California State Parks

Armstrong Redwoods State Reserve
Austin Creek State Recreation Area

Redwood Ecology
Teacher's Guide

Developed by Stewards of the Coast & Redwoods
Russian River Sector State Park Interpretive Association

Redwood Ecology Teacher's Guide

A curriculum based program for elementary grade levels

California State Parks/Russian River Sector

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Original funding for this program was provided by
the Dean Witter Foundation and Save-the-Redwoods League.

We are very grateful for their support.

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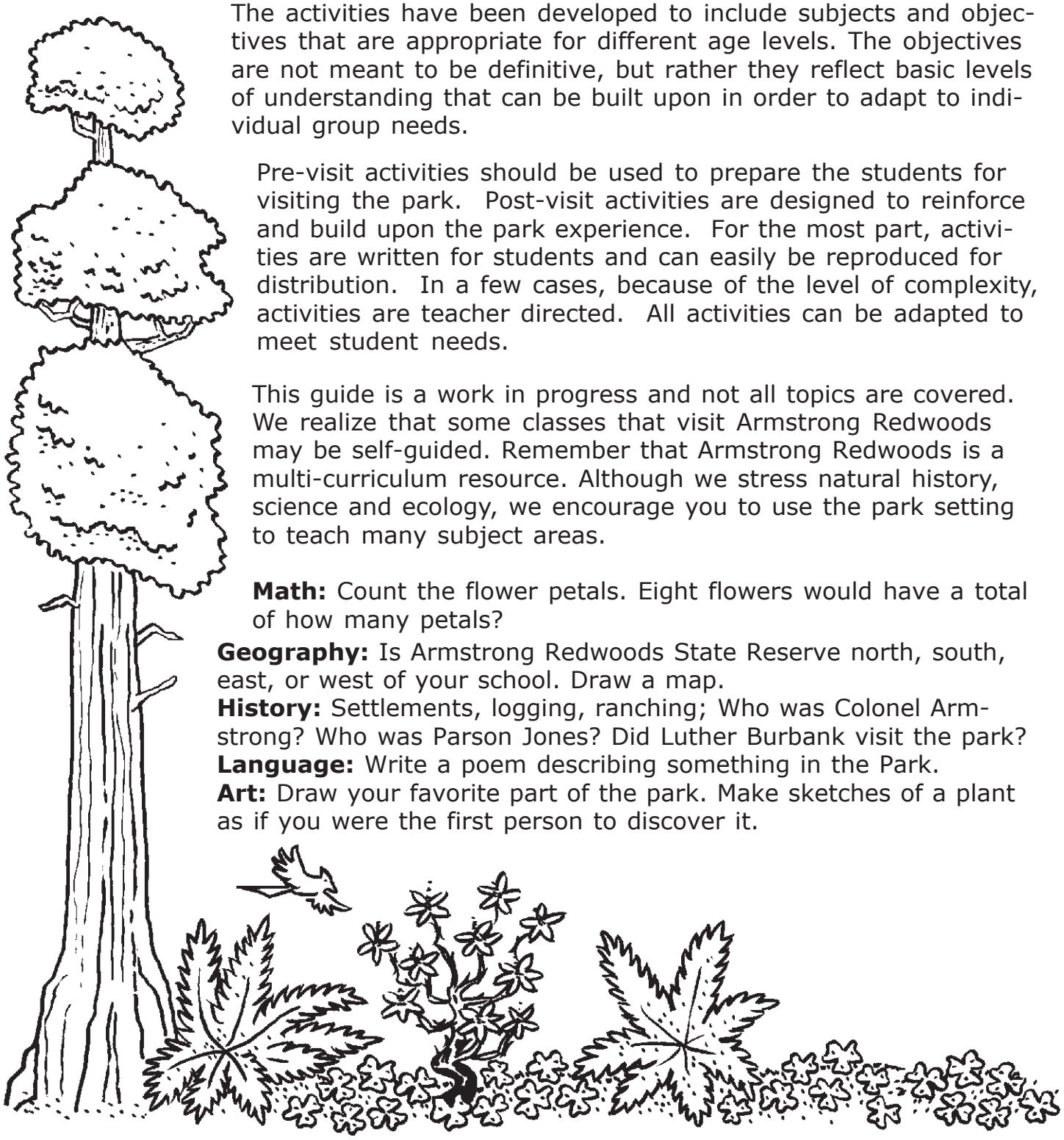
Introduction and Logistics

Introduction

Thank you for your interest in Armstrong Redwoods State Reserve. We are delighted that you are taking the opportunity to use park resources to enhance the classroom learning experience. This guide is designed to prepare you for your visit and provide additional learning opportunities for use in the classroom following your park program.



The activities have been developed to include subjects and objectives that are appropriate for different age levels. The objectives are not meant to be definitive, but rather they reflect basic levels of understanding that can be built upon in order to adapt to individual group needs.

Pre-visit activities should be used to prepare the students for visiting the park. Post-visit activities are designed to reinforce and build upon the park experience. For the most part, activities are written for students and can easily be reproduced for distribution. In a few cases, because of the level of complexity, activities are teacher directed. All activities can be adapted to meet student needs.

This guide is a work in progress and not all topics are covered. We realize that some classes that visit Armstrong Redwoods may be self-guided. Remember that Armstrong Redwoods is a multi-curriculum resource. Although we stress natural history, science and ecology, we encourage you to use the park setting to teach many subject areas.

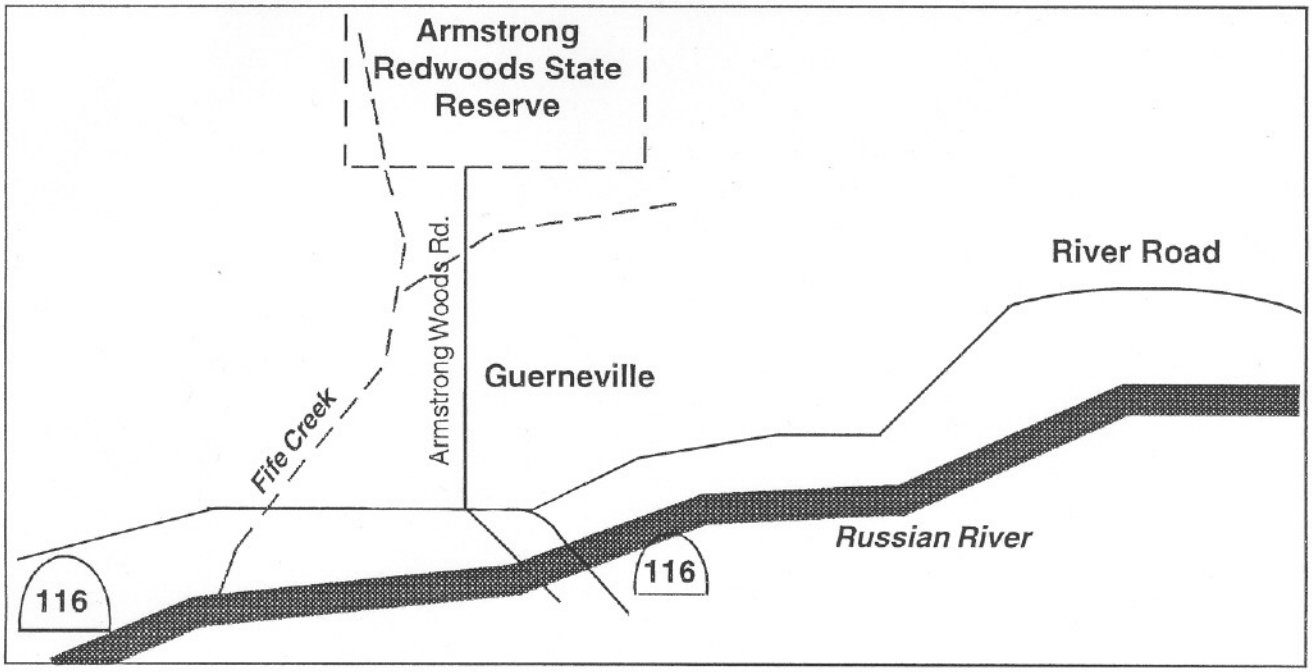
Math: Count the flower petals. Eight flowers would have a total of how many petals?

Geography: Is Armstrong Redwoods State Reserve north, south, east, or west of your school. Draw a map.

History: Settlements, logging, ranching; Who was Colonel Armstrong? Who was Parson Jones? Did Luther Burbank visit the park?

Language: Write a poem describing something in the Park.

Art: Draw your favorite part of the park. Make sketches of a plant as if you were the first person to discover it.



What You Need to Bring

Name tags for each student.

Sturdy shoes for the trail.

Lunches in backpacks. There are no stores or restaurants in the park. (Please remember water bottles, especially in warm weather!)

Warm layered clothing, waterproof jacket in case of rain.

Medical information for each student and a first aid kit.

Optional: Binoculars, camera and film.

Inclement Weather Alternatives

The hike can be conducted in the rain. In fact, that is one of the best times to see redwoods. The final decision will be with the teacher. Students, teachers, and parents need to provide their own rain gear. If the rain is not drenching, it is possible to conduct as much of the program as the students and teacher would like. There is no classroom space available indoors for the program or to eat lunch. If the weather is bad, Stewards' staff will be glad to reschedule the program at the teacher's requests. Call us at (707) 869-9177 as soon as possible and leave a message if no one is available.

Please remember that reservations are required to bring your students to Armstrong Redwoods State Reserve. See the following pages for forms. Please let us know if you have any accessibilty considerations so we can make accommodations.

Restrooms are available at the main parking lot and near the group picnic area. **Parking** is free for cars in the front lot and for buses (use designated spaces in the middle of the front lot), as long as you have your reservation form signed by our staff prior to your visit. (Carpooling is encouraged).

California State Park
Basic Rules and Policies

Parks are Forever with your help and cooperation. Parks are for people to use and enjoy, not abuse and destroy. Without protection, heedless people could destroy the highly perishable values of the areas preserved in California.

To protect the resources of the park, a summary of the rules is provided; please read them to your students prior to your visit to the park.

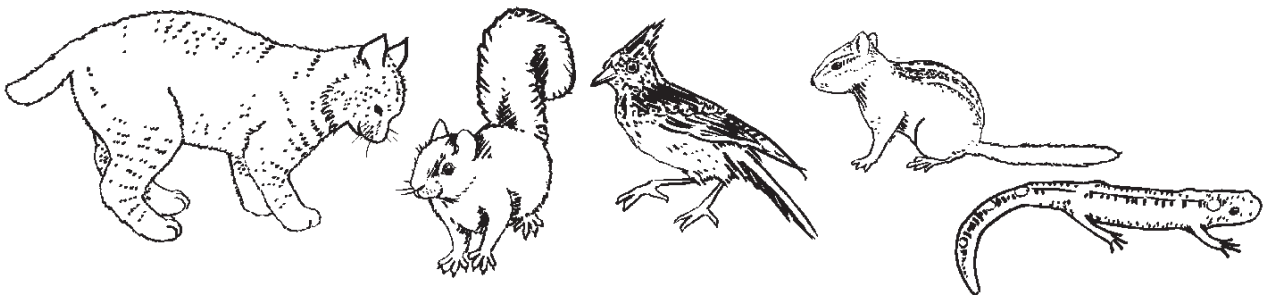
Animals: No one is allowed to hurt, injure, or otherwise disturb any animal within the boundaries of a state park. State Fish and Game regulations govern all fishing activity.

Plants, Wood, and Flowers: Visitors are not allowed to pick, dig up, mutilate, destroy, disturb, move, burn, or carry away anything from Armstrong Redwoods State Reserve.

Geological Features: No person shall destroy, deface, or remove earth, sand, gravel, minerals, or rocks from a state park.

Trails: We request that you stay on the trails and within designated areas of use. This helps to protect the trees and plants and keeps the damage of visitor usage to a minimum. Thank you for your support in maintaining the beauty and health of Armstrong Grove.

There are two things that may be taken from the Park:
Photographs and Memories!



DEPARTMENT OF PARKS AND RECREATION
Armstrong Redwoods State Reserve
17000 Armstrong Woods Road
Guerneville, CA 95446

Armstrong Redwoods School Group Reservation Form

Directions: Please fill-out this form completely by typing or printing legibly, then mail or fax to:

Stewards of the Coast & Redwoods
P.O. Box 2
Duncans Mills, CA 95430
Fax: 707-869-8252

You must return this form 2 weeks in advance to secure fee waivers and to confirm reservations. We strongly recommend reserving dates well in advance as our calendar fills quickly.

Visit Information Proposed Date:_____ Proposed Time:_____ No. of Busses:_____

Alternative Date:_____ Alternate Time:_____ No. of Autos:_____

School Information School Name:_____

Street:_____

City:_____ State:_____ Zip:_____

Point of Contact First Name:_____ Last Name:_____

Title/Position:_____ Phone No:_____

Fax No:_____

Student Information Age Group:_____ Grade:_____ No. of Students:_____ No. of Adults:_____

Educational objectives for your visit:_____

Admission fees will not be charged for California licensed school students (K-12), accompanying teachers, and adult leaders when reservations have been received and **confirmed**. Reservations must be made at least **2 weeks in advance** of the proposed date of your visit to allow preparation and scheduling by Stewards' personnel. A limit of 10 autos and 2 busses per group is permitted.

Careful advance planning, involving both teachers and park personnel, will ensure a quality educational experience. To maintain order and to supervise the behavior of students, school groups must be accompanied by a minimum of one (1) adult for every ten (10) students.

This request must be signed by the principal of the school where the students attend, and **a copy of this form must accompany the group on the day of the trip**. If more than one school is sending students to the proposed visit, the principal from each school must submit a request. The *Department of Parks and Recreation* reserves the right to combine tours when necessary and to limit the number of school groups per day to three.

CERTIFICATION

The above described visit is an official, educational, school outing or field trip and will be under the direction of school personnel.

SIGNED: _____ DATE: _____

Principal

****If you want a guided walk you must make specific plans in advance with Stewards.**
YES _____ I want volunteer tour guides.

FOR STATE PARKS USE ONLY

____ We are pleased to confirm your planned visit on _____ at _____ .
____ We regret that the time you have requested is not available.

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Armstrong Redwoods State Reserve
17000 Armstrong Woods Road
Guerneville, CA 95446

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P.O. Box 2
Duncans Mills, CA 95430
Phone: (707) 869-9177
Fax: 707-869-8252

RESERVATION AND FEE WAIVER INSTRUCTIONS

1. The group must be from a California licensed grade or high school (K – 12).
2. Fee waivers are limited to 10 automobiles per school group and not available for weekends or holidays. It is recommended that buses and autos park in the front parking lot.
3. The group must have one adult for each ten (10) students.
4. Complete and submit the attached form to the above address at least two (2) weeks in advance of your proposed visit.
5. If you must cancel, please notify the Stewards office immediately so your time can be reassigned to another school.
6. Incomplete paperwork will delay the processing of your Reservation and Fee Waiver.
7. You may FAX your completed paperwork to the Stewards office instead of mailing it, if you wish.
8. Bring an approved copy of the ***Reservation Request Form*** with you on the day of your visit.

In an effort to protect the fragile resources of Armstrong Redwoods State Reserve, it is imperative that the school groups:

- *Stay on designated trails and roads.*
- *Do not disturb the natural features.*
- *For your safety, keep children off the trail fencing.*
- *Stay with your own group.*
- *Do not leave litter of any kind on the trails.*
- Enjoy your time in Armstrong Redwoods State Reserve.

Activity

Before and After Your Visit

OBJECTIVE: To evaluate and summarize the students' knowledge

GRADES: K - 4

MATERIALS: 1-2 sheets of paper per student
Markers, pens, colored pencils, or crayons

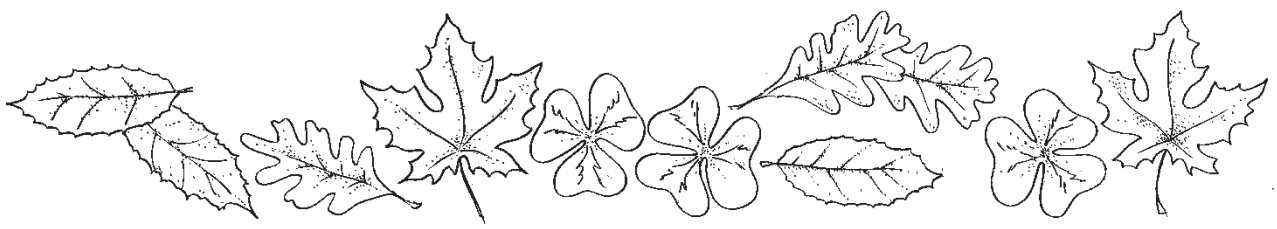
In this activity you will be able to compare the children's previous knowledge about the forest with the knowledge gained while at Armstrong Reserve. The children should be able to see a significant difference in their drawings as the second drawing usually contains more detail. If you have students who do not like to draw, have them use words for this project.

Before your visit to the park.
Give the students a blank page that is divided into two parts.
Have the students draw a picture of what they think the forest will be like.
Be sure their names are on their papers. Collect them for future use.

After your visit to the park.
Give the students back the same picture they drew before. Have them draw what they now know the forest looks like on the other half of the paper.

Have the students compare the two drawings. You can now have a discussion/review, about what kinds of things they learned. What did they see that was unexpected? What did they like best? Did they see any litter or defacement?

It is best to do this as soon after the field trip as possible, the same day would be great!



Armstrong Redwoods State Reserve
Austin Creek State Recreation Area

Armstrong Redwoods State Reserve is located in the Russian River area, about an hour and a half drive north of San Francisco. This 805-acre reserve features a magnificent grove of ancient redwoods, several miles of nature trails and a variety of picnic facilities. This State Reserve offers a unique opportunity to explore an ancient redwood forest; you'll see some of the tallest and oldest trees remaining in this part of California. Armstrong Redwoods is the largest remaining "old-growth" redwood forest in Sonoma County, a living reminder of the magnificent primeval redwood forest that covered much of this area before logging operations began during the 19th century. Armstrong Redwoods is currently in the process of a multifaceted grove habitat protection and restoration project in an effort to mitigate the damage done to the grove by millions of visitors over the past 100 years. This interesting and vital restoration project helps to promote the importance of environmental conservation, protection, and management.

Austin Creek State Recreation Area is located adjacent to Armstrong Redwoods State Reserve. This 6,000 acre park offers over twenty miles of hiking trails that encourage exploration and enjoyment of this wild and scenic area. Elevations within the park range from 150 feet to 1,900 feet above sea level; it is this rugged topography that helps to give a sense of isolation from the hustle and bustle of civilization. Austin Creek's open forests and rolling hills offer a striking contrast to the cool, dark redwood grove in Armstrong Redwoods. The grasslands, chapparal, conifer, oak woodland, and riparian habitats are home to a wide range of native flora and fauna. There are 23 family campsites located at Bullfrog Pond Campground that can accommodate up to 8 people per site. Austin Creek also offers 3 remote "back-packing" campsites that can accommodate up to 16 people per site.

Commonly Asked Questions About Armstrong Redwoods

How big is the reserve?
Armstrong Redwoods State Reserve encompasses 805 acres. Austin Creek State Recreation area is approximately 5,683 acres.

When was the fire?
Most of the fires were started by lightning strikes that hit the bases of trees during dry seasons. Fire travels through the root system to ignite the bases of other trees. The last big fire was in 1923. It swept through the forest and continued to almost reach the ocean. We know it was caused by human carelessness. One theory states that an accident at an illegal whiskey still may have caused the fire.

Why are some of the trees burned out on the inside?
When fire sweeps through the forest, the duff and slash around the bases of the trees burns hotter and longer, thereby finding a weak spot in the trunk and burning out the heartwood. The bark itself has "tannin" which insulates the redwood, especially further up the tree. These are called "goosepens" (the early settlers kept their geese in them!).

Why is it so quiet in the grove?
Because the grove is so well shaded, few plants can grow which would offer food and shelter for animals. Consequently, there are very few birds, but squirrels, chickmunks, and chickeree can be seen in many areas of the park.

Why are there so many small trees growing around older redwood stumps?
When a tree dies and leaves a decomposing stump, other trees sprout around its base, sometimes creating what is called a "fairy ring" – several mature trees growing in a nearly perfect circle.

What is the Burbank Circle?
Located to the left of the main road, this circle of trees appears to be a fairy ring, but encompasses too large an area. Theories include the idea that this circle was created by successive generations of fairy rings, but all we really know is that it is a natural cleared area. It is a true mystery, since no roots of a large tree can be found.

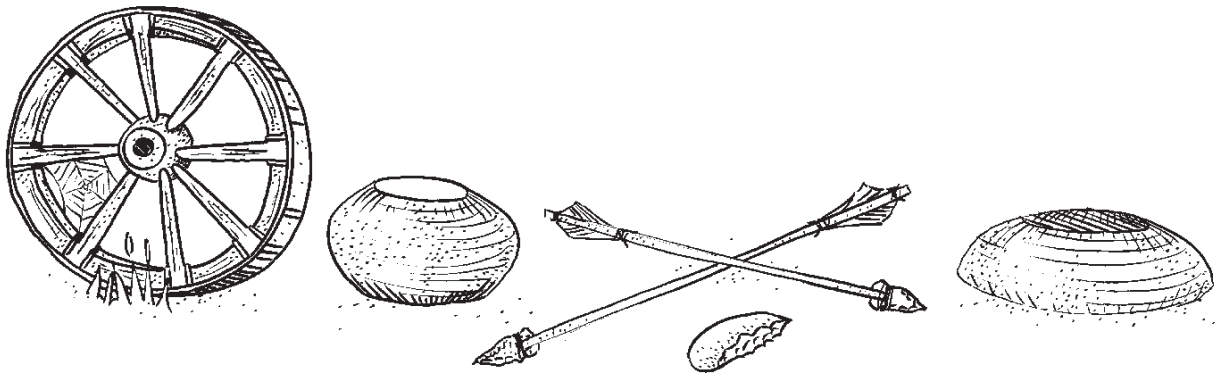
How and why do burls grow on the trees?
The knobby growths or burls on the sides of some of the trees are places where, for some unknown reason, the tree has budded over and over again in the same location. Although on examination burls appear parallel to cancer in humans, they are not harmful to the tree. In many places burl formation is a clear response to irritation, for example trunks rubbing against each other causing scaring.

How fast do redwoods grow?
Where their tops are exposed to drying winds and full sun, redwoods grow only an inch or so taller each year. In partial shade where they are protected from moisture loss, redwoods may grow two or three feet in a year under ideal conditions. The stems of young trees may increase in diameter by an inch or more each year, but this rate diminishes with age.

Was the Grove ever logged?
Some parts of the grove had been logged at the time it was set aside by Col. Armstrong, particularly from the entrance to the Armstrong Tree, so we see a combination of second and old growth trees here.

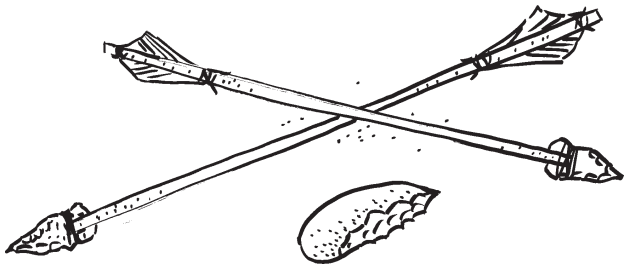
How much rain does the reserve get a year?
Rainfall averages 55 inches per year.

Part II
Cultural and Natural History



Humans and the Coast Redwoods

How did the Native Americans use the coast redwood?
Many Indian tribes lived near the borders of the redwood forests along side a body of water or some other food source. Because the forests are so dark and dense, traveling within the woods was extremely difficult. The Indians felt a great fear and awe of these forests because of their belief in evil spirits. Since game was not abundant here, the tribes could not depend on the forests to provide their livelihood. For these reasons the Indians settled on the outer fringes of the redwoods near meadows, streams, and the ocean. They used fallen logs and driftwood to build their dwellings and make many other useful tools and belongings.



The Yuroks, a tribe living on the Klamath River and the coast in extreme northern California, are particularly well known for the canoes they built from driftwood. They used stone hammers, elkhorn wedges, blades from mussel shells, and stone-handled adzes to design their boats. First they split the log in half and hollowed it out by spreading pitch on it and then setting it on fire. When the log had burned enough, they smothered the flames with green bark. Two Yuroks would spend five to six months burning, smoothing, scraping, and polishing these canoes to sell or trade to other tribes. The average length of one of the canoes was 18 feet. One boat could carry five tons of fish in rough seas and was also maneuverable on rivers. Indian tribes also used redwood to build their shelters and sweathouses. Women used the shredded inner bark for skirts, and they constructed baskets with root fibers.

What did early Spanish explorers think of these big trees?
When Portola was on a European expedition by land up the California coast in October, 1769, he marched from a camp on the Pajaro River, close to a town we now call Watsonville. Fray Juan Crespi, a Franciscan missionary and the scribe for the trip, must have been impressed by the redwood tree. In his words, the group traveled, "over plains and low hills, well forested with very high trees of a red color not known to us. They have a very different leaf from cedars, and although the wood resembles cedar somewhat in color, it is very different, and has not the same odor; moreover, the wood of the trees that we have found is very brittle. In this region there is a great abundance of these trees and because none of the expedition recognizes them, they are named 'Palo Colorado' or Red Tree, from their color."

As the Spanish moved northward in California, they built adobe missions. The redwood tree, a prized resource among these people, was used for the doors, beams, framing, and supports of their buildings. Because the struc-

tures could only be as long as the timber used to build them, the Spaniards valued the long, straight redwood. These people also constructed aqueducts, coffins, and vats for tanning out of this durable wood. These few thousand colonists and the Indians barely touched the forests around them, but this was soon to change.

When the Russian people colonized a small area on the coast north of San Francisco Bay, they built a settlement called Fort Ross, earlier known as Colony Ross. The stockade and village (now reconstructed as a state historical park) were built of redwood. Here the Aleuts, brought by the Russians from Alaska, trapped sea otter until this animal dwindled in numbers. Then the Russians sold their fort, supplies, and lumber and moved on.

What main event in California history triggered the demand for lumber?
A few years later, with the discovery of gold in California, the edge of the western frontier became a new center of activity. Thousands of people traveled from all parts of the world to seek their fortunes. As more and more people settled in California, the demand for lumber soared, and the present redwood industry saw its beginnings.

The big question asked by all the lumbermen was this: How do we convert these huge trees into usable lumber and move them into the gold country with the least trouble? Faced with the difficulty, the lumberjacks managed to find a solution. They cut notches in the trunk of the tree and constructed scaffolds to stand on at a point where the tree's diameter was a reasonable size for cutting. Still, it sometimes took two men a week to fell a tree. Sometimes when trees crashed to the ground, others fell with them.

The men would use the best lumber and leave the remainder. Little thought was given to planning for the future. Land was inexpensive – $1.25 to $5 per acre – so the logging companies could afford to cut and then abandon the land. Ranchers would buy hundreds of acres, clear the forest, and try to graze stock. These men would spend much time and energy in cutting and burning the "obnoxious" stump sprouts. Finally, the forest was tamed and it gave way to permanent pasture.

As the loggers moved slowly inland, they first logged near the streams. Logs were floated down the rivers to mills near the ocean. There they would be processed and then loaded onto steamers bound for San Francisco. As the logging operations progressed farther up into the hills and away from water, chutes had to be built to get the logs down to the streams. Eventually, oxen were used to drag the logs along "skid roads" made up of half-buried greased logs, down to the water. Later, railroads were constructed to make the work easier. At the ocean, logs were stored in mill ponds until they were ready to become planks of lumber.

New machinery and more modern techniques were continuously being adopted – longer cross-cut hand saws, donkey engines, steam-powered locomotives – anything to make the work quicker and easier. Little thought was given to the care of the forests. Few loggers were concerned about the soil, problems of erosion, and regrowing the forest. In a very short time, acres of magnificent forest were reduced to battlefields of stumps.

Why do we have redwood state parks, and who is responsible for their existence?

In 1900, a group of concerned citizens who valued the coast redwood forests, formed the Sempervirens Club in hope that their efforts would produce a park that would be protected and preserved for future generations to see and appreciate. In 1902, many dreams became reality when the California Redwood Park was established by the Legislature. These lands are the nucleus of a park now called Big Basin Redwoods State Park in the Santa Cruz Mountains. Here, protected from a few of today's hazards, live a variety of birds, lizards, snakes, rodents, deer, and other forms of wildlife.

Today we are still battling to save remaining virgin groves, but this is a long and expensive fight because the costs of these lands are now so great. We have learned that forests aren't safe from destruction just because they are within park boundaries. Our park lands are not islands of peace in the midst of this disrupted earth. They are one part of a complete ecosystem. For example, each grove is closely related to the lands surrounding it. Cutting the trees upstream from our parks will affect the groves that we are trying to save downstream. These lower lands aren't protected from the erosion and flooding that may occur upstream. This is why today many persons are still dedicated to raising money for the purchase of our few remaining virgin forests.

It is not enough for us to stand by and gaze at these magnificent trees in amazement. Each of us can help maintain and protect the lives of our coast redwood forests by thinking about the trees and their needs while we are visiting the parks. Now that we understand more about the coast redwood and how it functions, we will be able to apply what we know to our activities within the forest. How will small feeder roots on the soil surface be affected by our footsteps, those of our classmates, and of the thousands of people who visit the area each year? How do we affect the wildlife and its food supply when we pick a single berry? What if I eat 20 berries? What will happen to the forest creatures if every visitor picks one single berry? In what other ways might we affect the coast redwood community? How can we make a beneficial impact on the forest during our visit? If we keep in mind what we have begun to understand about this tree, and act accordingly, we will have the coast redwood to admire, enjoy and use for a much longer time.

Colonel James B. Armstrong

A Man of Vision

Colonel James B. Armstrong was a conservationist with a vision. Thanks to his generosity and foresight, a remnant of the ancient redwood forest in Sonoma County has survived as Armstrong Redwoods State Reserve.

The man who dreamed of preserving the grove of redwoods we know as Armstrong Redwoods State Reserve was a lumberman who cut and milled millions of board feet of redwood. However, he realized that unless unrestricted cutting was curtailed, only stumps and memories would be left in a few years. Unfortunately, he died before his dream of preserving the redwood grove for posterity was fulfilled. The grove was left to his daughter Lizzie, who with family friends Harrison LeBaron and Luther Burbank finally fulfilled his dream.

James B. Armstrong was born Aug. 20, 1824, near Wooster, Ohio. By 1847, he lived in Stark Co., Ohio, where he married and started a family. He had already been a county treasurer, surveyor, and draftsman.

In 1856, James Armstrong made a trip to California as a correspondent for the Cincinnati *Gazette*. He returned home and in 1860 became a member of the Ohio delegation to the Republi- can convention that nominated Abraham Lincoln for president. In 1862, he served eight weeks as a lieutenant-colonel in the 95th Ohio Volunteer Infantry. In 1864, he enlisted as a colonel in the 134th Volunteer Infantry Regiment of Ohio for a term of one hundred days. He was honorably discharged and was known by the title of colonel for the rest of his life.

The trip to California may have influenced his decision to move his family to California in 1874. He settled in the town of Cloverdale, Sonoma County, where he had citrus orchards. He also established nurseries in Santa Rosa to study crop plants. This led to a lifelong friendship with Luther Burbank. Col. Armstrong's wife Eleanor, died in 1880.

Soon after arriving in California, Colonel Armstrong began buying timber land in the town of Guerneville, on the Russian River. In addition to the 440 acres which later became the state reserve, he owned other property near Guerneville, as well as land in Santa Rosa.

In addition to logging his land, he owned and operated the Big Bottom Sawmill north of Guerneville. By 1877, Colonel Armstrong's mill produced a capacity similar to those of the Korbel brothers' mill and the Heald & Guerne mill. As his land was cleared, he subdivided it into small tracts which he sold for reasonable prices and liberal terms.

On May 3, 1878, Colonel Armstrong gift deeded 440 acres of forested land in Guerneville to his daughter Kate, ". . .in consideration for one dollar, love and

affection." This act was the first step in his plan to dedicate the grove as parkland. In 1891, his plan to assure preservation of the grove under the administration of his friend Luther Burbank was presented to the State Legislature in the form of a bill to have the state buy the park and have Luther Burbank administer it. However, this plan was abandoned by the legislature.

At about the same time, Colonel Armstrong invested heavily in the San Francisco Safe Deposit and Trust Company, and when it failed, it nearly ruined him financially. He had to sell much of his real estate to meet his obligations. He suffered even more misfortune when his daughter Kate, who had always suffered from ill health, became even more seriously ill and died in 1898.

Following his marriage to Jesse Magee in 1891, Colonel Armstrong suffered the first of a series of strokes, which, by 1898, led to paralysis. He died in Cloverdale on October 15, 1900, at age 76.

Others took up Colonel Armstrong's fight to save the redwood grove. His daughter Lizzie, and her husband, the Rev. William Ladd Jones, befriended Harrison M. LeBaron, who took an option on part of the grove property which had been sold and spearheaded the campaign to put the entire redwood grove into state park hands. Along with LeBaron's six sons and horticulturist Luther Burbank, Lizzie and her husband joined the fight to preserve the redwood grove.

Their efforts were defeated in 1909 when state sponsored legislation to acquire and preserve the grove was "pocket vetoed" by Gov. Gillette. However, his daughter Lizzie and the LeBarons continued to rally support for Colonel Armstrong's dream. It was not until 1917 that the County of Sonoma acquired the redwood grove for a county park. Ownership of the grove was officially transferred to Sonoma County on Dec. 5, 1918.

In 1934, title was given to the State of California for a state park, and improvements began. The Forest Theater was built in 1934-1936. On March 14, 1917, the San Francisco Chronicle reported it as, ". . .the only remaining large holding of redwoods in this part of the state and [it] will make a beautiful natural park."

In 1964, the park was given added protection by being recognized as a State Reserve to
". . .preserve its native ecological associations, unique fauna or flora characteristics. . .in a condition of undisturbed integrity." Coast Redwood forest such as this once covered the land for miles around. If it were not for the vision of Col. James B. Armstrong, this last remnant of the local redwood forest might never have survived as a living monument for future generations.

Much of the article was abstracted by Doris Dickenson from: John C. McKenzie, *Colonel James B. Armstrong and his Redwood Park,* Stewards of Slavianka, Annadel Press, Santa Rosa, CA, 1995, and also includes other State Reserve resources.

What are Redwoods?

What is a redwood tree?
What size are redwoods?
How large are they underground?
How are other trees like the redwoods?
How is the redwood different from other trees?
Are all redwoods exactly the same?

Have you ever put yourself on the legs of an ant before? Did you ever wonder what a blade of grass might look like to such a small creature? Can you imagine lying on the ground, deep in the forest, looking up at the tallest living trees in the world? For a moment you might seem to be like an ant among blades of grass.

A coast redwood, like other trees, is built of many working parts. Beneath the soil grow many roots. They have several jobs. They are like your feet. They give the tree balance and stability. How great an expanse of roots do you think it would take to balance a single coast redwood?

Roots are also like our hands. They are the fingers on the tree that reach for all the nutrients and water they can absorb from the soil. Roots can store minerals for the tree until they are needed. Some plants have one large taproot to bring up water and nutrients from far into the soil. Others, like the coast redwood, grow in moist areas where much water is available near the soil surface. These trees, then, need only a shallow, spreading root system in order to obtain water, and do not have a taproot.

Most coast redwood forests are very dense — many of the trees grow side to side. Try to picture the root systems of these trees as a single network. How might this improve the balance of a single tree? Might this "close-knit" situation also affect the forest as a whole?

Above the ground the coast redwood, like other trees, is equipped with a trunk, branches, leaves, and a means of reproduction. High in the trees, leaves absorb and convert the sun's energy into sugars and starches that allow the tree to grow new roots and leaves, a taller trunk, and cones to produce new trees.

Although each of these parts has the same function in most plants, those of the coast redwood are distinct in appearance. Some trees very similar to the coast redwood in these characteristics are considered its relatives.

What are the other species of redwoods?
How have they adapted to their native habitat?

Another California redwood, the Giant Sequoia, grows naturally in a small range of about 250-miles on the western slopes of the Sierra Nevada. The climate here, with its seasonal fluctuations, is very different from that at the coast. Winters are much colder, and some snow is common. Summers are very hot and dry. What features of the Sequoia help it thrive in an area where its coastal relative cannot even survive? The deeper and farther-spreading root system of the Sierra Nevada species is useful in the dry climate. Let's consider the leaves of the three living redwood species. How is each unique?

Coast Redwood
Sequoia sempervirens

Giant Sequoia
Sequoiadendron giganteum

Dawn Redwood
Metasequoia glyptostroboides

The Giant Sequoia has leaves that are much smaller than those of the coast redwood. This enables the tree to conserve water. Leaf surface exposed to the sun loses some water due to evaporation. Coast Redwoods grow two distinct types of needles. Treetop needles, located where it is hot and dry, look like tight scale-like spikes (closely resembling the Giant Sequoia), creating less evaporative surfaces. Lower needles, growing within the shady forest canopy, are broader and flat so as to catch more of the available light. These are the needles we usually see; the upper needles come to our attention only when they are blown down from their high homes after a winter storm.

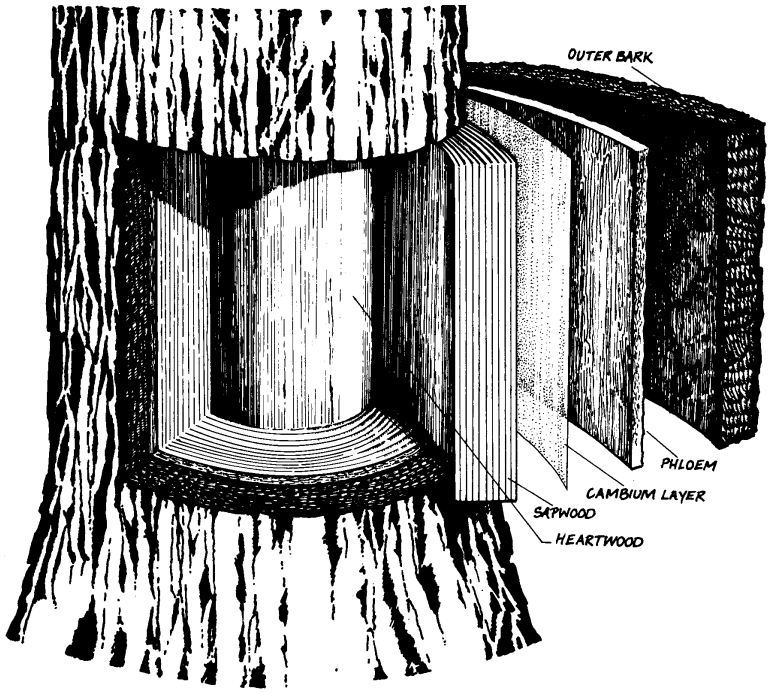
The Dawn Redwood, thought to have been extinct for 20 million years, was discovered in the mid 1940s living in Central China. It has adapted to the seasonal freezing temperatures by losing its leaves during the cold season. Many plants, such as some oaks, maples, and elms, conserve water and energy by being deciduous.

By the entrance station at Armstrong Redwoods State Reserve you can see an example of each of these types of redwoods.

Tree Life
Teacher Reference

Earth's forests contain thousands of species of trees, each of which is distinguished by the individual characteristics of its seeds, leaves, and growth. Regardless of species, however, all trees have the same general structure and requirements for survival. They all utilize water, soil, air, and light to manufacture food, increase in size, and produce seeds.

The root system of a tree, which in redwoods is 4 to 6 feet deep and as much as 250 feet wide, collects water and minerals from the soil. Root tips are protected with a hard covering that enables them to probe the soil both vertically and laterally. Microscopic root hairs cover the root's surface and literally embrace grains of earth from which they absorb moisture and nutrients.



The root system sends the water and dissolved minerals to the leaves of the tree, where food production takes place. The leaves, in turn, send food back down to the roots, which cannot produce any nutrients on their own. All this transporting of substances takes place through the trunk and branches, where the wood is arranged in several layers that have specific functions in the process. The outermost layer of the tree, the bark, provides protection for the plant; this layer is made up of dead and aging cells that formerly served as conduits for food. The inner bark is the active food transport system, called the phloem, and this layer also stores food for the tree. Beneath the phloem is the cambium, the only part of the trunk that produces new cells. The cambium layer is microscopically thin, its cells continually dividing to add new growth to the layers on either side of it. The cambium does not add to the height of the tree, but adds to its diameter; all upward growth is accomplished by the tips of the branches.

The xylem, or sapwood, of a tree carries water from the roots to the leaves. Like the phloem, this layer also stores food as a reserve supply for the tree, and it receives new cells from the neighboring cambium. As the xylem ages, its water-movement function ceases, and fungus-resistant chemicals are deposited, and this woody layer becomes the red heartwood, which constitutes the real strength of the tree. The heartwood is no longer living, but it will stay intact so long as the layers of cells around it continue to be nour-

ished.

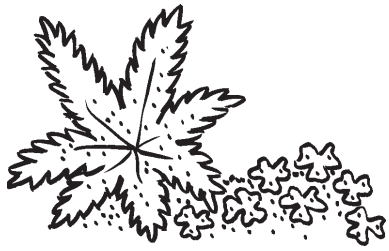
It is the heartwood and sapwood layers that reveal a tree's record of growth. The rings that are visible in any cut log or stump show the annual growth of that tree; their dark outside edges represent the summer growth of small cells, and the wider, lighter-colored interior section of each ring record the spring growth, which is less dense and made up of larger cells than those produced in summer. In very old trees, particularly the giant sequoia, the number of growth rings can be misleading. In some instances an annual ring may not have reached the level of the stump, because the rings begin at the tree's crown. In other instances, the pattern of growth rings may be distorted owing to a fire scar or a buttress on one side of the trunk.

Water and dissolved minerals flow through the roots and trunk of the tree in a continuous process known as transpiration. For the most part, the leaves (or needles, which are a conifer's leaves) pull the water upward through the tree's body as they release water from their many pores through evaporation. This process of upward movement is aided by the surface tension of water molecules in the tree's circulatory system. Water moving upward through the sapwood could be likened to the column of mercury in a thermometer; its molecules cling together as they move up or down in the narrow chamber inside the instrument. The water in the long vertical cells of the sapwood behaves similarly, forming an unbroken column from roots to leaves.

At its destination, the water meets chlorophyll, stored in the leaves in millions of cell bodies called chloroplasts. When carbon dioxide from the air and sunlight also reach the chlorophyll, photosynthesis occurs. In this chemical reaction, the life-giving process for the tree, carbon dioxide and water combine to form glucose, the food for the tree. Oxygen, a by-product of photosynthesis, is released into the atmosphere to sustain all nonplant forms of life. The chemical formula for this process is as follows:

$6CO_2$	+	$6H_2O$	+	energy	—>	$C_6H_{12}O_6$	+	$6O_2$
carbon dioxide		water		sunlight		glucose		oxygen

In addition to the products of photosynthesis, each leaf gives off excess water through its underside, adding moisture to the air and keeping the temperature of the leaf cool enough for photosynthesis to continue. Thus, through the combined actions of transpiration, fog drip, and photosynthesis, trees actually increase the moisture in an area, by raising the water table through the action of their roots and by recycling water into the air through their leaves.



The Redwood "Fog Drip" Connection

The coastal redwood rainforest grows naturally in the coastal summer fog belt allowing the trees to catch the moisture they require during the rainless summer months.

How fog drips occurs:

- During warm coastal weather, fog forms over coastal waters and drifts inland as far as 25 miles.
- As the moist Pacific ocean air temperature cools, fog forms, and condenses into droplets when it contacts the foliage of the tall trees.
- Most of the fog precipitation will occur between midnight and 4:00 am.
- A mature old growth redwood near the ocean can condense fog into as much as 80 inches of water during the months of July, August, and September.

The entire ecosystem depends on fog drip:

- Fog drip can account for over 40% of the water found in the forest.
- Tall redwoods capture more water than they need, allowing for the growth of understory species which themselves can't capture fog.
- Sword ferns, redwood sorrell, and rhododendrons are some of the plants that depend on the fog drip water for their summer growth.
- Amphibians such as frogs, toads, newts, and salamanders thrive in the fog drip moistened duff in the redwood forest. Their skin needs to be moist at all times.
- Fog drip water soaks into the soil and replenishes groundwater, springs, and rivers. Summer water temperatures and water levels are kept cool and adequate for salmon, eel, and steelhead.

Without tall trees to catch the fog, the entire ecosystem will and does change:

- Young redwood seedlings cannot grow without summer moisture. They will shrivel and die.
- The microclimate becomes hotter and windier without the tall trees and the fog water they catch, which leads to drier soils and more obstacles for seedlings.
- Summer water levels in streams will be lower without fog drip, which leads to higher water temperatures, leading to very stressful conditions for salmon, steelhead, and eels.

EVENTUALLY THE FOG ITSELF WILL DIMINISH. Hot bare soil radiates heat which will burn off fog before it can roll east to cover the redwood forest region.

Activity

A READ-ALOUD Story

THE STORY OF THE SOLOMON TREE

A very long time ago there was a redwood forest of really tall trees along a shiny river. There were many things in the forest: small furry animals with wide, bright eyes; lizards and worms; plants that flowered in the spring; birds who chattered in the trees; and silver fish in the stream that ran through the forest. Everything that lived in the forest loved being there.

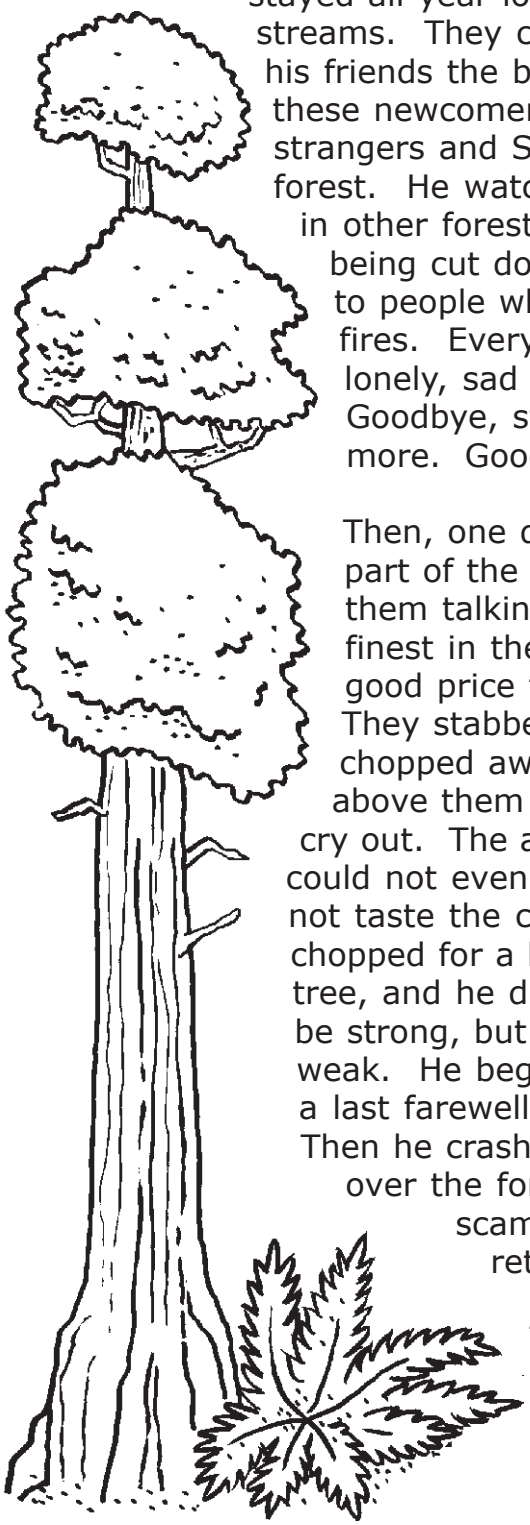
In the winter, great white clouds sailed over the mountains and called down to the forest, "Rain tomorrow, rain tomorrow," and the birds listened and hid in their nests in the branches of the tall trees. The furry animals burrowed deep into the ground beneath the sweet smelling redwood needles, in a shelter from the coming storm. In summer, when the stream hid underground from the summer heat, gray, misty fog came from the nearby ocean and nestled in the treetops to give the redwoods a needed drink of water. When the wind blew through the trees, it brought news of the different seasons and of its travels around the earth and the animals listened. It warned the animals of fire, and the animals listened. The trees talked to each other through the wind in their branches; the raccoons and black bear and deer listened to each other's stories; the squirrels and caterpillars and mice listened to each other. They didn't talk in words and sentences the way most people do today, but they had secret codes that all of them understood. They all lived happily together in the forest.

In this redwood forest, lived something that was the wisest being around. He had lived for over two thousand years. He was the biggest, the strongest, and the most beautiful being in the forest. His name was Solomon, and he was a redwood tree. Solomon stood in the forest, listening to the wind in his branches, talking to the clouds overhead, drinking from the stream that flowed near his roots, and soaking up the summer fog. Small birds, and even animals, made their homes in his great branches. He was very old and very wise, and all the animals came to sit beneath his branches and talked with him in their own way. They loved him very much, and he loved them.

Because Solomon had lived so long, he had seen many changes take place in the forest. He saw the black bears move their homes farther and farther into the tallest mountains. He watched strange creatures move into the forest in the summertime, creatures who had copper-colored skin instead of fur, and who had dark, dancing eyes. These creatures walked on two legs and killed the raccoons and deer, and used their skins for clothes and shelter. They built fires with a stick and a stone, and roasted some of the animals over fire for food. Solomon saw these creatures and was confused. But he saw that

they were good creatures; they took no more than they needed, and they respected the forest and the animals and the stream. These men became like brothers to the forest, so Solomon did not fear them. They lived with the forest and respected everything there.

After another long time, Solomon saw a different kind of man come to the forest. These men wore big boots and carried sharp axes, silver shovels, and big metal guns. They came alone on horses or together in wagons, and they stayed all year long. They built roads and dammed up streams. They chased the Indians away. Solomon watched his friends the birds and raccoons and deer being killed by these newcomers. The men took furs and sold them to strangers and Solomon became afraid for his friends in the forest. He watched as the animals left to find other homes in other forests. He watched his brothers, the other trees, being cut down and chopped up for houses, or being sold to people who lived far away, or even being burned in fires. Everywhere the birds and animals called out their lonely, sad song, "Goodbye, goodbye, Solomon. Goodbye, stream and forest. We cannot live here any more. Goodbye!" And Solomon became very sad.



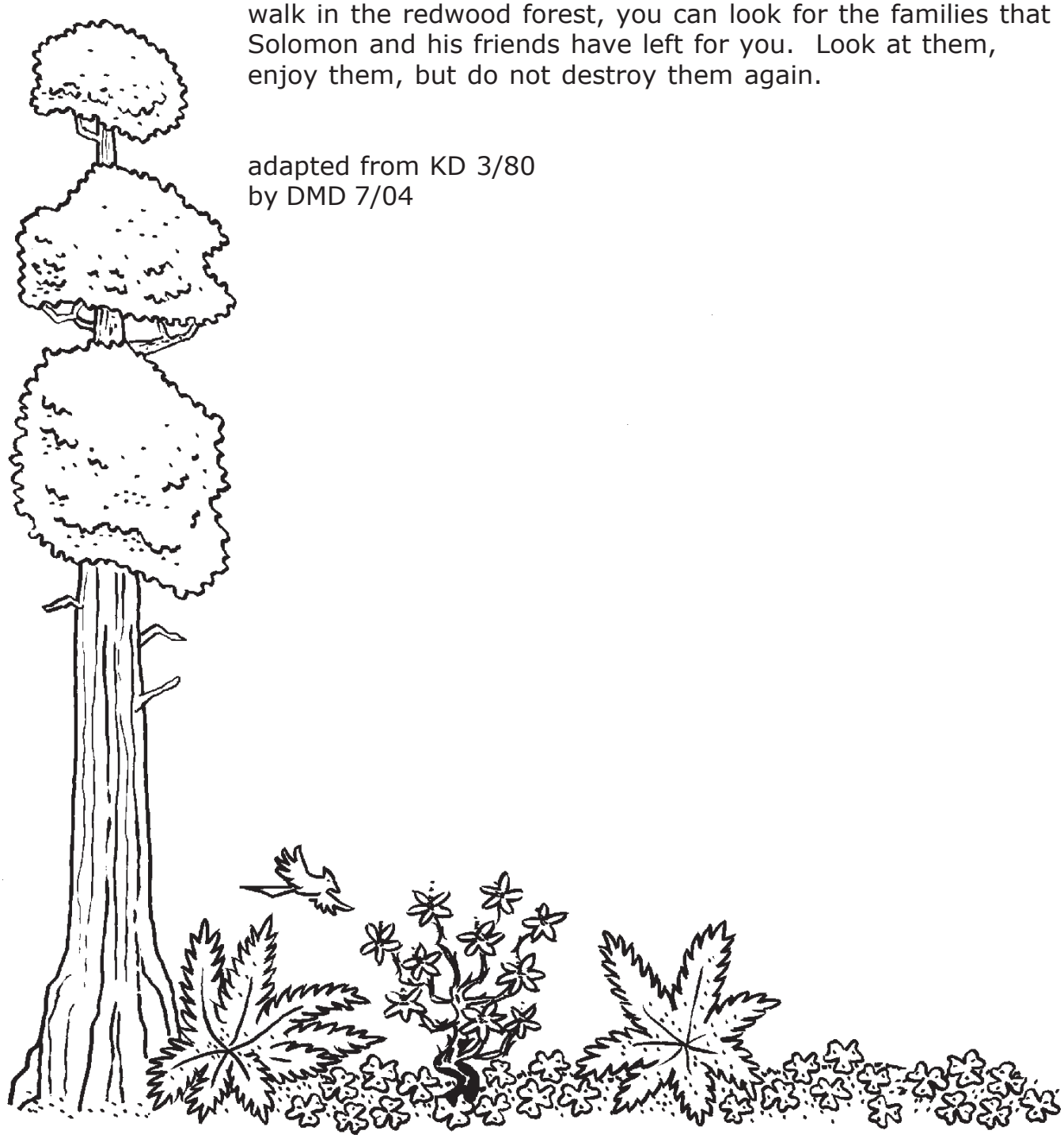
Then, one day, the men in big boots came into Solomon's part of the forest and looked up at him. Solomon heard them talking. They said, "That's a fine looking tree, the finest in the forest. We can chop it down and get a good price for it. We can sell it for a lot of money." They stabbed their axes into Solomon's trunk. They chopped away at his thick strong trunk as he stood above them watching, but he was very proud. He did not cry out. The axe wounds hurt him very much, and soon he could not even feel the earth beneath his roots. He could not taste the cool, sweet water of the stream. The men chopped for a long time, for Solomon was a very strong tree, and he did not give up easily. He tried his hardest to be strong, but under the weight of the axe he became very weak. He began to tremble. He lifted his great branches in a last farewell to the clouds and the sun and the stars. Then he crashed to the ground like a clap of thunder. All over the forest, his fall could be heard, and the animals scampered far away in fright. Some of them never returned.

This story could end here. It is sad to remember the rest of what happened to the forest. All that was left of Solomon and his brothers were great redwood stumps. But

Solomon left a message with the deer before he fell; he left a message with the wind and with the stream. Nowadays, if you walk in the forest, or listen to the stream, you can hear Solomon's message. He said, "Be careful with all of us. We cannot fight. We can only grow if you leave us alone." This is the message he left for all of us. His last wish was that we would listen to his message.

But this was not the end of Solomon and his brothers. The great stumps that were left still had life in them, and new trees began to grow around the stumps. Now, when you walk in the redwood forest, you can look for the families that Solomon and his friends have left for you. Look at them, enjoy them, but do not destroy them again.

adapted from KD 3/80
by DMD 7/04



Armstrong Redwoods State Reserve Word Search

M	G	L	E	R	R	O	S	W	O	R	D	F	E	R	N
P	W	D	U	F	F	L	B	N	E	H	C	I	L	A	N
Q	O	Y	O	K	R	P	I	A	R	F	E	F	E	Ś	V
Z	O	I	B	O	H	I	Z	Z	D	P	S	E	S	E	G
N	D	F	S	M	W	R	E	C	Z	U	V	C	O	N	N
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R	F	N	E	E	R	G	R	E	V	E	Z	U	C	P	D
A	U	V	N	L	K	G	U	L	S	A	N	A	N	A	B

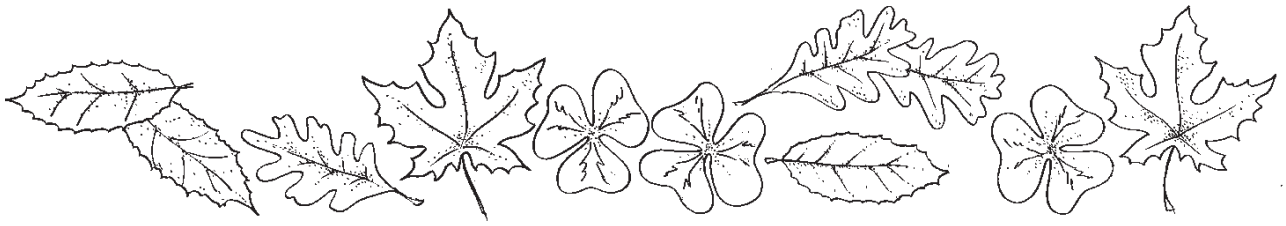
ARMSTRONG	*Reserve named for Col. James B. Armstrong (Tree is 1400 years old)*
BANANA SLUG	*A PGM! Pulmonate (with lung) Gastropod (stomach foot) Mollusk*
BURL	*Knobby growth where, for unknown reason, tree buds over and over*
CIYO'LE	*Indian name for the forest meaning shady place; pronounced see-oh-lay*
COAST REDWOOD	*Sequoia Sempervirens; other redwoods are Giant Sequoia and Dawn*
DUFF	*The layer on the forest floor that becomes humus, then soil*
ECOLOGY	*The science of relationships between organisms and their environment*
EVERGREEN	*Having foliage (leaves, needles) that remains green through the year*
FAIRY RING	*Circle of trees sprout from parent tree that may or may not be living*
FIFE CREEK	*Flows through the grove and down to the Russian River*
FOG DRIP	*Can account for 40% of the water in the forest*
GOOSE PEN	*Where the bottom of trees have been burned out on the inside*
HUMUS	*Decomposed duff -- next stage is soil*
LICHEN	*Fungus and algae -- grows on rocks and trees*
LIZZIE	*With the LeBaron family, fulfilled father's dream of preserving this grove*
MOSS	*Grows in moist areas; important in soil formation, food for some animals*
NATURE	*The physical world, including all living things*
PARSON JONES	*Tallest tree in the grove (310 ft.), named for Col. Armstrong's son-in-law*
POISON OAK	*"Leaves of three, let it be!"*
RESERVE	*The level of protection California granted Armstrong Redwoods in 1964*
SORREL	*Grows on the floor of the grove; looks like clover*
SWORD FERN	*Fronds may be 2 - 4 feet in length*
WOOD ROSE	*Grows in shady areas of the grove; rose hips are rich in Vitamin C*
WOOD TROLL	*The protector of Fife Creek, it can be seen from the Icicle Tree Trail*

Part III
Forest Identification

Some things to look for in a Redwood Forest

TREES	
Coast Redwood (Sequoia sempervirens, “ever living”)	Soft, spongy bark; flat green needles on lower part of tree, to catch any moisture; closed up needles at top of tree, to prevent losing moisture; burls growing on trunk, growths only on some trees; grow to be the tallest trees in the world
Douglas-fir	Hard, rough bark; sharp, rounded needles
UNDERSTORY PLANTS (growing beneath redwoods)	
Tanoak	Slightly barbed chestnut-like leaves; acorns with bristly caps; evergreen
California Hazel	Soft, velvety leaves; deciduous; nuts later in year are eaten by animals (or humans)
Bay (or California Laurel)	Evergreen; leaves have strong smell when squashed
Redwood Sorrel (Oxalis)	Most common groundcover; three leaves (resembles clover); small pink flower in center of plant in spring
Poison Oak	“Leaves of three, let it be;” touching leaves or stem can cause a rash
Blackberry	Low prickly bushes with edible berries
Sword Fern	Large leaves growing from a clump; each segment has a little “handle” near the stem
Bracken Fern	It grows 1 to 4 feet high with wide, triangular fronds that are highly divided.
Moss and Lichens	Grows on many old logs
Wood Rose	Small leaves on thin branches; spring flowers
ANIMALS TO LOOK FOR	
Gray Squirrel	Large, with bushy tail
Douglas Squirrel	Small, reddish brown underside; often called “chickaree”
Chipmunk	Brown grey in color with 3 strips on the back.
Banana Slug	May be yellow, or yellow with black spots; eats debris and fertilizes forest

Trees



Pre-Visit Activity - Student Handout

Meet a Tree

"**A** tree is a woody plant with a trunk."

Such a simple definition hardly gives credit to this complex and beautiful creation. Suppose you read in the newspaper that someone had invented an amazing machine. It was run by the sun's energy, manufactured its own food out of water and carbon dioxide. It also was powerful enough to split a rock or support tons of weight, produce oxygen, water, food and fuel and, rather than pollute the air, actually cleansed and beautified its surroundings. Incredible?

Hey, wait a minute this is the description of a **tree**!

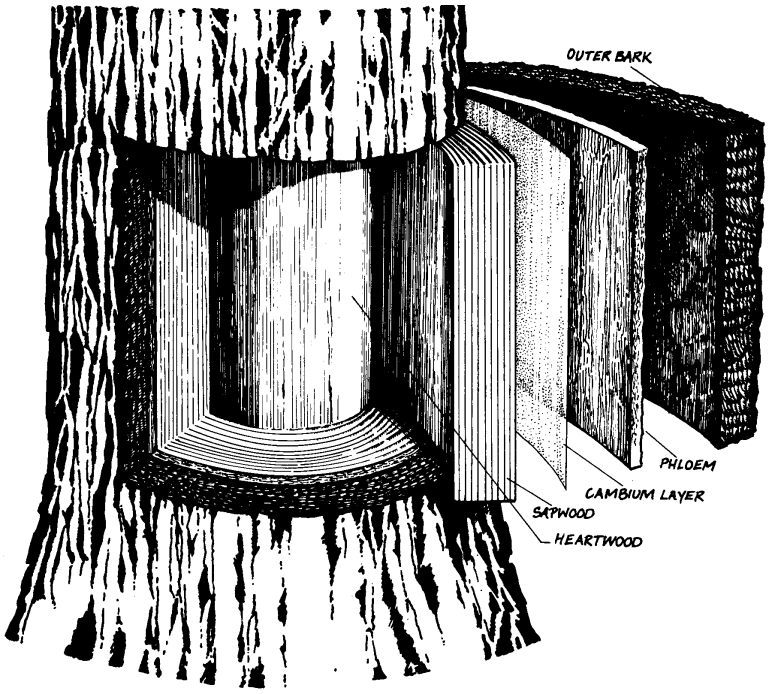
From a tree's tiny root hairs buried in the ground to highest leaves in the crown, each part of a tree plays a role in helping it to function. Here's a rundown of the various parts of a tree and what each one does:

Leaves
Leaves are the food factories of a tree. Using energy from the sun, which they capture with a pigment called ***chlorophyll***, leaves convert carbon dioxide and water into oxygen and sugar (food!) through the process of ***photosynthesis***. The gases needed for and generated by photosynthesis enter and exit through tiny holes called ***stomata*** on the under surface of the leaves. At night, a reverse process called ***respiration*** uses stored sugars and some oxygen to make carbon dioxide and water again. The process of ***transpiration*** occurs when the water vapor exits through the stomata in the leaves. Luckily for us, a plant makes more oxygen during the day than it uses up at night, otherwise there would not be any extra oxygen for us to breathe.

Leaves also can help to protect the tree against dryness and extreme cold. The greatest danger to trees in winter is drying out – ground water freezes into frost and is not readily available to the root hairs of the tree. ***Deciduous*** trees (those that loo\se their leaves at the end of the growing season) prevent this water loss by forming a waterproof, corky layer where each leaf is attached to the tree. When the leaf falls off, this thin layer serves as a waterproof and disease resistant patch. ***Conifer*** (cone-bearing evergreen trees) needles on the other hand, can remain attached year-round as they have less surface area through which to lose moisture and are covered with a waxy substance called ***cuticle***, which greatly slows down moisture loss.

Trunk
The trunk's main function is to support the branches and twigs, which in turn expose the crown of leaves to the sunlight. The trunk and branches contain the tree's "pipes" – the tubes that transport water and nutrients to the leaves and sugar from the leaves to the rest of the tree. They also contain the growing layer of the tree that makes the trunk, branches, and roots of the tree thicker each year.

Here is a look at a tree trunk



Heartwood forms the central core of the tree, is made up of dense dead wood and provides strength for the tree.

Sapwood, also called the ***xylem*** (ZEYE-luhm), brings water and nutrients up from the roots to the leaves; older xylem cells become part of the heartwood.

Cambium (KAM-bee-uhm), is a very thin layer of growing tissue, makes cells that become new xylem, phloem or cambium.

Phloem (FLOW-uhm), also called the inner bark, carries sap (sugar and nutrients dissolved in water) from the leaves to the rest of the tree; at certain times of the year, phloem may also transport stored sugars from the roots up to the rest of the tree.

Bark protects the tree from injury caused by insects and other animals, by other plants, by disease, and by fire; bark characteristics vary from species to species (for example, it may be thin, thick, spongy, rough, smooth, covered with spines, and so on, depending on the type of tree).

Roots
A tree's roots help anchor the tree in the ground. They also absorb water and nutrients from the soil. Trees have ***lateral roots*** that spread out from the tree and cover a broad area. Many trees also have a ***taproot*** that grows straight down into the ground. As a tree's taproot and lateral roots grow away from the tree, they branch into fine and finer roots called ***rootlets***. The rootlets themselves divide into even finer ***root hairs***. These root hairs absorb approximately 95 percent of the water and nutrients absorbed by the tree.

Pre-Visit Activity

Meet a Tree - Vocabulary Definitions

1. **Bark**: Protects the tree from injury caused by insects and other animals, by other plants, by disease, and by fire. Bark characteristics vary from species to species.
2. **Cambium**: A very thin layer of growing tissue. It makes cells that become new xylem, phloem, and cambium.
3. **Chlorophyll**: Pigment used in the process of photosynthesis.
4. **Conifers**: (evergreen trees) Their needles can remain attached year-round as they have less surface area through which to lose moisture and are covered with a waxy substance called ***cuticle,*** which greatly slows down moisture loss.
5. **Cuticle**: A waxy substance, which greatly slows down moisture loss.
6. **Deciduous**: Trees that lose their leaves at the end of the growing season.
7. **Heartwood**: Forms the central core of the tree, is made up of dense deadwood, and provides strength for the tree.
8. **Lateral Roots**: Roots that spread out from the tree and cover a broad area.
9. **Leaves**: Leaves are the food factories of a tree. Leaves also can help to protect the tree against dryness and extreme cold.
10. **Phloem**: Also called the inner bark. It carries sap (sugar and nutrients dissolved in water) from the leaves to the rest of the tree; at certain times of the year, phloem may also transport stored sugars from the roots up to the rest of the tree.
11. **Photosynthesis**: A process using energy from the sun, which is captured with a pigment called, chlorophyll; leaves convert carbon dioxide and water into oxygen and sugar (food!)
12. **Roots**: A tree's roots help anchor the tree in the ground. They also absorb water and nutrients from the soil.
13. **Rootlets**: As a tree's taproot and lateral roots grow away from the tree, they branch into finer and finer roots. Redwoods do not have a taproot.
14. **Root hairs**: The rootlets divide into even finer ***root hairs.*** These root hairs absorb approximately 95 percent of the water and nutrients absorbed by the tree.
15. **Sapwood**: Also called the ***xylem*** (ZEYE-luhm), brings water and nutrients up from the roots to the leaves; older xylem cells become part of the heartwood.
16. **Stomata**: Tiny holes on the under surface of the leaves where the gases needed for and generated by photosynthesis enter and exit.
17. **Taproot**: A root that grows straight down into the ground, but not redwoods.
18. **Tree**: A woody plant with a trunk. It is also a machine run by the sun's energy, manufacturing its own food out of water and carbon dioxide. It is powerful enough to split a rock or support tons of weight, produce oxygen, water, food, and fuel and rather than pollute the air, actually cleanses and beautifies the air.
19. **Respiration**: The evaporation of H_2O that uses stored sugars and some oxygen to make carbon dioxide and water again.
20. **Transpiration**: When water vapor exits through the stomata in the leaves.
21. **Trunk**: The trunk's main function is to support the branches and twigs, which in turn expose the crown of leaves to the sunlight. The trunk and branches contain the tree's "pipes" - the tubes that transport water and nutrients to the leaves, and sugar from the leaves to the rest of the tree. They also contain the growing layer of the tree that makes the trunk, branches, and roots of the tree thicker each year.
22. **Xylem**: Also called Sapwood. See definition above.

Tree Identification Background

Here is a list of characteristics that people use to identify trees, including definitions of commonly used terms.

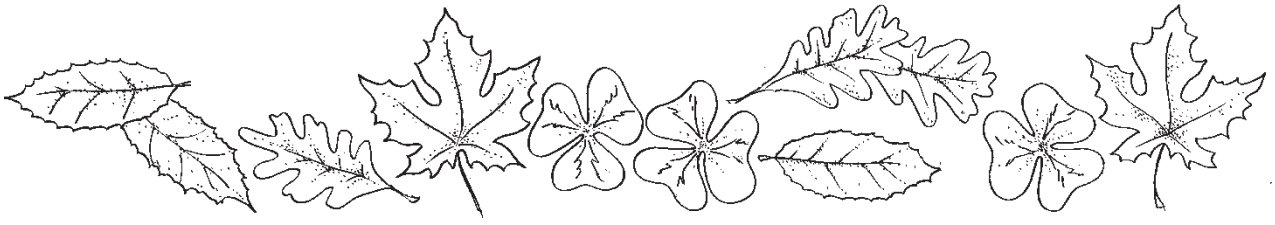
Needles or Broad Leaves
To make things simple we can divide trees into two basic groups: conifers and broad-leaf trees. Most **conifers** have seeds that develop inside cones, needle shaped leaves, and are evergreen. **Evergreens** do not lose all of their leaves each year, and thus they stay green year round. Pines, redwoods, and firs are examples of conifers. Broad-leaf trees such as oaks, maples, and apple trees have broad, flat leaves. Most broad leaf trees are **deciduous** in that they drop all of their leaves each year, many of them in Fall. There are exceptions to the general rules: live oaks are broad-leaf trees that are evergreen, the dawn redwood has needles and cones but drops its leaves every year, and some conifers don't even have cones.

The Shape of Leaves and Needles
The shape of a leaf can be used to identify the tree from which it came. For example, willows tend to have **lance shaped** or long, slender leaves, whereas madrones and tanoaks have oval shaped leaves. The tips of the leaves may be pointed or rounded, and the bases of the leaves can be tapered or rounded, or heart-shaped. Redwood and fir needles tend to be flat, while pine needles are usually rounded on one side, with a roughly triangular cross-section.

The Edge of Leaves
The edges or margins of leaves can also be used to identify the tree. Some are smooth, some have teeth along edges, and some are lobed; the lobes can be pointed or rounded.

Textures
Leaves vary in how they feel to the touch. Some leaves feel soft or are completely hairy, while others are slick or entirely smooth.

Simple and Compound
Simple leaves consist of one piece. Examples of trees with simple leaves are oak, maple, bay and plum trees. **Compound leaves** are made up of several leaflets. Walnut, ash and buckeye are examples of trees with compound leaves.



Alternate and Opposite
Another characteristic that can be used to identify a tree is the way its leaves are arranged on the branches: **alternate leaves** are staggered along a stem, whereas **opposite leaves** grow in pairs across from each other along the stem.

Pinnate and Palmate
Compound leaves can be arranged in two ways: **pinnate leaves** are composed of leaflets arranged along a single stalk, whereas **palmate** means that the leaflets, lobes, or veins radiate out from a single center, like the fingers of a hand. Pinnate leaves can be opposite, as with ashes, or alternate. **Palmate** can refer to simple leaves, such as those on maple trees, as well as compound ones.

Twiggy Clues
Even leafless branches can help you identify a tree; this is especially useful in trying to identify deciduous trees in the winter. Sometimes the color of the younger branches can be helpful, as in some willows. By checking where the buds or leaf scars are on the branch, you can tell whether the leaves grow in an alternate or an opposite pattern. Leaf scars are the places on the branches where the leaves used to be attached. The size, color, shape, and hairiness of the buds can be used to identify trees. Spines and thorns on branches, and their lengths, can also help tell you which tree you are looking at.

Flowers and Fruit
Flowers can be used to identify some trees. There are both male and female flowers. The male flowers, often in the form of catkins, usually develop first. A **catkin** is a group of flowers, often of one sex, growing tightly clustered along a stem. Trees like oak, willow, alder and hazelnut have long, narrow male catkins. Female flowers are the ones we are more used to seeing. Each species of tree has flowers that vary in size, shape, color, number of petals, and a variety other features. Trees can also be identified by the kind of fruiting bodies they produce. A wide variety of different kinds, sizes, shapes, colors, textures, and other characteristics exist. Some produce fruit like apples and oranges that have an outer fleshy covering with multiple seeds inside. **Drupes** are a fruit with a single seed inside a fleshy covering, like cherries and plums. Some other fruits are berries and pods. **Nuts** are a one-seeded fruit covered by a hard or woody shell like acorns and filberts. **Cones** are a way that some trees hide and protect their seeds inside overlapping scales or bracts**.** A few trees, like maple, have winged seeds called **samaras.** All of these fruiting bodies can be used to identify trees.

Bark
Looking at the color and texture of bark can help in identifying a tree. You should look at the bark on the trunk rather than that on the branches; even the bark on the trunk of the tree changes as it gets older. Some things to look for are whether the bark is smooth, rough, shaggy, or scaly, whether

there is great contrast in the color or darkness of the bark, how deep and long the furrows are, and the shape and size of the plates, scales, or ridges.

Shapes of Trees
Many trees have characteristic shapes that can be used to identify them: palms have a definite look, conifers are often tall and narrow with a conical shape, many broad leaf trees have broad, rounded tops, and some bushes and small trees grow in clusters forming thickets.

Region and Habitat
Trees can sometimes be identified by where they are found by region and habitat. A **region** is a certain part of the country, or even state, where certain trees could be found naturally. Most tree identification books and guides are specifically designed to be used for a particular area like 'West Coast' or 'Northern California.' Books from other regions are not very helpful and are of little use in the wrong region.

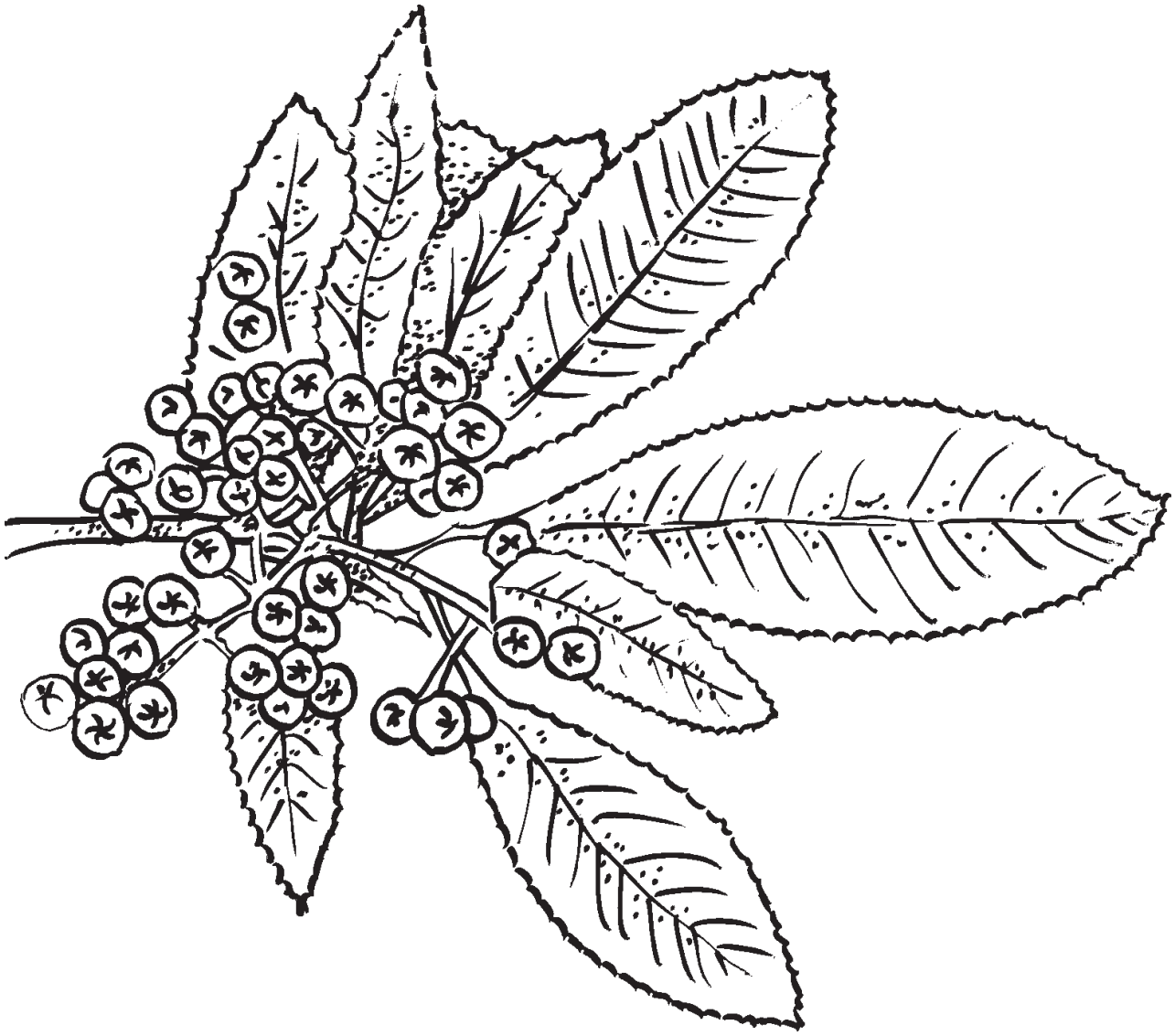
Habitat is the type of environment and growing conditions where living organisms are naturally found. While some trees are more tolerant to surviving in different habitats, others are only able to live in specific types of areas. Some major differences in habitats are the availability of water, amount of nutrients and soil, the exposure of sunlight, area temperature, and the presence of some poisonous substance. Here are some examples of different habitats.

In the **coast range habitat,** the climate has damp foggy sea air, a long growing season, and abundant rain. It supports a deep, dark, ferny forest where trees must compete for sunlight. **Dominant trees** grow rapidly, straight toward the light, with shade killing back lower trunk branches. **Understory trees** are shade tolerant throughout their life and often capture weak light with thin, broad, horizontally held leaves. Close to the **seacoast,** there are often trees that grow only on windy slopes facing the sea, usually in sandy soil.

California oakwoods is an area characterized by a mosaic of woods, grasslands and **chaparral** (stiff, dry, evergreen shrubbery) on hot slopes. The trees in this area are short, muscular-looking, and deep-rooted with small bristly leaves. They stand far apart or else cluster along canyons and north facing slopes. On warm sunny ridges, these trees grow slowly with roots in dry, rocky soil, where wind blows away the snow and shapes their resinous foliage.

On stream banks or in soggy soil, there is the **riparian habitat**. These trees, with lots of available water, grow fast, have shiny, pliable foliage, easily broken twigs, and softwood.

The **mixed evergreen forest** of the coast range is dominated by small Douglas-firs. There are no big redwoods or hemlocks in this habitat. The leaves here are often thick, leathery, and evergreen. This slows evaporation of moisture during dry summers and takes advantage of mild, wet winters.



Toyon
Heteromeles arbutifolia

Toyon is actually a shrub that sometimes grows into a small tree. The evergreen leaves are 4 inches long, shiny dark green on top, lighter green on the bottom. It grows both near streambeds and hillsides and is native to the Pacific Coast range the length of California. The white flowers in summer turn into bright red berries during the winter, hence its other common names, Christmas Berry or California Holly. Conservationists like the Toyon because it is one of the first plants to recover after a fire, helping to prevent erosion.

Did you know? The red berries are too sour to eat, but they make lovely Christmas decorations. Toyon are found in the Armstrong Grove flood plain.

Tanoak
Lithocarpus densiflorus

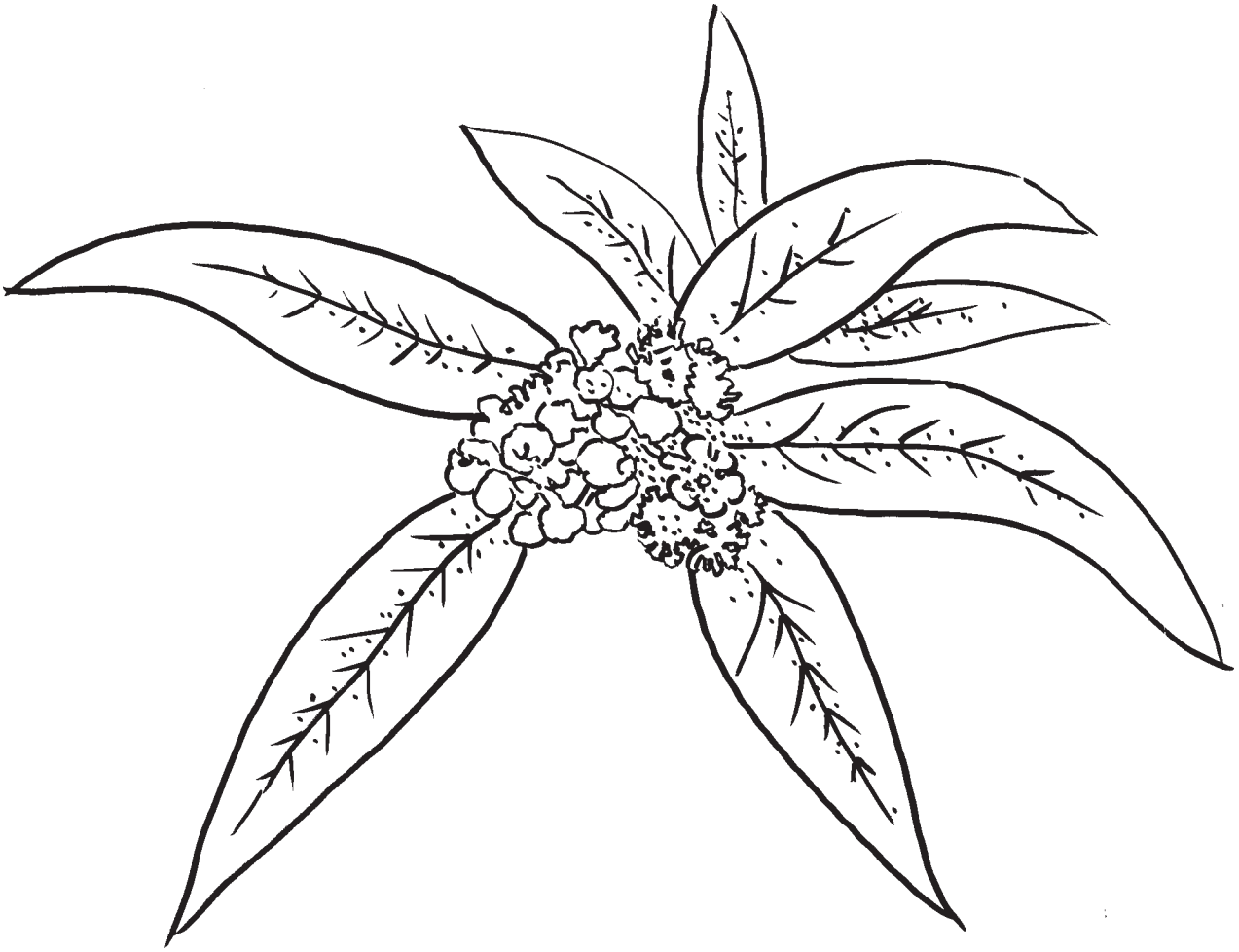
The Tanoak tree is not a true oak, based on how their catkins grow compared to true oak, but is closely related. It is an evergreen tree that grows slowly to 50 feet. It is native to moist valleys and hillsides along the Pacific coast from southern Oregon to southern California. It sometimes grows in pure stands, but usually is found growing with redwoods, Douglas-firs and oaks. The light green leaves are thick and shiny on top and densely woolly with reddish brown hairs underneath. The prolific acorns closely resemble those of live oaks.

Did you know? Some animals like to eat the acorns and the local Native Americans collected them for food. They would dry them, grind them into flour, and rinse the flour in water to get rid of the bad taste. Then the flour was used to bake bread and cakes. The bark of the Tanoak contains tannin, an organic compound, which was used to soften hides to make leather years ago.

Coast Redwood
Sequoia sempervirens

The Coast Redwood is the world's tallest tree and can grow to over 300 feet tall. This evergreen tree is native to coastal valleys in the fog belt from southern Oregon to the central California coast. It always grows in pure stands and is rarely found more than 35 miles from the Pacific coast. It differs from other trees in that it has two types of evergreen needles; most are flat, except for those at the top of the tree, which are curved to assist in collecting moisture from the air. This giant tree has very small cones, less than 1 inch wide and its seeds are very tiny. The bark of the redwood is very thick and fibrous, which protects the tree from insects, water, and fire. Redwoods reproduce both by seed and by sprouting from the base, creating circles of trees (fairy rings) around the stumps of old redwoods.

Did you know? Redwood is a prized lumber because the wood is naturally resistant to insects and rot. The native Pomo Indians used big pieces of redwood bark to cover their houses, because it sheds water and provides insulation.



California Laurel or Bay
Umbellularia californica

California Laurel or Bay tree is an evergreen tree native to southern Oregon and northern California. It is often found growing in redwood groves. It is a medium sized tree, often multi-branched. The shiny green leaves are thick and leathery and very aromatic when crushed. Small yellowish-white flowers bloom in clusters in early spring, followed by round greenish-purple fruit in the fall.

Did you know? Indians ate the nuts after roasting them or grinding them into flour and making small cakes. Placing a piece of leaf inside the nostril is reported to cure headaches, and sometimes a tea was made from the leaves to cure stomach pains. The leaves were also added to a hot bath to cure rheumatism. The Indians also used the leaves to repel fleas.

Doulas-Fir
Pseudotsuga menziesii

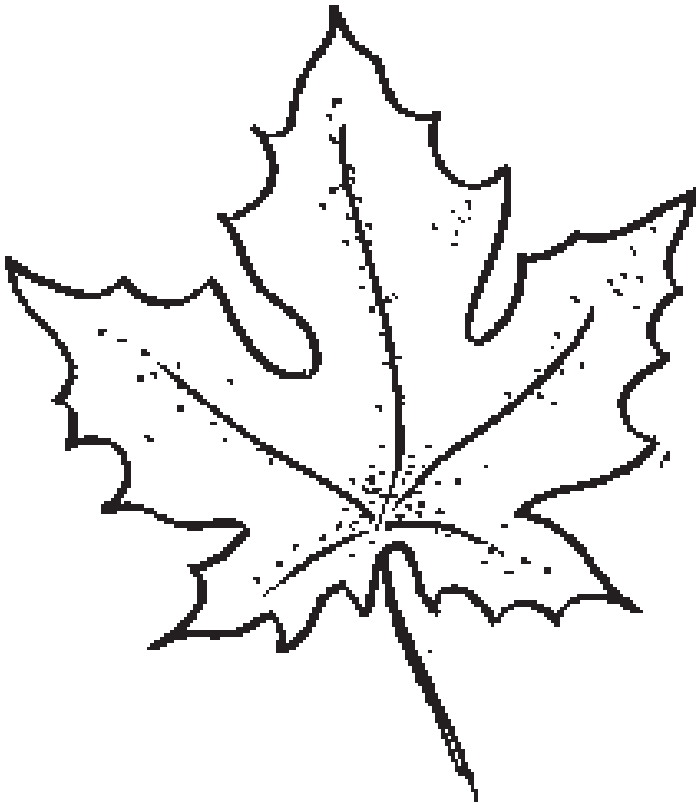
The Douglas-fir is a very tall, evergreen tree native to the Pacific Coast. It grows in pure stands along the Pacific Coast from southern Alaska to San Francisco. The blue green needles are about one inch long. The reddish-brown bark is very thick and furrowed in broad ridges. The cones are about three inches long, with three-point bracts, which look like the tails and hind feet of little mice hiding in the cones. The needles have a fruity fragrance and are eaten by deer and elk. Other mammals eat the seeds.

Did you know? The Douglas-fir is the #1 lumber tree in the U.S.A. It is also used in the manufacture of plywood, and we often decorate it for our Christmas trees.

California Hazelnut
Corylus cornuta

The native hazelnut is not really a tree, but more of a large shrub, rarely exceeding eighteen feet high. Although smaller, the native hazelnut, when roasted, has the same flavor as the commercial hazelnut. The fruit, often paired, mature in late summer and are covered by a tubular, bristly husk, like a little vase. You should wear gloves if you try to husk more than a few of them.

The two-inch long leaves are almost as wide as they are long with rounded bases and pointed tips. Young leaves feel very soft and take on a fuzzy appearance. In shady areas, mature leaves can retain that softness. The tree has slender branches that are spread out and open, giving the tree an airy, delicate appearance. They're a beautiful addition to the understory of a redwood forest. In winter the male catkins elongate and hang down, making a beautiful complement to the horizontal groups of branches.



Bigleaf Maple
Acer macrophyllum

The Bigleaf maple has one of the largest leaves of native trees in our area, usually six to twelve inches in diameter, sometimes 15 inches. The leaves are shiny, dark green above, and paler and hairy beneath, and give a bright green color in sunlight when viewed from below. The leaves turn yellow in the fall with brown and orange accents, pleasing to the eye. In Spring, small yellow/cream colored flowers mature into typical double samaras (winged seeds). When the seeds fall from the tree, the seeds spin rapidly, slowing their descent and allowing them to be distributed more widely by wind.

The Bigleaf maple can be a small to large (up to 100-feet tall) tree with a broad, rounded crown of spreading or drooping branches. It requires a lot of water, so it is usually found near streams or in moist, shady draws.

California Buckeye
Aesculus californica

The California buckeye is a small, shrub-like tree native to canyons and hillsides in chaparral and oak woodland in the California Coast Ranges and Sierra Nevada foothills. The dark green, five-fingered leaves are among the first to appear in the spring. The fragrant white flowers grow in clusters and bloom from late spring to early summer. The California Buckeye is one of the first trees to lose its leaves in late summer, revealing large round, smooth, pale brown seedpods that hang on the branches like Christmas ornaments.

Did you know? The seeds of the Buckeye are poisonous when raw. Local Indians put them in pools of water to stun the fish so they could be easily caught. If the toxic elements are leached out, the seeds can be ground to make flour for bread. The nectar and pollen are poisonous to bees.

Activity

Keying Out Trees Using Leaves

TIME:
Preparation: 30 minutes
Activities: 60 minutes

Materials:
1. Leaves (on the key)
2. Keying out trees- Leaf Key
3. Leaf Key Worksheet
4. Pencils

Grade level: 4th and up

DIRECTIONS:

1. **Prepare** by finding as many of the different leaves on the Leaf Key as possible. Set up a table of these for students to look at or take back to their desks. Number the leaves by marking on a piece of tape on the stem.

2. **Demonstrate** how to use the Leaf Key by selecting one of the leaves and working through the questions with the students.

3. **Record** the number of the leaf on the Leaf Key Worksheet. Start at the beginning of the Leaf Key, then go to the next number that most closely describes the leaves or needles. As they proceed, list the statements that apply to the leaf on the worksheet. This will allow students to track how they got to the ID. After a few choices, they should come to the name of the tree they are trying to identify.

4. **List** the name of the tree on the worksheet.

5. **Draw** a simple picture of the leaf in the box on the worksheet.

6. **Hand out** the Leaf Keys, worksheets, then have students select leaves or needles to identify. Determine if the students should work as groups or individually.

7. **Share the results** of the class at the end of the activity. Have students give the path they chose to come to the tree identity.

Keying Out Trees: Leaf Key

1.	Leaves are shaped like needles	go to 2
	Leaves are broad and flat	go to 7
2.	Needles are long	go to 3
	Needles are short	go to 4
3.	Needles are in-groups of two	**BISHOP PINE**
	Needles are in-groups of three and dark green	**MONTEREY PINE**
4.	Needles are arranged around the stems	**D.FIR OR SPRUCE**
	Needles are in two rows and flat	go to 5
5.	Needles have blunt tips	**TRUE FIRS**
	Needles have sharp tips	go to 6
6.	Needles are usually less than one inch long	**COAST REDWOOD**
	Needles are usually more than inch long and very sharp	**CA NUTMEG**
7.	Leaves are opposite	go to 8
	Leaf branches are alternate	go to 10
8.	Leaves are simple and palmate	**BIG LEAF MAPLE**
	Leaves are compound	go to 9
9.	Leaves are pinnate	**OREGON ASH**
	Leaves are palmate	**CA BUCKEYE**
10.	Narrow elliptical or lance-shaped with smooth edges	**BAY-LAUREL**
	Leaves are lobed or toothed	go to 11
11.	Leaves are lobed	go to 12
	Leaves are toothed	go to 13
12.	Leaves have rounded lobes	**WHITE OAK**
	Leaves have pointed lobes	**BLACK OAK**
13.	Points are well separated	**LIVE OAK**
	Teeth are close together	go to 14
14.	Main veins are branched, leaves stiff	**TOYON**
	Main veins are parallel	go to 15
15.	There are more teeth than main veins	**RED ALDER**
	Veins go to ends of points	go to 16
16.	Leaf is oval and stiff	**TAN OAK**
	Leaf is broad, blunt-tipped, and soft	**HAZELNUT**

Keying out Trees: Leaf Key Worksheet

Name:_____

Leaf # _____ Tree ID: _____ Draw a picture

Key Choice:

_____
_____
_____
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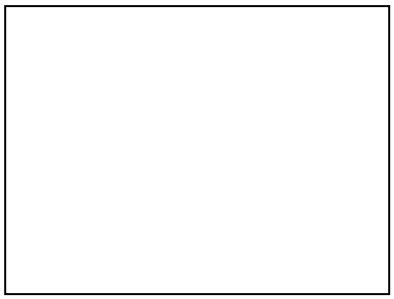
_____
_____



Leaf # _____ Tree ID: _____ Draw a picture

Key Choice:

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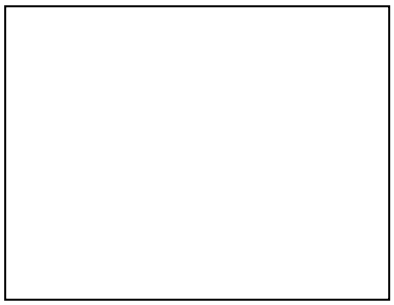

Leaf # _____ Tree ID: _____ Draw a picture

Key Choice:

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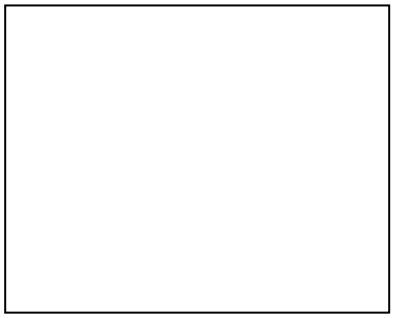

Leaf # _____ Tree ID: _____ Draw a picture

Key Choice:

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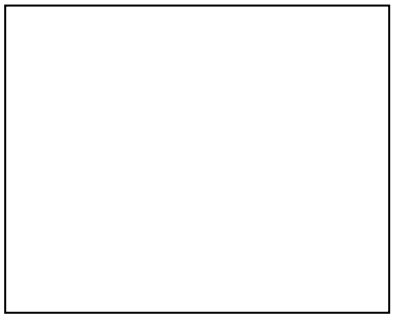


Activity

Find the Culprits

TIME:
Preparation: 30-45 min
Activity: 60-90 min

MATERIALS:
1. Field guides
2. Identification sheets
3. Pencils
4. Clipboards
5. Leaves

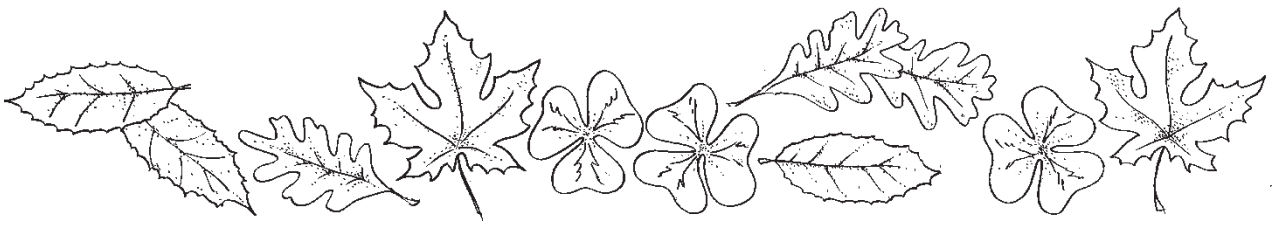
Grade level: 4th and up

DIRECTIONS:
Getting Ready
1. **Identify 7-10 trees** on your school property. If there are not that many different types of trees that are easy to tell apart, you can use shrubs instead. The field guides listed can be used to identify the trees or shrubs. You can also ask a groundskeeper, biologist, or other tree expert for help.

2. **Collect twigs or small branches** from 3 or 4 different trees. The twigs should be long enough to have several leaves. If possible, use twigs that have already fallen to the ground or have been pruned. Try to collect twigs from both needle and broad-leaf trees.

3. On a sheet titled "Tree Suspects" **copy drawings** of leaves from the different trees you identified. The field guides that use line drawings are a possible source for these drawings. Under each leaf, write the tree's name. See the Copy page provided.

4. On a second sheet titled "Tree Clues" **make a list of "clues"** about each tree: the shape of the tree, what the bark looks like, any flowers or fruit present during the time of the activity, etc. The clues should not include where the tree can be found on the school property. Under each set of clues draw a line for students to fill in the name of the tree after they have found the culprit. See the copy page provided.



Find the Culprits - continued

Doing the Activity

1. In class ask the students what characteristics or clues they might use to identify trees. As they give their ideas, ask how they could use these clues to identify trees. List their ideas on a chalkboard.

2. Hold up the branches you collected earlier, or pass them around the room. Have the students compare and contrast them. Can students suggest any other ways they might be able to tell trees apart? List any additional ideas on chalkboard.
3. Use the student's list and vocabulary terms from the previous activity to discuss ways people identify trees. Be sure to go over basic leaf characteristics such as shapes, tips, leaf edges, simple and compound, pinnate and palmate, and alternate and opposite branching patterns.

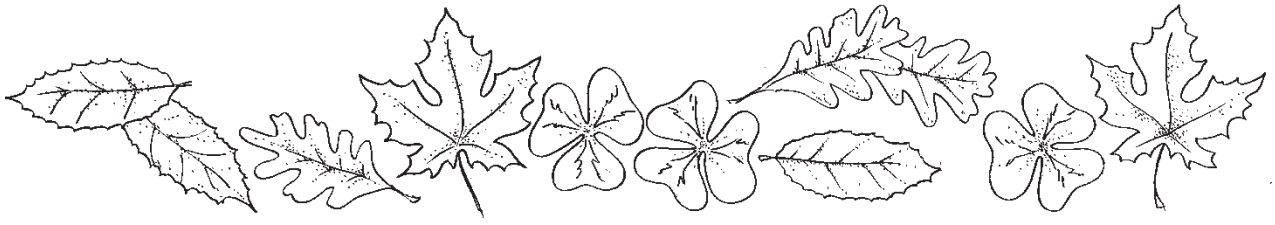
4. Divide the group into teams and give each student a copy of both sheets you made earlier (see Getting Ready).

5. Tell the teams that they will use trees on school property to match the leaf shapes and names on Tree Suspects with the Tree Clues. Explain that first the students should try to find a tree whose leaves match the drawings on Tree Suspects, then, by comparing their observations with the clues, they can make the match.

6. Some teams might find it easier to find a tree from the clues, and match its leaves to a drawing on Tree Suspects. This is also a valid method, so don't discourage it. Once the match is made, they should write the tree's name on the Culprit line below the clues.

7. Take the students outside and let them go to work. Don't forget to set limits on how far students can wander and how much time they have.

8. When back inside, go over the sheets as a group. Which team made the most correct identifications?



Find the Culprits

Tree Suspects

Leaf Drawings **Tree Name:**	**Leaf Drawings** **Tree Name:**
Leaf Drawings **Tree Name:**	**Leaf Drawings** **Tree Name:**
Leaf Drawings **Tree Name:**	**Leaf Drawings** **Tree Name:**

Find the Culprits

Tree Clues: (Examples: size and shape of the tree, bark, flowers, fruit)

Clues **Tree Name:**	**Clues** **Tree Name:**
Clues **Tree Name:**	**Clues** **Tree Name:**
Clues **Tree Name:**	**Clues** **Tree Name:**

Activity

Leaf Hunt Relay

Time:
Preparation: 10 min
Activity: 60 min

Materials:
1. Leaves
2. Slips of paper
3. Small paper bags

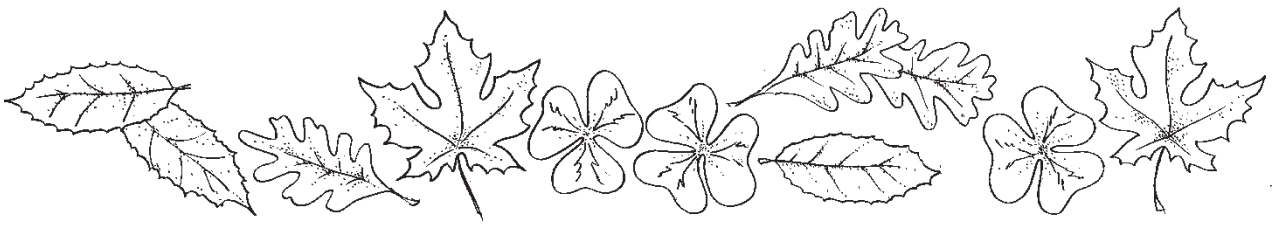
Grade level: 4th and up

Directions:
1. Divide the class into teams and have each team collect three leaves from each of the trees identified in Find the Culprit. Encourage students to collect fallen leaves rather than taking live leaves off of trees. They could also cut the proper leaf shapes out of heavy paper or cardboard (make sure that tree names are not on the leaf shapes).

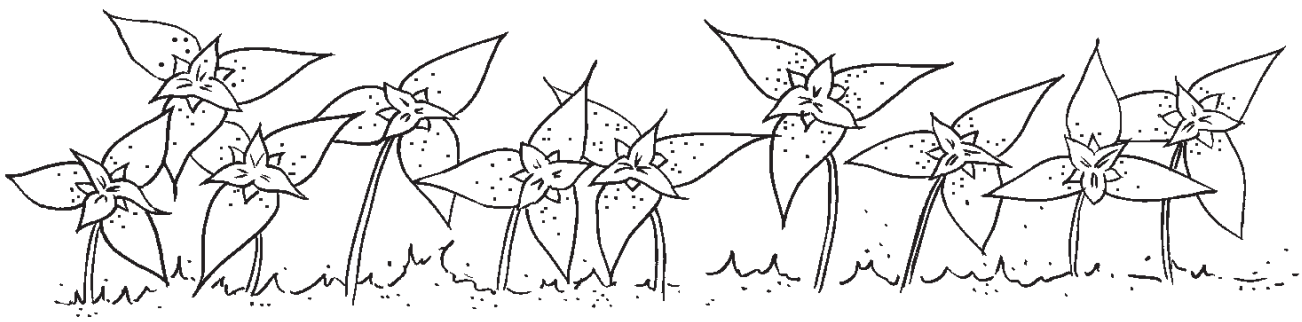
2. Take the students to an open area and explain that they will have a leaf hunt relay, in which their score will depend on the correct number of identifications made. Line them up in their teams and set each team's pile a set distance in front of each team. Tell the students that you are going to call out the name of the tree, and then you will tell them to "go."

3. At the signal "go" the first student in each team's line will go to his or her team's pile of leaves, find the leaf that comes from the tree you named, and hold it up. Be sure to give a time limit, and state that only the first leaf held up counts. Each team gets one point for each leaf correctly identified, and the team with the most points wins.

4. After each round, the contestants will put the leaves back in their piles, and then each contestant will go to the end of his or her team's line. Continue until you call out all of the tree names on the list.



Plants and Flowers



Flowers of Armstrong Redwoods

Flowering plants are plants that usually contain chlorophyll and can produce seeds. Seed producers are subdivided into gymnosperms (naked seed), which include the conifers and angiosperms (encapsulated seed) which include flowering plants.

Parts of a Flower
The pistil and ovary are the female part of the flower, and the anther and stamen are the male part.

Flowering plants can be subdivided into monocots (short for monocotyledon), which include the lilies and grasses; and the dicots, which include the rose, sunflower, and pea families. The monocots are named that because the sprouting part of the seed consists of one unit, as can be seen in a kernel of corn; in dicots the sprouting part is divided into two parts, as can be seen in a pea. Monocot flowers usually have petals in multiples of three, and their leaves are mostly parallel veined; dicots usually have four, five, or many petals, and leaves are network-veined. Most of the wild flowers with many petals are members of the sunflower, or composite, family. They can have two types: disk flowers, which are in the center, and ray flowers, which are around the edge. Each ray petal is connected to a complete flower with both female and male parts. Many composites, such as dandelion, have only ray flowers.

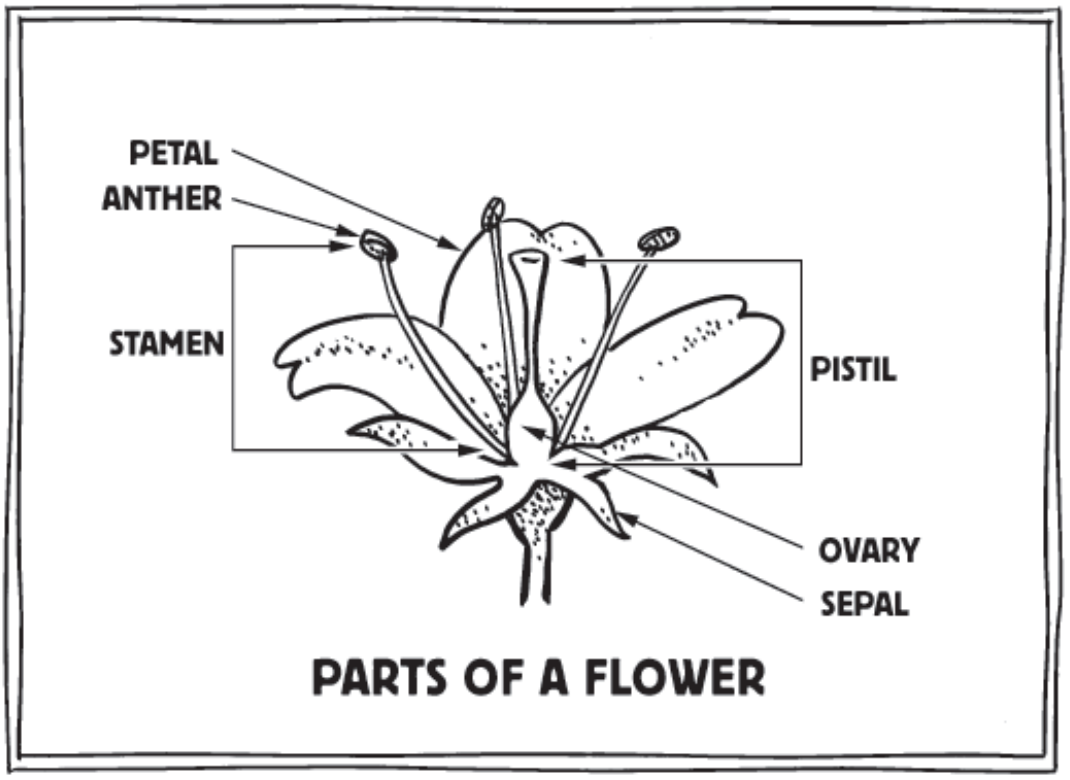
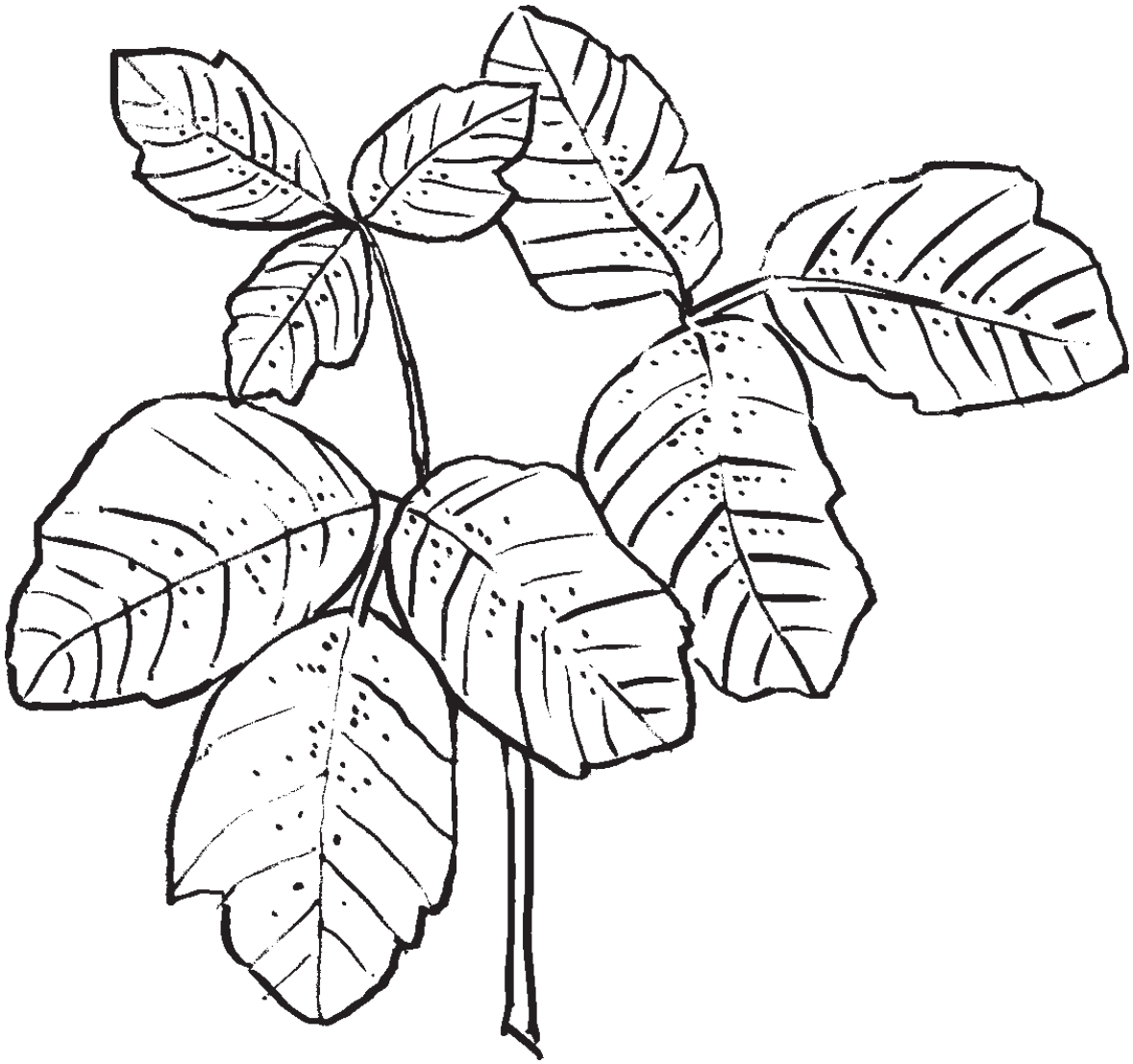


Illustration from The Nature of California
Raymond Leung

Redwood Sorrel
Oxalis oregana

The pink, sometimes white, funnel-like flowers, about one inch in diameter, with five symmetrical petals, grow individually on short stalks in an upright position. The clover-like leaves are heart-shaped, and are lighter colored close to the central vein; they will fold in hot weather or in direct sunlight. It is very common in redwood groves fairly close to the coast, growing low, and sometimes covering the forest floor like a thick carpet.



Poison Oak
Toxicodendron diversilobum

"Leaves of three, let it be." Small cream or white flowers matures to light green or white berries. Roughly oval leaves are separate and in groups of three. As its species name implies, there is great variety in the leaves, not only in terms of shape, but also in shininess. The leaves turn red in the fall, or, in dry years, in late summer. Even when the leaves have fallen, the stems can still cause a rash, so if you see a vine or many-stemmed bush without leaves in the woods, don't touch it unless you know for sure what it is. The local Native Americans were immune to poison oak; they used the stems to make baskets, and the sap for dyeing and even tattooing. Poison oak can take the form of vines, bushes, or even small trees; to see a really tall vine, check out the one on the Parson Jones Tree.

Fetid Adder's Tongue/Slinkpod
Scoliopus bigelovii

The half inch diameter flowers have purple veins on a white or light green background, making them difficult to spot in the shade, and belying their up-close beauty. It blooms from January through March. As you can guess from its name, they don't smell good. The flowers are on long, bendable stems. The wide, oval-shaped leaves have darker or purple spots. There are high concentrations of them around the Forest Theater and just east of the east parking lot.

Western Trillium
Trillium ovatum

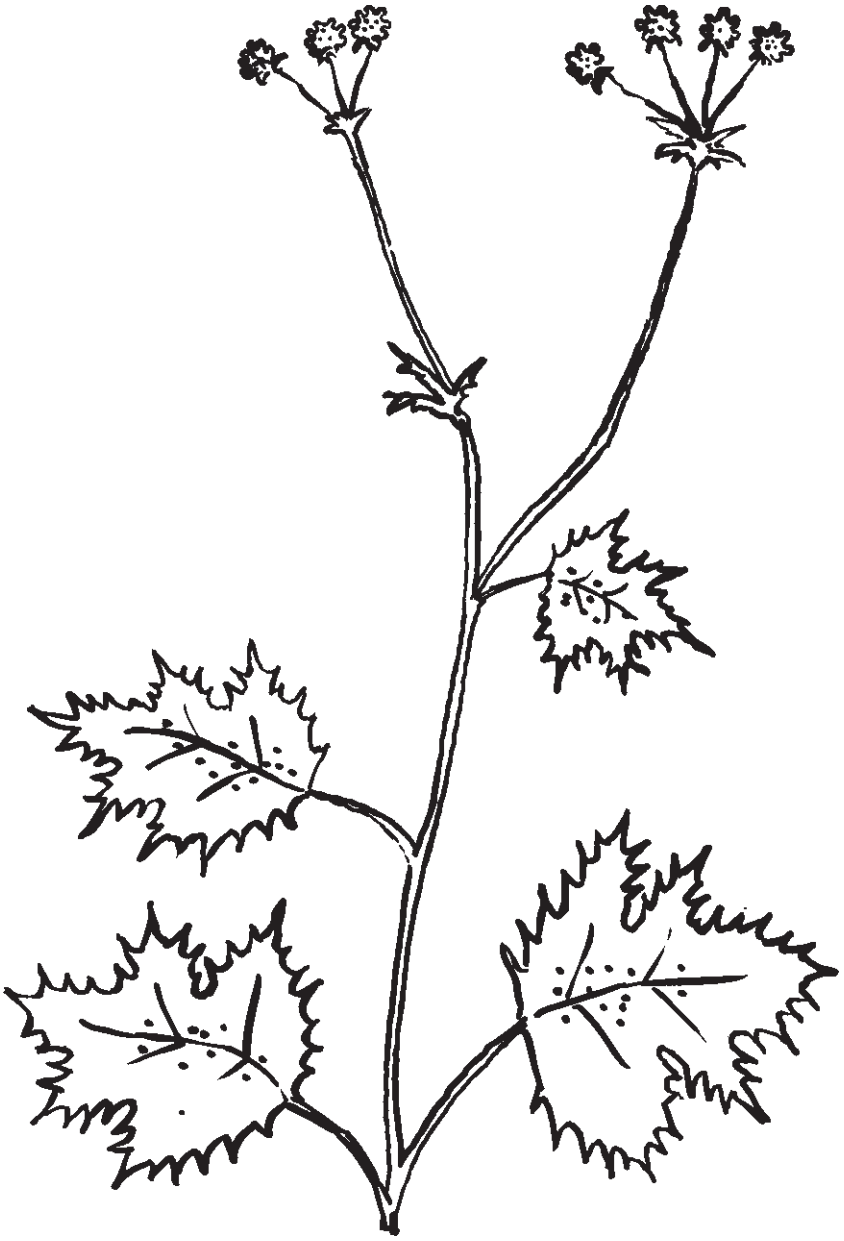
The pink, white, or purple flowers, about one and a quarter of an inch in diameter are on a stalk about three inches wide with sharp pointed green leaves. It blooms in early spring, and can be found on the Pool Ridge Trail near the Armstrong Tree. If you are lucky, you may also see Giant Trillium.

Calypso Orchid/Redwood Orchid
Calypso bulbosa

Each plant has a single, half inch flower of a unique purple-pink color on a leafless stem above a single oval leaf. The lip petal is mottled. There is a high concentration where the trail from the Forest Theater meets the Armstrong Tree Road, between the Picnic Area and where Armstrong Woods Road starts uphill, and there are a few behind the Visitor Center.

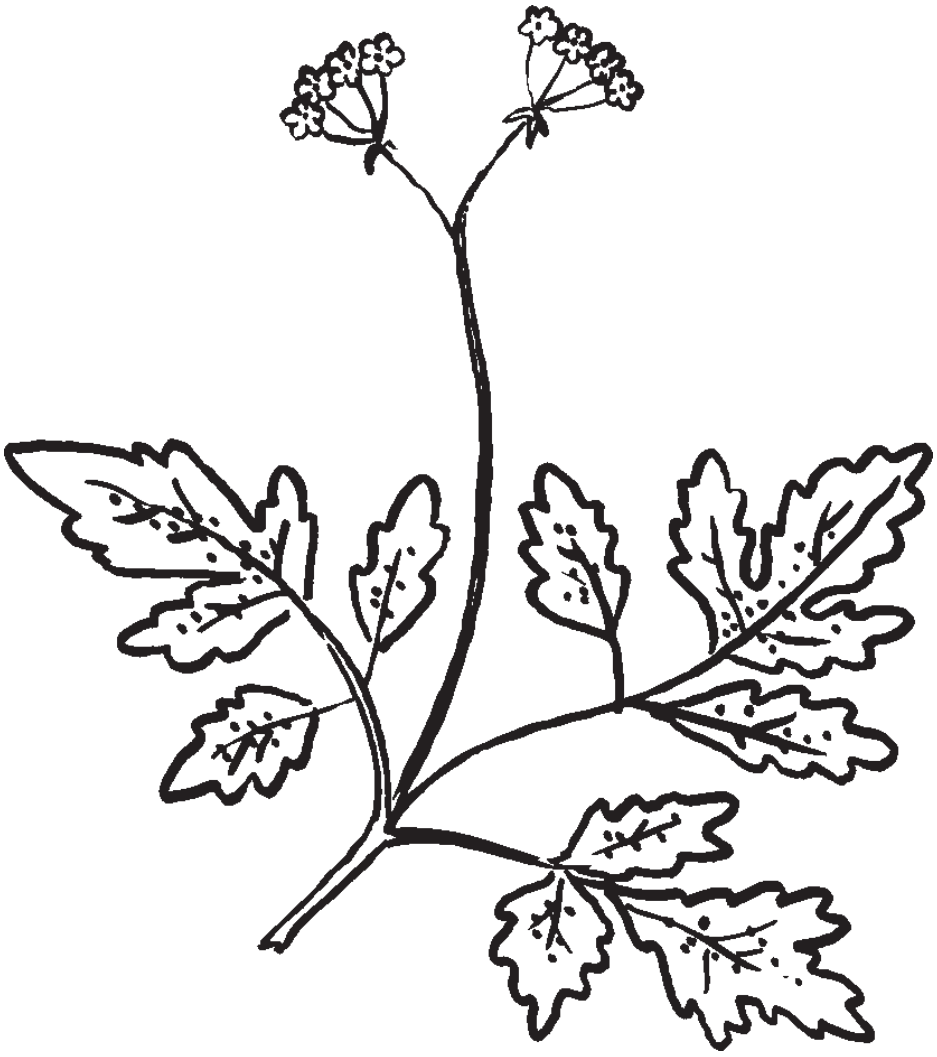
Henderson's Shooting Star
Dodecatheon hendersonii

The pink to pale purplish-red flowers, about five-eighths inch long, are on a fairly tall stem; the petals are steeply swept back, and the tip is pointed with the anthers all dark. The petals are yellow near their bases. They bloom in early spring. The leaves grow from the base and are a rounded oval shape near their ends. They can be found northeast of the East Parking Lot.



Pacific Snakeroot/Sanicle
Sanicula crassicaulis

Tiny yellow flowers grow in clusters, with bracts at the base of each group, on foot tall stalks. Basal leaves are three or five lobed, toothed, and about two inches in diameter. A typical early three-lobed leaf can be seen in the winter. It is found east of the Picnic Area, near the Volunteer Center building and on many forested slopes.

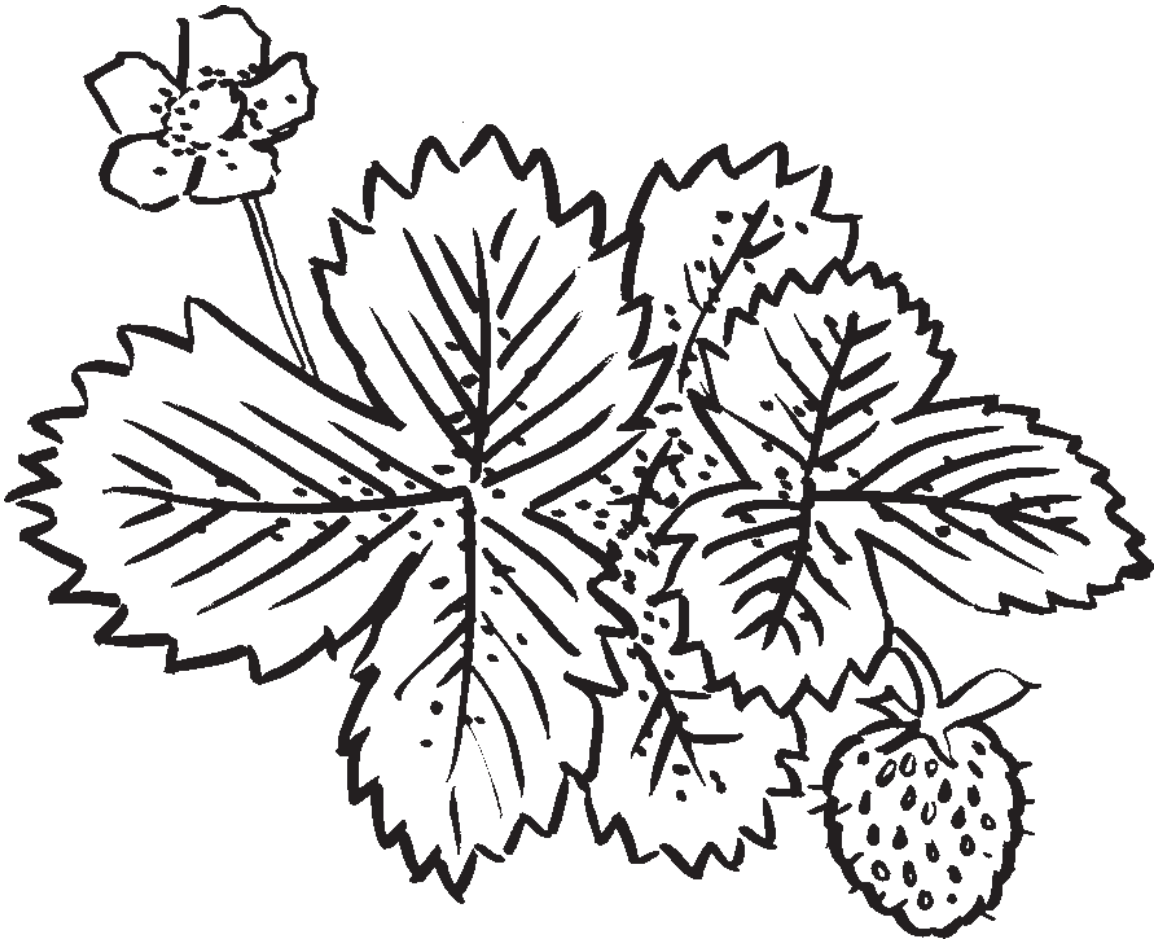


Sweet Cicely
Osmorhiza chilensis (Non-native)

A few tiny, white flowers arranged in an umbrella shape on fairly long stems mature to long, narrow, bristly seeds that point downward, clasping the stem. Triangular or diamond-shaped leaflets are in several groups of three and five about one-quarter inch long. Some can be found on the north side of the road to the Maintenance Building, northeast of the Picnic Area.

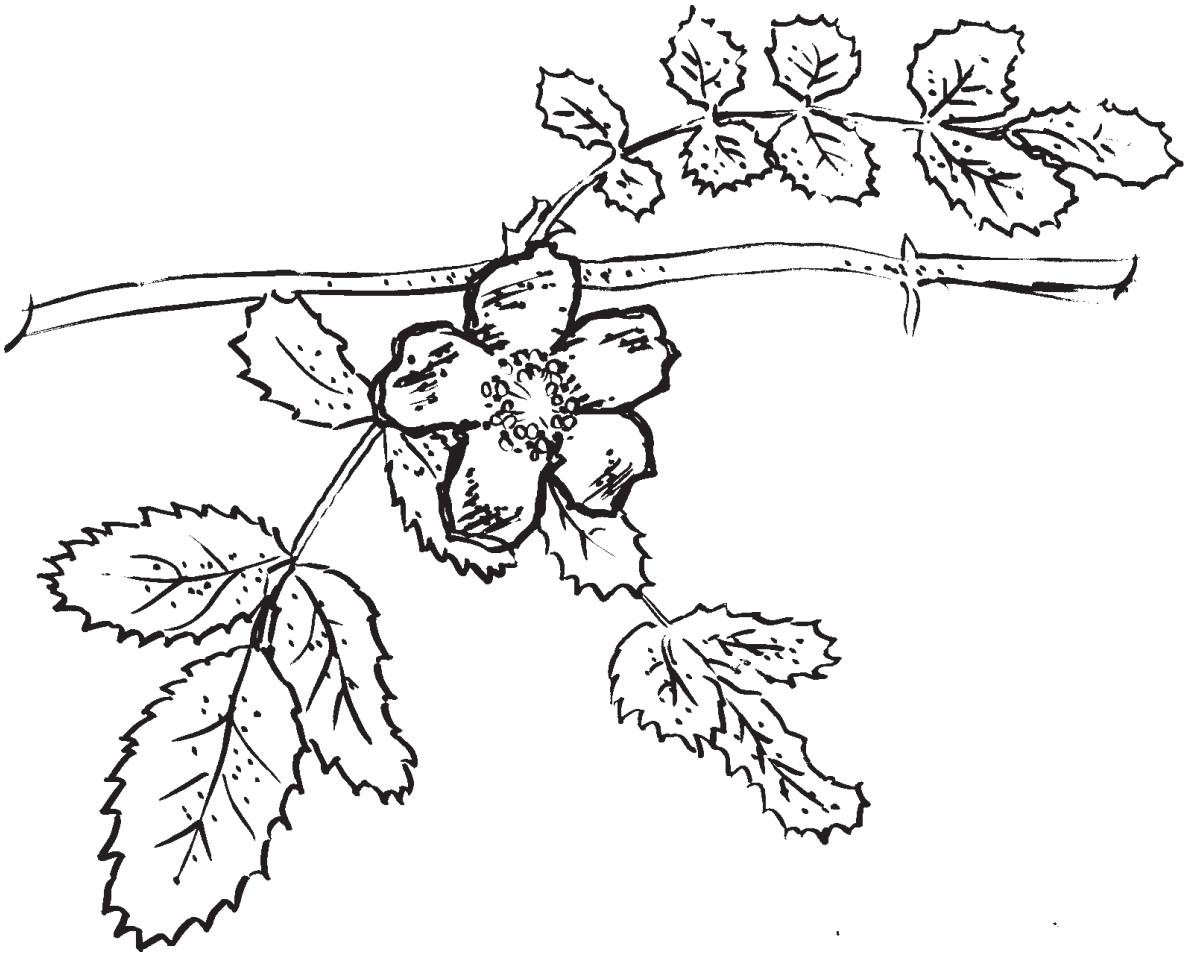
Golden Fairy Lantern/Yellow Globe Lily
Calochortus amabilis

The bright yellow, three-quarters inch in diameter flowers usually hang down, with the petals forming a near sphere, and the three sepals sticking almost straight out. The leaves are narrow and strap-like. They are found on the slopes of Armstrong Woods Road just above the Picnic Area, and behind the Maintenance Building.



Wood Strawberry
Fragaria vesca

Half-inch white flowers with five petals and a yellow center grow on stalks one inch or longer, usually blooming in early spring. Very small berries ripen in early summer. Leaves grow up from the base, consisting of three oval toothed leaflets about three-quarters of an inch long; their surfaces are a shiny green deeply indented at the veins. They can be found northeast of the East Parking Lot and in other moist shady places.



Wood Rose
Rosa gymnocarpa

A fairly tall shrub with narrow, prickly stems. The pink flowers are about three-quarters of an inch in diameter and have a sweet, powdery odor, sometimes with a hint of cinnamon. In fall the orange or red rose hips, about three-eighths of an inch long, are prominent. Leaves are pinnate compounds and opposite, with five to nine oval, toothed leaflets about one half inch long that are dropped in the winter. The thin thorns stick straight out.

Thimbleberry
Rubus parviflorus

This fairly tall stalky looking plant has large, soft hairy leaves. The one inch, white flowers have wide petals, which become light orange to red berries in the fall. The berries are ripe when red, and easily pull off of their attachments. The larger leaves are about three inches in diameter with a rounded maple shape. The many upright jointed stems have no thorns. They are found southwest of the park entrance station.

Himalayan Blackberry
Rubus discolor (Non-native)

This plant has white or light pink flowers, about one inch in diameter, with wide petals. The fruit is usually larger and tastier than those of Blue Stem Raspberry or California Blackberry. Leaves have three or five separated leaflets arranged palmately. Young stems do not have a bluish cast, and older stems are thicker and more ridged than those of the native berries, with fewer, larger thorns. This non-native plant is bad, not only because it can crowd out native plants, but also because animals that have adapted to the more numerous and smaller thorns of native berries and roses can get caught in the vine and tear their flesh when they try to pull away. They can be found along Armstrong Woods Road near the entrance to the park.

Sticky Monkey Flower
Mimulus aurantiacus

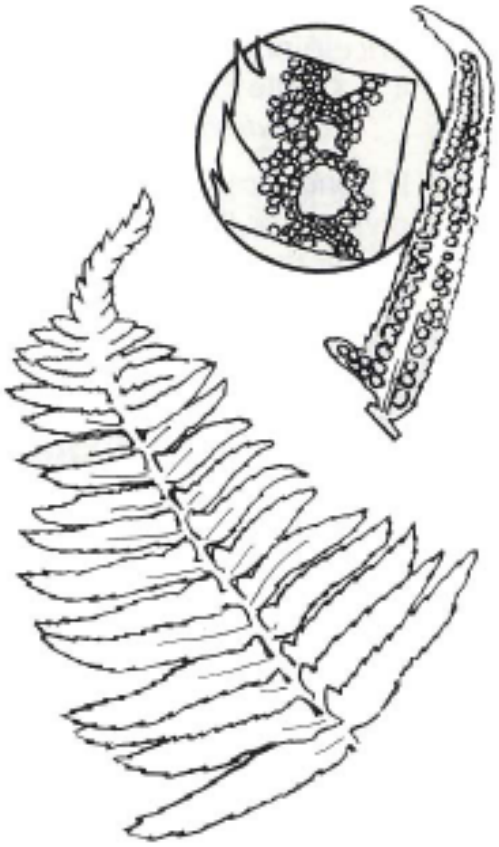
This plant has orange, often pale, tube-shaped flower with five fused petals, the upper two slightly being larger are about three-quarters of an inch in diameter. The narrow tapered ovate, dark-green, sticky leaves are about one inch long and are oppositely arranged on woody stems. They are found at the beginning of the East Ridge Trail and on steep, rocky slopes along Armstrong Woods Road.

Ferns at Armstrong Redwoods

Graphic from Pacific Coast Fern Finder
Glenn Keater, Ph.D, and Ruth M. Heady

Bracken Fern
Pteridium aquilinum

It is one of the most widespread plants in the world, growing in dry, open grasslands and in deep, moist forests, from sea level to high elevations. It is unusual in having branched stems. It grows one to four feet high with wide, triangular fronds that are highly divided. Conspicuous spores form in late spring and early summer, following the edges of the pinnae. Most turn yellow and brown and die back in the winter. Some consider the young fronds a delicacy, but eating too much can be dangerous, and mature plant parts are poisonous.

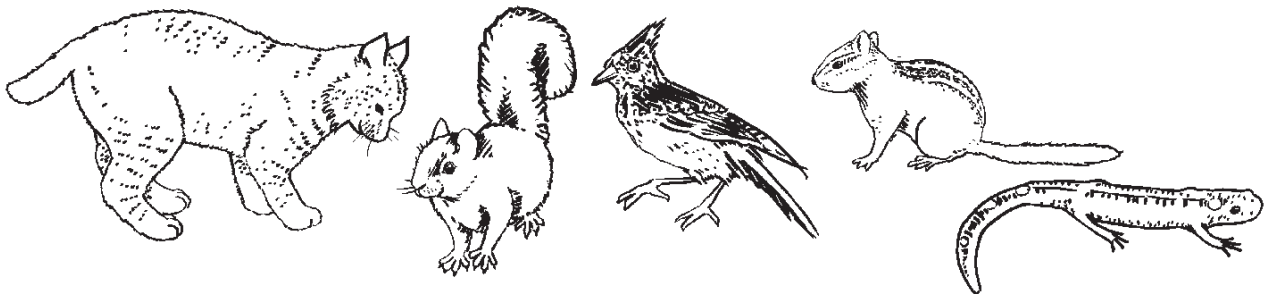


Graphic from Pacific Coast Fern Finder
Glenn Keater, Ph.D, and Ruth M. Heady

Sword Fern
Polystichum munitum

Coastal redwoods and sword ferns go hand in hand. The sword fern receives its common name from the small perpendicular projection at the base of its pinnae, or leaflet, which resembles the hilt of a sword. The sword fern is also known as "Christmas Fern." While common to the redwood forest, sword ferns have been a part of the earth's plant community for millions of years, since the time of the dinosaur. The sword fern has adapted to a wide range of growing conditions. It thrives best in the damp environment and rich soil of the redwood forest. It is a striking evergreen plant with blades that grow up to five feet in length. Sword ferns reproduce the old fashioned way—not by flowers and seeds, but by spores that are located on the underside of their leaves.

Mammals



Land Mammals

Mammals share certain characteristics:

1. Mammals have a backbone.
2. Mammals bear live young which nurse from the mother's mammary glands.
3. Mammals are covered with fur or hair.
4. Mammals have adapted to their living conditions, which is evident in their means of locomotion. Mammals that live on the ground are ambulatory (walking) or cursorial (running). They may walk with their heel on the surface (humans or bears) or they may run on their toes (rabbits, bobcats, and coyotes). If they live in the trees (arboreal) they usually have long toes ending in sharp claws, as in squirrels. Bats are the only mammals that are truly able to fly. Burrowing mammals (fossorial) have modified forefeet for digging (broad-footed mole).
5. Except for the whales, mammals' digits (fingers or toes) end in claws, nails or hoofs.
6. Teeth indicate the diet of mammals. Except for baleen whales and anteaters, all mammals have teeth.

Like most wild animals, mammals avoid human contact. Come in the early morning or visit at dusk and you will have the best chance of seeing some of these elusive creatures. Many of them are nocturnal or are starting to feed and move around just before sunrise and sunset. Your chances are enhanced by being alert, moving slowly, wearing clothing which blends with the surroundings, and being still.

Although it's difficult to see mammals, it's easy to see the signs of their presence: tracks, scat, fur caught on twigs, burrows, bones, paths, grazed areas, beds, and dens. Look for these clues when walking, and encourage visitors to do so as well. Mammal tracks, for example, are often found near burrows, in mud, in the dust along trails, or under sheltering boulders or logs.

Chipmunk

Eutamias spp.

These large dark chipmunks have blurred side stripes of the same width and light stripes that are yellowish. A favorite jester of the forests. They are eight inches, including a three to five inch tail. It feeds on a wide variety of nuts, seeds, fruits, and fungi.

Photo from National Audubon Society Field Guide to Mammals, Knopf

Douglas Squirrel or Chickaree

Tamiasciurus douglasii

This squirrel is reddish gray or brownish gray blending to chestnut-brown on the middle of the back. Ear tufts appear in the winter. They are very active and noisy, often seen running on the ground or in the trees. They are ten to fourteen inches, including a six inch tail. Douglas squirrels are often seen in the Armstrong Grove picnic area.

Gray Squirrel

Sciurus griseus

Larger than the Chickaree, their length is seventeen to twenty-three inches, including a twelve inch tail. They are gray with a white belly and a long and very bushy tail. They are active all year and are the only large gray coastal squirrel.

The gray squirrel is most active in morning and evening. They can often be seen on the ground collecting and storing acorns in shallow holes in the forest floor. They later find these caches by scent. Since not every acorn is recovered, the squirrels help in reforestation. They also strip the seeds out of Douglas-fir cones, and dig for truffle-like fungi.

Gray squirrels make their homes in redwood forests and oak woodlands, where their bulky nests, somewhat resembling arboreal nests of wood rats,

Raccoon

Procyon lotor

With its black mask across its eyes and ringed tail, the nocturnal raccoon may be familiar to you as your late night garbage can marauder. These omnivores will eat just about anything, including fruit, eggs, fish, small mammals, and insects. They live with equal facility along wild rivers or in densely settled residential areas. Dens for the young are situated in tree hollows, rock dens, or caves.

Raccoons are very curious animals. They like to handle everything, especially food, with their sensitive hands. They are also fond of water, and although they may wander far from it while hunting, most of their life is spent near streams, lakes, or marshes. Raccoons lack salivary glands to wet their food as they eat. That is why they often dunk their food in water before eating it.

When walking, these animals look ungainly and clumsy. Like a bear, a raccoon walks with its heel on the ground. Their agility, however, is demonstrated in climbing as they use their sharp claws.

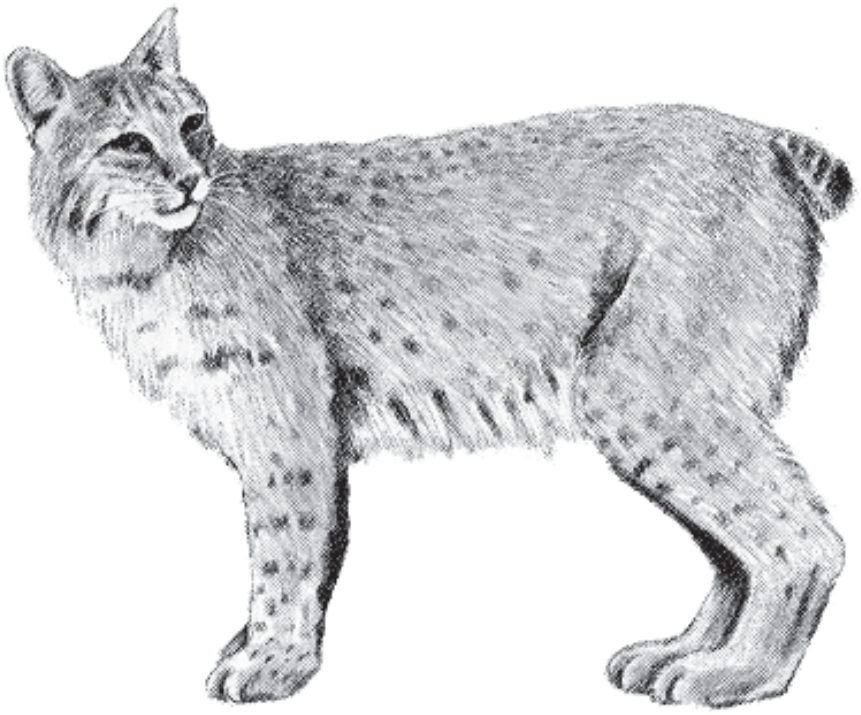


Illustration from The Nature of California
Raymond Leung

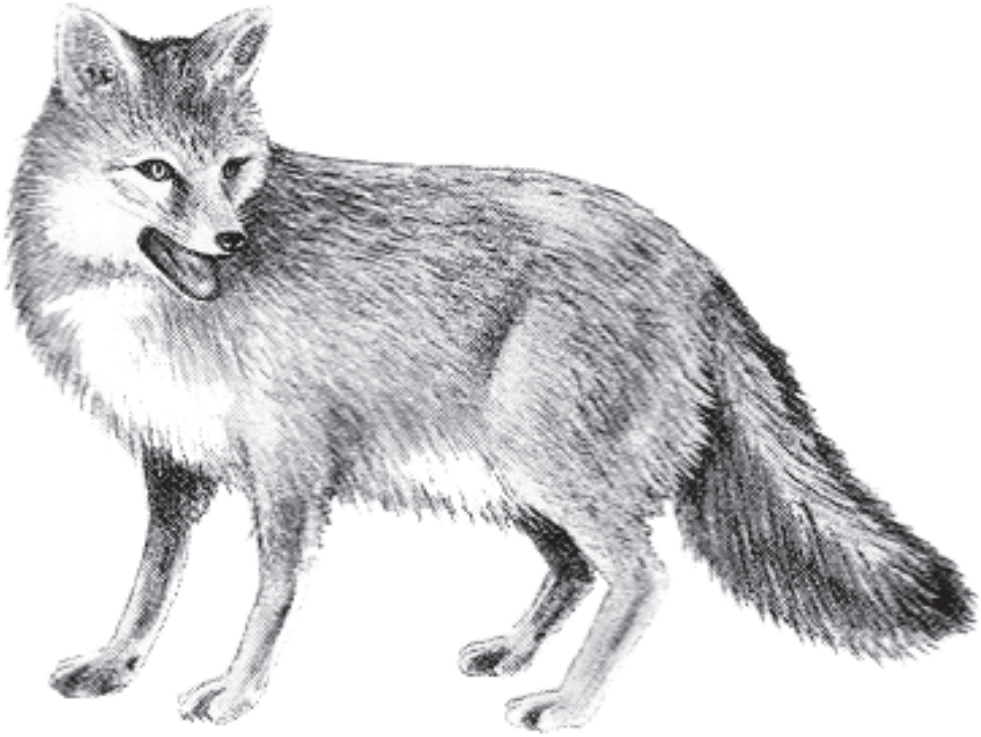
Bobcat

Lynx rufus

The large catlike animal lying in a clearing or sunning itself on a rock on chaparral-covered slopes is probably a bobcat, or wildcat, especially if it has long legs, a short tail, and sharp-pointed ears. They are seldom seen, however, because their mottled coats blend so well with their surroundings. Although usually more active at night, bobcats can hunt by day or night, because the vertical pupils of their eyes close to narrow slits in glaring sunlight or open wide to take full advantage of even dim starlight. Bobcats have a reputation for being killers of game birds and poultry. However, investigations have shown that most of their prey consists of rodents and rabbits, making them beneficial pest controllers.

The bobcat prefers rocky or brushy country for hunting and raising its young. But signs are often found in forested areas. The den may be a protected cavity or cave among rocks. The young (average 3 per litter) are born any time in the spring and summer months but probably in April.

Length to 49 inches including 7 inch tail, to 39 lbs.



Gray Fox

Urocyon cinereoargenteus

Nocturnal, but sometimes seen in open forests or crossing roads at twilight, the gray fox is much smaller than a coyote. It has a salt and pepper coat and the legs, feet, backs of ears, and sides of neck are reddish yellow. Long bushy tail.

A member of the dog family, the gray fox resembles a small shepherd dog. It is the most abundant and widespread fox in North America. Its chief enemies are eagles, dogs, and people. Although of fairly large size, gray foxes are timid creatures and readily retire, even when smaller animals threaten them. Large raccoons have been seen to drive gray foxes from their food.

Small mammals, birds, and carrion are primary items of diet, but fruits of many plants are taken when available.

Home ranges are several square kilometers in size. There is no direct evidence of territorial defense, but gray foxes generally avoid each other and mark their home ranges with urine and feces, as do most other carnivores.

Length to 45 inches including 8-17 inch tail, to 13 lbs.

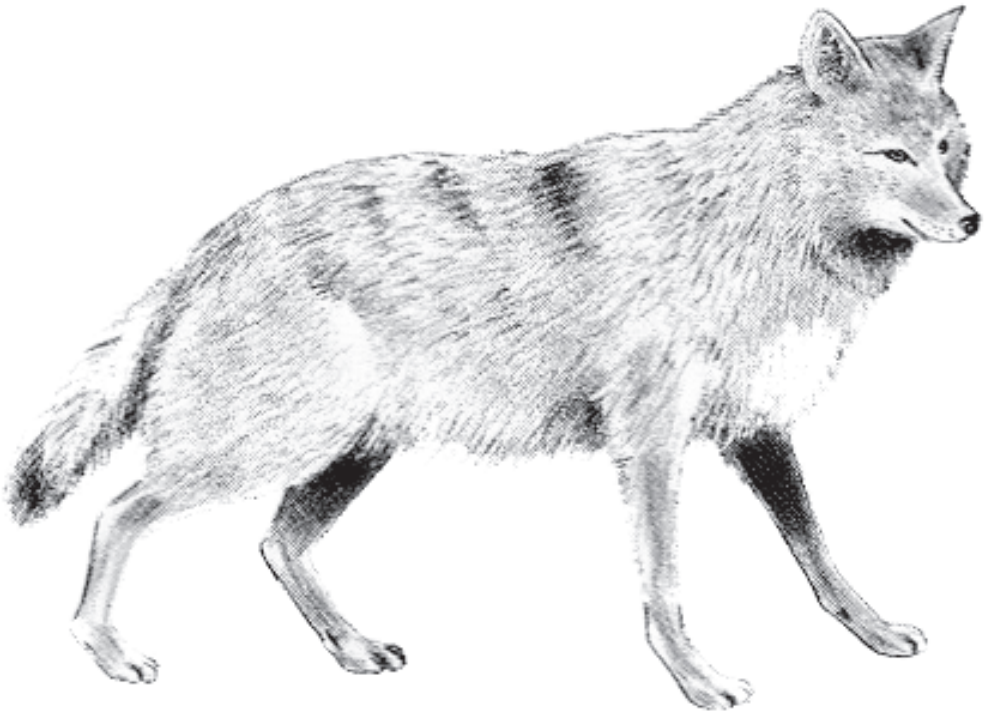


Illustration from The Nature of California
Raymond Leung

Coyote

Canis latrans

The wily coyote is the source of myth and legend. The coyote is an integral part of American culture. Despite being one of the most persecuted carnivores in North America, it has proven so flexible in its habits, so adroit in escaping the trap and gun, and so prolific, that it persists in good numbers even today. It is one of the few animals in America whose range has actually expanded from its original distribution. It prefers open country, but signs of it have been seen on forested slopes.

Coyotes are heard more often than seen. The setting sun or the first daylight may be greeted by a chorus of yapping howls; often the entire choral effect comes from a single animal.

Generally coyotes make their dens in natural crevices and caves, but they sometimes enlarge a burrow dug by a ground squirrel or a badger. Coyotes mate in February or March and may pair for several consecutive breeding seasons, although they do not usually associate outside of the reproductive season. After a seven-week gestation, the pups are born, averaging five per litter. They are cared for by both parents. The young disperse in the autumn, and those that survive the heavy toll of poison, traps, predation, and starvation, reach sexual maturity at one year of age.Illustration from The Nature of California
Raymond Leung

Length to 52 inches including 15 inch tail, to 50 lbs.

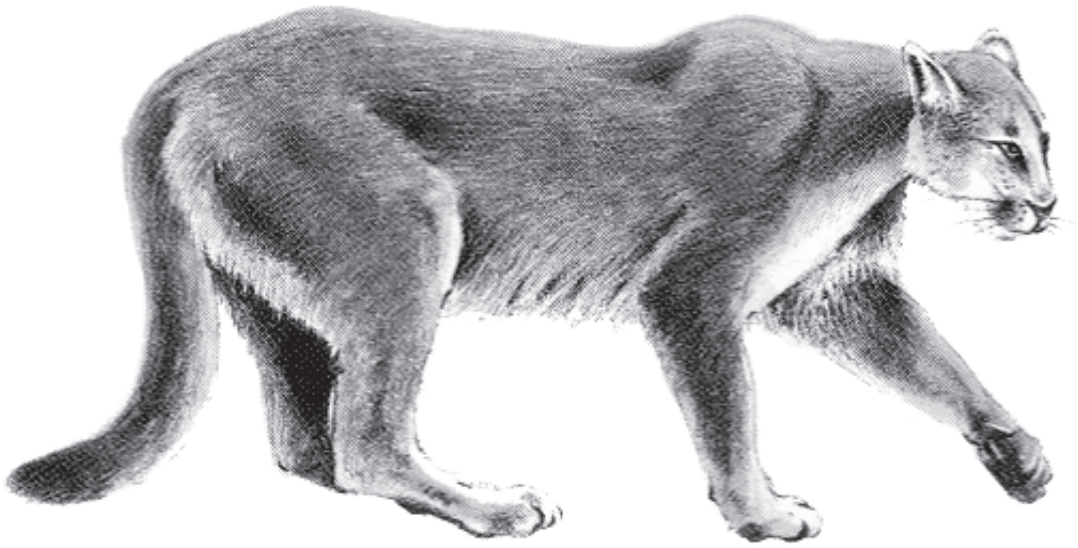


Illustration from The Nature of California
Raymond Leung

Mountain Lion

Felis concolor

The fearsome mountain lion, ranging from six to eight feet in length, is California's native big cat. Other names for it include puma, panther, cougar, and catamount. Shy and rarely observed, the mountain lion may be found wherever there are deer. They are not necessarily dangerous to the deer population as a whole, for the deer they kill are frequently diseased or crippled. In addition to deer, the mountain lion preys on smaller animals such as skunks, porcupines, rabbits, and large rodents.

Individual mountain lions each have their own ranges. The home areas of males are larger than those of females and overlap very little. Female home areas overlap substantially with those of other females and with home areas of males. Fighting over range jurisdiction is minimized by mutual avoidance, but males do fight occasionally.

Breeding occurs mostly in winter. The cubs, two to three per litter, most frequently arrive in April, although they may be born in any month. The den is generally in a cave or crevice of a big rockslide at the base of a rocky cliff and is often quite accessible.

Normally, mountain lions are very elusive, and people rarely get a glimpse of them.

Length 9 feet including 37 inch tail, to 275 lbs.

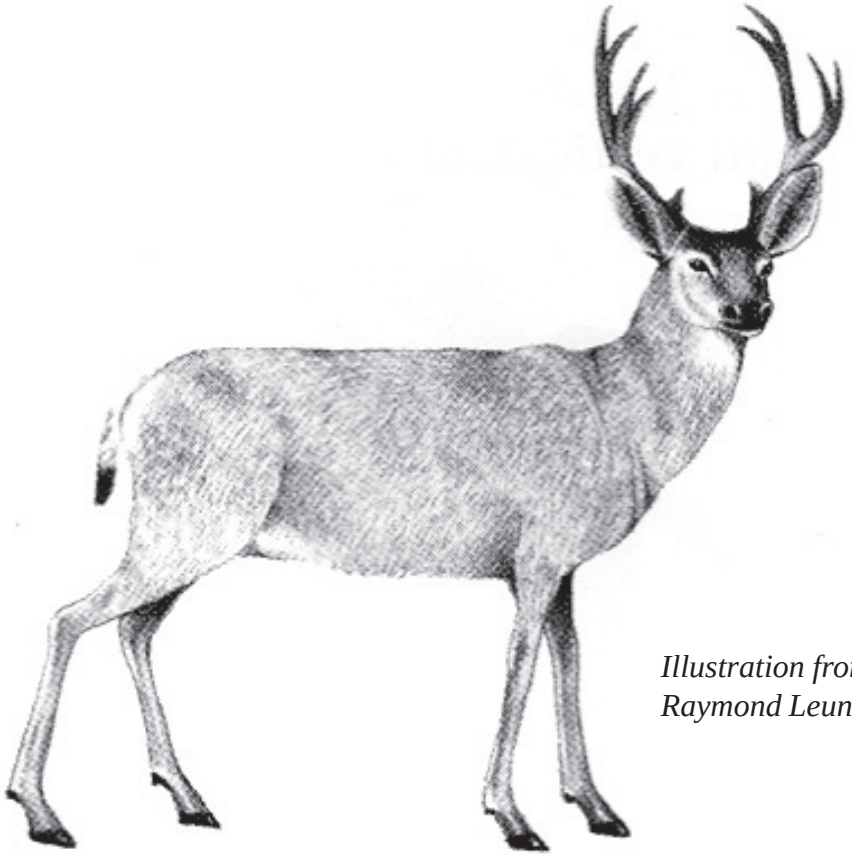


Illustration from The Nature of California
Raymond Leung

Black-Tailed Deer

Odocoileus hemionus

The black-tailed deer are the smallest deer in California. They are distinguished from other deer by their broad black tail and restricted white markings. They are recognized as a sub-species of mule deer.

The mating season, or "rut," occurs in September to December. Fawns appear 7 months later, in May to June, when the spring foliage is at peak growth. The fawns are difficult to see due to the camouflage effect of their spotted coat.

By fall the fawns usually lose their spots. A young buck begins to grow antlers the first winter but his first pair is usually single spikes. The antlers are shed each year in late winter, and new antlers start to grow in the spring. By early summer the new antlers are well grown but covered with short hair, or "velvet." As they mature and harden, the velvet dies and is scraped off against shrubs or saplings. Each successive pair of antlers is larger, until the animal is approximately five or six years old. The number of points on the antlers does not indicate the age of the buck, although up to a certain age older bucks usually have more points.

Black-tailed deer prefer open woodland where they can find acorns, grasses, clover, berries, and truffle-like fungi. They are frequently seen on the higher parts of the East Ridge Trail or Pool Ridge Trail.

A Mollusk

Banana Slugs (California's official state mollusk)

Habitat: Banana slugs live on damp foggy forest floors on the West Coast of North America only. They like foggy summers and rainy winters. They hide in damp places.

Morphology: (Body parts.) Slugs are believed to have evolved from snails. They need conditions with plentiful moisture. They are invertebrates called Mollusks. They are gastropods (stomach foot) and pulmanates (with lung), without an external shell.

Banana slugs are hermaphrodites. Each slug possesses both male and female reproductive organs. Thirty eggs are laid that can be eaten by birds or shrews. They have a high mortality rate. If they reach adulthood, they live three to five years. The longer set of antennae are eyes and the short set is for smell. If the antennae are broken off they will regenerate within 48 hours.

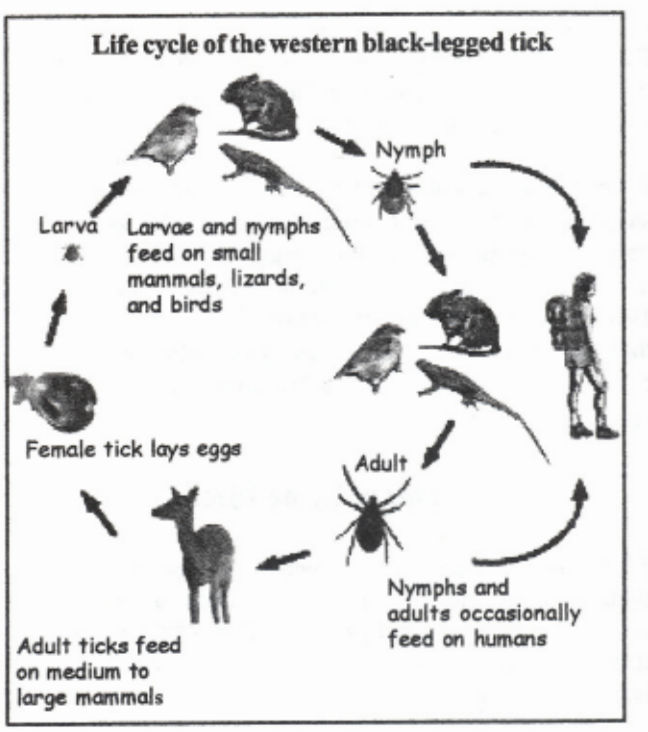
Predators: Snakes, ducks, foxes and salamanders eat banana slugs. For protection, they cover themselves with slime and contract to become shorter, fatter, and thicker. This behavior makes the predators gag in a big way. They can dig, climb, swim, move upside down, and lower themselves on a cord of slime. if picked up the mucus like slim is difficult to wash off.

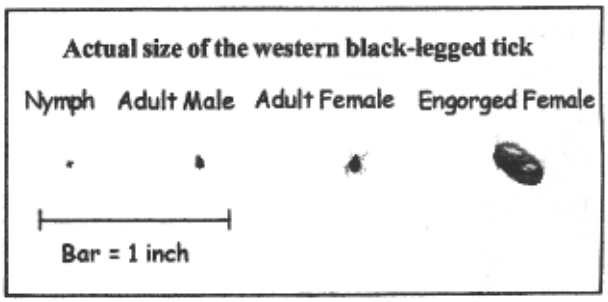
Job: Slugs clean the forest floor. They eat mushrooms, dandelions, wild flowers, ferns, scat, poison oak, mosses and leaves. They can smell a mushroom tenyards away with their short set of antennae. Redwoods benefit from the nitrogen rich scat produced by the slugs. The slugs will not eat any part of a redwood tree.

Cool Slug Facts

- Slugs have tongues with 30,000 teeth and rasp their food.
- Slugs go about .007 miles an hour.
- Slugs sometimes are both female and male, and if no one else is around will mate with themselves.
- Slug slime can take away the sting from nettles.
- Slugs can stretch out 11 times their normal length.
- Slugs mark their own trail so they can find their way home after dark.
- Banana slugs were a food source for the Yurok Indians.

An Insect to be Aware of





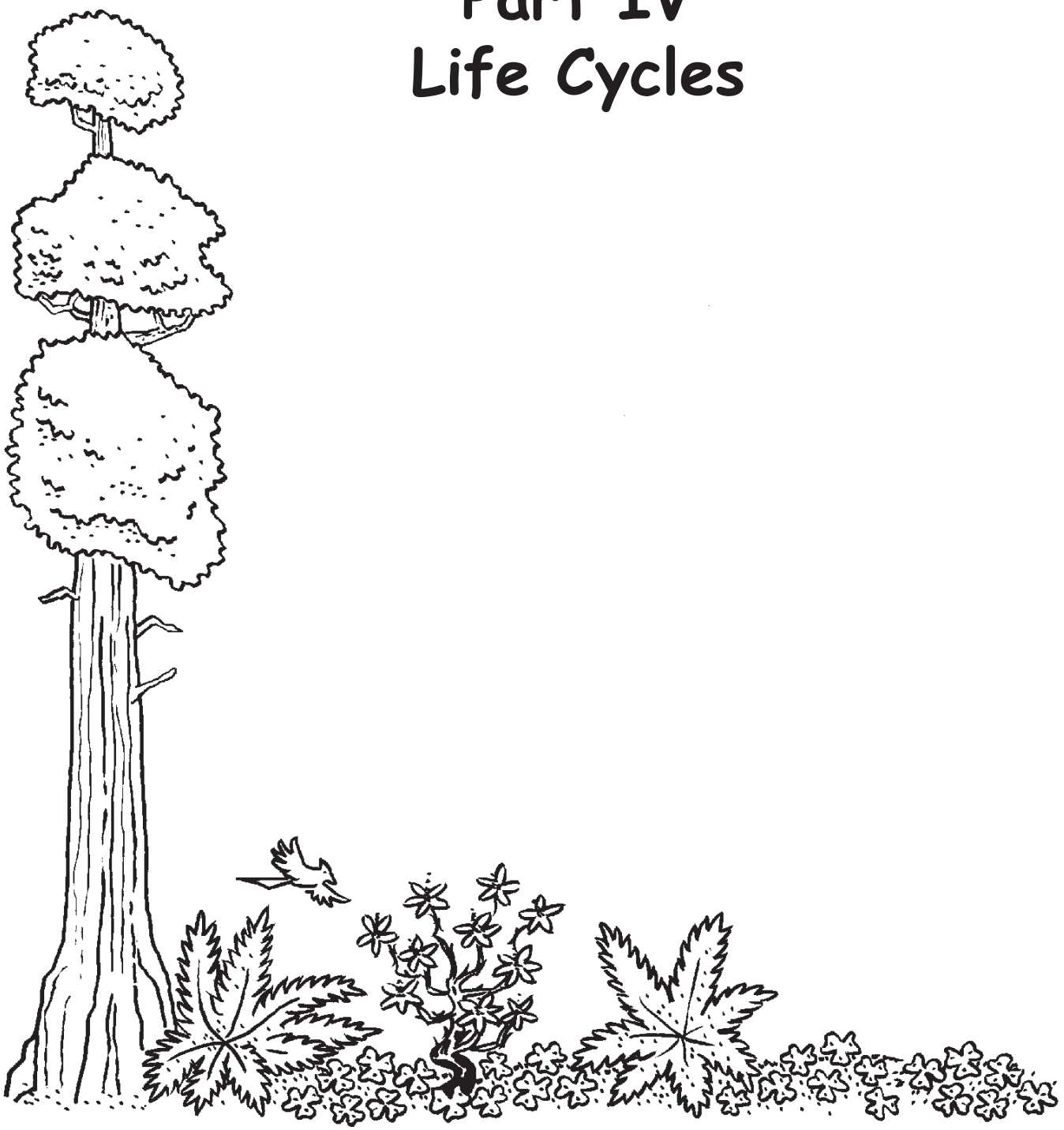
Western Black-legged Tick
Ixodes pacificus

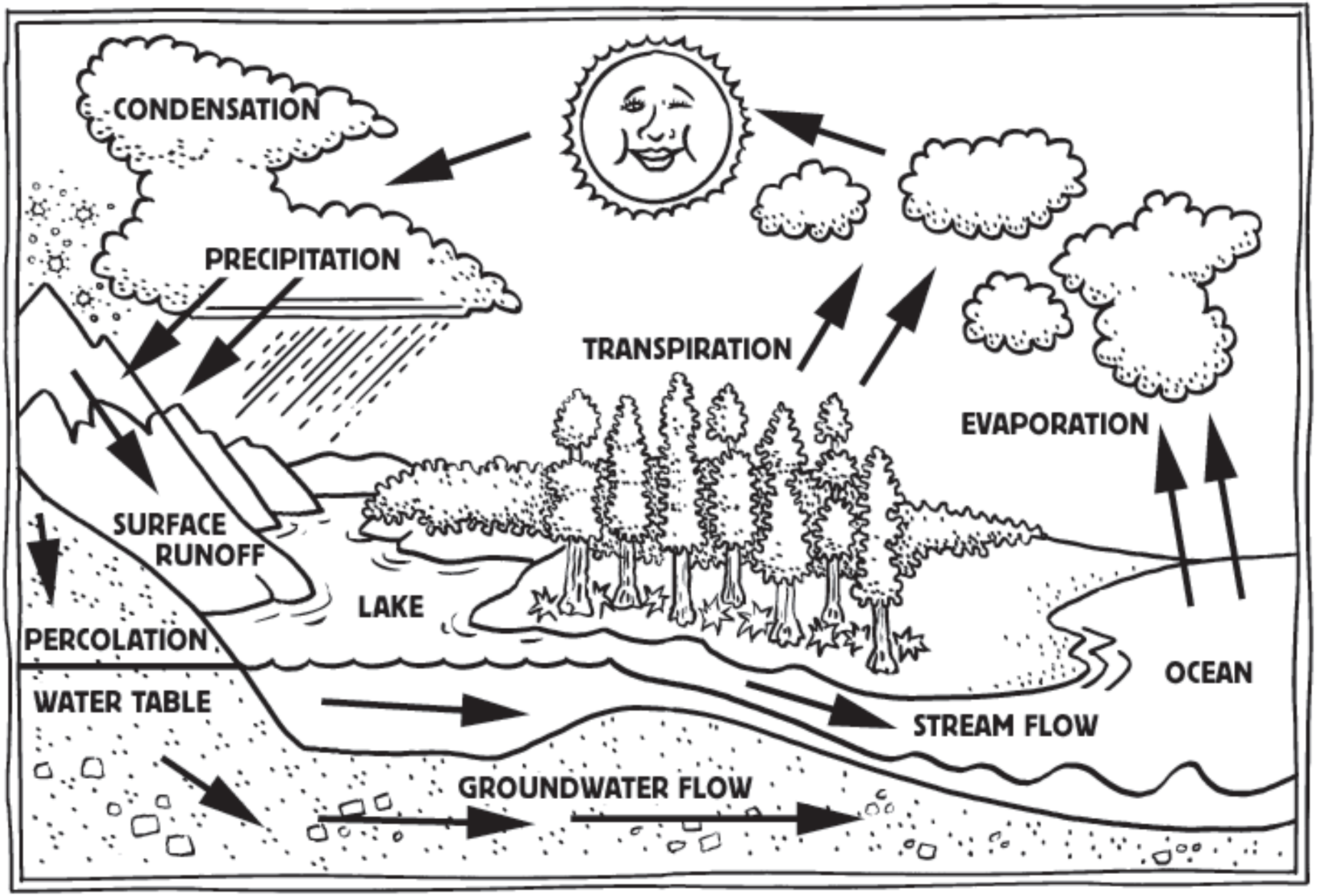
In California, the western black-legged tick transmits the bacteria Borrelia burgdorferi that cause Lyme disease. Western black-legged ticks are most common in the coastal regions and along the western slope of the Sierra Nevada range. Ticks prefer cool, moist environments such as shaded grasses, shrubs, and leaf litter under trees in oak woodlands.

To avoid ticks, stay on the trails and avoid contact with bushes or grasses alongside trails where ticks are common.

Check your body for ticks for several days after you being out in tick habitat. Consult a health professional if you are bitten by a tick.

Part IV
Life Cycles





THE WATER CYCLE

The Water Cycle and Watersheds

The pathway water takes as it moves through air, soil, streams, rivers, oceans, and ice is called the **water cycle**.

1. Rain falls on the land and begins to puddle or run off.
2. Small streams join larger streams and then become big rivers.
3. Rivers flow into oceans.
4. Water evaporates and turns into water vapor, which forms clouds.
5. Plant roots also take up and release water through their leaves and stems, which then is released into the atmosphere.
6. Water also reaches rivers or streams when raindrops soak into the soil and become part of the groundwater (water which flows underground).
7. The groundwater sometimes comes to the surface as springs or seeps and flows into streams and rivers.

The first step in learning about a stream is to learn about its watershed. A **watershed** is an area of land that drains into a particular stream, river or lake. Water flows downhill, so when raindrops fall on the land, they flow down to the lowest elevation – usually a river or stream. A small stream that runs through your town might receive rainfall run-off from only a few acres of land, but it is still an important part of a larger watershed.

Knowing a stream's watershed area is very important. Everything that happens in a stream's watershed – good and bad- affects the stream no matter how far away. If someone pours a quart of oil onto the ground a mile from a stream in its watershed, eventually that pollution may reach the stream. Because of this, all people need to be careful and not cause pollution, even if they do not live on a stream or lake.

Activity

The Water Cycle and Watersheds

TIME: Preparation: 10 minutes
Activity: 45-60 minutes

LEVELS: Middle School to Adult

OBJECTIVES:
Students will be able to:

1. Describe what the water cycle is, and draw a picture or diagram of how the water cycle works, including rain, runoff (overland flow), stream, river, evaporation, and clouds.

2. Describe what a watershed is, and include in the drawing how the watershed and the water cycle interact (see the diagram included at the beginning of this chapter).

MATERIALS:

1. Previous page information on the water cycle and watersheds; Xerox enough copies for your class teams.

2. Art paper, magic markers, crayons, colored pencils, or pens.

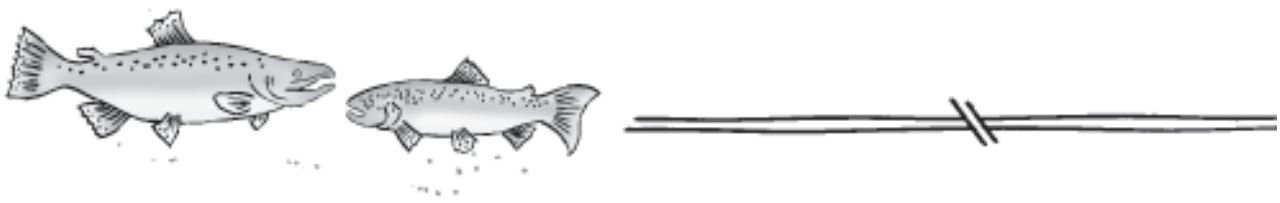
DIRECTIONS:

1. Divide the class into groups of four each and distribute the reading and diagram of the water cycle and watershed.

2. Explain that each team of four has been given information describing the water cycle and what a watershed is. It is the task of each team to read, understand and explain the reading to each team member so they can draw an example of the water cycle and a watershed interacting.

3. Refer to the diagram in the reading material. It is an example of what we are asking them to have fun with.

4. Circulate around the teams listening for their understanding of the water cycle and what a watershed is. Offer assistance when clarification is needed.



Activity

The Web of Life

OBJECTIVE: To understand how all things are interdependent.

GRADES: Elementary grades

SUBJECTS: Science and Language Arts

MATERIALS:

Masking Tape
3 X 5 Cards (1 per person)
Ball of String

DIRECTIONS:

In this activity students will identify themselves as different parts of the life cycle and food chain. Then they will create a web of life.

Devise a web of life starting with the sun. For example: Sun, grass, mouse, snake, hawk, fly larvae, beetle, salamander, worm, frog, mosquito, human, deer, squirrel, owl, moth, bat, butterfly, skunk, opposum, raccoon, tree, mushroom, etc. You can include other elements such as soil and water. Be sure that you explain what an element is before starting the activity.

Explain that every student is a detective. Everyone will be a part of a food chain and they need to figure out who they are. Have the students stand in a line and tape a web card onto their backs. Instruct them to find out who or what they are by asking "yes" and "no" questions only. For example: "Am I green? Am I a plant? Do I have legs?" They should ask one question per student, and as the facilitator, you can give hints if necessary.

When each student figures out who or what they are, they should sit down, but still answer questions for others. Once everyone knows who they are have them stand in a circle. Re-emphasize that everyone is a part of a food chain. Now start with yourself as the sun and hold onto the ball of string and ask, "Who needs the sun to survive?" Toss the ball to everyone who answers "yes." Whomever ends up with the ball of string should ask the group who needs them to survive. Continue until everyone is holding a segment of string. Direct the questioning as needed.

Point out the web that has been created and discuss interdependence. Describe some scenarios: If the mosquito dies, who feels the tug? If there is a drought, who will feel it? Now you can eliminate links by having students let go. What happens to the population, or the web in general? Discuss the cycle of life and death.

Activity

Oh, Deer!

OBJECTIVE: Students will:

1) Identify 3 components of habitat.
2) Define "limiting factors"
3) Recognize limiting factors in wildlife populations
4) Recognize the natural cycle of a population

GRADES: 4 and 5

SUBJECTS: Science, Math, Social Studies, Physical Education

MATERIALS:

Large piece of paper (to draw a graph)
Marker
Hard surface to write on

DIRECTIONS:

You will need a large outdoor space to play this game. With class participation, you will be able to demonstrate a population of deer and some of its fluctuations over a period of 10-12 years.

Tell the students that they are going to participate in an experiment involving animal survival. Divide the students into two lines about 25-30 feet apart, facing each other. Describe the following three resources:

1) Food - Place hands on stomach
2) Shelter - Hold hands over the head to form a roof
3) Water - Cup hands to the mouth

Assign one line to be the deer that will be looking for the resources and the other line tobe the resources. Have the students face away from each other. Huddle with each group and facilitate the following:

1) The deer will decide what resource they need
2) The resources will be divided between the students

As facilitator, you decide one situation at a time: drought, forest fire, etc.

On the count of three have the students face each other and show their resource symbol. The deer will need to run to match themselves with the resource they need to survive. Those that are successful take the resource back to their line to become deer. The deer who aren't matched up die and become a resource.

Activity - continued

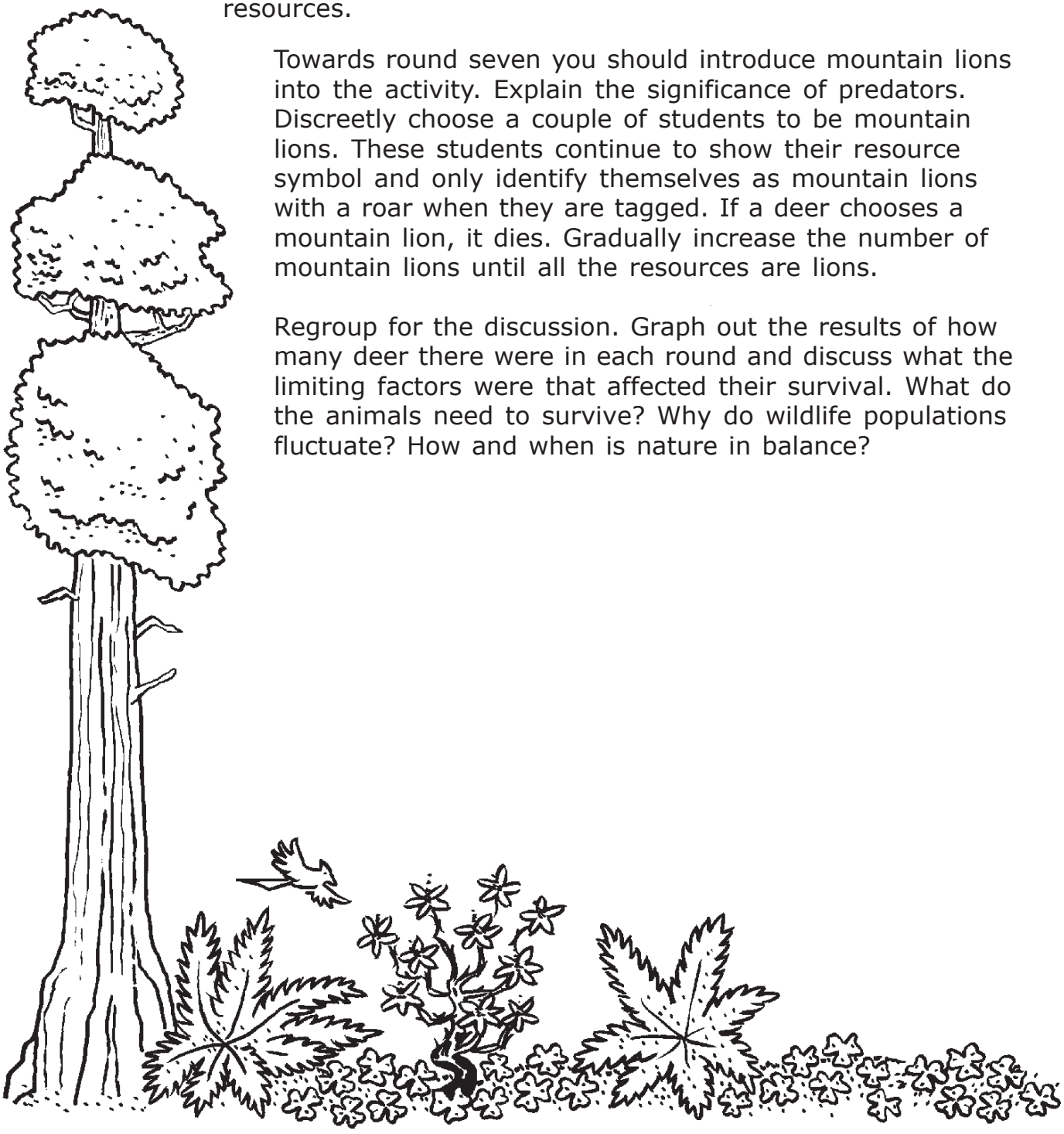
DIRECTIONS for "Oh, Deer!" continued:

As the facilitator you will keep track of the number of deer per round so they can be graphed at the end.

Continue providing different scenarios that require different resources.

Towards round seven you should introduce mountain lions into the activity. Explain the significance of predators. Discreetly choose a couple of students to be mountain lions. These students continue to show their resource symbol and only identify themselves as mountain lions with a roar when they are tagged. If a deer chooses a mountain lion, it dies. Gradually increase the number of mountain lions until all the resources are lions.

Regroup for the discussion. Graph out the results of how many deer there were in each round and discuss what the limiting factors were that affected their survival. What do the animals need to survive? Why do wildlife populations fluctuate? How and when is nature in balance?



Activity

Eat the Earth

OBJECTIVE: Demonstrate the relative percentage of the earth capable of supporting human needs.

GRADES: K-6

SUBJECTS: Science, Social Studies

MATERIALS:

Apple
Knife

DIRECTIONS:

To illustrate for students the fragility of our life support systems, you can do the following using an apple to represent the earth.

Cut the apple into quarters and set three of them aside. They represent the part of the earth that is covered by water. The remaining quarter represents the part of the earth's surface that is not under salt water.

Next cut this quarter in half and set one piece aside. The piece in hand represents the part of the earth that is suitable for human habitation. The other part is too cold, too dry, too mountainous, or too hot.

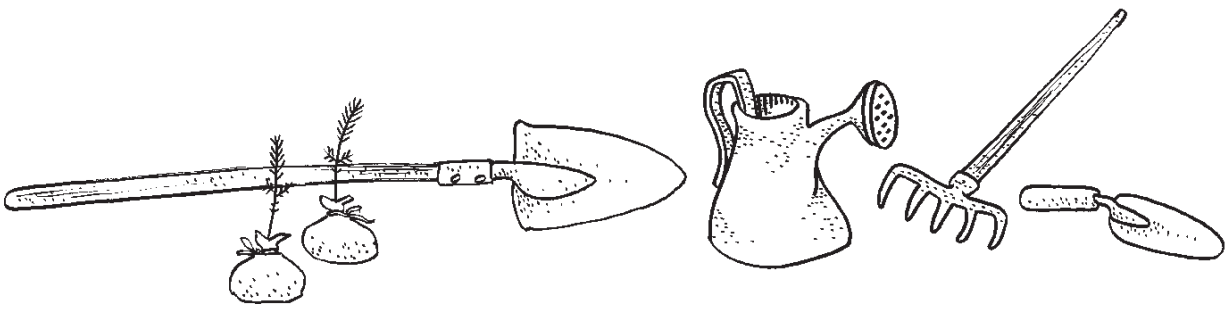
Now cut the last one-eighth, which represents the part on which humans can live, into four slices. Rather thin, aren't they? Just one of these four slices represents the part of the earth that supplies most of our food and clothing, the small part that is presently tilled. It is not too wet, not too cold, not occupied by cities, factories, or highways.

Cut a very small piece from the last slice used above. This represents the 3/100 of 1% of the earth's surface which contains potable water. Not very much.

Our human presence on earth has been very short. In that time, we have done great damage and destruction to those systems that are capable of sustaining our lives. How will we treat the remaining healthy portion?

Adapted from The Green Box, Humboldt Office of Education.

Part V
Restoration



You Can Help Save
Armstrong Grove

Stay on designated trails and roads. "Volunteer Trails" compact the soil and destroy the understory plants of the forest. Redwood roots are shallow and the herbaceous plants are very delicate. The ecology of this precious forest may be irreparably damaged if traffic strays from the trailways.

Do not disturb the natural features. From the tiniest fallen leaf to the mightiest redwood, all parts of the Grove are interconnected within Nature's plan and are dependent on one another for the well being of the whole. Take only memories, leave only footprints.

Make a contribution to the Habitat Restoration Project.
Restoration of damaged areas and prevention of further destruction is the goal of the Armstrong Grove Habitat Protection and Restoration Project. This vital project is entirely dependent on public donation. You can help make the project a success by becoming a "Friend of Armstrong Grove" and making a tax deductible donation of any amount to:

Stewards of the Coast and Redwoods'
Help Save Armstrong Grove Fund
PO Box 2
Duncans Mills, CA 95430
(707) 869-9177
stewards@mcn.org

Please use this Grove and our Earth with Love and Wisdom, they are all that we have!

Activity

Grow A Sprout!

LEVELS: Grades K-2

SUBJECTS & SKILLS:

1. Science Process: Observing, inferring, brainstorming, communicating, predicting, comparing, sorting, and classifying.

2. Integrated Curriculum: writing, language arts, comprehension.

OBJECTIVES:

The students will be able to:

1. Describe a tree seedling's roots and stem.
2. Discuss the things tree seeds and seedlings need in order to grow.

TIME:

Preparation: 30 minutes
Activity: To get started, 45-60 minutes

MATERIALS:

Citrus Seed Project:

1. Several citrus fruits- Grapefruit, lemons, limes, oranges with seeds.
2. Waxed paper cups or empty milk containers, one for each student.
3. Sand or half mixture of soil and perlite.
   (To avoid microorganisms that could damage the seed or young plants, get soil or sand from a store instead of digging it up.)
4. Several small spoons.
5. Felt-tip pen.

Avocado Project:

1. Several Avocado Seeds
2. Toothpicks. 3-4 per seed.
3. Glass jars. 1 per seed.

DIRECTIONS: Citrus Plantings

1. Explain to the students that they will be growing their own trees from seeds. This activity will help them get an idea of how trees sprout and what they need to stay alive. Grapefruit, lemons, limes, oranges, and other citrus trees are some of the easiest trees to grow indoors, and of these, grapefruit trees are the fastest growing.
2. Bring in or have the students bring in citrus fruits and avocado seeds. Most grapefruits sold in stores are "seedless," but these usually have at least a few seeds. Use only the largest, plump seeds.

3. Set up two or three planting stations around the room each with the following materials.
   - Paper cups or containers with several holes punched in the bottoms.
   - Sand or soil mixture.
   - Small spoons for filling cups with soil mixture.
   - Fruit seeds from citrus fruits. To avoid damaging the seeds, peel the fruit and break apart the sections instead of cutting through them with a knife. Also, put the seeds in a container of water to keep them from drying out. If possible, use seeds that have already started to sprout inside the fruit.
4. Have the students go up to the planting stations in small groups of two or three.
5. Each student can plant his or her own seed in one of the cups by filling the cup most of the way with the sand, laying a seed on top, and then covering it with another 1/2 inch of soil. Tell the kids not to pack the soil down too hard.
6. Put the cups in a very warm spot (but not too sunny). Add enough water to the soil to make it moist, but not soaking wet, and make sure the soil never dries out completely.
7. Have the students observe changes in the seeds every several days. They can even keep a record in words or pictures of the changes. The seeds should sprout within a few weeks. (If some seeds don't sprout have the students replace them with fresh seeds. You can get a grapefruit seed to sprout within three to four days or so by gently peeling off the seed's covering with a razor blade before you plant it. Be sure to start peeling from the seed's rounded end and to be especially careful when you reach the seeds pointed end, where the embryo is.)
8. Review with the students how seeds develop and what the seedlings need in order to grow.

DIRECTIONS: Avocado Planting

1. Explain to the students that by suspending an avocado seed in water, they will be able to see how a seedling's stem and roots grow.
2. Peel the brown papery covering away from the seed.
3. Determine the smaller (top) and the larger (bottom) ends of the seed. Poke 3-4 toothpicks into it at equal distances from one another near the middle of the seed.
4. Let the seed rest in a glass of lukewarm water with its large end submerged. Make sure the water doesn't evaporate to the point where it no longer covers the bottom of the seed. Replace the water with fresh water once a week.
5. Have the students observe changes in the seed every several days. They can even keep a record in words or pictures of the changes. Avocados take about three weeks to sprout roots and stems.
6. Plant the sprouted seed in a pot when the avocado's stem and roots are several inches long. The pot should be at least one inch wider than the avocado.
7. Review with the kids how seeds develop and what the seedlings need in order to grow.

Part VI
Field Trip Resources

Armstrong Redwoods State Reserve and Austin Creek State Recreation Area

Suggestions for walks and hikes

1. **Round Trip under a mile:** Parking lot to Armstrong Tree and Forest Theater along Pioneer trail or road and back. A short, easy stroll through the redwoods.

2. **A Little Longer:** (1.7 miles) Parking lot to Armstrong Tree and then to Picnic Area along Icicle Tree and Pioneer Trails. Back along Pioneed Trail or road, redwoods all the way.

3. **A 2.2 mile loop with a 400 foot climb:** Parking lot to Picnic Area by way of the East Ridge Trail. Back along road or Pioneer Trail. A moderate hike along a ridge shaded by firs, oaks and madrones with a stroll back through redwoods.

4. **A 2.3 mile loop – A bit more strenuous than #3:** Parking lot to Armstrong Tree and then up Pool Ridge Trail. Loop back to Picnic Area and return along the Pioneer Trail or road. A 500 foot steady climb with lots of switchbacks.

5. **A 3.3 mile loop – Definitely a hike:** Combine #3 and #4. Parking Lot to Picnic Area by way of East Ridge Trail. Then loop back along Pool Ridge Trail to Armstrong Tree and back to Parking Lot. Up 400 feet, down, up 500 feet and down again.

6. **A 5.6 mile loop with a 1100 foot climb:** East Ridge Trail from parking lot to Gilliam Creek trailhead, return along Pool Ridge Trail.

7. **A 9.0 mile loop:** East Ridge Trail from parking lot to Bullfrog Pond, along road to Gilliam Creek trailhead and return along Pool Ridge Trail.

8. **A 5.0 mile Back Country loop:** Elevation change of 1000 feet. Start at East Austin trailhead (park at Vista Point) to Gilliam Creek. Loop back along Gilliam Creek Trail and East Ridge Trail to Vista Point. (along the paved road is shorter).

9. **A 10 mile Back Country loop:** As in #8 but continue on East Austin Trail to Gilliam Creek service road and then loop back to Gilliam Creek Trail and back to Vista Point (along the paved road is shorter).

Back Country Campsite Mileages:

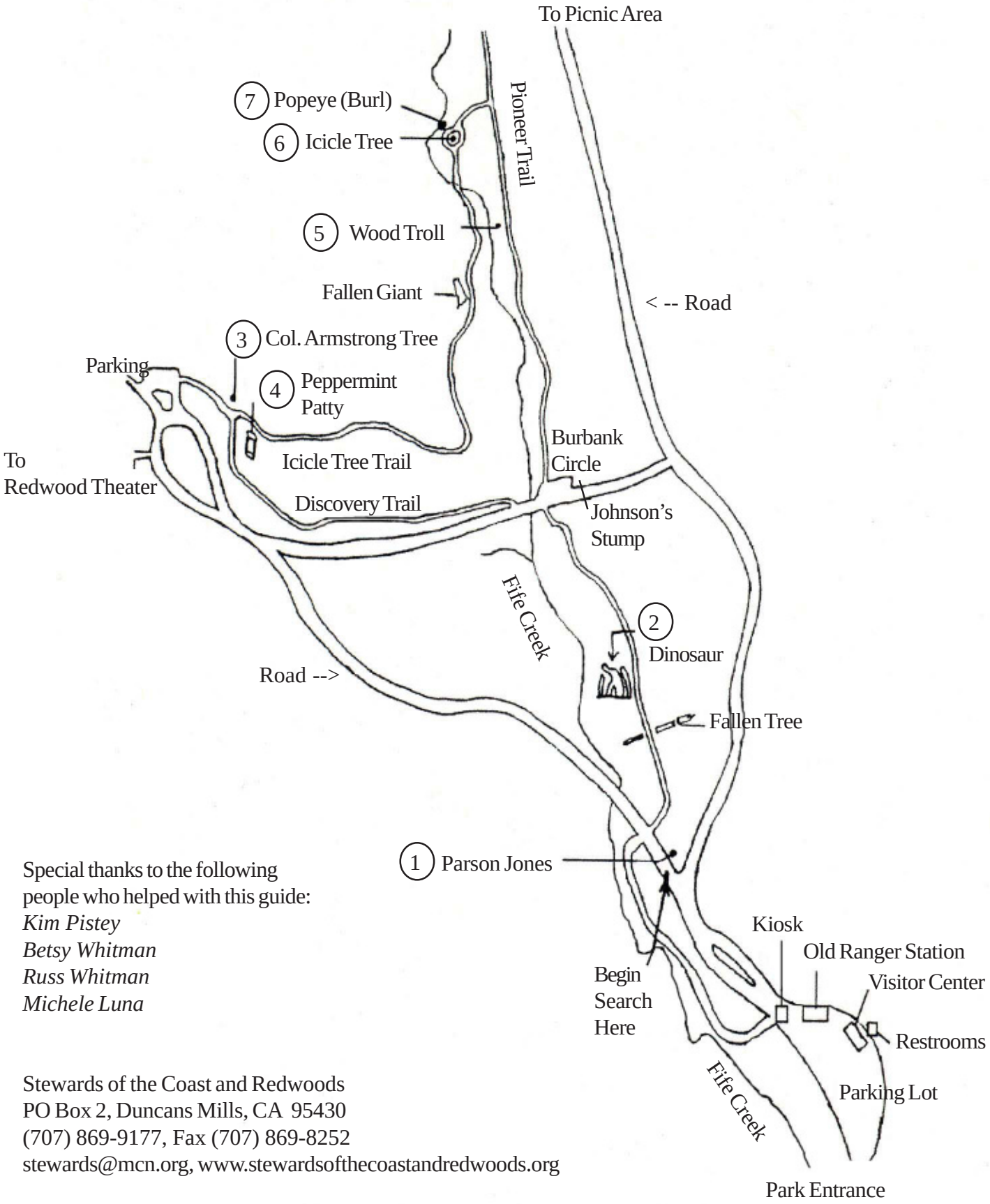
Tom King Camp – 3.1 miles from Vista Point
Manning Flat Camp – 4.1 miles from Vista Point
Gilliam Creek Camp – 3.9 miles from Trailhead

Elevations:

Parking Lot	120’	Picnic Area	172’
Manning Flat	293’	Gilliam Creek Camp	200’
Bullfrog Pond	1250’	Gilliam Creek Trailhead	1200’
East Ridge Trail at Picnic Area Cutoff	500’		

Armstrong Redwoods State Reserve

Children's Treasure Map



Special thanks to the following people who helped with this guide:
Kim Pistey
Betsy Whitman
Russ Whitman
Michele Luna

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Environmental Education Programs available for youth groups
Guided docent-led tours available for adult groups

Children's Treasure Hunt in Armstrong Reserve

"Home of the Ancients"

Can you find us?
We will be looking for you!

1. I am the tallest tree in the Reserve (310 feet), longer than a football field. See me as you cross the road just before the tree slice on the nature trail. Can you find a place to see my top?

2. I am the Dinosaur. When you walk by me I look like tree roots standing up in the air. Because I am shy, you won't see me until you walk past me and turn around.

3. My name comes from a "Colonel" who used to own us, but wisely decided we were more important alive than dead. Besides, I am the oldest living thing in the Woods. (1400 years)

4. I am Peppermint Patty. If you walk too fast, you'll miss my smiling face at the end of a fallen log, right next to the trail. I am only 45 steps from the "Colonel." **(GONE?)**

5. I may look like an old tree stump, but I am the Wood Troll. I hang out just across the stream from the bend in the trail and guard the woods during the day. My eyes have a "rocky" look.

6. If you see my burls hanging down like fat icicles, you'll know that's me, the Icicle Tree, a friend of Popeye.

7. I am Popeye, hiding in a burl in a tree just behind the Icicle Tree. I live not far from the bridge where the Wood Troll sleeps at night.

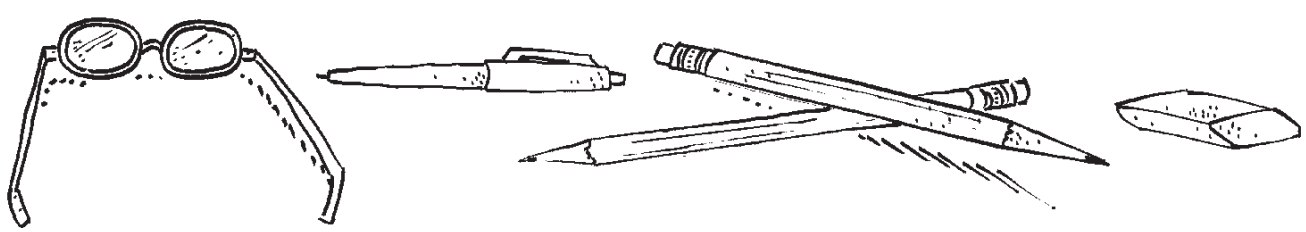
How many did you find? See map on the other side.

The Friends of Armstrong Redwoods hope that you had fun! Please recycle this paper back to the Visitors' Center. Thank You.

Friends of Armstrong Redwoods (FAR) is a program of Stewards of the Coast and Redwoods, the nonprofit interpretive association working in cooperation with the California Department of Parks and Recreation in the Russian River Sector.

For information on memberships or volunteer opportunities with ***Stewards of the Coast and Redwoods*** please contact us at (707) 869-9177, stewards@mcn.org, www.stewardsofthecoastandredwoods.org or write, P. O. Box 2, Duncans Mills, CA 95430

Part VII
References and Resources



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Armstrong Teacher's Guide
Survey

Our new Armstrong Redwoods Teacher's Guide is making its debut in Spring of 2006. We see this document as a work in progress and greatly value your feedback.

We thank you for taking a couple moments to let us know what you think and how we can improve the Guide in future editions.

Did the Teacher's Guide assist you in meeting your curriculum needs?

Was the Guide helpful in preparing for your field trip to Armstrong Redwoods State Reserve?

In what ways can we improve the Guide?

Anything else?

Please return your survey to:
Stewards of the Coast and Redwoods, P.O. Box 2, Duncans Mills, CA 95430, fax (707) 865-8252
Email: stewards@mcn.org