Of People and Fish
Oregon 4-H Natural Science and Cultural Discovery Program
Author/Contributors Statement

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Introduction

Welcome to Of People and Fish, the Oregon 4-H Natural Science and Cultural Discovery Program. The goals of the Of People and Fish program are for youth and adults to understand the complex cultural and scientific history that has led to the “salmon crisis” and to become active citizens in the search for solutions within their communities.

Urban and rural communities have conflicting visions of how best to manage Oregon’s shared natural resources. The vision changes within communities, too. People whose jobs depend on the timber, fishing, or tourism industries might have differing opinions about solutions. People from different cultural backgrounds value salmon in different ways and for different reasons. Likewise, leaders of this program might find conflict arising among learners as they work through the activities. If this happens, it can be an opportunity to teach respect for differing points of view and to work toward consensus. In the search for solutions, all voices should be heard.

Salmon live in the rivers that run through Oregon’s largest metropolitan areas. The salmon are affected by land-use practices from the headwaters to the ocean. Watersheds connect urban and rural communities to each other and to the salmon. In keeping all these systems healthy for salmon, there are no easy answers. Using the information and skills presented in Of People and Fish, youth may become leaders in finding common ground for solutions leading to a better future for people and fish.

The Of People and Fish curriculum is designed as a school enrichment program for grades 4 through 8. This version of the curriculum may be used without the materials support kit. There are 10 kits, which include the videos, posters, publications, and materials listed for each Activity. The kits are available from the Oregon 4-H Education Center in Salem. To reserve a kit, contact the Oregon 4-H Education Center at (503) 371-7920.

To support school delivery, the units are keyed to current (as of April 2001) Oregon Department of Education Benchmarks for grades 5 (Level 2) and 8 (Level 3) in science, social science, and English. This program also may be used in traditional 4-H clubs and 4-H camp programs as a stand-alone project or as an enrichment component with the 4-H Wetland Wonders, marine science, or sportfishing curricula. For ease of reading, the word “leader” has been used throughout the text to represent teachers, club leaders, camp counselors, program assistants, and others who can present these activities to youth. Leaders will find the
information they need to lead these activities in the “Background” section of each Unit and in the Web-based articles from *A Snapshot of Salmon in Oregon*.

The *Of People and Fish* program is divided into seven units. These units are designed to be presented sequentially. Units 1 and 2 include five activities that introduce basic fish science and salmon natural history. Units 3 through 5 present six activities on our human history with salmon, including a look at Native American legends, the Lewis and Clark Expedition, and Euro-American settlement of the Oregon Territory. Unit 6 contains two activities that explore and compare early and current fishing technology. Unit 7 provides three activities for learners to examine the status of salmon in Oregon today. Learners will put this knowledge to use to educate their community by writing their own “Salmon Newspaper.”

Before leading each activity, the leader should read the “Background” section and review the materials list. Leaders also may wish to review the information in the Web-based *A Snapshot of Salmon in Oregon*. Support materials for an activity could include items from appendices I through IV.

Each activity has an accompanying journal page that the leader must photocopy for learners. The journal pages are in Appendix I. There is one generic journal page (page 62) to photocopy for learners’ writing in addition to the specific pages for each activity. Photocopy and give a copy of all the journal pages to each learner. Ask learners to buy a 1-inch-thick (minimum) three-ring binder to use for their *Of People and Fish* journal pages. The completed journal and Salmon Newspaper (Activity 7C) make up the final assessment portfolio for learners in school-based programs.

The “Resources” section of each Unit lists materials for the leader’s reference and are to be used at the leader’s discretion. The leader may find some of the publications to be controversial. No endorsement of any of these materials is implied. Materials are intended to stimulate ideas and to illustrate the complexity and wide range of opinions encompassed by the “salmon crisis.”

For some units, Web site references are provided. The leader should review the sites before asking learners to use them. No endorsement of any of the materials on these sites is implied.

The materials section for each Activity lists the Journal page(s) needed from Appendix I and any posters, videos, and equipment needed for learners to complete the Activity.
Youth participating in 4-H programs develop life skills while learning subject-matter content. *Of People and Fish* provides a variety of educational opportunities through which youth will learn information and practice skills. Using the Purdue University Four-Fold Youth Development Model, the following life skills are targeted in this program:

**Head**
- Utilizing Scientific Methods
- Processing Information
- Understanding Systems
- Solving Problems
- Learning to Learn
- Thinking Critically
- Planning and Organizing
- Achieving Goals
- Developing a Positive View of the Future

**Heart**
- Communicating
- Cooperating
- Resolving Conflicts
- Valuing Diversity
- Being Empathetic

**Hands**
- Developing a Sense of Purpose
- Being a Responsible Citizen
- Working in a Team
- Completing a Project/Task

**Health**
- Being Responsible
Unit 1: Fish Fundamentals

Background
Fish are vertebrates that live in water without breathing air from the atmosphere. Vertebrates are animals with a backbone. Fish are the oldest of all animals with a backbone.

Most fish are covered with scales or plates. The scales are covered with a slimy mucus that lubricates the fish’s body and protects it from infection. A fish’s scales get longer as it grows. This creates annual growth rings on the scales that can be used to estimate age.

Fins are thin membranes supported by bonelike rays. All fins are used for balance, and some have additional functions. The pectoral fins help a fish stay in one place or allow for lateral and vertical movements. The caudal fin provides the primary power that moves a fish through the water.

Fish absorb oxygen from the water through membranes on the gills. Water enters the fish’s mouth, passes over the gills, and exits the body at the gill opening. The delicate gill filaments are covered by a bony, protective flap called the operculum.

The lateral line runs lengthwise down each side of a fish. It’s a system of openings or pores connected to sensory canals that are extremely sensitive to water currents and vibrations. In Activity 1A—Fish Function, learners study external fish anatomy and function.

Fish who live in fresh water and fish who live in salt water face different challenges in maintaining a proper balance of salts and water in their bodies. Ocean water has a higher concentration of salts than the blood of marine bony fishes. Ocean fish need mechanisms to remove excess salt from their bodies while maintaining their fluid levels. Marine fish move large quantities of water through their bodies. The excess salts are removed by the kidneys and by special cells in the gills.

A freshwater fish’s blood has a higher concentration of salts than the surrounding water. In fresh water, the process of osmosis draws water into the fish and removes salts from the body. To maintain balance, the specialized kidneys of freshwater fish pump out excess water as a dilute urine. Their gills contain salt-absorbing cells that move salt into the fish’s blood.
Salmon live in both salt water and fresh water at different times in their life cycles. Pacific salmon move between freshwater and saltwater environments, as juveniles migrating to the ocean and as adults returning to their natal stream. On these migrations, salmon pause in the estuaries of their parent watershed to allow time for the necessary physiological changes to occur.

Fish species have developed different body, fin, and tail shapes; mouth types; colors; and methods of reproduction that allow them to survive in different aquatic environments. A fish’s habitat includes the food it eats, where it finds shelter from predators, and the quality of the water it lives in. Some of the factors that affect water quality are temperature, level (amount) of dissolved oxygen, pH, and turbidity caused by sediment load (silt) and other particulates.

In addition to fish, many living things make up the stream habitat where salmon are born. To understand the interactions among the organisms that populate a stream, they can be arranged in a food chain. Any ecosystem is much more complicated than a single food chain or even a group of food chains—called a food web—can demonstrate. However, a food chain is a useful model for learners to begin to understand the interrelationships in ecosystems.

A stream food chain might seem to begin with phytoplankton or algae, which create energy through photosynthesis. However, these plants need nutrients too. Decomposers—bacteria and other microbes—break down dead plants and animals so they are recycled back into the aquatic system as nutrients. In salmon streams, the decomposing bodies of spawned-out salmon are crucial for returning nutrients to the ecosystem. These nutrients are important not only to the stream, but to the surrounding uplands as well.

In the stream food chain, small animals called zooplankton, which feed on phytoplankton, might come next. Salmon fry, which have absorbed their yolk sacs, feed on zooplankton. The salmon fry may be eaten by a variety of predators including trout, raccoons, and belted kingfishers.

Salmon are an example of how complicated ecosystem study can become. Pacific salmon do not spend their lives in the home stream of their birth. They live in the whole watershed, traveling down to the Pacific Ocean and then returning home to spawn. All the ecosystems within the watershed and the ocean affect salmon on their journey. In Activity 1B—What’s in a Stream? learners study some typical components of an upland stream ecosystem.
UNIT 1: FISH FUNDAMENTALS continued

Resources
- From the Web: A Snapshot of Salmon in Oregon (EM 8722), Oregon State University Extension Service, 1998. “One study found 22 kinds of birds, mammals feed on salmon carcasses”—eesc.oregonstate.edu/salmon/background/carcass.html
- Field Guide to Pacific Salmon

Activity 1A—Fish Function
In this activity, learners study external fish anatomy and function.

Materials
Ask learners to get a 1-inch-thick (minimum size) three-ring binder for their Of People and Fish journal pages, which they will receive throughout these lessons.
- One copy of the 1A—Fish Function journal page (Appendix I) for each learner
- Laminated poster: Pacific Salmon of North America (see Appendix III)

Procedure
Pass out a copy of the 1A—Fish Function journal page to each learner.

Using the information presented in the Background section and the Answer Box left, coach learners to label the parts of the fish, and explain the function of each part as they are labeled. Once all the parts are labeled, ask learners to match the parts to the list of functions provided.

Activity 1B—What’s in a Stream?
In this activity, learners study some typical components of an upland stream ecosystem.

Materials

Part 1: Stream Food Chain
- One copy of the 1B—What’s in a Stream? journal page (Appendix I) for each learner
- 1B—What’s in a Stream? answer key (Appendix I)

Part 2: Stream Web of Life
- One set of the Stream Web of Life Clue Cards (Appendix II)
- Two lengths of poly-rope

Answers: 1A—Fish Function Journal Pages
1. Adipose fin—E
2. Anal fin—G
3. Caudal fin—I
4. Dorsal fin—J
5. Gill opening—F
6. Lateral line—H
7. Operculum—A
8. Pectoral fin—D
9. Pelvic fin—B
10. Scales—C
Part 1: Stream Food Chain

Procedure
Pass out a copy of the 1B—What’s in a Stream? journal page to each learner. Using the information presented in the Background section, lead the learners to define a stream habitat. Coach them to think about what they have seen in a stream. What are some of the nonliving things that are part of the habitat found in a stream? Ask learners to list these on the four lines provided around the outside of the circle on the 1B—What’s in a Stream? journal page. Learners might list water quality characteristics such as the temperature or amount of oxygen, the amount of water, the types of stream bottom coverings such as boulders and gravel, and the logs and sticks that would make up other components of stream structure and provide pools and places for fish to hide.

In the center of the circle, ask learners to write down three to four components of a simple stream food chain. A food chain typically begins with a plant and then moves to an animal that eats that plant, followed by an animal that eats the first animal, and so on. Two examples of stream food chains follow.

(1) phytoplankton, (2) zooplankton, (3) juvenile salmon, (4) belted kingfisher
(1) algae, (2) snails, (3) crayfish, (4) raccoon

When learners have completed the journal page, discuss their answers. What other organisms might be added to create a stream food web?

Part 2: Stream Web of Life

Procedure
Copy the Stream Web of Life Clue Cards to make a set of 30 cards. For a group of fewer than 30 learners, remove some of the animal cards from the set. You must use all six of the Habitat Component Cards each time you demonstrate the activity.

Habitat Component Cards (6)
- Sun
- Salmon carcass
- Riffles/runs/gravel
- Woody debris
- Silt
- Water quality: temperature and oxygen
UNIT 1: FISH FUNDAMENTALS continued

Plant Cards (6)

- Phytoplankton
- Algae
- Duckweed
- Sedges
- Oak
- Alder

Animal Cards (18)

- Zooplankton
- Caddisfly larvae
- Mayfly larvae
- Stonefly larvae
- Snails
- Beetle
- Grasshoppers
- Juvenile salmon
- Tadpoles
- Crayfish
- Mallard duck
- Frog
- Ruffed grouse
- Raccoon
- Osprey
- Belted kingfisher
- Great blue heron
- Otter

Ask the learners to stand in a circle. Pass out one Stream Web of Life Clue Card to each learner. Have the six learners with Habitat Component Cards take two steps back from the main circle of learners. Position these six learners so they will be able to hold one of the lengths of poly-rope in a circle around the outside of the circle of learners. Have each of the learners with Habitat Component Cards read their cards aloud in turn as you pass the rope around the group. It is helpful to end with the Sun card, as it is the logical starting point of the next part of the activity.

Hand one end of the second length of rope to the learner with the Sun card. This learner will be holding a section of the first rope and the beginning of the second length of rope. Ask the Sun to hang on to the end of the second rope and pass the remaining coil to a learner with a Plant card. For example, Sun might pass the rope to the Phytoplankton.
The Phytoplankton reads its card to the group, then passes the rope on to one of the Habitat Components, Plants, or Animals listed on its card. Learners may pass the rope to any other learner who is not yet in the web. They may pass the rope to something they eat or use or to something that eats or uses them.

Each learner continues to hang onto his or her section of rope until all learners are holding a piece of rope and a web design has been created in the middle of the circle. Be sure the rope is passed across the circle to form a web, not just passed around. It is easiest for the leader to be in the center of the circle to facilitate this process.

Learners do not have to pass the rope to a plant or animal described on their card if they can explain a different interrelationship. For instance, crayfish would eat the salmon carcass.

Ask learners where people fit in the web. (People eat crayfish, frogs, and salmon.) What would happen to the web if there were suddenly no more insects? Ask learners who have Insect cards to drop their section of rope. What happens to the web? After the activity, collect all the cards and the two lengths of poly-rope.

References


Extend the learning

- *Project WILD Aquatic Education Activity Guide*, Fashion Fish; Fishy Who’s Who; Micro Odyssey.
Unit 2: Pacific Salmon Life Cycles

Background
There are nine species of salmonlike fish native to Oregon. Seven of these belong to the genus Oncorhynchus. One of them, the steelhead, was in the genus Salmo until 1989, when it was reclassified as the species Oncorhynchus mykiss.

For simplicity, this lesson presents information on four species: the steelhead, sockeye, coho, and chinook salmon. The illustrations presented on the Fish Chips and Salmon Identification Information handouts are males of these species.

The salmon we study in Of People and Fish are anadromous, which means “up running.” Salmon hatch in freshwater streams, migrate down their watershed to an estuary, then swim out to the ocean to mature. After 1 to several years in the ocean, they return through the estuary and swim upriver to their birth stream to spawn. Sockeye, coho, and chinook salmon are semelparous, which means they die after spawning. Steelhead may spawn more than once.

Spawning
When it’s time to spawn, salmon return to the stream of their birth, called the natal stream. Adult salmon change color and body form as they migrate upstream into fresh water. When a female salmon arrives at her natal stream, she selects a suitable nest site with the correct combination of stream velocity, water depth, and gravel size. She digs a nest with her tail in the gravel. Male salmon are attracted to the female’s digging. The female deposits thousands of eggs in the nest and the male fertilizes them by releasing a cloud of milt containing sperm. The female then covers the nest with gravel to protect the developing eggs. She will repeat this process several times, creating a group of nests called a redd. With the exception of the steelhead, adult salmon in the genus Oncorhynchus die shortly after spawning. The decomposing carcasses of the adults provide essential food and nutrients for numerous stream creatures including the juvenile salmon.

Development in the nest
As the eggs develop, the salmon embryos become visible, with the eyes appearing as dark spots. This stage is called the eyed egg. In late winter or early spring, the salmon hatch and are called alevins or sac fry. They are very fragile at this point and remain hidden in the gravel until the yolk sac is absorbed.
While the eggs and alevins are developing, they need adequate water flowing through the nest to bring in oxygen and remove waste products. The temperature of the water must stay between 40 and 65°F. Low water levels or removal of plants along a stream bank can cause higher water temperatures and reduced oxygen levels. Of the thousands of eggs in each nest, 85 percent will die before reaching the fry stage.

**Fry**
At about 1 inch in length, the salmon emerge from the redd and begin life as fry. They feed constantly, consuming zooplankton and bits of decomposing fish material from the adults. The juvenile salmon remain in their natal stream from a few weeks to 2 years, depending on their species. At 3 to 4 inches they are called fingerlings or parr, for the dark vertical parr stripes that develop along their sides. The parr marks help hide them from predators.

**Smolts**
When the salmon are 4 to 6 inches long, they are ready to begin their migration to the estuary. The small fish now are called smolts. They ride the stream’s current downstream, tail first, with their heads pointed upstream. Water flow and currents are critical to support and guide their migration.

In the estuary, the smolts adapt to salt water. This requires internal physiological changes (see Unit 1). Also, the smolts’ color changes: the parr marks disappear, and the fish become silvery with darker colors above and light colors below. This coloring, called countershading, makes the fish less visible to ocean predators. When these changes are completed, the smolts migrate to the open ocean.

**Ocean rearing**
Once in the ocean, their life and activities are less well known. Some stay close to shore, while others travel thousands of miles into the north Pacific. Depending on species, the adult salmon return to their natal stream after 1 to 5 years in the ocean. How salmon accomplish this remains unclear. It’s believed that salmon sense, or “smell,” the subtle changes in water chemistry between the streams of different watersheds. Once back at the spawning beds, the cycle starts over as a new generation begins.

In Activity 2A—Salmon Vocabulary, learners view a video on the life cycle of salmon and use the new vocabulary words to complete a crossword puzzle. In Activity 2B—Pacific Salmon Life Cycles, learners view preserved samples of salmon eggs, alevin, and fry and study specific life-cycle differences among the chinook, coho, and sockeye salmon and the steelhead (see the Salmon Identification Information sheets, Appendix II).
Activity 2C—Salmon Styles, learners use the information on the Salmon Information Sheets to create a dichotomous key to these four salmon species.

Resources
- *Salmon Nation*, page 45, “The Six Species of Salmon Nation” (see Appendix III)
- *Field Guide to Pacific Salmon* (see Appendix III)
- Pamphlet: “Salmon of the Pacific Coast” (see Appendix III)

From the Web:
  - “Salmon have lived here for millions of years”—
    [eesc.oregonstate.edu/salmon/background/million.html](http://eesc.oregonstate.edu/salmon/background/million.html)
  - “Oregon has nine salmon-like fish”—
    [eesc.oregonstate.edu/salmon/background/types.html](http://eesc.oregonstate.edu/salmon/background/types.html)
  - “Status of Oregon’s Pacific salmon under the Endangered Species Act”—
    [eesc.oregonstate.edu/salmon/background/status.html](http://eesc.oregonstate.edu/salmon/background/status.html)
  - “Many have vanished; others are in jeopardy”—
    [eesc.oregonstate.edu/salmon/background/vanished.html](http://eesc.oregonstate.edu/salmon/background/vanished.html)
  - “Dams”—
    [eesc.oregonstate.edu/salmon/human/dams.html](http://eesc.oregonstate.edu/salmon/human/dams.html)
  - “Estuaries”—
    [eesc.oregonstate.edu/salmon/human/estuaries.html](http://eesc.oregonstate.edu/salmon/human/estuaries.html)

- Bonneville Power Administration, Teachers Resources

- Salmon Biology
  [www.4sos.org/wssupport/ws_rest/salmbio.asp](http://www.4sos.org/wssupport/ws_rest/salmbio.asp)

- National Marine Fisheries—West Coast Salmon
  [http://www.nwr.noaa.gov/1salmon/salmesa/index.htm](http://www.nwr.noaa.gov/1salmon/salmesa/index.htm)

Activity 2A—Salmon Vocabulary
In this activity, learners view a video on the life cycle of salmon and use the new vocabulary words to complete a crossword puzzle.

Materials

**Part 1: Salmon Watersheds**
- ☐ Supply of old newspapers
- ☐ One white (not clear or black) plastic garbage bag
- ☐ Small cup of loose soil
- ☐ Water spray bottle, labeled “cloud”
UNIT 2: PACIFIC SALMON LIFE CYCLES continued

Part 2: Salmon Crossword Puzzle

- One copy of 2A—Salmon Crossword Puzzle (Appendix I) for each learner
- Salmon Crossword Puzzle answer key (Appendix I)
- Salmon Life Cycle poster (see Appendix III)
- Video: Life Cycle of Salmon (5:30 minutes) (see Appendix III)

Part 1: Salmon Watersheds

Preparation
It’s best to do this activity outside. To make the demonstration watershed, crumple several sheets of newspaper into loose balls. Place the crumpled newspaper sheets on the ground in close proximity to each other. Carefully spread the white plastic garbage bag over the newspaper, tucking it over the irregular surfaces. The lumps and bumps of the crumpled newspaper will create the hills and valleys of one or more watersheds. Adjust the paper under the bag to ensure that all the valleys drain off the bag. Any interior pockets that develop should eventually drain, as a lake does, when filled.

In the demonstration, you will use the “cloud” spray bottle to “rain” on the watershed. You might want to test this prior to the demonstration to determine how the water will flow off the plastic bag.

Procedure
Explain to learners that you will be using a model to demonstrate the streams and rivers of a watershed. “Watershed” is an important salmon word. Salmon live in watersheds from their natal streams to the ocean. Learners will see how salmon use different parts of the watershed at different stages of their lives in the video in Part 2.

Ask learners what they know about watersheds.
- Can they define what a watershed is? (A watershed is the land area drained by a stream or river. A series of small watersheds makes up the watershed of large rivers such as the Willamette and Columbia.)
- How much land is in a watershed? (The boundaries of the watershed divide the direction the water flows to reach a stream or river. All the land inside these divides makes up the watershed. The size of each watershed is determined by landform boundaries.)
- Where is the nearest watershed? (We are always in a watershed, but we might not always realize which watershed. Learners should be able to name a stream or river near their home or school.)
Spray some water on the model watershed and have learners notice how it flows. Learners can use what they see on the model to help them answer the following watershed questions.

Sprinkle some soil on the watershed model. “Rain” on the watershed again.
■ What happens?
■ Where have learners seen soil being washed into surface water and carried away?
■ Where does the soil go when it goes “away”?
■ What animals and plants in a stream might be affected by this soil?

Part 2: Salmon Crossword Puzzle

Procedure
Introduce learners to the vocabulary words on the puzzle as you lead a discussion of the life cycle of salmon.

As they watch the video, ask learners to listen for the answers to these questions:
■ What type of water do salmon fry need? (Cold, clean water that brings in oxygen and removes waste products.)
■ What is smolting? (Internal changes that take place to allow the salmon to transition from fresh water to salt water. Their external colors change. They become dark on the top half and light-colored on the lower half. Smolting is triggered by a rise in water temperature.)
■ What is an estuary? (The lower part of a watershed where fresh and salt water are mixed.)
■ What happens to the salmon’s carcass when it dies? (It provides food for the forest and aquatic environment.)

After learners view the video, discuss the answers to the questions above and then ask them to complete 2A—Salmon Crossword Puzzle. If the learners need more practice using the words before completing the puzzle, conduct Activity 2B—Pacific Salmon Life Cycles, and then return to the puzzle as the final assessment.

Extend the learning
■ 4-H Wetland Wonders (4-H 3801L), Watersheds, Where does it rain in Oregon?; Water Words; The Water Cycle; Oregon State University Extension Service.
■ Project WILD Aquatic Education Activity Guide, Hooks and Ladders
Activity 2B—Pacific Salmon Life Cycles

In this activity, learners study samples of preserved salmon eggs, alevin, and fry and the specific life-cycle differences among chinook, coho, sockeye, and steelhead.

Materials
- One copy of 2B—Salmon Life Cycle Basics journal page and 2B—Pacific Salmon Life Cycles journal page (both in Appendix I) for each learner
- Salmon Life Cycle poster (see Appendix III)
- Vials of preserved salmon eggs, alevins, and fry
- 18 hand lenses, 3 for each of 6 teams
- Six 6- by 8-inch mini-aquaria, one for each team, to hold the vials and hand lenses
- Six copies of the pamphlet Salmon of the Pacific Coast (see Appendix III)

Preparation
Whenever it best supports the learning throughout the Of People and Fish activities, the leader is asked to divide the group into six research teams. (With a class of 30 students, there would be 5 learners in each team. Thus, for most of the activities, the materials list is for six teams of five learners each.)

Assign learners to a research team. Each team will continue to work together throughout the Of People and Fish activities.

Divide the 18 vials of preserved salmon eggs, alevin, and fry into six sets of three vials for each research team. Leaders can use the mini-aquaria to hold each set of vials and hand lenses to make it easier to pass them out to teams.

Please be sure that the learners understand they must handle the vials with care, and that they must not open them. Do not leave the vials in the light for any length of time. This will cause the colors to fade.

Procedure
Arrange the learners into six research teams. Pass out one copy each of 2B—Salmon Life Cycle Basics and Pacific Salmon Life Cycles journal pages to each learner. Pass out a set of vials, three hand lenses, and one copy of Salmon of the Pacific Coast to each team.

Using the information provided in the Background, lead a discussion of what learners know about salmon. Ask learners how many different species of salmon there are in Oregon. (At
one time, scientists believed there were 50 or more species, subspecies, or races of Pacific salmon.) Explain that we will be studying the sockeye, coho, chinook, and steelhead salmon in these activities. Ask learners to open the pamphlet to the inside poster of The Pacific Salmon Life Cycle. Ask the learners to examine the vials and arrange them on the poster in the order in which the salmon developed. Remind learners not to open the vials.

When each team has finished arranging the vials, lead a discussion about how the fish are different at each stage. The alevin stage is sometimes called a sac fry. Why? As the yolk sac is absorbed, all that remains on the belly is a slit that resembles a button hole. At this stage they are sometimes called “button-up” fry. Can learners see a button on any of the preserved fry?

The darker blue boxes on the poster list Challenges to salmon survival. Read aloud the information in the Challenges boxes to learners. What can they do to help salmon with any of these hazards? After the discussion, collect the vials and other supplies before continuing with the activity.

One of the reasons scientists have trouble agreeing on the identification of salmon species is that each species spends a different amount of time in each part of its life cycle. To complicate matters more, some races of some species travel to the ocean in odd-numbered years and rarely interbreed with those who migrate in even-numbered years. Others may never travel to the ocean at all. For example, the kokanee salmon is a sockeye salmon that lives and completes its life cycle in lakes.

Have learners complete 2B—Salmon Life Cycle Basics journal page to help them recognize how the sockeye, coho, chinook,
and steelhead life cycles are different and how they are similar. Work with learners to fill in the blanks on the journal page.

**Extend the learning**

- *Our Water World 4-H Marine Science Discovery Project*  
  (4-H 350L), Gallon Ocean; The Density of Sea Water; Oregon State University Extension Service.

**Activity 2C—Salmon Styles**

In this activity, learners study the creation and use of dichotomous keys.

**Materials**

- One copy of the 2C—Salmon Styles journal page (Appendix I)
- Six Pasta Packs—Self-sealing bags with five varieties of dry pasta in each (elbow macaroni, rigatoni, spaghetti, spirals, and bow noodles), one for each team
- Fish Chips—Make one set of four fish each for each team (Appendix II).
- Six Salmon Identification Information handouts (Appendix II), one for each team

**FYI—Dichotomous keys**

Scientists use tools called *dichotomous keys* to help them identify plants and animals. These keys are made up of a series of questions about the characteristics of the plant or animal being identified. Each question has two answer choices. By following the steps through the key, the things being studied are sorted down to the smallest group, generally the species.

See “The Evolving Salmon,” in *Field Guide to Pacific Salmon*, for information on the complexity of classifying salmon (for example, female salmon often look more like females of other salmon species than like the males of their own species). We will simplify the process for the purposes of these lessons by creating a model key to pasta, then studying characteristics of male chinook, coho, sockeye, and steelhead salmon.

**Procedure**

Arrange the learners into their six research teams. Pass out a copy of 2C—Salmon Styles journal page to each learner. Give each team one Pasta Pack. Work with the learners to complete the Pasta Key.

Pass out one set of four Fish Chips and one Salmon Identification Information handout to each team. Read the information about each of the salmon presented to learners. Work with learners to complete the salmon key. Remind learners to put
their Salmon Key in their journal. They will use the keys again in Activity 5B—Salmon Hazards, Salmon Helpers.

After completing the activity, collect all the materials and reusable handouts.

**Extend the learning**

- Hatch some fish eggs with the learners. For assistance, contact the Oregon Department of Fish and Wildlife Salmon-Trout Enhancement Program at (503) 872-5252, www.dfw.state.or.us

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**Answers: 2C—Salmon Styles journal page**

**Pasta Key**

2a—elbow macaroni  
2b—rigatoni  
3a—spaghetti  
4a—spirals  
4b—bow noodles  
   A not-hollow, wide, not-round pasta shaped like a bow.

**Salmon Key**

1a—steelhead  
2a—chinook  
3a—only on upper lobe  
3b—sockeye
Unit 3: Native American Salmon Life Ways and Legends

Background
All people have the same basic needs for survival. The most basic include the need for food, water, and shelter. Humans also communicate through language, art, and music, and they seek explanations of their world. How these common human needs are met and passed down through generations in a group is called culture.

People require extensive understanding, knowledge, and skills to adapt to the environments and circumstances in which they live and practice their culture. The many different ways in which cultures have developed and changed to meet basic human needs result in the world’s rich cultural diversity. Cultures with less sophisticated forms of technology frequently are portrayed as simple and the people of that culture as naive. When scientifically studying other cultures, it’s necessary to withhold value judgments. One culture is neither better nor worse than another, just different.

The legends in this unit are from *Indian Legends of the Pacific Northwest* by Ella E. Clark (© 1953 The Regents of the University of California; © renewed 1981 Ella E. Clark). They are from tribal groups that developed many cultures over the approximately 13,000 years they lived in the Pacific Northwest. Without a written language, legends were a way for tribal leaders to teach their culture to the next generation. They preserved the group’s history, traditions, ethics, religion, and laws. The tribal groups whose legends are included in this unit are the Kalapuya, Chinook, Wishram, and a mixture of mid-Columbia River-area tribes.

Indians tell legends to their young people for the same reason we tell similar stories—to explain a view of the world (explanatory), to teach acceptable behaviors (behavioral), and to demonstrate important moral concepts such as sharing and respect for each other and for nature.

Oregon Benchmarks

Geography
Level 2
- Identify patterns of migration and cultural interaction in the United States.
Level 3
- Identify and understand worldwide patterns of population distribution, migration, and cultural diffusion and interactions.

Reading
- Extend and deepen comprehension by relating text to other texts, experiences, issues, and events.
Level 2
- Analyze and evaluate information and form conclusions.
Level 3
- Analyze and evaluate whether a conclusion is validated by the evidence in a selection.

Writing
Level 2
- Convey clear main ideas and supporting details in ways appropriate to topic, audience, and purpose.
Level 3
- Convey clear, focused main ideas supported by details and examples in ways appropriate to topic, audience, and purpose.

Objectives
Learners will be able to:
- List some characteristics that contribute to the culture of a group of people.
- Explain the importance of salmon to Native American tribes in Oregon and Washington.
UNIT 3: NATIVE AMERICAN SALMON LIFE WAYS AND LEGENDS continued

Resources
  “The Native American fishery”—eesc.oregonstate.edu/salmon/human/natam.html
- Salmon Nation, “Recalling Celilo” page 13, a version of the first salmon ceremony (see Appendix III)

Activity 3A—Discovering Culture
In this activity, learners study the characteristics that contribute to the culture of a group of people.

Materials
- One copy of the 3A—Discovering Culture journal page (Appendix I) for each learner
- Six copies of the legend “Why the Columbia Sparkles” (page 24), one for each team

Procedure
Using the information provided in the Background section, lead a discussion of the components of culture. Ask learners, “What do you need to have in order to live?” The learners’ list may include water, food, shelter, clothing, family, transportation, education, language, laws, and belief systems. The list should not include a TV or computer! Now ask whether this list was different in the past or will be different in the future. Ask learners, “What did your grandparents need to have to live?”; “What will humans need in the future wherever they live?”

Arrange the learners in their six research teams. Pass out copies of the legend “Why the Columbia Sparkles,” one to each team, and the 3A—Discovering Culture journal page, one copy to each learner. Read the legend to the group. Ask the teams to work together to answer the questions on the journal page.

Answers: 3A—Discovering Culture journal page
1) The sky world looked just like “this one” (Earth) with grass and flowers.
2) Berries, salmon
3) Salmon was dried to preserve it.
4) The Wishram could get foods they did not have or things they could not make by trading dry salmon.
5) The cup produced a spring of cold water and was a symbol of the Wasco people’s traditional use of that area of land.
6) The Wasco were jealous of the good luck the star rock brought to the Wishram.
Reference

Activity 3B—Salmon Legends
In this activity, learners study several legends and discuss what they tell us about the importance of salmon to Northwest Indian cultures.

Materials
- One copy of 3B—Salmon Legends journal page (Appendix I)
- Copies of the legends “Why the Columbia Sparkles,” “The Origin of Willamette Falls,” “The Origin of the Chinook Indians,” and “How Coyote Helped the People” (pages 24–27); one each for each team

FYI
Four legends are provided. To simplify this activity for younger learners, the leader may wish to use only two of the legends.

Procedure
Read the legends with the learners. Lead a discussion about each of the legends. In each one, salmon is the food that was the cure for hunger. Ask learners how the salmon are caught in each legend. Two of the legends, “The Origin of Willamette Falls” and “How Coyote Helped the People,” include the character Coyote. How is Coyote important in these legends? In some legends, Coyote is a trickster, portrayed both as intelligent and scheming, but not always wishing to help others. How does modern culture view coyotes?

Ask learners to identify how each of the legends is teaching explanatory, behavioral, and/or moral lessons. Learners should understand the difference between these elements in the legends. They will be asked to identify these elements in the legend they choose to write about.

For example, in the legend “Why the Columbia Sparkles,” all the elements are present.
- Explanatory—The star rock brought the salmon.
- Behavioral—The Wasco were jealous of the Wishram.
- Moral—What happens when the Wishram man guarding the star falls asleep?

After discussing the legends, pass out a copy of the 3B—Salmon Legends journal page to each learner. Ask them to complete the writing activity. It may be appropriate to ask learners to do additional research to complete this activity.
Why the Columbia Sparkles

Five stars once came down from the sky and slept beside the (Columbia) River, near The Dalles. Next morning, four of them rose into the air and took four sisters back to the sky with them. When the sisters got to the place where the stars live, they saw that the sky world is just like this one, with grass and flowers.

The oldest of the five stars did not go back with the others, because he was still tired from the long journey. He remained lying there on the ground by the river, but he changed himself into a white flint rock, very large and thick and round and bright. It shone so brilliantly that it could be seen from a long distance.

It became a good-luck rock for the Wishram people who lived near it. The star rock brought many salmon up the river, enough for the Wishram to dry for their own use and also to trade with the people who came to the Narrows and to the big falls (Celilo Falls) on the river. The place where the rock lay was a great gathering place for many tribes. Everyone knew the star. The Wishram became known as the Star people.

Across the river on the south side lived the Wasco people. They did not have a star, but they did have a big cup. Wasco means “those that have the cup.” Near their main village was a rock the shape of a big cup. Into it bubbled a spring of pure, cold water. The Wasco people prized the cup very highly.

The Wasco, who were always quarreling and fighting with their neighbors, became jealous of the good luck the bright star was bringing the Wishram. One night when the Wishram people were away, some of the Wasco people crossed the river and stole the star. They wrapped it in an elk skin and threw it in the river.

When the Wishram returned from picking berries, they could not find the star. Months later, when the water of the river was low, some people of the Wishram village saw it shining on the bottom. They got it and put it back on shore. Always thereafter, someone guarded the star. But three summers later, when the Wishram were again in the Mount Adams country picking berries, Wasco men found the guard asleep one day and stole the star once more. This time they broke it into pieces and threw it into the river.

When the Wishram came back to their winter village, the star rock was gone. Angrily they crossed the river and made war on the Wasco. Some of the young men pounded the big cup until they almost destroyed it. It had been very large and deep. It was now very small.

After the star was stolen and broken, the Wishram lost the name Star people and became very common people. But the broken star rock is still in the river. That is why the water sparkles in the sunshine.

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The Origin of Willamette Falls

Willamette Falls is a few miles upstream from the mouth of the Willamette River in an area now called Oregon City. The Willamette River once dropped 42 feet at this spot, making it an ideal place for Indians to fish with spears and nets. Several thousand Indians used to gather at Willamette Falls annually to catch and cure salmon for their winter supply. Now, most of the water is impounded to furnish electricity. This story was told to Professor H.S. Lyman by Louis Labonte, whose father was a member of the Astor expedition of 1811 and whose mother was the daughter of Chief Kobayway, a Clatsop. Mr. Labonte first heard the story in 1834.

When Coyote came to the Willamette Valley, he found the people cold and hungry and weak. Coyote had been along the coast, teaching the people there.

The Willamette River was full of salmon, but the people could not catch them. Coyote decided to make a tum-tum or waterfall, so that the fish could come to the surface. He began to work at one place but did not like it, so he left. A gravel bar shows where he began to work. Then he went to Rock Island and began to make a tum-tum there. But he did not like that place so he left it, too. The rapids show where he began to work.

The third place he chose he liked. There he made a tum-tum—the falls of the Willamette. There the salmon come to the surface when they try to leap over the falls. There Coyote taught the people how to spear salmon.

“But now I will make a salmon trap,” said Coyote.

So he set to work to make a salmon trap, there beside the tum-tum. It was to be a special trap, which would say “Noseepsk” when it was full. Coyote set the new trap near the falls and began to make a fire. He rubbed the fire sticks together, but before he had finished, Trap called, “Noseepsk.”

It was already full of salmon. Coyote emptied it, set Trap again by the falls, and began to rub the fire sticks together. But before he could make fire, Trap called a second time, “Noseepsk! Noseepsk!”

This time Coyote was angry. He was hungry, but Trap would not give him time to make fire. He said to Trap, “Don’t call so soon. Can’t you wait until I build a fire and get some salmon cooking?”

Then Trap was angry. He refused to catch any more fish. So the people had to spear the salmon at the falls of the Willamette.

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The Origin of the Chinook Indians

Long, long ago, when Old Man South Wind was traveling north, he met an old woman who was a giant.

“Will you give me some food?” asked South Wind. “I am hungry.”

“I have no food,” answered the giantess, “but here is a net. You can catch some fish for yourself if you wish.”

So Old Man South Wind dragged the net down to the ocean and with it caught a little whale. Taking out his knife, he was about to cut the whale and take out the blubber.

But the old giantess cried out, “Do not cut it with a knife, and do not cut it crossways. Take a sharp knife and split it down the back.”

But South Wind did not take to heart what the old woman was saying. He cut the fish crossways and began to take off some blubber. He was startled to see the fish change into a huge bird. It was so big that when it flew into the air, it hid the sun, and the noise of its wings shook the earth. It was Thunderbird.

Thunderbird flew north and lit on the top of Saddleback Mountain, near the mouth of the Columbia River. There it laid a nest full of eggs. The old giantess followed the bird until she found its nest. She broke one egg, but it was not good. So she threw it down the mountainside. Before the egg reached the valley, it became an Indian.

The old giantess broke some other eggs, and then threw them down the mountainside. They too became Indians. Each of Thunderbird’s eggs became an Indian.

When Thunderbird came back and found its eggs gone, it went to South Wind. Together they tried to find the old giantess, to get revenge on her. But they never found her, although they traveled north together every year.

That is how the Chinook were created. And that is why Indians never cut the first salmon across the back. They know that should they cut the fish the wrong way, the salmon would cease to run. Always, even to this day, they slit the first salmon down the back, lengthwise.

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How Coyote Helped the People

This is a composite of many tales related by many tribes that once lived along the Columbia River and its tributaries. For the sake of a unified story, the author has taken the liberty of weaving together many traditions from several sources. No one tribe told about all these deeds of Coyote.

After Old-One had made the earth and the ancient animal people, he sent Coyote among them, because they were very ignorant and were having a hard time. Coyote was told to kill the evil beings who preyed upon them and to teach them the best way of doing things.

First, Coyote broke down the dam which five Beaver women had built in the lower Columbia.

“It is not right,” he said to them, “for you to keep the salmon penned up here. The people further up river are hungry.”

Then he changed the Beaver women into sandpipers. “You shall forevermore be sandpipers,” he said. “You shall always run by the water’s edge. You shall never again have control over salmon.”

By this time, so many salmon had come up from the mouth of Big River that the water was dark with them. Coyote walked along the bank of the river, and the salmon followed him in the water. At all the villages, the animal people were glad to see him and the fish he brought. Their hunger was over.

When he came to the Little White Salmon River, he stopped and taught the people how to make a fish trap. He twisted young twigs of hazel brush and hung the trap in the river. Then he showed the people how to dry fish and how to store it for winter use. When he came to the bigger White Salmon River, he showed the people how to spear salmon. He made a spear from the inside bark of a white fir tree and caught the salmon with the pointed end of the spear.

“This is how you do it,” said Coyote.

Wherever he stopped, he showed the people how to cook fish. They had always eaten it raw. He showed them how to broil salmon holding it over the fire on sticks. And he showed them how to cook it in a pot hole. Along Big River, to this day, there is a round-bottomed hole in the rocks—a hole that people call Coyote’s Kettle. Coyote put salmon in that hole, poured a little water over it, dropped hot stones into the pothole, and covered everything with green grass to hold the steam. Thus the salmon was steamed until it was tender.

“This is how you should do it,” Coyote told the people.

Then he and the people had a big feast—a feast of salmon cooked in the proper way, the way he explained to them. Coyote said to the animal people along Big River and along all the streams that flow into it, “Every spring you must have a big feast like this to celebrate the coming of the salmon. Then you will thank the salmon spirits for guiding the fish up the streams to you, and your Salmon Chief will pray to those spirits to fill your fish traps. During the 5 days of the feast, you must not cut the salmon with a knife, and you will always have plenty of salmon to eat and to dry for winter.”

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The reports of Meriwether Lewis and William Clark following the completion of the journey of the Corps of Discovery began a massive westward migration. The new country was very big, and no one could imagine that all the resources would ever be used up. The common belief was that the resources should be put to use for the good of the individual and the growing United States.

Thomas Jefferson became the third President of the United States in 1801. He was an avid scientist who had long been interested in the further exploration of North America. Jefferson hired Meriwether Lewis to be his personal secretary and to begin planning for an expedition to explore the unknown western regions of North America. Congress funded the expedition in January 1803. With the conclusion of the Louisiana Purchase in April 1803, the urgency for the expedition increased.

Meriwether Lewis was a captain in the army when President Jefferson picked him to be his secretary. He was to be the commander and chief scientist on the expedition. He had learned botany and herbal remedies from his mother and studied zoology, celestial navigation, and medicine to prepare for the journey. Lewis recruited his army friend and former commander William Clark to share command of the expedition to the Pacific Ocean. Clark was an engineer, geographer, and surveyor, as well as a frontiersman with expertise in managing boats and dealing with Indians.

The expedition had three major objectives, which were outlined by President Jefferson in detail in a letter to Lewis dated June 20, 1803. In this letter, the President stated that the primary “...object of your mission is to explore the Missouri river...” and look for a water transportation route to the Pacific Ocean. Jefferson directed that detailed journals and maps were to be made. Of particular interest was the quick transportation of furs to avoid “...the circumnavigation now practiced.” Next, Lewis was to record detailed information about the native people of the nations through which they would pass. This information was to be used by “...those who endeavor to civilize and instruct them.” And, finally, scientific observations were to be recorded on the soil, geography, geology, climate, plants, and animals.
It would take nearly another year to prepare for the journey. On May 14, 1804, captains Lewis and Clark and the group now known as the Corps of Discovery set out up the Missouri River. They traveled up the Missouri until October, when they reached an area near present-day Bismarck, North Dakota. Here the weather forced them to stop for the winter.

The Corps built Fort Mandan near five villages of native people called the Mandan and Hidatsa. This was a large and important trading center on the Missouri River. The captains thought the villages held about 4,400 people. This was four times the number of Americans living in St. Louis at that time.

During the winter of 1804–1805 at Fort Mandan, the captains gathered information from Indians and white visitors about the country further up the Missouri. They learned that they would need to cross the Rocky Mountains before the early fall snows, and that they would need horses for the journey. They were told the Shoshone people who lived east of the Rockies could supply horses and show them a trail.

Also during the winter, the captains met and hired a French-Canadian named Toussaint Charbonneau as an interpreter and guide. Charbonneau’s wife, Sacagawea, a Shoshone Indian, was to come along as well. She was about 15 years old in 1805. Sacagawea gave birth to a son named Jean Baptiste on February 11, 1805, just 55 days before the expedition set out from Fort Mandan in April. Clark became fond of the baby and nicknamed him Pompy.

Sacagawea proved to be a great asset to the Corps. Her presence with her baby indicated to the Indians they met that the group was not a war party. Sacagawea was skilled at gathering food and medicinal plants. When the Corps reached the area of her childhood, she helped locate her people, the Shoshone. Sacagawea’s brother, Cameahwait, was a Shoshone chief who arranged for the Corps to have a guide over the Rocky Mountains and sold them horses.

In September 1805, the Corps stumbled into the Nez Perce people at Weippe Prairie, Idaho. They had crossed the Rockies, but they were starving and cold. They had to kill some of their horses to eat, and melt snow to drink. The Nez Perce welcomed the strangers with a feast of fish, bison, dried berries, and camas roots. This was the first camas root the Corps had encountered. The camas made some of the men ill until their bodies learned to tolerate it.

The Corps now needed to build canoes to travel down the Clearwater River to the Snake River and then to the Columbia. They did this with the help of the Nez Perce. They left their horses
with the Nez Perce, who agreed to care for them during the winter until the Corps could return the following spring, when they would need the horses again for the journey across the Rockies.

On October 17, 1805, the Corps reached the confluence of the Columbia and Snake rivers. Here Clark notes that Indians offered to sell them salmon and dogs to eat. The captains chose dog over the salmon because they believed the salmon to be diseased. They eventually ate dried salmon, believing that it was made from healthy fish. Lewis and Clark’s hesitance to eat the dying fish is understandable, considering their preconceptions. The captains were familiar with Atlantic salmon (*Salmo* sp.), which can spawn more than once. Both the Atlantic and Pacific (*Oncorhynchus* sp.) salmon have an anadromous life cycle. This means they are born in fresh water, migrate to the sea to mature, then return to fresh water to spawn. Unlike the Atlantic salmon, most Pacific salmon are semelparous, meaning they die after spawning once. The exception to this is the steelhead, which does not die after spawning.

The Corps arrived along the Columbia during the fall spawning run and noted the vast numbers of people in the villages and the salmon on drying racks. It has been estimated that at the time Lewis and Clark traveled the Columbia River, its 12,935 miles of water provided habitat for 20 million salmon that helped support a native population of about 70,000 persons.

On November 7, 1805, Clark recorded in his journal that they were in view of the ocean. They were on the north side of the Columbia River estuary, where the river is several miles wide. After two wet and miserable weeks, the Corps determined that this was not a good location for their winter camp. On November 24, 1805, a vote was taken among all the Corps. Every member of the group was allowed to vote, including York, a black slave, and Sacagawea, a teenage Indian girl. Clark recorded each person’s vote in his journal. The decision was made to move to the south shore of the Columbia River to look for an area with good roots, fresh water, and a good supply of game. Finally, on December 7, 1805, the Corps arrived at a location about 3 miles up what is today called the Lewis and Clark River. They constructed a winter home, which they named Fort Clatsop. Today the site thought to have been the Corps’ winter home is the Fort Clatsop National Memorial, south of Astoria, Oregon.

The Corps spent the wet winter at Fort Clatsop repairing equipment and replenishing what supplies they could to prepare for the return trip in the spring. The captains worked on their journals and Clark worked on his maps. During their 106-day stay at Fort Clatsop, the sun came out only 6 days and only 12 days were without rain. The continual dampness caused
their leather and wool clothing to molder, their food to decay, and their spirits to droop.

On March 23, 1806, the Corps loaded their canoes and left Fort Clatsop to begin the journey eastward. The Corps expanded their explorations east of the Rocky Mountains, traveling along the Marias, Yellowstone, and Missouri rivers on the return trip. They reached St. Louis on September 23, 1806. Clark wrote in his journal, “We were met by all the village and received a hearty welcome from its inhabitants.”

Reference
The Journals of the Lewis and Clark Expedition, Gary E. Mouton, editor, University of Nebraska Press, Lincoln, 1990.

Activity 4A—“We Proceeded on…”
In this activity, learners view a video about the Lewis and Clark Expedition and study the importance of this expedition in opening Oregon to settlers from the United States.

Materials
- One copy of 4A-1—“We Proceeded on…” North America 1803 map (Appendix I) for each learner
- One copy of 4A-2—“We Proceeded on…” journal page (Appendix I) for each learner
- North America 1803 answer key (Appendix I)
- Laminated map: Lewis and Clark from the Bitterroots to the Pacific (see Appendix III)
- Video: “We Proceeded on…” (32 minutes) (see Appendix III)
- Six copies of the booklet Kids Discover Lewis and Clark (see Appendix III), one for each team

Procedure
Post the laminated map of “Lewis and Clark from the Bitterroots to the Pacific” where all the learners can see it. Show the video “We Proceeded on…”

Lead a discussion about Lewis and Clark and the Corps of Discovery using the map and information provided in the video and the Background section. Work with the learners to label the 4A-1—“We Proceeded on…” North America 1803 map.

Ask the learners to get into their six research teams. Give each team a copy of Kids Discover Lewis and Clark. Using this booklet and the information from the video, ask the teams to answer the questions on the 4A-2—“We Proceeded on…” journal page.
## Answers: 4A-2—“We Proceeded on…” journal page

1) Page 7: $2,500.00, $669.50, beads, combs, knives, thimbles

2) Pages 12–13: horses, canoes, walking

3) Page 4: 15 years old or younger (according to this reference)

4) Page 17: The Corps of Discovery gave the U.S. valid claim on the Oregon Country (Territory)

5) Page 16: John Jacob Astor

### Activity 4B—“Your Observations…”

In this activity, learners study some of William Clark’s journal entries made in 1805 along the Columbia River.

#### Materials

- One copy of the *Of People and Fish* Journal cover page (Appendix I, page 80) for each learner
- One copy of the 4B—“Your Observations…” journal pages (Appendix I) for each learner
- Colored pencils, pens, or crayons
- Laminated map: Lewis and Clark from the Bitterroots to the Pacific (see Appendix III)
- Video: “We Proceeded on…” (32 minutes) (see Appendix III)
- Six copies of the booklet *Kids Discover Lewis and Clark* (see Appendix III), one for each of six work teams

#### Procedure

Provide one copy of 4B—“Your Observations…” journal pages for each learner. Divide the group into their six research teams. Give each team a copy of *Kids Discover Lewis and Clark* to help them answer the questions on the journal page.

Read to the group the journal entries of Captain William Clark provided on the 4B—“Your Observations…” Journal page. (Note: Lewis and Clark went to school in the late 18th century, before the rules of spelling and grammar were formalized. The spelling, unfamiliar words, and sentence structure are difficult at times.)
UNIT 4: THE CORPS OF DISCOVERY continued

Provide one copy of the Of People and Fish Journal cover page for each learner. Discuss the importance of the Lewis and Clark journals in documenting their discoveries. Do any of the learners keep a diary or journal? After the discussion, ask learners to create their own illustration to personalize the cover page.

Answers: 4B—“Your Observations…” journal page
1) Open answer
2) Eulachon, salmon, dog, Wap-pa-to, bison
3) Open answer
4) The numbers of canoes and the time taken to decorate them indicated they were important in several ways.
5) Mat lodges and houses thatched with straw and covered with bark
**Benchmarks**

**History and nature of science**
- Understand that scientific knowledge is subject to change based on new findings and results of scientific observation and experimentation.

**Diversity/interdependence**
Level 2
- Describe the relationship between characteristics of specific habitats and the organisms that live there.

Level 3
- Identify and describe the factors that influence or change the balance of populations in their environments.

**History**
Level 2
- Interpret data and chronological relationships presented in timelines and narratives.

Level 3
- Represent and interpret data and chronological relationships from history, using timelines and narratives.

**Geography**
Level 2
- Explain how human activities affect physical environments and the opportunities, constraints, and hazards they present for people.

Level 3
- Explain how human modification of the physical environment in a place affects both that place and other places.

**Reading**
Level 2
- Analyze and evaluate information and form conclusions.

Level 3
- Analyze and evaluate whether a conclusion is validated by the evidence in a selection.

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**Unit 5: A History of People and Fish**

**Background**
To prepare to teach this unit, read the Resource publications listed below, and section 5A—The Oregon Territory and Salmon History learner reading pages.

**Resources**
- **Salmon Nation**, “Muddied Waters, Muddied Thinking” (see Appendix III)

From the Web:
  - “Mining”— eesc.oregonstate.edu/salmon/human/mining.html
  - “Ranching”— eesc.oregonstate.edu/salmon/human/ranching.html
  - “Farming”— eesc.oregonstate.edu/salmon/human/farming.html
  - “Dams”— eesc.oregonstate.edu/salmon/human/dams.html
  - “Urban life”— eesc.oregonstate.edu/salmon/human/urban.html
  - “Hatcheries”— eesc.oregonstate.edu/salmon/human/hatcheries.html
  - “Commercial fishing”— eesc.oregonstate.edu/salmon/human/commercialfishing.html
  - “Recreational fishing”— eesc.oregonstate.edu/salmon/human/recfish.html
  - “Predators”— eesc.oregonstate.edu/salmon/human/predators.html
  - “Natural fluctuations”— eesc.oregonstate.edu/salmon/human/natural.html
  - “The ocean”— eesc.oregonstate.edu/salmon/human/ocean.html
  - “Cumulative effects”— eesc.oregonstate.edu/salmon/human/cumulative.html
  - “Scientists’ views reveal disagreement, but often that generates knowledge”— eesc.oregonstate.edu/salmon/background/views.html

- **Salmon and Watersheds**—extensive resource list from Oregon Sea Grant:
  http://seagrant.oregonstate.edu/links/salmsites.html

- **Bonneville Power Administration Loaner Videos list**:
UNIT 5: A HISTORY OF PEOPLE AND FISH continued

References

Activity 5A—The Oregon Territory and Salmon History
In this activity, learners study how settlement and development of the Oregon Territory contributed to a decline in the native salmon population.

Materials
- One copy of the 5A—Salmon History journal page (Appendix I) for each learner
- Copies of section 5A—The Oregon Territory and Salmon History learner reading pages (pages 37–40)
- Six copies of the pamphlet Salmon of the Pacific Coast (see Appendix III)

Procedure
Pass out section 5A—The Oregon Territory and Salmon History learner reading pages, one set to each team. Ask learners to read the history individually or in their group. The group then should work together to complete the timeline on the 5A—Salmon History journal page.

When they have completed these activities, ask learners, “Are the problems with salmon new? How might the early Oregon Territory settlers have behaved differently toward the land and salmon? Why did the settlers behave the way they did toward the resources they found in Oregon? Do people behave differently today?”

If learners need more help understanding the hazards faced by salmon today, pass out copies of Salmon of the Pacific Coast and refer to the Challenges in the darker blue boxes on the inside of the poster.

Objectives
Learners will be able to:
- Explain how settlement and development of the Oregon Territory contributed to a decline in the native salmon population.
- List hazards faced by salmon as they move through their life cycle.
- Describe restoration methods that might help increase salmon populations.
Extend the learning

- Our Water World: 4-H Marine Science Discovery Project (4-H 350L), Future Catch; Marine Debris. Oregon State University Extension Service.
- Project WILD Aquatic Education Activity Guide, Watered Down History

Answers: 5A—Salmon History journal page

1821—British fur companies tried to trap beaver to extinction south of the Columbia River. This was bad for salmon because salmon use the habitat beaver create.

1848—Oregon’s population was 13,000.

1850—Oregon mills began to supply lumber that was used by settlers for homes and barns. Splash dams damaged salmon streams because they remove gravel and woody debris that salmon need.

1859—February 14, Oregon became the 33rd state.

1860—Oregon’s population was 52,000.

1866—The first year salmon were canned.

1884—The largest number of salmon canneries on the Columbia River was 35 canneries.

1890—Oregon’s population was 318,000. Fish hatchery projects were begun by the states of Oregon and Washington and by the Federal government.

1910—Oregon’s population was 673,000.

1930—Oregon’s population was 953,000.

1933—The first dam on the Columbia River was Rock Creek Dam.

1938—Bonneville Dam was completed.

Today—There are 163 dams in the Columbia River Basin.

??—The year native salmon and trout return to their historic levels.
5A—The Oregon Territory and Salmon History

The Corps of Discovery was led by Meriwether Lewis and William Clark in 1804–1806. This was the first overland expedition to the Pacific Ocean. The expedition was sponsored by the United States Government. When they returned, Lewis and Clark made a report to Congress. They wrote that the Oregon Territory was a land rich in natural resources. They believed it was a good place for American settlement. Soon American fur trappers and traders were moving into the Oregon Territory.

During the first half of the 1800s, both Great Britain and the United States claimed they owned the Oregon Territory. John Jacob Astor was an American businessman who was interested in Oregon’s resources. In 1811, Astor sent fur traders to the mouth of the Columbia River. They built a fur-trading post called Fort Astoria.

In 1812, the United States was at war with Great Britain. Fort Astoria was sold to the British Northwest Company. By 1821, the British Northwest Company was joined by another British fur trade company, the Hudson Bay Company. These British companies set a policy to trap beaver to extinction in the lands south of the Columbia River. They hoped the removal of beaver would keep Americans from moving west. The reduction in the number of beaver was damaging to habitat used by salmon. The ponds and stream structures created by beaver were used by salmon for spawning and rearing areas.

The British were unsuccessful in halting the westward migration of Americans. In 1843, the first large wagon train left the Missouri River headed for Oregon with about 500 people. In 1848, Oregon officially was declared a territory of the United States. At this time, the population of Euro-Americans (Americans, English, and French-Canadians) in the territory was around 13,000.

To encourage American settlement in the west, the United States Government offered free land. The Donation Land Claim Act of 1850 allowed white settlers to claim up to 640 acres of land in Oregon just by moving onto the land.

In the 1850s, the Oregon Territory was developing quickly. In 1853, the border between Oregon and the Washington Territory was decided. In 1857, Oregon’s first constitution was written. On February 14, 1859, Oregon became the 33rd state in the United States.

By 1860, Oregon’s Euro-American population was 52,000. There were now 30 small towns along the Willamette River and its tributaries. People who had come from towns in the east often settled in the new small towns of Oregon. Some set up shops and businesses. Others worked as carpenters or found work in grain, wool, and sawmills.

When Euro-American settlers first came to the Oregon Territory, they were amazed at the size of the forests. People thought there were so many trees that they could never all be cut down. Settlers built their first homestead cabin from logs. They cleared the land of the Willamette Valley to create farmland. As soon as they could make enough money, many people built a new home out of milled lumber. By the 1850s, Oregon lumber mills began to supply boards for settlers’ homes and barns.

At first, timber was cut along waterways so that logs could be floated downstream to the lumber mills. When the streamside timber was cut, loggers moved deeper into the woods. Logs were dragged to the streams over skid roads by oxen or horses. Heavy logging in steep river valleys resulted in soil degradation and habitat loss for salmon.
The Oregon Territory and Salmon History continued

washing into streams. The loose soil settled in salmon spawning gravel. The removal of trees near the streams also reduced the shade that helped keep the streams cool.

Often in the summer, streams did not carry enough water to move the logs downstream. Wooden structures called splash dams were built across streams. The dams held back the water and formed a holding pond behind the dam. When many logs were collected in the holding pond, the wooden planks were removed or the dam was blown up. The logs would roar downstream in a great surge of water. Sometimes several splash dams had to be built along a creek. Logs were flushed from one dam to the next until they reached the main river. At the river, logs were chained together into rafts and floated to the mill.

These torrents of water and logs pouring down the stream took gravel and woody debris with them, leaving the stream bottom bare. Salmon, their habitat, and their offspring often were destroyed. Splash dams were used until 1919, when the Oregon legislature outlawed this practice.

Salmon canning was becoming a major industry in the 1860s in Oregon. As with timber, people thought the supply of salmon was endless. The first salmon cannery on the Columbia River was opened in 1866 by Hapgood, Hume, and Company. They sold 4,000 cases of salmon for $16 per case.

At first, canneries used salmon traps and weirs to capture salmon. Soon they developed fish wheels and seine nets. Fish wheels scooped salmon from the river onto a platform or waiting boat. Seines were huge nets used at low tide. They were hauled to shore by teams of horses.

Independent commercial fishing from boats began when four gillnets were towed from row boats in 1866. A gillnet is a nearly invisible net that catches fish, often by the gills. The number of gillnetters grew quickly to 1,650 in 1883. In 1883 and 1884, more salmon was canned than any other year before or since. This marked the high point of the industry. There were 35 salmon canneries along the Columbia River.

After 1884, the number of returning salmon dropped steadily. The lack of fish led to the closure of some canneries. Fewer people could earn a living gillnetting fish. Today, about 100 non-Indian gillnet fishermen fish the lower Columbia. In a 1998 treaty, Indian gillnetters were entitled to catch 40,000 fall chinook on the Columbia River between Bonneville Dam and McNary Dam.

By 1873, cannerymen had realized that something should be done to maintain the numbers of salmon returning from the ocean. They did not want to reduce their production of canned salmon. This would have meant a loss of income. The cannerymen organized the Oregon & Washington Fish Propagation Company to create salmon hatcheries.

By 1890s, Oregon’s population had increased to 318,000. These people all needed lumber and other natural resources for homes and to make a living. Fish hatchery projects were begun by the states of Oregon and Washington and by the Federal government. It was believed that artificially raised salmon would make up for overfishing.

From 1890 to 1910, many new people came to Oregon, more than doubling the population. The 1910 census counted 673,000 people in the state.
The Oregon Territory and Salmon History continued

In 1914, World War I started in Europe. There was an increased demand for Oregon’s natural resources. The natural resources sent to Europe included lumber, and food from farms, ranches, and fishing. Many new people came to Portland to work in the wartime industries. After the war, some of these people stayed and made their homes in Oregon.

By 1930, Oregon’s population had increased to 953,000. As the Northwest’s population continued to grow, so did the need for resources. Dams were the next major development to impact salmon. Dams provide many benefits to people, including assisting navigation on the river, flood control, and water for irrigation and electricity.

In 1931, the U.S. Army Corps of Engineers submitted a report to Congress calling for 10 dams on the mainstem Columbia River. The first mainstem dam was completed in 1933 by the Washington Electric Company. It’s called Rock Creek Dam and is located near Wenatchee, Washington.

The engineers who designed the dams knew they would block fish migration. Bonneville Dam, completed in 1938, was built with fish ladders to assist upstream migration to spawning grounds. A good solution to the problem of how to move juvenile fish downstream has not yet been found.

Grand Coulee Dam, located above Rock Creek Dam, was completed in 1941. It was built without fish ladders. Beginning in 1939, salmon were trapped at Rock Creek Dam and transported and released above Grand Coulee.

Today there are 27 Federal dams along the Columbia and Snake River system. The newest dam is Lower Granite Dam, on the Snake River. It was completed in 1975. In addition, within the Columbia Basin there are 136 dams that are not part of the Federal Columbia River Power System.

Congress recognized the dangers dams create for salmon. In 1938, Congress passed the Mitchell Act. The Mitchell Act funded building of hatcheries to replace the thousands of acres of salmon spawning grounds that were to be blocked or flooded behind dams. More than 80 U.S. Fish and Wildlife Service hatcheries were built along the Columbia River and its tributaries.

Not everyone thinks the hatcheries are successful. Today in some salmon streams, most of the returning fish are hatchery fish. Some people believe that hatchery fish are harming wild fish populations. In 1992, the Oregon Department of Fish and Wildlife adopted the Wild Fish Management Policy. This policy says it is the “goal of the people of the state of Oregon to restore native stocks of salmon and trout to their historic levels of abundance.”

Euro-American people came to the Oregon Territory to make use of its natural resources. They wanted to provide a better life for themselves and their families. The resources seemed endless. As the human population...
The Oregon Territory and Salmon History continued

As the population grew, they needed more resources. Lumber was needed to build homes and communities, land to grow food, fish for the canneries, and water to generate electrical power and for irrigation. The 2000 U.S. Census counted Oregon's population at 3,281,974—still growing rapidly and demanding more resources.

Over the past 200 years, all these developments were viewed as progress. Today, natural resource use and land use are regulated by state and Federal agencies. These agencies set policies, such as Oregon’s Wild Fish Management Policy, to meet the needs of all citizens. We are the citizens. The resource use decisions we make today will affect the quality and quantity of Oregon’s natural resources in the years to come.

Activity 5B—Salmon Hazards, Salmon Helpers

In this activity, learners view a video and use a simulated salmon population to collect data on the effects of various hazards and restoration methods.

Materials

- One copy of 5B—Salmon Hazards, Salmon Helpers journal pages for each learner (Appendix I)
- Salmon Life Cycle poster (see Appendix III)
- Video: The Return of the Salmon (30 minutes) (see Appendix III)
- One set of 160 Fish Chips, 40 chips of each species (Appendix II)
- Six 6- by 8-inch mini-aquaria, one for each team
- Six dice, one for each team
- Six Salmon Identification Information handouts (Appendix II), one for each team

From each learner’s Of People and Fish journal:
- Copies of 2C—Salmon Styles, dichotomous key developed to identify salmon
**Preparation**

Obtain six mini-aquaria “fish bowls” and photocopy enough Fish Chips to total 160. Mix the Fish Chips and place a random selection of 20 fish in each bowl. Reserve the additional 40 fish for the second half of the activity. If you run additional rounds of Sample E, you might need more Fish Chips (see below).

**Procedure**

Show the video *The Return of the Salmon* to the learners. While they are watching it, ask learners to listen for the following information in the first half of the video:
- A review of the definition of a watershed
- A review of the salmon life cycle
- Structure important in a salmon stream (gravel, rocks for aquatic insects, wood)
- The importance of salmon returning to the stream to replace nutrients

The second half of the video covers a historical view of settlement, including logging, railroads, canneries, and hatcheries. The video concludes with possible suggestions for salmon restoration. Ask learners to listen for information that led to salmon’s decline, and to listen for ideas about restoration.

After the learners watch the video, lead them in a discussion to create a list of salmon hazards and restoration ideas. Once the list is complete, ask learners to get into their six research teams. Pass out the fish bowls, one to each team. Pass out one copy of the 5B—Salmon Hazards, Salmon Helpers journal pages to each learner. Ask them to follow the directions on the journal pages.

Each team member captures one fish from the bowl; this is **Sample A**. Then, each team keys out each of the captured fish using the dichotomous keys they created in Activity 2C. Next, because sockeye salmon cannot get around the dam, learners place all the fish back into the fish bowl except any sockeye salmon captured in Sample A.

Repeat this procedure in **samples B, C, and D**. After all the teams have captured and recorded **Sample D**, pause the activity. How did the number of each species change over the four samples?

Now continue on to **Sample E**. Ask each team to select a salmon restoration method and a target salmon species to restore. The learners place all the fish from samples A through D back into the bowl and mix well. Pass out a die and extra Fish Chips to each group. Tell learners not to add the extra fish to the bowls yet. These extra fish will be used to increase the population if the chosen restoration method is successful.
For Sample E, each learner on each team again captures one fish. How successfully can the fish reproduce with the restoration method selected? Did the team capture two of the species of salmon they selected as their target species? If two of the target fish were captured, the species can reproduce. To do this, one member of the team rolls the die. For a roll of 1 or 4, learners add one of the extra fish back into the population; for a roll of 2 or 5 add two extra fish back into the population; and for a roll of 3 or 6 add no extra fish back into the population. The fish added to the population are from the extra Fish Chips, and may not always be the same species as the team’s target species. Remind learners to add all the captured fish back into the bowl after each sample.

How many samples must each team run to add all the extra fish back into the population in the fish bowl? Ask learners to use a sheet of notebook paper to record any additional samples needed after Sample H.

**Extend the learning**

- Make arrangements to take the learners to an Oregon Department of Fish and Wildlife fish hatchery. Call ODFW at (503) 872-5264; request a copy of *The Fish Hatchery Next Door*, www.dfw.state.or.us.


- *Project WILD Aquatic Education Activity Guide*, Net Gain/Net Effect; To Dam or Not to Dam; Dragonfly Pond
Unit 6: Fishing Tools and Techniques

Background
As the last great Ice Age ended (around 10,000 years ago), Native Americans already were beginning to build unique societies that used salmon. In Unit 3: Native American Salmon Life Ways and Legends, we learned several legends that native peoples used to communicate the importance of salmon in their cultures. In this unit, we will learn about some of the tools and techniques used to harvest salmon and other important fish. Many methods of harvesting fish were devised, including gillnets, traps, weirs, spears, and a variety of hooks and their accompanying gear. It’s interesting to note that while this equipment was made of natural materials including cedar, nettle, stone, antler, bone, and wood, the designs were similar to equipment still in use today.

Gillnets made of woven cedar bark with wooden floats on the top and stone sinkers on the bottom were used by Native Americans before the salmon canning industry made gillnetting a big business on the Columbia River in the 1860s. Overfishing by Euro-American gillnetters was a contributing factor to the depletion of native salmon stocks. See Unit 5: A History of People and Fish.

Of the variety of fishing gear found on the Northwest Coast, weirs were the most productive. Weirs are fencelike structures made of a row of wooden stakes driven into the bed of a stream or the arm of an estuary. Often latticework was mounted between the stakes. The lattice was woven from a variety of plant materials including willow, and cordage was made from cedar.

One type of weir allowed water to flow downstream, but fish that were trying to swim upstream to spawn could not pass. People standing on platforms on the weir could then spear or net the fish or guide them into traps. The stake frame of the weir was left up all year long. However, the latticework was removed until the next fishing season.

Weirs built on streams or channels in estuaries took advantage of the daily tides. Fish would swim over the top of the weir at high tide, but when the water fell on the ebb tide, they were trapped behind the weir. It was then relatively easy to gather up the fish.

Oregon Benchmarks

History and nature of science
- Understand that science is a human endeavor practiced by individuals from many different cultures.
- Understand that scientific knowledge is subject to change based on new findings and results of scientific observation and experimentation.

Geography
Level 2
- Explain how human activities affect physical environments and the opportunities, constraints, and hazards they present for people.

Level 3
- Explain how human modification of the physical environment in a place affects both that place and other places.

Objectives
Learners will be able to:
- Describe some Native American fishing tools and techniques.
- Describe some Euro-American fishing tools and techniques.
- Compare materials and techniques used by Native Americans to make fishing tools to basic modern fishing gear.
- Describe and demonstrate the equipment essential to a simple baitcasting setup.
Another type of weir is a rock fish trap. This is a V- or U-shaped enclosure made of rocks that directs migrating fish into a smaller rock enclosure or wooden stake trap at the back. Many were unique and showed innovation by the builders.

A leister is a type of spear commonly used at weirs. A leister has three points—two with prongs that grab the sides of the fish and a third point that keeps the fish from escaping.

The variety of hooks and associated gear that Native Americans used for various types of fish and fishing conditions is as overwhelming as a trip to the angling department of a well-stocked sporting goods store today. Thinly woven cordage of nettle, cedar, or human hair provided the line. The hook was made of bone, antler, or wood. The hook consisted of a shank, a point, and often a barb. The shape and size of the hook was designed for a specific species of fish. A stone often was used as a sinker, either above the hook on the line or mounted at the top of the hook. A piece of abalone shell might be added to the line. The shiny surface of the abalone shell would flash as it moved through the water, similar to a modern metal spoon or spinner.

A Native American fisherman could troll by pulling the baited hook behind his canoe as he paddled. The line would be attached to the paddle and the jerking of the line with each stroke would attract fish.

In basic modern fishing gear, the pole includes a reel with a line, a hook, and a weight or “sinker.” The least expensive and easiest rod and reel combination to use is spincasting tackle. It sometimes is called “closed-faced tackle” because there is a cap or cover over the spool and the line comes out through a small hole in the middle of the cover. A small pin under the cover picks up and directs the line on the reel. The spincast reel sits on top of the rod when fishing.

The simple casting method demonstrated in Activity 6B sometimes is called “can casting,” because a soda can may be used in
place of the dowel. The line is attached to the can with duct or electrical tape. Can casting works in a similar way to a spinning reel. The fixed spool—the can—holds the line. The momentum of the bait or lure pulls the line off the spool. Good can casters can rival spinning tackle for length of cast.

Can casting is common in many parts of the world. It is an advanced form of handlining. Some people do not have access to rods and reels, but they have access to line and terminal tackle such as hooks and sinkers. Early anglers used hand lines, where the line was simply coiled in the hand and the hook or lure was thrown into the water, allowing the line to pay out from the coils. This method is still in use in many regions today and still catches fish!

In Activity 6A, learners compare Native American and modern fishing gear and build a model weir or trap. In Activity 6B, learners identify the parts of a basic casting rig and practice casting at a target.

Resources
- *Salmon Nation*, “Recalling Celilo,” “Keep The Gift Moving” (see Appendix III)
- Look up local sportfishing organizations (such as The Association of Northwest Steelheaders) on the Web
References

- National 4-H Sport Fishing Curriculum, Draft 6/99 (provided at National 4-H Training)
- Modern Fishing Gear on page 82, 6A—Fishing Tools journal page: from Responsible Angling, The Oregon Angler Education Manual, 4-H Sportfishing Project; copyright © Empire Publishing Inc., Seattle, WA.

Activity 6A—Fishing Tools and Weirs
In this activity, learners study Native American fishing tools and techniques and compare them to basic modern gear.

Materials
- Three boxes of toothpicks (flat ones are easier for learners to glue together)
- Six bottles of white glue
- Six sheets of waxed paper
- Roll of masking tape
- Felt markers
- Twigs of evergreen or other plant material (optional)
- One copy of 6A—Fishing Tools journal pages (Appendix I) for each learner
- Overhead transparency: Fishing weir (illustration page 45)
- Six shallow storage boxes, one for each team
- Six sets of craft foam strips, stacked and glued together four high, measuring 1 by 4 inches
- 3-pound tub of blue modeling clay

FYI
Several types of artificial lures can be used to catch fish. See 6A—Fishing Tools journal page. The fish-shaped lure with the hook attached is called a plug. Plugs are shaped and colored to look and move like natural food. They are used for largemouth and smallmouth bass and walleye in fresh water, and for salmon in salt water.

Spinners are shiny metal blades that spin around a wire shaft to attract fish. A single or treble hook is attached to the shaft under the bright, feather like decorations. Spinners produce a vibration in the water when they are retrieved.
Lures of soft plastic are made in the shape of worms, crayfish, and other shapes. They may have a scent that attracts fish. They are used for many kinds of fish.

**Preparation**

Obtain a 3-pound tub of blue modeling clay and six storage boxes. Divide the clay into six equal parts, and place one lump in each of the boxes. Also, place in each box a craft foam strip, a half box of toothpicks, a sheet of waxed paper, and a bottle of white glue.

Make an overhead transparency of the illustration on page 45 of a fishing weir.

**Procedure**

First, lead a discussion.
- How many of the learners have been fishing?
- Do any of the learners’ families fish for a living?
- What type of gear have they used?
- Have any of the learners visited a moorage or harbor along the coast where they have seen fishing boats with large nets?

Pass out one copy of the 6A—Fishing Tools journal pages to each learner. Work with learners to label the modern gear in column two. Then ask learners to draw a line between the Northwest Coast Indian Fishing Gear represented in the first column and the modern gear it most closely matches in the second column.

Using the information provided in the Background section, work with learners to label the type of reel and the parts.

**Answers: 6A—Fishing Tools journal page**

| A, F: Hook with sinker | H: Pole            |
| B, D: Spinner         | I: Line            |
| C, E: Plug            | J: Weight          |
| G: Reel, closed-faced spincasting tackle | K: Hook |

Place the overhead transparency of a fishing weir on the projector and lead a discussion of fishing techniques. Would learners rather catch fish with a rod or a weir? Discuss the advantages of each method.

Distribute to each team a storage box with materials. Explain to learners that the storage box represents a tidal stream or estuary area. The success of fish weirs is due to both the drive of salmon
and other anadromous fish to go upstream, and the action of the tides. Ask learners: “How many times each day is there an incoming (high) tide? How many times each day is there an outgoing (low) tide?” (On average, there are two high tides and two low tides in each 24-hour period.) For more information on tides, see Our Water World, 4-H Marine Science Discovery Project, “The Ocean’s Tides.”

Ask learners to use the masking tape and a felt pen to label one end of the box “ocean” and one end “estuary.” Using any design they choose, learners then create a fish weir or trap in the dry box. They can push toothpicks into small balls of clay to form upright stakes. The toothpicks may be glued together to form a lattice or traps. (Have learners do their toothpick glue work on the sheet of wax paper to protect the table surface.) Remind learners to keep the direction of the water flow and the direction of fish travel in mind as they design their weir or trap. Allow time for the glue to dry on the models before completing the activity.

When each team of learners has completed its design, have them set the stacked craft foam strips into the middle of the lid of the storage box, set the storage box into the box lid, and add water to the box. The raised band of craft foam must be in the middle of the box lid. By rocking the box back and forth over this raised band of craft foam, a tidal shift from the estuary to the ocean is created in the box.

Allow enough time for each team to test their model. Some of the blue clay color will wash into the water as learners test their models. Ask a spokesperson from each team to show their design and explain why they chose the construction displayed.

When you have finished the activity, be sure to clean the clay off the toothpicks and return it to its storage container for later use. If the clay is very wet, leave the lid off the tub overnight to allow some of the moisture to evaporate.

**Extend the learning**

- Our Water World: 4-H Marine Science Discovery Project (4-H 350L), The Ocean’s Tides; Reading a Tide Table; Waves. Oregon State University Extension Service.
Activity 6B—Dowel, Line, and Sinker

In this activity, learners study Euro-American fishing tools and practice casting using basic equipment.

**Materials**
- Hat with a stiff bill or brim to be worn during the casting activity. This is an important safety measure to protect learners’ eyes and faces from the rubber casting plug during casting practice. Ask learners to bring one from home.
- One copy of 6B—Fishing Techniques journal page for each learner
- Overhead transparency: 6A—Fishing Tools (Appendix I)
- Six casting rigs—dowel, line, and rubber casting plug, one for each team (Appendix IV)
- Six casting targets (any set of paper targets or plastic buckets will do), one for each team

**Preparation**

Make an overhead transparency of journal pages 6A—Fishing Tools. Make casting rigs as described in Appendix IV.

The casting activity must be conducted outdoors in a large, open area with no overhanging obstacles. Leaders should practice the underhand casting technique with one of the casting rigs before leading this activity with learners. Check the knots on the casting rigs to be sure that they are secure each time before you use them.

The casting rig is used by grasping the end of the dowel away from the line. The line should be wrapped smoothly around the dowel to create the spool. The casting plug should swing freely about 12 inches below the dowel.

To begin the cast, place the index finger of the gripping hand over the loose end of the line about 12 inches above the casting plug. Make the cast with an underhand motion. Swing the arm behind the body and then forward, aiming the end of the dowel toward the casting target. At the forward point of the toss, release the index finger, and the line should spool off the end of the dowel, following the weight of the plug towards the target. Be careful not to swing back so hard that the casting plug strikes you in the back.

If any learners have trouble with this one-handed method, have them try a two-handed method. Ask the learner to grasp the dowel and line in her or his nondominant hand. Using her or his dominant hand, she or he will unroll about 12 inches of line.
and begin to swing it in a pendulum motion, pointing at the target. Again, it’s important not to swing so hard the plug strikes the learner. The plug is released at the forward point of the pendulum swing.

**Procedure**

Place the overhead transparency on the projector. Show the learners one of the casting rigs they are about to use. Ask them to refer to the overhead and name the parts of the casting rig as you point to them. These demonstration rigs do not include a hook. If learners actually were going to use this gear to go fishing, where would they attach the hook?

Ask learners to put on the hat they were asked to bring from home. Take the learners outdoors and ask them to line up in their teams, facing the casting targets. The teams should have at least 4 feet between each line. The casting targets should be about 3 feet in front of each team. Before handing out the casting rigs to the teams, demonstrate their use as described in “Preparation,” above.

Allow each member of each team to cast the plug at the target. If learners are hitting the targets successfully, move the targets further away.

Learners might wish to try the can casting method in a lake or stream. Before they do, be sure they know the Oregon Department of Fish and Wildlife (ODFW) Sport Fishing Regulations. ODFW regulations require that an angler use only one line. Bait may not be used in some areas. All persons over 14 years of age must have an Oregon Angling License to fish. Encourage learners to get a copy of the ODFW Oregon Sport Fishing Regulations from a local sporting goods store and become informed about any regulations that apply in the area where they plan to fish.

Pass out to each learner one copy of the 6B—Fishing Techniques journal page and ask them to complete the page.

**Answers: 6B—Fishing Techniques journal page**

1. A line and a hook. May also have something to hold the line and some type of bait.
2. Roots or bark for the lattice parts. Wooden stakes to hold the trap or weir in place. Cordage or string to hold the parts of the lattice or weir together.
Unit 7: Salmon for the Future

Background
Throughout the *Of People and Fish* program, we have studied ways that people interacted with salmon. We have seen that overharvesting the natural resources of the Pacific Northwest has reduced the biological diversity and health of watersheds. This began in the 1820s, when British fur-trade companies attempted to trap beaver to extinction. They did not understand the beavers’ role in a watershed, nor did they care. Their goal was money and the control of land.

Because salmon live in watersheds from their natal stream to the ocean, they are impacted by many aspects of human activity. Crucial stream attributes include water quality, habitat structure, stream flow patterns, sources of energy and nutrients, and biotic interactions. The five attributes are so closely linked that a change in one causes changes in others.

Because salmon are large, mysterious fish whose sheer numbers once made the rivers churn on their spawning migration, they have become an icon of the Pacific Northwest. The size of Oregon’s human population guarantees it will continue to be difficult to balance the needs of humans and the natural systems supporting salmon and people.

Technology alone cannot save biological systems. The problem of declining salmon runs belongs to all citizens. Citizens have the power to affect natural resource policy and decisions made by state and Federal agencies and to change their own behaviors and attitudes toward resource use. The choices made by Oregon’s citizens will determine the future of salmon.

In Activity 7A, learners locate their watershed and go on a field study to a local stream. In Activity 7B, learners practice collecting and analyzing data to predict fish populations. In the final lesson, Activity 7C, learners use what they have learned in *Of People and Fish* and collect additional information and opinions from a variety of sources to write their own Salmon Newspaper. Their Salmon Newspaper communicates their understanding of the status of salmon in Oregon.

Oregon Benchmarks

Diversity/interdependence
Level 2
- Describe the relationship between characteristics of specific habitats and the organisms that live there.
- Describe how adaptation helps a species survive.

Level 3
- Identify and describe the factors that influence or change the balance of populations in their environments.

History and nature of science
- Understand that scientific knowledge is subject to change based on new findings and results of scientific observation and experimentation.

Writing
Level 2
- Convey clear main ideas supported by details in ways appropriate to topic, audience, and purpose.

Level 3
- Convey clear, focused main ideas supported by details and examples in ways appropriate to topic, audience, and purpose.

Objectives
Learners will be able to:
- Identify the watershed they live in, and list some ways they can help improve the water quality in their watershed
- Appraise, interpret, and communicate some of the complex issues surrounding salmon management decisions through speaking, writing, and posters
Resources

- *Salmon Nation*, “Toward A New Salmon Economy,” Resources; Tools and Information for the Citizens of Salmon Nation (see Appendix III)

From the Web:

  
  “Why try to save wild salmon?”—
  eesc.oregonstate.edu/salmon/background/whysave.html
  
  “What makes a salmon wild?”—
  eesc.oregonstate.edu/salmon/background/wild.html
  
  “Cumulative effects”—
  eesc.oregonstate.edu/salmon/human/cumulative.html
  
  “Restoration projects popping up around Oregon”—
  eesc.oregonstate.edu/salmon/restoration/projects.html
  
  “What can you and I do to help salmon?”—
  eesc.oregonstate.edu/salmon/restoration/help.html

- Salmon Web, Community Based Monitoring for Biological Integrity of Streams:
  www.salmonweb.org/salmon_front.html

- For the Sake of Salmon, Salmon Biology, Materials for Teachers, Monitoring, Funding and Grants:  www.4sos.org

- Internet Resource List: Salmon and Watersheds:
  http://seagrant.oregonstate.edu/links/salmsites.html

- Oregon Trout:  www.ortrout.org

- Ecotrust, Watershed listings information:
  www.inforain.org/interactivemapping/salmonstock.htm

- Bonneville Power Administration, resources for teachers:

- West Coast Salmon and the Endangered Species Act, NOAA Fisheries, National Marine Fisheries Service:
  http://www.nwr.noaa.gov/1salmon/salmesa/index.htm

Reference

Activity 7A—Watershed Explorations

In this activity, learners locate their watershed and go on a field study trip to a local stream.

Materials

**Part 1: Oregon’s Watersheds**
- Make an overhead transparency: Oregon’s Major Drainage Basins and the Limit of Migratory Fish Populations (Appendix II)
- Six copies of any standard Oregon roadmap, one for each team

**Part 2: Local Hills and Valleys**
- Print six copies of a topographical map of the local area from an online site such as:
  - Topozone at http://www.topozone.com
  - or the USGS Terraserver at: http://terraserver.microsoft.com/default.asp
- Six blank, clear plastic overhead transparency sheets, one per research team
- Six “wet erase” pens, one per team
- White paper
- Felt pen
- One copy of 7A—Watershed Explorations journal page (Appendix I) for each learner
- Six lumps of blue modeling clay, one for each team
- Six sections of thin wire, about 10 inches long

**Part 3: Our Local Stream**
- Rubber gloves—use to prevent learners from contacting water in areas of questionable water quality
- Aquarium dip nets
- Plastic bowls to keep invertebrates wet while they are being identified
- From the 4-H Natural Science Project Records (4-H 303LR):
  - 4-H Natural Science Project Record (4-H 303LR-a)
  - 4-H Environment Observation Data Sheet (4-H 303LR-b)
  - 4-H Habitat Data Sheet (4-H 303LR-d)
  - 4-H Soil Observation Data Sheet (4-H 303LR-i)
  - 4-H Water Data Sheet (4-H 303LR-j)
  - 4-H Wildlife Observation Data Sheet (4-H 303LR-k)
- Find these on the OSU Extension and Experiment Station Communications Web site at http://eesc.oregonstate.edu
- “Quick Reference Guide to Aquatic Invertebrates” (Appendix II) from What Can We Learn at the Habitat Area Pond? (4-H 3101L)
Part 1: Oregon’s Watersheds

FYI
Oregon has many large river basins that begin as a series of smaller watersheds in the mountains. The largest river basin associated with Oregon is the Columbia River Basin. The Columbia River brings water from as far north as Canada and as far east as the Idaho headwaters of the Snake River. Its major tributaries from Oregon are the Umatilla, John Day, and Deschutes Rivers in eastern Oregon and the Willamette River in western Oregon. The Grand Ronde, Malheur, and Owyhee rivers of far-eastern Oregon drain first into the Snake River.

Procedure
Lead a discussion to remind learners of the definition of a watershed. Leaders might want to use the watershed model presented in Unit 2, Part 1: Salmon Watersheds.

Ask the learners to get into their six teams. Pass out one copy of the Oregon roadmap to each team. Place the overhead transparency of Oregon’s Major Drainage Basins on the projector. Work with learners to locate the Columbia and Willamette rivers on their maps and any large drainages close to where they live. Note the limit of migratory fish populations using the overhead transparency.

Part 2: Local Hills and Valleys

Procedure
Pass out the topographic maps of the local area printed from an Internet resource, one to each team. Demonstrate to learners how to read and recognize the hills and valleys of their maps.

Using the modeling clay, make a three-dimensional model based on the outline of one of the hills on the map. Grasp the thin wire tightly with one end in each hand and draw it through the model hill about one-third of the distance from the working surface. Repeat this procedure about one-third of the way down from the top of the model hill. You should now have three hill slices that can be separated from each other.

Place the bottom hill slice on a blank piece of white paper and draw the outline of the slice where the widest part of the base contacts the paper. Remove the bottom slice from the paper. Place the middle slice on the paper inside the outline of the bottom slice. Draw the outline of the second slice. Repeat this process with the top slice of the hill. Remove all the slices from the paper and hold it up for learners to see. Discuss how the topographic lines represent the model hill.
Pass out 7A—Watershed Explorations journal page to each learner. Pass out a lump of clay and a piece of wire to each team. Ask the teams to create a hill, then slice it and draw it on their journal page as demonstrated. Next, work with learners to connect the X’s on the Neely Creek watershed on the lower half of the 7A—Watershed Explorations journal page.

Pass out one clear plastic overhead transparency sheet and one “wet erase” pen to each team. Ask learners to place the plastic over their copy of the topographic map of the local area. Identify the tops of hills and ridges by placing a series of small X’s on the plastic sheet. Tell learners to refer to their copy of the topographic map of the Neely Creek Watershed to help with this task. Next, ask learners to connect the X’s to identify the tops of the ridges that make up a watershed boundary.

Using the map, ask learners to identify the names of the streams that run through their community, and to locate their school, home, and other points of interest. On many maps, learners will be able to locate their own homes if they were built prior to the date of the map. After completing this part of the activity, collect all the materials.

**Part 3: Our Local Stream**

**Procedure**

If you have access to computers that the learners can use, have them find the NOAA Fisheries and the National Marine Fisheries Service Web site at:

http://www.nwr.noaa.gov/1salmon/salmesa/index.htm

At this site, NOAA Fisheries and the National Marine Fisheries Service post current salmon listings and affected watersheds under the Endangered Species Act. Use this site to see whether any of your local watersheds have been listed.

After learners have had time to access the Web-based information on local watersheds, plan a field trip to a stream. Ask learners to use their knowledge of stream conditions to suggest some test they would like to perform and information they would like to gather on their local stream.

Chemical water-quality tests are accurate and popular. However, the aquatic insects found in a stream are also a good indicator of stream health. Use the “Quick Reference Guide to Aquatic Invertebrates” from *What Can We Learn at the Habitat Area Pond?* to determine the tolerance of each invertebrate to pollution.

To assist with the field experience, leaders might wish to use the “4-H Wetland Wonders Odyssey Field Trip Book” pages, or access the Bonneville Power Administration’s “Kids in the
Creek” pages, which include a Macroinvertebrate Data Worksheet and Bug cards, at:

If time and budget allow, have the learners visit the creek often over several months to note seasonal changes.

**Extend the learning**
- 4-H Wetland Wonders (4-H 3801L), Odyssey Field Trip Book Copy Pages, Oregon State University Extension Service.
- Project WILD Aquatic Education Activity Guide, Watersheds

From the Web:
- The Stream*A*Syst publication (EM 8761) from OSU Extension Service is designed for landowners to evaluate the conditions of a stream or creek on their property and to learn more about managing streamside areas. This publication is available from offices of the OSU Extension Service; look in the “government” section of your local telephone directory. Or, you can find it electronically as a PDF file on the OSU Extension and Experiment Station Communications Web site at: http://eesc.orst.edu/agcomwebfile/edmat/EM8761.pdf

**Activity 7B—Fishery Management Decisions**

In this activity, learners practice the method that fisheries biologists use to collect data to predict fish populations.

**Materials**

- Six pads of small (1½- by 2-inch) self-stick notes, one per team
- Six calculators, one per team
- One copy of 7B—Fishery Management Decisions journal pages (Appendix I) for each learner
- Salmon Life Cycle poster (see Appendix III)
- One set of 160 Fish Chips, 40 of each species (Appendix II)
- Six 6- by 8-inch mini-aquaria, one for each team
- Six Salmon Identification Information handouts, one for each team (Appendix II)
- Blank sheets of paper, one for each learner

**FYI**

Biologists use several fish-counting techniques to understand the population numbers and distribution patterns of wild
Salmon and trout. Physically to count every fish in an entire watershed would be impossible. The easiest way is to count fish visually as they swim by in a stream. However, this is not always accurate.

The “mark/recapture” method is more accurate. Biologists use nets, fish wheels, or some other method to capture a sample of the migrating salmon population. A numbered plastic tag is inserted in the fish’s back near the dorsal fin. Then the fish is released back into the river to continue its journey.

At a point farther upriver, biologists capture another sample of fish. Some of these fish will be carrying a tag, others will not. Biologists keep track of the total number of marked and unmarked fish caught in the second sample. At this point, they can use mathematical models to calculate the salmon population in the entire watershed.

With the information gathered in the “mark/recapture” survey method, biologists can do the following calculation:

\[
\text{Estimated salmon population} = \frac{M \times C}{R}
\]

Where:
- \(M\) = Number of fish caught and tagged in the first sample
- \(C\) = Number of fish caught in the second sample
- \(R\) = Number of tagged fish caught in the second sample

For example, in the first sample you catch and tag 100 salmon. In the second sample, further upstream, you catch a total of 100 salmon. Of the 100 salmon in the second sample, 10 have been tagged. Using these data, the calculation is:

\[
\frac{100 \text{ fish caught and tagged in sample one \times 100 \text{ fish caught in sample two}}}{10 \text{ tagged fish caught in sample two}} = 1,000
\]

The estimated total population of fish in the watershed is 1,000 fish.

**Procedure**

Lead a discussion about the difficulties biologists and fisheries managers face in managing salmon populations. Why do they need to know how many fish are returning each year? (To set commercial and sportfishing dates and catch limits; to learn whether the number returning is smaller or larger than past years.)
Explain to learners that they will be sampling a salmon population using the Fish Chips they have used before. The research teams will take population samples and then share their information to collect the total data for the watershed.

Pass out the materials needed for the lesson to each team, and one copy of 7B—Fishery Management Decisions journal pages to each learner. Ask team members to capture Sample 1 and fill in the value for M. Learners tag the salmon in Sample 1 by placing a self-stick note onto each captured fish. Ask the teams to wait for the whole group to complete Sample 1 before moving on to Sample 2.

Return the tagged fish to the bowl. Ask the teams to collect Sample 2. Each team then records the number of fish in Sample 2, the value for C. Next, they record the number of tagged fish in Sample 2; this is the R value. Now the leader needs to facilitate adding together the data from all six teams to get total values each for M, C, and R. When they have completed this, the learners will be able to estimate the salmon population.

The actual salmon population, which learners need to fill in on page 2 of 7B—Fishery Management Decisions, is 160 (or more, if the leader has provided additional Fish Chips). That is the total number of Fish Chips in all the teams’ bowls.

The learners need a blank sheet of paper to complete the data collection for two additional trials of two samples. Work with the teams to repeat the data-collection process. When they have three sets of data for the estimated salmon populations, work with learners to take the average of the totals of the three trials. How close was this averaged total estimate to the actual salmon population?

**Extend the learning**
- *Project WILD Aquatic Education Activity Guide*, Where have all the salmon gone?

**Activity 7C—The Choices We Make**

In this activity, learners use what they have learned in the *Of People and Fish* program and collect additional information and opinions from a variety of sources to write their own newspaper, “The Salmon Newspaper.” Their newspaper communicates to their families and the local community their understanding of the status of salmon in Oregon.

Participation in the development of this newspaper serves as the final assessment for learners in school-based programs.
**Materials**

- 7C—Salmon Questionnaire journal page (Appendix I)

**Preparation**

Arrange for learners to have access to the library and the Web to do research for writing articles for their Salmon Newspaper. A list of Web sites on salmon issues is included under the Resource section of this unit. There may be additional sites learners will want to explore. Leaders might wish to ask parent volunteers to help with typing the learners’ work into the final newspaper format.

**Procedure**

Lead a discussion about the purpose of creating a salmon information newspaper. Have the learners develop a mission statement. What did the learners discover about water quality, watersheds, fish, people, culture, and history that they want to share with others?

Ask the teams to brainstorm a list of possible topics to write about. When they have completed their lists, ask each team to share them with the group. Work with the group to create a final list of topics and student authors who will write each article. Encourage learners to use illustrations, charts, or poetry as needed to communicate the information.

Learners might want to do a community survey at a local shopping center to determine what members of the community believe about salmon issues. See 7C—Salmon Questionnaire journal page for a sample learners might use; or, they can create their own questions. If learners choose to do a survey, be sure they work in pairs with a parent volunteer to assist.

Learners may want to attend a local watershed council meeting and talk to council members. Members of watershed councils are citizens and representatives of many interest groups that may include landowners, private industry, the public sector, or advocacy groups. If possible, get a copy of the local watershed council’s action plan. Review the action plan with learners. Are there ways the learners can publicize service opportunities in their Salmon Newspaper that would promote the health of the local watershed and help the watershed council meet its goals? After the Salmon Newspaper is completed, learners might return to the watershed council to give a report on their work and distribute copies of the publication.

Learners may want to create educational posters and host a community Salmon Science Fair. This would be another place to distribute the Salmon Newspaper to the community.
Hold a contest to design and choose a logo for the Salmon Newspaper. Above all: Have fun.

**Extend the learning**

- *Project WILD Aquatic Education Activity Guide*, To Dam or Not
- To Dam, Living Research: Aquatic Heroes and Heroines
Appendix I

Of People and Fish Journal Copy Pages
Identify each of the fish parts listed below. Match the parts to their function listed on the next page.

- Adipose fin
- Anal fin
- Caudal fin
- Dorsal fin
- Gill opening
- Lateral line
- Operculum
- Pectoral fin
- Pelvic fin
- Scales
1A—Fish Function

A  A covering of the gills
B  A pair of fins used for balance; located below and behind the pectoral fins
C  A special covering on the fish that protects the body from injury
D  A pair of fins used to stay in one place, dive, or rise to the surface; located in front of the pelvic fins
E  A single fatty fin found on some types of fish including salmon and trout; the fin that is removed on hatchery-raised fish before they are released
F  The opening where water exits the fish after passing over the gills; oxygen is absorbed from the water by the gills
G  A single fin used for balance; located near the tail, on the lower surface of the fish
H  A line of scales on each side of the fish
I  This fin moves the fish forward in the water; located on the tail
J  A single fin used for balance; located on the upper surface of the fish
1B—What’s in a Stream?

(1)__________________  (2)__________________  (3)__________________  (4)__________________

(1)__________________  (2)__________________  (3)__________________  (4)__________________

(1)__________________  (2)__________________  (3)__________________  (4)__________________
1B—What’s in a Stream?
Answer key and examples

- Sun
- Riffles/runs/gravel

Habitat component

1. Phytoplankton
2. Zooplankton
3. Juvenile salmon
4. Belted kingfisher

Habitat component

1. Algae
2. Snails
3. Crayfish
4. Raccoon

Habitat component

Woody debris

Silt
### 2A—Salmon Crossword Puzzle

**Across**

(1) When the female salmon lays eggs in a nest and the male salmon fertilizes them. A group of nests is called a redd.
(2) A small, six-legged creature that salmon eat.
(3) Small rocks at the bottom of a stream used by the female salmon to make the redd.
(4) In Oregon, one of five Pacific fish species that have similar life cycles; scientists call them salmonids.
(5) Young fish 3 to 4 inches long.
(6) The area where the fresh water of a river and the salt water of the ocean are mixed.
(7) A large body of salt water where salmon live while growing to their adult size.

**Down**

(1) A small, running body of water that drains to a larger river; the system of connected streams and rivers make up a watershed.
(5) A young fish that has absorbed its yolk sac but has not yet reached fingerling size.
(8) Areas of low light and cool water temperatures where salmon hide.
(9) The groups of nests created by salmon while spawning.
(10) The changes in salmon fingerlings born in fresh water that allow them to live in the salty ocean water. These changes take place while the fingerlings are in the estuary. Young salmon who are ready to migrate out of the estuary into the ocean are called smolts.
(11) Animals traveling over a long distance to find food or to reproduce.
(12) Finding the correct direction to travel on a journey.
2A—Salmon Crossword Puzzle

Words to choose:

ocean  shade  gravel  estuary  smolting
insect  spawn  redds  navigate  fry
salmon  stream  migration  fingerling
2A—Salmon Crossword Puzzle KEY

Words to choose:
ocean  shade  gravel  estuary  smolting
insect  spawn  redds  navigate  fry
salmon  stream  migration  fingerling

Words:
- Ocean
- Shade
- Gravel
- Estuary
- Smolting
- Insect
- Spawn
- Redds
- Navigate
- Fry
- Salmon
- Stream
- Migration
- Fingerling
2B—Salmon Life Cycle Basics Journal

1. The four salmon species we are studying each emerge from the gravel as fry during different months. Number the salmon below with 1 being earliest, 2 being the middle (Note: there are two of these!), and 3 being the last to emerge.

Chinook_______ Sockeye__________

Coho_________ Steelhead________

2. Which two species of salmon may stay in the ocean the shortest period of time?
   A. ___________________________ B. ___________________________

3. Which two species of salmon may stay in the ocean the longest period of time?
   A. ___________________________ B. ___________________________

4. For each species of salmon, list the age span for their return from the ocean.

   Chinook_________ Sockeye__________

   Coho___________ Steelhead________

5. The four species of salmon each return to fresh water and spawn during different months. For each species of salmon, list the months in which they spawn.

   Chinook ______________________ Sockeye ______________________

   Coho ________________________ Steelhead ____________________

6. After spawning, the steelhead salmon may:

   ___________________________________________________________
   ___________________________________________________________
   ___________________________________________________________
   ___________________________________________________________
   ___________________________________________________________
**2B—Pacific Salmon Life Cycles**

**Time in gravel (eggs to eyed eggs to alevins)**
- Chinook: 90 to 150 days
- Coho: 80 to 150 days
- Sockeye: 90 to 150 days
- Steelhead: 50 to 150 days

**Emergence (alevin to fry)**
- Chinook: March to April
- Coho: April to May
- Sockeye: April to May
- Steelhead: June to July

**Fresh water rearing (fry to smolts)**
- Chinook: Less than 1 year
- Coho: Fry remain in stream for 1 year
- Sockeye: Juveniles spend 1 to 2 years in lakes
- Steelhead: 1 to 4 years

**Estuary rearing**
On reaching an estuary, the smolts undergo physical changes that make it possible for them to live in the salt water of the ocean.

**Spawning**
- Chinook: late summer to fall
- Coho: November to January
- Sockeye: August to November
- Steelhead: February to June

**Migration**
After spending from 1 to 5 years in the ocean, the mature salmon seek out the same estuary they left as smolts and begin their upriver journey.

**Grow and mature in ocean**
- Chinook: 3 to 5 years
- Coho: 1 to 2 years
- Sockeye: 1 to 2 years
- Steelhead: 1 to 5 years
2C—Salmon Styles Journal

A key can help you sort items into groups. Keys are made by asking a series of questions. Each question has two answer choices. The answers to the questions help sort the items into their separate groups.

We will create a Pasta Key first. Begin with all the different pasta in the bag. Lay them on the work table where everyone on the team can see them.

**Pasta Key**

1a. This pasta is hollow—go to 2a.
1b. This pasta is not hollow—go to 3a.

2a. Hollow pasta with a bend
2b. Hollow pasta without a bend

3a. Pasta is thin and round.
3b. Pasta is wide and not round—go to 4a.

4a. Pasta is shaped like a spiral.
4b. Pasta is shaped like a bow.
   Write the characteristics of pasta 4b below:

Now you can create a key to the chinook, coho, sockeye, and steelhead salmon.

**Salmon Key**

1a. This fish can spawn more than once.
1b. This fish does not spawn more than once—go to 2a.

2a. Average weight is 30 pounds, spots on upper and lower lobe of tail
2b. Average weight less than 12 pounds, tail with spots on upper lobe only or tail with no large spots—go to 3a

3a. Average weight 6 to 12 pounds, tail with spots (describe the location of the tail spots)
3b. Average weight 4 to 8 pounds, no large spots on tail

You’ve seen how to use a key to sort pasta and salmon. What other things might be sorted easily with a key?

Select one species of salmon to study. Design an experiment to learn more about this salmon’s life in the open ocean, or write a short story about salmon life in the ocean. Research information to support your writing.
3A—Discovering Culture Journal

Answer these questions after you read the legend, “Why the Columbia Sparkles.”

1. What world, other than Earth, is described in the legend? What does this other world look like?

2. What are the foods listed in the legend?

3. How was the salmon preserved to keep for a time and also for trade?

4. Why do the Wishram value dry salmon for trading?

5. What does the cup give to the Wasco? Why do they value their cup?

6. Why were the Wasco jealous of the Wishram?
3B—Salmon Legends Journal

Choose a legend from your culture. This may be a family story, such as How Uncle Ned Caught a Big Fish. You might choose a historical legend, such as George Washington and the cherry tree; or maybe a fable like Paul Bunyan or those written by Aesop.

Record a short version of the legend you chose below. Explain why it is interesting or significant to you and/or your family. Does this legend have a message to teach to future generations? Does your legend teach an explanatory, behavioral, or moral lesson? Use additional sheets of paper if needed.
4A-1—“We Proceeded on…”
North America 1803

1. United States in 1803
2. Louisiana Territory
3. New Spain
4. Spanish Florida
5. Indiana Territory
6. Oregon Country
7. Mississippi Territory
8. Lands held by Great Britain
4A-1—“We Proceeded on…”
North America 1803 (Key)

1. United States in 1803
2. Louisiana Territory
3. New Spain
4. Spanish Florida
5. Indiana Territory
6. Oregon Country
7. Mississippi Territory
8. Lands held by Great Britain
4A-2—“We Proceeded on…” Journal

1) How much money did Congress approve for the mission to explore the west? How much of this money did Lewis spend on gifts for Indians? What did he buy as gifts?

2) List some of the transportation methods used by the different Indian groups that the Corps of Discovery met.

3) How old was Sacagawea when she met Lewis and Clark at Ft. Mandan in the winter of 1804–1805? What did she do that helped the Corps of Discovery succeed?

4) Why was the journey of the Corps of Discovery an important step in reaching President Jefferson’s dream of the United States as a coast-to-coast empire?

5) Fur traders made their way into the Oregon Territory following William Clark’s maps. The city of Astoria near the mouth of the Columbia River in Oregon was the location of the first American fur-trading station. What was the name of the man who started this station?
4B—“Your Observations...” Journal

On June 20, 1803, President Thomas Jefferson wrote a letter to Captain Meriwether Lewis. Captain Lewis and his friend William Clark were to lead The Corps of Discovery in exploring the unknown western region of North America. In this letter, President Jefferson directed that, “Your observations are to be taken with great pains and accuracy, to be entered distinctly and intelligibly for others as well as yourself....”

Following are some journal entries made by Captain William Clark as the Corps of Discovery traveled down the Columbia River toward the Pacific Ocean. Read the journal entries and answer the questions that follow.

October 17, 1805
“Several men and women offered Dogs and fish to Sell, we purchased all the dogs we could, the fish being out of season and dying in great numbers in the river, we did not think proper to use them...”

“I took two men in a small Canoe and ascended the Columbia river 10 miles to an Island...On which two large Mat Lodges of Indians were drying Salmon, the number of dead Salmon on the Shores and floating in the River is incredible...”

October 22, 1805
“5 large lodges of nativs drying and preparing fish for market, they gave us Philburts and berries to eat...on Islands of rocks as well at their Lodges I observe great number of Stacks of pounded Salmon (butifully) neetly preserved...put in baskets two feet long and one foot diameter lined with the skin of Salmon Stretched and dried for this purpose...12 baskets of from 90 to 100 (pounds) each form a stack, thus preserved those fish may be kept sound and Sweet for Several years...”

October 28, 1805
“...The wind which is the cause of our delay, does not retard the motions of these people at all, as their canoes are calculated to ride the highest waves, they are built of white cedar or Pine very light wide in the middle and tapers at each end, with apers, and heads of animals carved on the bow, which is generally raised. These people make great use of Canoes both for transportation and fishing...”

November 4, 1805
“...we landed at a village of 25 houses (Sha-hala N): 24 of those were thatched with straw, and covered with bark...this village contains about 200 men of the Skil-loot nation I counted 52 canoes on the bank in front of this village money of them verry large and raised in the bow...invited us to a lodge...and gave us a roundish roots about the Size of a small Irish potato which they roasted in thee embers until they became soft, this root they call Wap-pa-to...it has an agreeable tast and answers verry well in place of bread. We purchase about 4 bushels...”
1. The Pacific salmon that William Clark saw in the Columbia River were a species of fish he had not seen before. Pacific salmon naturally die after they spawn. They are not sick. Clark thought they were like the Atlantic salmon, which does not die after spawning. He thought the Corps members should not eat the sick salmon. They bought and ate dogs.

If you had been along on the Lewis and Clark Expedition, would you have chosen to eat salmon or dog? Explain your choice.

2. List some of the new foods that the members of the Corps of Discovery learned to eat along their journey.

3. Do you think they would continue to eat these foods when they returned to the United States? Why or why not?

4. From these journal entries, how can we tell that canoes were important to the Indians of the Columbia River?

5. In these entries, what types of houses does Clark describe at the villages?
Of People and Fish Journal

By: __________________________________________
5A—Salmon History Journal

Using the reading pages “5A—The Oregon Territory and Salmon History,” fill in the timeline of salmon history below.

1821 British fur companies tried to trap _____________________ to extinction south of the Columbia River. This was bad for salmon because
____________________________________________________________________________________

1848 Oregon’s population was_______________

1850 Oregon mills began to supply lumber that was used by settlers for
____________________________________________________________________________________

Splash dams damaged salmon streams because they ____________________________________
____________________________________________________________________________________

1859 February 14

1860 Oregon’s population was_______________

1866 The first year ________________ were canned.

1884 The largest number of salmon canneries on the Columbia River was_______________

1890 Oregon’s population was_______________
Fish hatchery projects were begun by _________________________________________________
____________________________________________________________________________________

1910 Oregon’s population was_______________

1930 Oregon’s population was_______________

1933 The first dam on the Columbia River was:
____________________________________________________________________________________

1938 ___________________________ Dam was completed.

Today: There are _________ dams in the Columbia River Basin.

____ The year native salmon and trout return to their historic levels.
5B—Salmon Hazards, Salmon Helpers

Each member of the team captures one fish from the bowl. Place all the captured fish together outside the bowl. This is Sample A. Using the key made in Activity 2C, identify the fish in Sample A. List the number of each species captured in the spaces below.

Sample A data:

Chinook___________  Sockeye__________
Coho___________  Steelhead__________

Salmon Hazards

Dams seem to be especially destructive to sockeye salmon, restricting their ability to migrate to their home streams. Before selecting Sample B, remove all the sockeye salmon from Sample A. Return the other salmon species to the bowl.

Capture Sample B, one salmon to each team member. Identify the fish in Sample B. List the number of each species captured in the Sample B data spaces below. Remove all the sockeye from this sample and return the remaining salmon to the bowl. Repeat this sampling procedure for samples C and D. Record the sample numbers in the data spaces provided below.

Sample B data:

Chinook___________  Sockeye__________
Coho___________  Steelhead__________

Sample C data:

Chinook___________  Sockeye__________
Coho___________  Steelhead__________

Sample D data:

Chinook___________  Sockeye__________
Coho___________  Steelhead__________

How did the number of each species in the sample change over the four samples?
**Salmon Helpers**

Select a salmon restoration method: _________________________

Select a salmon species to restore: _________________________

This is your target species.

Your leader will give you additional Fish Chips and a die. For each round of Salmon Helpers, each member of the team captures one fish from the bowl. If you did not capture two fish from your target species, replace all the fish and go on to the next sample. If you capture two of your target species, roll the die and see how many fish the team will add back into the population in the bowl. Follow this chart to add salmon back into the population:

- If you roll a 1 or a 4 = add 1 fish.
- If you roll a 2 or a 5 = add 2 fish.
- If you roll a 3 or a 6 = add no fish.

After each sample, replace all the captured fish into the bowl and add any fish gained by restoration from the additional Fish Chips provided by your leader.

**Sample E data**: Two of our target species were captured.

- No—Return all the fish to the bowl and go on to Sample F.
- Yes—Roll the die. Die roll was a ___________. We will add ___________ fish.

**Sample F data**: Two of our target species were captured.

- No—Return all the fish to the bowl and go on to Sample G.
- Yes—Roll the die. Die roll was a ___________. We will add ___________ fish.

**Sample G data**: Two of our target species were captured.

- No—Return all the fish to the bowl and go on to Sample H.
- Yes—Roll the die. Die roll was a ___________. We will add ___________ fish.

**Sample H data**: Two of our target species were captured.

- No—Return all the fish to the bowl and go on to Sample I, if needed. Use a sheet of notebook paper to record additional samples.
- Yes—Roll the die. Die roll was a ___________. We will add ___________ fish.

How many samples did you run before the 10 extra fish were added into the bowl population?
6A—Fishing Tools

Label the modern fishing gear in the right-hand column. Draw a line from the Northwest Coast Indian Fishing Gear on the left to the Modern Fishing Gear it most closely matches on the right.

**Northwest Coast Indian Fishing Gear**

- **A**
  - Long line

- **B**
  - Natural sled of abalone

- **C**
  - Small fish put right over the bone barb

**Modern Fishing Gear**

- **D**
  - 

- **E**
  - 

- **F**
  - Snap swivel with a teardrop sinker with line or abalone 6-3.0mm

Small hook carved in wood 3.0cm

To rod

---

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6A—Fishing Tools (continued)

Fill in the blank with the name of the type of reel illustrated. Label the rod and its associated tackle using the words listed below.

G  Reel:___________________________________________________

<table>
<thead>
<tr>
<th>Pole</th>
<th>Line</th>
<th>Hook</th>
<th>Weight</th>
</tr>
</thead>
</table>

Illustrations of Northwest Coast Indian Fishing Gear are used with permission from Indian Fishing: Early Methods on the Northwest Coast, Hilary Stewart, The University of Washington Press, Seattle, 1977.

Illustrations of the Modern Fishing Gear are used with permission from Responsible Angling, The Oregon Angler Education Manual, © Outdoor Empire Publishing Inc. Seattle, WA.
6B—Fishing Techniques

1. List the equipment required for line fishing.

2. List the equipment required for fish traps or weirs.

3. Pretend there are no grocery stores where you can buy food and no sporting goods stores where you can buy fishing gear. You must catch or gather any animals or plants you eat. You must make any tools you need from natural materials such as rocks, bones, or plant parts. Fish are a good source of food. They live in a nearby stream. What method will you use to catch them? Explain why you chose this method. How much time will you spend making the equipment? How much time will you spend catching the fish?
7A—Watershed Explorations

Draw a topographic map to represent the model clay hill you have created.

Connect the X’s on the topographic map to mark the boundary of the large watershed. The light dashed lines indicate the smaller tributary basins that make up the larger watershed.
7B—Fishery Management Decisions

Each team member captures one fish from the bowl. Place all the captured fish together outside the bowl. This is Sample 1. Use the Salmon Identification Information handout to identify the salmon in Sample 1. List the number of each species captured in the spaces below.

Chinook_________________ Sockeye_________________
Coho____________________ Steelhead________________

Tag the Sample 1 salmon by placing a self-stick note onto each Fish Chip.

The total number of salmon caught and tagged in Sample 1 is M.

M = ___________

Return all the tagged salmon to the bowl. Shake the bowl gently to mix the fish chips. Each team member again captures one fish from the bowl. Place all the captured fish together outside the bowl. This is Sample 2.

The number of salmon in Sample 2 is C. C = ___________

How many of the salmon in Sample 2 have a tag? The number of fish caught in Sample 2 with a tag is R.

R = ___________

To estimate the total salmon population in the watershed, you’ll need to add the data from the other research teams in your class to the data you have collected.

Write all the M values from the class here and add them together to get a Total M value.

Total M = ___________ + ___________ + ___________ + ___________ + ___________ + ___________

Total M = ___________

Write all the C values from the class here and add them together to get a Total C value.

Total C = ___________ + ___________ + ___________ + ___________ + ___________ + ___________

Total C = ___________

Write all the R values from the class here and add them together to get a Total R value.

Total R = ___________ + ___________ + ___________ + ___________ + ___________ + ___________

Total R = ___________
Now, use the total data values to do the following calculation to estimate the salmon population:

\[
\frac{\text{Total } M \times \text{Total } C}{\text{Total } R} = \text{______________________________}
\]

The estimated salmon population = __________

The actual salmon population = __________

How close was your estimate?

Conduct the research for two more trials of two samples each exactly as you did above. Record your answers on a sheet of notebook paper. Does the estimated number of salmon in the population get closer to the actual number when you average your data from an increased number of trials?
7C—Salmon Questionnaire

Hello, my name is ________________________________________________________________________ .

I am a member of the Of People and Fish 4-H study group at ________________________________ .

For one of our projects, we are collecting information about how people feel about salmon and salmon habitats in our community. May I ask you six questions about salmon? (If the answer is “No,” say “Thank you” and ask the next person. If the answer is “Yes,” continue.) We are looking for your opinion; there are no right or wrong answers to these questions.

Questions
1. To what extent do you consider the loss of good-quality salmon habitat a problem in our community?
   1 2 3 4 5
   Not at all Moderate Great

2. To what extent do you consider the lower numbers of wild salmon returning to spawn a problem in our community?
   1 2 3 4 5
   Not at all Moderate Great

3. To what extent do you consider the lower numbers of wild salmon returning to spawn a problem in other communities in Oregon?
   1 2 3 4 5
   Not at all Moderate Great

4. To what extent do you consider hatchery-raised fish a solution to the problem of lower salmon populations?
   1 2 3 4 5
   Not at all Moderate Great

5. To what extent do you think dams have contributed to the loss of salmon?
   1 2 3 4 5
   Not at all Moderate Great

6. To what extent do you believe that individual citizens can help save salmon?
   1 2 3 4 5
   Not at all Moderate Great

7. Say “Thank you.”
Appendix II

Materials to Reproduce
<table>
<thead>
<tr>
<th><strong>Duckweed</strong></th>
<th><strong>Phytoplankton</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>We are small, multicelld plants. We grow very fast in quiet pools along the stream edge. Here we may provide shade and cover for tadpoles or juvenile salmon. We provide food for aquatic insects, mallard ducks, and raccoons.</td>
<td>We are small, single-celled plants. We cannot run away when zooplankton, salmon, aquatic insects, and snails come to eat us.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Sedges</strong></th>
<th><strong>Algae</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>We are a plant that grows in wet areas along the edge of the stream. Beetles eat our roots. Ruffed grouse and mallard ducks eat our seeds.</td>
<td>We are small, multicelld plants. We must grow and multiply very fast because so many animals eat us. Some of these animals are aquatic insects, crayfish, tadpoles, and mallard ducks.</td>
</tr>
<tr>
<td><strong>Alder</strong></td>
<td><strong>Oak</strong></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>We are trees and shrubs that grow near streams. When we drop branches, they may fall into the stream, adding to the woody debris. We shade the stream in summer. When we drop our leaves into the stream, algae may grow on them or aquatic insects and crayfish may eat them. Ruffed grouse feed on our catkins. Raccoons use us for shelter.</td>
<td>We are big trees. We may grow in forests and open prairie areas. Mallard ducks, ruffed grouse, raccoons, and humans use our acorns. Land insects such as grasshoppers and beetles may be found on our leaves. The osprey may rest on our branches while eating a salmon. The leftover salmon parts fall to the ground and become fertilizer for us.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Stonefly larvae</strong></th>
<th><strong>Zooplankton</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>We live on or under rocks or stones in the stream. That is where our name comes from. Some of us eat plants. Others of us eat small insects and zooplankton. Fish like to eat us. We also are eaten by raccoons and mallard ducks.</td>
<td>We are tiny animals that are eaten by many aquatic insect larvae, juvenile salmon, and other small swimmers. We need nutrients from phytoplankton, rotting leaves, and animals.</td>
</tr>
<tr>
<td>Snails</td>
<td>Caddisfly larvae</td>
</tr>
<tr>
<td>--------</td>
<td>-----------------</td>
</tr>
<tr>
<td>When we spot a water strider, beetle, salmon, or raccoon, we just pull our foot into our shells. Then we hope we don’t get eaten. Our eyes and mouth are on our foot. Pretty odd? Nope! The phytoplankton and algae we eat grow where we crawl.</td>
<td></td>
</tr>
<tr>
<td>We build little homes around our soft bodies from tiny pieces of gravel or pieces of leaves and twigs. We eat plants and leaves that drop into the stream. We try to hide from mallard ducks, crayfish, and raccoons.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Beetle</th>
<th>Mayfly larvae</th>
</tr>
</thead>
<tbody>
<tr>
<td>I hide under leaves or swim fast to keep from being eaten by frogs or salmon. I just want to eat my mayfly larvae and greens.</td>
<td></td>
</tr>
<tr>
<td>We eat zooplankton and plants. Many animals eat us, including stoneflies, beetle larvae, salmon, and mallard ducks.</td>
<td></td>
</tr>
<tr>
<td><strong>Juvenile salmon</strong></td>
<td><strong>Grasshoppers</strong></td>
</tr>
<tr>
<td>---------------------</td>
<td>------------------</td>
</tr>
<tr>
<td>Once we come out of our gravel nest we are very hungry. We need to eat a lot of food to grow. As we get bigger, we eat bigger food. We eat both plants and animals, including phytoplankton and everything from zooplankton to beetles. There are many of us, because we are eaten by mallard ducks, raccoons, osprey, belted kingfishers, great blue herons, and otters.</td>
<td>Sometimes we come to the stream in search of water, but mostly we get water from the tree and grass leaves we eat. Ruffed grouse, raccoons, and frogs will eat us if we don’t hop fast enough!</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Crayfish</strong></th>
<th><strong>Tadpoles</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>We are the stream sanitation department. We clean up anything dead, often using the body of a dead animal for a temporary home. We also eat algae, caddisfly larvae, and worms. Raccoons, otters, and some people consider us a delicacy.</td>
<td>We are vegetarians, eating only plants such as phytoplankton and algae. When I grow up, I will be carnivorous, eating other animals just like my parents do, who are frogs. Very few of my hundreds of brothers and sisters will survive to have their own eggs, because so many animals like to eat us. We must watch out for raccoons, otters, great blue herons, and belted kingfishers.</td>
</tr>
</tbody>
</table>
### Ruffed grouse
We are forest-loving birds. We like to eat grasshoppers, beetles, berries, sedge seeds, acorns, alder leaves and catkins, wild grape, and woody plants. Very few animals eat us once we are adults. Our chicks may be eaten by raccoons.

### Mallard duck
We live near the stream and on the water. We eat sedges, acorns, and duckweed. We also eat aquatic insects, fish eggs, tadpoles, small frogs, and fish. We even will scavenge on dead salmon. We have many ducklings each spring, because so many are eaten by great blue herons and otters.

### Osprey
We are called “fish hawks” because our main diet is fish. We also may eat snakes, frogs, and ducklings. We need large trees to roost in and to build safe nests for our young.

### Frog
We are mainly carnivorous animals. As you see in cartoons, we love to eat insects. We also enjoy snails and small crayfish. When feeding along the edge of the stream, we have to watch out for mallard ducks, otters, raccoons, and great blue herons.
<table>
<thead>
<tr>
<th>Great blue heron</th>
<th>Raccoon</th>
</tr>
</thead>
<tbody>
<tr>
<td>I can see a frog hiding in the cattails, and I sneak up on him with my big, wide feet. If the frog gets away, I’ll poke in the mud with my long bill to find crayfish or snap at a young salmon. I also enjoy snakes and grasshoppers.</td>
<td>I just love water! Clean, clear water where I can catch my food and wash it, too! I am not afraid of any other stream animals. I like to eat duckweed, acorns, grasshoppers, caddisfly larvae, stonefly larvae, snails, frogs, fish, crayfish, and small creatures found in the water and mud along the shore.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Belted kingfisher</th>
<th>Otter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Our loud cry can sound like a crazy laugh as we swoop over the stream. We eat any small swimmers we can catch: crayfish, frogs, small snakes, beetles, and even young birds. We nest in a burrow that is 3 to 7 feet deep in soft soil on banks or cliffs.</td>
<td>I would rather play than eat. I play every chance I get—even with my food! I like to eat crayfish, fish, beetles, and frogs.</td>
</tr>
</tbody>
</table>
**Habitat component**

**Water quality**

Consistent water temperatures and high oxygen levels are important to the stream. Plants growing on the stream banks shade the water. This helps to keep it cool. Woody debris and boulders help mix oxygen into the water.

**Habitat component**

**Woody debris**

Large branches, logs, and logjams provide shade and create deep pools of cool water.

**Habitat component**

**Riffles, runs, gravel**

Boulders and cobbles create riffles where aquatic insects live. Each type of salmon likes different types and sizes of gravel in a streambed.
<table>
<thead>
<tr>
<th>Habitat component</th>
<th>Salmon carcass</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silt</td>
<td></td>
</tr>
</tbody>
</table>
Unit 2—Fish Chips (These also are used in activities 5B and 7B)
Unit 2—Fish Chips (These also are used in activities 5B and 7B)
Unit 2—Fish Chips (These also are used in activities 5B and 7B)
Unit 2—Fish Chips (These also are used in activities 5B and 7B)
Unit 2—Salmon Identification Information
These also are used in activities 5B and 7B

Chinook salmon
This salmon has many common names, including king, tyee, and blackmouth. The chinook is the largest of the Pacific salmon. They average 36 inches in length with a weight of 30 pounds. Record salmon have been as much as 58 inches in length and 135 pounds.

Chinook can be identified by the black area on the lower jaw at the base of the teeth. This is the most reliable way to distinguish young chinook from young coho. In addition, chinook have large uneven spots along the back; the tail fin rays are smooth; and they have spots on the upper and lower lobe of the tail.

Chinook spawn during late summer and fall in large, deep streams with large gravel and cobble beds. The young stay in the stream until the first fall after they hatch. Mature adults return to their natal streams at 3 to 5 years of age to spawn. They die after spawning.

Coho salmon
This salmon also is known as a silver salmon. They average 25 inches in length, with a weight of 6 to 12 pounds. Large fish can reach 38 inches long and 31 pounds.

Coho can be identified by the white area on the lower jaw at the base of the teeth. In addition, they have small round spots on the back; the tail fin rays are ribbed; and the tail has spots only on the upper lobe.

Coho spawn from November to January. They prefer shallow, slow-moving streams with small gravel. The young stay in freshwater streams for 1 year. Mature adult coho return to their natal stream at 1 to 2 years of age to spawn. They die after they spawn.
Unit 2—Salmon Identification Information
These also are used in activities 5B and 7B

Sockeye salmon

This salmon also is known as red, blueback, and kokanee. Kokanee is the name given to sockeye salmon who live in lakes, never migrating to the ocean. Sockeye average 20 inches in length and weigh 4 to 8 pounds. Large fish can reach 33 inches and weigh up to 15 pounds.

Sockeye spawn from August to November. Eggs are laid in course gravel of streams that drain lakes. Upon hatching, the fry move upstream into the lakes. Sockeye juveniles rear for 1 to 2 years in the lakes before migrating to the ocean. After 1 to 2 years in the ocean, the adults return to the lake to spend 1 to 8 months before spawning. They die after spawning.

Steelhead salmon

Once considered a sea-run rainbow trout, the steelhead now is classified with the Pacific salmon. They average 25 inches in length and weigh 5 to 10 pounds. Large fish can reach 45 inches and 43 pounds.

Steelhead return from the ocean in two runs. The “summer run” begins in June. The “winter run” begins in September. Spawning for both runs occurs between February and June. Eggs are laid in clear, swift-moving streams with small to medium gravel. After 1 to 4 years in the natal stream, the young migrate to the ocean for the first time. They grow for another 1 to 5 years in the ocean before making their first trip back to the natal stream.

Steelhead do not always die after spawning. The younger steelhead go back to the ocean for a time, then return to their natal stream to spawn again.
Unit 7—Oregon’s Major Drainage Basins

- Willamette River
- Umpqua River
- Rogue River
- Illinois River
- Deschutes River
- Columbia River
- Umatilla River
- John Day River
- Snake River
- Malheur River
- Owyhee River
- Illinois River

Limit of migratory fish populations

Drainage basin boundaries
Appendix III

Resource Materials and Publications to Buy

Materials are listed in the order they are used first in the curriculum guide. Although some materials are used in more than one lesson, they are listed only once below.

Be sure to consult the materials list for each lesson you will conduct. To prepare for some lessons, you’ll need to photocopy journal page handouts (Appendix I) or activity cards (Appendix II), or build equipment (Appendix IV).

Not all materials for each lesson are listed below. Only those that may require purchase from a specialized source are listed here.

**Resources used in more than one lesson**

*Field Guide to Pacific Salmon* (Units 1 and 2)—The Adopt-A-Stream Foundation, (425) 316-8592

Salmon Life Cycle poster (Units 2, 5, and 7)—Washington Department of Natural Resources

*Salmon Nation* (Units 2, 3, 5, 6, and 7)—EcoTrust, 1200 NW Naito Parkway, Suite 470, Portland, OR 97209

*Salmon of the Pacific Coast* (pamphlet) (Units 2 and 5)—U.S. Fish and Wildlife Service

The following are available from your local OSU Extension 4-H office (see the “government” listing in your local phone book):

*Project WILD Aquatic Education Activity Guide* (available after participating in a Leader Training workshop)

*4-H Wetland Wonders* (4-H 3801L)

*Our Water World: 4-H Marine Science Discovery Project* (4-H 350L)

**Unit 1**


Two lengths of poly-rope

**Unit 2**

18 hand lenses

Fish bowls (6- by 8-inch mini-aquaria)—any biological supply company
Unit 2 (continued)

Vials of preserved salmon eggs, alevin, and fry—Blue Spruce Biological Supply, 1-800-825-8522

Video: *Life Cycle of Salmon* (V-99-002)—Oregon State University Extension Sea Grant Communications, (541) 737-2716

Water spray bottle

Unit 4

The following are available from the Ft. Clatsop Interpretive Store, (503) 861-4452.

Map: Lewis and Clark from the Bitterroots to the Pacific

Video: *We Proceeded on…*

Booklet: *Kids Discover Lewis and Clark*

Unit 5

Video: *The Return of the Salmon* (V-99-001)—Oregon State University Extension Sea Grant Communications, (541) 737-2716

Six dice

Unit 6

Shallow, plastic, shoe-size storage boxes

Blue modeling clay

Craft foam

Six casting rigs (see Appendix IV)

Six casting targets

Unit 7

Oregon roadmaps

Six sections of thin wire

*What Can We Learn at the Habitat Area Pond?* (4-H 3101L)—Oregon State University Extension Publications. For price and ordering information, see the online catalog ([http://eesc.oregonstate.edu](http://eesc.oregonstate.edu)) or fax (541-737-0817), e-mail (puborders@oregonstate.edu), or phone (541-737-2513 or 1-800-561-6719).
Appendix IV

Unit 6—Make a Casting Rig

You can make casting rigs using dowels or old soda cans for the fixed spool. The spool holds the line. The momentum of the bait, lure, or casting plug pulls the line off the spool.

The instructions below are for making a casting rig with a dowel. If you use a can, attach the line to the can with duct tape.

**Materials**

- Wooden dowel, 1½ inches across, cut to a length of 8 inches
- Nylon fishing line, approximately 5 feet in length
- Snap swivel
- Rubber casting plug

1. Sand the dowel, particularly on the cut ends, to avoid slivers.
2. Mark the dowel 3 inches from one end, dividing it into a 3-inch part and a 5-inch part.
3. Drill a hole through the dowel at the 3-inch mark. The hole need only be large enough for the fishing line to pass through.
4. Thread the line through the hole and tie it off.
5. Wrap approximately 5 feet of line around the 3-inch end of the dowel. The 5-inch end is the handle.
6. Attach a snap swivel to the line and a casting plug to the swivel.

You are now ready to practice casting.

When you are done casting, if you are storing more than one casting rig, put a piece of duct tape over the line on each dowel to keep them from getting tangled together.