BACKGROUND

For centuries Native Americans have lived on the land in harmony with their neighbors and their environment with a skill and philosophy that is an example well worth our note. Lowell Bean sums up the Native Californian approach to life in Mukat's People:

> "To the California Indians, humanity was seen as one of a number of cooperating beings who shared the workings of a universe that was an interacting system. All parts of this system were reciprocal and humanity had obligations to the rest of the universe and its creatures."

The concept of owning land was foreign to Native Americans. They saw themselves as a part of nature, and not apart from it. To the Indians, what was done to a tree or rock was done to a brother or sister. This outlook has important implications. Native Americans emphasize a close relationship with nature versus control over the natural world.

Three centuries ago our American forefathers' very existence depended upon their mastery of the outdoors. The heritage of the pioneers was rooted in the soil and there was abundance for all. When the early pioneers moved westward they were much like the Indian and had little effect on the wildlife and the habitat. But as their numbers grew so did their influence on wildlife populations. They exploited the wide-open spaces and the natural resources. The settlers began to clear the forests for farming and cut them for timber. Often the forests were deliberately burned. Thus, much of the habitat that wildlife species needed to survive was destroyed.

As more and more land was occupied by man, the harvest of wild animals increased. While some men killed only what they needed, or to protect their livestock, others slaughtered wildlife to sell on the market. Some people killed just for the sake of killing, leaving the animals where they fell. Wolves, mountain lions, elk and buffalo were eliminated from large areas of North America.

Many other animals, such as the deer, bear, turkey and beaver, became extremely scarce.

However, not all wild animals suffered. Rabbits, quail and many song birds liked the farms of the settlers, and thus increased in numbers. Other animals that increased were skunks, foxes, and woodchucks. In recent times many of these animals have also suffered as agricultural methods are changed and intensified.

Our technology has gained us many benefits, and it would not do to turn back the clock, to unwind the spring of progress. But it is good to pause and reflect what we will leave for future generations.

Today and long into the future our children will be challenged with opportunities to maintain the quality of life for all while sustaining an ecological balance with our planet. The need for conservation of the spaces and resources is critical. Our young citizens will need a rainbow of skills and knowledge with sensitivity to ecological, sociological, economical, cultural and political factors in resolving environmental issues.

PRIMARY NEEDS OF WILDLIFE

All wildlife species must have certain basic things. They need food to eat, water to drink, and over or shelter to protect them from the weather and their enemies. They also need a certain amount of living space. The living space , which we call habitat, must include all the things an animal must have to survive.

Almost any land can be wildlife land. Soil is important in the production of wildlife. Fertile soils will support more wildlife than will poor soils just as fertile soils will produce more corn or beans. Wildlife is a crop and needs a rich soil to produce an abundance.

Food must be near cover so enemies cannot catch the animals off guard. Surface water should also be nearby. Some kinds of wildlife get all the water they need from their food and from dew.

The cottontail rabbit needs bushy fencerows, weed and briar patches, and brush piles for cover. Nearby grasses and legumes provide summer food. Young, tender-barked trees and shrubs serve as rabbit food when winter snow shuts off other food.

In comparison, the gray squirrel needs nature forests with hollow trees in which he makes his den. His food is supplied by nut meats and a mixture of tree flowers and buds for seasonal variety.

At any given time, habitat in an area has a fixed limit for the kind and number of animals that my live in it. This number of animals that can be supported by the habitat is called "carrying capacity." In the same way, farm pasture land has a carrying capacity in that it is limited in the number of cattle it will graze. By improving habitat or pasture, the number of animals it will support can be increased.

The carrying capacity of the habitat is usually lowest during the late winter. Natural changes in vegetation, such as the maturing of a forest, changes habitat. These natural changes affect carrying capacity the same as do the changes made by man.

Some animals need lots of space. A bear may roam over several thousand acres looking for food. On the other hand, some small animals may never travel more than a hundred feet from their home. Any animal must be able to find the kind of food and cover it needs within the area it travels regularly.

Each animal must have a certain amount of "elbow room" or living space - the amount depends on the species. This determines how dense any animal population can become.

Most animals have a territory at certain times. This is an area, usually right around the home or nest, that the animal will defend against members of its own species and, occasionally, others. Many birds gladly share the tree they nest in with birds of other species, but chase off any of their own kind.

Each animal fills a slightly different place in nature. A chipmunk and a cottontail can live on teh same plot of ground because they don't eat the same foods and don't interfere with each other.

During favorable periods, wildlife numbers can increase rapidly. If they become too numerous, they can actually eat themselves out of house and home. The surplus animal crop can be harvested to maintain populations that the land can support during unfavorable periods.

A healthy animal that doesn't have to compete with too many others for its food is in better condition to avoid predators and withstand disease, parasites and winter weather. Land that isn't over-used is in better condition to support a new crop of wildlife the next year.

BALANCE OF NATURE

The "balance of nature" or the "web of life" refer to a relationship between animals and their environment and among animals within that environment.

On the rose bush there may be tiny insects called aphids. The aphids depend for food on the sap in the rose bush. But ants use the aphids for food, and birds such as flickers may eat the ants. In turn the flickers may be eaten by hawks or owls.

In a pond there may be plankton or algae which is eaten by insects such as stone fly or May fly larvae. Sunfish or small perch may eat the insect larvae. Bass may eat the sunfish or small perch. Man, ospreys, herons, or mink may eat the bass.

In each case the smaller forms of life are most numerous, and as you go up the scale of the food chain to the larger animals, the numbers of the animals get smaller.

In the natural arrangement of things, prey animals live on plentiful plant foods and they have lots of young - far more than can ever survive for very long. This "overproduction" or population surplus, goes largely to feed the meat-eaters or predators. Since it is mostly these excess animals that the predators take, they don't reduce their food supply very much and thus don't eliminate their means of making a living. And, since they are helping to keep the herbage feeders within reasonable limits, the plant-eating animals don't destroy their own food supply.

In this organization one thing tends to balance another in a way that permits the system to keep operating. The numbers of predators are partly determined by the ease with which they can obtain food and rear their young. And when the meat-eaters have had easy living for a while and managed to build up to a high density, another "control" enters the picture. Under those conditions, disease spreads readily in the population and cuts it down to size.

The numbers of animals are perpetually fluctuating. They do so with the annual cycle of the seasons, and they do so from year to year. First one species is plentiful and then another. But it all happens within certain limits, and for that reason the "balance of nature" is a real thing. Otherwise communities of plants and animals could not survive.

BEING A NATURALIST IS BEING A SCIENTIST

Humans can find their connections to natural resources, whether they live in downtown Los Angeles or high in the Sierra Nevada. Being a naturalist is exploring and discovering nature. It does not depend on expeditions to distant and grand places, such as the plains of Africa, or even to Yosemite National Park. It's all at one's doorstep - in our backyard, a schoolyard, en empty lot, a city park, a local pond, suburban gardens, along forest trails, by the shores of oceans, lakes or streams. All have wildlife and plants to observe and conserve. The wildlife might be a string of ants marching along cracked pavement or a song sparrow perched on a neighbor's rooftop. The plants may be the neglected weeds on a ball field or the budding tree in a nearby lawn. The stream might be the runoff from a leaking sprinkler running across a patch of dirt to the street. From the drop of rain to the Pacific Ocean, from the tiny mustard seed to the giant redwood, from a grain of sand to mighty "Half Dome", all are ours to behold if we choose to wonder, see, listen, smell, and touch.

Have you ever watched a baby closely? If so, you may have noticed how the baby learns about things in the world. What do babies do when they pick up something? (Taste, touch, smell, see, listen)

A scientist is someone who finds out about the world. Is the baby a scientist? S/he uses her/his senses to find out about the world. Scientists do, too. Do you use yours? Are you a scientist?

Scientists use their senses to find out about things in which they are interested. They use 6 senses to find out about the world: wonder, sight, hearing, touch, smell, taste. They start with an inquiring mind. They wonder about things so they feel like using their other senses. When scientists want to find out about something they first observe it. Then they write down descriptions or talk about how things look, sound, smell, taste, and feel. Sometimes they also record weights, measure, compare and sort. They make guesses and do experiments to see if their guesses were right.

If you or a scientist wanted to see something up close that is far away or very small, there are tools and instruments to use.

Scientist compare things to see how they are alike and different. If we become good observers then it will be easier to compare. There is great diversity among living things. These living things can be described, identified, compared and classified by many different categories, characteristics and behaviors. We must use obsevation and comparison skills to discover and communicate these differences.

There is much more to being a naturalist than simply collecting and identifying animals and plants. There is also detecting, observing, discovering and experimenting in the natural world around us. Whenever an animal or plant is studied, try to work out how it is connected with the other living things around it. Naturalists learn to understand nature by having an interest in every aspect of it. Does that make a naturalist a scientist? You bet it does.

Mary Engebreth
Sonoma County 4-H
February, 1991

WHAT CAN YOU DO TO MAKE ROCKS INTERESTING?

This depends on how you look at rocks and their interest to you. Hopefully, they will draw more attention than just as a projectile in the hands of an exhuberant youngster. At least acknowledge that they are around; they have different shapes; they're composed of different minerals, one of which is calcium, just like our own bones.

If you wish to look under a rock, roll the rock **TOWARDS** you. Do this carefully. This allows the critters under it to have a change to escape without being cornered. Talk about what is under the rock. Replace the rock gently when you are finished. This is the roof for the homes here. Discuss the importance of the rock - its part in the habitat?

Choose a large rock. Which side of the rock has the most plant growth? Which side of the rock has the most moisture? (Look for observable answers - the side facing the sun, away from the sun, on the top/bottom, next to a tree, etc., rather than the north/south/east/west side.) Was there anything found on or near the rock that the group did not like? What was it and why didn't they like it?

STREAM ROCKS

Discuss rocks found in the creek or along its edges.
Why are these rocks rounded, while rocks found elsewhere may be sharp?
Why does this site have smooth rocks?
How does rushing water help?
How does sandy bottom help?
From where did the sand come?
How do other rocks help?

ROAD CUT

Is there a difference or are the layers about the same?
Have the group look for the different kinds or rock. Are they in layers? Are all the layers the same depth? Look at the cut from a distance. Are the lines (strata) level with the surface of the area where you are standing? Can you find matching layers across the road? Explain.

MEETING A ROCK (works best with a group of 10 or less)

Try this in a place where there are lots of small rocks.
Have each member of the group pick up a rock.
Have group sit in a circle with their knees touching.
Make sure you are part of the circle.
Have them look at their stones, noticing any peculiarities, colors, holes, inhabitiants, etc. that would help them identify their own stone.
Place all of the stones near you when the group thinks they can identify their stones (or when you think enough time has been used.)
*They should close their eyes and keep them closed. You will pass out the stones by placing them one at a time on the knee of the person next to you. He/she will feel, smell, etc. - anything but looking at each stone as it passes by, and then place it on the knee of the next person. The last person will give the stones to you.
The next round when they *find* their stone they should keep it, and drop it in their laps, but will be needed to help keep passing the other stones until everyone has his/her own.

*Variation - Mix the stones in the pile. Have members of the group open their eyes and choose their own stone. Return stones to their original spots.

SUN OR SHADE?

Pick up a rock that has been sitting in the shade, and one from a sunny spot. Ask a member of the group which is which. Obviously the temperature of the rock is the indication.

LIFE IN A BOX

CONCEPT: All living things are interdependent and interrelated with each other.
The relationships of everything that are a part of the natural environment tend to work toward a balance.
In order to use natural resources wisely and still promote desirable interrelationships, it is necessary that man understand about the nature of the resources and their role in the natural environment.

OBJECTIVE:
Through exploration and discovery, learn the four essential elements necessary for life - sunlight, soil, air, and water

MATERIALS NEEDED:
several small boxes with covers (shoe box size or smaller)
one small rock and one small (leakproof) bottle of water with stopper (per box)
paper, pencil for each member

PROCEDUE:
Assemble the Life Boxes. Place one rock and one bottle of water inside each box.
Label the box "The Life Box".
Place the cover on the box before you start the activity.

Circulate the Life Boxes to members of the group. Ask each member to open the box and write down on a sheet of paper what is inside the box. After each person has examined the contents, he/she should place the cover back on the box and give it to the next person.

Ask members to tell you what they found in the box. There is a good chance that they will answer "a rock and a vial of water". Their interest will grow when you tell them that there are two more thing in the box. Circulate the boxes again and repeat the questions: "What is in the box?" If, after a shon brainstroming session, the members of the group still haven't indentified air and sunlight, give them the answer. Tell them that the box contains the four things necessary for life. Actually, three things are in the box - water, rock, and air. The fourth, light, went in when the box was opened.

For life to exist, explain that all four elements must be present. (See extensions 1 and 2.)

EXTENSIONS:

1. Discuss the concept of habitat as it related to the needs of humans and animals for food, water, shelter, and adequate space. Food, water, shelter, and adequate space, when available in the lproper quantities and qualties, are what is needed to have a healthy and prosperous living place or habitat. If one of the four is out of balance or is being affected by a problem (i.e., poor quality or inadequate quantities of water), the health and well-being of a living place is stressed. Have the members brainstorm some situations that could upset the balance of a system (i.e., drought, crowding, lack of food, etc.).

Ask: "How has man adapted to the situations that upset the balance or harmony of a system? How have aquatic plants and animals adapted to the changes that upset the balance of a system?"

To reenforce this concept, play a lively game of "Oh Deer!" from Project Wild. (See next page for instructions.)

2. Plant one bean seed in potting soil. Place the pot in sunlight. Water daily.
Plant one bean seed in potting soil. Add water. Place the pot in a dark area.
Plant one bean seed in potting poil. However, dry the potting soil in an oven or pan to remove moisture. Place the pot in a sunny spot. Do not water the seed.
Have members observe and record the results of this experiement. Discuss the importance of water to growing things.

from WET (Water education for Teachers), The Western Watercourse, Montana State University

FOOD CHAIN GAME

Feeding relationships are often difficult to observe. In this activity, you will gain some understanding of these relationships by assuming the roles of animals, playing tag, and simulating feeding relationships.

Popcorn is spread over a lawn area. The kernels of popcorn represent plants, which are food sources for the plant eaters. Some participants play grasshoppers (plant eaters), some play frogs (which eat grasshoppers), and some play hawks (which eat frogs). The object of the game is for each animal to get something to eat without being eaten before the "day" (five minutes) is over. In nature, the populations of plants and animals are usually large enough to insure continuation of the species if some are lost. In this game, populations (popcorn plants, grasshoppers, frogs, hawks) are so small that the survival of even one of each kind will be considered an indication of a "balanced", ongoing community.

You can repeat this game many times during one activity session. With each repeat encourage the participants to change rules of behavior and numbers of each kind of animal until a "balance" is achieved in the popcorn - grasshopper - frog - hawk food chain.

To set up this activity:

for each animal you need	a sash/colored ribbon/colored piece of paper 1 plastic bag "stomach" (sandwich bag)
for the group	4 - 5 liters of popcorn kitchen timer w/ bell, or watch 1 roll of masking tape 1 data board/marking pen (optional)

At least 10 participants are needed for best results.
Sashes - make the sashes from strips of cloth/paper/ribbon in three colors. Have enough for 3/4 of the group to be grasshoppers, 1/3 to be frogs, and 1/3 to be hawks. (for 10- 6 hoppers/3 frogs/1 hawk -
for 20 -13 hoppers/4 frogs/3 hawks). The unbalanced ratio provides the opportunity to change the population numbers in the game.
"Stomach" bags. To prepare place a strip of masking tape across the sandwich bag so the bottom edge of the tape is 4 cm from the bottom of the bag.

A section of lawn 15 meters on a side is sufficient. The group may decide to designate potential "safe" places such as trees, a walk, etc., where hoppers and frogs can hide.

Introduce Food Chains. Ask the particpants if they know what mice eat and what eats mice. "Mice eat seeds and snakes eat mice" they may respond. Diagram the relationship they describe and introduce it as a food chain. (Arrow points in the direction that the food goes. seed mice snakes
Ask if they can think of other food chains, including a food chain that contains man.

-Describe the limits of the gaming area. Spread popcorn over the area. Tell the group that you are distributing plants that grasshoppers eat.
-Hand out a plastic bag and a grasshopper sash (all one color) to the appropriate number. Tell grasshoppers to put their food in their stomachs when the game begins.
-Hand out a bag and a frog sash to the appropriate number, and hawk sashes to the rest.

-When the game starts, frogs will try to capture (tag) hoppers, and the hawks will pursue frogs. When a frog captures a hopper, the hopper's stomach contents are transferred to the stomach of the frog. When the hawk captures a frog, he takes the frog's whole stomach. Hawks do not eat hoppers in this game.

-State the challenge. Set the timer for 5 minutes and holler "Go!" The first game usually lasts only a few seconds with one of two things happening. Hoppers are gobbled up before they have a change to forage, or the frogs are gobbled up and hoopers continue to eat popcorn and get fat.

Analysis - How many animals survive?
For a hopper to survive, popcorn must fill the stomach bag to the bottom of the tape.
For a frog to survive, popcorn must fill the stomach bag to the top of the tape.
For a hawk to survive, he must have the equivalent of one frog with sufficient food.
If at least one of each kind of animal survives, you have an ongoing food chain. Return the corn to the activity area after each game.

Rule variations: learn by making changes
When you have settled on your new rule (usually one is changed for each replay), play again.
Suggested changes if participants don't offer any:
change the number of hoppers and/or frogs and/or hawks
let each hopper come back as another hopper once after being captured and transferring 'stomach" contents
provide a "safety" zone for frogs and/or hoppers where they can be safe
timed releases. Let hoppers go first to forage unmolested. One minute later release the frogs, and later the hawk(s).
spread out more popcorn

After each game analyze the results.

How many hoppers got a full stomach? How many frogs? Hawks?

Encourage participants to compare game results after each rule change, and to comment on how the game "balance" compares with balance in the real world. In nature's balance, there are more plants than plant eaters and more plant eaters than animal eaters.

What would happen it there were only half as many popcorn plants? What would happen to the animal that depends on those plants?

If there were no frogs, what would happen to the plant population? The hopper population? The hawk population?

Do hawks need plants to survive? Explain!

Describe some food chains of which you are part.

Are there any plants or animals that are not part of any food chains?

ECOSYSTEM CHORUS

UNDERSTANDING: In any ecosystem key components play vital roles in its maintenance and balance.

SPECIAL NOTE: Ecosystem Chorus is a good lead-in activity for styding any ecosystem in-depth because it introduces key living and non-living components.

NUMBER OF PARTICIPANTS: minimum 20, maximum 50.

TIME: 20 - 30 minutes

MATERIALS NEEDED: none

PREPARATION: Practice the activity so you feel confident leading and directing the ecosystem chorus.

WARM-UP:

Gather group in a large circle. Ask them to define a human chorus. Why does a chorus sound good? What happens if you take away several key singer? explain that an ecosystem works much like a human chorus. Tell them they will get a chance to sing in the Ecosystem Chorus.

ACTIVITY: Ask: "Can someone name something that is not alive today, has never been alive and will not be alive in the future?" Have the child who answers first go the middle of the circle. ask for another non-living element and continue to ask until water, aid, soil and sunlight have been identified. Have these children stand together. Explain that these non-living factors are the foundation and pulse of the ecosystem. Have the children begin humming quietly. Hmmmmmmmmmm.

Ask the remaining children: "What is green, moves very, very slowly, eats up all the sunlight it can get, and makes food?" (plants). Continue to ask for types of plants (producers) until a sizable number of children are chosen. The largest group of living factors should be plants, since they produce the food and support the animals. Have the plants form a circle around the non-living factors, on which they depend for their survival. Explain that plants use the non-living factors to produce sugars (food) and grow. Quietly have the "plant-children" practice their part in the chorus: "Grow, grow, grow."

Ask the remaining children to describe or name some creature that consumes plants, animals or both (animals). Have these children form a loose circle around the producers. Consumers eat producers and other consumers, and they do it noisily. Have the "animal-children" practice their part loudly in the chorus: "Crunch, munch, crunch, munch."

Ask the children whether plants and animals live forever. "What happens to them, do they just keep piling up and up?" Be creative - describe a world without decomposers (nature's garbage clearners and recyclers). Have the remaining children become decomposers by having them name a few (mushrooms, fungi, slime molds, bacteria). Have the decomposers form a circle around all the other ecosystem components and practice their part in the chorus: "Rot, rot, rot."

Have all the children practice their parts in the following order: Non-living factors (air, water, sunlight, soil/rock) = "Hmmmmmmmm." Living factors (producers) = "Grow, grow, grow." Consumer = "Crunch, munch, crunch, munch." Decomposers = "Rot, rot, rot." Keep the chorus going by directing all the parts to get louder and louder, then softer and softer.

Wrap-up: Ask: Did it sound chaotic? Was there any order? Can you see how everything in an ecosystem is connected to everything else? Did anyone feel his or her part was more important than another? Can someone name an ecosystem on Earth that is void of non-living and living factors?

Explain that, like a chorus, an ecosystem may appear to have no order and make little sense. Only after examining nature closely does order emerge. Further explain the same non-living and living factors can be found in any ecosystem. However, they have unique forms and play different roles in sustaining the ecosystem.

Options and further explorations:

Introduce a pollutant (i.e. a red handkershief, styrofoam cup, etc.) to the ecosystem chorus. How does its presence affect the living parts of the ecosystem? What is affected the most? The least? How do we resolve the problems the pollutant causes?

WILDFLOWERS, OR OTHER PLANTS

How important is it that the group you have on the trail with you knows the name of each flower, plant, or tree you spy? That is your decision. It has a lot to do with your background and knowledge, and perhaps the availability of field guides.

I encourage each child and adult to name one flower or plant that pleases them. It is usually introduced when the first person asks, "What is that?"

"That is your very own flower (plant, tree, etc). From now on whenever we see that flower we will call it by the name which you give it. First of all, get up close and personal with it. Think of words that tell: color of petals, number of petals, color of center, edges of petals (jagged, smooth, etc.), number of blossoms on the stem, what does it smell like, where is it growing, describe the stem, (thin, thick, short, long, fuzzy, glossy, color, etc), look at the leaves, color on top of leaf and bottom, same/different, edges (smooth, flat, ruffled), shape of leaf (round pointed, thin, banana-shaped, flat, curls), are there any holes in the plant, is there anyone living on the plant, who are its neighbors?

Now that you know all about your plant, what would you call it? It must have your name in its name."

(This is a good place to introduce the naming of plants and animals, i.e. - Douglas fir, squirrel, iris, Sequoia, Gambel's quail, etc.)

Yes, there are lots of questions, but I have had very few not be enthusiastic about having his/her own flower. Some names are very clever, some fairly tame. This gives each person time to be in the limelight and to have his/her name attahed to something. Every time we see that flower we call out its name. This leads to where it is growing, does it grow in one special place or is it found all over, what it needs, who are its neighbors in different locations (especially when other flowers around it have been named)?

After each person has named one, some might want to name a second.

If you do carry a field guide, and IF they are interested let them look it up for its "book" name (perhaps at lunch or other sitting down time). Otherwise, whoever wishes may identify his/her flower when the return by using the library, or other source provided. To help others learn the names, have your group draw and color their own flowers/plants, label them with the name which they have given it (plus the scientific name if it has been uncovered) and put them on the bulletin board for all to see, or make copies for each member to put in their own field books.

IDENTIFICATION GAME

This game could be played to help youngsters identify and remember the trees and shrubs that have been studied. Collect small samples of leaves, flowers and seeds from trees and bushes - you'll need about 7 - 10 specimens.

Form two equal teams and line them up facing each other, 30 feet apart. Put the plant specimens in a row on the ground between the two teams. The teams count off separately, so that each player has a number, and on each team there are players numbered one, two, etc.

When the teams are ready, call out the name of a tree or bush represented by one of the specimens lying between the teams, then call out a number. (To add to the surprise, call the numbers out of sequence.)

"The next plant is redwood, and the number is 3."

As soon as the 3's hear their number called, they race to the specimens, trying to be the first to find the redwood twig. Every successful player earns two points for his/her team. Picking up the wrong specimen results in a loss of two points.

BUILDING A TREE WITH A GROUP

The set-up for this activity can be arbitrary - select a few people to be each of the different parts of the tree. Or, you can prepare cards for the appropriate number of participants. I prefer this method because it also gives some visual awareness of the spelling of some pretty bizarre words. (You might include the definition of the word if you wish to take the time to write them out.)

Words to use: heartwood, xylem (sapwood), cambium layer, phloem, bark, tap root, lateral root
Hand out cards. Elicit from the group the different parts of the tree (as indicated on the cards). Discuss the meaning and purpose of each part as it is mentioned.

Tap root goes down deep in center. You act as an anchor to hold the tree steady. You sink down deep into the ground.

Lateral roots spread out on the sides of the tree to stabilize the whole thing. Your root hairs suck up water trapped by the soil and bring nutrients and water to the tree.

Heartwood is the center part of the tree - aged, dead sapwood. You hold the tree strong and straight. The rest of the tree . The branches, the growing wood, the bark and the leaves all depend on you to hold them up.

Xylem/sapwood is the pipeline for water and nutrients to go up into the tree from the roots. You are the best pumps in the world. You lift hundreds of gallons of water a day high into the air, sometimes at 200 miles per hour.

Cambium layer is the life giving part of the tree. From you come all other cells. You are the most important layer, also the thinnest.

Phloem is the layer just under the bark. You are the pipeline which carries sugar made from sunlight, water, and carbon dioxide in the leaves down to the roots.

Bark is the old phloem. You cover the outside of the trunk and insulate and protect the tree from disease and insects.

Now is the time to build the tree, slowly layer by layer. Once the tree is built all should act out their parts.

Heartwoods join together to form a circle, and say "Hmmmmm."

Call for the tap root to sit down at feet of Heartwoods and say, "I go down, down, down."

Xylem (sapwood) stand side by side around heartwood, hold hands, stoop down. Stand up and lift up hands while saying "Whoooo" ascending note (carrying water up).

Cambium layer stand sideways in a column around xylem. Hold fists up and together, then move them apart and say "POP" once (cambium cells dividing).

Phloem form a circle around cambium layer and face inward. Stretch arms upwards and outwards so they intersect each other at the wrists, leaving hands free to flutter like leaves. Phloem brings arms down and bend at the knees and say "Whoooo" descending note, (bringing sugar down).

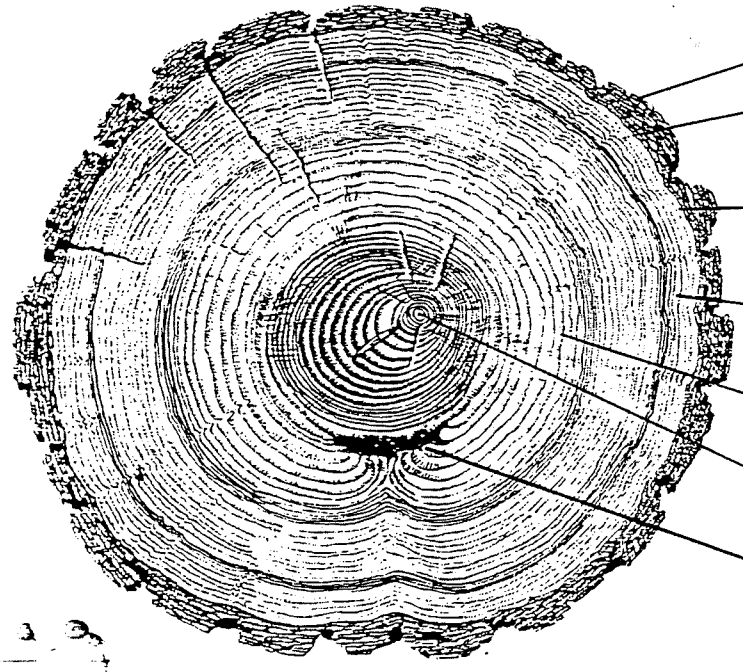
Bark stands around the outside of the trunk facing out, holding hands, and saying "I'll save you."

Lateral root(s) lie on back with feet reaching into xylem layer and arms spread out. (Spread out the hair of the lateral roots.) Laterals make a slurping sound and move their arms in.

GROUP SIZE - BUILDING A TREE CHART

GROUP SIZE	16	20	25	30	40	50	
HEARTWOOD	1	1	2	3	4	5	
TAPROOT	1	1	1	1	1	1	
LATERAL ROOTS	1	1	1	2	2	2	
XYLEM/SAPWOOD	2	2	3	4	6	7	
CAMBIUM LAYER	3	3	4	5	7	9	
PHLOEM	3	4	6	6	8	12	
BARK	5	8	8	9	12	14	

Adapted from Joseph Cornell, Sharing Nature with Children, Ananda Publications, Nevada City, CA 95959



Outer bark protects the tree from injury.

Inner bark (phloem) carries the food made in the leaves to the twigs, branches, trunk and roots.

In the *cambium* (a layer of cells between the inner bark and sapwood) cells divide, forming bark outside and wood inside.

Sapwood (xylem) carries water and nutrients, or sap, from the roots to the leaves.

Heartwood (inactive because cells have died) strengthens the trunk.

Pith is a small core of soft, spongy tissue at the growth center of the stem.

Shown here is typical growth to overcome an injury of 34 years ago.

The rings of a tree are like a memory. They show the history of a tree.

Each spring and summer a tree adds new layers of wood to its trunk. The wood formed in the spring grows fast, and is lighter because it consists of large cells. In summer, growth is slower; the wood has smaller cells and is darker. So when the tree is cut, the layers appear as alternating rings of light and dark wood.

Count the dark rings, and you know the tree's age. Study the rings, and you can learn much more. Many things affect the way the tree grows, and thus alter the shape, thickness, color and evenness of the rings.

CALIFORNIA IN THE PALM OF YOUR HAND

One can make a "map" of California's watershed arean with only a pair of cupped hands, and thereby gain an understanding of the relationship of Sierra Mountain ranges and rivers to the San Francisco Bay.

With your hands together and slightly cupped, the fingers of the right hand form the San Joaquin watershed with the tips of the fingers forming the mountains in Yosemite and Mount Whitney, and the rivers, Merced, Tuolumne, etc. running between the fingers to the San Joaquin River where the fingers join.

The left hand forms the Sacramento River watershed, with the Northern Sierra Mountains (Lassen, etc.) and the rivers (Pitt, Feather) flowing down to the Sacramento. Mount Shasta (left thumb) to the north, and the Condor Mountains at Bakersfield (right thumb) form the north-south boundaries of this handy map.

The Sacramento and the San Joaquin flow together where the hands meet, through the Central Valley (palms) and out between the Coastal Range (heels of hands) into San Francisco Bay and beyond.

Discovery on the Continent's Edge, adapted from Rasa Guistaitis, Reinhabiting a Separate Country: A Bioregional Anthology of Northern California.

SALMON LIFE CYCLE LOTTERY

CONCEPT: The life cycle of salmon

OBJECTIVE OF THE LESSON: to understand how few salmon actually make it from the egg stage to spawning

MATERIALS NEEDED:

set of 3 x 5 cards, cut into strips 1" x 3". Letter each card in the following amounts:

	15	25	35	50
E	6	11	14	18
A	4	6	8	13
F	2	4	6	9
S	1	2	4	6
CA	1	1	2	3
SP	1	1	1	1

DESCRIPTION OF THE ACTIVITY:

This is best used with more than 20 people - works with all ages.

Hand out a card to each student.

Everyone must stand up.

You are participating in a lottery. What is a lottery? Yes, it's a game of chance. You are now part of a nest, called a redd, of salmon, and you are taking a chance just to get on with your life.

How is the life cycle of a salmon a game of chance?

The most dangerous time of your life is when you are in the nest, called a redd. It is the time of greatest mortality.

Your mother has spent up to 10 days or so preparing the redd in the gravel. She has selected a site in a pool with steady current flow above and below the gravel to provide the necessary oxygen for your incubation. She digs a nest and places only part of her eggs in it. As the eggs are deposited your father releases a milky cloud of sperm called milt, which fertilizes the eggs. Your mother goes upstream from the first nest and digs another, so that in forming the second nest, the gravel is washed down and covers the first one formed. The completed series of nests is called a redd. Your mother may lay between 2,000 and 10,000 eggs.

EGGS

As an egg you are extremely fragile. You get your food from a yolk sac that is attached to your shell. You are bright pink in color. About 1 month after you were deposited in the gravel, your eyes begin to show.

However, the water was very low this year, and there was a heat wave which heated up the water. If you are an E, you are an Egg, and you died because you can't live in water that is warmer than 20 degrees C. You must sit down.

ALEVIN

In the late winter and spring, you hatch. You grow rapidly under the gravel for 3 to 4 months. You are a very fragile creature with huge eyes and a large yolk sac protruding from your belly.

However, you are very vulnerable to strong light. A construction company is clearing the bank of your stream and removes the streamside trees which where providing you with shade. If you are an A, you are an Alevin. You didn't make it. You died. Sit down.

FRY

You have absorbed your yolk sac and you emerge from the gravel beds as a free-swimming fish. You are still not used to light so you emerge at night. You begin migrating. If you are a sockeye and a coho you head for the "nursery" areaand will spend at least 1 year in streams or lake; pink, chums, and chinook head directly for the sea.

However, you find your way barred by a giant rock that fell in the stream. You are in a shallow pool. You are not very big and just the right size for many predatory birds and animals. If you are an F, you are a Fry and you didn't make it. You died. Sit down.

SMOLT

You are now ready to head for the ocean. You must undergo some physiological changes to prepare you for salt water. This is called "smolting". You will stay in an estuary for 3 - 4 weeks getting used to the salt water before you head out to the sea. This is the time called sea run.

However, since this year the water flow is a mere trickle, the coastal stream has almost dried up. You are stranded. If you are an S, you are a smolt, and you didn't make it. You died. Sit down.

OCEAN ADULTS

You have arrived in the ocean. You have a plentiful source of food in plankton and other fish. You range halfway across the Pacific ocean, roughly between the latitude of Oregon and Alaska. You are found near the surface, not much deeper than 24 meters.

However, you are preyed upon by whales, seals, larger fish, and humans. If you are an OA, you are an ocean adult, and you didn't make it. You died. Sit down.

SPAWNERS

As an anadromous fish, your eggs lack the ability to adjust to changes in salinity. They require a freshwater environment. So, you must head back to your native stream to lay your eggs. Man still doesn't understand how you navigate during this time. You usually do this in the summer of your maturing year. This may be 1 - 6 years after you left. When you enter your native stream to spawn your physiology changes again. You do not feed once you enter fresh water, but instead burn stored body fat. You may struggle for weeks against falls and obstructions (fallen logs, rocks, natural or man-made dams). During your trip up you may be killed by natural predators or by man. Or you may be hurled against rocks and river banks by the force of the river.

However, you make it to your birthplace and take part in the spawning process. Only a couple of fish out of the 10,000 eggs that were laid live to return to spawn. Your life cycle is now finished and within a short time you die and your body drifts downstream. If you are an SP, you are a spawner, therefore a breeder. You completed your life cycle, but you, too have died.

Talk about caring for the environment of the anadromous fish, what they could do to help, how they could help revitalize a stream.

ACTIVITY TO SHOW REGULATING BODY TEMPERATURES
AS MIGHT BE USED BY REPTILES AND AMPHIBIANS

Some reptiles and amphibians keep their body temperatures within a "preferred" range. For example, the deset iguana usually keeps its temperature between 104^{o} and 106^{o}F and the rose-bellied lizard's temperature usually doesn't vary more than a degree or two from 98^{o}. How do they do it? Most herps use a variety of techniques, such as basking in the sun when cool and retreating to shade or burrowing underground when hot, to stay within their preferred range. In this activity members can use "thermomether lizards" to discover for themselves how herps control their body temperatures.

GETTING READY

1. Choose an area with a mixture of sunny and shady places. There should be enough room for the members to spread out. Take temperatures around the area to find the lowest and highest temperatures. Allow enough time for the thermometer readings to stabilize (about 2 minutes) before you record the temperatures. (Note: the highest and lowest temperatures should be taken no more than one hour from the time than the participants start using their thermometers.)

2. Next decide on a series of five-degree temeprature ranges. The lower limit of the first range should be five degrees below the coldest temperature you recorded. (For example, if your lowest temperature was 60^{o} F, the first range would be 55-59^{o}.) Continue making non-overlapping five-degree ranges until you've reached a temperature that is five degrees warmer than the highest temperature you recorded (see example.

3. Assign each temperature range to an imaginary lizard (for example, Lizard A would have a temperature interval of 55 - 59oF). Then copy each lizard's letter and its temperature range on a separate 3 x 5 card.

4. Later you'll assign a range to each pair of members in your group. If you have a large group, you can assign more than one pair to a range. And if you have more ranges than pairs of kids, leave out some of the middle ranges.

INTRODUCING LIZARDS

Talk about warm blooded/endotherm, cold blooded/ectotherm.
Explain preferred temperature range and what happens if a lizard gets too hot or cold.
Point out that many herps have a preferred range, focus on lizards because they're some of the best" temperature regulators.

Give each team a thermometer and one of the lizard slips that you made earlier.
Discuss with the members ways to regulate their lizard's body temperature. (Encourage them to be creative, but don't tell them what techniques to use.) They may have to use different techniques to stay within range, and some may not be able to stay within their range at all.

LIZARDS IN ACTION

Have the teams spread out over the area and start taking temperatures. Emphasize that they should get their temperatures within their preferred range and keep them in range until time is up. (You may want to set a time limit of about 10 minutes for the teams to get within range.)

Give them these tips to follow as they take temperatures:

Leave the thermometers in place for at least a minute so they will register an accurate temperature.

Touch only the metal backing, not the bulbs of the thermometers.

Keep the thermometers close to the ground or other surfaces to avoid taking air temperatures.

BACK INSIDE: WHO MADE IT?

Copy this chart on a chalkboard or piece of easel paper. Then fill in the information as a group, using the following questions to discuss what happened.

Which lizards were able to stay within their preferred range? Have the "successful" pairs describe how they kept their thermometers within range.

SAMPLE CHART

LIZARD	RANGE	DID IT STAY IN RANGE?	WHERE DID YOU PUT IT?
A	55-59	NO	UNDER A BUSH
B	60-64	YES	IN SHADY GRASS
C			

AMPHIBIANS

COMPARISON BETWEEN TRUE TOADS (BUFO) AND TRUE FROGS (RANA)

TOADS	FROGS
Outline of head rounded	Outline of head slightly triangular
Pupil of eye usually round	Pupil of eye horizontally elliptical
Paratoid glands usually well developed	Paratoid glands absent
Skin rough and "warty"	Skin comparatively smooth
Teeth absent	Teeth on upper jaw and two small groups on roof of mouth
Active mainly at night	Active mainly in daytime
Hind legs relatively short (not well developed for jumping)	Hind legs well developed for jumping
Eggs laid in long, cylindrical, gelatinous strings	Eggs laid in more or less spherical masses
Slight webbing between toes of hind feet	Marked webbing between toes of hind feet

REPTILES

COMPARISON BETWEEN SNAKES AND LIZARDS

SNAKES	LIZARDS
Without moveable eyelids	Moveable eyelids present
Ear opening absent	Ear opening present
The two halves of the lower jaw independently moveable, connected in front by an elastic ligament	The two halves of the lower jaw fixed (not moveable)
Appendages usually absent. If present, then only as vestiges of the hind legs	Appendages usually present (absent in some forms - i.e. the legless lizard)
Ventral scales modified into broad plates-scutes - used as an aid to locomotion	Ventral scales not modified into scutes
Pelvic girdle absent	Pelvic girdle present

BIRD LIFE CYCLE LOTTERY

OBJECTIVE: to make people aware of how few birds actually make it to the breeding stage in life.

NUMBER OF PARTICIPANTS: Best with more than 20 - works with all ages, both sexes

PREPARATION: Cut 3 x 5 cards into strips - 1 1/2 x 2 1/2
Have a card to each participant - Put a letter on each card
For 40 cards (20 cards) - B, 3-4 (2); T, 2-3 (1); M, 4-5 (2); F, 6-7 (4); N, 7-8 (5); E, the rest

INSTRUCTIONS: Group should be standing. Have group move into clusters (nests) of 4, (a nest of 3 or 5 is OK)
Pass out cards - try to arrange 1 nest with all E's, otherwise mix them up.

EXPLANATION: You are participating in a Life Cycle Lottery. What is a lottery? Yes, it is a game of chance. You are now part of a nest of birds, and you are taking a chance just to get on with your life. (Talk about Spring, how most nests have about 4 eggs, how the parents worked hard to prepare the nest, anything that introduces the comcept of eggs in the nest.)

The most dangerous time of your life is when you're in the nest. Your parents have chosen this special spot to build your home - but it just so happens that a garter snake has watched the building and knows there are eggs in it. He loves bird eggs, so he crawls up the tree and eats a couple. Your parents like to eat grasshoppers, but the farmer next door thinks grasshoppers are pests, so he sprayed his land with insecticide. Your parents ate the poisoned grasshoppers. It didn't affect them, but when the eggs were laid, the shells were so soft that you couldn't hatch.

If you are an E, EGG, you didn't make it. You died. Sit down. (Point out the wiped out nest.)

Now you've hatched from your egg. The biggest and noisiest baby gets the most food and sometimes even pushes his nest mates out, trying to get food from their parents. (Flap you "wings" with bent elbows.) A child found you and took you home, but didn't know quite what to feed you. He didn't know that if he put you back in your nest, or even close to it, your parents would take care of you, that they really don't abandon you if you've been handled by a human.

If you are an N, NESTLING, you didn't make it. You died. Sit down.

You've made it to fledgling stage. You are now somewhat on your own. You are learning to fly, to find your own food. However, the neighbor cat found you under a bush . . . maybe you got lost and didn't make it back to the warmth of the nest on a cold night . . . perhaps you got caught in a net in the garden.

If you are an F, FLEDGLING, you didn't make it. You died. Sit down.

You are strong - you're well fed and prepared for the long migration flight. But, your molting stage comes late and the others leave without you. It is very harsh in your winter feeding grounds this year. Food is scarce. You used the Main flyway on your trip that harbors lots of hunters.

If you are an M, MIGRATORY, you didn't make it. You died. Sit down.

You've survived the winter. You have returned to to your nesting area. If you're a male you have your bright mating feathers - your song is flowing - you must establish a territory. It has to have enough of what you need for you new family, a proper place for a nest, enough food and water.

If you are a T- you failed to establish a territory. You're not dead, but you are out of the breeding for this year.

B is the breeder. You overcame all obstables to get to this point. (Sometimes it's all boys or girls. Discuss.) But, you're only assured of breeding this year - you still have a lot to endure to make it through to the next breeding season.

Discuss care for birds and wildlife. Add anything else to the story that illustrates any of the points. You might want to use specific birds in your area.

OH DEER!

CONCEPT: to describe habitat and the limiting factors or wildlife. It's easy to visualize how the population flucuates with the avialble food, water, and shelter.

This is a running game and uses up lots of energy.
Can be played with any number. Need a relatively clear field or even a parking lot.

PROCEDURE:

Have group line up and count off by fours. Have all "ones" come to opposite side of field and line up facing the others.

"Ones are the deer. Deer need certain things to be able to exist in their habitat. The need water, food, shelter, and appropriate space to live." (It's good to elicit these responses from the group.) Appropriate space is mentioned each time and when crowding takes place it is brought to the group's attention.
"The symbol for water is to place your hands on your mouth." (Have everyone do...
"The symbol for shelter is to join fingers pointing up and put hands over head...
"The symbol for food is to put hands on stomach." (Everyone do it.)
Practice symbols a couple of times.

INSTRUCTIONS: (Give instructions before having lines turn around.)

Members in both lines will turn their backs to the other line.
DEER decide what they need to live at this moment and make their symbol.
All others decide which part of the habitat they wish to be and make the appropriate symbol.
At the count of 3, both lines turn and face each other. DEER run over and try to find someone who provides what they need (food, water, shelter). If they find someone who matches, they both return to the DEER side. If a DEER doesn't find a match, it must become part of the habitat.

Get group resettled - turn lines around - DEER choose what they need - the "habitats" decide what they will provide. Face each other - DEER cross to "habitat" and hope to find what they need. (No changing symbols.)
Sometimes there will be a lot of DEER and not much habitat - question "What can happen?"

Do this exchange as many times as you need to help group "see" how outside factors influence the ability of the DEER to live. Keep discussions short.

EXTENSIONS YOU MIGHT TRY:

Leader keeps track of how many DEER start the game and makes a chart of the ups and downs of the DEER population.
After a few exchanges, name a predator who operates from the sidelines and tries to capture DEER on their search for habitat. Any DEER that is caught becomes another predator.
After inserting the predator, include a MACK truck or some other man-made "predator". This addition can eliminate DEER and/or predator.

PREDATOR/PREY GAME

RELAY OF SORTS

Start the game by introducing the basic law of survival. Hawks, like all wildlife, must conserve their energy unless they are seeking food, escaping danger, or giving birth. This game is a fun way to introduce this concept. Explain that there are two hawks (owls, etc), in the same habitat competing for the available food supply. The hawk with the better eyesight and faster reflexes will get more food and will survive the game.

Can be played with any number. Divide group into 2 equal lines. (If there is an uneven number one can be the "flipper". Call them hawks, owls, etc. (names of predators). Line holds hands to form the "backbone" of the animals, facing away from the other line.

Place a small toy/rock/special stick/bean bag, which is to represent the prey, between the two lines. This person's free hand represents the talon of the predator, which will pick up the prey. All eyes are closed except the first person in line who is the eyes and brain of the predator.

Use a quarter - flip it.

If it lands HEADS - that means a mouse has been spotted in the grass. The hawk would like to eat it. Brain must squeeze hand of person behind - each in turn squeezes the next hand on down the backbone to the talon. Talon squats down to pick up the prey.

If it lands TAILS - brain shouldn't send any message because this shape only looks like a mouse.

First predator to grab the prey wins the round. The brain becomes the talon, and the next person in line becomes the new brain.
Flip the coin again.

If a mistake is made and the brain squeezes on tails when it sees the object that only looks like the mouse, then it has wasted valuable energy. That hawk is penalized and the talon becomes the brain (the line goes backward).

Winner is the first predator which gets back to the original brain.
Up the challenge by having long lines, or really s p r e a d i n g out the backbone.
Be sure to let everyone get settled before flipping the coin. Remind them to close their eyes, etc. If it looks like the same people remain at the brain and talon, switch them so everyone gets a turn.

Discuss the difficulty of getting the message from the brain to the talon.

STATION WALK/ LIVING LABELS

The objective of this walk is that youngsters will be able to describe a natural object to their peers and adults in the group.

This activity makes each child an expert on at least one natural object, and gives each the opportunity to teach in a one-on-one situation.

Do this just a little ways into the day so the group can rely on the "experts" to keep telling them about their object.

Consult with another adult, or responsible person in the group. Describe the activity because s/he will be in charge of the remainder of the group while the leader is taking each "expert" to a station. Bring out the trail mix and have the group sit down.

Ask for one person to come with you and explain that this person will have some important information to tell the others. That person will remain at station #1, and be joined by another from the group. The "expert #1" will tell about the object, and remain at the station for person #3. Person #2 will follow the trail to the leader and become an "expert" on another object. When Person #3 finishes at #1, move to #2. When station #1 is free #4 then goes to #1. Person #3 will finish at #2 and move on to establish station #3.

It is important that the last people who are coming through don't bunch up. The "expert" from #1 should go to #2, and then #3, etc. before #2 begins to come through.

You might choose to have the stations highlight a specific tree or plant, rings on a cut stump, point out a wonderful spider web, a nest, talk about David Douglas and the fir, evidence of erosion, animal sign, etc. Give them 2 - 4 facts. It is amazing how much they will embellish their object, notice a lot of things about it that you didn't mention.

Shy people are notorious for doing a spectacular job in this situation.

Space the stations far enough apart so they don't interfer with each other.

This can be set up in a park, schoolyard, along a trail in the woods, along the sidewalk in the neighborhood.

If you are pressed for time, or have many in the group, assign 2 or 3 to man each station.

ANIMAL TRACKS

front

hind

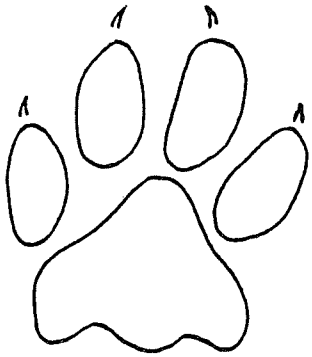
STRIPED SKUNK

hind

front

RACCOON

front



front

hind

GRAY FOX

hind

BOBCAT

COYOTE

front

hind

GRAY SQUIRREL X 1/2

DEER MOUSE

front

hind

GROUND SQUIRREL X 2/3

WOODRAT

coyote

dog