SUGGESTED PRE-TRIP ACTIVITIES

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Sierra Redwood and Coast Redwood Comparisons

Objective:

To compare and become familiar with the characteristics of California's two redwood species.

Materials:

- ✔ *Table from page 10*
- ✔ *Chart paper*
- ✔ *Drawing or painting implements*
- ✔ *Map of California*

▲ Read the table on page 10 and discuss with students.

▲ Have each student draw both types of trees using information from the chart, or have students in groups make large murals of the two trees.

▲ Identify their locations on a map of California.

▲ Discuss observations of any students who have visited a redwood grove.

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How Old Is a Big Tree?

Objective:

To relate the age of the oldest Sierra redwood with historical events.

Materials:

- ✔ *Chart paper or string marker*
- ✔ *Dates of historical events*
- ✔ *Writing materials*

▲ Make a large timeline extending from 3,200 years ago to the present out of chart paper or string.

▲ Draw a seedling at the beginning, and a mature Sierra redwood at the present.

▲ Add dates, descriptions, and drawings of historical events to the timeline:

Columbus' arrival in the New World	1492
Declaration of Independence	1776
Birth of Christ	0
Native California Indians living in California	10,000 years ago until the present
Sierra redwoods discovered	1852
Birthdate of a student in your class, etc....	

▲ Keep the chart up and add dates as they come up.

▲ Discuss the characteristics that allow individual trees to live so long.

▲ ***Extension:***

Write a story from the perspective of a 3,200-year-old tree.

SUGGESTED PRE-TRIP ACTIVITIES

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Tree Cookies

(Project Learning Tree)

Objective:

To perceive time from the perspective of tree growth.

Materials:

- ✔ *Cross-section of a tree that shows growth rings*
- ✔ *Map pins*
- ✔ *Yarn*
- ✔ *Tags*

For extension:

- ✔ *Cross-sections of tree limbs*
- ✔ *Crayons*
- ✔ *Paper*

▲ Tree trimming companies are a good source of tree limbs.

▲ Examine the annual growth rings on a cross-section of a tree, or "tree cookie," with the students. Each pair of dark and light rings equals one year's growth. The light wood is the spring and summer growth, and the dark wood is the fall and winter growth.

▲ Look at the differences in ring size. Discuss possible reasons for these differences, such as:

Drought	Competition with other trees
Fire	Soil condition
Tree damage	

—Are there any burn scars?

▲ Using map pins, mark the annual rings and connect with string to a bulletin board indicating events during that year in the tree's life. How large and old was the tree when:

? Your school was built?
? The students were born?
? The last president was elected?

▲ ***Extension:***

Do this activity with sections of tree limbs so that each student can count the rings on his or her "cookie." Is your tree limb older or younger than you? Students can also make a rubbing of the cut surface that will show the rings with the flat side of a crayon on paper.

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Sierra Redwood Stand

Objective:

To dramatize the structural strength of a Sierra redwood.

Materials:

- ✔ *Clay for extension activity*

▲ Have students stand with their feet close together, and then with their feet a foot or so apart. Which way feels more stable? (You can have students carefully try to push each other over). Which is more like the wide base of a Sierra redwood?

▲ Tell the students to imagine that their toes are growing down into the ground and out away from the tree like redwood roots. What will happen if your roots are weakened by fungus, erosion, a fire scar, or a saw?

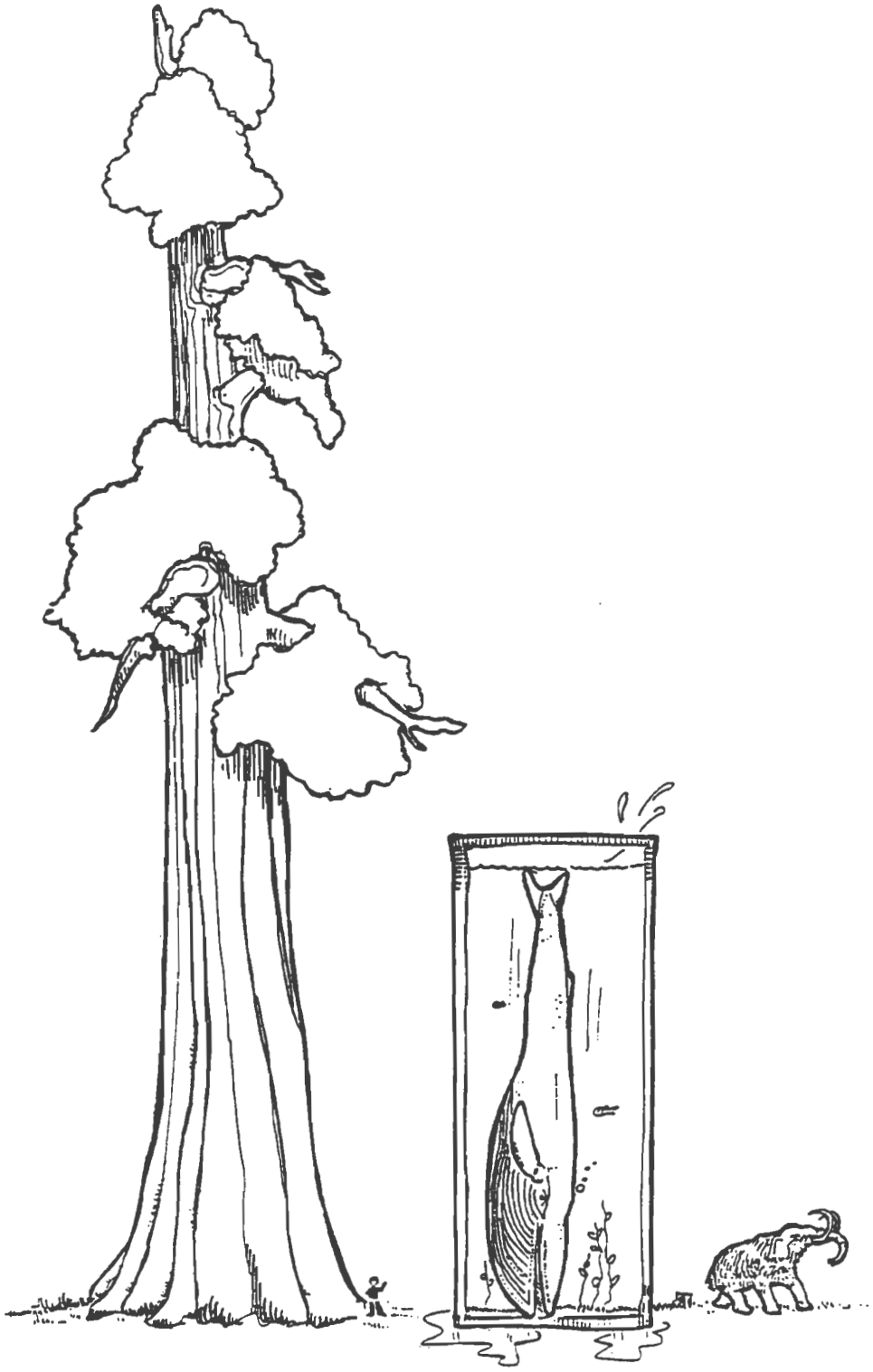
▲ Describe buttressing (page 11). Ask the students to dramatize buttressing.

▲ ***Extension:***

Use clay to make models showing the structural strength of a Sierra redwood.

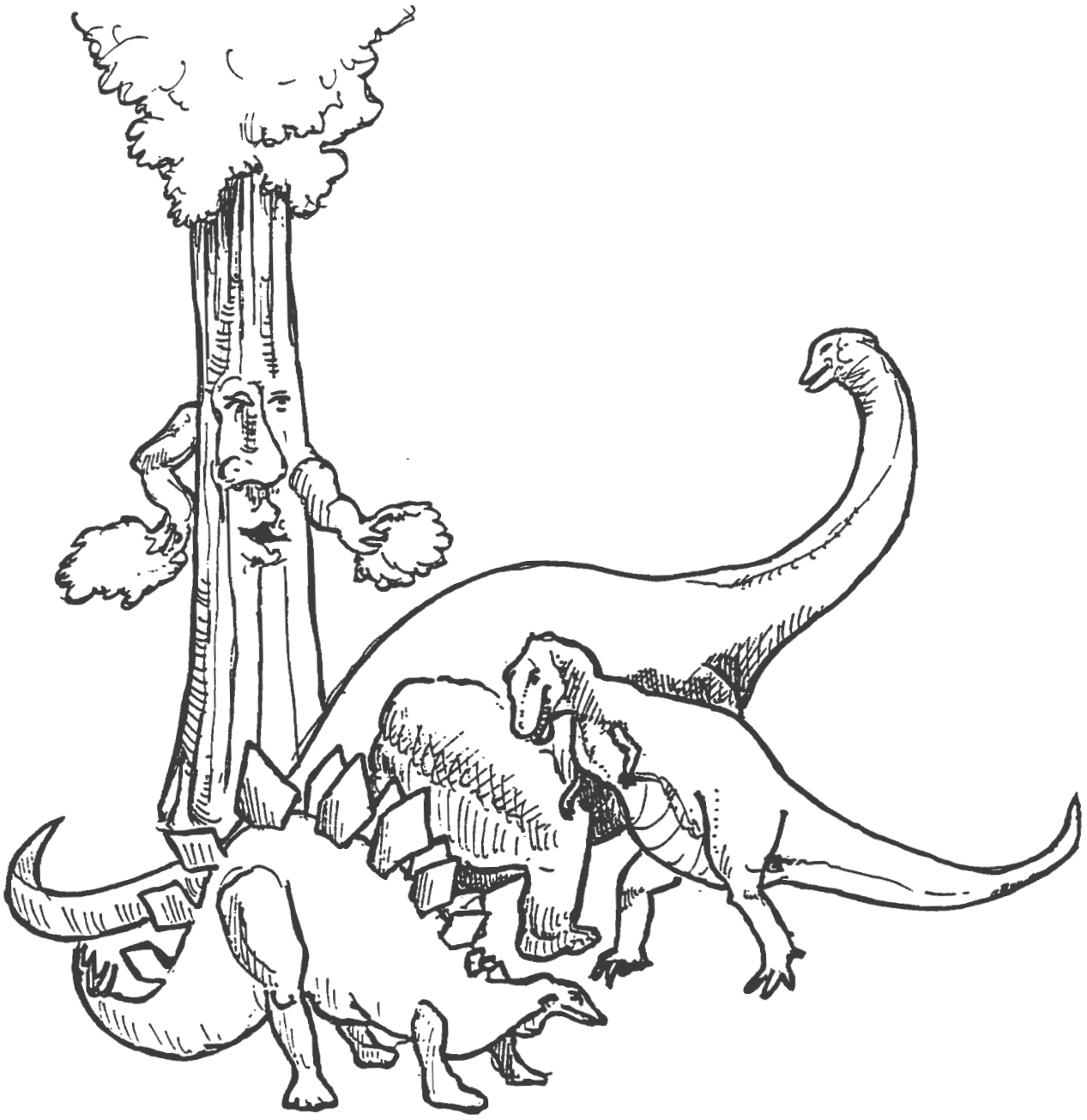
Hi! My name is Sierra redwood, but you can call me "Big Red." When you get to know me, you'll see that I have very thick bark, egg-shaped cones, tiny seeds, small needles, and shallow roots.

See activity on page 12.



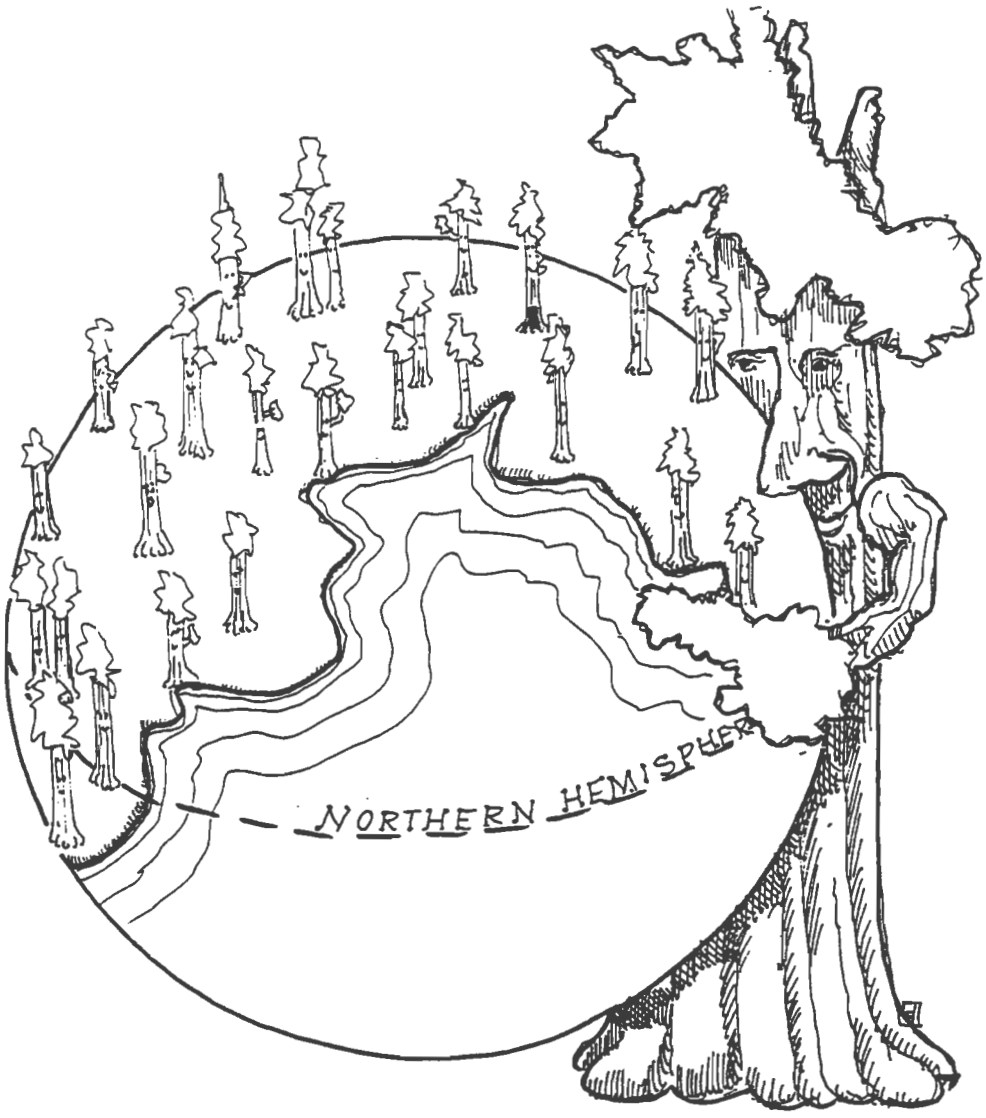
I am the largest being that has ever lived on the earth!

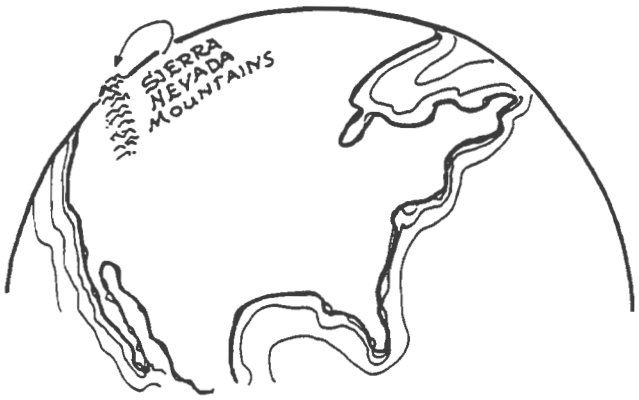
See activity on page 12.



Some of my relatives lived millions of years ago when dinosaurs were still alive.

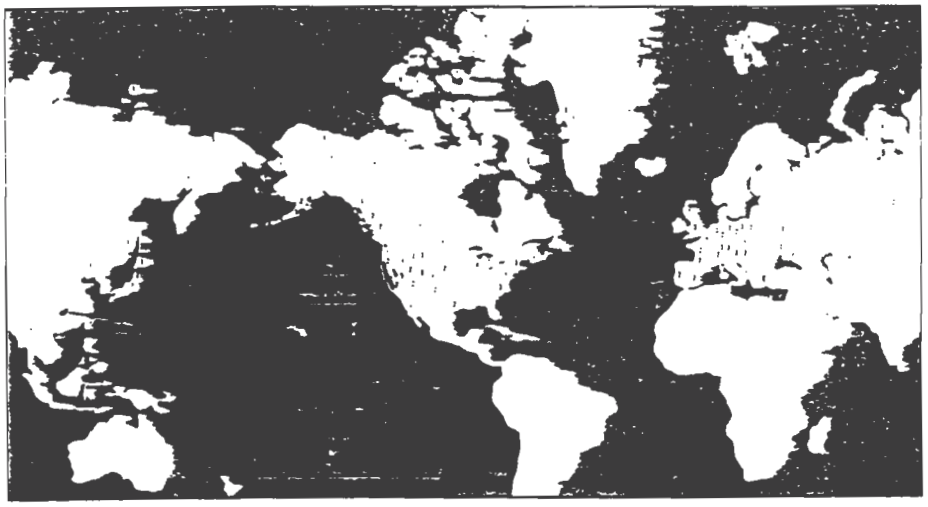
See activity on page 12.





My relatives used to live all across the northern hemisphere of the Earth. Now the only place you can find me is in the mountains of the Sierra Nevada in California. Come visit sometime! When you see me say, "Hi, Big Red!"

See activity on page 12.



2 Distribution and Geologic History

Try to imagine this scene... You are hiking through a peaceful grove of giant trees. Their shadows are making light and dark patterns on the path before you. Towering ferns look small compared to the mammoth trees. It is difficult to breathe because of the steamy, muggy air. You hear only the chorus of insects and sounds of a trickling stream. Suddenly, the quiet is shattered by a sound so loud it shakes the earth..... BOOM..... BOOM..... BOOM..... BOOM.....! You run and hide behind the trunk of a huge tree just in time to see an enormous animal with scaly green skin emerge from the forest. Its giant footsteps land where you had just been walking, leaving foot-deep imprints in the soil. The monster swings his head down low to rip the fronds off of a few ferns. He chews them noisily as he lumbers back into the forest and disappears from view. Your mind is racing as you lean back against your tree, and begin breathing once again. You think to yourself... Giant trees? Giant lizards? Can this be real?

This is obviously not a scene we would expect to see today; however, if people had been on the earth about 100 million years ago, they probably would have found a scene similar to the description above.

Past Distribution and Geologic History

The ancestors of our present day redwoods first appeared on the earth 175 million years ago. They reached their peak during the Cretaceous Period, from 65 to 135 million years ago, when they dominated the coniferous forest stretching across the Northern Hemisphere. Some of their fossils have even been found north of

the Arctic Circle. The earth's climate was much warmer and moister during the time of giant dinosaurs.

About 65 million years ago, as the earth's climate began cooling and drying, the ancestral redwoods and their associated forest community began a long, slow march south. Decendents of that community are still found growing with redwoods today: white fir, dogwood, white alder, and big leaf maple. In fact, many other forest communities were moving south during this time. The subtropical forest of mahogany, fig, palm, and avocado once present in ancient North America is now found in Central and South America.

Redwoods crossed westward over the young Sierra Nevada several million years ago when it was still only a range of low hills. Over the past 14 million years, periods of mountain building, glaciation, and climatic change have further restricted these trees to their present locations. The right combination of soil type, elevation, slope orientation, and water availability has enabled the present groves to survive in their locations for thousands—perhaps millions—of years.

Present Distribution

Today's geographic locations of the Sierra redwood and coast redwood give us some clues as to the past climate of the earth.

- ▲ Sierra redwoods grow naturally only on the western slope of the Sierra Nevada between 4,000 and 8,000 feet elevation. There are about 75 groves within this 250-mile range. These trees are always found near a constant supply of water where summers aren't too hot and winters aren't too severe.
- ▲ Coast redwoods occur naturally only in the coastal fog belt in a strip 500 miles long and up to 30 miles wide from the Santa Lucia Mountains to the southwestern tip of Oregon. They thrive on moderate temperatures, high winter rainfall, and summer fog—which can provide the equivalent of 20 inches of precipitation each year.

SUGGESTED PRE-TRIP ACTIVITIES

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Redwood Trees: Locations Past and Present

Objective:

To illustrate how the changing climate of the earth has affected redwood distribution.

Materials:

- ✔ *Map of North America or globe*
- ✔ *Map of California*
- ✔ *Information on pages 21-22*

▲ Using a globe, find the location of your school or town.

▲ Looking at the Northern Hemisphere, discuss the names of the countries there and the present climate. Show that redwoods once grew all across the Northern Hemisphere, even north of the Arctic Circle. Could a redwood tree live there today?

▲ Discuss the Earth's past climate and how it provided the right conditions for the ancestors of our present day redwoods.

▲ Discuss how the climate changed, leading to the present-day distribution of Sierra and coast redwoods. Find their present locations on the globe, and then on a map of California. Discuss the climate in the Sierra Nevada and coastal mountains, where redwoods now live.

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What Was It Like Way Back Then?

Objective:

To discuss the ways that climate, plants and animals have changed in North America over the past 150 million years.

Materials:

- ✔ *Drawing materials or clay*

▲ Read the first paragraph of Chapter 2 to the class (can be done as a guided imagery).

▲ Using the information on pages 21-22, discuss the changing climate of the earth, and the characteristics of the ancient redwood forest and ancient North America.

▲ Have the students draw pictures or make clay models of their image of ancient North America or the ancient redwood forest.

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.

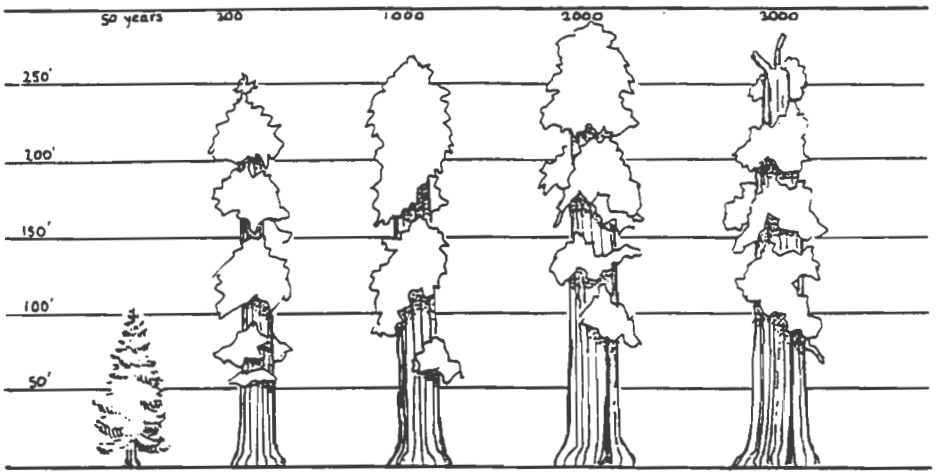
Right: Sierra Redwood cones and seeds.

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:

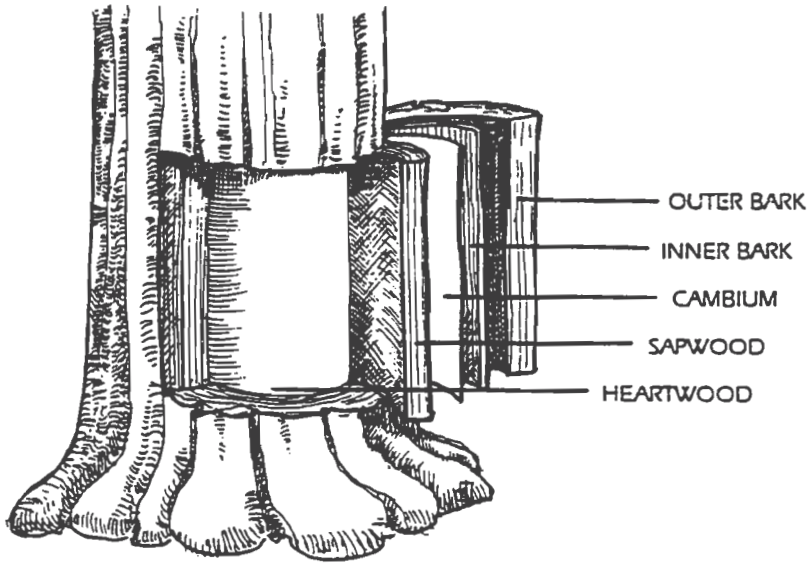
Heartwood: Provides stability, but is dead
Sapwood: Transports water from the roots throughout the tree
Cambium: The layer of cells that differentiates to become sapwood and inner bark
Inner bark: Transports food made in the leaves throughout the tree
Outer bark: Protects the tree from insects, fire,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

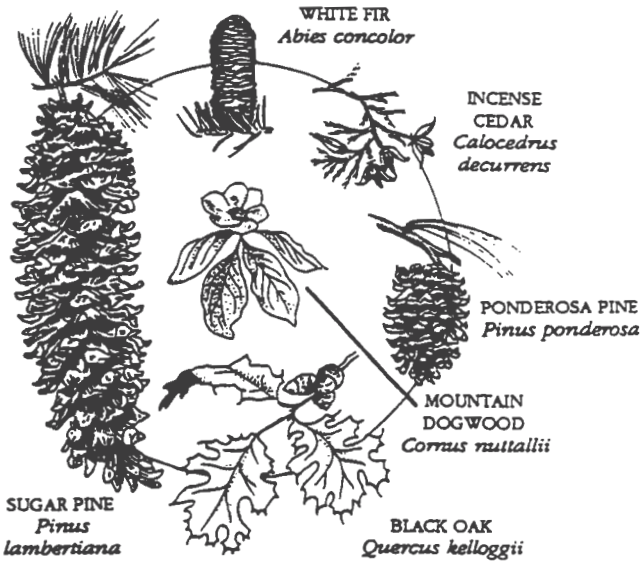
When you stop moving ..... night time

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.

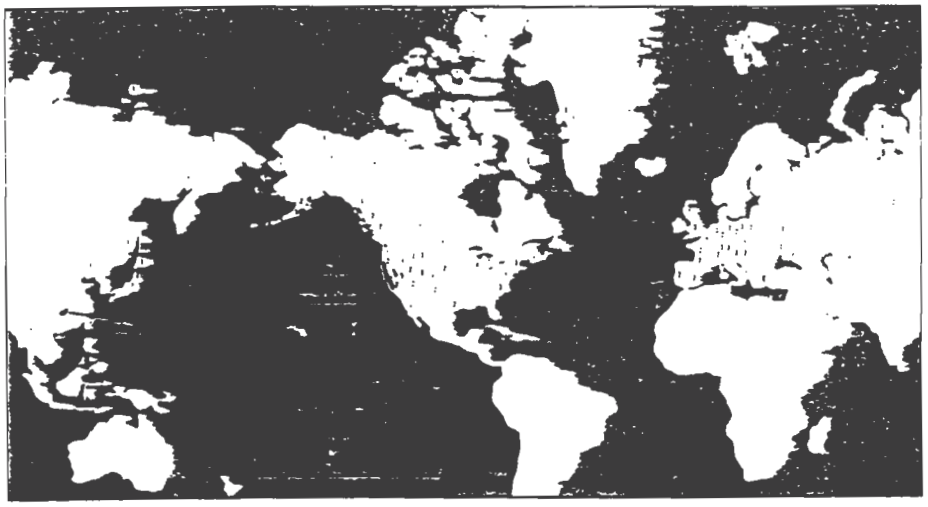
Food Chain and Food Web

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



2 Distribution and Geologic History

Try to imagine this scene... You are hiking through a peaceful grove of giant trees. Their shadows are making light and dark patterns on the path before you. Towering ferns look small compared to the mammoth trees. It is difficult to breathe because of the steamy, muggy air. You hear only the chorus of insects and sounds of a trickling stream. Suddenly, the quiet is shattered by a sound so loud it shakes the earth..... BOOM..... BOOM..... BOOM..... BOOM.....! You run and hide behind the trunk of a huge tree just in time to see an enormous animal with scaly green skin emerge from the forest. Its giant footsteps land where you had just been walking, leaving foot-deep imprints in the soil. The monster swings his head down low to rip the fronds off of a few ferns. He chews them noisily as he lumbers back into the forest and disappears from view. Your mind is racing as you lean back against your tree, and begin breathing once again. You think to yourself... Giant trees? Giant lizards? Can this be real?

This is obviously not a scene we would expect to see today; however, if people had been on the earth about 100 million years ago, they probably would have found a scene similar to the description above.

Past Distribution and Geologic History

The ancestors of our present day redwoods first appeared on the earth 175 million years ago. They reached their peak during the Cretaceous Period, from 65 to 135 million years ago, when they dominated the coniferous forest stretching across the Northern Hemisphere. Some of their fossils have even been found north of

the Arctic Circle. The earth's climate was much warmer and moister during the time of giant dinosaurs.

About 65 million years ago, as the earth's climate began cooling and drying, the ancestral redwoods and their associated forest community began a long, slow march south. Decendents of that community are still found growing with redwoods today: white fir, dogwood, white alder, and big leaf maple. In fact, many other forest communities were moving south during this time. The subtropical forest of mahogany, fig, palm, and avocado once present in ancient North America is now found in Central and South America.

Redwoods crossed westward over the young Sierra Nevada several million years ago when it was still only a range of low hills. Over the past 14 million years, periods of mountain building, glaciation, and climatic change have further restricted these trees to their present locations. The right combination of soil type, elevation, slope orientation, and water availability has enabled the present groves to survive in their locations for thousands—perhaps millions—of years.

Present Distribution

Today's geographic locations of the Sierra redwood and coast redwood give us some clues as to the past climate of the earth.

- ▲ Sierra redwoods grow naturally only on the western slope of the Sierra Nevada between 4,000 and 8,000 feet elevation. There are about 75 groves within this 250-mile range. These trees are always found near a constant supply of water where summers aren't too hot and winters aren't too severe.
- ▲ Coast redwoods occur naturally only in the coastal fog belt in a strip 500 miles long and up to 30 miles wide from the Santa Lucia Mountains to the southwestern tip of Oregon. They thrive on moderate temperatures, high winter rainfall, and summer fog—which can provide the equivalent of 20 inches of precipitation each year.

SUGGESTED PRE-TRIP ACTIVITIES

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Redwood Trees: Locations Past and Present

Objective:

To illustrate how the changing climate of the earth has affected redwood distribution.

Materials:

- ✔ *Map of North America or globe*
- ✔ *Map of California*
- ✔ *Information on pages 21-22*

▲ Using a globe, find the location of your school or town.

▲ Looking at the Northern Hemisphere, discuss the names of the countries there and the present climate. Show that redwoods once grew all across the Northern Hemisphere, even north of the Arctic Circle. Could a redwood tree live there today?

▲ Discuss the Earth's past climate and how it provided the right conditions for the ancestors of our present day redwoods.

▲ Discuss how the climate changed, leading to the present-day distribution of Sierra and coast redwoods. Find their present locations on the globe, and then on a map of California. Discuss the climate in the Sierra Nevada and coastal mountains, where redwoods now live.

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What Was It Like Way Back Then?

Objective:

To discuss the ways that climate, plants and animals have changed in North America over the past 150 million years.

Materials:

- ✔ *Drawing materials or clay*

▲ Read the first paragraph of Chapter 2 to the class (can be done as a guided imagery).

▲ Using the information on pages 21-22, discuss the changing climate of the earth, and the characteristics of the ancient redwood forest and ancient North America.

▲ Have the students draw pictures or make clay models of their image of ancient North America or the ancient redwood forest.