ACTIVITY 9-2: **MAKING TERRARIUMS**

OBJECTIVE(s): After completing the activity, students will be able to:

- ▹ build a miniature ecosystem.
- ▹ use their terrarium to explain how the water cycle works.

MATERIALS:	
70-9oz plastic cups	seeds-beans
1 bag of potting soil	1 flat of 30 tiny plants
Sand	30 pop bottle caps-
5 rolls of clear tape	(saved from water rockets)

BACKGROUND INFORMATION:

Water is essential to life. Cells and their associated chemical reactions require water. Chemicals dissolved in water are transported to various parts of an organism. Plants absorbed water through their roots and give off water vapor from their leaves. Animals drink water and give off water vapor when they exhale. Lakes, rivers, streams, oceans, and plants serve as water reservoirs.

The process of evaporation uses the energy from the sun to transport water into the atmosphere. This water, in turn, moves from the atmosphere to the earth in the form of rain or other types of precipitation. This constant movement of water from the atmosphere to the earth and from the earth to the atmosphere is called the water cycle.

PROCEDURE:

1. In this activity, students will build their own miniature ecosystem.
2. Students will work individually.
3. Instructors should discuss the water cycle before starting this activity.
4. Instructors need to demonstrate the correct amount of soil and sand to be added to one of their plastic cups. Each terrarium should contain 1 growing plant start, 2 beans, and a cap for water.
5. Students should follow the directions on Student Activity Sheet 9-2 to complete this activity.

DISCUSSION QUESTIONS:

1. What is the importance of trees/plants in the water cycle? Should we be concerned with the cutting down of our rain forests? Why?
2. Why is the water cycle important?
3. What is the purpose of the cap of water in your terrarium?
4. If you were a water molecule, trace your steps in the water cycle.

DAY 9

*Estimation game. Challenge students to guess the mass and volume of colored water in grams and milliliters. (Winners will be announced at the beginning of lunch.)

ACTIVITY 9-1: **ECOSYSTEM ART**

OBJECTIVE(s): After completing the activity, students will be able to:

- explain the interactions between 2 or more organisms that are found in a wetlands.

MATERIALS:	
construction paper-assorted colors	5 rolls of clear tape
color pencils/crayons	tissue paper-assorted colors
15 bottles of white glue	scissors

BACKGROUND INFORMATION:

An **ecosystem** is defined as a unit of the **biosphere** (the thin layer where life exists on earth) in which living and non-living things interact. Wetlands, lakes, forests, and ponds are all examples of ecosystems. As ecosystems are units of the biosphere, their are dependent on one another and on a important physical factor, energy. All energy ultimately comes from the sun.

An ecosystem that include a variety of species is more stable than one with fewer varieties. Ecosystems are communities of living things that offer mutual support to each other. The survival of each member of the system directly relates to the survival of the entire ecosystem.

PROCEDURE:

1. In this activity, students will construct a model of a wetlands ecosystem, showing the interaction between different organisms they saw on the field trip.
2. Students will work individually.
3. Instructors should hand out materials and allow students time to create!

Student Activity Sheet 9-2

MAKING TERRARIUMS

1. Put about one centimeter of sand in the bottom of one of the plastic cups with your plastic spoon.

2. Use your plastic spoon to fill your plastic cup 3/4 full of potting soil. The soil should be packed lightly with your spoon or hand.

3. Obtain a plant start and plant it somewhere in your plastic cup.

4. With the tip of your finger make two small holes in another part of your cup then plant your bean seeds.

5. After planting your plant and the bean seeds, **lightly** water your plants.

6. Now, place a pop bottle cap on the surface of the soil and fill it with water.

7. Take your second cup and use it as a lid to cover your plants. Carefully tape the second cup onto the first one using clear tape.

8. Label your finished terrarium with your name and place in the designated area.

DAY 1 **TEACHER NOTES**

Welcome: Construct Salmon Nametags for each student. Nametags should be placed on student work tables during the breakfast/welcome activity.

Salmon Survey: This pre-test is designed to evaluate the present knowledge of the students regarding Pacific Salmon. Students should be given approximately **15 minutes** to complete the survey. Students can draw or write information on the survey sheet. It is important that each student complete the bottom portion of the survey which includes their name, camp and date. A post-survey will be administered on Day 9 of the camp. The comparison of the pre- and post-surveys will be an important tool in the evaluation process (a copy of the survey can be found in the Day 1 materials following page 1-18).

Estimation Game: Challenge students to guess the number of pinto beans in the plastic container. Each pinto bean represents a chinook salmon egg. An adult chinook female lays between 3,000 - 8,000 eggs. The number of pinto beans in the container represents approximately 5,000 eggs which is the average number of eggs deposited by a female chinook. The estimation game is conducted each day during breakfast with winners announced later.

Group Names: Group students into teams of 5 to 6. Have student groups name themselves and show how the salmon rubber stamps will document their progress through the activities (Each time a student completes an activity, a salmon is stamped their paper - see page 1-9 for patterns).

Story Time: Journey of the *Oncorhynchus*-Chapter One-**15 minutes (see Teachers Guide ot Storybook following page 1-18).** Before starting the story, display either the Journey of the *Oncorhynchus* mural with the **salmon life cycle center piece and section one** or use the poster **(posters can be obtained by calling 1-800-622-4520).** Call attention to the mural/poster by having the students search for the hidden salmon in section one. The first student to find the hidden salmon will be awarded a prize. Each student will need their Journey of the *Oncorhynchus* story book which coincides with the mural/poster **(storybooks can also be obtained by calling the above 800 number).** Students may want to color illustrations as they listen to the story. Those needing more time can complete coloring during break or lunch.

ACTIVITY 1-3: **PACIFIC SALMON LIFE CYCLE HEXAFLEXAGON**

SCIENCE CONCEPTS/PROCESSES: Cycle, Change, Organism

OBJECTIVE (s): After completing the activity, students will be able to:

- understand the basic steps in the Pacific Salmon's life cycle.

MATERIALS:	
40 Pacific Salmon Life Cycle Hexaflexagon Patterns	20 rolls of clear tape
40 student scissors	40 metric rulers

BACKGROUND INFORMATION:

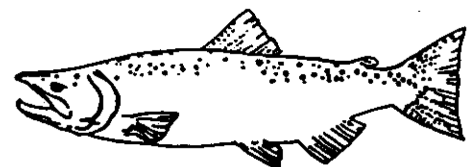
PACIFIC SALMON

Of all the fish in the Pacific Northwest, migratory or otherwise, salmon have been a cornerstone of human survival for thousands of years. Prepared fresh, smoked, dried, or salted, salmon were the foundation of coastal and Columbia River Indian diets. Native American cultures and spiritual beliefs were also intertwined with the great silver fish. In fact, the chinook salmon takes its name from a Northwest tribe.

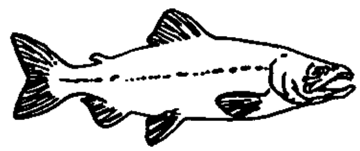
Salmon date back to the Miocene geologic epoch (12 to 26 m.y.a. (million years ago)). Scientists believe that salmon migratory behaviors originated over 10,000 years ago. These anadromous (a-nad-re-mes) fish evolved from cold, oxygen rich waters of the Northern Hemisphere. Salmon are called anadromous fish because they can live in both saltwater and freshwater at different times during their life. (Anadromous comes from the Greek words for "up river".) In the Pleistocene epoch (present day to 2 m.y.a.) the great glaciers of the Ice Age melted, revealing safe places for spawning and for rearing young. The salmon's anadromous behavior is thought to be a result of the advancement and receding of continental ice sheets. Also at this time, the Pacific Salmon became separated from the parent stock salmon in the Atlantic.

Classification

The Salmonidae family, which include the Pacific Salmon and trout, are naturally distributed throughout most of the Northern Hemisphere, from the temperate zone northwards to beyond the Arctic Circle. There are no native salmon or trout in the Southern Hemisphere but they have been successfully introduced into South America, Southern Africa and Australia. The Pacific salmon, steelhead, and trout also belong to the genus Oncorhynchus. (From Greek, *onko* meaning barbed or hooked and *rhynchos* meaning snout.) Throughout Hydromania II: Journey of the *Oncorhynchus* curriculum, we will focus on five species of Pacific salmon: **Chinook** or King (*Oncorhynchus tshawytscha*), **Chum** or Dog (*Oncorhynchus keta*), **Coho** or Silver (*Oncorhynchus kisutch*), **Pink** or Humpback (*Oncorhynchus gorbuscha*), and **Sockeye** (*Oncorhynchus nerka*). The species names were originally classified by Russian scientists working on rivers on the opposite side of the Pacific Ocean.



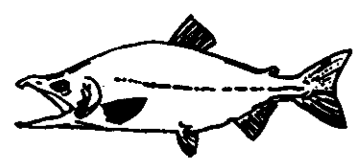
Chinook



Chum

Coho

Pink



Sockeye

Of the five species of salmon found in the Pacific Northwest, three are common to Oregon: the chinook, the chum, and the coho. Neither sockeye nor pink salmon return to Oregon streams in significant numbers although a major commercial offshore harvest of pinks occurs during the alternate years they spawn. Sockeyes migrate by the thousands up the Columbia River each summer but all spawn in Washington waters. Landlocked versions of sockeye, called kokanee, thrive in many Oregon mountain lakes. With minor differences, the three Oregon inhabitants have similar life and reproductive cycles, which divide neatly into three distinct periods, freshwater, saltwater and spawning phases.

Life Cycle

Freshwater Phase

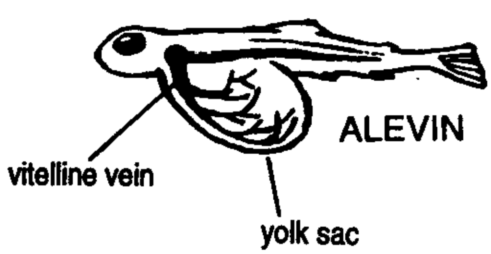
The salmon life cycle begins when the **eggs** are deposited and fertilized at the bottom of a swift-flowing, freshwater stream in a bed of gravel called a **redd**. Small salmon eggs, the size of a pea, are clustered in groups and rest just under the top layer of gravel. The gravel provides protection from predators and other hazards during the incubation period. Successful reproduction depends on an adequate supply of gravel with low sediment content.

FERTILIZED EGG

EYED EGG

About one month after being deposited, eyes begin to show. This is called the **eyed stage**. Incubation may take 50 days or longer, although this varies greatly, depending upon the water temperature. Generally, the colder the water, the longer the incubation period. During incubation, water flow (delivers oxygen and carries away waste products) and temperature (4°-18° C or 40°-65° F) must be suitable. Salmonids are cold-water fish and generally cannot tolerate temperatures above
20° C (68° F).

When the baby salmon hatch from the eggs in late winter or spring, they are only about an inch long. At this stage, these young salmon are called **alevins** (aL-e-vins). An alevin is a fragile creature with huge eyes and a large yolk sac protruding from its belly. The reddish-orange sac contains a completely balanced diet. Oxygen is absorbed (from the water) through the **vitelline vein** which runs up through the center of the yolk sac. Alevins rapidly grow under the gravel for one to three months.

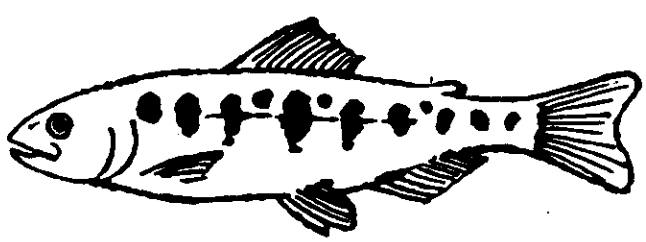


ALEVIN

As the alevin develop, the absorption of their yolk sac coincides with the development of the mouth, digestive tract and excretory organs. At this stage, they are called **fry**. The baby fish work their way up through the gravel and position themselves in a hollow between the stones on the river bed. (A dye test will show that there is a vortex in these hollows which prevents the fry from being washed away and allows them to remain in position with the minimum of effort.) This occurs in late spring and summer. The fry are less than a year old and measure about an inch and a half in length. They feed on zooplankton carried down to them by the current. They are easy prey for larger fish and other predators. Chinook, coho, and sockeye fry spend a year or more in streams or lakes, while chum and pink fry begin to migrate directly to the sea.

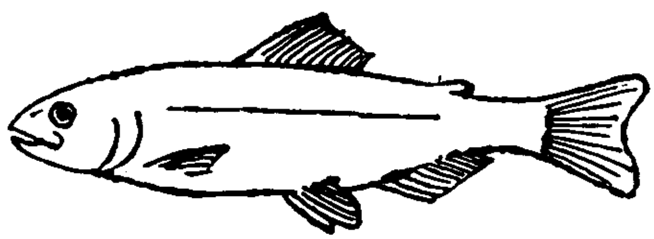
FRY

When the young fish reach about two inches in length, they are known as **parr** (fingerlings). Parr spend most of their freshwater life in shallow riffles, where the water is broken and well-oxygenated but the current is not strong. They become voracious feeders on insects, worms, mussels and snails. This growth phase is best recognized by the development of dark bars aligned vertically along each side of the fish. These markings help them hide from enemies along the river banks. The parr stage is the most vulnerable time in a salmon's life. At this stage of their life, they are preyed on by sculpins, bigmouth minnows, minks, raccoons, mergansers, great blue herons, cormorants, ospreys, and kingfishers among others. The greatest mortality in the salmon's life cycle is during the egg-to-parr stage.



PARR

As the parr live in the rivers or lakes they continue to grow and soon develop into young salmon called **smolt** or fingerlings. The salmon smolt are about two years old and are over five inches in length. It is at this stage that most young salmon begin a physical change that triggers their downstream migration and allows them to eventually adapt to a salt-water environment. Smolt have shiny, silvery coats and have lost all of the dark markings that helped them to hide in the river. In addition to predators (bears, foxes, birds, fish), smolt must run a barrage of natural (volcanic eruptions, storms) and manufactured (polluted water, erosion, dams) obstacles. Those that are successful will rest in the brackish water of estuaries as they adjust to the salt-water.

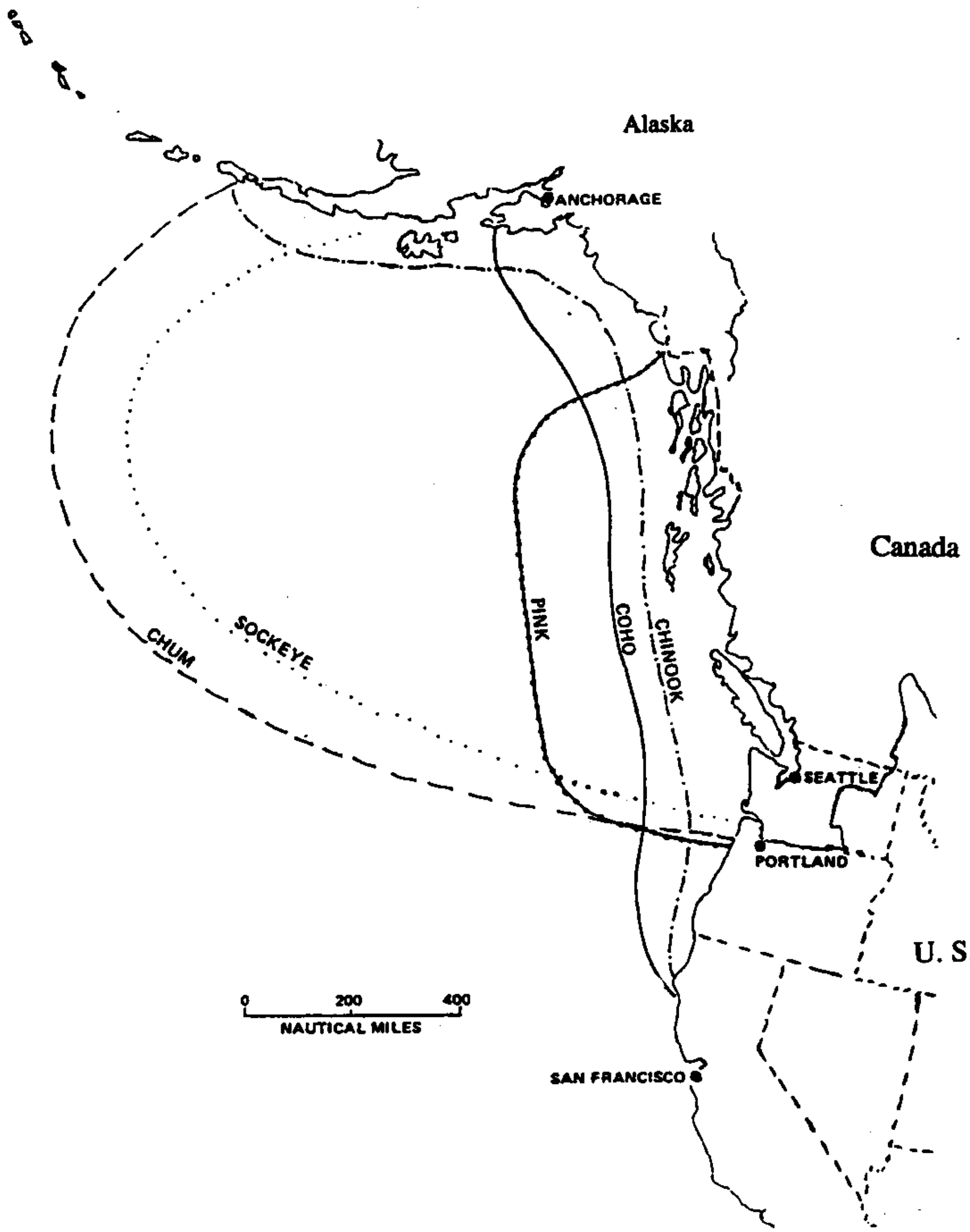


SMOLT

Saltwater Phase

Salmon spend varied amounts of time in the sea, up to five years, depending on the species (pink-15 to 16 months, coho-1 to 2 years, sockeye-2 to 3 years, chum-3 years, chinook-3 to 5 years). As they become young adults, their diet changes from small plants and bugs to small sea creatures and plankton. As the fish grow, krill, anchovies and herring make up the majority of their diet. Sharks, marine mammals, killer whales, sea birds and other predators prey on a portion of the maturing salmon. Commercial and sports fisheries also take their toll on the salmon population.

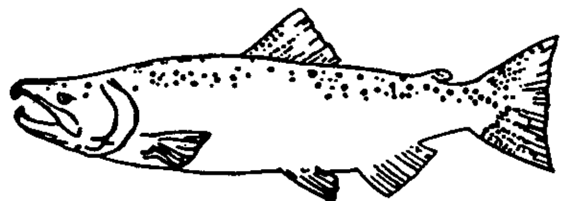
Having reached the sea, the young salmon will head toward their hereditary feeding grounds. Some of these large schools will travel north to Alaska and others will feed in the deeper waters off California.



Migratory paths of five species of Pacific Salmon

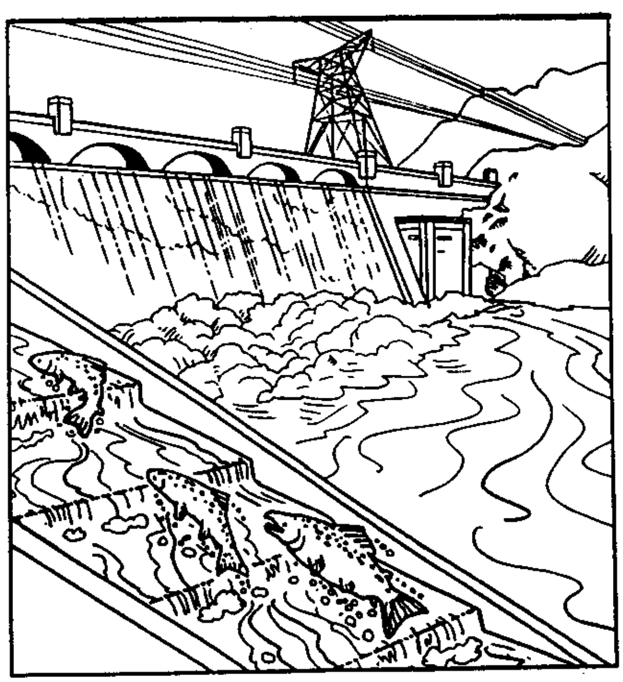
Spawning Phase

Usually in the early summer of their maturing year, salmon begin to head back to their home streams. Researchers believe salmon navigate by electromagnetic signals, the moon and stars, or by the smell of their home stream. Salmon stop feeding when they enter fresh water, and live on stored body fats for the rest of the trip. The salmon's body has changed again; some of their bodies may be red and green instead of silver. They also have a large hooked nose.

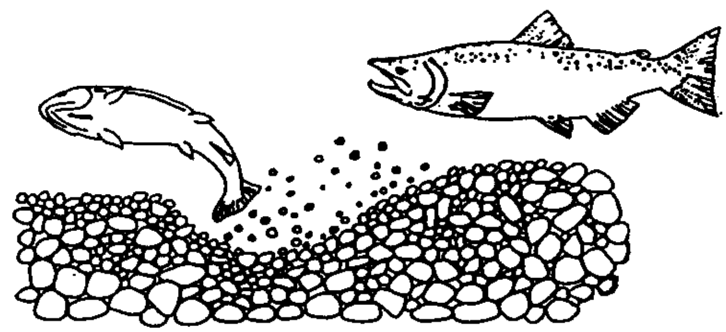


Chinook

As salmon continue their upstream journey to their spawning beds, fishermen and natural predators continue to reduce their numbers. Most hydroelectric dams, which block normal passage upriver, now have fish ladders which allow the salmon to continue their journey. However, as salmon search for these passages they use their limited energy supply. Other barriers such as landslides, log jams, road culverts and low water levels can also cause problems for migrating salmon. When water levels are too low for upstream movement, water temperatures may become quite warm in the holding pools and allow the development of disease organisms. Salmon can rest for days in these holding pools waiting for improved water flows. Restricted flows may delay salmon too long, and reduce the chance of successful spawning when they finally reach the spawning beds.



Upon reaching the spawning grounds, the female digs a nest, or **redd** in the gravel with vertical sweeps of her tail. These redds are approximately 40 centimeters (16 inches) deep. When the nest is ready, which may be weeks or months after they reach the gravel beds, the female begins laying her eggs. The male moves alongside the female and fertilizes the eggs by covering them with milt, a milky substance that contains the sperm. The female does not extrude all her eggs at one time. After a resting period, the female moves a short distance upstream and digs another redd. The clean gravel from the second nest is washed down and covers the eggs deposited during the first shedding. They repeat this process in separate redds until all eggs have been laid. A female chinook deposits between 3,000 - 8,000 eggs. Salmon die within days of spawning. As their bodies decay, they contribute nutrients to the stream from which they originated, which completes their life cycle.



☑ See Backgrounder brochures entitled The Magnificent Journey and The World's Biggest Fish Story: The Columbia River's Salmon for additional information on salmon. They are located at the end of Day One teacher notes section.

PROCEDURE:

1. In this activity, each student will construct a Pacific Salmon Life Cycle hexaflexagon.
2. Using the Journey of the *Oncorhynchus* mural/poster, instructors should introduce the Pacific salmon life cycle using the center portion of the mural.
   See background information preceding this section.
3. In order to construct the hexaflexagon, instructors will need to demonstrate the scoring technique necessary to make folding possible. It is important that students score directly on the hexaflexagon lines (use the blunt side of a scissors and a ruler).
4. See the instructions printed on the hexaflexagon for details. A copy of the Pacific Salmon Life Cycle Hexaflexagon is located at the end of Day One teacher notes section.

CONCLUSION:

Instructors should use the completed hexaflexagon to review the Pacific salmon life cycle. Discuss the important stages represented on each side (or turn) of the hexaflexagon.

ACTIVITY 1-4: **KINGFISHERS, SMOLT, AND CADDISFLY LARVAE**

SCIENCE CONCEPTS/PROCESSES: Change, Organism, Observation, Hypothesize, Discussion

OBJECTIVE (s): After completing the activity, students will be able to:

- understand the components of a food chain and food web.

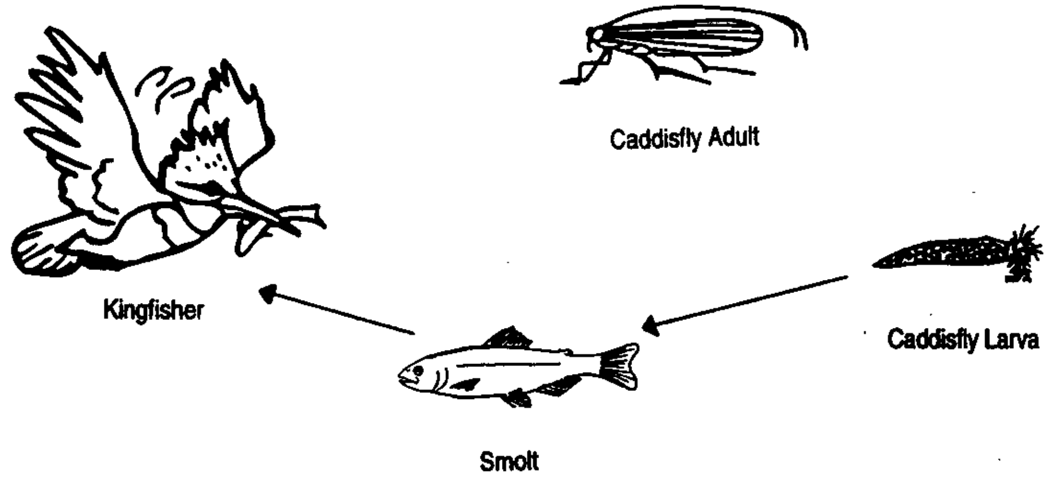
MATERIALS:	whistle, stopwatch, and two 40 foot ropes

BACKGROUND INFORMATION:

A food chain is a direct succession of consumers in a feeding hierarchy, with higher organisms feeding on lower ones. A food web is a complex association of food chains (see Activity 4-4: Connections).

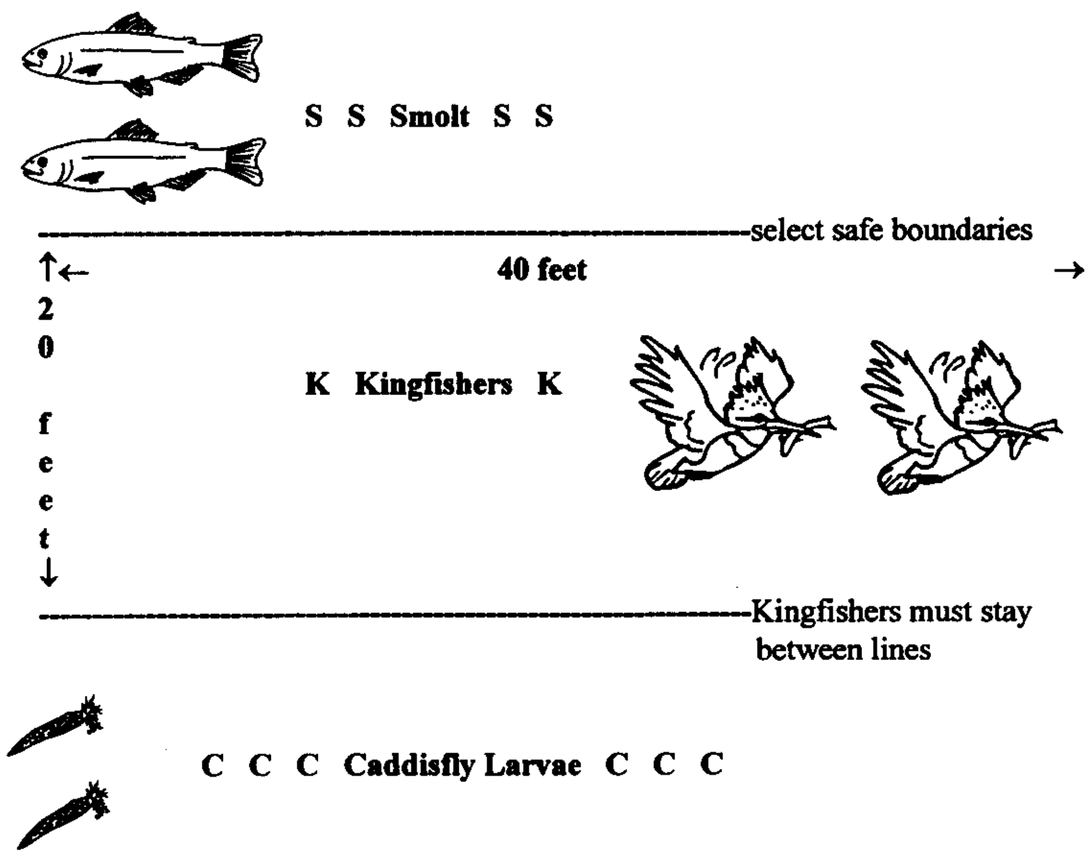
The Belted Kingfisher is the most common kingfisher in North America. Kingfishers are seen singularly or in pairs along streams and ponds. They are large-headed, short-tailed birds that dive for fish, which they catch with their long sharp beaks. They perch motionless in the open, over water and often hover before diving. Females usually lay between 3-8 white eggs in a deep burrow in a steep bank.

Caddisflies have hard-shelled head capsules. In some species, this same hard material makes up the first three segments of the body. The rest of the body is soft and often cylindrical. The larvae possess two small hooks on the last segment. Some species make a case out of silk, sand grains, pebbles, or bits of plant matter to protect their soft bodies. Caddisflies undergo complete metamorphosis and the larvae transform into winged adults in the water. As adult, caddisflies only live a few days and do not eat at all.



PROCEDURE:

1. In this activity, students will learn about food chains and food webs. A change in any part of the food chain affects all other parts of the food web.
2. This activity is best done outside in a large open area. Mark boundaries for the smolt area and the caddisfly larvae area with a rope or string. (See diagram below.) The kingfishers will catch their prey between these two boundaries. The smolt will have to cross the kingfishers area in order to catch their prey, the caddisfly larvae. Each predator must catch their prey by using both hands, tagging isn't enough.



3. Divide a class of 40 students into two groups of 20. Next, have each group subdivide into of 6 smolt, 3 kingfishers, and 11 caddisfly larvae. Set a time limit of 2-3 minutes.
4. Explain how the game works. Emphasize boundary limitations and rules of the game. At the blow of the whistle, the smolt swim to catch a caddisfly larvae and bring it back to their home. Meanwhile, the kingfishers are trying to catch the smolt. If a smolt gets a caddisfly larva back to his/her home without being eaten by a kingfisher, then the caddisfly larva becomes a smolt. If a kingfisher catches <u>both</u> a smolt and a caddisfly larva together, the larva goes back to its home and the smolt becomes a kingfisher.

5. Blow the whistle after 2-3 minutes and count how many there are of each animal. Let each 2-3 minute time period represent a day. Record the number of each animal at the end of each "day." Play the game for about 20 minutes. You may want to discuss the results following each trial or after the game is completed.
6. If you want to focus on the marine part of the salmon's journey, the kingfisher, smolt, and caddisfly larvae food chain can be substituted with the seal, salmon, and krill food chain.

CONCLUSION:

If the kingfishers are too successful, then all the smolt and caddisfly larvae become kingfishers and there is nothing left to eat. If the smolt are too successful, then they eat all the caddisfly larvae and the caddisfly larvae become smolt and again there is nothing to eat.

After the game is over, have the students form a circle and discuss the implications of what they have been doing:

1. How important is it to have enough food to eat?
2. What happens if there are not enough predators (kingfishers)?
3. What happens if there are too many smolt? Too few?
4. Do we need kingfishers, smolt and caddisfly larvae to keep everything in balance? Why?

Journey of the *Oncorhynchus*
A Story of the Pacific Northwest Salmon

Teacher's Guide to Storybook

DAY ONE

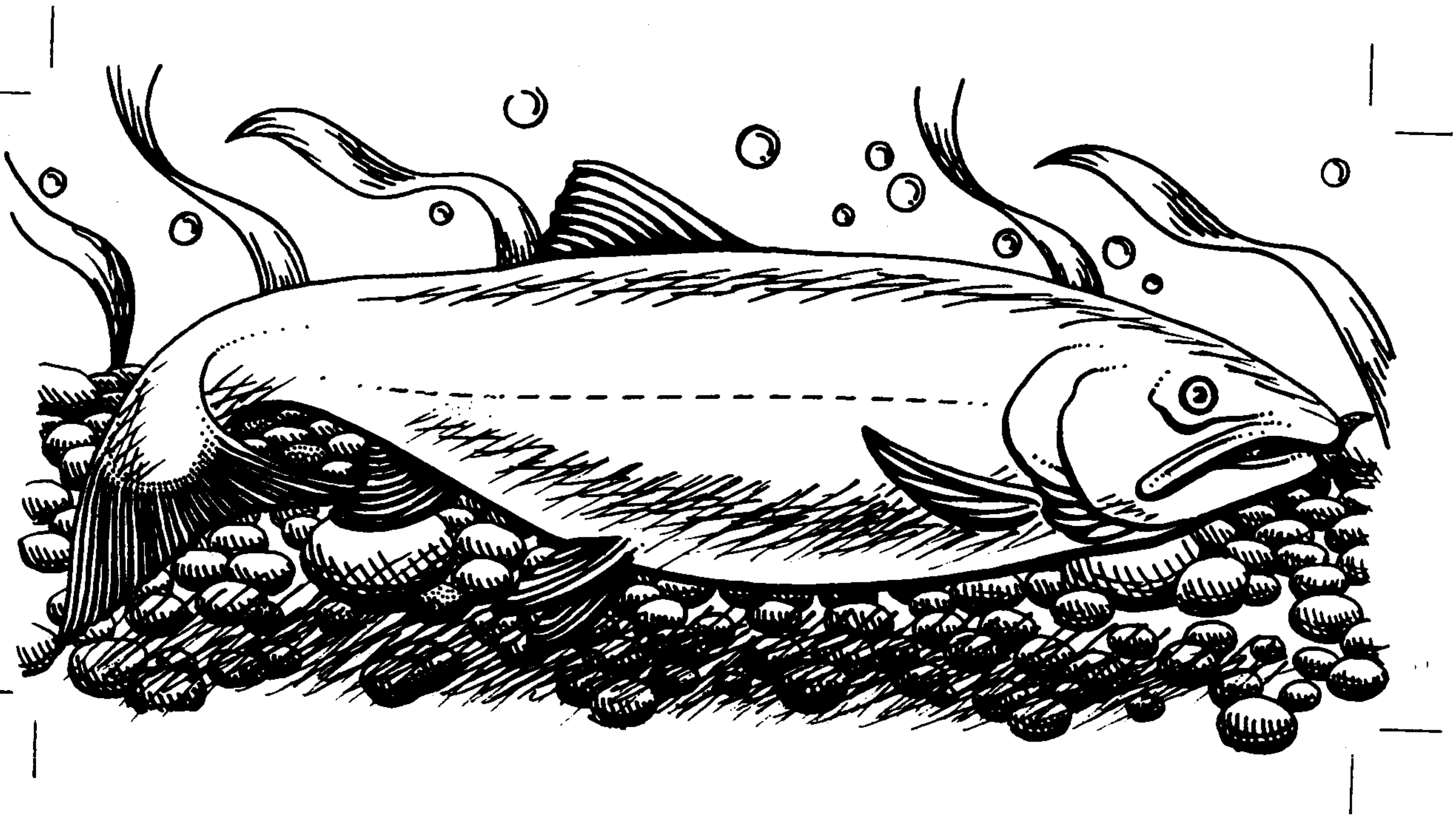
It's December. Clouds brush against the tip of Mount Hood, 50 miles east of Portland, Oregon. As snow falls on the mountaintop, a gentle rain falls on a small stream low on the mountain's northeast slope. Several drops hit the arching blades of grass shading a shallow pool at the edge of the stream. One hangs at the tip, lingers for a moment then pulls itself into a droplet we'll call "Hydroid."

From its perch, Hydroid has a close view of the world around it. Pine trees shrouded in mist tower overhead. Shrubs grow to the edge of the stream. Clumps of grass and branches hang over the water's edge. Several old logs lie in the stream, slowing its flow and creating pools. The water is shallow, only 12 inches deep. But it is cool and clear, even in the pools where the water is still. It's easy for Hydroid to see through to the gravel bottom. There's something different about the gravel below Hydroid, though. Each rock is placed just so. The rocks are arranged in a circle, about two feet in diameter. Hydroid looks more closely. Hidden among and under the rocks are smaller pebbles. These are red, round and about the size of peas. Hydroid starts counting them and comes close to 5,000 when something startling happens. Some pebbles have a pair of dark spots! Suddenly the pebbles come alive. One turns over and rolls out a tail. Hydroid realizes these aren't rocks, these are eggs. The dark spots are eyes. Each *eyed egg* is a fertile egg. And each *fertile egg* has a chance of becoming a fish – a salmon to be exact. Hydroid landed right over a fish nest. Fish nests are called *redds*. Hydroid knows the salmon in this small stream are all chinook. They also are called king salmon, because, one day they could grow as long as four feet to be the largest of all salmon.

But now, the tiny fish are a little more than one inch long. They are called *alevins*. Each has an orange pouch on its belly. The pouch is a yolk sac that provides food during the first few weeks of the salmon's life. The alevins stay deep in the gravel, hiding from ducks, raccoons and the large fish that prowl the stream, searching for food. Hydroid decides to linger on the grass blade, watching over the young chinook.

Late one night in March, the young fish slip up through the gravel. The yolk sacs are gone. The young fish, now called *fry*, are hungry and ready to eat, but do not stray far from the clump of grass where Hydroid is perched. Their eyes are bugged out, so they are sensitive to light. They have no marks on their bodies to hide them from their enemies. They stay in the shade for two months, grabbing mosquito larvae and other small insects as they drift by.

SALMON NAME TAG



2-15

Reflections Sheet

(in the space provided, write or draw pictures about what you learned in camp today)

NAME: ______________________________ **DATE:** __________