steps with them.

5. Discuss that such keys only work if the plant is in it. A key for redwood region wild flowers, for example, would not be much use in the desert or in Africa.

VARIATIONS, ADAPTATIONS, DIFFERENTIATION

1. Cover the keys with plastic shelf lining material to protect them from water both in the classroom and when used in the field.
2. Students can make up keys to school yard plants and teach others to use them.
3. Students can bring in leaves from plants that grow in their yards or neighborhood.
4. In preparation for a trip to a redwood park, students can become "experts" in identifying ferns, conifers, flowers, berries, etc.
5. Students can make and use keys for identifying rocks, animals, or other things.
6. See the activity "Who am I?"

ASSESSMENT

1. Present a student or a group with an "unknown" leaf type and have them use a key to identify it. (Be sure that the plant is in the key.)

REFERENCES AND RESOURCES

Most "field guides" can be used to identify organisms from pictures or drawings. The use of dichotomous keys enables users to identify organisms by making a series of choices. See Appendix IV for sources.

The Nature Study Guild, of Berkeley, publishes a series of Nature Finder Guides, including:

Pacific Coast Berry Finder by Glenn Keator
Pacific Coast Bird Finder by Roger Lederer
Pacific Coast Fern Finder by Glenn Keator and Ruth Hardy
Pacific Coast Mammals by Ron Russo
Pacific Coast Tree Finder by Tom Watts
Redwood Region Flower Finder by Phoebe Watts

Two more technical keys to plants in the redwood region are:

Pocket Flora of the Redwood Forest, by Rudolf Becking
and
Flora of the Santa Cruz Mountains of California, by John Hunter Thomas

Redwood Pi

ACTIVITY SUMMARY
Students measure various cylindrical objects and use the measurements to derive an approximate value for pi.

Students are given some values and calculate circumferences from diameters and diameters from circumferences.

CONCEPTS TO BE LEARNED
1. The ratio of a circle's circumference to its diameter is a constant called *pi*.

2. How to use the circumference formula

2. How to derive the formula for diameter from the formula for circumference

STANDARDS ADDRESSED
Focus Standards:
- Grade 4: Mathematics: Number Sense S.S. 3.0 Solve problems
  Mathematics: Measurement and Geometry S.S. 1.0: Understanding perimeter
- Grade 5: Mathematics: Number Sense S.S. 1.0: Computation
- Grade 6: Mathematics: Number Sense S.S. 1.0: Calculate and solve problems
  Mathematics: Measurement and Geometry S.S. 1.0: Measurement of plane…shapes, including the use of *pi*.
- Grade 7: Mathematics: Mathematical Reasoning S.S. 2.0: Using estimation

ANTICIPATED OUTCOMES
1. Students will learn to calculate the circumference of a circle if they are given the diameter.

2. Students will learn to calculate the diameter of a circle if given the circumference.

3. Students will learn to derive the formula for finding diameter if given circumference.

GROUPING
Groups of two and whole class.

TIME
60 minutes

MATERIALS
- ❒ Study Guide: Using *pi*
- ❒ A variety of cylindrical objects such as cans and jars: one per team of two students
- ❒ Tape measures: one per team

(Tape measures used in sewing are commonly 60 inches long. Such a tape can be cut into 20 inch lengths and a permanent marker can be used to renumber as necessary.)

- ❒ Calculators: one per team

TEACHER PREPARATION

1. Obtain a variety of cylindrical objects. Use a permanent marker or masking tape to number each.
2. Obtain a tape measure for each team of two students.
3. Duplicate the Study Guides.

PROCEDURE

1. Give each student a copy of the Redwood Pi Study Guide.

2. Give each team of students a tape measure and a cylindrical object.

3. Define diameter and circumference (or remind students of the meanings).

4. Have students follow directions on the Redwood Pi Study Guide.

VARIATIONS, ADAPTATIONS, DIFFERENTIATION

1. A simple way to do this is to use a can with a seam, such as a juice or soup can. Have the student place the can on a piece of paper with the seam down and mark the spot. The can is then rolled until the seam is again downward and that spot marked. The distance between the marks will be the circumference. The diameter can be measured directly, but be sure to have the students find the greatest distance across the circle/cylinder.
2. String can be used instead of a tape measure by wrapping the string around the cylinder and laying it on or beside the ruler. Caution students not to stretch the string.
3. See the activities "How Big?" and "Making a Forester's Diameter Tape."
4. Consider having students use metric measurements in addition to inches.

ASSESSMENT

1. Check for accuracy in calculations.
2. The Study Guide can be used for assessment.
3. Students can be given tape measures and cylinders to measure.

ANSWERS TO SELECTED STUDY GUIDE QUESTIONS

(1) 6.8" diameter = 21.35 " circumference
(2) 9.2' diameter = 28.89' circumference
(3) 15 cm diameter = 47.1 cm circumference
(4) 24.7 yd diameter = 77.56 yd circumference

(5) 82.4' circumference = 26.24' diameter
(6) 56 cm circumference = 17.83 diameter
(7) 6.2 m circumference = 1.97 m diameter

<u>redwoods:</u>
(8) 5' circumference = 1.59' diameter
(9) 18.5' circumference = 5.89' diameter
(10) 34.2' circumference = 10.89' diameter
(11) 26.8' circumference = 8.54' diameter

Redwood Pi
Study Guide

The distance across a circle is called the diameter, and the distance around a circle is called the circumference. Your teacher will provide each team with a cylindrical object and a tape measure.

1. Record the number of your cylinder. Measure the diameter and circumference of your cylinder and record them in the table below. Measure to the nearest eighth of an inch. Use the table below to convert eighths to decimals.

1/8 = .125	2/8 = ¼ = .25	3/8 = .375	4/8 = ½ = .5
5/8 = .675	6/8 = ¾ = .75	7/8 = .875	

2. After you have measured your cylinder, trade cylinders with other groups until each team has measured four objects.

3. After you have measured the diameters and circumferences of four objects, compare the diameters and circumferences by dividing the circumferences by the diameters.

For example, <u>if</u> a circumference is 22 and the diameter is 7, the ratio would be 22 ÷ 7 = 3.14 (rounded to the nearest hundredth).

object #	**Diameter (nearest 1/8")**	**Circumference (nearest 1/8")**	**<u>circumference</u> radius**

What do you notice about the ratio (comparison) of the circumference and the radius?

It should be close to 3.1428. Thousands of measurements have determined that the ratio of a circle's circumference to its diameter is always 22/7, which is called *pi*. The symbol for *pi* is π, and *pi* is approximately (but not exactly) equal to 3.1428.

- ❒ Since the circumference of a circle and its diameter are always related in a constant way, if you know one, you can determine the other. The following formula can be used to find a circle's circumference if you know its diameter:

Circumference = π x diameter or c = π d

continued next page

Practice determining circumferences by completing the table below. Check your answers with your teacher. Use 3.14 for π.

#	**diameter**	**Work** **(Write the value in the formula, <u>then</u> do the calculation.)**	**Circumference** **(round to nearest .01)** **(include units!)**
e.g.	4.25 in.	C = π x 4.25 in. = 3.14 x 4.25 in.	13.35 in
1.	6.8 in.		
2.	9.2 feet		
3.	15 cm.		
4.	24.7 yards		

If you know the circumference of a circle, you can also find the diameter. If you divide both sides of the circumference equation by *pi*, you get:

$$c = \pi d \quad \text{equals} \quad \frac{c}{\pi} = \frac{\pi d}{\pi} \quad \text{so} \quad \frac{c}{\pi} = d \quad \text{and} \quad d = \frac{c}{\pi}$$

Practice determining diameters by completing the following table. Check your answers with your teacher. Use 3.14 for π.

#	**circumference**	**Work** **(Write the value in the formula, <u>then</u> do the calculation.)**	**diameter** **(round to nearest .01)** **(include units!)**
e.g.	12.5 in.	d = 12.5 in. ÷ π = 12.5 in. ÷ 3.14	3.98 in.
5.	82.4 feet		
6.	56 cm.		
7.	6.2 m.		

When foresters want to know how much wood can be obtained from a tree, they need to determine its diameter. Using the diameter, they can use tables in books to find how much lumber might be obtained from the tree. Measuring the diameter is difficult, so they measure the circumference instead. Find the diameters of the following trees:

#	**circumference**	**Work** **(Write the value in the formula, <u>then</u> do the calculation.)**	**diameter** **(round to nearest .01)** **(include units!)**
8.	5 feet		
9.	18.5 feet		
10.	34.2 feet		
11.	26.8 feet		

Washing a Watershed

ACTIVITY SUMMARY

Students use crumpled paper to model a watershed. Colored pens, some water soluble and some not, are used to indicate various types of ground cover. Water from a spray bottle is used to model rain, and students observe the effects of runoff.

CONCEPTS TO BE LEARNED

1. Water runs downhill and can carry materials and chemicals as it does so.
2. Some types of land use discourage pollution of streams and others increase pollution.

STANDARDS ADDRESSED

Focus Standards:

Grade 4: Life Sciences 3. a: Ecosystems are characterized by living and non-living components.
Science Investigation and Experimentation 6: Students ask meaningful questions and conduct careful investigations.

Grade 5: Earth Sciences S.S. 3: Water moves between oceans and land
Science Investigation and Experimentation 6: Students ask meaningful questions and conduct careful investigations.

Grade 6: Earth Sciences S.S. 2: Topography is reshaped by weathering and transportation of sediment.
Science Investigation and Experimentation 7: Students ask meaningful questions and conduct careful investigations.

Grade 7: Science Investigation and Experimentation 7: Students ask meaningful questions and conduct careful investigations.

Environmental Principles and Concepts

Principle I: Humans depend on natural systems.
- Concept a: Humans depend on natural systems for goods and materials.
- Concept b: Humans depend on ecosystems.
- Concept c: The health of ecosystems affects their usefulness for people.

Principle II: Humans affect natural systems.
- Concept a: Human populations and consumption affect natural systems.
- Concept b: Human extraction, harvesting, and use of resources affect natural systems.
- Concept c: Expansion and operation of human communities affect natural systems.
- Concept d: Human social systems affect natural systems.

Principle III: Natural systems have cycles on which humans depend and that can be altered by humans.
- Concept a: Natural systems have cycles.
- Concept b: Humans depend on and utilize natural cycles and processes.
- Concept c: Human practices can alter natural cycles and processes.

Principle IV: The exchange of matter between natural systems and human societies affects the long-term functioning of both.
- Concept a: Effects of human activities on natural systems depend on quantities of resources used and the quantity and characteristics of the byproducts of use.
- Concept b: Byproducts of human activities affect natural systems.
- Concept c: The ability of natural systems to adjust to human-caused alterations depends on several factors.

ANTICIPATED OUTCOMES
1. Students will understand some effects of runoff on streams and communities.
2. Students will understand some ways of reducing erosion and runoff.

GROUPING
Groups of two to four students

TIME
15-30 minutes

MATERIALS: for each group:
- ❒ One to three sheets of white paper
- ❒ Water base pens: brown, black
- ❒ Permanent markers: green, blue, red (or crayons)
- ❒ Spray bottle with water
- ❒ Sponges or towels for cleanup
- ❒ Optional: plastic or newspaper to cover desks/tables

TEACHER PREPARATION
1. Obtain materials above.

PROCEDURE
1. Demonstrate crumpling piece of paper into a tight ball, then gently opening it without completely flattening it.

2. Show the students how the high points can represent mountains and the low points can represent the bottoms of valleys where streams flow.

3. Direct teach that each of those valleys represents a watershed.

4. Ask the students where there would be a good place to build a town. Lead them to the idea that it is easiest to build on relatively level areas near streams.

5. Use the pens to color the following features:
   - ✓ Blue for streams and lakes (permanent markers)
   - ✓ Green for forests (permanent markers)

- ✓ Brown for dirt roads on hillsides and hillsides that have had the vegetation removed by fire, road builders, logging, clearing for building, landslides, or other factors (water soluble)
- ✓ Black for roads and parking lots (water soluble)
- ✓ Red for buildings, houses, towns (permanent markers)

5. Have the student teams make and color their own watersheds, including towns and roads.

6. Ask the students to predict what might happen if rain fell on the hills. What would happen to the soil on the hillsides? What would happen to the rivers, streams, and lakes?

7. Then have the students use the spray bottles to simulate light rain on the watersheds.

8. Have the students observe the erosion of the exposed soil (brown), and runoff from the roads (oil and other chemicals…black). Ask where the runoff ends up and what effects it might have on the streams and lakes, and the organisms, including people, that depend on them.

9. Discuss with students what might be done to reduce or eliminate soil erosion from fire, logging, or clearing of land. (Point out that there are now laws and regulations intended to minimize or eliminate erosion.)

VARIATIONS, ADAPTATIONS, DIFFERENTIATION

1. If crayons are used for the trees, buildings, and rivers, they may tend to flatten the paper more than felt tip markers.
2. Students can make flour and salt relief maps of the local watershed. Water will dissolve the map if too much is used, so caution the students not to spray too much.
3. This activity can be used in conjunction with teaching about topographic mapping.
4. Some parks have relief models of their watersheds. Be sure to have the students study the relief map when you visit.

ASSESSMENT

1. Students should be able to define a watershed and describe what happens to soluble materials when rain falls on them.

REFERENCES AND RESOURCES

Kids in Creeks: An Interdisciplinary Creek Exploration Program

We're All in This Together

ACTIVITY SUMMARY
After learning about food chains, students form a model of a food web, showing the interconnectedness of organisms with each other and with the physical environment.

CONCEPTS TO BE LEARNED
1. Plants and animals depend on each other and on the physical environment.
2. If something affects one part of the environment, it will affect other parts.
3. A food web is a simplified model of the interconnectedness of organisms.

STANDARDS ADDRESSED

Focus Standards:

Grade 4: Life Sciences S.S. 2: All organisms need energy and matter to live and grow.
Life Sciences S.S. 3: Living organisms depend on one another and their environment.

Grade 6: Ecology (Life Sciences) S.S. 5: Organisms exchange energy and nutrients among themselves and with the environment.

Other Standards:

Grade 5: Life Sciences S.S. 2

Grade 7: Life Science Structure and Function in Living Systems S.S. 5

Environmental Principles and Concepts

Principle I: Humans depend on natural systems.
- Concept a: Humans depend on natural systems for goods and materials.
- Concept b: Humans depend on ecosystems.

Principle II: Humans affect natural systems.
- Concept a: Human populations and consumption affect natural systems.
- Concept b: Human extraction, harvesting, and use of resources affect natural systems.
- Concept c: Expansion and operation of human communities affect natural systems.
- Concept d: Human social systems affect natural systems.

Principle III: Natural systems have cycles on which humans depend and that can be altered by humans.
- Concept a: Natural systems have cycles.
- Concept b: Humans depend on and utilize natural cycles and processes.
- Concept c: Human practices can alter natural cycles and processes.

ANTICIPATED OUTCOMES
1. Students will understand that all organisms depend on the physical environment.
2. Students will understand the concept of food webs.
3. Students will know about the niches and foods of various organisms.

GROUPING
About eight to twelve students will form the food web. The rest of the class can observe.

TIME
10-30 minutes, including discussion

MATERIALS
- ❒ Drawings or pictures of organisms and abiotic environmental factors, preferably from the coast redwood ecosystem, approximately 8" x 8" in size, mounted on tag board, with strings for hanging around students' necks
- ❒ Include pictures that represent (for example):

Water (cloud, fog, stream)	Sunlight	Minerals (soil or rocks)
Decomposers (bacteria)	Producer (grass)	Producer (blackberry)
Herbivore (grasshopper)	Herbivore (deer)	Omnivore (black bear)
Omnivore (raccoon)	Carnivore (fox)	Scavenger (Steller's jay)

- ❒ Also have one card represent people. On one side label the person something like "Wasteful Wally" and on the other side draw and label "Wonderful Wally."
- ❒ Strong cord (approximately 50')

TEACHER PREPARATION
1. Obtain pictures or drawings of the above. Pictures or drawings used in the "Who's for Dinner?" activity might be used. Pictures can be obtained from magazines, old calendars (donated by parents?), the Internet, or students can draw them. Students can also color illustrations from Section I of *Redwood Ed*.

2. Mount the pictures on tag board. Laminate. Attach a 2-foot length of string so that each picture can be worn around a student's neck.

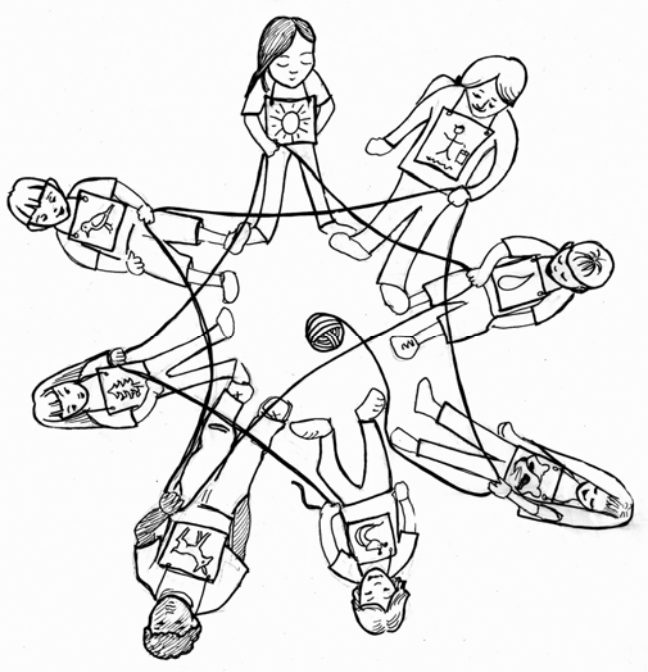
PROCEDURE
1. Select eight to ten students to represent the parts of the environment listed under Materials above. Have the students form a circle, facing inward.

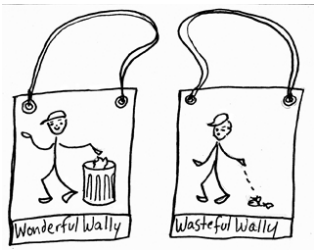
2. Give the students their role cards and have them hang them around their necks. The human card should have "Wasteful Wally" facing outward. Be sure to issue the role cards in such a way that a web will form. (For example, have the producer across the circle from the sun, rather than next to the sun.)

3. Have the "sun" student hold the end of the string.

4. Pass the cord back and forth across the circle of students forming a web-like pattern, instructing students to hold the cord securely. Continue until all eight to ten students, including "Wasteful Wally" are connected. The last one connected should be the "sun."

5. Securely tie the ends of the cord.





"Wally's" sign, front and back

Figure 117

6. Now have all of the students hold their cord firmly in one hand and pull the string taut. A web should be formed among the organisms and the non-living parts. Point out that everything is connected (or "hitched to everything else," as John Muir said).

7. Have each student tell how he or she (or, rather, their part of the web) is connected to two other parts. For example:

   "I'm a plant and I'm connected to the sun because I need light for photosynthesis. I'm connected to the banana slug because the banana slug eats my leaves."

   "I'm the water, and I'm connected to the deer because the deer drinks me, and it also eats plants that need water. I'm connected to the sun because the sun evaporates me, and on cloudy or foggy days I block some of the sun from reaching the plants."

8. Tell the students that you are going to tap a student and tell something that happened to that part of the environment.

9. Instruct the students to hold their cord firmly, and to tug gently when they feel a tug.

10. Walk around the circle and tap a student on the shoulder and tell something that happened to the organism. This is the initial event. The tapped student is to give a

tug on the string. (The deer was eaten by a cougar, or the minerals washed into the stream during a severe storm, or the bear died and began to decompose, returning minerals to the soil, etc.) (The sun itself may not be affected, but the amount of sunlight available to organisms is affected by plants as they produce shade.)

11. This should start a chain reaction, and every part of the environment should soon have been affected by the initial event. Have each affected student (or someone in the class) tell how they were affected.

12. Do this several times, with different initial events, pointing out that if one part of the environment is affected, all parts are affected.

13. In one or two cycles, have the human be "Wasteful Wally," who does damage to the environment. (e.g.: "Wally has polluted the stream." or "Wally threw an aluminum can or plastic wrapper into the bushes.")

14. Then be sure to have "Wonderful Wally" do a couple of things that help the environment. (e.g.: "Wally chose to recycle his plastic water bottle." or "Wally used a cloth sack for his lunch rather than a paper bag.")

In the ensuing discussion, be sure to discuss how we all affect the environment, and that we can make choices that will help improve and protect the environment. Discuss how people affect the environment with their jobs and their daily habits.

VARIATIONS, ADAPTATIONS, DIFFERENTIATION

1. If you use a strong cord, you can tie the ends **securely**, then have students lean back until the cord web is supporting them. Ask the students what would happen if the cord were cut or broke while they were leaning on it. This emphasizes that the different parts of the environment don't merely affect each other, they depend on each other.

ASSESSMENT

1. Have students tell how different organisms depend on each other and on the physical environment.
2. Have students tell ways that Wasteful Wally can be Wonderful Wally.

REFERENCES AND RESOURCES

Roa, Michael. *Environmental Science Activities Kit.*

Who's For Dinner?

ACTIVITY SUMMARY

Students learn about organisms of the redwood forest and how they are related in food chains. (It is recommended that this activity be followed by the food web activity "We're All in this Together.")

CONCEPTS TO BE LEARNED

1. Living things depend on the non-living environment.
2. Living things depend on other living things.

STANDARDS ADDRESSED

Focus Standards:

Grade 4: Life Sciences S.S. 2: All organisms need energy and matter to live and grow.
Life Sciences S.S. 3: Living organisms depend on one another and their environment.

Grade 6: Ecology (Life Sciences) S.S. 5: Organisms exchange energy and nutrients among themselves and with the environment.

Other Standards:

Grade 5: Life Sciences S.S. 2

Grade 7: Life Science Structure and Function in Living Systems S.S. 5

Environmental Principles and Concepts

Principle I: Humans depend on natural systems.
- Concept a: Humans depend on natural systems for goods and materials.
- Concept b: Humans depend on ecosystems.

Principle II: Humans affect natural systems.
- Concept a: Human populations and consumption affect natural systems.
- Concept b: Human extraction, harvesting, and use of resources affect natural systems.
- Concept c: Expansion and operation of human communities affect natural systems.
- Concept d: Human social systems affect natural systems.

Principle III: Natural systems have cycles on which humans depend and that can be altered by humans.
- Concept a: Natural systems have cycles.
- Concept b: Humans depend on and utilize natural cycles and processes.

ANTICIPATED OUTCOMES

1. Students will understand that all organisms depend on the physical environment.
2. Students will understand the concept of food chains.
3. Students will know about the niches and foods of various organisms.
4. Students will improve their research skills.

GROUPING
Four to six students per food chain

TIME
Research: varies (15-30 minutes or more)
Doing the activity and discussion: 15-30 minutes

MATERIALS
- ❒ Reference books or other resources such as the Internet
- ❒ White paper or tag board, approximately 8" x 8" (1 per student)
- ❒ Either colored pencils, pens, or crayons with which students can draw organisms, or pictures of organisms from magazines, calendars, or Section I of *Redwood Ed.*
- ❒ Tape or glue with which to attach pictures to tag board

TEACHER PREPARATION
1. Consider having a parent volunteer mount and laminate pictures.
2. Prepare either a drawing or a picture to represent the physical environment, including sunlight, water and minerals. This might be a river with rocks and the sun visible.
3. Group the food chains into groups of 4-6 students. Have some optional organisms in case some students are absent. Some examples of groups are:

Abiotic Factors	Producer	Herbivore (first degree consumer)	Carnivore (second degree consumer	Carnivore or Omnivore	Next Step
sun, water, and minerals	wild oats (grass)	grasshopper	red legged frog	raccoon	fox
	Douglas-fir seed	tree vole	spotted owl	barred owl	bacteria
	blackberry	banana slug	giant salamander	salmon	fisherman
	tanbark oak	back tailed deer	cougar	deer hunter	bacteria
	algae in a stream	mosquito larva	young salmon	bear	bacteria
	algae in a stream	stonefly larva	trout	kingfisher	bacteria
Other types of organisms to consider: dead organisms, mosquitoes, Steller's jays, worms, skunks					

PROCEDURE
1. Assign one organism to each student.

2. The student does research to find out what their organism eats and what eats it. For plants, students can find out what plants need to survive—light, CO_2, water, minerals.

3. Unless a picture is provided, the student draws a picture of the organism.

4. The student then gets together with his or her food chain group and decides the order of the food chain, starting with the physical environment.

5. Students line up in food chain order, holding their organism pictures.

6. For each chain, the teacher holds up the large physical environment card and reminds students about the importance of sunlight, minerals, and water for all food chains. This is the start of the food chain.

7. When all food chains are formed, students explain to the rest of the class why they are in that order. They might hold up their picture and say something like "I'm a grasshopper. I eat plants and birds eat me."

8. Tell the students that when they see an organism in the redwoods, they should be ready to tell what it eats and what eats it.

9. Remind the students that most organisms eat many things and that many things eat each organism. See the activity "We're All in this Together."

VARIATIONS, ADAPTATIONS, DIFFERENTIATION

1. After the students line up, ask them if there are any other food chains into which they fit.
2. Place food chain pictures on the bulletin board with arrows indicating what is eaten by what. Then use arrows or yarn to show what organisms eat organisms in other chains, thus forming a food web.
3. To keep the groups of food chain pictures together, you might mount them on different colored paper or card stock.

ASSESSMENT

1. Ask students to explain why they placed themselves where they did in their food chains.

REFERENCES AND RESOURCES

Roa, Michael. *A Guide to the Side of the Sea*.

Roa, Michael. *The Environmental Science Activities Kit.*

Other Pre-Trip Activities

Virtual Field Trip

While you are previewing the trip, you might take slides or make a video. These can be used to help prepare the students for the trip through a "virtual field trip," in which the students see pictures of many of the organisms or other features that they will see on the actual trip. This preview will help the students know what to expect without diminishing their excitement and interest. Students enjoy seeing an organism in real life after seeing it in pictures, and they are more likely to remember it.

The preview can also be used to point out safety issues such as poison oak, steep trails (remind students not to take shortcuts on switchbacks), or slippery areas.

A virtual field trip can also be used to review what was seen on the trip. You might have the students prepare a slide show of their trip for parents—maybe a digital slide show using Power Point.

STANDARDS ADDRESSED

Focus Standards:

Grade 4: Life Sciences S.S. 3.a: Ecosystems are characterized by living and non-living components.

Grade 5: Life Sciences Standard Set S.S. 2: Plants and animals have structures for various life processes.

Grade 6: Earth Science Standard Set S.S. 2: Topography is reshaped by weathering and transportation of sediment.

Grade 7: Life Science Standard Set S.S. 5: Anatomy and physiology

Environmental Principles and Concepts

Principle I: Humans depend on natural systems.

Concept a: Humans depend on natural systems for goods and materials.

Principle II: Humans affect natural systems.

Concept a: Human populations and consumption affect natural systems.

Concept b: Human extraction, harvesting, and use of resources affect natural systems.

Principle III: Natural systems have cycles on which humans depend and that can be altered by humans.

Concept b: Humans depend on and utilize natural cycles and processes.

Concept c: Human practices can alter natural cycles and processes.

Principle IV: The exchange of matter between natural systems and human societies affects the long-term functioning of both.

Concept a: Effects of human activities on natural systems depend on quantities of resources used and the quantity and characteristics of the byproducts of use.

Concept b: Byproducts of human activities affect natural systems.

Concept c: The ability of natural systems to adjust to human-caused alterations depends on several factors.
Principle V: Decisions affecting natural resources and systems are based on many factors.
Concept a: Students need to understand the spectrum of factors that are considered in making decisions about natural resources.
Concept b: Students need to understand the decision making process and how it changes with time.

REFERENCES AND RESOURCES
Roa, Michael: *A Guide to the Side of the Sea*

Notebooks and Journals: Redwood Logs

Students can prepare for the trip by making notebooks or journals in which to record their observations.

Notebook covers can be decorated beforehand or after the trip. Clear adhesive shelf lining material can be used to cover the front and back covers. This will help protect it from soil and moisture. "Decorations" might consist of:

- student drawings of the site or organisms
- prints of photos taken before or during the trip
- pictures from magazines or brochures
- dry redwood branchlets with needles
- dried leaves or flowers from the redwood region…**Do not pick within a state or national park!**

STANDARDS ADDRESSED
Focus Standards:
Grade 4: English: Writing 2.3: Write information reports.
Grade 5: English: Writing 2.3: Write research reports.
Grade 6: English: Writing 2.3: Write research reports.
Grade 7: English: Writing 2.3: Write research reports.

REFERENCES AND RESOURCES
Roa, Michael: *A Guide to the Side of the Sea*

Checklists

Teachers can provide checklists of things for the students to look for. Two examples are given below. The lists provided include items found throughout the redwood region. Blank spaces are provided for the addition of other items that might be found in your area.

Teaching Idea

Discuss with students whether or not people should be included on the check list as redwood ecosystem organisms.

STANDARDS ADDRESSED

Focus Standards:

Grade 4: Life Sciences 3.a: Ecosystems are characterized by living and non-living components.
Investigation and Experimentation 6.a: Observation and inferences

Grade 5: Life Sciences S.S. 2: Plants and animals have structures for various life processes.
Investigation and Experimentation 6.a: Classify objects.
Investigation and Experimentation 6.g: Make and interpret graphic representations of data.

Grade 6: Ecology (Life Sciences) 5.e: Numbers and types of organisms in an ecosystem depend on abiotic factors.
Investigation and Experimentation 7.d: Communicate in written and oral presentations.

REFERENCES AND RESOURCES

Roa, Michael: *A Guide to the Side of the Sea*

Redwood Ecosystem Organism Checklist

Which of these organisms have you seen before going on the field trip to the redwoods?

Which organisms do you see on the trip?

Organism	Have seen before trip.	See on trip.	Notes or Sketches:
Coast redwood tree			
Douglas-fir tree			
Tanoak tree			
Madrone tree			
Live oak tree			
Black oak tree			
California bay (laurel) tree			
Big-leaf maple			
Moss			
Horsetail/scouring rush			
Sword fern			
Bracken fern			
Maidenhair fern			
Five-finger fern			
Stinging nettle			
Poison oak			
Redwood sorrel			
California blackberry			
Millipede			
Centipede			
Banana slug			
Acorn woodpecker			
Steller's jay			
Black-tailed deer			

Redwood Ecosystem Observations

Which of these things have you observed before? Which do you observe on the trip?

Observation	Observed before trip.	Observe on trip.	Notes or Sketches:
Coast redwood cone			
Douglas-fir cone			
Tanoak acorn			
Live oak acorn			
Black oak acorn			
Black oak tree			
Smell of a laurel tree leaf			
Big-leaf maple seed			
Moss spore capsule			
The feel of a horsetail (scouring rush)			
Sword fern spore cases			
Maidenhair fern spore cases			
Banana slug slime			
Growth rings on a log			
A rotting log			
Redwood sorrel leaves drooping in the sunlight			
Acorn woodpecker holes in a tree			
Deer scat (droppings)			
Smell of redwood needles			
Smell of Douglas-fir needles			

Sensory Awareness

We tend to be very sight oriented. Students can be encouraged to use other senses. One way to do this is to have students complete a Sensory Awareness Chart. This can, of course, be extended to other environments, including the classroom, playground, home, or other places. Space has been left in the charts below for adding items. Before your field trip, be sure that students don't have known allergies to things that they're likely to encounter. If you do the taste activity, consider bringing something with which to wash the item(s), and don't require tasting.

STANDARDS ADDRESSED

Focus Standards:

Grade 4: Science Investigation and Experimentation 6.a: Observations.

Grade 7: Science Investigation and Experimentation 7.b: Use a variety of resources to collect data.

REFERENCES AND RESOURCES

Roa, Michael: *A Guide to the Side of the Sea*

Snively: *Once Upon a Seashore*

Sense of Touch

How many of these have you felt?	Before the field trip?	On the field trip?	Notes or Sketches:
The end of a coast redwood needle			
The end of a Douglas-fir needle			
Humus or soil under the duff layer			
The edge of a live oak leaf			
Temperature of soil in the shade and sun			
Coast redwood bark			
Douglas-fir bark			
Madrone or manzanita bark			

Sense of Hearing

How many of these have you heard?	Before the field trip?	On the field trip?	Notes or Sketches:
Wind in the coast redwoods			
Wind in an oak tree			
Water in a creek			
Footsteps on duff-covered ground			
Footsteps on pavement			
Acorn woodpecker making holes			
Steller's jay call			
A squirrel chattering			

Sense of Smell

How many of these have you smelled?	Before the field trip?	On the field trip?	Notes or Sketches:
Coast redwood needles			
Douglas-fir needles			
Coast redwood bark			
Douglas-fir bark			
Decaying leaf litter			
California Bay tree leaf			

Sense of Taste

How many of these have you tasted?	Before the field trip?	On the field trip?	Notes or Sketches:
A coast redwood needle			
A Douglas-fir needle			
A redwood sorrel stem			
A ripe (black) blackberry			
An unripe (red) blackberry			
A ripe thimbleberry			

Sense of Sight

How many of these have you seen?	Before the field trip?	On the field trip?	Notes or Sketches:
A coast redwood seed (not the cone)			
A Douglas-fir seed			
The bracts sticking out between the scales of a Douglas-fir cone			
Lichens on redwood bark			
The sand grains in a piece of sandstone			
Fern spore cases			
A millipede's 2 legs per segment			