Salmon Watch®

CURRICULUM

10th edition

Prepared by
The Freshwater Trust Staff

Illustrations by Adriana Martinez

TABLE OF CONTENTS

INTRODUCTION TO SALMON WATCH

When we see land as a community to
which we belong, we may begin to treat
it with love and respect.

-Aldo Leopold

THE THE FRESHWATER TRUST SALMON WATCH VISION AND MISSION

Historically, an estimated 16 million wild salmon returned in a given year to their native streams in the Columbia River basin to spawn. Now, fewer than one million wild salmon will return. Human activity in the Pacific Northwest has resulted in severe loss of natural habitats, including those that support native salmon populations.

From its beginnings in 1983, The Freshwater Trust has worked for the restoration of our wild fish heritage. Through innovative programs and projects, the non-profit organization has actively supported:

- effective fish resource conservation advocacy at state, regional and federal levels.
- coordinated and collaborative regional fishery management.
- more funding for watershed restoration and hands-on habitat improvement.
- restoration of stream flows that will support healthy wild fish
- protection of the last remaining healthy native fish populations.
- and advocacy for inclusion of watershed protection within natural resources planning.

In 1993, The Freshwater Trust launched the Salmon Watch program with the goal of instilling in the next generation of decision-makers an ethic of stewardship that incorporates the conservation of our wild fish heritage into their view of watershed management. Coupled with classroom instruction and community service projects, Salmon Watch is designed to enable students to understand and relate to the natural world on a personal level by witnessing spawning salmon, one of nature's great spectacles, and actively assessing the health of local watersheds. The program's objectives are to foster a deeper appreciation and understanding of the value of native salmon to our natural heritage and to indigenous cultures, and to empower students with the capacity for taking responsible action in their communities.

Since 1993, hundreds of classrooms, serving over 60,000 students in Oregon, have experienced Salmon Watch. In 1997 the Salmon Watch program earned the Governor's Community Partnership Award for its collaborative approach. Recently, The Freshwater Trust received word that the Salmon Watch program had been selected for national recognition by the U.S. Forest Service for raising public awareness. The Freshwater Trust was presented with its award at the U.S. Forest Service's Rise to the Future reception held in Washington D.C. on June 21, 2005.

SALMON WATCH PROGRAM GOALS

To foster:

- a deeper connection between humans and the ecosystems with which we live.
- a strong recognition of salmon as an important indicator of watershed and environmental health.
- a greater respect of the value of restoring native wild stocks to sustainable levels.
- an understanding of the importance of salmon to native culture and Native American philosophy about nature.
- a sense of stewardship towards the environment through participation in community service projects.

UNIQUE PUBLIC-PRIVATE PARTNERSHIP

Salmon Watch is a collaborative educational effort involving: The Freshwater Trust, local, state and federal governmental agencies, private foundations, corporations and business, educators, Native Americans and other interested volunteers. Partners contribute both dollars and volunteer time to help implement the program. Some partners assist Salmon Watch by providing expertise on a specific work task, i.e. reviewing curriculum, providing equipment, etc. Listed below is the current list of Salmon Watch Partners. For the most a complete listing of *Healthy Waters Institute*® supporters, please visit www.healthywaters.org/partners.html.

Principal Salmon Watch Partners

The enclosed curriculum was prepared with the aid and advice of Melanie Anderson, Eric Baack, Glenn Biehl, Erica Brim, Patty Bowers, Mike Cloughesy, Susan Cross, Rose Marie Davis, Norie Dimeo-Ediger, Roy Iwai, Marlene Orchard, John Femal, Rand Fisher, Frank Graham, Jay Hopp, Al Hughes, Walt Hollands, Debbie Hollen, Dave Homer, Rebecca Martin, Karen Kelly, Cherie Kinnersley, Judy Li, PhD, Jim Martin, Mark McCallister, Paula Minear, Jason Miner, Elizabeth Moore, Suzanne Moore, Marvin Pemberton, Stephen Phillips, Lizanne Saunders, Mary Ann Schmidt, Julie Schreck, Deborah Scrivens, Julie Smith, PhD, Bill Smiley, Jim Stark, Dan Shively, Debbie Suing-Cassell, Tom Tattam, Ellen Taussig, Karl Weist, Scott Welch, Lynn Wilson, and Jennie Winston.

Organizational support from the U.S. Forest Service, Oregon Department of Fish & Wildlife, P.S.U. School for Science Education, Weyerhaeuser, EWEB, Oregon State University, Metro Parks & Greenspaces, Pacific States Marine Fish Commission, Northwest Power and Conservation Council, Portland Public Schools, North Clackamas School District, The Freshwater Trust Conservation Department, Forests Today and Forever, Oregon Forest Resources Institute

CURRICULUM AND TEACHER'S GUIDE

> *When students are invited to move their education beyond the walls of the classroom and engage genuine action, they are given the opportunity to synthesize knowledge, skill and character; to test their preconceptions and misconceptions against real experience; and to learn both to follow and to lead as members of a learning organization. Thus, the action components of environmental education have the potential to help schools manage the transition to a postmodern world.*
>
> William F. Hammond, "Educating For Action"
> November/December 1997, Clearing Magazine

The Salmon Watch curriculum is designed to provide a holistic, multi-disciplinary and watershed-based approach to environmental education, using the salmon as the key indicator species of watershed health and the cultural icon of the Pacific Northwest. The following units contain many different ideas, lessons, and supplementary resources to help in your teaching about nature, salmon, water quality, and human choices.

Central to Native Americans is the belief that all things and all beings are interconnected. The circle or hoop symbolizes this, because anything that affects one part of the circle affects all the others. How humans interact with animals, with nature, with the spirit world, and with each other, therefore, touches everyone's well being. Central to a scientific understanding of watersheds, ecosystems and life of the salmon, one also must understand the cycles, circles and hoops or the interconnectedness of all things. To this end, cycles, circles and hoops will form a theme that weaves itself through this curriculum instilling students with a clear understanding of interconnectedness.

It is understood that because Salmon Watch field trips often occur within the first month of school, teachers are hard-pressed to provide students with background knowledge of this subject matter and the skills to not only appreciate an outdoor experience, but also to conduct a serious assessment of the health of the watershed site that they visit. To this end, the curriculum has been designed so that Units 1 and 2 contain lessons, activities and information that provide good and balanced preparation for students before they are thrust upon nature and sensitive salmon habitat. Upon completion of the Salmon Watch Field Trip, Units 3-7 will fill in the gaps of knowledge and provide a more comprehensive view the subject matter and the issues surrounding salmon in the Northwest.

The curriculum was designed not only to serve a wide variety of ages, grades and skill levels, but also to accommodate the gamut of learning styles and ethnic backgrounds and to help teachers meet the requirements of the Oregon 21st Century School Act. Particular measures were taken to develop lessons that require active, participatory and experiential learning.

Each unit designates lessons and activities as introductory, advanced, and extension. For example, if you are an instructor teaching a senior advanced biology class, you may want to review some of the ideas and concepts in the introductory lessons, move right into the advanced activities and possibly the extension lessons. If you are a seventh grade earth science teacher, you probably want to engage your students in the introductory activities and skip the advanced lessons. Obviously, only a teacher will know exactly what is appropriate for a class or particular student; that is why we have tried to make this guide as user-friendly and accessible as possible.

SW Alignment with Science Standards

The Salmon Watch program has gone to great lengths to align itself with the ODE Science Standards. We believe the curriculum is designed in such a way that students can achieve the high standards set forth by the state. This curriculum will raise student achievement by:

- Raising expectations for students.
- Focusing curriculum and instruction on higher standards built on the basics.
- Holding students accountable for achieving the standards through assignments and projects.
- Using the community as a learning resource.
- Forging new working partnerships among schools, parents, employers and communities.

At the beginning of each lesson we have identified 6th grade, 8th grade, and High School Core Science Standards: Structure and Function, Interaction and Change, Scientific Inquiry, and Engineering Design.

A complete list of the aligned standards for the SW curriculum can be found in the APPENDIX

CURRICULUM OUTLINE:

Unit 1	Preparing for Salmon Watch
Unit 2	Field Trip Planning and Implementation
Unit 3	Native American Indian Relationship to Salmon
Unit 4	Salmon
Unit 5	Life in a Watershed
Unit 6	Humans and their Environment
Unit 7	Service Learning Projects
References & Resources	Internet Resource
	Salmon Related Videos
	Bibliography
	Maps and Atlases
	Glossary

TIMELINE FOR A SALMON WATCH YEAR

TIME	ACTIVITY
Summer	Visit and evaluate site/develop field trip schedule
September	School year begins, prepare students for field trip experience, Salmon Watch field trips begin (Trips run from mid-September through Mid-November)
October	Begin discussion of community service project opportunities
November	Select community service project and develop implementation strategy
December	Send in SW field trip Teacher and Students Evaluations, due by Dec. 31 Send in reimbursement requests and documentation, due by Dec. 31 Post SW data to StreamWebs
April	Re-enrollment letters sent for next Salmon Watch field season
May	Registration fees and contracts due for fall field trips
June	Service-Learning Project evaluations due

RESPONSIBILITIES OF SALMON WATCH PARTICIPANTS

The Freshwater Trust and Salmon Watch Staff

- ❑ Provide school reimbursement funds for transportation and substitutes if needed.
- ❑ Recruit and prepare teachers and volunteers for field trip with full-day summer training sessions.
- ❑ Provide teachers with curriculum, instruction on how to best use the curriculum, and selected educational resources.
- ❑ Work with agency officials to determine appropriate field sites and optimal salmon viewing dates and times.
- ❑ Coordinate field trip staff.
- ❑ Assist teachers and students with their community service projects when requested.
- ❑ Provide the communication link between teachers, agencies and volunteers.
- ❑ Secure program funding and partner support.
- ❑ Facilitate on-going program expansion, revision and planning.

Volunteers

- ❑ Attend half-day training session. (Required for all new volunteers).
- ❑ Assist, support and facilitate the students' field trip learning experience. (The key is to find the balance between helpful and overbearing).
- ❑ Communicate with teachers about trip agenda, equipment needs and teacher expectations.
- ❑ Ensure safety! Bring a first aid kit, cell phone, know the hazards of the site, etc.
- ❑ Assist teachers and The Freshwater Trust staff with on-going site selection and review.
- ❑ Follow through and attend field trip date(s) agreed to (or arrange for a replacement).
- ❑ Assist with community service learning projects where appropriate.
- ❑ Assist in the evaluation of the program.

Teachers

- ❑ Attend half-day training session. (Required for all new teachers).
- ❑ Prepare students for Salmon Watch field experience:
  - ✓ Clarify program goals.
  - ✓ Discuss safety guidelines.
  - ✓ Communicate appropriate outdoor clothing.
  - ✓ Communicate lunch, drink and snack needs.
  - ✓ Discuss field trip behavior with students.
- ❑ Complete preliminary visit to trip site:
  - ✓ Meet with The Freshwater Trust representative.
  - ✓ Check out safety hazards.
  - ✓ Complete preliminary agenda
  - ✓ Prepare map and/or driving directions to site.
  - ✓ Identify nearby toilet and emergency medical facilities.
- ❑ Provide pertinent information for parents:
  - ✓ Purpose and nature of trip.
  - ✓ Site of trip.
  - ✓ Times of departure and return.
  - ✓ Proper student clothing.
  - ✓ Invitation to attend field trip.
  - ✓ Obtain signed parental permission slip.
  - ✓ Information about The Freshwater Trust.
- ❑ Contact volunteers and other adult participants (at least two weeks before trip):
  - ✓ Discover and utilize their areas of expertise.
  - ✓ Arrange preliminary planning meeting among all adult participants (if possible).
  - ✓ Discuss preliminary field trip agenda.
  - ✓ Clarify what you expect of them.
  - ✓ Explain student expectations.

  - ✓ Determine time and place of rendezvous.
  - ✓ Confirm equipment needs, equipment available for check out from The Freshwater Trust office or other designated pick-up location.
  - ✓ Finalize field trip agenda.
- ❑ Complete school administrative requirements:
  - ✓ Obtain permission from school officials.
  - ✓ Obtain written permission from parents.
  - ✓ Complete standard field trip procedure in your school.
  - ✓ Order bus.
  - ✓ Arrange for substitute teacher if needed.
- ❑ Confirmation of trip information with The Freshwater Trust representative:
  - ✓ Send copy of agenda to The Freshwater Trust in advance.
  - ✓ Number of students expected (30 or fewer).
  - ✓ Grade level of students.
  - ✓ Times of arrival and departure.
- ❑ Safety precautions:
  - ✓ Bring first aid kit.
  - ✓ Identify in advance any field trip participants with medical or safety training.
  - ✓ Bring cell phone (if available).
  - ✓ Bring list of participants with special medical needs.
- ❑ Complete other necessary arrangements:
  - ✓ Student handouts prepared.
  - ✓ Special equipment acquired.
  - ✓ Lunch provisions.
- ❑ Facilitate classroom learning using Salmon Watch curriculum.
- ❑ Facilitate and coordinate student community service project development and execution.
- ❑ Evaluate Salmon Watch program.
- ❑ Provide site-monitoring information.
- ❑ Ensure students report data to StreamWebs

Students

BEFORE THE TRIP
- ❑ Have all permission slips signed and turned in.
- ❑ Know objectives and basic concepts of watersheds and salmon.
- ❑ Have snacks, a lunch and something to drink.
- ❑ Have layered clothing and rain gear (see list in Unit 2).
- ❑ Bring other equipment that will improve your trip experience (see list in Unit 2).

DURING THE TRIP
- ❑ Use techniques and skills for experiencing nature (see Unit 1).
- ❑ Practice low impact walking and follow field site and safety protocols.
- ❑ Leave no trace of your visit.
- ❑ Bring sense of adventure and curiosity.
- ❑ Practice good data collection and field notes.

AFTER THE TRIP
- ❑ Complete Student Evaluation.
- ❑ Use your data to analyze the health of the watershed you visited.
- ❑ Develop and execute an action plan for your community service learning project.
- ❑ Write and mail thank you letters to volunteers.
- ❑ Report data to StreamWebs.

PREPARING FOR
SALMON WATCH

Illustration by Susan Schwarts, Hidden Valley High

UNIT 1. PREPARING STUDENTS FOR SALMON WATCH

INTRODUCTION:

Because Salmon Watch field trips are almost always in the fall, when school is just under way, we have designed the five lessons in Unit One to be activities that will provide a good base of knowledge and understanding and some pertinent skill development for participation in their field experience.

OBJECTIVES:

Students will know and understand:

- the purpose of the Salmon Watch program and program expectations.
- how to reestablish and fine-tune skills and senses for nature observation, exploration and appreciation.
- the interconnected, dynamic and complex nature of watersheds and the efforts under way to restore unhealthy systems.
- how to use and read topographic maps to gain a further understanding of the watershed site they are visiting.
- the general terms and process of the life cycle of the salmon.

SECTIONS:

A. Introduction of The Freshwater Trust, and the Salmon Watch Program
B. Nature Awareness and Observation: Skills, Techniques, and Exercises
C. The Watershed Web of the Wild: Major Concepts and Terms
D. Watershed Mapping
E. Salmon Life Cycle – See The Journey of Wild Pacific Salmon in Salmon Chapter 4

1A. INTRODUCTION TO THE FRESHWATER TRUST AND SALMON WATCH

TIME (min.)	LEVEL
20-30	All

MATERIALS:

- STUDENT HANDOUT 1A: *A Celebration of Wild Fish*
- STUDENT HANDOUT 1B: *The Importance of Wild Salmon*
- STUDENT HANDOUT 1C: *The The Freshwater Trust/Salmon Watch Mission & Vision*
- STUDENT HANDOUT 1D: *Student Responsibilities for Salmon Watch*

OBJECTIVES:

A. To facilitate student understanding of the purpose, goals, and objectives of the Freshwater Trust and the Salmon Watch experience.

B. To facilitate student understanding of the expectations and responsibilities of being involved in the Salmon Watch program.

C. To facilitate an understanding of why wild salmon are magnificent and important fish.

PROCEDURE:

1. Read aloud the STUDENT HANDOUT 1A: *A Celebration of Wild Fish*. This legend will help to illustrate the historic legacy of wild salmon to this region. Assign STUDENT HANDOUT 1B: *The Importance of Wild Salmon*. This is an excellent essay, which begins to reveal to students the magnificence and importance of the fish they are about to study.

2. Following the legend, read the brief introduction in STUDENT HANDOUT 1C: T*he Freshwater Trust/Salmon Watch Mission and Vision*. This lays out the purpose, goals and objectives of the Freshwater Trust and the Salmon Watch program. Also, review with students their responsibilities as well as what the Freshwater Trust and the Salmon Watch staff will do for them in STUDENT HANDOUT 1D: *Student Responsibilities for Salmon Watch*.

1B. NATURE AWARENESS AND OBSERVATION: SKILLS, TECHNIQUES AND EXERCISES

TIME (min.)	LEVEL	BENCHMARKS
60-90 to review skills Practice: on-going	All	H.2L.2

MATERIALS:
- ❑ STUDENT HANDOUT 1E: *Nature Awareness and Observation*
- ❑ STUDENT HANDOUT 1F: *Pathways to Nature*

OBJECTIVES:
In preparation for nature observation and fieldwork, students will learn and practice skills and techniques that will:

A. re-invigorate senses.
B. increase awareness of surroundings.
C. hone observational skills for detecting wildlife.

PROCEDURE:
1. As a class, read aloud with students STUDENT HANDOUT 1E: *Nature Awareness and Observation*.

2. Using the PATHWAYS TO NATURE section as your guide, facilitate sensory skill building. It is best, if at all possible, to have students perform these skills in an outdoor, natural setting.

3. The culminating fun activities that requires students to use and hone their skills and techniques are THE RABBIT GAME and THE NATURE HUNT EXERCISE. Again, it is best, if at all possible to have students perform these skills in an outdoor, natural setting.

4. Hand out to students STUDENT HANDOUT 1F: ***Pathways to Nature***. This handout reiterates, reminds and reinforces all that they have actively learned.

PATHWAYS TO NATURE:
1. TECHNIQUES FOR LEARNING RELAXATION & PATIENCE
The first skill to acquire to experience nature is to learn the art of quieting, relaxation, or, as Tom Brown puts it, “the sacred silence.” When the mind is tense, all functions are impaired and perceptions obscured, and the ability to observe keenly is hampered. But when the mind is at peace, we function better, learn better, and one’s sensory awareness is more heightened and keen.

To teach students to relax, this should be done under the guise of some other activity. This way concentration can be on learning a new lesson or skill, without guessing that you are teaching them to slow down and be at peace. It is not necessary to have them sit to learn relaxation. Relaxation can be dynamic and moving. It is best, if at all possible, to have students perform these skills in an outdoor, natural setting.

Before entering nature remind students to:

Clear your mind of all the clutter that has accumulated during the process of daily living. This mental purification actually occurs quite naturally during an extended stay in the wilderness.

Slow Down and escape the "time trap" of modern life. Walk and move at a snail's pace. A slower pace makes it easier for your eyes to pick up the swoosh of a salmon's fin, the flick of a deer's tail or the claw marks of a bobcat.

Sit Down and stop altogether. Don't let speed and time rob you of wonder and discovery. Nature will begin to unfold its secrets.

Be Quiet. It should be obvious that you will experience more in nature if you are silent. In nature, silence is the rule and noise is the exception. Most animals communicate more by gesture and touch than by sound. Since humans are the most lethal predator, the human voice almost always a danger signal that causes wildlife to run or hide.

2. TECHNIQUES FOR LEARNING TOTAL SENSORY AWARENESS

Students need to be taught to reach out with their senses. Encourage them to watch the landscape carefully, paying attention to colors, textures, shapes, shadows, and movement. Help them to pay attention to scents and where those smells come from. Have them listen carefully to the various songs of nature, and let them touch and feel everything they can. By teaching students to exercise their senses, you sharpen those senses, make them more vivid and inexorably effect a reversal of the dulling routines of society.

SENSORY EXERCIZES

Get outside! Take students into a field or as far from the classroom and the modern world as seemingly possible to conduct these exercises. Students, at first, may seem reluctant and feel ridiculous with these activities, but gradually they'll get into it and will enjoy watching their senses become acute. As the facilitator, have students exercise their various senses through the following suggestions:

A. SIGHT

Have students:

- ♦ Pick out color, texture, shape, shadow and movement on the landscape.
- ♦ Search the landscape for the less subtle colors and textures.
- ♦ Study details carefully.
- ♦ Look deeply at flowers, leaf shapes, grains of sand, and feathers.
- ♦ Observe closely the pattern of insects, spider webs, and other intricate things.
- ♦ Push their sight from near to far, and have them scan the landscape in ever-widening semicircles, from their feet to the horizon.
- ♦ If possible, hand out magnifying glasses to scan the ground looking intently at pebbles, plants, insects, etc.

B. HEARING

Have students close their eyes (or blindfold them) and:

- ♦ Listen to the purity of sounds.
- ♦ Listen near and far, and urge them to pinpoint as best they can the exact position of what they hear.
- ♦ Listen to the wind in the trees, the shrubs, and the grasses, and pick out the variations in the tone of each.
- ♦ Listen to the music of insect wings, the gurgling of water, and the trembling of sounds.
- ♦ Listen to the symphony of nature as a whole, then separate each part, until they know the origin and instrument of each sound.
- ♦ Focus hearing by cupping their hands around their ears, making a shape like a deer's ear. By doing this, one can hear in one direction and pick up sounds that would normally escape them.

Birding and hearing:

- Listen closely to what the birds are saying.
- Are they making long and musical sounds? If so, they are singing and all is well with them.
- Are they making a short, choppy, and hard to locate sound? This is called a call or alarm call. Birds use alarm calls to warn other birds and animals of approaching danger.

C. TOUCH

Have students (again, blindfolding students, will enhance their sense of touch and hence their ability to concentrate):

- Lie on the ground. Ask them to use their sense of touch to feel the earth, the atmosphere, the cool and warm places, and the damp and dry places.
- Touch everything through exploration (this also may be a good time to discuss low impact exploration), the rough bark on trees, the flowers, feathers, tracks, water, insects, and plants of all types.

D. **TASTE AND SMELL** (These two senses are dependent upon each other)

Have students hone their sense of smell and taste by conducting taste tests using the following. Have students first smell and then taste:

- Different kinds of water (bottled, tap, well, potable stream).
- Different kinds of exotic teas made from wild edible plants.
- Different kinds of fruits and veggies.

For smell only:

- Different types of wood, plants, mosses, soils, tree leaves, etc.

In nature, have students:

- Smell the ground at various locations and see if they can tell the difference in each area.
- Smell animal dens, runs, and trails to see if they can detect the smell of that animal in the landscape.
- Smell what is ordinarily not smelled, like leaves, the bark of trees, oncoming storms, or rocks.

SPLATTER VISION

This technique was used by Native Americans to spot game, and is also used by most animals to spot danger. Simply looking toward the horizon and allowing your vision to "spread out" does it. In other words, instead of focusing on a single object, allow the eyes to soften and take in everything in a wide half-sphere. The effect is a little like putting a wide-angle lens on a camera. Suddenly your field of vision is greatly increased.

The secret of making splatter vision work is to slip in and out of it at frequent intervals. Soon this shifting of focus will become habitual. You'll start out with splatter vision, detect movement, focus on it, and then move back into splatter vision all in a second or two. In time you will be able to process a great many things without even coming out of splatter vision.

The technique

Have students:

- Put their arms straight out to the sides at shoulder level.
- Point their fingers forward and wiggle them.
- By looking straight ahead – get so that you can see both hands.
- Think of seeing out of the corners of your eyes.
- Try to pick up the things that are passing on the outermost fringes—trees, bushes, logs, etc. Then notice that, without moving your head or your eyes, you can be aware of almost anything in your field of vision just by choosing to see it. If a bird blinks, a blade of grass moves, a flying bug --- you now can see it!

In nature, encourage students to:
- Look at more than just the trail ahead.
- Look beyond the prominent features of the landscape and pick out what is normally unseen.
- Move their eyes so that they can draw their attention to things that they would otherwise miss.
- Keep their senses active, keep them moving, and keep showing them exciting things so that they will want to keep their eyes moving.

MOVING IN NATURE

Learning how to move in nature is very important in order to fully observe your surroundings. There are proper techniques of moving much like dance or an oriental art form such as t'ai chi. With the technologization of walking surfaces, heavy footwear with big heels, and the fast pace of modern life, humankind's walk has become sloppy, damaging, and weak.

The Fox Walk

Learning from our sly four-legged friends, we can learn to effectively move through nature using the following techniques:

- Stop talking.
- Ease down your pace into slow motion.
- Shorten your stride.
- Lightly touch your foot on the ground before the weight of your body is committed.
- Place only the outside edge of your foot on the ground.
- Gently roll your foot down (inwardly) flat.
- Slowly move your weight forward in a flowing motion.
- Center your gravity at the center of your hips.
- Do not look at the ground.

Walkers should be able to feel exactly what they are stepping on. If you feel a twig that might snap, you now have the ability to pick your foot and place it in a new spot without looking down.

Upon feeling confident, have students take off their shoes and socks. Have them notice that when fox walking barefoot, even on sharp stones, they will not hit the heel, but will walk, quite naturally. Also, have them notice their ability, with the fox walk, to freeze easily.

The Rabbit Game

Form a circle with one person in the center pretending to be a **rabbit**. When the rabbit looks at you **freeze!** When the rabbit is not looking at you, **Fox Walk** toward it. See who can reach the rabbit first. Try two rabbits. This is the same way to sneak up on a real animal.

Practice the fox walk at home. See if you can sneak up on a cat or dog without scaring them.

Practice the fox walk outside. See if you can approach beetles, bugs, birds, frogs, chipmunks, squirrels, deer or anything else. In time your fox walking skills will allow you to observe more and more wildlife.

OTHER CONSIDERATIONS FOR NATURE OBSERVATION

- Think camouflage. It is important not to wear a solid color. Dress in a check or a plaid and darker-patterned clothing, to help break up the outline of the body.
- Wash beforehand with a natural, non-perfumed soap and/or shampoo.
- Do not wear perfumes, colognes or scented deodorants.
- Be aware of which way the wind is blowing and try to be upwind from where you think wildlife may be observed.

THE NATURE HUNT EXERCISE

To hone total sensory awareness, splatter vision, and the fox walk engage students in a non-competitive exercise similar to a traditional Easter egg hunt. Hide several small things that have some sort of an odor, and are out of character for the landscape, like hot dogs, or candies or perfumed stuffed animals. Explain to students that this is an exercise that requires use of all the skills that have been learned. The more items that one is able to find, shows that the person has the necessary skills to be an excellent nature observer. You may also give students style credit for the best fox walk, use of “deer ears,” etc. Make sure to relate and enforce the following two rules.

- Silence. We are learning techniques to view wildlife. If any noise is detected, especially talking, you are disqualified (you’ve scared the animals and they’ve run off!)
- Low impact. If any impact is detected like a broken branch, a moved rock, or a deep footprint, you are also disqualified.

1C. THE WATERSHED WEB OF THE WILD

TIME (min.)	LEVEL	BENCHMARKS
60-90	All	6.2L.2 8.2P.2 H.2L.2 H.2E.4

MATERIALS:
- ❑ STUDENT HANDOUT 1G: ***The Sacred Circle***
- ❑ STUDENT HANDOUT 1H: ***What is a Watershed?***
- ❑ Two large balls of string
- ❑ Scissors
- ❑ A large space to conduct the activity

INTRODUCTION:
This activity brings students out of their seats and introduces them to a host of important concepts and ideas that are central to preparing them for their Salmon Watch field experience. First, as students form a circle, they learn about the symbolic significance of the circle in Native American culture. Second, students engage in actively creating a symbolic, pristine watershed and learn how it functions as an interconnected, multifaceted, dynamic and complex web. Then, students witness and feel what happens to this watershed when parts of this dynamic system are impacted or damaged. Tension in the web is felt throughout and every part is affected. So as not to leave students "bummed out" or without hope by this experience, students learn about real actions by students, community members, agencies, organizations and governments currently in motion in Oregon to restore the health and viability of watersheds.

OBJECTIVES:
Students will know and understand:
- the significance of the circle in many Native American cultures.
- the significant parts of a watershed ecosystem.
- the concepts of an indicator species and biodiversity.
- the roles that parts of the watershed have to the health of the watershed and ultimately to the salmon and the stream.
- the interconnectedness of all parts within a watershed.
- the various elements that can have an impact on a watershed.
- the elements of restoration in Oregon's watersheds.

PROCEDURE:
PART I. The background
1. Have students read the brief introduction, STUDENT HANDOUT 1H: ***What is a watershed?***

2. Cut out the WATERSHED PARTS and WATERSHED ROLES sections on the following pages and randomly hand to each student a section representing a piece of the watershed web.

3. Explain that they now represent that watershed part in this activity and that they must be able to articulate the role of their part of the watershed with regard to the health of the watershed, the salmon and the stream.

PART II. The watershed web of the wild

4. Have students, with information in hand, form a large circle. When in the large circle, read aloud with students STUDENT HANDOUT 1G: ***The Sacred Circle*** to understand the importance of circle, cycles and hoops in Native American culture.

5. Have the student that received the <u>Pacific Salmon</u> part stand in the middle of the circle and hand him or her a ball of string. The Pacific salmon student must announce loudly, "I REPRESENT THE PACIFIC SALMON. PART OF MY

ROLE IN THE WATERSHED IS……" They then must hold on to the string and gently toss the ball to any student in the circle.

6. The next student, let's say, represents the macroinvertebrates in the stream. The macroinvertebrates student announces loudly whom they represent and what their role in the watershed is. They next must hold on to the string and gently toss the ball to anyone they wish in the circle. Continue this process until all students have participated.

7. Once the web is complete, finish by sending the ball of string back to the Pacific salmon representative in the middle, thus symbolizing the interconnectedness of all parts of the watershed with the salmon as the indicator species at the center of the watershed ecosystem. As the facilitator, at this point be sure to stress the concepts of interconnectedness within ecosystems and watersheds, biodiversity and indicator species.

PART III. The tension and break of the web

8. Begin to examine some of the different destructive forces that can occur within this intact watershed if not properly managed. Use the WATERSHED IMPACTS chart as a guide for some potential problems. For example, announce that within this watershed there have been some poor logging practices (i.e. removing all trees to the edge of the stream thereby increasing soil erosion). The person that represents the live alder tree, then takes a step back, creating tension on the web for all to feel—especially the salmon.. You can also choose different parts of the watershed, like the small mammals. What would happen to the watershed, if there suddenly were no small mammals? Have the small mammals representative take a step back. Continue announcing things that cause tension in the web of life in the watershed, and continue having individual students taking a step back until the string breaks or chaos ensues. Have everyone sit down, still in the circle. Announce that the salmon is near death (for effect, have the salmon representative writhe and cough if you wish).

PART IV. The restoration

9. Now that the web (the watershed) is in poor health, clear out the old string, and lead a discussion about possible methods to restore the impacted watershed.

10. Use the document called Restoration Efforts, which describes examples of actions within Oregon to restore watersheds. This would also be a great time to get the class brainstorming about possible community service learning projects in their watershed that help enhance or restore the watershed.

WATERSHED PART	WATERSHED ROLE
I represent cold, clean free-flowing water in the stream	Part of my role in the watershed is to provide habitat for fish, aquatic insects, beavers and a host of other wildlife.
I represent root wads in the stream	Part of my role in the watershed is to provide shade & cover, as well as resting and rearing areas for salmon.
I represent wood in the stream	Part of my role in the watershed is to provide shade, cover, & trap gravels, as well as resting and rearing areas for salmon.
I represent clean, porous gravel in the stream	Part of my role in the watershed is to provide the essential material for female salmon to dig nests called redds to lay their eggs (spawn).
I represent the stream side or riparian grasses & shrubs	Part of my role in the watershed is to provide cover, in addition to shade, for temperature regulation. In autumn, my leaves drop into the stream and eventually provide food for aquatic insects that are eaten by salmon.

I represent the willow, cottonwood and alder trees in the riparian or stream side zone	Part of my role in the watershed is to provide shade for water temperature regulation and food for invertebrates when leaves fall. My roots provide bank stabilization.
I represent large boulder clusters in the stream	Part of my role in the watershed is to change the flow pattern of the stream, and provide cover for fish, pools, and a greater diversity of habitat.
I represent pools in the stream	Part of my role in the watershed is to provide critical resting and rearing areas for salmon.
I represent groundwater	Part of my invisible role in the watershed is to release my underground reserves of stored water to streams during dry seasons.
I represent grasses, sedges & rushes	Part of my role in the watershed is to provide food & habitat for numerous species of wildlife and insects, & prevent erosion of soils.
I represent soil (it's a dirty job)	Part of my role in the watershed is to provide essential nutrients for plants and habitat for many insects like millipedes & wildlife like shrews.

I represent deciduous trees like maples, madrones, oaks and ashes	Part of my role in the watershed is to provide food & habitat for numerous wildlife species & shade to cool streams for salmon. I also produce oxygen, stabilize the soil from erosion & replenish soil nutrients.
I represent coniferous trees like firs, hemlocks, pines, spruces and cedars	Part of my role in the watershed is to provide food & habitat for numerous species & shade to cool streams for salmon. I also produce oxygen, stabilize the soil from erosion & replenish soil nutrients.
I represent shrubs like salal, Indian plum, vine maple, and red huckleberry	Part of my role in the watershed is to provide food & habitat for numerous wildlife species & shade to cool streams for salmon. I also produce oxygen, stabilize the soil from erosion & replenish soil nutrients.
I represent herbaceous plants like stream violets, Douglas' asters, large-leaved lupine & common red paintbrush	Part of my role in the watershed is to provide food for wildlife & insects, stabilize soil from erosion & replenish soil with nutrients.

I represent wetland plants like cattails, wapato, yellow pond lilies & water-plantain	Part of my role in the watershed is to provide habitat for an incredible number of wildlife, fish & insects. I also filter sediments & pollution for streams & provide a buffer against flooding.
I represent macroinvertebrates or aquatic insects like stonefly, caddisfly and mayfly nymphs	Part of my role in the watershed is to be the major food source for fish in streams & other aquatic and terrestrial life (birds). I also am a key indicator in determining pollution levels in streams.
I represent Pacific Wild Salmon	Part of my role in the watershed after spawning & death, is to provide nutrients for millions of tiny aquatic animals required to sustain hundreds of thousands of hatching salmon. I am a critical part of the food chain eaten by such animals as bears, bald eagles, gulls, and harbor seals. I am also a key indicator species in determining the health of Pacific NW watersheds.
I represent water microbes like algae, detritus, diatoms, copepods	Part of my role in the watershed is to be food for salmon fry and macroinvertebrates like mayflies, which are consumed by young salmon.

I represent waterfowl birds like grebes, herons, swans, and ducks	Part of my role in the watershed is to be critical indicators of the biodiversity and health of the watershed ecosystems.
I represent perching or song birds like kingfishers, sparrows, robins and warblers	Part of my role in the watershed is to eat fruits and berries from trees and plants and deposit seeds throughout the watershed.
I represent birds of prey or raptors like eagles, hawks, falcons, owls and ospreys	Part of my role in the watershed is to help maintain the natural balance of the ecosystem by eating a variety of small animals and fish.
I represent small mammals like shrews, bats, rabbits, chipmunks, bobcats, skunk, & porcupine	Part of my role in the watershed is to invigorate the soil for plants and to be a food source for larger animals like mountain lions and birds of prey like eagles.
I represent large mammals like bear, deer, elk, mountain lion, and humans	I occupy the highest level on the food chain. I help maintain the natural balance of the ecosystem by eating a variety of small animals, fish, and plants.

I represent reptiles like turtles, lizards, and snakes	Part of my role in the watershed is to be food for such wildlife as hawks and help maintain the balance of the ecosystem by consuming insects and adding nutrients to the soil.
I represent amphibians like salamanders, newts, toads and frogs	Part of my role in the watershed is maintaining the balance of the ecosystem by consuming insects and adding nutrients to the soil.
I represent beetles, worms, centipedes & millipedes	Part of my role in the watershed is to create high soil nutrient quality through constant consumption of woody and plant materials on the forest floor.

How can the following impact watershed health and salmon?
Over-fishing
Logging practices
Agricultural pesticides
Dams
In-stream gravel mining
Agricultural irrigation
Road building and runoff
Housing & commercial development
Global warming
Acid rain
Road culverts
Livestock grazing
Household toxic wastes
Floods
Industrial pollution
Exotic plant and animal intrusion
El Nino
Volcanic eruption
Erosion
Overpopulation
Wetland fill

RESTORATION EFFORTS
Mt. Tabor MS & Alameda ES students of East Portland are studying, monitoring, helping manage & restore wetlands at Blue Lake Regional Park.
Led by the NW Service Academy of Portland, students from Clackamas HS, Gregory Heights MS, & Seth Llewelling ES are involved in urban habitat restoration & watershed enhancement.
90 George MS students of Portland are involved in the restoration of Ramsey, Smith & Bybee Lakes.
The Portland Environmental MS & the City of Portland Bureau of Environmental Services are working to enhance the riparian & fish habitat of Johnson Creek.
The Tualatin River Watershed Council & Washington County Soil & Water Conservation District are working to enhance the wildlife habitat and water quality of Ash Creek & return the riparian corridor to a more natural condition.
The Tualatin Hills Park & Recreation District is working to plant trees & shrubs to improve shading & increase cover for wildlife along Fanno Creek.
With the help of community volunteers, Boise Cascade, in cooperation with Oregon Dept. of Fish & Wildlife, put in 24 logs into W Fork Trail Creek to increase woody debris.
George Karl of the Portland Bureau of Environmental Services, through an EPA grant, has planted over 8 miles of trees, shrubs & aquatic plants to improve water quality of the unhealthy Columbia Slough in NE Portland.
"Jobs in the Woods" people with support from Trout Unlimited, installed small woody material in Slate Creek in So. Oregon to improve fish habitat.
Friends of the Little Applegate River in So. Oregon in cooperation with state & federal agencies are working to increase juvenile coho & steelhead abundance through reopening natural side channels & adding large trees to streams.
Hoover ES of the Rogue Valley has adopted Lazy Creek and are conducting water quality testing and regular clean-ups and working to enhance the creek habitat.
Levi Anderson School students from St. Mary's Home for Boys are working to remove & control the invasive reed canary grass in the riparian area along Beaverton Creek.
The City of Eugene has created the Spring Creek Turtle Preserve to improve habitat for the western pond turtle & to offset impacts from a new housing development.
The Freshwater Trust's Anchor Habitats Program advances place-based conservation and restoration in Oregon's wild rivers. Prioritizing functioning habitat in the coastal rivers, the John Day River, the Deschutes River, the Klamath Basin, the Sandy River, and the Blitzen River, we develop on-the-ground restoration projects to build habitat for fish and improve water quality.

1D. WHERE IN THE WORLD…ARE YOU? (using topographic maps)

TIME (min.)	LEVEL
60-90	All

MATERIALS:

- Topographic maps of your local area, county and or state and a map which shows your field trip site. U.S. Geological Survey (USGS) 7.5-minute maps are optimal, but any map showing township, range and section will do. Use a map at either a 1:100,000 or 1:24,000 scale of the area you're visiting. Maps at a 1:100,000 scale show less detail, but a larger area; maps at a 1:24,000 scale show a smaller area in more detail. Both scales are helpful in determining your site location. For approximately $3-$5, maps generally can be purchased at your local outdoor store, bookstore, Forest Service or Bureau of Land Management office.
- Overhead transparency sheets and pens
- Tracing paper
- STUDENT HANDOUT 1I: *Using Maps*
- STUDENT HANDOUT 1J: *TOPO MAP SECTION*
- STUDENT HANDOUT 1K: *Topographic Mapping Symbols*

OBJECTIVES:

Students will:

- become familiar with topographic maps.
- be able to use maps to identify the location of sites using township, range and section.
- be able to read the elevation of sites through an understanding of contour lines.
- be able to identify watersheds and stream flow through topo maps.

PROCEDURE:

1. Give each student a copy of STUDENT HANDOUTS 1I and 1J.

2. As a class, follow along through the materials that explain how to use topographic maps, and how to determine township, range and section (TRS).

3. Now that students have some knowledge of maps and map reading, divide the class into small groups. Give each group a topographic map of the local area (you can make copies of topo maps, but be sure that copies include the map's edges that have the TRS degrees).

4. Ask students to locate familiar landmarks such as their school or roads. Have students locate local streams.

5. Ask students to look at the contour lines on their maps. Note that some of them are thicker than others. Select one of these thicker lines and follow it. Somewhere along the line there will be a number, written in the direction of and in place of the line. This is the elevation of the line. Elevation is the height—in feet or meters above sea level of a particular point or line. Every point on that line is at the same elevation.

Other points about contour lines to go over with students:

- A contour line never goes up or down hill.
- Contour lines never cross each other.
- The vertical distance between contour lines is called the contour interval. The contour interval used varies from map to map.
- By locating the closest labeled contour line and then counting lines, one can determine the elevation of a point.
- The closer together the contour lines, the steeper the slope.
- When contour lines cross a stream they form a "V" that points upstream.

6. Ask students to locate the highest points (ridgelines) between two streams, thus locating the boundaries of watersheds.

7. Have students use the "Topographic Map Symbols" handout to identify land uses in the watershed.

8. Finally, choose three or four labeled locations on the map. Have students identify the TRS. Also, choose three or four TRS coordinates and have them write what is located there.

9. Practice and review is the key to preparing students for mapping their location.

1E. SALMON LIFE CYCLE

TIME (min.)	LEVEL	BENCHMARKS
60-90	All	6.2L.2 8.2P.2 H.2E.4

MATERIALS:

- ❑ Use The Journey of Pacific Wild Salmon handout found in the beginning of the Salmon Chapter to review the life cycle of salmon with your students. If you need a simpler life cycle activity, Stream Scene has a short summary.

OBJECTIVES:

Students will:

- become familiar with the life cycle of the salmon.
- know and understand the key terms relating to the life cycle of the salmon.

VOCABULARY:

anadromous	fry
eggs	smolt
Salmonids	smoltification
alevins	parr marks
yolk sac	spawn
vitelline vein	redd
porous gravel	milt
percolation	

If your students only have time to briefly review the life cycle of the salmon before their field trip, engage them in a discussion with the following questions.

- What conditions are necessary for successful salmon reproduction?
- What conditions are necessary for successful rearing of young salmon?
- What do salmon fry feed upon?
- What is smoltification and do salmon go through this process?
- What is the importance of stream flow to salmon migration?
- How long do salmon spend in the ocean and what do they feed upon?
- What natural and human factors impact salmon survival rates?
- How do salmon navigate back to their native streams?
- What do salmon feed upon when they enter fresh water?
- What is the process for salmon reproduction?

UNIT 1. PREPARING STUDENTS FOR SALMON WATCH
STUDENT HANDOUTS

STUDENT HANDOUT 1A

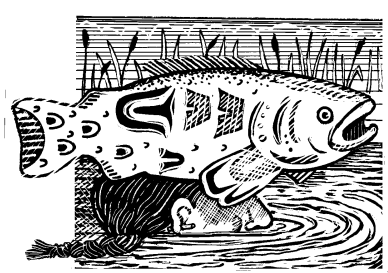
Celebration of Wild Fish

A Legend

Long ago in the time before the time, when all beings were men and wore their skins as blankets, the earth became overly populated. It was then that the leaders gathered together and determined that in order to survive, they must divide themselves. Donning new blankets, they each in turn journeyed into new and different territories. So it was that man clothed himself in scales, feathers and fur and wandered into the sea, air and forest.

At this time the salmon mother gathered her five children to her and bid them journey far into the ocean. "Remember, once a year you must return to the home from whence you came," she cried, reminding them that in order to survive they must gather strength from the land along the rivers of their birth.

Now it is known that the five children established villages far out into the sea. Each year in the early spring, the salmon change from human form into salmon and those at the farthest edge of the ocean start their journey across the sea and up the rivers along the Pacific Northwest coast. Along the way they alert the Salmon People of the other villages who promise to follow at different times of the year. So it is that the Silver, Chinook, Chum, Sockeye and Coho journey to our rivers from early spring until late fall.



STUDENT HANDOUT 1B

The Importance of Wild Salmon

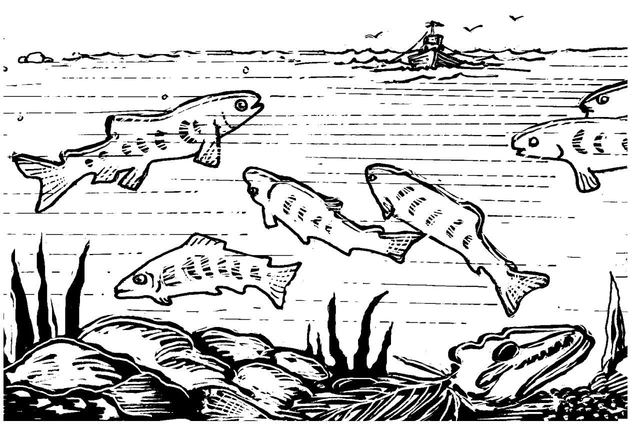
Adapted from
***Field Guide to the Pacific Salmon* by Robert Steelquist and**
an *Oregonian Special Report "River of Ghosts: Lessons of the Past"* by Brian T. Meehan

Our eyes follow the water downstream. Surely it is them.

Strange wakes appear on the river's lightly rippled surface--impulses of water that move against the flow of the current. The night's rain brought the river level up. This pulse signaled to the waiting salmon that it was time to enter from the sea. On the flood tide they entered and as tide slackened and the river current quickened, they began their ascent.

They reach our pool three hours later—about 200 salmon. Around us they loll to the surface, rolling sideways. In the green depths of the pool beneath the logjam, they form a single body –that of a great fish that wrestles in the current, its head upstream, its tapering body following. Beneath us they pass, spreading under the bank, on the edge of the current's thrust.

Along the North Pacific's shore, this scene is reenacted on many tides, on many rivers, each month between August and January, as various stocks of salmon conclude their tours of the ocean by returning to the streams of their origin. The return marks one of nature's grandest spectacles, an event in a sequence of events around which the lives of the salmon, the humans, the bears and eagles that await them, even the forests revolve. We humans repair our nets and tie our flies. Other predators time their migrations inshore to water's edge, they're gathering to feed, and even the bearing of their offspring to this meter. For the forest, it means the return of nutrients that have drained off the land—nitrates and phosphates swept away in freshets, coming to rest on the continental shelf of the ocean, then stirred by currents and made alive again in plankton, small fish, and the salmon that carry them inland.

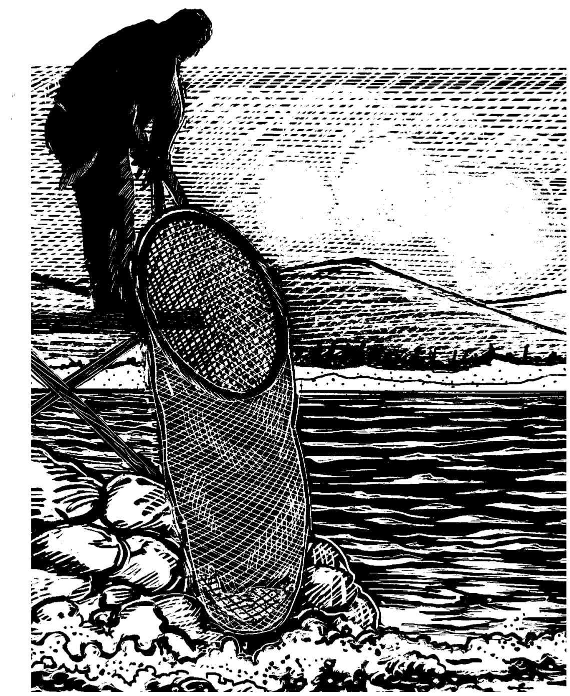


Salmon accomplish their magic with their bodies throughout their life cycle. They undergo massive physiological changes as they smolt and migrate from fresh water to salt water. It is akin to a tadpole turning into a frog and crawling up on land. The methods by which salmon use to navigate their way home are still one of nature's great mysteries. It may be the angle of the sunlight as it penetrates the seawater, or from water temperatures, tides or currents, magnetic fields or their keen sense of smell. The best guess seems to be their basic instincts are imprinted in their genes through millennia of evolution.

So unlikely is the survival of a single returning salmon that Nature compensates heavily. Of the other 3,000 to 7,000 eggs in a nest, only one spawning pair, on average, will make it back. Too much or too little water at hatching can wipe out great swarms of young fish life. Bigger fish, bears, seals…all take their share of salmon. Nature allows for these natural events.

The death of salmon completes one of nature's most awesome cycles and circles. Homeward-bound salmon generally stop eating after they enter fresh water; a spring chinook will live nine months on oils stored in its body. Salmon burn themselves up in a deluge of sex hormones that wreck their immune systems, open them to fungal infections and harden their arteries. The magnificent struggle through countless obstacles and predators is truly magnificent and unparalleled.

Pacific Rim peoples share a long tradition of "salmon watching" the rivers for the great return. The First-Salmon Ceremony evolved among the cultures of salmon-eating people. At Celilo, the great falls on the Columbia River now submerged behind The Dalles Dam, native fishers awaited the first salmon with great anticipation. When it had been caught, fishing stopped until a ceremony was organized. The fisherman would take the fish to the shaman, who would cut it lengthwise and remove the backbone and head. It would be baked in a hole in the ground lined with chokecherry leaves and covered with mats. Everyone would be invited to taste the fish; prayers would be said. Following the ceremony, fishing would resume, its success or failure determined by the respect shown the salmon during the ceremony. Thus, homage was paid to the returning ones, those who brought with them their fat flesh and its promise of sustenance, and along with it a sense that the world was working, as it should.



Summer chinook once braided a silver chain between desert and sea. The fish mined the Pacific's bounty and carried it home 1,200 miles. Their migration demonstrated nature's genius. From 100-pound "June Hogs" to 10-pound desert chinook, the Columbia produced more king salmon than any river in the world. Early gill-net fishermen couldn't tailor the mesh size of their nets to match the variety of Columbia Chinook. Some were as small as a 5-pound pink salmon; other as large as a man.

Studies have estimated the native harvest at 18 million pounds a year, about 40 percent at the peak commercial catch of Columbia chinook in 1883.

In one October day in 1805, Lewis and Clark passed 29 Indian villages on the Columbia. Salmon were drying in every one.

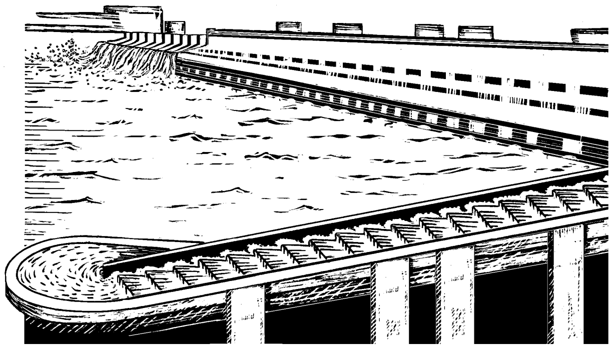
"The number of dead salmon on the shores and floating in the river is incredible to see," Capt. William Clark wrote in his journal. "The water of this river is clear, and a salmon may be seen at a depth of 15 or 20 feet."

In 1889, British writer Rudyard Kipling exclaimed: "I have lived!" "The American Continent may now sink under the sea, for I have taken the best that it yields, and the best was neither dollars, love nor real estate." For Kipling, America's best was a 12-pound steelhead he caught on a fly on Oregon's Clackamas River.

Salmon have roamed the Northwest since prehistory. Smilodonichthys (smilo-don-ICK-this), the "saber-toothed salmon," lived 10 million years ago and grew to 8 feet. Fossils of the prehistoric fish have been found near Madras, but its fearsome looks are deceiving: the fish ate plankton and saved its 11/2-inch fangs for spawning battles.

In the Pacific, steelhead trout, coho, chinook, chum, pink and sockeye emerged as the evolutionary clock ticked. The fish's famed spawn-and-die characteristic – a specialization that emerged with the coho—is the product of more evolution, not less. It frees salmon to make the long migration from sea to spawning ground, because they don't have to save anything for the return trip.

The evolution of the Pacific salmon shows us remarkable things about the fit between organisms and their environment. Salmon evolved in the cool waters of the temperate north and have distributed themselves for centuries in an environment of change. Salmon survived 1,000-foot-high floods that roared down the Columbia from prehistoric Lake Missoula in western Montana when ice dams cracked on the Clark Fork River. The floods washed more water in a single event than all the rivers of the world and dug the Columbia Gorge. The fish survived the Ice Age in the Columbia, Yukon and Sacramento Rivers and recolonized western North America when the glaciers retreated. They sustained a native economy for thousands of years and coped with lava flows and floods.

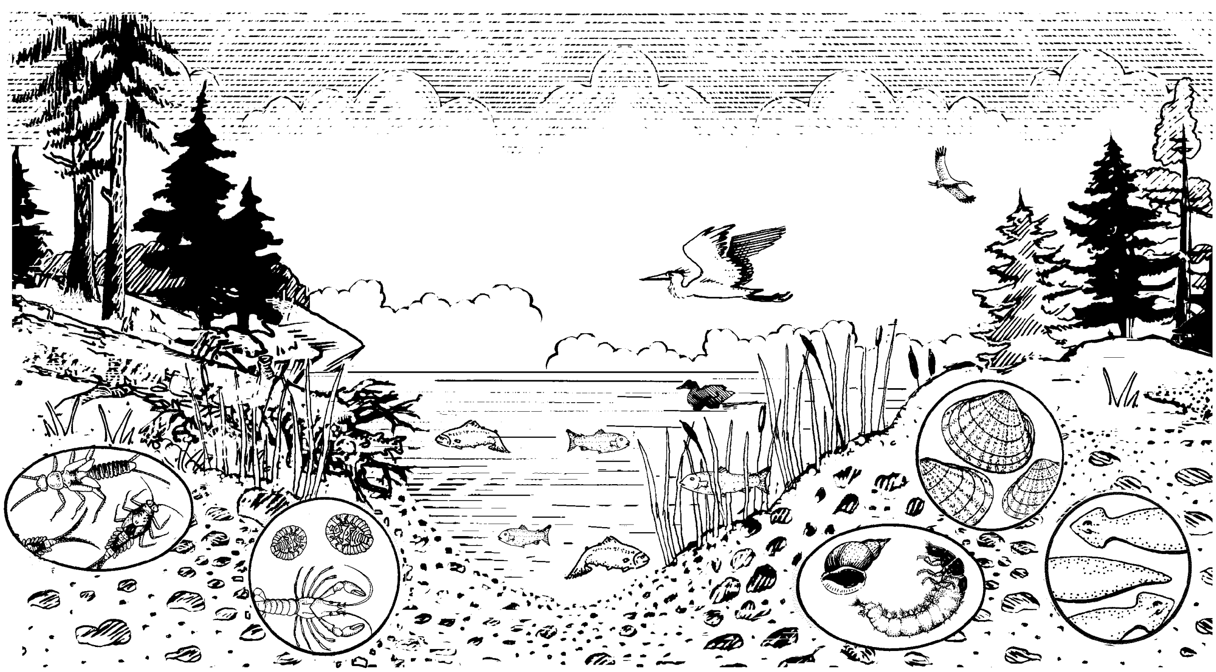


Yet we humans have not only transformed the land, the rivers, and the estuaries that salmon evolved in; we have also transformed the fish themselves. Most serious, we have quickened the pace of change, brought up the tempo with which evolution itself must struggle to keep step.

It seems almost inconceivable, that humans could lay on this fish a more rigorous habitat problem than occurred during the Ice Age, but we have done it.

We are at a crossroads with these amazing fish. The debts of the past have come due. In less than two centuries, we have shoved to the brink a creature that survived the Ice Age.

The mighty salmon has ruled the Columbia Basin and the Northwest for thousands of years, surviving the harshest whims of nature. It nurtured the bodies and souls of native people for centuries. Its range defined our boundaries; its image inspires our art. Its icon is our regional signature. But there is more at stake than fish. From bald eagles devouring salmon carcasses in Cascade headwaters to the slate gray chop of the Gulf of Alaska, Pacific salmon are the silver thread that weaves through every part of this grand tapestry of fir, sage and sky we call the Northwest.



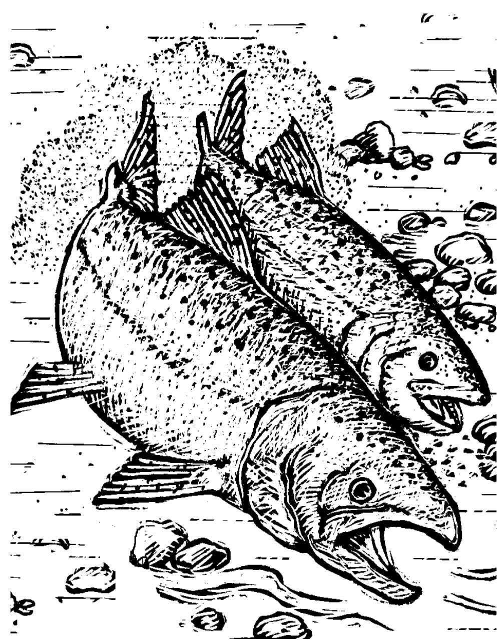
STUDENT HANDOUT 1C

The The Freshwater Trust/Salmon Watch Mission and Vision

Historically, an estimated 16 million wild salmon returned in a given year to their native streams in the Columbia River basin to spawn. In 2005, probably fewer than one million wild salmon will return. Human activity in the Pacific Northwest has resulted in severe loss of natural habitats that support native salmon populations.

From its beginnings in 1983, The Freshwater Trust has worked for the restoration of our wild fish heritage. Through innovative programs and projects, the non-profit organization has actively supported effective fish resource conservation, more state funding for watershed restoration and hands-on habitat improvement, restoration of stream flows, protection of the last remaining healthy native fish populations, and the inclusion of watershed protection within natural resources planning.

In 1993, The Freshwater Trust launched the Salmon Watch Program with the goal of giving the next generation of decision-makers the opportunity to understand first-hand the importance of wild fish that incorporates the conservation of our wild fish heritage into their view of watershed management.



Coupled with classroom instruction and community service learning projects, Salmon Watch is designed to give students the opportunity to understand and relate to the natural world on a personal level by witnessing spawning salmon, one of nature's great spectacles, and actively assessing the health of local watersheds. The program's objectives are to foster a deeper appreciation of the value of wild salmon to our natural heritage and to native cultures, empower students with collaborative problem solving strategies in watershed management, and to engage students in responsible stewardship in their communities.

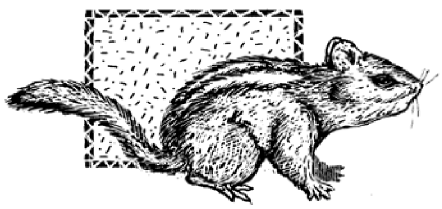
Since 1993, several hundred classrooms, over 35,000 students, and hundreds of volunteers in Oregon have experienced Salmon Watch. In 1997 the Salmon Watch program earned the Governor's Community Partnership Award for its collaborative approach. In 2005, Salmon Watch was one of nine programs to be selected by the U.S. Forest Service for their National Rise to the Future Award for raising public awareness.

STUDENT HANDOUT 1D

Student responsibilities for Salmon Watch

BEFORE THE TRIP

- ❑ Have all permission slips signed and turned in.
- ❑ Know objectives of field trip and basic concepts of watersheds and salmon.
- ❑ Have snacks, a lunch and something to drink.
- ❑ Have layered clothing and rain gear (see list in Unit 3).
- ❑ Bring equipment that will improve the trip (see list in Unit 3).



DURING THE TRIP

- ❑ Use techniques and skills for experiencing nature.
- ❑ Practice low impact walking and field work.
- ❑ Leave no trace of your visit.
- ❑ Bring sense of adventure and curiosity.
- ❑ Practice good data collection and field notes.

AFTER THE TRIP

- ❑ Use your data to analyze the health of the watershed you visited, create portfolio.
- ❑ Write and mail thank you letters to volunteers.
- ❑ Develop and execute an action plan for a community service- learning project.
- ❑ Present your community service- learning project to an audience.

The Freshwater Trust and Salmon Watch Staff responsibilities

- ❑ Provide school reimbursement funds for transportation and substitutes.
- ❑ Recruit and prepare teachers and volunteers for field trip with half-day training session.
- ❑ Provide teachers with curriculum, instruction on how best to use the curriculum, and educational resources.
- ❑ Work with agency officials to determine appropriate field sites and optimal salmon viewing dates and times.
- ❑ Coordinate field trip volunteers and teachers.
- ❑ Assist teachers and students, with community service learning projects.

What you will likely experience on your field trip:

Viewing spawning salmon
In-stream aquatic organisms collection and study
Water quality testing and data collection
Surveying and inventorying plants and wildlife
Assessment of the status and health of the watershed
Examination of salmon biology and issues
Interaction with fish, wildlife, forest, and angling experts

STUDENT HANDOUT 1E

NATURE AWARENESS AND OBSERVATION

"The tragedy of life is not what men suffer, but what they miss."

-- Thomas Carlyle

Since we are no longer hunter-gatherers, it is not as important for us to be so aware of and alert to nature. Our society does not place much value on nature awareness because modern conveniences have taken away its survival value. But we pay an unseen price for our comforts.

Living in a fast-paced, technology/industry-based society, we are more likely to spend much of our time in front of some type of screen, in a motor vehicle on asphalt byways or in a climate-controlled room than in the outdoors. In the course of a day, a barrage of unnatural sounds and sights bombards us, and regimentation, time and schedule drive our lives.

Given this disconnection from the wildness of the natural world, it is not easy for any of us to slow down long enough to truly appreciate the splendor of nature. These battered down and dulled senses need to be reinvigorated to explore the outdoor world. According to Tom Brown, "the connection [to nature] can be reestablished- in a large part simply by awaking and nourishing our innate awareness. With a few simple skills and some dedicated practice, any person can open his or her senses to the full richness of nature…."

You will be practicing some of these skills and techniques that will help exercise, and ultimately sharpen your senses. At first, you may feel a bit uncomfortable with these exercises, but quickly you find enjoyment, relaxation and fun. With sharpened senses you will be better able to appreciate nature and being outdoors and you will be a better monitor of the health of the watershed ecosystem in your community and at your Salmon Watch site.

These techniques and ideas have been adapted from <u>Tom Brown's Field Guide to Nature and Survival for Children</u>, by Tom Brown, Jr. with Judy Brown and <u>The NatureMapping Observers Guide</u>.

STUDENT HANDOUT 1F

PATHWAYS TO NATURE: TECHNIQUES FOR LEARNING RELAXATION, & PATIENCE

The first skill to acquire to experience nature is to learn the art of quieting, relaxation, or, as Tom Brown puts it, “the sacred silence.” When the mind is tense, all functions are impaired, perceptions obscured, and the ability to keenly observe is hampered. But when the mind is at peace, we function better, learn better, and one’s sensory awareness is more heightened and keen. It is not necessary to sit to relax. Relaxation can be dynamic and moving. It is best, if at all possible, to perform these skills in an outdoor, natural setting.

WHEN ENTERING NATURE, PRACTICE THE FOLLOWING:
Clear your mind of all the clutter that has accumulated during the process of daily living. This mental purification actually occurs quite naturally during an extended stay in the wilderness.

Slow Down and escape the “time trap” of modern life. Walk and move at a snail’s pace. A slower pace makes it easier for your eyes to pick up the swoosh of a salmon’s fin, the flick of a deer’s tail or the claw marks of a bobcat.

Sit Down and stop altogether. Don’t let speed and time rob you of the wonder and discovery. Nature will begin to unfold its secrets.

Be Quiet. It should be obvious that you will experience more in nature if you are silent. In nature, silence is the rule and noise is the exception. Most animals communicate more by gesture and touch than by sound. Since humans are the most lethal predator, the human voice almost always a danger signal that causes wildlife to run or hide.

TECHNIQUES FOR LEARNING TOTAL SENSORY AWARENESS

When in nature try to reach out with your senses. Watch the landscape carefully, paying attention to colors, textures, shapes, shadows, and movement. Pay attention to scents and where those smells come from. Listen carefully to the various songs of nature, and touch and feel everything you can. Exercising your senses, you sharpen those senses, make them more vivid and inexorably effect a reversal of the dulling routines of society.

STUDENT HANDOUT 1F continued

SENSORY EXERCISES

SIGHT

- ✓ Pick out color, texture, shape, shadow and movement on the landscape.
- ✓ Search the landscape for the less subtle colors and textures.
- ✓ Study details carefully.
- ✓ Look deeply at flowers, leaf shapes, grains of sand, and feathers.
- ✓ Observe closely the pattern of insects, spider webs, and other intricate things.
- ✓ Push your sight from near to far, and scan the landscape in ever-widening semicircles, from their feet to the horizon.
- ✓ If possible, use a magnifying glass to scan the ground looking intently at pebbles, plants, insects, etc.

HEARING

- ✓ Listen to the purity of sounds.
- ✓ Listen near and far, and pinpoint as best you can the exact position of what you hear.
- ✓ Listen to the wind in the trees, the shrubs, and the grasses, and pick out the variations in the tone of each.
- ✓ Listen to the music of insect wings, the gurgling of water, and the trembling of sounds.
- ✓ Listen to the symphony of nature as a whole, and then separate each part, until you know the origin and instrument of each sound.
- ✓ Focus hearing by cupping you hands around your ears, making a shape like a deer's ear. By doing this, you can hear in one direction and pick up sounds that would normally escape.

Birding and hearing:

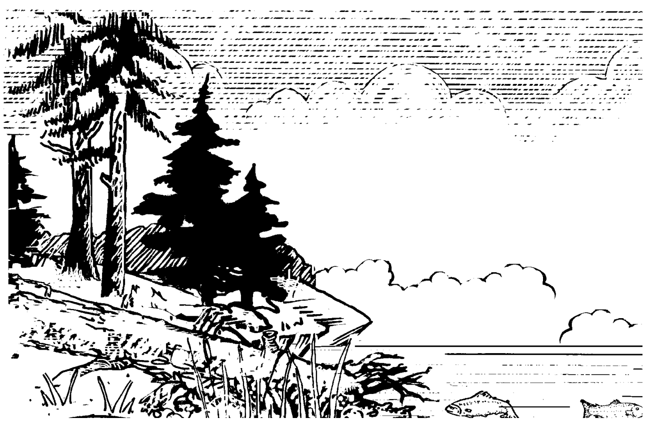
- ✓ Listen closely to what the birds are saying.
- ✓ Are they making long and musical sounds? If so, they are singing and all is well with them.
- ✓ Are they making a short, choppy, and hard to locate sound? This is called a call or alarm call. Birds use alarm calls to warn other birds and animals of approaching danger.

STUDENT HANDOUT 1F continued

TOUCH

- ✓ Lie on the ground. Use your sense of touch to feel the earth, the atmosphere, the cool and warm places, and the damp and dry places.
- ✓ Touch everything through exploration, the rough bark on trees, the flowers, feathers, tracks, water, insects, and plants of all types.

SPLATTER VISION



This technique was used by Native Americans to spot game, and is also used by most animals to spot danger. Simply looking toward the horizon and allowing your vision to "spread out" does it. In other words, instead of focusing on a single object, allow the eyes to soften and take in everything in a wide half-sphere. The effect is a little like putting a wide-angle lens on a camera. Suddenly your field of vision is greatly increased.

The secret of making splatter vision work is to slip in and out of it at frequent intervals. Soon this shifting of focus will become habitual. You'll start out with splatter vision, detect movement, focus on it, and then move back into splatter vision all in a second or two. In time you will be able to process a great many things without even coming out of splatter vision.

The technique

- ✓ Put your arms straight out to the sides at shoulder level.
- ✓ Point you fingers forward and wiggle them.
- ✓ By looking straight ahead – get so that you can see both hands
- ✓ Think of seeing out of the corners of your eyes.
- ✓ Try to pick up the things that are passing on the outermost fringes—trees, bushes, logs, etc. Then notice that, without moving your head or your eyes, you can be aware of almost anything in your field of vision just by choosing to see it. If a bird blinks, a blade of grass moves, a flying bug --- you now can see it!

STUDENT HANDOUT 1F continued

When in nature
- ✓ Look at more than just the trail ahead.
- ✓ Look beyond the prominent features of the landscape and pick out what is normally unseen.
- ✓ Move your eyes so that they can draw their attention to things that they would otherwise miss.
- ✓ Keep your senses active, keep them moving, and keep showing them exciting things so that they will want to keep their eyes moving.

MOVING IN NATURE
Learning how to move in nature is very important in order to fully observe your surroundings. There are proper techniques of moving much like learning dance or an oriental art form such as t'ai chi. With the technologization of walking surfaces, heavy footwear with big heels, and the fast pace of modern life, humankind's walk has become sloppy, damaging, and weak.

The Fox Walk
Learning from our sly four-legged friends, we can learn to effectively move through nature using the following techniques:

- ✓ Stop talking.
- ✓ Ease down your pace into slow motion.
- ✓ Shorten your stride.
- ✓ Lightly touch your foot on the ground before the weight of your body is committed.
- ✓ Place only the outside edge of your foot on the ground.
- ✓ Gently roll your foot down (inwardly) flat.
- ✓ Slowly move your weight forward in a flowing motion.
- ✓ Center your gravity at the center of your hips.
- ✓ Do not look at the ground.

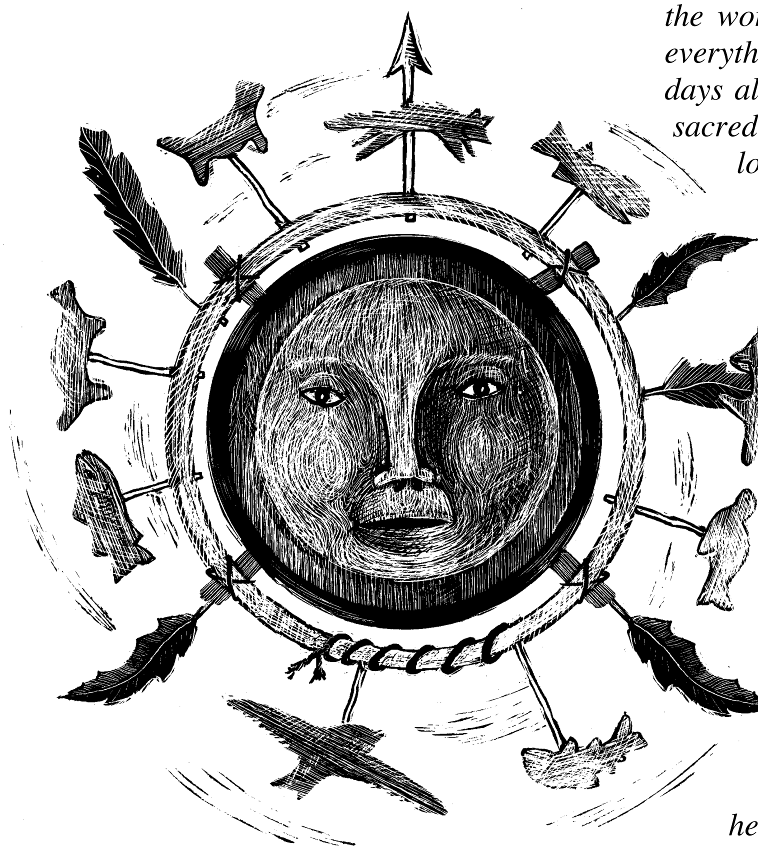
Walkers should be able to feel exactly what they are stepping on. If you feel a twig that might snap, you now have the ability to pick your foot and place it in a new spot without looking down.

When you feel confident as a fox walker, take off your shoes and socks. Notice that when fox walking barefoot, even on sharp stones, you will not hit the heel, but will walk, quite naturally. Also, notice your ability, with the fox walk, to freeze easily.

OTHER CONSIDERATIONS FOR NATURE OBSERVATION
- ✓ Think camouflage. It is important not to wear a solid color. Dress in a check or a plaid and darker-patterned clothing, to help break up the outline of the body.
- ✓ Wash before hand with a natural, non-perfumed soap and/or shampoo.
- ✓ Do not wear perfumes, colognes or scented deodorants.
- ✓ Be aware of which way the wind is blowing and try to be upwind from where you think wildlife may be observed.

STUDENT HANDOUT 1G

The Sacred Circle



…Everything the Indian does is in a circle, and that is because the power of the world always works in circles, and everything tries to be round. In the old days all our power came to us from the sacred hoop of the nation and so long as the hoop was unbroken the people flourished. The flowering tree was the living center of the hoop, and the circle of the four quarters nourished it. The east gave peace and light, the south gave warmth, the west gave rain and the north with its cold and mighty wind gave strength and endurance. This knowledge came to us from the outer world with our religion. Everything the power of the world does is done in a circle. The sky is round and I have heard that the earth is round like a ball and so are all the stars. The wind, in its greatest power, whirls. Birds make their nest in circles, for theirs is the same religion as ours. The sun comes forth and goes down again in a circle. The moon does the same and both are round. Even the seasons form a great circle in their changing and always come back again to where they were.

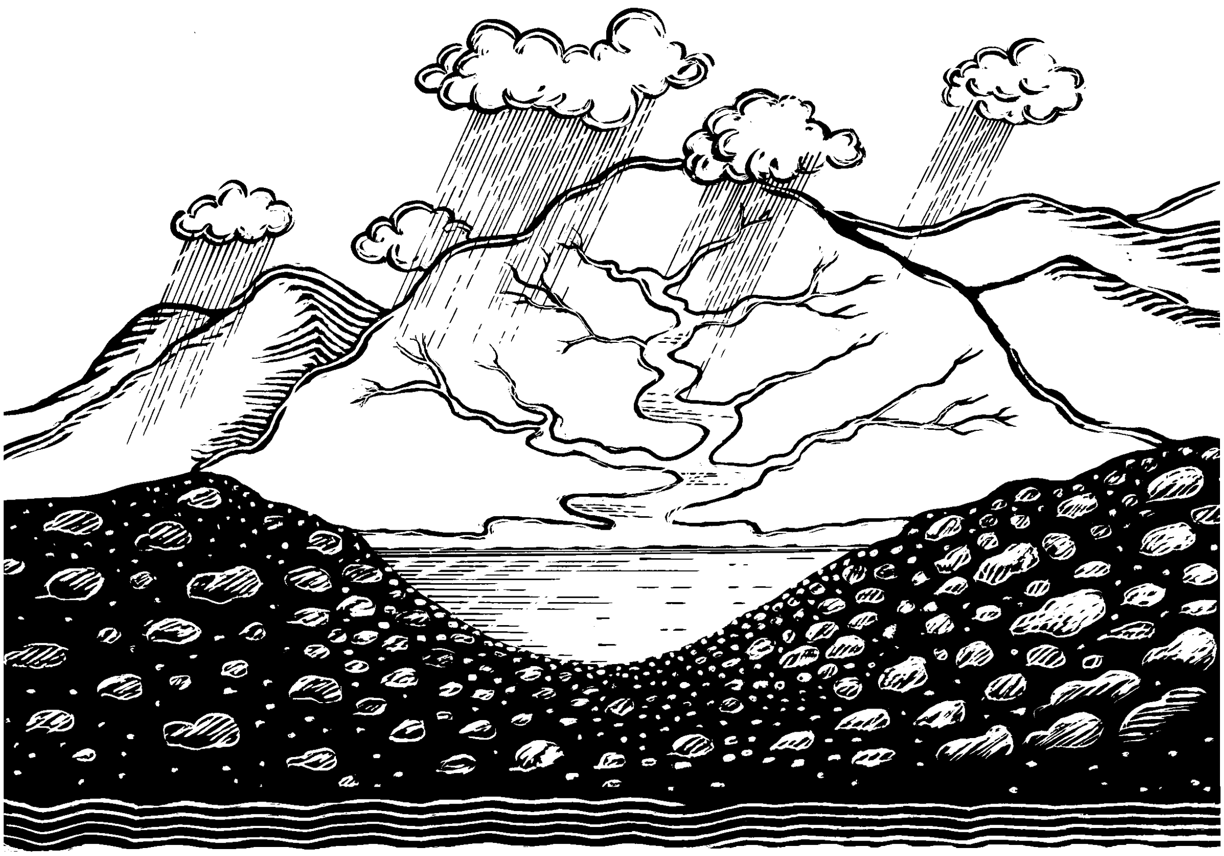
-- Black Elk

STUDENT HANDOUT 1H

What is a Watershed?

All land on earth is in a watershed. Not everyone lives by a stream, but we all live in a watershed—the ultimate source of every stream. A watershed is an area of land that collects (captures) rainfall and snow melt which later flows into a stream. Many small watersheds make up the larger watershed or major rivers. Watersheds act as reservoirs storing rainwater in soil, leaves, grasses, trees and other vegetation, slowly releasing it into a river or stream throughout the year.

A watershed includes the entire area—visible and invisible—drained by a particular creek or river. The visible area is the landscape on which rain and snow fall; surface water runs off hillsides into streams and rivers or collects in lakes or in shallow depressions—marshes, swamps, bogs, sloughs, and so forth—collectively called wetlands.



The larger, invisible portion of the watershed lies beneath the surface, within the soils and rock that act like a giant sponge. There, rainwater that has infiltrated the duff or topsoil collects as groundwater above deep impermeable layers of rock or clay.

Watersheds range in size from the smallest coastal stream to huge river systems such as the Columbia, Frazer, or even the enormous Mississippi system, which drains the entire central portion of the United States.

Rivers, hillsides, mountaintops, and flood-formed bottomlands are all part of one system. All are integrated with each other. Hillside shape controls the energy expenditure rate of water flow. All life in the watershed interact with and modify the energy flow through the system. So it follows that the shape of the watershed is a function of what lives there. The combination of climatic conditions, soil types, topography, vegetative cover, and drainage system define the particular character of each watershed.

Rivers do not stop at state lines. The effects of natural and human processes in a watershed are focused at its outlet, wherever it may be, even if it crosses another state or country's borders. Each watershed is a part of a larger watershed whose downstream portion may suffer from upstream influences. Everyone who lives or works in the same watershed is interconnected, in an intimate and tangible way, with every instream animal and every other person or animal that depends on the watershed's streams and groundwater for drinking or waste removal, or for industrial processes, hydroelectric power, or irrigation. We are intimately connected, in fact, with every animal, plant, and grain of mineral in our entire watershed.

(adapted from Adopt-a-Stream Handbook & Stream Scene)

STUDENT HANDOUT 1I

Using Maps

Maps

Contour lines…quads…elevation…true north. Welcome to the world of topographic maps.

Topographic maps, also called "topo" maps, are the least expensive means for determining your location. For a few dollars, U.S. Geological Survey (USGS) topo maps are optimal for Salmon Watch. Like most maps, they show a portion of Earth's surface by reducing it to a practical size with various symbols representing feature in the mapped area. Unlike typical two-dimensional maps, topographic maps add a representation of the vertical dimension through the use of contour lines. Each contour line represents a particular elevation above mean sea level. Although other types of maps may show the hills and valleys of the mapped area, the contour lines on topo maps provide much more detail and accuracy. To one who does not understand the markings, lines, and symbols on a topo map, it may well look like some two year old had fun with a light brown pencil. But to a person with a bit of training, these squiggly lines provide a wonderful view of the countryside.

Global Positioning System Receiver

One of the most accurate methods for determining site location is a Global Positioning System (GPS) receiver. This handy device picks up signals from satellites orbiting the Earth and instantly displays the latitude and longitude (and altitude, if desired) of your location.

Location Methods

There are two primary methods used to determining site location:

1) Township, range and section (TRS), or
2) Latitude and longitude (Lat/Long)

The former can be determined by using maps; the latter by maps or GPS receivers. If you don't have access to a GPS receiver, you'll need to use a topo map.

Township, Range and Section

On the following handout is a portion of a USGS map of Christmas Valley, Oregon (1:100,000 scale). We have identified a site, Doughnut Mountain (circled on the map), and drawn arrows from the Township and Range numbers in the margins to illustrate its location. To practice your skills at determining TRS, follow the sets below to determine the TRS of Doughnut Mountain.

Township Template

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

Explanation: All states are divided into township grids of 36 square miles. Township numbers are found on the extreme right and left sides of a map; range numbers at the top and bottom. Each grid is further divided into 36, one square-mile sections, numbered in sequence and beginning in the top right-hand corner. Section 8 is highlighted here to indicate the section location of Doughnut Mountain.

Note: Some 1:24,000-scale maps use non-standard section numbers (i.e., numbers other than 1-36). In these cases, locate your township/range grid of 36 squares and assign the correct number to each of the 36 squares following the number sequence of the above grid.

Source: *Naturemapping Guide*

<u>Determining Township:</u> A township is 36 square miles. Township numbers are printed in the margins on the extreme right and left sides of maps (in this example, we only show numbers for the right side of the map) and centered between two lines that delineate the township. Notice that the two horizontal lines are slightly darker in color than the surrounding lines.

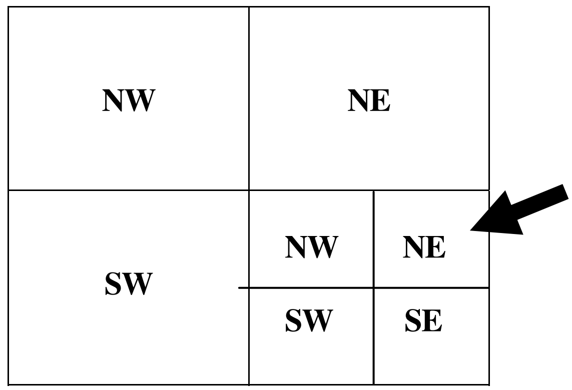
Doughnut Mountain is located in Township 29 South, or T 29 S

<u>Determining Range:</u> Range numbers are printed in the margins at the top and bottom of maps (in this example, we only show numbers for the bottom portion of the map), and are also centered between two slightly darker vertical lines that delineate the range.

Doughnut Mountain is located in Range 22 East, or R 22 E

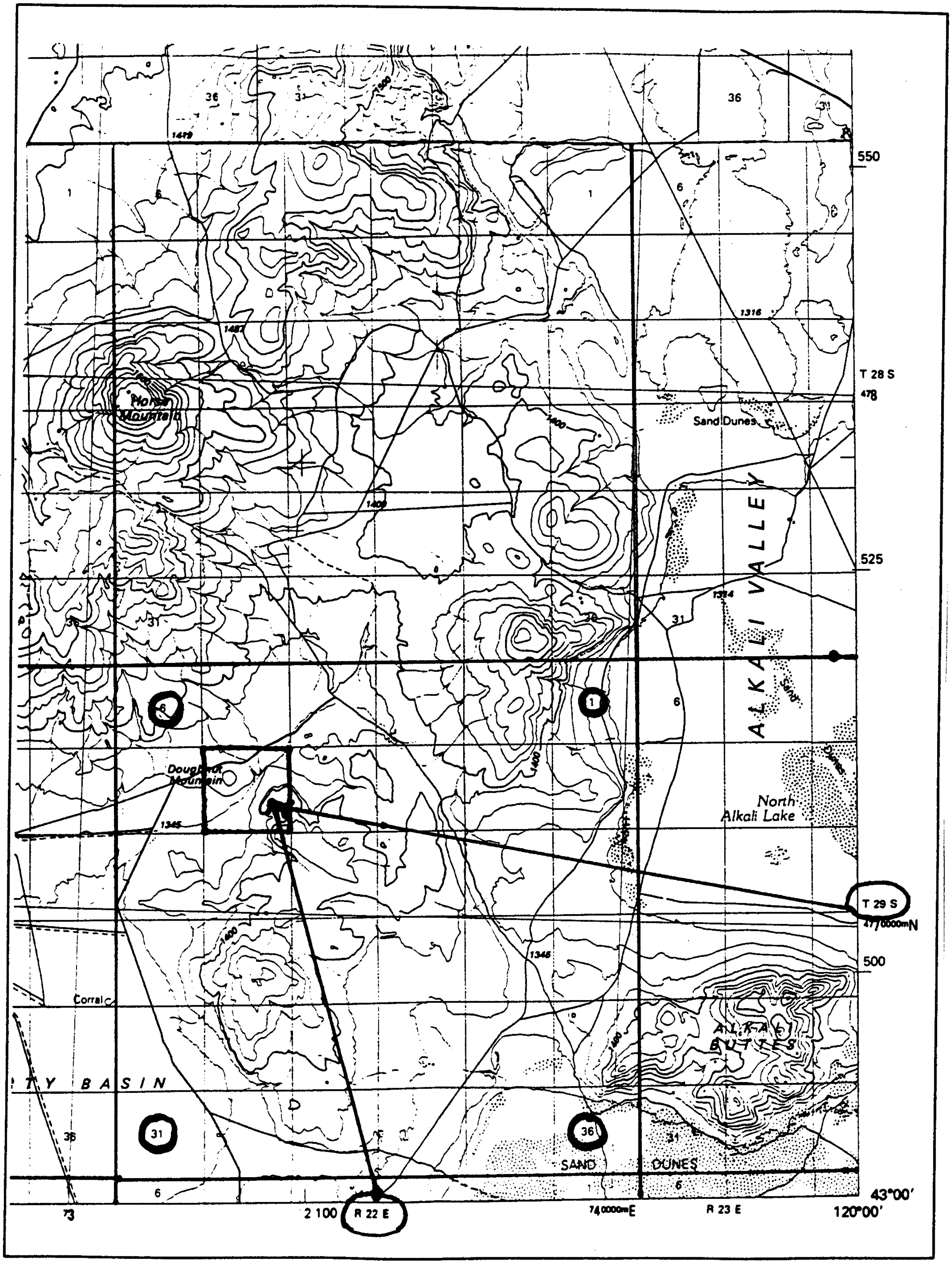
<u>Determining Section:</u> A section is one square mile. There are 36 sections in each township. On most maps, only the four corner section numbers (1, 6, 31, 36) are printed within each township. The first row of section numbers (1-6) reads from right to left, the second row (7-12) reads from left to right, and so forth to section 36. You'll need to count across the grid in this sequence to find the section for Doughnut Mountain. (Refer to the Township template to help you determine the correct section number for Doughnut Mountain.)

Try to be accurate to within a quarter of a quarter mile. Well, what do we mean by "a quarter of a quarter mile"? Since a section is one square mile, divide the section into four equal quadrants (NE, SE, NW, SW) to get your location down to a quarter of a mile. Then, to get it even smaller to a quarter of a quarter mile, divide the quadrant into four again. Thus, in the case of Doughnut Mountain, your site might be in the *NE quarter of the SE quarter of Section 8*, as shown by the dark square that follows:



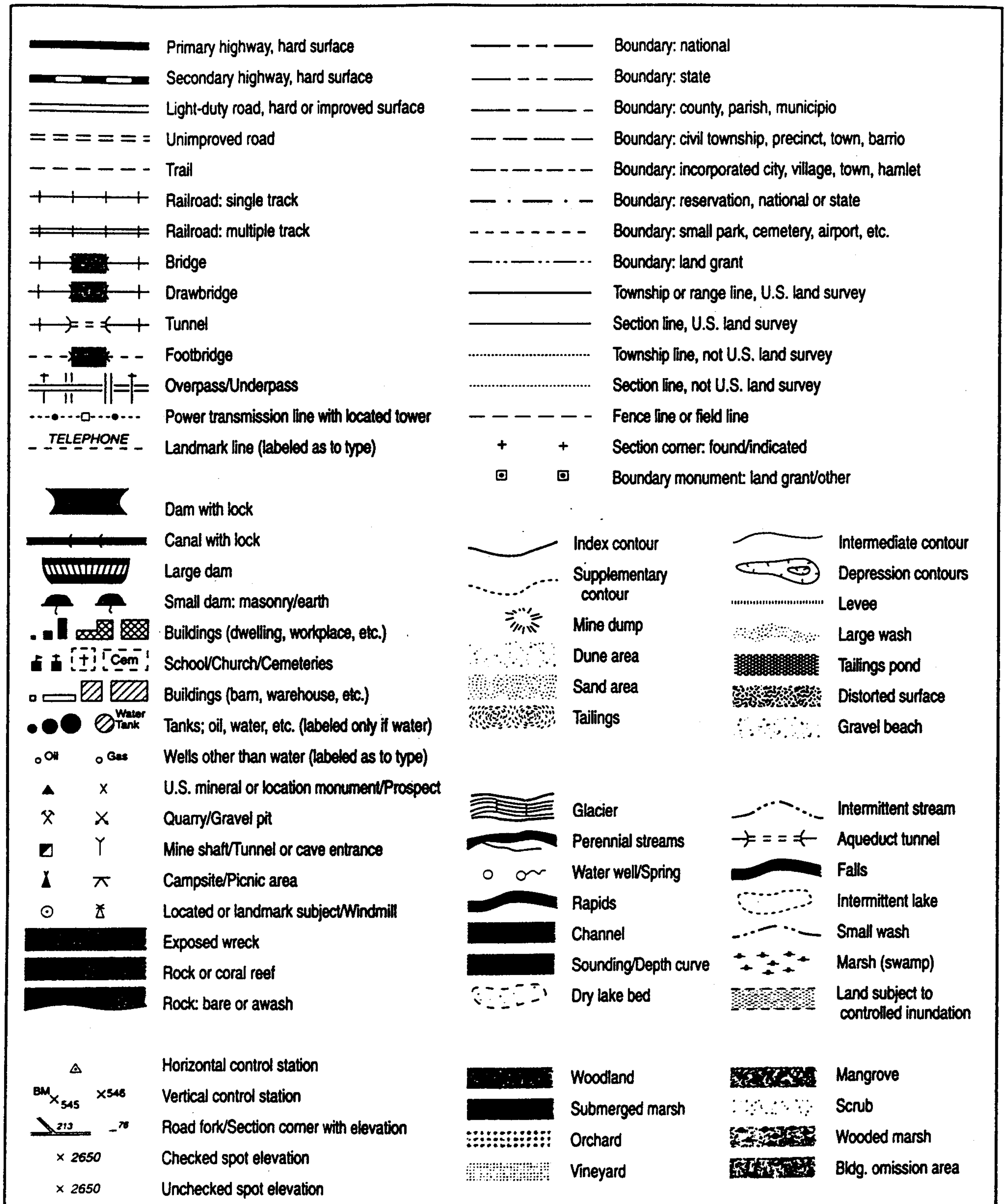
Putting It All Together: Standard recording procedure requires that the final location recording begin with the smallest area and work backwards: *Thus, your final site identification for Doughnut Mountain should read:*
NE ¼, SE ¼, S8, T29S, R22E

STUDENT HANDOUT 1J

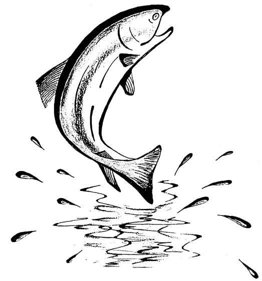


STUDENT HANDOUT 1K

Topographic Mapping Symbols



From *Topographic Maps* (Issued by the U.S. Department of the Interior/Geological Survey) U.S.G.P.O.: 1990—252-213



UNIT 2. SALMON WATCH FIELD TRIP PLANNING AND IMPLEMENTATION

Illustration by Sari Ogden, Hidden Valley High

POTENTIAL BENCHMARKS FOR FIELD TRIP			
6.2L.2	8.L1.1	H.2P.1	H.4D.1
6.2E.1	8.2P.2	H.2L.2	H.4D.6
6.3S.1	8.2L.1	H.2L.3	
6.4D.1	8.3S.1	H.2E.4	
6.4.D.3	8.4D.1	H.3S.1	

INTRODUCTION

Getting to know new friends is more than a matter of just meeting them. The place where they live helps to put them within a context that helps you understand them better. Your students have learned about salmon, who they are, where they live, and how humans share their habitat. If your students haven't yet met a salmon, your Salmon Watch field trip is a wonderful opportunity for them to do so.

This unit is designed to help you plan and implement your Salmon Watch field trip. To ensure that your students get the most out of their Salmon Watch experience, careful and organized field trip planning is a must. This section takes you step by step through your field trip site preview, developing an agenda, organizing volunteers and agency experts, and the actual day of your Salmon Watch field trip.

EDUCATIONAL OBJECTIVES OF FIELD TRIP

Students will:

- Establish their own personal connection to salmon as living creatures.
- understand the importance of high quality salmon habitat.
- collect meaningful data regarding salmon habitat.
- experience the interconnectedness of all living creatures in the web of life.
- understand their own personal impact on their natural environment.
- be exposed to a variety of perspectives about the salmon crisis.
- help facilitate science inquiry benchmark.

You are encouraged to determine what your own additional expectations and objectives are for your Salmon Watch field trip and keep those in mind while developing your field trip.

MATERIALS:

- ❑ FIELD TRIP PREPARATION ITEMS
- ❑ CHARTS FOR INTERPRETING WATER QUALITY DATA
- ❑ STUDENT DATA FORMS

PREPARING FOR YOUR FIELD TRIP

TEACHER INSTRUCTIONS

1. **Field Trip Planning Checklist -** to guide you through the planning process.

2. **Tips for Field Trips.**

3. **Field Site Preview Sheet -** helps you prepare for your pre-site visit.

4. **What to Wear and Take.**

5. **Salmon Watch Stream Safety and Etiquette.**

6. **Selecting your Field Trip Activities.**

7. **Field Trip Agenda.**

8. **School Administration Requirements –** to assist you in arranging for substitutes, buses, communicating with parents, etc.

9. **Contacting Field Trip Participants –** a guide for contacting volunteers to accompany and assist you with the field trip.

10. **Other Field Trip Resources** – to further guide you in the planning process.

11. **After the field trip**, complete the **<u>Teacher Field Trip Evaluation*, the Student Evaluation Forms* and Reimbursement Form* (if needed)</u>** and submit them to The Freshwater Trust by **<u>December 31.</u>**

12. **Background information for field trip activities.**

13. **Data Forms* for all field trip activities.**

These forms* will be included in the packet you receive at the beginning of the school year along with your Salmon Watch glasses. The teacher and student evaluations, the SW Reimbursement Form and required documentation (invoice from district or statement on school letterhead) <u>are required</u> in order to be reimbursed for your field trip expenses. Data Forms can also be downloaded from StreamWebs at www.streamwebs.org.

STUDENT HANDOUTS

Teachers can choose whatever handouts they would like to have their students use in the classroom and/or in the field. Please make copies of the materials needed for your students. It is your responsibility to email your field trip volunteers prior to the field tip and notify them of the data forms you intend to use. On the day of the field trip give copies to the appropriate volunteer when the bus arrives at the field trip site or mail prior to the field trip. If you would like an electronic version of just data forms and protocols you can download and print them from StreamWebs www.streamwebs.org or contact your local The Freshwater Trust Education Coordinator.

FIELD TRIP PLANNING CHECK LIST

Complete preliminary site visit prior to trip:

- ❑ Meet with The Freshwater Trust representative or returning teacher
- ❑ Check out safety hazards
- ❑ Complete preliminary agenda
- ❑ Using the *Field Site Preview Sheet*, identify locations for field trip activities
- ❑ Have site descriptions and maps available (check with The Freshwater Trust office or print from The Freshwater Trust Website http://www.thefreshwatertrust.org/education/salmon-watch/sw-site-directions).
- ❑ Identify nearby toilet and medical facilities

Provide pertinent information for parents:

- ❑ Purpose and nature of trip
- ❑ Times of departure and return and site information
- ❑ Proper student clothing
- ❑ Invitation to attend field trip
- ❑ Obtain signed parental permission slip
- ❑ Information about The Freshwater Trust

Contact volunteers and other adult participants (at least <u>two weeks</u> before trip):

- ❑ Discuss volunteer's assignment and role
- ❑ Arrange preliminary planning meeting among all adult participants (if possible)
- ❑ Discuss preliminary field trip agenda & locations of activities
- ❑ Clarify what you expect of them
- ❑ Explain student expectations
- ❑ Determine time and place of rendezvous
- ❑ Discuss responsibility for necessary equipment, handouts, etc.
- ❑ Finalize field trip agenda & provide volunteers with copies of any student worksheets, data forms or journals
- ❑ Discuss field trip equipment arrangements, if you would like assistance from a volunteer with pick up and drop off of equipment from The Freshwater Trust office.
- ❑ Utilize the Salmon Watch online calendar to check-in on volunteer sign ups and communicate with volunteers: http://www.thefreshwatertrust.org/education/salmon-watch/field-trip-sign-up

Complete School Administrative Requirements:

- ❑ Obtain permission from school officials
- ❑ Obtain written permission from parents
- ❑ Complete standard field trip procedure in your school
- ❑ Order yellow bus (as soon as you have confirmed your field trip date, could be previous spring)
- ❑ Arrange for substitute teacher

Confirmation of trip information with The Freshwater Trust representative:

- ❑ Send copy of agenda to The Freshwater Trust in advance including: number of students expected (30 or fewer), grade level of students, times of arrival and departure

Safety precautions:

- ❑ Bring first aid kit
- ❑ Identify in advance any field trip participants with medical or safety training
- ❑ Bring cellular phone (if available)
- ❑ Bring list of participants with special medical needs and have students with bee allergies bring their epinephrine kit

Complete other necessary arrangements:

- ❑ Student handouts prepared: review data forms and choose activities that help to meet your goals for the field trip.
- ❑ Share your selections with your volunteers and allow adequate time for the riparian activity(s) you have selected.
- ❑ Special equipment acquired and viewing glasses packed
- ❑ Lunch provisions

Student orientation/preparation:

- ❑ Field trip goals clarified
- ❑ Field trip questions and projects assigned
- ❑ Safety guidelines discussed
- ❑ Warnings issued for hazards
- ❑ Appropriate clothing required
- ❑ Lunch, drink and snack needs communicated
- ❑ Discuss appropriate student behavior in nature

TIPS FOR FIELD TRIPS

BEFORE THE TRIP

- Know your objectives and communicate them to the volunteers and students.
- Make it exciting.
- Know the subject and assist your volunteers as needed.
- Prepare your group in advance.
- Know your site thoroughly.
- <u>Be prepared</u> for a change in your schedule or a missing volunteer.

DURING THE TRIP

- Provide the appropriate equipment.
- Give the volunteers an orientation to the site and the agenda for the day.
- Explain the expectations to all participants.
- Serve as the disciplinary figure when needed.
- Prepare students for appropriate site behavior i.e. stay on the trail, leave no trace of your visit, and practice good conservation stewardship.
- Prepare for emergencies i.e. cell phone, phone numbers, Epipen for allergic emergencies, etc.
- Keep the group on time.
- Provide an opportunity to debrief the day with the volunteers before leaving.

AFTER THE TRIP

- Share your data with others through StreamWebs at www.streamwebs.org
- Relate data collected on the field trip to the science inquiry question.
- Explore the community service learning opportunity.
- Evaluate the experience (includes completing the teacher and student evaluation forms and sending them to The Freshwater Trust office by Dec. 31).
- Continue with more related curriculum to synthesize the information.
- Send thank you notes to volunteers and appropriate sponsors.
- Design and implement community service learning projects with students.
- Encourage field trip volunteers to be involved in community service learning projects.
- Complete necessary paperwork to process reimbursement requests for bus and substitute.
- Required documentation includes an invoice for field trip expenses from the school district or a statement on school letterhead.

SALMON WATCH FIELD TRIP SITE PREVIEW SHEET

This is your chance to get a head start on your Salmon Watch field trip. You will visit your assigned field trip site with an experienced Salmon Watch teacher to begin to explore the possibilities for your field trip. In order for your students to make the most of their time on the site, they should have a comprehensive set of plans and tasks. It's much easier to begin to formulate these plans and tasks when you can see all of the parts of the ecosystem you will bring your class to observe. Take some time now to partition this environment with your students and curriculum in mind.

1. Salmon Viewing
Identify:
- ❑ Areas where students can stand to observe spawning salmon.
- ❑ Areas of sensitive habitat, where students should not tread.

2.Nature Walk
Identify:
- ❑ A nature walk route with which to take that will give students a chance to observe a variety of ecosystems and habitat.
- ❑ Interesting things not to be missed on the nature walk.
- ❑ Contrasting habitats and ecosystems.
- ❑ Human and natural disturbances along the walk.
- ❑ Wildlife habitats on the walk.

3. Riparian Zone (stream banks)
Identify:
- ❑ Sections where there is good riparian habitat to study.
- ❑ Sections where there is poor riparian habitat to study.
- ❑ Contrasting riparian habitat areas.

4. Substrate (stream bottom)
Identify:
- ❑ Sections where good salmon spawning gravels are for observation.

5. Stream Form
Identify:
- ❑ Sections where you would like students to map or sketch.

6. Stream Flow (Optional)
Identify:
- ❑ Sections where stream flow is rapid and potentially dangerous.
- ❑ A 20 foot section where students can safely determine stream flow velocity.

Please note that schools/teachers are responsible for reviewing safety and site protocols and should know that schools assume all liability and risk as far as students wading into potentially deep and fast-moving water

7. Stream Morphology
Identify:
- ❑ Sections where you would like you students to profile the stream and what they should include.

8. Water Quality
Identify:
- ❑ Areas where students can conduct water quality tests.
- ❑ Potential contrasting bodies of water nearby like a lake, pond, or slow eddy to conduct water quality tests.

9. Fish Habitat

Identify:

- ❑ Areas where the stream is partitioned into fish habitats (pools, riffles, etc.).
- ❑ Potential spawning areas.
- ❑ Potential rearing areas.
- ❑ Areas where cover is available to protect fish from predators and where there is not cover.

10. Aquatic Organisms

Identify:

- ❑ Areas where your students might sample the aquatic biota, without disturbing spawning grounds.

11. Watersheds:

Identify:

- ❑ The geography and geology of the area that defines the site's watershed (use your topographic maps).

12. Lunch/Class Gatherings

Identify:

- ❑ Areas where all can congregate to eat lunch and have group gatherings.

13. Restroom facilities

Identify:

- ❑ Where the nearest restroom facilities are.
- ❑ Where you would like students to "go," if there are no facilities at the site.

14. Safety Hazards

Identify:

- ❑ All potential safety hazards in the area. Be sure students are aware of these areas before the field trip.

Before the trip be sure to also:

- ❑ Establish student groups.
- ❑ Prepare maps and/or driving instructions to site for The Freshwater Trust volunteers, agency biologists, and other guests accompanying your field trip.
- ❑ Once you've discovered the uniqueness of your stream, decide on issues and themes for the classroom curriculum and field trip will be much easier.
- ❑ Develop a field trip agenda.
- ❑ Make copies of the data sheets you wish to use. (electronic copies can be downloaded and printed from StreamWebs at www.streamwebs.org).
- ❑ Obtain the necessary field equipment and materials from The Freshwater Trust.

WHAT TO WEAR AND TAKE

Clothing

Layer system is best in the Northwest (bring a backpack to put removed layers):

- ❑ Tee shirt
- ❑ Long-sleeved shirt
- ❑ Sweater
- ❑ Jacket
- ❑ Rain gear
- ❑ Hat
- ❑ Gloves
- ❑ Boots or extra shoes
- ❑ Long pants
- ❑ Warm socks (wool or synthetic are best)
- ❑ Name tags for all

Other essentials

- ❑ Water
- ❑ Lunch and a drink
- ❑ Paper and pencil (a clip board is also great)
- ❑ First aid kit (available in field kit provided by TFT)
- ❑ Epinephrine kit for bee allergies
- ❑ Sense of humor, wonder and gratitude
- ❑ Respect for nature

Equipment

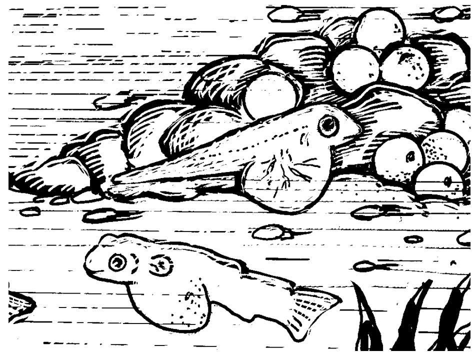
- ❑ Field equipment - checked out from The Freshwater Trust or provided by teacher *
- ❑ Data Forms and/or Field Journals

Recommended equipment

- ❑ Extra socks
- ❑ Extra sweater
- ❑ Sunglasses (TFT provides polarized glasses for students)
- ❑ Backpack
- ❑ Trash bags
- ❑ Sun screen
- ❑ Mosquito repellant
- ❑ Topographic maps of the area
- ❑ Hip waders &/or knee waders (set provided by The Freshwater Trust, extras may be needed)
- ❑ Camera
- ❑ Binoculars
- ❑ Spotting scope
- ❑ Hand Warmers (one time use packets available at sporting goods stores)

*** All required field trip equipment is provided by The Freshwater Trust. Additional equipment may be provided by either the teacher and/or volunteer and be utilized if determined to be useful and appropriate for the learning outcomes.**

SALMON WATCH STREAM SAFETY AND ETIQUETTE



1. Take care when near any stream from September 15-April 15. During these months salmon are spawning, and their nests (redds) are vulnerable to damage. In some streams, steelhead and cutthroat redds persist until late July. Redds can be hard to see, and salmon eggs are easily killed by a poorly placed foot.

2. While walking or working around the stream, take precautions to limit the impacts of your activities. Take steps to avoid creating unnecessary erosion, or disturbing fish and wildlife.

3. If spawned-out fish carcasses are removed from the stream for close observation, be sure to return them to the stream. These carcasses are an integral part of the food web, providing nutrition both to salmon fry and macroinvertebrates, which themselves become fry prey.

4. Stream surveying is not a dangerous activity but you should keep in mind that stream channels are natural, uncontrolled environments. A few common sense precautions will help ensure your safety.
   a. Never survey alone.
   b. Fast-moving water can be dangerous. Know what depth and velocity of water are safe for you and your group to work in. When crossing a stream or river it is best to use one or more of the following precautions: cross with a partner, use a walking stick or staff, and/or use footgear with felt-soled shoes for improved traction.
   c. Be prepared for the unexpected. Know your stream; study available maps and be aware of your location and neighboring access points. Have a plan of action prepared in the event of an accident or injury. If possible, carry a cellular phone or other communication device and a first aid kit.
   d. Never drink the water!

5. As collectors of data, you are responsible for its use. If you discover a serious problem that is impacting the stream or the salmon in it (such as a fish barrier), notify the appropriate agency.

6. OBSERVATION SUGGESTIONS: Observation techniques vary from situation to situation, and experience will reveal which techniques work best. However, these suggestions may help in getting started.

Salmonids, both adults and juveniles, are sensitive to movement on the streambank. To avoid scaring off spawning fish, you should limit your movement as much as possible during the period of observation. Avoid getting too close to the fish, and wear clothes that blend into the surroundings; bright colors are easily seen and may spook any fish in the area. Remember that female salmon guard their nests. Take precautions not to scare them away.

Keep in mind that even professional fish biologists have difficulty seeing and identifying fish and fry from the streambank. There are occasions when adult spawning salmonids can be swimming right in front of a surveyor but are nearly impossible to observe.

(adapted from NatureMapping for Fish and Streams, Washington Department of Fish and Wildlife Ecosystems Education, March 1996)

SELECTING YOUR FIELD TRIP ACTIVITIES

Described below are activities that have been used successfully by teachers on their Salmon Watch field trips in the past. Please review the core teaching stations materials thoroughly, <u>as this reflects what volunteers are trained to teach</u>. The other activities may be helpful as back up or alternates if needed. Please feel free to use your creativity to come up with your own ideas for field trip activities. Anything beyond the core activities that you would like taught by volunteers will need to be communicated to your assigned volunteers

These activities are probably best taught in small group rotations. We recommend that you divide your class into small groups of no more than seven or eight students per group. Assign one or more adults to supervise each small group. Provide nametags for all students, as this helps volunteers connect with students

<u>Core Teaching Stations</u>

- **Salmon Biology:** The Salmon Watch field trip is the perfect time for a discussion about the species of salmon they will observe on the field trip, and their life cycle, anatomy, and spawning behavior. All of these topics will bring more meaning to the students' observations. An agency fish biologist usually teaches this station.

- **Macroinvertebrates:** This activity reinforces what students have learned about water quality and the kinds of organisms, which inhabit a stream with a particular water quality profile. At this station, students sample for macroinvertebrate populations in the stream and use that information to evaluate the health of the stream as salmon habitat.

- **Water Quality:** The salmon's home stream helped to form the land through which it flows, and in turn, is modified by the land and its inhabitants. First hand experience of the riparian habitat and water quality parameters will strengthen your students' connection to salmon and illustrate another way humans impact the salmon life cycle. Suggested water quality parameters to test on your Salmon Watch field trip might include: temperature, pH, turbidity, dissolved oxygen and flow. Water quality parameters can be measured using manual/chemical equipment, electronic Vernier equipment or by doing a comparative study using both.

- **Riparian Ecosystem:** It is important that during their Salmon Watch field trip students understand the interrelationship among salmon, humans and the watershed they share. This station allows students to understand salmon in a larger context and emphasizes the importance of high quality habitat for salmon survival. Activities that help students gain a broader perspective include: Riparian and Aquatic Area Survey, Riparian Area Transect, Riparian Mapping, Riparian Profile, Soil Survey and Canopy Cover Survey.

<u>Other Activities</u>

(Teachers may want to utilize these either in the classroom or at the field site)

- **Nature Walk or Plant & Wildlife Identification:** Use nature observation skills to explore the terrestrial ecosystem. Have students identify their location on a map, and then document observed wildlife and wildlife signs. The activity could include, for example, plant identification, bird watching, animal signs, etc. You can collect data to share with other classrooms and The Freshwater Trust to help create an annual site profile. This activity may be incorporated into the riparian assessment.

- **Art/Poetry:** An art and/or poetry station has worked well for an interdisciplinary field trip and allows the students to experience nature, and the salmon, on many different levels. Successful activities have included drawing, painting, making fish prints, and writing haiku poetry.

- **Salmon Politics:** The salmon crisis is one of the most critical issues in the Pacific Northwest today. What better time to start students thinking about these issues than when they are sitting beside a salmon stream watching the miracle of spawning. Experiencing salmon and their watershed on a personal level will give students powerful insight into discussions about historic abundance of salmon and declining runs, factors contributing to population declines, the Endangered Species Act, possible solutions, importance of salmon in the Pacific Northwest, and what individuals can do to help. This activity is best done as a group with all of your volunteers present to participate.

- **Guided Visualization:** If you or one of your adult volunteers is interested in leading guided visualizations, then the field trip will be enhanced by devoting one station to this activity. Find a quiet place for this station, one that is close to the stream. An excellent example of a recorded guided visualization is The Drought by Barry Lopez.

- **Miscellaneous Other Activities:** "Hooks and Ladders." This activity allows students to appreciate the strength, determination, and perseverance of the salmon along their life's journey. We only recommend this activity if a large open area is available that will have minimal impact on the site. The activity may be more appropriate for a pre or post-field trip activity because of the time required.

- **Fly-casting Demonstration:** If you or one of your adult volunteers are interested in fly-fishing, then a possible station might be a demonstration on fly-fishing techniques, along with a discussion on issues such as catch & release fishing and hatchery vs. wild fish, artificial lures and the macroinvertebrate life cycle.

- **Journal Writing:** Find several areas where the forest floor is relatively clear, or the stream bank provides a place which "feels quiet". Have the adult volunteers take students to these quiet places. The volunteer should sit down, and remind students of the assignment that you made in class: students are to relax and open their minds (be present) to the place where they are. When they feel ready, they respond to an assignment you have posed. This assignment can be to describe their thoughts or feelings, write a poem, relate their experiences to a parent in a letter, etc. Once the students are engaged, the volunteers leave and gather at a base area designated by the teacher. When students have finished writing, they also move to the base area. (They have been instructed by the teacher beforehand to do this.)

- **Native American Culture/Philosophy:** If available, contact a Native American who is knowledgeable about the role of salmon in the culture of Indian tribes that inhabited this area in the past. He or she might share legends or other information that will allow students to better appreciate the importance of salmon to Native Americans. Encourage your students to prepare questions beforehand. Other topics may include treaty rights, tribal customs, and attitudes toward nature, music, dance, artifacts, art or food.

- **Stream Flow:** Flow affects everything from the concentration of various substances in the water to the distribution of habitats and organisms throughout the stream. Flow is the volume of water moving past a point in a unit of time. This activity has students determine the two components that make up flow: the volume of water in the stream and the velocity of the water moving past a given point. They then use a formula to calculate the stream flow. Flow can be done as its own independent activity or as part of the Water Quality station.

  Safety and site protocols need to be strictly followed during this activity:
  - **avoid redd areas.**
  - **life jackets required if students are above knee level in the stream.**
  - **school assumes all risk associated with having students wading into potentially deep and fast moving streams.**

FIELD TRIP AGENDA

Once all the pieces of your Salmon Watch field trip are in place, be sure to finalize your field trip agenda. This agenda should include information concerning the times, locations, names of people involved in the day's activities, and the various activities that will take place on the trip. Please refer again to the two sample field trip agendas.

A copy should also be left with your school administration together with emergency numbers. Sending a copy to all of the field trip participants in advance of the field trip is mandatory and is extremely helpful in their planning and preparing for the day's events. **At a minimum, teachers should contact all volunteers 1-2 weeks in advance of the field trip and again the day before the trip to confirm details and discuss any changes. You are encouraged to utilize the Salmon Watch online calendar and your personal home page to communicate with volunteers. www.thefreshwatertrust.org/education/salmon-watch/field-trip-sign-up**

SAMPLE FIELD TRIP SCHEDULES

Sample Agenda # 1

Salmon Watch - Field trip to Fish River [site]
Joe Jones [teacher's name]
West Middle School [name of school]
Wednesday, Sept. 20, 2000 [date of trip]

8:00 a.m.	All Participants meet at West Middle School (in front of flag pole)
8:15 a.m.	Board bus
9:30 a.m.	Bathroom stop at Rest Area
9:50 a.m.	Arrive at Fish River site
10:10 a.m.	Opening Circle – introduce volunteers, review wildlife watching techniques, safety and site protocols (you may ask a volunteer to assist with the opening circle)
10:35 a.m.	Students then break up into small groups of about seven students each and rotate through 4 different small group activities 35 minutes each: 1. Salmon Biology (led by agency fish biologist) 2. Water Quality (led by volunteer's name) 3. Macroinvertebrates (led by volunteer's name) 4. Riparian Assessment (led by volunteer's name)
10:35-11:10 a.m.	1st small group session
11:15-11:50 a.m.	2nd small group session
11:55-12:20 p.m.	Lunch
12:25 p.m.- 1:00 p.m.	3rd small group session
1:05 p.m. – 1:40 p.m.	4th small group session
1:45 p.m – 2:00	Closing circle and debrief (you may ask a volunteer to assist with the closing circle)
2:00 p.m.	Board bus
3:00 p.m.	Arrive at School

Sample Schedule # 2

Salmon Watch
[teacher's name]
[name of school]
[date of field trip]
[site]

8:30 a.m.	Everyone meet at school in room 214
8:40 a.m.	Board bus
8:45 a.m.	Leave School
9:45 a.m.	Arrive at Wet Creek site/Bathroom Break/Opening Circle
10:00 a.m.	Group Nature Walk to Streambank Area
10:15 a.m.	If available, presentation by Northwest tribal member (Cultural Importance of salmon and relationship between humans and nature)
Approximately 10:15a.m.-12:15 p.m.	Small groups rotations (7-8 students per group) Each group will visit four stations for a thirty-minute activity involving a different aspect of the ecosystem and complete the portion of their field trip log that corresponds to the lesson. Allow at least 5 minutes for transition between stations. 1. Macroinvertebrates (led by [name of volunteer]) 2. Riparian environment (led by [name of volunteer]) 3. Water Quality (led by [name of volunteer]) 4. Observation of salmon and discussion of salmon biology (led by [name of fish biologist])
12:15 p.m.	Lunch/Bathroom Break
12:45 p.m.	Journaling
1:15 p.m.	Walk back to bus
1:30 p.m.	Closing Circle - Board bus/Debrief with volunteers
1:45 p.m.	Depart Wet Creek site
2:45 p.m.	Arrive at School

SCHOOL ADMINISTRATION REQUIREMENTS

In addition to preparing your field trip agenda and organizing volunteers, don't forget to complete other necessary administrative requirements for your field trip. **Remember to clear the field trip with appropriate administrative personnel at your school, reserve your bus and arrange for a substitute teacher as soon as possible. This will help prevent unnecessary confusion, as your field trip gets closer.**

Letters will also need to be sent to students' parents and guardians informing them about the Salmon Watch program and the purpose of the field trip, inviting them to join the class, and obtaining permission for the student to participate in the field trip. To help you in this process, a sample letter to parents has been included below.

[date] [school letter head]

Dear Parent/Guardian:

This is to inform you that your child, and his/her classmates will be going on a Salmon Watch field trip to Fish Creek on Tuesday, Oct. 17, 20XX.

Salmon Watch is a unique environmental education program for selected elementary, middle and high school students in Oregon. The program, begun in 1993, is co-sponsored by Oregon Tout and numerous other organizations. The Freshwater Trust is a non-profit conservation organization dedicated to promoting healthy waters and to the protection and restoration of wild fish and their ecosystems.

As part of the Salmon Watch program, students have studied salmon biology, habitat, and human impacts on the environment in their classrooms.. The field trip is designed to allow students to further their understanding by observing wild salmon spawning in their native streams and engaging in hands-on learning about the natural world.

We will be leaving the school promptly at 8:00 a.m. and are scheduled to return no later than 2:45 p.m. Enclosed for your information you will find a preliminary schedule of the day's events.

On the day of the field trip students will need to bring:

A sack lunch and beverage (no glass containers please!).

Appropriate clothing (including wool or fleece sweater and water resistant jacket, outdoor shoes + warm socks, hat and gloves).

Please sign and return the enclosed permission slip to me by [date] to ensure that your child will be able to participate in this unique Salmon Watch outdoor learning experience. If you have any further questions, please call me at (xxx)xxx-xxxx.

Sincerely,

[teacher's name]

CONTACTING FIELD TRIP PARTICIPANTS

Now it is time to speak with the people who will help to make your Salmon Watch field trip a success. Participants in your Salmon Watch field trip may include one or more of the following:

Agency Fish Biologist
Community Volunteers
Native American (if available)
Parents
Other Special Guests

All of your field trip participants are dedicated to making your field trip a success. The more they are informed and involved in your field trip planning, the more your students will get out of their Salmon Watch experience.

All participants should be contacted **at least two weeks** prior to the date of your field trip. Volunteers will be assigned to teach a water quality, macroinvertebrates, riparian assessment or fish biology station by The Freshwater Trust staff. Communicate with each of your volunteers regarding trip agenda, equipment needs, and expectations or education goals for the field trip. Remember that Salmon Watch volunteers come from all walks of life, and therefore have diverse backgrounds, expertise and perspectives to contribute to your Salmon Watch field trip.

We encourage you to talk with your assigned field trip participants to understand their areas of interest/expertise and how they would best like to assist you on your field trip. Utilizing their strengths will help make your field trip more enjoyable and beneficial for all.

Please be sure to schedule time when you arrive at the field trip site to meet briefly with your volunteers, confirm any schedule changes, and identify the locations for each of the activities they will be leading.

We encourage teachers to make a reminder phone call or e-mail message the day before the trip to all adult participants. The Salmon Watch online calendar and your personal home page can assist you with communicating with volunteers. www.thefreshwatertrust.org/education/salmon-watch/field-trip-sign-up

OTHER FIELD TRIP RESOURCES

Depending on which activities you choose to incorporate into your Salmon Watch field trip, there may by additional materials you will need to bring on your field trip. First, you need to determine what equipment you'll need on the day of the field trip. Be sure to confirm where you'll be getting the equipment from and who will be responsible for bringing it to the field trip site. Equipment is available for check out at the The Freshwater Trust office or at a designated location.

You will also need to prepare student worksheets and other handouts for your Salmon Watch field trip. Consider preparing either individual worksheets or a multi-page Salmon Watch field trip log that allows students to document their Salmon Watch experience (see data forms section).

Be sure to provide volunteers with a copy of all data forms or field journals prior to the field trip.

AFTER THE TRIP

Following the field trip, please do the following:

- ❑ **Complete the TEACHER FIELD TRIP EVALUATION** and **STUDENT EVALUATIONS** and **return to The Freshwater Trust no later than December 31st.**
- ❑ **Complete the Reimbursement Form** and **return to The Freshwater Trust no later than December 31st.** (If you will be requesting reimbursement for substitute teacher and/or bus expenses, it is required that the evaluations be completed and received before the new year).
- ❑ **Log onto StreamWebs www.streamwebs.org and assist your students in uploading their Salmon Watch field trip data.**

Please note, the school or school district will need to provide documentation (on school letterhead or invoice from school district) for field trip expenses reimbursement.

NOTE: Reimbursement monies for buses & substitute teachers are contingent upon our receipt of this evaluation. Deadline is December 31, 2010.

The Freshwater Trust™

Salmon Watch®

2010 TEACHER EVALUATION – PAGE 1 OF 5

Name ______________________ School ______________________

Field Trip Date ______________________ Grade Level ______________________

Field Trip Site ______________________ # of Students Participating ______________

Does your class also participate in Outdoor School? ☐ Yes ☐ No

We continually seek to improve the quality of our educational programs. By completing this survey, you are giving us permission to add your responses to information provided by others participating in this program. We will be using this information to demonstrate the effectiveness of the training and to make future program changes. Thank you for your input.

Pre-Field Trip

How would you rate the coordination of this year's Salmon Watch® field trip by The Freshwater Trust staff?

- ☐ Excellent
- ☐ Very Good
- ☐ Good
- ☐ Fair
- ☐ Poor

Comments ____

Field Trip Date

Number of live salmon __________

Number of dead salmon __________

pH __________

Dissolved Oxygen __________

Water Temperature __________

Weather Condition:

- ☐ Clear
- ☐ Cloudy
- ☐ Rain
- ☐ Other ______________________

Field Trip Site

How was the quality of salmon viewing conditions on your field trip?

- ☐ Excellent
- ☐ Very Good
- ☐ Good
- ☐ Fair
- ☐ Poor

Comments ____

2010 TEACHER EVALUATION – PAGE 2 OF 5

Please rate how conducive the site was to the success and effectiveness of the following activities:

	Excellent	Good	Fair	Poor	Not Applicable
Salmon Biology/Life Cycles	☐	☐	☐	☐	☐
Macroinvertebrate Sampling	☐	☐	☐	☐	☐
Water Quality Testing	☐	☐	☐	☐	☐
Riparian Study & Assessment	☐	☐	☐	☐	☐
Upland Nature Study	☐	☐	☐	☐	☐

List predominant aquatic insect species found: ____________________

List predominant plant species found: ____________________

List other wildlife found: ____________________

Setting the Tone and Wildlife Watching

Opening Circle and Wildlife Watching Techniques reviewed ☐ Yes ☐ No

Comments ____________________

Closing Circle and Debrief ☐ Yes ☐ No

Comments ____________________

Field Trip Volunteers

Please give us the names of the Salmon Watch Volunteers who participated in your Field Trip:

1. ____________________
2. ____________________
3. ____________________
4. ____________________
5. ____________________
6. ____________________

Have you sent thank you notes to all of your Salmon Watch field trip participants?

☐ Yes ☐ No (If no, please do so as soon as possible!)

How would you rate the overall contribution of the volunteers on your Field Trip?

☐ Excellent
☐ Very Good
☐ Good
☐ Fair
☐ Poor

Comments ____________________

Student Experience

How would you rate your students' overall reaction to the field trip?

☐ Excellent
☐ Very Good
☐ Good
☐ Fair
☐ Poor

Comments ____________________

2010 TEACHER EVALUATION – PAGE 3 OF 5

Please rate the overall field trip in terms of its effectiveness in teaching students about salmon and watersheds at an introductory level:

- ☐ Excellent
- ☐ Very Good
- ☐ Good
- ☐ Fair
- ☐ Poor

Comments ____

____

____

____

____

Post — Field Trip and Service-Learning Projects

What concerns, if any, did you have about this year's field trip? Please elaborate: ________________

____

____

____

What ideas do you and your students have for Salmon Watch service-learning projects: ___________

____

____

____

Would you like assistance from the Salmon Watch Staff or Salmon Watch Volunteers?
If yes, please elaborate and indicate the most effective way to help you:

- ☐ Yes
- ☐ No

If yes, elaborate ____

____

____

Number of hours spent by class on Salmon Watch program *(estimate if actual # of hours is not known)*:

_______ Classroom instruction/preparation **BEFORE** field trip

_______ Actual field trip

_______ Classroom instruction **AFTER** field trip

_______ Service Learning Project

_______ **TOTAL** hours spent (or estimated to be spent) by your class on the Salmon Watch program

Choose the number below that best rates your student's knowledge level about salmon and their habitat:

	Very Little Knowledge				Very Knowledgeable
BEFORE participating in the Salmon Watch program	1	2	3	4	5
AFTER participating in the Salmon Watch program	1	2	3	4	5

NOTE: Reimbursement monies for buses & substitute teachers are contingent upon our receipt of this evaluation. Deadline is December 31, 2010.

2010 TEACHER EVALUATION – PAGE 4 OF 5

Choose the number below that best rates your student's knowledge level about salmon and their habitat:

How important is Salmon Watch:

	Not At All	Not Significant	Adequate	Significant	Very Significant
For your science teaching program	1	2	3	4	5
In helping meet your student's science benchmark requirements	1	2	3	4	5

What % of your Life Science teaching efforts does Salmon Watch account for? __________ %

What did you like most about the Salmon Watch program? ______________________________

____

____

The least? ______________________________

____

____

What parts of the program do you think your students enjoyed the most? ______________________________

____

____

The least? ______________________________

____

____

How was Salmon Watch different from your regular school programs? ______________________________

____

____

How would you improve the Salmon Watch program? ______________________________

____

____

How important are the following for you participation in Salmon Watch:

- ☐ Bus and substitute reimbursements
- ☐ Curriculum alignment with ODE standards
- ☐ Other ______________________________

As a teacher, what is the biggest challenge you face participating in the Salmon Watch program?

____

____

____

NOTE: Reimbursement monies for buses & substitute teachers are contingent upon our receipt of this evaluation. Deadline is December 31, 2010.

My overall rating for the Salmon Watch program would be:

☐ Excellent
☐ Very Good
☐ Good
☐ Fair
☐ Poor

Comments ______________________________

Was your field trip data entered into StreamWebs™? ☐ Yes ☐ No

Next Year

Are you interested in participating in Salmon Watch next year?

☐ Yes ☐ No

Would you be willing to take your students to the same site if you participate in Salmon Watch next year?

☐ Yes
☐ No

If no, please explain: ______________________________

Are you interested in a similar field trip date next year?

☐ Yes ☐ No

2010 Salmon Watch Curriculum Revisions

The Freshwater Trust has integrated some new curriculum content into Salmon Watch this year. Please let us know if these new activities were used in the field and share any comments or feedback you may have so we can continue to improve the program.

Water Quality:	Was Vernier technology used?	☐ Yes	☐ No
	Was flow monitoring conducted?	☐ Yes	☐ No
Riparian:	Was the canopy cover surveyed?	☐ Yes	☐ No
	Was the soil survey conducted?	☐ Yes	☐ No

Comments ______________________________

Please send form (along with check) to:

THE FRESHWATER TRUST
SALMON WATCH
65 SW YAMHILL, SUITE 200
PORTLAND, OR 97204

503.222.9091 x25 FAX 503.222.9187

PLEASE SUBMIT TO
THE FRESHWATER TRUST
BY DECEMBER 31, 2010. THANK YOU!

We hope that you enjoyed Salmon Watch! Your feedback is appreciated—Thank you!

The Freshwater Trust™

Salmon Watch®

2010 STUDENT EVALUATION

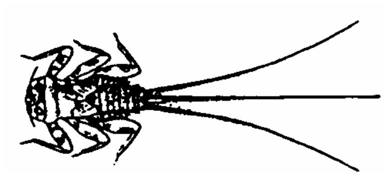
Name ______________________________ School ______________________________

Grade ______________________________ Teacher ______________________________

Please mark the answer or face that best describe what you think about the following:

1. One of the functions of a healthy riparian area is to:
   - A. Increase erosion
   - B. Provide shade for aquatic and terrestrial animals
   - C. Drive wildlife away from streams and rivers
   - D. Increase water contamination

2. The macroinvertebrate pictured below is a:
   - A. Stonefly
   - B. Mayfly
   - C. Caddisfly
   - D. Dragonfly



3. Which of the following water characteristics are good for salmon?
   - A. Excessive sediments
   - B. Dissolved oxygen
   - C. pH above 8.0
   - D. 80°F temperatures

4. The name of a salmon nest is:
   - A. Parr
   - B. Smolt
   - C. Redd
   - D. Drey

	Strongly Disagree	Disagree	Not Sure	Agree	Strongly Agree
5. I understand why healthy water is important.					
6. I want to share what I learned with my family and friends.					
8. I care about water.					
9. I want to work on projects that will help my watershed.					
10. I think I can make a difference in the health of my watershed.					

MORE QUESTIONS ON NEXT PAGE

11. Why is healthy water important?

12. How do you plan to help your watershed?

13. In the space below, please draw or describe at least one interaction within an ecosystem.

The Freshwater Trust™

Salmon Watch®

2010 REIMBURSEMENT FORM — FOR BUS &/OR SUBSTITUTE TEACHER

IMPORTANT NOTES:

- Please remember that reimbursement is contingent upon receipt of your Field Trip Evaluation Form and Student Evaluations (return within two weeks of your field trip).
- All reimbursement requests must be received by December 31, 2010, the end of The Freshwater Trust's fiscal year.
- Documentation Required: Return this form with district invoices or bills from the school on letterhead.

Teacher ______________________________

District ______________________________

Today's Date ______________________________

Field Trip Date ______________________________

School ______________________________

Bus

Bus Expense (max $300) ____________________

Check Payable to ______________________________

Address where bus payment should be rendered

____

City, State Zip ______________________________

Bus Company (if applicable)

____

Substitute

Substitute Expense ____________________

Check Payable to ______________________________

Address where substitute payment should be rendered

____

City, State Zip ______________________________

Total reimbursement $____________________

Please send form to:

The Freshwater Trust
Salmon Watch
65 SW Yamhill, Suite 200
Portland, OR 97204
PHONE 503.222.9091 x20 FAX 503.222.9187

Questions?
Contact Sarah Oakley at 503-222-9091 x20 or sarah@thefreshwatertrust.org.

Office Use Only

☐ Teacher evaluation received ☐ Student evaluations received

Date to administrator ____________________

☐ Documentation recieved Invoive #____________________

Date payment sent ____________________

☐ Education staff approval

BACKGROUND INFORMATION FOR FIELD TRIP ACTIVITIES

The following pages include some of the relevant background information, charts and potential discussion questions for topics covered in each of the four field trip stations during Salmon Watch. For more complete information on each station including full procedures, protocols and field studies, refer to the Volunteer Resource Guide which can be downloaded off of The Freshwater Trust website: www.thefreshwatertrust.org.

Salmon Biology

- Observation of salmon spawning behavior and study of anatomy.

Water Quality

- Testing and analysis of temperature, dissolved oxygen, pH, turbidity and flow.

Aquatic Macroinvertebrates

- Collecting and identifying macroinvertebrates.

Riparian Ecosystem

- Studying the riparian ecosystem through conducting one or more of the following activities: Riparian and Aquatic Area Survey, Riparian Area Transect, Riparian Mapping and Profile Activities, Soil Survey and Canopy Cover Survey.

Human Impact

- Evidence of human activity and impact at the site.

*Please note you have to choose which activity(ies) you want your students to complete. Our limited time in the field will not allow your students to complete all the activities provided, specifically in the Riparian station and occasionally in the Water Quality station.

Salmon Biology

Below is a description of potential methods for observing salmon and activities to do so. Please refer to the Salmon section of this binder for more complete and in depth salmon biology, habitat and life cycle information.

Weather: _____ Storm _____ Overcast _____ Rain

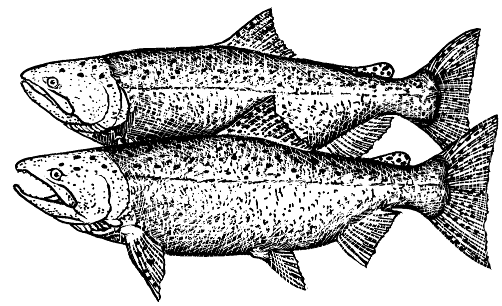
_____ Clear _____ Showers ________ Snow

Date:

Time:

Name/School:

Stream name:



Any fish present?

_____ yes _____ no ________ number of fish sighted

______ number of live fish ______ number of carcasses (dead fish)

Length of observation:

Identify, describe and sketch the fish. Identify the species (if possible) or family of the fish observed. List the numbers of each species. Describe as best you can, what the fish looks like. Make some sketches. If there are carcasses, identify, describe and sketch these as well.

Salmon Observation:

Sex ratio. If identifiable, list the ratio of females to males. If this is not possible, estimate the percentages of females and males.

Behavior. Indicate significant behavior, such as digging, redd guarding, general spawning behavior, fighting, or attempted passage of a barrier.

Location. As if you were looking down from above, sketch the stream section you are observing and plot where you have observed certain fish activity and redds.

Habitat. Describe and sketch the stream section you are observing. To you knowledge, is this good salmon habitat? Why or why not? If you have not seen a salmon at this site, why do you think this is?

Water Quality

Water in the stream in which salmon live provides conditions, which allow the salmon to continue to thrive. When we measure these conditions, we say we are evaluating water quality. The tests that we will be conducting in the field will be temperature, dissolved oxygen, pH, turbidity and stream flow.

Salmon Watch trips provide an opportunity to use more than one method of data collection. Not only do we use manual, chemical based tests, but we now also use Vernier digital LabQuests and probes to obtain data for the same parameters. This provides an opportunity to not only show students different techniques for data collection but it also provides a reliable and efficient method of archiving data from all of our Salmon Watch sites.

Vernier LabQuests are hand held electronic devices capable of taking all of the same tests Salmon Watch trips have historically taken. LabQuests come with probes for pH, turbidity, temperature, dissolved oxygen and stream flow. Our hope is that these new tools will provide another option for teachers, students, and volunteers to explore the world of water quality as well as make available the techniques for obtaining the most accurate and reliable data possible. Water Quality parameters can be measure using the manual chemical based test, the Vernier digital LabQuests or both to conduct a comparative study.

Water Temperature Background Information

Water temperature is one of the most important factors for survival of aquatic life. Most aquatic organisms acclimate to be the same temperature of the water that surrounds them. Their metabolic rates are controlled by water temperature. This metabolic activity is most efficient within a limited range of temperatures. If temperatures are too high or too low, productivity can decrease or metabolic function cease. The organism can die. These extremes, or lethal limits, vary for different species.

Dissolved Oxygen Background Information

Oxygen is as essential to life in water as it is to life on land. Oxygen availability determines whether an aquatic organism will survive and affects its growth and development. The amount of oxygen found in water is called the dissolved oxygen concentration (DO) and is measured in milligrams per liter of water (mg/l) or an equivalent unit, i.e. parts per million of oxygen to water (ppm).

DO levels are affected by:

- Altitude
- Water agitation
- Water temperature
- Types and numbers of plants
- Light penetration
- Amounts of dissolved or suspended solids

As water low in oxygen comes into contact with air, it absorbs oxygen from the atmosphere. The turbulence of running water and the mixing of air and water in waterfalls and rapids add significant amounts of oxygen to water.

pH Background Information

The concentration of hydrogen ions in a solution is called pH and determines whether a solution is acid or alkaline. A pH value shows the intensity of acid or alkaline conditions. In general, acidity is a measure of substance's ability to neutralize bases, and alkalinity is a measure of a substance's ability to neutralize acids.

The pH scale ranges from 1 (acid) to 14 (alkaline or basic) with 7 as neutral. The scale is logarithmic so a change of one pH unit means a tenfold change in acid or alkaline concentration. A change from 7 to 6 represents 10 times the concentration, 7 to 5, 100 times, and so most organisms have a narrow pH range in which they can live. While some fish can tolerate a range of 5 to 9, others cannot tolerate a change of even one pH unit. Because of this narrow range of tolerance, pH limits where many organisms can live and the composition of a community.

While pure distilled water has a pH of about 7, any minerals dissolved in water can change the pH. These minerals can be dissolved from a streambed, the soil in a watershed, sediments washed into a stream, or the atmosphere.

Turbidity Background Information

As long as there has been water in streams, it has carried solid particles called sediments. Sediments occur naturally as products of weathering and erosion. Wind, water or frost action on rock surfaces result in the gradual breakdown of large, solid rock pieces to smaller particles such as sand and silt. Nutrients necessary to life are also transported as sediments, using rivers, and streams as pipelines.

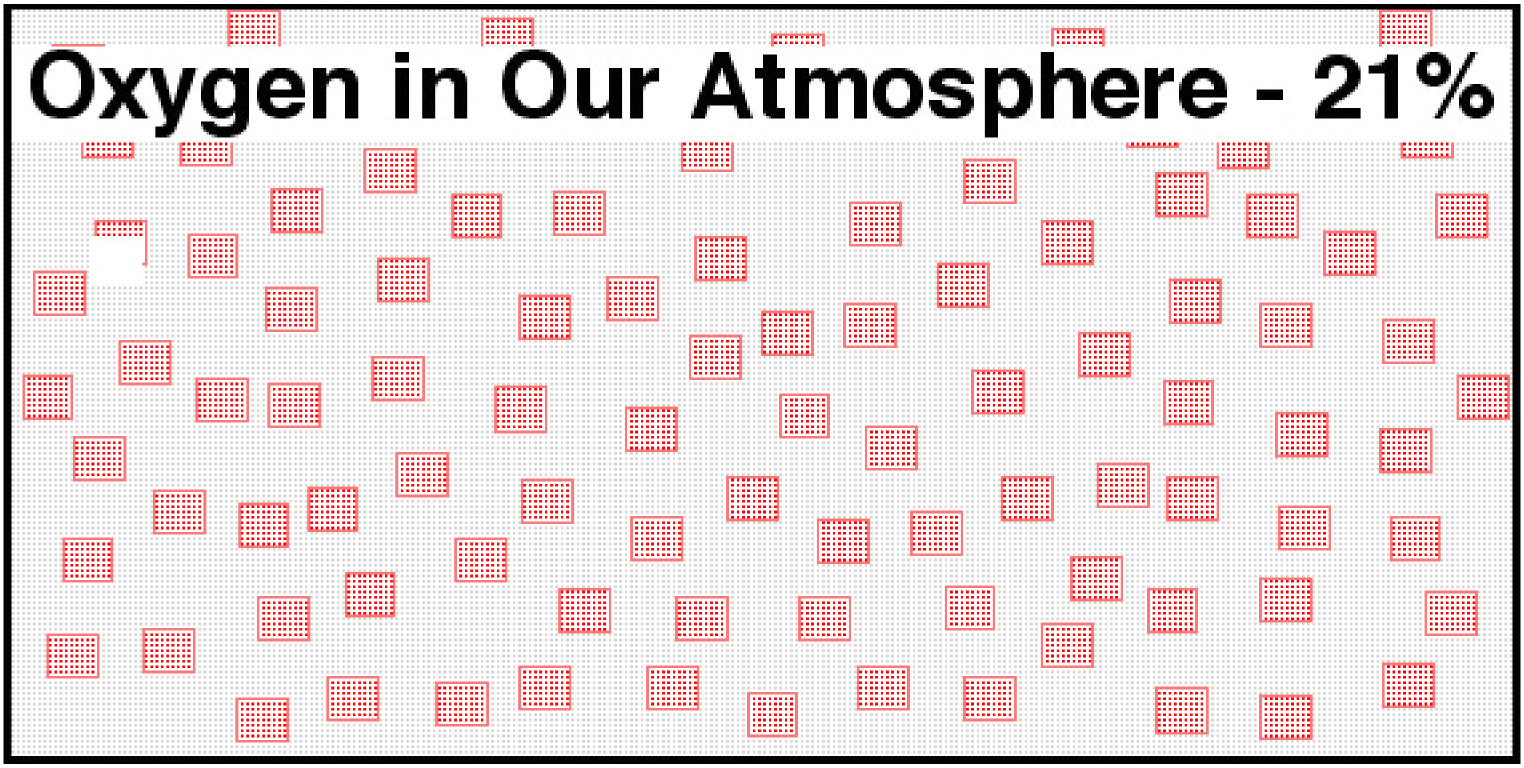
Ecosystems depend on sediments for their health but excessive amounts are harmful. Erosion and sediment transport are natural phenomena that can improve as well as degrade habitats within a watershed. Water erodes gravel banks to provide a continuing source of gravel for streams, shifts gravel bars, and forms or deepens pools, all of which benefit spawning and rearing fish. However, erosion of fine-textured soils such as clays, silts, and fine sand can reduce habitat quality by compacting gravel or lowering water quality.

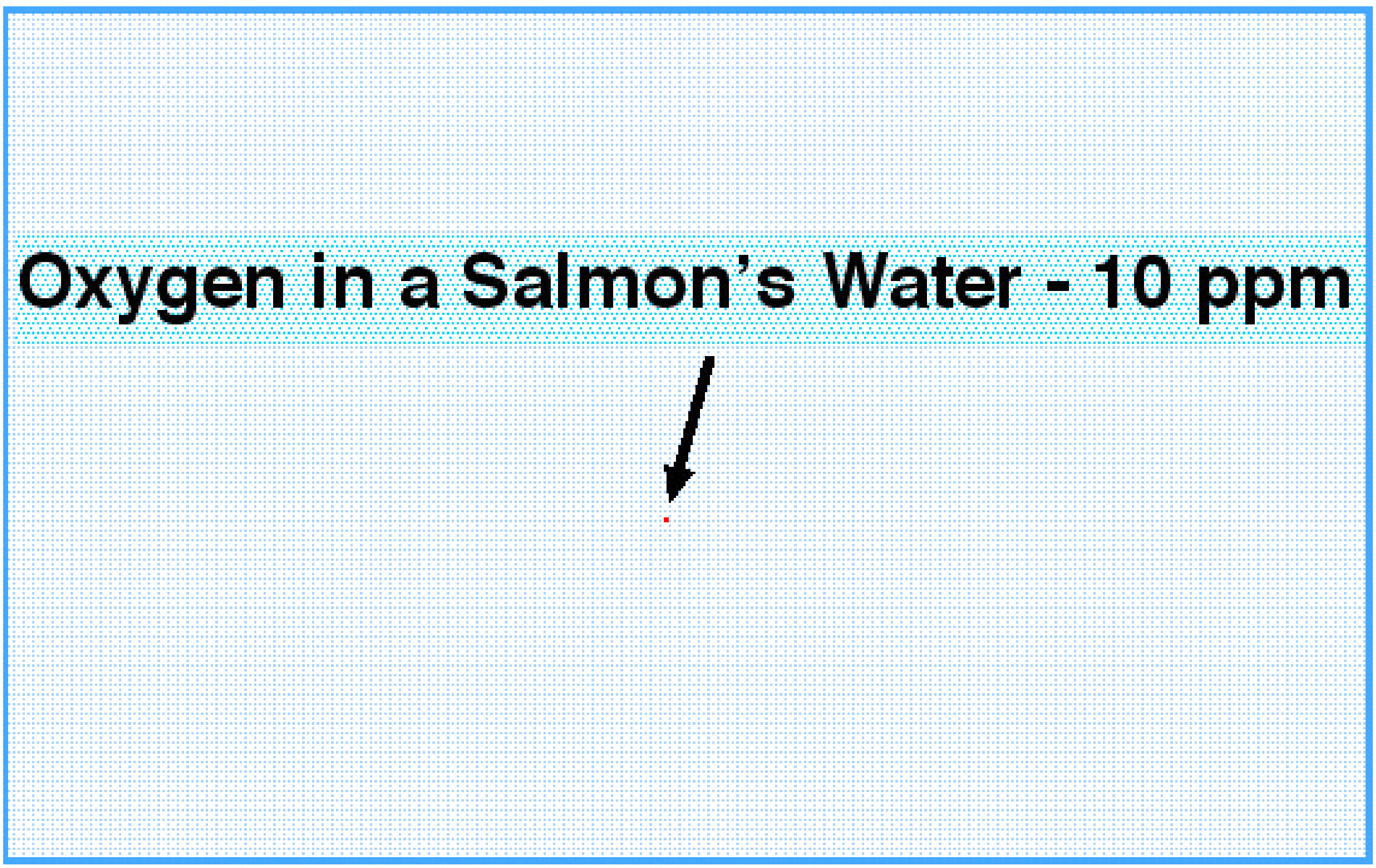
Flow Monitoring Background Information

Every summer, many streams across Oregon go dry or nearly dry. Often, more water is authorized for out of stream uses than naturally flows in the stream. As water becomes scarce, the stream's temperature increases and oxygen and water quality decrease. More importantly, less water means fewer habitats.

In many parts of Oregon, the water in our rivers and streams is over-appropriated – landowners have more rights to divert water for industrial and agricultural use than are actually in the river or stream. When periods of naturally low flows (typically, in the summer) coincide with withdrawals, many streams suffer from inadequate streamflows. In fact, some are dewatered entirely. When this happens, the ecology of the river system, the watershed and the basin are all negatively affected because the stream can no longer support aquatic habitat.

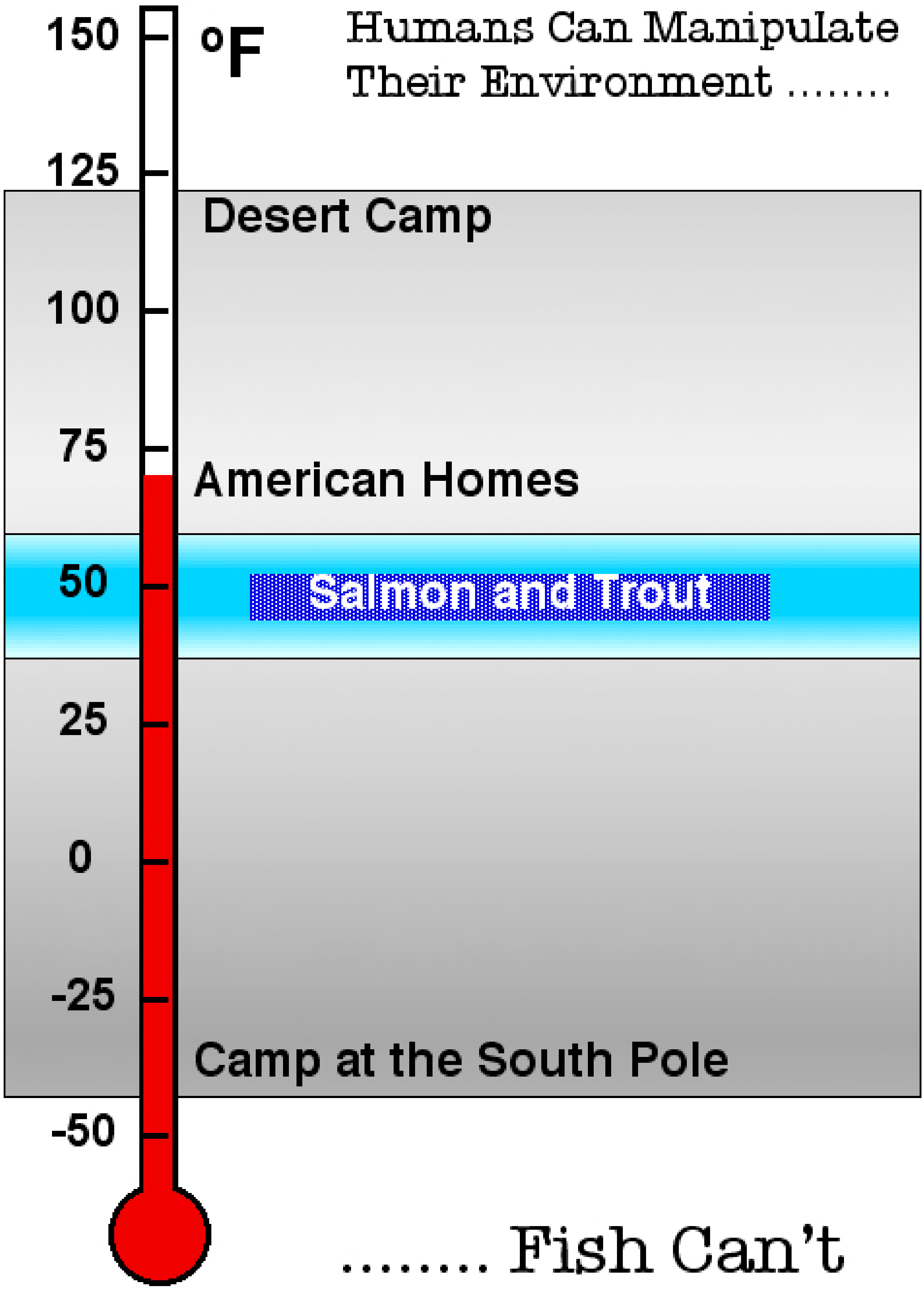
It is not an easy task to reallocate our scarce water resources in a way that accommodates industry, agriculture and the resource. Since irrigation accounts for 82% of total surface water withdrawals in the state, The Freshwater Trust devised a system to address instream flow, while still keeping agricultural lands productive. By using the instream water rights act, The Freshwater Trust works collaboratively with landowners and compensates them to leave all or a portion of their water rights instream in lieu of using it for out-of-stream purposes. The Freshwater Trust also works with these landowners to improve irrigation practices so that even more water can be kept instream.

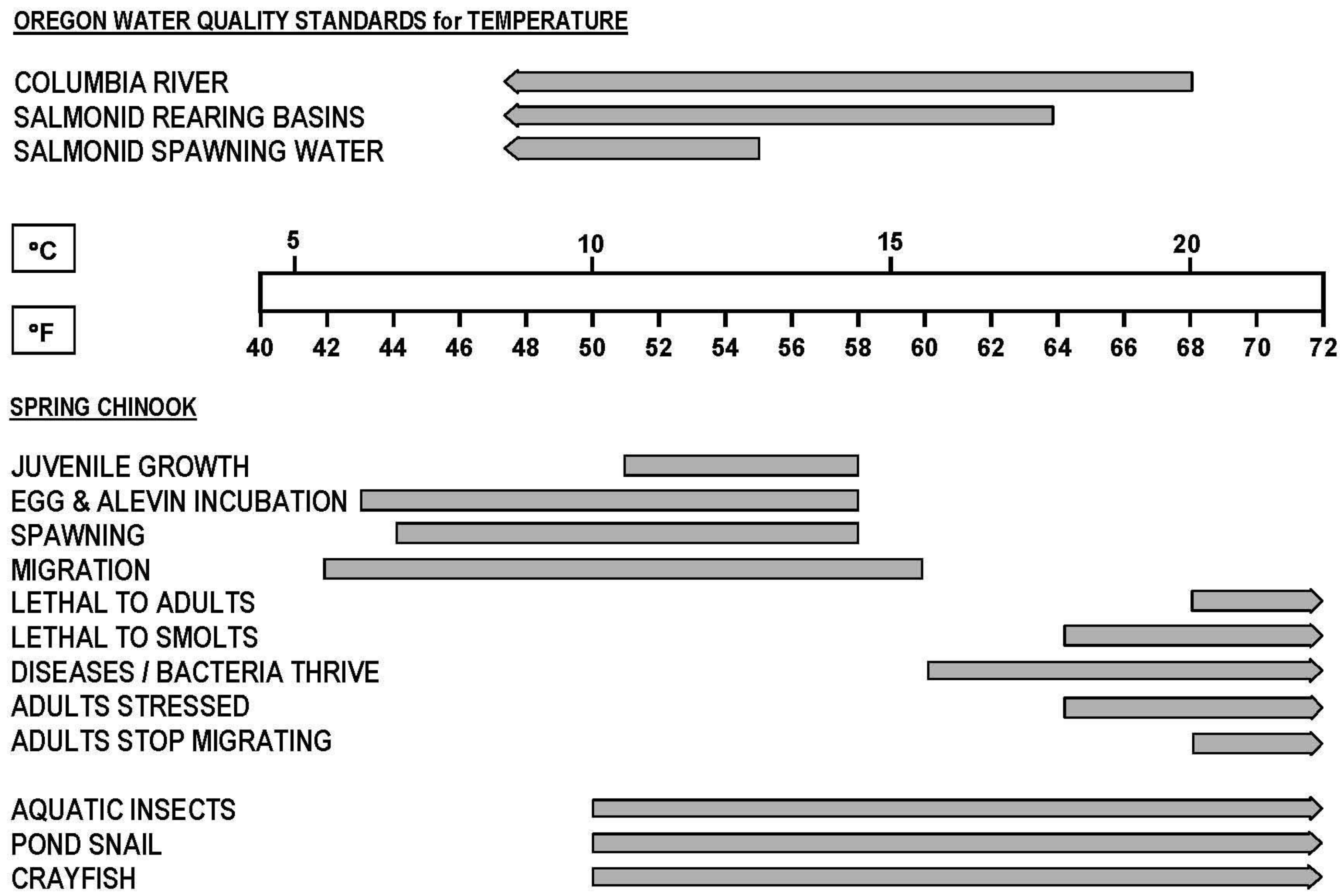




The red square is 0.5mm x 0.5mm = 0.25 square mm
The blue rectangle is 125 mm x 200mm = 25,000 square mm
0.25/ 25,000=10/ 1,000,000 which is 10 parts per million

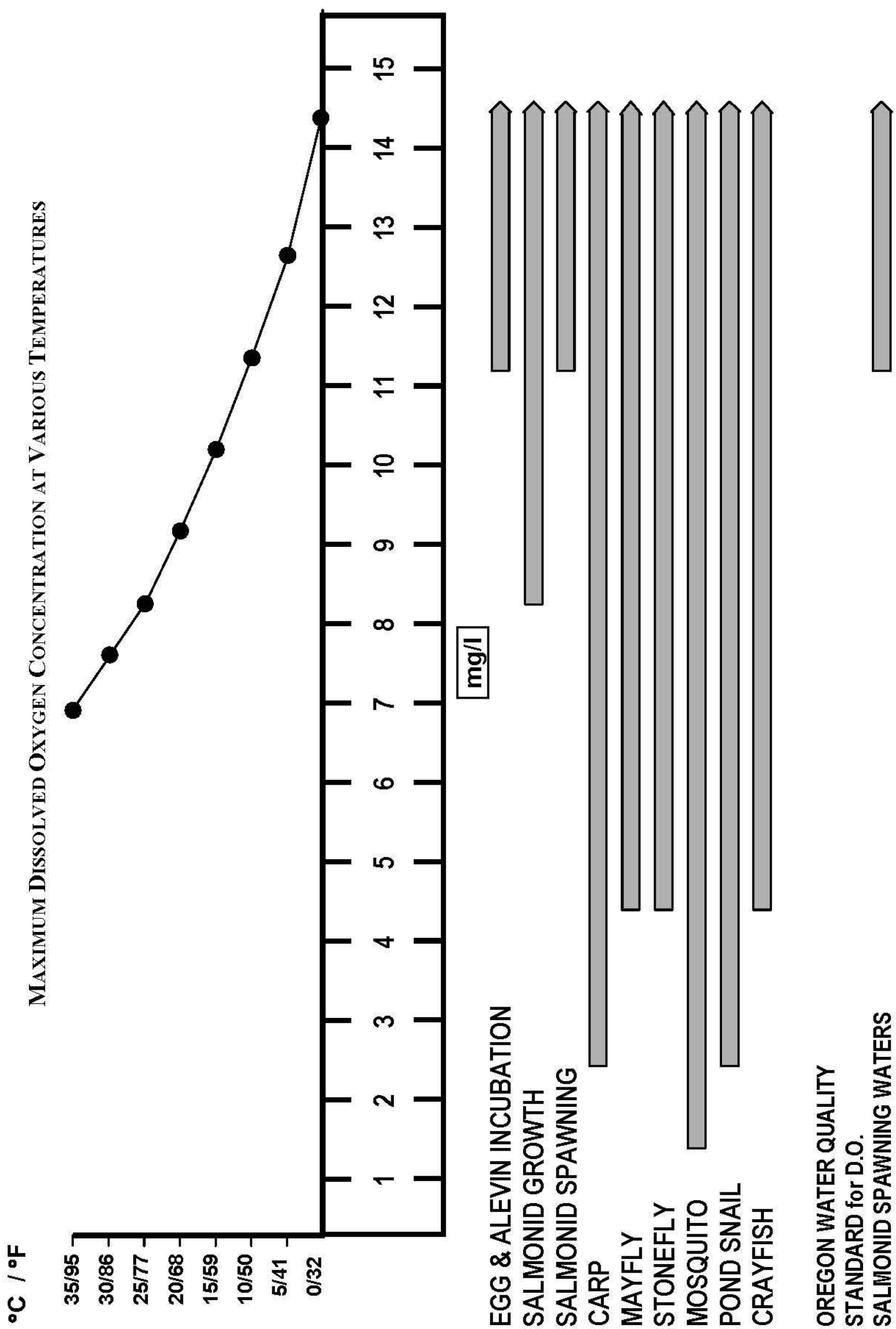
Landsberg
090915


Humans Can Manipulate
Their Environment ....
°F
150
125
Desert Camp
100
75
American Homes
50
Salmon and Trout
25
0
-25
Camp at the South Pole
-50
.... Fish Can't



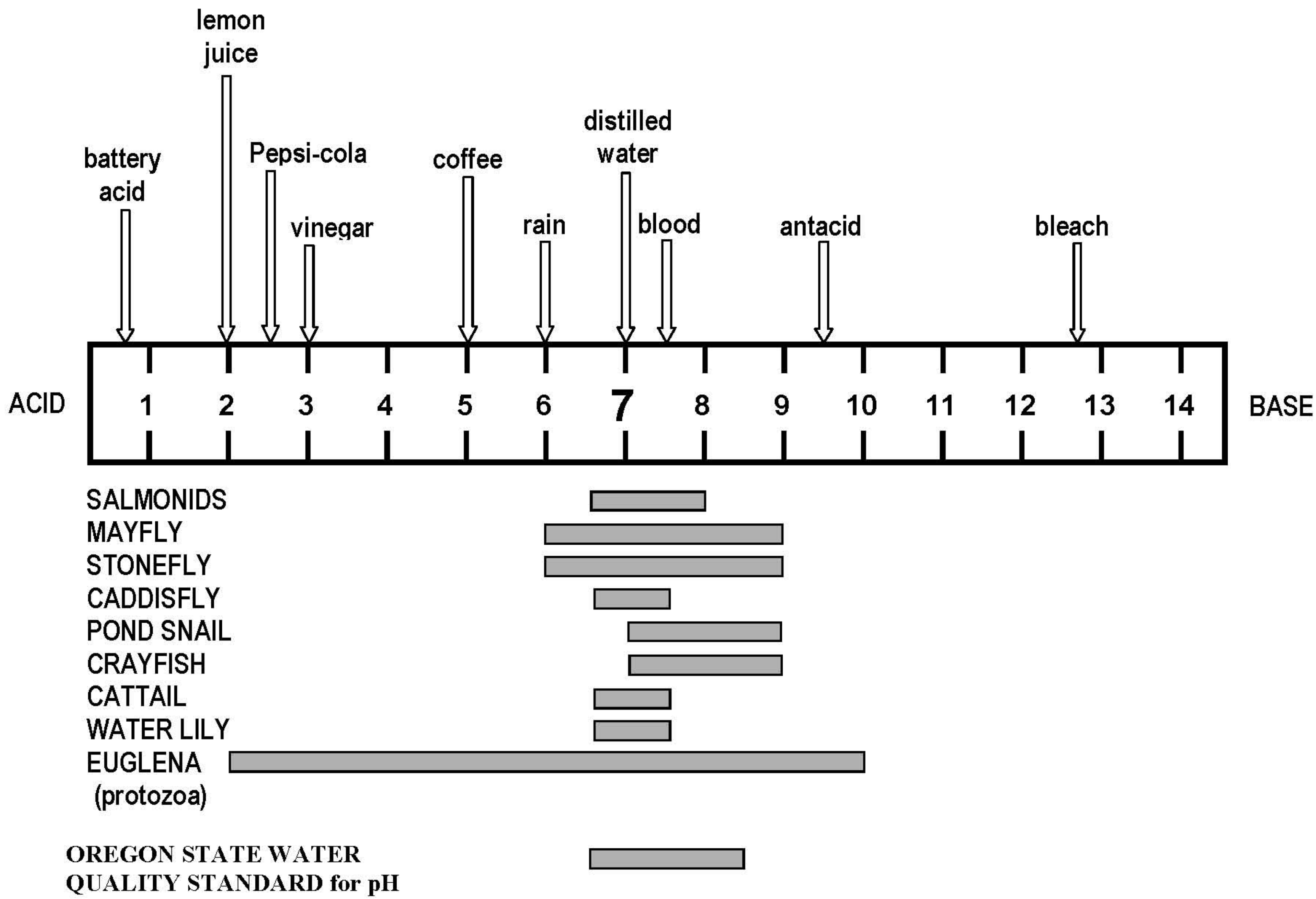
OPTIMUM TEMPERATURE LIMITS FOR AQUATIC ORGANISMS AND STAGES OF SALMONID GROWTH

Compiled from Stream Scene, Streamkeepers Field Guide, DEQ Administrative Rules, Aquatic Project Wild, Investigating our Ecosystem



OPTIMUM DISSOLVED OXYGEN LIMITS FOR AQUATIC ORGANISMS

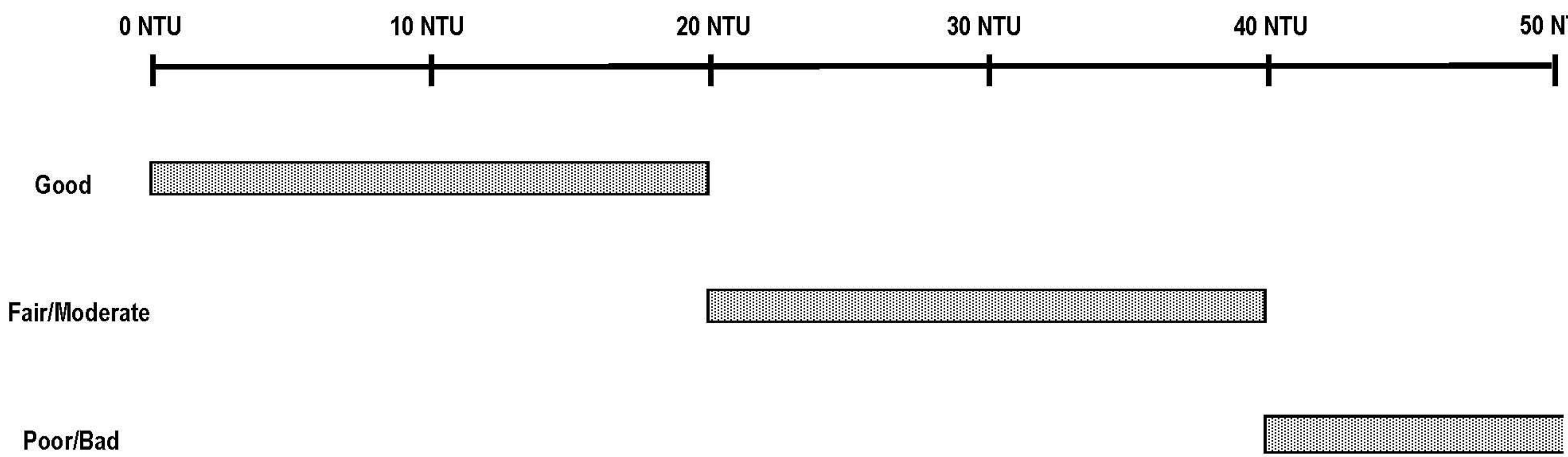
Compiled from Streamkeepers Field Guide, DEQ Adminstrative Rules, Project WILD Aquatic, Stream Scene, Investigating Our Ecosystem.



LETHAL pH LIMITS FOR AQUATIC ORGANISMS

Compiled from Stream scene, Investigating Our Ecosystem, Aquatic Project Wild, Streamkeeper's Field Guide

OPTIMUM TURBIDITY LEVELS FOR AQUATIC ORGANISMS



NTU = nephalometric turbidity unit

10 NTU: Level not to be exceeded for coldwater fisheries per state/federal water quality standards.

50 NTU: Turbidity level which interferes with site feeding; level not to be exceeded in any type of river/stream per State/Federal water quality standards.

Compiled from information regarding water quality from the Oregon Department of Environmental Quality and the U.S. Environmental Protection Agency.

Salmon Watch®

Aquatic Macroinvertebrates

What are macroinvertebrates?

Macroinvertebrates are animals that lack a backbone ("invertebrate") and can be seen with the unaided eye ("macro"). They include insects such as mayflies, mosquitoes, and beetles, as well as mussels, leeches, sideswimmers, and worms. Aquatic macro-invertebrates spend the majority, if not all, of their lives, in streams, wetlands, lakes, and other aquatic environments, and depend on healthy aquatic and upland ecosystems to survive.

Aquatic macroinvertebrates are beautiful, fascinating animals with many different body shape and structure adaptations that allow them to live in different parts of streams or lakes. Some mayflies (Ephemeroptera) that live on rocks in fast flowing water have very flattened, streamlined bodies, and some even have a suction cup-like structure on the underside of their bodies to help keep them from being washed off the substrate; other types of mayflies have curved tusks to help them dig into soft substrate (Ephemeridae, common burrowing mayfly). Black flies (Simuliidae) use hooks to anchor themselves to a little pad of silk they place on the rocks, while caddisflies (Trichoptera) build a variety of cases from sand, stones, pine needles, bark, or leaves and live and feed within their protective houses.

Aquatic macroinvertebrates are animals, just like we are, and like us they need oxygen to breathe. Aquatic macroinvertebrates can acquire dissolved oxygen across the surface of their bodies, but many types such as mayflies, damselflies, and stoneflies have elaborate branched, tufted or leaflike gills that help them obtain dissolved oxygen from the water. Still others have breathing tubes or siphons that they stick up above the surface of the water to breathe (water scorpions, mosquito larvae), while some water beetles capture bubbles of air at the water's surface and dive down with their own portable "scuba tank".

Aquatic macroinvertebrates are affected by multiple different physical and chemical factors in both the stream and the surrounding watershed. The structure and composition of the aquatic macroinvertebrate community tells an important story about the biological health of our rivers and streams.

What is biological assessment?

Biological assessment uses the characteristics of biotic (living) communities, such as fish, invertebrates, amphibians, or plants, to provide data about the biological "health" of a body of water. It allows us to detect biological responses to the effects of pollution and disturbance. Measuring water chemistry alone (temperature, pH, heavy metals, etc.) doesn't give a complete picture of stream health. It isn't possible to test for every different contaminant that might be present in a stream or lake, but the invertebrates live in that water all the time. They are constantly exposed to whatever chemicals, sediments, or changes in temperature may be occurring, and may respond by dying out, migrating away, or reproducing in even higher numbers, depending on the type of invertebrate.

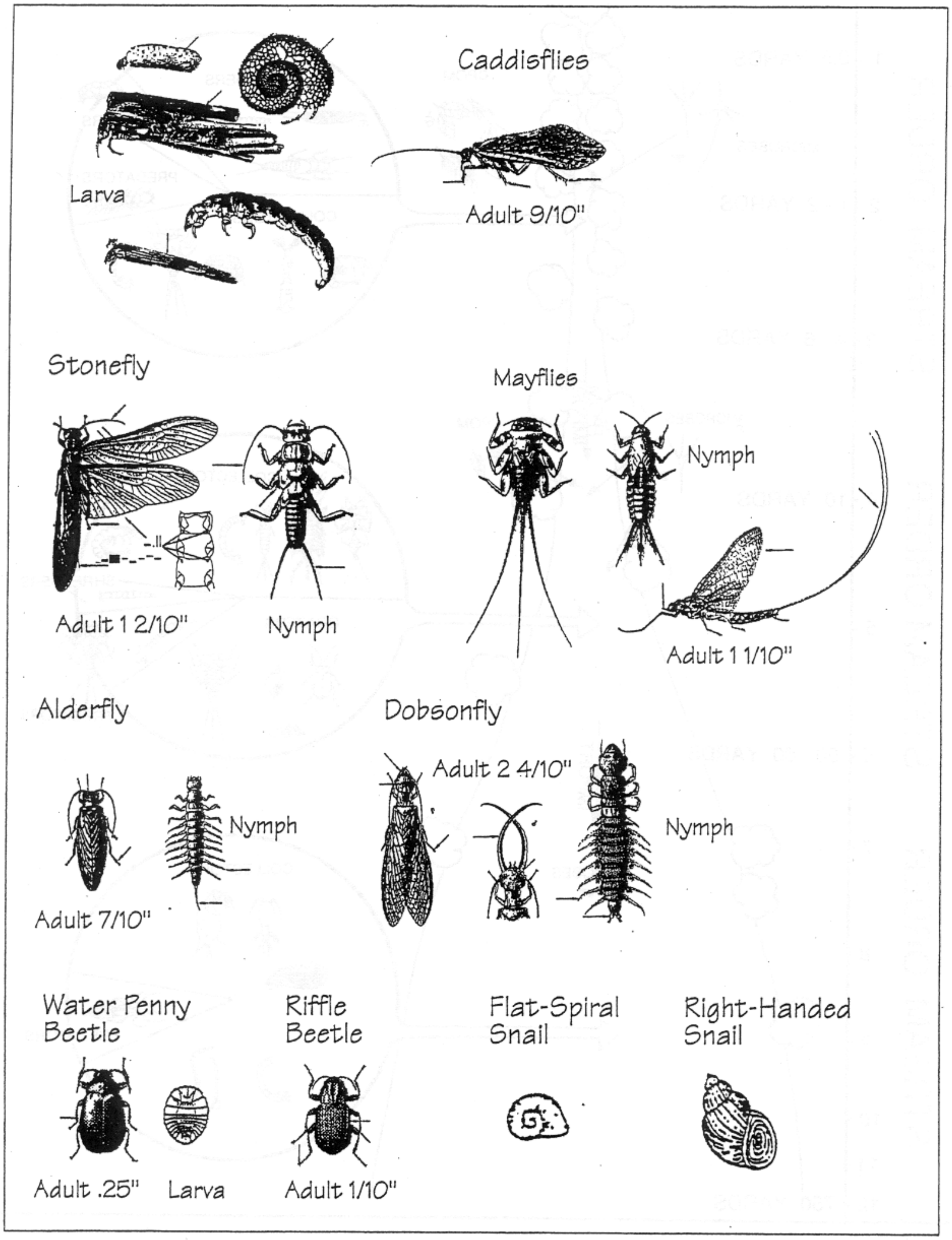
Aquatic macroinvertebrates are excellent "bioindicators": they are found everywhere, generally in large numbers, and are easy to collect; they are confined to the aquatic environment for most or all of their life cycle; they integrate the effects of many stressors (sediment, temperature, pollution, etc.) over their life span; different taxa have different known responses to specific stressors; and they are a critical part of the stream food web. Changes in the presence, condition, diversity, community composition, and relative abundances of specific groups of macroinvertebrates can signal pollution or disturbance occurring in a stream or its watershed.

Parameters	Poor	Fair	Good	Actual
Taxa Richness (# of species)	< 8	8-15	> 15	
Mayfly Taxa	< 3	3-6	> 6	
Stonefly Taxa	< 2	2-4	> 4	
Caddisfly Taxa	< 2	2-4	> 4	
*** HBI Index** (lower is better)	> 4	3.5-4	< 3.5	

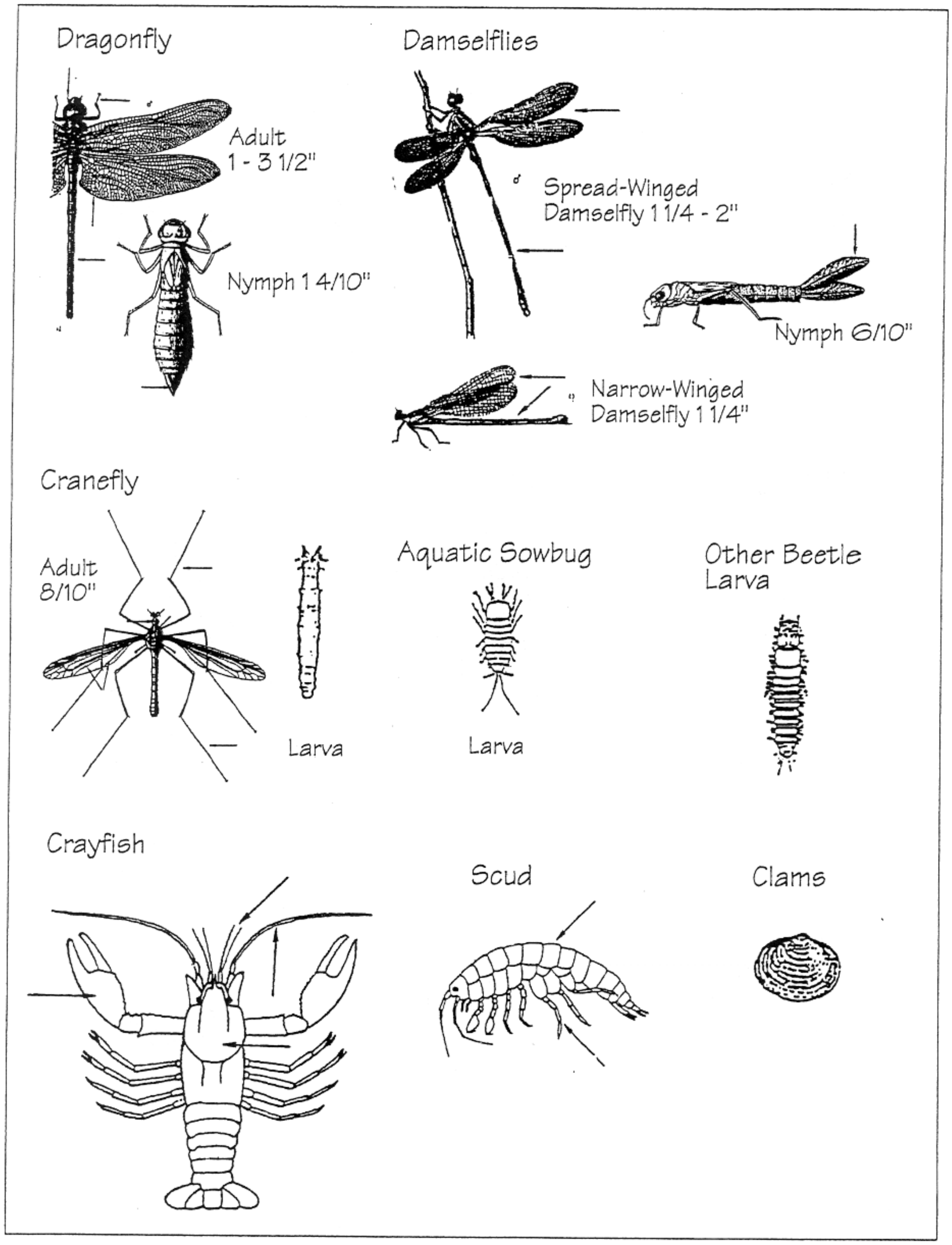
***** The HBI Pollution Index for various aquatic insect species can be found in the Northwest Guide to Macroinvertebrates. This is a numeric value related to an organism's sensitivity or tolerance to nutrient enrichment (the source could be fertilizers, manure, or sewage).

INSECT GROUPS ARRANGED BY TOLERANCE TO POLLUTION

Group 1: Intolerant
These organisms are sensitive to pollution.
Their dominance generally suggests good water quality.

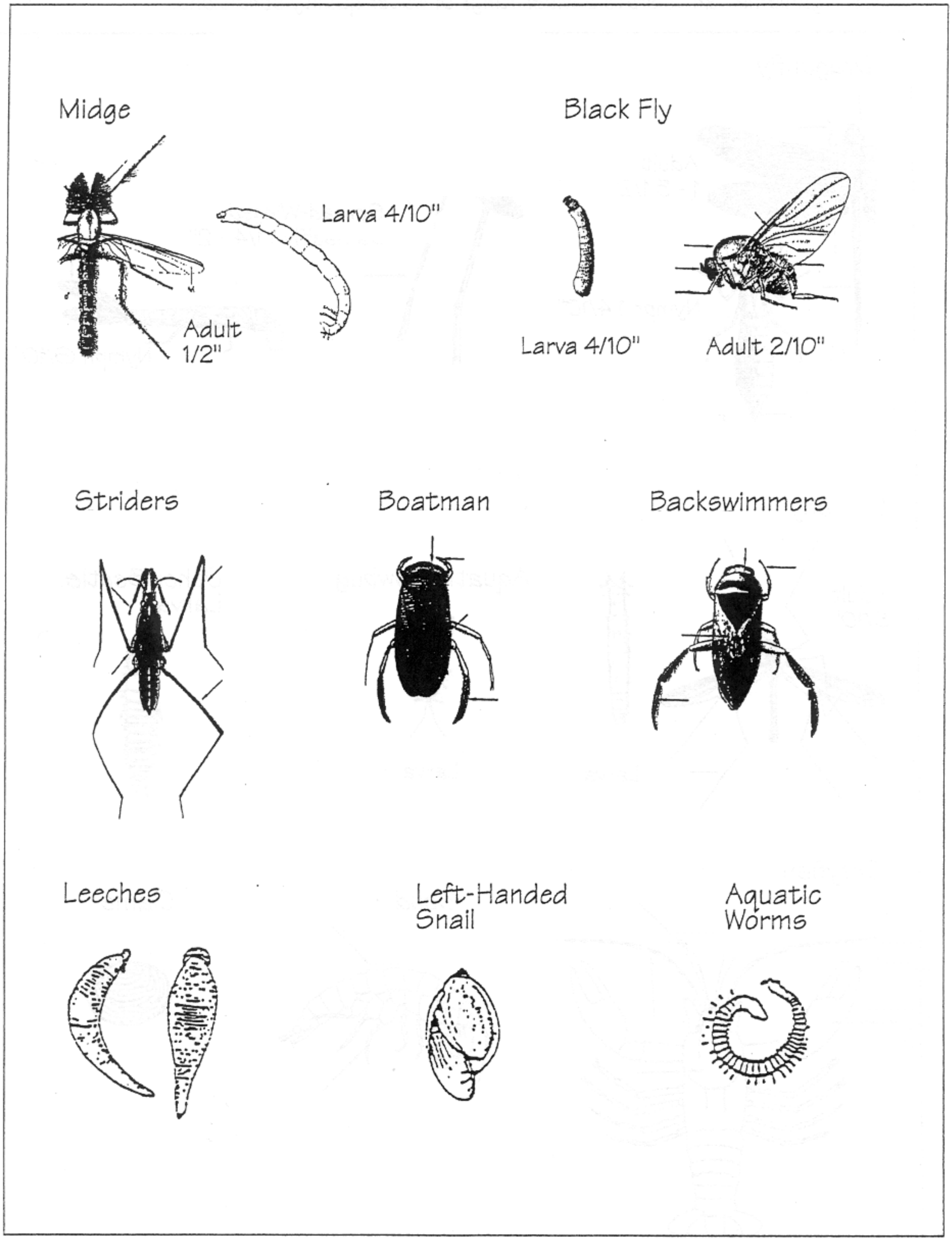


Group 2: Somewhat Tolerant
These organisms can tolerate a wider range of water quality conditions.



Group 3: Tolerant

These organisms are generally tolerant of pollution. Their dominance suggests poor water quality.



Riparian Ecosystems

Plants along the streambed influence the entire stream ecosystem. This green zone is called a **riparian area** and has several unique properties. A riparian area is linear, has a water transport channel and floodplain, and is interrelated with upstream and downstream ecosystems. Riparian habitat is a combination of three areas; each is distinctive and contributes to the entire ecosystem:

Aquatic area:
The aquatic area of streams, lakes, and wetlands is generally wet. During dry periods, aquatic areas have little or no water flow. Any side channels or oxbows containing freshwater ponds are included in this area.

Riparian area:
The riparian area is a terrestrial zone where annual and intermittent water, a high water table, and wet soils influence vegetation and microclimate. Since these areas are next to water, they tend to have more moisture, and plants and soils that reflect wetter conditions. For example, they may have more tree species such as cottonwoods or alders that need more saturated soils.

Area of influence:
This is a transition area between a riparian area and upland cover. An area of influence has soil moisture and is characterized by a noticeable change in plant composition and abundance. Trees in this area contribute shade, leaves, woody debris and insects to the stream. In the Pacific Northwest, the area of influence includes ground covers, shrubs, and understory trees (usually deciduous) on the floodplains, and canopy trees (usually coniferous) on hillsides. This stair-stepping of vegetation provides a variety of wildlife habitat.

Role of Riparian Vegetation

Riparian vegetation provides cover for aquatic and terrestrial animals. Shade created by the riparian vegetation moderates water and air temperatures. This vegetation limits water contamination, slows water velocities, and filters and collects large amounts of sediment and debris. Uncontrolled sediments can kill fish and destroy spawning areas.

Functions of Riparian Vegetation as They Relate to Aquatic Ecosystems

Riparian Vegetation Component		
Site	**Component**	**Function**
Above ground-Above channel	Canopy and stems	Shade- controls temperature and in-stream photosynthetic productivity Source of large and fine plant debris Source of terrestrial insects
In channel	Large debris derived from riparian vegetation	Control routing of water and sediment Shape habitat—pools, riffles, cover Substrate for biological activity
Streambanks	Roots	Increase bank stability Create overhanging banks--cover
Floodplain	Streams and low-lying cover	Retard movement of sediment, water, and floating organic debris in flood flows

Source: William Meehan et al., *Influences of Riparian Vegetation on Aquatic Ecosystems With Particular References to Salmonid Fishes and Their Food Supply*, 1977, p. 137.

Stream food chains depend on organic debris for nutrients. In small headwater streams, 99 percent of the energy for organisms comes from the vegetation along the stream, and only 1 percent from photosynthesis. The leaves, needles, cones, twigs, wood, and bark dropped into a stream are a storehouse of readily available organic material that is processed by aquatic organisms and returned to the system as nutrients and energy.

A diverse population of insects depends on this varied food base. Sixty to 70 percent of the debris is retained and processed in the headwaters by bacteria, fungi, insects, and abrasion, with very little leaving the system until it has been processed.

Riparian areas have a high number of edges (habitat transitions) within a very small area. The large number of plant and animal species found in these areas reflects habitat diversity. Since they follow streams, riparian areas are linear, increasing the amount and importance of edge effect. Extensive edge and resulting habitat diversity yield an abundance of food and support a greater diversity of wildlife than nearly any other terrestrial habitat.

Floodplains

Floodplains are an important part of a riparian area. Floodplain vegetation that shades or directly contributes material to a stream is considered part of the riparian area.

Stream channels rely on natural flooding patterns. Frequency of flooding and groundwater supply are the major factors controlling the growth of floodplain trees. Floodplains and backwaters act as reservoirs to hold surplus runoff until peak floods are past. This controls and reduces downstream flooding. Floodplains also spread the impact of a flood over a larger area as vegetation helps collect debris and sediment.

Composition of riparian plant communities depends on the water pattern (fast or slow moving or dry or wet periods). Both wet and dry phases are necessary in this area to complete the stream's nutrient cycle and food chain. Flooding is critical to the exchange of nutrients and energy between the stream and the riparian area.

When healthy, vegetated banks in the riparian area act as natural sponges. They help maintain soil structure, allow increased infiltration, and reduce bank erosion. Vegetated streambanks also contribute to aquifer (groundwater) recharge. Precipitation is filtered through the riparian soils and enters underground reservoirs called aquifers. Good cover slows the flow and increases percolation into underground aquifers. Stored water is then available during drier periods to maintain and improve minimum flow levels. A major benefit of this aquifer recharge is maintenance of year-round streamflow.

Riparian vegetation uses large amounts of water in transpiration. Often, vegetation needs the most water during the period of lowest streamflow. At these times vegetation may actually reduce streamflow.

Soils in riparian areas and floodplains

Soil types in both riparian areas and associated floodplains can tell a lot about the current and historic conditions of the stream. In addition to providing helpful information about current soil composition, an understanding of soil types can reveal the location of historic streambeds, floodplain location, and moisture content of the soil. Examining the types of rock materials found within the soil can unearth gravel, cobble, sand, loam, or clay. Certain soil types such as gravels and cobbles might indicate that you are standing on an ancient flooplain!

Wildlife in riparian areas

Riparian ecosystems provide the essentials of wildlife habitat—food, water, and cover. In general, the area within two hundred yards of a stream is used most heavily by wildlife. In western Oregon, of 414 known species of wildlife, 359 use riparian ecosystems extensively and 29 species are tied exclusively to this area. While riparian areas cover less than one percent of the land in eastern Oregon, 280 of 379 species use this area extensively.

Riparian areas provide migration routes and corridors between habitats for many animals. The riparian area provides cover, food, and water during these movements. Woody plant communities in the riparian area provide cover, roosting, nesting, and feeding areas for birds; shelters and food for mammals; and increased humidity and shade (thermal cover) for all animals.

Birds are the most common and conspicuous form of wildlife in a riparian ecosystem. In this important breeding habitat, as many as 550 breeding pairs have been found per 100 acres. Bird density is just one indicator of the productivity of a riparian area.

Mammals of all sizes are found in riparian areas. Many rodents are parts of various food chains. Some, such as beaver, may modify riparian communities. Amphibians and reptiles are another indicator of riparian quality. Nearly all amphibians depend on aquatic habitats for reproduction and overwintering. Certain turtles, snakes, and lizards also prefer riparian ecosystems.

Animal populations in riparian areas are affected by the size and diversity of available habitat. Adjacent land-use activities may have a direct impact on wildlife population size within a riparian area. Fish populations can be an indicator of watershed and riparian ecosystem health. Large woody materials, such as fallen trees and limbs, create pools, and protective cover—necessary components of fish habitats. This woody debris also increases the diversity of invertebrates, which are a basic part of the food chain on which fish depend.

People in riparian areas

Since the land along streambanks and floodplains is often fairly flat, riparian areas are attractive locations for roads. Roadbuilding may increase sedimentation, which can adversely affect aquatic life, especially fish. Runoff from roads can carry oil, antifreeze, and other contaminants into the stream. Road construction can also damage valuable wildlife habitat. Traffic, a hazard in itself, may disturb or displace many wildlife species.

Roads probably have a greater and longer lasting impact on riparian areas than any other human activity. Routes should be selected and designed with careful consideration of potential long-term impacts.

Riparian vegetation is often cleared for farming purposes. This often weakens bank structure, making it more susceptible to erosion and a contributor to sediment deposition downstream. Landowners who convert riparian areas to farmland for short-term gains in agricultural production may lose in the long run. The loss of vegetation on stabilized banks could cause the stream to wash away that same valuable land during periods of high flow.

Livestock, like wildlife, area attracted to shade, water, and forage in riparian areas. If mismanaged—allowing the area to be grazed excessively or at the wrong time—livestock can severely affect the riparian area's value. Livestock can compact the soil near the water, reducing its infiltration capacities. When riparian vegetation is damaged—either by trampling or overgrazing—shading is reduced, erosion potential is increased as streambanks slough away, water tables are lowered, and water quality is affected. Animal wastes may also threaten water quality. Livestock can be managed, thus the impact of livestock can be reduced by controlling access and grazing levels along stream banks. By utilizing good management techniques, ranchers can actually increase economic gains as well as enhance the value of their property.

Residential and commercial development has occurred near riparian areas throughout history. Development in these sites has generally degraded the value of the resources. Degradation has included filling and altering of stream channels, removing vegetation for building construction, and paving large amounts of land for roadways.

Some problems associated with development can be avoided by good planning and site design. Residential communities can be planned with riparian area values in mind. Construction sites can avoid steep slopes, wetlands, and sensitive biological sites. Areas that offer the amenities of a relatively healthy riparian area often have an increased real estate value.

Construction of campgrounds and recreation sites in riparian areas encourages use by anglers, birdwatchers, hikers, boaters, and others. This use, especially irresponsible acts like littering or erosion caused by improper use of off-road vehicles, may conflict with the welfare of wildlife and reduce water quality.

Streams and their riparian areas are the source of domestic water for many cities. High water quality is important for these uses. To maintain it, riparian areas must be carefully managed. Mining in and near streams has severe impacts on riparian ecosystems. Mining often increases sedimentation and disrupts spawning areas by moving large amounts of gravel, rock and soil. In addition, mining may introduce poisonous or toxic heavy materials into streams.

Forest canopy in riparian areas

The upland forest that sits adjacent to the riparian area along a stream provides an important function. Although it is not directly connected to the stream, the upland area that contains taller trees also provides valuable shade that keeps streams cool. A dense overhead canopy cover can shade the riparian area as well as the stream channel to reduce the potentially harmful effects of water warming from the sun. By assessing the canopy cover, or density of shading that is associated with upland trees, instream and riparian health can be better understood.

Timber harvest in riparian management areas

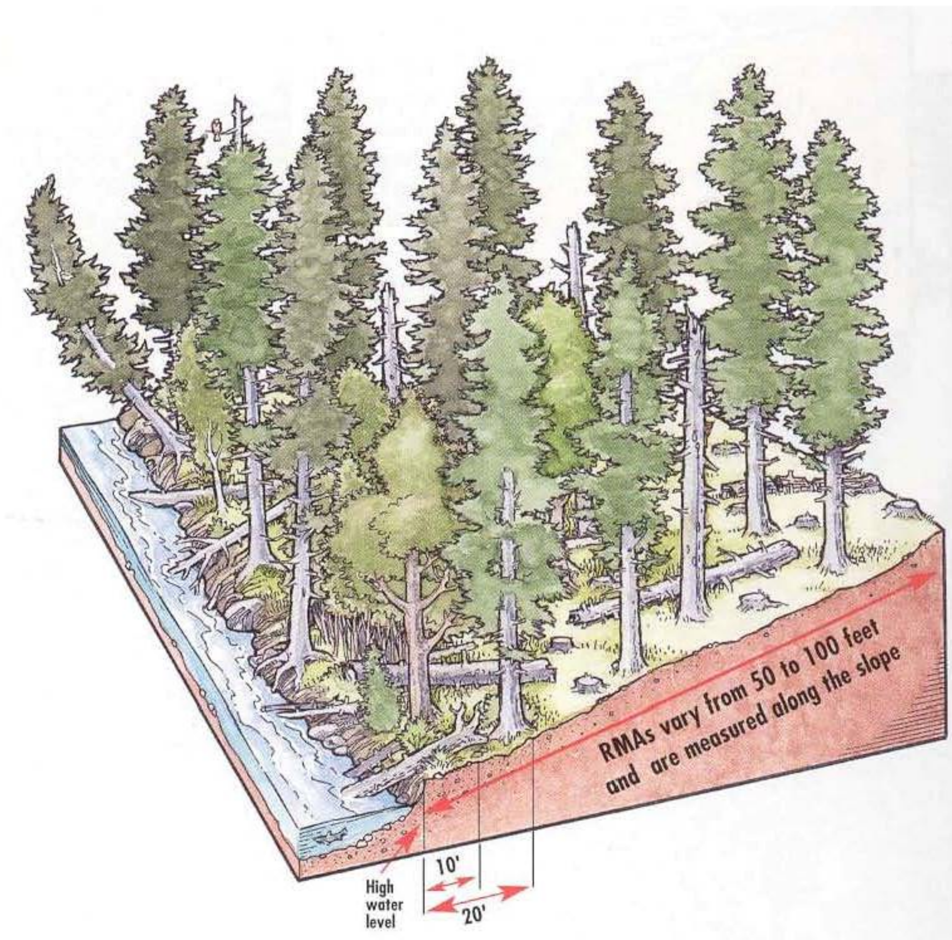
Timber harvest in riparian areas requires careful management. Until the Oregon Forest Practices Act, which regulates state and private land, was enacted in 1971, clearcuts commonly went to the stream's edge. In addition to removing trees that shade streams, the understory and groundcover were heavily damaged. A future source of woody debris in streams was eliminated and erosion increased. Historically, direct destruction of spawning grounds occurred by dragging logs through streams, building roads along banks, and transporting logs down streams and rivers. These practices affected water flow, bank erosion, siltation, and temperature fluctuations.

Modern forest management calls for the maintenance of vegetation buffer strips along the sides of streams, lakes, estuaries, and wetlands. These riparian management areas (RMAs) are designated by the Oregon Forest Practices Act, the State Board of Forestry, and federal management agencies because they protect fisheries, domestic water supplies, and recreational water use.

A riparian management area includes both sides of a stream and usually includes the riparian area and riparian area of influence. Its width on each side of the stream is required by law to average three (3) times the stream width. It cannot average less than twenty-five feet, nor require an average of more than one hundred (100) feet. Width may vary with terrain and other circumstances and is generally the average width over the length of the stream where logging operations will occur.

Not all streams are protected, however. To qualify for protection, streams must fit guidelines set by the Oregon Forest Practices classification system. Under the Oregon Forest Practices Act, all forest activities—including road-building, timber harvesting, chemical use, and slash disposal—must be planned, approved, and completed in a manner that protects riparian areas, as well as other forest resource sites. The act is enforced and records show that only a very small number of forest operations are conducted in violation of the Act's rules.

Oregon Forest Practices Act – Riparian Management Areas
For non-federal lands (i.e. private, state-owned, and city/county-owned)

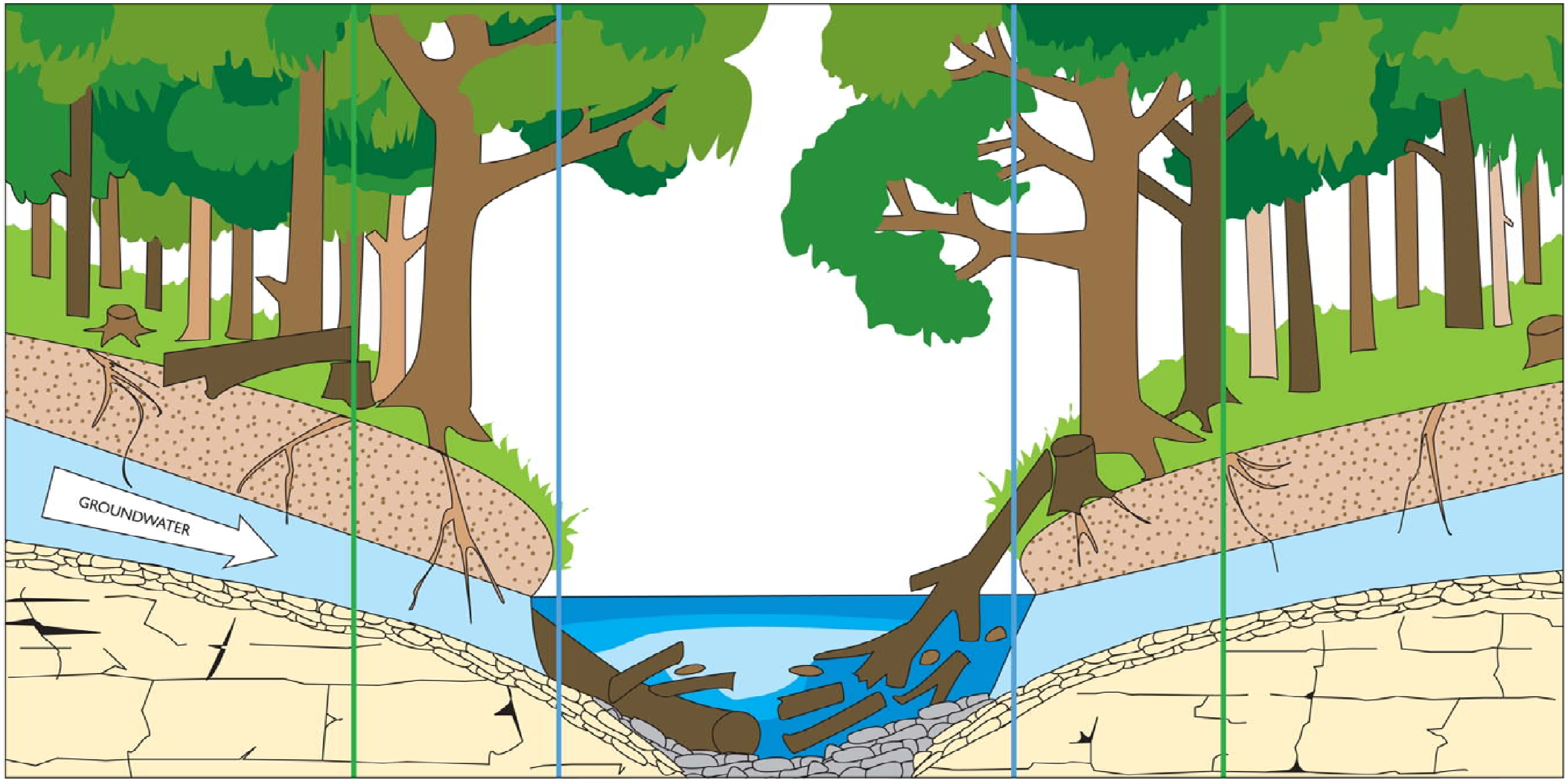


Leave tree requirements:

- **All trees within 20 feet of high water**
- **All trees in RMA leaning over stream**
- **All understory vegetation within 10 feet of high water**
- **About one half of the live conifers trees within 50-100 fee of the high water level.**

Note – federal lands managed by the USDA Forest Service and USDI Bureau of Land Management are not directly regulated. Both however have agreed to meet or exceed the requirements established under the Oregon Forest Practices Act.

Actively Managed Streamside Buffer

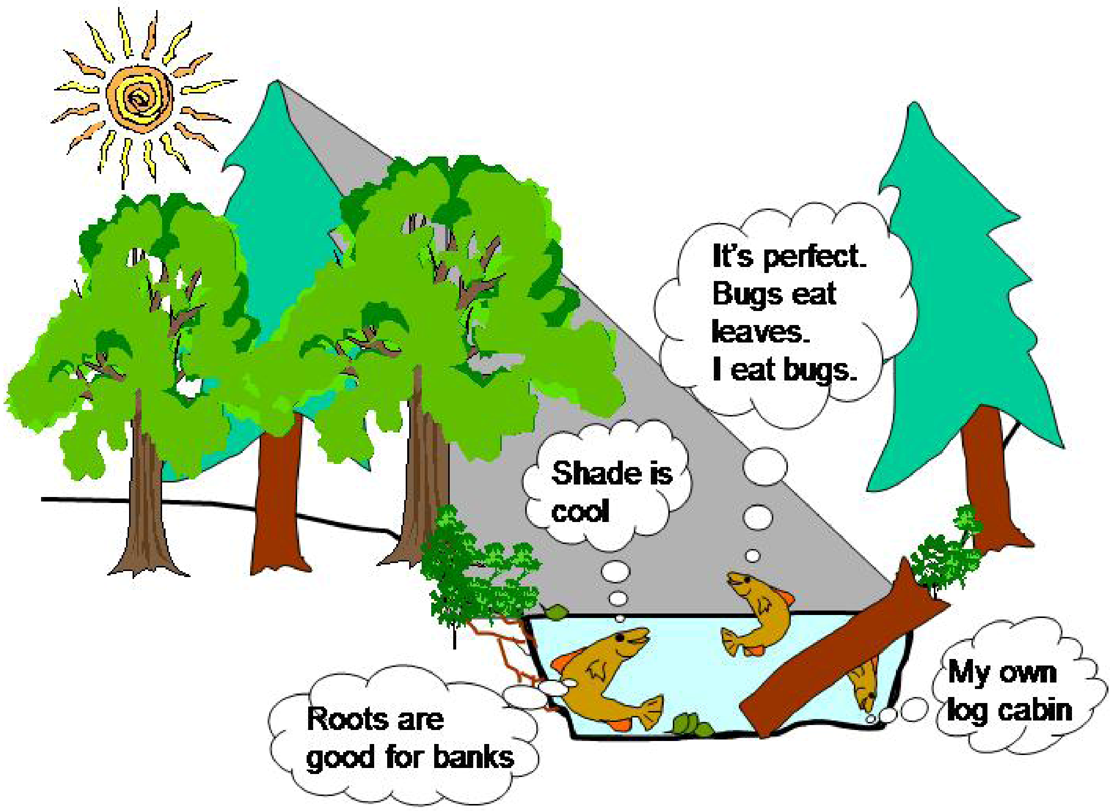


Zone 2 Managed Forest	Zone 1 Undisturbed Forest	Stream Bottom	Zone 1 Undisturbed Forest	Zone 2 Managed Forest
Filtration, deposition, plant uptake, anaerobic denitrification and other natural processes remove sediment and nutrients from runoff and subsurface flows.	Maturing trees provide detritus to the stream and help maintain lower water temperature vital to fish habitat.	Debris dams hold detritus for processing by aquatic fauna and provide cover and cooling shade for fish and other stream dwellers.	Tree removal is generally not permitted in this zone.	A riparian management area includes both sides of a stream and usually includes the riparian area and riparian area of influence (above).

Note – this illustration is provided to give the reader a general visual idea of what a riparian area might include. Specific requirements governing forest activities in Oregon are included in the Oregon Forest Practices Act	USDA Forest Service, Northeastern Area State & Private Forestry Forest Resources Management

The Oregon Forest Practices Act provides other regulations for responsible timber harvest management. Seventy-five percent of the initial shade potential that existed over an aquatic area must remain to protect stream water temperatures. Fifty percent of the original tree canopy material must be left to provide organic material essential to a stream and a source of insects for fish food. All downed timber in an aquatic and riparian management area is to be left to provide instream structure as habitat for fish and aquatic insects and den sites or burrows for other forms of wildlife. All snags (dead standing trees) not designated as a safety hazard, as well as future down logs or instream woody debris, must be left to provide habitat for insects, birds and small animals. Live conifer trees must be left in the riparian management area, preferably I clumps, to provide better wildlife habitat.

Benefits for fish habitat from healthy riparian areas. (Reiter, 2004)



<u>Human Impacts</u>

Below is a list of possible discussion questions regarding human impacts. Please refer to the Humans & Environment and Life in a Watershed sections of this binder for more complete and in depth informatior

Based on your observations at the field site, describe any human influences on the riparian area. (Note – identify human activity and signs of activity from an upstream location looking downstream.).

What activities upstream in the watershed could create the site you see today?

What impact could your activity today have on the watershed down stream?

How can you help minimize the impact of humans at your site. Is their evidence of human use that you c help remove?

What have humans done to this site to help the stream habitat?

DATA FORMS FOR FIELD TRIP ACTIVITIES

The following is a list of data forms that can be used for field trip data collection. These materials can be used individually or combined into a field trip log that students complete during the course of their Salmon Watch study. Additionally, data forms can be downloaded and printed off of StreamWebs at www.streamwebs.org.

Water Quality & Flow

Macroinvertebrate Sampling

Riparian Ecosystem

Riparian & Aquatic Area Survey
Riparian Area Transect
Riparian Mapping & Profile
Soil Survey
Canopy Cover Survey

*Please note you have to choose which activity (ies) you want your students to complete. Our limited time in the field will not allow your students to complete all the activities provided, specifically in the Riparian station and occasionally in the Water Quality station.

The Freshwater Trust™

Salmon Watch®

Now you can share your Salmon Watch® data quickly and easily using StreamWebs™. You can graph your water quality data, compare your macroinvertebrate count with other schools, and learn more about your home watershed. To find out more, visit: **www.streamwebs.org**

WATER QUALITY DATA FORM

School: ______________________ Teacher: ______________________

Date: ____________ Time: ________ Weather: ______________________

Stream/Site Name: ______________________

Any fish present? ☐ Yes ☐ No # of live fish: ____ # of carcasses: ____

TEST	Sample 1	Sample 2	Sample 3	Sample 4
Water Temperature ☐ °C ☐ °F				
Equipment used?	Vernier ☐ Manual ☐	Vernier ☐ Manual ☐	Vernier ☐ Manual ☐	Vernier ☐ Manual ☐
Air Temperature ☐ °C ☐ °F				
Equipment used?	Vernier ☐ Manual ☐	Vernier ☐ Manual ☐	Vernier ☐ Manual ☐	Vernier ☐ Manual ☐
Dissolved Oxygen (mg/L)				
Equipment used?	Vernier ☐ Manual ☐	Vernier ☐ Manual ☐	Vernier ☐ Manual ☐	Vernier ☐ Manual ☐
pH				
Equipment used?	Vernier ☐ Manual ☐	Vernier ☐ Manual ☐	Vernier ☐ Manual ☐	Vernier ☐ Manual ☐
Turbidity (NTU)				
Equipment used?	Vernier ☐ Manual ☐	Vernier ☐ Manual ☐	Vernier ☐ Manual ☐	Vernier ☐ Manual ☐

Adapted from: Environmental Services City of Portland

The Freshwater Trust™

Salmon Watch®

Now you can share your Salmon Watch® data quickly and easily using StreamWebs™. You can graph your water quality data, compare your macroinvertebrate count with other schools, and learn more about your home watershed. To find out more, visit: **www.streamwebs.org**

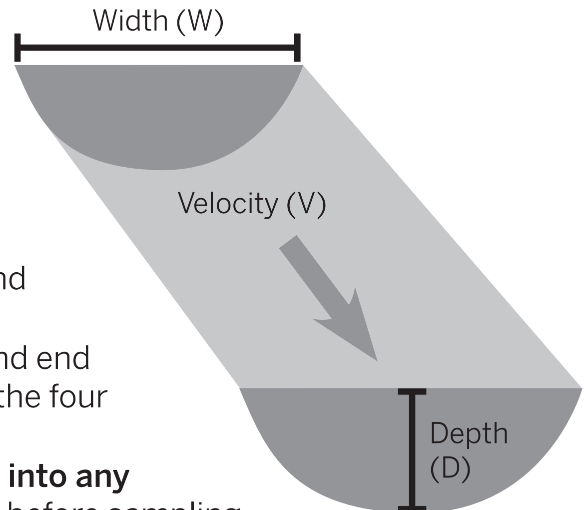
STREAM FLOW DATA FORM

School: ______________________________ Teacher: ______________________________

Date: ________________ Time: ___________ Weather: ______________________________

Stream/Site Name: ______________________________

Measuring Stream Flow with Vernier



What You Need:

- ☐ Measuring staff
- ☐ Measuring tape
- ☐ LabQuest
- ☐ Flow Rate Sensor

Procedure:

1. Measure the Width (W) of the stream at your start and end points and get the average.
2. Measure the Depth (D) at two points for both the start and end points of your section of stream, and find the average of the four measurements.
3. Plug the Flow Sensor into the LabQuest right away **(plug into any channel)** to ensure a warm up time of at least **5 minutes** before sampling. (This should be done as your next group is in transition to your station so while you are welcoming them and explaining the water quality station your probes are warming up).
4. Assemble Flow Rate Sensor by connecting the alternating black and white plastic rods together (two black rods, one with propeller and one without, as well as two white rods.
5. Submerge the entire propeller half way to the bed of the stream. **Do not stick the rod so far in that the cords get wet.** It is best to get a reading as close to the middle of the stream as possible, keep in mind the safety of the students and only take a sample that is no more than knee deep.
6. Using the stylus, change the unit of measurement by pressing the screen in the box providing the Velocity (V) reading (m/s and f/s), this will give you a drop down menu and allow you to change between units of measurement.
7. Once the reading has become steady and you have properly recorded data, carefully disassemble the pieces of the Flow Rate Sensor and you are ready for cleanup.

Width (W):
Width (ft) = __________

Depth (D):
Depth (ft) = __________

Velocity (V):
Velocity (ft/s) = __________

Stream Flow (Q):

Stream Flow (Q) = _______ (ft) (W) x _______ (ft) (D) x _______ (ft/s) (V) = __________ cubic feet per second (cfs)

The Freshwater Trust™

Salmon Watch®

Now you can share your Salmon Watch® data quickly and easily using StreamWebs™. You can graph your water quality data, compare your macroinvertebrate count with other schools, and learn more about your home watershed. To find out more, visit: **www.streamwebs.org**

MACROINVERTEBRATE SAMPLING DATA FORM

School: ______________________ Teacher: ______________________

Date: ______________ Time: __________ Weather: ______________________

Stream/Site Name: ________________ Time spent sorting/identifying: ________________

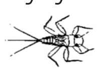
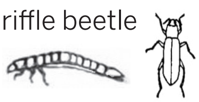
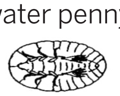
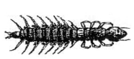
# of people sorting/identifying: __________ ☐ Riffle ☐ Pool

Directions:

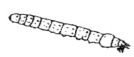
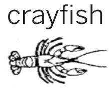
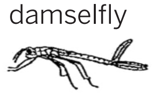
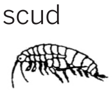
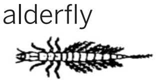
1. Record the number of each type of organism found in the **# found** column of each section.
2. Then circle the number in the **score** column (3, 2, or 1) if any of that organism was found.
3. Complete the equation at the bottom by adding up the circled numbers from each score column.

SENSITIVITY TO POLLUTION

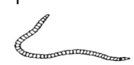
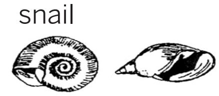
Sensitive / Intolerant

	# found	score
caddisfly 		3
mayfly 		3
riffle beetle 		3
stonefly 		3
water penny 		3
dobsonfly 		3
Sensitive TOTAL =		

Somewhat Sensitive

	# found	score
clam/mussel 		2
crane fly 		2
crayfish 		2
damselfly 		2
dragonfly 		2
scud 		2
fishfly 		2
alderfly 		2
mite 		2
Somewhat Sensitive TOTAL =		

Tolerant

	# found	score
aquatic worm 		1
blackfly 		1
leech 		1
midge 		1
snail 		1
mosquito larva 		1
Tolerant TOTAL =		

☐ Sensitive total
\+ ☐ Somewhat sensitive total
\+ ☐ Tolerant total
= ☐ **Water Quality Rating**

☐ Excellent (>22) ☐ Good (17-22)
☐ Fair (11-16) ☐ Poor (<11)

Adapted from: Environmental Services City of Portland

The Freshwater Trust™

Salmon Watch®

Now you can share your Salmon Watch® data quickly and easily using StreamWebs™. You can graph your water quality data, compare your macroinvertebrate count with other schools, and learn more about your home watershed. To find out more, visit: **www.streamwebs.org**

RIPARIAN & AQUATIC AREA SURVEY DATA FORM

School: ______________________________ Teacher: ______________________________

Date: ________________ Time: ____________ Weather: ______________________________

Stream/Site Name: ______________________________

What You Need:

☐ Riparian & Aquatic Area Survey data form ☐ ID books/charts ☐ 100 ft tape measure

STREAM SURVEY			
Survey Area			
Length of stream (in feet):			
# of riffles:			
# of pools:			
Substrate	Very Little	Some	A Lot
Silt/Organic matter *(stays suspended)*			
Sand *(settles to bottom when disturbed)*			
Gravel *(pea to baseball size)*			
Cobble *(baseball to bowling ball size)*			
Boulders *(larger than a bowling ball)*			
Bedrock *(solid rock)*			
Instream Woody Debris	Very Little	Some	A Lot
Small *(6 inch diameter x 10 ft length)*			
Medium *(12 inch diameter x 20 ft length)*			
Large *(24 inch diameter x 35 ft length)*			
Comments:			
Vegetation Type	Very Little	Some	A Lot
Coniferous trees *(with needles)*			
Deciduous trees *(with leaves)*			
Shrubs			
Small plants			
Ferns			
Grasses			

PLANTS IDENTIFIED	
Species	Significance to Riparian Area

WILDLIFE & BIRDS IDENTIFIED	
Type, Species, or Track/Sign	# or Comments

More to identify? *Use the back of this form.*

Now you can share your Salmon Watch® data quickly and easily using StreamWebs™. You can graph your water quality data, compare your macroinvertebrate count with other schools, and learn more about your home watershed. To find out more, visit: **www.streamwebs.org**

The Freshwater Trust™

Salmon Watch®

RIPARIAN AREA TRANSECT DATA FORM

School: ______________________ Teacher: ______________________

Date: ____________ Time: __________ Weather: ______________________

Stream/Site Name: ______________________

What You Need:

- ☐ 100-foot tape measure
- ☐ Riparian Area Transect data form
- ☐ 15-foot rope with a ring attached in the middle of its length
- ☐ Instructions
- ☐ Plant and tree identification books or charts

Procedure:

1. **Set the transect.** Stretch the transect tape measure from the water's edge or a clearly discernible high water line perpendicular to the stream into the riparian area. Hold the two ends so that the tape is stretched out to its full 100' length. The tape is divided into five parts, each 20 feet long. These divisions mark off five 20-foot "zones" in the riparian area, "Zone 1," "2," "3," etc.

2. **Count trees.** Place the ring on the 15-foot rope over the transect tape. Start from the 0-foot mark, and walk parallel to the transect tape towards the 100-foot mark. Each time you reach one of the 20-foot marks, check to see if the rope touches any trees, shrubs, etc, by using the rope to measure out a circle with a diameter of 15 feet (an area with a radius of 7.5 feet, with the attached ring as the centerpoint). Identify any plants within the diameter of the area that the rope covers. Then tell the recorders whether the plants are conifers or hardwood trees; or shrubs; and the zone that they are in.

3. **Record data.** Record your data on the back of this form. The recorders should fill out the information about the transect site at the top of the data form, record the number of conifers, hardwood trees and shrubs. Additional comments about dead wood, side channels, etc., may also be recorded. Either during the data collection or after, enter data on the graph on the reverse of this form. Shade in the box above the appropriate zone in either the conifer or hardwood category. Shade one box per tree tallied.

RIPARIAN AREA TRANSECT

Date:

Student's Names:

Stream:

Estimated slope (rise/run) of stream bank:

Zone	Conifers	Hardwoods	Shrubs	Additional Comments
1 Set 15' rope at 20' from water				
2 At 40' from the water				
3 At 60' from the water				
4 At 80' from the water				
5 At 100' from the water				

Other Observations:

RIPARIAN AREA TRANSECT DATA GRAPH*

Conifer	Hardwood	Conifer	Hardwood	Conifer	Hardwood	Conifer	Hardwood	Conifer	Hardwood
ZONE 1		**ZONE 2**		**ZONE 3**		**ZONE 4**		**ZONE 5**	

**Shade in the box above the appropriate zone in either the conifer or hardwood category. Shade one box per tree tallied.*

The Freshwater Trust™

Salmon Watch®

RIPARIAN AREA MAPPING DATA FORM

School: ______________________________

Teacher: ______________________________

Date: ________________ Time: ____________

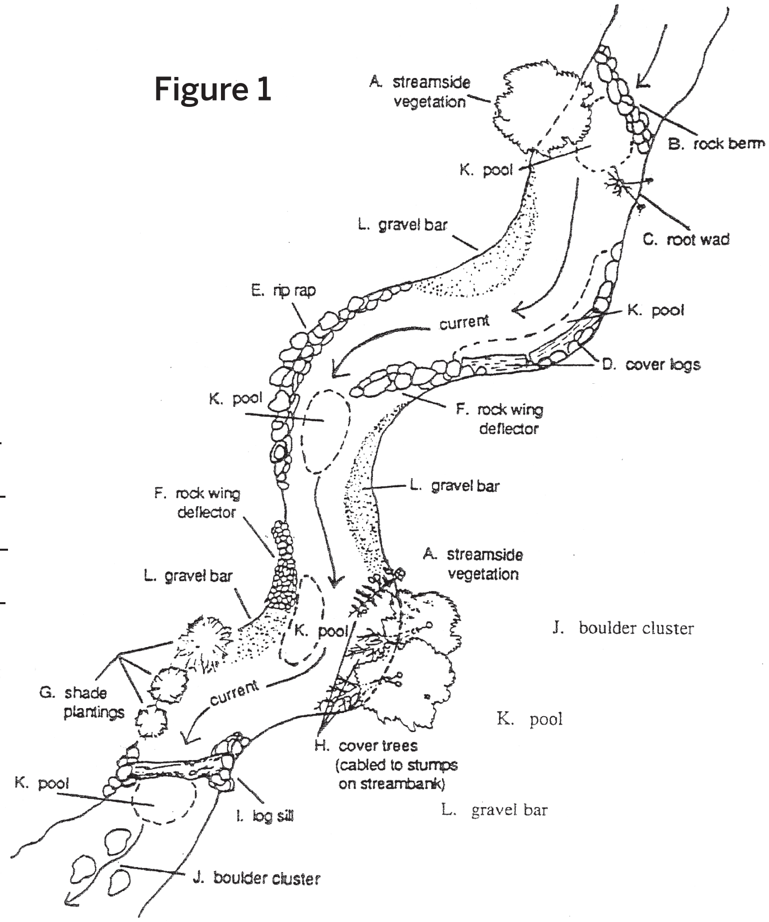
Weather: ______________________________

Stream/Site Name: ______________________

Directions: Use this space to make a map of the part of the stream that you think is important (imagine the stream from a “bird’s-eye-view”). Be sure to map both the aquatic and riparian zones. Draw in all the features you think are important (see **Figure 1**).

Turn over for profile activity. ⟶

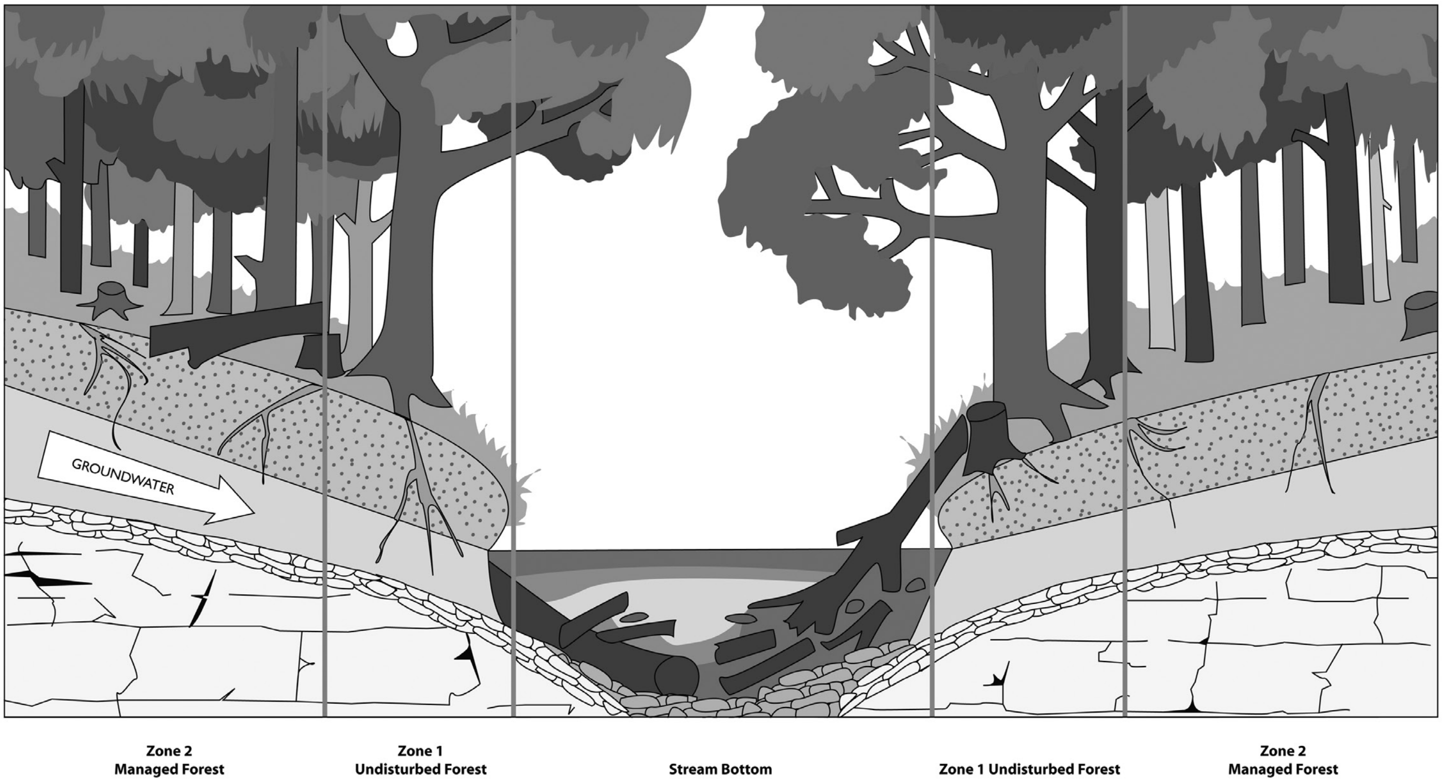
Figure 1



RIPARIAN AREA PROFILE DATA FORM

Directions: Pick a place along the stream that you particularly like. Draw a profile (cross-section, see **Figure 2**) of this place. Include the near bank, stream, and opposite bank in your drawing. If you aren't sure how to do this, ask your adult group leader. Show the water level in your drawing. Now, draw in features of the riparian zone that you think are important to salmon.

Figure 2



The Freshwater Trust™

Salmon Watch®

Now you can share your Salmon Watch® data quickly and easily using StreamWebs™. You can graph your water quality data, compare your macroinvertebrate count with other schools, and learn more about your home watershed. To find out more, visit: **www.streamwebs.org**

RIPARIAN SOIL SURVEY DATA FORM

School: ______________________________ Teacher: ______________________________

Date: ________________ Time: ____________ Weather: ______________________________

Stream/Site Name: ______________________________

Landscape Position:
- ☐ Summit
- ☐ Slope
- ☐ Depression
- ☐ Large Flat Area
- ☐ Stream Bank

Cover Type:
- ☐ Bare Soil
- ☐ Rocks
- ☐ Grass
- ☐ Shrubs
- ☐ Trees

Land Use:
- ☐ Urban
- ☐ Agricultural
- ☐ Recreation
- ☐ Wilderness
- ☐ Other

Distance from stream: ______________________________

Distinguishing site characteristics:

____

____

____

____

Reference: GLOBE® 2005 Appendix- 2 Soil

SOIL CHARACTERIZATION SURVEY ACTIVITY

Task: Use an auger to expose a soil profile to determine soil characteristics within the riparian zone.

What You Need:
- ☐ Soil auger
- ☐ Spray bottle
- ☐ Riparian Soil Survey data form

In the Field:

Exposing the Soil Profile

1. Identify a location where an auger can be used to expose a soil profile.
2. Remove the surface vegetation.
3. Place the auger at the top of the soil and turn the auger one complete revolution (360˚) to dig into the ground. Do not turn the auger more than one complete circle (360˚) to prevent the soil from being compacted.
4. Remove the auger with the sample from the hole
5. Keeping the soil sample inside the auger, identify if you have more than one soil horizon in your sample. If no, use the soil characterization key to identify your sample. If yes, use the soil characterization key to identify all different soil horizons.
6. For each soil horizon found, collect a small sample in your hand (about the size of a ping-pong ball). Using the spray bottle, moisten the soil and work between your fingers until it is the same moisture throughout. Begin the soil characterization key (on the back).

SOIL CHARACTERIZATION KEY

START

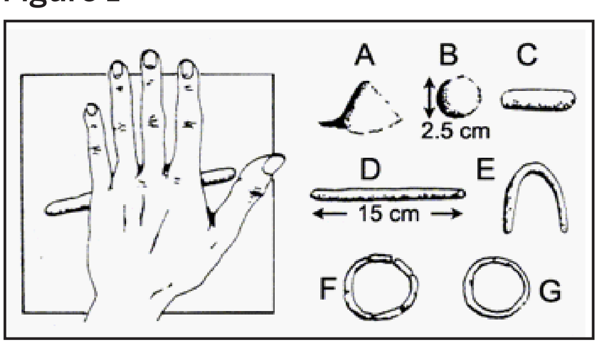
CIRCLE YOUR ANSWERS

A	Soil remains loose and single-grained; can only be heaped into a pyramid.	YES → SAND	NO ↓
B	The soil contains sufficient silt and clay to become somewhat cohesive; can be shaped into a ball that easily falls apart.	YES → LOAMY SAND	NO ↓
C	Same as for loamy sand but can be shaped by rolling into a short, thick cylinder.	YES → SILT LOAM	NO ↓
D	About equal sand, silt, and clay means the soil can be rolled into a cylinder about 15 cm long that breaks when bent.	YES → LOAM	NO ↓
E	As for loam, although soil can be bent into a U, but no further, without being broken.	YES → CLAY LOAM	NO ↓
F	Soil can be bent into a circle that shows cracks.	YES → LIGHT CLAY	NO ↓
G	Soil can be bent into a circle without showing cracks.	YES → HEAVY CLAY	

The letters refers to the corresponding image in Figure 1 below.

My soil type is:

Figure 1



Method and drawing after Ilaco (1985)

The Freshwater Trust™

Salmon Watch®

Now you can share your Salmon Watch® data quickly and easily using StreamWebs™. You can graph your water quality data, compare your macroinvertebrate count with other schools, and learn more about your home watershed. To find out more, visit: **www.streamwebs.org**

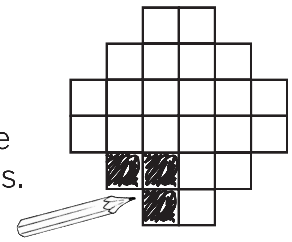
CANOPY COVER DATA FORM

School: ______________________ Teacher: ______________________

Date: ____________ Time: __________ Weather: ______________________

Stream/Site Name: ______________________

Directions: Working with a partner, take one sample of canopy cover in each cardinal direction using the spherical densiometer. Once you have the densiometer positioned correctly, fill in the areas on this worksheet that are covered with canopy shade. **If the square is 50% shaded or more, fill in the entire square.** Record the number of shaded boxes for each sample. Add up the numbers for all four samples. The result is your estimated percent canopy for your location.



		A	B		
	C	D	E	F	
G	H	I	J	K	L
M	N	O	P	Q	R
	S	T	U	V	
		W	X		

North

 # Shaded Boxes ________

		A	B		
	C	D	E	F	
G	H	I	J	K	L
M	N	O	P	Q	R
	S	T	U	V	
		W	X		

East

 # Shaded Boxes ________

		A	B		
	C	D	E	F	
G	H	I	J	K	L
M	N	O	P	Q	R
	S	T	U	V	
		W	X		

South

 # Shaded Boxes ________

		A	B		
	C	D	E	F	
G	H	I	J	K	L
M	N	O	P	Q	R
	S	T	U	V	
		W	X		

West

 # Shaded Boxes ________

________ + ________ + ________ + ________ = ______________

North + **East** + **South** + **West** = ***Estimated % Canopy***

CANOPY COVER

What You Need:

- ☐ Spherical Densiometer
- ☐ Compass
- ☐ Canopy cover data sheet

Procedure:

With a partner take one sample of canopy cover in each cardinal direction.

1. Imagine your Spherical Densiometer (SD) has letters in each square proceeding alphabetically corresponding to the data sheet.

2. Hold the SD 12”-18” in front of your body at elbow height, so that operators head is just outside of grid area. Do your best to keep the SD steady by utilizing the provided level.

3. Tell your partner which lettered boxes to fill in based on the boxes covered more than 50% by shade. (Your partner may want to hold the data sheet up next to the SD to make it easy to relay the letters of the shade covered boxes.)

4. Repeat step 3 for North, South, East and West.

5. Add shaded boxes for all directions, the result is your estimated canopy cover for your location.

StreamWebs™

www.streamwebs.org

StreamWebs is a web-based platform designed to get students outside and engaged in freshwater research and restoration projects, while providing students the tools they need to assume an active role in improving the health of our freshwater ecosystems.

The Freshwater Trust™

Every year, thousands of Salmon Watch students collect a wide range of watershed data in the field, and now there is a way for them to quickly and easily analyze and share that data online. Introducing **StreamWebs**, a new web-based platform from The Freshwater Trust that helps build on the Salmon Watch experience. Now teachers have additional resources and tools to help contextualize and expand concepts introduced during the Salmon Watch field trip. With data templates designed to mirror Salmon Watch field data forms, students have an intuitive venue to report the results of their field findings.

Read through the next few pages, and discover how **StreamWebs** can benefit your class. If you have any questions about what you find, feel free to direct them to Ryan Johnson, StreamWebs Coordinator, at ryan@thefreshwatertrust.org.

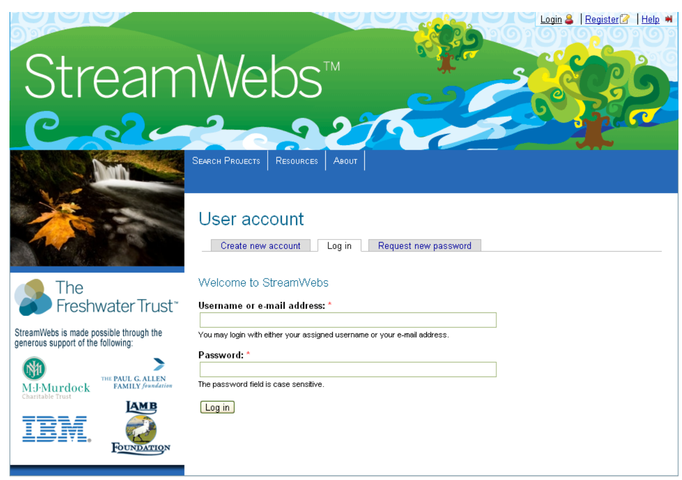
Getting Started

Getting going with StreamWebs is easy. But there are a couple of things to keep in mind. Online use is restricted by law for youth under the age of 13, so if you have students under that age you will want to create an account for your entire class. Otherwise, each student in your class can register their own profile if they have an email address.

Simply go to **www.streamwebs.org** and select *Create New Account*. Fill out the form and submit. You will quickly receive an email that will allow you to continue with registration. Once you click on the link in the email, you will be ready to set your password and start exporing StreamWebs!

When you enter your school, it should auto-fill based on the first few letters of your school name. If your school is not part of the list, email the StreamWebs Coordinator at the above address.

Keep in mind that you can add a description to your profile and change the profile photo when you edit your profile information.



StreamWebs uses a social-networking style profile and structure. If your class has students under 13 years of age, COPPA (Child Online Privacy Protection Act) legislation prohibits StreamWebs from allowing each student to register individually. But you can still register a profile for use by your class.

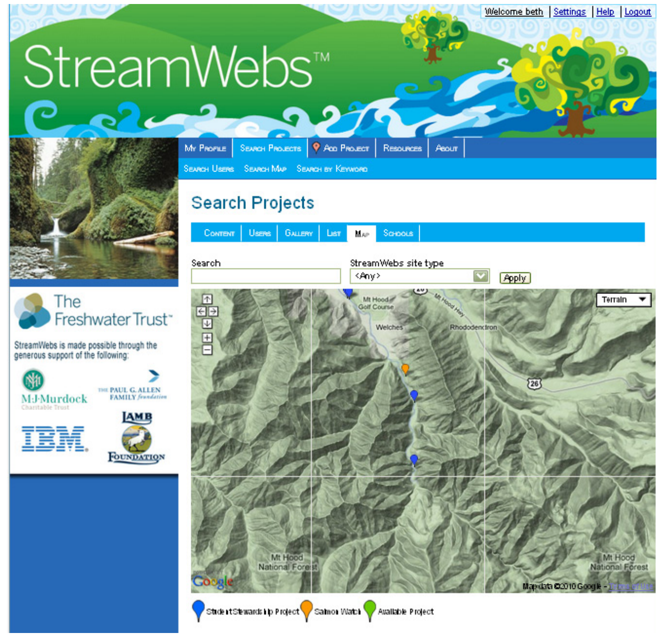
Finding Your Salmon Watch Site

StreamWebs allows you to enter your Salmon Watch data by location, so you'll want to find your Salmon Watch site on the map provided. If your school is a new addition to Salmon Watch, your Salmon Watch site designation will accompany your Teacher Registration Packet.

Select *Search Projects* from the menu. Salmon Watch sites are indicated in the key and on the map by a distinctly colored "peg".

Find your Salmon Watch site on the map and click on it. Click the site name to be taken to the profile page for that site. If you are having trouble locating your site, you can try searching for the site name in the search field.

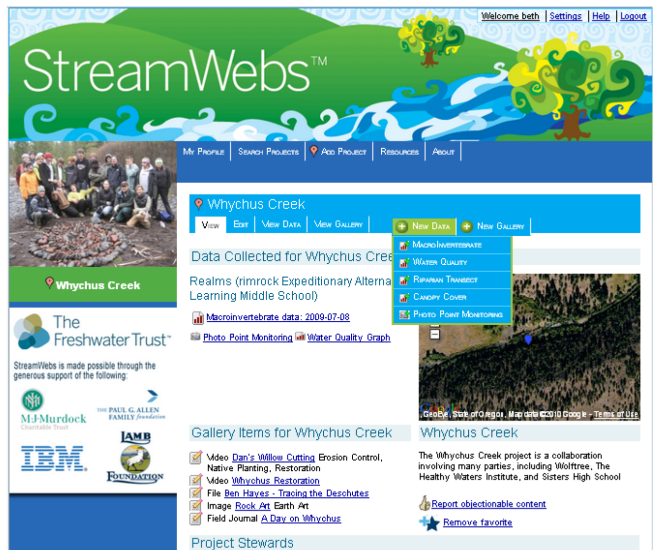
Once there, you are ready to begin entering your Salmon Watch data.



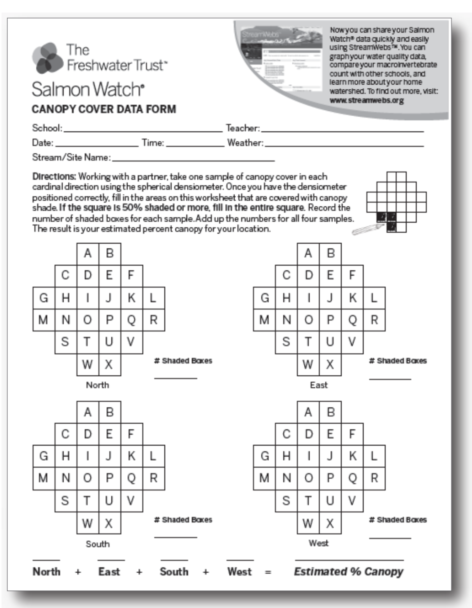
Entering Data

On your Salmon Watch site profile, you will notice two categories for entering information into StreamWebs. The first is Data, which is a menu of all Salmon Watch data for which StreamWebs has an input template. They include Water Quality, Macroinvertebrates, Riparian Transect, Riparian & Aquatic Survey, Canopy Cover Survey, Soil Survey, and Streamflow. Each of the data templates in StreamWebs closely mirrors the 2010 Salmon Watch data field forms, so please be sure to use the 2010 Salmon Watch data forms on your Salmon Watch field trip (these forms include a StreamWebs reference at the top-right of the page).

The second category for entering information is called the Gallery. This includes a series of input pages to allow you and your class to enter other documents relevant to your watershed study, including videos, photos, Word documents, PDFs, and other types of files. Feel free to use the Gallery to catalog addition projects from the field or classroom.



A single Salmon Watch site typically includes multiple schools, so each school's data will be listed individually. You can compare your data with that from other schools as the Salmon Watch season progresses.



The Freshwater Trust

Salmon Watch®

CANOPY COVER DATA FORM

Now you can share your Salmon Watch® data quickly and easily using StreamWebs™. You can graph your water quality data, compare your macroinvertebrate count with other schools, and learn more about your home watershed. To find out more, visit: **www.streamwebs.org**

School: ______ Teacher: ______

Date: ______ Time: ______ Weather: ______

Stream/Site Name: ______

Directions: Working with a partner, take one sample of canopy cover in each cardinal direction using the spherical densiometer. Once you have the densiometer positioned correctly, fill in the areas on this worksheet that are covered with canopy shade. **If the square is 50% shaded or more, fill in the entire square.** Record the number of shaded boxes for each sample. Add up the numbers for all four samples. The result is your estimated percent canopy for your location.

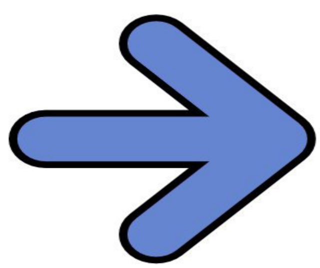
North: A B / C D E F / G H I J K L / M N O P Q R / S T U V / W X — # Shaded Boxes ______

East: A B / C D E F / G H I J K L / M N O P Q R / S T U V / W X — # Shaded Boxes ______

South: A B / C D E F / G H I J K L / M N O P Q R / S T U V / W X — # Shaded Boxes ______

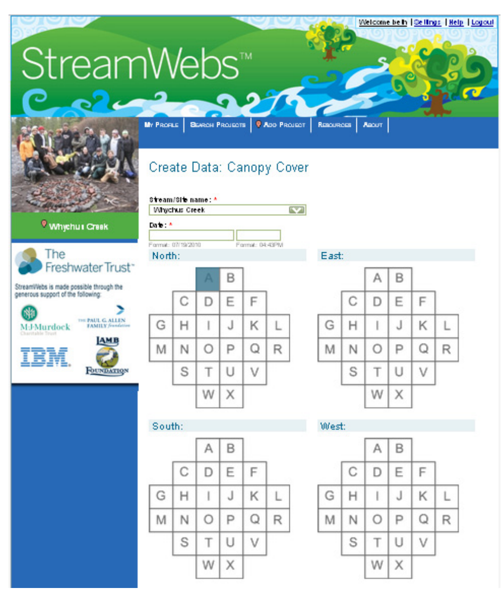
West: A B / C D E F / G H I J K L / M N O P Q R / S T U V / W X — # Shaded Boxes ______

North + East + South + West = Estimated % Canopy



StreamWebs is designed to provide an intuitive interface for data input. The data input templates mirror the Salmon Watch data forms for easy transfer.

This is an example of a data form and data input template for ***Canopy Cover*** *for the Riparian Station of Salmon Watch.*

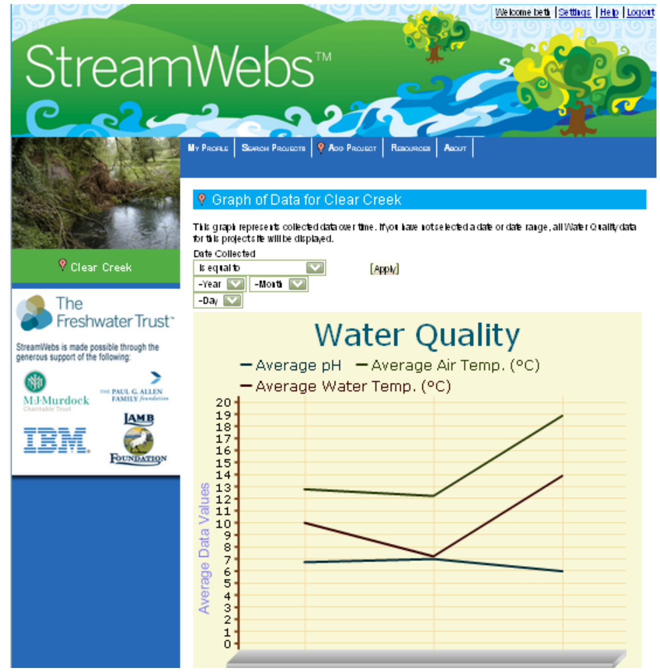


Data Analysis

Once you have entered your Salmon Watch water quality data, it will be added to a graph representing data for the site over time.

You can use this to see the relationship between two or more water quality parameters, such as dissolved oxygen and water temperature, helping to make connections between concepts your students encounter on the Salmon Watch field trip. You can also use the graph to analyze trends at the site over time or introduce concepts before your students attend their Salmon Watch field trip.

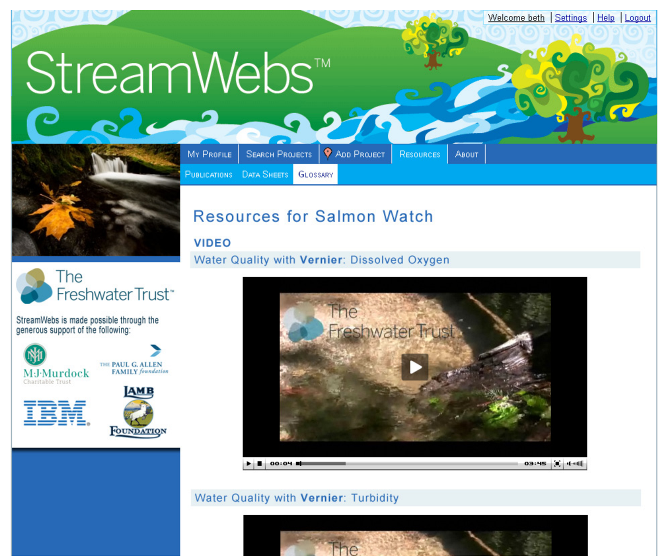
Over time, The Freshwater Trust will continue to add tools for data analysis into StreamWebs. Be sure to keep an eye out for new functionality as we continue development!



Resources

StreamWebs provides a number of resources to support curriculum in the classroom and the field. From tutorial videos demonstrating how to collect water quality data, to a glossary of watershed terms, to publications such as *freshwater stewards*, StreamWebs is helping to consolidate numerous resources and make them available to classrooms throughout the state.

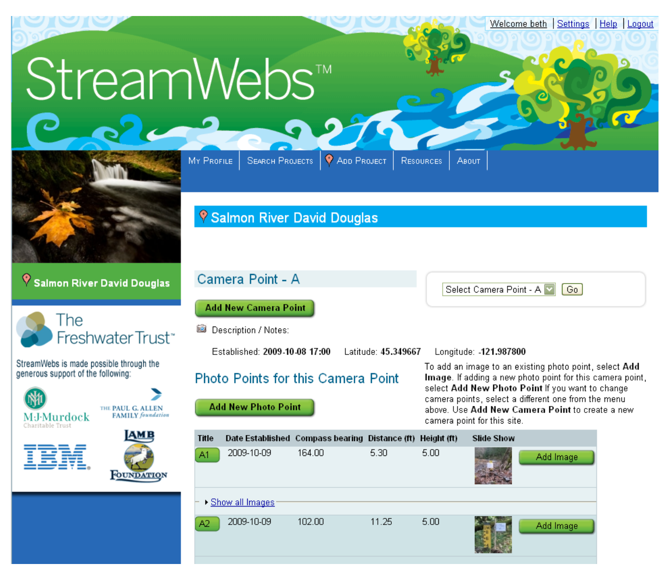
The Freshwater Trust is actively adding to this list of resources all of the time, so be sure to check back often to find updates to data forms, new videos and protocols, or additional tools and curricula.



Extensions

There are many ways to take advantage of StreamWebs to challenge and excite your students beyond Salmon Watch. In StreamWebs, you can draw on additional data protocols and tutorials, service-learning best practices, and a host of other resources related to The Freshwater Trust's Student Stewardship Project Guide (SSP), a step-by-step framework that helps classrooms plan, implement, and report on authentic freshwater research and restoration projects.

StreamWebs can connect classrooms to available projects in their neighborhood and help teachers identify potential partners and resources in their community to access field instruction and equipment.



StreamWebs + SSP Project Modules

Beginning Winter 2011, The Freshwater Trust will initiate development work on resources related to the Student Stewardship Project Guide in StreamWebs.

If you would like to track the progress, please visit:
www.thefreshwatertrust.org/education/streamwebs

StreamWebs + SSP will provide a customizable project dashboard, allowing educators and students to build a project that meets the ecological needs of the project site and the educational needs of the class.

Student Stewardship in StreamWebs

Johnson creek New urban

View Edit

NUHS Riparian Rhapsody

In 2009, students at New Urban High School initiated a Student Stewardship Project on Johnson Creek in Portland. As a culmination of their restoration project, they recorded "Riparian Rhapsody", a creative, 16-track musical production about their experiences working in their watershed.

Whychus Creek

View Edit

Image

There are many ways to express care for your watershed, and students at Sisters High School in Bend found a creative avenue to do so. Their rock art project, in the spirit of Andy Goldsworthy, served to express their stewardship and care for Whychus Creek. This artwork accompanied a restoration project, serving as a model for comprehensive stewardship.

Salmon River David Douglas

View Edit

Camera Point - A

Select Camera Point - A Go

Add New Camera Point

Description / Notes:

Established: **2009-10-08 17:00** Latitude: **45.349667** Longitude: **-121.987800**

Photo Points for this Camera Point

Add New Photo Point

To add an image to an existing photo point, select **Add Image**. If adding a new photo point for this camera point, select **Add New Photo Point** If you want to change camera points, select a different one from the menu above. Use **Add New Camera Point** to create a new camera point for this site.

Title	Date Established	Compass bearing	Distance (ft)	Height (ft)	Slide Show	
A1	2009-10-09	164.00	5.30	5.00		Add Image

David Douglas High School students have been monitoring the health of the Salmon River for years now, and StreamWebs helps them store and organize their data. Their collection of photo points is referenced by restoration professionals, as it documents changes along an important side channel restoration site.

High Lakes

View Edit

Healthy Waters 2009

Students at High Lakes Elementary School in Bend wanted to educate their community about the Deschutes watershed. Their 2009 video called "Healthy Waters" is nearly 30 minutes in length and documents everything from the water cycle to the economic importance of their home watershed. The video also captures their contribution to the health of the watershed, helping to replant native vegetation and monitor water quality.

The Freshwater Trust™
65 SW Yamhill Street, Suite 200
Portland, OR 97204
www.thefreshwatertrust.org

Ryan Johnson
StreamWebs Coordinator
503.222.9091 x18
ryan@thefreshwatertrust.org

UNIT 3. NATIVE AMERICAN INDIAN STORYTELLING

POTENTIAL BENCHMARKS FOR THIS UNIT			
6.2L.2	8.2L.1	H.2L.2	H.4D.6
	8.2E.4	H.2E.4	

INTRODUCTION

Every Native American Indian tribe traditionally used storytelling as a primary means of educating young people. Not only were stories experienced directly, but they also challenged the young imagination and respected the inner wisdom each child owns. Stories not only told of a legend or occurrence of long ago, but gave reference to many other things. The stories in this unit may tell of what is happening now and have hidden meaning in the words, characters, creatures, places, numbers, or all of the above. There could be morals or lessons to be learned. They are very colorful stories that are easy to remember and may be told over and over so as to stimulate our minds.

All these stories that have been orally passed down from generation to generation, were lessons passed down with a whole rainbow of purposes and meanings. When speaking of old stories that have been handed down from the elders, we must have respect for those stories and not change their meanings or ways of being told to our own preference, but to keep telling them as they were told to us.

This unit introduces storytelling as an effective way of involving young people in the deeper ideas of ecology. It shows the student the art, sophistication and meaning of storytelling with three readings. There are then nine wonderful stories to chose from, each story, in a different way, relates how Native American Indians view the Natural World.

OBJECTIVES:

For students to know and understand:

- the art of storytelling and the importance storytelling not only as it relates to Native American Indian cultures, but to all cultures.
- that for Native American Indians there is no separation between humans, the animals, the natural world, and the sprit world; they are all one, all part of the sacred hoop which binds them together.
- the tremendous importance of natural resources, such as salmon to coastal Native American Indians and the rituals, stories and traditions surrounding them.
- that Native Americans believe that humans were put on earth to be caretakers of the land and of the animals. The belief that this is their sacred duty helps to explain why Native American Indians revere the land and why the loss of their land was so devastating to them.
- that Native American Indians practiced sustainability because they had a valuable food source in salmon and other animals and took measures to ensure these creatures would be available for generations in the future.

MATERIALS:

- STUDENT HANDOUT 3A: *Native American Indian Beliefs and Symbols as described by John Fire Lame Deer*
- STUDENT HANDOUT 3B: *Native American Indian Storytelling*
- STUDENT HANDOUT 3C: *Animals and Nature in Native American Indian Stories*

Introductory Stories:

- STUDENT HANDOUT 3D: *Salmon Boy*
- STUDENT HANDOUT 3E: *Salmon Story*
- STUDENT HANDOUT 3F: *Coyote Stories*
- STUDENT HANDOUT 3G *Legend of the Lost Salmon*

Advanced Stories:

- STUDENT HANDOUT 3H: *Navajo Deer Hunting Way*
- STUDENT HANDOUT 3I: *Koyoda & How He Brought Salmon to the Columbia River*
- STUDENT HANDOUT 3J: *It Is Important (poem)*

IMPORTANT QUESTIONS:

- What purposes did storytelling serve in past generations of Native American Indian cultures?
- What purpose does storytelling serve in Native American Indian cultures today?
- What values are passed down in the stories?
- How did Native American Indians regard the Natural World?

PROCEDURE:

1. *Mitakuye Oyasin* is a Lakota phrase meaning WE ARE ALL RELATED. Write this on the board to begin to get students to think about a Native American Indian's perspective, and/or to facilitate a brainstorm discussion. *Mitakuye Oyasin* captures an essence of the tribal perspective of Native American Indians. It reflects the understanding that Native American Indians are truly and profoundly connected to other people and the physical world. According to Gregory Cajete, "Tribal education is, at its essence, learning about life through participation and relationship in community, including not only people, but plants, animals, and the whole of Nature."

2. Explain to students (for all levels) that they are about to begin an exploration of Native American Indian beliefs and values as they're embodied in legends that have come down to us through many generations. Native American Indians hold these same beliefs and values today. To facilitate further discussion about Native American Indian beliefs and symbols, read aloud or pass out STUDENT HANDOUT 3A as described by John Fire Lame Deer, a holy man of the Lakota tribe.

3. Storytelling, a traditional educational form, presents an ecological paradigm of respectfulness. Through a seemingly simple story, complex ideas are brought forth. It is a way of immersing students in an experiential narrative that challenges their imagination. The following information gives you some background and methodology for facilitating applied storytelling.

4. Assign to students two essays, STUDENT HANDOUTS 3B and 3C (these are fairly high level reading, thus you may have to make adaptations depending on the students you are working with), either as homework or in-class silent reading. Instruct them to be prepared to discuss each essay. These essays are meant to give background information needed before getting into the art of applied storytelling.

5. Review the following text boxes, *Ideas for How to Facilitate Storytelling* and *Native American Teachings*, for your own background knowledge.

APPLIED STORYTELLING

(adapted from <u>One With the Watershed</u> by Tom Heidlebaugh)

Teachers have a technology which is thousands of years old called Storytelling. It helps us all learn how to be a part of life. Although all teachers use Story in their work, there may be little attention paid to the disciplines, practices, and applications behind the telling. Native Americans developed this special gift of Story into a participatory process that is still used in traditional cultures. It can be a basic tool for the classroom. Story gives teachers a powerful, interdisciplinary form that brings experience into context for children. Through Story, students efficiently retain what they learn and apply it more consciously to a variety of school activities. In Whole Language activities, Story is a basic tool. After all, *We all want to be a part of the story*.

The Four Posts to the Longhouse of Story are:

I. WE ARE ALL STORYTELLERS – each and every one of us. Students need to know this. In telling the stories of their own lives, they need the appreciation, the sense of respect and responsibility that comes with storytelling. The skills required to tell a story well are fundamental to learning and basic to every person's development.

II. STORYTELLING SUSTAINS COMMUNITY – The exchange that takes place in the storytelling experience is an essential ingredient to social connection. The inverse is also true. When we stop telling each other our stories, community goes away.

III. EACH STORY IS A LIVING BEING – A teacher's work is to recognize how each student is a story, complex and wonderful, full of risk and potential. Our job is to help that story unfold. As the student finds the thread of his or her personal tale, he or she begins to know coherence in a confusing world. Story should be no more manipulated for ideology than a student should be against her or his story.

IV. STORYTELLING IS ABOUT LISTENING – Performing is not as important as paying attention. Traditional elders always begin by teaching young people to listen to the heartbeat of the earth, the silence of their hearts. When students learn to listen, they feel they are part of the life they want so much more to live.

From these core principles, schools can build a story process into any area of learning. Environmental studies and writing are integrated in the support that Story provides. Applied Storytelling allows the teacher to turn the classroom, the school year and the vary act of teaching into pieces of the great experience of being human.

6. There are five introductory and three advanced stories. Read through the stories to decide which would be most appropriate for your students. Each story has questions to stimulate thought and discussion.

EXTENSION ACTIVITIES

1. In Unit 6, lesson/activity 6E, there is a Native American Fishing Rights Mock Treaty Negotiation Role-Play. This would be an excellent compliment to this unit.

2. A wonderful compliment to this unit is *The Chinook Trilogy* videos. They are three thirty-minute videos. All three videos are most suitable for high school level students. They are available as a set or individually. See the Bibligraphy section for descriptions of each video and how to obtain them.

Ideas for How to Facilitate Storytelling
(Reference to STUDENT HANDOUT 3B for further descriptions of storytelling methods)

- Form a story circle when reading aloud.
- Use a story stick to facilitate students telling stories of their won. Perhaps use a word or a phrase to get them going.
- Use the "storyteller's bag" method to facilitate storytelling.
- Use the "Ho-Hey" method to involve listeners.
- Have a storytelling contest. Give the best dramatic storyteller/performer special privileges or prizes.

Native American Indian Teachings
(Based on Cedar Tree Teachings of Elders of the Pacific Northwest Tribes and the text Look to the Mountain by Dr. Gregory Cajete of Santa Clara Pueblo)

This is a brief outline of deep principles upheld by many traditional cultures that are transferable to contemporary society. The terms used by contemporary ecologists are also indicated.

1. SEVENTH GENERATION THINKING – Considers our responsibilities in terms of both our future and our past. We honor our ancestors back at least seven generations when we make an important decision that affects our society. This means we take their way, which worked well for so long into account when we plan a new road or teaching process. It doesn't mean we can't change but that we change carefully.

   We honor our descendants not only because they carry the future but also because we will be their ancestors and we are responsible for how they will live. This means we leave wetlands and regenerate deforested slopes so our great-great-great-great-great grandchildren thank us for our decisions. This is called "integrated equity" by ecologists.

2. LISTENING IS PARTICIPATING – Paying attention is considered the beginning of all knowledge. Traditional teachers will point out to children that the Creator gave us two ears but only one mouth, so we listen at least twice as much as we talk. We are taught to consider that everything has wisdom and that if we learn the skills of listening we can hear the voices of the animals and plants and mountains. Ecologists call this sensory integration.

3. WE ARE A GIFT TO EACH OTHER – In a consumer society the goal is to acquire more than is used so there is a surplus that creates wealth. In a society based on sharing, the individual is aware of here or his responsibility, giving in equal value to what is received. This can be as simple as keeping toxic chemicals out of local waters or as difficult as asking the basic questions of mutual interdependence.

4. WE ARE ALL ON A JOURNEY TOGETHER – We grow and change in much the same way other living beings do. This link to life both supports us and challenges us. If we learn where we are meant to go from other living beings we also learn how to behave in this interspecies adaptation.

5. WITH CAREFUL WORK WE CAN RESTORE OURSELVES TO BALANCE – Much of Native American Indian environmental activity is ceremonial. This is conscious community action that acknowledges the basic harmony of the natural world and the unique ability human beings have to get out of balance with that existence. The two steps are to recognize when we are not connected and then restore ourselves to stablity.

BIBLIOGRAPHY

Keepers of the Earth. 1989. Michael J. Caduto and Joseph Bruchac. Fulcrum Publishing. Golden, Colorado.

Keepers of the Earth Teachers Guide. 1988. Michael J. Caduto and Joseph Bruchac. Fulcrum Publishing. Golden, Colorado.

Kwakiutl Legends. Chief James Wallas, as told to Pamela Whitaker.

Look to the Mountain: An Ecology of Indigenous Education. Gregory Cajete.

Native American Values/Beliefs: A Literature Curriculum. 1994. Judith Komishane. Title IX Indian Education Program. Washington County ESD, Hillsboro, OR 97124.

One with the Watershed: A Story Based Curriculum for Primary Environmental Education. Tom Heidlebaugh. Presented by the Tribal Communities of the Northwest, the Northwest Indian Fisheries Commission and the Seattle Aquarium.

The Oregonians: An Illustrated Collection of Essays on Traditional Lifeways, Federal-Indian Relations, and the State's Native People Today. Published by the Oregon Council for the Humanities.

Rethinking Columbus: Teaching About the 500th Anniversary of Columbus's Arrival in America. 1991. Rethinking Schools, Ltd. Milwaukee, WI. 53212.

UNIT 3. NATIVE AMERICAN STORYTELLING STUDENT HANDOUTS

3A	*Native American Beliefs and Symbols*
3B	*Native American Storytelling*
3C	*Animals and Nature in Native American Stories*
3D	*Salmon Boy*
3E	*Salmon Story*
3F	*Coyote Stories*
3G	*Legend of the Lost Salmon*
3H	*Navajo Deer Hunting Way*
3I	*Koyoda & How He Brought Salmon to the Columbia River*
3J	*It Is Important (poem)*

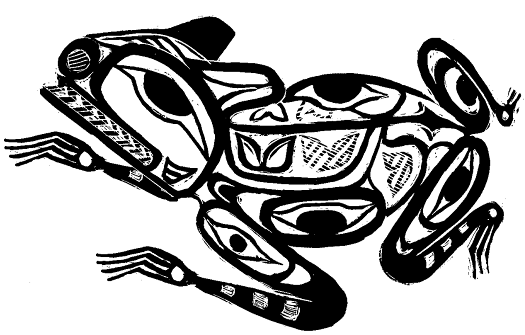
STUDENT HANDOUT 3A

Native American Beliefs and Symbols as described by John Fire Lame Deer, a holy man of the Lakota Tribe:

What do you see here, my friend? Just an ordinary old cooking pot, black with soot and full of dents…It doesn't seem to have a message, that old pot, and I guess you don't give it a thought. Except the soup smells good and reminds you that you are hungry….

But I'm an Indian. I think about ordinary, common things like this pot. The bubbling water comes from the rain cloud. It represents the sky. The fire come from the sun which warms us all – men, animals, trees. The meat stands for the four-legged creatures, our animal brothers, who gave of themselves so that we should live. The stream is living breath. It was water; now it goes up to the sky, becomes a cloud again. These things are sacred. Looking at that pot full of good soup, I am thinking how, in this simple manner, Wakan Tanka takes in our mind are mixed up with the spiritual. We see in the world around us many symbols that teach us the meaning of life….

We Indians live in a world of symbols and images where the spiritual and the commonplace are one. To you symbols are just words, spoken or written in a book. To us they are part of nature, part of ourselves – the earth, the sun, the wind and the rain, stones, trees, animals, even little insects like ants and grasshoppers. We try to understand them not with the head, but with the heart, and we need no more than a hint to give us the meaning.



STUDENT HANDOUT 3B

Native American Indian Storytelling

All cultures seek to answer the basic questions of where we humans came from and why we're here on earth. Their answers take the form of philosophies, religions, legends, mythology, and in Native American Indian cultures, storytelling is a dominant means for understanding.

Humans are storytelling animals. Through story we explain and come to understand ourselves. Story—in creative combination with encounter, experience, image making, ritual, play, imagination, dream, and modeling, forms the basic foundation of all human learning and teaching.

One of the primary learning techniques of Native American Indian Tradition is the Story Circle. There are actually many hundreds of ways to use the circle, from everyone telling a long traditional story, to passing a story stick in silence from one person to the next. The circle is a metaphor for the larger circle of the world and the process of using the circle signifies our role in the cycle of life.

Native American storytelling was and still is a communal experience. It brings people together to share a past that is still alive. The events in the stories, though they may seem fantastic and unlikely, can also be experienced as a type of reality. Stories may show us important things about the world we live in and teach us ways to behave in that everyday world.

The value placed on stories in Native American Indian culture is described by Chris Landon in "American Indian Baseline Essays:

> *The thousands of years of American Indian Experience on this Turtle Island, this Mother Earth, is the heartbeat that pulses through the arteries and veins of our stories. American Indian stories are our understanding of the universe, the Creator, all the beings with whom we share life, and the events that happened and happen in the course of our collective experience of life…They are…stories, the telling of which links our living culture to that of our ancestors. The stories themselves can be, and are thought of as, living beings, full of mystery, wisdom, and power, capable of evolving along with the People, and deserving respect for their own sake…They are alive, they are our lives, and we are uniquely human because of their uniqueness.*

In the Northwest, stories and myths were part of the sacred winter season and for practical and spiritual reasons were not to be repeated at any other time. During the rest of the year only quoting from the stories was allowed. Seeing a coyote, one might say something the Coyote of the stories would characteristically say, such as "I'm hungry." To tell myths outside of winter might bring rattlesnakes or other misfortune.

Stories themselves were not merely spoken, but shared as dramatic performances, often told by an elder person who might be invited to come to a house for several nights and be presented with gifts. Against the enclosed light of a smoldering fire, the narrator would develop a story using different voices for the various characters, highlighting their characteristic turns of expression, underlining foolishness and pathos with tone of voice, imparting emphasis with gestures. One or more of the audience would be expected to respond at intervals, perhaps after every verse, with

STUDENT HANDOUT 3B continued

the equivalent of "yes" or "indeed." A child who fell asleep might be made to go bathe in a frozen river; but if all response ceased, it would be time to end the story for the night.

Another common means of involving the listeners was the use of a response word. Whenever the storyteller says "Ho?" the people listening all have to say "Hey!" It is a method that has been used for years in storytelling. Stories were usually told at night around a fire during the cold months of the year. Everyone knows how drowsy you can get around a nighttime fire and no storyteller wants to tell a tale to people who are not awake.

In traditional settings, a storyteller is not speaking to an audience, but instead engages people in the tale. If a storyteller asks a question, he or she expects an answer. If there is a song within a story, that song will be known by or taught to the people. To Native American Indian people, stories are among the greatest gifts which human beings have been given. The way the storytellers were regarded by their people shows this.

Because Native American Indian cultures had an understanding of this powerful role of story and its cross-generational value, people of all ages gathered around when a story was told. From our knowledge of different Native American Indian cultures, we know that storytelling was not "just for children." In fact, stories were so powerful that they were treated with a special respect. Many stories, in fact, could be told only by certain people at specific times.

Because certain men and women showed more ability than others, there were sometimes specific individuals who acted as "professional" storytellers. Among the Iroquois, these people had the title of Hage'ota, "a story person or storyteller." These people traveled from lodge to lodge during the storytelling seasons.

Basic Native American environmental themes like sustainability and biodiversity, as well as a process with which watersheds and salmon can be understood, are at the heart of the stories you will be reading. When people recognize their relationship with the rest of the natural world, they feel empowered to learn. "The care of the rivers," an elder said, "begins in the human heart."

Adapted from:

The Oregonians: An Illustrated Collection of Essays on Traditional Lifeways, Federal-Indian Relations, and the State's Native People Today; published by the Oregon Council for the Humanities.

One With The Watershed: A Story Based Curriculum For Primary Environmental Education; presented by the Tribal Communities of the Northwest, the Northwest Indian Fisheries Commission and the Seattle Aquarium; written by Tom Hedlebaugh.

Keepers of the Earth Teacher's Guide; by Michael J. Caduto and Joseph Bruchac; 1988; Fulcrum Publishing; Golden, Colorado.

STUDENT HANDOUT 3C

Animals and Nature in Native American Indian Stories

People have always had a strong desire to understand the world around them, from small children repeatedly asking "but why is it that way?" to students gazing through microscopes and telescopes, and astronauts traveling to distant stars.

Native American Indians have innumerable stories to explain everything from "Why the Owl Has Big Eyes" and "How to Scare a Bear" to "Coyote Places the Stars" and "Daughter of the Sun."

In the Native American Indian belief system, animals were created before humans and were the ones who went on to create the stars and plants and humans. For this reason animals are often referred to in stories as our "elder relatives" and our teachers – when an animal speaks to a human being, it is wise to pay attention, listen, and learn.

The animal people in the stories of the Pacific Northwest Native American Indians were giants. Mosquito, Spider, and Ant were larger than our cows. Salmon, Eagle, Beaver, Fox, Coyote, and others had the characteristics of today's animals, yet they could reason, talk and do many things that neither animals nor people can do now. The animal people in the tribal tales lived exactly as the Indians themselves lived later. When telling the stories in English, Native Americans today refer to these animal persons simply as "the people."

Animal relationships were expressed through ceremonial rituals that focused on their ability to connect humans with the universal order. The world and animal renewal ceremonies, practiced by all tribes, expressed the human responsibility to preserve, protect, and perpetuate all life. In the Northwest, the salmon ceremonies reflect this responsibility:

The salmon ceremony was observed everywhere along the Northwest coast. For the Huroc and others it symbolized a renewal of the world's creation. Many groups also held ceremonies for the first fish taken or other species- the first deer, the first berries, or even the first acorn in the southern regions.

The salmon (or first four salmon) received the most elaborate rites, though this varied from place to place. Usually the salmon were laid with their heads pointing upstream on a newly woven mate or cedar board, often under a special shelter and sprinkled with down feathers of birds. A formal speech or prayer of welcome was intoned as in this particular example:

> *Old friends, thank you that we meet alive. We have lived until this time when you came this year. Now we pray you, supernatural ones, o protect us from danger, that nothing evil may happen to us when we eat you, supernatural ones, for that is the reason why you have come here, that we may catch you for food. We know that only your bodies are dead here, but your souls come to watch over us when we are going to eat what you have given us to eat now.*

The salmon were offered fresh water symbolically after their long journey through the salt sea. The first salmon were then cooked and divided in small pieces among all the people present at a communion. The celebration, often seven days in length, included feasting, gift-giving, torch-bearing processions, dancing and singing. During all the ceremonies of welcome, countless salmon were allowed to pass upstream to the spawning grounds, and thus the ritual actually helped to assure the continuation of the salmon runs.

Guided by these principles, Native American Indian people acknowledged that all living and non-living entities of Nature have important inherent meaning within the context of human life. Central to the spirituality of Native American Indians is the belief that all things and all beings are interconnected. This is symbolized by the circle or hoop, because anything that affects one part of the circle affects all the others. Based on this understanding, Native Americans symbolically recognized their relationship to plants, animals, stones, trees, mountains, rivers, lakes, streams, and a host of other living entities. Through seeking, making, sharing, and celebrating these natural relationships, they came to perceive themselves as living in a sea of relationships.

In the minds of many Europeans, Native American Indians were never understood for what they were and are; a people who, in a variety of ways and with all their heart and being, tried to establish a direct relationship with natural life. They understood Nature as the essence of the Great Mystery, which guides and breathes life into all things. For Native American people, the land was full of spirit, full of life energy. Everything—a

STUDENT HANDOUT 3C continued

rock, a tree, a plant, a mountain, an animal, a bird, an insect—had its unique expression of life and way of the Spirit.

Since we are all part of the same whole, say Native American Indians, we can communicate directly with other parts of creation- nature, animals, the spirit world, and we can all help each other. If humans ask the assistance of plants and animals in a respectful and honoring way, they will respond by serving as messengers or by offering themselves up as food or for use in healing. In return, there are times when humans can help plants and animals. Similarly, if we help another person in need, he will be grateful and eager to reciprocate.

To further explain their deep reverence for each other and for nature, the Native American Indians feel that humans and nature are a precious gift from the Creator. Therefore, by caring for each other and by using nature's resources in a way that protects rather than depletes them, we show our appreciation for the gift and, we insure our own well being and survival. This is why balance and harmony among all beings must be maintained.

Ella Clark, in Indian Legends of the Pacific Northwest, explains this special relationship between Native Americans and animals and nature.

> *"To the Indian in his native state," said Martin Sampson, an Indian grandfather of the Puget Sound region, "Everything had life or spirit; the earth, the rocks, trees, ferns, as well as birds and animals, even the hail which fell from the sky had a spirit and a language and song of its own and might be an inspiration to a warrior."*
>
> *Each wind was the breath of some being who lived far away in the direction from which the wind blows. To each the Indians gave a name, and every sign, whistle, moan, or roar of thunder, the growth of plants, the changed position of the stars – all were caused by the spirits living in them. The spirits of nature control nature, the Indians believed, just as the spirits that live in human bodies control human actions.*
>
> *Whether the spirits were regarded as good or evil depended, chiefly, on how they treated the Indian. He tried to win their favor and protection, therefore, and to avoid their wrath. If angered, the spirits of the mountains would cause a storm or avalanche or perhaps a volcanic eruption. The spirits living in the rapids of the Columbia River and in the*

dark pools along its banks might seize the canoe of the man who had angered them. Some spirits, always evil, hid in caves and in caverns below the earth, but roamed forth from time to time to do their wickedness.

The spirit of the storm was visualized as a huge bird, known as Thunderbird. The flapping of its wings caused the sound of thunder; the flash of its eyes was the lightning. It lived in a cloud above the highest peak the tribe could see, or in a cave in the mountains...Indians near the coast believed that Thunderbird flew to the Pacific Ocean to get whales which were its foods. Rain clouds and thunderstorms often followed it home from the ocean. The Indians feared Thunderbird and tried not to anger it.

STUDENT HANDOUT 3D

Salmon Boy
(Haida Tribe – Pacific Northwest)

(From Keepers of the Animals by Michael J. Caduto and Joseph Bruchac)

Long ago, among the Haida people, there was a boy who showed no respect for the salmon. Though the salmon meant life for the people, he was not respectful of the one his people called Swimmer. His parents told him to show gratitude and behave properly, but he did not listen. When fishing he would step on the bodies of the salmon that were caught and after eating he carelessly threw the bones of the fish into the bushes. Others warned him that the spirits of the salmon were not pleased by such behavior, but he did not listen.

One day, his mother served him a meal of salmon. He looked at it with disgust. "This is moldy," he said, though the meat was good. He threw it upon the ground. Then he went down to the river to swim with the other children. However, as he was swimming, a current caught him and pulled him away from the others. It swept him into the deepest water and he could not swim strongly enough to escape from it. He sank into the river and drowned.

There, deep in the river, the Salmon People took him with them. They were returning back to the ocean without their bodies. They had left their bodies behind for the humans and the animal people to use as food. The boy went with them, for he now belonged to the salmon.

When they reached their home in the ocean, they looked just like human beings. Their village there in the ocean looked much like his own home and he could hear the sound of children playing in the stream which flowed behind the village. Now the Salmon People began to teach him. He was hungry and they told him to go to the stream and catch one of their children, who were salmon swimming in the stream. However, he was told, he must be respectful and after eating return all of the bones and everything he did not intend to eat to the water. Then, he was told, their child would be able to come back to life. But if the bones were not returned to the water, that salmon child could not come back.

He did as he was told, but one day after he had eaten, when it came time for the children to come up to the village from the stream, he heard one of them crying. He went to see what was wrong. The child was limping because one of its feet was gone. Then

STUDENT HANDOUT 3D continued

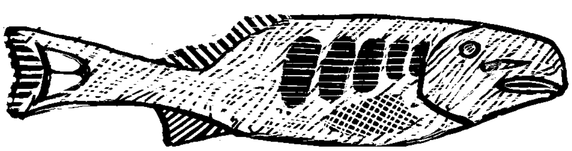
the boy realized he had not thrown all of the fins back into the stream. He quickly found the one fin he had missed, threw it in and the child was healed.

After he had spent the winter with the Salmon People, it again was spring and time for them to return to the rivers. The boy swam with them, for he belonged to the Salmon People now. When they swam past his village, his own mother caught him in her net. When she pulled him from the water, even though he was in the shape of a salmon, she saw the copper necklace he was wearing. It was the same necklace she had given her son. She carried Salmon Boy carefully back home. She spoke to him and held him and gradually he began to shed his salmon skin. First his head emerged. Then, after eight days, he shed all of the skin and was a human again.

Salmon Boy taught the people all of the things he had learned. He was a healer now and helped them when they were sick.

"I cannot stay with you long," he said, "you must remember what I teach you."

He remained with the people until the time came when the old salmon who had gone up stream and not been caught by the humans or the animal people came drifting back down toward the sea. As Salmon Boy stood by the water, he saw a huge old salmon floating down toward him. It was so worn by its journey that he could see through his sides. He recognized it as his own soul and he thrust his spear into it. As soon as he did so, he died.



Then the people of the village did as he had told them to do. They placed his body into the river. It circled four times and then sank, going back to his home in the ocean, back to the Salmon People.

Questions:

1. What do the salmon do when the young boy treats them disrespectfully? What would you have done?
2. Why do the salmon make the boy one of their own?
3. How is the young boy changed by his experience? What does he learn?
4. How can Salmon Boy die and come back to life so many times in this story?
5. What finally happens to Salmon Boy in the end?
6. Identify some circles and cycles revealed in the story. Why are they important? Why is it important for our relationship with nature to be practiced in circles?
7. What are some the cultural values passed down in this story?

STUDENT HANDOUT 3E

A Salmon Story
(Kwakiutl Tribe – Pacific Northwest)

(From Kwakiutl Legends as told to Pamela Whitaker by Chief James Wallas)

"We have come to meet alive, Swimmer. Do not feel wrong about what I have done to you, friend Swimmer, for that is the reason why you come that I may spear you, that I may eat you, Supernatural One, you, Long-Life-Giver, you, Swimmer. Now protect us, (me) and my wife, that we may keep well, that nothing may be difficult for us that we wish to get from you, Rich-Maker-Woman. Now call after you your father and your mother and uncles and aunts and elder brothers and sisters to come to me also, you, Swimmers, you Satiater," says he.

--**A Kwakiutl Prayer to Salmon**

When a man eats salmon by the river, he sings the salmon song. It is in the river in the roasting in the spearing in the sharing in the shoring in the shaking shining salmon. It is in the song too.

--Kwakiutl Poem

A powerful man, one who knew how to make plans, once lived at the top of a cliff on Nigei Island. He had a wonderful canoe. The canoe would become the size that he needed, either large enough to carry a hundred people or small enough to take just a few. He could dip his paddle into the water and say where he wanted to go, pull the paddle once, and the canoe would be there.

Many people resented the man who could make plans because he was different from themselves, so he lived alone with his family at the top of the cliff. On the rock face of the island, there was an opening through which he used to climb to escape his enemies. The opening led into a passageway and to the top of the cliff where there was a

STUDENT HANDOUT 3E continued

smaller hole to come out of. At the bottom of the embankment stood a pillar of stone and, farther down, another on which Planner's great canoe rested.

Planner had a son who was of the age to be married. He did not want his son to marry an ordinary girl. He wanted a union that would help provide food for his people, who were often hungry.

The powerful man had heard of a type of fish called "salmon" that dwelled at the other side of the world. He said to his people, who lived down below the cliff, "I want my son to marry the salmon girl who is far across the water. We will take my canoe and go to where the salmon are."

The people did not know where he was going but they all climbed into the great canoe. Planner headed toward the open sea and put this paddle in the water. "Take us where the salmon are," he said, and gave the paddle one strong pull. The canoe with all the people in it moved as fast as lightning across the water to the other side of the world.

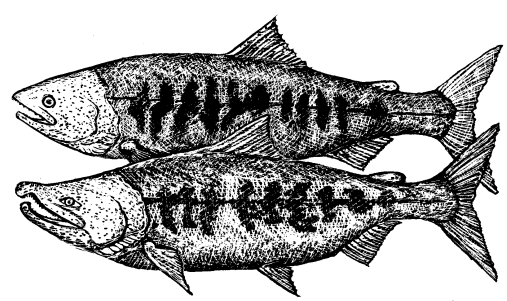
At the edge of the water of the strange place were big bins teeming with fish of different kinds. "They must be the salmon of which we have heard," the people said to one another in wonder.

Planner asked to speak to the chief of the nearby village and was invited into his lodge. He discussed with the man the possibility of marriage between his son and the chief's daughter.

"We do not have salmon where we come from," Planner explained. "Sometimes our people are very hungry. If your daughter marries my son, we would like her to bring salmon with her."

The chief looked at Planner. He looked out at the magnificent canoe and replied, "Yes, my daughter may marry your son and she will bring salmon. But before you go you must stay for a feast. It will be many days before the salmon reach Vancouver Island. During the feast we will teach you how to cook and preserve fish."

So a great wedding feast that lasted four days was held. The planner and his people tried all the different kinds of salmon. They learned how to prepare it and how to tell one kind from another. They ate the mild flesh of the small, spotted Pink, and the redder meat of the large Coho. They tried speckled-sided Chum and were surprised at the size of the delicious Spring salmon.



"One Spring salmon will feed many," the people exclaimed to one another. But their favorite was the rich red meat of the slim, silvery-blue Sockeye.

The guests learned many ways to cook salmon. They were taught how to smoke it and dry it for the winter and how to barbecue it. When they were preparing the salmon, they were instructed to leave the head on the end of the backbone so that the salmon would come alive again.

"When you barbecue salmon over a fire, there is a hole that you put the stick through," they were told. "Be careful that you don't drop any bones of the salmon through that little hole or something will be missing when that salmon comes alive again—a fin or tail or something like that."

"You may throw the bones of the salmon into the water or anywhere else and they will come back again the next year. But do not drop them through the hole where the barbecue stick goes."

The chief of the village said to the planner, "When a child is born to our children who have just married, it will have a dance all its own—The Salmon Dance." He did the dance to show him how it went. "When twins are born, they too will have this dance, for twins are children of the salmon."

"There's another thing you must remember," added the chief. "When the salmon are coming up the river, no one should mourn. Even if someone dies at that time, do not allow your people to mourn or the salmon may cease to come up your river."

After four days of feasting and learning, the people of Nigei Island climbed back in the wonderful canoe. The son of the planner and his bride, the salmon girl, were with them. The salmon followed the canoe across the ocean to the shore of Nigei Island.

Planner stood up in the canoe and said to the salmon, "This is where the planner lives." The fish all spread out behind the canoe, jumping and splashing in the water. Each group was given a river of Vancouver Island in which to spawn.

Questions:

1. What was unique about the Planner and his canoe?
2. What type of girl did he want his son to marry?
3. Describe the four-day wedding feast. What did they learn?
4. What specific instructions were given on how to prepare and cook salmon? What would happen if these instructions were not followed?
5. What will the child of the two just married have all its own?
6. What is the significance of twins?
7. What should no one do when the salmon are coming up river? Why do you think this is?
8. What happened when the salmon reached the Pacific Northwest?
9. What do you think are the cultural values passed on in this story?
10. How did the relationship between Planner and his people change? Why did this occur?
11. How do you think the storyteller would involve the audience in this story?

STUDENT HANDOUT 3F

Coyote Stories:

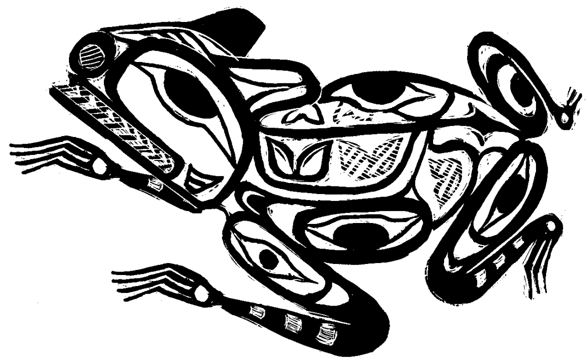
Coyote Takes Water from the Frog People

(from Columbia River: It's Future and You)

and

The Legend of Coyote

(told by Moses George, Colville Confederated Tribes)



Coyote Takes Water from the Frog People

Coyote was out hunting when he found a dead deer. One of the deer's rib bones looked just like a big shell. Coyote picked it up and took it with him to see the Frog People. The Frog People had all the water. When anyone wanted any water to drink, to cook with, or to wash with, he or she had to get it from the Frog People.

Coyote said, "Hey, Frog People, I have a big shell. I want a big drink of water, and I want to drink it for a long time." "Give us that shell," said the Frog People, "and you can drink all you want." Coyote gave them the shell and began drinking. The water that Coyote drank was behind a large dam.

Coyote began drinking. He drank for a long time. Finally, one of the Frog People said, "Hey Coyote, you sure are drinking a lot of water there. What are you doing that for?" Coyote brought his head up out of the water. The Frog People wondered how Coyote could drink so much water. They thought Coyote might be trying to trick them.

All the time he had his head underwater, Coyote was digging. He was making a hole under the dam. When he was finished, he stood up and said, "That was a good drink just what I needed." Then the dam collapsed and the water went out into the valley and made the creeks and rivers and waterfalls. The Frog People were very angry. "You have taken all the water, Coyote!" They cried. Coyote said, "It is not right that one group of people has all the water. Now it is where everyone can have it."

Now, anyone can go down to the river and swim or get water to drink or to cook with.

STUDENT HANDOUT 3F continued

The Legend of Coyote

After Old-One, the Great Spirit and Creator, had made the earth and the ancient Indian people, he sent Coyote among them, because they were very much in need 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. It was because of Coyote that the salmon were first brought to the Wenatchee River. First, he 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 farther up the 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 Indian 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 a young white fir tree and tipped the point with a sharp flint rock found along the Big River bank and caught the salmon with the pointed end of the spear. "This is how you should 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 by holding it over the fire on sticks. Coyote put salmon in a 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 followed him. Often he came to a smaller stream flowing into Big River. Because the people along the Yakima and Wenatchee Rivers treated him kindly, Coyote sent the fish up their rivers and promised them that every spring the salmon would return. Where he was treated very kindly he made the river narrow in one spot. He made the two banks of the river almost meet, so that there would be a good place for catching salmon. This Salmon Place where we are gathered today is the place where he has always given us fish to meet all of our needs.

STUDENT HANDOUT 3F continued

Questions:

In *Coyote Takes Water from the Frog People,*

1. Who had all the water?
2. What did Coyote exchange for water?
3. What was Coyote really doing, when he said he was drinking?

In *The Legend of Coyote*,

4. Why was Coyote sent to earth? What was his purpose?
5. What was the first thing Coyote did? What was his reason for doing this?
6. What did he do to the Beaver women? Why do you think he did this?
7. What many things did Coyote teach the Indian people?
8. Why did Coyote send fish up the Yakima and Wenatchee Rivers?
9. Why did he make narrow spots along certain parts of the rivers?

In both stories,

10. Why were the Frog People and Beaver women, seen as evil by Coyote?
11. What are the major themes and cultural values passed on in the Coyote stories? How do these themes and cultural values relate to water issues of today?

STUDENT HANDOUT 3G

Legend of the Lost Salmon
(Yakima Tribe – Pacific Northwest)

This is a Yakima Indian legend about the Red Salmon or Chinook and its disappearance. It dates back to ancient times when their Creator first provided salmon on the earth for the people.

The Creator taught the people how to care for the salmon, which was created especially for them. He said, "Do not neglect this food, pay close attention to how you care for it, and do not take more than you need." He told them if they observed these rules, the salmon would multiply several times over as long as they lived.

At first the people diligently obeyed what they were told, and they lived happily with a bounty of fish. All along the river there were different bands of people living in their fishing villages, busy catching and drying their supply of salmon.

But after time something strange happened. The people became careless and they neglected to follow the instructions made by the Creator. They became greedy. They did not take care of the salmon. They let it go to waste when they caught more than they needed for their families. They would not listen to the advice from those who were trying to follow the teachings. In time, the salmon disappeared.

When the salmon were no longer coming up the stream for the people to catch, everybody frantically searched the rivers, but all in vain. There was not one salmon left to be found. Soon they became hungry. Their little children were crying and the old people were forced to beg for food.

One day, while searching the river, they found a dead salmon lying on the bank of the river. They stared at it in disbelief. They began to cry out in shame. They pleaded to the Creator, "If we are given one more chance, we will do better."

"If only we could awaken this salmon, other salmon might come up the stream," one person said.

The people called a council and they talked about how they could give life back to the salmon. In the past, those with supernatural powers could revive a lifeless creature by

STUDENT HANDOUT 3G continued

stepping over it five times. The people tried this in order to revive the salmon. One by one they each stepped over the salmon five times, but to no avail.

There was a recluse named Old Man Rattlesnake. He never went anywhere, always staying off by himself. He was very ancient and the people referred to him as "Grandfather." Someone said, "Let's ask Grandfather to help us! He is wise and has special powers. Let him try to revive the salmon!" A messenger was sent.

"Oh Grandfather, would you come and help us revive the salmon. Everyone else has failed." Old Man Rattlesnake listened and said, "What makes you think I am capable of reviving this lone salmon after everyone else has failed? I am an old man. How do you expect an old man to possess powers to do the impossible!" The messenger was saddened and responded, "You are our last hope. Please help us, Grandfather." Finally Old Man Rattlesnake agreed, "I will do my best." He was so old it was very painful for him to move fast. He moved ever so slowly and it seemed like such a long way for one so old.

Meanwhile, as Grandfather slowly made his way, Coyote tried desperately, using all his wily skills to show the people he possessed supernatural powers. He was thinking to himself, "If I revive this salmon, I will be forever famous." He stepped over it four times, and just as he was stepping over the fifth time, he pushed the salmon with the tip of his toe to make it appear as though it moved. He announced loudly, "Look my people. I made the salmon come to life. Did you see it move?" But the people were wise to the trickster ways of the Coyote, and paid him no attention.

Finally, Old Man Rattlesnake arrived. Painfully he crawled over the salmon four times. The fifth time something magical happened. Grandfather disappeared into the salmon and the salmon came back to life. Soon the salmon came back to the rivers.

The people learned their lesson well and took care to protect their salmon from then on passing on the lesson of the lost salmon to the next generations.

Today, when you catch a salmon, and you are preparing it for eating or preserving, if you break the spine you will find a while membrane inside. This is Old Man Rattlesnake who gave life back to the salmon.

Questions:

1. What did the Creator warn the people about the salmon?
2. What happened after time?
3. What did the people find in the search for fish?
4. Why did they think they could revive this last salmon?
5. Who did the people turn to revive the salmon?
6. Who stepped in to try to prove he possessed supernatural powers? What was the result?
7. What finally happened when Old Man Rattlesnake stepped over the salmon for the fifth time?
8. What do you think are the values being passed on to young people in this story?
9. Do you think this story has meaning today? How?

STUDENT HANDOUT 3H

The Navajo Deer Hunting Way

(From Look to the Mountain by Dr. Gregory Cajete)

There was a hunter who waited in ambush. Wind had told him, "This is where the tracks are. The deer will come marching through in single file." The hunter had four arrows: one was made from sheet lightning, one from zigzag lightning, one of sunlight roots, and one of rainbow.

Then the first deer, a large buck with many antlers, came. The hunter got ready to shoot the buck. His arrow was already in place. But just as he was ready to shoot, the deer transformed himself into a mountain mahogany bush, *tse esdaazii*. After a while, a mature man stood up from behind the bush. He stood up and said, "Do not shoot! We are your neighbors. These are the things that will be in the future, when human beings come into existence. This is the way you will eat us." And he told the hunter how to kill and eat the deer. So the hunter let the mature Deerman go for the price of his information. And the Deerman left.

Then the large doe, a shy doe, appeared behind the one who had left. The hunter was ready again to shoot the doe in the heart. But the doe turned into a cliffrose bush, *aweets aal*. A while later a young woman stood up from the bush. The woman said, "Do not shoot! We are your neighbors. In the future, when man has been created, men will live because of us. Men will use us to live on." So then, for the price of her information the hunter let the Doewoman go. And she left.

Then a young buck, a two pointer, came along. And the hunter got ready to shoot. But the deer transformed itself into a dead tree, *tsin bisga*. After a while, a young boy stood up from behind the dead tree and said, "In the future, after man has been created, if you talk about us in the wrong way we will cause trouble for you when you urinate, and we will trouble your eyes. We will also trouble your ears if we do not approve of what you say about us." And for the price of his information, the hunter let the young Deerman go.

Then the little fawn appeared. The hunter was ready to shoot the fawn, but she turned into a lichen-spotted rock, *tse dlaad*. After a while, a young girl stood up from the rock and spoke: "In the future all this will happen if we approve, and whatever we shall disapprove shall be up to me. I am in charge of the other Deer People. If you talk badlyabout us, and if we disapprove of what you say, I am the one who will respond with

STUDENT HANDOUT 3H continued

killing you with what I am. If you hear the cry of my voice, you will know that trouble is in store for you. If you do not make use of us properly, even in times when we are numerous, you will not see us anymore. We are the four deer who have transformed themselves into different kinds of things. Into these four kinds of things we can transform ourselves. Moreover, we can assume the forms of all different kinds of plants. Then when you look you will not see us. In the future only those of whom we approve shall eat the mighty deer. If when you hunt, you come across four deer, you will not kill all of them. You may kill three and leave one. But if you kill all of us, it is not good."

"These are the things that will bring you happiness. When you kill a deer, you will lay him with the head toward your house. You will cover the earth with plants or with branches of trees lengthwise, with the growing tips of the plants pointing the direction of the deer's head, toward your house. Then you will take us to your house and eat of us. You will place our bones under any of the things whose form we can assume. At these places you may put our bones. You will sprinkle the place with yellow pollen. Once, Twice. Then you lay the bones. And then you sprinkle yellow pollen on top of the bones. This is for protection of the game animals. In this manner they will live on; their bones can live again and live a last life."

Questions:

1. What were the four arrows the hunter had made from?
2. What did the large buck turn into? What did the mature man tell the hunter?
3. What did the shy large doe turn into? What did the young woman tell the hunter?
4. What did the young buck turn into? What did the young boy tell the hunter?
5. What did the little fawn turn into? What did the young girl tell the hunter?
6. If one kills a deer, how should one deal with the body?
7. What do you think is the purpose of this story-- entertainment, passing down of values, rituals, traditions? What are the themes and messages of this story?
8. Why do you think rituals surrounding hunting is so important to Native American Indians?
9. Explain the concept of sustainability, using this story.

STUDENT HANDOUT 3I

Koyoda and How He Brought Salmon to the Columbia River
(Klickitat Tribe – Pacific Northwest)

(Adapted from Legends of the Klickitats)

Many years ago, before the Great Stone Bridge was destroyed, Koyoda, half-god and half-man, served the Creator by helping the people of the Earth. He gave the people mouths and taught them to eat. He also taught the people how to grow and prepare maize (corn) and other foods so they would have plenty to eat during the cold winter months. And he also gave the Law to the people so they would know how to be good and to live in peace with each other.

At a time when the two great snow mountains, Pa-toe (Mt. Adams) and Yi-East (Mt. Hood) were carrying out one of their terrible battles, they destroyed the great in-land sea. This happened when Loo-wit was still guarding the Great Stone Bridge. During this particular fierce quarrel between the mountains, the animals had been killed or fled in terror. The forests around the mountains were burned. The berries and the maize, which would have served for the people's winter food supply, was buried beneath the ash. Thoughts turned towards Koyoda, and the people sought him out. Since Koyoda had given the people mouths and taught them how to eat, surely, he would help them as they faced starvation. Messengers were sent to find Koyoda, but he had already heard of their hardship and was on his way to help.

Koyoda listened quietly as the leaders complained of their situation and blamed Koyoda. Why had he given them mouths to eat with? At first Koyoda was angry, for eating should be a blessing and they were cursing the person who had given the blessing. But it wasn't long before the leaders saw their error, and they asked Koyoda to forgive them for complaining and to help them. He told them, "Give me one of your best war-canoes and six of your best young men. There is no food here. The animals are gone and the maize and berries are buried under the ash. We must follow the river down to the old sea until your fish can be found. Then we will drive at least part of them back up the river."

The people quickly found the best of the remaining canoes and named six braves to join Koyoda on this journey down the great river Columbia. Taking a few small food

STUDENT HANDOUT 3I continued

supplies, which was willingly shared by the villagers, Koyoda and the six braves started on their quest. This was the first time anyone had gone down this great river. No one had any idea where it would lead after they passed under the Great Stone Bridge. Would they be sucked down to the center of the Earth? What awaited them once they entered the great dark hole under the mountains?

Although each man was terrified, they were determined to make the journey with Koyoda. At first the river flowed swiftly and smoothly. There were no sharp turns or rocks to create dangerous swirls in the river. Nothing seemed to disturb their progress.

As they reached the great tunnel under the bridge, darkness came upon them and they were frightened. The darkness seemed to surround them as they rounded that first bend. The noise of the rushing water was deafening. Suddenly the canoe rammed head on into a stone wall or an island in the middle of their path. As the canoe jerked violently, cold water splashed over the sides of the canoe and everyone was thrown overboard. The swirling water rushed over them. Gulping for their every breath, all except one managed to pull themselves to safety. The canoe was also saved, but the paddles and what little supplies they had taken from the village were lost.

Before leaving on this journey, Koyoda had carefully wrapped his fire flint and some cedar bark in buckskin and tied it in his hair. Carefully removing it, he was able to use it to start a small fire. The men found driftwood all around them, and before long a good fire was burning. As they warmed themselves, the braves mourned for their lost companion.

They knew they could not remain on the banks of the river for long, for the people back home would soon be starving. After finding pieces of driftwood that could be used for make-shift paddles, they climbed into the canoe and started on their way. Koyoda noticed a hole in the hull that had been made when the canoe first hit the obstruction in the river. But the hole was high enough, so that even with everyone in the canoe, their combined weight did not push the hole below the water level and they could stay afloat.

Because of the darkness, the party of braves and Koyoda decided to leave their fire burning on the banks so the light from the fire could help to guide their way. Suddenly in the dim of the light they saw a moving figure and realized it was their lost companion. He was clinging to a piece of driftwood, alongside a rock wall, at the edge of the river. A shout of joy filled the air as the braves paddled to rescue their brother. But as they pulled him to safety, their canoe settled deeper into the water, so that the water poured through the hole in the hull. They had no supplies and nothing to bail out the in-rushing water. Their canoe soon began to sink. Suddenly and unexpectedly, Koyoda jumped into the river. As half-god and half-man, Koyoda could take different forms and he became a great beaver. As a beaver, he took the canoe in tow, and gently guided them

STUDENT HANDOUT 3I continued

down the river. Before long they passed through the darkness and entered into bright sunlight and more quiet waters.

But as their eyes became accustomed to the light, they were shocked at what lay before them. Everywhere the land was devastated. It was worse than their own land. In addition to the destruction caused by the fire, ash, and lava, the waters of the great in-land sea had hurled through the mountains and destroyed everything before it. In all directions, everything was flooded. Silence overcame the group as they looked in horror at the site before them. Koyoda, in the form of a beaver, was still guiding their direction, and after spotting a small island pushed them to shore. Thoughts of food soon broke the silent trance and as they reached shore the braves gathered wood as Koyoda changed back into a man and caught a few nice fish that had been lost to the great destruction on this side of the bridge.

After regaining their strength from the hearty meal, they found a balsam tree and gathered some pitch to repair the hole in their canoe. Soon they were on their way and Koyoda felt certain they had found the lost fish. But he had no idea how to get them back through the mountain.

Just as dusk began overshadowing the day, the party sighted another small island. A small stream of smoke was rising upwards to the clouds, and they were certain they would find another camp. But it was too late to investigate that night, so they wrapped themselves in their blankets and lay down in the bottom of the canoe to sleep.

But while they slept, the waters continued to flow and pushed them past the channel of the Willamette. They continued to drift. Suddenly, as they awakened from their night's sleep, there was a deafening roar from the waters as they tumbled through the channel between the hills. Caught in the pull of the current, the braves could do nothing but try to keep their canoe upright. But it was to no avail. The canoe overturned and all were once again thrown into the swirling rumbling waters. This time, there was no island, for they were on the bar at the mouth of the great river and entering the ocean. Instantly, Koyoda changed himself into a beaver and gathered his companions. They rode on his back to the safety of a sandy beach. The beach extended as far as the eye could see. In one direction was the great river they had just traveled down in search of the lost fish. It carried the waters from their own sea. In the other direction, they saw a number of faint smoke columns spiraling to the clouds. Surely this meant a large village, and perhaps this village had plenty of food.

During their last overturn, the canoe was damaged beyond repair, so they decided to walk to the village. They had never before seen the roar of ocean waves as they rolled upon the beach. After a short time, they wondered if they had angered the God of this great water, because the waves began to roll in from the sea and seemingly drive them further towards the bank. Before long, they found themselves climbing the rocky cliffs to avoid being showered with the spray of salty waves. The young men cried out to Koyoda, and he succeeded in casting a spell on the waves, and they once again began to recede back into the ocean.

As they walked along the moist sand, they noticed dead fish all around them. These were the fish from their own homeland. They also found parts of canoes, pieces of wigwams and other relics from their own homes that had been carried away by the great river.

STUDENT HANDOUT 3I continued

Upon reaching the village, they were ushered into the presence of the chief, who ended up being an acquaintance of Koyoda. Koyoda had once saved his life from an enormous bear. After embracing, the chieftain ordered a feast of salmon and venison. Koyoda and the chieftain talked late into the night, and Koyoda told him how they journeyed down the river to find the lost fish.

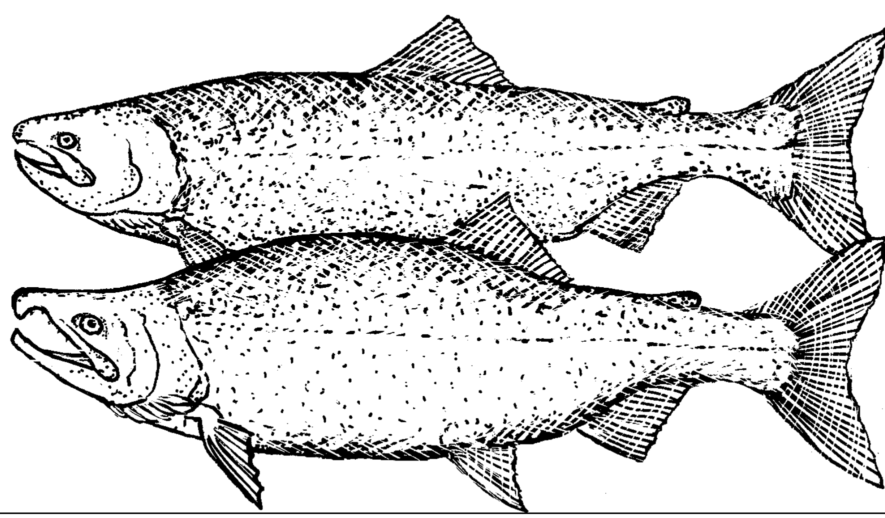
At early dawn, Koyoda rose to greet the light of a new day. His friend led the party to the seashore and pointed toward the horizon. Everywhere there were dead fish. “There are your fish,” said the chieftain. “See the seagulls? They are feasting upon their dead carcasses. Your fish were carried down to here by the great flood. They could not live in our salty water. I have an idea. Take some of our great white birds, the Klickitats, and with them, drive the salmon back up the new river over which you came. The salmon can live in fresh water, for that is where they are born.”

Koyoda though this was an excellent plan. The next morning, he called together his party to start the journey back to their village. He called the great white birds and the dogs of the sea and asked for their help. They were delighted with his offer and a new adventure. They gathered a great host of salmon and began to drive them into the river. Koyoda and his companions followed behind the seagulls and the sea dogs in a new canoe, given to him by the chieftain of the ocean village. All along the journey, you could hear the cry of the gulls as they called out, “Klick-tat, klick-tat.”

As the party reached the country beyond the Great Stone Bridge, some of the gulls liked it so well, they begged Koyoda to let them stay there always. So Koyoda, with his enchanted power, changed them into people and they settled at the base of Pa-toe, whose name was changed to Klick-tat, in honor of the gulls. Each year, the seagulls, brothers from the sea, follow the salmon to Klickitat country and visit their distant family members.

When Koyoda’s party reached the village, the salmon had already found their way through the mountains. All the people were well fed and were preparing salmon for the winter food supply. The Great Spirit instructed Koyoda and his friends the gulls and the sea dogs, to drive the salmon up the river twice each year for six years. Afterwards, the salmon would learn the way themselves and return of their own accord.

And that is how the salmon were brought to the Columbia River. Thereafter, the people along the river always had plenty of salmon to eat. The mountains were at peace, and Loo-wit guarded the Great Stone Bridge.



STUDENT HANDOUT 3I continued

Questions:

1. Who was Koyoda and what was his role?
2. What do you think was happening in the "terrible battles" between Pa-toe (Mt. Adams) and Yi-East (Mt. Hood)? What happened to the land and the animals during their battle?
3. Why did the people think that Koyoda would help them?
4. What was Koyoda's plan for returning food to the people?
5. Why were the people so worried about travelling down the great river?
6. Describe the first mishap on their adventure on the great river.
7. Why did the canoe begin to sink? What did Koyoda do to guide them down the river?
8. Describe what happened as they slept in their canoe. Where did they end up? What did the spirals of smoke mean to them?
9. What sorts of things did they find on the beach?
10. Why did the fish die in the ocean?
11. Who help Koyoda bring the fish up river?
12. What happened to the sea gulls when they made it past the Great Stone Bridge? How did Koyoda accommodate them?
13. What did the Great Spirit instruct Koyoda?
14. What do you think is the purpose of this story? Does this story give one an understanding of life, culture, history, or geology? How? Is this a story for entertainment, meaning, transference of culture, tradition or ritual to younger generations?

STUDENT HANDOUT 3J

It is Important
By Gail Tremblay
(from Dancing on the Rim)

*On dark nights, when thoughts fly like nightbirds
looking for prey, it is important to remember
to bless with names every creature
that comes to mind; to sing a thankful song and hold
the magic of the whole creation close to heart,
to watch light dance and know the sacred is alive.
On dark nights, when owls watch, their eyes
gleaming in the black expanse of starless sky,
it is important to gather the medicine bones,
the eagle feathers, the tobacco bundles, the braided
sweetgrass, the cedar, and the sage, and pray
the world will heal and breath feed the plants
that care for the nations keeping the circle whole.
On dark nights, when those who think only of themselves
conjure over stones and sing spells to feed their wills
it is important to give gifts and to love everything
that shows itself as good. It is time to turn
to the Great Mystery and know the Grandfathers have
mercy on us that we may help the people to survive.
On dark nights, when confusion makes those who envy
hate and curse the winds, face the four directions
and mumble names, it is important to stand
and see that our only work is to give what others
need, that everything that touches us is a holy
gift to teach us we are loved. When sun rises
and light surrounds life making blessings grow,
it is important to praise its coming, and exhale
letting all we hold inside our lungs travel east
and mix its power with the air; it is important to praise
dawn's power breathing in and know we live in good
relation to all creation and sing what must be sung.*

Questions:
According to the author,
1. What is it important to remember? Why?
2. What is it important to gather? Why?
3. What is it important to give? Why? What is one trying to counteract?
4. What is it important to stand and see? Why?
5. What is it important to praise? Why?
6. Why does the author refer to *dark nights* throughout the poem? What do think are the *dark nights*?

What are the major themes of this poem with regard to the environment and conservation?

Illustration by Zach Mandell, Hidden Valley High

UNIT 4. SALMON

INTRODUCTION

This unit introduces the student to the star of our program, the Pacific Northwest Salmon. In order to understand the plight of the salmon, and to conceive possible solutions to their declining populations, it is necessary to understand what and who they are. This means learning their anatomy and taxonomy (the "what"), and how salmon change during their lives (the "who"), as well as how they use their senses to cope with a difficult, migratory life. In this unit, we hope to give the student an opportunity to swim for a while with a salmon's fins. Focus on making the salmon come alive as a living organism in the student's mind. This awareness plays an important part in establishing an ethic, which incorporates the conservation of our wild fish heritage into the student's view of Pacific Northwest watersheds. Another important aspect to this unit is to provide you with a host of information about the salmon to use to compliment the lessons and activities and/or to use in any manner you see fit to facilitate learning about salmon.

OBJECTIVES:

Students will:

- know and understand the general anatomy and physiology of salmonids.
- be able to identify the similarities and differences among the five salmonid species.
- further understand the life cycle of the salmon.
- know and understand the habitat requirements of salmonids.

SECTIONS

A. The Journey of Wild Pacific Salmon
B. External Characteristics of Salmonids
C. Goin' Fishin' - Identifying Salmon Species
D. Sniffin' Salmon - Salmonid Life Cycles
E. Salmon Supplemental Information

4A. THE JOURNEY OF WILD PACIFIC SALMON

ACTIVITY	TIME (mins)	LEVEL	BENCHMARKS
The Journey of Wild Pacific Salmon	30	Introductory	6.2L.2 H.1L.3 H.2L.4
The Life Cycle of Wild Salmon	20-30	Introductory	6.2L.2 H.1L.3 H.2L.3 H.2L.4
Challenges to Salmon	30-45	Advanced	6.2L.2 H.2L.2 H.4D.6
My Life Cycle	60	Introductory	8.2L1 H.1L.3

OBJECTIVES:

Students will:

- gain an understanding of the life cycle of the salmon and the many challenges faced in their migratory journey.

MATERIALS:

- STUDENT HANDOUT 4A: *The Journey of Wild Pacific Salmon*
- STUDENT HANDOUT 4B: *The Life Cycle of Wild Salmon*
- TEACHER PAGE 4B: *The Life Cycle of Wild Salmon*
- STUDENT HANDOUT 4C: *Challenges to Salmon*
- TEACHER PAGE 4C: *Potential Challenges to Salmon*
- STUDENT HANDOUT 4D: *My Life Cycle Compared to a Salmon's*
- Dictionary and/or biology textbook

PROCEDURE:

1. Give students STUDENT HANDOUT 4A: *The Journey of Wild Pacific Salmon* and STUDENT HANDOUT 4B: *The Life Cycle of Wild Salmon*. As students read *The Journey*, have them fill in the blanks for each of the ten stages in the chart. Refer to the TEACHER PAGE 4B when reviewing the *Life Cycle Chart*. Also, words in bold are important to understanding salmon and may be unfamiliar to students. Encourage students to use reference materials to look up and define these words.

2. Have students refer again to STUDENT HANDOUT 4A as they brainstorm and/or conduct research about the challenges at each stage of a salmon's migratory journey. Use the chart in STUDENT HANDOUT 4C: *Challenges to Salmon* to organize their thoughts. Refer to TEACHER PAGE 4C to review this activity.

3. After the *Challenges to Salmon* chart is complete, facilitate a discussion about solutions to the problems. Ask students to think about the difficulties in the management of a natural resource.

4. After learning about the life cycle of the salmon and the challenges they face in their journey, use STUDENT HANDOUT 4D: *My Life Cycle Compared to a Salmon's*. Have students follow the directions to develop a timeline with a narrative about their life cycle compared to a salmon's.

EXTENSION QUESTIONS:

What other animal species migrate in the Pacific Northwest? Compare and contrast the different migration patterns of animal species with that of the salmon.
What is the difference between the life cycle of wild salmon compared to that of a hatchery salmon?

4B. EXTERNAL CHARACTERISTICS OF SALMONIDS

TIME (min.)	LEVEL	BENCHMARKS
45-60	Introductory	8.1L.1

OBJECTIVES:

Students will know and understand:

- the external characteristics of salmonids in terms of form and function.

MATERIALS:

- ❑ STUDENT HANDOUT 4E: *External Characteristics of Salmonids*
- ❑ TEACHER PAGE 4E: *External Characteristics of Salmonids*

PROCEDURE:

1. Make an overhead transparency of STUDENT HANDOUT 4E: *External Characteristics of Salmonids* and use the TEACHER PAGE 4E as a guide. Have the students fill in the blanks with you as you facilitate a discussion about the external characteristics of salmonids. Challenge them to hypothesize why a salmon has developed into their design and the function of each of their external parts. Have students also define and explain the characteristics of the salmon like the fin structure, body shape, mucus covering, etc.

4C. GOIN' FISHIN – IDENTIFYING SALMON SPECIES

TIME (min.)	LEVEL	BENCHMARKS
60	Introductory	8.1L.1

INTRODUCTION
Have you ever picked out the face of a friend in a crowd? We recognize someone by discovering the details, which make him or her different from others; pulling them into relief from the "faceless" masses. In Goin' Fishin', students learn the major anatomical parts of a salmon, how these parts vary from one species of salmon to another, and how to recognize a coho or sockeye from other salmon (similar to picking someone out of a crowd).

In this section, students develop the skills and understanding necessary to identify five of the salmon species found in the Columbia River watershed. This activity introduces salmonid external anatomy and species characteristics through a simulation in which the student is going fishing, but has a very specific license: there are stiff penalties for catching the wrong fish. During the activity, "***Goin' Fishin'***..," students get to know the salmonid species by studying their similarities and differences, then devising an identification key to sort them out.

Don't forget to use your Adopt-a-Stream-Foundation's ***Field Guide to the Pacific Salmon*** as an excellent reference in this unit. Keep it with you and refer to it first when you have questions.

OBJECTIVE:
- Students will become familiar with the anatomy of salmonids and identify similarities and differences among the five salmonid species

MATERIALS:
- ❑ reference materials about salmonid species provided in this Unit
- ❑ Adopt-A-Stream Foundation's *Field Guide to the Pacific Salmon*
- ❑ STUDENT HANDOUT 4F: Goin' Fishin
- ❑ (5)STUDENT HANDOUTS 4G: Fish and Fish Facts
- ❑ STUDENT HANDOUT 4H: Sample dichotomous key

KEY QUESTIONS:
What are the parts of a salmon? Do these parts change as salmon migrate?
Will I be able to recognize a salmon in the stream?
How are salmon anatomically distinct from other fish in Northwest streams?
How many kinds of salmon are there? How do I tell them apart?

VOCABULARY: *(Brief definitions of vocabulary terms are found in the Glossary):*

dichotomous key	anadromous
salmonids	life cycle
Coho	Sockeye
Chinook	Pink
Chum	Steelhead
Cutthroat	physiological adaptations

PROCEDURE:

1. Before you begin this activity, review the bibliography to select reference materials for your students. Organize the reference materials that you have available, and ask your students to review the reference materials about salmonid species. Have them note the differences between the species including timing of life cycles, habitat requirements and physical features. Consider assigning one species to each group of students, who will produce an annotated poster describing the anatomy of a representative of their species. You might even ask them to write a poem or story about their species, and then present this to the class.

2. Let's go fishing...

3. Say to your students, "You are going on a most excellent fishing trip, but there are things you have to do to get ready. You've got your pole, you've got your license, and you've got your snacks and drinks. However, you have to know what kind of fish you plan to catch. Your license is very specific-- if you take home the wrong kind of fish, you could be fined lots of money!"

   "Unfortunately you left this part of your preparation until last and your friends are ready to go. You have ten (10) minutes to devise a chart or tool you can use to identify the fish that you might catch. Make your tool an instrument of identification for all the possible fish you might run into. After all, if fishing is bad, you and your friends may go somewhere else."

   HELPFUL HINTS
   - You might want to include information about: age, color, size/weight, sex differences, and habitat, along with anything else you find helpful. Remember: too much information is just as bad as too little!
   - You might ask your students to make their own fishing licenses. These licenses can have spaces for species identifications, rules and fines, and a title section. Organize the spaces for writing so that the licenses can be folded, like a brochure.
   - Organize students into groups, then pass out the STUDENT HANDOUTS, and ask them to follow the directions therein.
   - After your students have created their tool for identifying the fish (their key), break them into small groups. Provide each group with several pictures of STUDENT HANDOUT 4G: Fish and 'Fish Facts' on the reverse. Have them take turns 'fishing' from the selection of pictures, and identifying the species that they have caught. (An alternative is to exchange tools and evaluate their ease of use in sorting and identifying pictures of salmon.)

4. Share the sample dichotomous key (STUDENT HANDOUT 4H) or a key from a published field guide with your students. Compare this sample key with their tools for identification. Do this in groups, or as a class discussion.

5. Identify which salmonids live in your river basin. Have students discuss the status of these fish populations. Are they listed as threatened or endangered? Students can do research through local media articles and agency publications to determine the status of salmonids in local watersheds.

EVALUATION

6. Set out “unknowns” (pictures of salmon that students haven’t seen) for students to identify with their keys. You might bring in fresh fish, and have students use their keys to identify them. A good way to do this is to have groups exchange their keys, and then evaluate the facility with which they are able to use these tools to identify the fish.

The descriptions[1] below are contained in STUDENT HANDOUTS 4G, except that the student pages do not have names appended.

COHO:

Vital Statistics:

1. 27 inches, 11 lbs, gray mouth with white gums. Caught in shallow water.
2. 20 inches, 6 lbs, gray mouth with white gums. Caught in slower moving stream with small gravels.
3. 23 inches, 8 lbs, you've seen these fish (younger ones) in the same stream for over a year.

CHINOOK:

Vital Statistics:

1. 36 inches, 28 lbs, this is a husky looking fish. You caught this one in a very large stream.
2. 42 inches, 43 lbs, a monster!! You pull out a scale and count the rings... it is 7 years old!
3. 36 inches, 30 lbs, gray/black mouth. You caught this fish in a fast moving, deep stream.

SOCKEYE:

Vital Statistics:

1. 20 inches, 7 lbs, your fish is very red.
2. 18 inches, 5 lbs, you caught this fish very close to a lake.
3. 21 inches, 8 lbs, your fish has a dull green head and the body is turning a reddish color.

PINK:

Vital Statistics:

1. 18 inches, 5 lbs, you caught your fish down by the coast.
2. 15 inches, 4.5 lbs, your fish has a reddish cast to it.
3. 20 inches, 6 lbs, your fish was hanging out with some very odd-looking humpbacked fish.

CHUM:

Vital Statistics:

1. 24 inches, 7.5 lbs, you caught your fish where water was flowing pretty well and there was medium sized gravel in the stream.
2. 28 inches, 9 lbs, you caught your fish close to the ocean.
3. 30 inches, 10 lbs, your fish is greenish blue with white tips on its pelvic and anal fins.

[1] Remind students that these are just examples of some individual adult fish and that there is great variation even within species.

4D. SNIFFIN' SALMON: SALMONID LIFE CYCLES

TIME (min.)	LEVEL	BENCHMARKS
60	Introductory	

INTRODUCTION

Can you remember when you were born? How about your first birthday? What is your earliest memory? How old were you then? How do you appear now, compared with when you were two? Twelve? Twenty? We all change in appearance from the time when we were a single fertilized egg. What is the nature of these changes? Are humans the only organisms which experience this?

Have you ever been "turned around" in the city, then found your way? What markers did you use? Could you describe the process to someone else? Do salmon experience the same thing? How do they know when they're "home?" How many of us are living in the same place where we were born? Would your friends recognize you in your baby picture? Did our growth, development and travels dictate our needs, or visa versa?

This section uses the activity, *Sniffin' Salmon* to simulate a salmon's journey back to their home stream, using their keen sense of smell.

OBJECTIVES:

- Students will simulate and discuss the life cycle of salmon, identify habitat requirements of salmon during stages of its life cycle, and understand how a salmon finds its way back to its native stream.

MATERIALS

- ❑ paper cups
- ❑ masking tape
- ❑ pencil
- ❑ paper towels
- ❑ cards with different salmon names on them
- ❑ several to many "smells" (cloves, garlic, vanilla, rum flavoring, peppermint, etc.)
- ❑ STUDENT HANDOUT 4I: *Sniffin' Salmon!*
- ❑ STUDENT HANDOUT 4J: *Sniffin' Salmon Diagram*
- ❑ FILM*: Life of the Sockeye Salmon* (optional. See Supplementary Curriculum for source.)

KEY QUESTIONS:

What are the 'stages' of a salmon's life?
What happens during each stage of their lives?
Where do they go?
Which stages will I observe at my site?
What are salmon's needs during the part of their life cycle that I will observe?
How does a salmon know when it is home?

VOCABULARY *(Brief definitions of vocabulary terms are found in the Glossary):*

egg	alevin
fry	smolt
life cycle	fingerling
home stream	adult
migrate	parr
smoltification	

PROCEDURE

This activity is adapted from *The Comings and Goings of Coho, Water Water Everywhere....*, Oregon State University Sea Grant College Program and Oregon Department of Education.

1. You will need to gather the materials first. (You might have the students bring in some of the "smells." It is best to use smells that they can't recognize by brand name, so that they really have to remember the smell and not the name of the smell.)

2. Make the ***Field Guide to the Pacific Salmon*** and other reference materials available to the class. If you show the *Life of the Sockeye Salmon* video, they can use it as a reference also. Ask for student volunteers to read the first two paragraphs of Part I: ***Sniffin' Salmon***. Facilitate any ensuing discussion. Have the students read the third paragraph. They should ask clarifying questions after reading.

3. Students then construct their "home streams" using the materials provided and following the directions on the handout. Basically, they crumple a paper towel, sprinkle or pour a "smell" on it, and stuff it into a paper cup. They then invert another cup over that cup, and tape them together. Place the cups so that the paper towel is in the upper half. Write the name of the hypothetical stream on the bottom of the bottom cup. Try to avoid visual differences amongst cups so that students won't have visual clues as they attempt to find their "home stream." (See diagram on STUDENT HANDOUT 4J.)

4. Using the reference materials at your disposal, explain the life cycle stages of the salmon. A prepared transparency with one stage of the cycle on successive overlays would enhance the study. As you discuss each stage, list on the transparency what the salmon needs to survive that stage.

5. After constructing their "home stream," students memorize its smell. They then leave the room, simulating the passage of salmon to the ocean. While they are out of the room, you might have them work on something, attempt to travel through a set of hazards, or watch the film, *Life of the Sockeye Salmon*. The idea is that the salmon are away from their home stream for some time. (This might be an opportunity to play ***Hooks and Ladders*** see *Project Wild Aquatic*.)

6. In the meantime, you or a cohort carefully move each "home stream" to another place. As long as containers are similar, students may not have an easy time recalling their "home stream" from visual memory. When it is time for the students to return to their "home streams," call them into the classroom, and ask them to find their "home stream" using their sense of smell.

EVALUATION

7. After students are "home," encourage discussion of their experiences. An appropriate evaluation of this activity is a journal entry in which students describe their feelings upon returning to the classroom and searching for their home stream.

4E. SALMON SUPPLEMENTAL INFORMATION

In the STUDENT HANDOUTS/TEACHER PAGES Section of this unit, we have provided you with a host of information from various sources to supplement not only this unit, but also the entire curriculum. Please read through this section and use the various articles, tables, charts and maps to enhance your teaching about salmon.

EXTENSION CURRICULUM

1. Have your students make “Salmon Cards,” which are “baseball cards” for salmonid species. Explain to your students that you are making cards for many fish, with special cards for salmon species. Use fish in an aquarium, in the classroom, a pet shop, or the zoo for the student models. If there are no living fish available, then use pictures. Like baseball cards, these Salmon Cards should have a drawing on one side and facts on the other. Facts used should be compiled from a list generated by the class and supplemented by you. When students get the idea, ask them to find out about the species of salmon, and make special cards for them.

   When students have made their cards, ask them to use them to identify pictures of fish or living fish. Consider having students exchange cards, use them for identification, and then evaluate their ease of use. Finally, ask your students to share their favorite card with the rest of the class. Then, after gathering facts about salmonid species ask them to use their cards to answer questions you ask and that they have made up. Finally, make a class poster with a place for each student’s favorite card.

   Explore salmon fry adaptations by looking at the physical appearance of salmonids at different stages in their life cycle. These stages can be compared across species as well. Ask students to identify how a salmon’s appearance helps it to survive in its changing habitat.

2. Have students write their own 'CLUE' game for the different species of salmon. Ask them to review the rules for the CLUE game, and play the game once to understand it. Then, in groups, they should design their own game based on salmonid species. When the games are completed, have pairs or groups exchange games and play them. As they play, they should evaluate the game they are playing. Evaluative criteria should cover the construction of the materials, clarity of directions, ease of play, and factual integrity of questions and protocols involving salmon.

3. *Salmonids in the Classroom*. Canadian Department of Fisheries and Oceans, B.C. Both the Primary and Intermediate editions of this curriculum contain similar activities; the Intermediate version contains more activities and vocabulary. Pages 298-312 cover salmonid anatomy and dissection and the functions of anatomical features. Activities suggested here are taken from the Intermediate edition. You can look up their counterparts in the Primary edition if they seem to be too difficult for your students. This curriculum is available from Lesson Aids Service, B.C. Teachers’ Federation, 2235 Burrard Street, Vancouver, B.C., Canada, V6J 3H9, (800) 663-9163, FAX 737-9593.

4. *Fashion a Fish*, Project Wild Aquatic, pp. 56-60. This is an activity in which students learn about the evolutionary adaptations of fish, which help them to survive in their environments. Students design a particular fish whose adaptations are determined from “adaptation cards” which depict coloration, mouth type, body shape and reproductive adaptations. They fashion their fish from these adaptive characteristics, then report their fish to the class. You can then use these learning’s about evolutionary adaptations to open a discussion of the anadromous life cycle of the salmon as a particular adaptation. (See the Bibliography for ordering address.)

5. Have students research various physical adaptations that salmon species exhibit throughout their life cycle which change their appearance or behavior such as: coloration, physiological adaptations, or mating behaviors. You can organize students into groups by species or adaptation. They should make posters, which communicate their assigned information, and provide written descriptions detailing the adaptation or behavior. The posters and written descriptions should be posted on the bulletin board so that students can refer to them during other Salmon Watch activities.

6. *California's Salmon and Steelhead, Our Valuable Natural Heritage*, pp. 18-36, contains a series of dissection and recitation activities on salmonid anatomy, finishing with a fish printing activity in which students make ink or paint prints from an actual salmon, and generate a life-sized drawing of a salmon from a smaller picture. (See the Bibliography for ordering address.)

7. Look up the World Wide Web address, http://www.streamnet.org/, for a very useful source of information about salmon. This is the StreamNet home page that contains an online database of information about salmon, the life history and ecology of species, color species of a male and female of each species listed, and extensive data on salmonids and their habitats. It might be used to organize Units 1-3 for your students.

8. Order the 25-minute film, *Life of the Sockeye Salmon*. Show the film, and then set out reference material on salmonid species. Introduce or review the names of all the species of Pacific Salmon (coho, sockeye, chinook, pink, chum, and the two sea-run trout: steelhead and cutthroat). Explain that their life cycles are similar to the sockeye, but differ in number of eggs deposited, length of time spent in the ocean, weight, length, and use (commercial, sport, subsistence). A detailed study of life cycle differences can be done using the ***Field Guide to the Pacific Salmon*** and other reference materials.

   Use the film to compare the life cycle of the sockeye with other species of Pacific Salmon. The film explores the needs of the sockeye during each stage of its life cycle, the fishing industry, which is dependent on sustained fish runs, and the hazards, which may prevent salmon from living out their life cycles. It is available for rent from:

   Continuing Education Film Library
   1633 SW Park Avenue
   PO Box 1383
   Portland, OR 97207
   (503) 229-4890
   (Refer to film no. 12240)

9. *Salmon Life Cycle*, Stream Scene, pp. 169-172. This section contains more information on the salmonid life cycle, which students can use in a class work or homework activity.

10. *Hooks and Ladders*, Project Wild Aquatic, pp. 43-48. This is a kinesthetic activity, which introduces the student to some of the hurdles fish must overcome during migration. Students play the roles of fish or obstacles to the migration of fish such as a dam or rapids.

11. *California's Salmon and Steelhead, Our Valuable Natural Heritage*, pp. 37-75, contains several interesting life cycle activities for students at all levels. Included are drawings, readings, art constructions, poetry, and mathematics vehicles for delivering information about salmonid life cycles.

BIBLIOGRAPHY

A Snapshot of Salmon in Oregon. OSU Extension Service. 1998. One study found 22 kinds of birds; mammals feed on salmon carcasses by Andy Duncan.

A Wild Salmon's Excellent Adventure. 1991. Wayne Thompson. The Oregonian, October 27.

Adopt a Stream Foundation's Field Guide to the Pacific Salmon. 1992. Robert Steelquist. Sasquatch Books. Seattle, WA.

F.I.S.H. Important Coastal Fish and Their Habitat Needs. Pacific States Marine Fisheries Commission, 45 SE 82nd Drive, Suite 100, Gladstone, OR 97027-2522; (503) 650-5400.

How to Catch and Identify the Game Fish of Oregon. 1978. E.A. Lusch. Frank Amato Publications.

Introduction to a Complex Problem, Curt Smith. Pacific Salmon and their Ecosystems. 1997. Chapman & Hall.

The Magnificent Journey, Bonneville Power Administration. July 1995.

Oregon's Migratory Fish, Pat Wray. Oregon Dept. of Fish and Wildlife. 1989.

The Pacific Salmon Life Cycle. Presented by U.S. Fish & Wildlife Service – Pacific Region. September 1997.

Project Wild Aquatic, 2002. Western Regional Environmental Education Council, Inc. Boulder, CO 80308.
For workshop information go to http://oregon.4h.oregonstate.edu

River of Ghosts by Brian T. Meehan and Joan Laatz Jewett. The Oregonian. October 29, 1995.

Reading to Learn, California's Salmon and Steelhead, Our Valuable Natural Heritage. Teacher's Guide and Student Activities: Grades K-6. California Advisory Committee on Salmon and Steelhead Trout. Can be acquired through KREP Coordinator, 1271 Fieldbrook Rd., Arcata, CA 95521; (707) 822-0744.

Rogue Summer Steelhead: Half Pounders Worth Their Weight in Gold (video). 1996. Available through the Rogue Flyfishers, P.O. Box 4637, Medford, OR 97501.

Salmon of the Sandy River, Oregon. 1990. Douglas P. Cramer. Portland General Electric Co.

Salmonids in the Classroom: Intermediate & Primary. Canadian Department of Fisheries and Oceans, B.C. Teachers Federation Lesson Aids. 105-2235 Burrard Street, Vancouver, B.C. Canada V6J 3H9.

The Stream Scene - Watersheds, Wildlife and People. 1992. Oregon Department of Fish and Wildlife, 2501 SW 1st Ave., Portland, OR 97201.

Where Are We? Resources at the Brink by Deanna J. Stouder, Peter A. Bisson, and Robert J. Naiman. Pacific Salmon and their Ecosystems. 1997. Chapman & Hall.

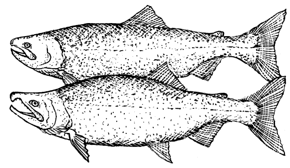
*This curriculum draws from themes in, or references, Chapter 2, *Fishes,* ***Adopting a Stream/ A Northwest Handbook***; *Hooks and Ladders*, **Project Wild Aquatic**, ; *Fishy Who's Who*, **Project Wild Aquatic**, ; *Fashion a Fish*, ***Project Wild Aquatic,*** ; ***F.I.S.H. Habitat Education Program****; Watersheds, Wildlife and People*; *The Comings and Goings of Coho*; *Water, Water Everywhere*; and the **Oregonian's** *A Wild Salmon's Excellent Adventure*.

UNIT 4 SALMON
STUDENT HANDOUTS
TEACHER PAGES

4A	*The Journey of Wild Pacific Salmon*
4B	*The Life Cycle of Wild Salmon*
4B	*TEACHER PAGE: The Life Cycle of Wild Salmon*
4C	*Potential Challenges to Salmon*
4C	*TEACHER PAGE: Challenges to Salmon*
4D	*My Life Cycle Compared to a Salmon's*
4E	*External Characteristics of Salmonids*
4E	*TEACHER PAGE: External Characteristics of Salmonids*
4F	*Goin' Fishin'*
4G	*Fish and Fish Facts #1-#5*
4H	*Sample Dichotomous Key*
4I	*Sniffin' Salmon*
4J	*Sniffin' Salmon Diagram*

STUDENT HANDOUT 4A

THE JOURNEY OF WILD PACIFIC SALMON



ACTIVITIES:

- As you read, complete the chart in Student Handout 1B: *The Life Cycle of Wild Salmon*.
- As you read about each stage of a salmon's life, think about all the possible human and natural challenges a salmon might encounter. Use Student Handout 1C: *Challenges to Salmon*, to organize your thoughts and to develop a list of potential problems and challenges to salmon on their journey.
- Use Student Handout 1D: *My Life Cycle*, to compare the similar stages of your life with those of the salmon's.
- Use a dictionary or biology textbook to look up the definitions of words that are unclear. Words that are in **bold** are of particular importance to understanding salmon and are defined in the glossary.

For nearly 10,000 years, salmon have used the rivers and streams of the Pacific Northwest to travel from their birthing streams to the ocean and back. A century ago, between 10 and 16 million salmon returned from the ocean each year to spawn in Northwest rivers. Today less than a million return.

Nothing is more awe-inspiring and remarkable in nature, and nothing defines the character and beauty of the Northwest better than the migratory journey of salmon. It represents life as a cycle, the power of survival and endurance, and the promise of return.

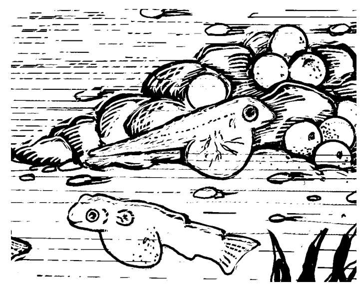
Pacific salmon are extremely important for several reasons. They have been a critical food source for the people of the region, and a significant food resource worldwide. Second, salmon are an **indicator species**. Because salmon migrate thousands of miles, moving from streams and rivers through estuaries to the ocean and back, they provide a valuable indication of environmental conditions in those habitats. Third, salmon play a central role in maintaining biologically diverse and productive ecosystems. For example, they are prey for a multitude of species, and their carcasses bring ocean-rich nutrients to relatively nutrient-poor freshwater environments. And finally, Northwest Native American cultures and spiritual beliefs are deeply connected with the great silver fish. In fact, the Chinook salmon takes its name from a Northwest tribe.

The salmon have evolved with incredibly strong instinctive patterns. Born in freshwater streams, **anadromous** or sea-run species like salmon are uniquely compelled to travel to the ocean. The vast ocean food chain supports a growth rate that freshwater members of the same species could never hope to achieve. However, travel to and from the ocean is a very risky venture. Travelling up to a thousand miles, migratory fish are inherently vulnerable to a variety of threats, both human and natural, along the way. Only the strongest, luckiest and most tenacious fish withstand the journey to reproduce. Of the 3,000 to 7,000 eggs in a nest, only one spawning pair will likely make it back to its original spawning habitat.

1. EGG STAGE

Salmon begin their lives in shallow gravel beds within the **substrate** of the freshwater streams and rivers in which their parents were born. The fertile, reddish-orange eggs develop in the safety of the gravel. Cold, clean **sediment-**free water must wash the eggs and bring them oxygen. Eggs lie in the gravel through the winter, as the embryos develop. **Incubation** may take 50 days or longer. For example, the colder the water, the longer the incubation period.

2. ALEVIN STAGE

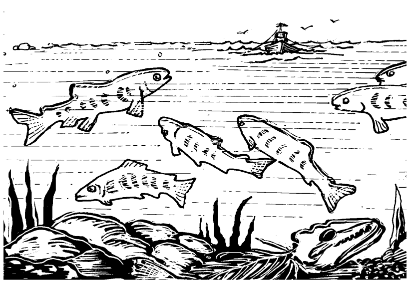


In late winter or spring, young translucent fish with large protruding eyes, called **alevins** (sometimes called yolk-sac fry), hatch and lie protected under the gravel. An orange **yolk sac** attached to the bellies of the tiny fish carry a food supply consisting of a balanced diet of protein, sugars, vitamins and minerals. As the fish grows, the yolk sac gets smaller. They will not leave the protection of the gravel until the yolk is used up, which can be twelve weeks or more. A flow of water is critical to alevin survival.

3. JUVENILE STAGE

In late spring and summer, with yolk sacs buttoned up, or absorbed, and eyes still protruding, small fish called **fry** emerge upward through the gravel and begin to forage for food. They are about the length of a fir needle and stay in shallow pools near the edge where the current is slow.

When the young fish reach about two inches in length, they are known as **parr** (sometimes called fingerlings) and become intense feeders on plankton, small insects, worms, mussels and snails. The parr growth phase is best recognized by the development of dark bars aligned vertically along each side of the fish. The parr phase is the most vulnerable time in a salmon's life, as they become the morsel of choice for sculpins, raccoons, kingfishers and large trout. **Juvenile** (fry and parr) salmon will remain in the river four months to two years depending on the species before moving downstream to the estuary.



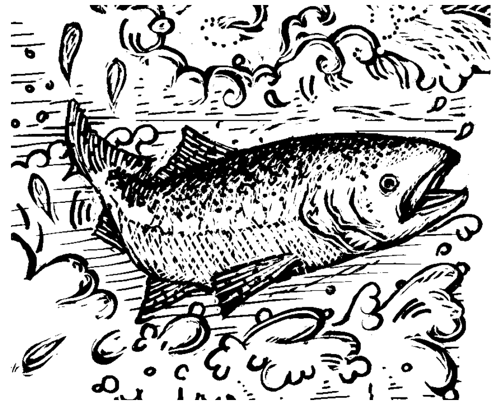
4. SMOLT STAGE

At four to six inches in length, salmon are known as **smolts**. As the parr marks disappear, most young salmon begin a physical change that triggers their downstream migration and adaptation to saltwater environment. Smolts let the current carry them downstream, tail first. Much of their travelling is done at night to avoid predators.

Estuaries occur where coastal rivers enter the ocean, creating a mix of fresh- and saltwater habitats. For salmon, the estuary represents the drastic transition from the river to the sea. Nutrient-rich sediment in estuaries produces nurseries for thousands of tiny organisms, upon which salmon feed. The inner waters of eelgrass beds and salt marshes provide habitat for the fish as they transition from fresh to salt water. This transformation involves amazingly complex body-chemistry changes. In addition, other physical changes occur during smolting: scales become larger, color turns silvery, and tails lengthen and become more deeply forked. Depending upon the species, salmon spend from a few days to a few months in an estuary.

Water flow is again a critical factor during downstream smolt migration. High flows mean higher survival rates. Decreased flows can increase the amount of time it takes smolts to reach the ocean and affect their ability to adjust to saltwater conditions. A delay can also increase their susceptibility to predators and disease.

5. OCEAN-FARING ADULT STAGE



Some theories suggest that salmon follow a life cycle of going to the ocean in order to overcome the limits of food and space in freshwater habitats. Upon entering the ocean, salmon will turn toward their **hereditary** feeding grounds. For some it is north to Alaska. Others will feed in the deeper waters off of the California coast. To avoid predators like seals they will remain in large numbers called schools. Their two-tone coloring helps conceal them from enemies. Seen from above, they blend with the dark ocean waters; from below, they blend with lighter sky. They feed heavily on such prey as crab larvae, barnacles, herrings, sand lance, rockfish, anchovies and squid. Time spent at sea varies according to species ranging from one to five years.

6. UPSTREAM MIGRATION STAGE

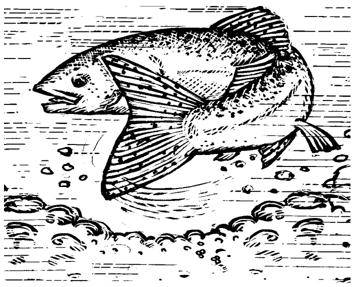
The salmon's return to the estuary is remarkable. For a fish to travel thousands of miles in the open ocean, up to thirty miles a day, and then locate and return to the estuary of its origin seems to defy all odds. This is called **homing**. Although still a mystery, scientists hypothesize that salmon navigate at sea with the aid of an inner magnetic map and a strong sense of day length, thus a salmon knows approximately where it is in relation to its home stream. As changing day length signals the advance of the season, the fish moves more or less directly toward the river mouth. As the salmon gets closer to the river the salmon's keen sense of smell comes into play, drawing it toward water smells encountered during the juvenile phases of life. Salmon can pick up the scent of their home river with noses so sensitive that they can detect dissolved substances in parts per 3,000,000,000,000,000,000! Arrival occurs during all seasons depending on the species.

A unique feature of the life cycle is that salmon migrate and spawn in mass groups called stocks or runs. The fish within each stock or run has a unique "map" with special genetic codes that instruct and direct the fish's behavior specifically to when and where to migrate and spawn. For example, the Sandy River Fall Chinook is a stock or run of salmon that migrate up the Sandy River in the fall to spawn.

The struggling, leaping salmon against the torrent of the stream is one of nature's most incredible feats. Upon re-entering fresh water to spawn, salmon lose their desire to eat and live off their accumulated fat reserves. In proceeding toward their spawning grounds, the fish move quickly upstream in groups. They make their way by stages upstream, pausing for days at a time to rest in **pools**, often waiting for improved water flows. They tend to move as long strands, hugging the deeper channels and shaded areas of the stream. At shallow **riffles**, where the river steps down a gravel ramp, running fish raise rooster tails of water as they speed over the rocks.

7. COURTSHIP STAGE

Once they come to their home gravel, females search for suitable egg-laying territories to build nests, called **redds**. As the sac around the eggs loosen, the urge to **spawn** quickens. Aggressive displays between the fish occur at this time. Males chase, bite and attack to ward off competitors. Females butt other females that appear to threaten their redd.

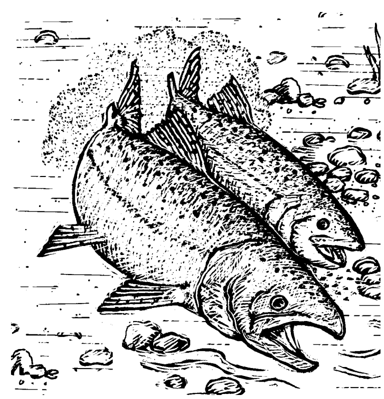


At this stage, the final days of the salmon are near, with many changes in color and body apparent. The males of some species get humped backs, hooked jaws, and sharp canine teeth. With muscles softening, skin thickening and body chemistry changing, white fungus may grow over sores or the eyes of the fish. The fins and tail fray from pounding against rocks and wounds from the journey may mark the body.

8. SPAWNING STAGE

Spawning is the process of reproduction for salmon. When a female salmon arrives at her home stream, she chooses a nesting site with just the right combination of clean gravel, adequate depth, and good flow to provide oxygen for her eggs. Once the female has selected the general location for laying eggs, she turns on her side and uses sweeping or **undulating** movements of her tail to dig the nest in the gravel. Every so often she checks the depth of the nest by "**crouching**" or lowering herself into the nest. In time, she eventually produces a cone-shaped nest up to 16 inches deep. Within that site, she may dig several nests and deposit eggs in them over a period of several days.

The digging of redds attracts males. As a male manages to ward off competitors, he joins the female in the nest in a series of courting movements. Eventually, he will move alongside the female and move his body against hers slightly. Frequently he will open his mouth in a "**gape**." When the female is ready to deposit her eggs, she too will open her mouth to resist the current and help her lower herself deeper into the nest. Finally, as both rapidly vibrate their tails, the eggs and sperm, or **milt**, are released. A female may lay up to 7,000 in a series of redds.



9. KELT STAGE

As the female has released her eggs, she instinctively covers them by moving upstream slightly and repeating her digging motions. This lifts gravel just above the nest, so that the current carries it into the depression. Females will defend their redds until they die, which may be a few hours or a week. Males can spawn more than once and often will leave the female, in search of another that is preparing a nest. Salmon that have spawned are called **kelts**.

10. CARCASS STAGE

Most salmon spawn only once during their lifetime (**semelparous**), although some steelhead have the ability to spawn more than once (**iteroparous**) and can re-generate, return to the ocean, then return to spawn another season. Both the male and female salmon die within a week after spawning. Their **carcasses** float downstream, get caught in roots and limbs, line beaches and sink to the bottom of the river. Opportunists like bears, gulls, crows, and eagles dine on the dead salmon.

The death of the salmon also serves the next generation. As decaying salmon add nutrients to the rivers, they feed aquatic life that will in turn feed young salmon already growing in the gravel in the streambed. In Cascade streams, as much as 40 percent of the nitrogen and carbon in young fish and 20 percent of the nitrogen in streamside plants come from dead salmon.

STUDENT HANDOUT 4B

1. Egg
a.

b.

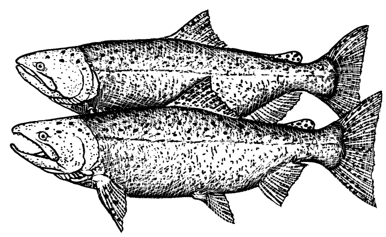
c.

2.
a. freshwater gravel

b.

c.

The Life Cycle of Wild Salmon



3.
a.

b. 4 months to 3 years

c.

4.
a.

b.

c.

5.
a.

b.

c. two-tone coloring; grow rapidly

6. Adult upstream
a.

b.

c.

7.
a.

b.

c.

8.
a.

b. several days

c.

9.
a. freshwater

b.

c.

10.
a.

b. varies

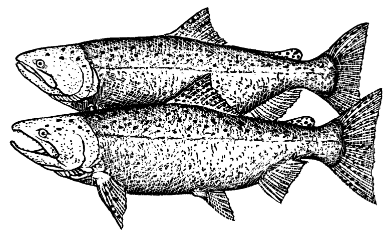
c.

DIRECTIONS: As you read *The Journey of Pacific Wild Salmon* (Student Handout 1A), complete the chart with the following information.

1. Stage
a. Location
b. Time at stage (approx.)
c. Distinct characteristics

TEACHER PAGE 4B

The Life Cycle of Wild Salmon



DIRECTIONS: As you read *The Journey of Pacific Wild Salmon* (Student Handout 1A), complete the chart with the following information

1. Stage
a. Location
b. Time at stage (approx.)
c. Distinct characteristics

1. Egg
a. freshwater gravel
b. 2 months +
c. eggs are reddish-orange

2. Alevin
a. freshwater gravel
b. 1-2 months
c. orange yolk-sac on bellies provide food

3. Juvenile
a. freshwater shallow pools
b. 4 months to 3 years
c. length up to two inches; parr have dark bars on sides called parr marks.

4. Smolt
a. estuaries
b. days to months
c. about 4-6 inches in length; transform into ocean looking fish

5. Adult
a. ocean
b. 1-5 years
c. two-tone coloring; grow rapidly

6. Adult upstream
a. freshwater
b. hours to several months
c. stops eating

7. Courtship
a. freshwater
b. days to months
c. males – humped backs, hooked jaws, sharp teeth. Both – white fungus and frayed fins show

8. Spawning
a. freshwater
b. several days
c. female digs redd, while male defends

9. Kelt
a. freshwater
b. hours to days
c. females defend redds; males can spawn again

10. Carcass
a. freshwater
b. varies
c. decomposing bodies add nutrients to stream and feed wildlife

STUDENT HANDOUT 4C

POTENTIAL CHALLENGES TO SALMON

According to the Pacific States Marine Fisheries Commission, there are six major factors, six potentially important factors, and two minor factors that could possibly challenge a salmon's migratory journey and contribute to their overall decline. For each factor, describe at least two potential problems created that might threaten salmon health, migration and/or habitat. In addition, try to determine at what life cycle stage or stages salmon would be challenged.

	FACTORS	PROBLEM CREATED	PROBLEM CREATED	LIFE CYCLE STAGE (S)
MAJOR	Agriculture			
	Dams			
	Drought			
	Fishing			
	Forestry			
	Urbanization			
IMPORTANT	Gravel Harvest			
	Irrigation			
	Bycatch Mortality*			
	Hatchery Fish Interference			
	Poor Ocean Conditions			
	Illegal Fishing			
MINOR	Bird Predation			
	Marine Mammal Predation			

*Salmon killed during fishing for other species

TEACHER PAGE 4C

Potential Problems and Challenges Contributing to Salmon Decline

The following list will assist you in completing the chart on page 4.19. (Information provided by Pacific States Marine Fisheries Commission):

AGRICULTURE
Loss of streamside vegetation and functions
Pesticide exposure
Increased amount of sediment entering streams
Stream straightening and channelization
Habitat destruction
Filling of the side channels of streams
Reduced freshwater flow in rivers and streams
Exposure to abnormal temperatures
Barriers preventing salmon migration
Forest fragmentation
Estuary degradation

DAMS
Reduced freshwater flow in rivers and streams
Habitat area loss
Barriers preventing salmon migration
Water supersaturation

DROUGHT
Reduced freshwater flow in rivers and streams
Exposure to abnormal temperatures

FISHING
Reduced numbers reaching spawning grounds
Loss of genetic integrity and diversity

FORESTRY (if not adhering to rules and regulation set by the Oregon Forest Practices Act)
Loss of streamside vegetation and functions
Pesticide exposure
Increased amount of sediment entering streams
Habitat destruction
Decreased amount of large logs in streams and loss of deep pools and channel form.
Exposure to abnormal temperatures
Forest fragmentation
Estuary degradation

URBANIZATION
Loss of streamside vegetation and functions
Industrial pollutants exposure
Stream straightening and channelization
Habitat destruction
Decreased amount of large logs in streams and loss of deep pools and channel form
Filing of the side channels of streams
Reduced freshwater flow in rivers and streams
Exposure to abnormal temperatures
Habitat area loss
Forest fragmentation
Estuary degradation

GRAVEL HARVEST
Habitat destruction
Loss of eggs & juvenile fish
Sediment downstream

IRRIGATION
Reduced fresh water flow in rivers and streams
Lack of screening of water diversion canals

BYCATCH MORTALITY
Reduced numbers reaching their spawning grounds
Loss of genetic integrity and diversity
Loss of stream nutrients due to fewer carcasses

HATCHERY FISH INTERFERENCE
Loss of genetic integrity and diversity
Competition between hatchery and wild fish
Elevated numbers of predators

POOR OCEAN CONDITIONS
Reduced upwelling
Altered ocean currents and flow
Decreased food abundance
Reduced numbers reaching their spawning grounds
Smaller fish
Confused migration & more strays

ILLEGAL FISHING
Reduced numbers of adults reaching their spawning grounds
Loss of genetic integrity and diversity

BIRD PREDATION
Reduced numbers of adults making it to the sea
Loss of genetic integrity and diversity

MARINE MAMMAL PREDATION
Reduced numbers reaching their spawning grounds
Reduced numbers of adults making it to the sea

TEACHER PAGE 4C

Problems and Challenges at Each Stage of the Salmon Life Cycle

Information is from U.S. Fish and Wildlife Service, the Bureau of Land Management, and the U.S. Forest Service.

EGG/ALEVIN STAGE

- Eggs suffocate when silt clogs spaces in gravel.
- Chemical pollutants can weaken and kill fish.
- Water diversions and natural drought dry up creeks and strand fry in pools, making them easy prey for birds and other predators.
- Removal of streamside vegetation through poor grazing management of livestock can remove shade and raise water temperatures—sometimes to lethal levels.
- Drought and water diversions lower water levels, making nests vulnerable to freezing in winter.
- Erosion, following clearcutting or fires, can smother nests with silt if logging operation are not following good management practices..
- Floods can sweep eggs out of gravel.
- Fish and birds eat salmon eggs.
- If good spawning habitat is scarce, females may dig up each others' nests.
- Clearcutting along streams can raise water temperature and reduce oxygen in water if adequate buffers are not present, this could result in eggs being suffocated.

JUVENILE STAGE

- Riverbank clearing and rip-rap bank protection structures remove streamside vegetation that provides shade and keeps the water cool
- Altering of riparian vegetative instream characteristics and water quality impacts habitat conditions for fry.
- Insects and other food sources are reduced.
- Clearing woody debris or dredging gravel can ruin habitat.
- Agricultural, urban, and industrial pollution kills salmon fry.
- Excessive removal of trees in riparian areas could reduce insect food available to young salmon.
- Floods, either natural or caused by human activity, can sweep fry from streams before they are ready to migrate.

SMOLT STAGE

- Changes in the natural river flow such as dams, diversions, and turbulence can confuse and delay migrating salmon.
- Migration delays increase losses from predation.
- If delayed, smolts may lose the urge to migrate.
- Estuaries are valuable nurseries that can be lost when coastal wetlands and estuaries are filled, dredged, or developed.
- Anglers who mistake them for trout take coho and spring Chinook smolts.
- Anglers who catch & release can fatally injure fish.
- Migration is slowed as smolts swim through slackwater pools above dams.
- Slackwater pools are ideal habitat for pike minnow that eat young salmon.
- Many smolts are killed and injured going through hydroelectric turbines or over spillways.
- Smolts are preyed on by birds, mammals, and larger fish.
- Pollution kills or weakens smolts.
- Pollution of estuaries reduces food available to smolts at a critical time.

OCEAN FARING ADULT STAGE

- Overfishing results in inadequate numbers of fish returning to spawn.
- Poor ocean conditions can result in altered ocean currents and flow, decrease food abundance and reduce upwelling.

UPSTREAM MIGRATION STAGE

- Dams, gill nets, siltation, natural predators, and low water levels can all prevent fish from reaching the spawning grounds.
- Adult salmon are confused and slowed by slackwater pools above dams and tailwater turbulence below dams, using up precious energy reserves.
- By raising water temperatures, slackwater pools contribute to "warmwater disease," a major killer of adult salmon.
- Adult salmon run the gauntlet of predators: humans, sea lions, bears, and others.
- Poorly constructed dams and natural rockslides block adult migration.
- Pollution can weaken or kill adult salmon.

COURTSHIP/SPAWNING STAGE

- People can disrupt courtship behavior or frighten spawning salmon from their nests if they approach too closely.
- By controlling and diverting water, humans interfere with natural cycles of flushing and gravel deposition that create spawning habitat.

STUDENT HANDOUT 4D

My Life Cycle Compared to a Salmon

From birth to death, we progress through a cycle that contains specific stages such as infant, toddler, child, teenager, young adult, mature adult and senior. As you have learned, salmon also, go through cycles in their lives. Salmon start out as an egg, and grow through a series of stages to become an adult salmon. This activity is designed to help you think about your own life cycle stages and how they compare to the salmon's life cycle.

Below is a timeline with some of the major life stages of the salmon. In examining your own life determine the stages that are equivalent, either in age or event importance. From that comparison, draw your own life cycle, including ages and important events that occur at each stage.

Your assignment is to compare the similar stages of your life with those of salmon. For each stage, explain two important events that occur in your life cycle, as well as the salmon.

EGG

↓

ALEVIN

↓

JUVENILE

↓

SMOLT

↓

OCEAN
ADULT

↓

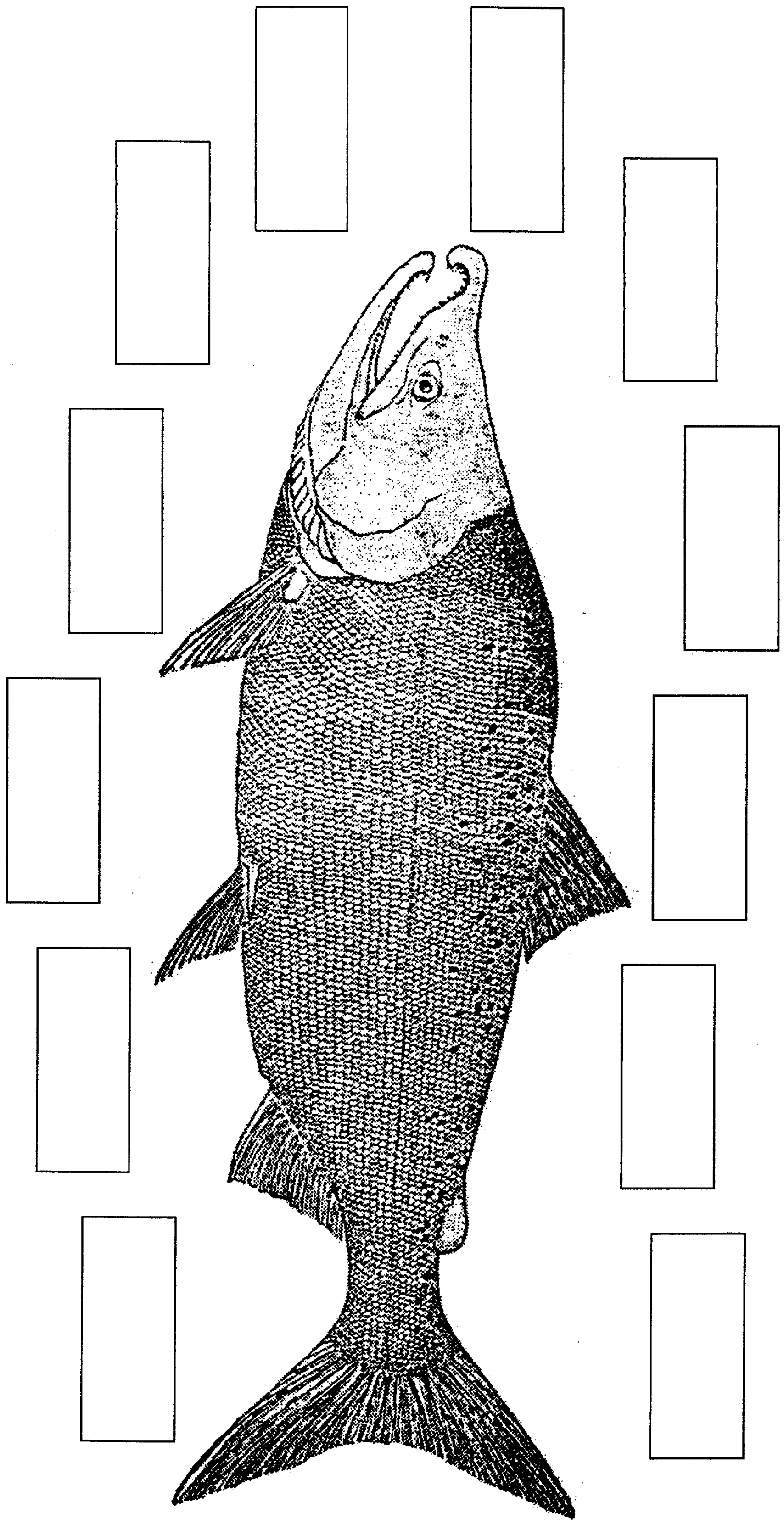
MIGRATION
UPSTREAM

↓

COURTSHIP

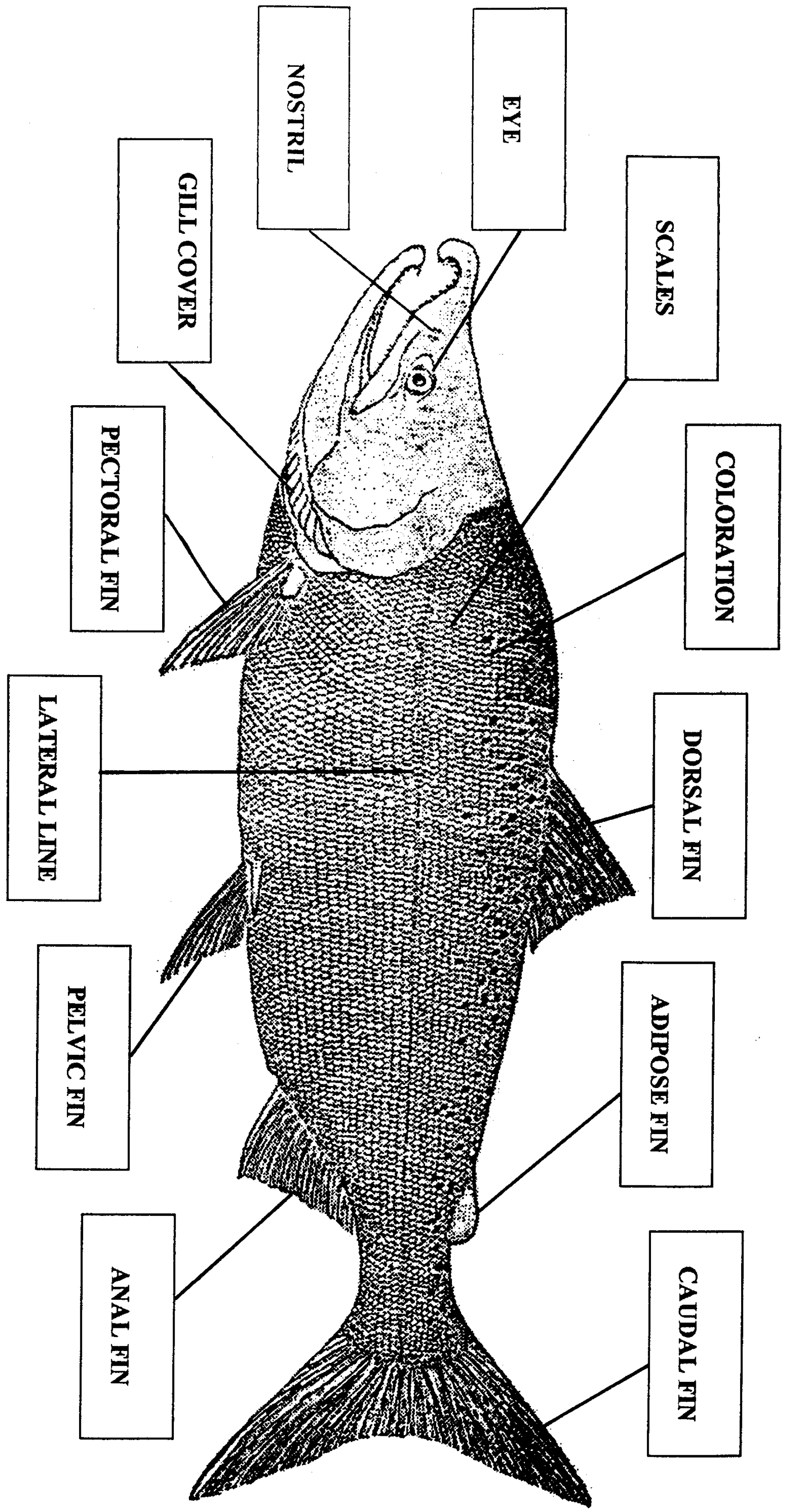
STUDENT HANDOUT 4E

EXTERNAL CHARACTERISTICS OF SALMONIDS



TEACHER HANDOUT 4E

EXTERNAL CHARACTERISTICS OF SALMONIDS



STUDENT HANDOUT 4E continued

EXTERNAL CHARACTERISICTS OF SALMONIDS

FINS

DORSAL & ANAL

PECTORAL & PELVIC FINS

CAUDAL OR TAIL FINS

ADIPOSE FIN

BODY SHAPE

MUCOUS COVERING

STUDENT HANDOUT 4E continued

EYES

NOSTRILS

HEARING

GILLS

COLORATION

LATERAL LINE

SCALES

TEACHER PAGE 4E continued

EXTERNAL CHARACTERISICTS OF SALMONIDS

FINS help a fish swim. Salmonid fins are supported by branched, flexible rays rather than stiff sharp spines. Thus, they are placed in the "soft rayed" family of fish.

DORSAL & ANAL FINS help keep the fish balanced so its body won't tip from side to side. One function of the anal fin may be to sense the size and texture of the gravel that is best suited for spawning

PECTORAL & PELVIC FINS are found on each side of the body, like arms and legs in animals. These fins are used for turning, backing up and stopping, in addition to balancing.

CAUDAL OR TAIL FINS sweep from side to side and push the fish forward.

ADIPOSE FIN is small and fleshy and has no apparent use.

BODY SHAPE: The shape of a salmonid fish is highly efficient and streamlined for movement and stability in swift water. Salmon can move at an estimated speed of 14 mph and have been observed to jump to a height of 10 feet.

MUCOUS COVERING: A mucous coating covers the skin of the fish and protects it from fungal and bacterial attack. The slippery texture of the mucous also allows the fish to swim more easily through the water. To prevent damage to its mucous protection, it is important to wet your hands before handling live fish.

EYES: A fish has eyes that can see in all directions. Each eye works by itself, so the fish can see to the front and back at the same time. Eyelids and tear glands are not needed. Water keeps the eyes wet and clean. It is important to note that most fish are nearsighted, using other senses to detect food at a distance then moving closer to visually identify it. Their eyes are large and pupils do not contract in response to light. Consequently, they are more likely to remain in shaded areas.

NOSTRILS: A fish uses its nostrils for smelling, but not for breathing. Salmon have an extremely sensitive sense of smell. They return to the spawning area by following the faint scent of the stream in which they were reared.

HEARING: Although the salmonid lacks external ear openings, the inner ear and swim bladder sense can detect sounds in the water.

GILLS: Just like people, fish must breathe oxygen in order to live. While we get oxygen from breathing the air around us, fish get the oxygen they need from the water, which flows through their mouths and passes by their gills. Gills are found under a flap just behind the head. They have many folds and pieces of thin skin, which take oxygen from the water.

COLORATION: The dorsal or top surface of salmonids is dark colored and the ventral or bottom surface is a silvery white. A predator viewing the fish above sees a dark back, which blends in with the color of deep water or stream bottom. If viewed from below, the white belly blends with the lighter color of the water surface.

LATERAL LINE: Most fish have a line running along each side of their body. The lateral line has a series of pores that detect low frequency vibrations and pressure changes near the fish's body.

SCALES: The bodies of most fish are usually covered with thin overlapping scales. Just like the cross section of a tree trunk, the oval scales of the salmon show annual growth rings. And just like a tree, annual rings can be used to learn the age. During the summer or other times when growing conditions are good, the fish grows quickly and the rings are far apart. In the winter when living conditions are not as good, the fish grows slowly so the rings are closer together.

STUDENT HANDOUT 4F **NAME**____________________

Goin' Fishin'...

LET'S GO FISHING...

You are going on a most excellent fishing trip, but there are things you have to do to get ready. You've got your pole; you've got your license; you've got your snacks and drinks. However, you have to know what kind of fish you plan to catch. Your license is very specific and if you take home the wrong kind of fish you could be fined lots of money!

Unfortunately you left this part of your preparation until last and your friends are ready to go. You have ten (10) minutes to devise a chart or tool you can use to identify the fish that you might catch. Make your chart or tool an instrument of identification for all the possible fish you might run into; after all, if fishing is bad, you and your friends will go somewhere else.

HELPFUL STUDENT HINTS: *You might want to include information about: age, color, size/weight, sex differences, and habitat, along with anything else you find helpful.*

After your have created your tool for identifying the fish, break up into small groups. Each group has several pictures of fish with "fish facts" on the reverse. Take turns 'fishing' from the selection of pictures, and identifying the species that you have caught.

Finally, look at the sample dichotomous key that your teacher will make available. Compare the sample with your tools for identification.

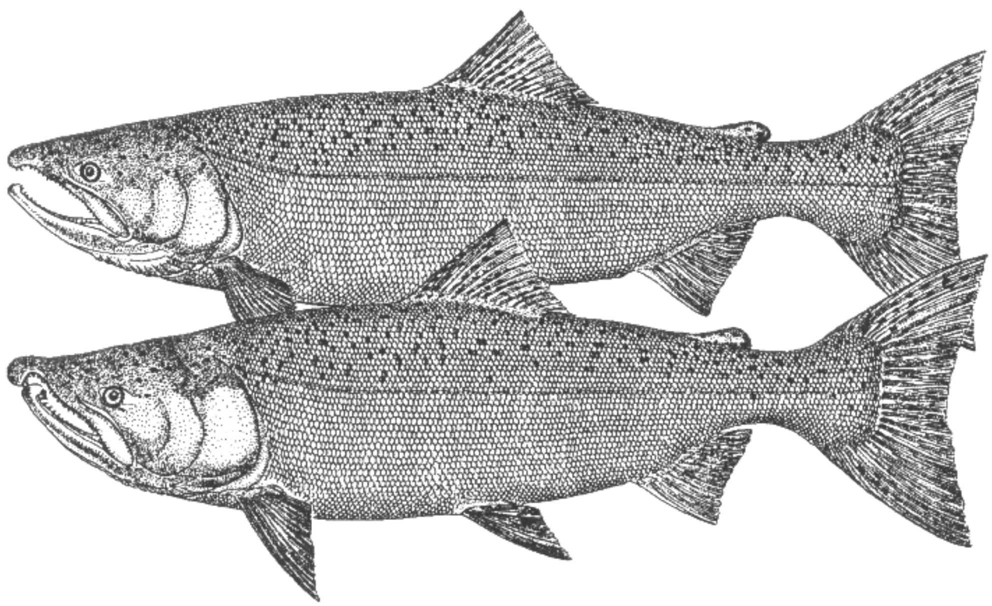
STUDENT HANDOUT 4G – FISH #1

Fish and Fish Facts

FISH #1:

Vital Statistics:

1. 27 inches, 11 lbs, gray mouth with white gums. Caught in shallow water.
2. 20 inches, 6 lbs, gray mouth with white gums. Caught in slower moving stream with small gravels.
3. 23 inches, 8 lbs, you've seen these fish (younger ones) in the same stream for over a year.



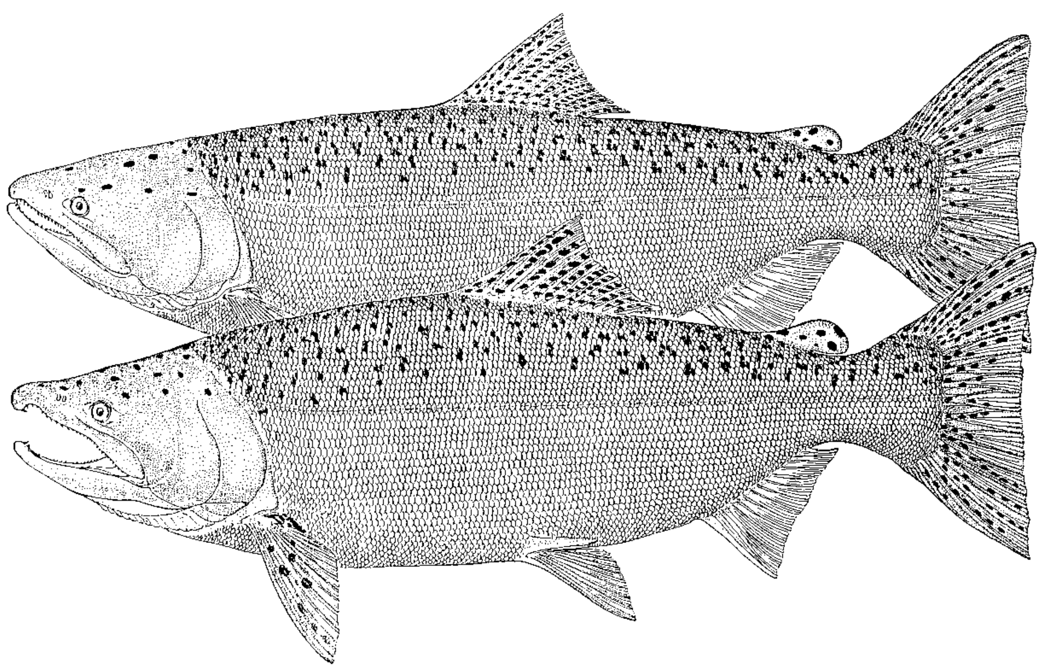
Artwork courtesy of NOAA

STUDENT HANDOUT 4G – FISH #2

Fish and Fish Facts

FISH #2:

Vital Statistics:
1. 36 inches, 28 lbs, this is a husky looking fish. You caught this one in a very large stream.
2. 42 inches, 43 lbs, a monster!! You pull out a scale and count the rings... it is 7 years old!
3. 36 inches, 30 lbs, gray/black mouth. You caught this fish in a fast-moving, deep stream.



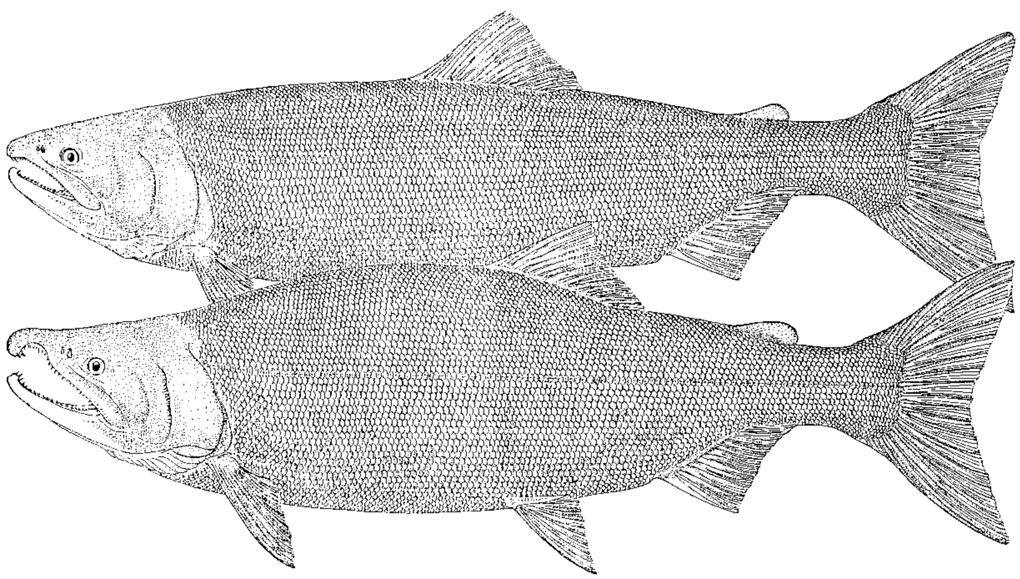
Artwork courtesy of NOAA

STUDENT HANDOUT 4G – FISH #3

Fish and Fish Facts

FISH #3:

Vital Statistics:
1. 20 inches, 7 lbs, your fish is very red.
2. 18 inches, 5 lbs, you caught this fish very close to a lake.
3. 21 inches, 8 lbs, your fish has a dull green head and the body is turning a reddish color.



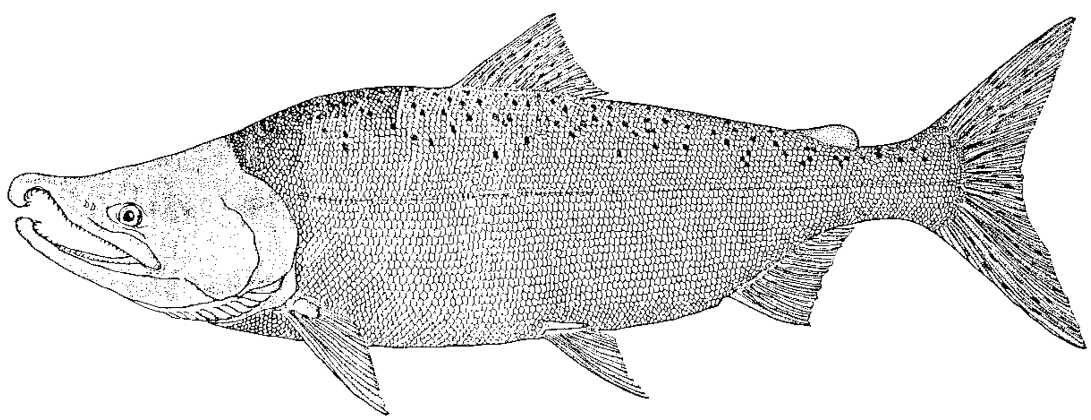
Artwork courtesy of NOAA

STUDENT HANDOUT 4G – FISH #4

Fish and Fish Facts

FISH #4:

Vital Statistics:
1. 18 inches, 5 lbs, you caught your fish down by the coast.
2. 15 inches, 4.5 lbs, your fish has a reddish cast to it.
3. 20 inches, 6 lbs, your fish was hanging out with some very odd looking humpbacked fish.



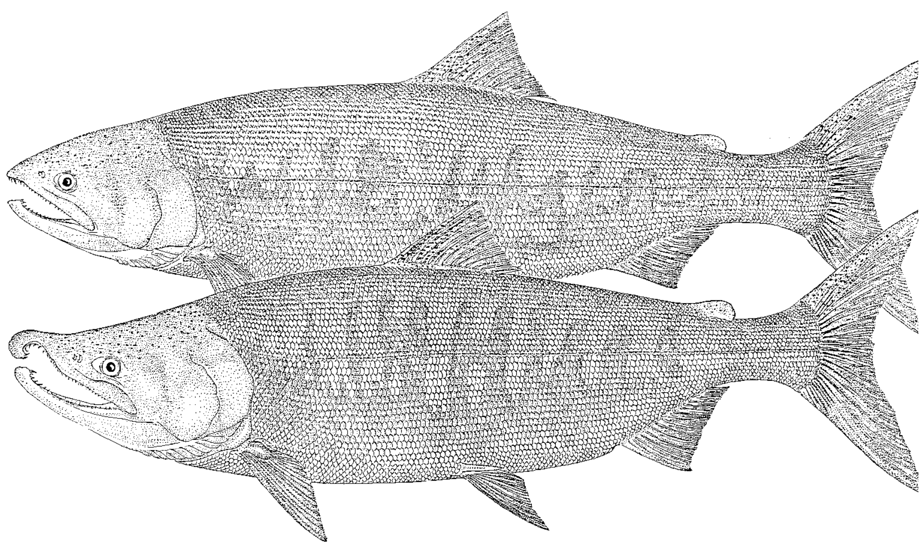
Artwork courtesy of NOAA

STUDENT HANDOUT 4G – FISH #5

Fish and Fish Facts

FISH #5:

Vital Statistics:
1. 24 inches, 7.5 lbs, you caught your fish where water was flowing pretty well and there was medium sized gravel in the stream.
2. 28 inches, 9 lbs, you caught your fish close to the ocean.
3. 30 inches, 10 lbs, your fish is greenish blue with white tips on its pelvic and anal fins.



Artwork courtesy of NOAA

STUDENT HANDOUT 4H

Dichotomous Key for Five Salmon Species

1.	a.	Dorsal, adipose and caudal fins spotted..	Go to #2
	b.	Dorsal, adipose and caudal fins not spotted.......................	Go to #3
2.	a.	Caudal fin is speckled on the upper half only..................	**Coho**
	b.	Caudal, dorsal and adipose fins are heavily spotted..........	Go to #4
3.	a.	Caudal fin is divided into distinct lobes; Pectoral, anal and pelvic fins have a dark band on the trailing edges.....	**Chum**
	b.	Caudal fin is lobed, but less distinctly; no dark band on the edges of the pectoral, anal and caudal fins.................	**Sockeye**
4.	a.	Head has distinct spots; spots extend to the tip of the dorsal fin and are arranged in rows on dorsal and caudal fins...	**Chinook**
	b.	Spots randomly scattered on dorsal and caudal fins; body dark; male has pronounced hump...........................	**Pink**

Note: Male salmon have a hooked upper jaw and large, bony gill covers. Some are humpbacked.

STUDENT HANDOUT 4I NAME______________________________

Sniffin' Salmon![2]

WHAT THIS IS ALL ABOUT:

This is a story about a salmon. The Salmon's name is ____________________ (write in YOUR name)

After a long period at sea, salmon return to spawn in the stream in which they were hatched. Just how they find their "home stream" was a mystery to us for many years. Now that many scientists have conducted research in this area, it seems probable that anadromous fishes (fish that migrate from their home streams to the sea and return to their fresh water stream to spawn) use the smell of the water to find their home streams. Other research has shown that salmon may use solar clues (the sun) at sea, but when they enter rivers, the sense of smell takes over in guiding them home. This seems to make sense because the sun would not be a very practical "landmark" to a fish traveling up a winding stream. Smell would be much more reliable.

The most remarkable thing about this method of navigation is the fact that the fish can "remember" the smell of their home stream after such long periods in the ocean. It is also surprising that similar streams would differ much in smell.

WHAT WE'RE GOING TO DO:

In this activity, you will experience first-hand what it would be like to be a returning salmon attempting to identify a home stream by smell. The activity enables the entire class to participate in the salmon life cycle and the hazards of their journey. You will first select a home stream and try to memorize its smell, leave the room for a time to simulate going to the ocean to feed and grow, and then return and try to identify the stream by smell.

[2]This activity was written by Marvin Pemberton and Lynn Wilson for the first Salmon Watch curriculum in 1993.

STUDENT HANDOUT 4I continued

1. You will need the following materials:
   Paper cups
   Masking tape
   Pencil
   Paper towels
   Cards with different salmon names on them
   Several "smells"

2. Construct your simulated "home stream" by crumpling up a paper towel, sprinkling or pouring a "smell" on it, and stuffing the towel into a paper cup. Invert another cup over this cup, and tape them together. The paper towel should be in the upper end. Write the name of your hypothetical or actual stream on the bottom of the cup. See the drawing on the next page to help orient yourself.

3. Now, you are going to leave the room and do something else. This simulates the salmon smolt leaving its home and going to the ocean. When it is time, your teacher will tell you to return to the classroom.

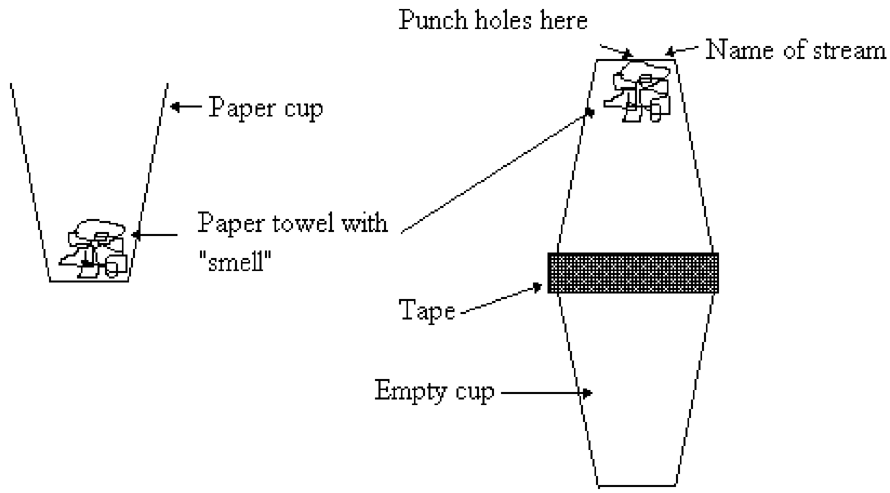
4. Using your sense of smell and memory of the smells of your "home stream," find your "home stream." Describe how you knew you were in the right place.

5. How did you feel when you finally found your "home stream?"

6. Open your journal and reflect on what you have learned today.

STUDENT HANDOUT 4J

Sniffin' Salmon Diagram



UNIT 4. SALMON SUPPLEMENTAL INFORMATION

#	INFORMATION	PREPARED BY
4.1	*A Changing Columbia Basin, 1770-Present*	Oregon State University
4.2	*Causes of Salmon Mortality 1770 –Present*	Oregon State University
4.3	*Table 1. WHERE ARE THE SALMON, WHEN?*	Pacific States Marine Fisheries Commission
4.4	*Table 2. Salmonid Habitat Requirements*	Various Authors

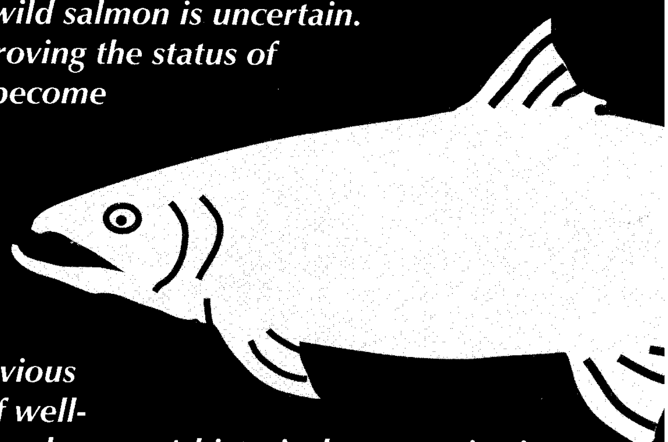
SALMON HANDOUT 4.1

A Changing Columbia Basin, 1770-Present

Since the 1700s, when the human impact on salmon was limited to native fisheries, salmon have been increasingly affected by the Northwest's growing population and economy.

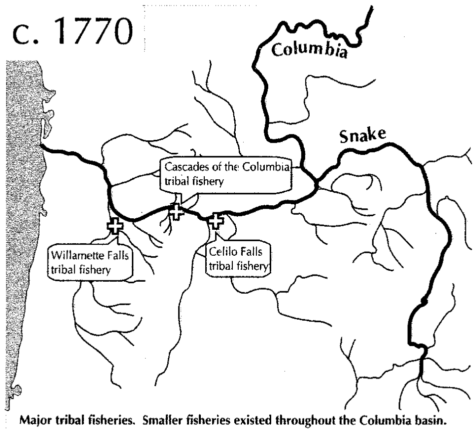
The first major European impact on the natives of the Columbia River occurred in the 1770s; by the mid-1800s, European diseases had reduced their population by 90% and the Columbia's resources were being exploited for the benefit of the European population. By the 1890s, dams were significantly affecting salmon runs; hydroelectric and flood-control projects eventually reduced the area available to salmon by half. Salmon of the Columbia are also affected by grazing, irrigation, logging, mining, overfishing, pollution, urbanization, ocean conditions, and predators.

As the Northwest's population and economy grow, the future of wild salmon is uncertain. Plans for improving the status of salmon have become increasingly common, but many projects simply undo the damage caused by previous generations of well-intentioned developers. A historical perspective is essential for understanding the current and future status of salmon and steelhead in the Columbia Basin.



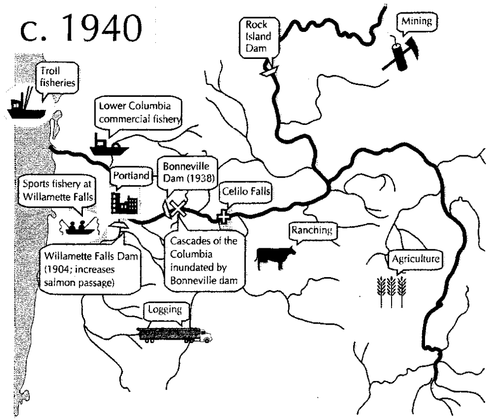
How has the Columbia changed from 1770 to the present? These maps and graphs illustrate how humans have altered the river and how these alterations have affected salmon survival.

A Changing Columbia Basin, 1770-Present

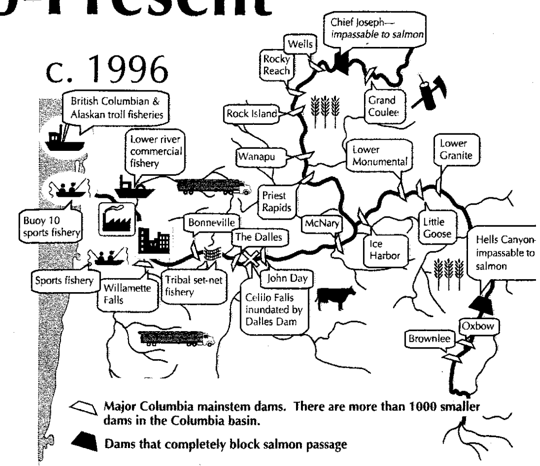


Major tribal fisheries. Smaller fisheries existed throughout the Columbia basin.

"We were but few, while the white men were many . . . we could not hold our own with them. We were like deer. They were like grizzly bears. . . . We were contented to let things remain as the Great Spirit Chief made them. They were not; and would change the rivers and mountains if they did not suit them." —Chief Joseph of the Nez Percé, c. 1879



"To build an industrial empire from the wasted power of the Columbia . . . They moved mountains and froze a land slide. . . . Bonneville and Grand Coulee are only the beginning. Ten million horsepower of new energy swiftly can be harnessed on America's mightiest stream. Tame the hazardous rapids. Open the Columbia waterway to navigation 500 miles inland. Provide endless water power . . . Reclaim another million acres of dry but fertile land." —BPA film "The Columbia," c. 1950

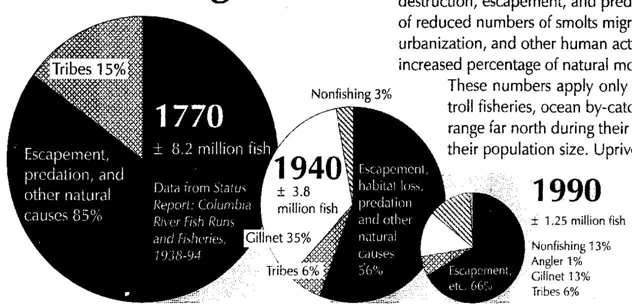


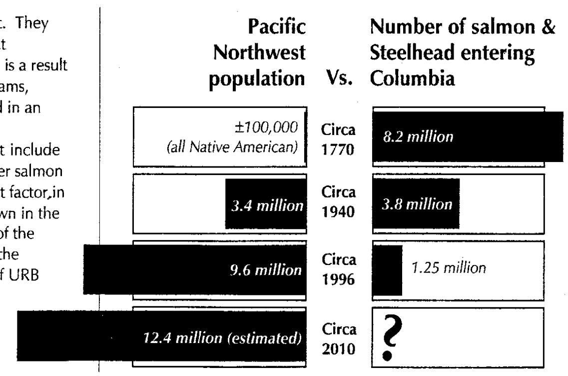
"Fish are to the northwest what wheat is to Kansas. Fish are this big integrator. They spawn 900 miles inland and they travel to the ocean all along the coast. They bind this region together." —Ed Chaney (Idaho fishery consultant). "Salmon are part of the heart and soul of the Pacific Northwest. They have defined its history, and its culture, and hopefully its future." —Will Stelle Jr. (National Marine Fisheries Service)

Diminishing Returns

These pies show the relative size of returning salmon runs from 1770 to the present. They compare in-river harvest, dam-induced mortality, and other losses caused by habitat destruction, escapement, and predation. In addition to adult mortality, run decline is a result of reduced numbers of smolts migrating to the ocean (due to habitat destruction, dams, urbanization, and other human activities). Fishing reductions in 1990 have resulted in an increased percentage of natural mortality.

These numbers apply only to returning Columbia River salmon and do not include troll fisheries, ocean by-catch, El Niño or other factors. Since Columbia River salmon range far north during their life in the ocean, ocean mortality is an important factor,in their population size. Upriver bright fall Chinook salmon (URBs), which spawn in the Hanford Reach—the last undammed stretch of the Columbia—are a good example. In 1985-94 the Canadian fishery was responsible for 48.9% of URB fishing mortality, while Alaskan trollers accounted for 29.8%. (*Source*: Pacific Salmon Commission Joint Chinook Technical Committee 1994 Annual Report).





SALMON HANDOUT 4.2

Causes of Salmon Mortality 1770 – Present

Mortality Circa 1770:

Natural mortality of salmon was due to factors like natural death after spawning; **predators**, including mammals, birds and other fish; and naturally occurring population fluctuations caused by ocean and river conditions. Tribal fisheries were the only human impacts at this time.

Mortality Circa 1940:

The ratio of natural mortality declines was due to human activity such as commercial fishing, **trapping of beaver** which reduced rearing habitat in beaver ponds; **overgrazing** resulted in damage to streamside vegetation; river corridors and estuaries were affected by **urbanization**; the use of **splash dams** for logging destroyed stream beds; **hydroelectric facilities** and **irrigation** dams on tributaries blocked access to spawning areas; **water drawn** for irrigation, industry, cities, and towns reduced river flow; and **water quality was degraded** by a wide variety of causes.

Mortality Circa 1996

Mortality in the ocean increased with El Nino conditions and ocean trolling in Alaska and British Columbia. The Chief Joseph and Hells Canyon dams blocked passage to large areas of habitat. Other large dams caused 5% or more mortality (per dam) for smolts descending to the sea and adult salmon returning to spawn. Dams also changed water temperatures, reduced flow of rivers, increased nitrogen levels, and allowed more predation by Northern Pike Minnow and other predators. The destruction and filling of wetlands and estuaries reduced habitat. Forest harvest operations may have resulted in increased silt, reduced shade, and disturbed spawning beds. Urbanization, i.e. the spread of cities, roads, and other development, reduced habitat and increased pollution. Over withdrawal of water for irrigation for agriculture frequently reduced flow of rivers. Unscreened water diversions trapped fish in ditches (in 1990, less than 5% of the diversions in Oregon were screened). Hatchery fish often increased disease rates and reduced diversity of wild stocks. Improper grazing of livestock harmed inland spawning habitat by destroying vegetation and polluting streams. Physical or natural disasters, such as landslides and floods, also influenced salmon mortality rates.

Out of approximately 1000 original wild native anadromous stocks found in Oregon, Washington, and California, 106 are now extinct and 314 are at risk of extinction. Currently, hatcheries produce two-thirds of the salmon found in the Columbia River.

Attempts to improve salmon survival include:

Improved **fish passage facilities** at dams; **streamside or riparian buffers** in logged areas (specific requirements spelled out in the Oregon Forestry Practices Act); **barging** or trucking of salmon smolts past dams; **habitat enhancement**; a **Northern Pike Minnow bounty** to reduce predation; **regulation of commercial and recreational catches**; additional spill from reservoirs to increase flow speed during smolt out-migration and to promote more natural riverbeds; **improved hatchery practices**; and adoption of fish friendly road construction and culvert standards.

Adapted from: Gilden, Jennifer, Smith, Courtland, Department of Anthropology, Oregon State University, Research funded by Sea Grant Oregon through NOAA. Sea Grant Oregon, Oregon State University 1998

SALMON HANDOUT 4.3

Table 1. WHERE ARE THE SALMON, WHEN?

Generalized Life History Patterns of Salmon, Steelhead, and Trout in the Pacific Northwest

	ADULTS RETURN TO STREAMS FROM OCEAN	SPAWNING LOCATION	EGGS IN GRAVEL	YOUNG IN STREAM	FRESH WATER HABITAT	YOUNG MIGRATE DOWNSTREAM	TIME IN ESTUARY	TIME IN OCEAN	ADULT WEIGHT (average) English(Metric)
COHO	Sept. –Jan	coastal streams shallow tributaries	Sept -May	1+ years	tributaries, main stem side channels, and slack water	Mar-Jul (2^{nd} year)	few days to one month	2 years	5-20 lb (8)
CHUM	Sept. –Jan	coastal rivers and streams, lower reaches	Sept-Mar	days-weeks	little time spent in freshwater	shortly after young leave gravel	7-14 days	2.5-3 years	8-12 lb. (10)
CHINOOK **Spring run** **Summer run** **Fall run**	Jan. – July Jun-mid Aug Aug. – Nov.	main stem- large and small rivers	Jul-Jan Sept-Nov Sept-Mar	1+ years 1+ years 3-7 months	main stem- large and small rivers	Dec – Mar. (2^{nd} year) Spring (2^{nd} year) Dec. - Mar (2^{nd} year)	days-months	2-5 years	10-20 lb. (15) 10-30 lb. (14) 15-40 lb.
CUTTHROAT (Coastal-Sea Run)	Jul-Dec	tiny tributaries of coastal streams	Dec-Jul	1-3 years (2 avg)	tributaries	Mar-Jun (of 2^{nd}-4^{th} yr)	days-months	0.5-1year	0.5-4 lb (1)
PINK	Jul-Oct	main stem of streams, tributaries, and lower reaches	Aug.-Jan	days-weeks	little time spent in freshwater	Dec-May	few days	1.5 years	3-10 lb (4)
SOCKEYE	Jul-Aug	streams, usually near lakes	Aug. –Apr	1-3 years	lakes	Apr-Jun (of 2^{nd}-4^{th} yr)	few days	1-4 years	3-8 lb (6)
STEELHEAD **Winter run** **Summer run**	Oct-Jun Jun-Oct (Columbia) Apr-Nov (Coastal)	tributaries and small and mid-size streams and rivers	Feb-Jul Dec-May Feb-Jun Feb-Jul	1-3 years 1-2 years 1-2 years 1-3 years	tributaries	Mar-Jun (of 2^{nd} – 5^{th} yr) Spring & Summer (of 3^{rd}- 4^{th} yr) Mar-Jun (of 3^{rd}- 5^{th} yr) Mar-Jun (of 2^{nd}- 5^{th} yr)	less than a month	1-4 years	5-28 lb (8) 5-20 lb 5-30 lb (8)

Adapted by Pacific State Marine Fisheries commission. Sources: Ocean Ecology of North Pacific Salmonids, Bill Pearcy, University of Washington Press, 1992 Fisheries Handbook of Engineering Requirements and Biological Criteria, Milo Bell, U.S. Army corps of Engineers, 1986; Adopting A Stream, A Northwest Handbook, Steve Yates, Adopt-A Stream Foundation, 1988.

Table 2. Salmonid Habitat Requirements
Oregon Coastal Streams
Spawning (including upstream migration)

	Migration	Spawn Time	Location	Substrate Size	Water Depth	Water Velocity	Dissolved Oxygen	Spawning Water Temp	Percent Fines Tolerable	Notes
Chinook – Fall	Sept-Dec	Oct- Jan	Mainstem and large tributaries	Pea to Orange (1.3-10.2 cm)	Extremely variable 0.05-7 m	0.1 – 1.5m/s; max is 2.4 m/s	> 5 mg/l	5.6-13.9°C	Fines (<6.4 mm) make up less than 25% of substrate	Large body size limits movement over barriers
Chinook-Spring	Mar-Jun	Late Aug -Oct	Upper mainstem streams	Pea to Orange (1.3-10.2 cm)	Extremely variable 0.05-7m	.21-1.5 m/s; max is 2.4m/s	>5 mg/l	5.6 –13.9°C	Fines (<6.4 mm) make up less than 25% of substrate	Require deep water for travel-pools for summer habitat
Coho	Sept-Jan	Sept - Jan	Small tributaries	Pea to Apple (1.3-9.0 cm)	0.18 – 1 m	0.08 – 0.11 m/sec; max is 2.4 m/s	>8 mg/l	4.4-14°C	Fines (<6.4 mm) make up less than 25% of substrate	Primary target for many sport fisherman
Chum	Oct -Dec	Nov-Dec	Lower mainstem and tributaries	Pea to Orange (0.5-10.2 cm)	13-50 cm; ideal 21cm	0.21-0.83 m/s; max is 2.4 m/s	>5 mg/l; above 80% saturation best	7.2-12.8°C	Fines (<6.4 mm) make up less than 25% of substrate	Strong swimmer but doesn't jump
Steelhead-Winter	Nov-May	Dec -May	Small & mid-size tributaries with moderate gradient	Pea to Apple (0.5-9.0 cm)	> 18 cm	<2.4 m/s	>5 mg/l	3.9-9.4°C	Fines (<6.4 mm) make up less than 25% of substrate	May spawn more than once
Steelhead-Summer	May-Jul	Jan-Jun	Small & mid-size tributaries with moderate gradient	Pea to Apple (0.5-9.0 cm)	>18 cm	<2.4 m/s	>5 mg/l	3.9-9.4°C	Fines (<6.4 mm) make up less than 25% of substrate	May spawn more than once
Sea Run Cutthroat Trout	Jun-Oct	Dec-Feb	Small headwater tributaries 1st & 2nd order streams	Pea to Golf Ball (0.5-7.5 cm)	0.01 –1 m; 10-15 cm best	0.11-0.90 m/s; max is 2.4m/s	>5 mg/l	6-17°C; best is 10°C	Fines (<6.4 mm) make up less than 25% of substrate	May spawn more than once

Salmonid Habitat Requirements
Oregon Coastal Streams

	Incubation		Rearing						Status
	Incubation Temp.	**Fry Emerge**	**Fry Habitat**	**Juvenile Habitat**	**Preferred Temp.**	**Freshwater Residency Period**	**Estuary Residency Period**	**Notes**	**2004 Status**
Chinook – Fall	0.0-20°C; best 5.0-14.4° C	Mar-May	Stream; river edges	Deeper water in main river channel	7.3-14.6° C Growth stops at 20.3° C lethal at 25.2° C	Days to 2 or 3 months Fall smolt	Extensive 5-6 months April-Oct.	Estuaries play a vital role in survival of young	Healthy and stable
Chinook-Spring	0.0-20°C; best 5.0-14.4° C	Feb-Mar	Stream; river edges	Deeper water in main river channel	7.3-14.6° C Growth stops at 20.3° C lethal at 25.2° C	Days to 2 or 3 months Fall smolt	Extensive 5-6 months April – Oct	Large body size limits movement over barriers	Depressed
Coho	4.4-13.3° C	Feb-June	Backwater pools and stream edges	Pools in summer, off channel alcoves, ponds, dam pools with complex cover in winter	11.8 – 14.6° C Growth stops at 20.3° C Lethal at 25.8° C	One year Spring smolt	Move through 2-9 days, sometimes longer	Low pH (<5.01) can be lethal to alevins	Depressed
Chum	4.4 – 13.3°C	Late Mar-Apr	Move directly into estuary	High sediment levels (15.8-54.9 g/l) will kill juveniles	6.7 – 14.6°C Growth stops at 20.3°C lethal at 25.8°C	Hours to few days, leave quickly Spring smolt	2-32 days	Use estuaries immediately for food and adjustment	Depressed
Steelhead Winter	4.4- 13.3° C	May – June	Stream edges	Pools, riffles, and runs of tributary, streams, complex habitat with, large woody debris, (LWD) preferred	7.3-14.6°C Growth stops at 20.3° C Lethal at 24.1° C	2-3 years Spring smolt	Move through in days	Good habitat =small and large wood complexity	Depressed
Steelhead-Summer	4.4 – 13.3°C	May-June	Stream edges	Pools, riffles, and runs of tributary, streams, complex habitat with, large woody debris, (LWD) preferred	7.3 – 14.6°C Growth stops at 20.3° C lethal at 24.1°C	2-3 years Spring smolt	Move through in days	Summer steelhead require deep cool pools to live in before spawning	Primarily hatchery fish
Sea Run Cutthroat Trout	6.1 – 17.2°C	Mar-May	Stream edges and backwater pools, large wood, (LWD) important	Prefer pools but are often displaced by coho or steelhead, low velocity pools, and side channels	9.5-12.9°C Growth stops at 20.3°C lethal at 23.0°C	2-4 Years Spring smolt	Used extensively as adults before upstream migration	Rearing in estuary is common	Depressed

1. Emmett, R.L., S.L. Stone, S.A. Hinton, and M.C. Monaco. 1991. *Distribution and abundance of fishes and invertebrates in West Coast estuaries*, Volume 11: *Species life history summaries*. ELMR Rep. No. 8
2. Groot, C. and L. Margolis, 1991. *Pacific Salmon Life Histories*. University of British Columbia Press, Vancouver, British Columbia
3. Nickelson, T., J. Nicholas, A. McGie, R. Lindsay, D. Bottom, R. Kaiser, and S. Jacobs. 1992. *Status of Anadromous Salmonids in Oregon coastal Basins*. Oregon Dept. of Fish and Wildlife. Corvallis, OR
4. Reiser, D.W. and T.C. Bjornn, 1979 Habitat Requirements of Anadromous Salmonids. In W.R. Meehan (editor), *Influence of forest and rangeland management on anadromous fish habitat in western North America*, US Forest Service General Technical Report PNW-96 Pacific Northwest Forest Range Experiment Station, Portland, OR.

UNIT 5. LIFE IN A WATERSHED

INTRODUCTION

Why do you live in your neighborhood? Is it a matter of livability? A job? The beauty of the region? Something brought you here, something told you that "this is the right place." Do salmon have this experience of knowing when they're in the right place? If so, how can we find this out?

You may not have consciously applied criteria to possible places to live. However, when you chose your place, you knew it was the right place. So it is with our salmon friends. No matter how old they are, they know the right place. What makes a place "right" for them? In this unit, we examine the places where salmon choose to live, and attempt to understand why. Understanding why is not easy -- we can't interview a salmon!

After completing this unit, students will better understand watersheds. They should know the characteristics of good habitat for salmon, and understand how physical and biotic activities up- and downstream affect this habitat. They should also be aware of the concept that the presence of an organism in an environment is an indication of its ability to adapt to the range of physical and biotic parameters presented by its environment. Thus, the organisms that live in a habitat are a good indication of its condition.

OBJECTIVES:

Students will:

- know and understand physical features, functions and management of watersheds.
- ascertain the characteristics and qualities of good salmon habitat.
- know and understand how salmon are a key indicator species of watershed health.
- learn how to use aerial photos and maps to learn about watersheds.
- develop and demonstrate how watersheds work.
- know and understand the relationship between wetlands and salmon.
- know and understand the properties and benefits of wetlands.
- identify and understand the physical characteristics of streams.

SECTIONS

A. Watersheds
B. Water quality and quantity
C. The role of wetlands
D. Physical structure of streams
E. Salmon as an indicator of the health of a watershed

5A. WATERSHEDS

ACTIVITIES	TIME(min.)	LEVEL	BENCHMARKS
Watershed reading & discussion	30-45	Advanced	6.2E.1 H.2L.2
Bird's Eye View of a Watershed	60-90	All	6.3S.1 6.3S.2 6.3S.3 6.4D.1 8.3S.1 8.3S.2 8.3S.3 H.3S.3 H.3L.2
Creating a Watershed Model	2-4 class periods	Introductory	6.3S.1 6.2E.1 8.3S.1 8.3S.2 H.2L.2 H.2E.4 H.3S.2 H.4D.2 H.4D.3 H.4D.4

INTRODUCTION

We are all familiar with our own neighborhood. We know the homes and their inhabitants. We become less familiar as we consider what lies outside the neighborhood. Neighborhoods are part of a larger structure: city, county, and region. Watersheds, large and small, and their connections, are the salmon's cities, counties and regions. Just as our larger civic bodies provide our neighborhoods' needs, watersheds provide a salmon's needs. The watershed provides the water at the site; what happens upstream affects this water; what happens at the site affects water downstream.

In this section, we learn what watersheds are, the different kinds, the effects upon them, and how they are managed. Students read about watersheds, then explore them using aerial photographs and maps, engaging in a discussion of watersheds and their place in providing for the needs of organisms who live in or depend upon the stream.

OBJECTIVES:

- Students will gain a full understanding of the physical features and functions of watersheds, with salmon as the key indicator of watershed health.

KEY QUESTIONS

What is the difference between a stream and a watershed?
How do watersheds fit into the life of a salmon?
What are a salmon's habitat needs and how does land uses affect them?

VOCABULARY *(Brief definitions of vocabulary terms are found in the Glossary.)*:

watershed	precipitation	contour
stream flow	in situ	topographic
stream channel	channel area	run off
channel movement	ecological	watershed management
channel gradient	temperature	

ACTIVITES:

WATERSHED READING AND DISCUSSION

MATERIALS:

- ❑ Reference material
- ❑ STUDENT HANDOUT 5A: *Watersheds*, Stream Scene

PROCEDURE:

1. Assign STUDENT HANDOUT 5A: *Watersheds*, *Stream Scene*, which describes the types of watersheds. A more detailed version may be found in the *Stream Scene* curriculum.

2. Engage the class in a discussion about their own watershed.
   - What is it?
   - Can they find it on a map?
   - How can we tell that what we see on a map is our watershed?
   - Where do your students get their drinking water?
   - Where does water and sewage go when they flush their toilet?

Note: Oregon Dept. of Environmental Quality Water Laboratories 503-229-5983 has water quality reports on file for many watersheds in the state. These reports are available for classroom use. They contain measurement records for a number of water quality parameters. Use these in the classroom to learn more about your own watershed. Obtaining these reports makes a good student project.

BIRD'S EYE VIEW OF THE WATERSHED

(This activity was developed by Paula Minear of OSU)

MATERIALS:

- ❑ Aerial photos of your site:
  1. Recent low elevation
  2. Within last 10 years at higher elevation
- ❑ Historical maps of your site:
  1. Recent of site
  2. Pre World War II
  3. Original survey maps (1800)
- ❑ Overhead pens

Note: aerial photos can be borrowed from resource agencies and city/county governments or university map libraries. You may also contact The Freshwater Trust for assistance.

PROCEDURE:

1. Introduce the bird's eye view activity by talking with the students about how they observe tiny little things, then larger and larger objects. How do they see things differently as they pull away and look from a distance? Ask them what their classroom might look like if they were looking down from the ceiling. You might have them sketch an aerial view of their home or neighborhood or of their school and grounds. Depending upon the readiness of your students, you may want to introduce the idea of different scales (micro to mega; not metric versus English).

2. Present each team with the first aerial photograph. You might explain that aerial photos may be taken from a variety of aircraft, including ultralights and spy planes, and have many uses. Aerial photos were first used extensively in the 1930s. Natural resource agencies like B.L.M. and the Forest Service use them to spot landslides, identify diseased trees, map roads, and measure vegetation, among other things. Private timber companies like Weyerhauser will also use aerial photos to keep track of their lands.

3. Ask them to pick out a major feature of your choice, perhaps the river or the school. Have each student put their finger on the object you have asked them to identify, so you are sure they are with you. Now have each team orient themselves and their aerial photo with the real world, holding it flat in front of them as they turn appropriately. Check them for comprehension. Can they point to objects on the ground that they have identified in the photo?

4. Give each team 5 minutes to identify other features in the photo, by discussing it within their teams. You may wish to point out that conifer trees show up somewhat darker green and pointy at the top, while deciduous trees are lighter green and fluffier-looking in the color aerial photos. If you wish, you could have the students actually label the features on the aerial photo using the overhead pens (non-permanent). At the end of the time have each team show one interesting thing they see in the photo. Does this new view of the world give them an interesting perspective they didn't have before?

5. During the analysis of this aerial photo, make sure the students have discussed conditions of special importance to salmon, for example: Where is the nearest stream? (Have them put their finger on it to check.) Does it have a riparian area? Are there places where the riparian vegetation is missing? (Review the importance of riparian vegetation to stream conditions.) Can they identify bridges, houses, and roads near the stream? What other land uses are nearby?

6. Now give them the second photo, taken at a higher altitude, and again have them orient themselves, identify major features, and then discuss in their teams and present additional features they have found and differences they have seen from the first photo. What has been gained by taking the picture from a higher altitude? What has been lost? If the photo was taken several years previously, they may also notice differences in buildings, roads, and vegetation.

7. What major land uses do they notice in this aerial photo (#2)? If you are at your Salmon Watch site, you may see agriculture, forestry, and roads. In an urban setting, you may notice that the stream disappears into culverts, has been forced to bend around buildings, etc. Talk about how each of these land uses has a potential impact upon salmon or their habitat. Alternatively, you may give each team one land use to discuss and have them share with the class how they think that land use would affect salmon. Also point out that land uses upstream of the stream will affect salmon habitat downstream. Have them show you some examples of upstream land uses on the photos.

8. Let them keep the original photos for comparison, and hand them the last aerial photo, the one taken a long time ago. It will probably be black and white, so help the students make the adjustment from seeing vegetation and features in color to black and white. Again, give them time in their groups to discuss similarities and differences and then share with the class. How have conditions in this watershed changed over time? Is the riparian area wider or narrower? Rather than tell them what year the photo was taken, have them guess first. You will be reminded that their understanding of the concept "old" is different from yours!

   Time is another important scale. (You may want to include a full discussion of this concept). It is critical to evaluate how watershed land uses have changed over time in order to understand the decline in our salmon populations.

9. What would it look like if someone could have taken an aerial photo back before the settlers and trappers came to this area? Perhaps the students would like to draw what they imagine it would have looked like. You may wish to use students' knowledge of early pioneers to discuss how settlers changed the landscape (clearing and burning land for fields, clearing rivers for navigation, cutting riparian timber and creating splash dams to float logs to market, damming and diverting water for irrigation, building roads, etc.) Native Americans were known to have set fires in the valleys to reinvigorate the grasslands. How would a fire pattern look different from a cultivated field?

10. If you have located old maps, show them to the students, help them orient to the maps, and have them point out features as they did with the aerial photos. Maps are somewhat more abstract than aerial photos, so it is possible that not all students will comprehend the meaning of the symbols on the maps. You may be able to go back as far as the 1850s with the original plat maps, drawn after the survey that divided the land into sections, ranges and townships. This survey established the major north-south; east-west grid pattern that we see imposed upon the landscape in the aerial photos and in the land ownership. Have the students observe or measure the difference in plot size between present times and the original survey. These plat maps show major river channels, land ownership, towns, sections, and describe vegetation, Students may recognize names that have persisted locally since the 1800s.

CREATING A WATERSHED MODEL

OBJECTIVES:

Students will be able to:

- explain and demonstrate how contour lines on a topo map are related to the features on the three dimensional map
- show the following on a model:
  - the boundary of a watershed
  - the course that water takes over the land
  - the stream(s) and/or river that watershed drains into
- identify, in general, how the land within a watershed is used and how those uses may effect water quality in a stream.

MATERIALS:

- ❑ Topographic map of a watershed (your own if possible)
- ❑ Sheets of ¼ or ½ inch Styrofoam (4x8 feet is a standard size, they may be cut to the size you need)
- ❑ Butcher paper
- ❑ Pencils and marking pens
- ❑ Burnishing instrument
- ❑ Serrated butter knives
- ❑ Masking tape
- ❑ Rulers
- ❑ Overhead projector
- ❑ Paper mache
- ❑ Paints and paint brushes
- ❑ Push pins
- ❑ Pitchers and buckets

BACKGROUND INFORMATION TO RELATE TO STUDENTS:

A watershed is a place, which receives and stores water. It is made up of rock, soil, leaves, grasses, trees, brush and many other forms of life. Acting much the same as a sponge, it absorbs water and releases it slowly. The key to a healthy watershed is topsoil. Topsoil is more than dirt; in nature it does not exist separate from vegetation, which builds it, nor from animals, which live in it and refine it. The watershed's contributions to life forms are oxygen, a mellowing influence on climate, plentiful food and shelter, pleasant scenery and water.

PREP:

Make a transparency of the watershed from the topo map or use an opaque projector to enlarge it. If you are in a hilly area, you will probably not trace every contour line. You should trace at intervals so that the scale is about 2-½ units vertical to one unit horizontal.

It may be easiest to blow up the map until the contour lines are big enough that they could be cut out into the Styrofoam. Look for little fingers of the land that may cause problems. Now figure out what the new scale is. If it was 1 inch = 1 mile, and you have increased the size by five, then 5 inches = 1 mile. (Horizontal)

PROCEDURE:

1. CUT THE STYROFOAM SHEETS. Begin at the lowest elevation. This will be the innermost contour line on the map, and will have the least amount cut out of the Styrofoam. This section will be placed on a base sheet. Continue to trace and cut each level. The Styrofoam will break, so warn students to be careful when they are cutting around fingers of land or other narrow pieces.

2. STACK THE LAYERS AND GLUE. As you cut out each elevation level, put in on top of the one below it. When you are done, look at the slope to see if it looks reasonable. It is still not too late to make adjustments, such as adding or taking out a few sheets to give the proper scale. When it looks right, glue the sheets together. Begin at the bottom. You will need plenty of glue, and several workers for this task!

   The glue will take a couple of days to dry. Put heavy books or boards on the top of the model to assure good contact between all surfaces.

3. ROUND OFF SHARP EDGES. Once the model has dried, you should round off the edges of the Styrofoam layers, so the land doesn't look like staircases. Usually, landforms are more sloping, but his will depend on the geology in your area. Use a knife to shave off the sharp corners.

4. FINAL TOUCHES. Once the basic model is a complete, challenge student to use their creativity to make the watershed a comprehensive model. Use any number and kinds of materials as symbols representing and designating vegetation, land use, etc. Soil, sticks, leaves, legos, matchsticks, etc. make great symbolic materials. Discuss the kinds of activities that occur in this watershed and relate them to the condition of the streams. Label all geographic features and parts of the watershed. Place materials in the stream or river like gravel, sand, root wads, woody debris, etc.

5. WATERSHED IN ACTION. Place a bucket at one end of the watershed model. Have a student slowly pour water down a several sides of the watershed. Lead a discussion about how the watershed functions and problems that can occur like flooding. How do roads, development, etc. affect the watershed? How should the watershed be managed?

EXTENSION ACTIVITIES

1. As a homework exercise, you might have students check out the aerial photos or maps to show to long time residents and report back their findings. Students could research aspects of area history they have discovered in the photos/maps.

2. Each team could compile and present a report on a particular land use in the watershed, how this land use affects salmon habitat, when it first started, how widespread it is, whether it is expected to increase or decrease in the future, and what could or should be done about it.

3. Have your students study pre-settlement conditions in their watershed. Create a pre-settlement map or representation of an aerial photo. How do they think the land and river looked in the 1700s? Be sure they consider natural processes such as floods and fire in their representation.

4. Create a salmon timeline, marking off the major events from the first salmon ancestors to the use by Native Americans, the coming of the settlers, major canning operations, extensive log drives on the rivers, construction of hydroelectric dams, first listings of endangered salmon runs, etc. Have your students reflect on the length of time salmon have existed, the conditions to which they adapted during that time, and the relative length of time humans have impacted those conditions.

5. If you have access to a satellite image of your watershed, have students find major landmarks, then compare relative amounts of each kind of vegetation (depending upon what information is available with the image). Talk about the use of satellite imagery in monitoring the environment (or invite a guest speaker). What is gained or lost in using this new scale for observation of your watershed?

6. Pass out worksheets from Stream Scene, *Does the earth wear a raincoat?* pp. 37-40 to the class. Students then use the worksheet to analyze the Umatilla Watershed. After they have finished, discuss the concept of watersheds with the class.

7. Find a map with local rivers and streams and have your students find a stream near their house. Then, ask them to find streams that drain into it. What happens if someone pollutes the stream or if the student pollutes? Use this approach to adapt the Stream Scene watershed curriculum to your class. As the year progresses, encourage your students to pin out events on the map. Keep track of rainfall, and ask your students to contribute their observations about their stream during periods of high or low rainfall. They can make turbidity observations once a week, and add them to the rainfall data. If you do this on a large poster, students will begin to see relationships between the weather and events near their home.

EXTENSION CURRICULUM

1. *Watershed, Project Wild Aquatic*, pp. 132-139, involves an activity in which students measure the area of a small watershed using a local site approximately 100 ft x 100 ft. They calculate the amount of water received by this area each year, and then explore the role watersheds play in human and wildlife habitat. This can be done in any schoolyard.

2. *California's Salmon and Steelhead, Our Valuable Natural Heritage*, pp. 116-117, uses an outline of a river and drawings of physical and biotic stream components to teach how to make a river map. Pp. 124-126 teaches how to interpret graphs of data. Pp. 127-132 contain reading, map-making and modeling activities to teach about watersheds.

3. INTERDISCIPLINARY INTEGRATION IDEA: Have a math teacher help students learn how to calculate irregular areas. Then, they can apply this to the measurement of watersheds, slopes, etc. Locate and do this for your schoolground watershed. Review this section with the math teacher and provide as much information as you can about the watershed of your field site. Coordinate this lesson with a social studies unit on early settlers, the Homestead Act, or Native Americans.

5B. WATER QUALITY AND QUANTITY

ACTIVITY	TIME (min.)	LEVEL	BENCHMARKS		
Water Temperature & Comfort	45	Introductory	6.2L.2 6.2E.1	H.2L.2 H.2E.4	
Fish & Water Temperature Chart Analysis	60-90	Introductory	6.2L.2 6.3S.1 6.3S.2 6.3S.3	8.1L.1	
Goldfish Lab Activity	30-45	Advanced	6.2L.2 6.3S.1 6.3S.2 6.3S.3	8.1L.1 8.3S.1	H.3S.1 H.3S.2 H.3S.3 H.4D.3

OBJECTIVE:
- Students will observe the properties of water and identify the qualities of water needed by salmon.

INTRODUCTION
Have you ever been thirsty? Do you remember water rationing in the summer? Are your water bills increasing? We all need water; we cannot live without it. Neither can we work without it. Manufacturing and agricultural processes use water and electricity. What about the salmon? Is water important to them? We know they need water to stay alive, much as we do. For what else do salmon need water? What does water provide for the salmon? In this section, we attempt to answer these questions.

In this section, we study and observe water for its properties and inhabitants. Then, we attempt to make some inferences about relationships that may exist between the inhabitants of a body of water, and the properties of that water. We do this by exploring the effects of temperature on dissolved oxygen, and on the respiration rates and temperature tolerances of fish species.

We have provided several lessons and activities to study water quality and quantity. Examine each lesson to find the appropriate fit for you class.

KEY QUESTIONS:
What kind of water do salmon need?
How much of it do they need?
Why are water quality and quantity important to salmon?

VOCABULARY *(Brief definitions of vocabulary terms are found in the Glossary.)*:
aquatic	diversity
ecosystem	pH
microhabitat	habitat
sediment	

ACTIVITIES:

WATER TEMPERATURE AND COMFORT

MATERIALS:
- STUDENT HANDOUT 5B: *Water Temperature*, Stream Scene
- STUDENT HANDOUT 5C: *Where Am I Comfortable?*

PROCEDURE:
1. How do you feel when you're hot? Cold? Do other species have the same feelings? Have students read STUDENT HANDOUT 5B: *Water Temperature*, Stream Scene

2. Use the questions in STUDENT HANDOUT 5C: *Where Am I Comfortable*? to reinforce the learning in the reading. These readings discuss the effects of temperature on aquatic organisms, and the role of plants, air, surface area, streambed, stream flow, sediments and discharges in mediating water temperature.

FISH AND WATER TEMPERATURE CHART ANALYSIS

MATERIALS:
- STUDENT HANDOUT 5D: *Fish and Water Temperature*

PROCEDURE:
1. Discuss human reactions to heat stress. Then have students read and complete the activity in STUDENT HANDOUT 5D: *Fish and Water Temperatur*e. This reading describes the effects of temperature on fish, and how to perform a standardized measurement of a fish's temperature tolerance. Students are given temperature tolerance data for 20 fish, and then respond to questions based on that information.

GOLDFISH LAB ACTIVITY

MATERIALS:
- STUDENT HANDOUT 5E: *Effects of Temperature on Goldfish Respiration Rate*
- 1 600 ml beaker, filled with 300 ml of aquarium water
- 1 goldfish
- 1 thermometer
- 1 large culture dish with ice

1. Have students read through the procedure for STUDENT HANDOUT 5E: *Effects of Temperature on Goldfish Respiration Rate* then break up into groups. After groups have completed the experiment, discuss observations, and then answer the question. This activity directly measures thermal responses in goldfish within the 55-80^{O}F range, and relates the results of these measurements to metabolic rates of goldfish.

5C. WETLANDS SITE STUDY

(Adapted from Project Learning Tree: Watch on Wetlands)

TIME (min.)	LEVEL	BENCHMARKS		
On-going	Introductory Advanced with adaptation	6.2L.2 6.3S.1 6.3S.2 6.3S.3 6.4D.1	8.3S.1 8.3S.2	H.2L.2 H.2E.4 H.3S.1 H.3S.2 H.3S.3

OBJECTIVES:

- Through observation, data collection and study students will understand the properties of a wetland.
- Students will gain an understanding of the relationship between wetlands and salmon.
- Students will gain an understanding of the functions and benefits of wetlands.

INTRODUCTION:

This section provides guidelines for how to develop and implement a wetlands study near a school. The key objective is to develop an understanding of the life links between wetlands and salmon, humans, and wildlife. It is highly recommended that you obtain and use Adopting A Wetland: A Northwest Guide by Steve Yates for this section. It is an outstanding guide and resource.

KEY QUESTIONS:

What is the relationship between wetlands and streams?
How do wetlands benefit salmon?
How do wetland benefit humans?
What are the properties that identify a wetland other than wetness?

MATERIALS:

- ❑ STUDENT HANDOUT 5F: ***Wading into Wetlands,*** National Wildlife Federation
- ❑ camera and film
- ❑ clipboards
- ❑ flagging material
- ❑ graph paper
- ❑ magnetic compasses
- ❑ sketch paper (rite-in-the-rain paper is best)
- ❑ field guides
- ❑ water sampling equipment (buckets, nets, etc.)
- ❑ aquarium or large jars (if applicable)
- ❑ drawing materials
- ❑ microscopes and slides (if available)
- ❑ pH and dissolved oxygen water test kits
- ❑ thermometers
- ❑ meter sticks
- ❑ several jars
- ❑ long-handled dip net
- ❑ a sieve
- ❑ a magnifying glass
- ❑ binoculars and/or spotting scope
- ❑ clip boards
- ❑ white enamel tray
- ❑ wildlife field guides

PROCEDURE:

GETTING READY

1. Designate a local wetland as a study site that your class could visit several times during the year. Make sure to contact all adjacent landowners to make them aware of your study.

CLASSROOM PREP

2. Using the information in STUDENT HANDOUT 5F: *Wading into Wetlands*, discuss with students the characteristics of a wetland. Describe various types of wetlands. Get students to begin thinking about the relationship between wetlands and creeks, streams and rivers and the benefits that wetlands can provide to salmon as well as humans. Also, with student participation, develop a set of guidelines for "wetland etiquette" in the field so that good observation and data collection will occur and impact on the site will be minimal.

3. Obtain local topographic map(s) with the wetland site. Have students look closely at the differing elevations. Wetlands are essentially topographic low spots!

4. Before visiting the wetland site, have students gather preliminary information about it from owners or managers or from local biologists or naturalists. Assign several students to be contacts for gathering this information. They should share with the rest of the class all information they receive. The class should determine the boundaries of the area they will study. Also, assign another group of students the task of characterizing the land use around the wetland. Is it stable or changing? Are there activities on nearby land that threatens the wetland?

5. Prepare for trips to the wetland site by dividing the class into several study teams. Be sure that each team is clear about their mission. Each time you go into the field, rotate the teams' duties.

6. **IN THE FIELD**

Photo Survey Team

Materials Needed:

- ❑ at least one camera and film (preferably color)
- ❑ clipboards
- ❑ flagging material

Pre-Trip Conference:
Discuss what features of the wetland they should capture on film (for example, photos of wetland vegetation).

Mission:
When visiting the wetland, they should walk slowly around the perimeter of the designated area. Several students should tie pieces of flagging to items they want to identify in the photos (such as a particular plant, boulder, or log). One or more students will take pictures of the flagged item plus general pictures of the area. One student will keep notes about every picture taken. Remind students to remove the flagging before they leave the area.

Map Survey Team

Materials Needed:

- ❑ graph paper
- ❑ clipboards
- ❑ magnetic compasses
- ❑ flagging material

Pre-Trip Conference:
Decide how to design their map of the area and what features they should highlight on the map.

Mission:
When they arrive at the site, pairs of students will use clipboards and graph paper to make rough maps of the area from different vantage points. Students should estimate the distances as best they can or use a long tape measure. They should use a compass to indicate directions on the map. Afterward, with colored markers and symbols, the team should use the pairs' rough maps to create a large, detailed map of the wetland on a piece of poster paper.

Plant Survey Team

Materials Needed:
- clipboards
- basic field guides for trees, plants, and grasses
- sketch paper (rite-in-the-rain paper is best)

Pre-Trip Conference:
Decide how they will categorize and record the plants they observe (tall trees, small trees, shrubs, tall grasses, short grass, flowers, water plants). For their plant survey, they will set up a chart that has columns for describing each plant, its immediate environment, and its location. Rather than spend a lot of time thumbing through field guides, have students sketch the plants and use time in class to identify.

Wildlife Survey Team

Materials Needed:
- several jars
- long-handled dip net
- a sieve
- a magnifying glass
- binoculars and/or spotting scope
- clip boards
- white enamel tray
- wildlife field guides

Pre-Trip Conference:
Decide how they will locate and record wildlife. Remind them to look for insects and other invertebrates in addition to birds, mammals, amphibians and reptiles. For recording wildlife, they should make up a chart that has columns for descriptions, immediate environment, and location.

Mission:
At the site, have students use binoculars, spotting scopes and magnifying glasses to look for wildlife. They can isolate aquatic creatures by dragging a dip net through the water or by gently straining wet mud. They can observe organisms in a white enamel tray or white plate partially filled with water. Students should describe or sketch these creatures as best they can and should use field guides to identify them.

Water Quality Team

Materials Needed:
- pH testing kit or litmus paper
- dissolved oxygen test kit
- thermometer
- meter stick
- clipboards

Pre-Trip Conference:
Practice using the testing equipment. Assign pairs to perform tests at different locations (in the water, at the water's edge, at five meters from water).

Mission:
When at the site, the pairs should gather information about water quality at various locations. Tests should include measuring the depth of standing water in various spots, along with describing the water's color, smell, and movement, or the soil's moisture.

Back in class, they should transfer their data to a chart that has columns for various water quality factors and for the location where factors were tested. Remember that sight and smell are not reliable indicators of water quality; low pH and low dissolved oxygen are more significant but also need to be analyzed by an expert.

POST SITE VISIT

7. After teams make one or more data-collecting trips to their wetland site, have them prepare data charts, reports, or maps. Each team should take 20 minutes to brief the group on their team's findings, lead a class discussion on the general features of the wetland, and give an impression of the area's ecological health.

8. Ask students to use the data presented so they can discuss whether some environmental warning signs in this wetland need further attention (such as low oxygen content in the water, oil in the water, trash in the area, lack of wildlife, etc). They should document why there might be problems and then should contact the owners or managers of the area to discuss ideas on how they might help improve the situation. Often, students can get permission to clean up a site or can take on more complicated projects under the supervision of those who manage the area.

EXTENSION ACTIVITIES

1. Ask your students to study a stream near their school or home. They draw or map a 500-foot length of a stream, then draw in and identify features or conditions that will benefit fish. Once a week for four weeks, they record observations on changes in the stream. These changes can be in the plants, animals, water level, water quality, or streambed. At the end of the four weeks, students draw their map again, and present both maps to the class, explaining changes they have observed.

2. If you plan to have your students sample for macroinvertebrates during the field trip, then do *Aquatic Organisms*, *Stream Scene*, pp. 143-168. This unit explores the place of macroinvertebrates in the watershed, and their use in determining water quality. This is a good unit, and presents the student with a water quality determination methodology that is used across the United States. It is relatively simple to do, and gives the student a good hands-on experience in the watershed.

3. Have your students complete *Puddle Wonders!* Project Wild Aquatic, pp. 114-117. Students predict where puddles will form and observe organisms that live in or near puddles. They then measure and records amounts of water in puddles and make inferences about the kinds of organisms which might occupy puddle habitats.

4. California's Salmon and Steelhead, Our Valuable Natural Heritage, p. 23 and pp. 78-81, contain readings, which can be used to teach some adaptations to anadromy and long migratory routes. Pages. 87-93 contains readings that can be adapted to teach the habitat requirements of salmonids.

5. Look up the World Wide Web address, http://www.streamnet.org/, for a very useful source of information about salmon. This is the StreamNet home page that contains an online database of information about salmon, the life history and ecology of species, color species of a male and female of each species listed, and extensive data on salmonids and their habitats. It might be used to organize Units 1-3 for your students.

6. If you cannot take your students away from the school, find a standing puddle on the school grounds, or bring the aquatic environment into the classroom by filling an aquarium with water and sediments from a local pond. (Wetland ponds usually provide a good assortment of living organisms, and they are not as fragile as streams, especially spawning grounds. You can fill one or two 5-gallon plastic buckets, and provide enough material for all of the work in this section.) Before going to a wetland, discuss "wetland etiquette" with your students. With student participation, make a very short list of guidelines, which will ensure a good set of observations, yet leave the environment unharmed, and ensure students' safety.

Have student groups maintain pond water in 2-quart peanut butter jars. (Should you choose to maintain an aquarium in your classroom, it is best to leave it unattended. It may not look pretty from time to time, but it will provide your students with a rich source of aquatic organisms, as well as water to test.) These jars can be set in windows, and used when needed.

(An interesting alternative to bringing pond water into the classroom is to collect a small part of a dried pond or pool and add it to tap water which has been left standing overnight. Eggs and spores contained in the collected material will provide a representative set of aquatic organisms within a few days. Two good materials to collect are the sediments on the bottom and the pond “scum” that drapes in sheets over the grass and stubble at the edge of water bodies as they dry up. A small piece of plastic pipe can be used to take up sediment on the bottom, and this sample transferred to water; pond “scum” can be dispersed by simply punching out a “dot” with a paper punch into a test tube or baby food jar of water!)

5D. PHYSICAL STRUCTURE OF STREAMS

ACTIVITY	TIME (min.)	LEVEL	BENCHMARKS
Stream Structure & Fish Habitat	45	Introductory	6.2R.1 H.2L.2 6.3S.E
Fish Habitat Needs Vocabulary	35	Advanced	6.2L.2 H.2L.2

INTRODUCTION

If the water is the "neighborhood" where a salmon grows up and lives, then the physical structure of the stream is the neighborhood's streets, roads, houses and parks. The physical structure, which you observe, is developed by forces, which originate outside the "neighborhood," much like development in our own areas is generated by forces outside the neighborhood. What is the nature of these forces? How do they affect the stream in front of you? How does the stream affect spawning salmon? This section provides some answers to these questions. The answers will affect your students' perceptions of their field trip site.

In this section, we study the needs of salmon and the properties of streams that meet salmons' needs. Students learn how the stream provides riffles and pools, and how these affect the salmon. They prepare themselves for the questions they will ask on the field trip: Where will we observe spawning when we go on our field trip? Where will the adult salmon prefer to be? Would fry prefer to be there also? What are a fry's requirements for life?

OBJECTIVE:

- Students will identify, know and understand the physical characteristics of streams and their effect on salmonids.

KEY QUESTIONS:

What are the parts of the physical structure of streams?
How are these parts organized?
How is this related to spawning salmon?
How is this related to the needs of salmon fry?

MATERIALS

- ❑ reference materials
- ❑ STUDENT HANDOUT 5G: *Stream Structure and Fish Habitat*
- ❑ STUDENT HANDOUT 5I: *Fish Habitat Needs Vocabulary*
- ❑ drawing materials

VOCABULARY *(Brief definitions of vocabulary terms are found in the Glossary.)*:

riffle	carrying capacity	eddies
porous	sediment-free	stream gradient
stable	substrate	debris
scouring	root wad	riparian

PROCEDURE

1. Engage students in a discussion in which they recall what they have learned about salmon habitat needs during the life cycle of a salmon. Then hand out copies of the STUDENT HANDOUT 5G: *Stream Structure & Fish Habitat*.

2. Ask your students to read STUDENT HANDOUT 5G. Use a strategy of your choosing for this text reading. Have them work in small groups to answer the reading questions as they encounter them.

3. This is a homework assignment. The student reads STUDENT HANDOUT 5G: *Stream Structure and Fish Habitat* and STUDENT HANDOUT 4A: *The Journey of Wild Pacific Salmon*, then, working from the STUDENT HANDOUT 5I: *Fish Habitat Needs Vocabulary List*, write the term and the definition vocabulary using the following format: They read the sentence where the word is found, and write a definition for each term. Remind them not to use a dictionary. They should try to find the meaning from context instead. Students leave a blank line below the definition to revise or clarify it after reading the whole article and talking about the subject. If the students have worked to learn these words, then they will have a useful vocabulary to employ on the field trip.

4. Assign groups of students to describe the three recommended habitat by a combination of written descriptions and drawings to show desired conditions. Have them present and explain these to the class.

EVALUATION

Evaluate this work by requiring its completion, then by evaluating students' field records after the field trip. They should use many of these descriptive terms knowledgeably and include appropriate observations.

EXTENSION ACTIVITIES

1. While an ideal course would include a complete set of observations on the streambed and waters which flow through it, our time limits what we can learn about the structure of streams. The unit, *Riparian Areas*, <u>*Stream Scene*</u>, pp. 41-64, provides a minimal background for the student. In it, students learn how the riparian area of a stream is compartmentalized, and the part it plays in the life in a stream.

2. *Fish Habitat Needs*, <u>*Stream Scene*</u>, pp. 181-208, explores fish habitats in the Northwest. It uses prior understandings about stream structure and water quality, and then relates them to stages in the life cycle of salmon. The unit begins with spawning habitats, so would be a good one to consider in order to prepare your students for the field trip. (Note: This extends learnings from *Riparian Areas*, above.)

EXTENSION CURRICULUM

1. *Hands On Streams & Rivers*, *Save Our Streams*, pp. 2 - 10, outlines a program for describing a stream channel from *in situ* measurements. Students measure channel area, monitor channel movement, and determine channel gradient. They observe stream flow, sediments and temperature. These observations are then compared with land uses and ecological relationships of organisms inhabiting the stream. It can be taught in this section as well as in the Salmon and Humans and the Environment units.

2. <u>California's Salmon and Steelhead, Our Valuable Natural Heritage</u>, pp. 100-110, supplements the <u>Stream Scene</u> Riffles and Pools section. In this section, students use a game format involving a map of a stream and "critters" hidden in the stream, to reinforce learnings about habitat requirements. Pages. 133-135 teach how to make physical measurements of a stream, and would be a good preparation for the field trip. Pages. 94-99 teach about life cycles and habitat requirements via a "rummy" card game.

INTERDISCIPLINARY INTEGRATION IDEA

During steps 4 and 5 in the Core Curriculum procedures, have an art teacher emphasize nature drawing. For each term which students define, they also make a drawing. The drawings must graphically describe the term they illustrate, and include a salmon during some stage in its life cycle. Review this section with the art teacher, and then integrate the work that you will do. Students should learn how to shade, draw elevation vs. plan views, scale, annotate drawings, and make thematic illustrations showing good/bad habitat. This work relates well to the field trip, where students often journal and/or illustrate their field logs.

5E. SALMON AS AN INDICATOR OF THE HEALTH OF A WATERSHED

TIME (min.)	LEVEL	BENCHMARKS		
45	Advanced	6.2L.2	H.2L.2	8.3S.1
		6.3S.1		
		6.3S.2		
		6.3S.3		

OBJECTIVE: Students will identify characteristics of the stream needed by salmon and recognize the role of salmon as indicator species

MATERIALS:

- ❑ reference materials
- ❑ STUDENT HANDOUT 5G: *Stream Structure and Fish Habitat*
- ❑ STUDENT HANDOUT 5H: *Home Wet Home…*, Stream Scene

INTRODUCTION

Did you ever have a fever when you were a child? Your forehead often told your parents how you were feeling. Aquatic organisms are like foreheads, they act as "thermometers" which tell us about the state of the health of the environment that they inhabit. What in the watershed of a salmon acts as a thermometer? In this section, students learn that they can ascertain the probable state of an environment by knowing which organisms live in it.

In this section, we relate aspects of stream structure and quality to the needs of the salmon during stages in their life cycle. Then, we alter our perspective to relate the organisms inhabiting a stream to its probable structure and quality.

KEY QUESTIONS

How are salmon like thermometers?
What is the relationship between a salmon and the watershed's health?

VOCABULARY *(Brief definitions of vocabulary terms are found in the Glossary.)*:

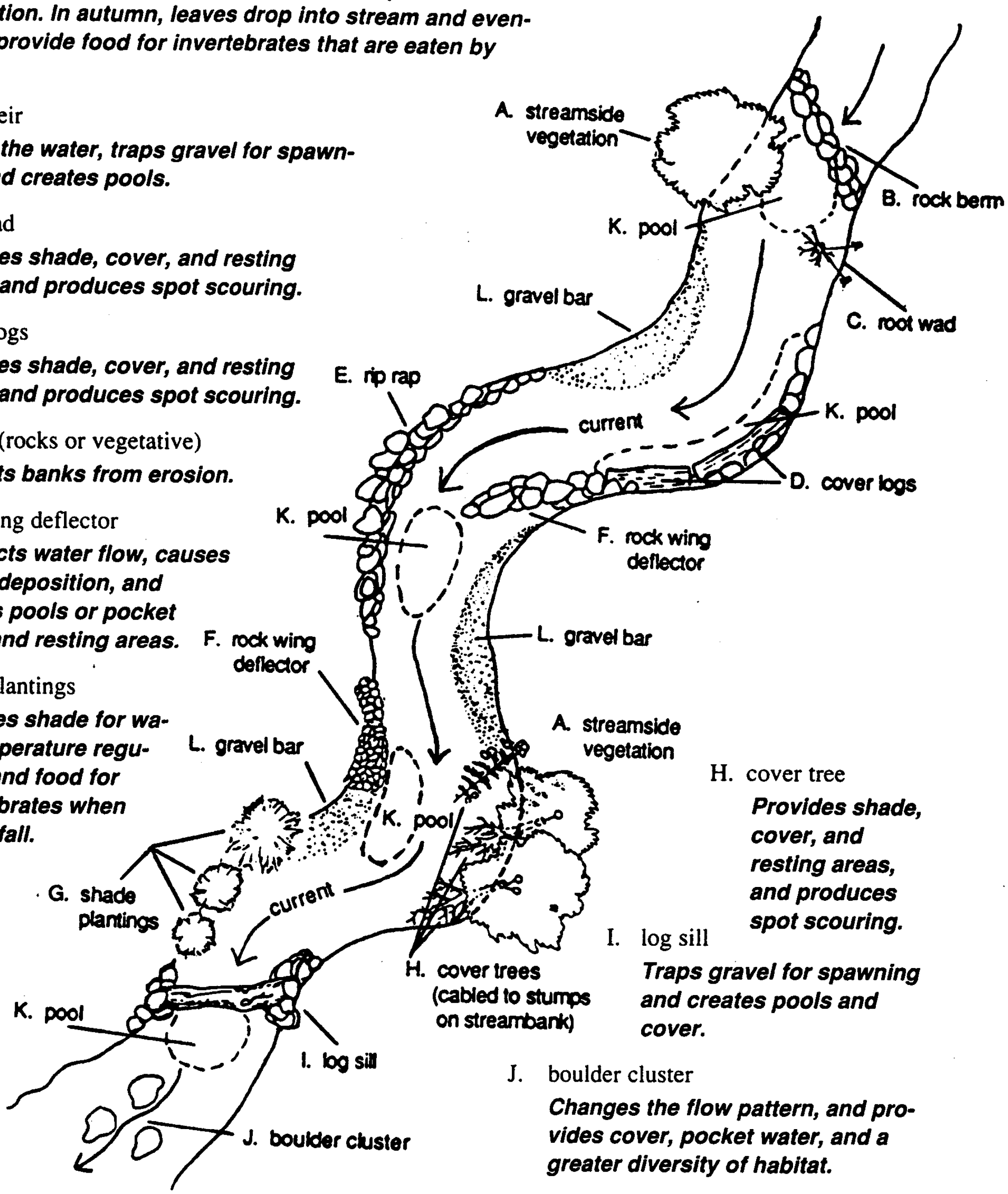
spawning area
riffle
indicator species
substrate
embedded

PROCEDURE

1. STUDENT HANDOUT 5G: *Stream Structure and Fish Habitat*, explores fish habitats in the Northwest. It uses your students' prior understandings about stream structure and water quality, and then relates them to stages in the life cycle of salmon. Begin with a discussion of the idea of "indicators." You might refer to indicators of the starting line for a popular race, or atmospheric indicators of weather.

2. Pass out STUDENT HANDOUT 5H: *Home Wet Home...*, *Stream Scene*. In this activity, students relate various components of a hypothetical stream's structure to its effect on salmon. When students have finished, discuss their responses to questions (answers to *Home Wet Home* follows).

Answers to **STUDENT HANDOUT 5H**: *Home Wet Home…*



A. streamside vegetation
Provides cover in addition to shade for temperature regulation. In autumn, leaves drop into stream and eventually provide food for invertebrates that are eaten by fish.

B. rock weir
Slows the water, traps gravel for spawning, and creates pools.

C. root wad
Provides shade, cover, and resting areas, and produces spot scouring.

D. cover logs
Provides shade, cover, and resting areas, and produces spot scouring.

E. rip rap (rocks or vegetative)
Protects banks from erosion.

F. rock wing deflector
Redirects water flow, causes gravel deposition, and creates pools or pocket water and resting areas.

G. shade plantings
Provides shade for water temperature regulation and food for invertebrates when leaves fall.

H. cover tree
Provides shade, cover, and resting areas, and produces spot scouring.

I. log sill
Traps gravel for spawning and creates pools and cover.

J. boulder cluster
Changes the flow pattern, and provides cover, pocket water, and a greater diversity of habitat.

K. pool
Provides a resting area.

L. gravel bar
Provides spawning habitat.

EXTENSION ACTIVITY

If your students have kept pond water, then you can observe its inhabitants under different conditions of water quality. In this "heartbeat" activity, students take a sample of the pond water containing aquatic organisms which they can see and moderate its temperature or chemistry. Begin by having students transfer a sample of the pond water to a small container (like a vial or baby food jar). Next, have the students observe the movements of any organisms in their sample. For instance, copepods move in a series of jerks, and make very good organisms to observe in this activity.

Cool the container in ice or cold water, then count the number of jerks, or other movements which have been observed. Next, warm the container and make another count. If these temperatures have an effect on the organisms, then the rate of the motion might have changed. Other effects you can measure include the effects of adding salt or mud. Have your students keep records of their observations, and then share them with the class.

EXTENSION CURRICULUM

1. *Water Canaries*, Project Wild Aquatic, pp. 24-30, describes an activity in which students conduct investigations on a water body. They assess its relative environmental quality through interpretations of measurements of pH, water temperature, and the diversity of the organisms found there.

2. *Water Wigglers*, Stream Scene, pp. 155-168, describes an activity to do in a stream, which relates the quality of the water in the stream to the macroinvertebrates found in it. If you cannot go to a stream, read the activity and adapt it to the classroom.

BIBLIOGRAPHY

Adopt a Stream Foundation's Field Guide to the Pacific Salmon. 1992. Robert Steelquist. Sasquatch Books. Seattle, WA.

Adopt A Wetland: A Northwest Guide. 1989. Steve Yates. Adopt-A-Stream Foundation.

California's Salmon and Steelhead, Our Valuable Natural Heritage. Teacher's Guide and Student Activities: Grades K-6. California Advisory Committee on Salmon and Steelhead Trout.

The Comings and Goings of Coho, Water Water Everywhere.... Oregon State University Sea Grant College Program and Oregon Department of Education.

F.I.S.H. Habitat Education Program; Watersheds, Wildlife and People. Pacific States Marine Fisheries, 45 SE 82nd Drive, Suite 100, Gladstone, OR 97027-2522; (503) 650-5400.

The Illustrated Salar the Salmon. Henry Williamson. Webb and Bower, Devon, England. Copyright 1935, 1987. ISBN 0-86350-152-4.

Macroinvertebrates and River Continuum (video 21:18). Oregon Department of Fish and Wildlife.

Project Wild. Kate Ferschweiler. Western Regional Environmental Education Council, Inc. Boulder, CO 80308-8060.

Project Wild Aquatic, Revised. 2002. Western Regional Environmental Education Council, Inc. Boulder, CO 80308-8060.

Project Learning Tree: Environmental Education Activity Guide. 1994. American Forest Foundation. Washington, DC 20036.

Riparian Pastures. Univ. of Nevada Cooperative Extension Fact Sheet Pages 87-53.

Salmonids in the Classroom: Intermediate. Canadian Department of Fisheries and Oceans, B.C. Teachers Federation Lesson Aids. 105-2235 Burrard Street, Vancouver, B.C. Canada V6J 3H9.

Salmonids in the Classroom: Primary. Canadian Department of Fisheries and Oceans, B.C. Teachers Federation Lesson Aids. 105-2235 Burrard Street, Vancouver, B.C. Canada V6J 3H9.

Save Our Streams, Hands On Streams & Rivers. Richard D. Klein. Maryland Department of Natural Resources. Owings Hills, MD 21117.

Save Our Streams, Monitor's Guide to Aquatic Macroinvertebrates. 1992. Loren Larking Kellog. Izaak Walton League of America. Arlington, VA. 22209.

Save Our Streams, Stream Quality Assessment. Richard Klein. The Izaak Walton League of America. Arlington, VA 22209.

The Stream Scene - Watersheds, Wildlife and People. 1992. Oregon Department of Fish and Wildlife, PO Box 59, Portland, OR 97207, (503) 229-5403.

Wading into Wetlands. 1995. National Wildlife Federation. Vienna, Virginia 22184.

UNIT 5 LIFE IN THE WATERSHED
STUDENT HANDOUTS

5A	*Watersheds*, Stream Scene
5B	*Water Temperature*, Stream Scene
5C	*Where Am I Comfortable?*
5D	*Fish and Water Temperature*
5E	*Effects of Temperature on Goldfish Respiration Rate*
5F	*Wading into Wetlands,* National Wildlife Federation
5G	*Stream Structure and Fish Habitat*
5H	*Home Wet Home,* Stream Scene
5I	*Fish Habitat Needs Vocabulary*

STUDENT HANDOUT 5A

Watersheds

Stream Scene, Oregon Dept. of Fish & Wildlife, 1992

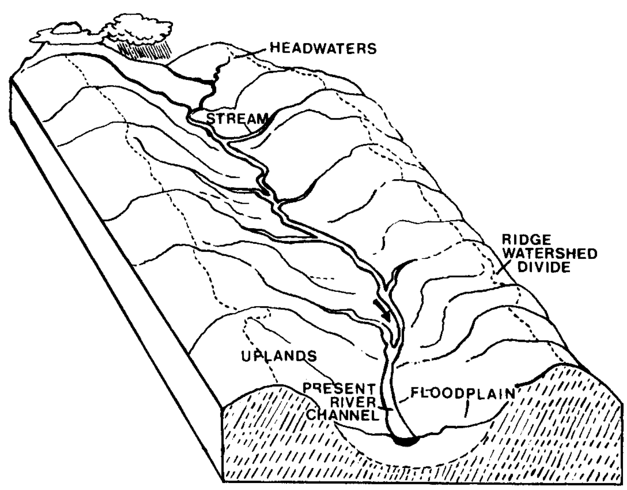
All land on earth is a **watershed**. Humans and their activities play an important and essential role in watersheds, yet few people understand them. Still fewer know the dynamics and boundaries of the ones in which they live.

A watershed is a system. It is the land area from which water, sediment, and dissolved materials drain to a common watercourse or body of water. For each watershed there is a drainage system that conveys rainfall to its outlet. A watershed may be the drainage area surrounding a lake that has no surface outlet, or a river basin as large as that of the Columbia River. Within a large watershed are many smaller watersheds that contribute to overall streamflow.

All land on earth is a watershed.

The point where two watersheds connect is called a **divide**. A watershed is drained by a network of channels that increase in size as the amount of water and sediment they must carry increases.

Streams are dynamic, open-water systems with channels that collect and convey surface runoff generated by rainfall, snowmelt, or groundwater discharge to the estuaries and oceans. The shape and pattern of a stream is a result of the land it is cutting and the sediment it must carry.



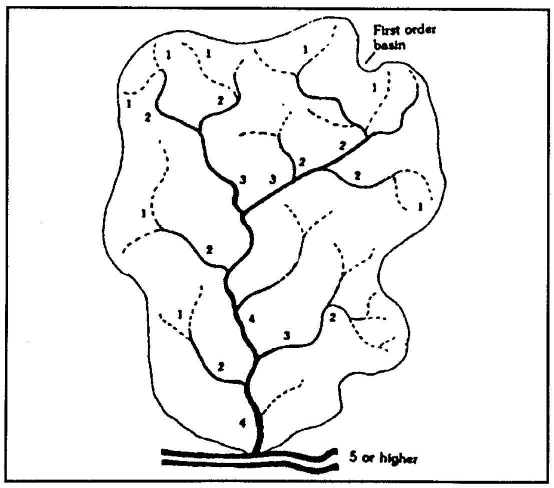
A watershed is almost like a domicile, a mini-biosphere, with halls of hills and mountains, a floor of river or lake, and a roof of rain clouds.

Stream orders

In most cases, a watershed system is almost entirely hillsides. Only about one percent of a watershed is stream channels. The smallest channels in a watershed have no tributaries and are called **first-order streams**. When two first-order streams join, they form a second-order stream. When two second-order channels join, a third-order stream is formed, and so on (figure 5). First- and second-order channels are often small, steep, or intermittent. Orders six or greater are larger rivers.

Channels change by **erosion** and **deposition**. Natural channels of rivers increase in size downstream as tributaries enter and add to the flow. A channel is neither straight nor uniform, yet its average size changes in a regular and progressive fashion. In upstream reaches, the channel tends to be steeper. **Gradient** decreases downstream as width and depth increase. The size of sediments tends to decrease, often from boulders in the hilly or mountainous upstream portions, to cobbles or pebbles in middle reaches. More sand or silt are found downstream. In some cases, large floods cause new channels to form, leaving once-productive streams dry and barren.

Figure 5. Stream Orders



Streamflow types

Besides the ordering system previously described, streams may be classified by the period of time during which flow occurs.

- **Perennial** flow indicates a nearly year-round flow (90 percent or more) in a well-defined channel. Most higher order streams are perennial.
- **Intermittent** flow generally occurs only during the wet season (50 percent of the time or less).
- **Ephemeral** flow generally occurs during and shortly after extreme precipitation or snowmelt conditions. Ephemeral channels are not well defined and are usually headwater or low order (1–2) streams.

The physical, chemical, and biological make-up of a stream relates to surrounding physical features of the watershed and geologic origin. Analysis of these features aids understanding of stream-watershed relationships and predicts effects of human influences on different stream types.

Factors affecting watersheds

Climate

Land and water are linked directly by the water cycle. Solar energy drives this and other cycles in the watershed. Climate—the type of weather a region has over a long period of time—is the source of water. Water comes to the watershed in seasonal cycles, principally as rain or snow. In some areas, condensation and fog-drip contribute water. The seasonal pattern of precipitation and temperature variation control streamflow and water production.

Some precipitation infiltrates the soil and percolates through permeable rock into groundwater storage and recharges areas called **aquifers**. Natural groundwater discharge is the main contributor to streamflow during dry summer and fall months. Without groundwater discharge, many streams would dry up.

Pumping water from an aquifer for industrial, irrigation, or domestic use reduces the aquifer's volume. Unless withdrawals are modified or recharge increased, the aquifer will eventually be depleted. A drained aquifer can collapse from the settling of the overlying lands.

Collapsed underground aquifers no longer have as much capacity to accept and hold water. Recharge is difficult, volume is less, and yields are considerably reduced. Springs once fed from the water table also dry up.

Land and water are linked directly by the water cycle.

Climate affects water loss from a watershed as well as providing water. In hot, dry, or windy weather, evaporation loss from bare soil and from water surfaces is high.

The same climatic influences that increase evaporation also increase transpiration from plants. Transpiration draws on soil moisture from a greater depth than evaporation because plant roots may reach into available moisture supply. Transpiration is greatest during the growing season and least during cold weather when most plants are relatively dormant.

Wind may cause erosion, control the accumulation of snow in sheltered places, and may be a significant factor in snowpack melting. Wind erosion can occur wherever wind is strong and constant, or where soil is unprotected by sufficient plant cover.

Physical features

The area of a watershed affects the amount of water produced. Generally, a large watershed receives more precipitation than a small one, although greater precipitation and runoff may occur on a smaller watershed in a moist climate than on a large watershed in an arid climate.

Shape and slope of a watershed and its drainage pattern influence surface runoff and seepage in streams draining the watershed. The steeper the slope, the greater the possibility for rapid runoff and erosion. Plant cover is more difficult to establish and infiltration of surface water is reduced on steep slopes.

Orientation of a watershed relative to the direction of storm movement also affects runoff and peak flows. A rainstorm moving up a watershed from the mouth releases water in such a way that runoff from the lower section has passed its peak before runoff from the higher sections has arrived. A storm starting at the top and moving down a watershed can reverse the process.

Orientation of a watershed relative to sun position affects temperature, evaporation, and transpiration. Soil moisture is more rapidly lost by evaporation and transpiration on steep slopes facing the sun. Watersheds sloping away from the sun are cooler, and evaporation and transpiration are less. Slopes exposed to the sun usually support different plants than those facing away from the sun. Orientation with regard to the prevailing winds has similar effects.

The area of a watershed affects the amount of water produced.

Soils and geology

Soil is a thin layer of the earth's crust. It is composed of mineral particles of all sizes and varying amounts of organic materials. It is formed from breakdown of parent rocks to fine mineral particles. This occurs by:

- Freezing and thawing in winter
- Heating expansion and cooling contraction in summer
- Wind and water erosion
- The grinding action of ice
- Gravity rockfall and avalanche movement
- Rock minerals in rain and snowmelt water
- Chemical action of lichens and other plants

Soils are of two types. **Residual** soils are those developed in place from underlying rock formations and surface plant cover. **Transported** soils include those transported by gravity, wind or water. Characteristics of residual soils are closely related to the parent material from which they were formed.

Soil is the basic watershed resource ... to be carefully managed and protected.

Climate, particularly precipitation and temperature, strongly affects soil formation. Rainfall causes **leaching**—movement of dissolved particles through soil by water. Temperature affects both mechanical breakdown of rocks and breakdown of organic material. Soil bacteria, insects, and burrowing animals also play a part in breakdown and mixing of soil components.

Soil often determines which plants will establish a protective vegetative cover. Plants also modify and develop soil. Plant roots create soil spaces. Plant litter adds organic matter to soil and extracts water and minerals in solution through the roots. Plant litter slows surface runoff and protects the soil surface from rainfall's beating and puddling effects. Soil depths and moisture-holding capacities are usually less on steep slopes, and plant growth rates are often slower.

Forage, timber, and water are all renewable resources. Water is renewed by cycles of climate. Forage and timber are renewed by growth in seasonal cycles. The availability of these resources is dependent upon soil. Soil is, except over long periods, a non-renewable resource. It may take more than a century to produce a centimeter of soil and thousands of years to produce enough soil to support a high-yield, high-quality forest, range, or agricultural crop. Soil is the basic watershed resource. Careful management and protection is necessary to preserve its function and productivity.

Vegetative cover

Grasses, **forbs**, shrubs and trees make up the major plant cover types. All four types build up organic litter and affect soil development. They usually develop under differing climatic conditions and all are important to watershed management.

A forest usually includes, in addition to trees in various stages of growth, an understory of shrubs and a low ground cover of forbs and grasses. While all plants in a forest have some effect on water, trees are the most important. Tree-litter fall protects the soil's surface. Tree roots go deep into the soil and help bind it, and tree crowns provide the most shade. The effects of shrubs and grasses are similar to those of trees including increased protection for soil against the beating action of rain and drying action of the wind.

Plant cover benefits a watershed. The canopy intercepts rain and reduces the force with which it strikes the ground. The canopy and stems also reduce wind velocity.

When leaves and twigs fall, they produce litter, which decomposes and is eventually incorporated into the soil. Litter protects the soil surface, allows infiltration and slows down surface runoff.

Stems and roots lead water into the ground. Roots open up soil spaces for water retention and drainage as well as add organic materials to the soil. The movement of minerals from roots to canopy provides recycling.

Windbreaks of trees and shrubs protect crops and reduce moisture losses from evaporation.

Water Temperature

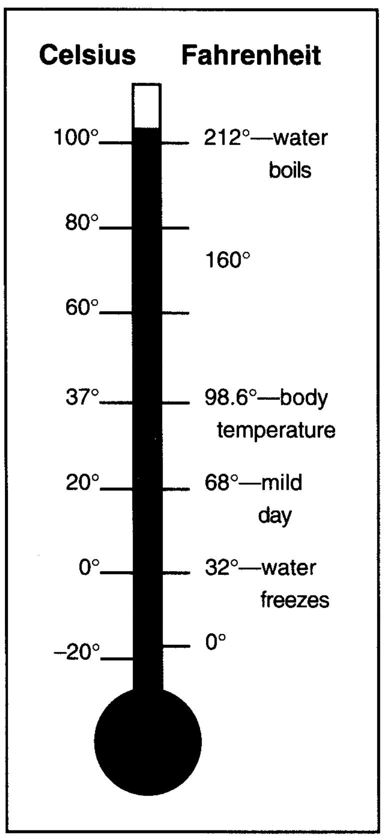
Stream Scene, Oregon Dept. of Fish & Wildlife, 1992

Water temperature is one of the most important factors for survival of aquatic life. Most aquatic organisms become the temperature of the water that surrounds them. Their metabolic rates are controlled by water temperature. This metabolic activity is most efficient within a limited range of temperatures. If temperatures are too high or too low, productivity can decrease or metabolic function cease. The organism can die. These extremes, or lethal limits, vary for different species.

Lethal limits

Within the lethal limits there is an ideal range of temperatures. In this range, an organism is more efficient, and the species has a greater chance of success. Various species of fish have adjusted to upper and lower levels of an optimum temperature range. Spawning, hatching and rearing temperature ranges vary from species to species. In this way, temperature determines the character and composition of a stream community.

In the Pacific Northwest, most streams have had populations of salmon and trout, which prefer temperatures between 40° and 65°F. In the summer, when temperatures are highest and water flows lowest, juvenile fish live in the pools of smaller streams. Pools offer deeper, cooler, oxygen-rich water and increased protection from predators. Because of low water flows, fish can be confined to a limited area. A temperature rise in a rearing pool can kill fish by exceeding their lethal temperature limits.



Plant cover's role

With the exceptions of hot springs and thermal pollution, solar radiation is the cause of increased water temperatures. Shade from riparian vegetation plays a major role in keeping streams cool. During midsummer, adequate shade will keep a stream 7° to 12°F cooler than one exposed to direct sunlight. Even the shade from debris in the water will help keep temperatures low. If there is enough debris, temperatures can be 3° to 8°F cooler than if there was no shade. Once water has warmed, it does not cool rapidly, even if it flows into a shady stretch.

It is important to recognize that water temperatures change from day to night and that cool-water areas exist in a stream.

Warmer temperatures encourage the growth of life forms that adversely affect fish and human health. Pathogens such as bacteria, as well as several parasitic organisms, thrive in warmer waters.

Water temperature is one of the most important factors for suvival of aquatic life.

Air temperature, surface area

As water in a stream mixes with air through exposure and turbulence at the surface, water is influenced by the air temperature. This mixing action can also increase the evaporation rate.

The greater the surface area of a body of water, the greater its exposure to both solar radiation and air. Because of its increased surface area a wide, shallow stream will heat more rapidly than a deep, narrow stream.

Streambed, streamflow, orientation and sediments

Color and composition of a streambed also affect how rapidly stream temperature rises. A dark bedrock channel will gain and pass to the stream more solar radiation than a lighter-colored channel. Similarly, solid rock absorbs more heat than gravel.

The streamflow, or volume of water in a stream, influences temperature. The larger a body of water, the slower it will heat. Rivers and large streams have more constant temperatures than smaller streams.

The direction a stream flows also affects how much solar radiation it will collect. Because of the angle of the sun's rays, southerly flowing streams receive more direct sunlight than streams flowing north. Eastward or westward flowing streams receive shading from adjacent ridges, trees and riparian vegetation.

Sediments suspended in water can absorb, block or reflect some of the sun's energy depending on their color and position in the water. Particles on or near the surface can have a beneficial influence through reflection, but those with a dark color increase the total energy absorbed from the sun.

Effects of thermal pollution

Thermal pollution occurs when heated water is discharged into cooler streams or rivers. This heated water generally has been used to cool power plants or industrial processes and can be as much as 20°F warmer than the water into which it is discharged. This increase in temperature can have drastic effects on downstream aquatic ecosystems.

Figure 11. Temperature Ranges (approx.) Preferred by Certain Organisms

Temperature (Fahrenheit)	Examples of life
Greater than 68° (warm)	Redside shiner, crappie, bluegill, carp, catfish, caddisfly, dragon fly, and much plant life
Middle range (55°-68°)	Brown trout, rainbow trout, stonefly, mayfly, caddisfly, water beetles, sculpins, and some plant life
Low range (cold, less than 55°)	Brook trout, sculpins, caddisfly, stonefly, mayfly, and some plant life

Adapted from Claire Dyckman and Stan Garrod, eds., *Small Streams and Salmonids*, p. 73.

Name________________________

Where Am I Comfortable?

Use **STUDENT HANDOUT 5B: Water Temperature, *Stream Scene*** for this activity.

1. For the two questions below, list causes and explain how they work.

    a. What causes water to heat in a pond, lake or stream?

    b. What might cause water there to cool?

2. You measure the temperature of a stream. It is 62^{O}F. What kinds of organisms might you expect to find there?

3. You sample a stream and find rainbow trout, caddisfly larvae, dragon fly larvae, water beetles, and some plant life. Estimate, as closely as you can, the temperature of the water in that stream. Explain how you made your decision.

4. Explain how you can use a list of the organisms found in a stream to assess its physical properties.

5. Use all of the information in the article and on this sheet to make a stream analysis worksheet. Your worksheet should be designed so that someone who had followed the directions in the stream analysis worksheet (made observations and recorded them on the worksheet) could determine the general health of the stream. Think carefully, consult with your partners, and then design your stream analysis worksheet.

STUDENT HANDOUT 5D **Name**_______________________

Fish and Water Temperature

(Adapted from Stream Scene)

Different fish require different water temperatures to survive. Most fish are killed by high temperatures, not by low ones. They may grow more slowly at lower temperatures, but they are not usually killed unless they freeze.

Human activities can quickly change water temperature. For instance, a coal or nuclear power plant takes water from the river, turns it into steam, then puts hot water back into the river, thereby raising the temperature. Removing the trees along a river or stream can also raise the temperature.

Biologists perform a test to find out what water temperature fish need. The fish are put into an aquarium at a certain temperature and left for twelve hours. The biologist then checks to see how many fish are still alive. The temperature is raised until half the fish die within a twelve-hour period. This temperature is the "12-hour tolerance limit median" (12-hour TLM). It is the tolerance limit because it is the highest temperature that fish can tolerate. It is called the median because half of the fish die.

Remember that this is not the temperature at which the fish do best. Rather, this is the temperature where half of them die in just twelve hours. A similar number for humans might be 150 degrees Fahrenheit. This is not where we do best, but the limit for our survival.

The table below lists the 12-hour TLM for several fish species.

COMMON NAME	12 HR. TLM	COMMON NAME	12 HR. TLM	COMMON NAME	12 HR. TLM
Cutthroat Trout	77 F	Speckled Dace	85 F	Bluegill Sunfish	94 F
Coho Salmon	77 F	Yellow Perch	87 F	Pumpkinseed	94 F
Brook Trout	78 F	Long Nose Dace	88 F	Redside Shiner	95 F
Steelhead	80 F	Tui Chub	89 F	Brown Bullhead	97 F
Rainbow Trout	80 F	Common Shiner	90 F	Largemouth Bass	98 F
Brown Trout	81 F	Short Nose Dace	92 F	Carp	106 F
Redband Trout	82 F	Fathead Minnow	93 F		

STUDENT HANDOUT 5D continued

QUESTIONS

1. Explain how you might perform a 48-hour TLM test?

2. Which five species would you expect to survive best if a coal plant raised the stream temperature by 10 degrees Fahrenheit from 80 degrees Fahrenheit?

3. How would Coho salmon probably be affected by an increase in stream temperature caused by a power plant?

4. Look only at the salmon and trout species listed in the table: which one is the least tolerant of high temperatures? Which is the most tolerant?

5. Explain how each of these human activities could cause problems for the salmon by increasing the water temperature.

   a. removing trees next to a stream

   b. building a dam

   c. taking water out of a stream for irrigation

STUDENT HANDOUT 5E **Name**____________________

Effects of Temperature on Goldfish Respiration Rate

(Adapted from Stream Scene)

Purpose: To determine how temperature affects the respiration rate of a fish.

Materials needed:

- ❑ 600 ml beaker, filled with 300 ml of aquarium water
- ❑ goldfish
- ❑ thermometer (Celsius)
- ❑ large culture dish with ice

Procedure:

A. Put the goldfish in the 600 ml beaker.

B. Observe your fish carefully. Watch how the gill plates on either side of the head move. Watch the mouth open and close.

Questions:

1. How do the mouth and gill plates coordinate their movements?

2. As water moves from the mouth, across the gills, and then out of the gill slits, what type of gas will diffuse from the water into the blood of the fish? (This will be the same gas that humans take into their blood as they breathe). How do you think this transfer of gas occurs in the gills?

3. As water moves across the gills, what type of gas will diffuse from the blood and into the water? (Again, the same gas leaves the lungs of humans.)

4. Describe your fish's behavior.

STUDENT HANDOUT 5E continued

5. Observe your fish. Count how many times the gill plate opens and closes in 15 seconds. Repeat this calculation until you are confident that you can record it accurately. Record that measurement here:

6. Predict: Will the fish open and close its gill plate faster or slower when the water is cold? Why do you think so?

7. Place your thermometer inside the beaker with your fish. Position it so that you can read it without disturbing your fish.

C. Fill the culture dish around the beaker with ice. Pack the ice against the side of the beaker. You may wish to add salt to the culture dish (not the beaker) to speed up the melting (and so speed the cooling of the water in the beaker). Allow the beaker to reach 5 degrees Celsius, then remove it from the culture dish. Dump out the ice.

D. Count the number of times that the gill plate opens and closes in 15 seconds. Repeat. Record your observations on the following chart. At each temperature, note your fish's behavior.

E. Fill the culture dish with lukewarm water. Place the beaker with the fish in the culture dish. Allow the fish to warm to 12 degrees Celsius.

F. Count the gill plate movements for 15 seconds. Repeat and record.

G. Continue to allow the fish to warm up, stopping at 15, 20, and 25 degrees Celsius to record gill plate movements. **Do not warm the fish above 25 degrees Celsius!** You will need to warm your water in the culture dish periodically.

H. Return the goldfish to the aquarium.

STUDENT HANDOUT 5E continued

I. Average your two observations for each temperature. Record your average on the overhead data sheet for the class.

	5 degrees C	10 degrees C	15 degrees C	20 degrees C	25 degrees C
Count 1					
Count 2					
Average					
Class average					

Temperature	Behavior
5 Celsius	
10 Celsius	
15 Celsius	
20 Celsius	
25 Celsius	

STUDENT HANDOUT 5E continued

8. Graph your data on the graph below.

Label the Y axis “Breaths per 15 seconds”. Label the X axis “Temperature in Celsius”.
Plot two lines on your graph: your average values, and the class averages.
Label your two lines carefully.

STUDENT HANDOUT 5E continued

Discussion questions:

1. How did your goldfish change its behavior during your experiment?

2. As the temperature increased, what happened to the respiration rate of the goldfish?

3. How does your graph compare to the class average?

4. What are some variables (differences) in your experiment that could explain why your data are different from the other groups? List as many variables as you can.

5. There are two types of animals: warm-blooded and cold-blooded. Warm-blooded animals maintain their bodies at about the same temperature at all times, examples of warm-blooded animals include humans, beavers, and whales. Cold-blooded animals change temperature as the environment changes temperature, such as lizards and frogs. Chemical reactions, such as using oxygen to get energy, happen more slowly at colder temperatures. Are goldfish warm-blooded or cold-blooded? Explain how you know from this lab.

6. If you had very little food for a goldfish and you wanted to make it last as long as possible, at what temperature should you keep your fish? Why?

STUDENT HANDOUT 5F: ***Wading into Wetlands*****,** National Wildlife Federation

Wading into Wetlands

Published by the National Wildlife Federation

WWEG96

The water's up to your ankles and a pungent smell reaches your nose. You move along slowly, watching a great blue heron search for its lunch. When you round a bend, you're startled by a flock of ducks as they take off from the water. A dragonfly zips past your head as you watch the ducks fly off over trees.

You could be in a swamp. Or a salt marsh. Or one of many different types of wetlands. In this teacher's guide you'll learn what we mean by the word "wetland"—and why wetlands are so special.

There are many kinds of bogs, marshes, swamps and other wetlands. But all wetlands share some characteristics that set them apart from other kinds of habitats.

Most ecologists define wetlands as areas that, at least periodically, have waterlogged soils or are covered by shallow surface water, which supports plants and animals that are adapted to living in a watery environment.

Various factors can create wetlands. Since most wetlands are located in low-lying areas, rain and runoff help to keep them saturated. Some wetlands lie where groundwater is at or very near the surface of the Earth and feeds the wetlands from below. Other wetlands stand next to rivers or other bodies of water that regularly overflow. In coastal areas, tides keep many wetlands saturated.

Some wetlands start with a little outside help. Beavers, for example, turn meadows into marshes or parts of forests into swamps by damming streams. People create wetlands, too. For example, a state wildlife agency might flood an area to create fish and wildlife habitat.

SALTWATER WETLANDS

Because they exist along coastlines, the major kinds of saltwater wetlands—salt marshes and mangrove swamps—support rich networks of life adapted to dynamic environments. Twice each day along most of the world's coasts, the tide rises and falls, exposing coastal wetlands to a rapidly changing environment. The plants and animals that live in these wetlands must be able to adapt to shifting water levels, fluctuating temperatures, periodic exposure to air and increases and decreases in the salt content, or salinity, of the water.

Salt Marshes

Found primarily along the Atlantic and Gulf coasts, but also in scattered locations along the U.S. West Coast, salt marshes are open areas filled with a sea of grasses or grass-like plants. Often they're found in the inner reaches of coves, inlets and bays since this protects them from the full force of the pounding surf. Sediment brought in on the tides and nutrient-rich silt carried by rivers can settle in these calmer areas, giving marsh plants an ideal place to

sprout, grow and spread.

Because of all the food salt marshes have to offer, they support a considerable amount of wildlife. But many salt marsh organisms are small or even microscopic. Few larger animals make the salt marsh their permanent home, and many migrating birds make only brief stopovers.

Mangrove Swamps

Mangrove swamps are the tropical counterparts to the salt marshes of cooler climates. They reach their most lush growth in the United States along the coasts of southern Florida. With their jungle of roots and dense leaves and branches, mangrove trees are the dominant plants in these swamps. They are great storm breakers, in addition to being popular places for wildlife.

Certain animals, like some oysters, cling to mangrove roots. Others, such as shrimp, fish and crabs, hide and feed among the roots submerged by high tide. And in the mangrove branches, storks, herons, egrets and a dozen other birds nest or roost. The swamps are also the last stopover for birds migrating across the Gulf of Mexico in the fall and the first stop for those returning in the spring.

FRESHWATER WETLANDS

Many ducks and geese, with numbers in the tens of millions, along with numerous shorebirds and other types of wildlife, start their lives in a marshy wetland area, better known as prairie pothole country. It covers more than 300,000 square miles throughout parts of the Dakotas, Minnesota, Montana, Iowa and Canada. Prairie potholes, which are numerous small ponds created by glaciers long ago, and other types of freshwater marshes along with swamps and bogs make up freshwater wetlands.

Marshes

From small cattail marshes along major highways in California to huge expanses of sawgrass in Florida to prairie potholes, freshwater marshes are a common sight throughout much of North America. Thick clumps of soft-stemmed plants such as grasses, sedges and rushes are abundant, along with cattails and water lilies. According to some biologists, freshwater marshes make up about 90 percent of our wetlands.

The water in a marsh fluctuates from season to season, rising during heavy rainfalls and often disappearing during dry periods. Seasonal or ephemeral wetlands are overlooked by people as vital areas because they may only be saturated with water for short periods during the year. The importance of these areas for migratory birds and flood control is often discounted simply because they don't look like typical wetlands.

Bogs

Bogs are freshwater wetlands that usually contain a huge build-up of peat—rich organic material that is made up of partially decayed plant material. Peat forms as plants die and their parts fall into the water.

Bogs are usually found in wet areas of the colder regions of the world where there is very little water flowing in or out. The high acidity of the peat, the cold year-round temperatures and the limited oxygen supply due to poor water circulation discourage bacteria and other decomposers from breaking down plant material, so peat layers grow year after year, becoming up to 40 feet thick.

Some bog plants, such as black spruce, have root systems adapted to low-oxygen supplies and waterlogged conditions. Others, such as some orchids and heath plants, have symbiotic relationships with fungi that help them get nutrients they need, which are in short supply in most bogs. Many bog plants, such as bladderworts, pitcher plants and sundews, trap and digest insects and other tiny animals as a source of nutrients.

Swamps

Swamps are wetlands dominated by shrubs or trees. They are usually saturated with water during the growing season but may dry out later in the summer. Swamps can have anywhere from a few inches to a few feet of water.

Two groups of freshwater swamps predominate. Forested swamps are often associated with major river systems, such as the Mississippi, and they often occur on river floodplains. These swamps are famous for their huge trees and contain stands of enormous bald cypress, overcup oak and water tupelo. On the other hand, shrub swamps are characterized by scrubby, low-growing vegetation. These swamps often form in poorly drained areas on the edges of lakes, forested swamps, marshes and streams.

WETLANDS AND WILDLIFE

Wildlife benefits from wetlands in many ways. Some examples follow:

Migration

While traveling between winter and summer homes, geese, herons, egrets, sandpipers, plovers and other birds converge on wetlands to "refuel" on rich food supplies before resuming their journeys. Many birds nest and winter in wetlands, too.

Natural Nurseries

The young of certain fish, crustaceans and other creatures spend their earliest days in wetlands, taking advantage of the rich food supply before moving to open waters. Thick wetland vegetation also provides a good place to hide.

Habitat and Breeding Grounds

Wetlands provide hundreds of kinds of plants and animals vital habitat in which to live. In particular, the health of our nation's waterfowl population is directly tied to these areas. Seventy-five percent of all waterfowl breed only in wetlands.

Havens for Rare Species

Wood storks, snail kites, whooping cranes and American crocodiles are all endangered species—and they all live in wetlands. In fact, about 43 percent of U.S. threatened and endangered species either live in wetlands or depend on them in some way for their survival. This means that almost half of the nation's rare animals and plants are inseparably linked to areas that, altogether, make up only about five percent of the total land area in the lower 48 states.

WETLANDS AND PEOPLE

Wetlands provide people with countless benefits. Here are a few:

Flood Busters

Sponging up excess water, wetlands offer an easy and cheap way to control floods. Because they lie in low spots or depressions, wetlands function like giant, shallow bowls. Water flowing into the bowls spreads out and slows down, which helps to reduce flood damage to the natural and human environment.

Natural Pollution Filters

As Mother Nature's maid, wetlands and the aquatic plants that grow there provide free cleaning services by removing excess nutrients, heavy metals and other toxic chemicals from polluted runoff water. Contaminants adhere to vegetation and sediment that settle on the wetland floor. In this way, wetlands help protect the nation's drinking water.

Silt Trappers

When wetlands slow flood waters, the silt and other sediments in the water settle out among the roots and stems of wetland plants. This helps to protect streams, lakes and other bodies of water downstream from a build-up of sediment that could stifle aquatic plants and animals.

Storm Breakers

Coastal wetlands buffer the effects of the ocean's strong winds and waves on shoreline communities of people and wildlife.

Groundwater Rechargers

The nation's groundwater can be replenished and recharged by wetlands. Surface waters that feed into groundwater systems recharge or refill these systems. Water migrates downward through wetlands to maintain groundwater levels.

Stock for Fisheries

Wetlands support the commercial fishing industry because they provide fish and shellfish with food and a place for breeding and raising young.

Recreation Hot Spots

Hunters and anglers of wetland-dependent species rely on intact wetland ecosystems to support and nurture their recreation. Many more Americans seek wetlands as retreats to birdwatch, photograph and otherwise appreciate wetland species and habitat.

WATCHING OUT FOR WETLANDS

Wetlands are highly sensitive to disruption caused by human activities. Since the first European settlers colonized North America, we have lost well over 50 percent of our wetlands. And the latest reports put the losses at up to 290,000 acres of wetlands every year.

As wetland areas have become more populated, development has crept farther and farther into these critical areas. More channels, dikes and diversions have been installed. Much of the rich peatland that had taken hundreds of years to form has been drained and turned into farmland. Other former wetland areas have become pastures for livestock. Fertilizers from farms and lawns seep into our water, reducing its quality.

Wetland areas are in trouble all over the country. Here are some examples:

Everglades

One of the largest marshes in the world, the Everglades once covered most of South Florida. Disrupting the balance of alternating wet and dry seasons, urban and agricultural development since 1900 have put the entire Everglades ecosystem in jeopardy, including the 1.2 million acres that lie in Everglades National Park.

Prairie Potholes

Only 5.3 million acres remain of the 17 million acres of prairie wetlands that once dotted North Dakota, South Dakota and Minnesota. About 33,000 acres of prairie potholes continue to disappear each year.

Great Lakes

Marshes along the Great Lakes have decreased 90 percent. These marshes not only provide habitat for fish and wildlife, but also help to prevent shoreline erosion and minimize the destructive effects of storms.

California

Less than 450,000 acres of California's original 5 million acres of wetlands remain.

Lower Mississippi Valley

Only about 15 percent of the bottomland hardwood wetlands that once covered the lower Mississippi Valley still exist.

TAKING CARE OF WETLANDS

From local zoning laws to state wetland acquisition to provisions in the national Clean Water Act, wetlands have some protection at all levels of government. But because of lack of support and money, much of the legislation for wetlands protection is poorly enforced, and some of it has been offset by conflicting legislation that encourages wetland destruction.

Two of the most effective wetland-protection programs are the Federal Migratory Bird Stamp Program (known as the Duck Stamp program) and Section 404 of the Clean Water Act. The Duck Stamp program, administered by the U.S. Fish and Wildlife Service, requires waterfowl hunters over 16 years of age to purchase a duck stamp annually. The funds raised help buy valuable wetland habitat. Section 404 of the Clean Water Act helps prevent wetland destruction while still allowing certain development under a permit program.

Although these and other programs have given wetlands a helping hand, many conservation groups feel that much more wetland protection is needed. The National Wildlife Federation and other groups are working to establish a national wetland policy that would: prevent any additional loss of wetlands; restore wetlands that have been dredged, drained and overdeveloped; construct artificial wetlands as needed; support wetland research; and strengthen existing wetlands legislation.

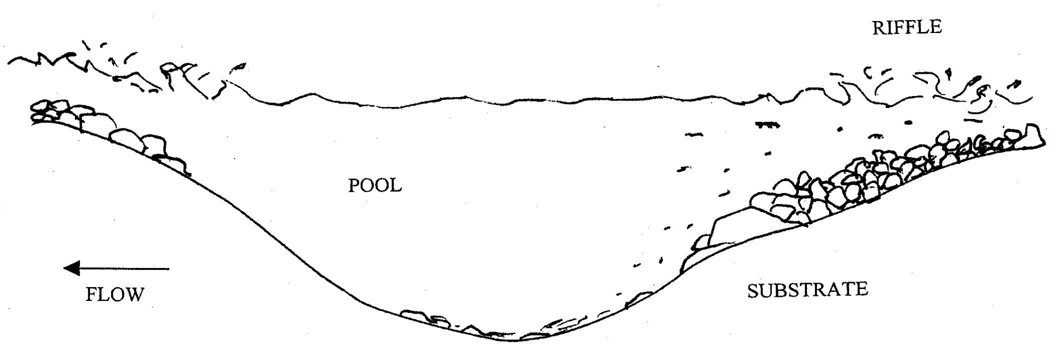
STUDENT HANDOUT 5G

Stream Structure and Fish Habitat

Streams are unique, constantly changing environments that support an array of aquatic life. The organisms that live in a stream are adapted to the changes and fluctuations that occur in a stream over time. Here we will discuss the structure of a stream and how aquatic animals, such as insects and fish, use the stream to their advantage.

Stream Structure

The way water moves through a stream is heavily influenced by the land that is surrounding and underneath the stream channel. The **stream channel or bed** consists of the area that cradles the water. If this area is narrow the water moves quickly, if it is wide the water slows down. The depth of the stream also influences water movement, and the reverse is also true: the water alters the depth of the stream. The stream bed itself is constantly changing. When the water level is high and the stream is moving quickly, rocks and soil in the stream bed are easily moved. Banks can be carved away or gravel can be scoured out. When the water slows, rocks and soil are deposited at the bottom of the stream.



The land at the bottom of the stream is called the stream **substrate.** Examples of substrate are bedrock, gravel, or silt. When you look at a river bottom you can see the substrate change in relationship to the movement of the water. Where the water is moving quickly there is usually more rock and where the water slows you see finer particles like sand and silt.

As the water moves through the stream channel, it changes its speed, depth, and temperature depending upon the surrounding conditions. When water enters an area that is deep and wide, it spreads out and slows down as it fills the channel. This area is called a **pool.** When the channel narrows and is shallow, the water moves swiftly, forming small waves or white water. This area is called a **riffle.**

A Chain Reaction

If we look at how the structure of the stream bed influences the movement of the water and how the water influences the stream channel, we can see that there is a chain reaction that occurs when a change takes place in a stream. When the bank of a stream gives way, the soil falls into the water. The water carries the soil particles downstream to a slow moving section of the river where the particles drift to the bottom, becoming substrate. This new substrate makes the stream bed shallower. The water begins to move a little more quickly in the shallow area. As the water moves more quickly, some of the deposited soil is stirred up and carried further downstream. The area where the bank originally eroded also widens the stream channel, slowing the water a bit as it passes.

Fish Habitat

Their riffles, pools, different substrates help to characterize streams. If we think about the needs of fish like salmon and trout, we can identify what stream characteristics they need. Fish need oxygen to breathe. They don't breathe oxygen from the air like we do; they breathe it from the oxygen in the water called **dissolved oxygen**. Oxygen can be added to the water when it interacts with air.

Question: Does the water mix more with the air in a riffle or a pool?

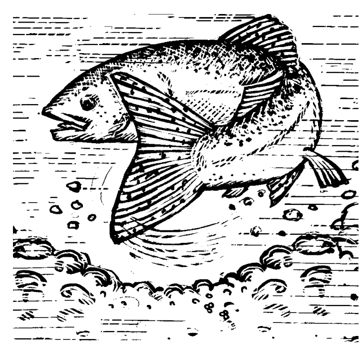
The "white water" of a riffle adds fresh oxygen to the water, so our fish need streams with riffles and adequate dissolved oxygen. Salmon and trout are also in need of cool water. The speed or velocity of the water in a stream helps keep it cool as does the depth.

Question: Would shallow or deep water warm up more quickly in the summer sun?

When the water level in a stream goes down in the late summer, the temperature goes up. Shallow water warms up more quickly than deep water. Our fish need cool water so they need streams that have deep pools to keep the water cool and that have water moving all summer long. In addition, shade from the plants along the bank of a stream keeps the temperature down. These plants in the **riparian** area (the area along the stream) are important not only for shade but also to help stabilize the bank and provide a food source for aquatic insects.

Salmon and trout also need places in the stream to lay their eggs. Like birds, these fish build nests or **redds**, to protect their eggs while they develop. The eggs need cool water and oxygen to develop.

Question: Think about the substrate of a stream. Where would you want to hide your eggs? Where will they get cool water and oxygen? Where will predators not find them and they won't wash away?



Salmon use gravel as the substrate for their nests. They dig a depression in the small rocks, lay their eggs, and cover them up with gravel. Gravel allows water to circulate through the rocks bringing oxygen to the eggs. It also hides the eggs from predators and keeps the eggs from drifting downstream. The best location for their redds is found at the end of a riffle where the water is beginning to slow down as it enters a pool but is oxygen rich. It is also in this area where aquatic insects hide, the future food source for young salmon.

Juvenile salmon spend time in the stream eating and growing before heading to the ocean. These small fish need to protect themselves from predators and from strong currents that might push them downstream.

Question: Where in the stream can a young fish hide? Where will food be found?

Young salmon vary in the use of the stream depending upon species. In general, young salmon stay close to the banks or near fallen logs or rocks to hide from predators. They find their food, aquatic insects, drifting in the current. As the salmon get bigger they venture into faster water to find more insects being carried downstream.

Salmonids and Physical Stream Characteristics

Physical stream characteristics useful in differentiating habitat preferences of salmonids.

Habitat preference	SPECIES Coho	Chinook	Steelhead	Cutthroat
% pools	50–80	50–100	< 50	40–60
% gradient	<3	< 2	>1–5	1–20
Stream order	2–5	≥ 5	2–5	> 2
Maximum temperature	<65°F 18°C	< 68°F 20°C	< 73°F 23°C	< 65°F 18°C

Physical stream characteristics useful in evaluating stream quality preferences for salmonids.

Characteristics				
Cover	woody structure	pool depth	boulders & wood	wood, volume, boulders
Channel profile	flat	moderately flat	steep	undercut banks
Riparian	Presence of riparian vegetation important for all species. Vegetation type (fir, alder) and age of vegetation determine quality.			

Stream Scene, Oregon Dept. of Fish & Wildlife, 1992

STUDENT HANDOUT 5H
From ***Stream Scene***, Oregon Dept. of Fish & Wildlife, 1992

Name

Home wet home . . .

Do you know . . .

Salmon and trout (salmonids) are important to anglers. Salmonids are also important to biologists because their presence helps indicate the health of the stream in which they live. Salmonids are one of the first organisms to be affected if their watery home starts to change or if their habitat is unsuitable. Biologists refer to sensitive animals like salmonids as "indicator" species.

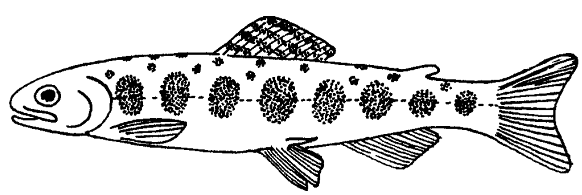
Because salmonids are so significant, fish biologists have developed many ways to improve stream habitat to enhance fish survival. In some cases, biologists can produce a fishery where none was previously found.

The ecological requirements of salmonids are:

- Cool, clear, well-oxygenated water
- Sections of gravel bottom for spawning
- Occasional pools for feeding and resting
- Adequate food (aquatic and terrestrial insects, the latter usually falling from streamside vegetation)
- Cover for protection from predators

Now it's your turn . . .

The figure on the next page shows several ways a stream can be modified to improve salmonid habitat. Each structure or management technique has been used to meet the special needs of these sensitive fish. Next to each feature, describe fully the contribution each will provide for fish.



STUDENT HANDOUT 5H: ***Home Wet Home…, Stream Scene***

A. streamside vegetation

B. rock weir

C. root wad

D. cover logs

E. rip rap (rocks or vegetative)

F. rock wing deflector

G. shade plantings

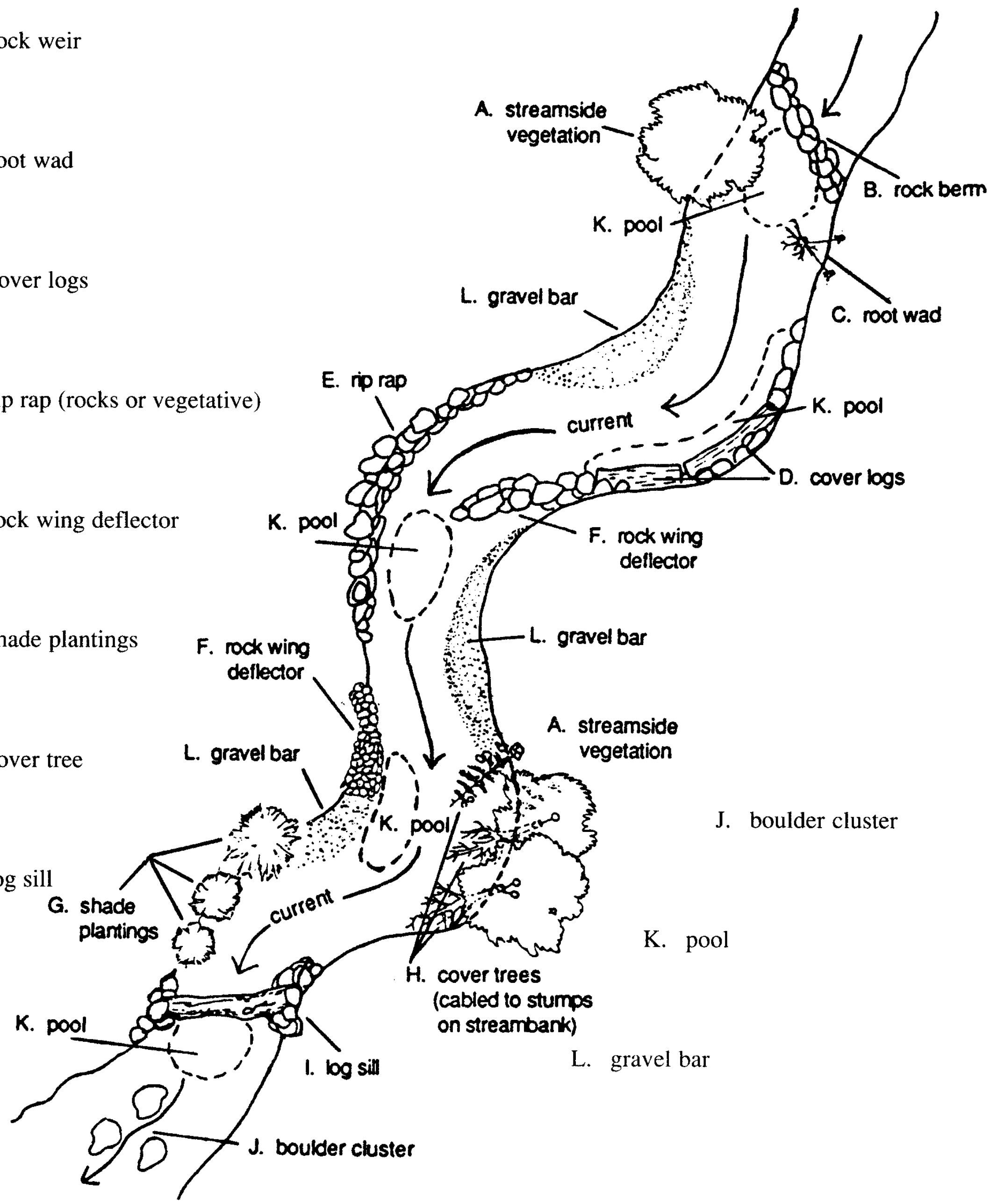
H. cover tree

I. log sill

J. boulder cluster

K. pool

L. gravel bar



Name____________________

Fish Habitat Needs Vocabulary

DIRECTIONS

1. Read ***Fish Habitat*** Handout.

2. On a separate sheet of paper, write definitions for the terms below, using the following guidelines:

   A. Read the sentence where the term is found.

   B. Write a definition for the term. Do not use a dictionary. Instead, try to find the meaning from context.

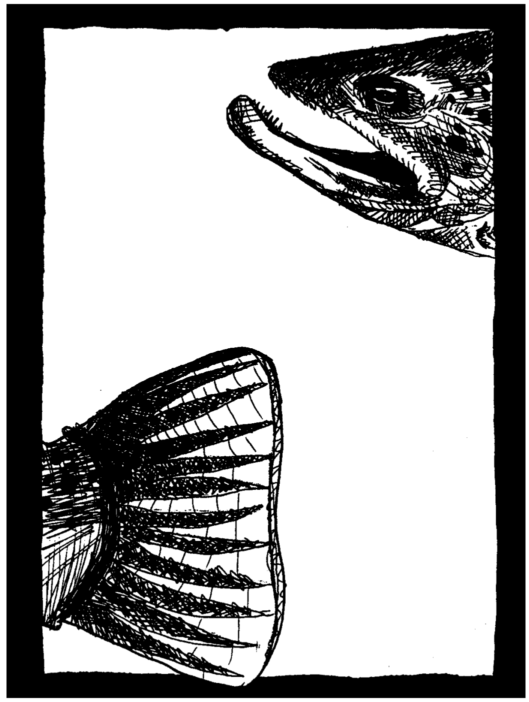
   C. Leave a blank line below the definition to revise or clarify it after reading the whole article and talking about the subject.

   D. Find examples of these words in your neighborhood. Name and describe them.

   E. Where appropriate make and label a sketch to illustrate the concept.

3. The terms are:

   riffle
   stable
   porous
   sediment-free
   stream channel
   substrate
   debris
   litter
   dissolved oxygen
   pool
   root wad
   riparian
   carrying capacity



Charnelle Alexander, Hidden Valley High

UNIT 6. HUMANS AND THEIR ENVIRONMENT

INTRODUCTION

A Pledge: "We, the people of Oregon, promise to do our best, to understand and respect the needs of salmon, and to make meaningful commitments in the way we conduct our lives, in the hope that both salmon and people, will survive and flourish, together, long into the future."
Jay Nicholas, Oregon Coastal Salmon Restoration Initiative, 1997.

Perhaps the single greatest factor impacting salmon in the Pacific Northwest has been human development of the region in the last 150 years. Humans have altered the salmon's environment from the earliest settlement in the region. Since the 1850s, however, human interactions with the salmon and its environment have caused some dramatic changes to the land, waters and society of the Pacific Northwest.

Population of the region increased dramatically. The 1850 Census listed the population of Oregon Territory at 12,093. Currently Oregon's population is over 3.5 million

Humans have altered the landscape by clearing forests for farms and cities. They have taken water from streams and rivers to irrigate formerly desert land to grow crops. They introduced cattle and other animals that graze in and around streams, wetlands and other riparian areas. They have dredged the Columbia and other rivers to make them useable for large ocean going vessels. They straightened rivers and streams to suit their needs. They filled in wetlands. They built dams, both large and small, to help harness the power of the rivers to generate electricity, to store water for agriculture, to aid navigation, and to protect settled areas from floods. They added chemicals, oil, trash and other pollutants to the waters. They devised more deadly and efficient means of catching larger numbers of fish, like fish wheels and gill nets. As impacts to salmon from human activities became apparent, society enacted laws, rules and regulations to protect the salmon. States banned certain types of fishing equipment, such as fish wheels. The states also imposed restrictions on fishing seasons and eventually limited numbers of fish caught through treaties with the tribes and the Canadian government. The federal government established large forest reserves, now the National Forest System, to better manage the forests of the west and lessen the impact of some logging practices. We created national parks and wilderness areas, to preserve particularly scenic and sensitive sections of the country. Both the federal government and the states developed a series of agencies to regulate activities like mining, agricultural practices, the licensing of dams, the marketing of power and the use of land. We passed laws, such as the Clean Water Act, and the Forest Practices Act to control the spread of pollution and to govern forestry activities in order to help rivers and streams stay healthy or return to health. Listed on the following page are the specific of the Oregon Forest Practices Act.

In 1973, Congress passed the Endangered Species Act as a last line of defense for species in danger of extinction. In 1991, Snake River sockeye salmon became the first Northwest salmon species to come under the protection of the Endangered Species Act. Snake River Chinook joined sockeye on the endangered list five months later. Some species of Coastal Coho and Columbia/Snake River Steelhead have recently received listings. Other salmon species from Puget Sound to Idaho to the Willamette River to Northern California are candidates to follow Snake River Chinook and Sockeye onto the Endangered Species List. For the most current listings check the NOAA website at http://www.nwr.noaa.gov/1salmon/salmesa/pubs/1pgr.pdf.

Several government agencies and organizations have prepared plans to help recover salmon impacted by human activities. In 1980, the Northwest Power Act established the Northwest Power and Conservation Council. The Council, composed of the states of Montana, Oregon, Idaho and Washington, developed a Fish and Wildlife Program to "protect, mitigate and enhance" fish and wildlife affected by the development of the Columbia River hydropower system while assuring the Northwest of a "reliable, efficient and economic" power supply.

When the Snake River Sockeye and Chinook received their endangered species listings, the National Marine Fisheries Service crafted the Biological Opinion to guide operation of the Columbia River to prevent the extinction of these species. The 1995 Biological Opinion currently forms the operating plan for the river.

The Nez Perce, Umatilla, Warm Springs and Yakama tribes combined to produce *Wy-Kan-Ush-Mi Wa-Kish-Wit, Spirit of the Salmon* recovery plan in 1995. The tribal plan covers all aspects of Columbia and Snake River management and includes a large subbasin by subbasin watershed and habitat planning section.

In 1997, the State of Oregon created the Coastal Salmon Restoration Initiative, which relies upon the citizens of the state to make voluntary changes to the way they use their watersheds for the benefit of the salmon. The Oregon Plan for Salmon and Watersheds (as it is now called) focuses on watershed councils - diverse groups of citizens organized by the watershed in which they live and work - to plan and carry out restoration activities. The Oregon Plan was amended in 1998 to cover steelhead. For more details see page 6.4.

In March 2003 Oregon Department of Forestry incorporated Salmon Anchor Habitat strategies into their Northwest Forest Plan. This plan identifies the anchor habitat approach as a strategy for managing species of concern. The "Salmon anchor Habitats Strategy for Northwest Oregon State Forests" establishes salmon focus areas in the Tillamook and Clatsop state forests. Seventeen watersheds were identified as the core of salmon recovery efforts on the state forests.

The effort to recover salmon species is impressive. The question we all face, however, is: has the recovery effort come too late to avoid losing these species forever?

This unit is designed to give students the opportunity to explore the issues revolving around the salmon crisis through role-plays, simulations, lab experiments, discussion and reading.

SECTIONS

A. John Day Dam Role-play
B. Salmon Fisheries Simulation
C. Human Population Growth – Flies Lab
D. What Are Your Energy Needs?
E. Native American Fishing Rights Mock Treaty Negotiation Role-Play
F. Salmon Political Science: Management and Regulation
G. The Role of Hatcheries

The Oregon Forest Practices Act

The Oregon Forest Practices Act (OFPA), originally implemented in 1971, governs forest operations in Oregon. Basically, the OFPA set standards for any commercial activity involving the establishment, management or harvesting of trees on non-federal lands (i.e. private, state-owned, and county/city-owned). Federal lands managed by the USDA Forest Service and USDI Bureau of Land Management are not directly regulated. Both however have agreed to meet or exceed the requirements established under the Oregon Forest Practices Act.

Specifically, the Act guides the management of Oregon 's forest lands to insure:

- ❑ Responsible harvest practices and prompt reforestation.
- ❑ Diverse and abundant forest habitat for fish and wildlife.
- ❑ Environmentally sensitive forest road contraction and maintenance.
- ❑ Safe use of chemicals.
- ❑ Protection of air and water resources.
- ❑ Reducing the potential of soil degradation and erosion.

Today the OFPA contains some of the most comprehensive forest protection regulations in the country and it continues to grow and evolve.

For more information on the OFPA contact either:

Oregon Department of Forestry
2600 State Street
Salem, Oregon 97310

Or

Oregon Forest Resources Institute
317 SW Sixth Avenue, Suite 400
Portland, Oregon 97204-1705

The Oregon Plan for Salmon and Watersheds

Origins of the Oregon Plan

In 1997, with the support and participation of a wide spectrum of stakeholders from all sectors and regions of the state, the Oregon Legislature and then-Governor John Kitzhaber established the Oregon Plan for Salmon and Watersheds. Motivated at first by the conviction that the state must devise its own home-grown response to listings of coho and other salmon species under the federal Endangered species Act, Oregon expanded the plan into an unprecedented statewide program to preserve and profit from Oregon's natural legacy.

Key Elements of the Oregon Plan for Salmon and Watersheds

Voluntary restoration actions by private landowners – individuals and industry, rural and urban –with support from citizen groups, businesses, and local government.

Coordinated state and federal agency and tribal actions to support private restoration efforts, effectively administer regulatory programs, soundly manage public lands, and promote public education and awareness about watersheds and salmon.

Monitoring watershed health, water quality, and salmon recovery to document existing conditions, track changes, and determine the impact of programs and actions.

Strong scientific oversight by an independent panel of scientists who evaluate the plan's effectiveness, identify needed changes, and guide research investments.

The Oregon Legislature allocates Oregon Lottery and salmon license plate funds to implement the Oregon Plan for Salmon and Watersheds. Every dollar the state invests is matched by more than $150 of private, federal, and local government funds – and those dollars remain in the state, stimulating local economies. While a host of state agencies support plan implementation, the Oregon Watershed Enhancement Board (OWEB) has lead coordination responsibility and administers a restoration grant program.

You can learn more about the Oregon Plan for Salmon and Watersheds at www.oregon-plan.org or by calling OWEB in Salem at (503) 986-1078.

6A. JOHN DAY DAM DRAWDOWN ROLE-PLAY

LEVEL	TIME (min.)	BENCHMARKS			
Advanced	270	6.2L.2	8.3S.2	H.2E.4	H.4D.3
		6.4D.1	8.4D.1	H.4D.1	H.4D.6
				H.4D.2	

INTRODUCTION: This activity was developed in 1998 by Karl Weist of the Northwest Power and Conservation Council. This role-play exercise presents students with social, political and economic issues involved in the problem of declining salmon runs. It challenges them to sort through options to reach mutually beneficial solutions.

OBJECTIVES:

Students will:

- learn about the political issues involved in salmon recovery and how to balance those issues in arriving at solutions to the problem of declining salmon runs.
- be actively engaged in the democratic process.
- learn to interact with each other and develop and communicate concepts and positions about salmon issues.
- learn to understand differing perspectives.

MATERIALS:

- ❑ STUDENT HANDOUT 6A: *The John Day Dam Drawdown*
- ❑ STUDENT HANDOUT 6B: *John Day Dam Options*
- ❑ STUDENT HANDOUT 6C: *Profiles of John Day Dam Roles*

PROCEDURE:

1. Distribute copies of STUDENT HANDOUT 6A: THE JOHN DAY DAM DRAWDOWN. We suggest that you read this aloud with students so that you can respond to questions and to facilitate discussion about the scenario and about their task.

2. There are eleven roles in this activity. Divide the class into eleven small groups. Give each group STUDENT HANDOUT 6B: John Day Dam Options, and their role profile from STUDENT HANDOUT 6C.

3. Research and planning. Allow students time to review their profiles, research their roles, examine the options, create a plan, and develop a presentation. Let students know how much time they have before they have to present. Meet with the Council Members and the Council Chairperson to facilitate the development of criteria for the presentations and questions.

4. The hearing. Have the classroom set up for the hearing with the Council Members in the front of the class with nameplates denoting whom they represent. Allow each group to come up to present/testify making sure no group goes over five minutes. Allow about five minutes after each presentation for Council Members to ask questions to help the Council better understand the positions of the testifiers and to arrive at an informed decision.

5. The debate and vote. Give the Council a set time to debate and then vote in front of the classroom. The Council Chairperson conducts this debate. Remind them that the Council must have a super-majority in favor of one option (the vote has to be at least 3-1).

6. Be sure to debrief this activity by leading a discussion about the process and the result.

6B. SALMON FISHERIES SIMULATION

LEVEL	TIME (mins.)	BENCHMARKS			
Advanced	60	6.3S.1	8.3S.1	H.2E.4	H.3S.3
		6.3S.2		H.2L.2	H.4D.1
		6.3S.3		H.3S.1	H.4D.2
				H.3S.2	H.4D.3

INTRODUCTION

Historical and archaeological evidence indicates that native Columbia River salmon populations were large in the past, just as the bison herds were once plentiful on the Great Plains. However, within the past two human generations, salmon have declined to possible extinction; a decline which mirrors that of the bison. Human population pressure directly and indirectly caused the decline of the bison. Are there any indications that the same might be true of the salmon? How does this compare with what we have learned about our community's attitudes about salmon?

In this section, we explore the effects of human populations on a salmon fishery. The core curriculum opens with an activity in which students simulate a large ocean fishery, and explore the effects of fishing fleet owners' decisions on the salmon population. In the supplementary curriculum, students graph and interpret human population, geographical areas, and salmon populations. The extension provides an opportunity to compare the relative changes in population in five salmonid species.

OBJECTIVES:

- Students will explore and discuss the effects of human populations on a commercial salmon fishery.

MATERIALS:

- ❑ Large area: 30 meters on a side, such as gym, mowed lawn, parking lot
- ❑ 600 paper clips
- ❑ play money
- ❑ poster board/black board to record data
- ❑ large area
- ❑ STUDENT HANDOUT 6D: *Salmon Fisheries Group Worksheet*
- ❑ STUDENT HANDOUT 6E: *Salmon Fisheries Simulation Directions & Questions*
- ❑ STUDENT HANDOUT 6F: *Pacific Fisheries Status Report*
- ❑ STUDENT HANDOUT 6G: *Salmon Fisheries Graph*

KEY QUESTIONS:

How do we know salmon populations are declining?
What are some factors which contribute to such a decline? How do they contribute to the decline?
What are possible solutions to increase salmon populations?

VOCABULARY *(Brief definitions of vocabulary terms are found in the Glossary.)*

fishery
fleet
population
simulation
carrying capacity

PROCEDURE:

Background: The simulation, *Salmon Fisheries*, was developed in 1994 by Eric Baack. In the game, student groups act as fishing fleets, capturing as many salmon as possible each season. At the end of each season, they can choose to keep their earnings, or use them to purchase more fishing boats.

1. The simulation requires a large surface area, about 30 meters on a side, to be used as the fishery. A large square is marked out, and four student groups, each acting as a fishery, situate themselves on its corners. Each group will represent a different fishery. For example, they might be the Alaskan fishing, deep Pacific gillnet, Canadian fishing, and Oregon coastal fleets. Up to 600 paper clips are scattered randomly throughout the square fishing area. Each group starts with one "boat" and $100. To play each game year, the "boats" will have one minute to pick up as many paper clips as they can. Each paper clip represents a ton of salmon. For every ton of salmon (paper clip) collected, the group will earn $10.

2. One student is designated as Timer. When the Timer calls “start,” each “boat” (one student per boat) enters the “fishery” and collects as many paper clips as possible in one minute. (Each group fields one boat in the first round.) At the end of the minute, the boat returns, and the group totals its catch (paper clips), calculates profits, decides whether to purchase new boats, and turns in an accounting sheet (STUDENT HANDOUT 6D: *Salmon Fisheries Group Worksheet*) to a student acting as Banker, who posts a *Pacific Fisheries Status Report* (STUDENT HANDOUT 6F). See the ***Pacific Fisheries Status Report*** for an example of how this report is filled out for one season. (You might copy this worksheet on to 11 x 17 paper to make it easier for the class to see.)

3. Then, salmon “reproduce,” one paper clip being added to the fishery for each paper clip remaining in the fishing area, up to a total of 600 paper clips. (Each paper clip represents one ton of salmon, so one paper clip reproducing another is not the same as one salmon reproducing another salmon. The carrying capacity is arbitrarily set at 600 paper clips, so there can never be more than 600 tons of salmon (paper clips)). Have students randomly spread these new salmon out in the ocean.

4. The Timer then calls out another 1 minute fishing season. This procedure continues until either all of the paper clips are gone, or there is no change in the number of paper clips caught by each fleet. Groups may "buy" additional boats for $100 each. Then, instead of one person "catching salmon", two people may. The only limit to the number of boats is the number of people in the group and their profits. If a group cannot catch enough salmon to pay for the operation of their boats, they either sell excess boats or are eliminated from the game. Continue to play the game until there are no more salmon, or there are no changes in the number of salmon being caught by each fleet.

5. Students keep tables of data, then graph their results and respond to questions about the process and its results. Time permitting, students should complete the Extension offering, *Where Have All the Salmon Gone?* This activity explores the actual changes in the number of salmon in the Columbia River salmon fishery from 1870 to 1989.

Simplified Student Rules

1. Each group starts with one boat.
2. Any fleet may call a Pacific Fisheries Conference to discuss fishing.
3. Each boat gets to fish for one minute. This equals one year in the game.
4. To fish, a person (the boat) goes and picks up paper clips (the salmon).
5. Each paper clip caught represents one ton of salmon, and is worth $10. Take them to the banker to cash them in.
6. It costs $100 to operate each boat each year. Pay this to the Banker.
7. You may buy a new boat for $100. Pay the cost to the Banker.
8. You cannot have more boats than members in your group.
9. If you ever don't have the money to pay for the operation of your boats, you can sell excess boats for $50 each.
10. If you either have no boats, or cannot pay the $100 operating fee, then you are bankrupt and out of the game.

EVALUATION

Have the students consider the following questions

a. How well did you maintain the salmon resource? Is this resource renewable or non-renewable? How do you know?
b. Did any fishery change its strategy about the salmon resource during the game? Why?
c. Were you able to conserve the salmon resource by the end of the game? Why or why not?
d. Did anyone win? What does this mean?
e. Describe other human impacts, which might affect the number of salmon in the fishery.
f. How is this model similar to fishing in the Pacific Northwest? How is it different? The rest of the world? (You might direct discussion towards issues of knowledge of populations, patterns of reproduction, etc.) (You may wish to play the game a second time after announcing the explicit goal of maintaining fish populations while allowing the fishermen a reasonable profit. Will the class be able to agree on a strategy? You might also wish to expand the game to include Native American and sport fisheries.)

6C. HUMAN POPULATION GROWTH – FLIES LAB

LEVEL	TIME (mins.)	BENCHMARKS		
Introductory	On-going	6.2L.2	8.3S.1	H.2E.4
		6.3S.1	8.3S.2	H.3S.1
		6.3S.2	8.4D.1	H.3S.2
		6.3S.3		

INTRODUCTION:

The decline of the Columbia River salmon can be attributed to several causes, but they are all driven by the current exponential increase in human population growth. We live our lives day by day, and don't notice these increases except when looking back over a lifetime. It is probably beneficial for students to begin to understand the magnitude of the change in human population. In this activity, students plot the change in the population of a vial of flies, and then make analogies between a plot of the flies and that of humans. You should introduce the concept of *carrying capacity* if your students are not familiar with it. The carrying capacity of an environment is simply the maximum number of organisms of a particular species, which the environment can support. When a population grows beyond its carrying capacity, then limiting factors in the environment will reduce the size of the population, bringing it back to a sustainable level.

OBJECTIVE:

- Students will observe and analyze a population of black flies and their ability or inability to sustain themselves in order to critically compare and examine human population growth pattern on earth.

MATERIALS:

- ❑ vial of black flies
- ❑ graph paper
- ❑ STUDENT HANDOUT 6H: *Population Information*
- ❑ STUDENT HANDOUT 6I: *Population Data*
- ❑ STUDENT HANDOUT 6J: *Population Evaluation Form*

KEY QUESTIONS:

Will human populations respond to environmental limits?
What might be done to keep human populations from crashing?
What effect can one have on the size or growth of human populations?
Can the earth sustain unlimited exponential growth?
What is in store for humans if population continues to grow?

PROCEDURE:

1. Set up one vial of flies for your class. Do this about three months before you plan to do the curriculum section. Students estimate the number of adult flies (those which fly) in the vial each week, and record this in a table they maintain themselves. (While students may claim that they cannot make an accurate count of the flies, their estimates are generally consistent with one another.)

2. Once the number of flies starts to increase, have your students graph the data they have tabulated thus far. Have them make room for about 15-20 weeks' worth of data on the x-axis, and estimate the largest number of flies they expect they will count in setting up the y-axis. Later, if they have many more or fewer flies, they can recalibrate the y-axis.

3. The week after starting the graph, have your students make a hypothetical curve, on the graph they have set up, of what they think will happen to the population week by week until the 20th week. This forces them to think about the system they are studying. They plot the hypothetical curve, and label it. After this, they plot each week's data as points, connecting them with a line as they go. They continue to record their counts in their table.

4. Continue this pattern until all of the flies have been dead for two consecutive weeks. Then, hand out STUDENT HANDOUT 6H: ***Population Information***, which contains information on the size of the human population from 1650 to 2050. It also contains information about the square mile area of the city of Beaverton. While the curves graphed are generated by data from diverse sources, their shapes (slopes) are similar, and illustrate the influence of population size. (Students collected this data, and it is presented as an example. You should have your students research this information for the town or city where they live.)

5. The next step is to make extra y-axes on the right end of the graph of fly data for human and municipal area data. Ask students to make the data fit the axes. Then, they make another x-axis at the top of the graph for years 1650 - 2050. This creates some confusion, as some students feel they should begin with 1650 on the right, and work to the left. They plot the human population and square mile areas from 1650 to 2050 using this new x-axis. Students use these curves to finish the population project.

6. Now, students work in groups to complete the project. They answer the questions presented in the worksheet, and present their responses to the class. If there is time, have them present their ideas to the class in a seminar format. If not, either have them critique the plans in pairs, or simply post their posters. Use STUDENT HANDOUT 6J: ***Population Unit Evaluation*** to evaluate the poster, responses, and graphs for each group.

6D. WHAT ARE YOUR ENERGY NEEDS?

LEVEL	TIME (mins.)	BENCHMARKS		
Introductory	60	6.2L.2 6.4D.1	8.4D.1	H.3S.1 H.4D.1

INTRODUCTION:
This lesson not only challenges students to examine their own use of energy and the impact that has on salmon, but also analyze and explore the costs and benefits of a number of energy sources. Students will hone their skills to develop charts and graphs and analyze information.

OBJECTIVES:
- Students will critically analyze energy and energy sources to gain an understanding of the sources of energy and the benefits and drawbacks.

MATERIALS:
- ❑ STUDENT HANDOUT 6K: *What are your energy needs?*
- ❑ STUDENT HANDOUT 6L: *Sources of Energy*

KEY QUESTIONS:
What are your energy needs?
How much electricity do you use each day?
How much does energy cost?
What kinds of energy sources are there?
What are the benefits and drawbacks of energy sources?
What energy sources have high impact on salmon? Which do not?

PROCEDURE:
1. Use STUDENT HANDOUT 6K to get students thinking about energy and their own personal usage. After students have hypothesized which activities in their daily lives consume the most power, facilitate a discussion/brainstorm about where energy comes from and how much it costs.

2. Have the students graph (STUDENT HANDOUT 6K) the costs, benefits and drawbacks of nine different energy sources using the information provided in STUDENT HANDOUT 6L: *Sources of Energy*.

3. Students are then asked to answer some important questions and create a pie chart of Oregon's sources of power according to what they discovered in their energy sources analysis.

6E. NATIVE AMERICAN FISHING RIGHTS MOCK TREATY NEGOTIATION ROLE-PLAY

(Provided by Columbia River Inter Tribal Fish Commission)

LEVEL	TIME (mins.)	BENCHMARKS
Advanced	120	8.4D.1 H.2E.4 H.4D.1 H.4D.6

INTRODUCTION

For many centuries, many Pacific Northwest Indian tribes incorporated salmon into their lives in ways which most of us do not. How has the decline in the salmon affected them? Have they simply lost a food resource, or has the decline in salmon affected them in ways we do not understand or cannot comprehend?

In this section, students listen to a reading of an excerpt from the book, Winterkill, by Craig Lesley, and then respond to it. Through this activity, students learn about the traditional Celilo Indian tribal relationship to the salmon, and the effects on the Celilo People of building The Dalles Dam, and the flooding of Celilo Falls. In addition, students may engage in a mock treaty negotiation concerning historical treaties between the tribes and the U.S. government.

OBJECTIVE:

- Students will learn about the traditional importance of salmon to Indian tribal culture in the Pacific Northwest.

MATERIALS:

- ❑ STUDENT HANDOUT 6M: *Winterkill reading*
- ❑ STUDENT HANDOUT 6N: *Indian Tribes: Fishing Rights Role Play Protocols & Negotiating Points*
- ❑ STUDENT HANDOUT 6O: *United States: Fishing Rights Role Play Protocols & Negotiating Points*
- ❑ STUDENT HANDOUT 6P: *Summary of 1855 Treaties with the Columbia River Tribes*

KEY QUESTIONS:

Which are the Indian tribes in our area to whom salmon are important?
How are salmon important to them?
How can tribal members maintain the cultural importance of salmon in the Northwest?

VOCABULARY:

Native American
Celilo
Nez Perce
Celilo Falls
treaty
ceded area
treaty
demarcation

PROCEDURE:

BACKGROUND:

1. As an introduction to the Mock Treaty Negotiation, read aloud, or have students read the STUDENT HANDOUT 6M: Winterkill excerpt by Craig Lesley, on the closing of Celilo Falls. This piece works well when read aloud.

2. Divide the class into two groups: one half of the class represents Indian tribes while the other half represents the United States federal government.

   Indian Tribes: The Indian group is made up of leaders of three tribes. Divide students into the following three tribes:
   - Hungry Otter
   - Soaring Eagle
   - Fast Bear

   Have each tribe choose a chief spokesperson. The other students in this group will act as members of the tribal council for their assigned tribe and advise their spokesperson during the negotiations.

   United States: The United States group consists of:
   - two generals (chosen by teacher)
   - two translators (chosen by generals)
   - two scribes (chosen by generals)
   - soldiers
   - settlers
   - gold miners
   - railroad barons

3. Hand out STUDENT HANDOUT 6N to the Indian tribes representatives and STUDENT HANDOUT 6O to the United States representatives. Ask students to read their handouts to understand their roles and begin thinking about how to frame their proposals or concerns for the negotiations. Suggest that each side not share their handout assignments and talking points with the other side.

THE ROLE PLAY:

4. Each group decides on strategies for negotiation following the protocols indicated on STUDENT HANDOUTS 6N and 6O. Allow less than ten minutes for the two sides to establish initial negotiating positions. According to the instructions, scribes record the above proceedings and the negotiations that follow.

A. Translators for the United States tell Indian tribal leaders what the United States proposes.

B. Tribal leaders and their councils discuss the U.S. proposal.

C. Chief spokespersons then instruct the translators to make a response to the U.S. proposal.

D. Continue negotiations back and forth, as time permits, attempting to reach agreement.

E. End role-play after 30 minutes to allow time for discussion.

F. Ask the scribes to summarize what happened, including what was proposed and how proposals and counterproposals were received. (The scribes may want to begin by describing what their assignment was.)

G. Discuss the treaties of 1855 (STUDENT HANDOUT 6P).

6F. SALMON POLITICAL SCIENCE: THE DILEMMA OF GOVERNMENT MANAGEMENT AND REGULATION

LEVEL	TIME (mins.)	BENCHMARKS
Advanced	180	6.2L.2 8.3S.3 H.2E.4 H.4D.1 6.2S.2 8.4D.1 H.3S.3 H.4D.6 6.4D.1

INTRODUCTION:
Because salmon have been of economic, recreational, historical and cultural importance to the people of the Northwest, government has always had an interest in managing, regulating and, now, attempting to slow their decline. Over the years, federal, state and local governments have developed numerous policies and a multitude of government bodies, each with a role in the management and regulation of salmon. This activity introduces students to the often frustrating world of politics. Through a critical examination of the these governmental acts and entities that influence salmon, students will gain an understanding of this complex system and will work to creatively rethink and redesign it. This lesson was developed by Karl Weist and Jay Hopp, with contributions from Michael C. Blumm and Brett M. Swift from the Northwest Water Law and Policy Project.

OBJECTIVES:
Students will:
- gain an understanding of the complex system of management and regulation of salmon.
- critically examine the system of management and regulation and creatively work to rethink and redesign the decision-making, management and regulation process.

MATERIALS:
- ❑ STUDENT HANDOUT 6Q: Salmon Political Science Activity
- ❑ Reference materials (library)
- ❑ Computers with internet access
- ❑ Butcher paper to make two large class charts
- ❑ Marking pens
- ❑ State of Oregon Map: Surface Management Responsibility, 1994. Available from the Bureau of Land Management (BLM) for $3 (optional, but strongly recommended – great visual)

KEY QUESTIONS:
Is it possible to get all governmental bodies to agree on policies of management of regulation and management of salmon? Why or why not?
How can the process be streamlined so that good decisions can be made, implemented and enforced in a reasonable timeframe?
Why are there "turf wars" over regulation and management, when most involved are interested in saving the salmon?
Where do you see contradictions in management and regulation?
Are there other bodies outside of government who also have an interest in managing and regulating salmon? Who are they? What is their perspective?

VOCABULARY:
jurisdiction regulatory

PROCEDURE:

1. If you have a computer lab at your school with internet access, reserve a day or two for your class to conduct research. If not available, reserve a day or two in the library to conduct research. (you may want to split the class up and send half to the library and half to the lab and then switch).

2. Cut out each of the GOVERNMENT BODIES and each of the GOVERNMENT POLICIES.

3. On two large pieces of butcher paper, create two charts. The first chart should be titled, SALMON MANAGEMENT AND REGULATORY GOVERNMENT BODIES, with the following headings:

GOVERNMENT BODY	FEDERAL, STATE, OR LOCAL	MANAGEMENT PURPOSE	REGULATORY AUTHORITY	JURISDICTION

   The second chart should be titled, SALMON MANAGEMENT AND REGULATION GOVERNMENT POLICIES, with the following headings:

GOVERNMENT POLICY	FEDERAL, STATE, OR LOCAL	PURPOSE OF POLICY	HOW IS POLICY ENFORCED?	JURISDICTION

4. Divide the class into groups (there are 25 government bodies and 7 government policies). Out of the “hat,” have the groups draw the bodies and policies, until all have been chosen.

5. As with any type of group work, make sure all in the group have a role and share the workload.

6. Review STUDENT HANDOUT 6Q, which reviews the tasks for each group in this research activity.

7. Have the students conduct research, filling out the chart as they go. Use the document, created by Karl Weist, entitled GOVERNMENT BODIES AND THEIR AUTHORITY TO REGULATE SALMON, as a teacher guide.

8. When the chart is complete to your satisfaction, use the KEY QUESTIONS to guide a discussion. Within this discussion be sure to guide the students in a direction where they attempt to streamline the process of decision-making.

9. When you have come up with some good ideas, you may want to encourage students to take action by writing or e-mailing your federal, state, or local political officials informing them of their recommendations.

Confederated Tribes of the Umatilla Indian Reservation (CTUIR)	Bureau of Land Management (BLM)	Portland Bureau of Environmental Services (PBES)
Confederated Tribes of the Warm Springs Reservation of Oregon (CTWSRO)	Northwest Power and Conservation Council (NPCC)	Columbia River National Estuary Program (CRNEP)
Army Corps of Engineers (COE)	Oregon Department of Fish and Wildlife (ODFW)	Tillamook Bay National Estuary Project (TBNEP)
Pacific Salmon Commission (PSC)	Oregon Department of Environmental Quality (DEQ)	Oregon Plan for Salmon and Watersheds
National Marine Fisheries Service (NMFS)	Oregon Department of Forestry (ODF)	Columbia River Fish Management Plan
U.S. Fish and Wildlife Service (USFWS)	Oregon Water Resources Department (WRD)	Clean Water Act
Environmental Protection Agency (EPA)	Oregon Department of Agriculture (ODA)	Endangered Species Act
Bureau of Reclamation (BOR)	Oregon Department of Land Conservation and Development (OLCDC)	National Estuary Program

Federal Energy Regulatory Commission (FERC)	Oregon Watershed Enhancement Board (OWEB)	Federal Power Act
Bonneville Power Administration (BPA)	Grand Ronde Model Watershed Council (GRMWC)	Northwest Forest Plan
U.S. Forest Service (USFS)	McKenzie River Watershed Council (MRWC)	

GOVERNMENT BODIES AND THEIR AUTHORITY TO REGULATE SALMON

(created by Karl Weist of the Northwest Power Planning Commission)

Confederated Tribes of the Umatilla Indian Reservation (CTUIR)
- 1855 Treaty with the Walla-Walla, Cayuses and Umatilla Tribes established reservation
- Reserved water rights to serve the purposes of the reservation, including support of fisheries. Guaranteed the right to fish both on and off reservation at "usual and accustomed" places "in common with citizens of the United States."
- US v. Oregon and US v. Washington– court cases assured the tribe the right to 50% of the salmon harvest.
- The tribe is a party to the Columbia River Fish Management Plan that allots the in-river harvest of Columbia River salmon.

Confederated Tribes of the Warm Springs Reservation of Oregon (CTWSRO)
- 1855 Treaty with the Tribes of Middle Oregon established reservation
- Reserved water rights to serve the purposes of the reservation, including support of fisheries. Guaranteed the right to fish both on and off reservation at "usual and accustomed" places "in common with citizens of the United States."
- US v. Oregon and US v. Washington– court cases assured the tribe the right to 50% of the salmon harvest.
- The tribe is a party to the Columbia River Fish Management Plan that allots the in-river harvest of Columbia River salmon.

Army Corps of Engineers (COE)
- Operates 19 major federal dams in the Columbia River Basin for flood control, hydropower, recreation, navigation, irrigation and other purposes. (Examples- Bonneville, The Dalles and John Day dams)
- Conducts other river management activities like the dredging of the Columbia for the Port of Portland's navigation channel
- Issues dredge and fill permits for rivers and wetlands under the authority of the Clean Water Act.

Pacific Salmon Commission (PSC)
- Allocates harvest of five Pacific salmon species between the US and Canada.
- Established by the 1985 US and Canada Pacific Salmon Treaty to make the harvest decisions.

National Oceanic and Atmospheric Administration (NOAA)
- Administers the Endangered Species Act for salmon and steelhead; ESA responsibilities include listing the species as threatened or endangered, designating critical habitat, developing recovery plans, regulating "taking" of a listed species.
- Develops fishery management plans that set ocean harvest limits.
- Is a part to the Columbia River Fish Management Plan that allocates the in-river harvest of Columbia River salmon?

US Fish and Wildlife Service (USFWS)
- Administers the Endangered Species Act for all non-anadromous fish and other species; lists species as threatened or endangered, designates critical habitat, develops recovery plans, regulates the "taking" of listed species.
- Manages federal lands designated as wildlife refuges.

Environmental Protection Agency (EPA)
- Oversees states' efforts to comply with the Clean Water Act: wetland regulations and state water quality programs.
- Administers the National Estuary Program.

Bureau of Reclamation (BOR)
- Operates 9 major dams and reservoirs in the Columbia River Basin, primarily for irrigation. (Example – Owyhee Dam and Reservoir)
- Operates numerous projects for secondary purposes, including hydropower generation, recreation, municipal and industrial use.
- Enters into contracts with irrigation districts and other users for the delivery of project water.

Federal Energy Regulatory Commission (FERC)
- Created to carry out the oversight of the Federal Power Act.
- Regulates the construction and operation of nonfederal hydropower projects. (Examples – Brownlee, Oxbow and Hells Canyon dams)
- Issues and conditions original licenses and relicensing of nonfederal hydropower projects.

Bonneville Power Administration (BPA)
- Markets and distributes power produced from federal hydropower projects on the Columbia and its tributaries.
- Funds the protection, mitigation and enhancement of fish and wildlife resources affected by the Federal Columbia River Power System

US Forest Service (USFS)
- Authorizes and monitors timber harvest, grazing, mining, recreation and other activities that occur on all national forest lands and some wilderness areas and wild and scenic river corridors in the Columbia River Basin.
- Has limited water management authority, but does monitor federal reserved water rights and regulates access to national forests for water project purposes.
- Has recently developed the Northwest Forest Plan, PACFISH and INFISH planning documents that address fish and wildlife concerns.

Bureau of Land Management (BLM)
- Authorizes and monitors timber harvest, grazing, mining, recreation and other activities that occur on all federal “public lands” and certain wilderness areas and wild and scenic river corridors in the Columbia River Basin.
- Has limited water management authority, but does monitor federal reserved water rights and regulates access to BLM-managed lands for water project purposes.
- Has recently developed the Northwest Forest Plan and PACFISH planning documents that address fish and wildlife concerns.

Northwest Power and Conservation Council (NPCC)
- Interstate compact agency (Oregon, Idaho, Montana and Washington) created by the Northwest Power Act of 1980.
- Develops regional Fish and Wildlife Program and Northwest Power Plan.
- BPA must act “consistent with” the Council Fish and Wildlife Program. COE, FERC and BOR must take the Council Program “into account.”

Oregon Department of Fish and Wildlife (ODFW)
- Develops and implements state fishing regulations, licenses, length of seasons.
- Runs state-funded salmon hatcheries.
- ODFW is a party to the Columbia River Fish Management Plan that allocates the in-river harvest of Columbia River salmon.
- Participated in the development of the Oregon Plan for Salmon and Watersheds.
- Developed the Native Fish conservation Policy

Oregon Department of Environmental Quality (DEQ)
- Implements the state water quality program under the Clean Water Act. Develops list of water quality limited streams and rivers and develops standards to comply with the Clean Water Act.
- Participated in the development of the Oregon Plan for Salmon and Watersheds.

Oregon Department of Forestry (ODF)
- Administers the Oregon Forest Practices Act affecting the timber harvest and uses of state and private forests. Covers about 11 million acres of state and private timberland.
- Participated in the development of the Oregon Plan for Salmon and Watersheds.

Oregon Water Resources Department (WRD)
- Allocates and distributes water within the state; issues water rights and establishes state rules governing the use, sale and transfer of water rights.
- Participated in the development of the Oregon Plan for Salmon and Watersheds.

Oregon Department of Agriculture (ODA)
- Regulates agricultural practices on state and private lands.
- Participated in the development of the Oregon Plan for Salmon and Watersheds

Oregon Department of State Lands (ODL)
- Administers fill and removal laws

Oregon Department of Land Conservation and Development (ODLCD)
- Monitors and implements the state land use planning program. Includes state goals to protect farm and forest land and to preserve the Willamette River Greenway and coastal shore lands.

Oregon's Watershed Enhancement Board (OWEB)
- Allocates grant funding for local groups to perform watershed restoration work.

Grande Ronde Model Watershed
- Local watershed council located in La Grande; group of citizens, businesses and landowners that help protect, restore and preserve the Grande Ronde River. Conducts basin assessments, develops watershed projects, involves local landowners in watershed enhancement projects.

McKenzie River Watershed Council
- Local watershed council located in Springfield; group of citizens, businesses and other landowners that help protect, restore and preserve the McKenzie River. Conducts basin assessments, develops watershed projects, involves local landowners in watershed enhancement projects.

Portland Bureau of Environmental Services
- Responsible for Portland's stormwater and sewage treatment and collection system. Currently separating the stormwater and sewage systems so untreated water does not spill into the Willamette and Columbia Rivers.

Columbia River National Estuary Program
- Joint project of Oregon and Washington along with the EPA. A group of citizens, local and state governments, businesses and others responsible for protecting, preserving and restoring the health and water quality of the Columbia River estuary.

Tillamook Bay National Estuary Project
- Joint project of Oregon and the EPA. A group of citizens, local and state governments, businesses and others responsible for protecting, preserving and restoring the health and water quality of the Columbia River estuary.

6G. THE ROLE OF HATCHERIES

LEVEL	TIME (min.)	BENCHMARKS			
Advanced	180	6.2L.2	8.2L.1	H.2E.4	H.4D.3
		6.3S.2	8.4D.1	H.3S.3	H.4D.4
		6.4D.1		H.4D.1	H.4D.6

INTRODUCTION:

The first fish hatchery in the Pacific Northwest opened over 100 years ago on the Clackamas River. Since then, the region has increasingly turned to hatcheries as a way to compensate for the losses in fish populations due to human activities, mainly resulting from dams, habitat destruction and overharvest. Oregon currently operates 34 hatcheries, 15 remote rearing/fish collection facilities, including Salmon Trout Enhancement Program (STEP) facilities and the Clatsop Economic Development committee (CEDC) facilities. In 2001 these operations produced about 53 million salmon, steelhead and trout. The Legislatively Approved Budget for fish propagation for the 2003-05 biennium totaled $43.96 million dollars.

As we have begun to learn more about the ecological effects of hatchery fish on wild salmon populations, many have started to question the use of hatcheries as a catchall solution to fish management problems. There are efforts underway to improve hatchery practices to minimize the negative impacts of hatchery fish on wild stocks. In this unit, students will learn about some of the reasons why hatcheries came into existence, and some of the reasons why fish management is becoming increasingly complex. The following information gives you some base for understanding hatcheries and wild fish.

Some arguments in favor of hatchery fish

1. Some hatchery fish were intended to compensate for declines in wild fish populations caused by the construction of dams. Dams are not only an important source of energy for the region -- they also allow the rivers to be used as waterways for the transport of crops and other goods throughout the Pacific Northwest. If we remove dams, we will be forced to either be more serious about conservation, or find alternative forms of energy and transportation.
2. Hatchery fish help support the angling industry. Sport fishing is not only a popular hobby, but also supports the economy of the region. In 2003, anglers spent almost $623 million according to the American Sportfishing Association.
3. According to the Pacific Coast Federation of Fishermen's Associations, Incorporated, 80% of the salmon caught by the commercial fishing industry are hatchery fish.
4. The salmon are of great traditional importance to Native Americans. The U.S. government has treaty obligations to the tribes to restore the salmon so that Native Americans may continue to use the salmon both as a food and a spiritual resource. If natural production continues to decline, we may have to increasingly rely on hatcheries to fulfill this treaty obligation.
5. If we catch only the hatchery fish for human consumption, we could leave the wild fish alone to reproduce on their own.
6. Hatchery fish could be used to supplement stocks in serious jeopardy or to reintroduce stocks that have been eliminated from their natural range, given the proper groundwork for habitat improvements and resolution of passage problems.

Some arguments for wild fish

1. Through a process called *natural selection*, the wild fish that are best suited to their environment are the fish that survive to spawn. However, hatcheries promote *artificial selection*, which means that humans choose the fish that will survive to spawn. Sometimes, we have made this decision based on which fish will make a good dinner, rather than on which fish will best be suited to survive in the wild. Another

problem is that some hatcheries tend to spawn the first fish to return to the river to ensure that they will be able to
harvest enough fish. However, this means that early breeders are more likely to be chosen to spawn. The resulting hatchery offspring tend to return too early. This is a problem if all of the hatchery fish return at the same time, and the weather is too rainy or too dry for the fish to survive.

2. *Genes* carry pieces of information that allow fish to inherit traits from their parents. In a population of fish with a lot of genetic diversity, there is a greater chance that at least some fish will have the traits necessary to survive if there is a sudden change in environmental conditions. Conversely, in populations of fish without a lot of genetic diversity, there is a greater likelihood of extinction if the fish are faced with a changing environment. Populations of hatchery fish have less genetic diversity than populations of wild fish because hatchery fish have had fewer ancestors than wild fish. Unfortunately, sometimes hatchery fish spawn with wild fish, rather than returning to the hatchery. This means that the genetic diversity of the wild fish populations decreases as well.
3. When wild fish die, their carcasses provide nutrients to the rivers and streams where they spawned. Hatchery fish are often removed from the stream to be spawned, depriving the habitat of precious nutrients.
4. We have a moral obligation to do something to repair the habitat that we have destroyed in order to assure that wild fish can continue to survive in the future.
5. Hatcheries create a false sense of abundance for people who consume fish and utilize their habitat, meaning that people are less concerned about conserving the habitat that remains. It also means that harvest levels are often based on numbers of hatchery fish. Since there are often some wild fish that are caught along with the hatchery fish, harvest can drive dwindling numbers of wild fish into extinction.
6. Wild fish use precious energy competing against hatchery fish for limited resources. Hatchery fish are more prone to disease than wild fish because they are raised so closely together. Diseases from the hatchery stock can then be passed on to wild fish. This means that the presence of hatchery fish can actually weaken wild fish populations.
7. Wild fish learn to avoid predators, or they get eaten. They also learn to find food in their natal stream efficiently, or they starve. Hatchery fish, on the other hand, are hand-fed by humans. They learn to approach humans (who would normally be predators) and eat fish pellets. Then, when they are released, they are less able to find food and are less afraid of predators than wild fish. This means that, once they are released into the wild, hatchery fish are less likely to survive than wild fish.
8. Raising hatchery fish is very expensive. According to Sterne, the average cost of producing a spring chinook salmon in a state run hatchery is $27.43, although this number can reach as high as $228.93 per fish. Some might argue that this money could be better spent on habitat restoration to improve survival rates for wild chinook.

OBJECTIVES:

For students to know and understand:

- The difference between hatchery fish and native fish.
- Some of the complexity surrounding fish management decisions.

MATERIALS

- ❑ STUDENT HANDOUT 6R: *A History of the Hatchery System*
- ❑ STUDENT HANDOUT 6S: *The Trask Hatchery Scenario*
- ❑ STUDENT HANDOUT 6T: *Profiles of Hatchery Roles*

PROCEDURE:*

1. Distribute copies of STUDENT HANDOUT 2J: *A History of the Hatchery System* and STUDENT HANDOUT 2K: The *Trask Hatchery Scenario*. You may want to read this aloud with students so that you can respond to questions and facilitate discussion about the scenario and about their task.
2. There are five roles in this activity. Divide the class into five small groups. Give each group a different role from STUDENT HANDOUT 2L: *Profiles of Hatchery Roles*.
3. Allow students time to review their profiles, research their roles, and decide which of the hatchery options their character would prefer. Have them create a coherent presentation of their point of view for the rest of the class. Encourage students to create charts, graphs, or any other visual aids that might enhance their presentation.
4. Allow each group of students to make an opening presentation to the rest of the class. Post any visual aids in the classroom.
5. Give students time to meet with one another. Is it possible for some groups to form alliances or coalitions with one another? Students with very different characters might find that they have similar opinions about hatchery issues.
6. Allow students to make proposals to the rest of the class. Have students write the options that they prefer on the board. Open the floor to a debate of the options.
7. Allow students to argue for or against the options listed on the board, but provide a time limit on their arguments so that all students have a chance to present their ideas.
8. Take a vote on the options.
9. Facilitate a discussion. Is there an easy solution to the fish hatchery dilemma? Is it possible to compromise? Who should be responsible for making decisions about hatcheries?

* If you prefer to have a governing body facilitate the debate, refer to the procedure set up in the John Day Dam Drawdown role-play. The dam role-play procedure creates a Council to facilitate a debate and make a decision based on students' presentations.

For more information on this topic, try these resources:

- <u>*Why Wild? A Genetics Primer for Students*</u>, Oregon Department of Fish and Wildlife

Contains an introduction to genetics, information about the genetic differences between native and hatchery fish, and student activities.

- <u>*A Common Fate*</u>, Joseph Cone. Oregon State University Press

Contains a chronology of the decline of the Pacific Northwest salmon runs, the construction of dams and hatcheries, and the fishing industry in the region.

- <u>*Oregon's Wild Fish Management Policy: Balancing Oregon's Fishery Future*</u>. *Oregon Department of Fish and Wildlife or background publication*.

Contains a background on the use of hatcheries as a fish management policy.

- <u>*Supplementation of Wild Salmon Stocks: A Cure for the Hatchery Problem or More Problem Hatcheries?*</u> Jack K. Sterne Jr. Coastal Management. Volume 23, pp. 123-152

INTERDISCIPLINARY INTEGRATION IDEAS

1. Examine the history of salmon decline due to human population pressures: Review *Where Have All The Salmon Gone?* Project Wild Aquatic with Math and Social Studies teachers, then do an interdisciplinary unit in which students learn, through graphical analysis techniques, how to comprehend the data presented in the unit, and through historical analysis techniques, how to make sense of this data in terms of human actions.

2. Have an English teacher help your students to write legends about salmon. Investigate traditional words for salmon, rivers, and land. An Art teacher can help them create Native American masks and other artwork to illustrate and amplify their legends. Then, work with a Social Studies teacher to place these learnings in a context, which integrates the history of regional Indian tribes, immigrants from other nations and Pacific Northwest salmon.

3. Work with an English teacher when you prepare this section, integrating the book, Winterkill, by Craig Lesley, into your students' English class reading.

4. Review this section with an English and/or Social Studies teacher, and use the book, Mountain in the Clouds, by Bruce Brown, as the focus of an interdisciplinary unit. Explain the book and share your lesson plans for the section with them. Develop reading and writing extensions of the section, which are based upon an understanding of the historical and cultural roots of the story.

EXTENSION CURRICULUM

1. *Philosophical Differences*, Project Wild, Students select a wildlife issue or other environmental issue in the community, and correspond with representatives of a range of interest groups about their philosophical positions concerning the issue. They learn to identify points of view and describe possible effects of various groups and organizations having differing points of view about wildlife, natural resources and environmental issues.

2. Students use the *Food Web* exercise to explore what might happen when a species is eliminated from a food web. Each group of students receives a scenario in which they eliminate one organism from the food web, and then describe the immediate, intermediate, and terminal effects of eliminating their particular organism. *Blue Ribbon Niche,* Project Wild Aquatic, explores the effects of food webs in riparian areas. You might adapt this activity to the food webs activity.

3. Invite a representative of a local Indian tribe to come to your classroom. Have your students prepare questions to ask him or her. If you are doing Salmon Watch as an interdisciplinary unit, have your students work with a social studies teacher to learn the history of that person's culture. Ensure that student questions will elicit information about the place of salmon in Native American culture, salmon fishing sites in the area you will be visiting, and the effects of salmon stock depletions on his or her society today.

4. *California's Salmon and Steelhead, Our Valuable Natural Heritage,* pp. 141-145, contains reading and art activities based on Native American salmon creation myths. These activities make a good supplement to the core curriculum in this section. If you review this curriculum, look at the story writing activity in which students learn to express their personal feelings about salmon, pp. 146-149.

5. Review the information and the table Chinook Salmon Spawning Density, John Day District, 1967-1989 (*Stream Scene*, pp. 191-192) for this activity. This represents a portion of a 29-year study of 116 total miles of index streams in the John Day River Basin (pp. 2.81-2.84).
   Have the students calculate the average number of redds per mile in the right hand column for each year (see p. 197).

   Ask your students to create a line graph by plotting the number of redds per mile for each of the 23 years of data. (Ask them to use the entire sheet of paper for the graph axes so that it will be easier to interpret.) Repeat the process for each of the three streams and the average. NOTE: Use a different color for each of the four lines, and a legend with the color representing each line. Have the students complete the worksheet, answering the questions about the John Day River Basin on p. 198.

Review the information and Clackamas River map on pp. 199-200, then have them complete the worksheet, answering the questions about the Clackamas River Basin on pp. 205-207. (Extra Credit Opportunity: Have your students research data on the number of salmon in this fishery from 1980 to date.)

6. Do the activity "*Where Have All the Salmon Gone"*, Project Wild Aquatic. Information is supplied for five species of salmon caught from 1870 to 1989, and explores possible effects of an expanding human population on numbers of salmon caught.

7. Look up the World Wide Web address, http://www.streamnet.org/, for a very useful source of information about salmon. This is the StreamNet home page that contains an online database of information about salmon, the life history and ecology of species, color species of a male and female of each species listed, and extensive data on salmonids and their habitats. It might be used to organize Units 1-3 for your students.

8. Use the World Wide Web address, http://www.nwp.usace.army.mil/co/fishdata/daily.htm. This web site provides daily updated fish passage data, by dam, and by ladder. It also provides water turbidity data (secchi units), water depths by ladder bay, water temperature, total discharge, and fish counts and totals by species. Daily and annual total passages for chinook and coho at all dams are provided at the end of reports. This data presents an interesting set of information for engaging your students in the critical thinking which scientific inquiry excels in. Are fish numbers distributed evenly among the ladders at a particular dam? Are their distributions associated with any of the other parameters provided in the data set? Can you, using the information available, explain the reported fish passage patterns? What other inferences can you make from the data? What further information would you like to know?

BIBLIOGRAPHY

Adopt a Stream Foundation's Field Guide to the Pacific Salmon. 1992. Robert Steelquist. Sasquatch Books. Seattle, WA.

Adopting a Stream/ A Northwest Handbook.1988/1991. Steve Yates. University of Washington Press. ISBN 0-195-96796-X.

Aquatic Project Wild, 2nd Ed. 1992. Western Regional Environmental Education Council, Inc. Boulder, CO 80308-8060.

California's Salmon and Steelhead, Our Valuable Natural Heritage. Teacher's Guide and Student Activities: Grades K-6. California Advisory Committee on Salmon and Steelhead Trout.

Columbia River Fisheries: ENDANGERED SALMON: A Reading. THE COLUMBIA RIVER: IT'S FUTURE AND YOU, EM 8475, Oregon State Removed from survey. University Agricultural Communications, Administrative Services A422, Corvallis, OR 97331-2119. pp. 49-60.

The Comings and Goings of Coho, Water Water Everywhere... Oregon State University Sea Grant College Program and Oregon Department of Education.

A Common Fate. 1996. Joseph Cone. Oregon State University Press. ISBN 0-87071-391-4.

Dwindling Northwest Salmon. 1991. Billy Frank. *CLEARING*. Jan/Feb, pp. 20-23.

F.I.S.H. Adverse Effects of Logging on Fisheries. Univ. of Nevada Cooperative Extension Fact Sheet 87-53.

F.I.S.H. Habitat Education Program; Watersheds, Wildlife and People. Pacific States Marine Fisheries, 45 SE 82nd Drive, Suite 100, Portland, OR 97207; (503) 650-5400.

F.I.S.H. U.S. Coastal Habitat Degradation and Fishery Declines. 1992. James Ross Chambers. Presented at 57th North American Wildlife and Natural Resources Conference, Wildlife Management Institute. pp. 1-10.

The Fish Hatchery Next Door: An Educator's Guide. Oregon Department of Fish & Wildlife. Portland, OR.

The Future of Salmon is in Your Hands. 1992. Ron Klein and John Esler. CLEARING. Sep/Oct, pp. 9-10.

Hatchery salmon unfit for life in the wild, report says. December 3, 1998. Jonathan Brinckman. Oregonian.

How to Catch and Identify the Game Fish of Oregon. 1978. E.A. Lusch. Frank Amato Publications.

In Search of the Last Sockeye. 1993. Jeff Kuechle. VISIONS, from the Oregon Graduate Institute of Science and Technology. Summer, pp. 14-19.

Ishmael. 1993. Daniel Quinn. Bantam Books. ISBN 0-553-56166-9.

Macroinvertebrates and River Continuum (video 21: 18). Oregon Department of Fish and Wildlife.

Making Room in the Ark, The Endangered Species Act and the Columbia River Basin. 1992. John M. Volkman. *ENVIRONMENT*, May, pp. 18-43.

Mountain in the Clouds. 1990. Bruce Brown. Collier Books. ISBN 0-02--13095-3.

My Strength Is From The Salmon (video). Columbia River Inter Tribal Fish Commission. Available at CRITFC, 729 N.E. Oregon, Suite 200, Portland, OR 97232; (503) 238-0667.

The Northwest Salmon Crisis. 1996. Joseph Cone and Sandy Ridlington, eds. Oregon State University Press. ISBN 0-87071-390-6.

Project Wild. Kate Ferschweiler. Western Regional Environmental Education Council, Inc. Boulder, CO 80308-8060.

A Race to Rescue the Salmon. 1992. Jeanne McDowell. TIME, March 2, pp. 59-60.

Reading To Learn, California's Salmon and Steelhead, Our Natural Heritage. Teachers Guide and Student Activities: Grades K-6. California Advisory Committee on Salmon and Steelhead Trout. Can be acquired through Diane Higgins, KREP Coordinator, 1271 Fieldbrook Rd., Arcata, CA 95521; (707) 822-0744.

The Return of the Salmon. A 30-minute educational video about salmon and watershed restoration. Sea Grant Communications, AdS 402, Oregon State University, Corvallis, OR 97331; (541) 737-0756. $30.00.

Riparian Pastures. Univ. of Nevada Cooperative Extension Fact Sheet 87-53.

The River Stressed Out. 1993. Northwest Power Planning Council,

Salmon of the Sandy River, Oregon. 1990. Douglas P. Cramer. Portland General Electric, Environmental Services Department. Portland, OR.

The Salmon Dammed. 1992. Bob DeVine. AUDUBON. Jan/Feb, pp. 83-90.

Salmonids in the Classroom: Intermediate. Canadian Department of Fisheries and Oceans, B.C. Teachers Federation Lesson Aids. 105-2235 Burrard Street, Vancouver, B.C. Canada V6J 3H9.

Save Our Streams, Hands On Streams & Rivers. Richard D. Klein. Maryland department of Natural Resources. Owing Hills, MD 21117.

Save Our Streams, Monitor's Guide to Aquatic Macroinvertebrates. Loren Larking Kellog. 1992. Izaak Walton League of America. Arlington, VA 22209.

Save Our Streams, Stream Quality Assessment. Richard Klein. The Izaak Walton League of America. Arlington, VA 22209

A Snapshot of Salmon in Oregon.1998. Tom Gentle, Theresa Novak. Oregon State University Extension Service. Corvallis, OR.

Straying of Umatilla River Hatchery Origin Fall-run Chinook Salmon into the Snake River. 1995. Richard W. Carmichael. NOAA Technical Memorandum NMFS – NWFSC. Seattle, WA.

Striking a Balance in the Pacific Northwest. 1990. Keith W. Muckleston. ENVIRONMENT. Jan/Feb, pp. 10-36.

The Stream Scene - Watersheds, Wildlife and People. 1992. Oregon Department of Fish and Wildlife, PO Box 59, Portland, OR 97207; (503) 229-5403.

Supplementation of Wild Salmon Stocks: A Cure for the Hatchery Problem or More Problem Hatcheries? Jack K. Sterne Jr. Coastal Management. Volume 23, pp. 123-152.

Survey of Columbia Basin Water Law Institutions and Policy. 1997. Northwest Water Law and Policy Project.

Uncertainty, Resource Exploitation, and Conservation: Lessons from History. 1993. Donald Ludwig, Ray Hilborn, and Carl Walters. SCIENCE. Volume 260(2) April 2, pp. 17, 36.

Upstream: Salmon and Society in the Pacific Northwest. 1996. National Research Council. National Academy Press. Washington, D.C.

When The Salmon Runs Dry. Films and videos for a Safe & Sustainable World, 5332 College Ave., Suite 101, Oakland, CA 94618; 1-800-4-PLANET.

A Wild Salmon's Excellent Adventure. 1991. Wayne Thompson. <u>The Oregonian</u>, October 27.

Wildlife Watching. 1993. Elizabeth Moore and Deborah Scrivens. Metropolitan Regional Parks and Greenspaces, 600 N.E. Grand Ave., Portland, OR 97232-2736.

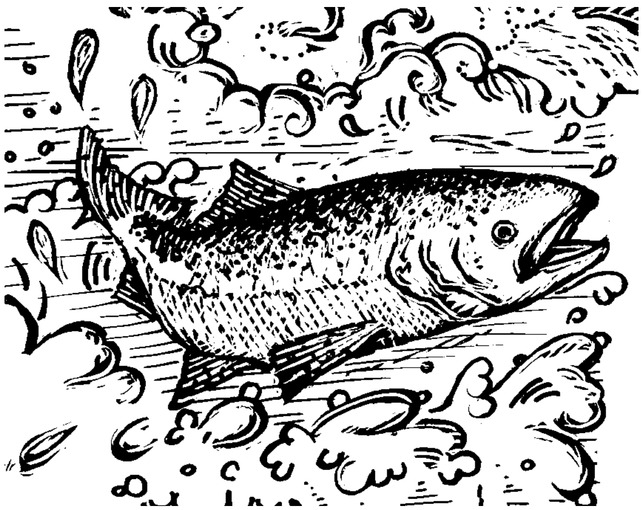
Commercial fishing. *1998. Tom Gentle. <u>A Snapshot of Salmon in Oregon</u>. Oregon State University Extension Service. Corvallis, OR.*

UNIT 6 HUMANS AND THEIR ENVIRONMENT
STUDENT HANDOUTS

6A	*The John Day Dam Drawdown*
6B	*John Day Dam Options*
6C	*Profiles of John Day Dam Roles*
6D	*Salmon Fisheries Group Worksheet*
6E	*Salmon Fisheries Simulation Directions & Questions*
6F	*Salmon Fisheries Status Report*
6G	*Salmon Fisheries Graph: Total Salmon/Total Boats*
6H	*Population Information*
6I	*Population Data*
6J	*Population Unit Evaluation*
6K	*What Are Your Energy Needs*
6L	*Sources of Energy*
6M	*Winterkill Excerpt by Craig Lesley*
6N	*Indian Tribes: Fishing Rights Role Play Protocols & Negotiating Points*
6O	*United States: Fishing Rights Role Play Protocols & Negotiating Points*
6P	*Summary of 1855 Treaties with the Columbia River Tribes*
6Q	*Salmon Political Science Activity: The Dilemma of Government Management and Regulation*
6R	*History of the Hatchery System*
6S	*The Trask Hatchery Scenario*
6T	*Profiles of Hatchery Roles*

STUDENT HANDOUT 6A

THE JOHN DAY DAM DRAWDOWN



BACKGROUND INFORMATION

The Columbia River has many functions to life in the Pacific Northwest. The Columbia was once one of the most productive salmon rivers in the world. The Columbia provided a bountiful source of food for Native American tribes that inhabited the Pacific Northwest.

With the arrival of European settlers, the Columbia continued as an important fishery through much of the 20th Century. The river, however, has been transformed in the last 70 years. With the arrival of Rock Island Dam in 1933 and Bonneville Dam in 1938, the river became an important source of electricity generation.

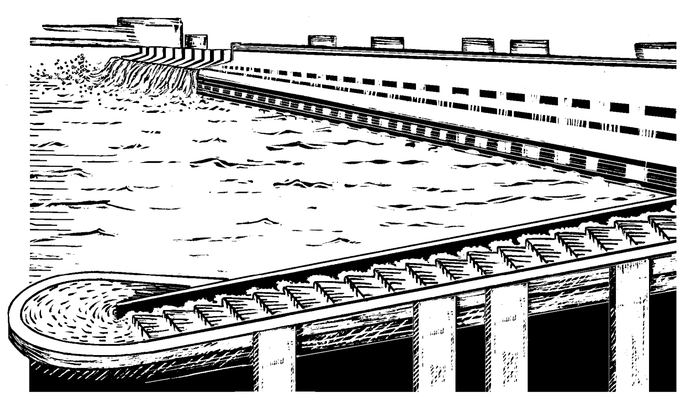
Grand Coulee Dam in Washington blocked salmon from over 1000 miles of the Columbia. The massive "June Hogs," 100-pound salmon, perished at the base of the dam. With each new dam, the Columbia was transformed from a free flowing river, to a series of lakes backed up behind the massive concrete and steel dams.

The hydropower generated by the Columbia and Snake River dams comprise approximately 80% of the Northwest's energy needs. Dams have dramatically helped farmers transform desert land into highly productive and profitable agricultural land through irrigation. Dams have brought big power using industries, like aluminum, to locate in the Northwest to take advantage of the cheap hydropower. And dams have promoted navigation, allowing deep-draft barges to run the Columbia and Snake Rivers up to Lewiston, Idaho. To this end, dams have helped provide the Northwest with a strong economy and thousands of jobs.

The dams, however, have also been blamed for helping destroy the great symbolic salmon runs of the Columbia and Snake Rivers. By altering the habitat for the fish, slowing travel times for migrating juvenile fish, blocking previously usable habitat, making passage through or around the dams dangerous for both juveniles and adult salmon, changing the temperature of the river and increasing fish exposure to gas saturation and to predators, the dams have impacted the previously abundant runs.

1n 1991, the National Marine Fisheries Service (NMFS) listed Snake River Sockeye Salmon as endangered. In 1992, NMFS listed Snake River Fall and Spring Chinook Salmon as threatened species, which was later changed to endangered. In 1997, they added Snake River and Upper Columbia River Steelhead to the endangered list. And the listings continue.

THE JOHN DAY DAM SCENERIO



The Northwest Fish and Power Council is a government organization charged with restoring salmon runs to the Columbia River while also maintaining an adequate power supply for the region. The Council has just received a scientific report that could mean major changes in the way the Northwest manages the Columbia River system.

The report calls for broad changes in dam operations to return the river to a more natural condition to help restore Columbia River salmon. By returning the river to a more natural condition, the report states that salmon habitat will increase, and endangered salmon runs will have a chance to recover. Without changing the way the river is run, the report states that salmon runs are doomed to extinction in the Columbia River system.

The report suggests that drawdowns of dams or dam removal will help restore habitat. A drawdown means a lowering of the level of water that is stored behind the dams. Lower water levels will provide more natural river conditions for fish. Drawdowns or dam removal will have dramatic effects on shipping, power generation, agriculture, drinking water (for the City of Umatilla), flood control and recreation.

The council has gathered to listen to testimony from various interest groups on a proposal to drawdown the John Day Dam. The John Day Dam, managed by the Bountiful Power Administration (BPA), is the third largest power-producing dam in the system and the John Day Dam Reservoir is the largest and slowest flowing pool on the Columbia River system. The report states that drawing down John Day to "natural river" levels will help increase salmon habitat. A "natural river" is considered fifty-five feet below the normal dam water level.

The Council has the following five suggested options under consideration, all coming with a variety of impacts to the current uses of the river and benefits to the salmon that inhabit the river.

YOUR TASK

1. You will be assigned one of the following eleven roles to research and represent:

    - **Confederated Tribes of the Umatilla**
    - **Umatilla County Farmer**
    - **Port Director for the Port of Umatilla**
    - **Director of Power Marketing – Bountiful Power Agency – Portland, Oregon**
    - **Families in Salmon Heaven (FISH) – Conservationist Organization – Vancouver, Washington**
    - **Outfitter and Fishing Guide – Salmon, Idaho**
    - **President, Aluminum Company of Oregon**
    - **Northwest Fish and Power Council – State of Oregon Representative***
    - **Northwest Fish and Power Council – State of Washington Representative***
    - **Northwest Fish and Power Council – State of Idaho Representative***
    - **Northwest Fish and Power Council – State of Montana Representative – Council Chair****

2. With your role you will be given a **profile** that provides an overview of whom you're representing. Conduct further research into your role – make some phone calls, use the internet, the library, etc. Contact members of the community familiar with your role to provide suggestions and guidance. Also, try to understand the perspective of the other people involved in this role-play. The more you know about the other players involved the more likely you will gain a decision that's favorable to you, but also takes into consideration all interests.

3. Develop a **3-5 minute presentation** to the Northwest Council of Fish and Power that clearly gets across your perspective, your position and your coherent plan. Make sure that you back up all statements with facts. Create charts, graphs, handouts, etc. that enhances your presentation and your position.

    ***Council Members:** The day of the hearing, you will be at the front of the room, listening to all the presentations. You should have a clear understanding of all positions beforehand. You should prepare questions and develop criteria for the most favorable and informed decision. When all have testified, you will debate amongst the Council and then come to a vote. For a decision, the Council must have a super-majority in favor of one option (the vote has to be at least 3-1).

    ****Council Chairperson:** The Chair of the Council is responsible for conducting the hearing, facilitating the debate, and calling for a vote.

STUDENT HANDOUT 6B

John Day Dam Options

OPTION #1

ACTION:
- Do nothing.
- No drawdown.
- Continue with operations as the presently exist.

IMPACTS:
- **Shipping, recreation, power generation, agriculture and drinking water**: No impact.

- **Fish habitat**: To avoid passage problems at the dam, juvenile fish will be collected for transport, in barges or trucks, around the dam.

OPTION #2

ACTION:
- Minimum operating pool drawdown.
- Drawdown the reservoir to minimum operating pool, 12 ft. below the normal dam level

IMPACTS:
- **Shipping**: No impact.

- **Recreation**: Two exposed boat ramps will have to be extended to reach water level, costing $45,000.

- **Power Generation**: Minimal effect. There will be a loss of storage capacity for peaking power for the Bountiful Power Agency (BPA).

- **Agriculture**: Some irrigation pumps will be exposed by lower water and will need adaptation.

OPTION #3

ACTION:
- Mid-range drawdown.
- Drawdown the reservoir to the upstream sill block, 23 ft. below the normal dam level.

IMPACTS:
- **Shipping**: Minor effects. Some dredging will be required to allow deep-draft barges to pass through the locks.

- **Recreation**: Boat ramps will be exposed and will have to be extended to reach water level. Some impacts on an existing, warm-water bass fishery in the John Day Dam Reservoir by making the reservoir colder and faster flowing. Possible positive impact by increasing salmon production and survival behind the dam.

- **Power generation**: Impacts from loss of turbine efficiency and loss of peaking generation capacity for the BPA. May have to transfer peaking generation to another less efficient dam. Some loss of overall power generation occurs with the need to spill water.

- **Agriculture**: All irrigation pumps will be exposed. Irrigators will have to pay to extend the pumps to the lower water level to use water. Electricity costs to pump the water from the lower water level will increase for all irrigators.

- **Drinking water**: The City of Umatilla's municipal water pump would be exposed. The city uses the river to supply drinking water to its residents. The city will also have to pay to extend the pump to the lower water level and the costs to pump the water will rise.

- **Fish Habitat**: The report suggests a drawdown to this level will have some benefits to fish habitat by improving water temperature, speeding water flow and providing some pools and resting and feeding areas for smolts on both sides of the reservoir. The report suggests, however, that drawdown to this level might not be enough of an improvement to assure salmon survival. To avoid passage problems at the dam, some juvenile fish will have to be collected and barged around the dam.

OPTION #4

ACTION:
- Spillway crest drawdown.
- Drawdown the reservoir to the spillway crest, 55 ft. below normal dam level.

IMPACTS:
- **Shipping**: Major impacts. Shipping will be reduced to some shallow draft barges, with dredging required to allow passage near the dam. Deep draft barges will be eliminated from the river.

- **Recreation**: Major impacts. Exposed boat ramps will have to be extended to get to the water level. All existing boat ramps will be exposed causing loss of access to the river for boaters. A wildlife refuge will be exposed in the middle of silty, muddy bank flats. Possible negative impacts to the existing bass fishery, through the reservoir becoming a colder, more rapidly flowing "river" rather than a slow-moving, warmer lake. Possible positive impacts by improved salmon production behind the dam. Boaters may like the fact that the river now flows like a river. Possible increased tourism to view the more "natural" river, though this may be only a temporary benefit.

- **Power generation**: There will be a huge loss in the ability of the dam to deliver peaking capacity for the BPA. This will result in other less efficient dams, having to supply peaking power. Large loss in total generation through loss of water stored in reservoir. The BPA will possibly need to build other types of generation or purchase power from other areas of the country to make up for the lost generation.

- **Agriculture**: All irrigation pumps would be exposed because of lower water level. Major expense to extend the pumps to reach river level to irrigate. Far greater electricity costs to pump the water up from the lower river level.

- **Drinking water**: The City of Umatilla water pump will have to be extended for the city to continue to draw drinking water from the river.

- **Fish habitat**: The report states that drawdown to spillway crest provides very good habitat for salmon, making the reservoir act more like a river. Shallow pools provide resting and feeding areas for juvenile fish on both sides of the reservoir. Water flows faster and carries more nutrients for young salmon to feed on during migration. Spilling water through the spillway reduces juvenile salmon passage problems at the dam. Spillway crest drawdown will allow the river to have spring "flooding" events, creating new habitat and a meandering river channel beneficial for salmon. Passage problems through the dams will be diminished through this option. Fish will not have to be collected for transportation around the dam, though there still will be some loss of fish while passing the dam.

OPTION #5

ACTION:
- Dam removal.
- Remove a large section of the dam, allowing the water to flow through.
- This action will return the river its natural state and will eliminate the dam.

IMPACTS:
- **Shipping**: This option will eliminate all deep-draft navigation. Shallow-draft barges will still make runs through the area at times of high flow.

- **Recreation**: Dam removal will seriously reduce or at least transfer the warm water bass fishery to another location further down the river. Power boating will be seriously reduced from that stretch of the river. Boat ramp extensions to the new water level will need to be built for boats to get to the river at all but the highest flow times. The wildlife refuge will be exposed and left in a dry, muddy area of the riverbank.

  Positive impacts could result from increased rafting, kayaking and canoeing on the now returned stretch of river. Increases in salmon will result in different types of sportfishing taking place on the river that could replace or enhance the bass fishery. New wildlife habitat would be created in the restored river, perhaps eliminating the need for the former wildlife island refuge now left in the dry riverbank. Potential increases in tourism to the restored river.

- **Power generation**: This option will cause the loss of power generation at the dam site. John Day is the third largest power-producing dam in the system. BPA will have to replace the lost generation through power purchases with other areas of the country, building new generating facilities or increasing energy conservation efforts. Loss of the dam will also cause system reliability problems, possibly resulting in power blackouts at certain times of the year. The system will also lose the peaking capacity that the dam provides.

- **Agriculture**: Irrigators will have major expenses in restructuring and extending their pumps to reach the river. Some may have to find alternative sources of water to irrigate their crops. Electricity costs will rise to pump the water for greater distances. These added costs may make some of crops grown on these lands money losers.

- **Drinking water**: The City of Umatilla pump will be totally exposed and useless. The city will have to find an alternative water supply.

- **Fish habitat**: Dam removal will provide a 42 mile stretch of free-flowing river. According to the report, this is the most beneficial option for fish. The river will return to natural river conditions. The fish will no longer through or around the dam, meaning no loss of fish through the dam's turbines. The water will run colder and swifter, aiding fish migration. The river will be able to provide better nutrient transportation. Spring flood events will take place, scouring out trapped sediment and creating new pools and resting and feeding habitat for juvenile fish. There is no need to collect fish for transportation around the dam. All fish will be able to migrate the river.

STUDENT HANDOUT 6C

PROFILE: CONFEDERATED TRIBES OF THE UMATILLA

You represent the Confederated Tribes of the Umatilla Indian Reservation. The tribes have had treaty rights from 1855 guaranteeing them half the catch of the salmon runs. Salmon runs have declined so drastically, the tribe has only had a ceremonial catch from the Columbia River that amounted to about 100 fish. These fishing rights are extremely important to the tribe. You fear the loss of the salmon also represents a loss of your culture and your tribal identity.

Your tribe strongly objected to the building of the dams. Tribal members had always feared the loss of the salmon, steelhead, sturgeon, and lamprey when the dams were built.

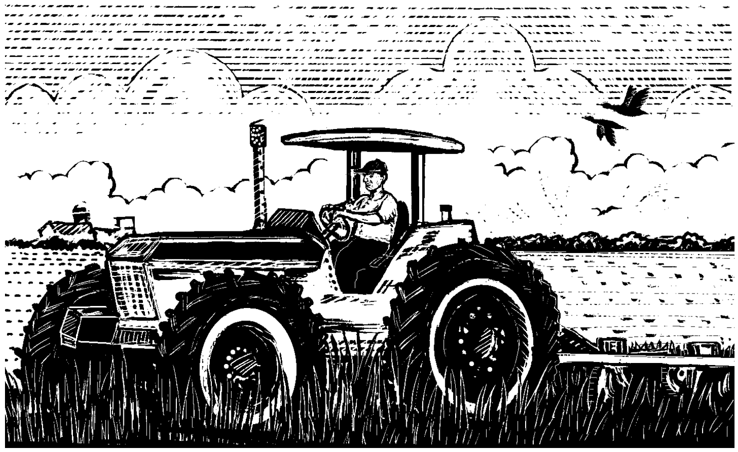
The Confederated Tribes also have to live among the non-tribal farmers who irrigate their fields from the John Day Dam. You have participated in a project that pumps water from the Columbia into the Umatilla River to keep water in the Umatilla for fish, while still allowing irrigation to continue with water from the Umatilla.

The tribe also uses the Port of Umatilla to ship some of the grains grown on the reservation to the Portland area, though these crops are not a major cash crop, as they are for some of your non-tribal neighbors.

Questions to consider:
- Which John Day Dam option do you favor?
- What groups do you think are your allies in your position?
- What groups do you think oppose you?
- How do you think the Council could help enforce your treaty rights?
- Do you have any other suggestions or options for the Council to consider?

STUDENT HANDOUT 6C

PROFILE: UMATILLA COUNTY FARMER



You have owned a large wheat and alfalfa farm outside Hermiston, Oregon for the last twenty-five years. You come from a family that has been farming in this area since before the John Day Dam was built. You remember the salmon runs from your childhood and you are concerned that the runs have decreased so drastically. However, you also make your living by irrigated farming.

You are concerned that some of the proposed solutions would force you to extend the length of your irrigation pumps subsequently costing you more money to power these pumps. Your profits have increased the last several years. You know that since the John Day Dam went in it has been far easier to make a profit off irrigating your land. You remember the struggles your family had in getting water to the land.

You also worry that since you ship your crops from the Port of Umatilla, the Port could have major alterations or possibly close. You have investigated the possibility of alternatives to shipping.

Questions to consider:
- Which John Day Dam option do you favor?
- Who are your potential allies for the option you favor?
- Are there any guarantees you want from the Council if they choose an option you do not favor?
- What groups do you think oppose you?
- Do you have any other suggestions or options for the Council to consider?

STUDENT HANDOUT 6C

PROFILE: PORT DIRECTOR FOR THE PORT OF UMATILLA

You are the Director of the Port of Umatilla. The Port has been a major shipper of wheat and other grains from the irrigated farms in the area. The Port has also served as the place for receiving fuel oil and other bulk items shipped from Portland to serve the farms of the area.

The Port employs over seventy people and is the largest business in Umatilla. You are concerned that changes in John Day Dam will alter the nature of the Port, perhaps even cause the Port to close. You like living in Umatilla and enjoy the pace of life there.

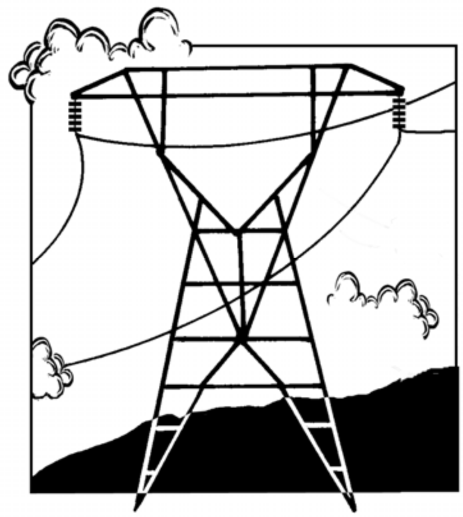
You have noticed the salmon decline, but you believe there are causes other than the dams. You wonder how the oceans and downstream pollution from cities like Portland could affect the salmon.

You also wonder about the bass fishery that has developed in the John Day Dam pool and if those who worry about the salmon might also care about the bass that could be affected by different dam operations.

Questions to consider:
- What John Day Dam option do you favor?
- Who are your potential allies for the option you favor?
- Are there any guarantees you want from the Council if they choose an option you do not favor?
- Do people who have made a livelihood from the Dam being there have a right to rely on the Dam continuing to operate in the same way?
- Do you have any other suggestions or options for the Council to consider?
- What groups do you think oppose you?

STUDENT HANDOUT 6C

PROFILE: DIRECTOR OF POWER MARKETING – BOUNTIFUL POWER AGENCY (BPA)



You have been the Director of Power Marketing for the Bountiful Power Agency, based in Portland, for five years. In that time you have seen great changes take place in the power industry, especially at BPA. When you started, the Northwest had a balanced supply. Now the region has a power surplus. Gas-fired power plants have been able to compete in price with power from the dams.

California could use the surplus power you have available, but you need to deliver it at the moments that they need it. John Day Dam has been the major supplier of that “peaking” power, but you worry that might disappear if Dam operations change drastically.

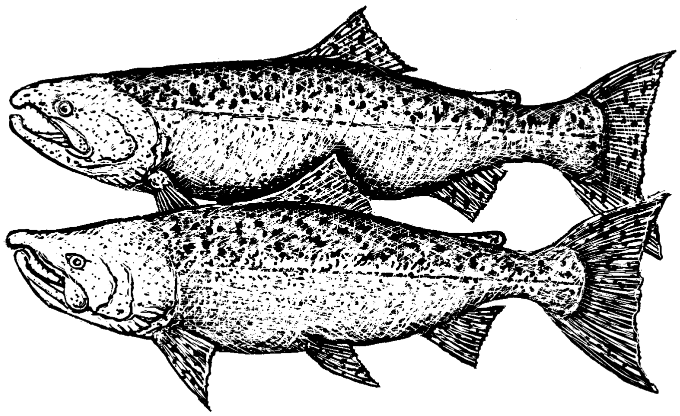
You also feel that the dams have been unfairly blamed for the declines in the salmon runs. You feel there may be other factors causing the declines. You know the law creating the Council directed BPA to “protect, enhance and mitigate for the loss” of fish and wildlife in the Columbia river system. You think BPA has paid a great amount for salmon recovery and that in the changing energy market, more costs associated with salmon recovery will affect your ability to market your power in prices, which you large industrial customers will want to pay. You think they may desert you for alternative energy sources.

Questions to consider:

- What John Day Dam option do you favor?
- Who are your potential allies for the option you favor?
- Are there any guarantees you want from the Council if they choose an option you do not favor?
- Do you see any possible compromise positions that, though you might not prefer it, you could support?
- Do you have any other suggestions or options for the Council to consider?
- What groups do you think oppose you?

STUDENT HANDOUT 6C

PROFILE: MEMBER OF FAMILIES IN SALMON HEAVEN (FISH) A NON-PROFIT CONSERVATION ORGANIZATION



You work in a high tech firm in Vancouver, Washington and have lived your entire life in the Northwest. You used to fish for salmon in your youth. You have always had an interest in the environment and the salmon. You want to see the salmon runs restored to their historic numbers.

When the Snake River salmon were declared endangered, you joined Families in Salmon Heaven (FISH). FISH members have staged some protests at the dams, arguing that the dams have caused the loss of the salmon runs. You have statistics that show there has been downward trend in salmon returns since the Bonneville Dam was completed in 1939.

You have read the scientific report that the Council is considering and you find it interesting, but think the scientists may not have gone far enough in their recommendations on restoring the river to save the salmon. You also realize that people have made a living off the river for many purposes, but the loss of the salmon runs have caused a loss of other lifestyles as well.

Questions to consider:
- What John Day Dam option do you favor, if any?
- Who are your possible allies in the position you favor?
- Are there any guarantees you want from the Council if they choose an option you do not favor?
- How should the Council prioritize the uses of the river?
- Does the option you favor support the priorities that you think the Council considers in developing a salmon recovery plan?
- Do you have any other suggestions or options for the Council to consider?
- What groups do you think oppose you?

STUDENT HANDOUT 6C

PROFILE: OUTFITTER AND FISHING GUIDE

For nine years you have served as guide for groups fishing for salmon and steelhead on the Salmon River in Idaho. You also sell fishing supplies that support the groups you lead on fishing excursions.

Business has declined since you opened in 1987. You now fear that unless the salmon start returning, you may have to close up shop or switch to a different type of fishery. You love Idaho and do not want to move. However, you have started to believe that salmon may never return to Idaho in any fishable numbers.

Questions to consider:

- What John Day Dam option do you favor?
- Who are your potential allies for the option you favor?
- Are there any guarantees you want from the Council if they choose an option you do not favor?
- Do you have any other suggestions or options for the Council to consider?
- What groups do you think oppose you?

STUDENT HANDOUT 6C

PROFILE: PRESIDENT – ALUMINUM COMPANY OF OREGON

You are President of the Aluminum Company of Oregon (ACO) located in The Dalles, Oregon. Your company supplies 15% of all the aluminum produced in the United States. Your company is a major employer in The Dalles.

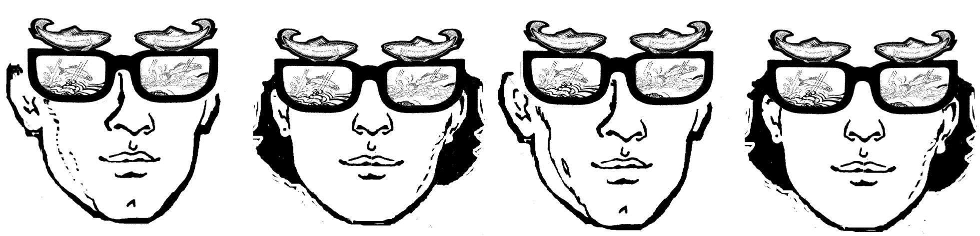
ACO uses vast amounts of electricity supplied by hydropower from the Bountiful Power Agency (BPA). If you are unable to obtain that power from the BPA, you may have to purchase your power from other sources, which may be more expensive than BPA's hydropower.

You worry that a drawdown of the John Day Dam would cause serious problems for BPA to supply you with power. You have explored some options. Purchasing power from other sources would cost you more money. Since power is the major cost to your business, increased power costs may cause you to shut down production, forcing you to lay people off work.

You could also build your own natural gas fired power plant, which might be as cheap as hydropower, but would cause pollution from burning the natural gas to generate power.

Though you like the thought of having salmon in the rivers, they have never been a concern of yours.

Questions to consider:
- What John Day Dam option do you favor?
- Who are your potential allies for the option you favor?
- Are there any guarantees you want from the Council if they choose an option you do not favor?
- Do you have any other suggestions or options for the Council to consider?
- Do you have any methods or possibilities to compromise on a solution?
- What groups do you think oppose you?



STUDENT HANDOUT 6C

COUNCIL PROFILE: STATE OF IDAHO REPRESENTATIVE

You represent the state of Idaho on the Northwest Fish and Power Council. The new governor appointed you last year to give the water users of Idaho more of a voice on the Council. Previously, you had represented eastern Idaho in the State House of Representatives. Your home area has remained a stronghold of irrigated agriculture.

Idaho has experienced the sharpest declines in salmon numbers. Three Idaho salmon species, sockeye, spring chinook and fall chinook, have been listed as endangered. The listings have affected water users in Idaho by limiting water withdrawals for irrigation. Drawdown of dam levels to help save salmon threatens the existence of Idaho's only port, the Port of Lewiston.

Sportfishing groups and a growing environmental community in Idaho are pressuring the governor to do more to restore the salmon runs. They have been joined by the Nez Perce Tribe, who have claimed their treaty fishing rights.

Your governor faces a difficult election next year and does not want to do anything that will alienate large groups of voters.

Questions to consider:
- Faced with the conflicts that exist within your state, which John Day Dam option do you favor?
- The law creating the Council charged Council to "protect, enhance and mitigate for the loss of the salmon runs in the Columbia River system. Given that law, how can you do what your governor has asked and "give a greater voice to Idaho's water users?"
- Do you have any other solutions or options to suggest?

STUDENT HANDOUT 6C

COUNCIL PROFILE: STATE OF MONTANA REPRESENTATIVE – COUNCIL CHAIRPERSON

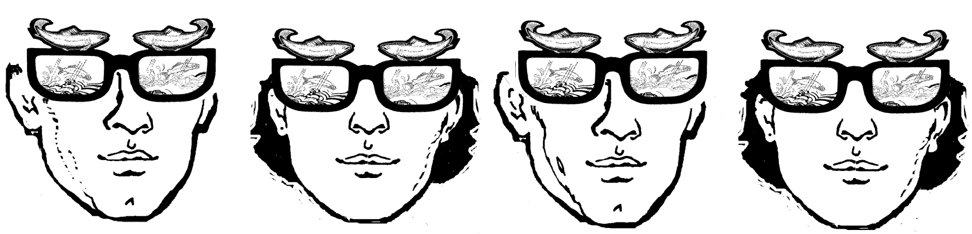
You are the Northwest Fish and Power Planning Council representative from the State of Montana. You also serve as Chair of the Council and will be responsible for calling witnesses to testify, allowing you and your fellow Council members to ask questions of the testifiers, keeping the proceedings moving smoothly and on time.

Montana is the only state on the Council that has never had anadromous salmon within its border, even prior to dam construction. You have great concerns over the loss of public power, represented by the Bountiful Power Administration and the public power interests in Montana. The dams have provided inexpensive sources of electricity that have powered Montana industry. You have concerns that major changes in dam operations will affect Montana power users and Montana industry.

You also have sympathy with ranchers and irrigated agriculture. Together these groups comprise most of Montana's agriculture community. They ship some of their products by barge from Lewiston, Idaho down to Portland. You can also identify with people concerned about water level fluctuations behind the dams. Montana has experienced problems with water levels rising and falling rapidly behind their dams, largely to supply peaking power. These water level variations have caused problems with boaters using Montana reservoirs and have affected sturgeon and bull trout, species that are also endangered.

Questions to consider:

- What John Day Dam option do you think will best serve the citizens of Montana?
- What option will best help the citizens of the entire Northwest?
- The law creating the Council says that you will "protect, enhance and mitigate for the loss of fish and wildlife in the Columbia River system." Do you have a problem upholding that law and representing the interests of Montana on the Council?
- Do you have any other suggestions or options for the Council to consider?



STUDENT HANDOUT 6C

COUNCIL PROFILE: STATE OF OREGON REPRESENTATIVE

You have served on the Northwest Fish and Power Council for two years as the representative from the State of Oregon. Your term expires in four months and you hope to get reappointed. You were appointed by a governor who has promised that restoring salmon runs to the state was the highest priority in the government. The governor has recently pushed for a salmon recovery plan that stresses restoring lost salmon habitat as the key to salmon recovery.

The governor has also just completed a deal with the Port of Portland to dredge the Columbia River to allow larger ocean-going ships to enter the Port, expanding foreign trade. The Port has concerns that drawdowns of dams, such as the one you are considering for John Day, may affect the Port's trade and ability to move products throughout the Columbia River system. The Port's Director has recently contacted you and expressed those concerns, saying that the matter might be brought before the governor if the Port is unhappy with the result.

You represented Eugene in the State Senate before joining the Council. The environmental community helped elect you to the Senate and have continued to support your efforts, considering you their ally. Power interests have always considered you an enemy, noting that you have a long history of voting against them.

Questions to consider:

- Given your political ideals, the policy of your governor and the Port of Portland issue, which John Day Dam option do you favor?
- The law creating the Council states that the Council should "protect, enhance and mitigate for the loss of salmon runs" in the Columbia. Does that law affect the John Day option you favor?
- Do you have any other possible solutions or options for the Council to consider?

STUDENT HANDOUT 6C

COUNCIL PROFILE: STATE OF WASHINGTON REPRESENTATIVE

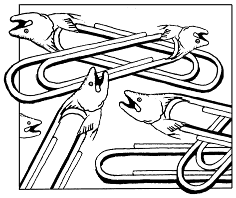
You have been appointed to the Northwest Fish and Power Council by the new governor to help restore salmon runs and rebuild the Washington fishing industry. You are a member of the Yakama Indian Nation and have become the first Native American to serve on the Council. Prior to joining the Council, you served as the Director of the Washington Public Utility Districts (WPUD), a group advocating for public power, particularly for the rural areas of Washington. As Director of WPUD, you sought ways to help restore fish, while maintaining a steady supply of hydroelectricity.

You recognize the plight of the fishing industry in Washington. Many fishing boast owners have been unable to fish for salmon for four years and unemployment is some fishing communities is nearly 30%. You know the plight of the tribes and you realize they have treaty fishing rights for salmon that date from 1855 and have been consistently upheld in court.

You also know that drawdowns could affect the public power industry. Public power is a major factor in Washington's power supply, particularly in your home area in the eastern part of the state. Your governor has little support in the public power community and people think that the governor is trying to make ties to public power by appointing you to the Council.

Questions to consider:
- Which John Day Dam option do you favor?
- The law creating the Council states that the Council must "protect, enhance and mitigate for the loss of fish and wildlife in the Columbia River system." Given that law, how does the balanced approach that you used with WPUD, restoring fish while maintaining hydroelectric power, work with the Council and the options you must consider?
- Do you risk offending your old public power associates or do you alienate the fishing communities and tribes with the options you favor?
- Do you have any other suggestions or options for the Council to consider?

STUDENT HANDOUT 6D



Salmon Fisheries Group Worksheet

Names:

Fleet:

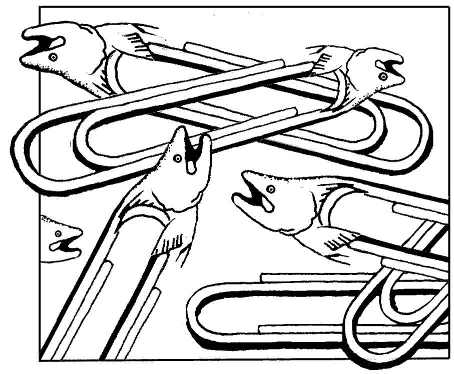
YEAR	$$$ AT START	# OF BOATS	FISH CAUGHT	$$$ EARNED	SUBTRACT COSTS	NEW BOAT COST	BALANCE
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							

STUDENT HANDOUT 6E Name___________________

Salmon Fisheries Simulation Directions & Questions

Directions

1. Each group starts with one boat.
2. Any fleet may call a Pacific Fisheries Conference to discuss fishing.
3. Each boat gets to fish for one minute. This equals one year in the game.
4. To fish, a person (the boat) goes and picks up paper clips (the salmon).
5. Each paper clip represents one ton of salmon, and is worth $10. Take them to the Banker to cash them in.
6. It costs $100 to operate each boat each year. You pay this cost to the Banker.
7. You may buy a new boat for $100. You pay this to the Banker.
8. You cannot have more boats than members in your group.
9. If you ever don't have the money to pay for the operation of your boats, you can sell excess boats for $50 each.
10. If you either have no boats, or cannot pay the $100 operating fee, then you are bankrupt and out of the game.



1. Graph the data on numbers of salmon and fishing boats on the sheet provided. Use it, the Salmon Fisheries Group Worksheet, and the Pacific Fisheries Status Report to help answer the following questions.

2. List at least three factors that affected the salmon resource in your fishery. Describe their effects.

   A.

   B.

   C.

3. How well did you maintain the salmon resource? Is this resource renewable or non-renewable? How do you know?

4. Did any fishery change its strategy about the salmon resource during the game? Why?

5. Were you able to conserve the salmon resource by the end of the game? Why or why not?

6. Did anyone win the game? What does this mean?

7. Name and describe one other factor that might affect the number of salmon in the fishery.

8. How is this model similar to fishing in the Pacific Northwest? How is it different? The rest of the world? Do your best thinking and writing here.

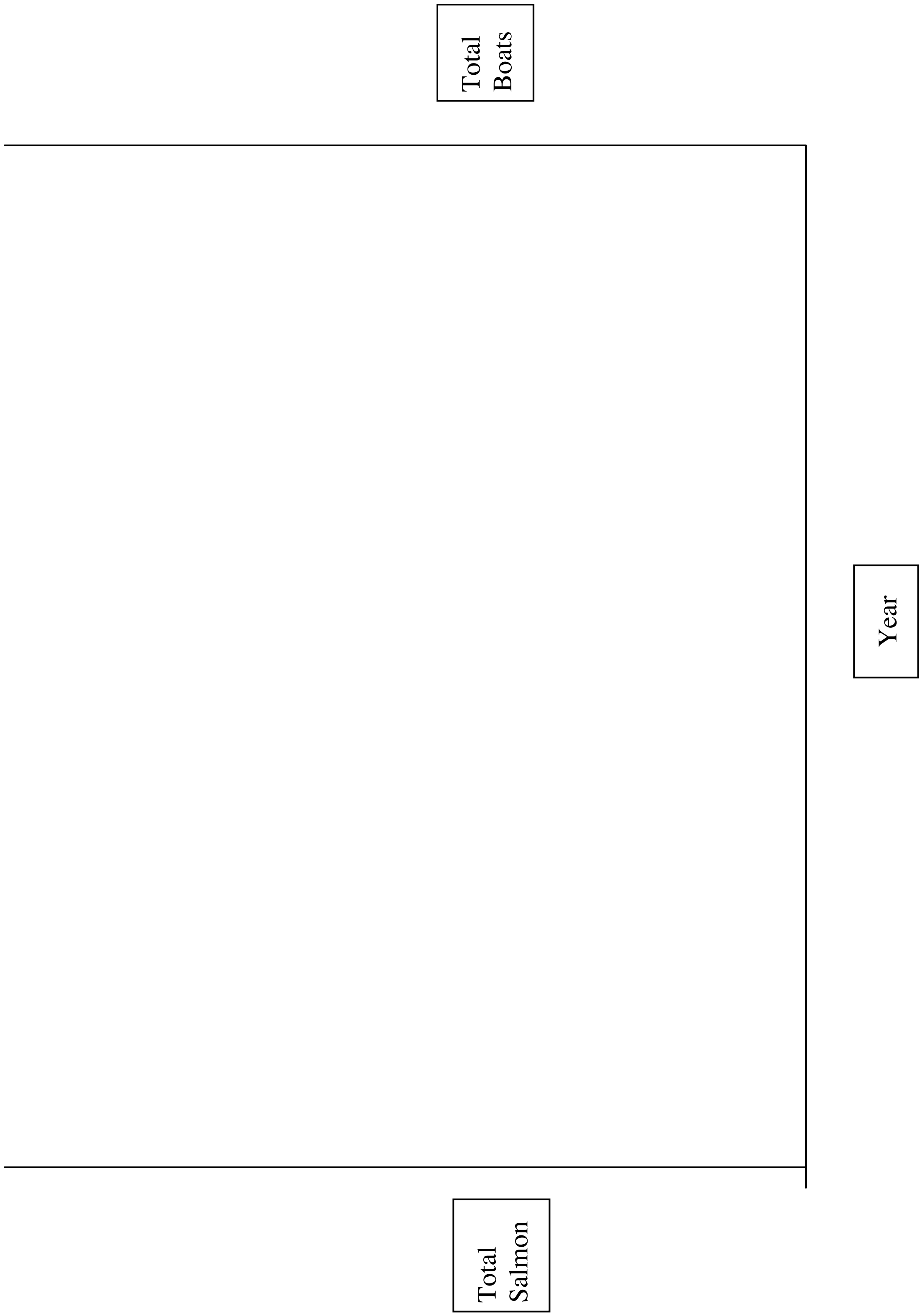
STUDENT HANDOUT 6F

Pacific Fisheries Status Report

Yr.	Ex: Yr	Ex: Yr 1	1	2	3	4	5	6	7	8	9	10	11	12
Earn:														
G1		150												
G2		200												
G3		350												
G4		240												
Boat:														
G1		1												
G2		2												
G3		2												
G4		0												
$Tot:														
G1	100	50												
G2	100	0												
G3	100	150												
G4	100	240												
Fish Survive	600	506												
New Fish		94												
Total Fish	600	600												

STUDENT HANDOUT 6G

SALMON FISHERIES GRAPH



STUDENT HANDOUT 6H Name ____________________

POPULATION INFORMATION

1. Review the table of information in STUDENT HANDOUT 6I: *Population Data* about the human population, and the square mile area of a city.

2. Plot the data in the tables on STUDENT HANDOUT 6J: *Population Unit Evaluatio*n onto a graph of the human population. Make the y-axis for the square mile area of the municipal area on the right side of your graph. Make the axes the same size as for the human population data. Why?

3. Review all the work you have done so far. As a group, answer the questions below. Write written responses that are legible and thoughtful.

   a. Compare and contrast the curves. Are there any overall patterns?

   b. The earth has been referred to as a "test tube" because, even though it is very large, it has only itself as a source of food. Does this mean that the human population will respond to environmental limits in the same way as the fly population? What makes you think this?

   c. Suppose, for a moment, that the human population could "crash." What might be done to keep this from happening?

   d. You are one small group of human beings. What effect can you have on the size of the human population?

   e. Present your ideas about how human population growth will affect human life on earth. Will the earth sustain unlimited growth? Will there be changes in the way we live? What we do? What will life be like in the year that you become 50? Illustrate your ideas in a poster. Make the presentation of your ideas a "Plan for the Future."

STUDENT HANDOUT 6I

POPULATION DATA

Year	Human Population (billions)	Beaverton Area (mi^2)
1650	.5	
1850	1.1	1.1
1930	2.0	
1952	2.6	1.1
1962	3.1	
1975	4.0	
1985	4.9	
2000	6.2	16.0
1600	.5	
1700	.6	
1800	.8	
1830	1.0	
1900	1.6	1.1
1960	3.0	
1978	4.2	
1981	4.5	
2050		30.8

Note: Dates may not be in sequence. Use your graphing skills to discover how to plot them.

STUDENT HANDOUT 6J Group ________________________

Population Unit Evaluation

Presentation:

1. Answer each question (3.a-e): _________
2. Participation:_______________________

Poster:

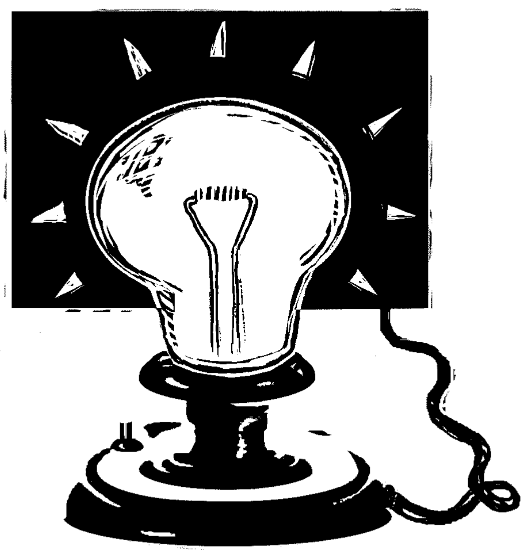
1. Readable:________
2. Based on data:__________
3. Reasonable:____________
4. Accompanied by accurate area graph:__________

Individuals:

1. Table of fly data:_________
2. Graph of hypothetical fly data:_________
3. Graph of actual fly data:_________
4. Graph of human data:_________
5. Graph of municipal area data:_________
6. Answers to first set of questions:_________

STUDENT HANDOUT 6K

WHAT ARE YOUR ENERGY NEEDS?[1]



How much electricity do you use each day? Where does it come from? Questions about electricity are closely tied to the survival of the salmon. In order to make decisions about the salmon and the Columbia River, we need to understand better about the electricity that we use and the options for the future.

First a question: what do you do in your daily life that uses the most electricity? Check the four activities below that you think consume the most power.

_____ watching TV for an hour

_____ having a light on for an hour

_____ drying a load of clothing

_____ cooking dinner

_____ running the refrigerator for an hour

_____ listening to the radio for an hour

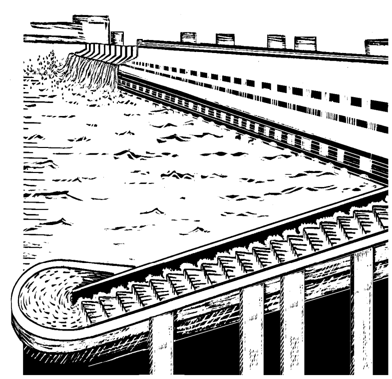
_____ washing a load of clothing

_____taking a hot bath

_____ heating your house
for an hour in the winter

Of course, the products that we use in our daily lives also consume vast amounts of electricity. The production of aluminum cans requires huge amounts of electricity. So does keeping food and restaurants cold. Almost every product that we use requires electricity. Where does it come from? How much does it cost?

Clearly the dams of the Pacific Northwest contribute to our power. If we alter how the dams operate, then we consequently will need to find alternative sources of energy to replace any power lost. However, dams do more than provide electricity in the Northwest. Even if we can replace the lost power, we may lose other benefits of dams. For instance, farmers in Idaho use the dams to provide a cheap way to ship their grain to Portland. Other dams provide water for irrigation. Many of the dams provide flood control in the winter.



[1] This activity was contributed to the 1996 curriculum by Eric Baack.

What about other sources of energy? Listed below are different sources of energy. Use the information in STUDENT HANDOUT 6L: *Sources of Energy*, to determine and graph the costs associated with each source, its benefits, and drawbacks.

Power Source	Cost	Benefits of Power Source	Drawbacks of Power Source
Hydropower			
Coal-burning Generators			
Natural gas Generators			
Solar power			
Wind power			
Geothermal power			
Biomass (burning crops or trees)			
Nuclear power			
Conservation			

Discussion Questions:

What are advantages of the current sources of power for Oregon? Who benefits?

What are the drawbacks of the current sources of power for Oregon? Who has paid most of the costs?

Using the information that you now have, draw the pie chart for what you think Oregon's sources of power should be. After you have completed the pie chart, explain how your proposed chart differs from the present. What are the benefits of the changes that you are proposing? What are the possible drawbacks of your proposal?

STUDENT HANDOUT 6L

SOURCES OF ENERGY

Hydropower

The Columbia River basin has more than forty dams. Almost all of these dams were built using funds from the federal government. The government made the loans very long term and inexpensive, making the dams relatively inexpensive to build. The dams were built for several reasons. Some of the highest dams, such as John Day, Grand Coulee, and Brownlee provided inexpensive irrigation to farmland. Before the dams, very few crops could be grown in much of Oregon, Washington, and California. Many of the dams were built for flood control. During the fall and winter these dams release most of their water so that during heavy rain or early snow melt they can prevent flooding downstream. Before the dams on the Columbia, no ships could travel above Hood River. The falls at Celilo once blocked any travel. Now, ships can travel to Pendelton, Oregon, and Lewiston, Idaho, thereby saving considerable money for farmers. The dams speeded development of large parts of the states. The dams allowed new industry in the Northwest, including paper companies and aluminum plants.

Hydropower is cheap and renewable. Each time it rains it provides more electricity. Dams create no pollution. Today, the power from dams costs about six cents per kilowatt hour. However, the hydropower system has had other costs. In particular, the dams severely hurt the salmon runs. Dams without fish ladders such as Grand Coulee and Brownlee blocked huge stretches of salmon habitat. Before Grand Coulee, huge Chinook salmon once traveled all the way up to Canada - the dam ended that. The dams slowed down the spring floods going to the ocean. Now young salmon spend three or four weeks going to the ocean when they once would have spent one. The slower speed affects the salmon's ability to adapt to salt water and gives bigmouth minnows a chance to devour them. The slower water also warms up, hurting salmon. As the young salmon pass through the dams and the turbines, as many as 10% can be killed immediately by shock. Others die later or are easy prey for birds, fish, and other predators.

Coal plants

In recent years an increasing amount of Oregon's power has come from burning coal. The United States has huge reserves of coal that can last for hundreds of years. Coal plants can produce power relatively cheaply. However, coal has some significant costs. Coal usually contains sulfur: when it is burned, it releases that sulfur into the atmosphere, causing acid rain. Power plants can reduce the problem of acid rain, although that increases the cost of energy production. Burning coal also releases carbon dioxide into the atmosphere, thereby contributing to the gradual warming of the earth. Getting the coal to burn also has costs. Coal is obtained by strip mining, which removes all of the soil and life from a place. Regulations now require restoration of mining sites, but mining still requires the temporary removal of all life.

Natural Gas

Natural gas is rapidly emerging as the most popular new power source. The United States has large natural gas reserves, with much more available in Canada. Unlike coal, natural gas burns cleanly, creating little pollution that can cause acid rain. It also contains more energy, so less carbon dioxide is released for the same amount of power generated. All the same, it does pose a risk for global warming.

The newest natural gas generators are extremely efficient, making the cost of power from these generators fairly low. Of course, that cost could change. Prices for natural gas have been low in the last ten years, but at other times were much higher. The cost for power would rise and fall accordingly. As demand grows for natural gas, the price could increase. Natural gas is a fossil fuel, but it can sometimes be renewable. For example, natural gas can be captured and burned at waste dumps.

Solar cells and solar-powered steam generators

Solar cells have left the time of experimentation and have moved into use. In places where power lines don't exist and where the cost of installing them would be too high, solar cells are definitely the cheapest option. In the United States, however, solar cells are still much more expensive than other alternatives yet families are beginning to use solar collectors in their homes for power. A different solar technology has been used successfully recently, one that uses mirrors to focus the sun's energy on a container of water, generating steam that can fuel a power plant. This too is still more expensive than most other power options.

Solar power has other challenges as well. The highest electrical demand each day occurs usually in the early morning and early evening, times when people are cooking. Unfortunately, the peak power from solar is mid-day. On a large scale, solar power could replace other sources of power at certain times of the day, but it could not replace the other power sources completely. Other problems affect the use of solar cells in Oregon: the winter is too dark to generate electricity effectively, but that is when the most electricity is needed. If the solar power could be stored efficiently, we might be able to use it in the morning, evening, and at night - but storage is far too expensive at the present. Solar cells also use several hazardous metals in their manufacturing. Even if generating power from solar cells does not pollute, making the solar cells in the first place does generate pollution.

Wind power

Wind power has turned the corner from experimental to practical. In the 1970s, the wind turbines often broke down. They could not be used in very strong winds without falling apart. Twenty years later, new designs have allowed wind turbines to become much more durable and inexpensive. If a place has enough wind, wind turbines can be used effectively.

Wind turbines are non-polluting and totally renewable. All the same, they are not perfect. In California, wind turbines have killed many large birds, including golden eagles. From the power point of view, they are also not reliable. You cannot count on a gust of wind to occur at the same time the city of Eugene wakes up and cooks breakfast. Therefore, wind turbines can be part of the power solution, but they cannot entirely replace more controllable generators such as hydropower, coal, and gas. They are most successful when used on a small scale to support individual homes with power, particularly when used in tandem with solar panels.

Geothermal power

Most power sources rely on heat to boil water, and then use the steam to turn a turbine. Geothermal power substitutes the heat of the earth instead of coal or natural gas. Since nothing is burned, there is limited pollution and depletion of the earth's resources. The earth doesn't charge anything for the heat either, so geothermal plants can be competitive in price.

Many environmentalists have mixed feelings about geothermal energy. Although it is clean and renewable, they worry about the location. The highest heat is usually available near volcanoes. This would mean constructing power plants on the sides of some of our most beautiful mountains. Over the last few years people have disputed about the source of Crater Lake's blue color. It is fed by hot springs deep in the bottom. Scientists have worried that building a geothermal plant near the park could adversely affect the lake. Some worry that geothermal plants near Yellowstone have affected the spectacular geysers there. In Hawaii, proposed geothermal plants would require eliminating parts of the remaining forest for roads and power lines.

Biomass

Biomass is in some ways our oldest power source. Long before electricity we burned wood to provide heat for cooking. The advantages of biomass are that it can be inexpensive and renewable. Need more fuel? Plant a tree or another crop. Biomass has been used successfully, but it is not yet widely used. Today in Oregon one opportunity in wood biomass utilization exists, which is to harvest small trees and smaller parts of big trees that are not large enough to make wood products. This creates a market for small diameter wood and helps to pay for thinnings that can reduce fire danger on overstocked forests on public lands, especially in eastern and southwest Oregon. Although biomass power releases carbon dioxide by burning fuel, it recaptures that carbon dioxide as the plants grow, so it has no effect on the earth's climate. Where it has been used, the costs of biomass power have been competitive. It works well if you have a fuel source that is considered garbage - such as the stalks of wheat or corn that are not eaten.

Nuclear power

At this time, Oregon has no nuclear power plant in operation; Trojan was closed several years ago. However, we still pay for nuclear power in our electric bill. In the late 1970s, several nuclear plants were built that turned out to be unnecessary. This cost a huge amount of money, and we still pay for it in every electric bill.

Nuclear power was once seen as the energy source of the future. However, in the United State no new nuclear plants are under construction. Some countries, such as France and Japan, are still committed to nuclear power development. Others, such as Sweden, are trying to close down existing power plants. Nuclear power does not produce air pollution if operated correctly, but it does produce hazardous waste that takes thousands of years to become safe. In the United States, there is still no agreement on how to dispose of such waste safely. Accidents such as Three Mile Island and Chernobyl also illustrate the dangers of nuclear power, which does not always operate correctly. Companies are trying to develop safer versions of the power plants, but these have not yet been tested adequately. More importantly, nuclear power has been far more expensive than other options as concerns about safety and waste have increased.

Conservation

Conservation may seem a strange source of electrical power, but it makes sense. If you were to reduce your electricity use by half, then that saved power could be used for other things. In the United States, large amounts of electricity are wasted that could easily be saved. Poorly insulated houses waste heat, inefficient lights consume far more electricity than needed, appliances such as washers, dryers, and refrigerators have inefficient motors, and stoves with air leaks waste valuable energy.

Conservation is the cheapest source of electrical power, but still problematic. It is difficult for an electrical company to make money by NOT selling electricity. While it is cheaper to conserve energy than to build a new coal plant, it does cost money. Electrical companies have investors that are gradually paid off over twenty or more years. The savings of conservation usually go directly to the consumer, not the company, and most consumers want to receive their money sooner than twenty years.

STUDENT HANDOUT 6M

Excerpted from Winterkill by Craig Lesley

[Red Shirt, a Nez Perce Indian, takes his son Danny to see the great falls on the Columbia River at Celilo. There, they meet their friend Sammy.]

When Red Shirt actually kept his promise instead of leaving with his friends, Danny figured going to Celilo must be important.

They arrived at midday. The salmon were moving upriver, as they did every spring, and the Celilos were catching them in hooped, long-handled dip nets when they were in the basalt chutes or trying to leap the falls. Danny and Red Shirt watched.

The Celilos stood on shaky wooden platforms extended over the churning waters, holding the long dip nets steady by bracing the pole handles against their chests and shoulders. They wore rubber boots and raingear to keep from getting soaked by the mists rising above the falls, and they smoked their pipes upside down to prevent the mists from putting out the tobacco. Some wore floppy hats, and all had safety ropes tied to their waists and hooked to support posts on the platforms.

Red Shirt told Danny that if the men fell, they most likely would drown in the churning whitewater before their friends could pull them to safety, but the ropes made them feel better anyway. He added that if a man cheated on his wife, she might cut the rope nearly in half, and then cover the cut with grease so it still looked strong. Then he winked and said it was a good thing he wasn't a Celilo.

Danny saw the salmon rise out of the water like silver ribbons as they leaped the tiers of the falls. When the fish bumped against the hoop shaped net, the Indians jerked and swung the pole handles down, lifting the fish vertically from the water. With the jerks, metal rings slid down the nets, trapping the salmon inside the twine. After catching fish, the men brought them to women waiting at the end of the scaffold, who clubbed the salmon as they flopped against the twine webs. The women took the fish from the nets and cleaned them quickly, throwing their entrails into the water before the dogs could eat them and get salmon poisoning. The men joked and relit their pipes, tapping out the damp tobacco. "Huk-toocht," they called to one another as they walked back to the platforms, "Good luck."

. . . . After the feast, in the quiet time before the dancing started, Danny followed Red Shirt and Sammy down to the falls. The platforms were empty.

"No one fishes at night," Sammy told him. "That way enough salmon get upstream to spawn." He turned to Red Shirt. "They tell us the new dam will swallow the falls. How can this happen? The falls are so powerful many Celilos believe the waters will crush the dam when they close the floodgates. We still have our fishing rights, but what good are they if the dam swallows the falls? The fish are more than money."

[Later, Danny tells his son Jack about the falls at Celilo and the day when he saw them disappear.]

"There was a treaty that said the Indians could always fish the falls. But the government wanted to build a dam to generate electricity for the cities and store water for the farmers. They offered the Indians money for their fishing rights. It seemed like a lot. Compared to the fish money, it probably was."

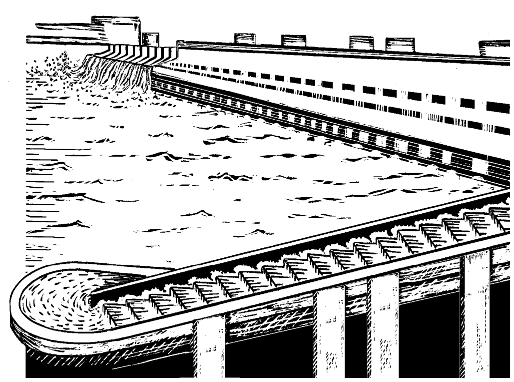
"Some wanted to sell, especially the younger ones or the ones from reservations who just visited Celilo. But others said no. Old Tommy Thompson, the Celilo chief, begged them not to sell their rights. The Indians argued among themselves so long that the government finally just gave them all checks and went ahead and built the dam."

"After the dam, there were no more fish. Before that, no matter what happened, the people always had the fish. For the Celilos, fishing was a way of life. When they caught the first salmon each spring, they laid it on the rocks with its head upstream to make sure more salmon would follow. But after the dam . . . "

Danny shook his head. "Some of the old people like Tommy Thompson never even cashed their checks. They thought maybe if they didn't take the money, things would be okay. They kept their hair long and braided it to show the Maker they had been faithful."

"They were really out of it," Jack said. "You need lawyers. Of course, they built the dam anyway."

"That's right," Danny said. "Even then some of the old people refused to believe it could destroy the falls. The river seemed so powerful, and the falls had been there longer than anyone knew."



"Red Shirt took me back to Celilo the day they closed the floodgates on the dam. For a few hours, it didn't seem to make much difference. The whitewater came rushing down the chutes, roaring and crashing over the falls. But down below you could see it hit the dam and start rolling back against itself, like wild horses driven into a blind canyon cutting back on their trail. By the middle of the afternoon, you could tell the water was rising. A large pool of it stretched all across the

river and started eddying back towards the falls. But the falls kept on roaring as if nothing could stop them."

"Red Shirt pointed to some sticks floating towards us, and when I saw they weren't sticks but logs, I knew that rising lake was a lot bigger than I had imagined."

"Finally, the lake reached the base of the first falls, so the engineers in their hardhats and ties, and the politicians, lined up for pictures -- the last pictures of the falls."

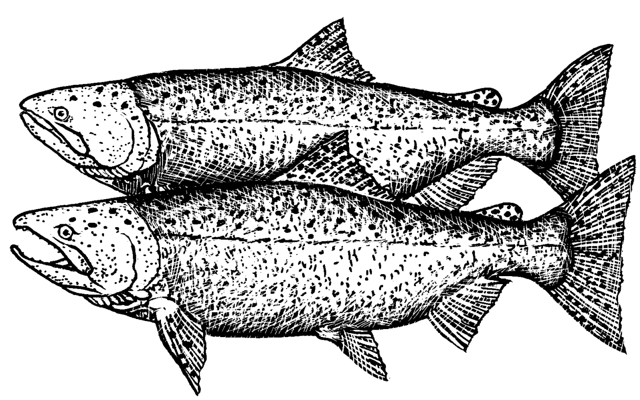
"Then I heard a high wail. It was even louder than the roar of the falls. All the old Celilos had turned their backs to the rising water and were lined up facing the canyon wall. Their arms were crossed and they were chanting the falls' death chant."

"The lake rose against the falls. The water kept pouring over the falls, but the more it crashed into the lake, the higher the lake rose, choking it back. I closed my eyes, praying it would stop. Then I opened them and stared."

One after another, the falls drowned themselves, until the roaring stopped and I couldn't hear anything but the sucking of the dark, eddying lake as it grew larger and larger, filling up the canyon."

"As the noise from the falls died, the wailing grew louder, like a shriek. One of the reservation chiefs, who had been standing with the engineers and photographers, walked away then and joined the old men and women with their backs turned to the dark water. He was crying when he passed us, and he said, "We sold our mother, and now they have drowned her."

"It was very bad for the Celilos," Danny said. "Most left the village and moved back into town or back to the reservations. Some catch a few salmon. But there are no more big feasts, and if you look into the old people's eyes, you can tell that they are still dreaming of the falls and salmon."



DISCUSSION QUESTIONS:

a. If you had been a Celilo Indian living when the dam at The Dalles was built and had watched the falls disappear, what would your feelings have been? Why?

b. What are your thoughts about building the dam at The Dalles? Answer this from your own point of view. Explain what you say.

c. Imagine again that you were a member of the Columbia River tribes living at the time that The Dalles dam was being built: if you had been offered the money for your fishing rights at Celilo Falls, would you have accepted it? Explain.

d. Why shouldn't the Celilo Indians simply move away from the river and raise cattle instead of fishing for salmon? Couldn't they just start a new life in this way? (When you respond to this question, think of all you have studied in this unit.)

You are a member of a committee that approves or disapproves dam-building permits on the Columbia River. You know about the energy needs of people and industries in Oregon, and also know the Celilo culture. How will you vote on the request to build The Dalles dam? Why?

STUDENT HANDOUT 6N **Indian Tribes**

Fishing Rights Role Play
Protocols and Negotiating Points

"The earth was created by the assistance of the sun, and it should be left as it was… The country was made without lines of demarcation, and it is no man's business to divide it… I see the whites all over the country gaining wealth, and see their desire to give us lands, which are worthless Perhaps, you think the Creator sent you here to dispose of us as you see fit. If I thought you were sent by the Creator I might be induced to think you had a right to dispose of me. Do not misunderstand me, but understand me fully with reference to my affection for the land. I never said the land was mine to do with it as I chose. The one who has the right to dispose of it is the one who has created it. I claim a right to live on my land, and accord you the privilege to live on yours."

-Inmutooyahlatlat (Chief Joseph), Nez Perce

Background

U.S. Army scouts have told leaders of the Hungry Otter, Soaring Eagle, and Fast Bear tribes that representatives of the U.S. government are coming to the Big River Country to discuss terms of a peace agreement between the tribes and the United States government. Tribal leaders have agreed to meet the U.S. representatives.

Protocols

- All members of the Indian group attending the meeting or negotiations are leaders of the three tribes. Each tribe has a chief spokesman who is able to summarize tribal discussions and present tribal positions to the United States through translators.
- Because of language barriers, the tribal positions and responses will be delivered to United States' representatives by translators.
- In preparing for negotiations with the United States and in responding to U.S. proposals, Indian leaders base their positions on the objectives and concerns listed in the Negotiating Points outlined below.
- All Indian leaders participate in the discussions to determine negotiating strategies and responses, but only the tribal spokespersons communicate with and instruct the translators.

Negotiating Points

Main Objective of Tribal Negotiators:

- Because salmon are central to their way of Life—their religion, diet, economy, and culture—tribal leaders must assure that they and their future generations have salmon.

Related Concerns of the Tribes:

- Ability to move freely to harvest the different salmon species at the different places and times of the year as is their custom.
- Freedom to practice their religion and maintain their way of life.
- Right to govern themselves.
- Protection from settlers.

STUDENT HANDOUT 6O **United States**

Fishing Rights Role Play
Protocols and Negotiating Points

"The Great Father has been for many years caring for his red children across the mountains…many treaties have been made…Andrew Jackson…said I will take the red man across a great river into a fine country where I can take care of them; they have been there twenty years; they have their government, they have their schools…the Great Father and his chiefs; they did much for John Ross and his [Cherokee] people twenty years ago. This brings us now to the question. What shall we do at this council? We want you…to agree upon tracts of land where you will live…On each tract we wish to have one or more schools…blacksmiths…carpenters…we want you and your children to learn to make plows, to learn to make wagons….

-Isaac Stevens, Washington Territory governor

Background

The President of the United States and his Secretary of War have sent two U.S. Army Generals to urge the Hungry Otter, Soaring Eagle, and Fast Bear tribes of the Big River territory of the Northwestern United States to sign treaties.

Protocols

- The generals choose two translators and two scribes.
- After discussing negotiating strategies and, later, responses to tribal positions with the rest of the U.S. side, only the generals communicate with and instruct the translators.
- Neither the generals nor the scribes understand the Indian language. The generals must use translators to communicate with tribal leaders. The translators understand that tribal leaders have designated a chief spokesperson for each tribe and that is the person with whom the translator is to speak.
- The scribes also must use the translators to understand what the tribal spokespersons have said. In addition to following the negotiations, the scribes may get reactions from other members of the U.S. side or, with the help of translators, from other tribal leaders.

Negotiating Points

Main Objective of U.S. Negotiators:

- The United States government wants the Big River territory to be safe for non-Indian settlement by farmers, ranchers, merchants, and for industrial development.
  Related Concerns of the United States Government:
- Want the tribes to sign treaties to transfer title to all the land in the Big River territory
- Keep the Big River open as a transportation corridor
- Prevent tribes from armed resistance to non-Indian encroachments

STUDENT HANDOUT 6P

Summary of 1855 Treaties With the Columbia River Tribes

In 1855, the United States negotiated separate treaties with the Nez Perce, Umatilla, Warm Springs, and Yakama tribes. These treaties were ratified and proclaimed by the United States in 1859. They are agreements, both binding and legal, between two or more sovereign nations and are upheld in the U.S. Constitution as "the supreme law of the land." They do not lose their validity with age and both parties must agree to any changes.

These four tribes, also known as the Columbia River treaty tribes, ceded over 30 million acres of land to the United States in exchange for the following:

- Establishment of tribal reservations
- Confirmation and protection of certain rights:
  - fishing and hunting rights
  - jurisdiction over their own lands
  - religious freedom
  - self-government
- Protection for Indians from attacks upon their lands (This protection included legal assistance.)
- Health Care
- Education
- Some monies

Other considerations

The federal government has a trust responsibility to the tribes to act in a manner consistent with the treaty. This trust responsibility has three components: it is obligated to safeguard and enhance tribal land and natural resources, tribal government, and tribal social services – and to provide funds, when necessary to meet these obligations.

The Supreme Court has also adopted general rules of interpretation that apply to nearly all treaties, and unique rules of interpretation that apply only to Indian treaties:

1) treaties must be interpreted as the parties understood the treaty at the time of the signing;
2) when a treaty provision is doubtful or unclear, the treaty must be interpreted so as to promote its central purpose;
3) in interpreting Indian treaties, ambiguities are to be resolved in favor of the Indians; and
4) terms of a treaty are to be construed, not according to technical meaning, but the way in which the Indians would have understood them at the time of the signing.

STUDENT HANDOUT 6Q

SALMON POLITICAL SCIENCE ACTIVITY: THE DILEMMA OF GOVERNMENT MANAGEMENT AND REGULATION

1. Each group will draw out of the "hat" several pieces of paper. Each piece of paper will have a different GOVERNMENT BODIES and/or GOVERNMENT POLICIES that have to do with the management and regulation of salmon in Oregon.

2. Your group will equitably divide up the task of obtaining the necessary information about each government body and each government policy. You will conduct your research using the library and/or the internet.

3. The goal, as a class, is to complete the two large charts in the classroom. The first chart should be titled, SALMON MANAGEMENT AND REGULATORY GOVERNMENT BODIES, with the following headings:

GOVERNMENT BODY	FEDERAL, STATE, OR LOCAL	MANAGEMENT PURPOSE	REGULATORY AUTHORITY	JURISDICTION

The second chart should be titled, SALMON MANAGEMENT AND REGULATION GOVERNMENT POLICIES, with the following headings:

GOVERNMENT POLICY	FEDERAL, STATE, OR LOCAL	PURPOSE OF POLICY	HOW IS POLICY ENFORCED?	JURISDICTION

4. When the chart is complete to your teacher's satisfaction, as a class attempt to answer the following KEY QUESTIONS.

KEY QUESTIONS:

- Is it possible to get all governmental bodies to agree on policies of management of regulation and management of salmon? Why or why not?
- How can the process be streamlined so that good decisions can be made, implemented and enforced in a reasonable timeframe?
- Why are there "turf wars" over regulation and management, when most involved want to save the salmon?
- Examine each of the government bodies. Try to discover what each agency's mission is with regards to salmon.
- Where do you see contradictions in management and regulation?
- Are there other bodies outside of government who also have an interest in managing and regulating salmon? Who are they? What is their perspective?

STUDENT HANDOUT 6R

History of the Hatchery System

How a hatchery works:
As hatchery salmon return from the ocean, they are collected in large cement ponds. When the salmon are ready to spawn, they are anesthetized and then killed by a sharp blow to the head. The eggs are removed from the female with a special knife. The milt, or sperm, is taken from the male by applying pressure to the underside of the fish. The eggs and sperm are then combined to fertilize the eggs. The fertilized eggs are placed in an incubator to allow them to develop. Conditions at the hatchery are closely monitored to ensure that the eggs develop at the desired rate. After six weeks, the eggs are resilient to handling. At this point, humans can remove any dead eggs to prevent fungus from spreading to live eggs.

After the eggs hatch they are put into ponds, or “raceways”. The fry are generally fed a special fish feed to allow them to grow at the greatest rate possible. Fall chinook are released into the main river after 90 days of rearing. Spring chinook are released after 12-18 months.

Information taken from The Fish Hatchery Next Door

A timeline of the Northwest hatchery system

- 1877- Chinook are released into the Rogue River at the Hume cannery.
- 1878- The first hatchery on the Columbia system is opened on the Clackamas River by cannery owners. The hatchery is intended to augment fish catches, which are already declining as a result of overfishing.
- 1907- 12 Oregon hatcheries are producing 27 million salmon fry.
- 1938- Bonneville Dam is constructed, originally without fish passage.
- 1941- Completion of the Grand Coulee Dam completely prevents salmon passage on the upper Columbia River.
- 1948- Widespread construction of federal fish hatcheries to make up for losses in the fish populations caused by dam construction and other human influences.
- Late 1980’s- In Washington State, 360 million salmon and trout are stocked each year from over 120 state, federal and tribal hatcheries and at least 150 volunteer managed facilities. In Canada, 180 million Pacific Salmon are being released annually.
- 1996- 76 million salmon, steelhead, and trout are produced at 34 state operated hatcheries throughout Oregon.
- 1997- Hatchery closures due to Endangered Species Act listings.

Information taken from the Oregon Department of Fish and Wildlife; A Common Fate, by Joseph Cone; and Salmon Fact Sheet, by Guido Rahr.

STUDENT HANDOUT 6S

The Trask Hatchery Scenario

INTRODUCTION:

There is controversy about how hatcheries should be run, and whether they should exist at all. There are many different people with a variety of opinions on the issue. Your task will be to research at least one of these perspectives in order to learn more about the complexity of the situation.

TYPES OF HATCHERIES:

According to the National Research Council report, *Upstream: Salmon and Society in the Pacific Northwest*, there are two main types of hatcheries:

1. *Catch-Augmentation Hatcheries*: Catch-augmentation hatcheries try to raise and release the greatest possible number of fish as a way to try to compensate for the fish lost to harvest and habitat destruction. In an attempt to ensure that at least some fish survive to adulthood, these types of hatcheries put so many fish in a river that they often exceed the carrying capacity of the habitat, especially if the habitat has been degraded by human activity. Many of these hatcheries raise fish under artificial conditions and feed the fish by throwing them pellets from above. However, in recent years, the Native American Indian tribes have attempted to run production hatcheries that mimic natural spawning conditions.
2. *Temporary Hatcheries*: Temporary hatcheries are used to rehabilitate the original wild stocks of an area. They are to be used in the short term while habitat is being restored. They place a higher priority on restoring the watershed, rather than on relying on hatcheries long into the future. Since the main concern of these hatcheries is restoration of watersheds and original populations, temporary hatcheries do not attempt to improve catches for human consumption by exceeding the carrying capacity of the habitat. Once the hatchery has re-established the wild stock, the hatchery is phased out, and the fish are left to survive on their own. Temporary facilities would be much less expensive than permanent catch-augmentation hatcheries.

THE TRASK HATCHERY SCENARIO:

The Trask fish hatchery is a large production hatchery run by the Oregon Department of Fish and Wildlife along a coastal stream. Assume that the funding for this hatchery is being re-evaluated. Consider the options listed below for the future of Trask hatchery.

OPTIONS:

1. Allow the hatchery to continue to function as a catch-augmentation hatchery. This will have no immediate effect on the employment of hatchery workers, commercial fishermen and people in the recreational angling industry. This will eventually have an effect on the wild fish populations of the region.
2. Convert the hatchery into a temporary hatchery. As the hatchery is slowly phased out, there will be gradual effects on the employment of people whose jobs depend on the stocking or harvest of fish. The interactions between hatchery and wild fish will gradually be reduced.
3. Eliminate the hatchery entirely. This will have immediate effects on employment of hatchery workers and people who catch fish. The interactions between hatchery and wild fish will be dramatically reduced.

YOUR TASK:

You will be assigned one of the following roles to research and represent:

- Wild fish advocate
- Sport Angler
- Commercial fisherman
- Hatchery employee
- Native American

1. After reading your role, conduct further research. Which of the Trask hatchery options would your character feel most comfortable with?
2. Create a brief presentation to share your perspective and your position with others in your class. Be sure to back up all statements with facts. Create charts, graphs, or any other visual aid that might enhance your position.
3. Make an opening presentation to the class about your perspective. Post any visual aids that you have prepared.
4. While listening to other presentations, think about whether any other groups have similar positions on the Trask hatchery scenario. Consider meeting with other groups to form coalitions with them.
5. Make a proposal to the class detailing your position on the Trask hatchery scenario. Write your proposal on the board.
6. Debate the options on the board. You may argue for or against any of the options listed.
7. Take a vote to determine which of the options is most popular amongst the roles.
8. Think about the outcomes of the Trask hatchery scenario. Is there an easy solution to the fish hatchery dilemma? Is it possible to compromise? Who do you think should be responsible for making decisions about hatcheries?

STUDENT HANDOUT 6T: Profiles of Hatchery Roles

WILD FISH ADVOCATE PERSPECTIVE

Wild fish learn the necessary skills to survive in the wild. Hatchery fish, on the other hand, do not. They learn to approach humans (who would normally be predators) to eat fish pellets. Then when they are released, they are less able to find food than wild fish, and less afraid of predators

In a hatchery, humans artificially select the fish that spawn. Natural selection is more successful because the fish that are best suited to their environment are those that survive to spawn.

As a result of artificial selection, there is less genetic diversity in a hatchery fish population than there is in a wild fish population. In a population of fish with a lot of genetic diversity, there is a greater chance that at least some fish will have the traits necessary to survive if there is a sudden change in environmental conditions. Considering the amount of tinkering that humans like to do to their environment, these sorts of changes in environmental conditions seem quite likely. Therefore, wild fish are less likely to become extinct than hatchery fish because their populations have greater genetic diversity. Unfortunately, sometimes hatchery fish spawn with wild fish, decreasing the genetic diversity of wild fish populations.

Besides, hatchery fish actually hurt wild fish. Hatchery fish are more prone to disease because the fish are so crowded in the hatchery. Then, when the hatchery fish are released into the wild, the wild fish run the risk of catching those diseases from the hatchery fish. Wild fish also have to use a great deal of energy to compete against hatchery fish, which are normally bigger than wild fish because they have been hand fed since they were hatched.

SPORT ANGLER’S PERSPECTIVE

I like to fish purely for the sport of fishing, and because I love to be outside. I do not keep the fish that I catch, but release them live.

I am very concerned about the health of wild stocks. I want to see the fish that have lived in these rivers and streams for hundreds of years continue to survive in this area. Salmon have spawned in this area for a very long time, and I think they should be able to spawn here long into the future.

I have been fishing for many years, and, unfortunately, I have noticed that the number of salmon has been declining. Worse still, the proportion of wild fish in comparison to hatchery fish has been declining, too. I know that hatchery fish can harm wild fish and that hatchery fish can sometimes interbreed with wild fish. It’s a shame that wild fish have to compete with hatchery fish to survive in an already severely degraded habitat. I am worried that hatchery fish will eventually do enough damage to wild fish populations that wild fish will become extinct.

STUDENT HANDOUT 6T: Profiles of Hatchery Roles

COMMERCIAL FISHERMAN

I work on a commercial fishing boat. Hatcheries are crucial to my way of life. So much habitat has been lost that without a hatchery program, there would be no salmon fishing at all. Some say that 80% of the fish that are caught by commercial fishermen are hatchery fish. By catching mostly hatchery fish, we are able to allow the wild fish in the ocean. Since hatchery fish cannot be listed under the Endangered Species Act, the presence of hatchery fish provide some job stability at a time when more and more fish are being listed or considered for listing.

Without a fish hatchery, there wouldn't be enough fish for everyone to continue to catch fish at the current levels. If the hatchery were to close, there would be two main problems. First, if salmon populations were to fall drastically enough, the industry wouldn't be able to meet the demand for this popular and healthy food resource.

Second, the number of fishermen who can support themselves by catching salmon has already fallen drastically from historic numbers. According to the Oregon Coastal Zone Management Association, the commercial fishing industry was expected to generate $4 million in personal income in 1998. While this is a very significant contribution to the economy of the region, it is still a massive decrease from the annual average of $41 million just 20 years ago. Entire coastal cities have become ghost towns as a result of the dwindling numbers of fish. Without a hatchery to supplement the salmon population, those few commercial salmon fishermen who remain will be out of work.

--

HATCHERY EMPLOYEE PERSPECTIVE

The press is overly critical of hatchery production. It does not fully take into account the fact that hatcheries play a critical role in making up for habitat that was lost to dam construction. A massive amount of habitat was lost when we built dams on all the major rivers. Transporting fish above the dams has been only marginally successful, and hatcheries are the only other way to compensate for the number of fish that cannot make it to their historical spawning grounds.

I understand the appeal of wild fish, but conservationists need to be realistic about the likelihood that people in the Northwest would not be willing to live with the consequences that would result from eliminating fish hatcheries. If we were to eliminate hatcheries, Northwesterners would have two options. The first option is to make important changes in lifestyle in order to conserve the few wild fish that remain. The second option is to live with the risk of extinction of some species.

Hatcheries create jobs, too. People ranging from commercial fishermen to the owners of tackle shops along the river all benefit from the fact that there are fish to be harvested.

Besides, hatcheries have made big improvements in the management of their fish in recent years. Our understanding of fish biology has changed greatly since the opening of the first fish hatchery, and our hatchery practices have changed accordingly.

STUDENT HANDOUT 6T: Profiles of Hatchery Roles

NATIVE AMERICAN INDIAN PERSPECTIVE

In 1855, the tribes of the Columbia River signed over title to about 40 million acres of our lands in exchange for, among other things, a guarantee that we would be able to fish at all of our "usual and accustomed fishing places in common with citizens." Salmon are of great importance to us, spiritually, culturally, and as a food resource. It would be tragic if the salmon were to be driven to extinction. Unfortunately, native salmon populations are simply unable to sustain themselves, so great is their habitat loss and so high is the rate at which they are killed by dams on the way to the ocean. Our hope is that we can use hatcheries to help keep salmon from becoming extinct altogether while we try to fix these problems.

Salmon have a very high rate of survival in the hatchery setting. It is important to us not only that we have salmon to catch, but for the fish to return and spawn naturally. In contrast to non-tribal hatcheries, whose only purpose is to produce salmon for fishermen to catch, our hatcheries are also meant to be used to help rebuild naturally spawning salmon populations. Our driving goal is to "put the fish back in the rivers."

Many of our hatcheries are much less artificial than non-tribal hatcheries. For example, food is released from the bottom, so fish learn to look for food under more natural conditions. In other hatcheries, salmon learn to rely on humans to feed them from above. Also, the walls of our pens are painted in camouflage colors mimicking natural streams. This causes the salmon fry to develop camouflage markings, enabling them to blend into the river systems where they are released. By creating a hatchery that mimics nature more closely, our fish are more likely to survive in the wild.

Maintaining our hatcheries helps make up for the salmon habitat that humans have destroyed. We realize that under the existing conditions that salmon face, they can’t survive on their own. That’s why we need to use hatcheries to give them a boost.

SERVICE LEARNING
PROJECTS

UNIT 7. SERVICE LEARNING PROJECTS

INTRODUCTION

All students who participate in Salmon Watch are expected, as part of the program, to undertake some individual or concerted genuine action on behalf of the salmon or its habitat. They must also present their results or creations to some greater audience beyond their classroom. The purpose of this lesson is twofold: students should understand that their individual actions have impact, and students should understand the concept of community. Because every local community has many unique opportunities for service-learning, students and teachers must carefully select and implement plans that have the desired connection with both curriculum and community. The Student Service Learning Projects Unit suggests project resources, implementation strategies, and evaluation processes for students and teachers. Additional resources and contacts for your region are also available through Salmon Watch.

SECTIONS

A. Project Selection and Planning
   1. Planning Flow Chart
   2. Sample Timeline for Service-learning Project Planning
   3. List of Possible Projects
   4. List of Local Partners and Project Opportunities
   5. List of Grant Information
   6. Other Resources

B. Designing a Personal Action Plan

C. Designing a Presentation
   1. List of Presentation Ideas
   2. List of Regional Symposiums and Education Fairs

D. Service-learning Project Evaluation

Crystal Ashmead, Hidden Valley High

TIME(min.)	LEVEL	BENCHMARKS
ongoing	all	Service Learning Projects could potentially meet numerous science benchmarks, especially career related learning

OBJECTIVES:

Students will

- know and understand what service learning is and the concept of community.
- know and understand that individual actions do have impact.
- apply their knowledge of salmon and watersheds to develop and implement a service learning project that will benefit their local community.

MATERIALS:

- ❑ STUDENT HANDOUT 7A: *What is Service Learning?*
- ❑ STUDENT HANDOUT 7B: *Service Learning Planning Flow Chart*
- ❑ STUDENT HANDOUT 7C: *List of Service Learning Project Ideas*
- ❑ STUDENT HANDOUT 7D: *Service Learning Project Presentation Ideas & Forums*
- ❑ STUDENT HANDOUT 7E: *Designing a Personal Action Plan*
- ❑ STUDENT HANDOUT 7F: *Service Learning Project Action Plan*
- ❑ TEAHCER HANDOUT 7G: *Service Learning Project Evaluation*

PROCEDURE:

1. Read aloud with your class STUDENT HANDOUT 7A, so that students have a good introduction into what Service Learning is all about and what constitutes an effective project.

2. Review with your class, STUDENT HANDOUT 7B, which is a flow chart of the course to take to developing and implementing a project from selection to presentation.

3. Using STUDENT HANDOUT 7C as a guide, brainstorm with your students about potential projects in your local community. Write down all ideas on an overhead or chalkboard. Before the brainstorm, be sure to consult the LIST OF LOCAL PARTNERS AND PROJECT OPPORTUNITIES and the LIST OF GRANT INFORMATION. Let your students know the potential partnerships, opportunities and grants for projects. You should also decide whether your class is going to take on a whole class project, let small groups work on their own projects or allow individuals to tackle a project. You also need to decide whether or not you want this project or projects to be long term or short term. For example, a long-term project would be one where you might adopt-a-site for monitoring, managing and/or restoring year after year.

4. One of the requirements of the service learning projects is to have students present what they have learned and accomplished from their project to an audience of some kind. Have students use STUDENT HANDOUT 7D to help them discover innovative and creative ways to make a presentation and effective forums for them to make their presentations.

5. Use STUDENT HANDOUT 7E: Designing a Personal Action Plan to help organize the planning and preparation work necessary to achieve an effective service learning project. Please take advantage of Oregon Trout's offer to review and assist with projects. Oregon Trout's staff possesses much expertise in watershed management and restoration that would be of help to a project.

6. At the end of the academic year, please carefully fill out *The Salmon Watch Service Learning Evaluation Form*(7F). This form is an important tool for both teachers and our own program development. We encourage teachers to review this form before planning begins, and use it as a guide to better assist students in the development of their projects. In each stage of development, there are several cautions and problem areas that require some foresight before proceeding on. The evaluation form may be helpful to view the entire project, to keep focused on the goals and not fall victim to insurmountable difficulties.

   Salmon Watch will collect the Evaluation Forms from all of our teachers and will create a summary of Service-learning Projects at the end of the academic year. The summary report will be available to partners, volunteers, and especially other teachers, to better evaluate the program as a whole. Also, it will be a valuable reference for Salmon Watch to develop better connections with the community, and further our long-term commitments in service to the community.

   For questions about past Salmon Watch Service-learning Projects or any other question you have, be sure to call Salmon Watch for assistance**. Please return the evaluation form to Oregon Trout by May 31 of the program year.**

SAMPLE TIMELINE FOR SERVICE-LEARNING PROJECT PLANNING

Summer	Visit and evaluate site/develop field trip schedule
September	School year begins, prepare students for field trip experience, Salmon Watch field trips begin (Trips run from mid-September through Mid-November)
October	Begin discussion of community service project opportunities.
November	**Select community service project and develop implementation strategy**
December	Send in SW field trip Teacher and Students Evaluations, due by Dec. 31 Reimbursement requests and documentation, due by Dec. 31
April	Re-enrollment letters sent for next Salmon Watch field season
May	Registration fees and contracts due for fall field trips
June	**Service-Learning Project evaluations due**

LIST OF LOCAL PARTNERS AND PROJECT OPPORTUNITIES

The following service-learning project resource lists were compiled to assist teachers and students in designing projects. Included are names of organizations and agencies in need of volunteer assistance organized by region: Corvallis area, Eugene area, Medford area, and Portland area. Schools are encouraged to partner with one or more of these organizations for projects in the local watershed to help with technical and material support. A partner may also be able to enhance the learning component of their projects to meet your needs. It's a good idea to alert your local watershed council coordinator of the project you and your students are planning. To find out which watershed your school belongs or if you have any questions, please contact Salmon Watch and assistance will be provided.

CENTRAL OREGON

LOCAL WATERSHED COUNCILS

Upper Deschutes Watershed Council
Contact: Kolleen Yake

541-382-6851 W
kyake@deschuteswatersheds.org
www.deschuteswatersheds.org
Upper Deschutes Watershed Council
700 NW Hill St.
Bend, OR 97701
Contact the watershed council for available projects.

AREA-WIDE RESOURCES

Deschutes Basin Land Trust
Contact: Amanda Egertson

541-330-0017 W
amanda@deschuteslandtrust.org
www.deschuteslandtrust.org
760 NW Harriman, Suite 100
Bend, OR 97701
The mission of the Deschutes Basin Land Trust is to protect special lands in the Deschutes Basin for present and future generations by working cooperatively with landowners and communities. Contact Amanda for information on restoration opportunities in the Metolius basin.

ODFW- High Desert Region
Contact: Jennifer Bock

541 388-6363
jennifer.a.bock@state.or.us
61374 Parrell Rd.
Bend, OR 97702
Contact Jennifer for information about restoration or monitoring projects in the Bend, Prineville, Redmond and Sisters areas.

reSource
Contact: Jessica Born
541-388-3638
jborn@resourceoregon.org
www.resourceoregon.org
740 NE 1st St
Bend, OR 97701
The mission of reSource is to create a sustainable future for Central Oregon by educating people about what sustainability means and how to put it into practice. Contact Jessica for information on service learning projects.

USFS
Contact: Scott Cotter
541-549-7725
sacotter@fs.fed.us
PO Box 249
Sisters, OR 97759
Contact Scott for information about restoration or monitoring projects within the Metolius basin.

CORVALLIS AREA

LOCAL WATERSHED COUNCILS

Calapooia WC
Contact: Denise Hoffert-Hey
541-367-6735
calapooia@centurytel.net
Restoration and monitoring projects. Call Denise for info.

Jackson Frasier Watershed Council
Contact: Jerry Davis
541-757-6871, FAX 541-757-6891
jerry.davis@co.benton.or.us
360 SW Avery, Corvallis, OR 97333
Project opportunities at Jackson Frasier Wetlands and other sites possibly further up stream. Monitoring and data collecting projects are available through the council.

Mary's River Watershed Council
Contact: Sandra Coveny
541 929-5768
sandrac@peak.org, www.scgis.org
330 N 13th St., Philomath, OR 97370
Many projects such as water quality monitoring and working on fish traps are possible in the Philomath area. Technical support and equipment is available for projects.

North Santiam Watershed Council
Contact: Liz Redon
311 N. Third Ave.
Stayton, OR 97383
503-930-8202
nsantiam@open.org

<u>South Santiam Watershed Council</u>
Contact: Council Coordinator, SWCD
Eric Hartstein
541-367-5564
sswc@centurytel.net
3225 Hwy 20
Sweet Home, OR 97386
Both middle and high schools can participate in water quality monitoring projects. Call for information on monitoring projects and other volunteer opportunities.

AREA-WIDE RESOURCES

<u>City of Corvallis, Public Works Department</u>
Contact: Sue Ross
541 757-6916
P.O. Box 1083, Corvallis, OR 97339
The Storm Drain Marking Program can be done by any age student and by any number of students. All of the needed materials are provided including the paint, stencils, safety vests and cones. The Public Works Department has just begun its outreach program and is in the process of developing other projects. Please call Sue to find out about these opportunities.

<u>Corvallis Environmental Center</u>
Contact: Connie Wiegers
541 753-9211
ecenter@peak.org, www.peak.org/~ecenter
254 SW Madison, P.O. Box 2189, Corvallis, OR 97339-2189
Project opportunities include removing non-native plants, working on the Avery House (new nature center), working in collaboration with the Parks Department, and helping in the office. Call Connie to discuss other opportunities through the Environmental Center.

<u>Greenbelt Land Trust</u>
Contact: Karlene McCabe
541 752-9609
P.O. Box 1721, Corvallis, OR 97339
Currently the Greenbelt Land Trust does not have projects underway. However, Karlene is a great resource regarding other possible projects in the area.

<u>Oregon Department of Fish & Wildlife</u>
Contact: Karen Hans
541-757-4186 X251
Karen.M.Hans@state.or.us
7118 NE Vandenberg Ave., Corvallis, OR 97330
Karen is very knowledgeable about the different projects and opportunities in this area. Potential projects include constructing and monitoring fish traps, streamside plantings and clean up projects. Projects are suitable for both middle and high school students.

OTHER RESOURCES

<u>Audubon Society</u>
Contact: Kate Matthews
541-754-7364
mathewsk@ava.bcc.orst.edu
P.O. Box 148, Corvallis, OR 97339-0148

They could possibly use some help on a wetland project at Jackson Frasier Wetland. Individuals might also be able to help with office tasks as well. Please call and talk to Ray for more information.

EUGENE AREA

LOCAL WATERSHED COUNCILS

McKenzie Watershed Council
Contact: Kate Ferschweiler
541 988-9904
kfersch@callatg.com
341 S. E Street, Springfield, OR 97477
The McKenzie Watershed Council can use students to help them with water monitoring along the McKenzie River. Since much of Eugene's drinking water comes from this watershed, Eugene students are encouraged to explore their problems with the council.

Middle Fork Willamette WC
Contact: Amy Chinitz
541-937-9800
mfwwc@efn.org
PO Box 27
Lowell, OR 97452
Contact Amy for more info on possible restoration or monitoring projects.

AREA-WIDE

Cascade Family Flyfishers
Contact: Jane Sageser
541-687-5957
msageser@earthlink.net
84499 Boods Road, Eugene, OR 97405
The Cascade Family Flyfishers are involved with the Adopt-A-River program each year. They do clean-ups twice a year and could use volunteers to help them. The flyfishers meetings are open to the public and students are welcome to attend.

East Lane Soil & Water Conservation District
Contact: 541-465-6648
55 D Oakway Center, Eugene, OR 97401
Depending on the time of year, projects such as tree planting and clean-ups may be done. Contact Lorna for availability of projects.

Eugene Stream Team
Contact: Lorna Baldwin
lorna.j.baldwin@ci.eugene.or.us
541 682-4850
1820 Roosevelt Blvd., Eugene, OR 97402
The Eugene Stream Team is the volunteer component of the City of Eugene's Water Management Plan. Students can help with storm drain stenciling and clean-ups. Call for information on these volunteer opportunities and others. Lorna can help classrooms set up individual projects as well.

Eugene Water & Electric Board
Contact: John Femal
541 484-2411
john.femal@eweb.eugene.or.us
500 East 4th Avenue, P.O. Box 10148, Eugene, OR 97440-2148
Currently Eugene Water & Electric Board (EWEB) does not have projects available for students, but later this year and beginning in the fall there will be project opportunities, such as trail maintenance. Contact John to discuss these opportunities.

Oregon Department of Fish & Wildlife
Contact: Eric Moberly
541-726-3515
erik.r.Moberly@dfw.state.or.us
3150 East Main Street, Springfield, OR 97478
ODFW needs seasonal help with various projects such as clean-ups and restoration projects. These projects are best suited for high school students. The biologist can help design projects to fit location and resource limitations.

OTHER RESOURCES

Nearby Nature
Contact: 541-687-9699
P.O. Box 3678, Eugene, OR 97403
Nearby Nature is an environmental education non-profit organization that teaches children the ecological importance of being environmentally conscientious. They use Alton Baker Park as their classroom and always welcome students to help with restoration efforts within the park. Call Wendy for more information (if she's not available, the other staff members can organize projects as well). It's best to leave an evening phone number where you can be reached because they are out in the field during the work day.

Old McKenzie Fish Hatchery
Contact: Ken Engelman
541- 822-3358
RivRef@aol.com
P.O. Box 1117, Leaburg, OR 97489
The Old McKenzie Fish Hatchery was closed in the 1950s and is now being restored. The Hatchery is on 46 acres of privately and publicly owned land. Stream enhancement projects, watershed analysis, and brochures for a self-guided tour of the Hatchery could be developed and produced by students. There are also monthly Hatchery meetings in which students could participate. Project partners include McKenzie River Watershed Council.

MEDFORD

LOCAL WATERSHED COUNCILS

Applegate River Watershed Council
Contact: Daniel Newberry
(541) 899-9982
Upper Applegate Rd, Jacksonville, OR 97530
There are many projects in most of the small drainages within this watershed. Projects include planting, environmental assessments, restoration work, and native seed gathering. Call for specific opportunities in your area.

Bear Creek Watershed Council
Contact: Kara King
(541) 261-6202
kjk_75@hotmail.com
PO Box 1548 Medford, OR 97501
Multitudes of projects with schools within the Bear Creek Watershed. Projects include monitoring of water quality and macroinvertebrates, restoration work of fish habitat and wetlands, etc. Call for a complete listing of current projects.

Illinois Valley Watershed Council
Contact: Glenn Ginter
(541) 592-3731
P.O. Box 352, Cave Junction, OR 97523

Little Butte Creek Watershed Council
Contact: Lu Anthony
(541) 826-2908
1094 Stevens Road, Eagle Point, OR 97524
Continuing projects at Golden Coyote Wetlands in Josephine County include scotch broom removal and various plantings. Inquire for other project sites in this watershed.

AREA-WIDE

Oregon Department of Fish & Wildlife
Contact: Chuck Fustish, STEP biologist
(541) 826-8774
1495 E. Gregory Road
Central Point, OR 97502

OTHER RESOURCES

Bear Creek Watershed Education Partners
Contact: Lindsay Lims
(541) 482-8592
PO Box 8128
Medford, OR 97504

Rogue Valley Council of Governments
Contact: Craig Harper
(541) 664-6674 ext. 211

charper@rvcog.org

Regional Ecosystems Applied Learning Corps (REALCorps – Americorps at SOU)
Contact: Willowsong Detar
(541) 488-9426
Unique opportunities to work with Americorps Members out in the field doing a variety of projects including restoration work along streams. Project partners include City of Ashland, Rogue National Forest (USFS), and Jackson County Parks & Recreation.

Science Works
Contact: Christy@scienceworks.org
(541) 482-6767
PO Box 1177
Ashland, OR 97520

Siskiyou Environmental Ed. Center
541-552-6876
SOU Biology Bldg.
1250 Siskiyou Blvd.
Ashland, OR 97520

Medford BLM
Contact: Leah Schrodt
(541) 618-2468
3040 Biddle Rd
Medford, OR 97504

OSU Extension Services
Contact: Megan Kleibacker, Natural Resource Instructor
(541) 776-7371 ext. 209
596 Hanley Rd.
Central Point, OR 97502

North Mt. Park Nature Center
Contact: Keri Gies
(541) 488-6606
620 N. Mt. Ave
Ashland, OR 97520

Jefferson Nature Center
Contact: Susan Cross
(541) 773-1039
319 E. Main #4
Medford, OR 97501

PORTLAND AREA

LOCAL WATERSHED GROUPS

Columbia Slough Watershed Council
Contact: Scott Bradway
(503) 281-1132, FAX (503) 281-5187

scott.bradway@columbiaslough.org
7040NE 47th Ave, Portland, OR 97218
The Columbia Slough Watershed Coordinator can help organize different projects within the area, including those at Whitaker Ponds. Schools within this area are encouraged to participate in these projects.

Johnson Creek Watershed Council – Healthy Waters Institute Pilot Watershed
Contact: Michelle Bussard
(503) 652-7477
michelle@jcwc.org
1900 SE Millport Rd., Suite B, Milwaukie, OR 97222
The Johnson Creek Watershed runs from Milwaukie east to Gresham. The council is constantly doing watershed restoration projects. Projects are suitable for middle school and high school students. Call for a list of projects with names of the project coordinators

Tualatin Riverkeepers
Contact: Monica Smiley
(503) 624-0955
monica@tualatinriverkeepers.org
3883 SE Oak Ct., Hillsboro, OR 97123
The Tualatin Riverkeepers is the umbrella organization for all "Friends of" groups in the Tualatin River watershed. Projects for schools within this watershed can be found here. For those close to a creek or river in the Tualatin area, students can participate in river monitoring. This project is for high school students who would be able to commit to monitoring the river four times throughout the year. River clean-ups can be arranged for your group almost any time of the year. There is also an annual Clean-up Day on Earth Day in April in which everyone can participate.

West Multnomah County Soil & Water Conservation District
Contact: 503-238-4775
info@westmultconserv.org
Montgomery Park
2701 NW Vaughn St., Suite 450, Portland, 97210
West Multnomah SWCD is involved in conservation planning, watershed assessment, education and enhancement projects. Projects are suitable for middle or high school students.

AREA-WIDE RESOURCES

Friends of Trees
Contact: 503 284-TREE
fot@teleport.com
2730 NE Martin Luther King Blvd., Portland, OR 97212
"Seed the Future" campaign goes on annually. Students can participate in tree plantings in many neighborhoods in the greater Portland area. They partner with many different schools, public agencies and non-profit organizations. Call for a schedule of plantings.

Portland Parks and Recreation
Contact: 503 823-5121
Volunteer Services, Portland Parks and Recreation
1120 SW 5th Ave., Room 1302, Portland, OR 97204
Projects are done in wetland areas, parks and neighborhoods. Possible projects in the fall and spring, include plantings and clean-ups. These projects can be done by all ages; each project is designed to best suit the students' ages and needs.

The Wetlands Conservancy
Contact: 503 691-1394

9675 SW Tualatin-Sherwood Rd., Portland, OR 97062
Small projects can be designed for each individual group on any one of their wetland preserves (located in Washington, Clackamas, and Multnomah Counties). These might include tree planting and blackberry removal. Call for information on the preserve closest to your school.

OTHER RESOURCES

Community Energy Project
Contact: (503) 284-6827
422 NE Alberta St., Portland, OR 97211
High school projects: Every Saturday they need help weatherizing senior citizens' homes. Weatherizing houses cuts the costs of electric bills which in turn reduces the amount of hydroelectric power needed directly affecting the salmon.

Friends of Columbia Gorge
Contact: (503) 241-3762
319 SW Washington #301, Portland, OR 97204
Trail Restoration: During May there is a Trail Restoration Week where students can help restore trails in the Columbia Gorge. Another option is to call Kristin about your individual group and she can find a trail that needs fixing. There is always work to be done!

Friends of Forest Park
Contact: Sandy Diedrich
(503) 223-2708
117 NW Trinity Place, Portland, OR 97209
Ivy Removal: In Forest Park ivy is a non-native plant species that is taking over areas that used to be inhabited by native plants. Project(s) could be after school or on a Saturday.

Hoyt Arboretum Friends Foundation
Contact: Sue Thomas
(503) 823-3601
4000 SW Fairview Blvd., Portland, OR 97221
Projects include ivy removal, tree planting, and/or trail work (depending on what is needed at the particular time a group wants to do service)

Jackson Bottom Wetlands
Contact: Pat Willis
(503) 681-6206
205 SE 3rd St., Hillsboro, OR 97123
Maintenance work on these Wetlands in Hillsboro can be done in the spring. Project(s) could entail dusting trails with wood chips, repairing bird boxes, planting native plants and removal of non-native plants. Tools will be provided as well as some education about the wetlands.

METRO Regional Parks and Greenspaces

Contact: Mary West
(503) 797-1814
600 NE Grand Ave., Portland, OR 97232-2736
Volunteer opportunities include restoration work at Metro greenspaces, Smith & Bybee Lakes or Oxbow Park. Juniors and seniors in high school can join METRO's Volunteer Naturalist Program and become certified to lead elementary school children on Salmon Field Trips next fall.

The Nature Conservancy
Contact: Volunteer Manager
(503) 230-1221
821 SE 14th, Portland, OR 97214
Projects at local Nature Conservancy preserves in West Linn, and along the Sandy River. Help with trail maintenance or non-native plant removal.
Individual Opportunities for older students: Every Wednesday night at the Nature Conservancy office volunteers are needed to do a variety of tasks, including stuffing envelopes, mapping local areas, etc. This is a great way to meet and talk with other people interested in the environment.

Portland Audubon Society
Contact: 503 292-6855
5151 NW Cornell Rd., Portland, OR 97210
One-day projects are available for students age 13 and older in the sanctuary within Forest Park. Groups of 8-10 students are needed to help with a wide range of projects (i.e. sanctuary maintenance, pulling ivy, bark dusting, etc.). Supervision will be provided.

Tryon Creek State Park (Friends of)
Contact: Stephanie Wagner
(503) 636-4398
tryonfrn@teleport.com
11321 SW Terwilliger Blvd., Portland, OR 97219
Tryon Creek State Park is located west of the Willamette River just north of Lake Oswego. Projects would have to be organized by the individual group in partnership with the State Park. Projects include ivy removal, trail maintenance, and stream restoration (in the late spring).

LIST OF GRANTS

Salmon Watch can provide assistance with planning, coordination, and implementation of Salmon Watch Service Learning Projects. The grant opportunities listed below typically have 2-4 page applications and are not especially competitive. Please use this preliminary list as a reference for future planning if deadlines have passed for this year. All of these opportunities should be renewed for another cycle. For further details, contact Salmon Watch or refer to the numbers for each grant.

STATEWIDE

Diack Family Oregon Ecology Education Fund (through the Oregon Parks Foundation)
503 297-6043
Goal: Assists in funding activities in Oregon which take children K-12 into the study of ecology in their fields, forests and waters to see personally what lives there and how it thrives. Funding primarily for long-term field ecology studies program development, rather than one-day events. Does not cover substitute teachers or transportation.
Award:
Deadline: none

Learn & Serve America *Youth In Action* **Oregon Department of Education**
503 378-3584x369
Goal: This grant is designed specifically to remove barriers for service learning projects directly connected to the school curriculum. Barriers include **transportation** and plant materials. Projects must be student initiated, planned, and implemented and must provide opportunities to develop leadership and citizenship skills. Grants must be written by students and are reviewed by students. All applications that meet the grant criteria will be funded.
Award: up to $500

Deadline: usually mid-February and mid-March

Meyer Memorial Trust Teacher Initiatives Program
503 228-5512, http://www.mmt.org/~mmt.
Goal: Stimulating or facilitating more effective learning.
Award: Up to $1500 for individual teachers, $5000 for teams
Deadline: February 1 *each year*

The Oregon Parks Foundation
503 297-6043
Goal: Land protection, community outdoor recreation and education programs, administrative expenses, publications, conferences and seminars, emergency funding, recognition and student internship in the context of providing for natural park settings and outdoor recreation and educational opportunities.
Award: $1500 – 5000
Deadline: none

SOLV (Stop Oregon Litter & Vandalism) *SOLV CUP projects*
1-800-322-3326, 503-844-9571
Goal: Cleanups, prevention (recycling, signage), restoration (for those in need of social services), plantings, development (trail repair, brush removal)
Award: Up to $250 plus free SOLV materials, does not cover transportation
Deadline: none

PORTLAND AREA

METRO *Waste Reduction Education Program*
503-797-1521, wred@metro.dst.or.us
Goal: Waste prevention and reduction strategies to increase awareness, create more space for recycling, increase efficiency, and decrease paper costs. Many ideas included. Projects must be within METRO boundary.
Award: $500
Deadline: none

METRO *Environmental Education & Restoration Grant Program*
Deb Scrivens 503-797-1852, scrivensd@metro.dst.or.us
Goal: Provide funding from the US Fish & Wildlife Service to regional schools and programs with grant projects in environmental education or restoration. Projects must be in METRO area.
Award: Range from $250-20,000.
Deadline: Early fall – contact for dates.

Unified Sewerage Agency *Community Best Management Practices Funding Project*
Mark Jockers 503-693-4501, mjockers@usa-cleanwater.org
Goal: Funding for projects that improve water quality, emphasizes water quality as a community resource, and is the result of a partnership. Projects must be within Washington County.
Award: Average funding level $500 with a maximum of $5000
Deadline: none

Environmental Services City of Portland *Clean River Works Community Stewardship Grant Program*
Lynn Vanderkamp 503-823-5625
Goal: To provide direct and long term benefits to community and watershed. Projects must involve citizens in the watershed and other partners. Projects must be within the city of Portland.
Award: Up to $5000
Deadline: April 1

OTHER RESOURCES

DIRECTORIES

OWEB Oregon Watershed Enhancement Board
List of Watershed Groups http://www.oregon.gov/oweb/wsheds/index.shtml

Urban Natural Resources Directory *Portland Audubon* (503) 292-WILD

River and Watershed Conservation Directory *River Network* (503) 241-3506

Conservation Directory *National Wildlife Federation* 1-800-432-6564

REGIONAL MAPS

Metro Greenspaces Program *(Greater Portland Area Only)* (503) 797-1750

WEBSITES

Corvallis Environmental Center www.peak.org/~ecenter

Habitat Restoration Information Center www.habitat-restoration.com

Salmon Nation *EcoTrust bioregional citizenship program* http://salmonnation.com

Portland Regional Watershed Calendar www.upa.pdx.edu/CWSP/WATSHED/
watershed related activities

Riverdale School Salmon Page www.riverdale.k12.or.us

BIBLIOGRAPHY

Make It Right: SOLV Planning guide for service learning projects. SOLV (Stop Oregon Litter and Vandalism) P.O. Box 1235, Hillsboro, OR 97123.

Sourcebook for Watershed Education. 1996. Sally Cole-Misch, Larry Price and David Schmidt. Global Rivers Environmental Education Network (GREEN). Ann Arbor, MI 48104, USA.

UNIT 7 SERVICE LEARNING PROJECTS
STUDENT HANDOUTS

7A	*What is Service Learning?*
7B	*Service Learning Planning Flow Chart*
7C	*Service Learning Project Ideas*
7D	*Service Learning Project Presentation Ideas and Forums*
7E	*Designing a Personal Action Plan*
7F	*Service Learning Project Action Plan*
7G	*Service Learning Project Evaluation*

STUDENT HANDOUT 7A

What is Service Learning?

Service learning is a method by which young people learn through active participation in thoughtfully organized experiences that:

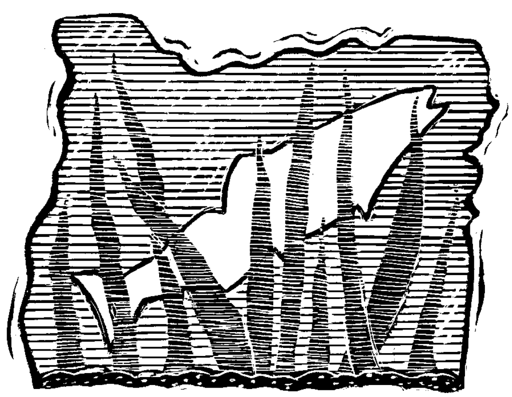
- Meet actual community needs.
- Coordinate in collaboration with the school and community.
- Integrate into each young person's academic curriculum.
- Provide structured time for a young person to think, talk, and write about what he/she did and saw during the service activity.
- Provide young people with opportunities to use newly acquired academic skills and knowledge in real life situations in their communities.
- Are a practical application of what is taught in the school.

From Alliance for Service-Learning in Education Reform March 1995

The Effective Service-Learning Project

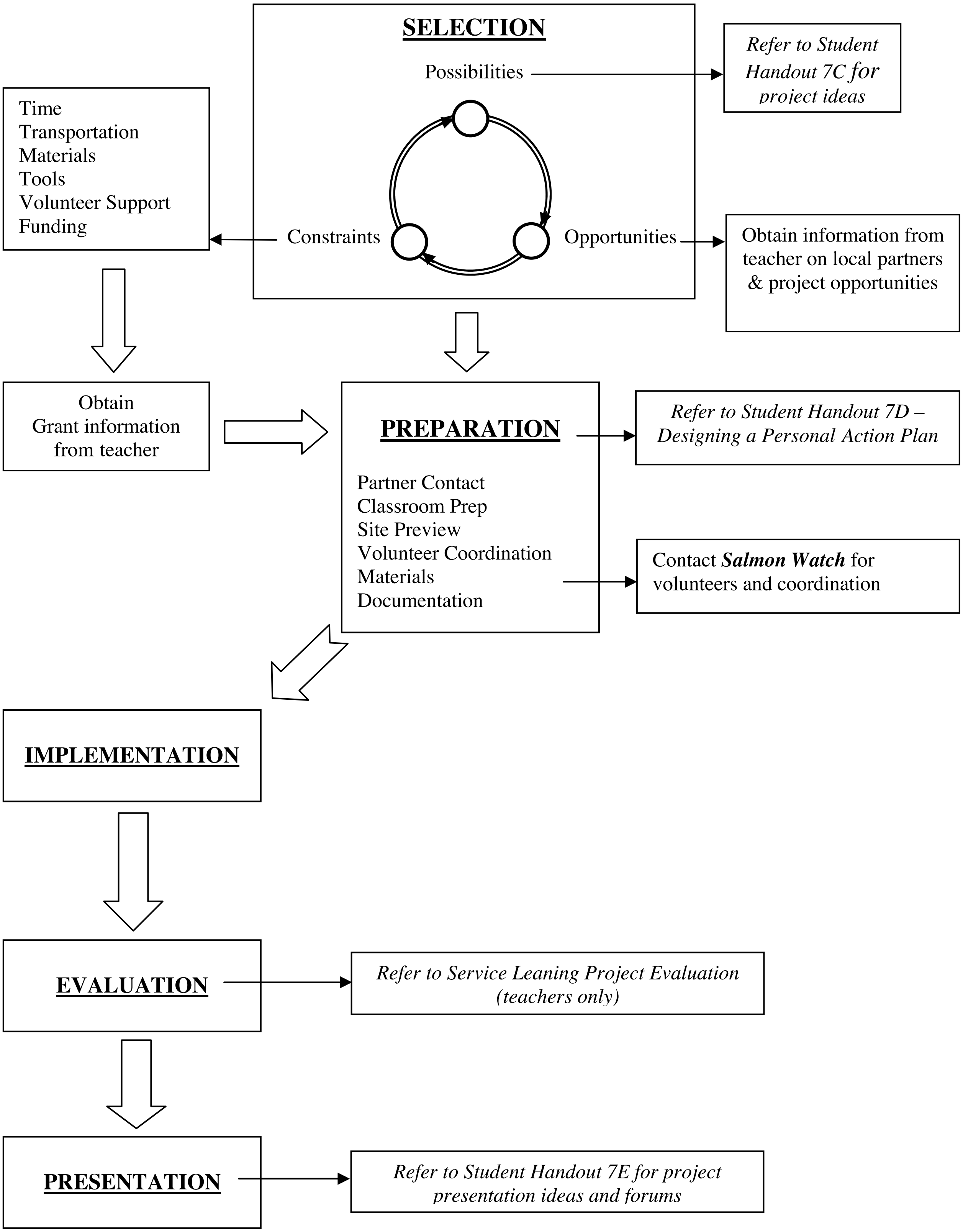
An effective service-learning project is achieved with a clear objective for both service and learning. Projects should address local issues and impact the community in which you live, while providing a relevant learning experience. The challenge is to keep a vision, work with community members, and make an impact! Salmon Watch encourages teachers and student groups to utilize partner resources, especially those at Salmon Watch, to create new opportunities and relieve project constraints and undue anxiety.

Depending on your interests and the local influences on community needs, each project will have unique opportunities and constraints. The balance you strike between these features will become the ultimate plan, and represents real problem solving. You must document each phase of planning and implementation. This will serve not only as a reference for current and subsequent projects, but also as a tool for reflection. (Journaling is a suggested way to ensure good records of the process and that you're meeting your objectives.)



STUDENT HANDOUT 7B

SERVICE LEARNING PLANNING FLOW CHART



STUDENT HANDOUT 7C

LIST OF SERVICE LEARNING PROJECT IDEAS

The following list is only a partial list of possible ideas and is intended to serve as a catalyst for brainstorming other ideas that would be most suitable for individual students and student groups. Ideas for projects must have an outcome that involves some form of an audience, in a way that connects the efforts of each student to the greater community. Use this list in conjunction with the List of Local Partners and Project Opportunities.

- ❑ Volunteer with an environmental organization
- ❑ Organize and/or participate in an environmental enhancement project such as:

    A river clean-up project
    A stream restoration project
    A wetland restoration and planting project
    A tree planting project
    A wildlife/salmon habitat enhancement
    A Naturescaping project

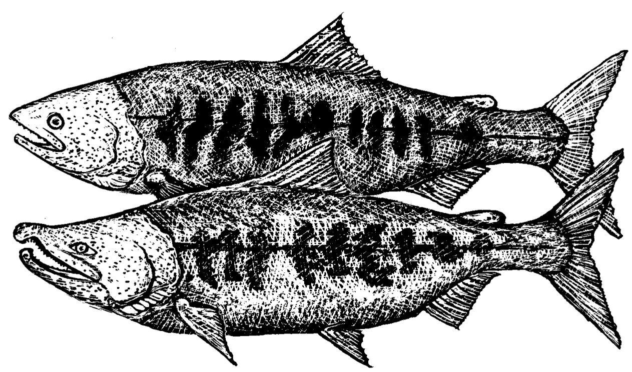
- ❑ Volunteer at the Salmon Festival at Oxbow Park
- ❑ Give ideas at Land Use meetings or Watershed Council meetings
- ❑ Conduct an Northwest Earth Institute Eco-Audit of your home or school
- ❑ Create a play about the salmon crisis and show it to other classes or PTA
- ❑ Organize a forum for debate on salmon and watershed issues
- ❑ Make a presentation to the school board, PTA or elected officials
- ❑ Write, illustrate, and publish a children's book about the salmon life cycle or crisis
- ❑ Write, illustrate, and publish a children's book about the role of salmon in the life of Native American societies
- ❑ Set up recycling at your school
- ❑ Write an article for a newspaper or other publication
- ❑ Prepare and show artwork on environmental issues
- ❑ Organize a school ecology club activity
- ❑ Develop and show a video about your entire Salmon Watch experience
- ❑ Teach younger students in your school or an elementary school about salmon issues
- ❑ Paint storm drains in your area or create signs that explain them
- ❑ Participate in a stream survey or water monitoring program
- ❑ Create a bulletin board about salmon or other conservation issues to be displayed at school
- ❑ Produce a Public Service Announcement

STUDENT HANDOUT 7D

SERVICE LEARNING PROJECT

PRESENTATION IDEAS AND FORUMS

Advertisement
Animated movie
Art gallery
Bulletin board
Charts/Graphs/Diagrams
Clay sculpture
Collage
Comic strip
Computer program
Database
Debate
Demonstration
Detailed illustration
Diorama
Display
Editorial
Etching
Experiment
Film
Filmstrip
Game
Graph
Illustrated story
Interview (published)
Large scale drawing
Learning center
Letter to the editor
Map with legend
Mural
Museum exhibit
Newspaper story
Oral report
Painting
Pamphlet
Paper mache
Petition
Photo essay
Pictures
Play
Poetry
Press conference
Puppet show
Radio program
Sculpture
Skit
Slide show
Survey
Tapes –audio-video
Television program
Timeline
Travel brochure
Write a new law
Video film



FORUMS FOR PRESENTATIONS

School symposiums/education fairs
Watershed Councils
Watershed Fairs
Land use planning meetings
County Commission meetings
City Council meetings
Environmental Celebrations like Earth Day
State or county fairs
Agencies like Oregon Dept of Fish and Wildlife
Organizations like Sierra Club or Cattlemen's Assoc.
NW Earth Institute's Earth Club Challenge

STUDENT HANDOUT 7E

DESIGNING A PERSONAL ACTION PLAN

The following worksheet is designed to help organize the planning and preparation work necessary to achieve an effective service-learning project. Though some questions may be difficult to answer at the preliminary stage in the planning, we encourage you to make an attempt at all the answers now and send in the worksheet to Oregon Trout Salmon Watch for review, comments, and assistance. You can go back later and make modifications or changes as developments arise during the course of this planning. We intend that this form be used after brainstorming sessions and some consensus review.

The questions on this form are intentionally similar to those found on typical mini grant applications. If you are planning to apply for grant monies, this form may be useful as a preliminary draft.

Salmon Watch®

Date____________________

STUDENT SERVICE-LEARNING PROJECT ACTION PLAN

Student name_______________________________________

Teacher name_______________________________________

School name_______________________________________

Project Title_______________________________________

Please list any resources you would like Salmon Watch to provide:

What is the goal(s) of the project?_______________________________________

____

____

Why have you selected this project?_______________________________________

____

____

Who is the Project Partner(s)______________________ Partner phone______________

______________________ ______________

What role will the partner(s) play in your project?_______________________________________

____

____

What other resources (people, materials, etc.) will you utilize?_______________________________________

____

What obstacles will you face with this project? How will you resolve these problems?______________________

____

Who will see the results of your project?_______________________________________

____

How do you plan to document the project?

- ☐ Photographs
- ☐ Charts & Graphs
- ☐ Artwork
- ☐ Essay
- ☐ Other______________________

The Freshwater Trust
65 SW Yamhill Street
Suite 200
Portland, OR 97204

(SEE BACK SIDE)

Describe the steps you will take towards achieving your project goal on the timeline provided below. Please use the months on the right as a guide.

FALL

SEPTEMBER

OCTOBER

NOVEMBER

WINTER

DECEMBER

JANUARY

FEBRUARY

SPRING

MARCH

APRIL

MAY

SUMMER & BEYOND

JUNE

Salmon Watch®

Date____________________________

Service-learning Project Evaluation

We would like to know about your classroom's Salmon Watch Service-learning project experience(s) during this past year. Your candid and thoughtful comments will help us improve Salmon Watch for future years. Thank you for your support! Please return this evaluation by May 31.

Teacher's name____ School Year__________________________________

School name____

About how many students were taught from the Salmon Watch curriculum during this school year? ____________________

About how many of those students participated in a Service-learning project during this school year?____________________

Were the service-learning projects done individually, in small groups, or with the entire class? ____________________

Project name(s)____ Date(s) of implementation ____________________

Project location(s)____ ____________________

Project description(s)____

____

____

What were the major difficulties in planning the project(s)? Comments?

- ❑ Time ____
- ❑ Budget ____
- ❑ Materials ____
- ❑ Other_________________ ____

What were the successes during the planning phase?____

____

____

What were the major difficulties in the implementation? Comments?

- ❑ Coordination ____
- ❑ Transportation ____
- ❑ Other__________________ ____

What were the successes in the implementation? ____

____

How did your students document and/or evaluate the project ? Was it an effective tool?
- ❑ Journal ____________________
- ❑ Photographs ____________________
- ❑ Other__________ ____________________

How did your students present the information/materials from the project? To what audience?____________

____

We would like to show our volunteers, partners, and the public the products (displays, art, etc.) of your projects at training sessions, symposiums, and other events. Would you be willing to share these with Oregon Trout? If yes, please describe.
- ❑ YES ____________________
- ❑ No ____________________

How useful was the curriculum in planning, implementing and evaluating the project?

❑ Excellent ❑ Very Good ❑ Good ❑ Fair ❑ Poor

Comments:

How effective was Salmon Watch in assisting you and your students with your project?

❑ Excellent ❑ Very Good ❑ Good ❑ Fair ❑ Poor

Comments:

In what ways can Salmon Watch better support your efforts in service-learning?____________

____

____

Salmon Watch is considering developing long term Salmon Watch Service-learning sites in partnership with other local organizations. What is your interest in developing such a site with other Salmon Watch Classrooms in your area?

- ❑ Definitely Participate
- ❑ Might Participate
- ❑ Would Not Participate

Please make suggestions:____________________

____

____

Please add any additional comments below.

Please return this form to:

The Freshwater Trust
Salmon Watch
65 SW Yamhill Street, Suite 200
Portland, OR 97204

Thank you for your support of the program!

Pacific Northwest Salmon & Watersheds

ALIGNMENT OF OREGON DEPARTMENT OF EDUCATION SCIENCE STANDARDS FOR: 6TH, 8TH, AND HIGH SCHOOL

6th Grade	

6.1 Structure and Function: Living and non-living systems are organized groups of related parts that function together and have characteristics and properties.	
6.1L.1	Compare and contrast the types and components of cells. Describe the functions and relative complexity of cells, tissues, organs, and organ systems.

6.2 Interaction and Change: The related parts within a system interact and change.	
6.2L.1	Describe the relationships and interactions between and among cells, tissues, organs, and organ systems.
6.2L.2	Explain how individual organisms and populations in an ecosystem interact and how changes in populations are related to resources.
6.2E.1	Explain the water cycle and the relationship to landforms and weather.

6.3 Scientific Inquiry: Scientific inquiry is the investigation of the natural world based on observation and science principles that includes proposing questions or hypotheses, and developing procedures for questioning, collecting, analyzing, and interpreting accurate and relevant data to produce justifiable evidence-based explanations.	
6.3S.1	Based on observation and science principles propose questions or hypotheses that can be examined through scientific investigation. Design and conduct an investigation that uses appropriate tools and techniques to collect relevant data.
6.3S.2	Organize and display relevant data, construct an evidence-based explanation of the results of an investigation, and communicate the conclusions.
6.3S.3	Explain why if more than one variable changes at the same time in an investigation, the outcome of the investigation may not be clearly attributable to any one variable.

6.4 Engineering Design: Engineering design is a process of identifying needs, defining problems, developing solutions, and evaluating proposed solutions.	
6.4D.1	Define a problem that addresses a need and identify science principles that may be related to possible solutions.

8th Grade

8.1 Structure and Function: Systems and their components function at various levels of complexity.	
8.1L.1	Explain how genetics and anatomical characteristics are used to classify organisms and infer evolutionary relationships.

8.2 Interaction and Change: Systems interact with other systems.	
8.2P.2	Explain how energy is transferred, transformed, and conserved.
8.2L.1	Explain how species change through the process of natural selection. Describe evidence for evolution.
8.2E.4	Analyze evidence for geologic, climatic, environmental, and life form changes over time.

8.3 Scientific Inquiry: Scientific inquiry is the investigation of the natural world based on observations and science principles that includes proposing questions or hypotheses and designing procedures for questioning, collecting, analyzing, and interpreting multiple forms of accurate and relevant data to produce justifiable evidence-based explanations and new explorations.	
8.3S.1	Based on observations and science principles propose questions or hypotheses that can be examined through scientific investigation. Design and conduct a scientific investigation that uses appropriate tools, techniques, independent and dependent variables, and controls to collect relevant data.
8.3S.2	Organize, display, and analyze relevant data, construct an evidence-based explanation of the results of a scientific investigation, and communicate the conclusions including possible sources of error. Suggest new investigations based on analysis of results.
8.3S.3	Explain how scientific explanations and theories evolve as new information becomes available.

8.4 Engineering Design: Engineering design is a process of identifying needs, defining problems, identifying design criteria and constraints, developing solutions, and evaluating proposed solutions.	
8.4D.1	Define a problem that addresses a need, and using relevant science principles investigate possible solutions given specified criteria, constraints, priorities, and trade-offs.

High School

H.1 Structure and Function: A system's characteristics, form, and function are attributed to the quantity, type, and nature of its components.	
H.1L.1	Compare and contrast the four types of organic macromolecules. Explain how they compose the cellular structures of organisms and are involved in critical cellular processes.
H.1L.3	Explain and apply laws of heredity and their relationship to the structure and function of DNA
H.1L.4	Explain how cellular processes and cellular differentiation are regulated both internally and externally in response to the environments in which they exist.

H.2 Interaction and Change: The components in a system can interact in dynamic ways that may result in change. In systems, changes occur with a flow of energy and/or transfer of matter.	
H.2P.1	Explain how chemical reactions result from the making and breaking of bonds in a process that absorbs or releases energy. Explain how the rate of a chemical reaction is affected by temperature, pressure, and concentration.
H.2L.1	Explain how energy and chemical elements pass through systems. Describe how chemical elements are combined and recombined in different ways as they cycle through the various levels of organization in biological systems.
H.2L.2	Explain how ecosystems change in response to disturbances and interactions. Analyze the relationships among biotic and abiotic factors in ecosystems.
H.2L.3	Describe how asexual and sexual reproduction affect genetic diversity
H.2L.4	Explain how biological evolution is the consequence of the interactions of genetic variation, reproduction and inheritance, natural selection, and time.
H.2E.4	Evaluate the impact of human activities on environmental quality and the sustainability of Earth systems. Describe how environmental factors influence resource management

H.3 Scientific Inquiry: Scientific inquiry is the investigation of the natural world by a systematic process that includes proposing a testable question or hypothesis and developing procedures for questioning, collecting, analyzing, and interpreting multiple forms of accurate and relevant data to produce justifiable evidence-based explanations and new explorations.	
H.3S.1	Based on observations and science principles formulate a question or hypothesis that can be investigated through the collection and analysis of relevant information.
H.3S.2	Design and conduct a controlled experiment, field study, or other investigation to make systematic observations about the natural world, including the collection of sufficient and appropriate data.
H.3S.3	Analyze data and identify uncertainties. Draw a valid conclusion, explain how it is supported by the evidence, and communicate the findings of a scientific investigation..

H.4 Engineering Design: Engineering design is a process of formulating problem statements, identifying criteria and constraints, proposing and testing possible solutions, incorporating modifications based on test data, and communicating the recommendations.	
H.4D.1	Define a problem and specify criteria for a solution within specific constraints or limits based on science principles. Generate several possible solutions to a problem and use the concept of trade-offs to compare them in terms of criteria and constraints.
H.4D.2	Create and test or otherwise analyze at least one of the more promising solutions. Collect and process relevant data. Incorporate modifications based on data from testing or other analysis.
H.4D.3	Analyze data, identify uncertainties, and display data so that the implications for the solution being tested are clear.
H.4D.4	Recommend a proposed solution, identify its strengths and weaknesses, and describe how it is better than alternative designs. Identify further engineering that might be done to refine the recommendations...
H.4D.6	Evaluate ways that ethics, public opinion, and government policy influence the work of engineers and scientists, and how the results of their work impact human society and the environment.

INTERNET REFERENCES

http://www.aquarium.org/salmon The Oregon Coast Aquarium web site has resources and information on Pacific salmon and their related exhibits and programs.

http://www.blm.gov - US Department of the Interior Bureau of Land Management

http://www.bpa.gov/ - Bonneville Power Administration

http://www.cdc.noaa.gov This web site supplies information on climate variations in time periods from a month to centuries including data on precipitation and oceanic influences.

http://www.critfc.org The Columbia River Inter-Tribal Fish Commission describe the cultural importance of salmon to the Confederated Tribes of the Nez Perce, Warm Springs, Yakama, and Umatilla.

http://www.deq.state.or.us/ - The Oregon Department of Environmental Quality (DEQ) is a regulatory agency whose job is to protect the quality of Oregon's Environment.

http://www.dfw.state.or.us The Oregon Department of Fish & Wildlife web site with information about their programs, policies, staff and facilities.

http://www.epa.gov/surf3 The EPA Surf your watershed site allows your to narrow in on your home watershed. The site has an array of maps and resources.

http://www.epa.gov/volunteer/stream/ EPA's Volunteer Stream Monitoring: A Methods Manual

http://www.fs.fed.us - USDA Forest Service

http://www.fws.gov - US fish and Wildlife Service

http://www.globe.gov/ - The Globe Program *Global Learning and Observations to Benefit the Environment*

http://www.interrain.org Interrain Pacific produces this web site which focuses on GIS maps in watersheds.

http://metro-region.org/ - Metro Regional Parks and Greenspaces

http://www.nmfs.noaa.gov/ This web site provides a variety of links to salmon resources.

http://www.nwr.noaa.gov/1salmon/salmesa/pubs/1pgr.pdf - Endangered Species Act Status of West Coast Salmon and Steelhead

http://www.nwf.org The National Wildlife Federation has information on endangered species including several species of salmon.

http://www.nwp.usace.army.mil This web site for the Army Corps of Engineers has regional information on fish passage and dam improvements. Adding /op/FishData/daily to the web address will provide daily fish passage information by dam and by ladder. It also contains data on water turbidity, depth, temperature, discharge, and fish counts by species.

http://www.nwcouncil.org The Northwest Power and Conservation Council site has information on the hatchery, habitat, harvest, and hydropower issues impacting salmon including the text of many reports.

http://www.odf.state.or.us/ - Oregon Department of Forestry

http://www.oregon-plan.org This web site contains the text for the Coastal Salmon Restoration Initiative (Governor's Plan) as well as maps, monitoring references, and other useful information.

http://thefreshwatertrust.org The Freshwater Trust's home page with policy and education information on native fish.

http://www.oweb.state.or.us/ - Oregon Watershed Enhancement Board

http://seagrant.oregonstate.edu/ - Oregon Sea Grant works to further knowledge of the marine and coastal environments of the Pacific Northwest, and the forces – natural and human – that shape their destiny.

http://www.streamnet.org This web site from Pacific States Marine Fisheries Commission contains an online database about salmon, extensive data on salmon habitat, species specific information and color pictures.

http://www.swrp.org Student Watershed Research Project

SALMON-RELATED VIDEOS

1. **A Time for Action**

The Northwest Power Planning Council was formed in1980 to come up with a plan to conserve energy for the future. This fifteen-minute video is a general overview of their mission. It focuses on conservation of energy, using high efficiency resources, using renewable resources, changing regulations, and getting individuals to participate. Good for middle and high school level students.

Available for checkout through Northwest Power Planning Council, Public Affairs Division, 851 6th Ave., Suite 1100, Portland, OR 97204, (503) 222-5161, 1(800) 222-3358.

2. **The Bull Trout Story a Living Legend**

The Bull Trout Story documents the history of the Bull Trout in Oregon. This twenty-five minute film concentrates on the factors causing the Bull Trout's decline and on the habitat restoration projects being done to enhance the trout habitat. Suitable for middle and high school students.

Available for checkout through Portland General Electric, Environmental Services, 121 SW Salmon St., Portland, OR 97204. Contact Diane Bricker at (503) 464-8526.

3. **The Chinook Trilogy**

The Chinook Trilogy is composed of three thirty-minute videos. Below is a brief description of each. All three videos are most suitable for high school level students. They are available as a set or individually.

My Strength is From the Fish gives the history of the beliefs and traditions of the Indians of the Columbia River (including the Warm Springs, Yakama, Umatilla and Nez Perce tribe). It covers the salmon issues of today and explores them from the perspective of the Indians. The film depicts the social and spiritual importance of salmon to the Indians' culture.

Empty Promises, Empty Nets outlines the history and the implications of the Treaties of 1855 in which the Indian Nations of the Columbia River ceded a majority of their land to the U.S. government in trade for reservations and fishing rights. It focuses on the landmark legal decisions that confirmed the fishing rights of Columbia River Indians. The film details the Indians' view regarding how their treaty rights are not being upheld today and the implications this has on the Indians themselves.

Matter of Trust outlines the problems facing salmon populations in the Columbia River and describes the types of changes that the Indian tribes believe need to occur in order for the salmon runs to be restored. The Indians of the Columbia River have come up with their own salmon restoration plan that is based on the salmon life cycle. The film details their plan which includes honoring the Treaties of 1855, federal agencies taking responsibility for their actions within their fish management plans, and better educating students regarding the history of the salmon decline.

Available for check out from your local Education Service District. The Chinook Trilogy can be bought from the Columbia River Inter Tribal Fish Commission, 729 NE Oregon, Suite 200, Portland, OR 97232, to order call 1(800) WILD-HARE. The Chinook Trilogy (a complete three-part series includes 20-page booklet) is $115.00, The Chinook Trilogy School Edition (includes teaching guide, 20-page booklet and public performance rights) is $125.00, each video can be bought separately (includes a 20-page booklet) each is $39.95.

4. Journey of the Kings

Journey of the Kings is a thirty-minute overview of the salmon crisis in the Northwest. The film briefly discusses the history of Oregon rivers, the effects of harvesting and dams, and the salmon life cycle. It describes what the Northwest Power Planning Council has mandated for the salmon runs and dams. It is suitable for middle school and high school students.

Available for check out through The Northwest Power Planning Council, 851 SW 6th Ave., Suite 1100, Portland, OR 97204, call (503) 222-5161.

5. Life Cycle of the Salmon

Life Cycle of the Salmon is a 6 minute video that captures the remarkable life story of the salmon. This video portrays memorable images that reveal the salmon's world, often from their underwater point of view, as they are born in a river, migrate to the ocean, and return to spawn. A clear, informative narration highlights the video and makes the program suitable for viewers of all ages.

Available through Oregon Sea Grant Communications, Oregon State University, 402 Kerr Administration Bldg, Corvallis, OR 97331-2134, 800-375-9360 sea.grant.communications@orst.edu, the cost of the video is $10

6. Long Live the Kings

"Long Live The Kings" is a non-profit organization working to protect King (Chinook) salmon in the state of Washington. This twenty-four minute film covers what Long Live the Kings and other organizations are doing to restore the salmon runs. It shows non-profit organizations, public/private agencies, volunteers and private landowners and businesses teaming together on stream enhancement, restoration efforts and hatchery projects. Best suited for high school students.

Available through the Hancock Timber Resource Group, Bullitt Foundation, copyrights 1995, (206) 788-6023.

7. Oregon Field Guide

This is a special thirty-minute video documenting the decline of the Klamath River Basin. It focuses on the possible reasons that salmon runs have declined, including over-fishing, mining, logging, agriculture, ranching, weather changes and hatcheries. This video is particularly relevant for schools in southern Oregon and suitable for high school students.

Available from Oregon Public Broadcasting, 7140 SW Macadem Ave., Portland, OR 97219-3013. Contact Audience Services at (503) 293-1982, cost is $25.00.

8. The Return of the Salmon

The Return of the Salmon is a thirty-minute film introducing the complicated natural resources challenge of salmon recovery and the approaches that some agencies, organizations, and citizens are taking to address the salmon crisis. The film is organized into chapters including scientific background, historical background, social implications, and possible solutions. It is suitable for middle and high school students.

Available through Oregon Sea Grant Communications, Videotape Orders, ADS 402, Oregon State University, Corvallis, OR 97331. Call (800) 375-9360, the cost of the video is $30.00.

9. Rogue Summer Steelhead: Half Pounders Worth Their Weight in Gold

A thirty minute film presented by the Rogue Flyfishers concentrating on the decline of salmon runs and what is being done to restore them in southern Oregon. It identifies key organizations working on collaborative restoration projects. It is suited for middle and high school students and ideal for schools in Southern Oregon.

Available through the Rogue Flyfishers, P.O. Box 4637, Medford, OR 97501.

10. The Streamkeeper starring Bill Nye "The Science Guy"

1997 Winner of Environmental Media's "Best Educational Video" award, "The Streamkeeper" is a great training tool. Designed in three parts to pique watershed interest of students and community groups. Topics include watersheds, hydrologic cycle, stream flow, inventorying and monitoring the streams, and community action. 26:58 minutes.

Available through the Adopt-A-Stream Foundation, 600-128th Street SE, Everett, WA 98208-6353. Cost is $19.95.

11. When the Salmon Runs Dry

A fifty-minute film presented by KINO News documenting the politics and factors of the salmon crisis in the Columbia River. This film covers key topics such as the history of harvesting fish by Native Americans, the effects of hatcheries, dams, logging, ranching, commercial fishing, and agricultural irrigation. It also addresses what is being done to protect the river and identifies the different interest groups concerned about salmon issues. Good for high school level students.

Available through Films & Videos for a Safe & Sustainable World, 5332 College Ave., Suite 101, Oakland, CA 94618. Call 1-800-4-PLANET, the video is $39.95.

12. Torrents of Change

"Torrents of Change" is a thirty-minute film produced by the Forest Service Employees for Environmental Ethics. It documents the effects the February 1996 flood had on the rivers in the Siuslaw National Forest. The film compares past floods with the 1996 flood and the contributing factors of each (including logging practices and logging roads). U.S. Forest Service hydrologists and fish biologists discuss cost-effective ways to improve the logging roads and restoring the land to its natural contours. It is best suited for high school students.

13. World Population, A Graphic Simulation of the History of Human Population Growth

"World Population" is a six-minute dramatic visualization of the history of global population growth. This film is a good starting point for examining more closely the dynamics of human population growth and how it affects the environment and natural resources. Suitable for middle and high school students.

Available through Zero Population Growth, Inc., 1400 16th Street, NW Suite 320, Washington, D.C. 20036. Call (202) 332-2200, the video is $19.95 plus $5.00 shipping and handling.

14. Life on the Edge: Improving riparian Function

"Life on the Edge" helps viewers discover what role the riparian area plays in the health of our watershed. Included a 12-page study guide.

Available from Oregon Sea Grant Communications, Videotape Orders, ADA 402, Oregon State University, Corvallis, OR 97331. Call (800) 375-9360, the cost of the video is $19.95.

15. Buying Time: Instream Restoration

"Buying Time" is a 15 minute video that helps viewers explore the critical role streams play in our watersheds and seeing what landowners from the Oregon coast range to the high deserts are doing a to help improve Oregon's precious streams.

Available from Oregon Seat Grant Communications, Videotape Orders, ADA 402, Oregon State University, Corvallis, Or 97331. Call (800) 375-9360, the cost of the video is $24.95

BIBLIOGRAPHY

Adopt a Stream Foundation's Field Guide to the Pacific Salmon. 1992. Robert Steelquist. Sasquatch Books. Seattle, WA.

Adopting a Stream/ A Northwest Handbook.1988/1991. Steve Yates. University of Washington Press. ISBN 0-195-96796-X.

Aquatic Project Wild, 2nd ed. 1992. Western Regional Environmental Education Council, Inc. Boulder, CO 80308-8060.

California's Salmon and Steelhead, Our Valuable Natural Heritage. Teacher's Guide and Student Activities: Grades K-6. California Advisory Committee on Salmon and Steelhead Trout.

Columbia River Fisheries: ENDANGERED SALMON: A Reading. THE COLUMBIA RIVER: IT'S FUTURE AND YOU, EM 8475, Oregon State Removed from survey.University Agricultural Communications, Administrative Services A422, Corvallis,OR 97331-2119. pp. 49-60.

The Comings and Goings of Coho, Water Water Everywhere... Oregon State University Sea Grant College Program and Oregon Department of Education.

A Common Fate. 1996. Joseph Cone. Oregon State University Press. ISBN 0-87071-391-4.

Dwindling Northwest Salmon. 1991. Billy Frank. *CLEARING*. Jan/Feb, pp. 20-23.

F.I.S.H. Adverse Effects of Logging on Fisheries. Univ. of Nevada Cooperative Extension Fact Sheet 87-53.

F.I.S.H. Habitat Education Program; Watersheds, Wildlife and People. Pacific States Marine Fisheries, 45 SE 82nd Drive, Suite 100, Portland, OR 97207; (503) 650-5400.

F.I.S.H. U.S. Coastal Habitat Degradation and Fishery Declines. 1992. James Ross Chambers. Presented at 57th North American Wildlife and Natural Resources Conference, Wildlife Management Institute. pp. 1-10.

The Future of Salmon is in Your Hands. 1992. Ron Klein and John Esler. CLEARING. Sep/Oct, pp. 9-10.

How to Catch and Identify the Game Fish of Oregon. 1978. E.A. Lusch. Frank Amato Publications.

In Search of the Last Sockeye. 1993. Jeff Kuechle. VISIONS, from the Oregon Graduate Institute of Science and Technology. Summer, pp. 14-19.

Ishmael. 1993. Daniel Quinn. Bantam Books. ISBN 0-553-56166-9.
Keepers of the Earth: Native American Stories and Environmental Activities for Children. 1989. Michael J. Caduto and Joseph Bruchac. Fulcrum, Inc. Golden, CO.

Look to the Mountain: An Ecology of Indigenous Education. 1994. Gregory Cajete. Kivaki Press. Durango, Colorado.

Macroinvertebrates and River Continuum (video 21: 18). Oregon Department of Fish and Wildlife.

Make It Right: SOLV Planning guide for service learning projects. SOLV, PO Box 1235, Hillsboro, OR 97123.

Making Room in the Ark, The Endangered Species Act and the Columbia River Basin. 1992. John M. Volkman. *ENVIRONMENT*, May, pp. 18-43.

Mountain in the Clouds. 1990. Bruce Brown. Collier Books. ISBN 0-02--13095-3.

My Strength Is From The Salmon (video). Columbia River Inter Tribal Fish Commission. Available at CRITFC, 729 N.E. Oregon, Suite 200, Portland, OR 97232; (503) 238-0667.

Native American Values/Beliefs: A Literature Curriculum. 1994. Judith Komishane. Title IX Indian Educaiton Program. Washington County ESD, Hillsboro, OR 97124.

The Northwest Salmon Crisis. 1996. Joseph Cone and Sandy Ridlington, eds. Oregon State University Press. ISBN 0-87071-390-6.

One with the Watershed: A Story Based Curriculum for Primary Environmental Education. Tom Heidlebaugh. Presented by the Tribal Communities of the Northwest, the Northwest Indian Fisheries Commission and the Seattle Aquarium.

The Oregonians: An Illustrated Collection of Essays on Traditional Lifeways, Federal-Indian Relations, and the State's Native American People Today. Published by the Oregon Council for the Humanities.

Project Wild. Kate Ferschweiler. Western Regional Environmental Education Council, Inc. Boulder, CO 80308-8060.

A Race to Rescue the Salmon. 1992. Jeanne McDowell. TIME, March 2, pp. 59-60.

Reading To Learn, California's Salmon and Steelhead, Our Natural Heritage. Teachers Guide and Student Activities: Grades K-6. California Advisory Committee on Salmon and Steelhead Trout. Can be acquired through Diane Higgins, KREP Coordinator, 1271 Fieldbrook Rd., Arcata, CA 95521; (707) 822-0744.

Rethinking Columbus: Teaching About the 500th Anniversary of Columbus's Arrival in America. 1991. Rethinking Schools, Ltd. Milwaukee, WI. 53212.

The Return of the Salmon. A 30-minute educational video about salmon and watershed restoration. Sea Grant Communications, AdS 402, Oregon State University, Corvallis, OR 97331; (541) 737-0756. $30.00.

Riparian Pastures. Univ. of Nevada Cooperative Extension Fact Sheet 87-53.

The River Stressed Out. 1993. Northwest Power Planning Council,

Salmon of the Sandy River, Oregon. 1990. Douglas P. Cramer. Portland General Electric, Environmental Services Department. Portland, OR.

The Salmon Dammed. 1992. Bob DeVine. AUDUBON. Jan/Feb, pp. 83-90.

Salmonids in the Classroom: Intermediate. Canadian Department of Fisheries and Oceans, B.C. Teachers Federation Lesson Aids. 105-2235 Burrard Street, Vancouver, B.C. Canada V6J 3H9.

Save Our Streams, Hands On Streams & Rivers. Richard D. Klein. Maryland department of Natural Resources. Owing Hills, MD 21117.

Save Our Streams, Monitor's Guide to Aquatic Macroinvertebrates. Loren Larking Kellog. 1992. Izaak Walton League of America. Arlington, VA 22209.

Save Our Streams, Stream Quality Assessment. Richard Klein. The Izaak Walton League of America. Arlington, VA 22209.

Sourcebook for Watershed Education. 1996. Sally Cole-Misch, Larry Price and David Schmidt. GREEN. Ann Arbor, MI 48104, USA.

Striking a Balance in the Pacific Northwest. 1990. Keith W. Muckleston. ENVIRONMENT. Jan/Feb, pp. 10-36.

Streamkeeper's Field Guide: Watershed Inventory and Stream Monitoring Methods. 1996. Tom Murdoch and Martha Cheo. Adopt-A-Stream Foundation, Evertt, WA.

The Stream Scene - Watersheds, Wildlife and People. 1992. Oregon Department of Fish and Wildlife, PO Box 59, Portland, OR 97207; (503) 229-5403.

Tom Brown's Field Guide to Nature and Survival For Children. 1989. Tom Brown, Jr., with Judy Brown. A Berkley Book. New York.

Uncertainty, Resource Exploitation, and Conservation: Lessons from History. 1993. Donald Ludwig, Ray Hilborn, and Carl Walters. SCIENCE. Volume 260(2) April 2, pp. 17, 36.

When The Salmon Runs Dry. Films and videos for a Safe & Sustainable World, 5332 College Ave., Suite 101, Oakland, CA 94618; 1-800-4-PLANET.

A Wild Salmon's Excellent Adventure. 1991. Wayne Thompson. The Oregonian, October 27.

Wildlife Watching. 1993. Elizabeth Moore and Deborah Scrivens. Metropolitan Regional Parks and Greenspaces, 600 N.E. Grand Ave., Portland, OR 97232-2736.

MAPS/ATLASES

Oregon Environmental Atlas. 1988. Oregon Department of Environmental Quality and Cartographic Center Geography Department Portland State University.

Portland/Vancouver Toxic Waters Map. 1992. Columbia-Willamette River Watch. Northwest Environmental Advocates.

Columbia River—Troubled Waters: A Map of the Columbia River Basin; A Look at the Human Impacts and the Challenges. 1992. Columbia-Willamette River Watch. Northwest Environmental Advocates.

Atlas of Oregon Wildlife. 1997. Blair Csuti, A. Jon Kimerling, Thomas A. O'Neil, Margaret M. Shaughnessy, Eleanor P. Gaines, and Manuela M.P. Huso. Oregon State University Press. Corvallis, OR.

Atlas of Oregon, 2002. William G. Loy, Stuart Allan, University of Oregon Press

Atlas of the Pacific Northwest. Philip L. Jackson and A. Jon Kimerling. Oregon State University Press. Corvallis, OR.

Atlas of Pacific Salmon 2004. Xanthippe Augerot and the State of the Salmon Consortium, Ecotrust

GLOSSARY

abundance pattern — the establishment of an identifiable increase in a population over a period of time

adaptations — inherited physiological or behavioral mechanisms which enable an organism to survive

adipose fin — located on posterior dorsal surface; no bones or spines; contains fatty deposits, hence name; often removed on hatchery fish for easy identification

adult — an organism which has matured to a stage capable of reproduction

alevin — newly hatched salmonid; yolk sac attached

anadromous — migratory life cycle which begins in fresh water, moves to salt water, then returns to fresh water to spawn; derived from Greek - *up running*

anatomy — the component parts of a living multicellular organism; the study of those parts

anchor ice — heavy ice buildup in streams; creates very cold pockets of water which can freeze fish

aquatic — pertaining to water

attitude — assumptions based on implied beliefs and values, with a predicted behavior; e.g., “Foxes should not be controlled”

belief — an information-based assumption; may be right or wrong; i.e., “Where there are more pheasants, there are more foxes”

bypass screens — very fine screens which allow water, but not fingerlings to pass; used to protect fish from areas such as turbines or irrigation ditches

caddis fly larvae — tube-making aquatic insect larvae

carnivore — A carnivore is an animal that gets food from killing and eating other animals

carrying capacity — the concept that each ecosystem or environment's nutrient and energy resources will support a maximum number of each species due to limited resources

catadromous — migratory life cycle which begins in salt water, moves to fresh water, then returns to salt water to spawn; derived from Greek – *down running*

caudal fin — located on the distal posterior end of the spine; largest fin; often referred to as tail fin

ceded area — land yielded or given up especially by treaty

Celilo — Native American society in the Columbia River Basin; traditional culture based on salmon

Celilo Falls — enormous water falls and rapids where Celilo and other Indians traditionally fished for salmon, which were flooded as result of the construction of Bonneville Dam

channel area — area of a plane transect across a stream

channel gradient — degree of slope of stream channel; steepness

channel movement — lateral movements of a stream channel in response to kinetic energy of stream; can be initiated by flooding

chinook — *Oncorhynchus tshawytscha*, ("on-ko-rink-us tau-wee-cha) a species of salmon characterized by large body size, large irregular spots on back, upper sides and tail, black gums (king salmon)

chum — *Oncorhynchus keta*, ("on-ko-rink-us kee-ta") a species of salmon characterized by purple, yellow, and pink streaks on sides during spawning; broadest migratory range (dog salmon)

coho — *Oncorhynchus kisutch*, ("on-ko-rink-us ki-sooch") a species of salmon characterized by blue black and silver flanks at sea, turning dark green and bright red in fresh water; white gums (silver salmon)

coloration	the hues and patterns with which an organism is colored
compile	to bring many pieces of information into one comprehensive document
compromise	to collaborate; to give up part of one's own interests in order to reach an agreement
conservation	careful planning and use of resources to save and protect them
contour	a line on a map which represents a particular altitude or height above sea level
cover	brush or other material which provides shade or a camouflaged hiding place
Coyote	a Native American character frequently depicted as clever and cunning
cutthroat	*Oncorhynchus clarkii*, ("on-ko-rink-us clark-ee-i") a species of Pacific trout characterized by blue-green coloration on back and silver on sides; vivid red "slash" along lower jaw
debris	dead plant material in stream or coarse woody material which provides shelter for fry and fingerlings
decadal shift	a change over a decade, such as population numbers
detritus	Undissolved organic or inorganic matter resulting from the decomposition of parent material
dichotomous key	a written procedure which uses couplets of questions for taxonomic identification, as found in field guides
discharge	fluid which flows from land or a structure in the water into a river, stream or lake
dissolved oxygen (D.O.)	oxygen in an aqueous solution as molecular oxygen (O_2)
diversity	the kinds and numbers of species in an ecosystem or environment
dorsal fin	located mid-dorsally on the spine; generally a large fin

ecological	pertaining to the interactions between and among the biotic and abiotic (physical) elements of an ecosystem; derived from Greek – *house (ecos) knowledge (logos)*
ecosystem	all of the living and non-living components of an environment
eddies	areas of reverse flow in an aquatic system
egg	in plants and animals, the cell produced by ovaries; in most cases, they begin development into an individual organism upon fertilization by sperm
embedded	set or fixed firmly in a surrounding mass; applies equally to physical objects and concepts
endangered	threatened with extinction
Endangered Species Act	federal law which protects species which are threatened with extinction
environment	the place within which phenomena occur; often refers to our natural world
evidence	facts which are observable and measurable
exponential	a number increased to a power; in populations, growth which is measured as a power
fertilized	an egg whose membrane has been penetrated by the nucleus of a sperm
fingerling	stage in salmonid life cycle between fry and smolt; salmon are “finger-sized” in this stage
fishery	geographical location where fish are commercially caught; species or type of fish caught by anglers
fleet	boats or ships which engage in coordinated movements
food web	all of the plants and animals in an ecosystem organized into an interrelated “who eats whom” structure
forum	a place where people come together for the purpose of discourse

fox walk	a technique used to approach wildlife quietly; involves rolling of the foot from outside to inside when walking
fry	young salmon which have absorbed their yolk sac and begun to feed
generation	all of the offspring produced in a given season or time period
gill cover	bony plate which protects gill tissue
gravels	beds of small rocks, up to several inches in diameter, in a stream, where salmon deposit their eggs and milt
habitat	the environment in which an organism lives; its "address"
hatcheries	constructed facilities where milt from returning male salmon is used to artificially fertilize eggs taken from returning female salmon; development from egg to fingerling takes place within the confines of the facility
heat stress	physiological response to elevated temperatures; extremes can lead to coma and death
herbivore	A herbivore is an animal that gets its energy from eating plants, and only plants
home stream	the stream where a return salmon had hatched from an egg
homing	Scientists hypothesize that salmon navigate at sea with the aid of an inner magnetic map and a strong sense of day length, thus a salmon knows approximately where it is in relation to its home stream
indicator species	a species of plant or animal which exhibits a strong sensitivity to an altered range of environmental conditions; used to indicate health of the ecosystem
individual sensitization	the idea that each person must develop his or her own empathy with organisms in their environment
inference	arriving at a conclusion or decision from known facts
in situ	occurring in the place in the environment; literally, "in the place;" opposite *in vitro*, literally, "in the glass;" in the lab

irrigation	water diverted from streams or rivers or pumped from groundwater, often used for crops
issue	a situation, event or phenomenon which is disputed
iteroparous	producing offspring in successive, e.g., annual or seasonal batches, as is the case in most fishes. Opposite of semelparous
key	a series of questions, which correctly answered, identifies an organism
life cycle	life history in stages, e.g. begins in fresh water, moves to salt water, then returns to fresh water to spawn
litter	the plant debris deposited on a forest floor or streambed
macroinvertebrates	animals without backbones large enough to identify with the unaided eye; often aquatic insects
mating behaviors	observable and predictable kinetic behaviors which result in the fertilization of animal eggs by animal sperm
methodology	the steps and protocols which contribute to the application of a process
microhabitat	within a habitat, this is the actual zone of interaction between the organism and its home environment
migratory	behaviors which result in the movement of an organism from one location to another; cyclical, often synchronized with seasons or stage in life cycle
milt	salmon sperm
monitor	to observe and record, especially over time
Native American	people who are indigenous to the Americas
Nez Perce	Native American people who are indigenous to Idaho, Oregon, and Washington
niche	the physical habitat and function of an organism in its ecosystem; its “occupation”

nitrogen bubbles	nitrogen in the gaseous state in water; concentrations are increased by aeration and/or rapid submersion to depth
Northern Pike Minnow	a species of fish with large digestive system, capable of holding several fish at a time; prey on salmon in reservoirs
observations	records of sensory inputs according to protocols which include operationally defined criteria
Oncorhynchus (“on-ko-rink-us”)	a genus of animals refering to NW salmon, steelhead, and cutthroat trout; derived from Greek – *hook nosed*
opinions	a belief not based on certainty; a judgement
organism	a living thing
out of phase	an anticipated cycle which shifts unexpectedly out of its pattern
parameter	a specific entity or condition which is measured, and whose value varies with its conditions
parr	salmonid fry before smoltification
pectoral fin	lateral anterio-ventral fin; analogous to arms in a human
pelvic fin	lateral posterio-ventral fins; analogous to legs in a human
pH	a measure of the activity of hydrogen ion in an aquaeous environment
physical structure	the abiotic components of a stream
physiological adaptations	cellular and molecular adaptations of organisms to their environments or reproductive strategies
pink	*Oncorhynchus gorbuscha*, (on-ko-rink-us gor-boo-scha) most abundant species of Pacific salmon; large oval black spots on tail and back; rigid two-year life cycle
pool	place where water in a stream exhibits a very weak current
population	the number of individuals in a species within a prescribed area

porous	state of having holes; absorbs water
quadrant	a measured area, usually a small piece of land
questionnaire	a set of questions designed to elicit opinions about an issue
reproduce	to make a copy of; in living organisms, to produce offspring
resource	something which is ready to use or put to a purpose
riffle	graded place in a stream where water runs over gravels and its surface is broken
rights	that which a person has a just claim to
riparian	area containing a stream and its associated plants and floodplain
root wad	the twisted roots of a tree which has fallen from the stream bank into a stream; provides protection for small fish
runoff	water which lands on a surface, is not absorbed, and runs into a stream or other water body
salmon	a group of bony fish; members of the family Salmonidae
salmonids	common name, or contraction of Salmonidae
sampling	using a portion of an environment or population for measurement or observation
scour	the abrasive effect of rapidly moving water on the sides and bottom of a stream, creating deeper water habitat and pools
sediment	geological material which has moved from land to stream and settles to the bottom
sediment-free	stream bottoms which contain no land-derived fine geological material
semelparous	term describing the fact the most salmon spawn only once during their lifetime

simulation an enactment of an actual event or process which provides its participants with participatory practice which they would not otherwise experience

smolt stage in salmonid life cycle in which some fingerlings undergo the physiological changes necessary for movement into salt water

smoltification occurs when fry enter estuary, the process by which salmonids adapt to saltwater

sockeye *Oncorhynchus nerka*, (on-ko-rink-us ner-ka") species of salmon whose greenish blue finely speckled back and silver sides turn bright red on return to fresh water; some remain in fresh water all of their lives (kokanee); juveniles prefer lakes to streams

spawning area that part of the stream bottom which contains gravels suitable for depositing eggs

species the definitive taxonomic group; a group of organisms which interbreed, but do not breed with other related organisms

spores asexual reproductive cells of some plants, fungi and protozoa

stable in a state of dynamic equilibrium, and not subject to easy disturbance

steelhead *Oncorhynchus mykiss*, ("on-ko-rink-us my-kiss") a species of anadramous trout with metallic blue back and silver sides; a red band on sides during spawning

stream water flowing toward base and its bed

streambed the rock, gravel and sediments which form the bottom of a stream

stream channel in cross-section, the land structure which holds a stream; consists of a main path and lateral channels, which may not be immediately obvious

stream flow water running through a stream channel; movement of water through its channel as measured in meters per second

stream gradient	steepness of the longitudinal slope of a stream bed
substrate	the nutrients and physical composition of a streambed
summit	a gathering of people for a decision making meeting
surface area	the square measure of the exterior of an entity
Takilma	Native American tribe which historically inhabited the Rogue River basin
taxa	a group or category, at any level, in a system for classifying plants or animals
taxonomy	the study of characteristics of organisms which differentiate them from others
temperature	amount of kinetic energy in a system
temperature tolerance	the range of temperatures which an organism endures without mortality
thermal responses	all of the behavioral and physiological responses of an organism to a range of temperatures
topographic map	a depiction of the surface area of a geographic feature in which it is illustrated by continuous lines representing intervals of elevation
treaty	an agreement, binding and legal, between two or more sovereign nations; sovereignty refers to the right of self-government and self-determination, or the ability of people to make decisions for themselves
turbidity	the amount of suspended matter in a water body; a measurement of such suspended matter
turbines	large bladed shafts which are turned by water, and whose rotary motion is used in dams to generate electricity
value	a worth attached to some event, place, idea, etc.; e.g., “Foxes are beautiful and important creatures”
vitelline vein	the vitelline vein, running through the centre of the yolk sac picks up oxygen from the water

water quality	an assessment of the content of a water body such as its chemical composition
watershed	the basin which holds a water system including main channels and tributaries
watershed management	using the geology, hydrology, sociology and biology of watersheds to plan their use