Section IV
LESSONS AND ACTIVITIES FOR TEACHING AND LEARNING ABOUT THE CONIFEROUS FOREST AND WATERSHED

The activities and lessons in *The Conifer Connection* are correlated with Standards for grades 4–7. Many can be adapted for somewhat higher or lower grade levels.

The following lessons and activities are grouped into four chapters:

Chapter 1: Activities are best done before a trip to a coniferous forest watershed.
Chapter 2: Activities are intended to be done in the woods.
Chapter 3: Lessons are intended to be used after a trip to the forest.
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 for the post-trip activities while on the trip by making observations, collecting and recording data, or asking questions.

While *The Conifer Connection* is written for use in teaching about coniferous forests and watersheds, most lessons could be used to teach about any kind of forest ecosystem.

What are "Anticipated Outcomes?"
For each lesson, one or more Anticipated Outcomes are listed. 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 *The Conifer Connection* 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 by providing context, depth, and meaning. The California State Content Standards are grouped into "Standard Sets." Each set contains several Content Standards. Some of the lessons in *The Conifer Connection* 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."

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.

National Standards

In addition to California State Standards, the activities in *The Conifer Connection* are correlated to National Standards in Science and Social Studies, as developed by the National Academy of Sciences and the National Council for the Social Studies, respectively.

State and National Standards addressed by activities are listed in paraphrased form, in Appendix I.

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 include references, in abbreviated form, to the Environmental Principles and Concepts that the lessons can help address.

Caution

Some activities have potential safety issues such as the use of glass or water hazards. Always warn students of safety issues and insist on safe behavior. Watch for the 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 and that they can be done safely by your students.

A word about assessment:
Some suggestions for assessment have been provided, but since different users of *The Conifer Connection* will have different goals and opportunities for assessment, these assessment ideas are intended to help instructors plan their own assessment strategies. Different teachers may wish to assess for different things in different ways.

CHAPTER 1
Pre-Trip Activities

The activities in Chapter 1 are generally best done prior to a visit to a coniferous 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.

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, page 277: Activities for Any Time.

The Anatomy of a Giant

ACTIVITY SUMMARY

Students learn the basic anatomy of a conifer such as a redwood or pine tree in the classroom. They then study the anatomy of a conifer in the forest or on the campus.

CONCEPTS TO BE LEARNED

1. Plants such as conifer trees have different parts that have different functions.

CALIFORNIA STANDARDS ADDRESSED (S.S. indicates a standard set.)

Focus Standards:

Grade 4: Science 2.a, 6.a
Grade 5: Science S.S. 2, S.S. 5
Grade 7: Science S.S. 5

Other Standards:

Grade 7: Science 3.1, 3.4

NATIONAL CONTENT STANDARDS ADDRESSED

Science Grades 5-8: Standard C

Environmental Principles and Concepts

Principle I, Concept a

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
- ❒ recommended: samples of tree branches, cones, bark, seeds

TEACHER PREPARATION

1. Obtain listed materials.
2. Make transparencies of the Study Guide.
3. Consider providing a word list to use with the crossword puzzle.

PROCEDURE

1. Have the students use reference books, texts, models, trees found on the campus, and the Study Guide to learn basic plant anatomy and physiology.
2. While on a field trip to a forested area, have the students compare the idealized plant anatomy drawings from the reference(s) to a real tree. Have them note differences and similarities.

VARIATIONS, ADAPTATIONS, DIFFERENTIATION

1. If you have a large 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. Have students compare conifers to broad-leaf trees.

ASSESSMENT

1. Can the students identify the major parts of a tree on a diagram? Orally “in the field?”
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 225

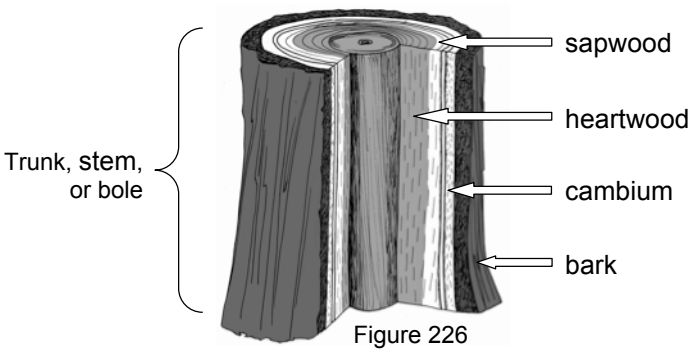


Figure 226

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 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 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 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:

(To be completed where live trees are available for study)

You have learned about the main parts of a tree. You have also seen drawings of a "typical" tree. Let's take some time to find out if actual trees always look like the "typical" or idealized drawings that we see in books.

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

In the space below, list some ways in which the trees that you observe are the **same** as the "typical" trees in books or other references and ways in which they **differ**.

Same: **Differ:**

The Anatomy of a Giant—Study Guide

The diagrams below represent a typical coast redwood tree. Other types of conifers will have needles, cones, and bark that look similar but somewhat different. 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).

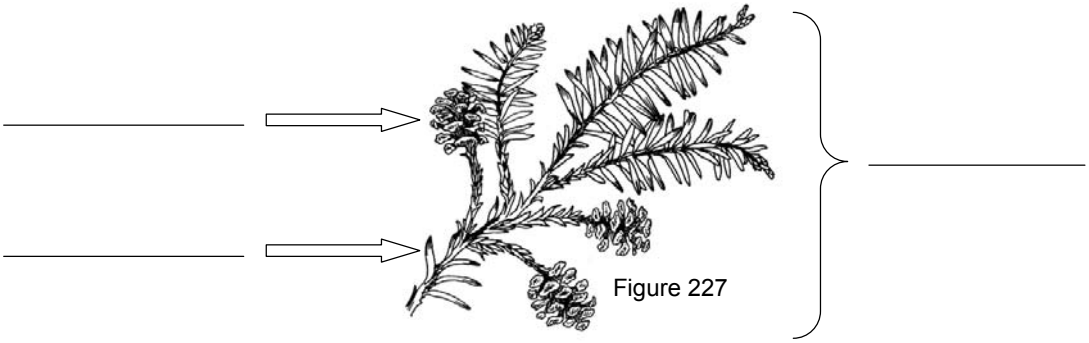


Figure 227

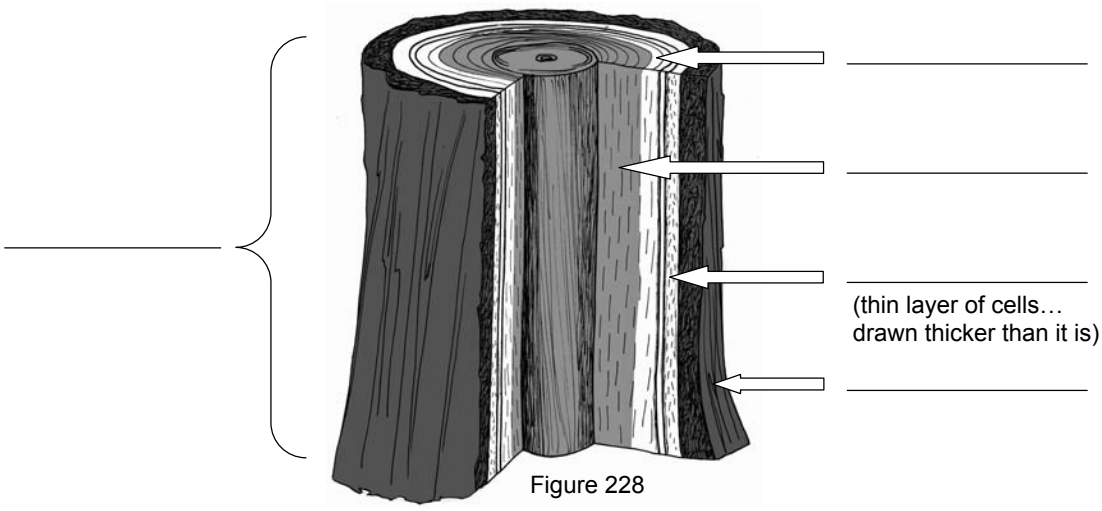
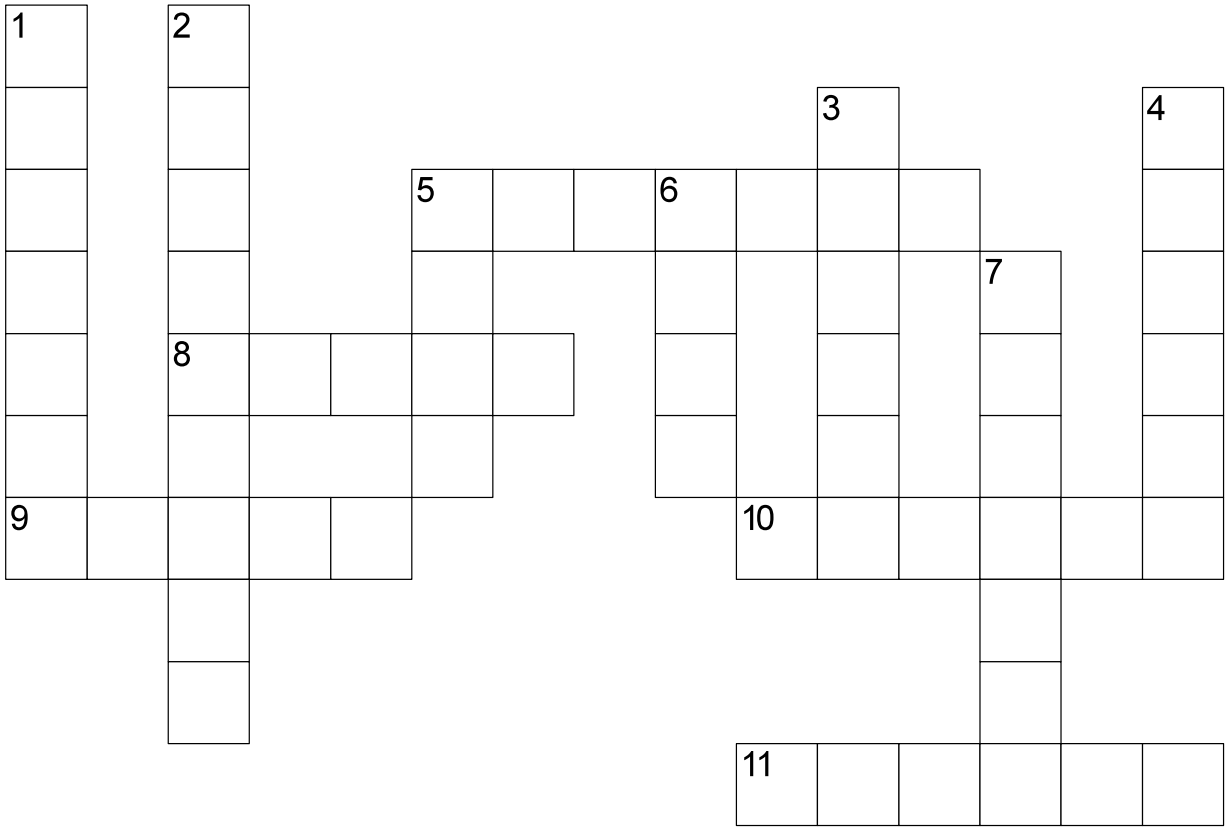


Figure 228

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 conifers to complete the following puzzle.



www.CrosswordWeaver.com

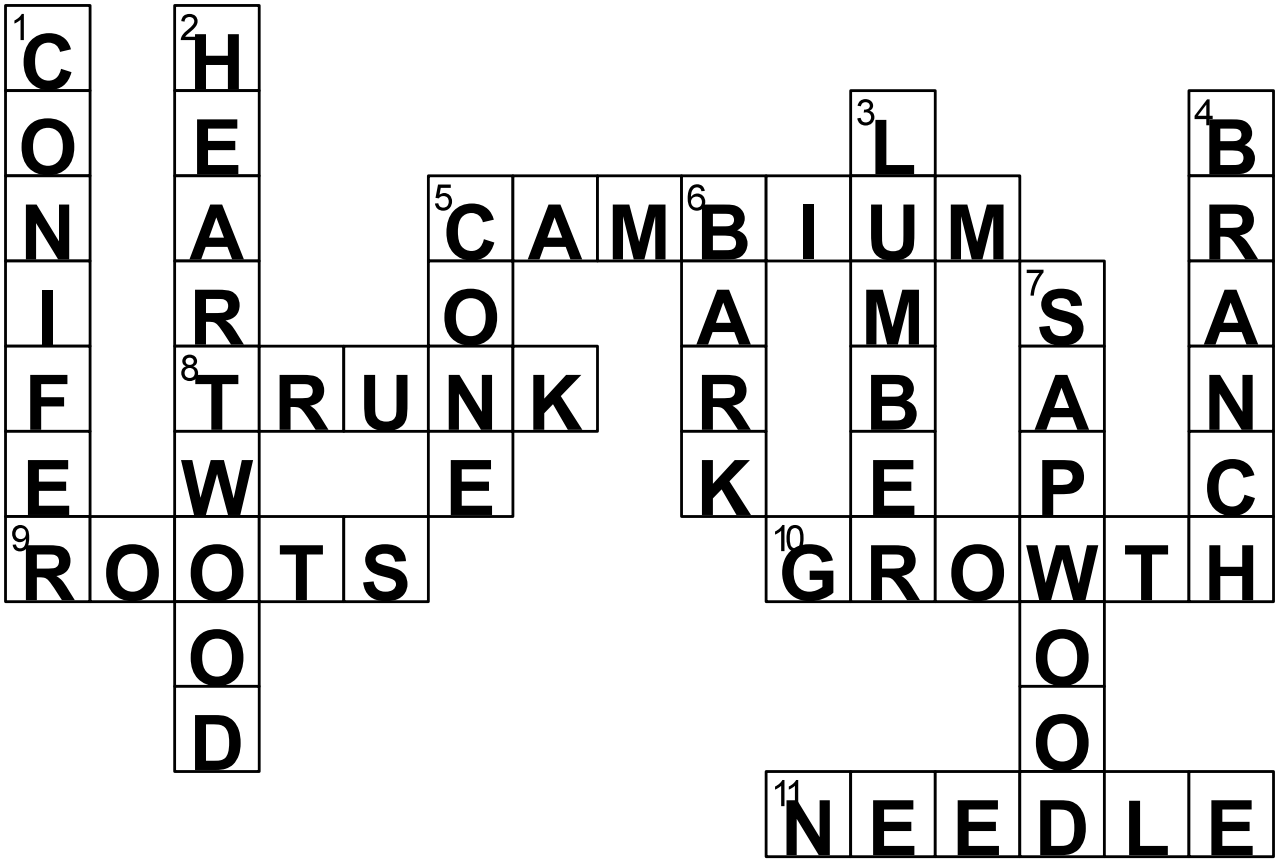
Across

5 Thin layer of cells that produces new wood
8 Stem or bole of a tree, supports the branches
9 Absorb water and minerals
10 A ___ ring indicates a year's growth
11 Narrow leaf of a cone-bearing tree

Down

1 Cone-bearing tree
2 Non-living center of a tree, often dark in color
3 Boards made from a tree
4 Supports a tree's leaves
5 Produces the seeds in some trees
6 Protects the tree from fire and insects
7 Living wood, usually light in color

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.

CALIFORNIA STANDARDS ADDRESSED (S.S. indicates a standard set.)

Focus Standards:

Grade 4: Life Sciences S.S. 3
Science Investigation and Experimentation S.S. 6
Grade 6: Earth Science S.S. 2
Science Investigation and Experimentation S.S. 7
Grade 7: Science Investigation and Experimentation S.S. 7

Other Standards:

Grade 4: History 4.1.4
History 4.3.3
History 4.4.5
Grade 5: Earth Sciences S.S. 3
Grade 6: History 6.1.3

NATIONAL CONTENT STANDARDS ADDRESSED

Science Grades 5-8: Standards A and D
Social Studies Middle Grades: III e, III f, III g, III h

Environmental Principles and Concepts

Principle II, Concepts a, b, c, d

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 10"–16" wide, 12"–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
- ❒ if you are using aluminum pans, use plywood to support them
- ❒ 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 the next time the lesson is taught
- ❒ sprinkling can, coffee can with holes punched in it, or spray bottle
- ❒ water
- ❒ towels, sponges for cleaning up
- ❒ a variety of ground cover materials…forest floor duff, leaves, straw, grass clippings, etc. A landscaping company may provide some turf.

TEACHER PREPARATION

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

Wearing a dust mask is recommended as diatomaceous earth may irritate the nose.

Add enough water so that water sprinkled on the surface runs off, forming a gully, instead of soaking in.

Figure 229. Diatomaceous earth in aluminum baking pans, with pine needle "duff."

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 on page 175, but <u>it is best if students learn to develop their own data tables for their own experiments</u>.

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 forest, look for places to point out erosion and hillsides that are and are not eroding.

Figure 230. Soil and sod.

VARIATIONS, ADAPTATIONS, DIFFERENTIATION

1. Try to find hillsides near your school where you can do similar experiments.
2. Soil and sod can be used. Sod might be obtained from landscaping companies, or simply temporarily removed from a lawn area.
3. In many communities, straw-filled netting and mesh "fences" are used to control erosion and soil runoff at construction sites. Locate such sites in your community and point them out to the students.
4. Insert white stakes or white plastic rulers into the soil. Measure how high up the mud splatters. If you line up the rulers or white stakes next to each other, the mud splatters will form a bar graph.
5. Use soil to create (or have students create) large (2'–3' tall) model of your local watershed. Include towns, roads, lakes, forested areas (covered with sod or duff), etc. Use a hose with a sprinkler attachment to simulate rain and study the water cycle, erosion, sedimentation, etc. Point out that the rivers flow to the ocean.

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?
3. Show pictures of various situations and ask the students to predict whether there will be much erosion.

REFERENCES AND RESOURCES

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

Haskin, Kathleen: The Ways of Watersheds

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

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

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 its annual growth rings.

CALIFORNIA STANDARDS ADDRESSED (S.S. indicates a standard set.)

Focus Standards:

Grade 4: Life Sciences 3.a
Science Investigation and Experimentation 6
Grade 5: Life Sciences S.S. 2
Science Investigation and Experimentation S.S. 6
Grade 6: Ecology/Life Sciences 5.a
Ecology/Life Sciences 5.e
Science Investigation and Experimentation S.S. 7
Grade 7: Science Investigation and Experimentation S.S. 7

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

NATIONAL CONTENT STANDARDS ADDRESSED

Science Grades 5-8: A, B

Environmental Principles and Concepts

Principle I: Concept a
Principle II: Concept a, b
Principle III: Concept c
Principle IV: Concept a

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 one or two 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…collect to reuse next time the lesson is taught)
- ❒ The Life Story of a Tree (one per student)

TEACHER PREPARATION
1. Obtain materials listed.
2. Make a transparency of The Great Tree Cookie Mystery Clue Sheet.
3. Duplicate The Great Tree Cookie Mystery Study Guide, The Life Story of a Tree, and (optional) 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 "Fence Post Studies" on page 286.
5. The Western National Parks Association has published an illustrated booklet called *Counting Rings: Tree-Ring Dating*. It discusses how tree rings are used to date past human habitation such as Mesa Verde and Jamestown. Obtain copies for students to read.
6. The Life Story of the Tree (page 181) can be done on a full sheet of paper, or on a paper plate, rather than the lower half of the instruction page.

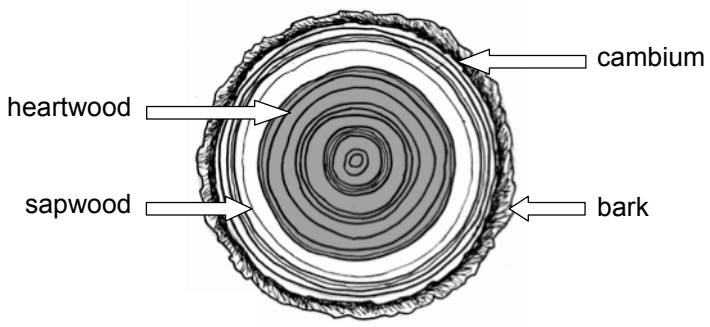
ASSESSMENT

1. The activity sheet “The Life Story of a Tree” on page 181 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. Sample



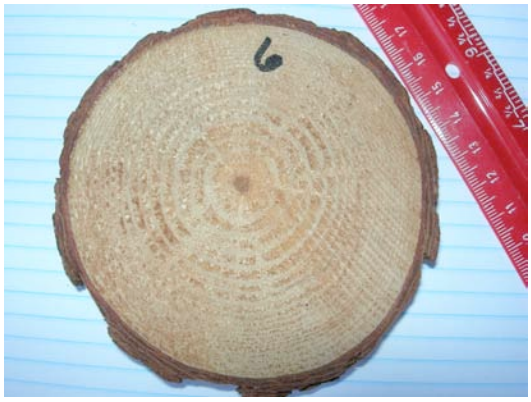
3. Average annual growth: With a <u>diameter</u> that was 9" achieved in 18 years, 9" ÷ 18 years = 0.5" average growth in <u>diameter</u> per year. Be sure to point out that this is an average; it doesn’t mean that it grew that much <u>each</u> year.
4. Sketches and observations should show the growth 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”

Gidwitz, Tom: *Counting Rings: Tree-Ring Dating*



Figures 232 (left) and 233 (right) Cookies showing suppressed/slowed growth (left) and recovering from an injury (right). Numbering specimens facilitates discussion.

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. Most trees 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.

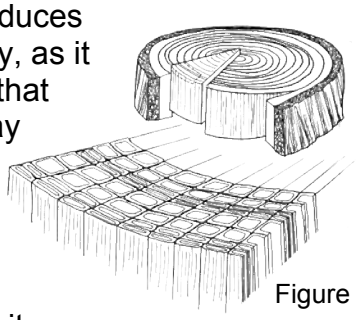
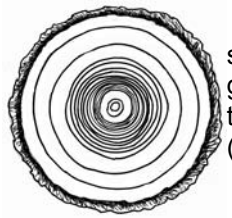


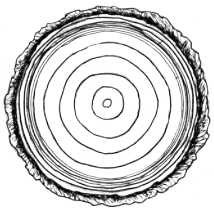
Figure 234.

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!)

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 round, showing that the tree grew over the stub. 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.” When they grow on a steep hillside, some types of trees grow more rapidly on the downhill side and other types grow more rapidly on the uphill side. This forms a “flatiron” shape. Some of these growth patterns are shown below.



slow growth, then fast (release)

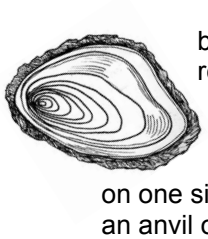


rapid growth, then slow (suppression)

fire scar/rot healed over

bark damage healing

parts of branches around which tree grew

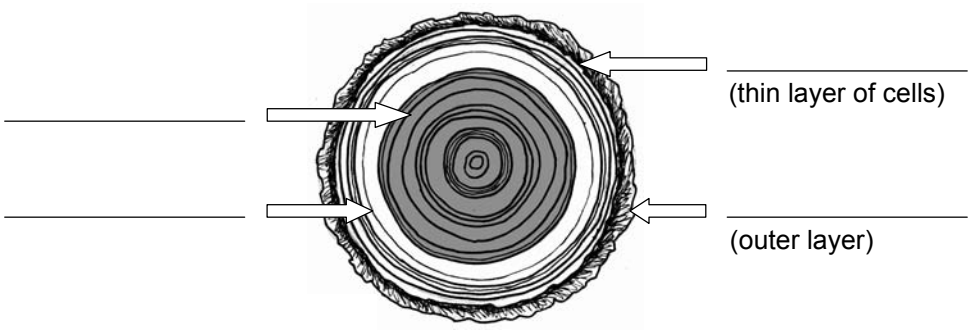


buttressing, resulting in a " flat-iron" tree with more rapid growth on one side, resulting in an anvil or (flat) iron shape

Figure 235.

The Great Tree Cookie Mystery—Study Guide

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



3. If the diameter of the tree drawn above was 9", 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 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. Space the rings far apart when the tree is growing rapidly and closer when it grows slowly. (You might want to draw the rings very lightly in pencil to be sure that you have enough space for 30 annual rings.)

The 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 trees 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 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 were killed by the fire, 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 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 transfer 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 returned to the environment.

CALIFORNIA STANDARDS ADDRESSED (S.S. indicates a standard set.)

Focus Standards:

Grade 4: Life Sciences S.S. 2, S.S. 3
Grade 5: Life Sciences 2.f
Grade 6: Ecology (Life Sciences) S.S. 5

NATIONAL CONTENT STANDARDS ADDRESSED

Science Grades 5-8: Standard C

Environmental Principles and Concepts

Principle III: Concepts a and b

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 on pages 24 and 26

TEACHER PREPARATION

1. Obtain listed materials.

PROCEDURE

1. It would be helpful if the students have done the activities “Who’s for Dinner?” on page 199 and “We’re All In This Together” on page 194 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 of their shirts or use 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 carries the popcorn in their hands as they run 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 for eating will be provided 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 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.
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?

REFERENCES AND RESOURCES

Roa, Michael: *Environmental Science Activities Kit*

Ideas for Using Historic Images

ACTIVITY SUMMARY
Ideas for the use of historic photographs in *The Conifer Connection* 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.

CALIFORNIA STANDARDS ADDRESSED

Focus Standards:
Grade 4: History 4.2.1, History 4.3.3
Grade 5: History 5.8
Grade 6: History 6.1.3

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, Concept a
Principle II, Concepts a, b, c, d
Principle III, Concept c
Principle IV, Concepts a, b, c

NATIONAL CONTENT STANDARDS ADDRESSED
Social Studies II e

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, bad, both, or neutral, depending on one's perspective.

GROUPING
Whole class

TIME
Varies

MATERIALS
- ❒ Illustrations from *The Conifer Connection* or other sources of historic photos
- ❒ *The Conifer Connection* Compact Disc

TEACHER PREPARATION

You might:

- Use a projector to show the images from *The Conifer Connection* DVD
- Use *The Conifer Connection* DVD and a laser printer to make overhead transparencies of illustrations.
- Photocopy the illustrations from a print copy of *The Conifer Connection*

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. The people often seem to be proud of their hard work but oblivious to the damage done. 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 or equipment 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. *The Conifer Connection* is available on a compact disc. Obtain the DVD 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.

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*

Gruell, George: *Fire in the Sierra Nevada*

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.

CALIFORNIA STANDARDS ADDRESSED (S.S. indicates a standard set.)

Focus Standards:

Grade 4: Mathematics Number Sense 3.0, Measurement and Geometry 1.0, Statistics 1.0
Science Investigation and Experimentation S.S. 6

Grade 5: Mathematics Number Sense 1.0, Statistics 1.0
Science Investigation and Experimentation S.S. 6

Grade 6: Mathematics Number Sense 1.0, 2.0, Measurement and Geometry 1.0
Science Investigation and Experimentation S.S. 7

Grade 7: Mathematics Mathematical Reasoning 2.0
Science Investigation and Experimentation S.S. 7

NATIONAL CONTENT STANDARDS ADDRESSED

Science Grades 5-8: Standard E

Environmental Principles and Concepts

Principle I, Concept a
Principle II, Concepts a, b, c, d

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 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. Avoid stretchy material.)
- ❒ fine tip permanent markers: one per group
- ❒ ruler, meter stick, or tape measure (preferred): one per group
- ❒ making a Forester's Diameter Tape Study Guide, on page 188
- ❒ optional: an actual diameter tape, available from forestry supply sources such as those found in Appendix IV, or borrow one from a local forester
- ❒ optional: calculator with a key for pi…and teach its use

TEACHER PREPARATION

1. Obtain listed materials. (A parent might be enlisted to melt the ribbon ends.)
2. Make a diameter tape to use as a model for the students.

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, how much 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 diameter 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. The tape could be made using metric units.
2. 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.

Figure 237. Commercial diameter tape. The hook on the end is placed into the bark to hold the end while the user wraps the tape around the tree.

Figure 238. Home-made diameter tape. The end of the tape has been heated to prevent unraveling.

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 Diameter Tape.

When you use the tape to measure a tree's circumference and diameter, you should make the measurement 4.5' 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' 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 circumferences on 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 region that they visit.

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.

CALIFORNIA STANDARDS ADDRESSED

Focus Standards:

Grade 4: Science Investigation and Experimentation 6.a
Grade 5: Life Sciences 2.a
Science Investigation and Experimentation 6.a

NATIONAL CONTENT STANDARDS ADDRESSED

Science Grades 5-8: Standard C

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 forest 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 plants found in the area to be studied (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 forest

TEACHER PREPARATION

1. Obtain listed materials.
   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 or a "spritz" of water 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. Point out that terms like 4' tall are more useful than terms like "short" or "big."

2. Ask for six volunteers. Select students with different appearances and clothing. **Avoid selecting students who are sensitive about 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 two to four students. 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, 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.
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 cottonwood) 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 of the plant after arriving at an "answer." Does their answer match the description?
   d. Give each group a leaf from a plant that is easy to identify with the key and lead the class through "keying it out" step-by-step.
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 them 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. Before a field trip, students can become "experts" in identifying ferns, trees, etc.
4. Students can make and use keys for identifying rocks, animals, or other things.
5. See the activity "Who am I?" on page 321.

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 (Keator)
Pacific Coast Bird Finder (Lederer)
Pacific Coast Fern Finder (Keator & Hardy)
Pacific Coast Tree Finder (Watts)

Washing a Watershed

ACTIVITY SUMMARY

Crumpled paper is used to model a watershed. Colored pens indicate different types of ground cover. Using a spray bottle to model rain, 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 it.

CALIFORNIA STANDARDS ADDRESSED (S.S. indicates a standard set.)

Focus Standards:

Grade 4: Life Sciences 3. a
Science Investigation and Experimentation 6
Grade 5: Earth Sciences S.S. 3
Science Investigation and Experimentation 6
Grade 6: Earth Sciences S.S. 2
Science Investigation and Experimentation 7

NATIONAL CONTENT STANDARDS ADDRESSED

Science Grades 5-8: Standards A, C, D, F

Environmental Principles and Concepts

Principle I, Concepts a, b, c
Principle II, Concepts a, b, c, d
Principle III, Concepts a, b, c
Principle IV, Concepts a, b, c

ANTICIPATED OUTCOMES

1. Students will understand some effects of runoff on streams and communities.

GROUPING

Groups of two to four students

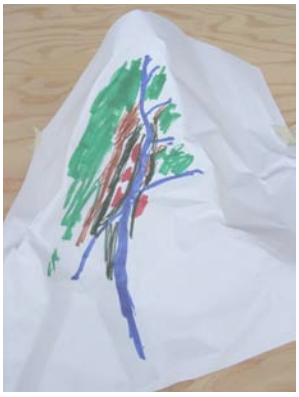


Figure 239. Watershed before the "rain."

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
- ❒ spray bottle with water (or plastic tub with holes punched in the bottom)
- ❒ sponges or towels for cleanup, and paper or plastic to cover desk tops

TEACHER PREPARATION

1. Obtain materials listed on page 192.

PROCEDURE

1. Demonstrate crumpling piece of paper into a ball, then opening it without 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 what a watershed is and that each of the valleys in the crumpled paper represents a watershed and ridges are boundaries.
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 (list on the board or overhead projector):
   - ✓ 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, logging, landslides, or for buildings or roads (water soluble)
   - ✓ black for roads and parking lots (water soluble)
   - ✓ red for buildings, houses, towns (permanent markers)
6. Have the teams make and color their own watersheds, including towns and roads.
7. Ask the students to predict what might happen if rain fell on the hills. What would happen to the soil on the hillsides? How would it affect rivers, streams, and lakes?
8. Then have the students use the spray bottles to simulate light rain.
9. Students observe the erosion of the exposed soil (brown), and runoff from the roads (oil and other chemicals…black). Ask where the runoff goes and what effects it might have on the streams and lakes, and the organisms, including people.
10. Discuss what might be done to reduce erosion from fire, logging, or clearing of land. (Point out that there are now laws and regulations intended to minimize erosion.)

VARIATIONS, ADAPTATIONS, DIFFERENTIATION

1. On their models, have the students identify and point out headwaters (first-order streams), second-order, and third-order streams.
2. Crayons may tend to flatten the paper more than felt tip markers.
3. Students can make flour and salt relief maps of the local watershed. Water will dissolve the map if too much is used, so caution them not to spray too much.
4. This activity can be used in conjunction with teaching about topographic mapping.
5. Some parks have watershed relief models. If they do, have the students study it.
6. See the activity “The Case of the Runaway Topsoil” on page 173.

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

Alton et al. *Watershed Curriculum*

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.

CALIFORNIA STANDARDS ADDRESSED (S.S. indicates a standard set.)

Focus Standards:

Grade 4: Life Sciences S.S. 2, S.S. 3
Grade 6: Ecology (Life Sciences) S.S. 5

Other Standards:

Grade 5: Life Sciences S.S. 2
Grade 7: Life Science Structure and Function in Living Systems S.S. 5

NATIONAL CONTENT STANDARDS ADDRESSED

Science Grades 5-8: Standards C, F

Environmental Principles and Concepts

Principle I, Concepts a, b
Principle II, Concepts a, b, c, d
Principle III, Concepts a, b, c

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 a forest ecosystem, approximately 8"x8" 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)

- ❒ 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')
- ❒ transparency of food chain/food web diagrams on page 24

TEACHER PREPARATION

1. Obtain pictures or drawings of the above organisms and factors. 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.
2. Mount the pictures on tag board. Laminate. Attach a 2' length of string or yarn so that each picture can be worn around a student’s neck.

PROCEDURE

1. Select students to represent the parts of the environment listed under Materials. 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 twelve students, including “Wasteful Wally” are connected. Finally connect back to the “sun.”
5. Securely tie the ends of the cord.

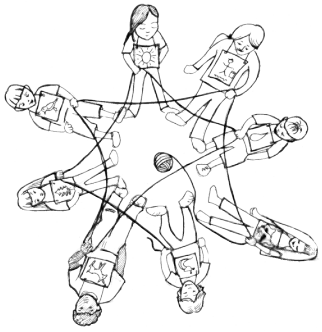
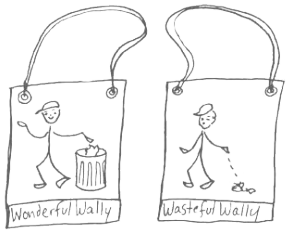


Figure 240.



“Wally’s” sign, front and back

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 me. I'm connected to the sun. The sun evaporates me, and on cloudy days I block some of the sun."

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 with one hand, and to tug gently when they feel a tug. Tell them to raise the other hand when they feel the tug.
10. Walk around the circle and tap a student on the shoulder and tell something that happened to the organism. The tapped student is to tug on the string with one hand and raise the other. (The deer was eaten by a cougar, or the minerals washed into the stream during a 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.") Discuss how we all affect the environment, and that we can make choices that will help protect the environment. Discuss how jobs and daily habits affect the environment.

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 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.

Do this only if you are sure that the cord is strong and well tied, and that you can trust your students to be careful.

2. Read *Brother Eagle, Sister Sky* (by Susan Jeffers) to the students.

ASSESSMENT

1. Have students tell how organisms are connected to each other and with the physical environment.
2. Have students tell ways that Wasteful Wally can be Wonderful Wally.

REFERENCES AND RESOURCES

Roa, Michael: *Environmental Science Activities Kit*
Jeffers, Susan: *Brother Eagle, Sister Sky*

What Do You Know?...and Now?

ACTIVITY SUMMARY

At the beginning of a unit on watersheds or forests, and working in small groups, students draw a picture of a forest watershed area. At the end of the unit, or after a field trip to a forest watershed area, they modify their picture and then present it to the class, explaining what they learned.

CONCEPTS TO BE LEARNED

1. Forests and their associated watersheds are complex environments.
2. A forest/watershed includes both biotic and abiotic parts.
3. Humans are an important part of forest watersheds.
4. Forests and watersheds are important to people.

CALIFORNIA STANDARDS ADDRESSED (S.S. indicates a standard set.)

Focus Standards:

Grade 4: Life Sciences S.S. 2, S.S. 3
History S.S. 4.1
Grade 5: Life Sciences S.S. 2
Earth Sciences S.S. 3
Grade 6: Ecology (Life Sciences) S.S. 5
Earth Science S.S. 2
Grade 7: Life Science 5.b, 5.f

NATIONAL CONTENT STANDARDS ADDRESSED

Science Grades 5-8: Standards A, C, F
Social Studies Middle Grades: III e, III f, III g, III h

Environmental Principles and Concepts

Principle II, Concepts a, b, c
Principle III, Concepts a, c
Principle IV, Concepts a, b, c

ANTICIPATED OUTCOMES

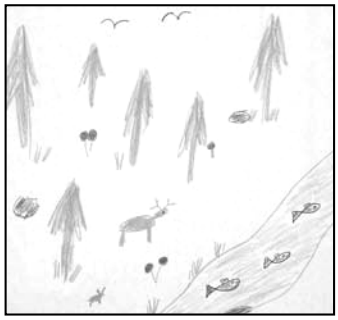
Students will increase their understanding of the complexity of forest ecosystems and watersheds.

GROUPING

Four to six students per group

TIME

30–60 minutes



Figures 241 (left) before lessons…drawn in crayon, and 242 (right) after lessons…with additions in marker pen. Before studying forest ecology, students typically omit such features as fire, dead trees (logs and snags), people, dead organisms, and insects.

MATERIALS

- ❒ chart paper (one sheet) or three feet of butcher paper per group
- ❒ colored pencils (preferably) **or** crayons **or** colored marker pens: a variety of colors for each group, (crayons and pencils facilitate shading)

TEACHER PREPARATION

1. Obtain listed materials.

PROCEDURE

1. This activity should be started before a field trip to a forest or watershed area.
2. Divide the class into groups of four to six students each.
3. Tell the students that today they will spend some time drawing a forest, including the important parts of the forest environment. Tell them that they won't be graded on their art, but that they should try to make the drawing clear enough that someone else would understand what is important in forests.
4. Tell them that after they draw their forest scene someone in the group will show and explain it to the class. They may write on the scene to help explain what they draw.
5. Issue the materials and tell them how long they have to work on their drawing… 15–20 minutes is suggested.
6. At the end of the designated time, tell the students to put their names on the poster.
7. Collect the drawing materials.
8. Have one or two students hold up the drawing while another explains it to the class.
9. Either collect the posters and save them for later or collect them and post them on the wall for the duration of the unit.

Then…

10. Periodically during the unit, at the end, or after the field trip, issue the groups a different type of drawing tool. (If they used crayons the first time, issue colored pencils or marker pens; if they used pencils or markers the first time, issue crayons.)
11. Assign the groups to add to or modify their poster to show their new learning.
12. Have the groups show their posters as they tell the class what they changed or added. (Using a different type of drawing tool makes it easier to see what has been changed, *i.e.*, what learning has occurred.)

VARIATIONS, ADAPTATIONS, DIFFERENTIATION

1. After other groups have shared their posters, allow them to incorporate into their posters things that they may have omitted.

ASSESSMENT

1. Do the posters include the parts of the ecosystem that you consider important, including human influences?

REFERENCES AND RESOURCES

Miller, Bob et al. *Forest Ecosystem* (part of the Adopt-A-Watershed Program)

Who's For Dinner?

ACTIVITY SUMMARY

Students learn about forest organisms and how they are related in food chains. (Recommendation: follow this activity with "We're All in this Together" page 194.)

CONCEPTS TO BE LEARNED

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

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.

CALIFORNIA STANDARDS ADDRESSED (S.S. indicates a standard set.)

Focus Standards:

Grade 4: Life Sciences S.S. 2, S.S. 3
Grade 6: Ecology (Life Sciences) S.S. 5

Other Standards:

Grade 5: Life Sciences S.S. 2
Grade 7: Life Science Structure and Function in Living Systems S.S. 5

NATIONAL CONTENT STANDARDS ADDRESSED

Science Grades 5-8: Standards C and F

Environmental Principles and Concepts

Principle I, Concepts a and b
Principle II, Concepts a, b, c, d
Principle III, Concepts a and b

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"x8" (one per student)
- ❒ either colored pencils, pens, or crayons with which students can draw organisms, or pictures of organisms from magazines, calendars, or the illustrations from Section I of The Conifer Connection (pages 60–104).
- ❒ tape or glue with which to attach pictures to tag board
- ❒ transparency of food chain/food web diagram on page 24

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.
3. Group the food chains into groups of four to six 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 tree	tree vole	spotted owl	barred owl	bacteria
	blackberry	slug	salamander	salmon	fisherman
	oak tree	deer	cougar	deer hunter	bacteria
	algae in a stream	stonefly larva	trout	kingfisher	bacteria
Other types of organisms to consider: dead organisms, mosquitoes, 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, soil.
3. Unless a picture is provided, the student draws a picture of the organism.
4. Each food chain group gets together and decides the order of their food chain.
5. Students line up in food chain order, holding their organism pictures.
6. When all food chains are formed, students explain to the rest of the class why they are in that order. As the groups explain their chains, the teacher reminds the class that every chain begins with the physical environment. They might hold up their picture and say something like “I’m a grasshopper. I eat plants and birds eat me.”
7. Tell the students that when they see an organism in the forest, they should be ready to tell what it eats and what eats it.
8. 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” on page 194.
9. Use the transparency of the diagrams on page 24 to review food chains and food webs.

VARIATIONS, ADAPTATIONS, DIFFERENTIATION

1. Have students 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.
2. To facilitate keeping food chains together, mount them on different colored paper.

ASSESSMENT

1. Ask students to explain why they placed themselves where they did.

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, take digital images for a slide show 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 things and places 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 be used to review what was seen on the trip. You might have the students prepare a slide show of their trip for parents.

CALIFORNIA STANDARDS ADDRESSED (S.S. indicates a standard set.)

Focus Standards:

- Grade 4: Life Sciences S.S. 3.a
- Grade 5: Life Sciences Standard Set S.S. 2
- Grade 6: Earth Science Standard Set S.S. 2
- Grade 7: Life Science Standard Set S.S. 5

NATIONAL CONTENT STANDARDS ADDRESSED

Science Grades 5-8: Standards C, D, F

Environmental Principles and Concepts

- Principle I, Concept a
- Principle II, Concepts a, b, c
- Principle III, Concepts a, b, c
- Principle IV, Concepts a, b, c

REFERENCES AND RESOURCES

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

Hunting For Treasure in the Forest

Chapter 2 includes an activity titled "Hunting For Treasure in the Forest" on page 221. That activity can be started prior to a trip to the forest.

Notebooks and Journals: Logs in the Woods

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

Commercial notebooks, composition books, report folders, or journals can be used, or students can make their own journals.

A quick search of the Internet will yield several designs for student-made journals. "Stick binding" can provide journals with a nice "nature" feel. Try searching for such terms as: *stick binding, homemade journals, camp journals, science journals*

Journal 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 strengthen it and help protect it from soil and moisture. Several variations below and on page 203.
"Decorations" might consist of:

- student drawings of the site or organisms
- prints of photos taken before or during the trip
- pictures from magazines, calendars, or brochures
- dry branchlets with needles or other leaves

CALIFORNIA STANDARDS ADDRESSED

Focus Standards:

Grade 4: English: Writing 2.3
Grade 5: English: Writing 2.3
Grade 6: English: Writing 2.3
Grade 7: English: Writing 2.3

MATERIALS

For student-made journals:

- ❒ paper: lined or blank
- ❒ file folders, card stock, or tag board (folded) for journal covers
- ❒ paper punch
- ❒ stick for the binding…not quite as long as the spine of the journal (Shallow notches will reduce sliding of the stick.)
- ❒ cord for binding: rubber band(s), string, yarn, shoe lace, ribbon
- ❒ optional: clear and/or colored adhesive shelf liner such as "Contact Paper®"
- ❒ optional: clear tape for attaching leaves to the cover

Figure 243. Stick-bound journal variation #1.

REFERENCES AND RESOURCES

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

Stick-bound Journal Variations

Variation #1: (Figure 243, page 202)
Cover: file folder cut to 9"x6"
Paper: 8½"x11", folded in half
Binding: ½ of a shoe lace
Decoration: student drawing

Variation #2: (Figure 244)
Cover: File folder cut to 6"x9"
Paper: cut to 5.5"x8.5"
Binding: rubber band
Decoration: leaf attached with clear tape and covered with clear shelf lining

Figure 244. Stick-bound journal, variation #2. (with cedar leaves)

Variation #3: (Figure 245)
Cover: File folder covered with shelf lining
Paper: 8½"x11"
Binding: ribbon (looped and tied around the center of stick first, then passed through the center hole, up through the top and bottom holes, around the stick and back through the hole(s), then tied at the back. Prunings from fruit trees (used here) are straight and the right diameter (about ¼").
Decoration: colored shelf liner, leaf attached with clear tape and covered with clear shelf lining.

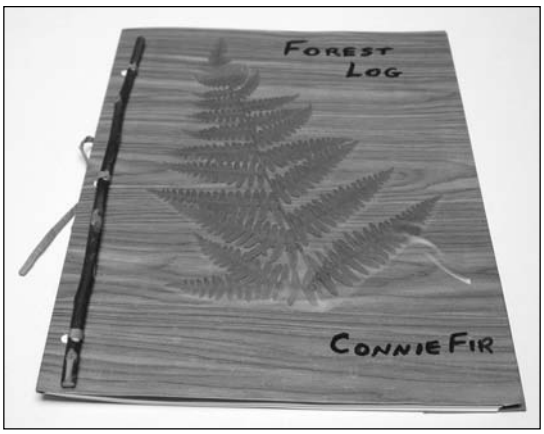


Figure 245. Stick-bound journal, variation #3. (with fern frond covered by clear shelf liner)

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 be extended to other environments, including the classroom, playground, and home. The charts on pages 204–205 are only a starting point. When you preview the field trip, look for things to add to the tables. Ask students and parents about allergy issues. Don't require students to taste things, and bring water with which to wash items.

CALIFORNIA STANDARDS ADDRESSED
Focus Standards:
Grade 4: Science Investigation and Experimentation 6.a
Grade 7: Science Investigation and Experimentation 7.b

REFERENCES AND RESOURCES
Roa, Michael: *A Guide to the Side of the Sea*
Snively: *Once Upon a Seashore*

Sense of Sight			
How many of these have you seen?	Before the field trip?	On the field trip?	Notes or Sketches:
A conifer seed (not the cone)			
Lichens on tree bark or a rock			
Sand grains in sandstone			
Fern spore cases			

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 conifer's needle			
Humus or soil on the ground			
The edge of an oak leaf			
Temperature of the soil in the shade and in the sun			

Sense of Smell			
How many of these have you smelled?	Before the field trip?	On the field trip?	Notes or Sketches:
Conifer needles			
Conifer tree bark			
Decaying leaf litter			

Sense of Hearing			
How many of these have you heard?	Before the field trip?	On the field trip?	Notes or Sketches:
Wind in the trees			
Chattering squirrel			
Water in a creek			
Footsteps on duff			
Birds (Can you describe the call?)			

Caution

Do not taste anything unless your teacher has said that it is safe to taste! Even if your teacher says that it is safe, rinse it with clean water.

Sense of Taste			
How many of these have you tasted?	Before the field trip?	On the field trip?	Notes or Sketches:
A conifer needle			
A ripe (black) blackberry			
An unripe (red) blackberry			
A pine or fir nut (seed)			

CHAPTER 2
Activities for During the Trip

See also Section III, page 157: Field Trips

The activities in Chapter 2 are intended to be done during a visit to a park or forest. They generally require the space or the organisms found there.

It is extremely important to visit the site prior to bringing students to the field trip site. Park rangers, naturalists, interpreters, docents, museum staff, or others can point out suitable places to do activities, suggest other activities, and inform you of safety and environmental concerns. Even if you plan to lead your own trip, a greeting by park personnel can help set an appropriate tone for the trip. Some activities may require you to leave the usual paths, pick leaves, or do other things for which you need permission.

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 safely with your particular students, equipment, and materials. This is important not only to ensure 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” beginning on page 277.

Equipment:
Basic equipment for field trips need not be expensive. It might include:

- A 5-gallon plastic bucket or two. These can be used to store materials between trips and for collecting litter and recyclable materials while on the trip.
- Simple first aid kit for cuts and scrapes, including disinfectant.
- Clipboards can be made from a binder clip and particle board or white paneling, available at building supply stores. A 4'x8' sheet can make a class set of 9" x 12" “clipboards that are easier to store than “regular” clip boards. White paneling can be used as a white board with dry erase markers.
- Pencils are preferable to pens because they don’t run when the paper gets damp.
- Plastic forceps, magnifiers and “bug boxes” are inexpensive and can be drilled for hanging from students’ necks.
- An assortment of containers such as butter tubs, yogurt containers, white plastic ice cube trays, shallow pans.
- Binoculars…which can be used as magnifiers when turned around and viewed through the large end.

Creek Studies

ACTIVITY SUMMARY

Students investigate stream temperatures, velocities, and amounts of suspended material. This activity is best done with more mature students and ample supervision.

CONCEPTS TO BE LEARNED

1. Faster flowing water can carry more suspended solids.
2. Faster flowing water is often cooler than slowly moving water.

CALIFORNIA STANDARDS ADDRESSED (S.S. indicates a standard set.)

Focus Standards:

Grade 4: Life Sciences 3.a
Science Investigation and Experimentation S.S. 6
Mathematics Number Sense 3.0

Grade 5: Earth Sciences 3
Science Investigation and Experimentation S.S. 6
Mathematics Number Sense 1.0, 2.0

Grade 6: Earth Science 2
Science Investigation and Experimentation S.S. 7
Mathematics Number Sense 1.0, 2.0

Grade 7: Science Investigation and Experimentation S.S. 7

NATIONAL CONTENT STANDARDS ADDRESSED

Science Grades 5-8: Standards A, C, D, F

Environmental Principles and Concepts

Principle II, Concepts a, b, c, d

ANTICIPATED OUTCOMES

1. Students will understand that stream velocity is a major factor in the amount of suspended material carried by the stream.

GROUPING

Groups of six

TIME

15–30 minutes

MATERIALS

Per group:

- ❒ stop watches or watches with second hands
- ❒ thermometer (preferably with carrying case)
- ❒ tape measure (minimum 10')
- ❒ clipboards
- ❒ pencils (work better than pens if the paper gets damp)
- ❒ plastic gallon jar or bucket

- ❒ coffee filter paper and funnel or filter holder
- ❒ ruler, meter stick, or 3' length of pvc pipe calibrated with a permanent marker (for measuring stream depth)
- ❒ towel
- ❒ Creek Studies Study Guide

TEACHER PREPARATION

1. When previewing the trip, locate sites where students can access a stream safely and without damaging the shoreline or vegetation. (Look for areas with varying velocities and conditions such as vegetation, rocky shores, sandy shores, etc.)
2. Be aware of steep banks, poison oak, deep pools, and strong currents.
3. Obtain the materials. If you use a plastic gallon jar (from the cafeteria or a restaurant?), carefully remove the “lip” that protrudes into the opening. Such a lip will keep some of the suspended solids from pouring from the jar with the water.
4. Try out the suspended solids collection in various sites. How many gallons or buckets does it take to obtain enough suspended material for the students to see?

PROCEDURE

1. Each team will be doing two studies: stream velocity and sediment load.
2. Assign the following jobs to team members:
   a. recorder
   b. launcher
   c. timer
   d. finish line observer
   e. water collector
   f. temperature and depth taker
3. Explain the procedures on the Study Guide and how to use the materials.

Caution

4. Caution the students not to go into the stream, accidentally or intentionally. Walking in the stream is likely to damage organisms living under rocks, and will stir up sediments, as well as being dangerous to the students.

Also caution them about slippery rocks and logs, and swift currents.

5. After the data are collected, have the teams share and compare their data.

VARIATIONS, ADAPTATIONS, DIFFERENTIATION

1. This activity correlates well with the activities “Invertebrate Inventory” on page 229, and “Stream Surveys” page 254.
2. You may want to attach a bucket to a pole for collecting water away from the shore.
3. Plankton nets can be purchased from some of the sources listed in Appendix IV. (If collecting plankton, be sure to obtain a plankton key or guide for identification, and you will need a strong magnifier or microscope to view plankton clearly.)

4. Some sites may have rocks, logs, or low bridges that provide safe access to the center of the stream**.**

Caution

5. *If the stream is rarely visited or little used, you might consider having students enter the stream wearing shoes or waders to protect their feet. They can collect water/sediment samples and might use plankton nets or other nets to collect organisms that float downstream when rocks or logs are overturned.* ***I do not encourage doing this in heavily used streams, as the organisms in them already get disturbed too much.***

6. Some jobs such as finish line observer and temperature taker can be combined.

ASSESSMENT

1. Do students follow directions?
2. Do students make good observations and record data accurately?
3. Can students explain the effect of stream velocity on the movement of suspended material in a stream?

ANSWERS TO SELECTED STUDY GUIDE QUESTIONS

1. Fast moving streams will usually contain more suspended material. As water loses energy, it slows down and doesn't have enough energy to carry suspended material.
2. In general, shallow, slow moving water will be warmer.
3. When dams slow or stop the flow of the water, suspended materials settle out and form sediments.
4. When dams slow or stop the flow of the water, the surface waters generally become warmer. Deep water may remain cool.
5. In general, deeper water will be cooler. (Cool water can hold more dissolved gases, such as the oxygen that fish need. An example of this can be seen when a glass of cold water is allowed to sit in the sun. Gas bubbles soon form on the side of the glass as air comes out of solution.)
6. If the dam results in warmer water, or fine sediments, salmon may not be able to successfully reproduce.
7. Plants provide shade, which helps cool the water. They also attract insects, which provide food for fish. Logging companies are now required to leave plants along streams to help provide suitable fish habitat.

REFERENCES AND RESOURCES

Shinkle, Jill: *Creek Watchers*

Creek Studies—Study Guide

Today you are part of a team of scientists that will collect some data about a stream.

- Be sure to follow directions and make and record your observations carefully.
- Ask your teacher if you have any questions.
- **DO NOT go into the creek!** Walking in streams can harm plants and animals that live in the sand and under rocks.

Team Members and Jobs:

Recorder: _____ Timer: _____ Temperature/Depth Taker: _____

Launcher: _____ Finish Line Observer: _____ Water Collector: _____

Site description: Shore/edge: rocky, sandy, covered by plants, or? _____

Shady, sunny, or? _____

Stream bottom: rocky, sandy, algae covered, mixed, or? _____

Stream flow: slow and smooth, splashing around rocks, or? _____

Other:

- ✓ Find the starting point for your velocity test. This is the **launcher's** station.
- ✓ Find the ending point for the velocity test. The **timer** and **finish line observer** are here.
- ✓ Determine where the water sample will be collected. The **water collector, temperature and depth taker,** and **recorder** will be here. (This must be a place where the sample can be collected **safely and without knocking sand or debris into the water.)**

Measure the distance the stream flows between the starting and ending points (from the launcher to the timer/finish line observer). It should be at least 10'. Distance: _____ feet.

To determine the stream speed:

a. When the timer says "go," the launcher drops a small stick into the **middle** of the stream. (Use a 2"–4" stick from the ground. Do not pick a twig from a living tree.)
b. When the stick reaches the end point, the finish line observer says "stop" and the timer notes the time that the stick took to travel the measured distance.
c. The recorder records the data on the data table (other side of this page.)
d. If the stick gets stuck on a rock, washes ashore, etc., disregard that trial and repeat.
e. Calculate the stream velocity by dividing the distance by the time.
   Example: If it took 5 seconds to travel 20': 20' ÷ 5 sec. = 4' per sec.
f. Use the same stick to repeat the process four times and find the average.

To determine the suspended materials carried by the stream:

a. Your teacher will tell you how much water to sample.
b. Fold the filter paper so that it fits snugly into the funnel or filter holder.
c. Use a bucket or jar to collect the proper amount of water. Be careful not to knock sand or other material into the stream, or to stir up the bottom by stepping into the stream, as this will affect your results.
d. **Carefully** pour the water through the filter. Gently swirl the water as you do this so that material doesn't stay in the bucket. Material that was being carried by the water will be trapped by the filter. This is suspended material.

To determine the temperature and depth: At the place where the water is collected, carefully dip the end of the thermometer into the stream. Hold the thermometer in place for two minutes, being careful not to drop it or break it by bumping it on the bottom or a rock. Use the ruler to measure the depth where the water is collected. Record the temperature and depth.

Stream Velocity

Distance (include units)	**Time** (seconds)	**Speed** Distance ÷ time	Calculate **average**	**Notes**
			(Add the 4 speeds and divide by 4.)	

Temperature: _____ º ___ (note: are these Fº or Cº ?) **Depth**: _____ in.

Suspended Solids

Describe the **amount** of material collected on the filter (none, little, some, lots) or draw the filter, showing the area covered by solids.
Describe the **types** of materials collected on the filter…mud, sand, gravel, leaves, sticks, or?

Describe the **sizes** of the materials that you collected…all one size, varying. How big?

Questions:

1. Compare the data collected by different teams.
   - ✓ Which had more suspended material—fast moving water or slowly moving water?
   - ✓ Which was warmer?
2. If a stream is dammed, what do you think will happen to the suspended material?
3. If a stream is dammed, what do you think will happen to the water temperature?
4. How does depth affect temperature?
5. Salmon and trout need cool, oxygen-rich water to live. They need gravel (not sand or mud) in which to lay their eggs. What affect do you think a dam is likely to have on the salmon population?
6. If fire, landslides, logging or something else removes the plants from the side of the stream, what affect do you think that would have on water temperatures?

   On salmon?

Duff Dwellers

ACTIVITY SUMMARY
Students observe organisms that live in the leaf litter or duff on the forest floor.

CONCEPTS TO BE LEARNED
1. Many organisms live in the leaf litter or duff on the forest floor.
2. Decomposers break down the leaf litter into soil components.

CALIFORNIA STANDARDS ADDRESSED (S.S. indicates a standard set.)
Focus Standards:
- Grade 4: Life Sciences 2.c, S.S. 3
  Science Investigation and Experimentation S.S. 6
- Grade 5: Science Investigation and Experimentation S.S. 6
- Grade 6: Ecology (Life Sciences) S.S. 5
  Science Investigation and Experimentation S.S. 7
- Grade 7: Science Investigation and Experimentation S.S. 7

Other Standards:
- Grade 5: Life Sciences 2

NATIONAL CONTENT STANDARDS ADDRESSED
Science Grades 5-8: Standards A, C, F

Environmental Principles and Concepts
Principle II, Concepts a, b, c, d
Principle III, Concepts a, b, c

ANTICIPATED OUTCOMES
1. Students will increase their understanding of the diversity of life.
2. Students will increase their understanding of the importance of food chains, food webs, and especially the role of decomposers.

GROUPING
Groups of two to five students, depending on equipment availability

TIME
30–45 minutes

MATERIALS: FOR EACH GROUP:
- ❒ a litter sifter (see various options below)
- ❒ white plastic pan such as a dish pan
- ❒ magnifier, two-way magnifier, or “bug box”
- ❒ plastic spoon
- ❒ forceps
- ❒ 3"x5" card
- ❒ clear plastic cup(s), or cups with white insides, or white plastic ice cube trays
- ❒ optional: trowel, clipboard and paper and pencil

Making a litter sifter:

1. Use duct tape to attach “hardware cloth”* screening material to a half-gallon milk carton, large juice can, coffee can, or #10 can (from a cafeteria or restaurant) from which the bottom and top have been cut**.
   OR
2. Use duct tape to attach “hardware cloth”* screening material to a 3" to 4" section of large (6" to 10") diameter plastic pipe**.

3. *Hardware cloth is available with various sizes of openings. If you only use one size, ½" is recommended. Consider making sifters with various sized openings ranging from ¼"–¾".

Figure 246. Litter sifters made from plastic gallon jar and #10 can. (Both are upside down and have the bottoms removed.)

Caution

***If you use a can, cover any sharp areas on the open top end with duct tape to prevent cuts. Also, be careful with the cut edges of hardware cloth.*

TEACHER PREPARATION

1. Make, or have parents or students make “Litter Sifters.”
2. Obtain the other materials.
3. Locate a site where there is ample duff or leaf litter accessible to the students.

PROCEDURE

1. While on the field trip, have teams of students sift through some leaf litter.
   - As they find organisms, have the teams place them in plastic cups or ice cube trays and show them to the other teams.

Caution

Warn the students not to pick up spiders or centipedes with bare hands…they should use forceps, plastic spoons, or cards, being careful not to injure the animals.

2. Since green plants are not part of the leaf litter, discuss where duff dwellers obtain their food. Discuss their role as decomposers.
3. Discuss the importance of decomposers and decomposition to the ecosystem.
4. Discuss the fact that bacteria, which are too small to be seen without a microscope, are present by the millions in the leaf litter and are very important in the decomposition process.
5. After the students are finished with the litter, it should be returned to the collection site.

VARIATIONS, ADAPTATIONS, DIFFERENTIATION

1. The simplest way to do this lab is to have students dump the duff into a light-colored plastic pan and remove large objects such as leaves and look for organisms as they sift through the remaining duff.
2. Have students compare the types and quantities of duff dwellers in different areas such as under different types of trees or in damp, shady areas as compared to dry, sunny areas.
3. Students can also examine leaves and twigs (detritus) from the bottom of a creek.
4. If organisms cannot be identified, have students sketch them in as much detail as possible for future identification, or bring a digital camera with “macro” capability.
5. If electricity is available, a “Berlese funnel” can be constructed. Use tag board and masking tape to make a funnel with a bottom “mouth” 1" to 2" in diameter. Cover the bottom opening with nylon or plastic window screening held in place with masking tape. Place the funnel over the mouth of a jar. Place duff, decaying leaf litter, or soil into the funnel, and place the funnel and jar under a warm light or in the sunlight. Soil and duff-dwelling organisms will move downward into the jar to escape the light and heat.

Figure 247.
Berlese funnel “in action.”

Figure 248.
Berlese funnel variations. Left to right: canning funnel with hardware cloth; 2-liter bottle top with pet screen; manila folder with pet screen. “Pet screen” is more durable than regular screen material.

ASSESSMENT

1. Ask students to explain the importance of decomposers to the ecosystem.

REFERENCES AND RESOURCES

American Forest Foundation: *Project Learning Tree: Pre K–8 Activity Guide: “Nature’s Recyclers”*

Outdoor Biology Instructional Strategies (OBIS): “Litter Critters”

From the Mountains to the Sea: Traveling Trash

ACTIVITY SUMMARY

Students collect and categorize litter found in a coniferous forest watershed. They then compare that data with date collected during the California Coastal Cleanup Day.

CONCEPTS TO BE LEARNED

1. Streams bring materials from watersheds to the sea.
2. Trash can harm organisms in a variety of ways.
3. There are ways that we can reduce litter.

CALIFORNIA STANDARDS ADDRESSED (S.S. indicates a standard set.)

Focus Standards:

Grade 4: Life Sciences S.S. 3
Science Investigation and Experimentation S.S. 6
History 4.1.3, 4.1.4, 4.1.5, 4.4.7
Mathematics Number Sense S.S. 3
Mathematics Statistics S.S. 1

Grade 5: Earth Sciences S.S. 3
Science Investigation and Experimentation S.S. 6
Mathematics Number Sense S.S. 1, 2

Grade 6: Earth Science S.S. 2
Science Investigation and Experimentation S.S. 7
Mathematics Number Sense S.S. 1, 2

Grade 7: Science Investigation and Experimentation S.S. 7
Mathematics Number Sense S.S. 1, 2
History Grades 6-8 Chronological and Spatial Thinking

NATIONAL CONTENT STANDARDS ADDRESSED

Science Grades 5-8: Standards A, C, D
Social Studies Middle Grades: III c, III e, III f, III g, III h, III I, III k

Environmental Principles and Concepts

Principle II, Concepts a, b, c, d
Principle III c
Principle IV a, b, c

ANTICIPATED OUTCOMES

1. Students will increase their understanding of the connectedness of mountain watersheds with other areas, including the ocean.
2. Students will increase their understanding of ways that trash affects ecosystems, and ways that it can be reduced.

GROUPING

Three to four students per group

TIME
Length of trip to coniferous forest plus 45–60 minutes at school or home

MATERIALS
- ❒ plastic buckets or bags for collecting litter, recyclable materials, and compostable materials
- ❒ gloves or tools for picking up litter
- ❒ clip board and pencil for each group
- ❒ state map showing that the streams in the field trip site connect to the ocean
- ❒ access to the Internet
- ❒ graph paper and colored pencils, crayons, or pens
- ❒ one rubber band per child
- ❒ one 6-pack neck ring
- ❒ five gallon plastic bucket with handle
- ❒ 15–25 pounds of canned food (or similar unbreakable weighted objects)
- ❒ length of strong cord or metal hook for hanging bucket from neck ring
- ❒ broom or similar object that will pass through a neck ring and span two desks
- ❒ Traveling Trash Study Guide for each group

TEACHER PREPARATION
1. Obtain listed materials.
2. Visit the California Coastal Commission Coastal Cleanup Web site at www.coastal.ca.gov/publiced/ccd/ccd3.html and decide:
   - ✓ What types of trash/litter you want the students to record? How should they group the various items?
   - ✓ How you want the students to record the data?
   - ✓ How you want the students to graph the data?
   - ✓ Be sure to look at the various graphs and data tables including the most recent Coastal Cleanup Day Totals by County data.
3. After looking at the Web site above, decide how to modify the Study Guide.
4. Contact the appropriate person at the field trip site to ask about recycling materials collected, or plan how to process them yourself. Also, ask about known hazards such as areas where drug paraphernalia might be found.

PROCEDURE
1. Before the trip to the forest, discuss what to do with lunch “waste” such as packaging, apple cores, bags, etc., and how to minimize it. Ask the students if they think that they will find/see litter while on the trip and what they might do about it. Elicit that they could collect it.

2. Ask the students what they think will happen to the litter if it isn’t collected. Elicit that it will most likely eventually roll or wash downhill into a stream and be washed downstream. Ask where the stream goes. Use the state map to show that the watershed that they will be visiting connects to the ocean.

3. Discuss problems with various types of litter such as entanglement in fishing line or nets, fish hooks, sharp edges, chemicals such as oil, pesticides, or medicines, plastic bags (turtles think they are food and fill their guts with them), 6-pack neck rings or fast food drink lids with large holes ensnaring birds, mammals, and fish, etc.

4. Demonstrate putting a rubber band across the back of your hand, hooking it on the little finger and thumb. Issue one rubber band per student and challenge them to try to remove it without using their other hand or rubbing it against something.

Figure 249.

Discuss how animals can become ensnared in fish nets, fishing line, and 6-pack neck rings. What if they were a bird whose beak was entangled in fish line?

5. Hold up a 6-pack neck ring. Ask the students what it is. Use cord, wire, or an “S-hook” to suspend a five-gallon bucket from it. Support the neck ring and bucket by passing a broom handle through the neck ring. Be sure that the bottom of the bucket is a few inches above the floor, as the neck ring will stretch.

   The broom can be supported by desks, as in Figure 250, or by two students.

Figure 250.

Ask the students how many pounds of cans in the bucket they think it will take to break the neck ring. (The amount will vary according to the type of ring. A typical ring might break at 10–20 lb.) Have a student or adult ready to catch the bucket handle when the ring breaks—or, let it crash to the floor!

Have a student add cans until the neck ring breaks.
Have another student record and then add up the amount of weight that it took.

Discuss whether an animal with their neck or foot ensnared by a neck ring could escape.

6. While on the trip have each group of students collect compostable, recyclable and non-recyclable litter both from your group and from the forest that you visit. As the material is collected, have one student record the number of items of each type.

Caution

7. *Warn students to be careful when picking up litter. Tell them NOT to pick up syringes, broken glass, sharp metal, dead animals, or other potentially dangerous items. They shouldn't reach under logs or into bushes where they can't see.*

8. At the end of the trip, have the students make a pile for each type of trash, and have them combine the data from their Study Guides. This is your class data.

9. Dispose of the material as appropriate…recycle, trash, compost, etc.

10. After the trip, have the students go to the California Coastal Commission's web site and look up data about the annual Coastal Cleanup Day. Have them record the data that you have decided on, and then graph it as per your instructions.

11. Have the students complete the Study Guide and discuss it.

VARIATIONS, ADAPTATIONS, DIFFERENTIATION

1. The California Coastal Commission has many resources available, including free resources, and an AV lending library. Go to: www.coastforyou.org.
2. Arrange for your class to participate in the Coastal Cleanup in September. Many inland areas have stream cleanups on the same day.
3. If your area doesn't have a cleanup day, work with students, local agencies, and service clubs to start one.
4. Students can graph various items from the Coastal Commission Coastal Cleanup Web site at www.coastal.ca.gov/publiced/ccd/ccd3.html and discuss trends.
5. For each type of material, discuss alternatives, including not using it.
6. Students can start a campaign to use re-usable lunch bags or boxes, thermoses, or other non-disposable materials at school.
7. Students can work to promote recycling at school and in the community.
8. Students can "adopt" a park and do periodic cleanups.

ASSESSMENT

1. The Study Guide can be used to assess student learning.

REFERENCES AND RESOURCES

Brown-Babcock, Maria: *Save Our Seas*

Haskin, Kathleen: *The Ways of Watersheds*

From the Mountains to the Sea: Traveling Trash—Study Guide

Today you're going to be a litter-getter, but also a litter-analyzer!

Be careful as you collect "trash" on your trip to the forest. Some of it can be dangerous. Do not pick up sharp objects such as broken glass or syringes. **If you do find a dangerous object, tell your teacher or other adult.**

Your teacher will show you the tools that you will use to collect litter and other trash that people have left in the environment.

Your teacher will also tell you how many categories you will divide the litter into and how to record it. After you have collected and categorized the litter, you will look at your data and compare it to data from the annual Coastal Cleanup Day.

We will separate our trash into these categories:

_____ _____ _____ _____ _____

Litter Data Table

Type of litter	Amount: My Group	Amount: Our Class
Other:		

Your teacher will tell you what to do with your data and how you should graph it.

Be sure to do the graph as your teacher instructs: give it a title, label the axes, use colored pencils, etc.

From the Mountains to the Sea: Traveling Trash: Questions

1. What was the most common type of litter that your class found?
   a) by number of pieces: _____
   b) by weight: _____

2. How could litter such as cigarette butts, neck rings, and plastic bags get from the mountains to the sea?

3. Follow your teacher's instructions as you go to the California Coastal Commission's Web site: www.coastal.ca.gov/publiced/ccd/ccd3.html

   Use complete sentences to answer these questions:
   a) What has happened to the number of volunteers since 1985?

   How would you explain that?

   b) What has happened to the total amount of debris (trash) collected since 1985?

   How would you explain that?

   c) What has happened to the amount of pounds of debris collected per volunteer since 1985?

   How would you explain that?

   d) What has happened to the number of plastic beverage bottles collected since 1989?

   e) What has happened to the number of cigarettes/cigarette butts collected since 1989?

Hunting for Treasure in the Forest

ACTIVITY SUMMARY
While on a field trip, students look for various things on a list, scavenger hunt style.

CONCEPTS TO BE LEARNED
1. Being alert and making careful observations can help one enjoy one's environment.
2. Scientists must make careful observations.

CALIFORNIA STANDARDS ADDRESSED (S.S. indicates a standard set.)
Focus Standards:

Grade 4:	Life Sciences 3.a
	Science Investigation and Experimentation 6.a
Grade 5:	Life Sciences S.S. 2
	Science Investigation and Experimentation 6.a, 6.g
Grade 6:	Depends on the teacher-generated list
	Ecology (Life Sciences) 5.e
Grade 7:	Life Science Structure and Function In Living Systems S.S. 5
	Others, depending on the teacher-generated list

NATIONAL CONTENT STANDARDS ADDRESSED
Science Grades 5-8: Standards A and C

ANTICIPATED OUTCOMES
1. Students will increase their ability to observe natural phenomena and objects.
2. Students will increase their ability to describe their observations.

GROUPING
Individuals or groups of whatever size the teacher decides

TIME
Varies

MATERIALS (PER GROUP/TEAM)
- ❒ Hunting for Treasure in the Forest Study Guide
- ❒ hand lens/magnifier/"bug box"
- ❒ clipboard and pencil (pencils work better than pens when the paper is damp)
- ❒ plastic bag for collecting litter
- ❒ optional: bag or other container for collecting items from the list

TEACHER PREPARATION
1. During a pre-trip visit, work with a ranger, interpreter, naturalist, or docent to develop the Hunting for Treasure in the Forest list. (Three models are provided.) *Also ask about hazards or places that the students should avoid.*
2. Create and duplicate the Hunting for Treasure in the Forest Study Guide/list.

PROCEDURE

1. Issue the Hunting for Treasure in the Forest Study Guide.
2. Tell the students the boundaries, time allowed, and any other limits.
3. Remind the students to be aware of poison oak, yellow jackets, etc.
4. Remind the students not to damage or kill anything.
5. Remind the students not to take anything home unless they have permission and a specific intended use. If the trip is to a park, remind the students not to take anything home.
6. Ask the students each to tell about the most interesting thing that they found. They might share verbally with the group and/or write about it.
7. Discuss whether there is value (treasure) in simple natural things that don't have an apparent monetary value. Are our lives richer when we get to see such things?
8. Read and discuss a book such as *The Table Where the Rich People Sit* by Byrd Baylor or *The Giving Tree* by Shel Silverstein.

VARIATIONS, ADAPTATIONS, DIFFERENTIATION

1. Modify the lists as appropriate for the site and your students.
2. This can be done over the course of the trip, for a short time and space (15 minutes, within sight of the teacher, for example), or during a large part of the trip (after lunch, for example).

ASSESSMENT

1. Do the students follow directions?
2. Do the students describe, collect, point out, or find the items on the list?

REFERENCES AND RESOURCES

Baylor, Byrd: *The Table Where the Rich People Sit*

Cornell: *Sharing Nature With Children*

Council for Environmental Education: *Project WILD® K–12 Activity Guide: "Microtrek Treasure Hunt"*

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

Silverstein, Shel: *The Giving Tree*

Stewards of the Coast and Redwoods: *Watershed Education Program*

Yandala, Deb. et al.: *All The Rivers Run*

Hunting for Treasure in the Forest Organism Checklist

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

Which organisms do you see during the trip?

Organism	Have seen before trip.	See on trip.	Notes or Sketches:
Moss			
Lichens			
Poison oak			
Fungi…mushrooms			
Millipede			
Centipede			
Black-tailed deer			

Forest 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:
Conifer tree cone			
Acorn			
Growth rings on a log or stump			
Woodpecker holes in a tree			

Hunting For Treasure in the Forest: Scavenger Hunt

As you visit the forest and watershed, see how many of the things in the boxes below you can find. **Do not collect anything**. Rather, **sketch** and **describe** it in the space provided. Be ready to share your discoveries with the group!

An animal's home	Animal tracks or other signs of animals
A plant with a flower or fruit	A fungus
A seed from a plant	A plant growing on another plant
Something growing on a rotting log	Two different types of insects
An animal sound (Sketch or describe the animal.)	Something interesting in the water

Hunting for Treasure in the Forest—Study Guide

There is treasure to be found in the forest! Listed below are a number of things that you may be able to find in the forest.

Follow your teacher's directions about whether to collect, describe, draw, or point out each of the things on the list.

Remember not to damage anything! Return all natural things to where you found them. Be careful of such things as poison oak, stinging nettles, yellow jackets, etc.

Teachers: The following list is just a starting point. Work with park staff or volunteers to develop a list that will work at your site.

Suggestions for things to collect **from the ground**:
- ❒ cones: redwood, Douglas-fir, different pines or firs
- ❒ acorns: tanbark oak, black oak, live oak, other oak
- ❒ a seed from a different plant (maple, berry, or?)
- ❒ leaves: redwood, Douglas-fir, tanbark, pine, fir, oak, other
- ❒ a feather
- ❒ something round
- ❒ something fuzzy
- ❒ something sharp
- ❒ something that you consider beautiful
- ❒ something that you consider interesting (and be prepared to explain why)
- ❒ a leaf that has been chewed on (not by a person)
- ❒ something white, blue, red, black or?
- ❒ two pieces of litter

Suggestions for things to point out, describe and/or draw:
- ❒ <u>evidence</u> of an insect, but not the insect itself
- ❒ <u>evidence</u> of a non-insect invertebrate
- ❒ <u>evidence</u> of a bird, but not the bird itself
- ❒ <u>evidence</u> of a mammal, but not the mammal itself
- ❒ an insect
- ❒ a non-insect invertebrate
- ❒ a bird
- ❒ a mammal
- ❒ a reptile
- ❒ <u>evidence</u> of ways that humans have changed the area in the last five years
- ❒ <u>evidence</u> of something that happened over 50 years ago
- ❒ <u>evidence</u> of camouflage

I Never Knew That!

ACTIVITY SUMMARY
Students observe individual or groups of organisms for an extended period of time, recording their observations.

CONCEPTS TO BE LEARNED
1. Careful observation can reveal things about organisms that had not been previously known to the observer.

CALIFORNIA STANDARDS ADDRESSED (S.S. indicates a standard set.)
Focus Standards:
Grade 4: Science Investigation and Experimentation S.S. 6
Grade 5: Life Sciences S.S. 2
Science Investigation and Experimentation S.S. 6
Grade 6: Science Investigation and Experimentation S.S. 7
Grade 7: Life Science…Structure and Function in Living Systems S.S. 5
Science Investigation and Experimentation S.S. 7

NATIONAL CONTENT STANDARDS ADDRESSED
Science Grades 5-8: Standards A and C

ANTICIPATED OUTCOMES
1. Students will increase their ability to observe and record both anatomical and behavioral characteristics of organisms.

GROUPING
Individual or groups of two

TIME
Introduction: five minutes
Observation and recording time: varies (15–30 minutes)

MATERIALS
- ❒ pencils and notebooks or clipboards with paper
- ❒ photo copies of the I Never Knew That! Study Guide
- ❒ optional: magnifiers or binoculars

TEACHER PREPARATION
1. While previewing the field trip, find a place where students might be likely to find insects, banana slugs, birds, fish, or other animals to observe. If there's any doubt, check with the park personnel to be sure that it is okay for students to sit in the area while they make their observations.

PROCEDURE

1. Discuss with the students the importance of careful observation when studying organisms.
2. Discuss the idea that scientists can observe both physical characteristics such as markings, color, number of legs, or body shape, and behavioral characteristics such as how an organism moves, how it reacts to sound, or how it feeds.
3. Pass out the I Never Knew That! Study Guide and explain that the students are to make and record careful observations of an organism.
4. Discuss safety issues such as staying in the study area, poison oak, etc.
5. Inform the students of the time limits.

VARIATIONS, ADAPTATIONS, DIFFERENTIATION

1. This activity can be done in any environment, including the home, neighborhood, or school grounds.
2. See the activity “Micro-hiking” on page 233.

ASSESSMENT

1. Are observations accurately recorded?
2. Were both physical and behavioral observations recorded?
3. Were the objective terms used in the descriptions (as opposed to subjective terms)?
4. Did students follow instructions?

ANSWERS TO SELECTED STUDY GUIDE QUESTIONS

These will vary according to the students’ observations.

REFERENCES AND RESOURCES

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

I Never Knew That!—Study Guide

Careful observation and accurate recording of observations are extremely important for scientists. For the next few minutes, you are going to be a scientist studying an animal more carefully than you have ever studied an animal before. Be sure to record your observations carefully and accurately. Drawings may help.

Also, be careful! Some animals can bite or sting, and don't get into poison oak!

Hint #1: Drawings may help. You don't have to be an artist to sketch your animal.

Hint #2: When you record your observations, try to use terms that everyone will understand. Using numbers may help with this. Think about these examples:

Not so clear	Clear
Has spots on its back	Has six oval-shaped spots on its back
Crawled slowly	Crawled 2' in 3 minutes
The biggest slug I've ever seen!	Is 3" long
Grayish with some brown	Body gray in color with brown on stomach

Hint #3: Be sure to include observations about how the animal looks **and** how it acts.

Hint #4: It may be useful to record your observations every 10 or 20 seconds, every minute, etc.

Observations (Continue on the back if necessary.):

What kind of animal are you observing? _____

What does this animal looks like? (**physical** observations) Look carefully and try to notice something that you have never noticed before.

Drawing Description…things that I notice:

Observations of **behaviors**:

Something that I observed that I hadn't observed before is:

A question that I have is:

Invertebrate Inventory

ACTIVITY SUMMARY

Students collect and identify invertebrates from a stream. By analyzing their findings, they determine whether the stream is "healthy."

CONCEPTS TO BE LEARNED

1. Different organisms have different environmental needs and tolerances.
2. By studying the organisms found in an environment such as a stream, one can determine the health of the environment.

CALIFORNIA STANDARDS ADDRESSED (S.S. indicates a standard set.)

Focus Standards:

Grade 4: Life Sciences S.S. 2, S.S. 3
Science Investigation and Experimentation S.S. 6
Grade 5: Life Sciences S.S. 2
Earth Sciences S.S. 3
Science Investigation and Experimentation S.S. 6
Grade 6: Ecology (Life Sciences) S.S. 5
Science Investigation and Experimentation S.S. 7
Grade 7: Science Investigation and Experimentation S.S. 7

NATIONAL CONTENT STANDARDS ADDRESSED

Science Grades 5-8: Standards A, C, D, F
Social Studies Middle Grades: III g, III h, III i, III k

Environmental Principles and Concepts

Principle I, Concept c
Principle II, Concepts a, b, c, d
Principle III Concept c
Principle IV Concepts a, b, c

ANTICIPATED OUTCOMES

1. Students will increase their understanding of stream ecology.

GROUPING

Two to four students per group

TIME

30–60 minutes

MATERIALS

- ❒ materials for collecting stream organisms, including: shallow plastic pans (white), such as darkroom trays, white ice cube trays, plastic butter tubs, yogurt containers, or other similar containers, forceps, and nets
- ❒ field guides, taxonomic keys, or other identification tools
- ❒ "bug boxes" or other magnification tools

- ❒ clip boards and pencils (which work better than pens when paper is damp)
- ❒ Invertebrate Inventory Study Guide (laminated copies)
- ❒ If the Study Guide is laminated, grease pencils for recording data
- ❒ old sneakers or rubber boots for wading; towels for drying off

TEACHER PREPARATION

1. If the field trip is to a park, check with park personnel about collecting organisms for this activity (and returning them to the stream).
2. Obtain listed materials.
3. Visit the field trip site to find a place where students can safely enter the stream to collect samples. Look for a shallow area with slow water and easy access.
4. Photocopy and laminate the Aquatic Macroinvertebrates guide on page 232.

PROCEDURE

1. Prior to the trip, show the students how to use the identification tool(s), and arrange for them to bring or wear old sneakers or rubber boots for wading, as well as a towel. Some students may have water shoes.
2. At the site, go over safety rules and where students may and may not go in the water.

Caution

INSIST *that students not go into the stream barefoot. There may be sharp glass, metal, rocks, sticks, fishhooks, or other dangerous items. They must also avoid rapids and deep areas.*

3. Instruct the students to look for organisms that indicate the stream's health.
4. Students can tally the organisms seen on their data table (in pencil), or on the laminated illustrations with an overhead marker or grease pencil.
5. Have the students complete the Study Guide and discuss it.

VARIATIONS, ADAPTATIONS, DIFFERENTIATION

1. This activity correlates well with activities *Creek Studies* page 207 and *Stream Surveys*, page 254.
2. There are several resources that provide extensive instructions for this sort of activity. See References and Resources.
3. Rather than laminating the guide, duplicate and have students tally on it.

ASSESSMENT

1. The Study Guide can be used to assess student learning.

REFERENCES AND RESOURCES

Firehook, Karen: *Hands-On Save Our Streams*

Harrington, Jim and Monique Born: *Measuring the Health of California Streams and Rivers*

Izaak Walton League of America: *A Volunteer Monitor's Field Guide to Macroinvertebrates*

Murdoch, Tom et al.: *Streamkeeper's Field Guide*

Invertebrate Inventory—Study Guide

Invertebrates are animals that don't have vertebrae (a.k.a. backbones). Insects, snails, worms, sow bugs, and crayfish (or crawdads) are examples of invertebrates. If they are large enough to be seen without a microscope, they are called macroinvertebrates.

Some kinds of invertebrates are very sensitive to pollution and can only live where the water is clean and has plenty of oxygen. Others are tolerant of poor water quality and can live in more polluted water or water with little oxygen.

In this study, you will be collecting invertebrates from a stream. After identifying them and indicating their relative abundance (many, some, few, none), you will return them to the stream where you found them. Do not injure or kill the critters!

Streams can be dangerous, so do not go into deep or fast moving water, and always wear shoes or boots to protect your feet. Follow your teacher's instructions!

1. Hundreds of kinds of organisms live in streams. A few are illustrated on the guide that your teacher will provide. Record the abundance of those listed on the table.

VERY POLLUTION SENSITIVE ORGANISMS	ABUNDANCE (many, some, few, none)
Caddis Fly Larvae	
Mayfly Nymphs	
Stonefly Nymphs	
SOMEWHAT SENSITIVE ORGANISMS	
Crane Fly Larvae	
Crayfish	
Damselfly Nymphs	
Dragonfly Nymphs	
Scuds (Amphipods)	
TOLERANT TO POLLUTION	
Aquatic Worms	
Midge Larvae	
Rat-tailed Fly Larvae	

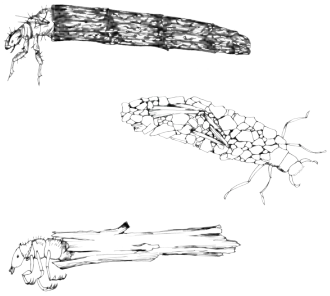
2. If you find other organisms, sketch them below, in the margins, or in your notebook, and try to identify them.
3. You will combine your data with the data collected by other groups.
4. Trout and salmon require clean water with lots of oxygen. Did you see any trout?
5. Based on your class data, how would you describe the water quality of this stream?
   Other organisms:

Figure 251

Aquatic Macroinvertebrates

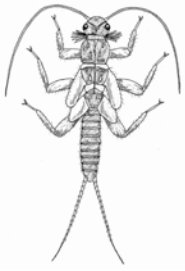
Pollution Sensitive (indicate clean water)

Caddis Fly Larvae
0.5-1.5 in. (1-3.5 cm)



Mayfly Nymphs (Naiads)
0.25-1 in. (0.3-2.5 cm)

Stonefly Nymphs (Naiads)
1-2 in. (2.5-5 cm)



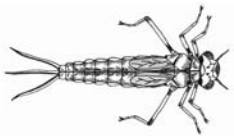
Somewhat Tolerant of Pollution

Crane Fly Larvae
0.5-1.5 in. (1-3.5 cm)

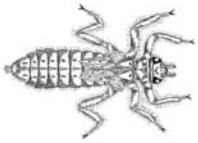
Scuds (Amphipods)
0.25-0.5 in. (0.3-1 cm)

Crayfish (Crawdads)
Adult 4-5 in. (10-12.5 cm)

Damselfly Nymphs (Naiads)
0.5-2 in. (1-5 cm)

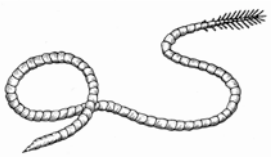


Dragonfly Nymphs (Naiads)
1-2 in. (2.5-5 cm)



Pollution Tolerant (may indicate polluted water)

Aquatic Worms
0.5-2 in. (1-5 cm)



Midge Larvae
0.3-0.5 in. (1-1.5 cm)

Rat-Tailed Fly Larvae
0.25-0.75 in (0.5-1.5 cm)
plus “tail”

Bottom two Caddis Fly Larvae and Rat-Tailed Fly Larva by Faith Rumm. Other illustrations courtesy Izaak Walton League.

Micro-hiking

ACTIVITY SUMMARY
Students make observations while “hiking” by crawling for a short distance, keeping their heads no more than a foot above the ground.

CONCEPTS TO BE LEARNED
1. Careful and close observation can reveal things that we don’t normally notice.

CALIFORNIA STANDARDS ADDRESSED (S.S. indicates a standard set.)
Focus Standards:
- Grade 4: Life Sciences S.S. 3
  Science Investigation and Experimentation S.S. 6
- Grade 5: Life Sciences S.S. 2
  Science Investigation and Experimentation S.S. 6
- Grade 6: Ecology (Life Sciences) S.S. 5
  Science Investigation and Experimentation S.S. 7
- Grade 7: Life Science…Evolution 3.a, S.S. 5
  Science Investigation and Experimentation S.S. 7

NATIONAL CONTENT STANDARDS ADDRESSED
Science Grades 5-8: Standards A, C, F

ANTICIPATED OUTCOMES
1. Students will increase their ability to observe and to describe their observations.
2. Students will observe things that they have not previously noticed.

GROUPING
Teams of two

TIME
10–30 minutes

MATERIALS
For each team of two students**:**
- ❒ 5' (or 1 or 2 meters) of string
- ❒ clipboard, paper, pencil
- ❒ optional: hand magnifier

TEACHER PREPARATION
1. Obtain the listed materials.
2. While on a pre-trip visit to the site, find an area where students can crawl along the ground safely.

PROCEDURE

1. Give each team the materials.
2. Tell them to spread their strings along the ground (or across a log, on a tree, over a rock, etc.) in such a way that they won't interfere with other groups. Encourage them to look for things that they have never before noticed.
3. One student crawls along the ground (on "all fours"), keeping his or her head no more than 1 foot above the ground. As the student crawls, he or she describes what is seen.
4. The second student records the observations of the first. Of course, the second student is encouraged to check out for himself/herself what the first student describes.
5. After the first student has "hiked" the string, the students place the string in another area and trade roles.

VARIATIONS, ADAPTATIONS, DIFFERENTIATION

1. Rather than "hiking" along a string, students can explore a small area determined by tossing a loop of string.
2. PVC pipe can be used to make a frame an area that is one square meter. If you glue only half of the corners, the frame can be broken down for storage.
3. To make a 0.1 m^2 frame, make it 25 cm x 40 cm.
4. See the activity, I Never Knew That! on page 226.

ASSESSMENT

1. Do students look closely and describe accurately? Have the students share their observations, emphasizing the value of accurate, objective observations.

REFERENCES AND RESOURCES

Cornell, Joseph: *Sharing Nature with Children*

The Only Constant is Change: Succession in Action

ACTIVITY SUMMARY
Students observe examples of succession, or changes in dominant species, in the field.

CONCEPTS TO BE LEARNED
1. Environments change over time.
2. Over time, the dominant organisms living in a place will change.
3. Different organisms inhabit a place at different successional stages.

CALIFORNIA STANDARDS ADDRESSED (S.S. indicates a standard set.)

Focus Standards:

Grade 4: Life Sciences S.S. 3
Science Investigation and Experimentation S.S. 6
Grade 5: Science Investigation and Experimentation S.S. 6
Grade 6: Earth Science 2.d
Science Investigation and Experimentation S.S. 7
Grade 7: Science Investigation and Experimentation S.S. 7

NATIONAL CONTENT STANDARDS ADDRESSED

Science Grades 5-8: Standards C, D, F

ANTICIPATED OUTCOMES
1. Students will increase their understanding of succession in biological communities.

GROUPING
Whole class and individuals

TIME
Varies

MATERIALS
- ❒ paper and pencils
- ❒ clipboards

TEACHER PREPARATION
1. When you do the pre-trip site visit, locate places where students can see various stages of succession such as:
   - bare earth or rock
   - grasses (on earth) or lichens (on rock)
   - non-woody herbaceous plants
   - small woody plants
   - trees

It would be ideal if you can locate an area where a fire, landslide, logging, road building, or other disturbance has obviously set succession back. Also, look for places such as a meadow or field where the forest was cleared some time ago. Look for bushes or forest trees growing along the edge of the meadow, *i.e.,* forest trees colonizing the meadow.

PROCEDURE

1. While on the field trip, point out to students different plants growing in different areas.
   - Discuss the concept of succession, wherein a group of plants and animals affect and change their environment, resulting in other plants and animals becoming dominant.
   - Discuss how such things as fire, road clearing, landslides, or logging can set succession back to an earlier stage. Include in the discussion the idea that such things create a diversity of communities in an ecosystem–biodiversity.
   - Discuss the idea that the plants and animals in a successional stage don't just appear. They are present but not dominant during the previous stage. Often, shade-tolerant plants survive and thrive in the shade of less shade-tolerant plants, eventually becoming dominant.
2. Have students draw and label the different vegetation types from bare soil to a forest with a canopy, sub-canopy, and understory, or herb, shrub, and tree layers.

VARIATIONS, ADAPTATIONS, DIFFERENTIATION

1. *Project Learning Tree* has a classroom succession activity called "Nothing Succeeds Like Succession." See American Forest Foundation, *Project Learning Tree: Pre K–8 Activity Guide*, 2006.
2. Ponds or small lakes can be found in many parks and forest areas. Look for the succession sequence of aquatic grasses, terrestrial grasses, bushes and trees.
3. Succession can be observed in the classroom by simply obtaining some unpurified water, perhaps from a creek or pond while on a field trip (or adding some straw or other "contaminant" to some tap water), and keeping it in an aquarium or jar on a windowsill and observing the changes over time as different groups of organisms grow.
4. While the term "succession" isn't used in *A Forest's Life: From Meadow to Mature Woodland*, the children's book by Cathy and Robert Mania describes changes in a forest over time.

ASSESSMENT

1. Look for various stages in the students' drawings.

REFERENCES AND RESOURCES

American Forest Foundation: *Project Learning Tree: Pre K–8 Activity Guide*
Mania, Cathy and Robert Mania: *A Forest's Life: From Meadow to Mature Woodland*

People Pictures

ACTIVITY SUMMARY
Students "take pictures" by pointing their partner's eyes towards something that they find interesting.

CONCEPTS TO BE LEARNED
1. Natural objects can be very interesting when viewed close-up.

CALIFORNIA STANDARDS ADDRESSED (S.S. indicates a standard set.)
Focus Standards:
Grade 5: Life Sciences S.S. 2
Grade 7: Life Sciences…Structure and Function in Living Systems S.S. 5

NATIONAL CONTENT STANDARDS ADDRESSED
Science Grades 5-8: Standards A and C

ANTICIPATED OUTCOMES
1. Students will increase their ability to observe and describe details.

GROUPING
Teams of two students

TIME
10–20 minutes

MATERIALS
❒ index card or notebook and pencil

TEACHER PREPARATION
1. Obtain the materials.

PROCEDURE
1. Tell the students that they are about to become nature photographers: one will be the camera, and one will be the photographer. They will then change roles.
2. Demonstrate how to "take a picture."
   a. The "camera" closes his or her eyes.
   b. The photographer **carefully** leads the "camera" to the place where the photographer finds something interesting to "photograph."
   c. The photographer then carefully points the camera at the subject and tells the subject whether this will be a close up, medium, or long-distance photograph. (This helps the camera to focus quickly on the subject.)
   d. When the camera is ready, the photographer taps the camera on the shoulder and says "click."
   e. When the camera hears "click," he or she opens his or her eyes and takes in the site visually. (No talking…cameras don't talk!)

f. Once that picture is taken, the camera then closes his or her eyes and is guided to another picture site.
g. After a number of pictures (five to ten), or about five to ten minutes, the photographer and camera switch roles.
h. After both students have taken their pictures, have them sketch the favorite picture that they took. They may do this from memory, or they might return to the site.

Figure 252. Click!

Caution

***Note**: Be sure to warn the students to be careful as they guide their "cameras," and not to position the camera where he or she might poke an eye. Also tell them of any "off limits" subject matter such as trash cans, roads, poison oak, water, or other people.*

VARIATIONS, ADAPTATIONS, DIFFERENTIATION

1. Students can "pan" their cameras by moving the student's head slowly from side to side or up or down.
2. Students can write stories about one or more of the scenes that they saw.
3. Students can investigate nature photographers such as Ansel Adams and their role in conservation efforts.

ASSESSMENT

1. Do students cooperate and are they careful?
2. Do their drawings and/or stories show attention to detail?

REFERENCES AND RESOURCES

Cornell, Joseph: *Sharing the Joy of Nature*

Poems in the Woods

ACTIVITY SUMMARY
Either during or after a trip to the forest, students create poems.

CONCEPTS TO BE LEARNED
1. Poetry can be used to express feelings and thoughts.
2. There are various kinds of poetry.

CALIFORNIA STANDARDS ADDRESSED
Focus Standards:

Grade 4: English Written and Oral Language Conventions 2.2.4
Grade 5: English Listening and Speaking Strategies Standard Set
Grade 6: English Listening and Speaking Strategies Standard Set
Grade 7: English Listening and Speaking Strategies Standard Set

ANTICIPATED OUTCOMES
1. Students will increase their willingness and ability to write various types of poetry.
2. Students will form a greater connection with the natural environment.

GROUPING
Individuals

TIME
Varies

MATERIALS
- ❒ notebook or clipboard, paper and pencil
- ❒ copies of “Poems in the Woods” Study Guide (page 241-242, two-sided)

TEACHER PREPARATION
1. Before the trip, introduce various types of poetry. The Poems in the Woods Study Guide may be useful for this.
2. Obtain the listed materials.
3. Decide whether to allow students to share their word lists. Doing so can help them have a richer collection of words to use. Telling them beforehand that they will be able to share word lists can relieve some anxiety, especially with students with a limited English vocabulary.
4. Decide whether to allow students to write in languages other than English.
5. Find a place where students can sit quietly to write.

PROCEDURE

1. Use the Poems in the Woods Study Guide to review various types of poetry and to prepare to write.
2. Review the various types of words to be listed in the word lists (nouns, verbs, adjectives, and adverbs). Give examples to help the students start their lists.
3. Have the students find a comfortable place, apart from each other, where they can write. Tell them that they will need to spend at least (10, 15, 20) minutes (or other time that you determine) at their site, so they should take their time rather than rush through this writing assignment.

VARIATIONS, ADAPTATIONS, DIFFERENTIATION

1. Before the field trip, students can practice writing poetry, or they can read samples of various types of poetry.
2. Students can write their poems on drawn or cut-out shapes such as trees or animals.
3. Student poems can be compiled into a booklet or on a tree-shaped bulletin board display.
4. Consider saving some samples of student poems to use as examples.

ASSESSMENT

1. Do the students follow the conventions (if any) of the poetry styles?

REFERENCES AND RESOURCES

American forest Foundation: *Project Learning Tree Pre K–8 Environmental Education Activity Guide: "Poet-Tree"*
Shinkle, Jill: *Creek Watchers: Exploring the Worlds of Creeks and Streams*

Poems in the Woods—Study Guide

Just as carpenters use boards and nails to build houses, and bakers use flour and other ingredients to make cakes, poets use words to create poems. Today you are going to write one or more poems about the forest. First, though, you will need to collect your tools—words. To get you started, a few examples have been provided below and on the next page.

List eight **nouns** (things) that have to do with the forest. For example: trees, air, deer, soil

List seven **adjectives** (words that describe things) that have to do with the forest, *e.g.,*: green, tall, cool

List six **verbs** (action words) that have to do with the forest: *e.g.,*: grow, live, whisper

List five **adverbs** (words that describe verbs, other adverbs, or adjectives) that have to do with the forest, *e.g.,:* slowly, quietly, majestically

There are many different kinds of poems. Several types are described below and on the next page. Use the words above **or others** to write a poem that shows how you feel about trees or the forest.

Haiku poems, which originated in Japan, have very a particular structure. Haiku poems have three lines: the first has five syllables, the second seven, and the third has five. Haiku usually are nature poems, and the last line is often surprising or strong.

Reaching for the sky
Green needles growing, tall tree
Look—the wet rain comes!

Your Haiku:

Continued

Cinquain poems have five lines and have a specific structure. Each line has a specific purpose or structure:

Line 1: title line in two syllables or two one-syllable words	Tall Trees
Line 2: four syllables or words, describe the first line	Red, green, and brown
Line 3: six syllables or words, describe action	Growing slowly in sun
Line 4: eight syllables or words, describe a feeling	Soft shade makes us smile as we rest
Line 5: another word for the first line/title in two words	The forest!

Diamante poems are shaped like a diamond. An example of a diamante poem structure might be:

Noun	tree
adjective adjective	tall green
participle participle participle	sprouting growing dying
noun noun noun noun	roots stems needles cones
participle participle participle	reaching shading living
adjective adjective	strong alive
noun	conifer

An **acrostic** is a series of words or phrases that begin or end with the letters of a word written vertically or horizontally.

Strong
Enriching
Quiet
Upright
Overgrowing
Inspiring
Awesome!

T R E E
a e v x
l a e c
l c r e
h g l
i r l
n e e
g e n
n t

Free verse has no set formula or style.

We grow
tall, strong, silent.
We live years
hundreds, thousands.
Hear us.
We welcome you!

Prints of the Forest

ACTIVITY SUMMARY
Students make leaf prints, leaf and/or bark rubbings, and/or plaster casts of tracks.

CONCEPTS TO BE LEARNED
1. Plants and animals have various anatomical features (adaptations) that enable them to live.

CALIFORNIA STANDARDS ADDRESSED (S.S. indicates a standard set.)

Focus Standards:

Grade 4: Science Investigation and Experimentation 6.a, 6.b
Grade 5: Life Sciences S.S. 2
Science Investigation and Experimentation 6.a
Grade 7: Life Science ... Structure and Function in Living Systems S.S. 5:
Science Investigation and Experimentation 7.a
Science Investigation and Experimentation 7.d

Other Standards:

Grade 6: Science Investigation and Experimentation 7.g

NATIONAL CONTENT STANDARDS ADDRESSED

Science Grades 5-8: standards A and C

ANTICIPATED OUTCOMES
1. Students will increase their knowledge of plant and animal anatomy.

GROUPING
Individual or groups of two to three

TIME
5–15 minutes per rubbing or print

MATERIALS

All Parts:
Plastic buckets for carrying materials
Water and towels for cleaning

Part 1: Leaf Prints
- ❒ tempera paint (carry the plastic bottles in re-sealable plastic bags)
- ❒ paint brushes and/or brayer, stored in re-sealable plastic bags
- ❒ white or colored paper, construction paper works well
- ❒ leaves of various plants, possibly leaves that have fallen
- ❒ newspaper (with a large plastic bag for carrying back for recycling)

Part 2: Leaf and/or Bark Rubbings
- ❒ plain white paper (typing/copy paper works better than construction paper)
- ❒ dark-colored crayons with paper peeled off (large "primary' crayons will be less likely to break)

Part 3: Plaster Casts
- ❒ Plaster of Paris (from hardware store) (If it doesn't come in a plastic container, transfer it to a plastic container with a tightly sealing lid.) The amount will depend on the number of tracks you want each student to make (plan for at least ½ cup per track)
- ❒ water (water bottle or water from a creek, in which case you'll need a cup, plastic bottle, or something similar with which to scoop it from the creek)
- ❒ cups in which to mix the plaster
- ❒ spoons with which to mix the plaster
- ❒ baby powder
- ❒ something with which to form a "dam" to hold the plaster:
  a 3" section of a milk carton or…
  a 3"x10" strip of plastic or cardboard and two small binder clips or some masking tape
- ❒ plastic pan(s) with lids, or boxes with which to transport casts
- ❒ newspaper or bubble wrap to use as padding while transporting casts

TEACHER PREPARATION

1. Talk with a park ranger about if and where you might pick leaves for prints and where animal tracks might be found.
2. Obtain materials as needed.
3. Find a place with flat surfaces, such as picnic tables, where the prints can dry, perhaps during lunch.
4. Test the materials that you plan to use to be sure that they will work with the types of leaves or bark that you have available.
5. If you are making Plaster of Paris casts, practice with your particular material to determine the amount of water needed to make a mixture that has the consistency of a thick cream—about two parts plaster to five parts water. If it is too thin, it will take longer to set up. If it is too thick, it won't flow into the details of the track. Mix the plaster by adding the plaster to the water rather than the water to plaster.

PROCEDURE

Part 1: Leaf Prints
1. Spread the newspaper on a flat surface such as a picnic table.
2. Place a leaf on the newspaper with the veined side upward.
3. Use a paint brush or brayer to apply an even coat of paint to the leaf.
4. Carefully lift the leaf and press the painted side on the paper. Flatten the leaf.
5. Carefully lift the leaf from the paper and set the paper aside to dry. Use a rock or piece of wood to keep the paper from blowing away.

Part 2: Leaf or Bark Rubbings

1. Leaf and Bark
   a. Leaf: Find a leaf with prominent veins and place it on a hard flat surface, vein side upward.
   b. Bark: Place the paper over the bark. Have a partner help hold it flat and smooth against the bark.
2. Gently but firmly rub the side of the crayon over the paper so that the texture of the leaf or bark shows up on the paper.

Part 3: Plaster Casts of Tracks

1. Gently blow or brush away any sticks, rocks, or leaves that are in the track.
2. Dust the track and soil around it with baby powder. This should help dry the area and help keep the plaster from sticking to the dirt or sand.

Figure 253. Cardboard strip and binder clips to make "dam" for Plaster of Paris.

3. Surround the track with a dam made from a section of a milk carton or a strip of plastic or cardboard that has been clipped or taped to form a ring. (Have the students put their initials on the ring in case they forget which is theirs.)
4. Use a spoon to mix the Plaster of Paris in a cup as indicated.
5. Gently pour the plaster evenly into and over the track, about 1" deep.
6. Let the plaster harden for at least 30 minutes. The time will depend on how wet the ground is, the mixture that you created, humidity, etc. You might set up a couple of test casts to remove before removing the actual track casts.
7. When the plaster is hard, gently lift it straight up. Carefully dust off any dirt. (You may want to let it cure (harden) for a while more before cleaning it.)
8. **It may take a couple of days for the plaster to completely cure. It will be fragile until then. Place the cast(s) in a pan with newspaper packing to protect the casts while being taken home or to school.**

VARIATIONS, ADAPTATIONS, DIFFERENTIATION

All parts:

1. Consider teaching and practicing the techniques at school before the trip.

Part 1: Leaf Prints

1. Students can use different contrasting colored paints and paper.
2. Students can make prints of different species on one page.
3. Students can make booklets (field guides) with prints from several species.
4. A piece of cord and clothes pins can be used to hang prints to dry.

Part 2: Leaf or Bark Rubbings

1. Students can make booklets with rubbings of different types of bark or leaves.

2. Orally or as a writing assignment, have the students describe the different bark or leaf patterns and textures so that others can identify the leaf or bark being described from the rubbing or print.
3. Leaf prints can be made after the leaves have been used for rubbings.
4. Several bark rubbings can be glued or taped to a cylindrical tube such as a carpet roll so that they simulate a tree trunk.

Part 3: Plaster Casts of Tracks

1. A paper clip can be inserted through a slit in the side of "dam" so that half of it projects from the plaster to serve as a hanger.
2. Students can also make leaf prints in plaster.
3. Use these casts when you discuss the formation of fossils.
4. The cast is an impression of the foot of the animal that made the track. To make another track (which would be similar to a fossilized track or leaf impression), coat the cast with petroleum jelly, place a dam around it, and pour 1" to 1½" half of plaster into the dam. (Sometimes the original cast will stick to the track being made, so don't do this unless you don't mind "sacrificing" the cast.)
5. Casts can be painted, lacquered, or left natural.
6. Other casting materials will produce harder, more durable casts, but are more expensive. See Appendix IV: Sources, or check at a hardware or craft store.
7. Some of the sources listed in Appendix IV sell rubber or plastic replicas of animal prints (or even animals) that can be used to create tracks or molds. Some of the sources also sell kits for casting and field guides of tracks.

ASSESSMENT

1. Are the prints or casts done as directed?
2. Can the students identify the plant parts and describe characteristics shown in the prints or casts?

REFERENCES AND RESOURCES

There are numerous resources available for teaching and learning about tracks and other signs of animals. See the resources in Appendix IV: Sources of Materials.
Some useful books include:

Burt, William and Richard Grossenheider: *Peterson Field Guides: Mammals*
Elbroch, Mark: *Mammal Tracks & Sign: A Guide to North American Species*
Farrand, John: *National Audubon Society Pocket Guide: Familiar Animal Tracks of North America*
Lowery, James: *The Tracker's Field Guide*
McDougall, Len: *The Encyclopedia of Tracks and Scats*
Olaus, Murie, Mark Elbroch, and Roger Tory Peterson: *Peterson Field Guides: Animal Tracks*
Sheldon, Ian: *Animal Tracks of Northern California*
Stall, Chris: *Animal Tracks of Northern California*
Whitaker, John: *National Audubon Society Field Guide to North American Mammals*

Sensory Awareness

ACTIVITY SUMMARY
While seated in the forest, students use all of their senses to make observations.

CONCEPTS TO BE LEARNED
1. All of our senses can be used to make observations.

STANDARDS ADDRESSED
Focus Standards:
Grade 4: Science Investigation and Experimentation 6.a
Grade 7: Science Investigation and Experimentation 7.b

ANTICIPATED OUTCOMES
1. Students will increase their ability to use all of their senses to make observations.
2. Students will increase their appreciation of their senses.
3. Students will increase their ability to describe what they sense.

GROUPING
Individual

TIME
10–30 minutes

MATERIALS
- ❒ notebook, 3"x5" card, or clipboard and pencil
- ❒ optional: Sensory Awareness Study Guides on page 249

TEACHER PREPARATION
1. Obtain the materials.
2. On a pre-trip site visit, locate an area where the students can be safely and comfortably seated (preferably on the ground or logs, as opposed to picnic tables).
3. Modify the Study Guide as appropriate for your site and your students.

PROCEDURE
1. Call on a couple of students to make an observation and tell it to the class. Ask the students what sense they used. Students will almost always make a visual observation.
2. Ask students to name the other senses besides sight.
3. Tell them that they are going to use their other senses to experience the forest.
4. Tell the students how long they will be sitting and whether they will be writing down their observations afterwards.
5. Tell them to remember one thing that they sense so that they can describe it to the group afterwards.
6. Either lead students to their sites, or have them select their own.
7. Issue the pencil, paper or card, and clipboard.
8. Students should be comfortably seated and close their eyes.

9. After the allotted time, have students open their eyes, write down one or two things that they noticed, and then get the group together to share.

VARIATIONS, ADAPTATIONS, DIFFERENTIATION

1. Working in partners, students can be led to a tree, bush, rock, or other natural object while blindfolded. They then describe the tree or other object without using their sense of sight.

Caution

Be sure to caution students to be careful while leading the blindfolded student, and also to avoid poison oak, stinging nettles, eye-level branches, etc.

2. If you pick out the leaves, students can taste various plants and attempt to describe their taste.

Caution

Of course you must be sure of what you're picking!

3. Modify the Sensory Awareness Study Guide on the following pages. Have students begin to fill it out before the trip.

ASSESSMENT

1. Do students cooperate by keeping their eyes closed?
2. Do students use senses of touch, hearing, and smell?

REFERENCES AND RESOURCES

Roa, Michael: *Redwood Ed*
Snively, Gloria: *Once Upon a Seashore*

Sensory Awareness—Study Guide

As you prepare for your trip to the forest, let's start thinking about using all of your senses while on the trip. How many of the things listed in the tables below have you seen, touched, smelled, heard, or tasted before the trip?

While in the forest, practice using **ALL** of your senses to experience your environment!

Sense of Sight			
How many of these have you seen?	Before the field trip?	On the field trip?	Notes or Sketches:
A conifer seed (not the cone)			
Lichens on tree bark or a rock			
Sand grains in sandstone			
Fern spore cases			

Sense of Hearing			
How many of these have you heard?	Before the field trip?	On the field trip?	Notes or Sketches:
Wind in the trees			
Chattering squirrel			
Water in a creek			
Footsteps on duff			
Birds (Can you describe the call?)			

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 conifer's needle			
Humus or soil on the ground			
The edge of an oak leaf			
Temperature of the soil in the shade and in the sun			

Sense of Smell			
How many of these have you smelled?	Before the field trip?	On the field trip?	Notes or Sketches:
Conifer needles			
Conifer tree bark			
Decaying leaf litter			

Caution

Do not taste anything unless your teacher has said that it is safe to taste!

Sense of Taste			
How many of these have you tasted?	Before the field trip?	On the field trip?	Notes or Sketches:
A conifer needle			
A pine or fir nut (seed)			

Similar, But Not the Same!

ACTIVITY SUMMARY
Students compare two similar species of trees.

CONCEPTS TO BE LEARNED
1. Careful examination can reveal anatomical differences between species of trees.

CALIFORNIA STANDARDS ADDRESSED (S.S. indicates a standard set.)

Focus Standards:

Grade 4: Science Investigation and Experimentation 6.a., 6.b
Grade 5: Life Sciences 2.a
Science Investigation and Experimentation 6.a
Grade 7: Life Science 3.4, S.S. 5
Science Investigation and Experimentation S.S. 7

NATIONAL CONTENT STANDARDS ADDRESSED

Science Grades 5-8: Standards A and C

MATERIALS
- ❒ notebooks or Similar But Not the Same! Study Guide, page 253
- ❒ pencils

TEACHER PREPARATION
1. During a pre-trip site visit, locate an area where students will have access to two similar species of trees such as Jeffrey and ponderosa pine, white and red fir, coast redwood and Douglas-fir, or cottonwood and aspen, or different oaks.

PROCEDURE
1. At the site, ask students to suggest what they might look at to tell the differences between various kinds of trees. Elicit such things as leaf/needle appearance, bark, cones, and overall growth pattern (shape).
2. Point out the two types of trees that you selected. Have students compare the two by writing observations and making drawings in their notebooks, or use the Study Guide on page 253.

VARIATIONS, ADAPTATIONS, DIFFERENTIATION
1. Consider doing the activity first with very dissimilar species such as black oak and Jeffrey pine, then with more similar species such as Jeffrey and ponderosa pine.
2. Obtain winter twigs of various species. (Label them!) Have the students compare and contrast them. How are they similar and how are they different?
3. Rather than identifying the species, give the students unidentified samples and ask them to describe them in detail, listing both similarities and differences.
4. This activity can lead to the use of dichotomous keying activities. (See “Name That Plant,” page 189.)

5. Students can practice finding similarities and differences and describing them by looking at pictures of almost anything…trees, rocks, environments, forest types.

ASSESSMENT

1. Do the students accurately describe the differences and similarities?

ANSWERS TO SELECTED STUDY GUIDE QUESTIONS will vary according to the types of trees. The answer key below is for coast redwood and Douglas-fir.

	Coast redwood	Douglas-fir
Bark	Fibrous (stringy-looking), soft, fibers run up and down the trunk May have lichens growing on it	Not fibrous, looks like jigsaw puzzle, flaky-appearing and hard May have lichens growing on it
Leaves: Individual	Needles end in sharp points Leaves are needle-like, ¾"–1" long	Needle ends are blunt Leaves are needle-like, ¾"–1" long
Leaves: arrangement on the twig	Needles of lower branches stick out to the side, flat, like a fan Needles from the top of a tall tree may lie close to the twig, scale-like.	Needles go around the twig, like a bottle brush
Cones	About the size of an olive (less than an inch long) Hang down from ends of branchlets	1.5" or more in length, with soft 3-forked "bracts" protruding from the cone Hang downward from branches
Other		

REFERENCES AND RESOURCES

Guiney, Miriam: *Redwood Parks Activity Book*
Lingelbach, Jenepher (Ed.): *Hands-On Nature: Information and Activities for Exploring the Environment with Children*

Similar But Not the Same!—Study Guide

Sometimes it is easy to tell the difference between different kinds of trees. Oaks and pines, for example, look very different.

Sometimes, however, it is not so easy. Various types of pine trees are similar in many ways, as are different species of fir. They are both "evergreen," meaning they don't lose their leaves (needles) in the winter. They produce cones that have seeds in them.

They are important lumber trees and can grow very tall.

Use the table below to compare the two types of trees selected by your teacher. Look for both similarities (how they are the same) and differences.

Sketches might be very helpful!

	Tree Type:	**Tree Type:**
Bark		
Leaves: Individual		
Leaves: arrangement on the twig		
Cones, seeds, or flowers		
Other		

Stream Surveys

ACTIVITY SUMMARY

Students walk along the stream(s) to learn about the riparian habitat and also about the stream's health.

CONCEPTS TO BE LEARNED

1. People's actions can affect streams in a variety of ways.
2. Organisms found in and near streams can indicate the stream's healthiness.

CALIFORNIA STANDARDS ADDRESSED (S.S. indicates a standard set.)

Focus Standards:

Grade 4: Life Sciences S.S. 3
Science Investigation and Experimentation S.S. 6
History 4.1.3, 4.1.4

Grade 5: Earth Sciences S.S. 3
Science Investigation and Experimentation S.S. 6

Grade 6: Earth Science S.S. 2
Science Investigation and Experimentation S.S. 7

Grade 7: Science Investigation and Experimentation S.S. 7

NATIONAL CONTENT STANDARDS ADDRESSED

Science Grades 5-8: Standards A, C, D, F
Social Studies Middle Grades: III c, III e, III f, III g, III h, III I, III k, IV b, IV h

Environmental Principles and Concepts

Principle II, Concepts a, b, c, d
Principle III c
Principle IV a, b, c

MATERIALS

- ❒ plastic buckets or bags for collecting litter and recyclable materials
- ❒ gloves or tools for picking up litter
- ❒ clipboard and pencil for each team (pencils work better than pens if the paper is damp)
- ❒ "Stream Survey Study Guide" page 257 for each team
- ❒ "Stream Survey Data Table" page 258 (one for each data collection point)
- ❒ optional:
  - ✓ flagging, laminated signs, lengths of cord or some other means of assigning teams of students "their" section of stream
  - ✓ optional: identification keys for local plants
  - ✓ optional: map, preferably topographic, of stream to be investigated
  - ✓ optional: camera—either waterproof or in a plastic bag (preferably <u>not</u> disposable!)
- ❒ appropriate student clothing:
  - ✓ old sneakers, boots, rain boots, or other protective footwear
  - ✓ extra shoes, socks, and pants to change into after the investigation; towels

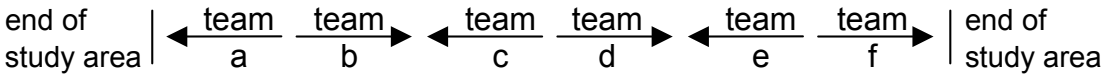
TEACHER PREPARATION

1. Obtain materials listed above.
2. On a pre-trip site visit, locate a place where the stream can be easily, safely, and legally accessed. Avoid steep banks or areas susceptible to erosion.

Caution

Determine whether there are any deep pools, rapids, slippery rocks, or other dangerous conditions. Are there likely to be people about whom you should be concerned near the stream? Also consider the judgment and behavior of your students. ***If you are not sure that the activity can be done safely, don't do it! If possible, arrange for an adult to supervise each group.***

3. Decide how many teams to form and what stretch of stream each group will study.
4. Determine how many observations each team should make. Depending on the length of the stream to be surveyed, data might be collected every 25–100'. To tell the students how frequently to collect their data, you might either
   a. Give each team a length of strong cord; they collect data for that distance
   b. Mark the data collection points with flagging tape or some other means. (Have the teams collect the tape as they go.) Using different colors of flagging tape can also tell teams when they have completed "their" stretch of stream.
   c. Locate landmarks (large rock, pool, bridge, tree, etc.) to delineate the section.
   d. Let the students estimate when they have proceeded the assigned distance.
   e. Have two teams start at the same place and walk in opposite directions. When they meet another team, they stop recording data.



5. Determine where students will be able to change clothes after the investigation.
6. Contact the appropriate person at the field trip site to ask about recycling materials collected, or plan how to process them yourself.
7. Determine to whom your class might report any pollution or other problems found.

PROCEDURE

1. When preparing the students before the trip, discuss safety and appropriate behavior and clothing. Also discuss bringing a change of clothes and a towel.
2. Either before or at the start of the trip, discuss the characteristics of a healthy stream (clear water, variety of habitats for organisms, not polluted).
3. If you are using markers to tell the students where their assigned stretch of stream is, place the markers along the stream before the group arrives.
4. Issue the Stream Survey Study Guide (page 257) and the needed number of data collection forms and go over the things that the students will be looking for as they walk the stream. This can be done before arriving at the site.
5. Designate students to be data recorders, photographers, recyclable materials collectors, and trash collectors. Issue the equipment accordingly.

6. Remind students of safety procedures, including not damaging vegetation or otherwise harming the environment. Tell them to watch out for nesting birds.
7. Escort each group to their starting point and tell them where to stop, where to make their observations, and where to meet after their survey.
8. As the student groups walk the stream, try to check in with each group at least once or, **preferably, have an adult accompany the teams.**
9. After all groups have collected their data, have them share with each other.
   - ✓ Did the stream seem healthy overall?
   - ✓ Are there things that should be reported to the appropriate agencies or individuals?
   - ✓ Are there things that could be done to improve the health of the stream such as removing invasive species, planting to prevent erosion, excluding cattle, providing buffer zones, mitigating pollution, rerouting trails, or others?

VARIATIONS

1. Consider having students prepare a display or presentation, possibly including a slide show, to an appropriate agency, company, or group.
2. This activity correlates well with the activities "Creek Studies," on page 207, "From the Mountains to the Sea," on page 215 and "Invertebrate Inventory" on page 229.

ASSESSMENT

1. The Study Guide can be used to assess student learning.
2. Students can prepare a display or slide show of their findings.

REFERENCES AND RESOURCES

Aston, Darcy et al.: *Mountains to the Sea: Watershed Curriculum for Grades 4–8*
Firehock, Karen: *Hands-On Save Our Streams*
Shinkle, Jill: *Creek Watchers: Exploring the Worlds of Creeks & Streams*

Stream Survey—Study Guide

Today you're going to walk along a stream to investigate whether it is "healthy."

What are the characteristics of a healthy stream? A healthy stream usually:

- ✓ is lined with vegetation. Vegetation helps keep the stream healthy by:
  - providing shade, which cools the water (Cold water can hold more oxygen, which fish, insects, and other animals need.)
  - holding soil in place so there is less erosion and less silt in the bottom
  - adding nutrients to the stream
  - providing habitat for animals
  - filtering sediment and pollution from land runoff
- ✓ has a mixture of pools, which provide feeding and resting places for fish, and riffles, where fish might spawn and feed and where oxygen is added to the water
- ✓ has banks that are not eroding
- ✓ has a rocky or sandy bottom, not covered with mud or concrete
- ✓ does NOT have pollution such as livestock waste entering it
- ✓ does NOT have pollution from human activities entering it

As you do your stream survey, you will describe the condition of the stream at intervals as instructed by your teacher.

Your teacher will provide a data sheet on which to record your observations.

Your teacher will also assign you a section of the stream to survey.

When you are finished collecting your data, you will share it with the other teams from your group.

As you do this activity, **follow all safety instructions**. Be careful not to slip on rocks or logs, not to fall in, not to damage vegetation or harm the environment in other ways.

Other instructions:

Stream Survey Data

Date: _____Time: _____ Team:_____

Location of Stream Survey: _____

Observation (data collection point) number: _____

Record your team's observations below. Be sure to write legibly. Sketches might help.

1. **Vegetation**: Describe the type and amount of streamside vegetation. Is there shade?

2. **Stream flow**: Is the stream flowing rapidly or slowly at this point? Are there pools or riffles or rapids? Describe the flow.

3. **Bottom type**: Describe the stream bottom. Is it rocky, sandy, or muddy, or something else?

4. **Erosion**: Does the stream bank seem to be stable, or is it eroding? Can you determine the cause of any erosion?

5. **Nearby human uses**: Are there houses, farms, roads, or signs of other human activities?

6. If there are farms, do animals have access to the stream?

7. Can fertilizers, pesticides, or other chemicals run off the land into the stream?

8. **Pollution**, including litter: type, amount, source

9. **Wildlife**: note any wild animals seen in or near the stream, tracks, nests

10. **Human changes in the stream**: concrete lining, bridges, road crossings, etc.

11. **Other notes**:

Other Activities for During the Trip

Alone Time

See Notebooks and Journals: Logs in the Woods on page 202.

Plan time in the trip for the students to have some alone time. Find a place where they can be spread out far enough to discourage talking, but where they can be observed for safety reasons. If students have made journals or notebooks ("Forest Logs"), they can be given a simple assignment such as:

- Sketch your favorite forest organism and tell why it is your favorite.
- Write a brief note to an organism. Tell the organism what you liked or what you learned on your trip to the forest, or what you wonder about.
- Write a brief poem about what you saw or learned today.
- Write a note to your parents or family. Tell them something interesting about the forest.
- Sit quietly, close your eyes, listen and smell. Arrange to have an adult tell you when five minutes are up. Write down what you heard, felt, and smelled.
- Go to a spot that is "natural" (not a parking lot or picnic table). Spend 5 minutes looking as closely as you can at an area half the size of a piece of binder paper. Write and sketch what you see. Write down five questions about what you see.

A commercially available book called *My Nature Journal*, by Adrienne Olmstead, includes numerous ideas for nature writing and other activities.

REFERENCES AND RESOURCES

Olmstead, Adrienne: *My Nature Journal*

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

End of the Trip Activities

Trash Patrol

Before leaving the parking lot at the start of the field trip, provide each group with a five-gallon plastic bucket or trash bag. (The bucket is more easily reusable and can be used to carry other things.) So that one person doesn't feel "stuck" carrying the container, determine a rotation system. Consider using two containers, one for trash and one for recyclable materials.

Caution the students about sharp glass or metal, poison oak, etc. After the litter has been collected, the students can sort it into categories, including recyclable, decomposable (compostable), and other. Discuss what people could have done rather than bring these things to the forest and leave them behind, including alternatives to disposable packaging. Dispose of the material properly, recycling what you can.

Talk with Parks personnel to find out about the Litter Getters program.

Wrapping it Up

As a class, discuss what was seen and learned while it is still fresh in the students' minds.

- What was most interesting?
- What was most surprising?
- What would they like to see again, or what did they miss?
- What do forest organisms do…
  - ✓ At night?
  - ✓ When it rains?
  - ✓ When a fire approaches?
  - ✓ When a stand is logged?

  (These will require some thought and conjecture. Are the students' responses logical and reasonable?)
- What can they, as individuals and as a class, do to help protect the park?

REFERENCES AND RESOURCES

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

Before leaving the lunch area or parking lot, have students do a litter patrol. Recycle whatever is possible. Leave the area cleaner than you found it.

CHAPTER 3
Post-Trip Activities

The activities in Chapter 3 are generally best done after a visit to a park or forest. They reinforce and expand upon concepts and information taught while on the trip.

A field trip should not be an isolated event. Connecting what the students see and do “in the field” will make the trip more meaningful. Activities done before and during a field trip can provide information about **what**. Discussion of the significance of the activities provides the “**so what?**” Follow-up activities can provide the very important “**now what?**”

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, starting on page 277.

Connie's Woods: Tough Choices

ACTIVITY SUMMARY
Students role play as they discuss various options for the use of a tract of forest land.

CONCEPTS TO BE LEARNED
1. Land use choices are usually complex.

CALIFORNIA STANDARDS ADDRESSED (S.S. indicates a standard set.)

Focus Standards:

Grade 4: History 4.1
English Listening and Speaking Standard Set
Grade 5: English Listening and Speaking Standard Set
Grade 6: English Listening and Speaking Standard Set
Grade 7: English Listening and Speaking Standard Set

NATIONAL CONTENT STANDARDS ADDRESSED

Science Grades 5-8: Standards F and G
Social Studies Curriculum Standards, Middle Grades: Standards I d, III e, g, h, l, k

Environmental Principles and Concepts

Principle I: Concepts a, b, c
Principle II: Concepts a, b, c, d
Principle III: Concepts a, b, c
Principle IV: Concepts a, b, c
Principle V: Concepts a, b

ANTICIPATED OUTCOMES
1. Students will increase their understanding of the complexity of land use choices.

GROUPING
Whole class

TIME
Day 1: 20–30 minutes (possibly more time on the same or different days for research)
Day 2: 30–60 minutes for the "hearing"
Subsequent days: time for writing of articles or letters to the editor (or as homework)

MATERIALS
- ❒ Internet access
- ❒ newspaper accounts of local land use discussions
- ❒ Study Guide: Connie's Woods: Tough Choices, page 264.

TEACHER PREPARATION

1. Copy the Study Guide for student use.
2. Modify role cards as needed, copy, cut up. (Consider laminating for future use.)
3. Identify Internet sites that may have useful information.
4. Select students for the various roles.

PROCEDURE

1. While on a field trip to a park or forest, discuss the idea that different people might use the same piece of land differently.
2. Issue individual students or, alternatively, teams of two to three students, the background information/role cards provided below. You may want to modify these or make up others.
3. Discuss the factors described in the scenarios, including:
   a. what taxes are and where they come from (including businesses)
   b. how businesses provide money to the local economy (jobs, taxes)
   c. what a city council or county commission is
   d. what a hearing is
   e. economic realities of parks—they cost money to operate
   f. what a second-growth forest is
4. Allow students time to prepare their presentations. If only the information cards provided are used, 15–20 minutes may be enough time. Students might also be given several days to do background research.

VARIATIONS, ADAPTATIONS, DIFFERENTIATION

1. It might be possible to have one or more guest speakers present information on actual land use choices that have been made locally. Landowners, planning department representatives, or representatives of citizen groups are possibilities.
2. Encourage the students to dress for their roles in appropriate attire.
3. Adapt the cards to reflect a real situation in your community and your students' knowledge and abilities.
4. Students can use maps (real or made-up) in their presentations.
5. Students can record their "hearing" and edit it for a "newscast."
6. Some students can serve as newspaper reporters who will write articles about the meeting.
7. Students can write "Letters to the Editor" for a fictitious classroom newspaper.
8. An excellent more extensive version of this activity can be found in the *Forest Ecosystem* unit of the *Adopt-A-Watershed* Program. "Are There Any Clearcut Answers?" includes map work, a worksheet with which students prepare their parts, and extensive background for the roles.

ASSESSMENT

1. Are students able to represent various perspectives?

REFERENCES AND RESOURCES

Miller, Bob et al.: *Forest Ecosystem*

Roa, Michael: *Environmental Science Activities Kit*

Connie's Woods: Tough Choices—Study Guide

Background Information:
When someone owns property, such as a stand of trees, they must make choices about its use. Should it be sold to someone else, or kept? Should it be developed for housing or a shopping center, or should it be kept the way it is? There are many other choices, of course, and each has advantages and disadvantages for the landowner and the community.

In this activity, students play the roles of various people as they debate or discuss what should happen to a fictitious tract of forest land known as Connie's Woods, which is right next to the town of Treeville, in Tall Tree County. In reality, the size and location of the land would be an important factor, as would surrounding land uses, the local economy and other things.

For the sake of this activity, we are going to assume that:

Connie Fir has died and left 100 acres of second-growth forest to Tall Tree County, to be used as the county commissioners decide. The property was logged many years ago, but some of the trees are now 2' in diameter and 125' tall, with some large trees growing near the creek that flows through the property.

Various proposals have been suggested, including:
- ✓ Donating the land to the County Department of Parks and Recreation for hiking and camping, but not hunting or fishing. (This would require money for insurance and maintenance.)
- ✓ Selling the land to developers for housing (The county needs money for maintaining roads, schools, and public safety.)
- ✓ Selling the land to developers for a shopping center.
- ✓ Keeping the land for a county open space area where citizens can use it in a variety of ways, including hiking, camping, hunting and fishing. (This would cost the county money for insurance and maintenance.)

Six students will play the roles of **county commissioners** who will decide what will happen to the land. The **teacher** will be the **chair** of the county commissioners and will run the hearing. Seven other students will play the roles of people who have different ideas about what the land should be used for. These **hearing participants** have character cards.

Some students will play the roles of **newspaper reporters**. Those students won't actually participate in the discussion, but they will write newspaper articles about the proceedings. Other students will play the roles of **citizens** from the community who don't participate in the discussion, but may write letters to the editor of the local newspaper, the *Redwood Reader*.

On day 1, roles will be assigned and hearing participants will begin to prepare their cases.

On day 2, the hearing participants will present their cases to the county commission.

On day 3, the newspaper reporters and letter writers read their articles or letters to the class.

✂.....

Maria or Miguel Mercado: grocery store owner (COUNTY COMMISSION MEMBER)
You have lived in Tall Tree County all of your life. You own the only grocery store in Treeville, but the new freeway has made it easier for people to travel farther to the larger town that has discount stores. Since you work so much, you have little time to enjoy the out-of-doors.

✂.....

Stuart or Susan Sellahouse: realtor (COUNTY COMMISSION MEMBER)
You sell real estate, mostly residential. You moved to Tall Tree County from the big city because you like the small town atmosphere of Treeville and the easy access to the forest. There are, however, very few homes for sale in the area, so you are worried about your job.

✂.....

Chris Coldwater: owner of Chris' Carvings (COUNTY COMMISSION MEMBER)
You have lived in Tall Tree County all of your life. Your father was a logger. You own a small business making carvings from local trees, which you sell to tourists. Connie Fir let you cut a few trees from her property each year.

✂.....

Bob or Betty Bibliophile: retired librarian and local activist (COUNTY COMMISSION MEMBER)
You retired to Treeville 10 years ago because you love the small town and the surrounding forests. You have been a strong supporter of controlling growth, generally voting against any development that would bring in more people or result in loss of forests.

✂.....

Tom or Teresa Teachemall: high school teacher (COUNTY COMMISSION MEMBER)
You are a local high school science teacher who frequently takes your classes on field trips to Connie's Woods. You have, in fact, been doing scientific studies of a stream in Connie's Woods and hope to publish a scientific article after one more year of study. You are concerned about your job because no new housing has been built in the last few years, so few families with children are moving to Treeville.

✂.....

Don or Dorothy Domestica: homemaker (COUNTY COMMISSION MEMBER)
Your spouse earns a good living selling gasoline, and you are able to stay home to take care of your two children. You love the small town atmosphere of Treeville, but worry about possible changes if the town grows too much.

✂.....

✂.....

Bob or Betty Bigbucks: resident of Treeville
You love living in Treeville and have just inherited quite a bit of money. You would like to be able to purchase about two acres of Connie's Woods to build your dream home.

✂.....

Carl or Carly Caresalot: resident of Treeville
You are involved in causes that benefit the less fortunate people in Treeville. There is very little low income housing in Treeville, and few jobs are available for unskilled workers. You would like to see part of Connie's Woods developed into low income housing and a shopping mall that would include some discount stores where people could shop and also get jobs.

✂.....

Ranger Robin: park ranger at Pine Cone State Park
Pine Cone State Park is right next to Connie's Woods. Over the years you have witnessed the increased pressure on the park, which is mostly due to more and more people visiting it. You would like to see Connie's Woods become part of the park both to provide a buffer from the town and to provide more area where people can hike and camp.

✂.....

Wanda or Wallie Woodworker: employee of Forest Resources Company, Inc.
Your company follows all of the state and local regulations and harvests trees for lumber in a responsible way. In fact, your company has repaired poorly designed roads and creek crossings in Connie's Woods. You would like to either have the county allow your company to log in Connie's Woods, or for your company to purchase the property for logging.

✂.....

Charlie or Cherie Citizen: local resident
You have been hiking in Connie's Woods for years and have been a volunteer at Pine Cone State Park, where you often lead groups of schoolchildren on field trips. You suspect that endangered species might be living in Connie's Woods, and you want to try to protect the woods from development and logging.

✂.....

Hal or Harriet Hikesalot: local resident
You have lived in Treeville for all of your 45 years, and you consider yourself an environmentalist and outdoors person. Connie allowed you to hike and hunt in Connie's Woods, and you would like to continue to do so.

✂.....

Sam or Sally Student: 11-year-old resident of Treeville
You like hiking in Connie's Woods, but sometimes you wish the town had a skate park and a shopping center within biking distance.

✂.....

Global Warming

ACTIVITY SUMMARY

Students model the "greenhouse effect," which contributes to global warming or global climate change.

CONCEPTS TO BE LEARNED

1. Energy can be converted from one form to another, including from light to heat.
2. The greenhouse effect can cause significant increases in temperatures.
3. Photosynthesis results in the removal of carbon dioxide from the environment.
4. An actively growing forest removes and stores (sequesters) a lot of carbon from the atmosphere, thereby reducing global climate change.

CALIFORNIA STANDARDS ADDRESSED (S.S. indicates a standard set.)

Focus Standards:

Grade 4: Life Sciences S.S. 3
Science Investigation and Experimentation S.S. 6
Mathematics Statistics, Data Analysis, and Probability S.S. 1.0

Grade 5: Life Sciences 2.f
Science Investigation and Experimentation S.S. 6
Mathematics Statistics, Data Analysis, and Probability S.S. 1.0

Grade 6: Ecology (Life Sciences) 5.a
Science Investigation and Experimentation S.S. 7
Mathematics Statistics, Data Analysis, and Probability S.S. 1.0

Grade 7: Science Investigation and Experimentation S.S. 7

Other Standards:

Grade 5: Earth Sciences 4

Grade 7: Life Science…Evolution 3.5

NATIONAL CONTENT STANDARDS ADDRESSED

Science Grades 5-8: Standards A, B, C, D, F

Environmental Principles and Concepts

Principle II: Concepts a, b, c, d
Principle III: Concepts a, b, c
Principle IV: Concepts a, b, c
Principle V: Concepts a, b

ANTICIPATED OUTCOMES

1. Students will increase their understanding of energy conversions.
2. Students will increase their understanding of the process of photosynthesis.
3. Students will increase their understanding of the greenhouse effect/global warming.

GROUPING

Teams of two to three students

TIME
45–60 minutes

Figure 254.

MATERIALS (FOR EACH TEAM):
- ❒ two clear, 2-liter bottles, with labels removed, and the tops cut off about 8" from the bottom
- ❒ two, 6" thermometers with scale on metal, plastic, or cardboard backings
- ❒ one piece of plastic wrap or plastic bag
- ❒ two pieces of thin cardboard, about 2"x3" (tag board or halves of a 3"x5" card)
- ❒ plastic ruler
- ❒ two rocks, approximately 2" in diameter, clean, dry, of the same type
- ❒ masking tape or clear tape
- ❒ either sunny area or light source with 100-watt bulb or a heat lamp
- ❒ graph paper

TEACHER PREPARATION
1. The bottles can be difficult to cut, so it is recommended that they be cut (by an adult) before class.
2. Prepare a demonstration set-up and test the activity.

PROCEDURE
1. Prior to the activity, discuss photosynthesis, respiration, and the production of carbon dioxide by the burning of fuels, including both fossil fuels and biomass. Also discuss the role of carbon dioxide in the greenhouse effect and global warming.
2. Have each team construct their global warming model as follows:
   a. Place a clean, dry rock in the bottom of each bottle to keep it from tipping over.
   b. Tape the small cardboard pieces on the outside of the bottle so that they cover the thermometers' bulbs so that they are not exposed directly to the light source.
   c. Using masking tape, attach the thermometers to the inside of the cut bottles (at the same height in each). The bottom of the thermometer should be about 2" above the bottom of the bottle.
   d. Cover one of the bottles with clear plastic held in place with tape. This is the "greenhouse."
   e. The other bottle remains uncovered and is the "control" for the experiment.
3. Have the students record the starting temperatures in each bottle and then set them in the sun or where a light shines on each equally.

4. Students should record the temperatures in each bottle every 2–4 minutes for 20–30 minutes. (Plan other activities to keep them occupied while waiting.)
5. Students can graph of the temperatures, with time on the horizontal (x) axis and temperatures on the vertical (y) axis.
6. Following the activity, discuss the following:
    a. When trees photosynthesize, they remove carbon dioxide from the atmosphere and store (sequester) the carbon in their tissues. What would be the affect of replacing forests with parking lots, shopping centers, and roads?
    b. While cutting mature trees temporarily reduces the photosynthesis in an area, young, vigorously growing trees may sequester more carbon than mature, slowly growing trees. (Point out that even mature, slowly growing forests continue to sequester carbon.)
    c. Burning of trees (or any other fuel, such as gasoline) produces carbon dioxide, which increases the greenhouse effect when it enters the atmosphere. How can we reduce the amount of fuel that we burn?

VARIATIONS, ADAPTATIONS, DIFFERENTIATION

1. Many variables can be tested. Students can test these questions, among others:
    a. What would be the effect of having soil in the bottles?
    b. What would be the effect of water in the bottles?
    c. What would be the effect of plants in the bottles?
    d. Does the color of the bottle affect the results?
    e. Are the results the same if the bottles are in the shade?

See “The Global Climate,” Activity #84 in the *Project Learning Tree Pre K–8 Activity Guide.*

ASSESSMENT

1. Do students follow directions?
2. Can students define the “greenhouse effect” and describe causes and effects?
3. Can students tell the role of photosynthesis, respiration, burning of fuels, and plants in global warming?

REFERENCES AND RESOURCES

Roa, Michael: *Environmental Science Activities Kit*

The U.S. Environmental Protection Agency has produced a “Toolkit for Teachers and Interpreters” called *Climate Change, Wildlife, and Wildlands*. For a copy, call (800) 490-9198 or www.epa.gov/nscep

Paper Making

ACTIVITY SUMMARY
Students make new paper from scraps of used paper.

CONCEPTS TO BE LEARNED
1. Paper is made from plant fibers, usually derived from trees.
2. "New" paper can be made from recycled paper.
3. We use many products from the forests.

CALIFORNIA STANDARDS ADDRESSED (S.S. indicates a standard set.)
Focus Standards:
Grade 4: Science Investigation and Experimentation S.S. 6
Grade 5: Life Sciences S.S. 2
Science Investigation and Experimentation S.S. 6

NATIONAL CONTENT STANDARDS ADDRESSED
Science Grades 5-8: Standards A, C, F

Environmental Principles and Concepts
Principle I: Concepts a, b, c
Principle IV: Concepts a, b, c

ANTICIPATED OUTCOMES
1. Students will increase their understanding of the importance of forest products.
2. Students will understand that paper is usually made from wood fibers.
3. Students will increase their understanding of the value and importance of recycling.

GROUPING
Varies according to materials available

TIME
Preparation: 30 minutes
Actual paper making process: two 30–50 minute sessions

MATERIALS
- ❒ scraps of fibrous paper such as construction paper, paper towels, or toilet paper (newspaper with ink will work, but the ink will discolor the paper; glossy paper such as binder paper and magazine paper doesn't work well; it has less fiber and more glue and clay)
- ❒ hot water or means for heating water
- ❒ large plastic tub into which the wooden frame (deckle) will fit
- ❒ blender
- ❒ cloth dishtowels or other blotting material
- ❒ wooden frame(s) (approximately 5"x7") for making a deckle or deckles
- ❒ nylon or wire screen

- ❒ stapler
- ❒ kitchen strainer
- ❒ kitchen blender
- ❒ sponge
- ❒ plywood
- ❒ optional: rubber gloves
- ❒ optional: starch
- ❒ optional: leaves, thread, dried flowers, herbs

Figure 255. Deckels can be made from scrap wood. A screen shop may donate screen material.

TEACHER PREPARATION

1. Obtain the materials needed, including "deckles" (see Procedure step 2)
2. Try out the process

PROCEDURE

1. Discuss with students where paper comes from, what it is used for, and the advantages and disadvantages of recycling.
2. Make, or have students or a parent make, "deckles," which are wooden frames covered with tightly stretched and securely stapled or taped nylon or wire screening.
3. Have students remove any staples or plastic and tear paper into 1" scraps.
4. Soak the paper scraps in hot water for at least 30 minutes, preferably overnight.
5. Blend the scraps at medium speed until the pulp has a thick, soupy consistency.
6. Pour the mixture into the large tub and add warm water, stirring until the ingredients are evenly mixed. Adding a little starch will make the paper more firm.
7. Slide the deckle into the basin and put pulp on top of the screen, moving it back and forth until the layer of fibers is evenly distributed on the screen.
8. Lift the deckle out of the mixture, keeping it flat while most of the water drips off.
9. Gently press out any remaining water. Use a sponge to remove water from below.
10. Place a dish towel, newspaper, or other blotting material on a flat surface such as a piece of plywood or counter top.
11. Turn the deckle upside down so that the paper-containing side is against the dish towel. Gently lift the screen, leaving the pulp behind; tap the screen gently as necessary to help loosen the pulp.
12. Cover the pulp with another piece of cloth or blotter and place a piece of plywood on top to further flatten the pulp and help squeeze out any remaining water.
13. Let the paper dry overnight (or longer, depending on the humidity, blotter thickness, etc.)

14. Gently peel the new paper from the blotter.
15. Left over pulp can be saved for future use by freezing it, or it can be recycled.

VARIATIONS, ADAPTATIONS, DIFFERENTIATION

1. Thread, dried flowers, bits of colored paper, herbs, or other items can be added to the paper either at the blending stage or immediately after placing on the blotter.
2. Students can design experiments to test various recipes for such characteristics as strength, absorbance, how well they work as writing paper, etc.
3. Embroidery hoops can be used as deckles.
4. A simpler process is to just spread the pulp over the exterior bottom of a baking pan or other smooth surface, then turn the pan over so that the pulp is on several layers of newspaper. Then close the newspaper over the pulp and use a rolling pin to squeeze out the extra water. Finally, open the newspaper and let the new paper completely dry.

ASSESSMENT

1. Do the students follow directions?
2. Can the students explain the paper making process?
3. Can the students describe advantages and disadvantages of recycling paper?

REFERENCES AND RESOURCES

American Forest Foundation: *Project Learning Tree: Pre K–8 Activity Guide: "Make Your Own Paper"*

Study Plots

ACTIVITY SUMMARY
Students collect and study data collected over a long period of time.

CONCEPTS TO BE LEARNED
1. Plants and ecosystems change over time.
2. To understand the effects of change, we need baseline data to compare to, and we also need ongoing observations.

CALIFORNIA STANDARDS ADDRESSED (S.S. indicates a standard set.)

Focus Standards:

Grade 4: Life Sciences S.S. 3
Science Investigation and Experimentation S.S. 6
Grade 5: Life Sciences S.S. 2
Science Investigation and Experimentation S.S. 6
Grade 6: Ecology/Life Sciences S.S. 5
Science Investigation and Experimentation S.S. 7
Grade 7: Science Investigation and Experimentation S.S. 7

Other Standards:

Grade 4: Mathematics: Number Sense 3.0
Mathematics: Measurement and Geometry 1.0
Mathematics: Statistics 1.0
Grade 5: Mathematics: Measurement and Geometry 1.0
Mathematics: Statistics 1.0
Grade 6: Mathematics: Number Sense 1.0, 2.0
Grade 7: Mathematics: Mathematical Reasoning 2.0

NATIONAL CONTENT STANDARDS ADDRESSED
Science Grades 5-8: Standards A and C

ANTICIPATED OUTCOMES
1. Students will increase their understanding of how plants and animals interact with each other and with their environment.
2. Students will increase their ability to make, record, and interpret observations.

GROUPING
Depends on the availability of study sites. Ideally, teams of two to four students per site.

TIME
Varies

MATERIALS

- ❒ varies with the types of data to be collected
- ❒ depending on the site, such tools as:
  cameras magnifiers forceps measuring devices pans
  notebooks thermometers file folders colored pencils or crayons
  labeling materials such as tags available from garden supply stores
  books including keys and field guides (see Appendix IV and V)

TEACHER PREPARATION

1. Obtain the materials needed for the types of studies to be conducted.
2. Arrange for security of study area(s).
3. Study areas might be on the school grounds or at a field site in a park or forest. A single tree or bush can be a site. It might be interesting to study the same type of tree in different areas, or begin recording data on newly planted trees.

PROCEDURE

1. Once the study site has been selected, the first objective is to collect baseline data. What is present at the start of the study? After the baseline has been established, students can periodically revisit the site and record any changes that have occurred
2. Have the students develop a system and forms for recording data.
3. Record such things as types and numbers of organisms, ground cover, sizes of plants (diameter of stem, height), general health of plants, shade cover at various times of day, air temperature, soil temperature, etc.
4. Students should draw, as accurately as possible, the whole plot and major plants.
5. As changes are observed, students try to figure out what might have caused the changes and what might happen next.
6. Photographs taken from the same viewpoint can be an important part of the record.
7. Continue with the study as long as possible, possibly for several years. Invite students to come back to visit the site after they have left the class or school.

VARIATIONS, ADAPTATIONS, DIFFERENTIATION

1. "Plots" can be a given area, such as a field, or can be delineated in various ways such as:
   a. some number of square meters
   b. a transect…identify all organisms along a straight line of some length
   c. a plot transect…identify/study all organisms within x some distance of a line
2. Student teams can either study similar sites or different types of sites.
3. Arrange to exchange and compare data with students who live in other areas.
4. Students can do bark rubbings, leaf prints, or draw plants and animals.

REFERENCES AND RESOURCES

For more detailed ideas and suggestions for long-term plot studies, see:

Firehock, Karen: *Hands-On Save Our Streams*
Miller, Bob et al: *Forest Ecosystem: A Science-Based, Multi-Disciplinary Instructional Unit for Grades 5–6*
Murdoch, Tom et al: *Streamkeeper's Field Guide*

Other Activities for After the Forest Field Trip

Letter Writing

- After the trip, every student should write a letter of appreciation. Letters should go to parent volunteers and helpers and to park personnel or volunteer docents. (Be sure to get names and addresses before or during the trip.)
- Students can write letters to organizations that are working to protect and improve the environment, such as organizations listed in Appendix III.
- Students can write letters to natural resource management companies or to users of forest products such as artists, builders, or lumber companies. See Appendix III.
- Students can write letters to newspapers. They might express concern about environmental issues, support and appreciation for good work being done, or express appreciation for those who helped with the trip.
- Students can write a thank you letter to a tree, forest, or animal.

Some suggestions for letter writing:

1. Have the students use the complete writing process that you use as part of your language arts program: brainstorming, mind mapping, writing and editing drafts, etc.
2. Check spelling, especially of names and addresses.
3. Keep the letters brief. If it's a letter to a legislator, it probably won't get read by the legislator himself or herself, but it will be tallied.
4. Be sure that the student makes a point, rather than just complaining. What does he or she want done?
5. Look for opportunities to write positive letters praising individuals, groups, agencies, or companies doing good things.
6. Be sure to request a response and supply a name and address, perhaps c/o the teacher at the school. (Students should **not** give their home addresses.)
7. Students who are unable to write can dictate their letters to a parent, other student, classroom aide, or other person who types or writes the letters for them.

Additional suggestions for letter writing can be found in the *Environmental Science Activities Kit*, by Michael Roa

CALIFORNIA STANDARDS ADDRESSED (S.S. indicates a standard set.)
Focus Standards:

Grade 4-7:	English Writing S.S. 1, S.S. 2
	English Written and Oral English Language Conventions S.S.1
Grade 4:	History/Social Studies 4.5.4
Grade 5:	History/Social Studies 5.7.3

Storytelling

California Indians, like all people, wondered about the causes of natural phenomena such as the creation of the earth, seasons, moon phases, and the origins of humans. The following books may be useful in teaching about California Indian stories:

- Caduto, Michael and Joseph Bruchac. *Keepers of the Earth*. Golden, CO: Fulcrum Publishing, 1988.
- Clark, Ella. *Indian Legends of the Pacific Northwest*. Berkeley, CA: University of California Press, 1953.
- Gifford, Edward et al. *California Indian Nights*. Lincoln, NB: University of Nebraska Press, 1990.
- Kroeber, Theodora. *The Inland Whale: Nine Stories Retold from California Indian Legends.* Berkeley, CA: University of California Press, 1959.
- Lake-Thom, Bobby. *Spirits of the Earth*. New York, NY:Penguin Books, 1997.
- Margolin, Malcom, ed. *The Way We Lived: California Indian Reminiscences, Stories, and Songs*. Berkeley, CA: Heyday Books, 1993.
- Monroe, Jean Guard and Ray Williamson. *They Dance in the Sky*. Boston, MA: Houghton Mifflin, 1988.
- Sarris, Greg. *Keeping Slug Woman Alive*. Berkeley, CA: University of California Press, 1993.

Have the students make up and illustrate their own stories. Some topic ideas:

- How/why a forest tree is so tall?
- Why the wood or bark of some trees is red in color?
- Why madrone bark peels?
- Why madrone bark changes color from green to red?
- Why poison oak leaves change to red in the fall?
- Why some trees lose their leaves in the fall and others don't?
- How the spotted owl got its spots (skunk its stripes, raccoon its mask)?
- Why redwoods or California Bay trees sprout new trees from stumps?
- What causes the seasons?
- Why do different plants live in different areas?
- How Native Americans learned to use fire to encourage oak growth
- Students can ask their own questions and make up their own topics.
- Students can write their stories down, illustrate them, and share them with younger students.

CALIFORNIA STANDARDS ADDRESSED (S.S. indicates a standard set.)

Focus Standards:

Grade 4-7: English Writing S.S. 1, S.S. 2
English Written and Oral English Language Conventions S.S.1
Grade 4: History/Social Studies 4.2.1
Grade 5: History/Social Studies 5.1.2
Grade 6: History/Social Studies 6.1.1

CHAPTER 4
Activities for Any Time

The activities in Chapter 4 might be done before or after a trip to the forest or, in some cases, during the trip. Consider when would be the most appropriate time to do them.

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 safely 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.

Coniferous Forest Crosswords

ACTIVITY SUMMARY
Four crossword puzzles are provided:
- Basic Forest Ecology
- Advanced Forest Ecology
- Forest Organisms
- Humans and the Forest

CONCEPTS TO BE LEARNED
Vocabulary

CALIFORNIA STANDARDS ADDRESSED
Vocabulary is useful in discussing all Standards and Environmental Principles.

ANTICIPATED OUTCOMES
1. Students will increase their knowledge of vocabulary.

GROUPING
Individual or any other configuration

TIME
Varies

MATERIALS
- ❒ copies of crossword puzzles
- ❒ transparencies of crossword puzzles and answers

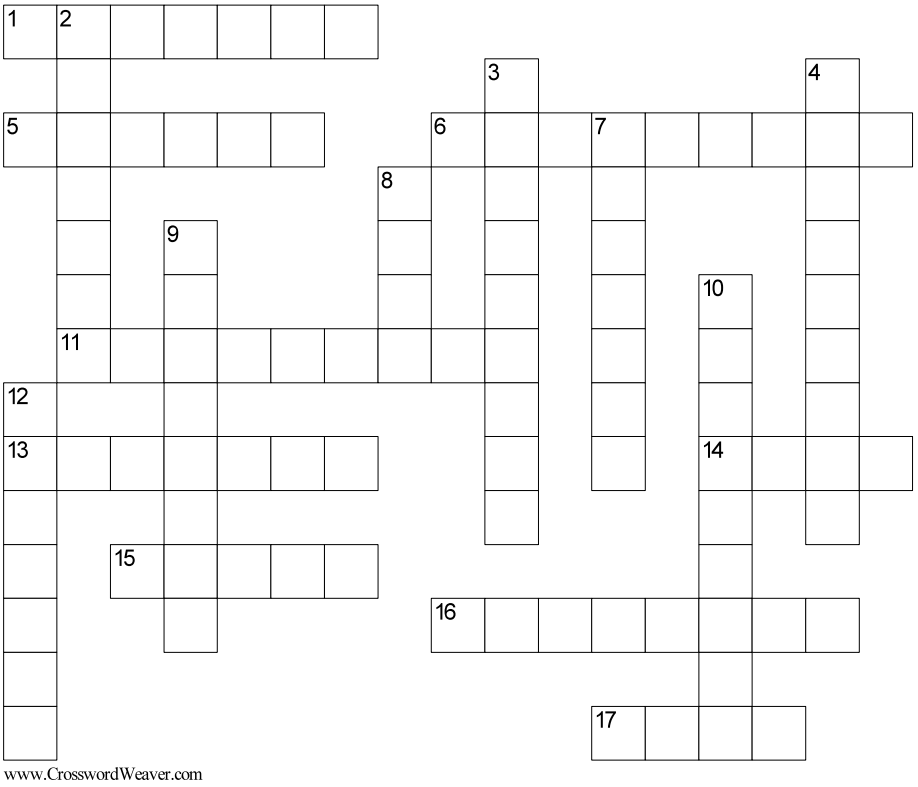
TEACHER PREPARATION
1. Duplicate crossword puzzles and make transparencies.
2. Unlike “real” crossword puzzles, these don’t have many places where words intersect, so the students don’t have many clues. Consider giving the students a list of words from which to choose. The list might include just the words from the puzzle, or it may include additional words.

PROCEDURE
1. Vocabulary must be taught before students will be able to do the crossword puzzles.
2. Crossword puzzles can be given as homework or class work.
3. Transparencies can be used to go over the answers.

ASSESSMENT
1. The puzzles can be used to assess vocabulary knowledge.

SOLUTIONS TO CROSSWORD PUZZLES FOLLOW THE PUZZLES

Basic Forest Ecology Crossword Puzzle



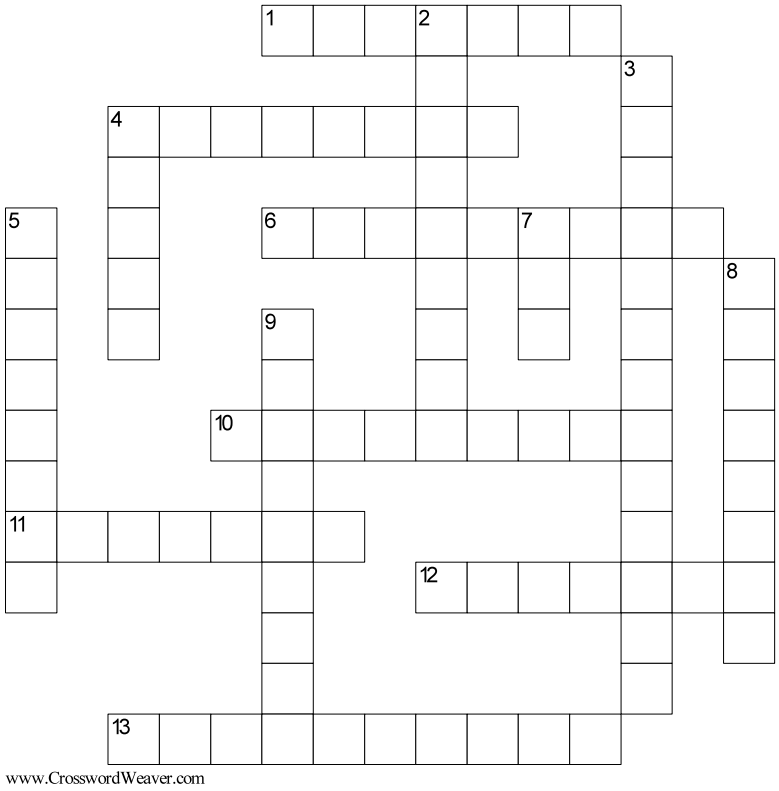
Across

1 A place where an organism lives is its _____.
5 _____ factors include plants and animals
6 I like to eat animals for dinner!
11 Organisms that eat other organisms.
13 A tree that produces seeds in a cone is a _____.
14 I am the protective outer layer of a tree's trunk
15 A sequence of what eats what is a food _____.
16 I like to eat both plants and animals.
17 If conditions are right, I can grow into a huge tree.

Down

2 _____ factors include air, water, sunlight, and minerals.
3 The area from which water flows into creeks and rivers.
4 Organisms, such as plants, that make sugars to use as an energy source.
7 Conifer leaves are usually long and thin and are called _____.
8 Conifers produce their seeds in a _____.
9 Plants need this form of energy for photosynthesis.
10 I like to eat plants for dinner!
12 The study of organisms and how they interact with each other and the environment.

Advanced Forest Ecology Crossword Puzzle



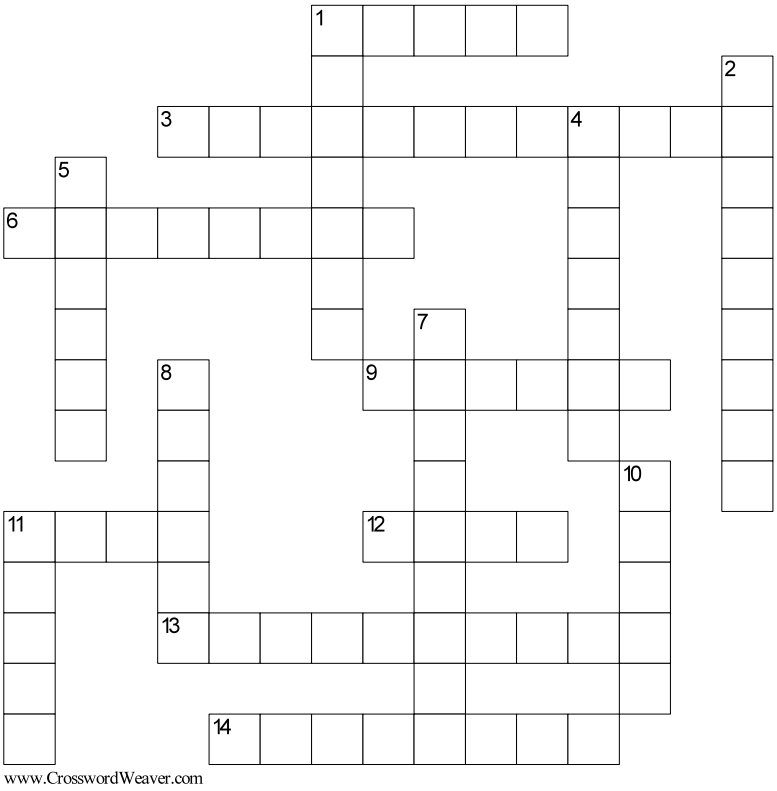
Across

1 The living wood of a tree, often light in color.
4 Carrying _____ tells how many individuals can live in a place.
6 The non-living center of a tree, often dark in color.
10 _____ trees lose their leaves in the winter.
11 The study of organisms and their relationships with each other and the environment.
12 Carbon _____ is a waste product of respiration.
13 A cone-bearing tree is a _____.

Down

2 The land from which water flows into creeks and rivers.
3 Why fallen trees and leaves and dead animals don't stay on the forest floor forever.
4 A food _____ is a simple way to show what eats what.
5 An organism that eats other organisms.
7 A food _____ shows what eats what.
8 Organism such as a plant that carries out photosynthesis.
9 _____ trees don't lose their leaves in the winter.

Coniferous Forest Organisms Crossword Puzzle



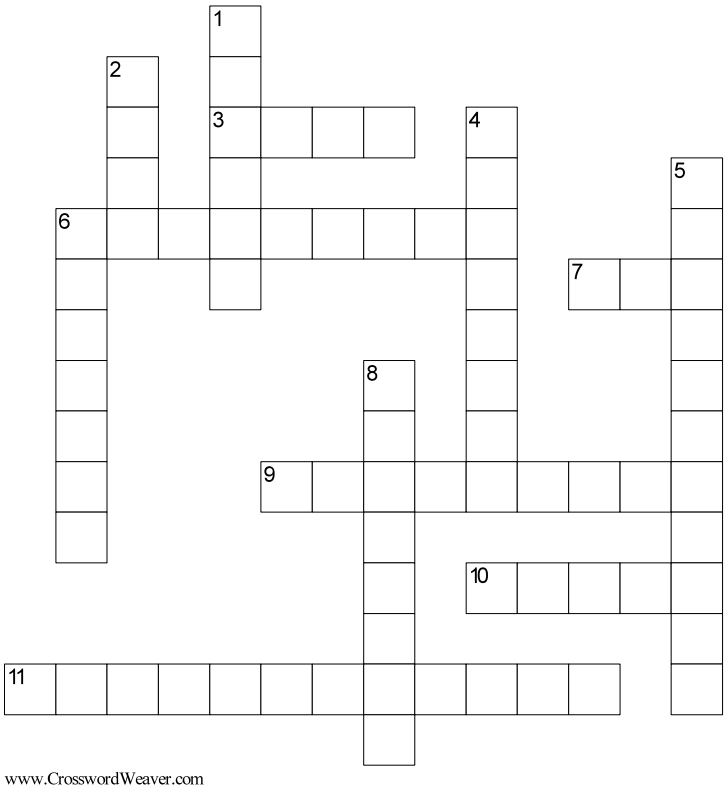
Across

1 I'm sort of like a seed for ferns, moss, and fungi.
3 The "I" in F.B.I., I may be a decomposer.
6 The "B" in F.B.I., I'm a decomposer.
9 _____ oak—leaflets three, let me be!
11 I am like a snail without its home.
12 I'm green, I reproduce with spores, and I can get pretty big.
13 I'm sort of like a newt, but often skinnier.
14 I'm a jaybird with a pointed crest.

Down

1 A particular type of organism.
2 I have one pair of legs per segment.
4 I look like a bandit.
5 I am a tasty fish that needs clean, cold water.
7 Scouring rush.
8 The "F" in F.B.I., I'm a decomposer.
10 I may grow into an oak tree.
11 I may be striped or spotted, but I stink!

Humans and the Forest Crossword Puzzle



Across

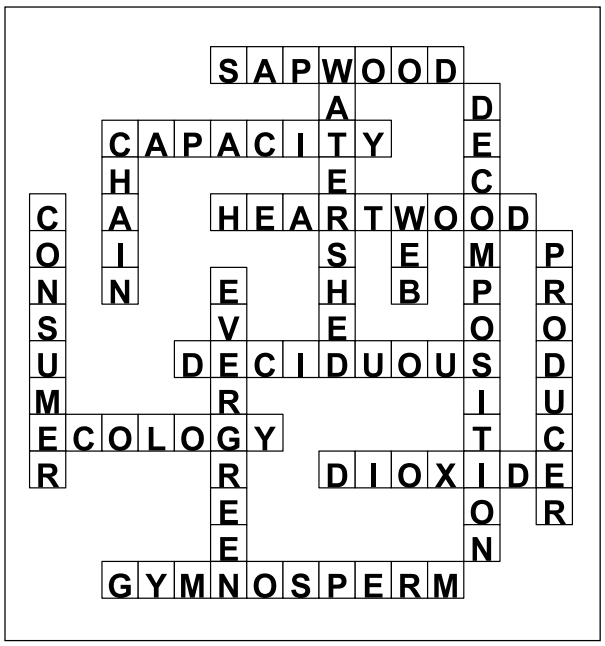
3 Where trees become boards.
6 In _____ logging, only a few trees at a time are taken from a stand.
7 Old time tree cutter.
9 Usually darker in color, found at the center of a tree.
10 Branches and brush cut during logging; may become a fire hazard.
11 Wise use of resources.

Down

1 Boards used for building.
2 Can kill trees, but in nature it helps remove competition.
4 Cutting all of the trees in an area.
5 Taking care of the environment.
6 Usually light in color, becomes heartwood as the tree ages.
8 Modern tree cutter.

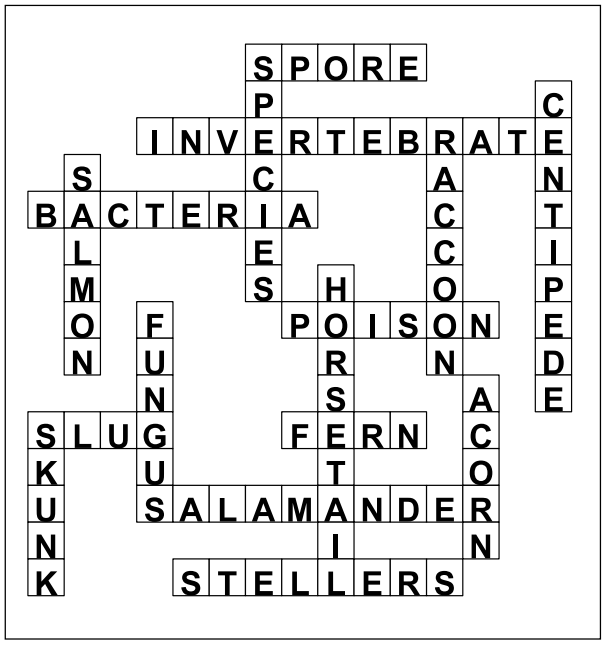
Crossword Puzzle Solutions

Advanced Forest Ecology

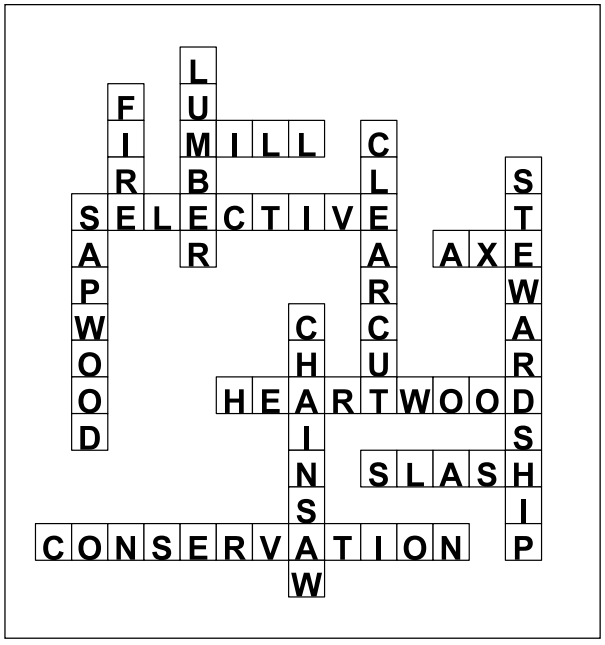


Basic Forest Ecology

Coniferous Forest Organisms



Humans and the Forest



Fantastic Photosynthesis

ACTIVITY SUMMARY
Students observe oxygen production in an aquatic plant.

CONCEPTS TO BE LEARNED
1. Plants produce oxygen through the process of photosynthesis.

CALIFORNIA STANDARDS ADDRESSED (S.S. indicates a standard set.)
Focus Standards:
- Grade 4: Life Sciences S.S. 2
  Science Investigation and Experimentation S.S. 6
- Grade 5: Life Sciences S.S. 2
  Science Investigation and Experimentation S.S. 6
- Grade 6: Ecology/Life Sciences S.S. 5
  Science Investigation and Experimentation S.S. 7
- Grade 7: Life Science 5.b
  Science Investigation and Experimentation S.S. 7

NATIONAL CONTENT STANDARDS ADDRESSED
Science Grades 5-8: Standards A and C

MATERIALS
For each group:
- ❒ large (1 to 4 qt.) glass or plastic jar or other container like an aquarium
- ❒ clear glass or plastic wide-mouth bottle or drinking glass that can fit into the jar or aquarium above
- ❒ 2 to 4 quarts of water with a teaspoon of baking soda dissolved in it, or soda water, or club soda (source of carbon dioxide)
- ❒ lamp or area where containers can be exposed to sunlight
- ❒ aquatic plants such as *Elodea* (available at pet or aquarium supply stores)
- ❒ optional: hand lenses, magnifying glass

TEACHER PREPARATION
Obtain the listed materials.

PROCEDURE
1. This activity can be done either before or after teaching about photosynthesis.
   a. If done before, let the composition of the bubbles remain a mystery until photosynthesis is taught.
   b. If done after, students should be able to suggest that the bubbles are oxygen.

Note: Gases dissolve more readily in cold water; the dissolved air and carbon dioxide will come out of solution as the water warms. To obtain a higher percentage of oxygen, let the water sit in the warm light for 30 minutes before inserting the plant.

2. Fill the aquarium or large jar with water. Add baking soda. (Or use soda water or club soda.) Stir, let sit.
3. Place a sprig of an aquatic plant in the glass or bottle.
4. Lower the glass sideways into the water so that it fills with the mixture and no air bubbles remain in the glass.
5. Invert the glass so that it is upside down without allowing air to enter. Let the glass rest on the bottom of the aquarium.
6. Aim the light towards the glass or place the aquarium on a sunlit windowsill.
7. Have the students observe the plant at the start and periodically during the day and over the next day or two. Do the leaves on the sunlit side give off more bubbles?

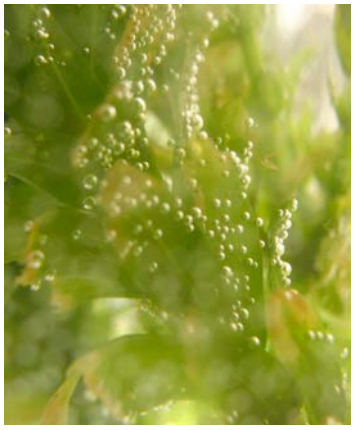


Figure 256. *Elodea* giving off bubbles of oxygen.

VARIATIONS, ADAPTATIONS, DIFFERENTIATION

1. An inverted funnel can be used to collect the oxygen and direct it into an inverted test tube full of water. When the tube is full of oxygen, light and blow out a wooden splint or craft stick. Immediately insert the glowing tip of the splint into the gas in the test tube. It should re-light or glow more brightly, indicating the presence of oxygen.
2. Use different types of plants. Try algae or different land plants.
3. Students can use hand lenses to look for stomata on the leaves.
4. One result of photosynthesis is carbon sequestration. Relate to global climate change and the greenhouse effect.

ASSESSMENT

1. When you have taught about photosynthesis, ask the students to explain the bubbles produced by the plant, either in writing or orally.

REFERENCES AND RESOURCES

American Forest Foundation: *Project Learning Tree Pre K–8 Environmental Education Activity Guide*

Hone et al.: *A Sourcebook for Elementary Science*

Fence Post Studies

ACTIVITY SUMMARY

Students compare an old redwood fence post with new redwood (or other wood) fence post lumber. They also compare the advantages and disadvantages of different types of fence post materials. (Redwood is commonly used for fence posts, but other types of wood may be used. Students should NOT handle pressure-treated fence post material.)

CONCEPTS TO BE LEARNED

1. Growth rings indicate the growth rate of a tree.
2. Trees growing in sunny conditions grow more rapidly than trees in shady conditions.
3. Different building materials each have advantages and disadvantages.

CALIFORNIA STANDARDS ADDRESSED (S.S. indicates a standard set.)

Focus Standards:

Grade 4: Mathematics: Number Sense S.S. 3.0
English: Writing 2.3

Grade 5: Life Sciences 2.a, 2.b
Mathematics: Number Sense S.S. 1.0, 2.0
English: Writing 2.3

Grade 6: Mathematics: Number Sense S.S. 2.0
English: Writing 1.4
Writing 1.5, 2.3

Grade 7: Mathematics: Mathematical Reasoning S.S. 2.0
English: Writing 2.3

NATIONAL CONTENT STANDARDS ADDRESSED

Science Grades 5-8: Standards A and C

Environmental Principles and Concepts

Principle I, Concepts a, b, c
Principle II, Concepts a, b, c, d
Principle IV, Concepts a, b, c
Principle V, Concepts a, b

ANTICIPATED OUTCOMES

Students will increase their understanding of plant anatomy and how sunlight affects the growth rate of trees, and their ability to:

- ✓ conduct research and write reports.
- ✓ plan and conduct experiments.
- ✓ measure accurately.
- ✓ multiply and divide.

GROUPING

Part 1: Individual or teams of two to four students
Part 2: Teams of about three to six students (one or two teams for each of the fence post material types)

TIME

Part 1: Redwood fence post comparison: 30 minutes
Part 2: Fence post material research and experiments: varies

MATERIALS

Part 1:

- ❒ Samples of an old redwood fence post (Post A) and new redwood fence post lumber (Post B)
  - ✓ magnifying glasses
  - ✓ rulers
  - ✓ Fence Post Studies Study Guide: one per student or per group

Part 2:

- ❒ Varies…see Teacher Preparation and Procedure

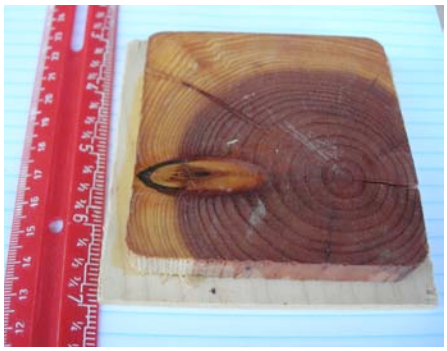


Figure 257. Section of a typical new redwood fence post, glued to plywood to protect it from breaking.

TEACHER PREPARATION

Part 1:

1. Obtain samples of old and new redwood fence posts and cut them into sections about 1" thick. (A junior high or high school wood shop teacher might help.)
2. For old redwood fence posts, look for posts cut 60 or more years ago so that they are likely to be from old growth forests. Contact wood recycling companies. Solid waste disposal sites ("dumps") often have wood recycling programs and may have old fence posts. Look for posts that have very closely spaced rings. (Figure 258)
3. When you buy new fence post material, look for posts with the widest rings that you can find. (Figure 257) With some looking, you may be able to find posts with rings ½"–¾" apart. Look also for posts with both heartwood and sapwood, as in Figure 257.
4. Make copies of the Fence Post Studies Study Guide: one/student or per group.

Part 2:

1. Visit local building supply stores to find out what kinds of fence post materials are available. Ask for brochures and samples. Try to get samples of:
   Redwood, treated fir, vinyl, recycled plastic composite, steel/iron
2. If the building supply store won't give you samples, they will probably give you brochures. You might check the yellow pages for fence builders who might have left over materials, or manufacturers of fence materials might provide samples.
3. Obtain web addresses for various manufacturers of fence materials and either contact them for information or plan to have students contact them.
4. A local company or individual that builds fences may give you scraps of various materials.

PROCEDURE

Part 1:

a. Label the old redwood post samples “Sample A” and the new ones “Sample B.”
b. Have the students use the magnifying glasses to examine the rings in the wood.
c. Have the students use the Fence Post Studies Study Guide to record and interpret their observations.

Figure 258: Old redwood fence post. (cut circa 1950)

Figure 259. New redwood fence post. (cut 2010)

Part 2:

a. Students conduct research using brochures or information obtained from building supply dealers, fencing contractors, or the Internet to compare the advantages and disadvantages of various types of fence post materials. They then present their findings in writing and/or orally.
b. Consider having two teams do research on each material type. (If the teams are too large, some students won’t be very involved.)
c. Students can present their findings as a report, in a brochure, as an advertisement, and/or orally.

VARIATIONS, ADAPTATIONS, DIFFERENTIATION

Part 1:

1. Larger samples can be used to make a display comparing redwood that grew rapidly and redwood that grew slowly.
   - Local redwood parks may be interested in adding such a display to their visitor center or museum.
   - Make the samples about 4"–8" long and cut them at an angle.
   - See *Redwood Ed*, by Michael Roa, available from California State Parks (www.parks.ca.gov/teachersguidess) and from Stewards of the Coast and Redwoods.
2. See the activity “The Great Tree Cookie Mystery,” on page 176.

Part 2:

1. Students can prepare displays to be placed at building supply centers.
2. If done at the start of the year, students can do a school-year long experiment by placing samples of materials in the ground at the beginning of the year and comparing them at the end of the year.
3. Groups can combine their findings in a bulletin board display showing the advantages and disadvantages of each material.

Ends of lumber can also be studied to determine growth rates.

ASSESSMENT

Part 1: Use the Fence Post Studies Study Guide to check for understanding, or ask students to explain differences observed.

Part 2: Reports should include such information as cost, durability, appearance, and environmental advantages and disadvantages.

ANSWERS TO SELECTED STUDY GUIDE QUESTIONS

1. In general, wood with more tannins will be more resistant to decay and insects, so wood from an old, slow-growing tree would tend to be more resistant. (Redwood cut from slow-growing trees in old growth forests earned the tree a reputation as an excellent wood for fence posts.)
2. To grow as much wood as possible, one would want to have the trees spaced far enough apart that each tree could receive enough sunlight for maximum growth.
3. To maximize growth of individual trees, one would probably harvest some trees (or all of the trees in a stand) when they began to compete with each other for sunlight.
4. Advantages and disadvantages in the table will depend on the students' research. Some possible advantages and disadvantages are given below.

Type of post	Advantage	Disadvantage
Redwood	Renewable resource Appearance (matter of taste) Accepts stains and paint well May produce less pollution and use less energy than some others	Depending on quality of wood, may decay or attract termites Requires cutting of trees
Treated fir	May last longer than redwood Fir trees more common than redwood Renewable resource	Appearance (matter of taste) Chemicals used as preservative May not accept stains or paints as well as redwood
Steel/iron	May last longer than wood Can be made from recycled metal	Pollution in manufacturing Energy used in manufacturing New iron is non-renewable resource
Vinyl	Appearance (matter of taste) Won't decay or attract termites Durable	Appearance (matter of taste) Uses non-renewable petroleum resource Energy used in manufacturing Pollution from manufacturing
Recycled plastic composite	Appearance (matter of taste) Won't decay or attract termites (reduces long-term cost) Uses recycled materials/supports recycling industry	Initial cost Toxic chemicals if burned Pollution from manufacturing

Fence Post Studies—Study Guide

When trees grow in the sun, they generally grow more rapidly than when they grow in the shade, other things being equal. In dense, dark forests, redwood trees may grow as slowly as 1/20" or less in radius in a year. In a sunny location, a redwood tree may grow as much as an inch in radius in a year…twenty times as fast!

When a tree grows rapidly, as it does in the spring and early summer, it produces wood with large, thin-walled cells that are light in color. In the late summer and fall, the slowly growing tree produces wood with smaller, thick-walled cells that are darker.

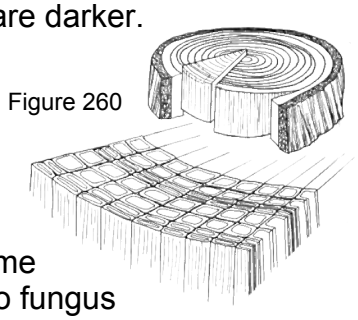


Figure 260

During a year's growth, a tree will usually produce some dark and some light cells, which results in growth rings. If you start at the outside of the dark part of a ring and measure to the outside of the part of the next dark ring, that's a year's growth.

Redwood is valued for such uses as fence posts because the same chemicals that give the wood its red color also make it resistant to fungus that causes rot and to insects such as termites. In general, the darker the wood, the more resistant it is. These chemicals, called **tannins**, accumulate as the tree grows older, so wood from older trees tends to have more tannins and be more resistant to decay and insects than rapidly growing young trees.

Examine the two redwood fence post samples and record your observations and answers.

	Sample A	Sample B
Did this sample probably grow in the sun or in the shade?		
Which sample is darker, indicating the presence of more insect-resistant and decay-resistant tannins?		
About how long did it take this tree to grow 1" in radius?		
About how long did it take this tree to grow 1" in diameter?		
About how many inches in diameter did this tree grow in 20 years? (assuming a constant growth rate)		
Which tree grew faster?		
Do you notice any other differences between the two posts?		

continued next page

Fence Post Studies—Questions

1. Which would probably make a better fence post—redwood that grew slowly and had lots of tannins, or redwood that grew rapidly and had not accumulated tannins, and why?

2. If you wanted to grow as much wood as possible on your land, would you want to grow trees close together or space them farther apart, and why?

3. If you were growing trees and wanted to grow as much wood as possible, would you let trees keep growing after their canopies grew together to produce shade, or would you harvest them when they started to produce shade?

4. For each type of fence post material, give one advantage and one disadvantage.

Type of post	Advantage	Disadvantage
Redwood		
Treated fir		
Steel/iron		
Vinyl		
Recycled plastic composite		

How Big?

ACTIVITY SUMMARY
Students learn about the size of conifers by painting a life-size tree on the school grounds.

CONCEPTS TO BE LEARNED
1. Some types of conifers can grow to great sizes.
2. Scale drawings can represent large or small things.

CALIFORNIA STANDARDS ADDRESSED (S.S. indicates a standard set.)

Focus 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., 2.0
Grade 7: Mathematics Mathematical Reasoning S.S. 2.0

Other Standards:

Grade 4: Mathematics: Measurement and Geometry S.S. 1.0
Grade 5: Mathematics: Measurement and Geometry S.S. 1.0
Grade 6: Mathematics: Measurement and Geometry S.S. 1.0

ANTICIPATED OUTCOMES
1. Students will comprehend the size of large trees.
2. Students will increase their understanding of scale illustrations.

GROUPING
Whole class

TIME
Varies

MATERIALS
- ❒ paint brushes…size and number vary
- ❒ rags and water for cleanup
- ❒ exterior latex (water base) paint (for a tree shaped like the one drawn in the grid that follows, assuming one coat coverage):
  - For a 120’ tall tree on the school yard:
    - ❒ 2–3 gallons of green
    - ❒ 1 gallon of red-brown
    - ❒ ½–1 pint of some other color(s) for a person
  - For a 6' scale painting on the classroom door or wall:
    - ❒ ½ pint each of red-brown and green
    - ❒ (less than) ½ pint of some other color(s) for a person
- ❒ gloves
- ❒ newspapers or paper plates on which paint cans can be placed

TEACHER PREPARATION

1. Get permission from your principal and buildings and grounds department.
2. Obtain the paint and brushes and cleanup materials. Paint stores often have cans of “mis-tints” that they will donate, but are unlikely to have large quantities of a given color. You might be able to obtain one-gallon cans of several shades of brown (or green) and mix them. Parents or school district buildings and grounds departments can often be helpful with this.
3. Prior to, or while on a field trip to a forest or park, find out the size of the largest tree that the students are likely to see.

PROCEDURE

1. To paint on the playground:
   a. Arrange to have a portion of the blacktop cleaned well, possibly with a power washer. Your buildings and grounds department or a parent may do this for you.
   b. Outline the tree in chalk on the blacktop. Since each tree has a different shape, there is no “perfect” shape for the tree. You may use the drawing on page 295 with a grid system. For a 120' tall playground tree, one side of a grid square would equal 10'.
   c. Assign a team of responsible students (or parents) to paint 2" to 3" wide outlines of the green and brown sections. This will provide “lines” for other students to paint within. Arrange for supervision while the outlines dry.
   d. When the outlines have dried, assign teams of students to paint within the outlines. Arrange for supervision while the painting dries.
2. To paint on the classroom door:
   a. Thoroughly clean the door. Place newspaper or a tarp under the door.
   b. Outline the tree in pencil. Since each tree has a different shape, there is no “perfect” shape for the tree. You may use the following drawings with a grid system.
   c. Assign a team of responsible students to paint ½" wide outlines of the green and brown sections. This will provide “lines” for other students to paint within. Arrange for supervision while the outlines dry.
   d. When the outlines have dried, assign students to paint within the outlines.

VARIATIONS, ADAPTATIONS, DIFFERENTIATION

1. Paper can be used to make a scale illustration indoors.
2. Students can make scale drawings of various organisms to add to the indoor tree.
3. Students can figure out the scale for various size representations on walls or on the playground.
4. Students can paint circles to represent the circumferences of trees.
5. Students can do research to find the size range for tree species that they are likely to encounter on a field trip or in the community.
6. See Figures 187-189 on pages 113-114 for some methods of measuring trees.

ASSESSMENT

1. Do students follow directions?
2. If students calculate the sizes of representations, are they accurate?

ANSWERS TO FENCE POST STUDIES STUDY GUIDE QUESTIONS

(Refer to Questions on page 297.)

1. If 3" equals 360', a ½" square would be 60' on a side.
2. The giant sequoia base is about half of a square across, or about 30'.
3. Since a ½" square represents 60' and the giant sequoia drawing is about five squares tall, the giant sequoia would be about 300' tall.
4. If you want to enlarge the drawing of the 360' tall tree using 12 squares, each square in the grid would represent 30' of tree height.
5. Since a ½" square represents 30', and the base of the coast redwood is about a third of a square, the base of the coast redwood tree would be about 10' in diameter.

Conifer for Enlarging to Paint

If this tree is 120' tall, each box of the grid is 10' on a side.

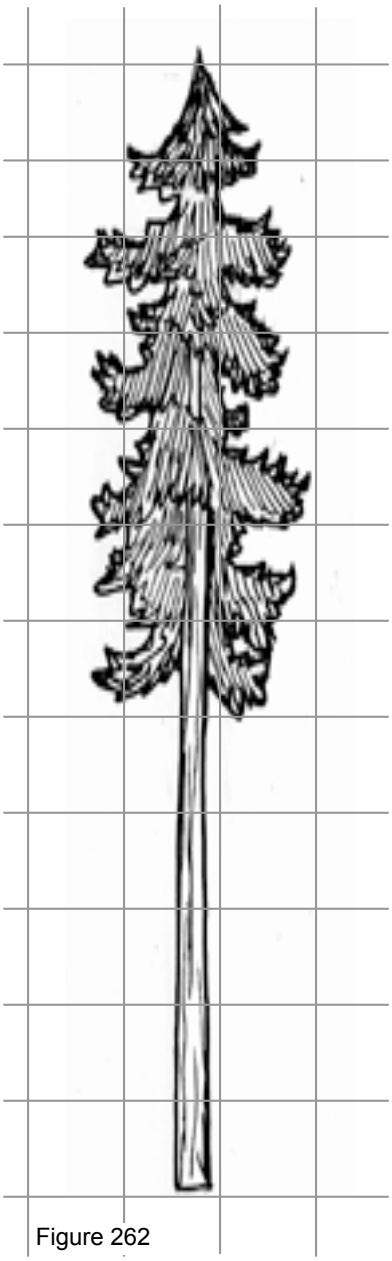


Figure 262

If the tree is 6' tall (as on a classroom door), each box would be 6" on a side.

To estimate how much paint it would require to paint the tree on a play-ground, for example, one could divide the tree into geometric shapes and calculate their areas. The top of the tree is a triangle, and the rest of the foliage could be considered a rectangle, as could the trunk (bole).

Figure 261

If the drawing is on a 10' grid, the triangle would have a base of about 3.3' and a height of about 3.3'. Its area would be about 11 square feet.

The rest of the foliage would be a rectangle about 20' wide and 50' tall. The area of that rectangle would be 1000 square feet.

The sum of the foliage would be about 1,011 square feet. If a gallon of paint covers about 400 square feet, 2–3 gallons would be required to cover this area. However, not all of the foliage reaches the edge of the rectangle, and some of the bole or trunk is visible, so one might be able to get by with 2 gallons of green paint. To be safe, though, one should probably buy 2–3 gallons in case a gallon doesn't actually cover 400 square feet.

The trunk below the foliage would form a rectangle about 3.3' wide and 50' tall, or 165 square feet. This would require about a half-gallon, but some of the trunk and some branches are visible within the foliage, so one ought to consider buying one gallon of brown paint.

Since every tree has a different shape, the precise shape of the tree isn't as important as illustrating the size that trees can reach. A 150' tall tree is not an exceptionally tall conifer. Coast Redwoods, can grow to be over 370' tall, but most are less than 300' tall.

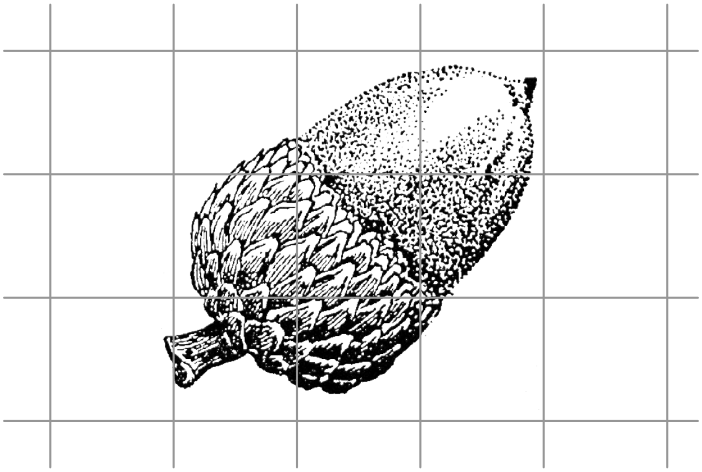
How Big?—Study Guide

How can you accurately draw something that is very large on a small paper? One way is to use a system of grids. The same method can be used to enlarge an illustration.

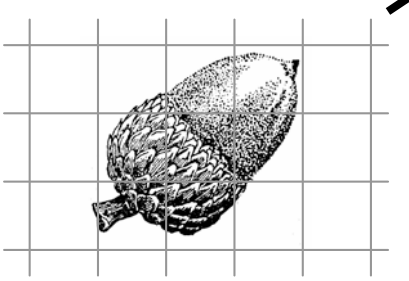
If you have an illustration that you want to **enlarge**, draw a series of grid lines on the original illustration (or on a picture of the object). Draw similar, but larger grid lines on the paper on which you want to make the enlarged drawing. Or, use graph paper with different sized grids.

Then simply copy the part of the image from the small grid to the corresponding larger grid.

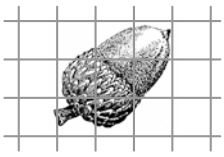
To **reduce** the size of a picture, use similar but smaller grid lines on the paper and copy the part of the image from the larger original grid to the corresponding smaller grid.



enlarged to approximately twice life size



black oak acorn, life size



reduced to approximately half life size

Figure 263. Original acorn drawing from Trees & Leaves CD ROM from Dover Publications, Inc.

How Big?—Questions

1. If the coast redwood tree drawn below is actually 360' tall, how many feet does each one-half inch square on the drawing represent?

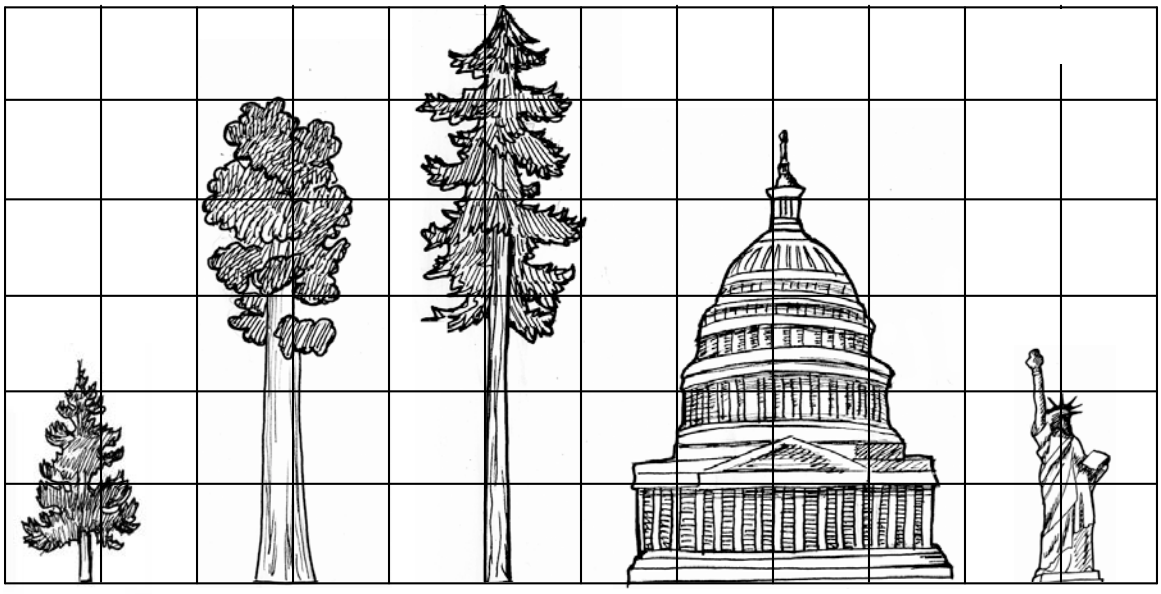
2. If the coast redwood tree is 360' tall, how wide is the giant sequoia tree at its base?

3. If the coast redwood tree is 360' tall, how tall is the giant sequoia?

4. If you wanted to use a 12 square tall grid to draw the 360' coast redwood on a 6' door, how many feet would each square represent?

5. If you want to draw the coast redwood tree life-sized, how wide would the base be?

Most coast redwoods are shorter than 300' tall, but some are more than 370' tall, and many are over 250' tall, especially in the streamside alluvial flats.



dawn redwood (140' tall) | giant Sequoia | coast redwood (360' tall) | Capitol Building (287' tall) | Statue of Liberty (151' from feet to torch)

Microhabitats

ACTIVITY SUMMARY
Students study and compare small areas of the forest or school grounds.

CONCEPTS TO BE LEARNED
1. Within a large area such as a stand of conifers, there are a variety of microhabitats, each of which has its own physical conditions and community of organisms.

CALIFORNIA STANDARDS ADDRESSED (S.S. indicates a standard set.)

Focus Standards:

Grade 4: Life Sciences S.S. 3
Science Investigation and Experimentation S.S. 6
Grade 5: Life Sciences S.S. 2
Science Investigation and Experimentation S.S. 6
Grade 6: Ecology/Life Sciences S.S. 5
Science Investigation and Experimentation S.S. 7
Grade 7: Science Investigation and Experimentation S.S. 7

Other Standards:

Grade 4: Mathematics: Number Sense S.S. 3.0
Mathematics: Measurement and Geometry S.S. 1.0
Mathematics: Statistics S.S. 1.0
Grade 5: Mathematics: Measurement and Geometry S.S. 1.0
Mathematics: Statistics S.S. 1.0
Grade 6: Mathematics: Number Sense S.S. 1.0
Mathematics: Number Sense S.S. 2.0
Grade 7: Mathematics: Mathematical Reasoning S.S. 2.0

NATIONAL CONTENT STANDARDS ADDRESSED
Science Grades 5-8: Standards A, C, F

ANTICIPATED OUTCOMES
1. Students will increase their understanding of how plants and animals interact with each other and with their environment.
2. Students will increase their ability to make, record, and interpret observations.

GROUPING
Depends on the availability of study sites. Ideally, teams of two to four students for each site.

TIME
Varies

MATERIALS

Varies with the types of data to be collected. Depending on the site, such tools as:

- ❒ cameras
- ❒ measuring devices (rulers, tape measures)
- ❒ magnifiers
- ❒ thermometers
- ❒ books including keys and field guides (see Appendix IV and V)
- ❒ pans
- ❒ forceps
- ❒ notebooks
- ❒ colored pencils or crayons

TEACHER PREPARATION

1. Arrange for the sites. Be aware of such issues as damaging the microhabitats, staying on trails, trampling plants, poison oak, etc.
2. Obtain the listed materials, or others as needed.
3. Study areas might be on the school grounds, or at a field site in a park or forest. Some possible study sites might be logs in various states of decay, bark of various species of trees, rocks (on the rock and under it), different parts of a stream (stream bank, sandy area, rocky area, area where water moves slowly or rapidly, etc.)

PROCEDURE

1. Have the students develop a system and forms for recording data.
2. Prior to taking the students to the forest, develop a K.W.L. chart, listing what they already **K**now, what they **W**ant to know or **W**onder about, and, afterwards, what they **L**earned.
3. Record such things as a description of the microhabitat, types and numbers of organisms, air or water temperature, moisture availability, etc.
4. Students should draw, as accurately as possible, the whole site and any organisms found.
5. Photographs can be helpful.

VARIATIONS, ADAPTATIONS, DIFFERENTIATION

1. Student teams can either study similar sites or different types of sites.
2. Students can compare the physical and biological data that they collect from different microhabitats.
3. Consider setting up a variety of microhabitats such as decaying logs, rocks, and various types of plants on the school grounds for ongoing studies over several years.
4. See the activities “I never Knew That!,” page 226, and “Micro-hiking,” page 233.

Mystery Objects

ACTIVITY SUMMARY
Various objects from a forest are placed in boxes or bags. Students describe and try to identify the objects without seeing them.

CONCEPTS TO BE LEARNED
1. All senses can be useful in gathering information.

CALIFORNIA STANDARDS ADDRESSED (S.S. indicates a standard set.)
Focus Standards:
Grade 4: Science Investigation and Experimentation 6.a
Grade 5: Science Investigation and Experimentation 6.a
Life Sciences 2.a
Grade 6: Science Investigation and Experimentation 7a

NATIONAL CONTENT STANDARDS ADDRESSED
Science Grades 5-8: Standards a and C

ANTICIPATED OUTCOMES
1. Students will increase their ability to use their sense of touch.
2. Students will increase their ability to identify various objects from a coniferous forest.

GROUPING
Individual

TIME
Depends on the number of objects.
Approximately one to three minutes per object.

MATERIALS
Remember that it is illegal to take materials from state or national parks.

Caution

Tell the students <u>not</u> to use their sense of taste!

Various objects from a coniferous forest (examples include):
- ❒ pieces of bark
- ❒ leaves, cones, acorns: conifers and broad-leaf trees
- ❒ deer or elk antlers, jawbones, fur (from a taxidermist?)
- ❒ rocks: various textures
- ❒ leaf litter/duff: from beneath a conifer and an oak
- ❒ litter: plastic water bottle, soda can, candy wrapper

- ❒ other objects?
- ❒ For each object: a box such as a shoebox, with a hole cut in the end, through which a student can insert his or her hand. Possibly use duct tape to attach a cloth flap to the end to serve as a "door" and prevent peeking. Possibly paint the box or cover it with pictures.
- ❒ Cloth or even paper bags can be used instead. Bags are easier to store, but students seem to take the activity more seriously if "mystery boxes" are used.
- ❒ Mystery Object Study Guide (page 302) for each student.

TEACHER PREPARATION

1. Create the boxes and obtain suitable objects.
2. Be sure to have extras in case the object becomes damaged.

PROCEDURE

Caution

Note: If possible, ascertain whether any students have allergies to items in the mystery boxes, including tree bark.

1. This activity can be done either before or after the students have been taught about the objects.
   a. Students who have been taught about the objects should try to identify them without seeing them.
   b. If the students have not yet been taught about the objects, they should describe them in as much detail as they can tell from feeling them. They can then guess the object's identity or make up a name for the object.

VARIATIONS, ADAPTATIONS, DIFFERENTIATION

1. Consider giving the students a list of objects, making it a multiple choice activity.
2. This activity can be used with objects from any environment.
3. Mystery objects can be displayed in the classroom, perhaps on a tray, before or after a trip to the forest.
4. If the boxes vary in size, they might "nest" inside each other, and take up less storage space.

ASSESSMENT

1. The Study Guide can be used for assessment.
2. Have students read their descriptions; encourage students to use precise adjectives and similes.

ANSWERS TO SELECTED STUDY GUIDE QUESTIONS

Will vary according to the objects.

Mystery Objects—Study Guide

For each mystery object, first write down the number of the mystery box or bag. Then, carefully reach into the opening and feel the object. **BE CAREFUL NOT TO DAMAGE THE MYSTERY OBJECT!**

Describe the object in as much detail as possible.

- Is it hard? How hard? Hard as a rock, hard as a piece of wood, or?
- Is it flexible? How flexible? Flexible like a hose? A straw? A hair? A paper?
- Is it smooth? How smooth or how rough? Smooth like a _____, rough as _____?
- Does it have different parts, or is it all one piece? Are all parts the same?
- Based only on feel, can you draw the object?
- What else can you tell?

If you don't know what it is, make up a name that describes the object.

Record your observations below:

#	Description	Made-up name	Actual name

The Mystery of the Disappearing Leaf!

ACTIVITY SUMMARY

Students place different materials in various soils and observe decomposition (or lack thereof) over time.

CONCEPTS TO BE LEARNED

1. Some materials will decompose and some won't.
2. Different soil types and conditions can either support or inhibit decomposition.

CALIFORNIA STANDARDS ADDRESSED (S.S. indicates a standard set.)

Focus Standards:

Grade 4: Life Sciences S.S. 2 and S.S. 3
Science Investigation and Experimentation S.S. 6
Grade 5: Science Investigation and Experimentation S.S. 6
Grade 6: Ecology (Life Sciences) S.S. 5
Science Investigation and Experimentation S.S. 7
Grade 7: Science Investigation and Experimentation S.S. 7

NATIONAL CONTENT STANDARDS ADDRESSED

Science Grades 5-8: Standards A and B

ANTICIPATED OUTCOMES

1. Students will increase their understanding of the process of decomposition.
2. Students will increase their ability to conduct scientific investigations.
3. Students will understand that not everything decomposes readily.

GROUPING

Groups of two to four students

TIME

Start: 15–30 minutes
Then: 10–15 minutes, observing every 2-3 days for an indeterminate amount of time

MATERIALS

For each group:

- ❒ one clear 2-liter soda bottle (or something similar), with four or five ¼" holes drilled in the bottom
- ❒ plastic/nylon screening: cut in a circle approximately the size of the bottle's bottom
- ❒ pie tin or other device to catch water draining from the bottle
- ❒ masking tape
- ❒ measuring cup, graduated cylinder, or similar liquid volume measuring device
- ❒ approximately 1.5 quarts (1.5 liter) of soil
- ❒ various materials such as leaves, glass, plastic, aluminum, fruit, paper
- ❒ The Mystery of the Disappearing Leaf! Study Guide
- ❒ Optional: various soil types

TEACHER PREPARATION

1. Obtain listed materials.
2. Cut off the top of the bottle so that it is about 8" tall.
3. Drill four or five ¼" holes in the bottom. (A parent might do this for you.)
4. Place the screen in the bottom of the bottle to retain the soil and allow drainage.
5. This investigation can be as simple or as complex as you (and the students?) decide:
   - ✓ All can use the same soil, or they can investigate decomposition in various soil types such as coniferous forest, potting soil, backyard soil, sand, compost, etc.
   - ✓ Only one type of leaf may be used, or various types of leaves and other materials such as orange peels, aluminum cans, plastics, or other materials can be used.
   - ✓ All samples can receive the same amounts of water, or students can investigate various watering amounts and timing.
   - ✓ Samples can be in the dark, in the light, or in varying conditions.
   - ✓ For a longer-term experiment, students can use small samples of different types of wood.

PROCEDURE

1. Ask the students what happens to a leaf that falls to the forest floor. Introduce the term decomposition and discuss its meaning and importance to the forest (or any other) ecosystem.
2. Ask the students how they might design an experiment to see how long it takes a leaf to decompose. Elicit the idea of placing the leaf in some soil and checking it periodically. Discuss the idea that the living things that cause decomposition need moisture and some air to effectively decompose materials.
3. Decide on variables–types of soils, materials, moisture, etc.
4. Students place leaves and, possibly, other materials in soil in the 2-liter bottles so that the leaf is about 3" from the bottom and has about 3" to 5" of soil on top of it, and so that the leaf and/or other item is visible through the side of the bottle.
5. Bottles are placed in the pie tins and watered so that the soil stays damp but not soggy. (The soil microorganisms need air and moisture.) All bottles can be given the same amount of water with the same frequency, or water can be an experimental variable.
6. Students observe their bottles every two to three days, recording their observations on the Study Guide.

Figure 266.

VARIATIONS, ADAPTATIONS, DIFFERENTIATION

1. Many variations are possible. Consider having the students all do the same experiment (same soil type, same leaf type, same watering schedule) for two to four weeks, and then let them design other variables such as leaf types, amount of water, and frequency of watering, soil types, etc.)

ASSESSMENT

1. Do students follow directions?
2. Questions on the Study Guide can be used for assessment.

ANSWERS TO SELECTED STUDY GUIDE QUESTIONS

1. Decomposition depends on living organisms such as bacteria, which require moisture to survive. They also need air (oxygen), so too much water will kill them.
2. Without decomposition, nutrients would not be returned to the soil for new organisms to use.
3. Buried deep under a soil cover (to prevent access by rats and birds, and reduce leaching of chemicals from rains), the garbage was cut off from air and moisture, so microorganisms couldn't live and decompose it.
4. Plastic bags cut off the supply of air and water that microorganisms need to effectively decompose the garbage.

The Mystery of the Disappearing Leaf!—Study Guide

- ✓ Your teacher will provide you with a 2-liter bottle with a screen in the bottom, a leaf, and some soil.
- ✓ Use masking tape to put your name on your bottle.
- ✓ Place about 3" to 5" of soil in the bottom of the bottle.
- ✓ Then place the leaf (and paper, plastic, or other item(s) to be observed) so that you can see it (them) through the bottle.
- ✓ Add 3" to 5" more of the soil on top.
- ✓ Place your experiment in the pie tin and water it as directed by your teacher.
- ✓ Record your observations in the table below. You will observe your experiment over several days, so be sure to make accurate observations each time.

soil type: _____ watering:_____ every _____days
(amount)
Other conditions being tested:

Date	Item(s) to observe	Observations of the item(s)	Other observations

The Mystery of the Disappearing Leaf!—Questions

1. What changes did you observe in the leaf or other item(s)?

2. Why is it important to keep the soil moist, but not too wet?

3. Why is decomposition important in a natural ecosystem?

4. Some years ago scientists dug up a garbage dump and were surprised to find newspapers that were 20 years old that had not decomposed. Why do you think the papers had not decomposed?

5. Many people put their garbage into plastic bags before placing it in the garbage can. What effect might this have on the decomposition of the garbage?

6. What is composting, and how can it help the environment?

Organism of the Year

ACTIVITY SUMMARY

Students do research on an organism and prepare a poster, brochure, or other presentation telling why that organism should be the "Organism of the Year."

CONCEPTS TO BE LEARNED

1. Every organism has a role in the environment and has value.

CALIFORNIA STANDARDS ADDRESSED (S.S. indicates a standard set.)

Focus Standards:

Grade 4: Life Sciences S.S. 3
English: Writing 2.3
English Listening and Speaking Standard Set

Grade 5: English: Writing 2.3
English Listening and Speaking Standard Set

Grade 6: Ecology (Life Sciences) S.S. 5
English: Writing 1.4, 1.5, 2.3
English Listening and Speaking Standard Set

Grade 7: Life Science…Evolution 3.1
English: Writing 1.4, 1.5, 1.6, 1.7, 2.3
English Listening and Speaking Standard Set

NATIONAL CONTENT STANDARDS ADDRESSED

Science Grades 5-8: Standard C

ANTIIPATED OUTCOMES

1. Students will improve their research and writing skills
2. Students will increase their knowledge about a particular organism.
3. Students will increase their knowledge of ways that organisms interact.

GROUPING

Individuals or groups of two to three

TIME

Introduce assignment: 10–20 minutes
Research, production, and presentation of poster, brochure, or other product: varies

MATERIALS

❒ Depends on presentation method: materials for making posters or brochures, computers for PowerPoint presentations, video recorder, or other materials.

TEACHER PREPARATION

1. Obtain pictures or slides of various organisms of the coniferous forest. Sources might include *The Conifer Connection*, the Internet, calendars, and magazines.
2. Obtain materials needed for the type of presentation planned.
3. Decide on group size and time to be allocated.

4. Duplicate the Organism of the Year Study Guide.
5. Optional: Obtain books for student use.

PROCEDURE

1. Show students pictures of various forest organisms. As you show the pictures, tape them on the wall or write their names on the board.
2. Have the students "vote" for their "favorite" organism. Generally, mammals and large "charismatic" species will receive more votes.
3. Ask students why they voted as they did.
4. Discuss the idea that all organisms are important in an ecosystem.
5. Give the students the Organism of The Year Study Guide.
6. Have the students select their organism (or assign them, or have them draw their organism's name from a hat). Some possibilities include the following, but many others are possible. Consider resources available, but information on most can be found on the Internet. Not assigning "charismatic" species such as mountain lions, black bears, raccoons, or organisms of obvious value such as trout, salmon, pine, fir, redwood, or Douglas-fir trees makes it more interesting and challenging, and may be more useful.

poison oak	stinging nettle	spikenard	miner's lettuce	horsetail
hound's tongue	manzanita	madrone	wild cucumber	coltsfoot
skunk cabbage	big-leaf maple	alder	bay (laurel)	willow
moss	mushrooms	algae	various ferns	lichens
earthworm	mosquito	crane fly	yellow jacket	mayfly
stonefly	caddis fly	termite	bottle fly	millipede
centipede	sow bug	tick	black widow	wolf spider
snail	banana slug	newt	salamander	tailed frog
tree frog	red-legged frog	pond turtle	rattlesnake	garter snake
rubber boa	gopher snake	fence lizard	ringneck snake	skink
alligator lizard	Steller's jay	scrub jay	red tailed hawk	winter wren
woodpecker	marbled murrelet	crow	snowy plover	spotted owl
flying squirrel	gray squirrel	chickaree	wood rat	voles
pond turtle	bat	mouse	opossum	stonecrop

7. After completing their research and poster or other product, students present their products to the class.

VARIATIONS, ADAPTATIONS, DIFFERENTIATION

1. Consider students' abilities when forming groups.

ASSESSMENT

1. Does the product show knowledge of the organism?

REFERENCES AND RESOURCES

Roa, Michael: *Environmental Science Activities Kit: "Endangered Species II: Who Cares?"*

Council for Environmental Education: *Project WILD K–12 Activity Guide: "Interview a Spider"*

Organism of the Year—Study Guide

It is easy to care about cute animals such as raccoons and spectacular plants like the coast redwood or ponderosa pine trees. But what about other plants and animals? Are mosquitoes, worms, poison oak, and moss important and worth caring about?

In this activity, you will prepare an advertisement to convince the class that "your" organism is an important part of the forest community. Your teacher will provide details, but be sure that your advertisement includes the following:

- the name of your organism
- picture or drawing of the organism
  - ✓ Include information about its size.
- its range—Where in the world is it found? A map might help.
- its habitat within the forest—Where in the forest does it live?
- its niche—its role in the forest
  - ✓ What does it eat?
  - ✓ What eats it?
  - ✓ How else is it important?
- some other interesting or important information

and, especially…

- **Why does this organism deserve to be the Organism of the Year?**

Be sure to give the source(s) of your information—author, title, publisher, date, or the url of the Internet site that you used.

Similes, Metaphors and Analogies

ACTIVITY SUMMARY
Students use a worksheet to study forest analogies, similes, and metaphors.

CONCEPTS TO BE LEARNED
1. Similes, Metaphors, vocabulary and analogies can be useful in communicating.

CALIFORNIA STANDARDS ADDRESSED (S.S. indicates a standard set.)
Focus Standards:
Grade 4: English Reading S.S. 1
Grade 5: English Reading S.S. 1
Grade 6: English Reading S.S. 1, Standard 3.7

ANTICIPATED OUTCOMES
1. Students will increase their ability to communicate.

GROUPING
Individuals or groups of varying sizes up to the whole class

TIME
30–60 minutes

MATERIALS
❒ Copies of Similes, Metaphors, and Analogies Study Guide

TEACHER PREPARATION
1. Decide whether to have the students do this activity individually or in groups.
2. Decide whether you want to focus on analogies, similes, or metaphors or all three.
3. Duplicate the Study Guide for the students.

PROCEDURE
1. Write some examples of analogies, similes, and/or metaphors on the board or overhead and ask the students to discuss how they communicate about forests
   or
   Direct teach about analogies, similes, and/or metaphors.

2. Have the students complete the portion(s) of the worksheet as appropriate.

VARIATIONS, ADAPTATIONS, DIFFERENTIATION
1. Find some analogies, similes, and/or metaphors in other materials that you may be using such as English/Language Arts texts, novels, poems, or other resources. After discussing those, have the students do this activity.
2. Do this activity before a trip to a forest, and then have the students repeat it while in the forest. Discuss how the experience of being in the forest facilitates the activity.
3. Use the Study Guide as a starting point to make up your own worksheet.

Answer Key to Similes, Metaphors, and Analogies—Study Guide

Similes

1. Complete the following similes: Sample answers:
   a. The shade in the forest was as dark as ***night, a cave, a raven***
   b. The trees were as dense as ***buildings in a city, the crowd at a basketball game***
   c. The falling pine cone hit him like ***a bomb, a rock***
   d. The burned over watershed was like ***a desert, a battlefield***

2. Write two forest similes of your own: ***Answers will vary.***

Metaphors

1. To what do you think the following forest metaphors refer?
   a. As he walked past the nest, a stinging bullet hit him on the ear. The "bullet" is probably:

      a bee or yellow jacket or wasp
   b. She sat in the shade of the skyscraper writing in her journal. The "skyscraper" is probably:

      a tall tree or rock
2. Write two metaphors that refer to things that one might observe in the forest: ***Answers will vary.***

Analogies

1. Use the following terms to complete the forest analogies that follow.
   a. traffic : highway / water : ***stream channel***
   b. milk : person / ***blood*** : mosquito
   c. trash collector : trash / ***decomposer*** : dead organism
   d. person : house / beaver : ***lodge***

2. Complete the following forest analogies: ***(other answers may be acceptable)***
   a. Grocery store : human / leaf : ***tree or other plant***
   b. skeleton : a dog : ***trunk, bole, stem, or branches*** : a tree
   c. fur : a bear : ***coat, clothing, jacket, blanket*** : a person

3. Write two forest analogies of your own. ***Answers will vary.***

ASSESSMENT

1. Do the students write and understand analogies, similes, and metaphors? Can they explain the ones that they write or that others write?

REFERENCES AND RESOURCES

Nelson, Dennis et al.: *Discover a Watershed.*

Similes, Metaphors and Analogies—Study Guide

Similes

Similes are figures of speech in which two dissimilar (different) things are compared by the use of words such as *like* and *as*. For example, a rapidly flowing river might be said to flow through the valley like a raging bull, while a gently flowing stream might flow as gently as a breeze.

1. Complete the following similes:

   a. The shade in the forest was as dark as _____

   b. The trees were as dense as _____

   c. The falling pine cone hit him like _____

   d. The burned over watershed was like _____

2. Write two forest similes of your own:

   a. _____

   b. _____

Metaphors

A *metaphor* is a figure of speech in which a word or phrase is applied to something to which it isn't normally applied. For example, falling pine cones might be referred to as bombs falling from the trees, or mosquito's mouth parts might be called a hypodermic needle.

1. To what do you think the following forest metaphors refer?

   a. As he walked past the nest, a stinging bullet hit him on the ear. The "bullet" is probably:

   b. She sat in the shade of the skyscraper writing in her journal. The "skyscraper" is probably:

2. Write two metaphors that refer to things that one might observe in the forest:

   a. _____

   b. _____

Analogies

Analogies are used to show how things are similar to each other in some ways by comparing otherwise different things.
For example, one might compare a river to a person's circulatory system by saying that a river is to the watershed as the arteries are to the heart.
This analogy could be written as: river : watershed / arteries : heart
The above analogy would be read "A river is to a watershed as arteries are to a heart."

1. Use the following terms to complete the forest analogies that follow.

   Vocabulary: lodge blood stream channel decomposer

   a. traffic : highway / water : _____

   b. milk : person / _____ : mosquito

   c. trash collector : trash / _____ : dead organism

   d. person : house / beaver : _____

2. Complete the following forest analogies:

   a. Grocery store : human / leaf : _____

   b. skeleton : a dog : _____ : a tree

   c. fur : a bear : _____ : a person

3. Write two forest analogies of your own

   a. _____ : _____ / _____ : _____

   b. _____ : _____ / _____ : _____

Transpiration

ACTIVITY SUMMARY

Students conduct experiments to see that transpiration results in the loss of water from a plant's leaves.

CONCEPTS TO BE LEARNED

1. Trees have tube-like cells that transport water throughout the tree.
2. Plants lose water through their leaves in a process called transpiration.

CALIFORNIA STANDARDS ADDRESSED (S.S. indicates a standard set.)

Focus Standards:

Grade 4: Science Investigation and Experimentation S.S. 6
Grade 5: Life Sciences S.S. 2
Science Investigation and Experimentation S.S. 6
Grade 6: Science Investigation and Experimentation S.S. 7
Grade 7: Science Investigation and Experimentation S.S. 7

Other Standards:

Grade 5: Earth Sciences 3
Grade 6: Ecology (Life Sciences) 5.b

NATIONAL CONTENT STANDARDS ADDRESSED

Science Grades 5-8: Standards A and C

MATERIALS

For each **student**: Transpiration Study Guide, page 317
For each **group**:

- ❒ two sandwich size plastic bags ("Zip Lock" type are preferable)
- ❒ 6" of masking tape (less if using "Zip Lock" type bags)
- ❒ petroleum jelly (a small amount…a half teaspoon or less)
- ❒ two branchlets or large leaves on living plants

TEACHER PREPARATION

1. Obtain listed materials.
2. Duplicate the Transpiration Study Guide.

PROCEDURE

1. Take the class outdoors to the selected plant(s) and go over the procedure. Plants with large leaves will probably work best.
2. Have the students begin the experiment.
3. Observe at the end of the period or day, and again the next day.
4. Discuss the observations and Study Guide questions.

Figure 267. Plastic bag over leaves with petroleum jelly (no transpiration).

Figure 268. Plastic bag over leaves without petroleum jelly. Water droplets indicate transpiration.

VARIATIONS, ADAPTATIONS, DIFFERENTIATION

1. This can be done with potted plants in the classroom, which might be preferable if the outdoor plants are not secure from vandalism or because of weather.
2. The experiment can be tried with different types of plants.

ASSESSMENT

1. The Study Guide can be used for assessment.

ANSWERS TO STUDY GUIDE QUESTIONS

Data Table: The leaves without the petroleum jelly would be expected to have more water on the inside of the bag.

1. Foggy days have high humidity, which reduces evaporation and transpiration. Fog also helps keep the air cool, which further reduces evaporation and transpiration.
2. Spines don't have much surface area from which to lose water in the hot, dry desert environment.

REFERENCES AND RESOURCES

Miller, Kenneth and Joseph Levine. *Prentice Hall Biology*

Transpiration—Study Guide

1. Pay attention as your teacher demonstrates the procedure for this activity.
2. Write your name or group number on two 1" pieces of masking tape. Attach the tape to the two plastic bags.
3. Place one of the plastic bags around a leaf or branchlet of the selected plant, bunching the opening up and wrapping the opening securely with a couple of inches of masking tape, or by “zipping” the bag shut.
4. Use your finger to apply petroleum jelly to both sides of the leaf (or leaves) of a second branch of the same plant. Then enclose the leave(s) with the second bag as in Step 3. **Try to use branches with the same number and sizes of leaves.**
5. Record your observations on the data table at the start of the experiment, at the end of the day or period, and on the next day.

Observations…including water in the plastic bag

	At the start	End of period/day	Next day
On branchlet/leaves **without** petroleum jelly			
On branchlet/leaves **with** petroleum jelly			

Transpiration—Questions

Answer the following questions with complete sentences.

You observed water loss through leaves, which is called **transpiration**. Warm, dry air increases evaporation of water, and, therefore, it increases transpiration.

1. Redwood trees live best in areas where there is lots of fog, especially in the summer. How might fog reduce water loss through transpiration? Hint: Discuss both temperature and humidity (the amount of water vapor in the air).

2. Desert plants often have their leaves reduced to spines. How might this help them survive in the desert?

Water…Cycling

ACTIVITY SUMMARY
Students observe evaporation, condensation, and runoff as parts of the water cycle.

CONCEPTS TO BE LEARNED
1. Water moves around in the environment in the water cycle.

CALIFORNIA STANDARDS ADDRESSED (S.S. indicates a standard set.)

Focus Standards:

Grade 4: Science Investigation and Experimentation S.S. 6
Grade 5: Earth Sciences S.S. 3
Science Investigation and Experimentation S.S. 6
Grade 6: Science Investigation and Experimentation S.S. 7
Grade 7: Science Investigation and Experimentation S.S. 7

Other Standards:

Grade 4: Life Sciences 2
Grade 5: Earth Sciences 4
Grade 6: Earth Science 2

NATIONAL CONTENT STANDARDS ADDRESSED

Science Grades 5-8: Standards A, B, C, D, F

Environmental Principles and Concepts

Principle I, Concepts a, b, c
Principle III, Concepts a, b, c
Principle IV, Concepts a, b, c

ANTICIPATED OUTCOMES
1. Students will increase their understanding of the water cycle.

GROUPING
Either teacher demonstration or groups of two to five students

TIME
Begin: 15–30 minutes
Activity: 30–60 minutes or more

Figure 269. Plastic cover on storage bin, with heat lamp.

MATERIALS
- ❒ large clear container such as gallon jar, glass bowl, 2-liter bottle, or plastic tub
- ❒ aluminum foil and/or clear plastic (such as plastic wrap or from a clear plastic bag)
- ❒ masking tape

Figure 270. Foil over plastic candy container and goose neck lamp with 100 W. incandescent bulb.

- ❒ ice cubes
- ❒ salt water (mix about four teaspoons of salt in 2 cups of water (the amount varies depending on the size of the jar, bowl, or tub)
- ❒ small cup, glass, jar, or plastic tub such as a yogurt or margarine container
- ❒ lamp with flexible “neck” with 100 watt bulb, preferably clear, or a sunny windowsill, or other light with a heat lamp
- ❒ gravel or flat rock(s) (the amount or size depend on the container size)

TEACHER PREPARATION

1. Obtain the materials listed for each group or for the demonstration.
2. To determine the time needed, try out the activity before having students do it.

PROCEDURE

1. Place about 1" of salt water in the bottom of the jar. Explain to students that this represents the ocean. (Or ask the students what it might represent.)
2. (As you go through the steps, diagram and label the water cycle on the board, an overhead projector, or on a piece of chart paper.)
3. Place the gravel or a flat rock into the “ocean” in the jar, off center. This represents land (continents), so it should rise above the water level.
4. Place an empty cup on the “land,” under the ice cube indentation. Explain (or elicit) that this represents a lake.
5. Place a strip of masking tape across the top of the large jar or tub so that it bisects the opening. (The tape is to support the foil or clear plastic, which will need to support ice cubes placed on the foil or plastic.)
6. Cover the top opening of the jar with aluminum foil or clear plastic. Extend the foil far enough down the side of the jar so that it is held firmly in place. Press down on the cover on either side of the tape so that some of the condensing water will drip into the cup/lake and some will drip onto the rock or gravel.
7. Shine the light directly on the “ocean.” Explain that this represents the sun. (Or place the jar on a sunny windowsill.) Ask the students what effect the sun will have on the water in the ocean. Elicit the response of evaporation.
8. Place about 6 to 10 ice cubes on each side of the (indented) cover. Explain that this represents the cooling that happens as air rises.
9. After a while, some water should begin to condense on the underside of the foil or plastic and run down the indentations so that some drips into the cup (lake) and some drips onto the “land.” Ask the students what this represents (precipitation). They will probably say rain, but point out that snow, hail, and fog are other forms of precipitation. Add more ice cubes if necessary. Point out that the dripping water is not from the ice cubes, but rather from condensation of water that is evaporating from the ocean.
10. Ask the students what happens to the rain that falls on the land. (It may soak in, collect in ponds or lakes, or run off the land. If it soaks in, it may be used by plants or may flow downhill in the underground water system known as the aquifer. If it collects in a lake or pond, it may be used by plants or animals, it may soak in, or it may run off into a creek or river.)

11. Discuss how plants and animals fit into the water cycle as they use water and give off waste water as urine, perspiration, water vapor in breath, or through transpiration or decomposition. Add these to the diagram.
12. After some water has collected in the cup, ask the students whether it is salt water or fresh water. After they have guessed, have a volunteer or two taste it.
    a. Discuss the idea that the salt is left behind in the ocean as the water evaporates.
    b. Discuss the idea that pollutants would also be left behind.

VARIATIONS, ADAPTATIONS, DIFFERENTIATION

1. Many different clear containers can be used for this activity, including 2-liter bottles, storage bins, large containers that had contained candy or other items.
2. Plastic animals can be placed in the jar.
3. Plastic or real plants can be placed in the jar.

Figure 271. 2-liter bottle with top cut off and inverted

ASSESSMENT

1. Have the students draw and label a water cycle.

REFERENCES AND RESOURCES

Allen, Maureen et al.: *All About Water*

American Forest Foundation: *Project Learning Tree Pre K–8 Activity Guide: "Water Wonder"*

The Watercourse and the Council for Environmental Education: *Project WET* (several activities)

Water Environment Federation: *Water Sourcebook*

Council for Environmental Education: *Project WILD Aquatic Education K–12 Activity Guide: "Where Does Water Run?"*

Contact your local water agency for additional resources. Many have posters and student activity guides.

Who Am I?

ACTIVITY SUMMARY

Students are each given an "identity" by having a picture of something from the coniferous forest either pinned to the back of their shirt or by having the picture mounted on cardboard or tagboard with a string which is hung around the neck with the picture on the student's back. The student then asks other students yes/no/maybe questions to try to determine their identity.

CONCEPTS TO BE LEARNED

1. Plants, animals, and other things can be described and can be identified by their descriptions.

CALIFORNIA STANDARDS ADDRESSED (S.S. indicates a standard set.)

Focus Standards:

Grade 4: Science Investigation and Experimentation 6.a
Grade 5: Life Sciences 2.a
Science Investigation and Experimentation 6
English Listening and Speaking Standard Set

NATIONAL CONTENT STANDARDS ADDRESSED

Science Grades 5-8: Standards A and C

ANTICIPATED OUTCOMES

1. Students will increase their ability to describe and identify objects, including plants and animals of the coniferous forest.

GROUPING

Whole class

TIME

30 minutes

MATERIALS

For each class member, a picture or specimen mounted on a string long enough to go around a student's neck so that the picture hangs on the student's back (24"–32" long). The illustrations in Section I, beginning on page 7 might be used.

TEACHER PREPARATION

1. Obtain pictures or drawings of various plants and animals of the coniferous forest.
2. If students do not know much about the organisms, include a brief paragraph about the organisms, or a list of likely questions and their answers. The information should include the organism's name, size, # of appendages, covering (fur, feathers, scales, exoskeleton, etc.), where it might be found, its niche, etc.
3. Affix the pictures and information to cardboard or tag board, or laminate them.
4. Leaves or other specimens can be mounted on cardboard and covered with clear plastic or inserted into a re-sealable plastic bag.
5. Punch holes in the two top corners and tie a piece of string (24"–32" long) so that the picture will hang on the student's back when the string is around the student's neck.

PROCEDURE

This activity can be done in two ways.

1. A student can be called to the front of the class and then given his or her organism picture while their back is turned to the class. (Be sure that the student doesn't see the picture.)

   The student then asks yes/no/maybe questions and the class responds. (If there is a question that the class can't answer, or answers incorrectly, the teacher can help.)

   When the student has guessed his/her identity, or has given up, it is another student's turn.
2. All students can be given their identities at once. They then circulate, asking each other the questions. When students have correctly determined their identity, they turn the picture so that it is on their chest.

VARIATIONS, ADAPTATIONS, DIFFERENTIATION

1. This activity can be done with pictures or specimens from any ecosystem.
2. It can be used to teach the names of plants and animals in other languages.

ASSESSMENT

1. Teachers can provide descriptions of plants or animals and students can try to identify the described organism.
2. Students can be shown or given a specimen or illustration and asked to describe it using appropriate vocabulary.

REFERENCES AND RESOURCES

Cornell, Joseph: *Sharing Nature With Children*

Several sources of posters and pictures that can be used are included in Appendix IV. Pictures of organisms can be found on the Internet.

Illustrations found in Section I might be colored and laminated.