3 Sierra Redwood Growth and Reproduction

You watch in amazement as the small, grayish bundle of fur races gracefully from the trunk of the tree to the branch, back to the trunk, down to the ground, and back up again. All the while he is squawking loudly at you, letting you know exactly to whom this forest belongs. After scolding you sufficiently, this tiny tree squirrel begins making his way up a Sierra redwood trunk. He is soon at the very top, 250 feet up, and you move away from the base of the tree as the small egg-shaped Sierra redwood cones begin to fall. After about 15 minutes of watching, you decide to continue your walk, but already 150 cones lie on the ground as a result of this animal's frantic activity. What is the fate of these Sierra redwood cones and the seeds they contain?

Animals' Roles in Seed Dispersal

Sierra redwood seeds are released from the cone in two ways: an explosive release of large numbers of seeds in response to environmental conditions such as fire, and a continuous release of smaller amounts by animals. The Douglas squirrel, or chickaree, is one of two animals known to play a part in the Sierra redwood reproductive process. Chickarees feed on the nutritious seeds of many conifers, but not the tiny seeds of the Sierra redwood. Redwood cones have very fleshy scales that the chickarees prefer over the seeds. It takes 6,000 of these seeds to weigh 1 ounce. Active all year long, chickarees scramble to the crowns of the trees, biting off thousands of the green cones annually. One squirrel was observed cutting 538 cones in 30 minutes. The cones are stored underground or in tree hollows in caches of just a few to hundreds of cones. The cones are eaten

SUGGESTED PRE-TRIP ACTIVITIES

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Plan a Field Trip Route

Objective:

To compare the location of the North Grove of Sierra redwoods with the student's own home.

Materials:

- ✔ *Map of California for each student*
- ✔ *The book* California Place Names *for Extension activity*

▲ Using the maps of California, locate your school or town, and Calaveras Big Trees State Park (Highway 4, east of Arnold). Plan a route of travel and mark it on the map. Calculate the distance in miles, and the amount of time it should take to travel there. Is there a difference in elevation?

▲ Can you locate any other Sierra or coast redwood groves?

▲ ***Extension:***

Research the meanings of place names you will pass on your route. On the trip, students can share the meanings of the place names as you pass that spot. For example: *Calaveras* means "skull" in Spanish. Early explorers found several skulls in a cave next to a creek, and so it was named Calaveras Creek. The county was named after the creek, and the park after the county.

See also "California Plant Communities" on page 44.

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Geologic Time

Objective:

To see the relationships of past events in the Earth's history.

Materials:

- ✔ *Research materials (science texts, encyclopedias)*
- ✔ *Large piece of butcher paper*
- ✔ *Drawing materials*
- ✔ *Geologic time scale*

▲ Students research one period or epoch of the Earth's history. Using a geologic time scale, find out what life forms were dominant during that time period, the climate, and any major physical events (ice ages, mountain building, etc.).

▲ Draw a large geologic time scale on butcher paper, with blanks left for the names of eras, periods, and epochs. Each student (or group) writes in the name of their time period, the range in years, and draws pictures or writes about the life forms, climate, and physical events. Especially note where redwoods fit into the scheme.

later, even when under the snow. Chickarees may actually be planting Sierra redwood trees in this way.

The other animal known to play a part in the process of Sierra redwood seed dispersal is a long-horned beetle (*Phymatodes nitidus*). Although over 140 species of insects use the Sierra redwood during part of their life cycles, only this one may actually help to release the seeds. The phymatodes beetle lays its eggs in a Sierra redwood cone. The larvae then feed on the inside of the green cone. This progressively kills the cone scales, which dry out and release the seeds.

Phymatodes Beetle
Phymatodes nitidus

Fertilization, Dispersal, and Germination

To gain a better understanding of the role these animals play in Sierra redwood ecology, let's take a look at the way the trees produce cones and release seeds. It takes 2 years for a Sierra redwood cone to mature. In the spring, you may notice clouds of yellow pollen being blown around the grove. This wind-borne pollen comes from small male cones or "flowers" on the tree tops and must come into contact with the larger female cones in order for the seeds to be fertilized.

Mature cones can remain green and closed on the tree for up to 20 years. The cone stems have rings that can be counted like tree rings to determine their age. Many seeds are released when heat from the sun causes the cones to open, or when cones are knocked off the trees by wind, heavy snowfall, ice deposits, or chickarees. However, Sierra redwoods evolved in the presence of fire, and the most important agent of seed release and germination is fire. When heat from a fire warms the cones they open, thereby releasing seeds. This results in many seeds being released at once onto soil prepared by fire for seedling germination and growth.

Left: Sierra Redwood seedlings.

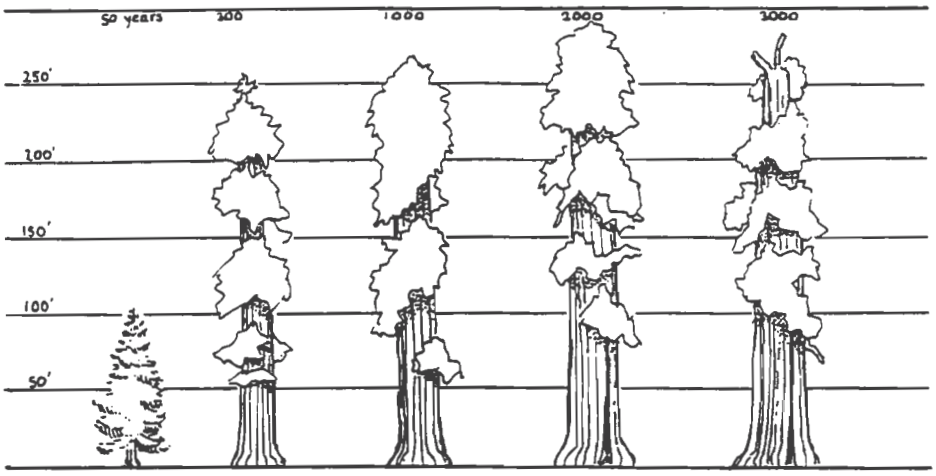
Right: Sierra Redwood cones and seeds.

Factors Affecting Seedling Survival

The percentage of seeds that find the perfect conditions for germination and seedling survival is very low. The seeds require access to mineral soil, plenty of moisture, and ample sunlight in order to survive. Some experts estimate that one in a million Sierra redwood seeds ever germinates, and that only a very small fraction of those ever grow to maturity. The trees compensate for this by producing an average of 1,500 new cones per tree each year. An individual tree may bear as many as 40,000 cones at one time. With each cone containing an average of 200 seeds, this theoretically could result in eight million seeds on each mature tree! However, the seeds are not all released at once as each tree drops an average of 1,500 cones each year.

Once a seed has reached moist mineral soil, and has succeeded in germinating, it must continue to receive favorable conditions in order to survive. The first 2 years of life are the most critical. If the seedling does not stay moist and receive the proper amount of sunlight, it will die. They are susceptible to several kinds of fungi. Field studies have shown that Sierra redwood seedlings have very high mortality rates—in one case over 98% of the seedlings in an area did not survive. The large amount of seeds produced ensures that at least a few seedlings will survive.

When a seedling has become established, it can grow very quickly if it receives enough water and plenty of sunlight. When young, these trees can add up to 4 feet in height a year. Eventually the pyramid-shaped young Sierra redwoods grow into massive round-topped trees with huge, gnarly branches. The average Sierra redwood does not become mature until about age 75, when viable seeds begin to be produced.



Form of the Sierra redwood at different ages.

The Role of Fire in Sierra Redwood Ecology

In discussing Sierra redwood ecology and reproduction, a mention must be made of the importance of fire. On your hike at the park, you will notice fire scars on most of the older, larger redwoods. These large marks and cavities are the result of natural, lightning-sparked fires. Sierra redwoods are a fire-adapted tree. In other words, not only can they survive forest fires, but they cannot survive as a species without fire. Small, frequent fires reduce the growth of small trees and brush, and burn off the material that accumulates on top of the soil such as dead branches, twigs, and leaves. This exposes the mineral soil and creates openings for sunlight, both necessary ingredients for Sierra redwood seedling germination. Fire also reduces the fungus and pathogens in the soil which can kill the seedlings. Without fire these trees would be much less successful at reproducing, and white fir would eventually become the dominant tree species.

Prescribed Burning

Since about 1900, fires of all kinds in the forests of the United States have been suppressed. This created a very dangerous situation, in which tons of potential fire fuel was allowed to build up. Many huge, uncontrollable and destructive forest fires have been the result. Since then we have learned that the smaller, frequent fires are beneficial, if not necessary, for the health of our forests and wildlife.

At Calaveras Big Trees State Park, prescribed burning is an important part of the management plan for not only both Sierra redwood groves, but for all areas of the park. A prescription burn is a carefully planned and administered fire, conducted only when moisture, wind, and fuel conditions will allow an easily controlled fire. The North Grove was burned in this way during 1983 and 1984. It has been exciting to watch the new redwood seedlings appear after the first burns were completed. Very few seedlings had been observed before the program of burning started and now there are areas of seedling germination in both the North and South Groves. These stands of ancient relicts are alive and well.

SUGGESTED PRE-TRIP ACTIVITIES

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What Do Plants Need?

Objective:

To demonstrate the needs of plants by growing plants from seed under varying conditions.

Materials:

- ✔ *Seeds (beans are easy)*
- ✔ *Soil*
- ✔ *Containers for planting*
- ✔ *Paper and pens for charting growth*
- ✔ *Paper towels*
- ✔ *Leaves or pine needles*

▲ Discuss what conditions seeds need to germinate and grow into plants (soil, water, sunlight, and air).

▲ Plant some seeds in wet paper towels to observe actual seed germination. These sprouts will die when they use up the energy stored in the seed.

▲ Plant some seeds in soil. After they germinate, try growing the plants under different conditions:

In darkness

With no water

With no air (in a plastic bag)

▲ Chart the growth of the plants, comparing growth under different conditions. Do Sierra redwoods need the same things in order to grow? (Yes.) Sierra redwoods also depend on fire, which clears the layers of litter and duff from the soil surface, enabling the redwood seedlings to survive.

▲ Try growing seeds on top of a layer of pine needles or leaves on top of the soil. Vary the depth of the layer and chart your results. You can usually buy Sierra redwood seeds at the park Visitor Center if you would like to try growing them.

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Tree Part Picture

Objective:

To identify the different parts of a tree and their functions.

Materials:

- ✔ *Chalkboard or overhead projector*
- ✔ *Drawing or painting materials*

Extension:

- ✔ *Coat hangers*
- ✔ *Scissors*
- ✔ *String*
- ✔ *Drawing or painting materials*

▲ Ask your class to name all the different parts of a tree. Draw each part on the board or overhead projector, and discuss the function of each. Be sure to include:

Leaves
Branches
Bark
Trunk
Roots
Seeds
Seed-holders (cones, fruit, etc.)

▲ How would it affect the tree if any part was injured or removed?

▲ Have students draw or paint a picture of any type of tree, making sure to include all the parts and label each by name and function. This activity goes well with Adopt-A-Tree from page 12, and Build-A-Tree from page 31.

▲ ***Extension:***

Make tree-part mobiles.

SUGGESTED PRE-TRIP ACTIVITIES

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Guided Imagery: A Trip Through a Tree

Objective:

To visualize the inner workings of a tree.

Materials:

- ✔ *Guided imagery from pages 34-35*
- ✔ *Drawing materials*

▲ This guided imagery will take the students on a "visit" to the inner working parts of a tree. Before reading the guided imagery, direct the students to put down all objects and sit in a comfortable and relaxed position with their eyes closed. Wait until the class has relaxed before beginning. Read slowly and steadily, allowing students enough time to create their own mental images. Once finished, ask the students to review all of the images they saw in their minds. After at least one minute, ask the students to open their eyes.

▲ Discuss their thoughts and impressions. Where did they go, and what was happening? You can use this time to reinforce the functions of different tree parts.

▲ Bring closure to the imagery by having the students draw a picture of any of their mental images.

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Heartbeat of a Tree

(Sharing Nature With Children)

Objective:

To listen to the life flow of a tree.

Materials:

- ✔ *Stethoscope*
- ✔ *Tree about 6 inches in diameter with thin bark*

▲ Spring is the best time to try this, and deciduous trees work better than conifers.

▲ Explain that trees are living creatures that eat, rest, breathe, and circulate fluids much as we do. Press the stethoscope firmly against the tree, keeping it still so as not to make interfering noises. Try several spots on the tree until you find the best one. You will be amazed at what you hear! What you will be hearing is the movement of fluids within the tree. You may also hear insect activity, such as bark beetles chewing wood.

▲ Try listening to the childrens' heartbeats, as well as any animals' you may have in your classroom.

SUGGESTED PRE-TRIP ACTIVITIES

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Build-A-Tree

Objective:

To simulate the inner workings of a tree.

Materials:

✔ *A space large enough for all students to stand*

▲ Divide the students into five groups of roughly equal size. Each group will dramatize one part of the trunk of the tree:

Heartwood	Inner bark
Sapwood	Outer bark
Cambium	

▲ Each group will need to come up with sounds and actions that describe the function of their tree part. Their major functions are:

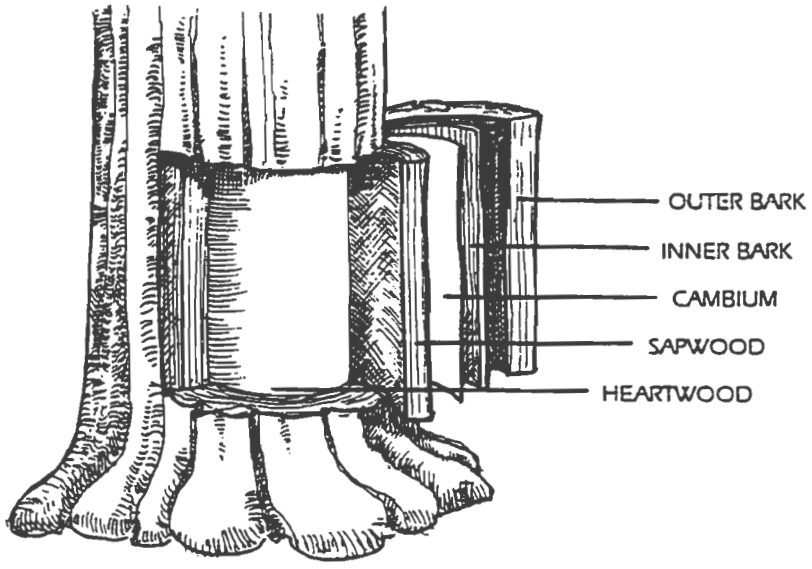
Heartwood: Provides stability, but is dead
Sapwood: Transports water from the roots throughout the tree
Cambium: The layer of cells that differentiates to become sapwood and inner bark
Inner bark: Transports food made in the leaves throughout the tree
Outer bark: Protects the tree from insects, fire, and disease.

▲ In the order given above, have each group come up and act out their sounds and actions until all the groups are assembled as would be a living tree:

Heartwood in the center, encircled by the layer of **sapwood,** a layer of **cambium,** the **inner bark,** and the **outer bark.**

▲ Have the students act out their parts as you play the insect, fire, or disease trying to penetrate the outer bark.

▲ To extend this idea and relate it to the Tree Part Picture activity on page 29, add limbs, foliage, roots, seed-holders, and seeds.



SUGGESTED PRE-TRIP ACTIVITIES

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Seed Need

(Adapted from Project WILD)

Objective:

To compare the many ways that plants disperse seeds.

Materials:

- ✔ *One old sock for each student*
- ✔ *A grassy field*
- ✔ *Different types of seeds*

Extension:

- ✔ *Bean seeds*
- ✔ *Odds and ends, like:*
  - *—Balloons*
  - *—Rubber bands*
  - *—Bottle caps*
  - *—Popsicle sticks*
  - *—Foil*
  - *—Glue*
  - *—Scissors, etc.*

▲ This is best done in late summer or autumn. Students can collect seeds on a walk near school, or bring them from home. A fun way to collect "hitchhiker" seeds is to walk through a field with an old fuzzy sock over your shoe. Look closely at all the seeds collected, and sort them according to way they are dispersed:

—Some "hitchhike" on animals and people.
—Some have wings and fly.
—Some are eaten by animals and deposited in other places (with fertilizer!).
—Some float on water.
—Some are shaped like parachutes and float in the wind.
—Some are even ejected by the plant itself.

▲ Discuss why seeds need to disperse (in order to avoid competition from the parent plant). Discuss the ways in which Sierra redwood seeds are released from the cones and dispersed (fire, chickarees, phymatodes beetle).

▲ ***Extension:***

Using bean seeds, have students design and engineer their seed so that it can hitchhike, float on water or in the air, or be ejected.

Sierra redwood seeds.

SUGGESTED PRE-TRIP ACTIVITIES

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Smokey the Bear Said *What?*

(Adapted from Project WILD)

Objective:

To identify positive and negative consequences of forest fires and describe some of the changes fire can make in a forest ecosystem.

Materials:

- ✔ *Chart for brainstorming*
- ✔ *Research materials*
- ✔ *Butcher paper and art supplies for a mural*

▲ Begin by discussing forest fire with the students. Be sure to point out that fire can both destroy and improve wildlife habitat. Very hot fires can destroy all life forms in an area and even burn off the soil. Smaller burns can have positive impacts such as:

Increasing soil productivity

Preparing soil for seed germination

Activating heat-dependent varieties of seed

Reducing insect populations

Providing a greater variety of food and shelter sources for wildlife

Increasing new growth of vegetation

▲ Brainstorm and record the possible positive and negative effects of forest fire.

▲ Using this list as a guide, have each student research a topic. Some topics could include:

Definitions of "prescription," "crown," and "ground" fires.

Federal and state agency policies towards forest fires.

Information about the number and types of fires typical in a specified area during 1 year.

Historical and present-day use of fire to improve wildlife habitat.

History of Smokey the Bear.

Plants that are fire-adapted (like Sierra redwood).

▲ Once the research is done, have the students create murals in groups showing the changes in a forest ecosystem from before to during and after a fire. Analyze and discuss the positive and negative consequences of forest fire.

▲ ***Extension activities:***

Research range fire also.

Visit and compare forested areas that have been burned recently with those that haven't been burned in many years.

Research the prescribed burning program at Calaveras Big Trees State Park and/or other sites.

Watch films of the Yellowstone Fires of 1988.

GUIDED IMAGERY: A TRIP INSIDE A TREE

(From activity on page 30.)

Directions: *Before reading the guided imagery to the students, direct them to put down all objects and sit in a comfortable and relaxed position with their eyes closed. Wait until the class has relaxed before beginning. Read slowly and steadily, allowing students enough time to create their own mental images. Once finished, ask the students to review all of the images they saw in their minds. After at least one minute, ask the students to open their eyes. Discuss their thoughts and impressions. Where did they go, and what was happening? You can use this time to reinforce the functions of different tree parts (see below). Bring closure to the imagery by having the students draw a picture of any of their mental images.*

What if, instead of going on a trip to the redwood forest, you could go on a trip inside the cells of a redwood tree? What do you think you would find there? The first thing you need to do is find a redwood tree. You are going outside the classroom now..... away from the school..... away from our town..... you travel until you find a huge redwood tree. You are now standing next to a very tall and very, very wide tree with soft, reddish-brown bark. Look up. Can you see the top? As you look up, you notice that everything around you seems to be getting bigger, and you seem to be getting smaller. Now you can't see the top of the tree at all. In fact, a nearby flower is taller than you. The ground seems to shake a little, and you notice a huge ant walking towards you. You can see its big hairy legs and vicious looking mouth as it steps right over you without even noticing you. You look up again and see a raindrop, which looks like a huge ball of water falling from the sky. The raindrop lands next to you. It makes a huge splash, and you find yourself sinking into the wet ground. You quickly grab onto a nearby water molecule, a shimmery, round, object.

Sssshhhhhlllluuuupppppp. Both of you are being sucked down into the ground and into a tiny dark tunnel along with thousands of other water molecules. They are like a sea of shiny, bouncy, spheres moving along together. You are pulled through the tunnel, which joins another tunnel, and then another. As this connecting system of passageways becomes more and more complicated, you wonder if you'll ever be able to find your way back. There are other kinds of molecules around you too... some are very large, and they are all different colors and shapes.

You now find yourself in a narrow tube that is taking you straight up. As you move slowly skyward, you look next to you and see another tube. It looks like the one that you're in, but it is full of a syrupy liquid, and is moving down, not up. On the other side of the tube is a dark, solid looking wall. Pretty soon, things start to move very slowly, and then stop completely. Nothing moves for a long time. It's getting cold. You begin to wonder if you'll be stuck inside this tree forever. After what seems like hours, you start slowly

moving up the tube again, and the syrupy liquid next to you starts moving down again. As you go higher and higher, you begin to hear loud knocking and chewing noises. You feel safe from whatever is knocking and chewing with the dark wall next to you.

All of a sudden, you begin moving sideways. Soon everything around you is a beautiful color of green, and you feel very warm. The green walls around you are made of cells that look like boxes stacked on top of each other. As you look closer, you notice some of the syrupy liquid coming out of the green cells. It is like a busy factory inside each cell. There are molecules inside the cells that grab other molecules and bring them into the cells. Those molecules are broken apart and combined with other molecules, which makes the syrupy liquid. You also notice that there are tiny holes in the floor, and every once in awhile, an oxygen or water molecule falls through a hole. You wander around, watching the molecules moving about. Without realizing it, you have stepped into one of the tiny holes. You begin to fall. You are outside the tree now, floating down, down, down... 250 feet down, past branches and leaves and a woodpecker and a beetle, and dark red bark... down all the way to the ground. How does it feel to be back on solid ground again? You look around and see that the flower, the ant, the tree, and you are all back to your normal sizes. You wave goodbye to the tree as you travel back to your town... back to your school... back to your classroom.... When you are ready, you may open your eyes.

Tree Parts in the story (in order of appearance):

Tunnels and passageways ..... root system

Tube going up ..... sapwood or xylem tissues transporting water and minerals

Tube with syrupy liquid ..... inner bark or phloem tissues transporting sugars

Dark wall ..... outer tree bark

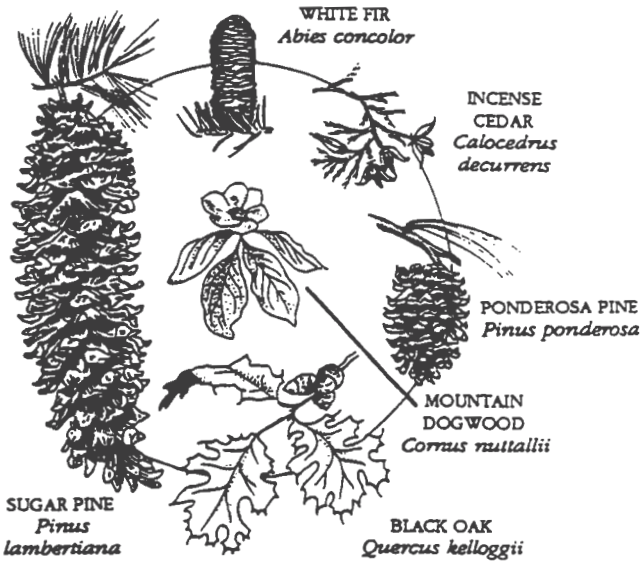
When you stop moving ..... night time

Knocking and chewing noises ..... woodpecker and beetles

Green, warm area ..... leaf in the sunshine

Factory ..... photosynthesis, which produces the sugars

Holes in floor ..... stomata in the leaf



Sierra mixed-conifer forest community.

4 The Forest Community

Sierra Mixed-Conifer Forest Community

People and other animals share the same basic needs: food, water, shelter, and space. All living things are part of communities that provide these basic requirements for survival. Human communities are usually called towns or cities, and consist of many interacting parts, both living and non-living. Natural communities consist of living things bound together by food chains. The interaction of the community members with the physical environment is described as an ecosystem. There are many types of communities throughout the world, each adapted to its own environment. They range from arctic tundra to tropical rainforest.

At Calaveras Big Trees, the main community present is called the Sierra mixed-conifer forest community. It is an interrelated group of plants and animals that occurs in a belt between about 2,000 and 7,000 feet elevation in the Sierra Nevada. The distribution of plant and animal communities in the Sierra is controlled by such factors as topography, slope, aspect, altitude, temperature, rainfall, and soil type. When you are hiking through the North Grove, you will notice that not all the trees in the grove are Sierra redwoods. Sierra redwoods do not grow in pure stands as do the coast redwoods, but exist as part of this community. Because of extremely favorable growing conditions here, and since much of the Sierra mixed-conifer forest has been logged elsewhere, the undisturbed ponderosa and sugar pines growing in the park are some of the largest in the world.

There are many types of plants and animals that are a vital part of the Sierra mixed-conifer forest community... too many to describe them all in this guide. Brief descriptions of some of the most

commonly seen and/or interesting members are provided in Section D, pages 99-110. Field guides and interpretive displays in the Visitor Center and at the trailhead will aid in identification of other species you may sight on your visit. The main tree species found in this community are illustrated on the previous page.

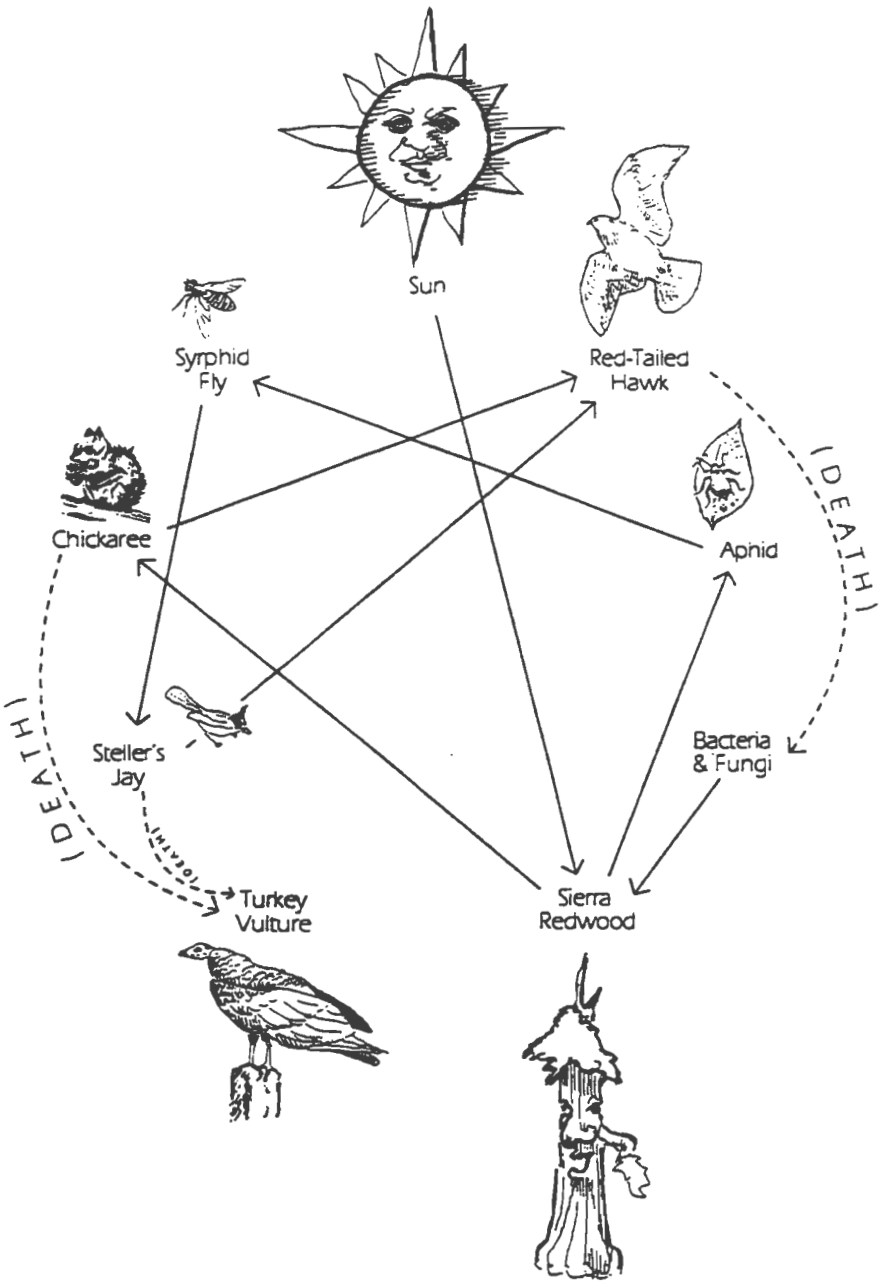
Food Chain and Food Web

Knowing the names of members of this forest community is important, yet seeing the connections between its members is more important to understanding the complexity of this forest habitat. A good way to approach this concept of interdependence and interrelationships is by teaching about food chains and food webs. Simply described, a food chain is a cycle of energy and nutrient transfer, powered by the ultimate energy source—the sun. This transfer of energy and nutrients begins with photosynthesis in green plants, and passes through a series of animals with repeated eating and being eaten. In the end, decomposers transfer the nutrients back to the soil, the energy is released as heat and fungus biomass, and the cycle begins again. A food web consists of many overlapping food chains. If any part of a food chain or web is damaged or removed, the whole community is affected.

The following is a brief description of the parts of a food chain:

- **The sun** provides the energy to power the process of photosynthesis in green plants.
- Green plants are called **producers** because they use solar energy combined with carbon dioxide, nutrients, and water to produce their own food in the form of sugars, proteins and other organic compounds.
- Animals are called **consumers** because they cannot make their own food, but must consume other plants or animals to acquire energy and the building materials for their bodies.
- **Herbivores** are animals that get their energy and nutrients by eating plants. *Herbi* means "plants" and *vore* means "eater."
- **Carnivores** are animals that get their energy and nutrients by eating other animals. *Carni* means "meat."
- **Omnivores** are animals that get their energy and nutrients by eating both plants and animals. *Omni* means "all."
- **Scavengers** are animals that feed on dead animals (that they haven't killed).
- **Decomposers** are organisms that break down dead plants and animals into various chemicals, which are then returned to the soil and used as nutrients by plants. They can be insects, bacteria, fungi, and protozoans.

When we try to isolate anything, we find it attached to everything else in the universe. —John Muir


Sun
Syrphid Fly
Red-Tailed Hawk
Chickaree
Aphid
Steller's Jay
Bacteria & Fungi
Turkey Vulture
Sierra Redwood
DEATH
DEATH
DEATH

A food web.

SUGGESTED PRE-TRIP ACTIVITIES

Habitat Lap Sit

(Project WILD)

Objective:

To identify the components of habitat; recognize how humans and other animals depend on habitat; interpret the significance of loss or change in habitat in terms of people and wildlife.

Materials:

✔ *Space large enough for all the students to stand in a circle*

▲ Discuss the definition of habitat: the arrangement of food, water, shelter, and space required for animals' survival. Divide the class into four groups, each representing a component of habitat:

Food
Water
Shelter
Space

▲ Form a large tight circle, adding four students at a time—one from each group. Have students all turn so that their left shoulder is in the center of the circle, and toes are touching heels. With their hands on the shoulders of the person in front of them, on cue, have them all sit on the lap of the person behind them while supporting the person in front of them. (This really works!)

? What could happen to the living things depending on this habitat if one component is removed:

By a drought?
Land being cleared?
Food poisoned?

? What living things depend on habitat? (*All.*)

Who Eats Who?

Objective:

To identify and dramatize the relationships in a food chain.

Materials:

✔ *Drawing materials*

The definition of a food chain is:

> *The transfer of energy from the source in plants through a series of animals, with repeated eating and being eaten.*
>
> —Project WILD

▲ As you describe the food chain, invite students up one at a time to act out the part you are describing.

▲ Start with the **sun** shining down on a green plant, which is making food in its leaves.

▲ The **producer** (grass) is eaten by an **herbivore** (mouse), which is then eaten by a **carnivore** (snake).

▲ When the snake dies, it is eaten by a **scavenger** (turkey vulture), and the nutrients are returned to the soil by **decomposers,** which will be used by green plants. Emphasize the transfer of energy and nutrients in this process.

▲ Have the students draw a food chain using plants and animals they may see at the park, that live in your area, or that includes themselves.

SUGGESTED PRE-TRIP ACTIVITIES

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Food Web Yarn Game

Objective:

To simulate a food web.

Materials:

✔ *Large ball of yarn*

Extension:

✔ *Old globe*

▲ A food web is made of interconnected food chains. (Students should be familiar with the food chain concept before doing this activity.)

▲ Students sit in a circle. You are the sun, and hold the ball of yarn. Ask students to name a living thing that makes its food using sunlight energy.

▲ Holding the end of the yarn, toss the ball to the student that answers correctly (any green plant). That student holds the string and tosses the ball of yarn to the student who can name something that would eat that plant.

▲ Continue until each student is holding a part of the "web," and all parts of the food web have been mentioned (see pages 38-39). You can include soil, water, and air, too. Notice how each member of the food web is connected to all other members by the string, or food chain.

▲ To demonstrate the importance of each member to the whole community, eliminate one member. That member drops his/her string. Anyone who felt their yarn go slack then drops theirs... and so on, until everyone in the web has felt the effect.

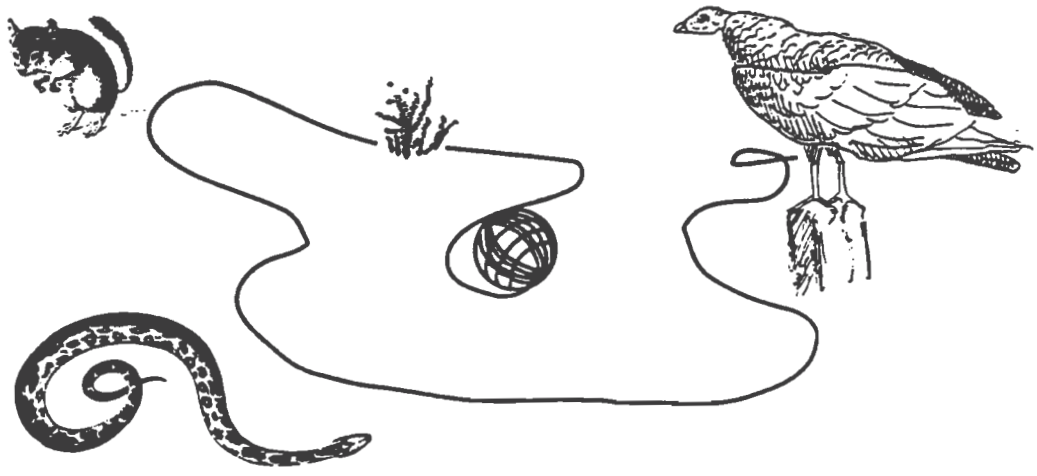
? How is this like a real food web? Because of these connections, we (humans) often have a larger impact on natural systems than we realize.

▲ Read the following passage to your students and ask them to explain what it means.

> ***Man did not weave the web of life; he is merely a strand in it. Whatever he does to the web, he does to himself.*** —Chief Seattle.

▲ ***Extension:***

Place an old globe in the center of the web, balanced on the yarn. When the strings fall the globe tips and eventually falls, dramatically illustrating the importance of healthy natural systems worldwide.



SUGGESTED PRE-TRIP ACTIVITIES

Creature Feature

Objective:

To identify, describe, and evaluate the adaptive traits of wildlife.

Materials:

- ✔ *Forest community descriptions from Section D, pages 99-110*
- ✔ *Drawing or sculpting materials*

▲ Animals all have adaptive traits (both physical and behavioral) that enable them to live successfully in a specific environment. Discuss the adaptations of wildlife found at the park. For example:

Hawks have clawed talons and curved beaks to grasp and kill prey.

Deer have large ears and camoflauge coloring to help evade predators.

Woodpeckers have thick bills used for making nest cavities and feeding on insects.

▲ Brainstorm or research the adaptations of other types of wildlife found at the park, and evaluate the advantages those bring to the animal.

▲ Students then create their own imaginary creature complete with adaptations that will help it survive in its habitat. Students need to include the animal's:

Habitat
Preferred food
Type of locomotion
Means of protection from predators
Name

▲ The creatures can be drawn or sculpted out of almost anything (litter works well). This can be done in groups, pairs, or individually, and may also be accompanied by a class presentation.

Make a Tree Finder

Objective:

To become familiar with the trees of the Sierra mixed-conifer forest community.

Materials:

- ✔ *Tree Finder master on pages 46-47*
- ✔ *Construction paper*
- ✔ *Scissors*
- ✔ *Brass paper fasteners*

▲ Discuss the characteristics to look for when trying to identify a tree:

Bark color and texture
Leaf shape, size, and texture
Type of seed-holder (cone, berry, etc.)
Silhouette

▲ Assemble the tree finders and review the characteristics of each type of tree found in the Sierra mixed-conifer forest community. Use the finders on your visit to the park.

SUGGESTED PRE-TRIP ACTIVITIES

▲▲▲▲▲▲▲▲▲▲▲

Leaf Sorting

Objective:

To observe, compare, and sort different types of leaves.

Materials:

✔ *Leaves*

Extension:

✔ *Crayons*
✔ *Paper*
✔ *Glue*

▲ If there aren't many types of trees at your school, ask the students to bring leaves from home. Sort the leaves by color, size, shape, texture, and/or vein pattern.

▲ Point out that leaves give us clues when we're trying to identify a tree.

▲ Extension:

Make rubbings of the leaves with the flat side of a crayon on a piece of paper, press and mount the leaves, or laminate onto white paper.

Record any observations they have made about each leaf.

The Leaf Hunt Relay from Project Learning Tree is a fun closure activity.

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Tree Keying

Objective:

To use a simple key to identify trees.

Materials:

✔ *A tree (or leaves from a tree)*
✔ *Bark sample*
✔ *Seed-holder (cone, berry, etc.)*
✔ *Simple tree key such as*
The Pacific Coast Tree Finder
published by Nature Study Guild (only includes native trees)

▲ You will need a copy of the tree key for each pair of students. Using the key involves making choices between two or more characteristics, and following the directions given. If you haven't done this before, try it yourself before trying it with your class.

▲ After practicing at school, you may want to bring the tree finders to the park to use. *The Pacific Coast Tree Finder* is pocket-sized, inexpensive, easy to use, and is sold at the park Visitor Center.

SUGGESTED PRE-TRIP ACTIVITIES

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Forest Community Diorama

Objective:

To create a visual display of the Sierra mixed-conifer forest community.

Materials:

- ✔ *Forest community descriptions from Section D, pages 99-110*
- ✔ *Manila folders*
- ✔ *Glue*
- ✔ *Scissors*
- ✔ *Tagboard*
- ✔ *Drawing materials*

▲ Discuss the concept of communities with your students. Introduce the descriptions of the plants and animals of the Sierra mixed-conifer forest community or have students research several on their own.

▲ Students can draw the plants and animals, or you can reproduce the illustrations from Section D for their use. Create a backdrop of forest trees, shrubs, and smaller plants on the manila folder.

▲ Stand the folder up with a strip of paper across the top for stability. Add the animals where they are most likely to be found in this forest:

A chickaree climbing a Sierra redwood

A flying squirrel gliding between trees

A pileated woodpecker chiseling apart a dead tree

A black bear lumbering through the woods

▲ The animals can be mounted on strips of tagboard so they can be moved about the forest.

▲ Ask your students to describe any possible interactions between the community members, or make up a story about their forest.

▲▲▲▲▲▲▲▲▲▲▲

California Plant Communities

Objective:

To identify different plant communities between your school and Calaveras Big Trees State Park.

Materials:

- ✔ *Descriptions of California plant communities*

  A good resource is California Plant Life *by Ornduff (U.C. Press)*

▲ If you are bringing students to the park from the Central Valley, you will pass through several different plant communities during your trip. These include:

Valley grassland
Valley and foothill woodland
Chaparral
Sierra mixed-conifer forest

▲ Discuss the concept of communities with your students using the information from pages 99-110. Discuss the factors that determine their locations, such as:

Elevation	Slope
Rainfall	Aspect
Soil type	Temperature
Topography	

▲ Have groups of students research each community you will see on your trip, and identify several plant and animal species that are typical of that community, as well as the factors that determine the community's location.

▲ During your trip, observe and discuss the change in communities between your school and the park.

SUGGESTED PRE-TRIP ACTIVITIES

Animal Riddles

(Sharing Nature With Children)

Objective:

To gather information about a park animal and organize it into a riddle.

Materials:

- ✔ *Forest community descriptions from Section D, pages 99-110*
- ✔ *Writing materials*

▲ Using the descriptions from Section D, or other resources you may have available, have students research an animal.

▲ After gathering the information, they write a riddle about their animal and try to stump the class. The riddle can be a rhyme, or it can be a series of clues that starts with general statements, and ends with more specific clues. For example:

My sight is poor, but I can hear and smell very well.

My tail is 6 inches long or less.

I live mostly on forest floors and in thickets.

Young and old of my kind are good climbers and if disturbed, find safety in a tree.

My diet includes the following:

Small mammals	Grass
Insects	Leaves
Any flesh	Fruit
Garbage	Nuts

When it starts to get cold and snow, I go inside for the winter.

I'm dark colored and sometimes weigh as much as 500 pounds.

▲ There are some excellent riddles in Sharing Nature With Children that you may wish to share with your students. Can you guess the answer to this one? ...Black bear.

More Activities

There are many more exciting activities for teaching concepts related to the forest community in Project Wild and Sharing Nature With Children. The following is a list of additional, related activities from these sources:

Project Wild:

What Bear Goes Where?
Owl Pellets
The Beautiful Basics
Habitracks
Habitat Rummy
Oh Deer!
Deadly Links
Shrinking Habitat
What Did Your Lunch Cost Wildlife?
Bearly Born
How Many Bears Can Live In This Forest?

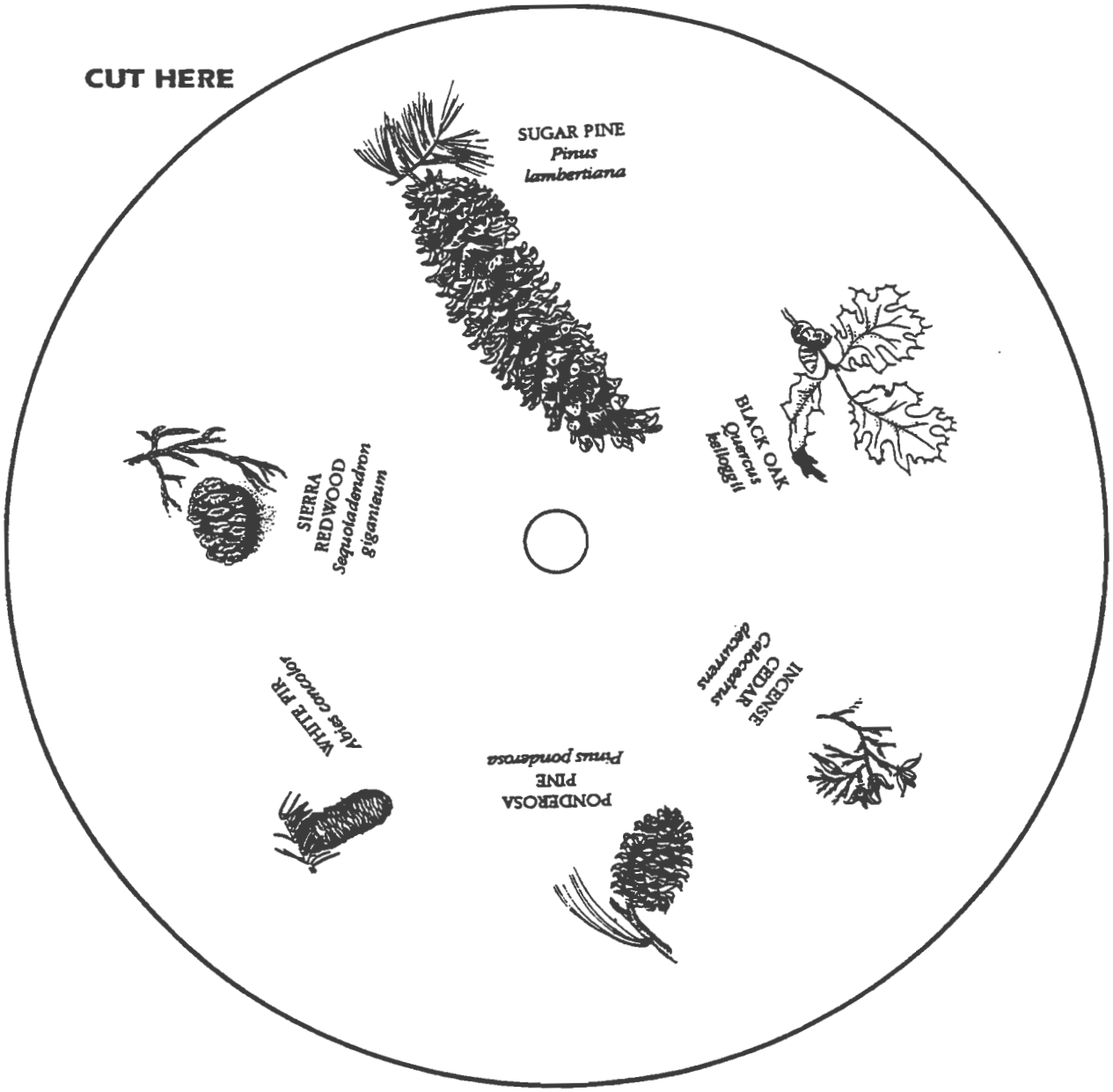
Sharing Nature With Children:

Predator Prey
Bat and Moth
Pyramid of Life
Recipe For A Forest
Animal Parts

TREE FINDER (PART 1)

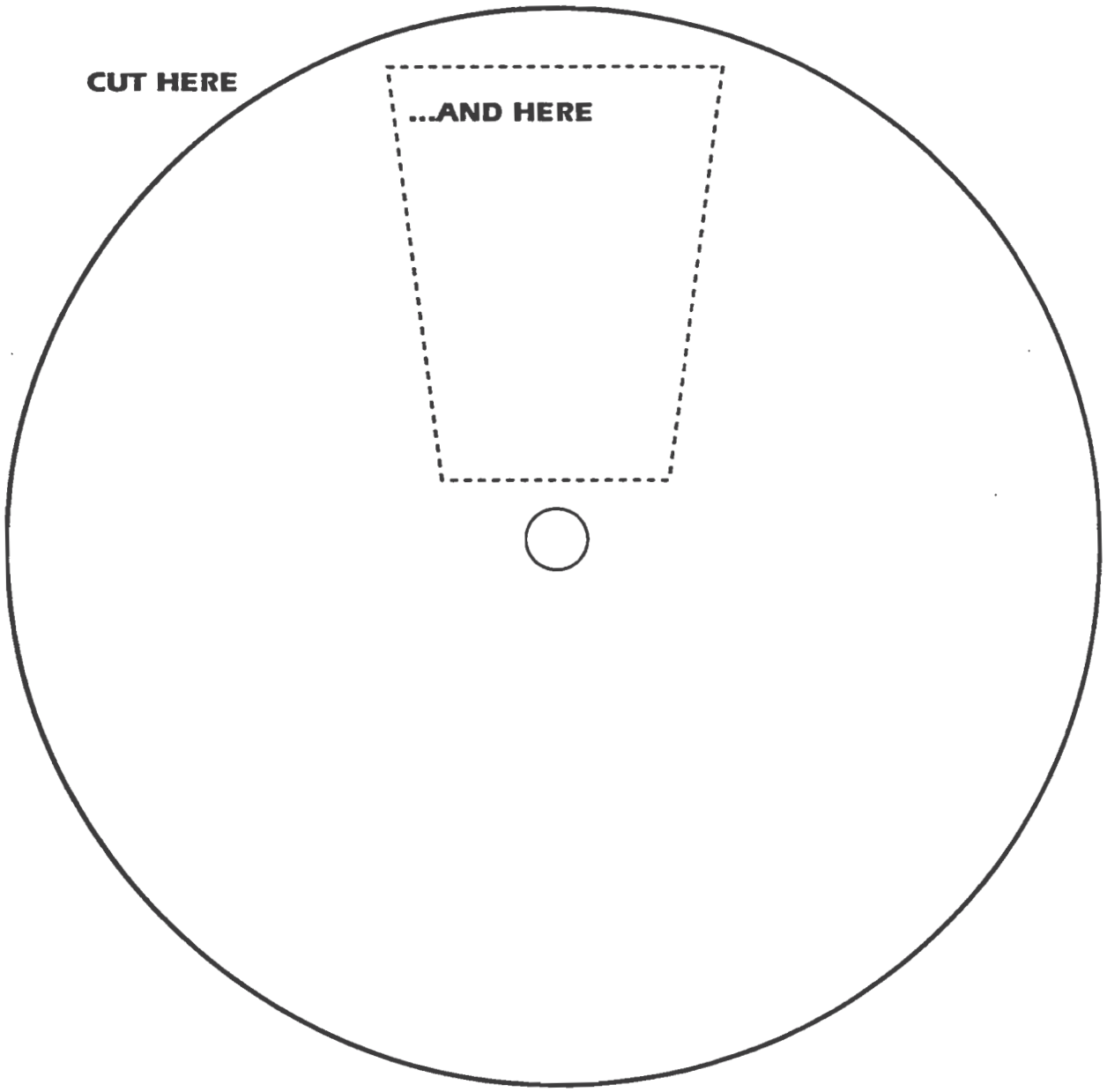
Directions:

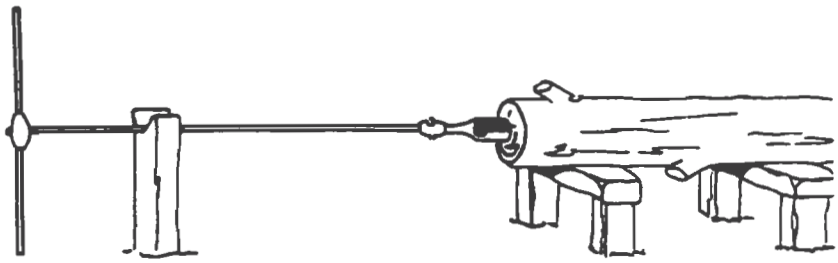
Cut along the outer edges of Parts 1 and 2 so that you have two circles. Cut along the dotted line in Part 2. Place Part 2 on top of Part 1 and attach at the center dot with a brass paper fastener. Now you can turn the top to view the illustrations of the trees. For sturdier Tree Finders, glue both parts onto tagboard or laminate. Bring your Tree Finder to the park and see how many trees you can identify!



See activity on page 42.

TREE FINDER (PART 2)





Type of pump auger used during the Gold Rush to bore out wooden pipes for transportation of water to miners and ranchers.
Courtesy Calaveras Big Trees State Park

5 Human History of the Sierra Redwoods at Calaveras

He had been chasing the wounded grizzly bear for miles. As he stumbled from the meadow into the forest, he was stopped in his tracks by the most incredible thing he had ever seen... a tree so big, he almost couldn't believe his eyes. It was at least 3 times larger than any tree he had ever seen before, with enormous branches, and reddish-colored bark. The year was 1852. The place was the North Grove at Calaveras Big Trees. A backwoods hunter named Augustus T. Dowd had just "discovered" the world's largest living objects.

Miwok Indians' Use of the Area

While Dowd has been credited with the discovery that brought these trees world-wide attention and recognition, other people had seen them before. The Miwok Indians, who had been living in this area for thousands of years, knew of their existence. These people lived most of the year in permanent villages in the Sierra Nevada foothills. During the sweltering summer heat, they would follow game animals to the cool higher elevations, where they would hunt, fish, and gather food. One of these summer sites is near the North Grove, as shown by granite rocks with deep holes where acorns were once ground into flour. The Miwoks viewed the ancient Sierra redwoods as they did the world as a whole: with reverence and respect.

The rings of the Stump were counted, and this tree was found to be 1,244 years old, which is young for such a large redwood. Its ⅛-inch thick growth rings showed that it had been growing rapidly. It is believed that if this tree had continued growing, it would by now be the largest living object on the planet. There were many people who protested the destruction of this tree (including Dowd) and began pressing for protection of the Sierra redwoods. As more groves were discovered, the conflict between logging, destructive speculators and those in favor of preserving the trees became fierce. About 35% of the Sierra redwood acreage was logged from the late 1880s through the 1950s. Most of the lumber ended up being used for shakes, fence posts, and shingles, since the wood of the massive trees usually shattered upon impact with the ground. It is only because of the tremendous efforts of conservationists like John Muir that 92% of the Sierra redwood groves are now under public protection.

...The Vandals Then Danced Upon The Stump!

—John Muir

Thomas Ayres' sketch of thirty-two persons dancing on the stump of the mammoth tree.

Courtesy Calaveras Big Trees State Park

A.T. Dowd's Discovery

Several Euro-American explorers had seen the Sierra redwoods earlier than Dowd. One of the earliest was Zenas Leonard of the Walker Party, which made the first east-west crossing of the Sierra Nevada in 1839. Leonard's journal mentions seeing very large reddish trees on that trip. John Bidwell (1841), William B. Prince (1849), and J.M. Wooster (1850) also claimed to have seen the trees before Dowd. But due to the preoccupation with gold rush fever and the struggle to survive in the California wilderness, the existence of the Sierra redwoods went largely unnoticed until Dowd's "discovery" in 1852.

Dowd worked for the Union Water Company, which supplied water to gold mining operations near Murphy's Camp. His job was to hunt wild game to feed the company employees. Known for his tall tales, Dowd had a hard time convincing his friends that his "big tree" story was true. Finally, a group of men agreed to be led to the spot where he had seen the unbelievable trees. Scepticism changed to awe when they reached the immense conifers.

It wasn't long before word spread of the giant trees, bringing attention from throughout the state, and then the world. Several newspapers sent reporters to the grove although published accounts of the trees often met with scepticism. The first few visitors also began to travel the rough trail to see the giants for themselves. This marked the beginning of Calaveras' use as a recreation area, which has continued uninterrupted to this day.

History of the Big Stump

The tree that Dowd first saw was the largest one in the grove. Called "THE" Tree, or "The Discovery Tree," it stood over 300 feet tall and measured well over 24 feet in diameter. In the spring of 1853, Captain William H. Hanford, President of Union Water Company, formulated a plan to make his fortune from this tree. His crew of four men immediately began stripping the 2-foot thick bark from the tree in 7-foot sections up to a height of 50 feet. Fifty cords of bark were stripped in 21 days. The bark was shipped to San Francisco, where it was assembled into the original form of the tree and put on display. The bark exhibit was sent to New York in 1854, but was a failure due to competition with P.T. Barnum's Crystal Palace. Hanford had just repacked the bark for shipment to Paris when it was destroyed by fire.

After stripping the bark, Hanford's crew began the task of felling the huge tree. Since there was no saw large enough for the job, long-handled pump augers, long-handled chisels, and wedges were used. After 22 days of work, holes had been bored into all sides of the tree, but the symmetrical tree did not fall. One story claims that the tree was blown down by a gentle breeze as workers ate lunch on June 27, 1853. The top of the stump was planed smooth, and it served many uses over the years. Many buildings were built nearby as the number of visitors increased.

TIMELINE OF EVENTS IN THE CALAVERAS NORTH GROVE

YEAR	EVENT
1852	The North Grove was discovered by Augustus T. Dowd.
1853	"THE Tree" was felled by William Hanford's Crew.
1853 on	The Stump was used for dances, theatre performances, concerts, lectures, church services, weddings, and close order drills by Civil War volunteers.
1854	The Bark was stripped from the Mother of the Forest to a height of 116 feet. It was exhibited in New York's Crystal Palace, then in London's Crystal Palace from 1855 until 1866.
1854	The Laphams, owners of the grove, built a small hotel 20 feet from the stump. A covered walkway led to the stump, where meals were often served.
1854	A saloon and 81-foot-long, two-lane bowling alley were erected on the log of the fallen tree. They were crushed by snow in the winter of 1862-1863.
1858	For 2 months the Big Tree Bulletin and Murphy's Advertiser were printed on a press atop the stump.
1858	A telegraph line was built from Angels Camp to the Big Stump.
1860	James Sperry and John Perry bought the Big Trees property.
1861	The Mammoth Grove Hotel was built near the present main parking lot. It was destroyed by fire in 1943.
1861	A "fancy" wooden pavilion was built on the stump. It stood until 1934, when it was crushed by snow.
1861	The first school house above Murphys was built at an unknown location in the North Grove area. It was used only in the summer, and was moved to Dorrington in the early 1900s.
1870s	The Pioneer Cabin Tree was hollowed out to keep pace with the smaller, but well-advertised Wawona Tunnel Tree on the road to Yosemite.
1880s	150 people crowded into the pavilion built on the stump.
1880s-1900s	The numbers of visitors at Calaveras decreased as Yosemite and the redwood groves there became a popular tourist destination.
1900	Big Trees property sold to Robert P. Whiteside, a lumberman. Although he had made a gentleman's agreement not to log the redwoods, the sale inspired a great public outcry and pressure to place the land under public protection.
1908	A fire burned the upper part of the North Grove, blackening the de-barked Mother Of The Forest.
1931	After 31 years of individual and group fund raising and legislative proposals, numerous pitfalls were overcome and the North Grove became part of the new Calaveras Big Trees State Park.
1954	After years of heroic private fund raising efforts and complex negotiations, the South Grove of Sierra redwoods was purchased from the Pickering Lumber Company for $2.8 million and added to Calaveras Big Trees State Park.

SUGGESTED PRE-TRIP ACTIVITIES

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Big Trees Discovered!

A Play

Objective:

To dramatize the discovery of the Sierra redwoods at the Calaveras North Grove.

Materials:

- ✔ *Play script from pages 60-61*
- ✔ *Props indicated in script*

▲ Using either the play script on pages 60-61 or one written by the students, act out the discovery of the Sierra redwoods by A.T. Dowd.

▲ Afterwards discuss what Dowd must have been thinking and feeling when he discovered the trees and while he was trying to convince people he was telling the truth.

▲ Try re-enacting the discovery while at the park.

▲ ***Extension:***

Students research a segment of the park's history, write a play or reader's theatre, and re-enact it for the class. The book *The Enduring Giants* is an excellent reference for park history and is sold at the Visitor Center.

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A Letter from the Past

Objective:

To hypothesize about travel in early California.

Materials:

- ✔ *Writing materials*
- ✔ *Original Mammoth Grove Hotel stationery from page 57*

▲ Discuss the early history of the park with the students, especially concerning events in the North Grove, and buildings in that area.

▲ Tell the students to imagine that they are going to take a trip to the Calaveras North Grove back in 1860. They will travel by horse-drawn carriage over long, dusty, bumpy roads for 2 days, and then stay in the Mammoth Grove Hotel in the heart of the North Grove area. They will dine and dance on the stump, bowl in the bowling alley, and tour the newly discovered North Grove.

- ? What was it like?
- ? Did they run into any gold miners?
- ? Did they see any wild animals?
- ? Was it worth the long trip?

▲ Have the students write a letter home from the North Grove describing their experiences on a copy of the original hotel stationery on page 57.

SUGGESTED PRE-TRIP ACTIVITIES

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Big Trees Public Broadcasting

Objective:

To become familiar with the sequence of events in park history by making a "TV" show.

Materials:

- ✔ *Timeline from page 52*
- ✔ *Butcher paper*
- ✔ *Box or paper plate*
- ✔ *Drawing materials*

Extension:

- ✔ *Portable video camera*

▲ Using the information from the timeline, students create a TV show that illustrates the sequence of events in the history of the North Grove. Students choose 10 or so events and illustrate in the correct sequence on a strip of butcher paper.

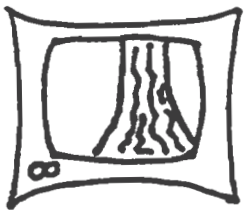
▲ The strip of paper is then drawn through a hole cut in a cardboard box to make it look like a television. This can be done with a shoe box, or even a paper plate with two slits cut in it to make a television frame.

▲ Students can then "turn on" their program for the class or a group of students.

▲ Extension:

If your school has a portable video camera, the students can do an historical documentary while at the park.

After researching a person or event, they can be videotaped while being "interviewed" during your visit to the North Grove.



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Calaveras Big Trees History Timeline

Objective:

To create a visual display of the history of the North Grove area.

Materials:

- ✔ *Timeline from page 52*
- ✔ *Newsprint*
- ✔ *Drawing materials*

▲ Make a large timeline out of newsprint, and place on a wall or bulletin board. You can begin with the Miwoks, or the discovery of the North Grove in 1852, and end with the State's acquisition in 1931, or the present.

▲ Assign one historical event to each student. Students illustrate that event, and place it on the appropriate spot on the timeline.

SUGGESTED PRE-TRIP ACTIVITIES

Big Trees Advertiser

Objective:

To illustrate an aspect of the park's history in an advertisement.

Materials:

✔ *Drawing materials*

▲ After discussing the history of the North Grove, ask students to create a poster for the year 1860 advertising an aspect that is interesting to them. This could be a poster advertising the tourist attractions of the grove, the qualities of the trees themselves, or to protest destruction of the Sierra redwoods.

▲ Some early posters and handbills are shown in *The Enduring Giants*.

CALIFORNIA LADIES WHO ARE NOW AT THE NATIONAL CAPITAL BENDING ALL THEIR ENERGIES FOR THE PRESERVATION OF THE SEQUOIAS.

SUGGESTED PRE-TRIP ACTIVITIES

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Big Trees Town Hall Meeting

Objective:

To experience different viewpoints regarding the Big Trees, and a method of public decision making.

Materials:

✔ *Activity cards from pages 58-59*
✔ *Writing materials*

▲ Almost as soon as the Sierra redwoods were discovered, the controversy began between those who wanted to preserve and protect the trees, and those who wanted to log or otherwise exploit them for financial gain. Assign each group of students the identity of one of these groups:

Logger
Preservationist
Speculator
Tourist

▲ Emphasize that they will be taking on an identity that may not match their own true opinion... it's sort of like acting.

▲ After researching their identity, students need to come up with a statement of their group's position regarding this controversy, and at least three supporting arguments. You can be the mayor, who facilitates the town meeting.

▲ Each group's spokesperson presents his or her statement and supporting arguments. You can then open the meeting for questions.

▲ Have a vote at the end to decide what will happen to the trees: Will they be preserved, or open for any type of use?

▲ Afterwards, you can discuss the actual process people went through to provide State Park protection for the trees (discussed in detail in ***The Enduring Giants***).

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Outdoor Manners Coloring Book

(Project Learning Tree)

Objective:

To become familiar with appropriate behavior in a protected natural environment by making a coloring book.

Materials:

✔ *Chart for list*
✔ *Drawing materials*

▲ Discuss the role of the State Park, which is to protect park visitors and the resources of the park. All park rules are designed with these two things in mind.

▲ Brainstorm a list of guidelines for appropriate behavior in a State Park or other protected natural area. Each student chooses one statement, draws a picture to illustrate it, then writes the statement at the bottom of the page.

▲ They can be reproduced, collated, and stapled so that each student has a coloring book, or bound into one class book that can be read together.

▲ The basic message to convey is to act with respect towards all parts of the ecosystem, both living and non-living. Some specific things to keep in mind:

Stay on the marked trail and behind the fences to protect the root systems of the Sierra redwoods.
Pick up litter.
Leave all natural objects where they are found.

▲ ***Extension:***

Students role play each statement before the trip.