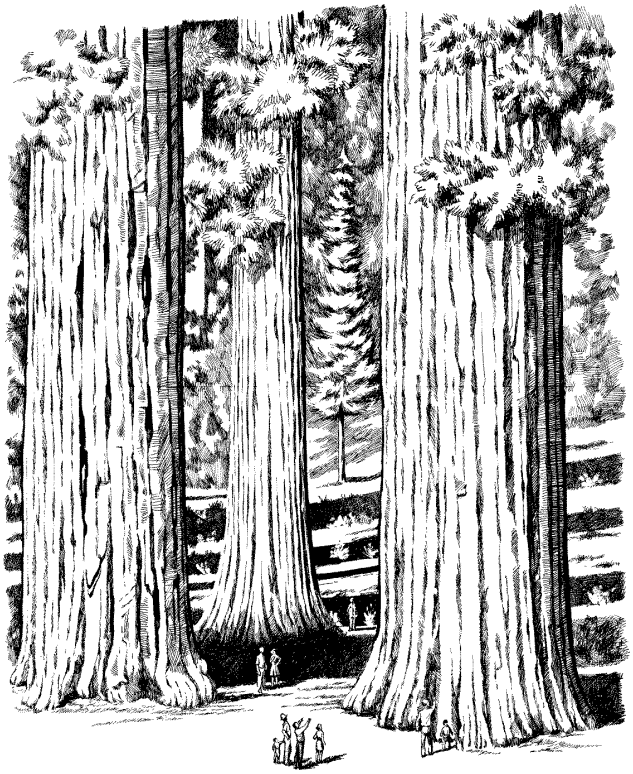
Plant Life



"It has been said that trees are imperfect men, and seem to bemoan their imprisonment rooted in the ground. But they never seem so to me. I never saw a discontented tree. They grip the ground as though they liked it, and though fast rooted, they travel about as far as we do. They go wandering forth in all directions with every wind, going and coming like ourselves, travelling with us around the sun two million miles a day, and through space heaven knows how fast and far."
—John Muir

Introduction

From giant redwoods to delicate wildflowers to the occasional blade of grass in the crack of urban asphalt, plant life is everywhere. The only life forms able to create energy directly from sunlight, plants serve many important functions. They provide food and shelter to wildlife, stability to soil, oxygen to the atmosphere, and beauty to the eye. At times we forget how much we depend on plant life. From plants, humans obtain food and create other products to enrich life, including paper products, pharmaceuticals, fuels, and building materials.

When interpreting plant life, you will have the opportunity to explore the beauty and wonder of plants. Each park has its own plants, plant life cycles, and food chains. In addition to including generalized information about plants, you should be sure to spend time discussing your own park's unique diversity of plant life.

Interesting Plant Facts

- The tallest living thing life formis a coast redwood tree (378' tall).
- The largest living individual ever found on earth is a giant sequoia tree.
- The largest leaf is found in the Amazon jungle, and can be 65 feet across.
- The California State Tree is the California redwood.
- The California State Flower is the California poppy.
- The average American uses seven trees a year in paper and wood products.
- Rainforests are destroyed at a rate of about 100 acres per minute.

Sample Programs: Plant Life

Plant Life

I. Introduction
   Introduce yourself.
   Introduce the Junior Ranger Program.

II. Focus
   A. Where are plants found?
      Plants are everywhere: mountains, valleys, meadows, deserts, oceans, rivers, streams, lakes, cracks in urban asphalt, and homes.

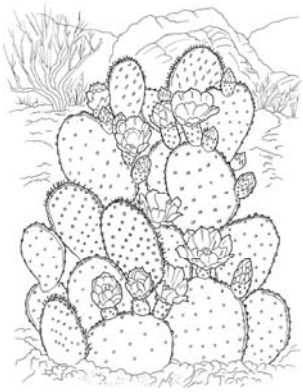
III. Objectives
   Today we're going to find out how amazing plants can be. There are many different types of plants, each with its own distinctive features and uses. We'll see these features and learn some of the uses for plants, as well as the value of preserving plant life.

IV. Inquiry/Discussion
   A. Plant Uses
      1. Did any of you eat a plant today? If so, what kind?
         Fruit, vegetable, cereal, grains, juice, etc.
      2. Are any of you wearing a plant today? If so, what kind?
         Cotton, linen, etc.
      3. What else do plants do for us?
         a. Plants produce oxygen (explain that oxygen is a byproduct of photosynthesis. (For information about photosynthesis, please see "Energy Information.")
         b. Plants create building materials.
            What is your school made of? Your house? (You can think of your house as a "tree house." Look at the walls, floors, doors, and furniture. Most of these are made out of wood.)
         c. Plants can be made into fuel (coal, firewood, petroleum, methane).
         d. Plants can be made into medicine (many drugs are plant derivatives).
         e. Plants can be made into paper (newspaper, writing paper, toilet paper, etc.).

V. Guided Discovery
   A. Feel Like a Plant
      1. Hike down a trail that has a variety of plant life. After a few minutes of quiet hiking, tell the children to "freeze," roots firmly embedded in the ground. Have them stand quietly and feel the sun beat down. Have them look around to see their surroundings. Are they warm or cool? Is there any water nearby or is the soil moist? Where do they get their food? Energy to grow? Explain how roots anchor plants to one spot. Although they cannot move, they can probe deep into the soil for water.
   B. Look for different kinds of plants
      Vines snaking up trees
      Trees
      Grasses
      Shrubs
      1. Discuss what makes a tree different from a bush, etc.
      2. Look at the plants' leaves. Do they all have the same shape?
         a. Explain the roles of leaf shape (water retention, gathering sunlight)
         b. Are they the same color, texture, thickness? Why? (Explain adaptations)
         c. Look at the veins on the leaf. Explain that the veins carry water and nutrients to all areas of the leaf, like the blood vessels in our bodies.
      3. Remind the group not to pick the plants. Why not?
      4. Point out potentially harmful plants like poison oak ("leaves of three, let it be"). Don't touch or eat plants you don't know (hemlock, mushrooms, etc.).
      5. Discuss erosion and staying on the trail.

C. Plant Energy
   1. How do plants get their energy?
   2. Are you a plant? Let's do an experiment to find out. Did everybody have something to drink today? Good. Now plant your feet firmly in the ground, take a deep breath, and stretch your hands up toward the sunlight. Do you feel full? No? I guess we're not plants, then.
   3. Explain how plants make sunlight into food energy.
   4. Activity: Photosynthesis Relay Race (see activity section below)

D. Plant Adaptations
   1. Plant species can, over time, adapt (or change) to increase their chances of survival in their environment.
   2. Find a plant that has adapted to its environment. How has it?
      a. Water adaptations
      b. Predator adaptations
      c. Solar adaptations
   3. What would a plant look like that could:
      a. Catch insects? (Venus fly trap)
      b. Hold onto rock in a swift current? (kelp)
      c. Store water? (cactus)
      d. Live on the surface of a pond? (water lily)
      e. Withstand high winds? (palm tree)
      f. Avoid being eaten by grazing animals? (thistle)



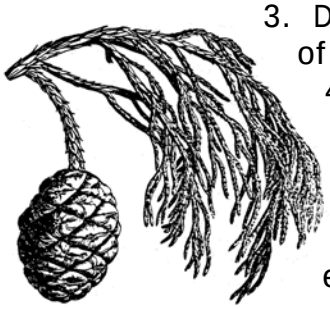
   4. Why do plants flower?
      a. Flowers are like flags that attract insects and other pollinators to them with bright colors, exciting shapes, or intriguing smells.
      b. Explain pollination.
   5. Activity: Plants that Hitchhike (see activity section below)

E. Trees
   1. If you come across a stump, go over annual growth rings (one ring per annual growth cycle).
      a. How old is the tree? (Count annual growth rings)
      b. Was there a drought, fire, or other type of stress to the tree? (Evidenced by narrow growth rings)
      c. Can you see any disease or injury? (Broken annual rings, fire scars, or dead or decayed portions)
   2. Activity: Build a Tree (see activity section below)

VI. Application/Conclusion
   A. Why are plants important?
   B. What can we do to protect plants?
   C. Remember to take only pictures and leave only footprints while in the park.
   D. Announce next Junior Ranger program and other interpretive programs.
   E. Stamp logbooks.

Trees

1. During sign-up time ask kids to be thinking of as many parts of trees as they can and what each part does.
2. After sign-up, briefly discuss tree parts and functions. Have the students describe the parts and functions.



3. Do activity "Build a Tree." This activity illustrates the functions of the different parts of trees.
4. Discuss how tree parts can be used to identify trees. Mention bark patterns, cone shapes/sizes, other seed-holders, leaves, needles/needle clusters.
5. Wrap-up: Using a hand-held piece of bark, cone, and needles, have the Junior Rangers describe the functioning of each and see if they know what type of tree they come from.

This sample program was designed by Wendy Harrison for Calaveras Big Trees State Park.

For other activities, try:

- Heartbeat of a Tree
- Tree Keying
- Tree Cookies
- Meet a Tree
- Tree Rubbings

(See activity section below)

Nature Walk

Introduce yourself and the Junior Ranger program.

I. Plants:
   A. Let's see how plants live and why they do not move about like animals. But first I'd like to point out a few cautions. Do not pull plants from the ground or there won't be any left for those who follow. Secondly, with poison oak remember "Leaves of three three, let it be." With this in mind please stay on the trail.[1]
   B. Now is the time to look for nature's treasures—a living museum for us to explore. Open your eyes, listen with your ears, smell with your nose. Silence can be a learning process.
      1. How many seeds have you eaten today? Leaves? Fruit? Roots?
      2. We also live in a type of tree house. Think of it. The floor, furniture, door, anything else? Without trees you wouldn't have books, magazines or comics

[1] This Plant Life Program was developed by Rodi Fregien, Folsom Lake SRA.

to read, nor would you have tissue or toilet paper. Some paper is made of cotton and linen rags rather than wood, but they are also from plants.

3. You may be wearing a plant (have children check themselves). Cotton and linen are plants. (Show a piece of rope and burlap). Rope and burlap are made out of jute plant fibers.
    a. A Frenchman who studied insects (Rene-Antoine de Reaumu) noticed that the female wasps were chewing up small bits of wood until they had a mushy pulp (show a paper wasp). They spread it out to form their next cells. The Frenchman suggested that chemicals be found to break down wood to make paper. Paper as we know it got its start because someone closely watched some busy wasps.

C. Walk down the path to an open area. Have everyone "freeze." Imagine that you cannot move and your feet are buried in the ground. The sun is hot and shining on your head. You become thirsty, but you cannot move. Just like a plant, your roots are held in the ground. Roots are anchors. They keep plants from blowing away. Roots also provide water and nutrients. Water in the soil enters the roots and is carried from the root into the stem and out the plant's leaves and flowers.

D. Move on:
    1. Look at the different plants and what their roots and stems are doing. Roots and stems may change direction as they grow, reacting to the world around them. Plant movements are called tropisms. Most plants move too slowly for us to see. (Point out stems, trunks, roots.) Why do they move? Roots grow toward water; stems and trunks grow toward light.
    2. Find a vine:
        a. Vines are not strong enough to stand alone. They feel their way along by sending out hair-like strands called tendrils. Tendrils are a special kind of leaf. Plants respond to touch when something is nearby, and grab with their tendrils. Some vines have leaves that bend over something while waiting for the stem to catch hold—like climbing a ladder.

II. Leaves:
    A. Leaves come in many sizes, shapes and shades of green. They can be almost round. They can be like your hand with your fingers spread. They can be long and narrow, heart or arrow shaped. There are leaves that are made of small leaflets joined on a stalk such as poison oak, blackberry and walnut. How many shapes, sizes and shades of green can we see from where we stand? (Show the children mounted leaves of various shapes, sizes, and colors that were put together before the walk).
    B. Pick up a leaf at random, and look at the veins. They look like a small collection of trails. Veins carry water and minerals from the roots and stem to the leaves. They are the pipelines. Veins also carry food which is made by the leaf to the rest of the plant.
    C. What about needles of a conifer? Did you know that they stay alive all year? Some leaves are poisonous to most animals. Leaves of the milkweed plant are

eaten by the caterpillars of the monarch butterfly. The caterpillars eat nothing but milkweed leaves. By the time they change into butterflies they are poisonous because of all the poisonous milkweed leaves they have eaten (show a monarch specimen along with a photo of caterpillar and milkweed).

D. Some leaves are covered with tiny hairs. Animals don't like the feel of the hairs so they leave those plants alone. Leaves are the food factories of plants. They make food from air, water, and sunlight. The leaves need a gas from the air which is carbon dioxide, which is poisonous to animals. Water and sunshine are also needed to make food. Chlorophyll, the green color in leaves, is a special chemical which allows the plant to use energy from sunlight shining on its leaves to make food from carbon dioxide and water. Without chlorophyll the plant cannot make food. Oxygen, which we need to breathe, is a gas. Leaves make oxygen and let it go into the air. Without plants to eat, animals would not be able to live.

III. Flowers (name State Flower):

A. Flowers are like flags or gems—they catch the eye with their color and shape. Some have a heady fragrance. Flowering plants are found just about anywhere. Why do plants have flowers? Flowers have two important parts: pistils and stamens. These parts work together to create mature seeds, which will eventually become new plants. Here's how it works: the pistil is shaped like a vase and has undeveloped seeds at the bottom. Pollen is the fine powder on the end of the stamens. When the pollen lands on the pistil, a pollen tube grows into the pistil, and fertilization occurs. The seeds then begin to mature. Sometimes insects help this process along. When an insect drinks a flower's nectar, pollen coats its body. As the insect visits other flowers of the same kind, the pollen on its body may be deposited and fertilize the seeds. Some insects are specialists who stay with one type of flower (example: yucca moth).

B. Some plants, like pine trees, depend upon the wind to spread their pollen. Although pollen carried by the wind may come into contact with pistils less frequently than other types of pollen, it may spread farther out when carried on the wind.

IV. Fruits

A. Find an acorn, pine cone, or seed pod. Fruits are simply the part of the plant containing the seeds. A fruit can be a tomato, pumpkin, grape, buckeye, strawberry, or pine cone. (Carrots and beets are roots, celery is a stem, and lettuce is a leaf.) A milkweed pod is a fruit. Fruits develop from flowers; the ovary, where the pollen is deposited, grows and grows and becomes the fruit.

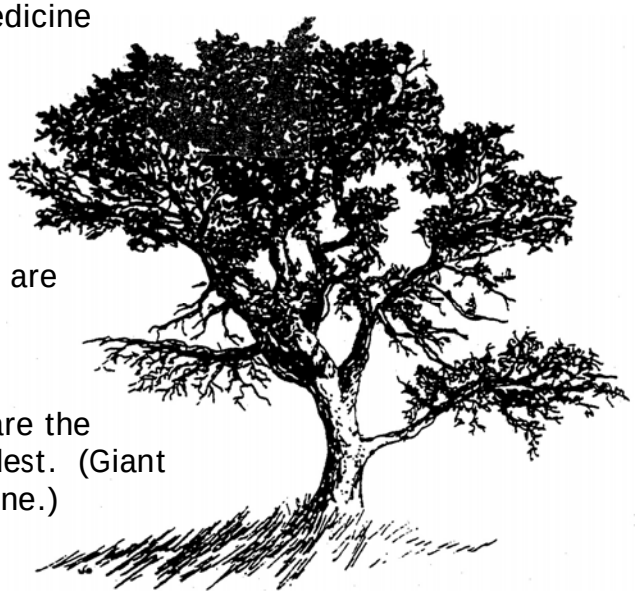
V. Seeds

A. Search along the path for seeds or examine socks. Some seeds are like corkscrews or arrows; some have blades or parachutes to be carried by the wind. There are burrs and explosive pods. Different modes of transportation are important for plant distribution. Animal fur and clothing, as well as water,

help in transporting seeds. When birds eat seeds and fly from place to place, they leave their droppings, which contain the undigested seeds. Fire is needed to pop open certain cones and shells. Not all seeds get a chance to grow into a new plant. How many of you had cereal, nuts, bread, apples, strawberries, etc. today?

VI. Trees

A. Trees provide shade, shelter, food, and medicine for animals. When it is hot, shade and coolness is nice to have. A large tree can pump up 200 gallons of water on a hot day. Leaves of a tree let go of some of their water, which cools the air. As the trees provide shade and cool the air, they also clean the air of carbon dioxide. Trees are always busy.



B. It would be difficult to live without trees. Trees help all animals live. This is why we should save and enjoy living trees. Trees are the largest plants on earth and some of the oldest. (Giant sequoia, coast redwood, and bristlecone pine.)
   1. Do you know California's State Tree? California redwood, of which there are two species: the coast redwood and the giant sequoia.

C. Trunks are tree stems. They continue to grow each year. The bark is the "coat" of the tree. It can be thick, thin, rough, or smooth. The sapwood is the living part of the trunk; it carries water and minerals to the rest of the tree. Heartwood is at the center of the trunk; it is the dead hard core of the tree. Each year part of the sapwood closest to the heartwood becomes part of the heart, making the center stronger and thicker.

D. Find a stump. A ring forms for each year of growth. Every year the tree is alive a ring is formed. Animals stop growing at a certain point, but trees don't.

VII. As we wander back:

A. Point out the difference between the trees.
   blue oak
   live oak
   buckeye
   gray pine

B. Count the number of different kinds of seeds in socks or shoes.

C. Stamp logbooks.

D. Tell the children to always look at the beauty around them!

Activities

Photosynthesis Relay Race

Number of Children: Eight or more
Environment: Open area, approximately 40' x 40'
Equipment Needed: Any objects that can be used to mark boundaries
Purpose: To learn about plants as producers, and about the elements necessary in photosynthesis
Activity:

1. Introduce plants as producers—making their own food through photosynthesis. Introduce the elements needed in photosynthesis (sun, carbon dioxide, and water).
2. Divide the group into two teams. Each team is divided into two groups. One group becomes "water molecules," and the other becomes "carbon dioxide molecules." One person (possibly the instructor) is the sun. One person from each team is the "producer." The producer starts at the sun.
3. On "go," each producer runs to and hold hands with one "carbon dioxide," and brings him/her to the sun. The producer then runs and gets a "water molecule" and brings her to and connects her with the carbon dioxide that is connected to the sun. Once connected, the producer must start at the sun and alternately weave through each member, then go back and pick up another molecule. This progresses until one team has all its molecules connected, when they shout "Photosynthesis!"

Plants that Hitchhike[2]

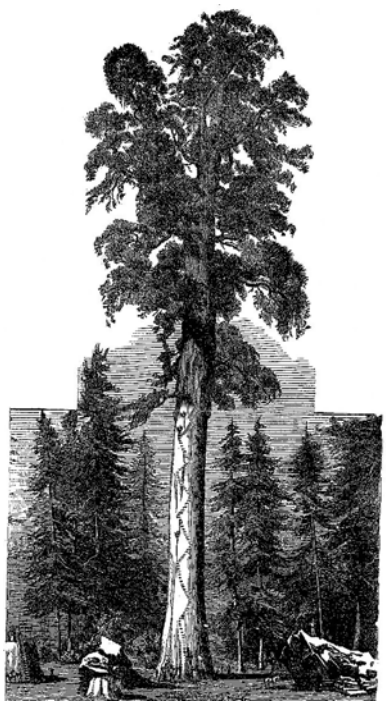
Number of Children: Three or more
Environment: An area where plants or grasses are going to seed
Equipment Needed: Burlap bag or other loosely woven cloth, hand lens
Purpose of Activity: To discover how seeds transport themselves
Activity:

1. Drag a burlap bag or other piece of loosely woven cloth over an area that has not been mowed, and where plants and grasses are going to seed.
2. How many different kinds of seeds do you find on the cloth? Are there more of some kinds? How did the seeds hitchhike on the cloth? Use a hand lens to discover the fasteners if they are too small to be seen unaided.
3. What do you think these seeds hitchhike on besides the bag? Match the seeds to their plants.
4. This is a variation of checking your socks for seeds after a hike.

[2] From *Indoor-Outdoor Natural Learning Experiences: Teacher's Guide*. Sacramento County Office of Education, 1978.

Build a Tree[3]

I. While choosing players to play each part of the tree, explain what their roles will be when the game begins.
   - Heartwood—Two or three tall, strong players stand with their backs to each other. Role: Stand straight and tall.
   - Taproot—Several players sit at the base of the heartwood, facing outward. Role: Hold the tree firmly in the ground.
   - Lateral Roots—Choose people with long hair who look as if they won't mind lying on the ground. Role: To suck up water from the ground. ("When I say, 'slurp,' you all make a slurping noise like this. Okay, let's practice. Slurp!")
   - Sapwood—Choose enough players to form an unbroken circle around the heartwood, facing inward and holding hands. Role: To draw water up to the tree's highest branches. ("When I say, 'bring the water up,' you go 'wheeee!'")
   - Cambium/phloem—Have several players form a circle around the sapwood, facing inward and holding hands. Have them stretch their arms upward and outward and cross arms with the next player at wrists and forearms, leaving hands free to flutter like leaves. Role: To turn sunlight and nutrients into food. ("When I say, 'Let's make food,' raise your arms and flutter your leaves, absorbing the sun's energy and making food. When I say, 'bring the food down,' you go, 'Whoooo!' While making the Whoooo sound, bend at the knees and drop your arms and body toward the ground").
   - Bark—All the remaining players circle the tree, facing outward. Role: To protect the tree from insect pests and weather. ("When I say, 'Get tough, bark!' growl and raise your arms like a football blocker, with elbows out and fists close to the chest.")



II. During the first round of play, announce, "Heartwood, stand strong! Get tough, bark!" Then shout the other players' commands several times (in the following order):
   1. "Let's slurp!"
   2. "Let's make food!"
   3. "Bring the water up!"
   4. "Bring the food down!"

III. Tell the group to continue, and instruct the bark to guard against beetles. Then go away and come back impersonating a beetle (in costume, if possible), and try to get through the bark's protection.

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[3] From *Sharing Nature With Children*, by Joseph B. Cornell. Nevada City: Ananda Publications, 1979.

IV. When the game is over, tell the players to give themselves a hand for being such a wonderful tree.

Heartbeat of a Tree[4]

Number of Children: One or more
Environment: Any area with young trees
Equipment Needed: Stethoscope, tree about six inches in diameter with thin bark
Purpose of Activity: To listen to the life flow of a tree
Activity:

- Spring is the best time to try this, and deciduous trees work better than conifers.
- Explain that trees are living creatures that eat, rest, breathe, and circulate fluids as much as we do. Press the stethoscope firmly against the tree, keeping it still so as not to make interfering noises. Try several spots on the tree until you find the best one. You will be amazed at what you hear! What you will be hearing is the movement of fluids within the tree. You may also hear insect activity, such as bark beetles chewing wood.
- Try listening to each other's heartbeats.

Tree Keying

Number of Children: One or more
Environment: Any area with trees
Equipment Needed: A tree (or leaves from a tree), bark sample, seed-holder (cone, berry, etc.), simple tree key such as *The Pacific Coast Tree Finder* (published by Nature Study Guild (only includes native trees)
Purpose of Activity: To use a simple key to identify trees
Activity:

1. You will need a copy of the tree key for each pair of Junior Rangers. Using the key involves making choices between two or more characteristics and following the directions given. If you haven't done this before, try it yourself before trying it in your program.
2. Now use the tree finders in the park! *The Pacific Coast Tree Finder* is pocket-sized, inexpensive, easy to use, and may be sold at the park visitor center.

Tree Cookies

Number of children: One or more
Environment: Any
Equipment Needed: Cross section of a tree that shows growth rings, map pins, yarn, tags. For extension: Cross sections of tree limbs, crayons, paper
Purpose of Activity: To perceive time from the perspective of tree growth
Activity:

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

[4] From *Sharing Nature with Children*, by Joseph B. Cornell. Nevada City, Ananda Publications, 1979.

2. Examine the annual growth rings on a cross-section of a tree, or "tree cookie," with the Junior Rangers. Each pair of dark and light rings equals one year's growth. The light wood is the spring and summer growth, and the dark wood is the fall and winter growth.
3. Look at the differences in ring size. Discuss possible reasons for these differences, such as: drought, fire, tree damage, competition with other trees, soil condition.
4. Using map pins, mark the annual rings and connect with string to a large bulletin board indicating events during that year in the tree's life. How large and old was the tree when:
   - The park was established?
   - The Junior Ranger was born?
   - The last president was elected?

Extension:

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

From Project Learning Tree.

Meet a Tree

Organize the Junior Rangers into pairs. One child in each pair is blindfolded, and the other is the leader. The leader guides the blindfolded student to a tree. The blindfolded student tries to find out as much as possible about the tree using the sense of touch, smell, and hearing. After five minutes or so, have all the kids come together. Remove the blindfolds, and let the Junior Rangers try to find the tree they have just met. Repeat the activity with the other partners. *Note: Choose the area carefully to avoid possible problems with poison oak, insects such as biting ants or yellow jackets, or pine pitch*.

Rubbings

Using the flat side of a crayon on paper, make rubbings of bark, cones, and foliage.

Background Information: Plant Life

Plant Adaptation

Most animals can move to a new location if wind, water, heat, cold, sunlight, dryness, or other animals become a problem. Plants cannot move to avoid unfavorable conditions, but they have developed certain characteristics that enable them to survive in less-than-ideal conditions.

Plants that don't receive much water have shallow root systems that can draw water from a light rainfall or heavy dew. Some of these plants can retain water for months or years and use the water economically for the plant's metabolism. Some plants develop waxy outsides on their leaves that reduce moisture loss. Others develop hair on their leaves that sunlight cannot penetrate. These hairs also reduce water loss and discourage animals from eating the leaves.

Often plants have leaves that drop off during periods of drought to reduce the amount of surface area through which the plant loses water.

Another way plants have adapted to protect themselves is by growing thorns and producing bad-tasting oils which discourage hungry animals.

Pollination

Flowers produce sweet nectar to interest insects and other animals. When the animals drink the nectar, pollen rubs off on their bodies, and when they visit other flowers, they deposit the pollen.

Pollen is the loose powder on the stamen of the flower. A pistil (shaped like a vase) has ova (unfertilized eggs) inside. When the pollen lands on the pistil, a tube grows into the pistil, and fertilization occurs. Seeds mature, and later they grow into new plants.

Pollination can also occur when wind or water transports pollen from one plant to another. Some plants have the special ability to pollinate themselves. Self-pollination occurs when pollen is transferred to the pistil of the same plant. Most plants have mechanisms to avoid self-pollination, because self-pollination discourages genetic mixing.

Seeds have many adaptations to ensure that they will be spread. Some are shaped like corkscrews or arrows, or have beads or wings to be better carried by the wind. Brambles and burrs get carried on animals' coats.

Fruits are actually specially designed “seed packages.” They are the part of the plant which develops from a flower once it has been pollinated. The seeds of the fruit may grow on the inside (a peach) or on the outside (a strawberry).

When animals eat the fruit, they carry the seeds in their digestive systems to new locations. The seeds have hard outer seed coatings and pass unharmed through the animal's digestive tract. Once they have been disposed of by the animal, they then can germinate and grow.

In addition to wind-borne seeds and animal-borne seeds, there is the coconut, which is a seed designed to be spread by floating in water!

Destruction of Rainforests

Rainforests affect us in ways we don't even realize. Your kitchen cabinets may be made of wood grown in tropical rainforests. Much of your breakfast (juice, cornflakes, bananas, coffee, sugar) is from plants that originated in tropical rainforests. Foods with rainforest origins include avocados, bananas, cashews, chocolate, cinnamon, coconuts, coffee, oranges, grapefruits, lemons, and vanilla. More than 25 percent of the current prescription drugs derived from plants have their origins in the rainforest. Rainforests cover only five percent of the earth's land surface, yet contain at least half of its plant and animal species.

Tropical rainforests are being destroyed at an alarming rate—approximately 100 acres a minute. This destruction is due to logging and burning to create new agricultural lands.

For information about effects of biodiversity loss, please see the Ecology section, and for information about photosynthesis see Energy.

Suggested Resources: Plant Life

Abrams, LeRoy, and Roxana Stinchfield Ferris. *Illustrated Flora of the Pacific States: Washington, Oregon, and California*. Stanford, CA: Stanford University Press, 1940. A classic reference.

Alexander, Taylor R. and R. Will Burnett. *Botany*. New York: Golden Press, 1970. A handy guide.

Audubon Field Guide Series. New York: Alfred Knopf, 1977. Titles include: *Western Forests*, *Grasslands, Deserts*, *Pacific Coast*, etc. Series describes the ecological components of the various habitats described. Identification is based on photographs depicting plants, animals, and geology of the biotic regions.

Balls, Edward K. *Early Uses of California Plants*. Berkeley: University of California Press, 1972. This small book identifies and describes those plants that were used by California Indians and explains how they were used.

Barbour, Michael G., Bruce Pavlik, Frank Drysdale, and Susan Lindstrom. *California's Changing Landscapes: Diversity and Conservation of California Vegetation*. Sacramento, CA: California Native Plant Society, 1993. This book presents an excellent overview of California's wild vegetation.

Barbour, Michael G. and Jack Major. *Terrestrial Vegetation of California*. Davis, CA: California Native Plant Society, 1988. A more in-depth and technical publication on the terrestrial communities in California. An excellent reference for background knowledge on California floristic provinces.

Becking, Rudolph W. *Pocket Flora of the Redwood Forest*. Covelo, CA: Island Press, 1982. Identifies the plants associated with redwood forests and briefly describes the plants.

Benyus, Janine M. *The Field Guide to Wildlife Habitats of the Western United States*. New York: Simon & Schuster Inc., 1989. A guidebook to eighteen distinctive habitat types, most of which occur in California.

Brown, Vinson. *The Amateur Naturalist's Handbook*. Englewood Cliffs, NJ: Prentice-Hall, 1987. An excellent reference on how a naturalist looks at the world, subject by subject, region by region.

Brown, Vinson. *Reading the Woods.* Harrisburg, PA: Stackpole Books, 1969. Text, charts, and illustrations show how climate, soil, fire, animals and human activity each shape the forest.

"California Natural History Guides." University of California Press. Series titles include: *Native Trees of the San Francisco Bay Region*; *Rocks and Minerals of the San Francisco Bay Region*; *Mushrooms and Other Common Fungi of the San Francisco Bay Region*; *Native Trees of Southern California*; *Seashore Plants of Northern California*; *Butterflies of the San Francisco Bay Region*; *Seashore Life of Southern California*, etc.

Cornell, Joseph. *Sharing Nature with Children*. Second ed. Nevada City, CA: DAWN Publications, 1998. Written by a leading environmental educator, *Sharing Nature with Children* shares some of the environmental games Joseph Cornell uses in his interpretive programs for children.

Cornell, Joseph. *Sharing the Joy of Nature*. Nevada City: Ananda Publications, 1989. A complement to *Sharing Nature with Children* with additional environmental games to use in children's interpretive programs.

Dawson, E. Yale. *Seashore Plants of Northern California*. Berkeley: University of California Press, 1966. This short book identifies those plants that grow just off the California coast. Identification is through photographs and line drawings.

Fuller, Thomas C., and Elizabeth McClintock. *Poisonous Plants of California*. California Natural History Guides: 53. Berkeley: University of California Press, 1986. Handy as well as comprehensive, this manual catalogues the state's toxic vegetation; algae, fungi, and vascular ("higher") plants are included.

Grillos, Steve J. *Ferns and Fern Allies of California*. Berkeley: University of California Press, 1966. Identifies the numerous ferns and fern allies found in California with a brief description of the plant and some photos and line drawings for identification.

Head, W.S. *The California Chaparral: an Elfin Forest*. Edited by Florence Musgrave. Healdsburg, CA: Naturegraph Publishers, 1972. A basic introduction to the chaparral community.

Hickman, James C. *The Jepson Manual, Higher Plants of California*. Berkeley: University of California Press, 1993. The new "Bible" of higher plants of California, this manual replaces Munz's *California Flora* with current classification, name changes, and numerous illustrations.

Johnston, Verna R. *California Forests and Woodlands: a Natural History*. California Natural History Guides: 58. Berkeley: University of California Press, 1994. Engagingly written yet packed with facts, this book guides the reader on a naturalist's tour of California's tree-dominated biotic communities.

Keator, Glenn. *The Life of an Oak: an Intimate Portrait*. Berkeley, CA: Heyday Books in cooperation with the California Oak Foundation, 1998. Clearly written, sections of the book examine oak architecture, life cycle, diversity, and habitats.

Lanner, Ronald M. *Conifers of California*. Los Olivos, CA: Cachuma Press, 1999. This book considers the variety of California conifers individually, combining informative species accounts with high-quality color illustrations, photographs, and range maps.

Leite, Daliel. *Don't Scratch!: the Book About Poison-Oak*. Walnut Creek, CA: Weathervane Books, 1982. Contains virtually everything a naturalist should know about poison oak, including clearing up common misconceptions and answers to common questions about the plant.

McMinn, Howard E. *An Illustrated Manual of California Shrubs*. San Francisco: J. W. Stacey Incorporated, 1939. This comprehensive work gives detailed descriptions of the hundreds of species of shrubs and shrub-like plants which are native to the state.

Murphey, Edith V. *Indian Uses of Native Plants*. Mendocino County Historical Society, 1959.

Niehaus, Theodore F., and Charles L. Ripper. *A Field Guide to Pacific States Wildflowers*. Boston: Houghton Mifflin Company, 1976. A convenient guide to nearly 1,500 species of Western wildflowers.

Ornduff, Robert. *An Introduction to California Plant Life*. Berkeley, CA: University of California Press, 1974. Describes plant communities of California and adaptations of California plants.

Pavlik, Bruce, Pamela C. Muick, Sharon Johnson, and Marjorie Poppin. *Oaks of California*. Los Olivos, CA: Cachuma Press, 1991. A coffee table book identifying and describing all oaks found in California. Included is their development, identification, life histories, and historical relations to humans.

Peattie, Donald Culross. *A Natural History of Western Trees*. Boston: Houghton Mifflin Company, 1953. Filled with interesting scientific facts, impressive statistics, noteworthy quotes, historical anecdotes, and romantic lore, this publication is a valuable resource for interpreters.

"Peterson Field Guide Series." The first major field guide series, Peterson's has been updated somewhat over the years, particularly the *Field Guide to Western Birds*. All identification plates are drawn (no photographs) with written descriptions of each plant or animal.

Project Learning Tree. *Environmental Education Activity Guide: Pre K-8.* Washington, D.C.: Project Learning Tree, 1993. www.plt.org.

Russo, Ronald A. *Plant Galls of the California Region*. Pacific Grove, CA: The Boxwood Press, 1979. Galls are common to many plants. This book identifies many of these galls, their host plants, and the insects that cause them.

Sargent, Charles S. *Manual of the Trees of North America*. New York: Dover Publications, 1965.

Schoenherr, Allan A. *A Natural History of California*. Berkeley: University of California Press, 1992. A comprehensive and abundantly illustrated book which fosters an appreciation for California's natural diversity and unique beauty. Describes the climate, rocks, soil, plants, and animals in each distinctive region of the state.

Smith, Alexander H. *A Field Guide to Western Mushrooms*. Ann Arbor: University of Michigan Press, 1975.

Sugden, Andrew. *Longman Illustrated Dictionary of Botany*. Harlow, England: Longman, 1992. Botanical dictionary with numerous illustrations.

Vieira, Linda. *The Ever-living Tree: The Life and Times of a Coast Redwood*. New York: Walker and Company, 1994. This book for younger readers tells the story of a 2,000-year-old redwood tree, charting its development against a backdrop of world history.

Watts, May T. *Master Flower Finder*. New York: Warner Books, 1986. A layperson's guide.

Watts, Tom. *Pacific Coast Tree Finder*. Rochester, NY: Nature Study Guild Publishers, 2004. A layperson's guide.

Whitney, Stephen. *A Sierra Club Naturalist's Guide: The Sierra Nevada*. San Francisco, CA: Sierra Club Books, 1979. Describes the natural history of the Sierra Nevada by communities found within the Sierra Nevada biotic zone.

Wow!: The Wonder of Wetlands. St. Michaels, MD: Environmental Concern Inc./Bozeman, MT: The Watercourse, 1995. Exploring the potential of wetlands as an educational tool, this guidebook combines useful background material with more than forty wetland-related activities for kindergarten-through-twelfth-grade youths. www.wetland.org/wowteacher.html.

Other Sources of Information

California Department of Forestry. "Just for Kids." www.fire.ca.gov/php/education_kids.php.

California Institute for Biodiversity. *CalAlive!* Produces educational materials for grades 4 through 8. www.calalive.org.

USDA Forest Service. "Just for Kids." www.fs.fed.us/kids.

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