SALMON WATCH

BENTON COUNTY

Volunteer Manual

2023

Benton Soil and Water CONSERVATION DISTRICT

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Salmon Watch History and Goals

Welcome to Linn Benton Salmon Watch! This interactive, outdoors-based program provides 4th-8th graders in Linn and Benton counties with a unique experience that we hope they will never forget.

Salmon Watch is a FREE experiential field trip program that teaches youth about salmon and healthy watersheds. Similar Salmon Watch programs happen all over the Pacific Northwest and are coordinated by various local organizations in partnership with schools and volunteers. The Linn-Benton Salmon Watch program is coordinated by a committee representing the Calapooia Watershed Council, South Santiam Watershed Council, Benton Soil and Water Conservation District, Oregon Department of Fish & Wildlife, Siuslaw National Forest, and a leadership cohort of retired teachers and other community experts.

SALMON WATCH'S MISSION

The Salmon Watch environmental education program teaches elementary and middle school students about the importance of wild salmon conservation in watershed management. The program is designed to instill in students and other participants a deeper appreciation of their wild salmon heritage and the importance of being well-informed and responsible citizens. Salmon Watch touches the hearts and minds of children to save the wild salmon.

HISTORY

Salmon Watch was founded by Oregon Trout (later The Freshwater Trust) in 1993. Over the past two decades, the program has educated more than 60,000 schoolchildren in Oregon. The program was discontinued by The Freshwater Trust at the end of 2010 (due to a shift in organizational mission) and is now under the leadership of the World Salmon Council.

WHY IT'S IMPORTANT

If we want our children as adults to value their natural heritage and to make informed and thoughtful decisions about natural resource issues, we must enable them to understand and relate to the natural world on a personal level.

Our youth, however, live increasingly urban and technological lives, isolated from the natural environment. Salmon Watch enables students to connect with nature and experience the relationships of humans to their environment through learning about the life cycle of wild salmon.

Salmon Watch also inspires hundreds of public agency experts and others to volunteer as field trip station educators, sharing their expertise and real-world experiences. These volunteers in turn help students to increase their knowledge of how scientific research in ecology is done. Engaging with these professionals also allows students to learn about diverse natural resource and STEM career opportunities.

Overall, Salmon Watch serves as a successful model of cost-effective collaboration among private and public organizations working together to enhance education as well as protect salmon populations and the ecosystems that sustain them.

HOW IT WORKS

Using salmon as the focal point, Salmon Watch provides comprehensive, multidisciplinary education in the classroom, field study and in-stream observation, and community service projects.

The curriculum incorporates diverse perspectives and innovative learning designed to enhance the critical-thinking and problem-solving skills of students and other participants.

On field trips, students conduct hands-on activities to understand salmon biology, identify macroinvertebrates (aquatic insects), conduct water quality monitoring, explore riparian zones and collect and disseminate data. This gives teachers a path to bridge field experiences back into the classroom and facilitate STEM educational opportunities.

Salmon-friendly projects in which students participate throughout the school year include hands-on stream restoration efforts, salmon spawning surveys, teaching younger kids about salmon, making presentations to community groups, art projects, installing rain catchment systems, and many other diverse activities chosen by the teachers and students.

PROGRAM GOALS

We aim to help participants:

- Appreciate the interdependence between humans and the ecosystem in which we live
- Recognize wild salmon as an important indicator of watershed health
- Understand the value of protecting native fish stocks
- Receive core-standard, STEM oriented education in the classroom
- Raise community awareness about healthy watersheds

Program Logistics

SALMON WATCH CLASSES

This program is designed for students in Grade 5, though students in grades 4th-8th also benefit from the experience. Ideally, one class attends Salmon Watch at a time with a maximum of 30 students, but two classes from one school may be accommodated at the same time if necessary. Students are divided into 4 groups that rotate through each of the 4 stations throughout the day.

TIMING

Linn Benton Salmon Watch programs run from late September to early November, depending on which county your school is located in.

LOCATION

Linn Benton Salmon Watch takes place in two locations: Clemens County Park in Alsea for Benton County students, and River Bend County Park for Linn County students. The curriculum and schedule for these two programs varies slightly. This guide is written primarily for Benton County participants.

CHAPERONES

A minimum of 4 chaperones is required for each class – one chaperone for each group. If necessary, the teacher may act as the 4th chaperone, but it is recommended that the teacher is not attached to a group so that they may move between the stations freely and assist where needed.

VOLUNTEERS

A minimum of 4 volunteers is required for each program – one to lead each of the 4 stations. For larger programs, additional volunteers may be requested by the Program Coordinator.

SCHEDULE

Please note that this is an "ideal" schedule where schools arrive and depart on time, stations run on time, etc. The program may be modified to suit different school and student needs. The goal is for each station to have about 30-40 minutes (including the time it takes to move to the next station).

TIME	ACTIVITY
9:15am	Volunteers Arrive
10:00	Students and Chaperones arrive, use the restrooms, and get into their 4 groups
10:10	Circle Up for introduction/Kalapuya Story by Program Coordinator
10:30	Station 1
11:05	Station 2
11:40	Lunch
12:10	Station 3
12:45	Station 4
1:20	Circle up for conclusions
1:30	School departs

STATION ROTATIONS

GROUP	10:00	10:30	11:05	11:40	12:10	12:45	1:20
A	Arrival, Intro-duction, Salmon Story	Salmon Observ-ation	Riparian Ecology	Lunch	Macro Inverte-brates	Salmon Stories	Conc-lusions and Good-bye
B		Riparian Ecology	Salmon Observ-ation		Salmon Stories	Macro Inverte-brates	
C		Macro Inverte-brates	Salmon Stories		Salmon Observ-ation	Riparian Ecology	
D		Salmon Stories	Macro Inverte-brates		Riparian Ecology	Salmon Observ-ation	

Volunteer Station Leader Responsibilities and Teaching Tips

Salmon Watch Volunteers make the program happen! Field trips cannot happen without the expertise and guidance of our Station Leaders. Thank you for being a volunteer!

VOLUNTEER STATION LEADER RESPONSIBILITIES

- Respond promptly to communications from Salmon Watch Program Coordinators.
- Attend a Volunteer Educator training session (if new to Salmon Watch).
- Sign up for one or more field trips (you'll receive a link to the Field Trip Sign Up page in early August).
- The Program Coordinator will contact you via e-mail at least one week prior to the field trip date(s) to confirm your participation and provide the school information and agenda. If you do not hear from us in a timely manner or think you may have missed an e-mail, please contact the Program Coordinator as soon as possible.
- Know where and when to meet on the day of the field trip.
- Sign and complete a liability waiver/photo consent form prior to the field trip.
- If you haven't completed a background check, we will email you a link to a secure third-party online form (provided at no cost to you).
- Review the Program Information in this document prior to your volunteer days, and ensure you have a good understanding of the station(s) you will be leading.
- Reach out to us! Your Program Coordinator is here to help answer your questions, refresh you on the curriculum, and meet any other needs you may have to be successful.
- Help ensure the safety of our students. To protect yourself, please make sure that you are not alone with a student at any time during the field trip.
- Complete an online program evaluation that will be emailed to you after your field trip. Please fill it out while the field trip is still fresh in your mind. Your feedback allows us to continually improve our program and is greatly appreciated!
- Attend a fun and festive Salmon Watch celebration party at the end of year (time and place TBA).

STATION LEADER TEACHING TIPS

Group Management

- Introduce yourself at the beginning of your station.
- Call students by their names using their name tags.
- Clearly communicate expectations and potential hazards, and establish any boundaries.
- Be courteous, friendly, respectful and firm with students, teachers, and chaperones
- Carry a time-keeping device and ensure that you are moving to the next activity at the designated time.

What the Station Leader should NOT be responsible for

- Student discipline or enforcing consequences for undesired behavior. That is the chaperone and teacher's job. If you have a chaperone who is not fulfilling their responsibility, it is perfectly okay (and encouraged) to ask your group chaperone for the support you need.
- Tending to student injuries. Contact your group's teacher, or call your Program Coordinator on the radio so that she may assist.
- Taking students to and from the bathroom. Ask the chaperone to do so. A volunteer should never be alone with a student.
- *And remember: your Program Coordinator is there for you!* Call on the radio if you need help managing a group, tending to an injury, leading an activity, etc.

Best Practices for Educators – Teaching 101

- Start by explaining the Big Picture and the questions you will be answering together. i.e. "We are going to be learning about _____ by doing _____..."
- Assess their knowledge of the topic before beginning. Ask a simple question: "What do you know about...?"
- Provide interactive activities to engage the students in learning – Avoid a lecture format
- Clearly and concisely explain the necessary details of the activity at hand
- Explain how equipment and tools are to be used (safety first!). Do not hand out equipment or tools until right before they are to be used.
- As much as possible, the children should be the ones doing the activity. Find ways to involve them even when you are talking and demonstrating.
- This is a multi-cultural world. Check your comments for bias in assumptions of experiences connected to economic class or ethnic background.
- Wrap up the activity by asking students to tell you what they learned and what questions they still have.
- Understand that developmental stages exist and what they are. Make sure your language is age and developmentally appropriate for the group. See the charts on the next page for more information about "the brain of a 5th grader".

Fifth Graders

Common Characteristics	School Implications
Social-Emotional	
■ Generally happy; enjoy family, peers, and teachers. ■ Work well in groups. ■ Usually truthful; developing a more mature sense of right and wrong. ■ Sensitive to and able to resolve issues of fairness. ■ Able to enjoy cooperative and competitive games.	■ Build group work into lessons, activities, and projects. (Flexible groups can work well; students can work with lots of different people, including adults and peers.) ■ Expect arguments (and that they will tend to end quickly). ■ Encourage their developing sense of fairness and of right and wrong. (These can lead to lively class debates and discussions.) ■ Provide opportunities for peer tutoring, book buddies, and development of conflict resolution and other interpersonal skills.
Physical	
■ Large muscles developing quickly. ■ Drawn to the outdoors and physical challenges. ■ Handwriting may become messier than in fourth grade. ■ Due to growth spurts, frequently hungry and can tire easily.	■ Set up schedules to include sufficient time for recess (and other outdoor play), energizers and other movement breaks, snacks, and lunch. ■ Consider a snack option that enables students to eat and work in the classroom. ■ Provide instruction and practice for use of tools such as rulers, compasses, and computers.

Fifth Graders

Common Characteristics	School Implications
Cognitive	
■ Good at memorizing facts. ■ Increasingly able to think abstractly; good at solving problems. ■ Enjoy rules and logic. ■ Enjoy collecting, classifying, and organizing. ■ Take pride in schoolwork. ■ Able to concentrate for longer periods of time.	■ Structure complex projects with proper scaffolding and guidance to build on their abilities to be highly productive with schoolwork. ■ Give ongoing encouragement and reinforcement for both effort and results. ■ Include lessons that help build their memory skills (for example, practicing math facts and learning facts about geography, history, and world records). ■ Support classification and other organizational skills with hands-on science work and math projects.
Language	
■ Expressive and talkative. ■ Like to explain things. ■ Able to listen well. ■ Interest in reading independently becomes stronger.	■ Encourage students to verbalize their thinking to help make discussions, debates, book groups, writing conferences, math groups, and so on more productive. ■ Provide opportunities for choral reading, singing, reciting poetry, and performing skits and plays. ■ Include time for independent reading and writing.

The information in this chart is based on *Yardsticks: Children in the Classroom Ages 4–14,* 3rd ed., by Chip Wood (Northeast Foundation for Children, 2007), and is consistent with the following sources:

Child Development Guide by the Center for Development of Human Services, SUNY, Buffalo State College. 2002.
WWW.BSC-CDHS.ORG/FOSTERPARENTTRAINING/PDFS/CHILDDEVELGUIDE.PDF

"The Child in the Elementary School" by Frederick C. Howe in *Child Study Journal,* Vol. 23, Issue 4. 1993.

Your Child: Emotional, Behavioral, and Cognitive Development from Birth through Preadolescence by AACAP (American Academy of Child and Adolescent Psychiatry) and David Pruitt, MD. Harper Paperbacks. 2000.

Helping kids get the most out of their experience

- Utilize the "learning moments" during the day; be alert to unique opportunities that may seem like tangents to the activity, yet offer a springboard for further discussion of the original topic.
- Ask students to describe their observations
- Offer positive comments for their all answers, even if they are incorrect; keep a positive attitude
- Remember that you represent a powerful role model for young people. Model awareness, respect for living things, and curiosity.
- Enthusiasm is contagious. Be upbeat, love your topic, and you will help your group to enjoy the field trip experience.
- Always take advantage of the "teachable moment". It is perfectly okay to be upstaged by an earthworm, otter, or eagle during your presentation.
- If students seem extremely distracted, tired, or not ready to listen, it's okay to take a few minutes away from your planned station activities to just "be" in nature. Have students sit quietly in a circle and report on what sounds they hear; take a two-minute silent walk and observe what they see, smell, and hear; play a quick game of tag to get their wiggles out; etc.

How do I involve everyone in the group?

Be sure to try to connect with all the students in the group. There will always be a few who have all the answers. Encourage the shy or quiet kids to share their ideas too. When an answer is given, ask the group to offer comments: agree? disagree? Elaborate and find relationships.

When dealing with a high-needs child, or one who really wants your full attention – get them to focus by assigning him or her small tasks and/or enlisting their support in other meaningful ways.

How do I deal with questions I don't know the answer to?

Don't be embarrassed to admit you don't know the answer to every question. You are not expected to. Also, there often isn't one simple explanation, or any correct answer. There are many ways to deal with this predicament. For example, you can:

- Reason aloud. Go through the process of how you would find out an answer.
- Show students the resources available. Have students look through field guides or other resources. Knowing where to find an answer is as important as knowing the answer.
- Turn the question back to the group as a whole. Encourage brainstorming.
- Turn the question over to your Program Coordinator.

Some great public speaking techniques

- Be sure to make your presentation age and knowledge level appropriate.
- Try to NEVER JUST TALK. Hands-on learning can and should be woven into every presentation.
- You make presentations with your body as well as with your words, and body frequently has greater impact. Be sure to make your body language consistent with your words.
- Get animated, be dynamic, move, gesture, use vocal variety. Don't stand in one place. Be aware of what your group can see and hear.

- ALWAYS speak to and engage with the whole group, not just the most interactive students.
- Use a few, gripping "wow" facts and use analogies the listener can relate to easily.
- Information should flow and be logically organized. Use repetition and internal summaries.
- Use impact words, simple sentences, personal statements and stories. Let them know WHY this information is important, or what it relates to.
- Engage them with questions – but not too many questions! Size up your group, read their body language.
- Pacing is very important. Make sure you keep it varied and interesting. Adjust your pace to their responses.

Dealing with wet and cold weather

Accept the weather. This program takes place in the Fall when it is very likely to be cold and/or rainy, possibly for the entire day. YOUR ATTITUDE will make a big difference in how much the group is affected by it! Be prepared by ensuring you wear warm layers and rain gear so you're as comfortable as possible.

Get under the trees or another shelter if it is raining hard. Move around frequently to keep warm. Frequently check in with students on their comfort level. Children can become hypothermic much more quickly than adults; know the warning signs and act quickly if a student demonstrates possible hypothermia.

Be aware that there is a box of warm kid-sized clothing available. Call your Program Coordinator on the radio if a student gets wet and/or needs warm clothing.

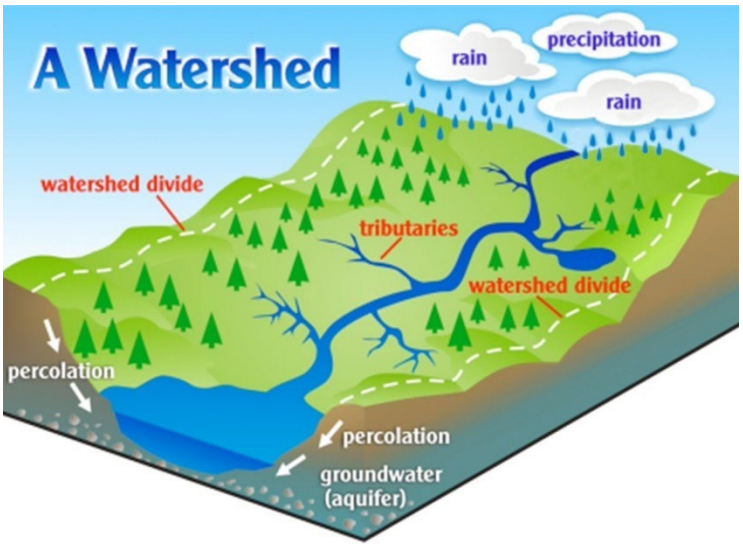
Background Information

Benton County Salmon Watch takes place at Clemens County Park in Alsea, nestled in the Oregon Coast Range off Highway 34. Here, the **Alsea River** flows along the edge of the park, with a tributary, **Seeley Creek**, flowing through the south end of the park. Salmon are known to spawn in both bodies of water. This is one of the few publicly-accessible places in our region where you can still see salmon migrating and spawning.

The two species of salmon which spawn here are **Coho** (*Oncorhynchus kisutch*) and **Chinook** (*Oncorhynchus tshawytscha*). Both of these species were plentiful before the arrival of European settlers, but now, many populations are in decline.

Salmon are amongst the few species of fish that can live in both freshwater and saltwater. They begin their lives in rivers and streams, born from eggs that were laid by their parents who then die soon after. The baby salmon then make their way downstream to the ocean, where they spend 2-5 years growing big and strong, before finally returning to the same river where they were born – often spawning within inches of where they were born themselves! Males compete fiercely to mate with as many females as they can. Females lay thousands of eggs in a nest they build called a **redd.** Within a few days, both parents die, but their lives are not in vain – their decaying carcasses nourish the trees along the river and also the small insects or **macro-invertebrates** which will feed their babies.

Salmon populations are being carefully monitored by scientists and environmental agencies because they are both economically important, and also excellent indicators of watershed health. A **watershed** is an area of land where the bodies of water within that area all flow to the same end point. Clemens Park is in the Alsea River watershed.



Salmon can tell us a lot about the health of the watershed because their successful migration and reproduction is dependent upon healthy rivers and streams. Young salmon are very sensitive to environmental factors such as water temperature, dissolved oxygen, and predators. Adult salmon return to the same place where they were born to spawn, so if that passageway becomes blocked (for example by a dam), or there is not enough water to swim upstream, they may not be able to reproduce. If a salmon population is declining, it is likely due to unfavorable conditions in the waterways where they spawn.

The region where our program takes place is the traditional homeland of the **Kalapuyan Peoples**, whose descendants are now members of the **Siletz and Grande Ronde Confederated Tribes**. Salmon have always been extremely important to these peoples, both as a food source, and a spiritual symbol. For Indigenous peoples, salmon are considered to be not just animals, but relatives – family. Their return to their spawning grounds each year is welcomed with communal feasts and expressions of gratitude for these fish that give their lives to feed the people.

This mural is an Indigenous representation of the connections of salmon to land, water, sky and people. The artist Clayton Gauthier is a Cree/Dakelh Artist who resides in Prince George, British Columbia.

Salmon feed all in their path - from the mountains to the sea. The circle depicts salmon's lifecycle; salmon travel from rivers to the ocean (feeding the orcas) and return to the rivers (feeding our forests, animals, and people).

LEARN MORE: https://www.pac.dfo-mpo.gc.ca/education/docs/sacred-smon-sacre-pub-eng.pdf

Introductory Talk: The Kalapuya Salmon Story

(To be told by the Program Coordinator)

When the Creator was preparing to bring humans onto the earth, He called a grand council of all the animal people, plant people, and everything else. In those days, the animals and plants were more like people because they could talk. He asked each one to give a gift to the humans—a gift to help them survive, since humans were pitiful and would die without help. The first to come forward was Salmon. He gave the humans his body for food. The second to give a gift was Water. She promised to be the home to the salmon. After that, everyone else gave the humans a gift, but it was special that the first to give their gifts were Salmon and Water. When the humans finally arrived, the Creator took away the animals' power of speech and gave it to the humans. He told the humans that since the animals could no longer speak for themselves, it was a human responsibility to speak for the animals. To this day, Salmon and Water are always served first at tribal feasts to remember the story and honor the First Foods.

LEARN MORE: https://critfc.org/salmon-culture/we-are-all-salmon-people/

Overview of Stations

Benton County Salmon Watch has 4 learning stations that students rotate through during their field trips. These stations provide the bulk of learning for the program, while also providing opportunity for students to explore the natural areas of Clemens Park, make observations, ask questions, and get to know their Station Leaders – many of whom are scientists or experts in the fields of salmon biology and conservation.

Station 1: Salmon Observation

OVERVIEW

Students hike to the farthest reaches of our program area to view a stream restoration site and a salmon spawning area.

LEARNING GOALS

- Students will understand that salmon are very special species that spend some of their life in freshwater, and some of it in saltwater.
- Students will be able to describe the salmon life cycle and developmental stages.
- Students will observe salmon spawning in the river and learn how to identify males versus females.
- Students will gain appreciation for the incredible navigation abilities of salmon.
- Students will learn about the physical changes that salmon undergo throughout their lives, and why these changes occur.

VOCABULARY

Redd, Alevin, Smolt, Spawn, Yolk Sac, Fry, Parr Marks, Imprinting, Magnetite

MATERIALS

- Polarized sunglasses
- Binoculars
- Salmon life cycle diagram
- Salmon physical features diagram
- Salmon eggs, fry, and smolt biofacts display

PROCEDURES

Part 1: Seeley Creek Bridge (20 mins)

1. Tell students that this body of water is a stream that travels through this park to the Alsea River, known as Seeley Creek.

2. Before going onto the bridge, pause to bring attention to the stream restoration sign just before the bridge. Tell students that this area is under active management by Oregon Department of Fish and Wildlife and other agencies to improve stream health and create salmon habitat.

3. Ask students, *what are some ways you think people help improve salmon habitat?* Allow them to brainstorm and briefly discuss responses.

4. Tell students that science is always evolving as scientists learn more. Stream restoration is a great example of this. At places like this, resource managers used to remove large logs and branches (also known as woody debris) from rivers, thinking they blocked fish passage and created human hazards. But when salmon continued to decline, they did more research, and realized that salmon NEEDED woody debris in

their streams. (Ask, *why do you think this is?*) Woody debris creates vital salmon habitat by providing shade and cover for both young salmon and adults. Now, resource managers know better, and are actively ADDING woody debris to streams such as this one.

5. Allow students to stand on the bridge and go down to the beach (if water is low enough) to look for salmon and other organisms. (This is a great place to look for animal tracks!)

Part 2: Observation Deck (20 mins)

1. *Introduction*
    a. Remind students that they are standing along the Alsea River, which flows west and ends at the sea, in the town of Waldport. (Ask students if any of them have been there.)
    b. Tell students that they are here to observe salmon spawning in the river. Ask, *what is spawning?* Explain that **spawning** means reproduction, including mating and the laying of eggs. Although salmon spend most of their lives at sea, they swim upstream into rivers and streams to spawn. (You will explain why later.)
2. *Observation*
    a. Keep your introduction brief, especially if there are salmon present in the river – students will immediately be distracted by the spawning show!
    b. Distribute polarized sunglasses if students are having a hard time seeing the salmon. Explain that these glasses help reduce the glare of the sun on the water.
    c. Provide binoculars to help students see better. They will need to take turns.
    d. Help students to spot the salmon, using landmarks. As you watch the salmon, point out behaviors and activities that they can observe.
    e. Use questions to help students understand what they are seeing. For example: *Why is that fish waving its tail around?* (It's likely a female digging her nest.) *Why are those two fish fighting or darting at one another?* (They are probably males fighting over a female.) *What is that dark area in the river bed?* (A nest, or **redd.)**
    f. If there are no salmon to be seen when you arrive, move on to the below *Explanation* section, providing information while you continue to watch for fish. Be sure that if and when you do see salmon, pause in your teaching to allow for plentiful observation time!
3. *Explanation*
    a. Save at least 10 minutes at the end of the station for this section. If salmon are still very active, have students sit on the deck with their backs to the river, or move away from the Observation Deck and find a place to sit on the trail. This will help reduce distractions.
    b. Ask students to describe what they observed in the river. This will help guide your explanation of the salmon life cycle.
    c. Ask students to recall where you told them that salmon spend most of their lives. (*The ocean.*) So, why do they go into the rivers to spawn? It's a very taxing and hazardous journey: salmon have to swim against the current, navigating through obstacles like fallen trees and jumping up waterfalls in order to make it up to their spawning grounds. It's a difficult journey that is so hard on the salmon, that they die after reproducing. So why leave the ocean to return to the stream?
    d. Salmon spawn in the river rather than the ocean for a number of reasons. First, there is more food for their babies in the stream. Lots of insects live both in and around the water in a river, and this

is what baby salmon eat. Second, there is more shelter and protection from predators in a river. Baby salmon can hide beneath the shade of a tree, in the gravel, and behind rocks to avoid predators such as birds and larger fish. Third, baby salmon need very specific water conditions to survive – specifically **clear, cold, clean** water. The fast-moving flow of a healthy river or stream provides these conditions.

e. Show students the Salmon Life Cycle diagram. Talk through the various stages of the life cycle, from **egg,** to **alevin**, to **fry**, to **parr**, to **smolt**, and finally adults.

f. Ask students to note the changes that they see in the fish as they move through their life cycle. Explain why salmon develop stripes or **parr marks** (they provide camouflage in the river), why they become dark on top and lighter on the bottom before entering the ocean (this is called **counter-shading** and helps marine animals to blend in with both the dark waters below and the sun-lit waters above), and why adults develop such bright colors (to attract mates) and large jaws (only males develop these, and it's to help them fight off other males so they can mate with more females).

g. Tell students that salmon not only find their way back to the same river where they were born – often, they mate within just a few feet of where they were born! That's pretty incredible considering that these fish have spent the last 3-5 years at sea, swimming thousands of miles across the ocean. Ask students, *how do you think salmon find their way home to spawn?* Allow students to brainstorm and share ideas.

h. Explain that salmon have two amazing tools that they use to navigate long distances. The first is **imprinting**. When salmon are born, they imprint on the stream, storing away memories of the exact smell, temperature, and flow of their river. Scientists aren't exactly sure how this works, it's sort of like a superpower that humans don't have! The second tool that salmon have is a built-in compass called **magnetite.** This material in their bodies help them to find their way using the earth's magnetic field. Wow!

i. Pass around the biofacts display, encouraging students to look closely at the preserved samples. (Students will often ask where this display comes from – they are fish that had already died at a hatchery, and were preserved for education purposes.)

4. *Conclusion*

a. Ask, *Why do you think adult salmon die after spawning?* They have exhausted their bodies swimming all the way upstream and mating. But in a larger ecological sense, they die to help feed the next generation of salmon. The decaying bodies of the adults attract insects into the water, which is what baby salmon eat for the first several weeks of their lives.

b. Tell them that this "fish and forest" connection will be discussed further by the Program Coordinator at the end of the program.

WOW! FACTS FOR SALMON OBSERVATION STATION

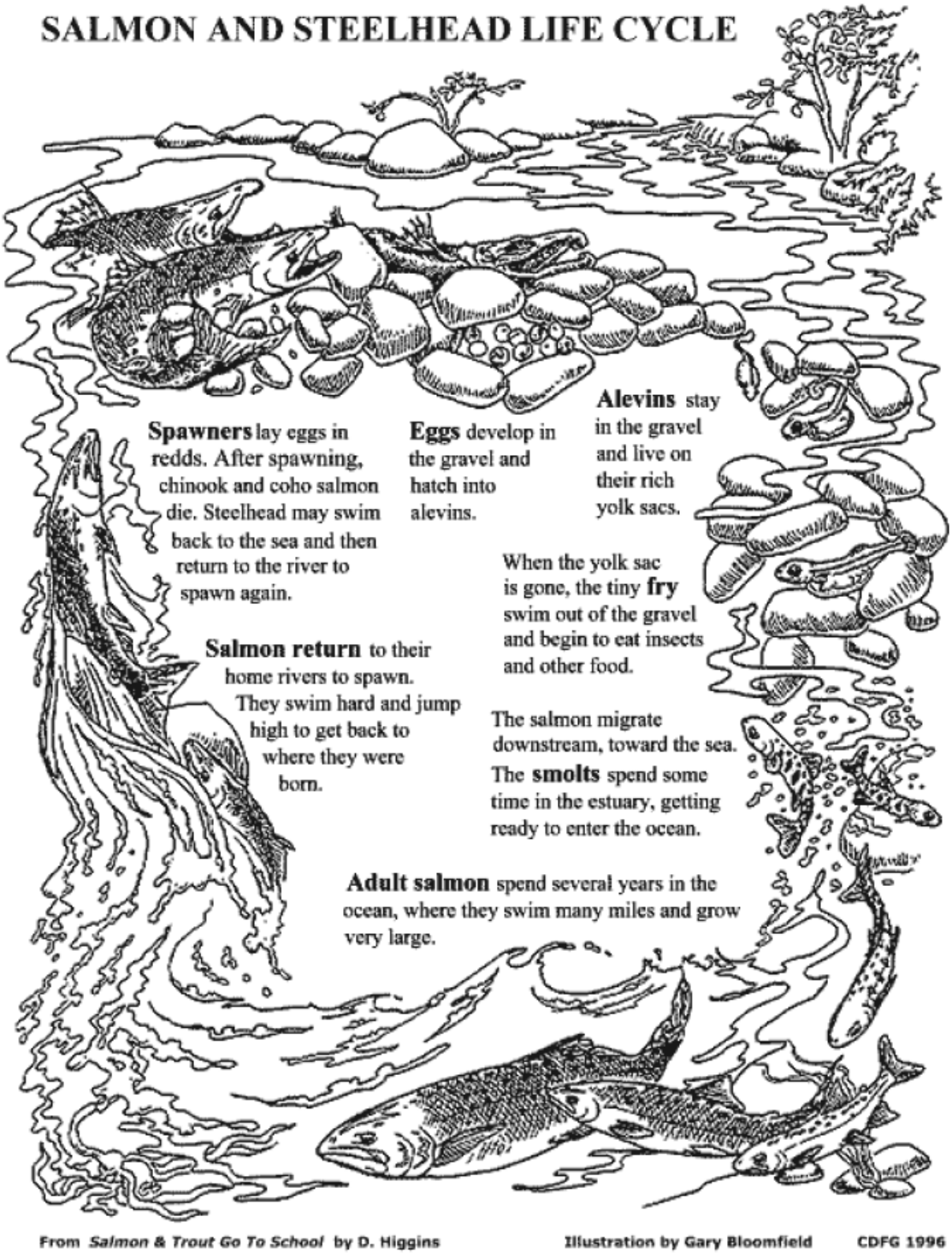
Salmon can travel up to 34 miles in one day!

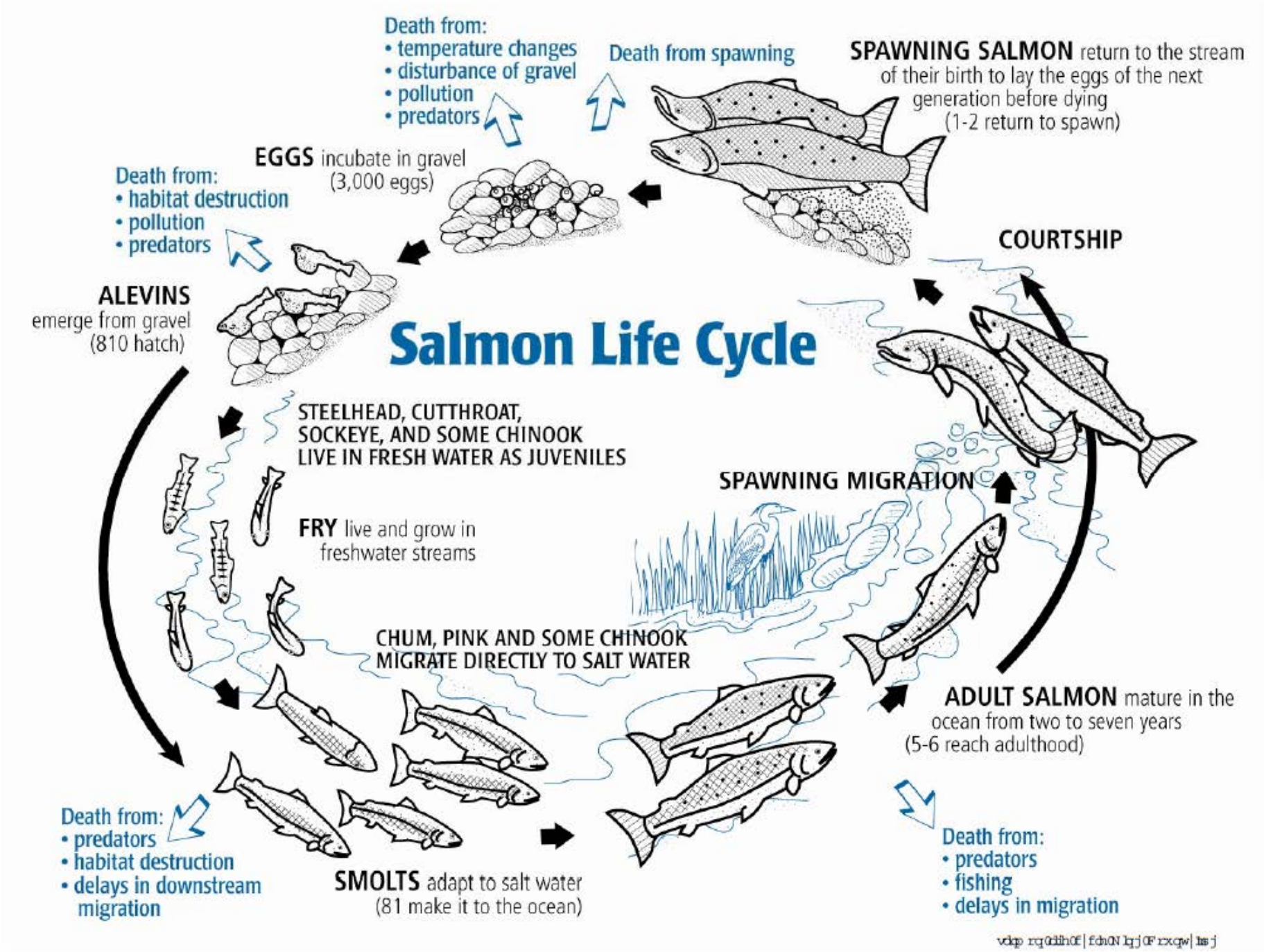
Salmon travel up to 7,000 miles during their lifetime!

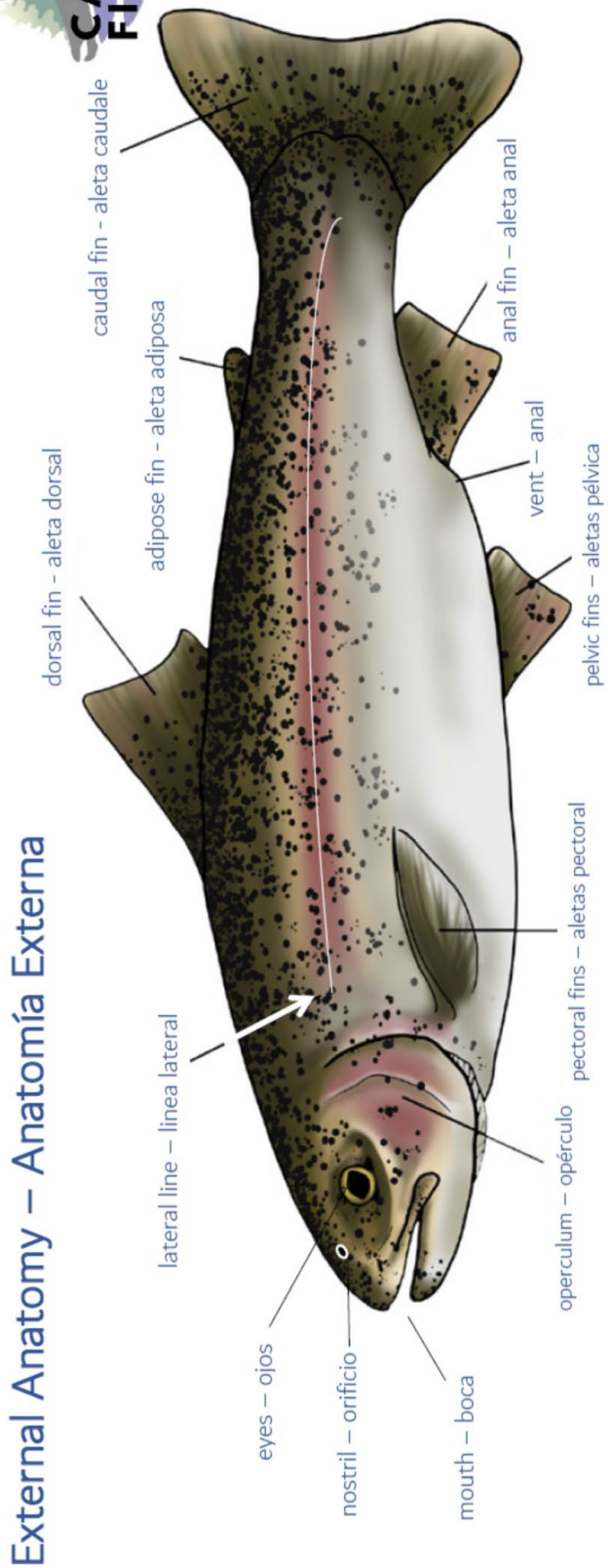
Female salmon can lay up to 6,000 eggs at one time! Of all these eggs, only 1 or 2 will survive to return to their birth stream to spawn!

LEARNING RESOURCES

- Salmon life cycle video (YouTube, 5 mins)
- How salmon find their way back home (Article) and Amazing salmon scent abilities (Article)
- Salmon Migration (StoryMap)
- The amazing story of salmon (Freshwaters Illustrated video, 6 mins)
- Questions and answers about salmon (USGS)




Death from:
• temperature changes
• disturbance of gravel
• pollution
• predators
Death from spawning
SPAWNING SALMON return to the stream of their birth to lay the eggs of the next generation before dying (1-2 return to spawn)
EGGS incubate in gravel (3,000 eggs)
Death from:
• habitat destruction
• pollution
• predators
COURTSHIP
ALEVINS emerge from gravel (810 hatch)
Salmon Life Cycle
STEELHEAD, CUTTHROAT, SOCKEYE, AND SOME CHINOOK LIVE IN FRESH WATER AS JUVENILES
SPAWNING MIGRATION
FRY live and grow in freshwater streams
CHUM, PINK AND SOME CHINOOK MIGRATE DIRECTLY TO SALT WATER
ADULT SALMON mature in the ocean from two to seven years (5-6 reach adulthood)
Death from:
• predators
• habitat destruction
• delays in downstream migration
SMOLTS adapt to salt water (81 make it to the ocean)
Death from:
• predators
• fishing
• delays in migration



COOL FACTS ABOUT FEATURES

LATERAL LINE – contains tiny sensors that allow salmon to sense small movements in the water around them, including prey. Also contains the **magnetite** which helps salmon to navigate using the Earth's magnetic field

NOSTRILS – also called Nares. Salmon have a very good sense of smell!

MOUTH – a forward-facing jaw which allows salmon to snap at food directly in front of them (rather than below or above)

EYES – a salmon's vision improves and becomes more light-sensitive as they mature and move into the deeper waters of the ocean

OPERCULUM – covers and protects the gills

DORSAL FIN – used for balance and stabilization

ADIPOSE FIN – helps fish sense movement and sound in the water around them

CAUDAL FIN (tail) – salmon have a broad "lunate" (half-moon) shaped tail that helps them to both cruise for long periods and quickly change direction

ANAL FIN – used for balance and stabilization (works in conjunction with the dorsal fin)

VENT – the anus where waste exits the fish. Also the outlet for eggs or milt (sperm) during spawning

PELVIC FINS – Allow for up-and-down movement in the water

PECTORAL FINS – Allows for side-to-side movement and also serve as the brakes

Station 2: Riparian Ecology

OVERVIEW

Students use scientific tools and their own observations to learn about stream health, and the connections between living and non-living things in a watershed.

LEARNING GOALS

- Students will understand that interactions between fish and forests are complex and changing.
- Students will appreciate the importance of healthy forests for healthy salmon populations, and vice-versa.
- Students will learn how riparian areas provide functions or 'jobs' in the watershed, but only if they are healthy.

VOCABULARY

Riparian, ecology, erosion, stream bank, survey, runoff, canopy, riffle, pool, run

MATERIALS

- Clipboards
- Vis-à-vis pens
- Student survey sheets
- Cloth and spray bottle for cleaning survey sheets
- Densiometers
- Measuring tape
- 2 orange cones
- Calculator

PROCEDURES

1. Ask students if they know what the term **riparian** means. Define this as the area of land surrounding a water body. We also call them stream banks and river banks, or shores. Do all riparian areas have trees? No, some riparian areas have been modified into parking lots or buildings, but they are still riparian areas.

2. Tell students that riparian areas are important to know about because salmon rely upon healthy riparian areas – not just the rivers and streams themselves, but the trees and forests surrounding them.

3. Ask students to brainstorm some reasons why salmon need healthy trees, and trees need healthy salmon. Recall that salmon need the "3 C's" in a river – **clear, cold, clean** water. Tell them that during this station they will be investigating a 4th C – **complexity.**

4. Using the laminated illustration sheets, *briefly* share what we're going to be investigating today. Save most of the details for during the activities below.

    a. Flora and fauna survey: students will identify species and signs of species that indicate riparian area health.

    b. Stream survey: students will locate and count different types of stream features.

    c. Shade survey: students will use a densiometer to calculate canopy cover.

    d. Ground survey: students will identify types of substrate along the stream and estimate how much there is of each type.

5. After explaining the 4 surveys, divide students into 4 groups and give each a clipboard and pen with their survey sheet. Tell students to spend the first 2 minutes reading the instructions together. As they do so, circulate between the groups and ensure they understand their instructions.

6. Ask the group chaperone(s) to help check in with each group periodically, explain instructions, and manage behavior.

7. While the groups conduct their surveys, circulate between them. Ensure they are staying on-task and working together. Help to engage any students that may be disinterested or not participating.

8. Have each group share out their results. If time allows, ask each group to give a full report including their results, the answers to their discussion questions, and their total stream health score.

9. Discuss all their results. Based on their scores and the overall picture this has given us, do they feel that this river is healthy enough for salmon?

WOW! FACTS FOR RIPARIAN ECOLOGY

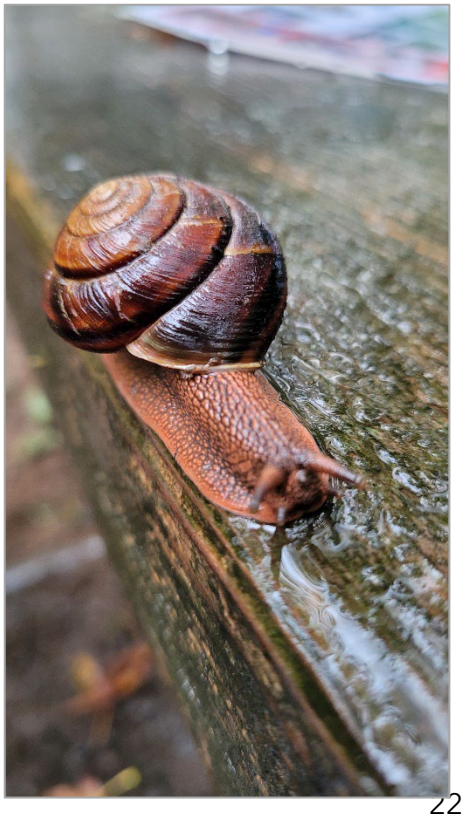
Heavy tree canopy shade will keep a stream 7° to 12° F cooler than a stream exposed to direct sunlight!

There are over 4,500 species of plants in Oregon!

The Pacific Northwest is the only place in America where you can find rainforests!

LEARNING RESOURCES

- How forests, rivers, and salmon were meant to be together (Freshwaters Illustrated video, 4 mins)
- Salmon River 360: Virtual Tour
- Measuring Stream Canopy Closure using a Spherical Densiometer (Video)
- Introduction to Riparian Areas (World Salmon Council)
- What are riparian ecosystems?

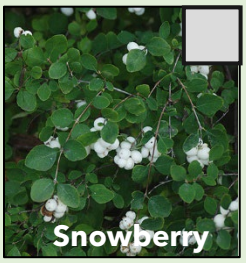


RIPARIAN ECOLOGY: FLORA AND FAUNA SURVEY

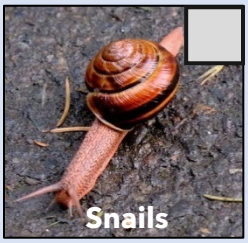
A healthy riparian zone needs lots of different types of *flora* (plants and trees) and *fauna* (animals such as insects, birds, deer, etc.). A riparian area with high *biodiversity* (variety of living things) can indicate a healthy forest and river. But, some *invasive* species and human impacts can have negative impacts on riparian health.

Use this guide to check off items as you find them. Then, answer the questions on the back side to determine the health of this riparian area.

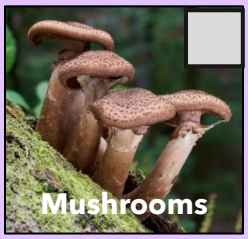
NATIVE PLANTS (+1 EACH)

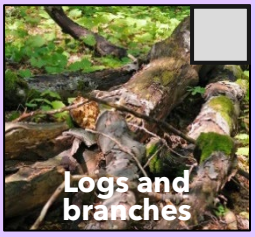


ANIMALS AND INSECTS (+1 EACH)

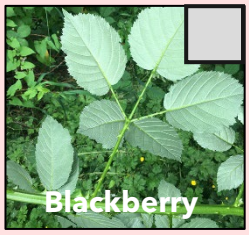


OTHER (+1 EACH)





INVASIVE PLANTS (-1 each)



HUMAN IMPACTS (-1 each)

RIPARIAN ECOLOGY: FLORA AND FAUNA SURVEY

HOW TO CALCULATE RIPARIAN HEALTH SCORE

Step 1. Count the number of items in the Native Plants group that you found: _____

Step 2. Count the number of items in the Animals and Insects group that you found:____

Step 3. Count the number of Other items that you found: _____

Step 4. Add up the above 3 numbers and write the total here: _____

Step 5. Count the number of items in the Invasive Plants group you found: _____

Step 6. Count the number of items in the Human Impacts group that you found: _____

Step 7. Add up the above 2 numbers and write the total here: _____

Step 8. Subtract the number in Step 7 from the number in Step 4 and write on the Total Score line below.

FINAL SCORE: _____

FINAL SCORE KEY (circle your result)

8-10	4-7	0-3
Healthy	Somewhat healthy	Needs improvement

ANSWER THESE QUESTIONS AS A GROUP.

Did you find more native plants or more invasive plants? Why do you think this is?

What are some other things that scientists might look for when determining the health of a riparian area?

What could be done to help improve the health of this riparian zone?

RIPARIAN ECOLOGY: STREAM SURVEY

All rivers and streams need a lot of different features and shapes in order to create healthy habitat for the fish and other animals that live in them. Three main types of stream features that you will be looking for are:

RIFFLES: shallow, fast-moving water with bubbles or white waves, also sometimes called rapids.

POOLS: deep holes of still or slow-moving water with a flat surface.

RUNS: stretches of fast-moving water where the river is straight and not blocked by rocks or logs.

Study the pictures on the back of this sheet to learn how to recognize these features.

INSTRUCTIONS

1. As a team, use the measuring tape to measure 100 feet along the stream. Mark both ends with an orange cone. This will be your study site.
2. Within your study site, discuss how many riffles, pools, and runs each of you sees. When you think you have a group agreement, record these numbers in the chart below.

STREAM FEATURE	NUMBER OBSERVED WITHIN STUDY SITE
Riffles	
Pools	
Runs	
Total number of features	

3. As a group answer the following questions:

   Which type of stream feature did we see the most of? _____

   Do we have about an equal number of pools and riffles? _____

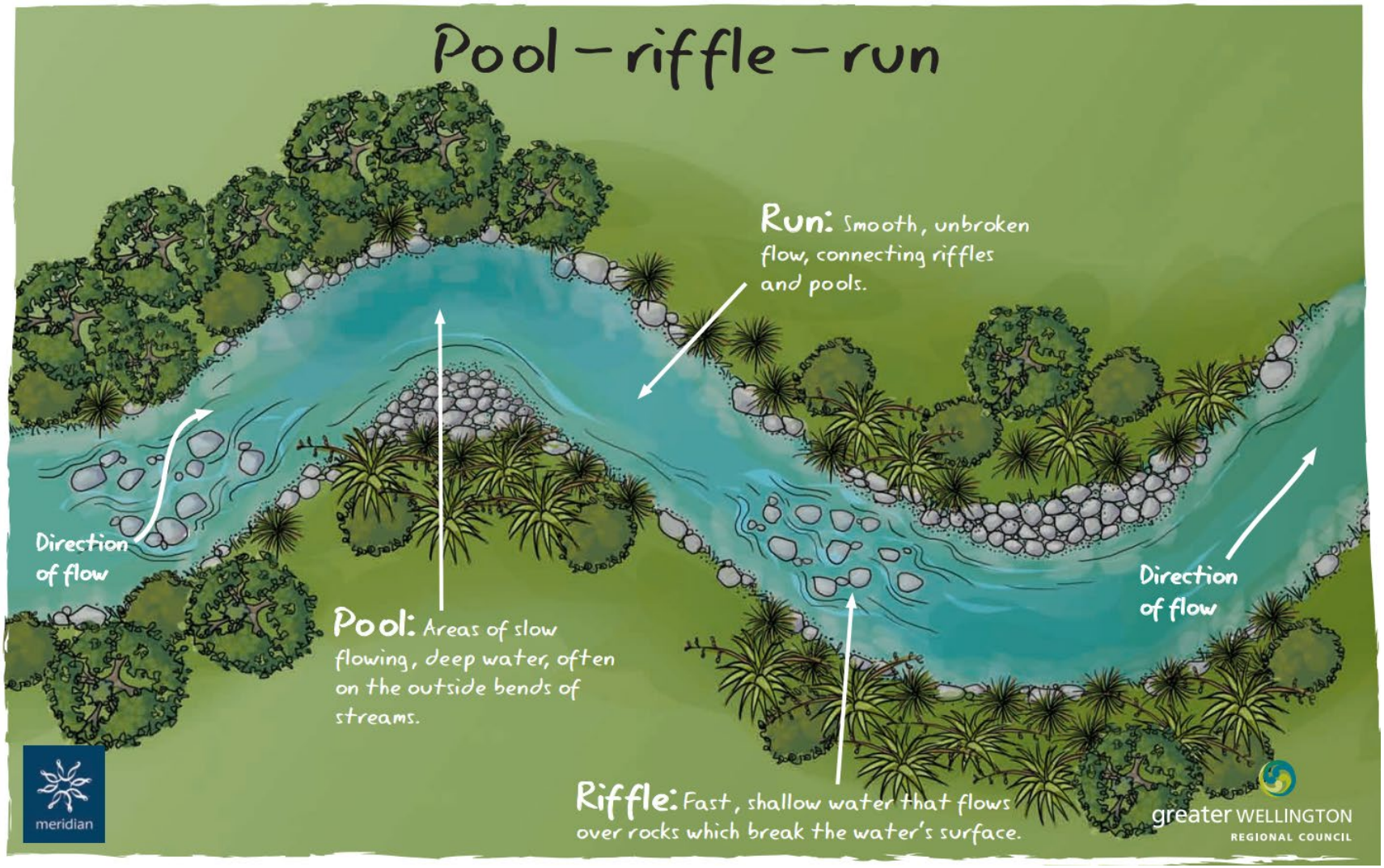
   Can we observe other healthy habitat features such as logs, rocks, or floating leaves?

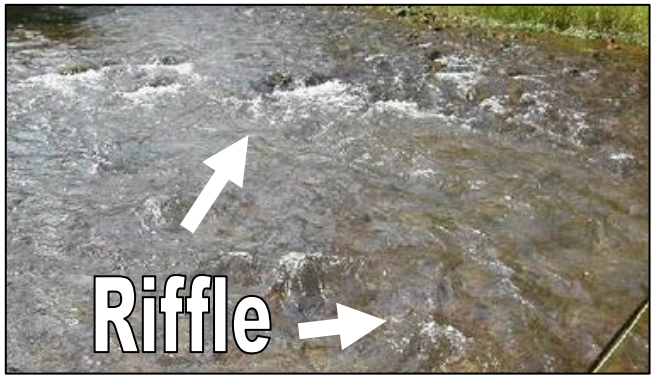
   _____

4. Use your **total number of stream features** from your chart above to determine your site's Stream Health Score. **Add 1 point each for other features like logs, rocks, and leaves.**

FINAL SCORE KEY (circle your result)

8-10	4-7	0-3
Healthy	Somewhat healthy	Needs improvement


Pool – riffle – run
Run: Smooth, unbroken flow, connecting riffles and pools.
Direction of flow
Pool: Areas of slow flowing, deep water, often on the outside bends of streams.
Direction of flow
Riffle: Fast, shallow water that flows over rocks which break the water's surface.
meridian
greater WELLINGTON
REGIONAL COUNCIL


Riffle

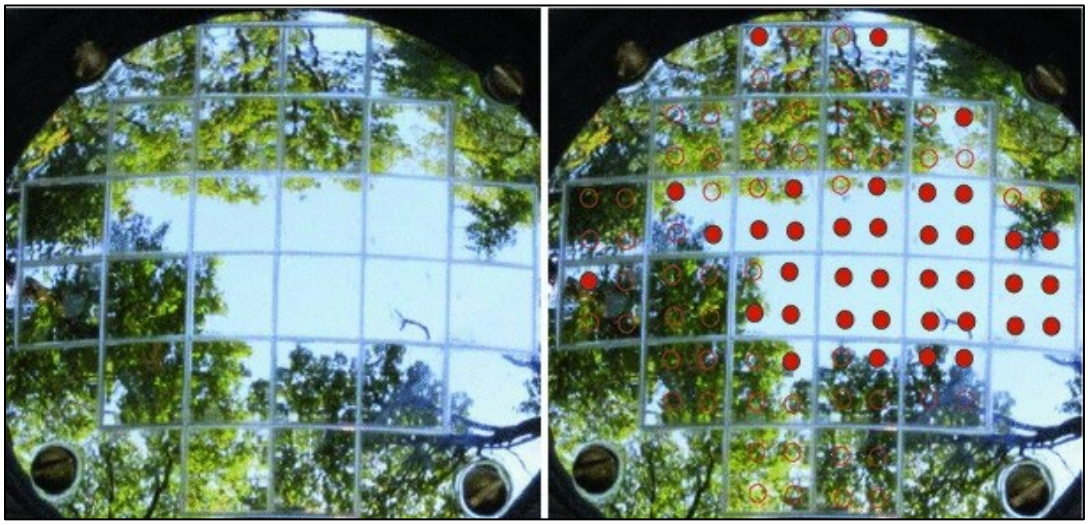

Pool


Run

RIPARIAN ECOLOGY: SHADE SURVEY

The shade provided by overhanging trees and bushes along a stream provide very important benefits for fish and other riparian animals. Shade helps to keep the water cool and provides dark places for young salmon to hide. Insects also tend to fall off leaves into the water, providing a tasty snack for young salmon!

A *densiometer* is a tool that scientists use to measure the amount of shade in an area. This tool has a mirror with boxes drawn on it (24 boxes total). When you hold the densiometer out in front of you, it reflects the tree canopy overhead. The number of boxes in the mirror that have shade in them is used to determine the percentage of canopy cover.



INSTRUCTIONS

1. Choose a Recorder who will write down the results from each of the volunteers below.
2. Choose a Calculator who will calculate and then write down the percent canopy cover.
3. *First volunteer:* Standing at the edge of the water, hold the densiometer 6-12 inches in front of your chest so that your head is just outside of the grid area. Do your best to keep the densiometer flat and steady.
4. While **facing** the stream, count the number of boxes that are *at least halfway* covered by the tree canopy. Have the Recorder write that number in the first line of the chart below. Have the Calculator use the calculator to determine and write down the percent canopy cover.
5. *Second volunteer:* Repeat the steps above while facing directly **away** from the stream (with your back towards it). Record the number of shaded boxes in the second line of the chart.
6. *Third volunteer:* Repeat the steps above while facing **downstream** (towards the direction that the water is flowing). Record this number in the chart.
7. *Fourth volunteer*: Repeat the steps above while facing **upstream** (away from the direction that the water is flowing.) Record this number in the chart.

DIRECTION	NUMBER OF BOXES SHADED	PERCENT % COVER
Facing towards stream		
Facing away from stream		
Facing downstream		
Facing upstream		
Total numbers		

8. Next, calculate your *total average* shade cover percentage by dividing your total Percent Cover by 4 (the number of recordings you took).

   Total average canopy cover = _____ %

9. Using your total average canopy cover percentage, determine and circle your Stream Health Score below.

FINAL SCORE KEY (circle your result)

75%-100% shaded	50%-75% shaded	Less than 50% shaded
10 (Healthy)	7 (Somewhat healthy)	3 (Needs improvement)

RIPARIAN ECOLOGY: GEOLOGY SURVEY

Geology is the study of rocks and minerals to learn about the history and nature of an area. As geologists, you will be conducting this survey to learn about the health of this riparian area.

You are going to be looking for several different types of *substrate* in and along the stream. Substrate is the type of material on the ground including dirt, sand, rocks, and boulders. Substrate does **not** include living or once-living things like leaves and sticks.

Salmon and other animals that live in streams need certain types of substrate to survive and thrive. Salmon prefer streambeds with gravel and cobble rather than silt, sand, or boulders. Too much silt and sand can cloud the water, making it hard for fish to breathe, and boulders make it harder for fish to navigate the river.

SUBSTRATE TYPES

Silt
Very tiny particles that feel smooth and stick together like mud

Sand
Tiny particles that don't stick together and feel rough between the fingers

Gravel
Small rocks that are pea-sized to baseball-sized

Cobbles
Medium rocks that are baseball to bowling ball sized

Boulders
Large rocks that are larger than bowling balls

Bedrock
Solid rock that makes up part or all of the streambed

INSTRUCTIONS

1. As a team, use the measuring tape to measure 100 feet along the stream. Mark both ends with an orange cone. This will be your study site.

2. You will be determining the types and amounts of substrate within your study area. You should record substrates **within about 5 feet of the measuring tape on each side.**

3. Work together to fill out the chart below. Use your hands to help measure the size of rocks and determine what category they fall in. If you disagree about the types of substrate or how much of it there is, use the pictures on the other side of this sheet, and work together to come up with the best estimate you can.

Substrate Type	**About what percent of your study area is made up of this substrate type?**
Silt	
Sand	
Gravel	
Cobbles	
Boulders	
Bedrock	

4. Add the percentages of **gravel and cobble only** for a combined percentage: _____ %

5. Answer the following questions together.

   Where did you find the most sand and silt? Why do you think that is?

   _____

   How do you think the substrate would change if there was a flood or a drought?

   _____

   Do you think salmon would want to spawn in this area of the stream? Why or why not?

   _____

6. Use the answer from Step 4 above to circle your stream health score below.

FINAL SCORE KEY (circle your result)

80%-100% gravel+cobble	60%-80% gravel+cobble	Less than 60% gravel+cobble
10 (Healthy)	7 (Somewhat healthy)	3 (Needs improvement)

Station 3: Water Quality

OVERVIEW

Students will use scientific tools and perform tests to determine water quality and watershed health in the Alsea River, and discuss what the results indicate about the ability of salmon to survive there.

LEARNING GOALS

- Learn how to conduct stream water quality tests measuring pH, dissolved oxygen, temperature and turbidity
- Practice detailed data recording methods
- Analyze and make judgments on the quality of water based on collected data
- Discuss the connections between water quality, salmon, and overall watershed health

VOCABULARY

Turbidity, pH, dissolved oxygen, water quality, Farenheit

MATERIALS

- pH test kit
- Dissolved oxygen test kit
- Turbidity tube
- Thermometers
- Test instruction sheets
- Clipboards
- Vis-à-vis pens
- Result key sheets
- Gloves

PROCEDURES

1. Introduction: Tell students that they are going to investigate the health of this riparian area – the Alsea River – by using scientific tools.

2. A good metaphor to describe this work is that the students are doctors performing a checkup and the water source is their patient. More than one test must be conducted to find the true health of the river just like a doctor conducts multiple tests before making a diagnosis. Or, the students are auto mechanics looking under the hood of a car, the water source being the car. They must run certain tests on the car to determine what kind of work the vehicle needs.

3. Ask them to recall, and name "3 C's" that salmon need: *clear, cold, clean water.* Tell students that they will be splitting into 3 smaller research teams to investigate the 3 C's. Each team will be in charge of performing one test and then reporting the results. Briefly explain each of the 3 tasks:

   a. *Is the river **clear** enough?* – Turbidity test - a measure of how clear or cloudy the water is. When a lot of sand or sediment is stirred up, the water is murky and the fish have a hard time breathing, just as we have a hard time breathing when the air is dusty or smoky.

   b. *Is the river **cold** enough?* - Temperature test - Salmon need water to be cooler than 64°F or they find it hard to survive.

c. *Is the river **clean** enough?* – pH test – a measure of how acidic the water is. A lemon, which is very acidic, has a pH of 3, and milk, which is not acidic, has a pH of 8. Salmon need water with a pH between 6.5 and 7.

4. Divide your group into 3 smaller groups. Give each one test instruction sheet. Instruct students to thoroughly read all the instructions before beginning their test.

5. As students work, circulate between the groups, helping to facilitate and answer questions.

6. With at least 10-15 minutes remaining in your station time, gather students back together. Ask each group to report their results. Use the result key sheets to discuss together whether their results indicate good or poor water quality, and what that means for salmon.

7. Tell the group they have one more test to perform – **dissolved oxygen.** Explain that dissolved oxygen is the amount of oxygen that is in the stream water. *Why is this important?* Like us, fish need oxygen to live. Unlike us, fish are able to use the oxygen that is dissolved in the water. The dissolved oxygen is a gas just like the carbon dioxide that is dissolved in water to make fizzy drinks like sodas. We need to make sure there is enough dissolved oxygen for the fish to breathe.

8. Use the test kit and follow the instructions to conduct the DO test. Use the time while waiting between steps to share more information, such as:

a. DO is closely connected to temperature. The colder water is, the more oxygen it can hold. This is a big reason why salmon prefer cold water.

b. Not only that, but there is actually *less oxygen* found in waters with high turbidity. So it's doubly hard for fish to breathe!

c. Salmon need different amounts of DO throughout their lives. Baby fry need higher DO than adults do.

9. To conclude the station, review all of your results together. Do students feel that this is a healthy part of the watershed? Would salmon be happy and healthy here?

WOW! FACTS FOR WATER QUALITY

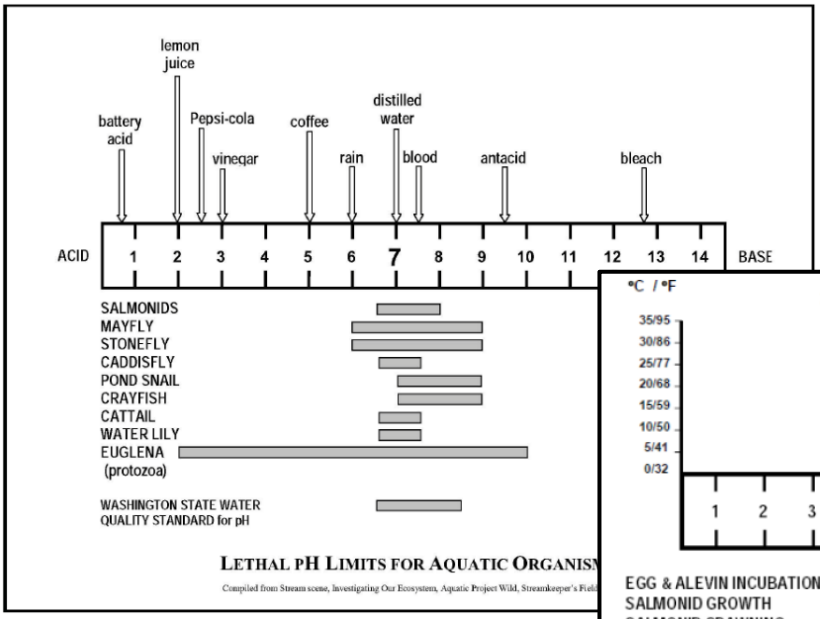
Heavy tree canopy shade will keep a stream 7° to 12° F cooler than a stream exposed to direct sunlight!

The most common pollutant in rivers and streams isn't plastic or chemicals – it's dirt from land erosion!

Some stream animals such as crawdads and snails can survive in dissolved oxygen levels as low as 3ppm! (But only for a short time.)

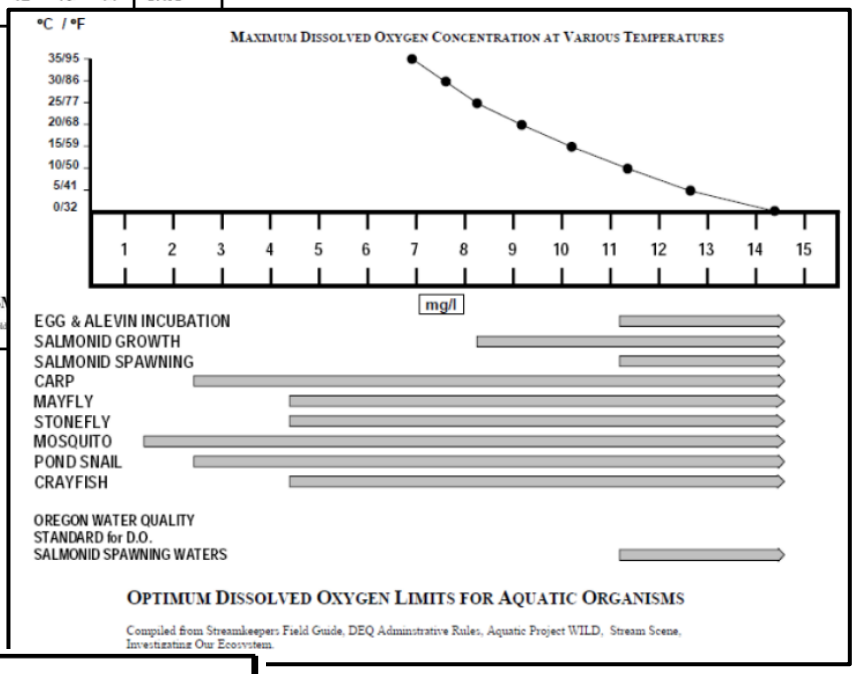
LEARNING RESOURCES

- An introduction to water quality and monitoring (U.S. EPA)
- Dissolved Oxygen Test step-by-step (Video)
- Water Quality testing in the field (Video)
- How's My Waterway? Interactive tool
- An overview of riparian systems and potential problems (OSU)



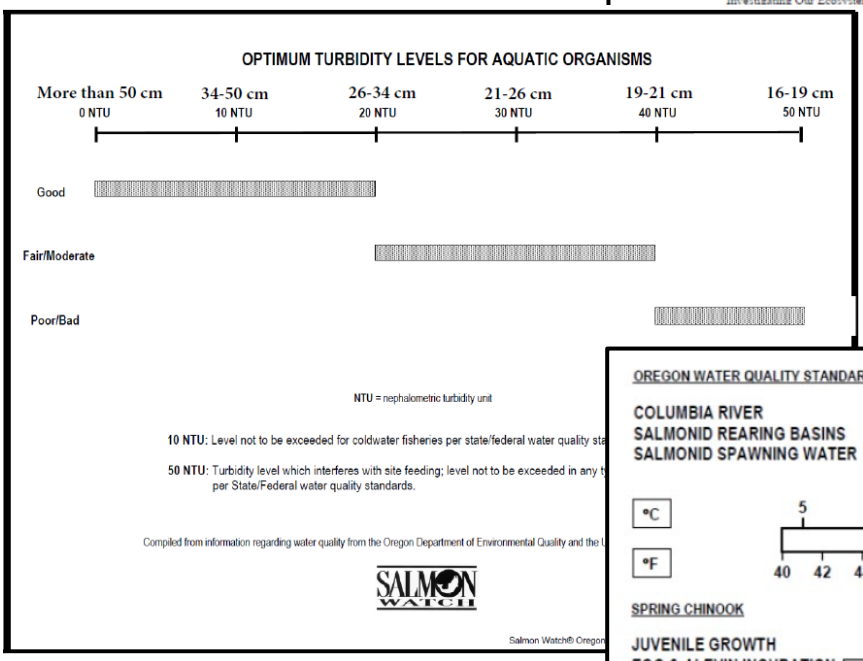
LETHAL pH LIMITS FOR AQUATIC ORGANISM

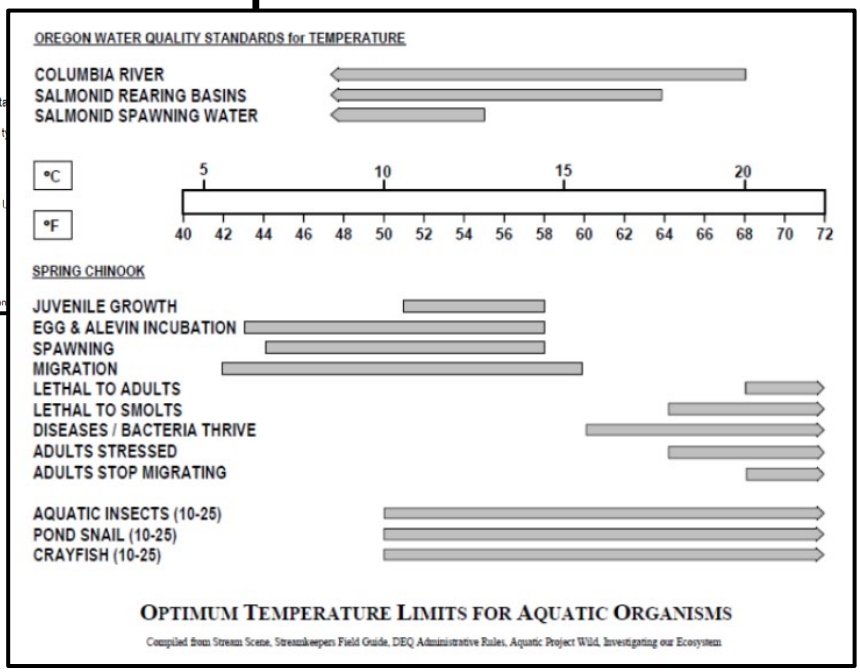
Compiled from Stream scene, Investigating Our Ecosystem, Aquatic Project Wild, Streamkeeper's Field



OPTIMUM DISSOLVED OXYGEN LIMITS FOR AQUATIC ORGANISMS

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





OPTIMUM TEMPERATURE LIMITS FOR AQUATIC ORGANISMS

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

WATER QUALITY: pH TEST

This test will help you investigate whether the stream is clean enough for healthy salmon and a healthy watershed. You will be using a kit to measure *pH,* which is a measurement of acidity. Stream water can become too acidic because of pollution. Salmon and most other aquatic animals cannot survive in water that is too acidic.

pH TEST INSTRUCTIONS

1. Fill a test tube to the 10 mL line with sample water.
2. Add 10 drops of Wide Range pH Indicator to the sample water test tube.
3. Cap test tube and mix.
4. Insert the test tube into the opening in the color key viewer.
5. With your group, determine which color on the viewer matches the color of the test tube water.
6. Record your pH result below.

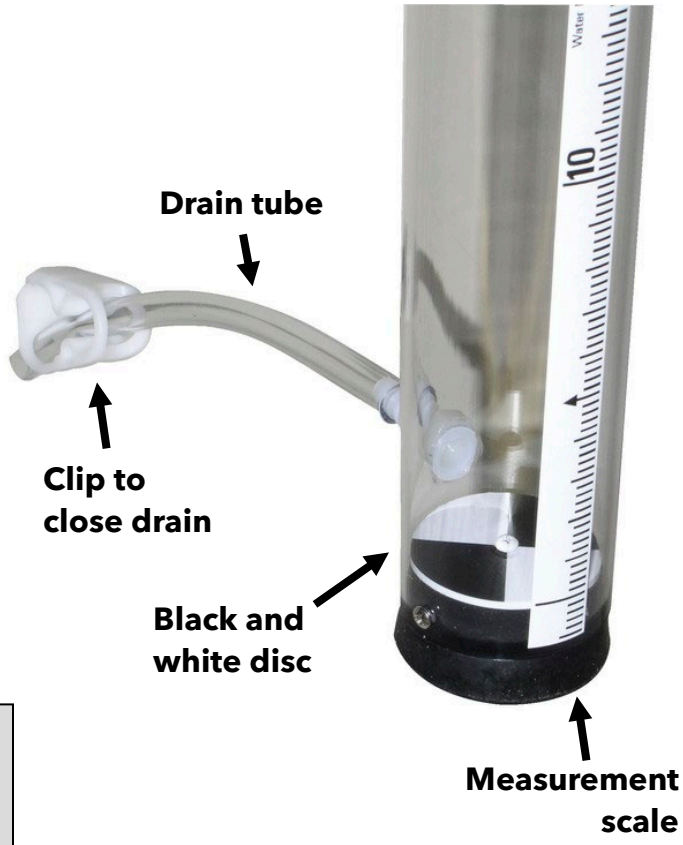
pH test result: _____

WATER QUALITY: TURBIDITY TEST

This test will help you investigate whether the stream is clear enough for healthy salmon and a healthy watershed. You will be using a kit to measure *turbidity,* which is a measurement of how clear or cloudy the water is. Stream water can become too turbid because of the erosion of dirt from the streambank or nearby land. Salmon and most other aquatic animals cannot survive in water that is too murky.

TURBIDITY TEST INSTRUCTIONS

1. Make sure drain hose is closed, then fill turbidity tube to the top with stream water.
2. Stand with your back to the sun.
3. Hold the tube vertically in front of you. Extend your arms down so you are looking down into the bottom of the tube.
4. Look down and determine if you can see the black and white disc at the bottom of the tube.
5. If you cannot see the black and white disc, open the drain hose by unclamping the clip on the hose. SLOWLY drain the water until the person looking down into the tube can see the black and white disc. Then, close the drain tube.
6. In the gray box at the bottom of this sheet, record the amount of water remaining in the turbidity tube in centimeters.
7. If time allows, conduct another test using stream water from another area.



Turbidity test result: _____

WATER QUALITY: TEMPERATURE TEST

This test will help you investigate whether the stream is cold enough for healthy salmon and a healthy watershed. You will be using a kit to measure temperature in multiple locations in the stream. Stream water can become too warm for salmon and other aquatic animals because of drought or unusually warm air temperatures.

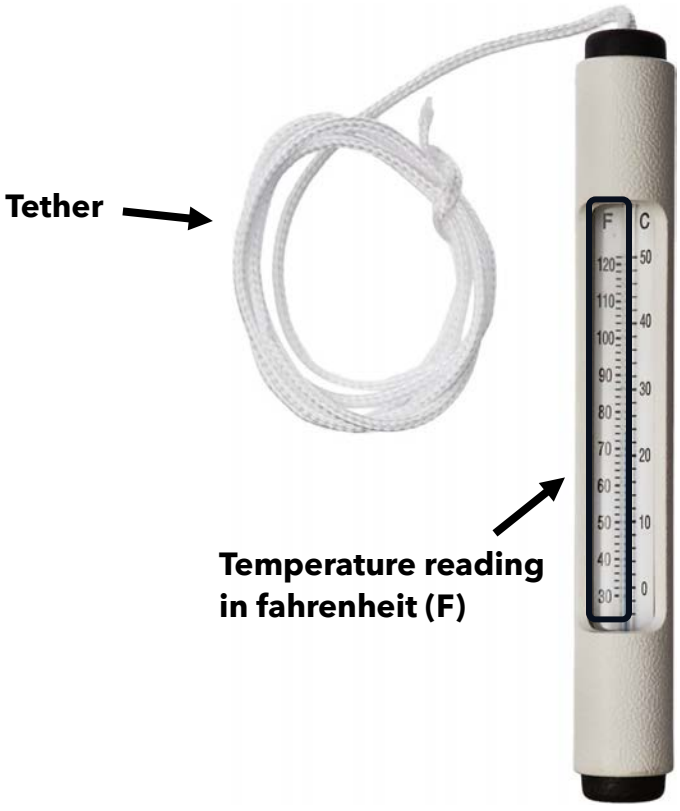
TEMPERATURE TEST INSTRUCTIONS

1. Make sure that your thermometer is securely attached to its tether (a long string).
2. Find a spot on the edge of the stream that is in the sun. This will be your Test Site 1.
3. Holding the end of the tether firmly, set the thermometer into the stream so that it is fully underwater in the sun.
4. Using a watch, leave the thermometer in the water for two minutes.
5. Pull the thermometer out and read the temperature in Fahrenheit. Record the temperature in the gray box below above “sun”.
6. Find a spot on the edge of the stream that is in the shade.
7. Holding the end of the tether firmly, set the thermometer into the stream so that it is fully underwater in the shade.
8. Using a watch, leave the thermometer in the water for two minutes.
9. Pull the thermometer out and read the temperature in Fahrenheit. Record the temperature in the gray box below above “shade”.

Temperature test results:

_____ °F
sun

_____ °F
shade



WATER QUALITY: DISSOLVED OXYGEN TEST

(led by Station Instructor)

1. Put on gloves.

2. Fill Water Sampling Bottle to the brim, then tightly cap while bottle is still underwater. Turn filled bottle upside down to make sure there are no air bubbles.

3. Uncap and ask a student to add 8 drops of **Manganous Sulfate Solution**.

4. Ask another student to immediately add 8 drops of **Alkaline Potassium Iodide**.

5. Recap and mix thoroughly.

6. Allow precipitate (the solids which form) to settle below bottle shoulder (2-3 minutes).

7. Uncap and add 8 drops of **Sulfuric Acid** (red cap). CAUTION: this liquid is highly acidic. Be sure that it does not touch your skin or any students. Do not let students perform this step.

8. Cap and mix until the precipitate dissolves and the liquid is clear yellow.

9. Fill test tube to the 20 mL line with test solution.

10. Ask a student to add 8 drops of **Starch Indicator**. The solution should turn black/purple.

11. Fill syringe with **Sodium Thiosulfate**.

12. Have students take turns adding one drop at a time, swirling after each drop, until blue color disappears and solution is colorless. This happens suddenly so be careful not to overshoot the endpoint. If you use all of the Sodium Thiosulfate in the plunger and the sample is still blue, refill the syringe, and add the number 10 to your final result.

13. Read the number at the bottom of the syringe plunger. This number equals the ppm (parts per million) of Dissolved Oxygen in the water sample.

Station 4: Aquatic Macroinvertebrates

OVERVIEW

Students will collect and identify insects and other macroinvertebrates from the stream and learn how these species can help indicate the health of a stream and the larger watershed.

LEARNING GOALS

- Learn how to collect macroinvertebrate samples from a stream
- Practice scientific methods, species identification, and inquiry
- Explore how the presence or absence of living things can indicate the well-being of an ecosystem

VOCABULARY

Macroinvertebrate, Aquatic, D-net, Tolerance, Sensitivity

MATERIALS

- D-nets
- Small nets
- Tubs
- Ice cube trays
- Turkey basters
- Identification cards/field guides
- Hand lenses
- Laminated data sheet

PROCEDURES

1. Introduction: Revisit the program's Driving Question from the Program Coordinator's introduction: *is this a healthy watershed for salmon?* One way to learn about the health of an ecosystem is by studying what is living there – or missing. For a stream or river, a type of animal called **macroinvertebrates** is a great indicator of water quality. Macroinvertebrates are animals without backbones that are large enough to see with the naked eye (without a microscope), such as insect larvae, snails, and crawdads. Because some types of macroinvertebrates can survive in polluted water and others cannot, what you find in a stream can give clues about how clean the water is.

2. Explain that students will be collecting samples from the stream, sorting samples into containers, recording the numbers and types of macroinvertebrates onto data sheets, and assessing the health of the stream based on the results. The field guides and cards will help identify the macroinvertebrates.

3. Before going to the stream, go over the safety rules: Students may not enter water above the calf, and in bad weather, should not go deeper than the ankle. Avoid fast-moving water. Take care when walking on slippery rocks. Never drink the water. Place nets safely to the side, when not being used, where they will not be tripped over.

4. Keep in mind that sampling should be done well away from any spawning salmon or redds. Ensure that chaperones understand the safety rules and recruit them to help enforce the rules.

5. Set boundaries downstream and upstream that students should not go past. Make sure these boundaries are within easy eyesight.

6. Demonstrate how to use a D-net. Enter the stream just up to your calf. Face upstream, with your back to the flow of the river. Set the flat edge of the D-net into the water and onto the riverbed. Shuffle your feet in the rocks and silt in front of the net so that the debris flows into the net.

7. Place the net over a tub filled with stream water. Carefully turn the net inside-out and then dip it into the water, using your hand to wash the debris off the net and into the tub.

8. Distribute tubs and D-nets to students and give them about 10 minutes to collect samples, monitoring them closely for safety and proper use of equipment.

9. When it's time to go through the samples, have students help you carry everything back up to your table.

10. Introduce the identification sheets. Remind students that some macro's can tolerate pollution while others are more sensitive and cannot. Tell students they are going to be sorting their discoveries into 3 different ice cube trays – one each for sensitive, less sensitive, and tolerant of pollution.

11. Have students look for organisms in their tubs by gently stirring the debris around. Have them take turns with the turkey basters to capture the organisms, then put them in the proper ice cube tray.

12. With about 5 minutes remaining in the station, review their finds. What do their results tell them about the health of the stream?

WOW! FACTS FOR MACROINVERTEBRATES

Some aquatic macroinvertebrates spend their entire lives living in water, while others just live in the water while they are larvae (babies)!

Macros provide a valuable "cleaning" service by scavenging dead or decaying bacteria, plants, and animals, which helps recycle nutrients back into the system!

Macros are eaten by almost everything in the food web, from fish to birds, amphibians, reptiles, and even some small mammals!

LEARNING RESOURCES

- Aquatic invertebrate slideshow and quick facts
- Macroinvertebrate page at Encyclopedia Britannica
- How macroinvertebrates are used in scientific research
- Suggestions for teaching about aquatic invertebrates

Key to Stream Macroinvertebrates

SAVE OUR STREAMS

Shells

Single

Gilled Snail
Spiral, open on right

Lunged Snail
Spiral, open on left

Orb Snail
Coiled

Double

Clam
Small, whitish tan or brown

Mussel
Large, dark colored

No Shells

Legs

No Legs

Aquatic Worm
Small, hair-like or looks like earth worm

Flatworm
Arrow shaped head, 2 eye spots

Leech
Suckers, expands and contracts, soft, slimy body

Midge Fly
Distinct head, white, clear, or red, <1/4"

Black Fly
Black head, shaped like bowling pin, <1/4"

Crane Fly
Plump, worm-like, often can see guts

8+ Legs

Crayfish
Lobster-like

Sowbug
2 long antenna flatter top to bottom

Scud
Shrimp-like, swims on side

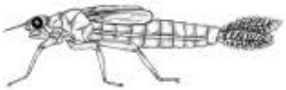
Water Snipe Fly
Small, whitish tan or brown

3 Pairs of Legs

3 Tails

Mayfly
3 long tails, gills on abdomen

Damselfly
3 oar-like "tails", no gills on abdomen



No Obvious Tails

Riffle Beetle

Larva
Brown body, 6 legs, "C" shaped, no gills on belly

Adult
Small, dark, crawls on bottom

Water Penny
Flat, oval disk

Caddisfly
Green, tan, orange, or white, may have gills on body

May be encased in sticks, stones, or leaves

Net Spinning Caddisfly
Dark head, tan, gill tufts on belly, 3 armored plates behind head

Dragonfly
Large eyes, stocky body

Dobsonfly
Large mouth, gill tufts between spines

Fishfly
8 pairs of spines, no gill tufts

One or Two Tails

Alderfly
Large mouth, spines on side

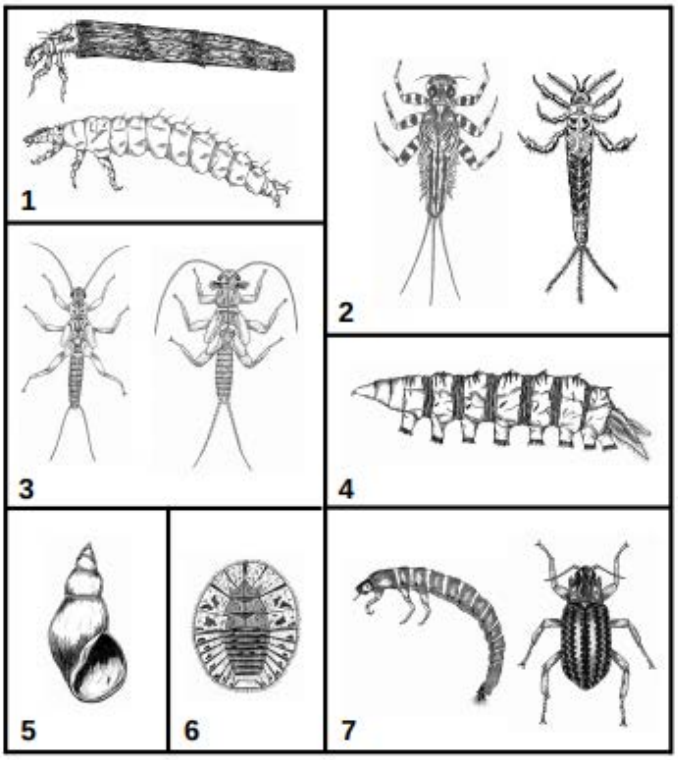
Stonefly
2 tails, gill tufts under arms

Mayfly
2 tails, gills on abdomen

Aquatic Macroinvertebrate Identification & Pollution Sensitivities

Sensitive to Pollution

These organisms are sensitive to pollution and indicate good water quality.



1 **Most Caddisflies: Order Trichoptera.** Up to 1", 6 hooked legs on upper 1/3 of body, may be in stick, rock, or leaf case, no gill tufts on abdomen, intolerant of impairment.

2 **Mayfly: Order Emphemeroptera.** ¼" – 1", plate-like or feathery gills on abdomen, 6 hooked legs, 2 or 3 long hair-like tails, tails may be webbed together, very intolerant of impairment.

3 **Stonefly: Order Plecoptera.** ½" – 1 ½", 6 legs with hooked tips, antennae, 2 hair-like tails, no gills on abdomen, very intolerant of impairment.

4 **Watersnipe Fly: Order Diptera.** ¼" – 2", body plump and maggot-like, caterpillar-like "legs" along body, feathery "horns" on end, intolerant of impairment.

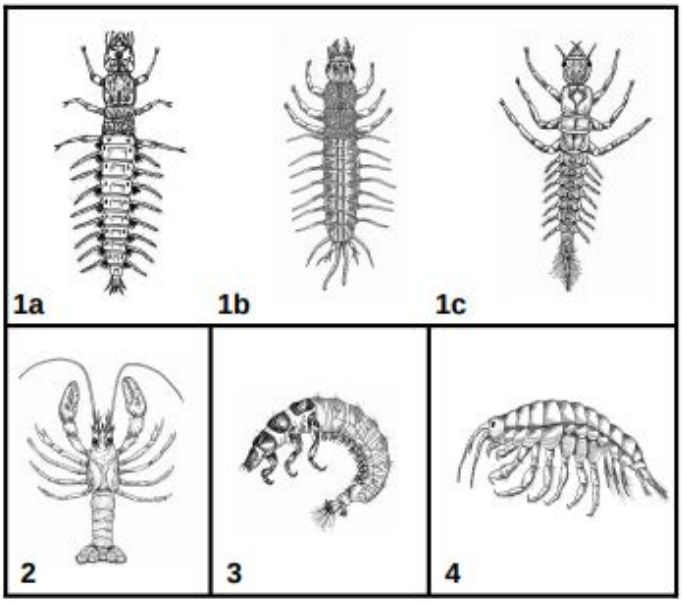
5 **Gilled Snails: Class Gastropoda.** Up to ¾", shell opening covered by a thin plate called an operculum, with helix pointed up shell opens to the right, intolerant of impairment.

6 **Water Penny: Order Coleoptera.** ¼" – 1", disk-like oval body with 6 small legs and gill tufts on underside, intolerant of impairment.

7 **Riffle Beetle: Order Coleoptera.** Small black beetle crawling on streambed OR comma-like brown "crunchy" body with 6 legs on upper 1/3 and possibly gill tuft on back end, intolerant of impairment.

Less Sensitive to Pollution

These organisms are somewhat sensitive to pollution and indicate fair water quality.

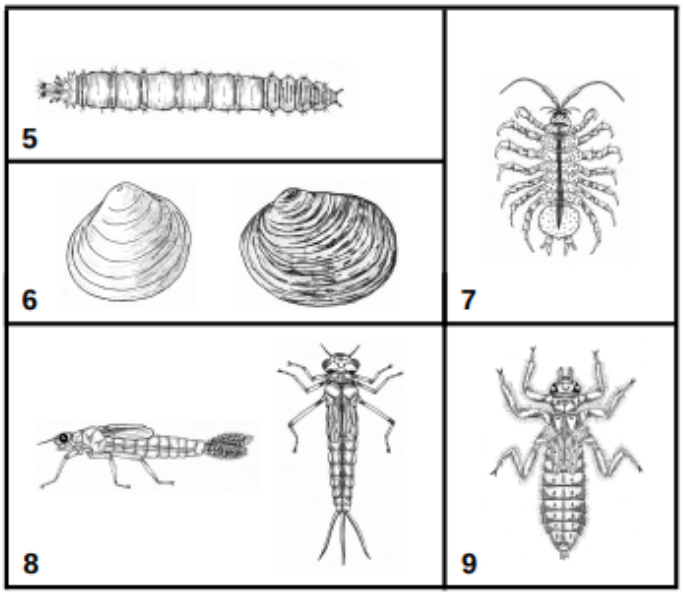


1 **Hellgrammite, Fishfly, and Alderfly: Order Megaloptera.** ¾" – 4", 6 legs, large pinching jaws. **a)** 8 pairs of fleshy appendages along abdomen with gill tufts, 2 hooks on tail end, **b)** 8 pairs of fleshy appendages along abdomen without gill tufts, 2 tube-like appendages on tail end, **c)** 7 pairs of fleshy appendages without gill tufts, 1 single spiky tail; somewhat tolerant of impairment.

2 **Crayfish: Order Decapoda**. Up to 6", 2 large claws, 8 legs, resembles a small lobster, somewhat tolerant of impairment.

3 **Common Netspinners: Family Hydropsychidae.** Up to ¾", 6 hooked legs on upper 1/3 of body, 2 hooks at back end, white gill tufts on underside of abdomen, somewhat tolerant of impairment.

4 **Scud: Order Amphipoda.** ¼", white to gray, body higher than it is wide, swims sideways, more than 6 legs, resembles small shrimp, somewhat tolerant of impairment.



5 **Crane Fly: Order Diptera.** ¼" – 2", bodies plump and maggotlike, caterpillar like "legs" along body, four lobes one end, tolerant of impairment.

6 **Clams and Mussels: Class Bivalvia.** Up to ¾", fleshy body enclosed between two clamped together shells (if clam is alive, shells cannot be pried apart without harming clam), somewhat tolerant of impairment.

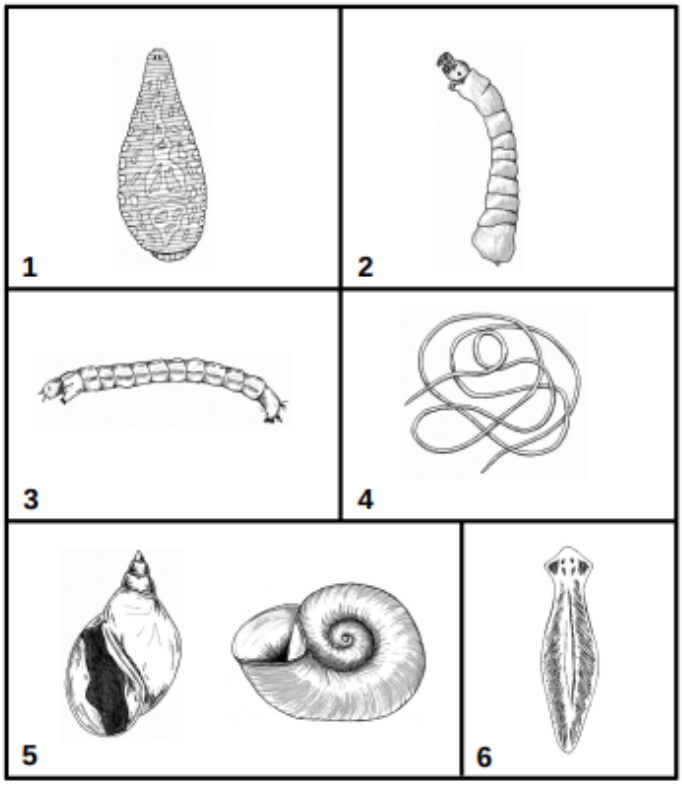
7 **Sowbug: Order Isopoda.** ¼" – ¾", gray oblong body wider than it is high, more than 6 legs, long antennae, somewhat tolerant of impairment.

8 **Damselfly: Order Odonata**. ½ " – 2", large eyes, 6 hooked legs, large protracting lower jaw, 3 broad oar-shaped tails, somewhat tolerant of impairment.

9 **Dragonfly: Order Odonata.** ½ " – 2", large eyes, 6 hooked legs, large protracting lower jaw, wide oval to round abdomen, somewhat tolerant of impairment.

Pollution Tolerant

These organisms are tolerant to pollution and indicate poor water quality.



1 **Leech: Order Hirudinea.** ¼" – 2", segmented body, suction cups on both ends, tolerant of impairment.

2 **Black Fly: Family Simuliidae.** Up to ¼", end of body wider (like bowling pin), distinctive head, sucker on end, tolerant of impairment.

3 **Midges: Family Chironomidae.** Up to ¼", distinct head, worm-like segmented body, 2 leg-like projections on each side, often whitish to clear, occasionally bright red, tolerant of impairment.

4 **Aquatic Worm: Class Oligocheata.** ¼" – 2", can be very tiny; thin, wormlike body, tolerant of impairment.

5 **Lunged Snails: Class Gastropoda.** Up to ¾", no operculum, with helix pointed up shell opens to the left, tolerant of impairment.

6 **Flat Worm: Family Planaridae.** Up to ¼", soft body, may have distinct head with eyespots, tolerant of impairment.

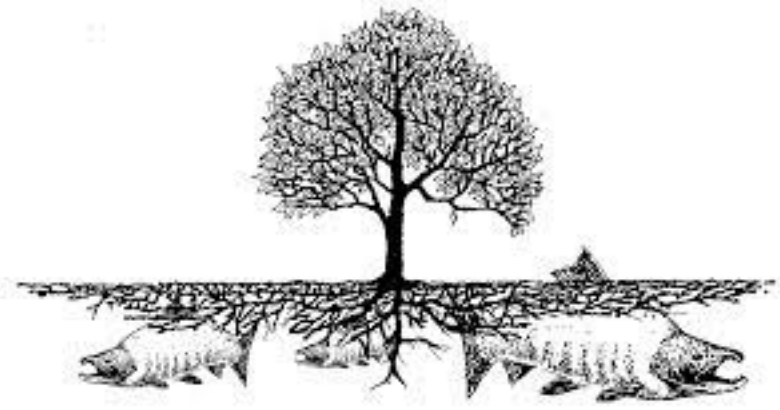
Conclusion: Fish and Forests

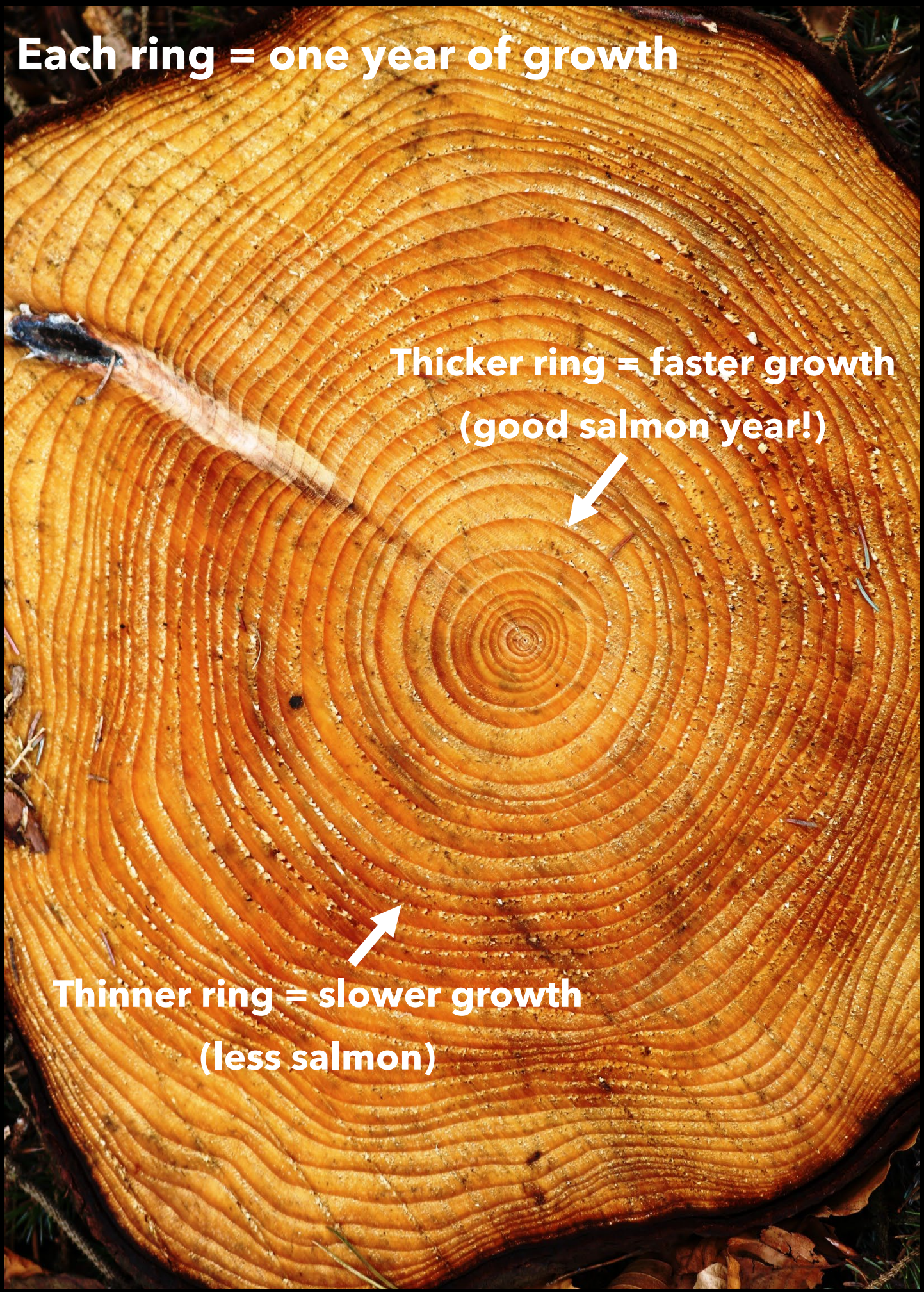
(To be led by the Program Coordinator)

1. Circle up as one large group. Ask students to respond to this question with either a thumbs up, a thumbs down, or a shrug – *Based on everything you've learned today, do you think this is a healthy watershed for salmon?* If time allows, ask students to give examples of why or why not.
2. After all of your experiments and explorations today, you should have a good understanding of why salmon need healthy watersheds and riparian forests. But guess what – forests need healthy salmon populations too! Why do you think that is?
3. You may have learned that salmon carcasses feed macroinvertebrates. Macroinvertebrates, in turn, feed salmon fry. Those macroinvertebrates also feed lots of other animals in the riparian zone, like birds and frogs. But it's even more complex than that. The trees themselves benefit from the spawning salmon. When salmon carcasses break down, they release nutrients such as nitrogen and phosphorus into the water and the streambed. This is called *decomposition.* These nutrients eventually makes its way up from the stream, and into the soil along the river, where all of the trees and plants absorb it. Nitrogen is essential plant food!
4. Scientists have learned that plants on the banks of rivers with healthy salmon populations are much healthier than those in places that don't have salmon. In fact, trees along rivers with salmon grow up to 3 times faster than other trees! You can actually see in a tree's growth rings which years had more salmon return to the river, because the tree grew faster that year (show visual). For example, growing side by side with salmon, Sitka spruce take only 86 years, rather the usual 300 years, to reach 50 cm thick.
5. And in turn, those bigger trees provide more shade and more bugs for the baby salmon as they grow in the river below. So it's all a great big circle. The salmon are IN the trees and the trees are vital for salmon.
6. So next time you enjoy a good salmon dinner, thank a tree. If you are lucky enough to encounter an ancient, huge Sitka spruce or Alder while hiking along a stream bank, thank a salmon as well!

LEARN MORE

- Why fish need trees and trees need fish (Article)
- "Salmon in the Trees" by Amy Gulick (Book)
- The Fish and the Forest (Scientific American)




Each ring = one year of growth
Thicker ring = faster growth
(good salmon year!)
Thinner ring = slower growth
(less salmon)

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

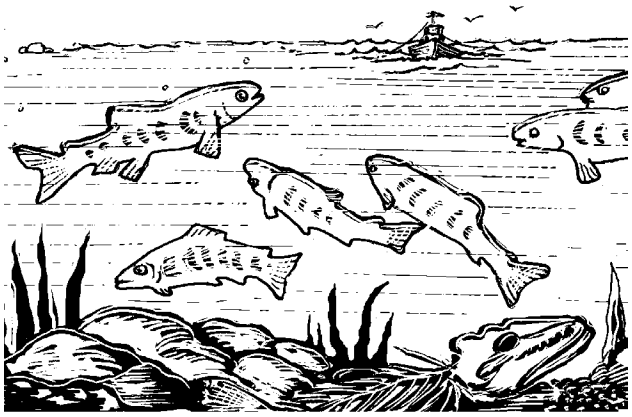
Adapted from
***Field Guide to the Pacific Salmon* by Robert Steelquist and**
an *Oregonian Special Report "River of Ghosts: Lessons of the Past"* by Brian T. Meehan

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."

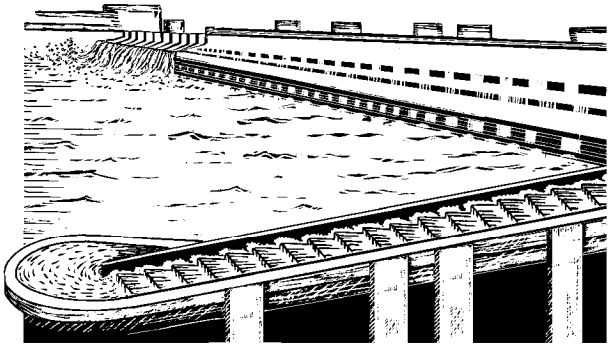
In 1889, British writer Rudyard Kipling exclaimed: "I have lived!" "The American Continent may now sink under the sea, for I have taken the best that it yields, and the best was neither dollars, love nor real estate." For Kipling, America's best was a 12-pound steelhead he caught on a fly on Oregon's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