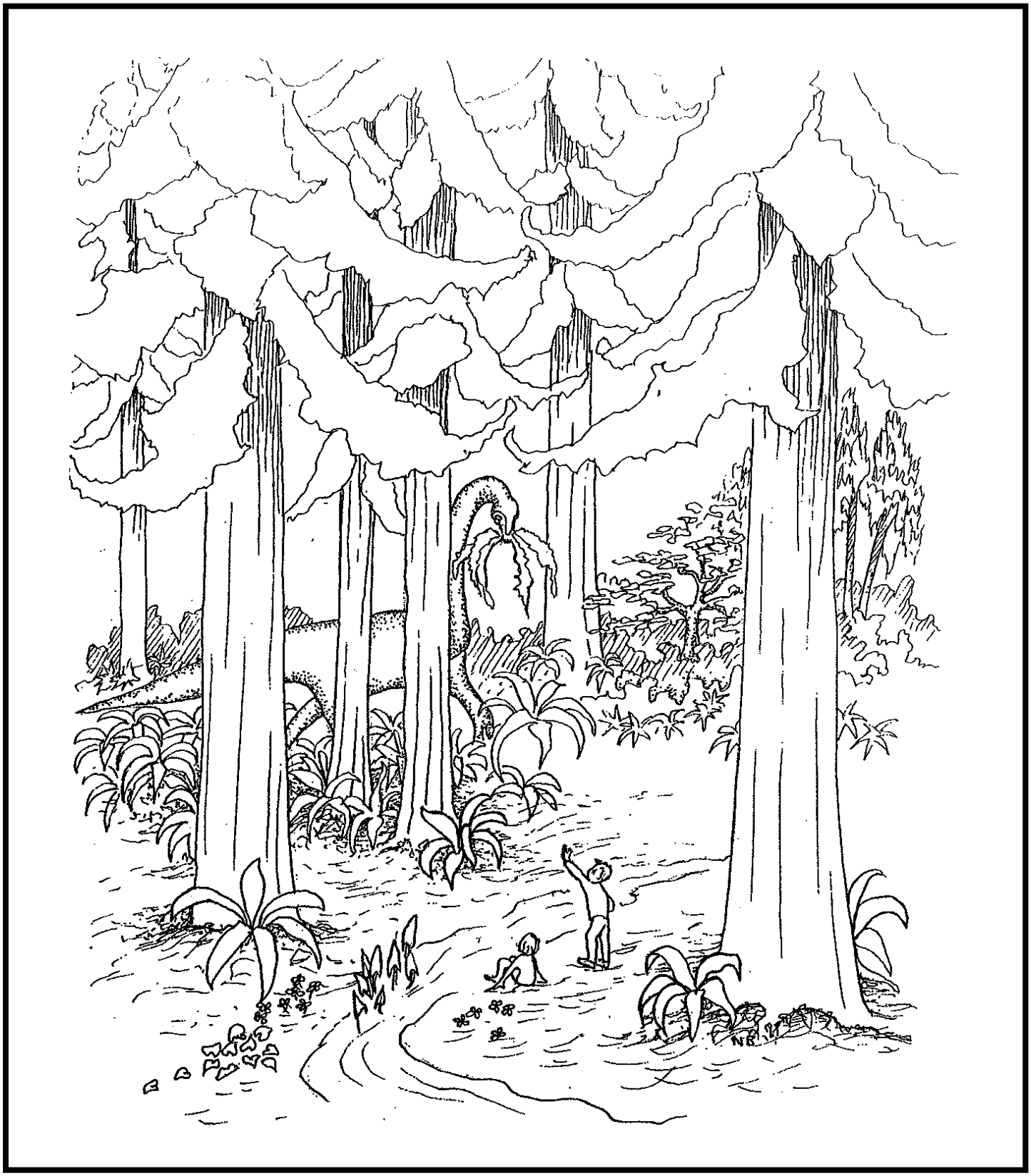
SAN FRANCISCO BOTANICAL GARDEN AT STRYBING ARBORETUM

Youth Education Program

of San Francisco Botanical Garden Society

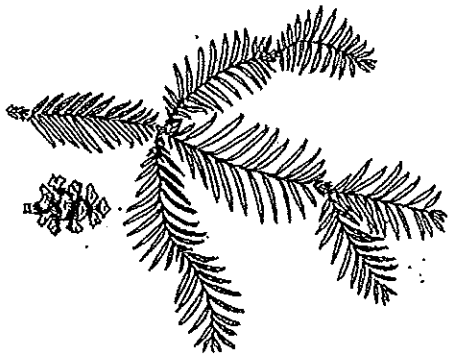
Teacher Packet

REDWOOD WALK



CONTENTS

Imagine exploring a forest where dinosaurs once roamed! During the time of the dinosaurs, redwood forests covered much of the land. Today only small patches remain – visit the redwood grove at the San Francisco Botanical Garden and discover the magic of these amazing trees!



Produced by the Youth Education Program, San Francisco Botanical Garden Society in conjunction with the Children's Walk Committee of the Docent Council, Spring 2000. Revised Fall 2003.
Illustrations by Nancy Baron, forest pop-up by Jean Marcy.

The Redwood Trail

The trees along the Redwood Trail are unique and beautiful. We look forward to guiding you and your class through the Redwood Trail at the San Francisco Botanical Garden (SFBG). We will study the coast redwood tree (*Sequoia sempervirens*) growing in its plant community. Since 1906 this redwood forest has developed as closely as possible to a natural ecosystem.

This teacher's guide is designed to help you and your students make the most of your visit. It includes some general background information for you to share with your class before your visit, activities to help prepare for the walk, other activities to extend the experience back in the classroom, and an annotated bibliography of useful materials. We strongly encourage you to prepare your class by making use of these materials, especially if you are just beginning your exploration of these concepts.

Basic concepts

The walk is designed to illustrate three key concepts:

1. Redwood trees can grow to be some of the biggest and oldest trees in the world. Their leaves, bark, roots and other parts help them to grow so big and live so long.

2. In the redwood forest, many different plants and animals live together underneath the redwood trees. The redwood forest is a lot more than just trees!

3. People use redwood trees to build houses and other things. We need to make sure that there are enough redwood trees for people and for the plants and animals that live in the redwood forests.

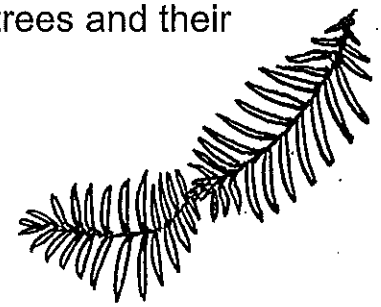
The Redwoods

When dinosaurs still roamed the land, many different kinds of redwoods grew all over the northern hemisphere. As the climate changed, most redwoods became extinct. In your walk at the SFBG, you will see the coast redwood, which grows in a narrow strip of land in California and Oregon. You may also see the sequoia, which grows on the western slopes of the Sierra Nevada, and the dawn redwood which grows in one valley in China.

Coast redwoods have survived for over 160 million years as a species, in part because they can reproduce in two different ways. Redwood trees make small cones that can hold about 100 seeds each. Even though a tree may make thousands of cones, and millions of seeds, only a few seeds ever grow to become a tree. Fortunately for the redwoods, they can also reproduce by sprouting new plants growing from stumps, fallen trees, and the bases of living trees. Sometimes you can find big bumps on the trees, called "burls," which will sprout quickly if a tree falls or is injured.

Redwoods have several adaptations that allow the trees to survive for many years. Their soft red bark can grow up to a foot thick, protecting them from fire and insect attacks. Their leaves have a special shape, which helps them catch the moisture from fog and drip it back down to the ground. Redwood roots are shallow, growing only three or four feet deep, which helps make sure that the roots can get oxygen even in a very wet environment.

Redwoods have grown in California for millions of years, but in the last two hundred years, most redwoods have been cut down to build houses, fences, and other things. In only a few places can we find the two thousand-year-old trees that used to grow all along the coast. When the biggest, oldest trees disappear, so do the special plant and animal habitats that they helped create. We need to think carefully and act responsibly to make sure that these special trees and their communities are around for many more years.

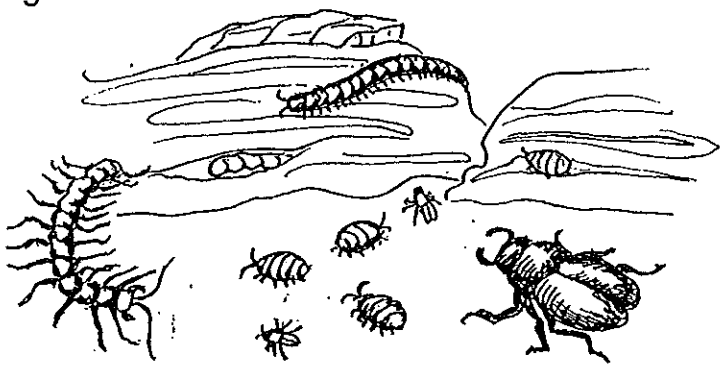


You may wish to read this story aloud to your class before your visit, or have students read the story themselves.

A Redwood's Story

More than a thousand years ago, a seed grew inside a redwood cone, hanging high in the branches of a redwood tree. One day the cone opened, and the tiny seed, along with many others, drifted to the ground. Many seeds fell in places where they could not grow, where it was too shady, or dry, or crowded. But one seed was lucky, and it landed on the trunk of a redwood that had fallen over long ago.

That old redwood trunk was slowly changing, as small living things ate the wood and the bark and turned it into rich soil. Earthworms, termites, millipedes, and pills bugs munched on the dead tree, while mushrooms sprouted up where fungus was growing through the log. These little recyclers broke down the tree so it could be used again by other plants. The soil they made was perfect for the tiny redwood seed to grow.



The tiny seed also had plenty of sun to help it grow. Before the big redwood tree fell over, the forest was dark and shady. After the old redwood tree fell down, the sun could reach all the way to the ground, since the tree no longer shaded it. The sunny spot in the forest was a good place for lots of different plants to grow, and the redwood seed was not alone.

For the first few years of its life, the tiny seed grew quickly, stretching its new branches and leaves high toward the sun. It was still a young tree when its branches began to shade the ground underneath it. Plants like wild ginger and oxalis grew under it, spreading their leaves wide to catch the sun that came through the tree's branches. Small animals like banana slugs, chipmunks, and snakes hid under the leaves of these plants that covered the ground.

Near the small tree a stream ran through the redwood forest. Skunk cabbage and ferns spread wide leaves along its banks. Animals came to the water to drink the cool water. The redwood tree stretched its shallow roots towards the water too.

The tree kept growing. Many kinds of bushes grew around the tree, also reaching for the sun. In the winter, deer hid in the rhododendrons and ate their leaves. In the spring, the bushes were covered with beautiful flowers and the air smelled sweet. In the summer and fall, bears and birds ate the huckleberries, thimbleberries and currants that grew on the bushes. But the redwood tree kept growing, and soon it was taller than all the bushes around it.

A hundred years had gone by and the tree was growing straight and tall. Around it grew other trees, like bigleaf maples, California bays and tanbark oaks. These trees gave shelter and food to birds and squirrels who lived up in their branches. These trees were tall, but the young redwood kept growing and soon it was even taller than the tallest of all of these trees.

One year a terrible fire burned through the forest. Many of the bushes and smaller trees died, but the redwood wasn't hurt. Its bark was more than a foot thick by now, and the bark kept the wood inside the tree from burning. The bark also helped keep away the insects that could have damaged the tree. The tree just kept on growing.

Now the tree was hundreds of years old. Its branches reached high up into the sky, and it was almost as tall as the other older redwoods around it. It was so tall that it could get all the sun it needed. It was so big that it needed lots of water.The tree grew in a place where it rained a lot every winter, but it could even get water from the summer fog. Its green needles helped pull water from the foggy air, and then the water dripped down to the roots spreading wide below.

Soon the tree was one of the tallest trees in the forest. Under its branches the air was cool, the light was dim, and the wind blew gently. A thick layer of dead needles covered the ground, slowly being turned to soil by recyclers. Ferns and skunk cabbage spread wide leaves to catch the little bit of sun that reached the forest floor. In a few brighter spots, elderberries, currants and other shrubs grew, while in the sunniest places maple and oak trees reached as high as they could. For hundreds of years, the forest seemed not to change at all.

One year, the forest began to change quickly. People came with noisy machines and began to cut down the redwood trees. They needed wood to build homes, furniture and decks. Tree after tree was cut, fell to the ground and was taken away. As the trees fell, the animals who lived in the forest disappeared, looking for better places to make their homes.

One day, the loggers came to the redwood tree. It took them a long time to cut through the thick trunk, but finally the tall redwood crashed to the ground. The huge trunk was cut into pieces and taken away to be made into boards for building. The redwood tree was gone.

Or was it? Soon green redwood shoots began growing right out of the old stump, growing from special cells that had been waiting just under the bark. These shoots were able to stay alive and grow thanks to the roots of the old redwood which reached far around the stump, pulling in water for the tree. Soon one shoot grew taller than the others. As years went by, it grew and grew. The old stump was recycled into soil, and the new tree stretched tall to the sun.

Vocabulary

We may use these words during your visit to the gardens. You may wish to share these definitions with your students, or have them use their dictionaries to find other definitions.

botanical garden – a place where different kinds of plants are grown to be studied and enjoyed

burl – knobby growths on redwoods that can sprout into new trees

chlorophyll – the green coloring in a leaf that uses the sun's energy to make food for the plant

cone – a seed container with hard, woody scales

decomposition – the breakdown of dead plant or animal material by fungi, plants, and animals

habitat – the home and environment of a plant or animal

needles – flat narrow leaves, like a redwood's leaves

photosynthesis – the process which plants use to turn sunlight, carbon dioxide, and water into sugar for food

Pre-visit activities

Becoming a nature detective

A visit to the SFBG is a chance for students to become nature detectives, exploring and discovering the wonders of the natural world around them. Help your students get ready to make the most of their trip with the following activity.

Introduce the concept of a "nature detective" to your students – a nature detective is someone who explores the natural world by observing closely, thinking about what they observe, and coming up with ideas about what they discover. Every one of us can be a nature detective – every one has special tools that can help them be a nature detective.

Divide children into small groups. Ask them to think about what tools we have *on our bodies* that we can use to explore the world around us. Each group can make of a list of the tools theythink of, or can draw pictures illustrating their ideas. Have each group share their results with the class, and compile their ideas in a large list or drawing.

Here are some suggestions – you and your class may think of others

eyes - counters, cameras
noses – scent detectors
fingers – tweezers, feelers
hands- rulers, cups
hair – wind detector
memories – notebooks and pencils
ears – tape recorders
feet – transportation
skin – thermometer

Sizing up the redwoods

Redwoods are the world's largest living organisms. The tallest coast redwood is as tall as a thirty-five story building, measuring 367 feet! The redwood's mountain cousin, the giant sequoia, is not as tall, reaching about 250 feet in height. On the other hand, the giant sequoia is a much broader tree – the trunk of an average coast redwood tree is about 40 feet around, while the trunk of a giant sequoia can be 90 feet in circumference! The trees you will see on your visit to the garden are not quite so big, since they are relatively young, only about a hundred years old. Use the following activity to help your students get a sense of just how big these tree giants can get, by measuring with their own bodies.

First, find two students of the same height. Use them to demonstrate that the arm span of a person is approximately the same as their height – have one student stand straight while the other stands next to them, touching the floor with the fingertips of one hand and reaching as high as they can with the other. If students don't know their own height, have them measure it with a tape measure or yardstick.

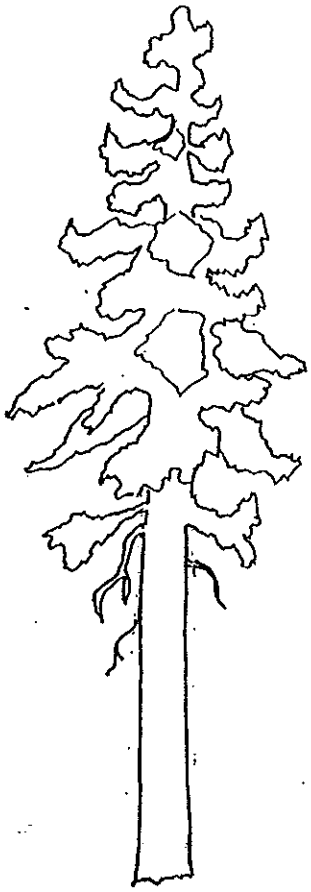
Measuring the height:

To understand the enormous height of the redwoods, you can draw a chalk line outside on the pavement that is as long as a redwood is tall, about 350 feet. Students can stand with finger tips touching to serve as human yardsticks (you could invite other classes to help out with this!), or they can lie head to toe to make these measurements. Alternatively, make the measurements first with a yardstick or tape measure, and then see how many students it takes to fill in that distance. If you can't find a space that is long enough to make a straight line, bend the line as necessary – it will still be an impressive demonstration of size!

You and your students could also measure a 350 foot piece of string, again using their bodies. If you use a string to measure, then you can use it to compare the height of a redwood to other measurements on the school grounds, such as the length of a hall, the height of an upper story window, the width of a playground. Is a redwood twice as long as your hallway? Is your school one tenth the height of a redwood?

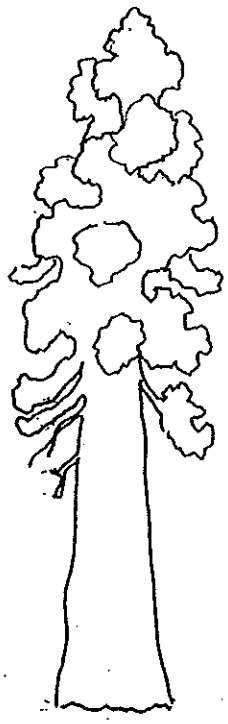
Measuring the trunk:

The trunk of a redwood is impressive in size, and you and your class may be surprised to discover how many children it takes to reach all the way around one! You can use this approach in the classroom, and then try it with the trees in the garden. You may also wish to measure some other kinds of trees in the schoolyard or the garden to see how they compare.



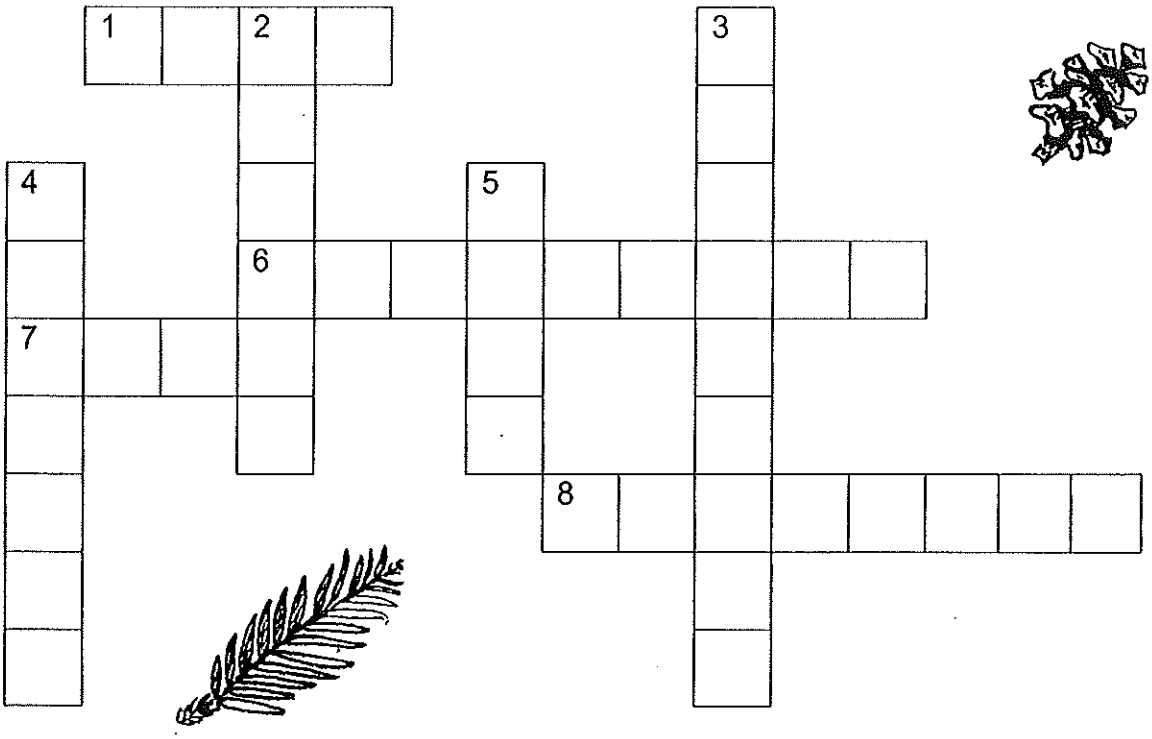
Coast Redwood

First, see how many students it would take to form a circle, with finger tips just touching, that is about forty feet around. How many redwood tree circles can your class make? How many students can fit inside a circle? For comparison, have your students make a ring the size of the average giant sequoia, ninety feet around. Does a ring this size fit in your classroom, or would your classroom fit in the ring?



Giant Sequoia

REDWOOD FOREST PUZZLE



Across

1. The small, woody container that holds a redwood's seeds
6. To break down dead plants and animals
7. A bump on a redwood that can sprout a new tree
8. A small mammal that lives high in the redwood trees

Down

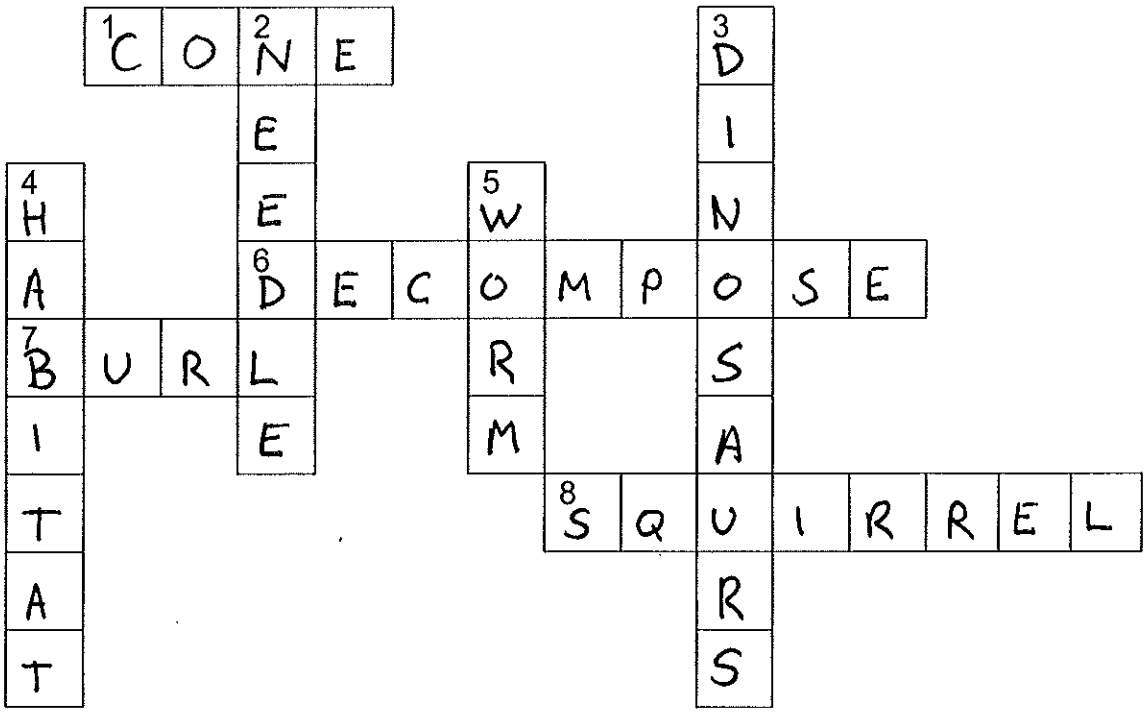
2. The leaf of a redwood
3. Animals that lived in the redwoods millions of years ago
4. A plant or animal's home and environment
5. An animal with no legs or eyes that lives in the ground and eats dead leaves

WORDS TO USE IN THE PUZZLE

needle	burl	decompose	squirrel
dinosaurs	cone	habitat	worm

REDWOOD FOREST PUZZLE

This will help familiarize your class with some of the terms they will hear on their walk. The student version is on the reverse.



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Post-visit activities

Pop-up redwood forest

Your students can create their own redwood forests using the worksheets on the following pages. Each student will need one copy (back to back) of the redwood forest background sheet. They will also need one copy (single side) of the plants and animals in the redwood forest.

Have each student color the forest sheet and the animal sheet with crayons or colored pencils. After they have completed the coloring, students will need to cut the sheets according to the following directions.

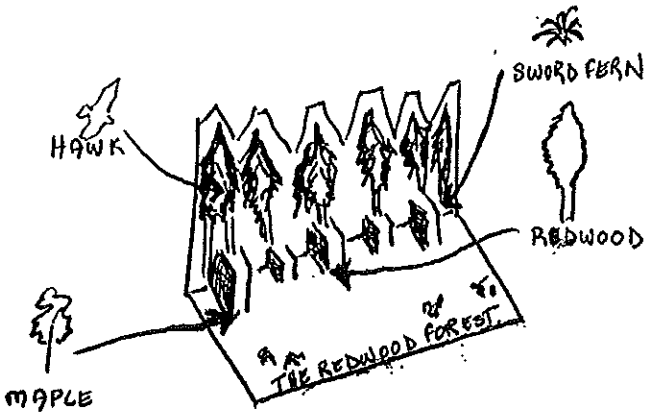
1. Fold the redwood forest sheet along the dotted line so that the forest scene is on the inside and the shaded strips are on the outside.

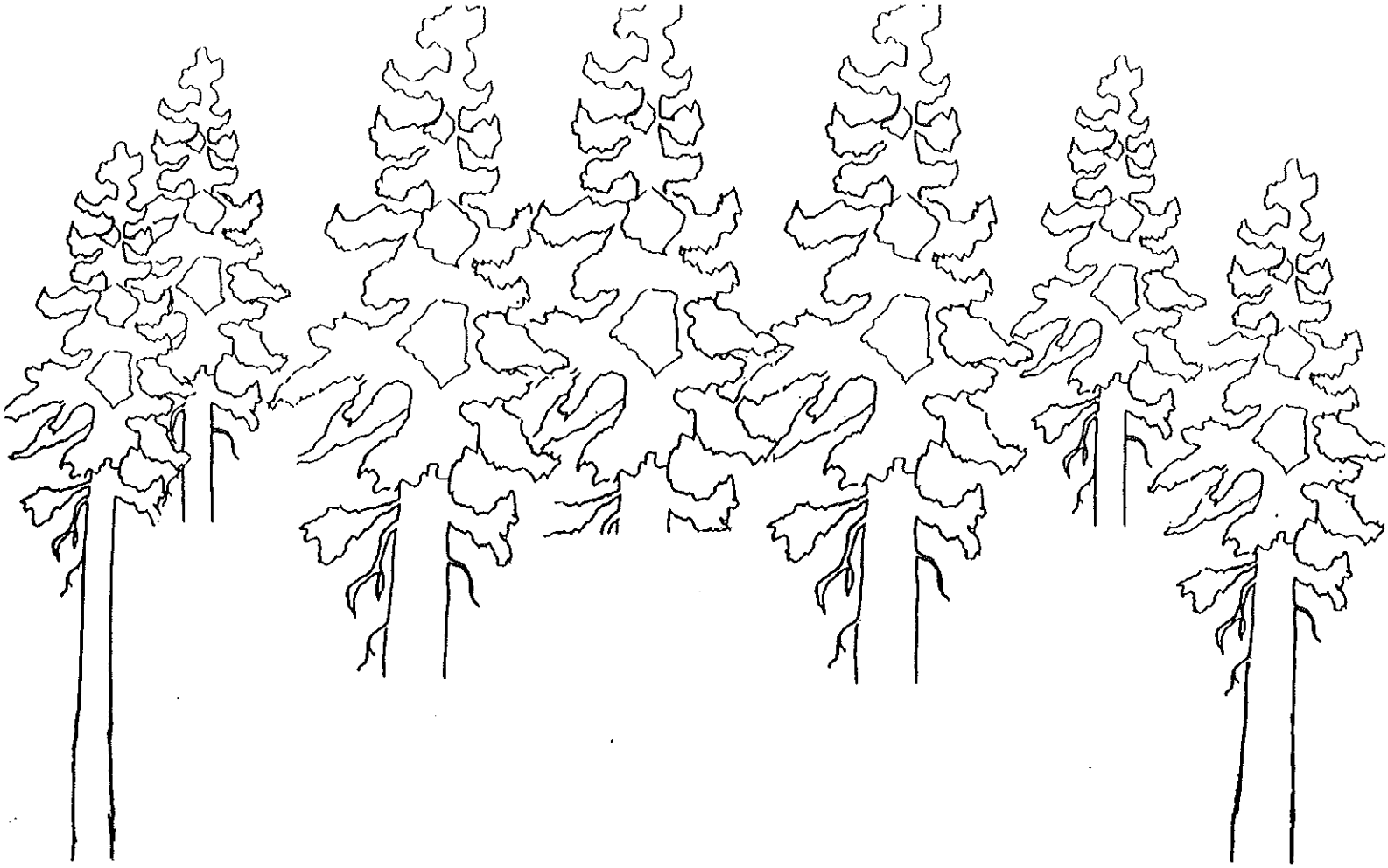
2. Cut along the sides of the shaded strips from the center fold. The ends of the strips must stay attached to the paper.

3. Partly unfold the sheet and push the shaded strips through the sheet so that they stick out in the forest scene.

4. Turn the sheet around. Pull out and crease the strips so that they are shaped like steps.

5. Cut out pictures of redwood forest plants and animals and attach them to the strips and to the background.





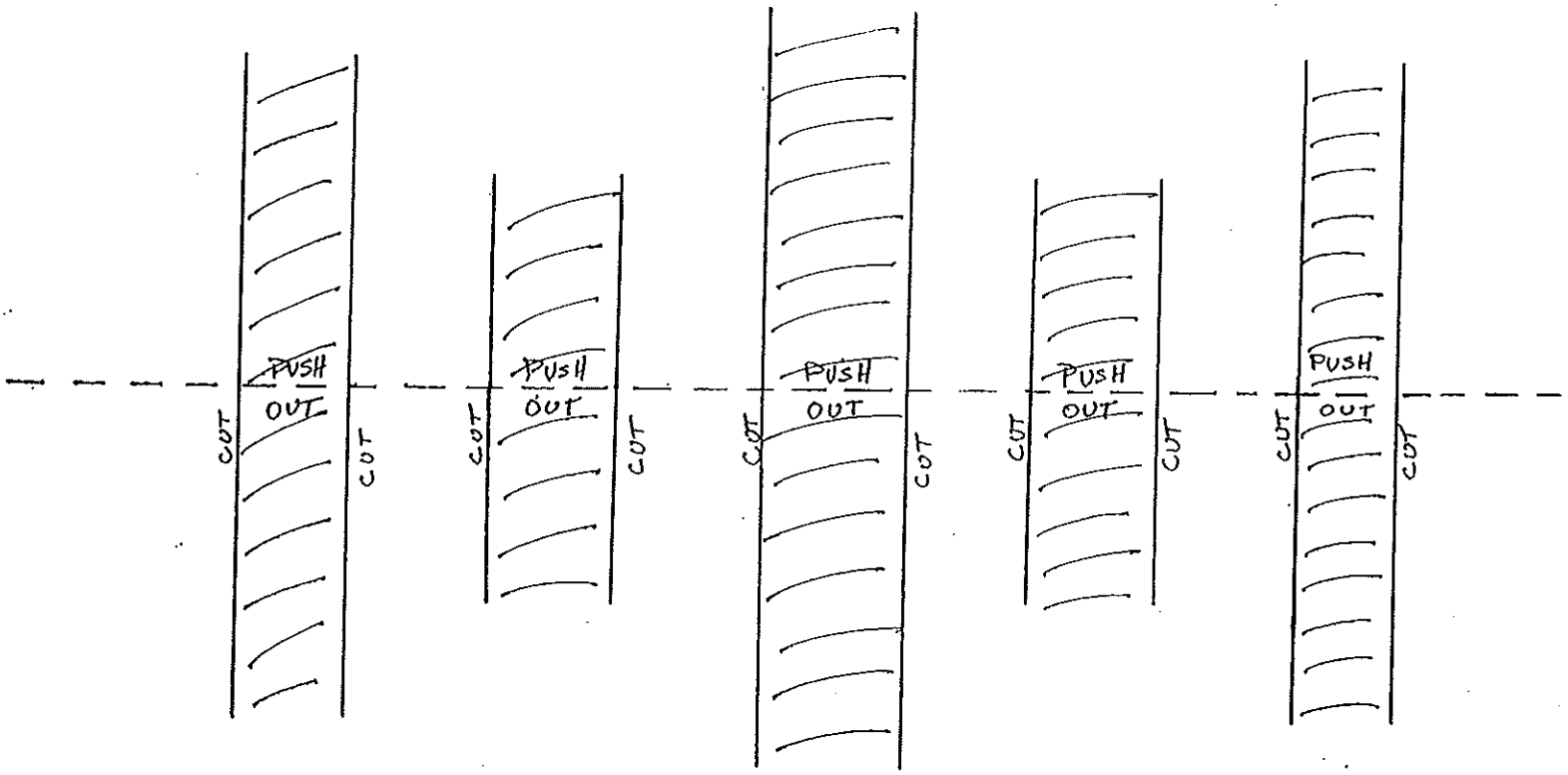
REDWOOD SORREL

WILD GINGER

BIG LEAF MAPLE

COAST REDWOOD

THE REDWOOD FOREST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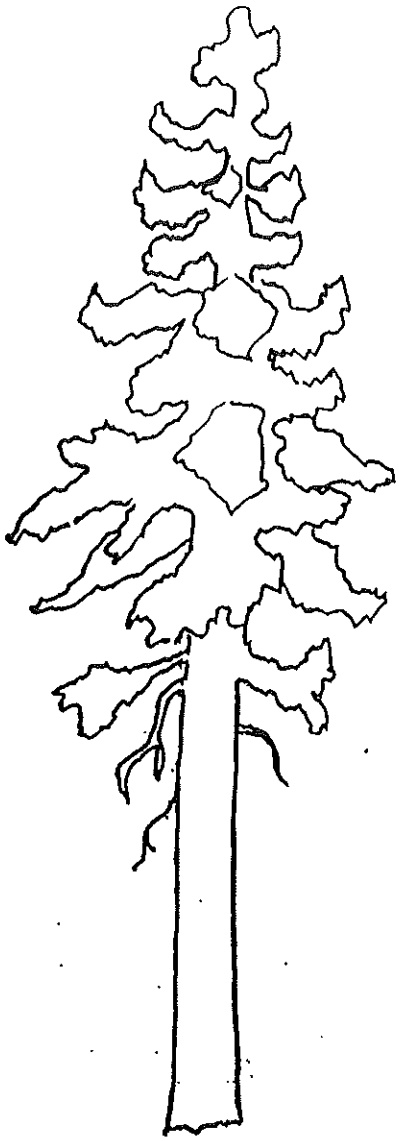
Draw your own plants and animals too!

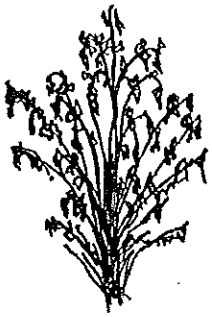


COAST REDWOOD

FOX

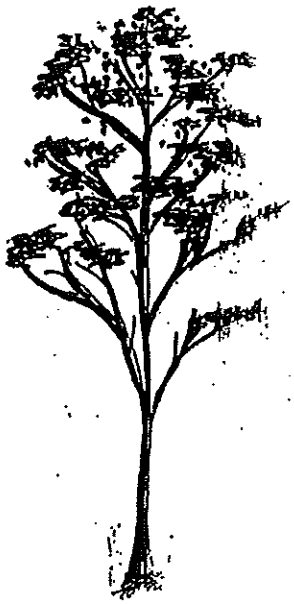
SQUIRREL

HAWKS



CURRANT

HORSETAIL



BIG LEAF MAPLE

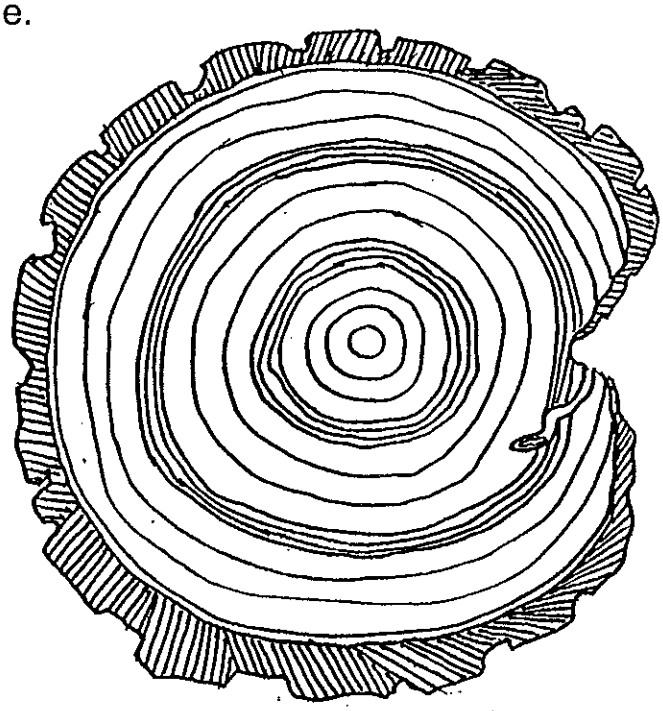
SWORD FERN

SKUNK CABBAGE

How to read the rings

When you look at a cross section of a tree trunk, you can see a pattern of rings. Each ring shows a new layer of wood that grew during the tree's growing season. By counting the rings from the center of the wood out to the bark, you can tell about how many years old the tree was when it was cut.

The size and the shape of the rings can tell you about the tree's life. A wide ring means that a tree was growing a lot that year and probably had lots of sun and plenty of rain. If a ring is very thin, the tree did not grow much - perhaps it was too cold or too dry. Sometimes a tree will grow very slowly for many years in the shade of bigger trees. When the bigger trees finally fall, the tree gets more sunshine and grows more quickly. If you look carefully, you may notice other things like holes made by insects or scars from fire damage.



1. How old was this tree when it was cut? _____ years
2. Find one ring that grew during a good year. Color it green.
3. Find two rings that grew during a bad year. Color them yellow.
4. Find a spot where the tree was damaged. Circle it with red.
5. Write a one paragraph story about this tree's life.

Web of life in the redwoods

The redwood forest is made up of many interconnecting parts that create a web of life in the forest. In this activity, students will recreate that web and discover how all parts of the forest depend on each other.

Imagine you had to build a redwood forest in a huge, empty space. What things would you need to make a redwood forest? In small groups, have students think back to their visit to the redwood forest in the botanical garden. Each group should make a list of everything they remember that can be found in a redwood forest. When the groups have finished their lists, have them share and write their ideas on the board or on a large piece of paper. Encourage students to think broadly, considering living as well as non-living parts of the forest.

Now ask students to look over the list and to choose one part of the redwood forest that they like or think is interesting. Remember that the biggest parts are not necessarily the most important parts! Encourage students to choose a part of the forest that theythink no one else will choose. Alternatively, assign students parts to ensure a wider representation. Each student should make a nametag for their part of the redwood forest and draw a picture of that part on the nametag.

When students have finished making their name tags, have them stand in a large circle, wearing their nametags. Explain that they will now discover how all the parts of the redwood forest are connected in a web, where each part depends on other parts of the forest. Ask them to describe how different things can depend on each other. You can encourage them to think about food, shelter, nutrients, pollination, seed dispersal - the whole range of ways that plants, animals, and the non-living parts of the environment interact.

Web of life in the redwoods, cont.

Give one student a large ball of string. Ask that student to explain what part of the redwood forest they represent. Then ask the student to find another student who represents something that the first student depends on, or who depends on that student. Thus a student could say"I am a squirrel, and I depend on that tree to give me shelter" or "I am a squirrel, and that fox depends on me for food." The first student should hold onto the end of the string and pass the ball to the student s/he has chosen. That student then chooses another student, explains how they depend on each other, and holding on to the string, passes the ball to that student. Continue until all children are part of the web. If necessary, they can pass to the same child more than once.

Ask the children what they think would happen if one part of the redwood forest disappeared. Imagine that all of the redwood trees in the forest were cut. Have any children representing the redwoods let go of the string. Then ask any children who were connected to the redwoods to drop the string, and then those who were connected to them. What is affected when the redwood trees are cut? Everything in the forest!

sun, air, water, minerals, soil

millipede, earthworm, beetle, banana slug, sow bug (roly poly)

snake, lizard, salamander, newt

moss, fungus/mushroom, fern, skunk cabbage, sorrel, wild ginger

redwood, maple, bay, huckleberry

jay, owl, woodpecker, deer, raccoon, squirrel, mole

Bibliography and Resources

If these books are not available in your library, you can find some of them at the Helen Crocker Russell Library at the SFBG. Some may also be available at the SFBG Bookstore.

The Ever-Living Tree. Linda Vieira. New York NY: Walker and Co., 1994.
Attractively illustrated book relates the life of a redwood to the passage of human history.

There Stand the Giants. Harriet Weaver. Menlo Park CA: Lane Book Co., 1960.
An older book which may still be in your library, it contains detailed discussion and description of the redwoods, suitable for older students.

The Tree Giants. Bill Schneider. Billings MT: Falcon Press Pub. Co. Inc., 1988.
Discusses the history and ecology of California's redwoods; includes redwoods, giant sequoias, and even mentions dawn redwoods.

Plants of the Coast Redwood Region. Kathleen Lyons and MaryBeth Cooney-Lazares. Boulder Creek CA: Looking Press, 1988.
Excellent text and photographs introducing every plant in the redwood community. Helpful for teachers, students will enjoy browsing through to help learn to recognize plants.

Redwoods, the World's Largest Trees. Jeremy Joan Hewes. New York NY: Gallery Books, 1988.
An all inclusive work with excellent charts and photographs of the redwoods; good for teachers and older students.