ACTIVITIES

The following activities have been organized by habitat regions. Many of the activities can be used for learning about any of the five habitat regions, while other activities specifically teach about one habitat in Washington state. The heading for each activity is organized in the following manner:

> **TITLE OF THE ACTIVITY**
> *Italicized* background information for teachers
>
> **Grade Level; Subject Codes**
> **Materials** needed for the activity
>
> We have suggested appropriate grade levels for each activity, but we encourage you to adapt activities for the level of your class. The subject codes list the different core subjects covered by the activity. These codes are based on core subjects outlined in the Essential Academic Learning Requirements. Codes are as follows:
> **A** = arts, crafts, drama
> **C** = reading, writing, communication
> **G** = geography/social studies
> **M** = math
> **S** = science

ACTIVITIES FOR ALL HABITATS

HABITAT REGION OVERLAYS

The overlays provided in this packet can be used at any time during the study of a habitat to give students an idea of the geography of our state. Discussions of geology, topography, climate and other topics can be enhanced with use of these overlays.

Grades K-5; G, C

Materials: Washington state habitat maps (the cross-section and the outline of the state plus the outlines of the Columbia Basin, montane areas, temperate forest areas, wetlands, and cities in Washington state are provided to make overhead transparencies), paper and crayons or colored pencils

- Project the overhead of the outline of Washington state and one of the habitat overlays on the screen. Discuss some of the aesthetic characteristics of that habitat with your students. Give each student a copy of the outline of the state (or a copy of all the habitat outlines together) and have them color the region of the state covered by the habitat being discussed. This can be done for each of the habitats studied by the class.

Grades 3-6; G, C

Materials: Washington state habitat maps

- Project all of the overlays together onto the screen. Give each student a copy of the outline of Washington state. Using the outline, have the students draw their own map showing each of the habitat regions. Have them color code the regions and include a legend. Discuss some of the characteristics of each habitat.
- Now, project the cross-section of the state showing the mountain ranges. Discuss with your students how the topography of the state influences the climatic conditions found within each habitat.

Grades 7-12; G, C

Materials: Washington state habitat maps

- Have your students study the overlays provided, both one at a time and in different combinations. Use the cross-section of the state to explain how mountain ranges influence climatic conditions and therefore help to create different habitats. Engage your students in discussions by asking questions that evolve from different combinations of overlays. For example, with the urban, wetlands and outline of Washington state overlays, question whether the majority of wetlands are located near or far from urban areas. Why? Is the location of cities near or far from alpine elevations? What reasons can they theorize for the trends they see?
- Ask your students to research and draw maps showing historical extents of some of the habitats (for example: wetlands, urban, forests). Have your students discuss the reasons for the changes in the extent of the habitats and what effects those changes might have environmentally and economically in Washington state.

If You Can't Visit...Imagine!

Grades K-5; C

Materials: pictures of plants, animals, and habitats; audio tapes of animal sounds; items for students to touch (cones, leaves, rocks, etc.)

- Based on your readings of the background information, take your students on a guided imaginary exercise of one or more of the habitats described. Create your own story: an owl maneuvering through the temperate forest while hunting for a flying squirrel, a lizard moving over the hot, dry steppe, or a beaver building a dam to flood a stream and make more wetland habitat. To enrich your imaginary trip, collect photographs and sensory items, such as cones, aromatic leaves, textured bark, colored rocks or shells and audio tapes with sounds from the habitat. After your students have returned from their imaginary trip, have them write a creative story or illustrate their experience in another form of art or dramatics.

HABITAT SCAVENGER HUNT

In this activity, students will use their observing and describing skills to learn more about a habitat, its biodiversity and ecological interconnections. We encourage you to take your students outside, explore your school yard or local natural area, and repeat this activity at different times of the year to compare the seasonal changes of the plants and animals the students discover. Woodland Park Zoo's Habitat Discovery Loop in the Temperate Forest is a good outdoor location for completing the following observations and "hunting" activities.

Grades K-3; C, S

Materials: paper, crayons, clipboards, magnifying glasses

- Divide students into pairs and explain that one student is the "camera" and the other is a photographer taking a picture. The "camera" starts with his or her eyes closed. Have the "photographer" lead the "camera" by the hand and position the "camera" in a place to take a picture of the landscape. The photographer should say "click" and the "camera" will open his or her eyes and close them immediately. The "camera" should then turn away and verbally describe, write in a journal, or draw what they saw in their instant view. The students should switch roles to repeat the observing and describing. If the observations are drawn or written, students can then share them with their partner or the rest of the class.
- Using ideas from the scavenger hunt provided in this packet, adapt a scavenger hunt for younger students. You may choose to read tasks aloud one at a time for your students to complete, regrouping after each session to share observations orally.

Grades 4-8; S, C, G

Materials: paper, pencils, clipboards, field guides, magnifying glasses, binoculars (optional)

Teachers may need to select several tasks that can be completed in the amount of time available. For Task 4 of the scavenger hunt, determine the number of minutes to be spent observing. For Task 6, teachers might want to dig two shallow holes for the students and fill them back in when the activity is complete.

- Divide students into small groups of five or fewer. Have your students complete the following scavenger hunt using their best observation skills and all their senses. Students can record their observations. If time allows, your students may want to complete the scavenger hunt in two different types of habitats covered in this packet, or two very different areas within one habitat type: for example, a park left to grow naturally and a heavily landscaped park both in an urban area. Compare the results of their observations.
- After completing the scavenger hunt, each group could draw a map of the area they explored. Include any prominent features and some (or all) of the locations where they found scavenger hunt answers. Also have them include directional information, such as a compass, landmarks and distances.
- Following the scavenger hunt, each group can write a walking tour of the area to highlight the places where they hunted and found special features of the habitat. This tour could be shared with another group of students on a return trip to the location. If different classes go to different locations, they could trade walking tours and then visit each other's locations.

HABITAT SCAVENGER HUNT

1. Describe any of the following interactions you can find. Give one example of how one of the species (or objects) involved is dependent on the other.

- plant with plant (e.g. licorice fern on tree; fern gets more light due to "boost" from tree)

- plant with animal (e.g. bee on flower; flower needs insect to pollinate it)

- animal with animal (e.g. bird eating insect; bird gets nutrition from insect)

- plant with nonliving thing (e.g. shrub on stump; shrub gets nutrients from stump and is higher up to get more light)

- animal with nonliving thing (e.g. insect on dead animal; insect gets nutrients from dead animal)

2.a) List three living things that you see when you look:

- on the ground near your feet (use magnifying glass if necessary)

- at eye level

- above your head (use binoculars if necessary)

b) For each of the three living things found in **2a**, try to find or think of one living thing that might eat it and one thing it might eat.

3. Find and describe one of each of the following. Something that is: smooth, rough, wet, young, old, rotten, smelly. Also find: two signs of human activity, two signs of animal activity, two food sources for animals. Which of the sounds or smells were made by humans? Which were made by nonhumans? (Use separate sheet if necessary.)

4. a) Stand in one spot for a few minutes. Looking all around you, how many different types of plants can you see? How many different types of animals can you see (include different types of birds, butterflies, other insects, etc.)? Do you know the names of these plants and animals? Use a field guide to find out the names of two of the plants or animals and draw their pictures here.

b) Closely observe and describe three other plants and three other animals that you listed above.

5. Using blank paper and crayons, find three different types of trees and do a bark rubbing of each. Write or draw a description of each tree.

6. Find and describe two different types of soils. Are they wet or dry? Light-colored or dark-colored? Hard or soft? Coarse or fine? Gritty or smooth? Describe some of the plants, if any, that are growing in each type.

7. Stand in one spot and close your eyes for one minute. Describe any sounds that you hear. What do you think made the sounds? What smells do you notice?

SHADES OF GREEN

In this simple color study, students will explore the biodiversity of nature through observing, drawing and describing the various shades of green found within different habitats. This activity can be used as a springboard for discussion about how the diversity of plants provides habitat for a diversity of animals.

Grades K-12; A, S

Materials: paper, shades of green crayons, green pencils and/or green watercolors

- Go outside to a vegetated area of your school grounds, Woodland Park Zoo grounds (which include a wide variety of plants) or a park. Each student should choose a small area and observe all the different shades of green. Using varying shades of green crayons or colored pencils, or by mixing watercolors, have the students draw or paint the shades of green and the different shapes of plants they see. Depending on their abilities, students can draw plants realistically or simply express through drawing techniques the shades of color and texture (for example, soft, prickly, droopy, stiff).
- Engage your students in a discussion about the diversity of plants illustrated by the varying shades of green found in one area. Ask students to speculate why there are so many different shades of green. If possible, complete drawings of more than one habitat and compare their colors and forms.

Grades 3-12; C, S

- Having completed the above activity, students can write a short essay about the scene they have drawn. Students can describe the different colors and textures present and write about why there might be such a variety of plant colors and textures.

* Extension: Students could research scientific texts and journal articles and present their findings on the physiological differences between plants that result in different shades of green.

ILLUSTRATING BIODIVERSITY AND INTERCONNECTIONS

Use the following activities to engage your students in a discussion of habitat layers and biodiversity. Discuss how a greater variety of layers creates a greater number of niches that are occupied by different animals.

Grades K-3; C, A

Materials: paper, scissors, glue, paints and old magazines (*National Geographic, National Wildlife, Natural History, Nature Conservancy, Ranger Rick*)

- Have your students choose one habitat from the packet and create a habitat collage. Using old magazines (be sure to find some with appropriate pictures for that habitat), students can find and cut out pictures of plants and animals that are found in that habitat and glue them onto a piece of paper to make a collage. Students should also find pictures representing climatic conditions found in that habitat, such as snow, sun or rain. If magazines are not available, students can illustrate plants and animals with torn paper of different colors.
- After completing their collages, ask the students to describe to the class each of the pictures in their collage and how the picture relates to the rest of the habitat. For example, for a picture of a duck in a marsh, the student would explain why a wetland is important for the duck, what ducks eat, and where they nest. Students should describe which level of the habitat (high, middle, low, underground/underwater) some of the animals in their collage use most.

Grades 4-8; A, C, S

Materials: butcher paper, paints, push pins, colored yarn

- Choose one habitat you've studied and have the class create a mural illustrating the plants and animals in each layer of the habitat. You may want to split the class into three or four groups and have each group work on one layer (canopy or highest level, understory or middle layer, ground or water surface, underground or underwater). Use a central component such as a tree, a sagebrush plant or a wetland emergent to connect each of the layers of your class mural. A mural of montane habitat could be divided into mountain top, subalpine meadows and low elevation forests with the shape of the mountain connecting the layers.
- Lead your class in a discussion on the diversity of these layers and the multiple niches they provide in this habitat. Use the class mural to illustrate examples of plants and animals that are dependent upon each other through a food web. Make connections between these species using colored yarn and push pins. With enough connections, a food web or "the web of life" will appear.

* Extension: Have each group design and act out a short play on a day in the life of the plants and animals in their chosen layer of a habitat. Students can use this play to demonstrate the diversity of animals, the different places they sleep, and how they get their food. Older students can demonstrate a food web, interdependence among species, or the impacts humans have had on that specific habitat layer.

TRACKING YOUR ANIMAL NEIGHBORS

Many of your students may never have the opportunity to see many of the wild animals found in our state. Even when people do take the time to look for them, animals are often elusive and prefer to travel unsuspected by humans. But our cities, suburbs and rural areas are filled with wildlife and one way you can teach about their presence is to find and follow their tracks. Get your students out to explore. By studying tracks and signs of animals, students will learn a great deal about animals, their habitats and the interdependence of the food web.

Grades 3-12; S, C, M

Materials: rulers, notebook, pencil, field guides to animals and tracks (for example, Rezendes, Paul. *Tracking & the Art of Seeing: How to Read Animal Tracks & Sign.* Charlotte, Vermont: Camden House Publishing, Inc., 1992.)

- Tracks are easy to find after a fresh snow or rain storm and can be seen anytime on a sandy beach, a muddy riverbank or an open field. Take a ruler to measure a track then use a field guide to research what kind of animal made the track, where the animal lives and what it eats. Students should also be on the lookout for signs of animals, including droppings, hair, claw marks or any other indications that an animal was present.
- Have your students keep records of their observations in a field notebook or on a chart. This information is key to understanding how wild animals move around and interact with other things in their habitats.
- Challenge your students to formulate questions, search for other clues and put their facts together for a better understanding of the wildlife in your community. Visit the location regularly to make continued observations.

Adaptation Experiments

Your students can perform the following four experiments for a better grasp of animal adaptations. Your class could further demonstrate these adaptations by creating arts, crafts or a play to go along with the activity. For example, younger students can make large paper jackrabbit ears (showing blood circulating through vessels) and wear them while completing the activity. As a challenge, have your students think of other experiments to explain the adaptations of other plants and animals in a habitat.

Jackrabbit Ears Are Cool

Jackrabbits live in the steppe and have large ears to help keep them from overheating. Blood circulating through the veins of a rabbit's ears is cooled by the air before it recirculates through the rabbit's body.

Grades K-6; S

Materials: two hand towels, hot water

- Immerse the hand towels in hot water and quickly wring them out. Bunch one towel into a ball and lay the other towel flat on a table. Ask your students to predict which towel will cool off the fastest. After one to two minutes, stretch out the balled up towel. Quickly have your students place a hand on each towel. Which towel feels cooler? The towel with the most surface area! Because a greater surface area of the flat towel is exposed to the air, the flat towel, like large jackrabbit ears, cools off more quickly.

Predator/Prey Eyes

Prey, such as deer or songbirds, must always be on the lookout for predators. Prey usually have eyes that face out to the sides so that the animals can be aware of what is going on around them, even when they are eating. Predators, such as cougars or hawks, must be able to look forward and focus in on prey while moving toward them; therefore predators' eyes face forward.

Grades K-3; S

Materials: one pair of toilet paper tubes, or wrapping paper tubes cut to size, for each student (students can collect these items from home)

- Engage your students in a discussion about the lifestyles of predators and prey. Split your students into pairs and have them act out the following:
  - One student of each pair pretends to be a grazing prey animal by bending at the waist as if feeding on grass. The prey animal students hold the tubes to their eyes with the tubes facing straight toward the ground.
  - The other student of each pair pretends to be a predator slowly sneaking up to the side of the prey. The predators should also hold their tubes pointing straight forward.
  - Ask the prey if they can see the predators. Ask the predators if they can see the prey.
  - Now, both prey and predators point their tubes out to the sides and act out the scenario.
  - Again, ask the prey if they can see the predators and the predators if they can easily see their prey.
  - Tell the prey and predators to point their tubes in the direction (both tubes forward or both tubes out to the sides) that works best for the survival of the prey or for hunting by the predators.
- Complete the activity by showing pictures (or skulls if available) of predators, such as wolves, fishers, or hawks and prey, such as deer, songbirds, and rabbits, and asking the students to point out where the animals' eyes are located on their heads.

* Extension: During a visit to Woodland Park Zoo, have your students determine whether different animals are predators or prey by analyzing the placement of the animals' eyes on their heads.

WATERPROOF WATERFOWL

Most birds have a gland, called the uropygial gland, at the base of their tail that produces oil. Birds spread this oil through their feathers when preening (running their beaks through their feathers). The oil helps to bead water from their feathers, keeping the bird dry and warm. For waterfowl, the oil also helps to keep the birds from sinking by preventing waterlogged feathers.

Grades K-6; *S*
Materials: cocoa butter or olive oil, water

- Have your students rub a small amount of cocoa butter or olive oil into the skin on the back side of one hand. Drip a small amount of water over each student's hand and ask him or her to observe how the water drips, or can be shaken, off of his or her hand. Discuss with your students how spreading oil through their feathers can help birds stay dry, warm and afloat.

SHEDDING SNOW AND CATCHING RAYS: TREES

Conifers growing in temperate forests have a conical shape, due to the direction that branches grow out from the trunk and the flexibility of the boughs. This aids their ability to catch light from all angles in the sky, which is important during long northern winters, when the sun shines from lower angles. This shape also aids in shedding heavy snow which could otherwise break branches. Higher up on mountains where snow is deeper, many conifers are even skinnier and droopier than those at lower elevations. Using pictures in a field guide, compare the shape and "droopiness" of a high elevation Alaska cedar with a lower elevation western red cedar. Deciduous trees lose their leaves before the winter which helps them to avoid heavy buildups of snow. Their leaves are usually broad and extend horizontally from the branch. This helps deciduous trees catch sunlight during spring and summer before they lose their leaves in the fall.

Grades K-6; S
Materials: six or more soft fluffy pillows (white), flashlights and map or globe showing latitudes

- With your students, perform the following activity:
  - Several students should stand in front of the class with their arms held horizontally out from their sides. These are the trees. Have a student stand on each side of the group shining a large flashlight simulating the sun at the sides of the trees. (You may want to dim the lights.)
  - Discuss with your students the necessity of light for plants. Assuming that it is winter and the sun is shining from low angles, ask the class if the trees are catching rays with their arms out to their sides. Ask the trees to adjust their branches so that they catch the most sunlight. The flashlight-holders can then return to their seats.
  - Again, have the trees hold their branches straight out to the sides. (A new group of students could replace the trees in order to involve the whole class). Other students should carefully pile pillows on the branches of the trees. The pillows will pile up and become heavy on the trees' branches. Ask the trees to move their branches into a position that will help them deal with the heavy "snow."
- Engage the students in a discussion of how conifers are adapted to heavy snow and limited light conditions at northern latitudes (use a map or globe to point out northern latitudes), focusing on light and snow. Students can also develop and test hypotheses that explain how deciduous trees survive light and snow conditions in temperate forests.

Grades 9-12; S

- Have students make observations of both coniferous and deciduous trees at given times throughout the day and record which parts of the trees are getting direct sunlight. Make sure that you are observing trees that stand alone as well as trees standing amongst a group of trees. Students should note the angle between the sun and the earth's horizon at different times of day through different seasons in order to predict when the trees will be receiving the most direct sunlight. How have the trees adapted to receive their necessary amount of sunlight?

COMPARE AND CONTRAST: ADAPTATIONS

Grades K-2; S, C

Materials: drawing paper, crayons or colored pencils, pictures of native plants and animals

- Choose a pair of animals or plants from the list below and display pictures of them for the class. On the board, record a list of student-generated ideas on the differences between the two species chosen. Discuss with the students how some of these differences may be their adaptations to living in their specific environments.

Grades 3-6; S, C, A

Materials: drawing paper, crayons or colored pencils, pictures of native plants and animals

- Complete the above activity, then have each student draw a line down the middle of a piece of paper and draw a picture of each animal or plant and a background showing its habitat on each side of the page. Ask students to write poems to compare and contrast the two species. Students should include descriptions of how each animal or plant is adapted to its habitat.

Grades 7-12; S, C

- Ask each student to choose a pair of animals or plants from the list below and research the biology of the species chosen, focusing on species' adaptations to their habitat. Students can write essays comparing and contrasting the two species and their adaptations. Have students share their essays with the class.

Animal Pairs

white-tailed jackrabbit (steppe) / snowshoe hare (montane and forest)
burrowing owl (steppe) / northern spotted owl (forest)
Pacific tree frog (wetland) / Great Basin spadefoot (steppe)
American kestrel (steppe, urban) / northern goshawk (forest)
kangaroo rat (steppe) / pika (montane)

Plant Pairs

big sagebrush (steppe) / cattail (wetland)
ponderosa pine (E forest) / western red cedar (W forest)
mountain heather (montane) / devil's club (forest)
Canada thistle (urban) / pathfinder (forest)
black cottonwood (wetland) / Douglas fir (forest)

How Much Water Does This Plant Drink?

Use scientific experiments to teach your students about how and why certain plants live in certain habitats.

Grades K-6; S, C, M

Materials: measuring cups and multiples of three house plants of the same species for each group

- Divide the class into groups. Give three house plants to each group to use in the following experiment:
  - Consult a house plant book to determine the water requirements of each species of house plant (and to make sure the other growing conditions, such as light and temperature, of the plants are met).
  - Have students take care of the plants over a period of time, but instruct them to use a measuring cup for consistency and give one plant too much water, one plant the right amount of water, and one plant too little water.
  - Have students record lighting conditions, temperature, water amounts and their observations of changes to the three plants over time.
- Engage your students in a discussion about how plants (and animals) are adapted to their habitats. If something in their habitat changes drastically, such as the amount of precipitation, how might this affect the survival of the plant (or animal)? After observing and discussing the changes in the plants, have the students adjust to the correct amount of water for each plant and observe whether or not all the plants continue to survive.

Grades 7-12; S, C

Materials: two different plant species and items such as lamps, plastic bags, etc. to control basic needs

- Using a scientific method, students should study two different plants of different habitats, such as a cactus (arid climate) and a philodendron (tropical climate) and perform controlled experiments to observe the plants' reactions to more or less amounts of water, light, oxygen and extremes of temperature. Compare and contrast the results. Have your students research what adaptations a plant has in order to live in its environment.

Graphing Temperature, Precipitation and Snow Depth

Grades K-2; M, C

Materials: Table of Temperature, Precipitation and Snow Depth (below), graph paper, blue construction paper

- Help your students create visual representations of average precipitation, temperature and/or snow depth for five locations listed in the table provided. To do this, choose one location from each habitat and tape blue construction paper together vertically to make a column representative of the correct number of inches of rainfall or degrees of temperature (using one inch = one degree). Using the columns of paper as a reference, discuss with your students what it might feel like during high/low temperatures, heavy/no precipitation or deep/no snow. How do these conditions affect the plants and animals that live in that location?

Grades 3-6; M, C, G

Materials: Table of Temperature, Precipitation and Snow Depth (below)

- Choose one location from each of the five habitats and have your students create the following bar graphs using the information provided in the table:
  - Compare the average maximum temperatures of five locations for the month of July.
  - Compare the average minimum temperatures of the five locations for the month of January.
  - Compare annual mean precipitation between each of the five locations.
  - Compare the average snow depth in the month of January between each of the five locations.

**Note: Because wetlands form due to certain conditions of topography and surface water, you may want to point out to the class that there may not necessarily be higher annual precipitation in locations near wetlands.*

- Ask students to interpret their graphs and discuss or write about how differences in weather might affect them. What adaptations might people, animals or plants have to cope with the specific climatic conditions in each of these habitats?

Grades 3-6; S, G, C, M

Materials: weather station equipment, state map, colored dot stickers

- Have students set up a rain gauge and thermometer (weather station) on school grounds. Precipitation and temperature can be monitored and recorded daily or weekly. Using the Internet or other means of communication, compare weather results with other schools in other parts of the state who also have weather stations. Students can make bar graphs to compare the weather conditions of their school's habitat with others. **Note: Information on how to set up a weather station is available through Foundation Approaches to Science Teaching (FAST), John Pauls, Curriculum Research and Development Group University of Hawai'i, 310 Sunset Ave. North, Edmonds, WA 98020. (425) 778-2531.*
- Using data from schools across the state or data given in the table below, have students place color-coded dots on a Washington state map or a photocopy of the map provided for overlay activities. These dots represent the amount of annual precipitation for that location. Break down amounts of annual precipitation into several groups and assign each group a color, for example: red = 0" to 10," yellow = 11" to 30", green = 31" to 50", blue = 51"+). Relate the patterns of dots representing precipitation to habitats the class has studied and the plants and animals that live there.

Grades 6-12; C, S, M

- Complete any of the above activities but rather than providing the students with the following data table, have them find the precipitation and temperature information on the World Wide Web. These numbers can be found at the Washington Climate Summaries Web page: www.wrcc.dri.edu/summary/climsmwa.html. (Or contact the National Environmental Satellite Data and Information Service at (206) 526-6263 to order a *Local Climatological Data Annual* Summary.)
- For a mathematics lesson, students should convert precipitation from inches to millimeters and temperatures from Fahrenheit to Celsius.
- For statistical practice, have students find the mean, median and mode of annual precipitation for different areas of the state. Then have them calculate how much their local annual precipitation deviates from the mean.

TABLE OF TEMPERATURE, PRECIPITATION AND SNOW DEPTH

Averages over a 30 year (or longer) period, ending 1997

	TEMPERATURE				PRECIPITATION	AVERAGE SNOW DEPTH	
	January average		July average		Annual mean	January	July
	max (°F)	min (°F)	max (°F)	min (°F)	(in.)	(in.)	(in.)
Location:							
Steppe							
Pullman	34.3	22.2	81.5	49.7	21.58	2	0
Richland	40.3	25.5	90.6	59.5	7.23	1	0
Montane							
Republic	29.0	13.6	81.1	45.9	16.53	11	0
Rainier Paradise Ranger S.	31.9	20.3	61.5	42.3	117.16	116	20
Temp. Forest							
Cle Elum	34.8	19.8	81.2	51.0	22.23	9	0
Clearwater	45.8	33.5	69.8	48.7	118.79	1	0
Wetlands							
Othello*	35.3	21.1	87.8	54.8	8.27	1	0
Mount Vernon**	45.1	33.1	73.2	50.3	32.07	0	0
Urban							
Spokane	32.8	21.5	83.8	55.8	16.13	3	0
Yakima	36.9	20.1	87.3	53.1	8.3	3	0
Seattle (SeaTac)	44.5	34.6	75.2	54.5	38.3	0	0

*located near Turnbull National Wildlife Refuge (marshes)

**located near wetlands found throughout the Skagit flats

Climate data obtained from the Western Regional Climate Center's Washington Climate Summaries Web page (www.wrcc.dri.edu/summary/climsmwa.html).

ETHNOBOTANY: HOW PLANTS WERE USED

Grades 4-12; C, A, G

Materials: field guides, books on Native American stories and ethnobotany (see Resources)

- If you saw a cattail, would you think of a mat? Could you make cedar bark into a hat? Native Americans of the Pacific Northwest used plants from all habitats to make their food, shelter, clothing, utensils, transportation and medicine. Have students research a plant for its many uses and present their findings to the class. A class play could combine their knowledge as they act out how Native Americans found and used resources in their environment.
- Have students design an object that could be constructed out of natural materials. They should create a drawing or a written description of the object and then explain to the class how it would be used. The objects need not be constructed.

* Extension: Research modern household products and medicines that come from plants native to Washington state. Are your students surprised at how many plants are used to make things they depend upon every day?

THIS LAND IS MY LAND

This activity will aid students in understanding land management decisions and how they affect entire ecosystems. As written, the activity uses a river as the focus, but it can apply to any habitat studied such as forest, urban or steppe. This activity is an effective "before and after" project and can help you gauge your students' awareness prior to studying a particular habitat. After learning about a habitat, repeat the activity and see how your students change their ideas of how land should be managed.

Grades 3-6; C, G

Materials: one piece of paper per student (or group of students), thick blue marker

- With your students perform the following activity:
  - Number each piece of paper on the back side, then lay the papers face up, side by side. Draw a continuous blue line through all the pieces of paper.
  - Mix up the pages and distribute one to each student (or group). Explain to your students that their paper is a piece of property with a river running though it, which they can develop or conserve however they choose. Allow students time to plan and draw their ideas on their piece of paper around the river.
  - Place the pieces of paper on the floor in their original numerical order, so the river "flows" through all pages again. Designate one end to be the head of the river, and discuss the development on each piece of paper as you move down river.
  - Ask students to describe their design and discuss with the class if their development activities are putting pollutants in the water, or if their design improves the ecosystem.
- Discuss how our decisions do not affect only ourselves; the quality of the water coming from each of the "land owners" might be affecting the people and habitats further downstream. Older students may choose to role play the discussions between land owners and people, plants or wildlife living downstream.

TEACHING EACH OTHER

Grades 9-12; C, G

Materials: information provided in this teaching packet

- Divide the class into five groups. Using the background information provided and other resources, have each group research one habitat. Ask each group to develop an interactive presentation to teach their classmates about that habitat. Each group's presentation could include information about animals native to Washington state that could be observed on a class trip to Woodland Park Zoo.
- Following these sessions, involve your students in a debate. Imagine that the City of Urb has used up all of its landfill space and is looking for a new place to dispose of its garbage. Urb would like to put a new dump somewhere in the state, either in the steppe, the mountains, the forest, a wetland or within the limits of another city. Have each group of students argue detailed reasons why Urb's dump should or should not be in the habitat they studied. After each group has presented its views, ask the class to decide how they would resolve this problem.

WASHINGTON WILDLIFE TRIVIA QUESTIONS

Designing and answering trivia questions based on information provided in the Background Information and Fact Sheets will help your students gain a better understanding of the plants, animals, and interconnections between plants, animals and their habitats. (See also Woodland Park Zoo's Northern Trail Teacher Packet for more fact sheets on montane animals native to Washington state.)

Grades K-2; C

Materials: Plant and Animal Fact Sheets (included), cardstock (thick paper)

- Using information from the fact sheets provided, engage your students in a trivia game. The questions can focus on adaptations of plants and animals, predator/prey relationships, physical characteristics, fascinating facts or any other type of information provided in the fact sheets. The class could be divided into teams with every member of each team taking a turn to answer a trivia question read by the teacher. Each team should keep tallies of the number of questions they answer correctly. Alternatively, each student could be assigned a trivia question to pose to the class. Each student should be prepared to present the answer if the class cannot give a correct answer to the student's question.

Grades 3-6; C

- Complete the above activity, then after describing a few characteristics of a plant or animal, have the students guess which habitat (or habitats) the plant or animal comes from and then which plant or animal it is.
- Have the class create a matching game. Split the class into large teams and have students draw a few pairs of cards: one card showing a plant or animal and its common and scientific names, and the second card describing the features of the plant or animal chosen. Each team should mix up their cards and give them to another team to match the species with their features. Then have each team place the pairs of cards in five piles according to which habitat region in our state the plant or animal inhabits.

Grades 7-12; C

Materials: index cards or paper and colored pencils

- Each student (or a team of students) can devise trivia questions using the enclosed fact sheets as resources. Students can then trade questions and test the knowledge of their classmates (or other teams).
- After completing the above trivia and matching games, have students create a word search or crossword with the species names and key words referring to the features of the species and their habitats.

* Extension: Give each group of students a list of scientific (Latin) names of plants and animals (see Plant and Animal Lists in this packet) to research. Using Latin-English dictionaries, students should determine the meaning of the scientific name and then try to figure out the common name of the plant or animal the scientific name describes.

DESIGN A POSTER TO SAVE A HABITAT

Grades 3-12; C, A

Materials: butcher paper, markers or paints

In groups or individually, have your students create conservation posters that promote the importance of one of the habitats the class has studied. Posters should include information and drawings about the plants and animals of the habitat as well as reasons the habitat should be protected. Posters encouraging protection of one species of plant or animal could also be designed. Display these posters in your school, at your school district office, at local stores or community centers, or ask for them to be used to decorate facilities for an appropriate meeting of parents, teachers, administrators or the public.

ACTIVITIES FOR STEPPE

WHO GETS THE WATER?

The following activities will help your students understand the demand for natural resources and the importance of their actions in water conservation.

Grades 3-6; C, G

Materials: markers, small paper cups, large jar, water

- Ask students to name all the ways water is used in Washington state (drinking, cleaning, gardening, watering golf courses, irrigation, aquifers needing to be recharged, fish needing runoff, waterfowl needing full ponds, hydroelectricity, etc.). Then perform the following activity:
  - Give each student a small paper cup and have him/her write one way water is used on the bottom of the cup.
  - Show the students a full jar of water representing the amount of water available from rain and snow in the Columbia Basin.
  - Pour a little water into each student's cup, asking them the purpose of their designated water. Use all the water in the jar, making sure each student gets an approximately equal amount.
- As your students realize there is limited water available for any one purpose, discuss the situation in the Columbia Basin. This area receives an average precipitation of only 15 inches (37.5 cm) per year. Have your students consider how the water resource might get divided to meet the many needs of the plants, animals and people in the region. Your students should come to the conclusion that conserving water is important. Ask students to brainstorm ways they can conserve water. Do people who live in an area where it rains a lot (such as western Washington) need to conserve water? Why? (Your city or county utilities or local Department of Ecology office may be able to supply information on water conservation.)

Grades 7-12; C, G, M

- Complete the above activity. After discussing the importance of water conservation, have your students keep a journal of how much water they use in a day. Use the information given below or have them gather their own data to make calculations. Include the amount of water used for flushing a toilet, drinking, showering, washing clothes and dishes, and washing hands. Remember that most of our electricity is also generated by water. Have students devise a plan for cutting their water usage per day in half and have them record their activities daily as they implement their plan for one week. Ask students if their plan worked and if they can sustain their plan long term. Discuss the ecological benefits of the water they are saving.

AMOUNTS OF WATER USED:
Faucet left running uses 2 to 5 gallons per minute
Toilet uses 5 to 7 gallons per flush
Shower uses 5 to 15 gallons per minute
Dishwasher uses 15 gallons per load
Washing machine uses 25 to 30 gallons per load

Grades 9-12; C, G

- Divide students into groups representing different users of water resources common to the Columbia Basin: farmers, miners, ranchers, fishermen, citizens. Explain the situation in the Columbia Basin where a limited amount of rain falls annually (approximately 15 inches). Have students research the water needs of their assigned user group and present a needs proposal for a proportion of the limited supply. If, as a class, the groups propose to use more than the total water available, have students devise a way to share the limited rainfall among all different users in the region. Their compromises to use less water should be based on practical means to conserve the available water supply.

**Note: Rivers also serve as sources of water in the Columbia Basin region. Restricting the debate to annual rainfall reinforces the importance of water conservation in the steppe.*

* Extension: If your students don't live in the Columbia Basin, discuss why occurrences in the Columbia Basin are relevant to their lives. For example, the Columbia Basin is a source for crops and livestock for the rest of the state and the Columbia River provides hydroelectric power to the entire region.

ACTIVITIES FOR MONTANE

BREEDING STRATEGIES: HOW MANY BABIES?

*All animals strive to produce offspring that will survive to have offspring of their own, thus continuing the genetic lineage. To accomplish this, different animals have different breeding strategies. Predators, particularly large mammals that are not themselves preyed upon, generally produce fewer offspring over their lifetime than do prey species. Grizzly bears, which are omnivores but do consume small mammals and have a very large body size, have the second slowest reproductive rate of North American mammals (muskoxen have the slowest). Ground squirrels, on the other hand, are small rodents sometimes eaten by grizzlies and are prolific reproducers. The large number of ground squirrel offspring is a strategy which ensures that this prey species will survive to reproduce even with a high level of predation. This is a common reproductive strategy among prey species, especially rodents, that lose many of their offspring to predation. *Note: There are many factors to consider when assessing breeding strategies. The muskox, for example, has a very low reproductive rate. Muskoxen are herbivores that live in the extremely harsh climate of far north Canada, Greenland and Arctic islands. Therefore, their low reproductive rate is due to limited amounts of nutrition available.*

Grades 3-6; M, C, S

Materials: pencils, paper, graph paper

- Using the information given, have your students complete the following:
  - Calculate how many offspring different animals would give birth to during their lifetime (assuming the female survives to an old age and continues to reproduce throughout her lifetime).
  - Make T-charts showing offspring produced by different animals (see "Chart I" below).
  - Guess from the numbers of offspring produced whether each animal is a predator or a prey animal. Make T-charts with predators listed in one column and prey listed in another column (see "Chart II" below).
  - Make bar graphs comparing the number of offspring produced by each animal.
- Discuss with your students different breeding strategies. Apart from being predators or prey, what are some other factors in their niches that would affect breeding strategy? Ask the students to list some reasons why an animal might not produce the maximum number of offspring possible.

BREEDING INFORMATION:

	grizzly bear	ground squirrel	vole	lynx	snowshoe hare	cougar
Average life span:	17 yrs	10 yrs	1 yr	13 yrs	5 yrs	14 yrs
Females begin breeding at:	6 yrs	1 yr	1 mo	2 yrs	2 yrs	2.5 yrs
Give birth:	every 3 years**	once a year	9 times a year	once a year	2.5 times a year	every other year
# offspring per litter:	2	5	6	2.5	5	3

** It is rare for a grizzly to have more than three litters in her lifetime.
**Note: All numbers provided are approximate.*
Breeding information can be found in: Maser, Chris, B. Mate, J. Franklin, and C. Dyrness. *Natural History of Oregon Coast Mammals.* General Technical Report - PNW-133. Portland: USDA, Forest Service, Pacific Northwest Forest and Range Experiment Station, 1981.

CHART I

Animal	Offspring per lifetime
lynx	
vole	
grizzly bear	
ground squirrel	

CHART II

Predator	Prey
lynx	snowshoe hare

Grades 7-12; C, S

Currently the U.S. Fish and Wildlife Service is considering augmenting the small population of grizzly bears in the North Cascades ecosystem by introducing grizzlies to the area. This opens for debate many ecological issues, including the difficulty of establishing a viable population with the grizzly bear's slow rate of reproduction.

- Have your students research and then discuss the issues involved with introducing grizzly bears into the North Cascades ecosystem. Students can use a variety of resources to research this topic including the World Wide Web and correspondence with experts, such as biologists with the U.S. Fish and Wildlife Service. Students can refer to the reproductive information for grizzly bears given in the chart above, but should also research statistics on cub mortality, the ecological factors that might affect grizzly bears' survival and reproduction, and the concept of a viable population. As a class, conduct a debate about the positive and negative implications of grizzly bear introduction.
- Using the provided information, have students calculate various population growths for grizzly bears over five generations. Calculate the grizzly bears' population growth with 100% survival rate for each generation, then calculate their growth with only 50% survival at each generation. For a more complex problem, have students create natural boom or bust cycles to solve their own population questions or consider that while each new generation is beginning to reproduce, all prior generations are reproducing as well.

**Note: This is a very simplified population growth model; a more accurate model would require a complex computer problem.*

Building a Mountain: Exploring Topography

Use this exercise in topographic mapping to help your students understand topography and characteristics of montane habitats.

Grades 4-6; G, M

Materials: dough (recipe follows), permanent markers, fishing line (two feet per group), plastic placemats (or laminated thick paper), topographic maps

Dough: 2 cups flour, 1 cup salt, 1 cup water, food coloring (mix to make brown for this activity)

- Working in pairs, have your students complete the following steps to create a model of a mountain and a topographic map of the mountain:
  - Using modeling clay or dough on a placemat, form a mountain that is about 6 inches (15 cm) in diameter at the base and up to 8 inches (20 cm) high. Be sure to include ridges and valleys molded into the clay.
  - Making sure that the edge of the base is a clean, well-defined line, trace around the bottom of the mountain with a marker onto the placemat.
  - Using fishing line held tight between two hands, slice off the mountain about 1 inch (2.5 cm) up from the base. Set the top of the mountain aside and scrape the bottom of the mountain away.
  - Replace the top of the mountain back down on the placemat in the center of the first ring and line up any ridge lines. Again trace around the base of the mountain onto the cardboard.
  - Repeat the slicing and tracing until the mountain is gone. You now have a topographic map of your mountain.
- Compare these maps with published topographic maps to understand how each line represents a difference in elevation. Using your map as an example of contour lines and their shapes, find the tops of mountains and the course of river valleys on the published topographic maps. Ask your students to imagine themselves standing in different places on the map. What would the area look like? What would it feel like? What would it smell like? Would it be wet or dry? How would the soils and plants look? What kind of animals would you see?

Grades 7-12; G, M

After completing the above activity, have students use the published topographic maps to calculate the elevation of mountains and the depth of valleys. This calculation is based on given information and the distance between the topographic lines. Then find the approximate elevation ranges of the alpine, subalpine and montane zones. Depending upon your map, students may also find mountain lakes, steep cliffs and color-coded areas discerning public lands such as National Forests, National Parks or Wilderness areas.

Fattening up the Grizzly Bear

Over a period of weeks before denning up for the winter, grizzly bears must eat up to 40,000 calories per day in order to build up enough fat to survive through the winter.

Grades K-6; M

Materials: pictures of bear food: fruit (blackberries), root (yellow glacier lilies), meat (pocket gopher) and human food: fruit (apples), root (potatoes), meat (cheeseburger)

- Using the amounts and calorie counts below, have the class calculate how much of the suggested three types of foods a grizzly must eat each day in order to build up enough fat before denning. As a comparison, have the students calculate how much of each type of human food a person would have to eat to match the bear's daily intake of 40,000 calories.

GRIZZLY BEAR	HUMAN
Blackberries: 3/4 cup (4.9 ounces [140 g]) = 90 calories	Apple: one medium (5.5 ounces [154 g]) = 80 calories
Root (compare four yellow glacier lily bulbs to one medium sweet potato): 4.6 ounces (130 g) = 130 calories	Potato: one medium (5.3 ounces [148 g]) = 100 calories
Pocket gopher (compare one pocket gopher to ground beef): 3 ounces (84 g) = 188 calories	Cheeseburger: one = 320 calories

NORTHERN TRAIL RESEARCH PROJECT

Woodland Park Zoo's Northern Trail is home to a variety of animals that inhabit Alaska, many of which are also found in Washington's mountainous areas. Through research and observation, students will become more familiar with the habits and habitats of some of these animals.

Grades 3-8; S, C

Materials: report folders, clipboards, paper, stopwatches, Animal Fact Sheets (included in this packet, with fact sheets on other animals available in the Northern Trail Teacher Packet)

- As individuals or groups, students can choose to do research on one of the following species of animals native to Washington state, and which can be observed in Woodland Park Zoo's Northern Trail: river otter, snowy owl, Roosevelt elk, gray wolf, grizzly bear, fisher, porcupine, mountain goat, bald eagle.
- Each student or group can begin by designing a cover for the report folder that will contain written information and records of observations on the chosen animal. Before visiting the zoo, students should use books, magazine articles and Woodland Park Zoo fact sheets to research information about their animal. This information should be written up and kept in the report folder. Questions to be answered could include:
  - What is the common name (or names) of the animal?
  - What is the scientific classification of the animal (include kingdom, phylum, class, order, family, genus and species)?
  - What does the animal eat?
  - What is the animal's strategy for food-getting (e.g. waiting and ambushing, stalking, running, cooperative hunting, grazing, etc.)?
  - In what types of habitat is the animal most commonly found? What are the important components of the habitat for the animal (e.g. dense canopy coverage, presence of lush herbaceous vegetation, clean rivers, streams, etc.)?
  - How is the animal adapted or suited to live in its habitat (e.g. teeth, muscle structure, bone structure, feet, skin covering, ears, nose, etc.)?
  - What behaviors might you expect to see if you observed the animal in the wild?
  - What are the animal's physical characteristics? (Students could include drawings showing outside covering and coloration, digestive system, muscle structure, and/or bone structure.)
  - What is the current status of the animal in the wild? Why?
  - What, in your opinion, is the future of the animal in the wild? Why?
  - Is the animal part of a breeding program in zoos? **Note: These captive breeding programs are called Species Survival Plans (SSPs).*

- On a field trip to Woodland Park Zoo, students can bring their report folders with the above information, a clipboard and a stopwatch.
  - Each student or group should spend several timed periods observing the chosen animal. On a piece of paper have the students record the date, weather, names of observers, start time and end time of each period of observation.
  - During their observations students can record activities or behaviors of the animal at given intervals, such as every minute or every three minutes.
  - Students should also record their observations about the surrounding environment that may be affecting the behavior of the animal (e.g. keeper present, large group of visitors at exhibit, etc.).
  - While at the zoo, students should also take notes on information provided on signs or bulletin boards that is relevant to their animal.
- After the zoo visit, have each student or group write an essay about what they learned about the chosen species through research and through direct observation. Students can include their personal feelings about the animal, their thoughts about the experience of observing the animal's behavior, and their ideas for a detailed plan to assure that the animal will have a place in the wild in the future.

PEANUT BUTTER AND CRACKERS: GEOLOGY OF WASHINGTON STATE

This activity provides a visual representation of the geologic processes that created Washington's topography. Displaying the elevational cross-section of the state during this activity will help students make the connection between the geologic history and the topography of the state. For information on the geologic history of Washington state, refer to the "Formation of Washington's Mountain Ranges" in the Montane Habitats section.

Grades 3-9; S, G

Materials: graham crackers, peanut butter, kitchen knife

- Demonstrate the following for your class. You may need to practice once or twice to make it work smoothly but you can eat your mistakes!
  - Spread a very thin layer of peanut butter over the upper surface of one graham cracker: this is the oceanic crust covered with sediments.
  - To illustrate a subduction zone, hold the oceanic crust in your left hand and continental crust (plain graham cracker) in your right hand. Gently, make the oceanic crust slide underneath and past the leading edge of the continental crust. Allow the continental crust to scrape up some oceanic sediments (peanut butter) from the oceanic crust. This represents the trench created at a subduction zone.
  - Now, break a third graham cracker up into small (one inch square) pieces. Place one piece in the middle of the peanut butter on the oceanic crust. This represents the Okanogan subcontinent, that is about to "dock" onto the continent.
  - Keep subducting the oceanic crust until the subcontinent runs into the continental crust. Explain to your students that if a graham cracker were as pliable, or able to be molded, as continental crust, the edges of both graham crackers might crumple up. This represents the creation of the Selkirk, Kettle and Blue Mountain ranges about 100 million years ago. Notice how some peanut butter ("trench filling") is squished between the continent and the subcontinent. This illustrates the Kootenay Arc, rock made of sediments that filled the trench, that lies between the old continental crust and the Okanogan subcontinent.
  - Repeat the process of a subcontinent docking. The second subcontinent is the North Cascades subcontinent, which docked between 40-50 million years ago and created the Okanogan Highlands and the Cascades.
  - Continue to scrape more peanut butter into the new trench off the left edge of the North Cascades subcontinent. Explain that this filling eventually floated up to become the Olympic Mountains and the Willapa Hills. These oceanic sediments also formed the lowlands of Puget Sound.

ACTIVITIES FOR TEMPERATE FOREST

CHAMPION TREES

Due to the ideal growing conditions for conifers in the Pacific Northwest, this region has some very large and very old trees. Trees that reach outstanding ages, heights or girths are often referred to as "champion" trees. Your students can illustrate the greatness of champion trees using their own heights and arm spans for reference.

Grades K-5; M, C

Materials: measuring tape, paper, pencil

- Using the information in the table below, have students run a tape measure down a long hallway or out on schoolgrounds to equal the height of a champion tree. Then have the students lie down along the tape measure until the height of the tree is equaled. It may take more than one class of students to do this! Older students may start by calculating how many students, standing one on top of the next, it would take to reach the height of one of our champion trees and then lie down along the tape measure to test their calculations.
- When measuring girth, again extend a measuring tape to the length of the circumference of a champion tree and have students stand along the tape outstretching their arms to meet one another. The number of students whose arm widths equal the circumference of the champion tree can then join hands in a circle to illustrate the size of the tree's trunk.
- To put the age of the tree in perspective, older students can research historical events that occurred when the champion trees were just beginning to sprout.

	Champion Circumferences:	**Champion Heights:**	**Champion Ages:** (Approximate)
Douglas fir	44 feet (13 m)	326 feet (99 m)	1300
Sitka spruce	60 feet (18 m)	305 feet (92 m)	1350
Western hemlock	25 feet (7.5 m)	230 feet (70 m)	1200
Western red cedar	60 feet (18 m)	178 feet (53 m)	1400

*Note: Lists of living tree champions often change due to lightning strikes and blow-downs.
Statistics on champion trees can be found in:
Franklin, Jerry F. and C. T. Dyrness. *Natural Vegetation of Oregon and Washington.* General Technical Report - PNW-8. Portland: USDA, Forest Service, Pacific Northwest Forest and Range Experiment Station, 1973.

Pojar, Jim and Andy MacKinnon, eds. *Plants of the Pacific Northwest Coast: Washington, Oregon, British Columbia, and Alaska.* Redmond, WA: Lone Pine Publishing, 1994.

MUSICAL NICHES

Within a given habitat, structural diversity of land and vegetation creates a variety of niches. A niche can be thought of as the role a species plays in its ecosystem. Food, water, air, shelter space, and how these things are obtained are important components of a species' niche. Animals of the same species compete with each other within their shared niche for resources such as food and breeding sites. Animals of different species have different niches, so competition between them is reduced. The greater the number of available niches, created by the structural diversity of the habitat, the greater the diversity of species within a habitat.

This activity is based on an animal's basic needs which are the necessary components of its niche. To demonstrate this, we've centered this activity in a forest ecosystem, but with several changes in the scenario, this activity could be used to learn about other habitats, such as the steppe. For example, you could use kangaroo rats and sage grouse for the animals and burrows, and sagebrush as the important components of their niches.

Grades K-2; G, S

Materials: chairs, construction paper shapes, source of music

- Play the following activity:
  - In a circle, set out one chair for each student, facing out. Divide students into two groups, the woodpeckers and the banana slugs. (Students may want to create pictures of their animal to wear around their necks during the game.) On the backrests of half the chairs, tape black circles of paper representing tree holes. On the other chairs tape pieces of paper shaped like mushrooms. Ask students which chair a woodpecker would sit on (tree hole) and which chair a banana slug would sit on (mushroom). The symbols on the chairs represent an important component of each animal's niche.
  - Have students walk in a circle around the chairs while music is playing. When the music stops, each student has to find his/her correct niche and sit down. During the first round all students will find a seat.
  - For the second round, replace half the tree holes with insects and half the mushrooms with leaves. Discuss with your students that the woodpeckers also eat insects and slugs also eat leaves so they can sit in either chair because these are necessary components of their niche. Play the game again and each student should be able to find a seat when the music stops.
  - For the third round, explain how a big wind storm knocked down many of the trees and eliminated the number of tree holes. Take most of the tree hole chairs away and play again. Woodpeckers who can't find seats (necessary components of their niche) will die or move away (students sit out of game).
  - For the fourth round, explain how a big fire came through the area. After the fire, lots of mushrooms pop up all over the forest. Replace some chairs and label them with a mushroom. Tell a few students who are sitting out that they are now slugs who move into the forest to feed on the mushrooms. Make sure to add more slugs than available mushroom or leaf seats. During this final round, too many slugs will compete for food and some of them will have to sit out.
- Finish this activity with a discussion of the natural changes in the forest environment and how each affected the diversity of vegetation and the available niches for the plants and animals.

Grades 3-8; G, S

- Use the musical chairs activity above but involve increasingly harder concepts for upper grade levels. For example, human-caused environmental changes such as logging, mushroom picking, pesticides, development and invasive species can change the ratio of species to available habitat components in the game. By starting the game with only three-quarters of the class playing, you can add different species (students) to the game as new components of their niche become available. After playing the game, ask your students what they have learned about the interdependence of species within a given ecosystem. Have them consider the long-term impacts humans have made on the availability of niches in this habitat.

ACTIVITIES FOR WETLANDS

BUILDING A MODEL: WATER DOWN THE MOUNTAIN

The following activity involves building a model to illustrate the movement of water through a watershed. The model shows how wetlands and vegetation affect water movement, water quality and erosion.

Grades 3-12; S, G

Materials: Each group of students should have two medium-sized plastic grocery bags, paper or newspapers from a recycle bin, two twist-ties, two large roasting pans (or used paint pans with an incline), several sponges (cut into quarters), and two jars, each filled with water and a handful of soil.

- Split the class into several groups. Have each group of students perform the following:
  - Shred the papers and stuff them into the two plastic bags until the bags are full, then tie the bags closed. This is your "mountain."
  - Fit one "mountain" into each of the two roasting pans making a bumpy slope (higher at one end than the other) and leaving some space in the pan at the low end. The pan can also be propped up with books on one end (the end with the high end of the mountain) to create more of an incline.
  - On one of the "mountains," place sponges in several of the valleys created by the bumps. The sponges represent the absorbing ability of freshwater wetlands and/or the ability of forests to prevent erosion. The other mountain has no wetlands or vegetation.
  - Shake the jars filled with water and soil and *slowly* pour one down each "mountain," starting at the higher end.
  - Observe how fast all the water from the jar reaches the bottom of each mountain and flows into the roasting pan. How did the water flow differently on the mountain with wetlands or forests (mountain with sponges) as compared to the mountain with no wetlands or forests? Observe the water in the bottom of each of the pans. Is the water in one pan cleaner than the other? Where is most of the soil from each of the jars?
- Relate the two roasting pans to a watershed with healthy wetlands (pan with sponges) and a watershed with unhealthy wetlands that are paved over or absent of vegetation (pan without sponges) OR to forested and deforested mountain slopes. Relate the soil to pollutants that might be contained in wetlands, thereby preventing pollution of rivers and lakes downstream, or soil that might be held by trees, preventing erosion. Discuss the filtering function of wetlands. How will cleaner water benefit the plants and animals downstream from the wetland?

WATCHING WATERFOWL BEHAVIOR

Woodland Park Zoo's Marsh mimics a wetland typical of Washington state and includes species of waterfowl that reside in or make migratory stop overs in our state. Waterfowl exhibit different techniques for obtaining their food, which allows different species to inhabit the same area without competing for the same resources. By spending time looking at feeding behaviors of waterfowl at the Marsh, students can explore the concept of niches. Depending on the time of year, students may also be able to observe courtship behavior.

Grades 3-8; S, C

Materials: paper, clipboards, stopwatches

- Before visiting the zoo, have each student choose a species of waterfowl present in Woodland Park Zoo's Marsh (see "Birds" in the Wetlands section of this packet for a listing of waterfowl). Each student should research their species and write a short summary about the animal. The summary could include:
  - Is the bird a year-round resident of Washington state or does it stop in the state during its migration? If the bird is migratory, what regions does it migrate between?
  - At what time of year does the bird begin showing courtship behavior? What type of behaviors are exhibited during courtship? Do the males or females have special breeding plumage? Describe or draw a male and female of the species showing breeding and non-breeding plumage.

- What does the bird eat? How does the bird obtain its food? *Note: Waterfowl feeding behaviors are often categorized as dabbling, diving, grazing or stalking. Students should be able to use one of these categories to describe the feeding behavior of their chosen bird.

- On a visit to the Marsh, students should bring clipboards and stopwatches. After identifying their chosen species, students can spend several timed periods observing the behavior of the bird. Information recorded should include date, weather, name of observer, start time and end time of the observation. Students can record the activities and behavior of the birds at given intervals of time, such as every minute. Interactions between the chosen bird and other birds should be noted. Students can also write down their observations of other activities in the Marsh that might affect the behavior of the bird they are observing, such as large groups of visitors, keepers in the area, etc.
- After the visit, have each student write an essay about their chosen bird. The essay should include information about the bird obtained through research and direct observation. Did the bird show any behaviors, either feeding or courtship, that the students expected to see? Did the bird show any behaviors that the students did not expect to see? What sort of interactions between birds were noticed?

* Extension: On their own or as a class, students can try to observe their species in the wild for the same number of timed periods they spent observing the bird at the zoo. Are any different behaviors observed?

WETLAND WONDER EXPERIMENTS

The following three activities will help your students understand how wetlands filter pollutants, clean water by allowing particles to settle, and prevent flooding by absorbing water and releasing it slowly. Your students should be able to draw conclusions on the importance of wetlands based on their experiments. (See "Functions of Wetlands" in Wetlands section.)

NATURE'S FILTER

Use this experiment to demonstrate how plants uptake water and nutrients.

Grades K-2; S

Materials: four jars, water, food coloring, four celery stalks

- Involve your students in the following experiment:
  - Fill all jars two-thirds full with water.
  - Add several drops of a dark food coloring to three of the jars of water.
  - Diagonally slice the ends off all of the celery stalks. Using three of the stalks, place one stalk in each of the jars of colored water.
  - As a control, place the fourth sliced celery stalk in the fourth jar of plain water.
  - Allow celery stalks to sit in the jars overnight.
  - Next day: cut the stalks into thick slices, distribute one to each student.
  - Discuss what the different slices look like. Are they the same or different as the day before?

Grades 3-6; S

- After completing the above exercise, have students observe the celery stalks and take note of any changes within the celery stalk and the jar of water. Relate the uptake of food coloring by the celery stalks to the uptake of chemicals by wetland plants. Continue experimenting to answer the following questions: Where do the chemicals go? Can wetland plants clean all pollutants out of water? Is there a limit to how much plants can take up? What happens to plants if there are too many chemicals in the water?

Silts, Sediments and Suspended Particles in Wetlands

Use this experiment to demonstrate how a river slows and settles into a wetland.

Grades K-2; S

Materials: several jars with lids, water, particles of various sizes (sand, gravel, dust, soil, and/ or stones)

- Have individual students or groups perform the following:
  - Fill jars with water and handfuls of mixed particles, then screw the lids on tightly.
  - Shake the jars vigorously for about a minute. This simulates a fast-moving river.
  - Pretend that the river carried the particles into a freshwater or salt marsh and as the water slows, particles fall to the bottom. Have students put down their jars and observe which materials settle to the bottom of the jar first, in between and last. Discuss the results as a group.
- Discuss why this settling is important for the animals of the wetland.

Grades 3-6; S, C

- After completing the above exercise, discuss how different materials in water might affect aquatic animals differently. For example, larger particles will settle out more readily and may not negatively affect animals, while small particles may stay suspended in the water and affect oxygen intake of animals and their eggs. Remind your students that when water flows into a wetland, the vegetation helps to slow the water down, allowing particles to drop out. The water that flows out of wetlands is very clean and clear. Discuss what would happen if wetlands didn't exist to do this important job.

Nature's Sponge

Use the following experiments to demonstrate how the soils and vegetation of a wetland store water and release it slowly.

Grades K-2; S

Materials: sponges, clear bowl, water

- Have students hold out their hand and feel the weight of an empty sponge. Compare this with the weight of a sponge full of water.
- Next, fill a clear bowl with water and dip a dry sponge into it. Let the sponge absorb as much water as possible and observe how much water is left in the bowl after the sponge is removed.
- Finally, lift a sponge out of water and demonstrate how the sponge, like a wetland, absorbs water and releases it slowly into the land which helps prevent flooding.

Grades 3-6; G, S, M

Materials: several sponges, plastic containers to fit a sponge, buckets of water, scales

- Have individual students or groups perform the following:
  - Weigh and record the mass of a dry sponge inside a plastic container.
  - Dunk the sponge into a bucket of water, return it to the plastic container and weigh the waterlogged sponge and container again.
  - Determine the mass of water absorbed by the sponge by subtracting the first mass from the second mass.
- With your students, compare the ability of a large sponge to absorb a lot of water to the ability of a healthy wetland to absorb water. What happens when a wetland is altered?

Grades 7-12; M, S, G

- Using the conversions given below, convert the mass of the water soaked up by a sponge to a volume, both in gallons and liters (metric). Next calculate how many sponges (the size of the sponge used in the activity) it would take to equal the area of a small wetland which is roughly rectangular in shape. **Note: For convenience, give your students an area that is equal to 1,200 sponges. For example, if their sponge is 3" by 5," or 15 square inches, the wetland area would be 30' by 50', or 1,500 square feet (18,000 square inches).*
- Using the volume of water soaked up by one sponge multiplied by the number of sponges it takes to equal the area of the hypothetical wetland, determine how much water, in gallons and liters, all the sponges would be able to absorb. **Note: The amount of water soaked up by sponges does not directly correlate to the amount of water soaked up by a wetland; this is simply a tool to aid in the thought process.*
- Discuss what might happen to that water if this hypothetical wetland were paved over. Ask students if they know of any wetlands in their neighborhood. Are they healthy wetlands or have they been altered by humans? Discuss what might happen if all the wetlands in their neighborhoods were paved over or filled in.

IF YOU HAVE:	MULTIPLY BY:	TO FIND:
ounces	1.0	fluid ounces
fluid ounces	.0625	gallons
feet	12.0	inches

fluid ounces	30.0	milliliters
gallons	3.8	liters
feet	30.0	centimeters
inches	2.5	centimeters
square inches	6.5	square centimeters
square feet	0.09	square meters

ACTIVITIES FOR URBAN & SUBURBAN

The Story of the Starling Introduction

When Europeans began to inhabit North America, they brought many species of plants and animals with them. Some arrived unintentionally, such as rats aboard ships. Others were brought over because settlers wanted familiar plants and animals from their native lands. Some of these introduced species have had drastic effects on the native flora and fauna of North America. For example, starlings, an introduced species, compete with cavity-nesting native birds for satisfactory nesting sites. During the winter, starlings feed in agricultural areas and can have devastating effects on crops.

Grades 6-12; G, C, S

- Share with your students the following story of how starlings were introduced to North America. Then have your students research and discuss how starlings have affected North American ecosystems. How have other bird species been affected? How have humans been affected?

During the 1800s, people found it fashionable to grow gardens containing all the species of plants mentioned in Shakespeare's works. One wealthy man in New York, Eugene Schiefflin, decided that in addition to gazing upon a garden full of Shakespeare's plants, he would also like to see all the birds mentioned by Shakespeare. After several unsuccessful attempts with other birds, Schiefflin successfully introduced 80 European starlings in 1880

and 40 more the following year. The starlings started out in Central Park in New York City, but by 1950, starlings ranged throughout the lower 48 states and each of the Canadian provinces.
(Paraphrased from Garber, Steven D. *The Urban Naturalist.* New York: John Wiley & Sons, Inc., 1987.)

- Have students use the local library and/or the Internet to research other stories about the introductions of plants and animals found in Washington state. Using the animal and plant lists in this packet, choose nonnative species (denoted by an asterisk) and research how they have affected their new ecosystems. How have introduced species affected biodiversity? Have each student or group of students present their findings to the class. *The Urban Naturalist* cited above is an excellent resource for this research.

Grades 9-12; G, C

- Divide the class into two groups and conduct a debate on the issue of whether or not introduced species should be eliminated. Oftentimes, introduced species have adverse impact on ecosystems. However, methods of removing the species may be considered inhumane or the cost to remove them may be prohibitive. Three possible subjects for debate are: mountain goats in Olympic National Park, which are negatively affecting native vegetation; bullfrogs in wetlands that are decreasing the survival of young native amphibians and reptiles, such as the western pond turtle; and Canada geese on urban lawns, which overgraze the grass and leave large amounts of waste behind. Washington Department of Fish and Wildlife, U.S. Fish and Wildlife Service or your local City Parks and Recreation may be able to provide more information on these topics.

CONSERVATION: CREATING AND RESTORING HABITATS

Our action, or inaction, and the choices we make can have significant effects on the environment and natural systems. The following activities are ideas to help students understand that they play an important role in conservation and that their efforts can benefit the natural environment.

Grades K-6; S, C

- Involve your students in the joy of gardening and the excitement of watching something grow. Primary grades can plant and water flowers that attract bees, butterflies or birds while upper elementary can study different species of plants, pick out appropriate plants for available sun and shade, and design where the plants should go in the garden. Have your students observe and maintain their garden over different seasons.

Grades 7-12; C, S, M, G

- Research and develop a schoolyard habitat. Incorporate studies of local wildlife, plants and their habitat needs, soils and geologic history of the area, mapping and design of site, budget and cost comparisons when shopping for the plants and, finally, animal behavior when observing your new neighbors.

Grades 6-12; C, G

- Get students involved with local restoration projects. Many community organizations coordinate these projects but need volunteers to repair a trail or a wetland or do plantings in a park. Have your students discuss how and why the area was impacted and how they can work to make sure the area doesn't become negatively impacted again. Include in your discussion aspects such as improving water quality, ecosystem health and habitat for animals. After your students see the value of their work, they will look for other opportunities to get involved and make their community a better place for wildlife. (See Contact Information list for restoration projects.)
- Students could plan and implement a community garden in an urban or suburban neighborhood using the methods described above for developing a schoolyard habitat.