Soil & Water Marion Conservation District

2024

Salmon Watch

Volunteer Handbook

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Ages and Stages

Ages 9 to 11

Physical
Very active, can't sit still easily.
Girls begin to mature before boys.
Provide active learning experiences.
Try to avoid competition between the gender groups

Social
Boys want to be with other boys, girls with other girls.
Difficulty seeing the views of others, but like to make others happy and will adapt to some extent.
Allow them to be in same sex groups.
They look up to older youth as mentors and will model their behavior.

Emotional
They want everything to be fair or equal. They judge things in absolutes - very little middle ground.
Recognize that each child has his or her own strengths. Place emphasis on individual progress they make as the complete a task or work on a project.

Intellectual
Easily motivated to try new things but may lose interest quickly. Begin to develop favorite subjects.
Provde simple short directions and keep learning experiences brief.
Provide a variety of different activities to ensure success for each child.

Ages 12 to 14

Physical
Experiencing many physical changes.
Both boys and girls are concerned about their body image.
Be sensitive to their feelings and avoid comments that criticize or compare youth physically.
Watch for youth who are making fun of others and put a stop to it to avoid hurt feelings.

Social
At this age, youth prefer activities that include both genders. They are more interested in what their peers have to say than their parent's advice.
Are becoming more opinionated and independent and tend to reject solutions from adults because they feel their solution is better.
Select activities they can do with their peers. They are also ready to begin working on individual goals instead of just group goals.

Emotional
Tend to compare themselves with outers. May be seen as melodramatic.
Emotions are all over the place.
Moods swing rapidly.
Be careful not to embarrass or criticize this age group. Provide activities that allow for critical thinking and perspective taking.
Allow them to assume planning of activities and set expectations for follow through.

Intellectual
Expanding to include more abstract thinking. Beginning to understand cause and effect and are ready for more in-depth and long-term experiences.
Can begin to give them real life problems to solve.
Let them make decisions and evaluate the results so that they can learn from mistakes and celebrate achievements. This age group thrives with service learning where they can identify a need and make a plan to address that need.

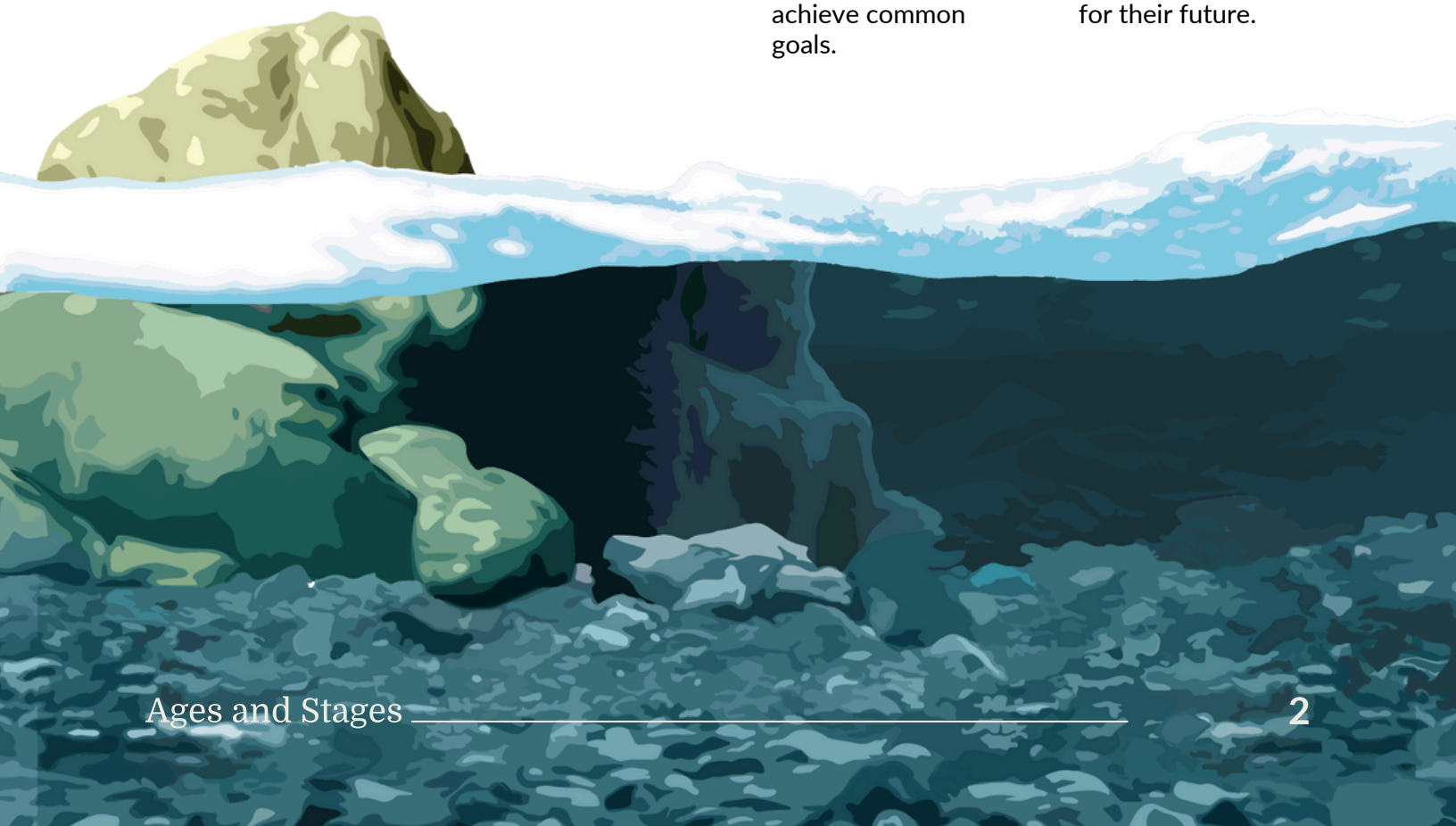
Ages 15 to 18

Physical
Approaching maturity; are concerned about their body image. Acne, weight, physical activity, and other issues are concerns. Impressionable re: appearance and can be easily misguided by advertising and societal emphasis on physical appearance. Avoid comments criticizing their appearance or implying that their physical appearance is related to who they are inside or their success and happiness.

Social
Desire status among their peers. They want to be part of a group and they want to be recognized as individuals. Interested in co-educational activities and dating. Learning how to make commitments and follow through. Encourage social development by involving them in planning and holding them accountable for successes and failures. Emphasize personal development and leadership skills.

Emotional
Focus on respect, developing confidence, and developing independence. They are looking for ways to express their uniqueness but still want approval from their peers. Developing their own set of values and beliefs. As they mature, we can encourage their emotional development by letting them assume more responsibility. Continue to challenge their thinking on identity, values, and beliefs. Encourage them to work in youth/adult partnerships to achieve common goals.

Intellectual
Mastery of abstract thinking and their ability to imagine how their behavior can impact the future. They like to show others what they have learned. They don't do well with meaningless activities or things that just take up time. To maintain engagement, provide real life problems for them to solve. Career exploration is important; this is when they are thinking about whether they will go to college, what career they will pursue, and other important decisions for their future.



Learning Styles

Understanding Learning Styles

Learning styles are how individuals absorb, understand, and retain information best. We may learn primarily by seeing (visual), hearing (auditory), or doing (kinesthetic-tactile). Many people do not fit perfectly into a single category. The categories are flexible and overlapping. As a teacher, incorporate elements of all three styles into your lessons.

Visual

Visual learners gravitate toward reading, writing, and visual elements such as pictures, symbols, maps, colors, shapes, videos, and charts.

Help learners by:

- Giving students time to write down words or sentences.
- Using visual materials such as flip charts, graphs, and diagrams.
- Highlighting key terms in bright colors.
- Encourage students to redraw pages from memory.
- Have students use colored highlighters and symbols when they read, study, or work in groups.
- Incorporate mind maps and use pictures in place of text.

Auditory

Auditory learners prefer listening and speaking as a means of learning new things. They absorb information best through lectures and group discussions. Auditory learners benefit from repetition and mnemonic devices (using rhymes, rules, phrases, or diagrams to memorize information).

Help learners by:

- Giving directions out loud.
- Incorporating small and large group discussion into activities.
- Encourage students to talk it out, explain things to others and reread assignments out loud.

Kinesthetic-Tactile

Kinesthetic-tactile learners prefer physical movement and hands-on activities. They learn best from experiencing or doing things and from tactile representations of information.

Help learners by:

- Providing objects to handle such as flashcards or models.
- Using real life examples and applications to illustrate abstract concepts.
- Incorporate lab experiments, projects, pictures and role play into lessons.

Group Management

Use an “Attention Please” Signal

- Decide on a signal that means, “time to listen to me now.” Only use this signal when you really need it. Best: find out and use the signal that is used by the teacher in the classroom. Or try one of these options:
- Say, “Clap once if you can hear my voice.” When some people clap, others will notice. If you need to say, “Clap twice (or 3 or 4 times) when you can hear my voice.”
- Use a silly, but loud, noisemaker, horn, chime, or drum.
- Teach kids a clapping, knee-slapping, or stomping rhythm.
- Say, “I need your attention in 5, 4, 3, 2, 1.” Get students to count down with you to add to your volume.

Keep It Positive

- Use positive reinforcement. For example, say “Walk, please.” instead of “No running!” Say, “Voices off,” instead of “No talking!”
- Say “thank you” and “I’m glad you said that because...”
- React positively to students’ contributions even when incorrect or off topic. Say “thanks for sharing.”
- Respect students’ previous experiences and knowledge.

Ready, Set, Go

- Plan what you’ll say to introduce activities quickly so kids won’t get restless waiting to begin.
- Stand where everyone can hear and see you, and be sure the sun isn’t in their eyes when they look towards you.
- Explain safety rules up front.
- Get kids into place, explain what will happen, and begin.
- Quite while you are ahead - stop an activity when players are having a great time and before it gets boring.

Keep Activities and Transitions Active

- Plan how to move from one activity to the next with little or no down time in between.
- Keep kids moving as much as possible.
- If needed, use tasks like jumping jacks, toe touches, and so on to keep kids moving.
- Change your voice often and smile.

Use Visual Aids

- Make posters or share objects that help bring lessons to life.

Make a Game out of Forming Small Groups/Teams

- Use one of the following methods to get kids into roughly equal sized groups.
- Ask kids to fold their arms or hands. People who put their right arms or thumbs on top are one team, left are the other.
- Ask players to group themselves by birth month. Put January to June and July to December together for two groups, or divide by quarters for 4 groups.

Teaching Tips

Engage with Students

- Be hands on and assist students.
- Talk to students at eye level.
- Walk around, avoid standing in one place.
- Be enthusiastic about your subject.

Make it Catchy

- Start by engaging students with a question.
- Give students something to do right away.
- Make lessons meaningful by relating to students' everyday lives.

Minimize Jargon

- When introducing new vocabulary, be clear and use it repeatedly. Don't use too many new words in one lesson. Have students help define the new word.
- Ask questions rather than making statements.
- Answer a question with a question: "That's a great question. What does everyone think?"
- Ask open-ended questions like, "What do you think will happen if...? Why do you think that will happen?"

Model Curiosity

- Be excited when a question is asked that you don't know the answer to - it's an opportunity to learn together!
- Often there isn't one simple explanation or one correct answer.
- Use different methods to reason it out:
  - Reason aloud. Go through the process of how you would find out an answer.
  - Show students the resources available. Have them look through field guides, etc.
  - Turn the question back to the group as a whole. Encourage brainstorming.
  - Ask the expert on hand (if there is one).

Make Space for Wonder

- Always take advantage of the teachable moment. It is great to be upstaged by an otter, heron, or whatever comes your way.
- Getting kids excited about these shared experiences will make them want to come back and experience that again.

Think, Pair, Share

- Give students a lot of different ways to participate and respond.
  - Talk to a partner first.
  - Write in a journal first.
  - Draw something.
- Encourage students who are not participating by figuring out jobs to keep them actively engaged.
- Put them in charge of something like handing out or collecting supplies.

Use Wait Time

- After asking a question, wait 8-10 seconds before calling on students.
- Reinforce a question/idea by waiting and then repeating it in a different way before calling on students.

Be Objective

- This is a multi-cultural world. Check your comments and actions for bias/assumptions connected to socioeconomics, ethnicity, or gender.
- It's a OK to discuss different view points and express your own point of view, but important to make space for other points of view as well.

Salmon Biology Station

OBJECTIVES

Students will learn:

- Wild salmon are indicator species and keystone species whose survival is connected to the health of the watershed.
  - Riparian - Salmon need trees and trees need salmon.
  - Aquatic Macros - Macros feed on carcasses and juvenile salmon eat macros.
  - Water Quality - Salmon do best in high quality water (Cold, Clear, Clean)
- Salmon life cycle stages
- Salmon have cultural and economic significance.

MATERIALS

- polarized sunglasses
- salmon life cycle diagram
- adult salmon carcasses
- knife for dissection & tail removal at end of day. Only station leader uses knife.
- butcher paper
- hand sanitizer

VOCABULARY

- alevin
- eggs
- redd
- spawn
- yolk sac
- anadromous
- milt
- fry
- smolt
- parr marks
- gravel
- salmonid
- keystone species
- indicator species
- semelparous

PREPARATION

- Determine if a salmon carcass will be available so you can plan what to cover in your lesson.
- Arrive early to scope out the river/park. Check out the designated Salmon Biology station(s) then walk around the park to look for other places where salmon might be. Knowing the park will also help you if you need to take the students for a nature walk or have a student with limited mobility. Even if you are familiar with the location, it is still good to arrive a bit early to scout and find where the salmon are in the river.

INTRODUCTION

- Orient students to our location in the watershed and where the park is relative to where their homes are in the watershed.
- Review some basic information about salmon. Some options to cover are:
  - conditions necessary for eggs/young salmon
  - what salmon fry eat
  - the process of smoltification
  - the importance of stream flow to salmon migration
  - how salmon migrate back to their natial streams

- Review the important roles salmon play in the lives of PNW tribes.
  - the annual return of the salmon is celebrated as a renewal and continuation of life
  - the abundance of salmon and trade made the tribes wealthy
  - salmon and salmon-bearing rivers provide native people with a sense of place and a sense of responsibility to care for the land and water.
- Review the salmon life cycle.
  - use the life stages model to show the students what eggs, sac fry, and fry look like.
  - discuss the fact that Coho and Chinook die after spawning, but steelhead can return to the ocean.
  - ask the students why it's important that the salmon die. (The streams where the salmon spawn are nutrient poor. The salmon have evolved to die after spawning in order to provide nourishment for the next generation so they can grow large and strong enough to survive in the ocean.)
  - explain why this area of the river might be good for salmon spawning or not. (Shade, lack of predators, gravel substrate, clear water, fast-flowing water and/or pools, macroinvertebrates for young salmon to eat, good water quality.)
  - tell the story of redd building and spawning as you observe the salmon in the river.

Note: It's ok to ask the chaperone to help manage the group if needed. It's also ok to separate disruptive students from each other. Try to ask questions and hand around models/visual aids to keep students engaged.

ACTIVITY

If spawning salmon are present:

- Do not allow the students to harass or disturb the fish.
  - students should not run, yell, or wade in the creek near spawning salmon.
  - explain that salmon are sensitive to disturbances and have limited energy for spawning.
  - students should never throw rocks or sticks on Salmon Watch field trips.
- Observe the fish with the students.
  - share information about the salmon life cycle.
  - discuss female salmon behavior, describe what they are doing and why.
  - discuss male salmon behavior, describe what they are doing and why.

If spawning salmon are not present:

- Take the students on a nature walk to other locations where you might find spawners or carcasses.
  - bring a bag to collect litter along the walk
  - point out features of a healthy riparian area and stream environment as you walk.

Whether or not salmon are present:

- Ask lots of, "Why do you think salmon do..." questions to get them thinking about behavior. For example, why is there so much variation in salmon behavior?
- Ask why they think the salmon don't just live in either the river or the ocean. Why do they migrate between the two?
- Talk about the relationship between salmon and their environment.
- Talk about the relationship between salmon and people - cultural, environmental, and economic ties.
- Ask how a healthy riparian zone might benefit the salmon. *(bank stabilization, flood protection, shade, food for invertebrates, fallen trees slow currents and add structure.)*

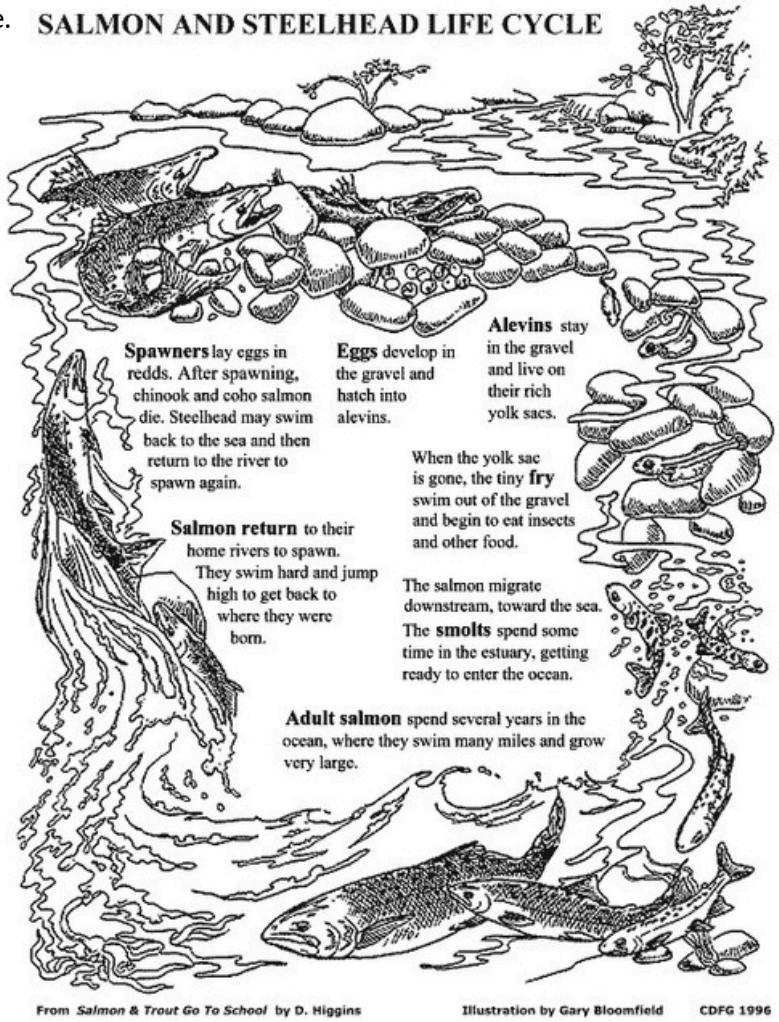
- Ask how returning salmon might benefit the forest. (fertilization, bringing nutrients from the ocean.)
- Fact: more than 20% of nitrogen in the tissues of riparian trees and shrubs comes from salmon.
- The circle of life: salmon carcasses feed macroinvertebrates. Macros, in turn, feed salmon fry.

Salmon Dissection:

- For detailed information, see the dissection lesson plan, which follows.
- At the end of the day, cut through and remove the caudal fin of the carcass and put the carcass and the fin into the stream. This ensures that the carcass is not counted when fish counts are done on the stream.

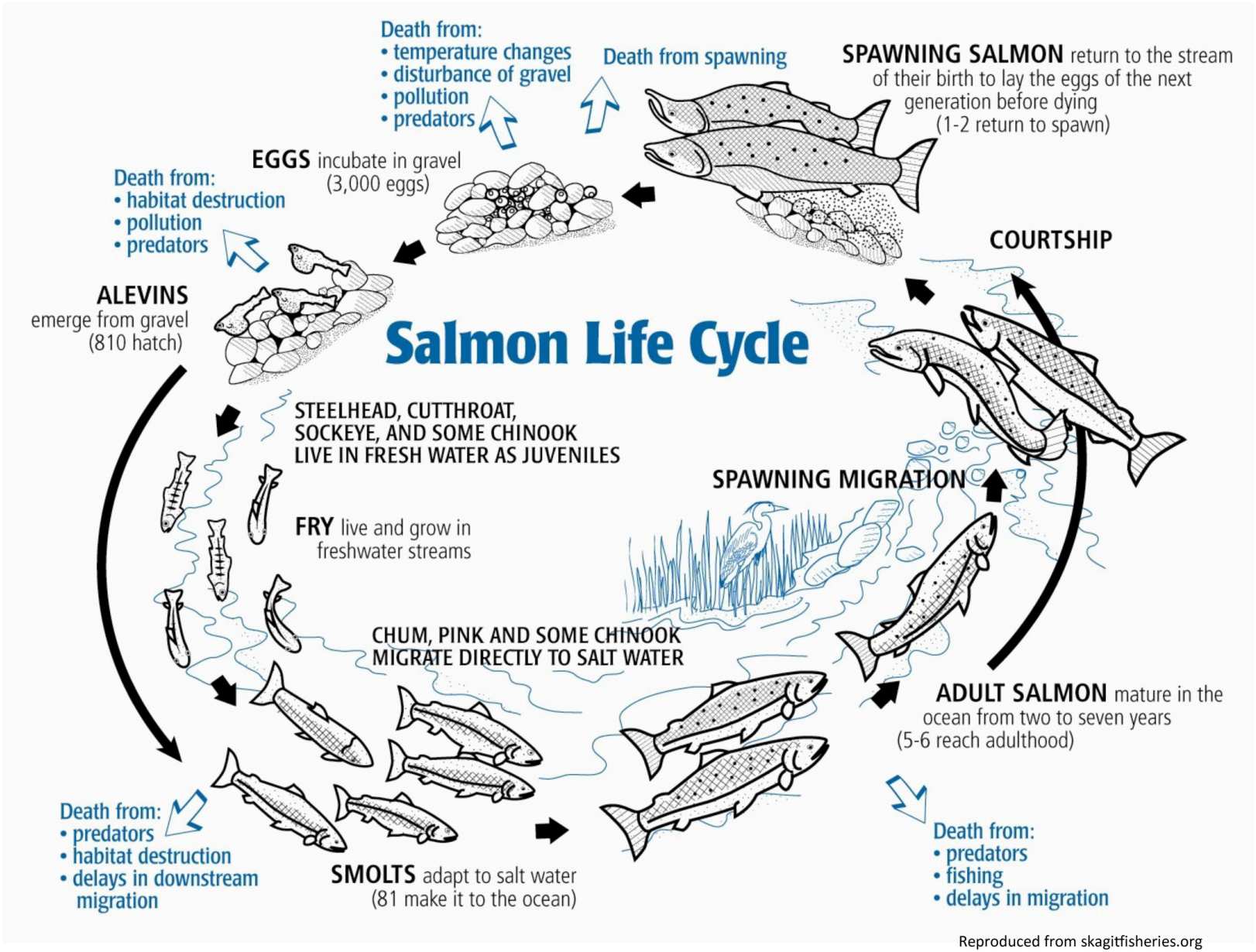
DISCUSSION

- Talk about similarities and differences in salmon and human biology.
- Ask the students about where they are in the watershed, the salmon life cycle, the importance of salmon to the ecosystem, and their cultural significance to Native Americans.
- Talk about all the challenges salmon face in a healthy ecosystem, and all the new challenges humans have added. Make the connection between how the students live their lives and how it affects the salmon in a positive or negative way.
    - How humans affect salmon in their daily lives: water use, pollution, habitat degradation
    - How students can help salmon in their daily lives: use less water, protect water quality, restore healthy fish habitat.
- Being a good steward: Lead by example. Talk to the students about things you do to help salmon.
- Relate the lesson from this station with what they learned at the station they came from or are going to.



EXTENSION

- Take advantage of times when you can share information about your profession.
- Talk to them about what you do in your profession.
- Relate stories about cool or interesting things you have seen or learned on the job;
- Discuss what they need to do if they want to enter your profession, what classes are important in high school and college, and what job shadow or internship opportunities there are at your office.



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WHERE ARE THE SALMON, WHEN?

GENERALIZED LIFE HISTORY PATTERNS OF SALMON, STEELHEAD, AND TROUT IN THE PACIFIC NORTHWEST*

	Adult Return	Spawning Location	Eggs in Gravel**	Young in Stream	Freshwater Habitat	Young Migrate Downstream	Time in Estuary	Time in Ocean	Adult Weight (Avg.)
COHO	Oct-Jan	coastal streams, shallow tribs.	Oct-May	1+yrs	tributaries, main-stem, slack water	Mar-Jul (2nd yr.)	few days	2 yrs	5-20 lb (8)
CHUM	Sep-Jan	coastal rivers and streams lower reaches	Sep-Mar	days-weeks	little time in freshwater	shortly after leaving gravel	4-14 days	2.5-3 yrs	8-12 lb (10)
CHINOOK		mainstem large and small rivers			mainstem-large and small rivers		days-months	2-5 yrs	
spring	Jan-Jul		Jul-Jan	1+yrs		Mar-Jul (2nd yr.)			10-20 lb (15)
summer	Jun-Aug		Sep-Nov	1+yrs		Spring (2nd yr.)			10-30 lb (14)
fall	Aug-Mar		Sep-Mar	3-7 months		Apr-Jun (2nd yr.)			10-40 lb
CUTTHROAT (Coastal-Sea Run)	Jul-Dec	tiny tributaries of coastal streams	Dec-Jul	1-3 yrs (2 Avg.)	tributaries	Mar-Jun (2nd-4th yr.)	less than one month	0.5-1 yrs	0.5-4 lb (1)
PINK	Jul-Oct	mainstem of large and small streams, tribs, lower reaches	Aug-Jan	days-weeks	little time in freshwater	Dec-May	few days	1.5 yrs	3-10 lb (4)
SOCKEYE	Jul-Aug	streams, usually near lakes	Aug-Apr.	1-3 yrs	lakes	Apr-Jun (2nd-4th yr.)	few days	1-4 yrs	3-8 lb (6)
STEELHEAD* **		tributaries, streams & rivers			tributaries		less than one month	1-4 yrs	
winter	Nov-Jun	Nov-Jun	Feb-Jul	1-3 yrs		Mar-Jun (2nd-5th yr.)			5-28 l b(8)
spring	Feb-Jun	Feb-Jun	Dec-May	1-2 yrs		Spr & Sum (3rd-4th yr.)			5-20 lb
summer(Col. R)	Jun-Oct	Jun-Oct	Feb-Jun	1-3 yrs		Mar-Jun (of 3rd-5th yr.)			5-30 lb (8)
summer(coastal)	Apr-Nov	Apr-Nov	Feb-Jul	1-2 yrs		Mar-Jun (of 2nd-5th yr.)			5-30 lb (8)

* There is much variation in life history patterns--each stream system having fish with their own unique timing and patterns of spawning, growth, and migration. Ask a local biologist about the specific patterns of the fish in your streams and update this chart for your area.

** The eggs of most salmonids take 3-5 months to hatch at the preferred water temperature of 50-55 degrees F; Steelhead eggs can hatch in 2 months.

*** Steelhead, unlike salmon and cutthroat trout, may not die after spawning. They can migrate back out to sea and return in later years to spawn again.

Adapted by Pacific States 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.

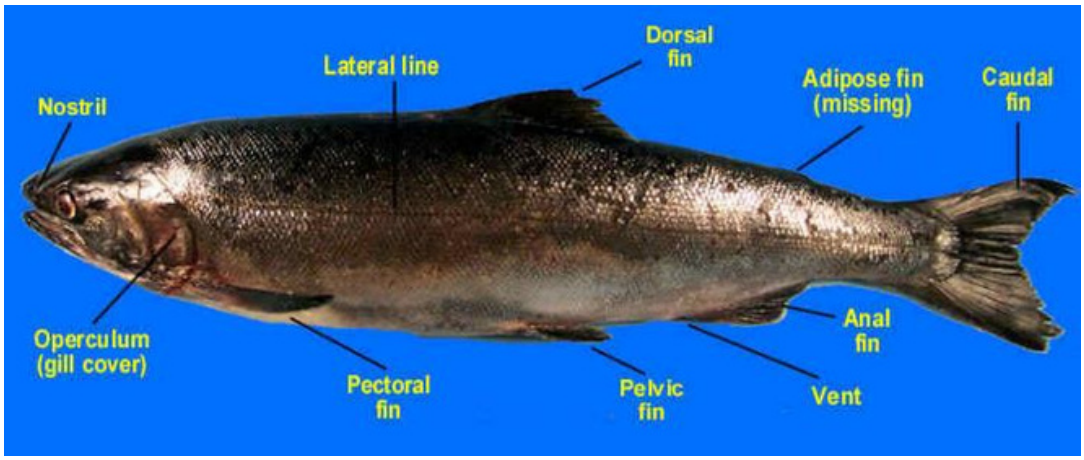
SALMON HANDOUT 4.4

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

Salmon Dissection

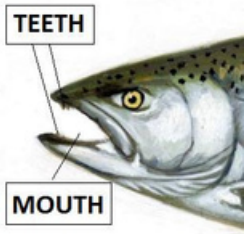
If you are unfamiliar with fish dissection, use this curriculum to guide you through the process.

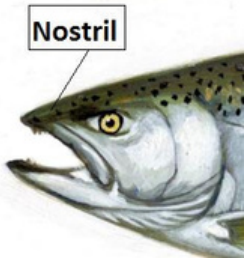


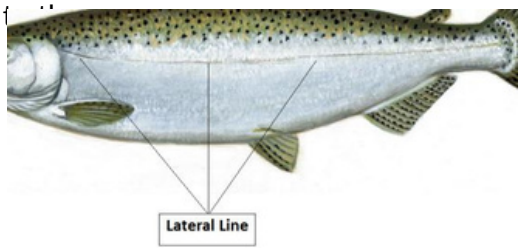
EXTERNAL ANATOMY

Using the diagram provided, explain the external/ internal anatomy and physiology of the salmon.

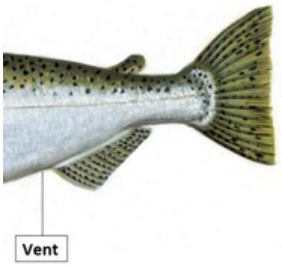
- Have the students feel the salmon. Why is it slimy?
  - So the fish can more easily slip away from predators such as bears. The slime also serves as an anti-abrasive so the fish can easily slip over rocks. This slime lubricates the fish and makes it easier for it to swim through the water.
  - It also works to protect the salmon against fungus, parasites, and disease.
- Point out and discuss the mouth, eyes, nostril, operculum, lateral line, vent, and fins.
  - **MOUTH** - The mouth contains sharp, needle-like teeth which the salmon use to grab their prey. They do not use their teeth for chewing! Salmon have taste buds like humans and are thought to taste salty, sweet, bitterness, and sourness.
  - Salmon **EYES** are different from humans eyes. Salmon can swivel each eye independently to provide a wider field of vision. However, salmon do not have depth perception like humans do.
  - **NOSTRIL** - Nostril is not attached to the mouth, and is not used for breathing. Salmon can smell small amounts of chemicals in the water and can detect pollution and to avoid potential threats. What else might salmon use their sense of smell for? This sense of smell is likely also used to help the salmon navigate back to their natal stream from the ocean. Salmon may be able to pick up on certain chemical signatures, such as mineral composition, of their native streams.
  - **LATERAL LINE** - The lateral line is a specialize feature of fish that allows them to sense their environment. It functions sort of like the sense of hearing, sort of like the sense of touch, and sort of like the sense of sight. The series of organs along the line emit low level vibrations (kind of like sonar) and can detect changes in environment, such as disturbances in the water and help the fish navigate through the water when they cannot see very well.

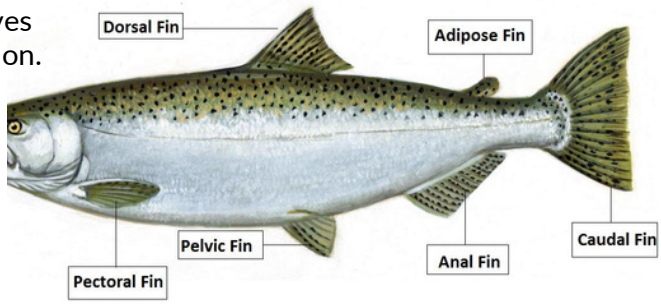


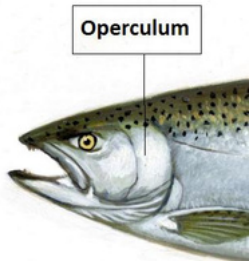


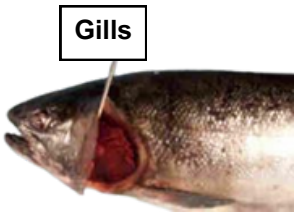


- **VENT** - The vent is a small opening on the underside of the salmon. This is where females lay their eggs from and where males release their milt. Both sexes eliminate waste from their vent.
- **FINS** - Salmon have eight fins, including their caudal fin or tail. They contain spines with a thin layer of skin between them.
  - The **CAUDAL fin** is the largest and most powerful fin. It pushes water to move the salmon forward.
  - Think of the **DORSAL fin** like the keel on a ship. What does the keel do? It keeps the ship upright and controls the direction on that ship moves in. The dorsal fin does this for the salmon.
  - The **ANAL fin** also helps keep the salmon stable and upright.
  - Salmon use their paired fins, **PECTORAL** and **PELVIC**, for steering and balance. They also use these fins to move up and down in the water column.
  - The **ADIPOSE fin** serves no known function. Sometimes at the hatchery, this fin is cut off to help differentiate these fish from wild salmon when they return or are caught.
- **OPERCULUM** - The operculum, or gill cover, protects the gills. Salmon can open and close their operculum to let water pass over the gills. Why do salmon pass water over their gills? Pull back the operculum to reveal the gills.
- **GILLS** - The gills are red because they are filled with blood. The gills are where salmon blood is oxygenated. Fish breathe by washing water over their gills, either by opening the operculum or by gulping water into their mouths and letting it run out through the gills. The gills look like think branched structures in order to provide a large surface area for oxygen absorption.





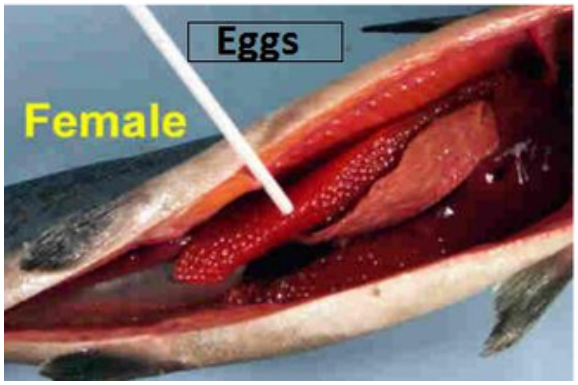


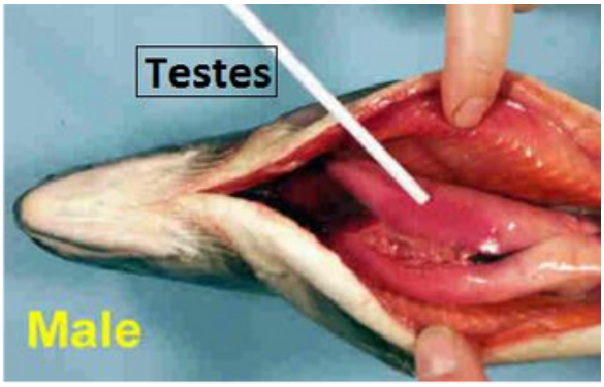


INTERNAL ANATOMY

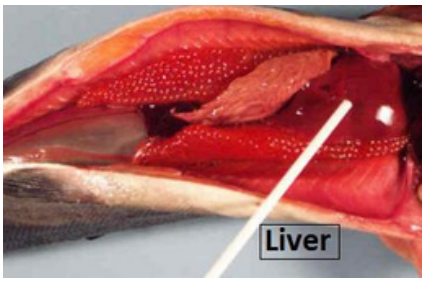
Point out and discuss the swim bladder, gills, kidney, heart, liver, stomach, and heart.

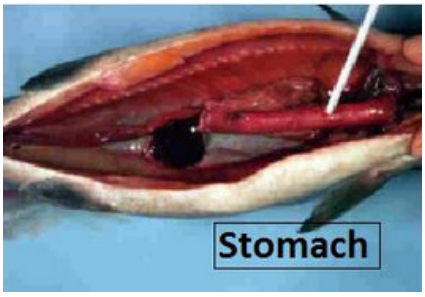
- Cut the salmon open but making an incision at the vent and cutting up towards the throat.
  - Point out the **eggs or testes** present.
  - If eggs are present, ask the students why there are so many. *Female salmon lay between 1,500 – 10,000 eggs, depending on the species. On average, only a few of these (0-10 will survive to adulthood.*

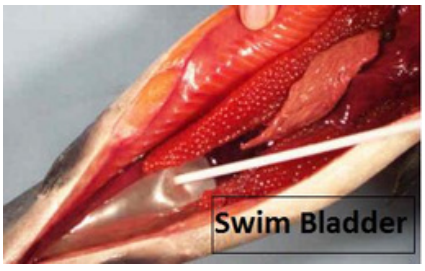




- **LIVER** - The liver is the largest organ in the salmon body. Like in humans, the liver helps maintain the proper level of chemicals and sugars in the blood.
- **STOMACH** - Like our stomachs, the salmon stomach breaks down food with digestive juices.
- **INTESTINES** - After leaving the stomach, partially digested food passes into an organ that humans do not have, called the Pyloric ceca. You may be able to observe this organ in your dissection. It is a series of small finger-like pouches. Food is further digested here before it passes into the intestines. Like in humans, the digestion process is completed in the intestines.
- **HEART** - The heart pumps blood through the body. It is close to the gills, where the blood can be recharged with oxygen. In humans, our hearts are close to our lungs for the same reason.
- **SWIM BLADDER** - Salmon fill their swim bladder with air for buoyancy, allowing them to float in the water. The fish fill the swim bladder for the first time as fry. They can adjust the air in the swim bladder so they can move up and down and hover in the water. “Do fish have lungs?” “Most, including salmon do not, so they use their GILLS to breathe.”
- **KIDNEYS** - Salmon KIDNEYS are crucial to smoltification. Salmon have two kidneys that are connected. Like our kidneys, the front one produces red blood cells, the back one cleans the blood.







Aquatic Macroinvertebrates

OBJECTIVES

Students will learn:

- The important roles of macroinvertebrates in streams as:
  - indicators of water quality.
  - an integral part of the stream food web.
  - links to riparian health and salmon rearing.
- Methods to sample for macroinvertebrates based on functional feed group and niches.
- How to use macroinvertebrates to determine the health of a stream.
- Practice using the scientific inquiry method (question, procedures, data collection, analysis).

INTRODUCTION

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 macroinvertebrates spend the majority, if not all of their lives in streams, wetlands, lakes and other aquatic environments.

Adaptations: Aquatic macroinvertebrates are animals, just like we are, and like us they need oxygen to breathe. They have many different methods, or adaptations for acquiring oxygen. 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 leaf like 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."

Sensitivity: Measuring water quality 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 invertebrates live in that water all of the time. They are constantly exposed to whatever chemicals, sediments, or changes in the temperature may be occurring, and may respond by dying out, migrating away, or reproducing in even higher numbers, depending on the type of invertebrate.

Bioindicators: This sensitivity makes aquatic macroinvertebrates 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 species have different known responses to specific stressors and they are a critical part of the stream food web. Changes in the presence, composition and relative abundances of specific groups of macroinvertebrates can signal pollution or disturbance occurring in a watershed. Government and other groups that monitor water quality are using this method more and more.

Food Web: Macroinvertebrates are critically important in the aquatic food web. Some serve directly as food for predators such as fish, amphibians, birds, and other invertebrates; others help make more food available in the aquatic system by breaking down leaves and plant material. Fish populations depend on healthy macroinvertebrate populations to survive. The availability of macroinvertebrates as food is determined by both the physical and biological condition of the stream, riparian areas and the whole watershed.

After the introduction, 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 results. The field guides and cards will help identify the macroinvertebrates.

MATERIALS

- D-frame/Kick nets
- Small 'fish tank' nets, spoons
- Dish pans
- Ice cube trays
- Hand lens or 2-way magnifying viewer
- Turkey basters or eye droppers
- Vials of preserved macros
- Tolerant / Intolerant to pollution ID cards
- Field guides, ID cards
- Clipboard, data sheets, pencils, wet erase

SAFETY

Safety is especially important in this station due to proximity to the water. Depending on site specific conditions, students may or may not be allowed to enter the water (be sure to check with your site coordinator). If students are not to enter the water, samples should be collected by adults. The station leader can then demonstrate how the samples were collected using the D-net.

Macroinvertebrate sampling should be conducted well away from and downstream of spawning salmon and redds. Students may not enter water above the calf, and in some cases, should not go deeper than the ankle. Avoid fast-moving water. Take care when walking on slippery rocks. Students should never drink the water. D-nets can be a tripping hazard; place nets safely to the side when not in use. Students should always be visible to the instructor.

ACTIVITY

1. Clearly explain safety precautions and rules.
2. Describe the 4 functional feeding groups, what they eat, where they live, and how to sample for them. Also mention sampling in stagnant areas where group 3 macros are likely to be found.
3. Split the group into 3 teams and have them all "compete" to see which team can collect the most and widest variety of macros, being sure to encourage use of various sampling techniques.
4. Collect sample from 1-square foot area immediately upstream from the net opening. To do this, approach site from downstream. Hold net downstream from area to be sampled, perpendicular to flow. Upstream, begin rubbing rocks, or leaf litter to remove any invertebrates. Or shuffle the stream bottom in place using your feet. The invertebrates should flow into the net. Replace the rocks.
5. Students release net contents into a dish pans filled part way with water, then sort macros into ice cube trays. Use small nets, plastic spoons, forceps, or basters to move individual macroinvertebrates. Use magnifiers to observe body parts such as different types of gills and mouth parts.
6. Use the field guides to help with identification. Identifying species can be difficult and is not a priority – sorting into similar groups and understanding some of the differences is more important.
7. Count the different kinds of invertebrates in each sensitivity group and record on data sheet.
8. With about 10 minutes remaining, summarize and discuss findings. Then clean up with group.

DISCUSSION

Have students use the completed data sheets to determine the general health of the stream. Which group best reflects the insect community found in the stream sampled? Does this make sense based on what they learned during the other stations that day?

Habitat Requirements

- What species are you more likely to find in moving water? Calmer water?
- Which particular nymph type (immature form) is only found in fast, cold water?
- Why might one insect need less dissolved oxygen than another?
- Why is there more dissolved oxygen in a fast flowing stream than in a pond?

Macroinvertebrates and Water Quality

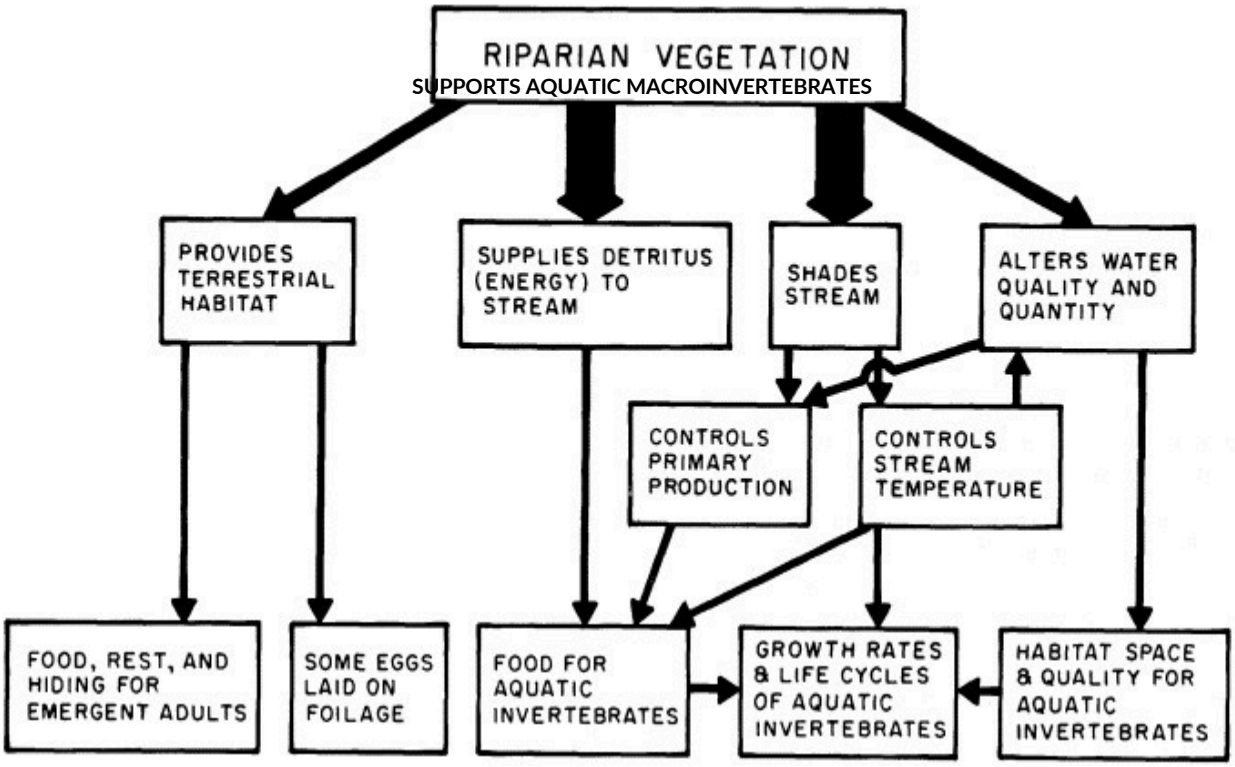
- Why are macroinvertebrates good indicators of water quality?
- What area of the stream contains the most diverse assemblage of insects?
- What species would be more likely found in stagnant areas with more fine sediments?
- What kinds of links on the food chain are filled by aquatic insects (herbivores, carnivores, detritivores (insects that eat dead stuff)?

What Can You Do?

- What measures can be taken to protect a stream with healthy macroinvertebrate populations that support salmonids?
- What measures can be taken to help restore a system that has been degraded and has lost the diversity of insects that are part of a healthy watershed for fish?

CLEAN-UP

- Clean off any debris from dish pans, trays, and nets.
- Put all items back into appropriate tubs,
- If using laminated ID sheets, erase all writing.
- At end of day, rinse and dry supplies and place them back into the bin.



BACKGROUND INFORMATION

Macroinvertebrates and the Aquatic Food Web

Macroinvertebrates are critically important in the aquatic food web. They are food for predators such as fish, amphibians, birds, and other invertebrates and they make more food available in the aquatic system by breaking down leaves and plant material. The availability of macroinvertebrates as food is determined by both the physical and biological condition of the stream, riparian areas and the whole watershed. Macroinvertebrates have a wide variety of adaptations in shape, size, appearance, and mouth parts, and a diversity of feeding habits. Macroinvertebrates may feed on living material (algae, plants, or other invertebrates), as well as on dead or decomposing material and particles of organic detritus, and they are often classified according to the way in which they obtain nutrients. The major functional feeding groups (FFG) are shredders, collectors, scraper/grazers, and predators. These distinctions are somewhat artificial, as some may fit into more than one category (i.e. scrapers may eat detritus while they graze on algae), but they are still a valuable method of classifying the stream macroinvertebrate community. By looking at the feeding habits of these invertebrates, you can begin to sort out different roles these animals play in the ecology of watersheds.

Shredders

Like The Shredder, arch-nemesis of the Teenage Mutant Ninja Turtles, shredders shred things.

- **Food:** Chew on intact or large pieces (>1 mm) of plant material.
- **Examples:** Giant stoneflies, Northern caddisflies.
- **Found in:** Leaf packs, water-logged wood, headwater streams and areas with dense canopy cover.
- **To collect:** Pick up leaf packs and other vegetative debris and swish around in dish pan, then place debris back in water. Also try running the D-net along the edges of the stream where grasses are growing in the water.

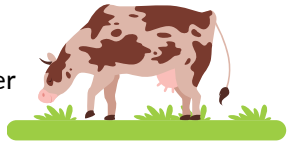
Collectors (filterers and gatherers)

Collectors gather or strain small bits of detritus. The net-spinning caddisfly creates a tiny underwater web to capture food. Wow!

- **Food:** Consume very small pieces of detritus (<1 mm).
- **Examples:** Common net-spinning caddisflies, black flies, brush-legged mayflies, mussels.
- **Found in:** Rocks and mud; common in all reaches, make up larger proportion in lower reaches where sediment collects.
- **To collect:** Use D-net to gather debris you stir up by grinding your feet in gravelly/silty river bottom.

Scrapers / Grazers

Scrapers are the cows of the creek, they move along rock surfaces munching up the algae and bacteria growing there.



- **Food:** Scrape off and consume thin layer of algae growing on solid substrates in shallower waters.
- **Examples:** Snails, flatheaded mayflies, water pennies.
- **Found in:** More open areas with enough sunlight to support algal growth; rocks in open-canopied areas, mid-stream reaches.
- **To collect:** Pick up rocks, brush off rock surfaces with hands or small brush into dish pan.

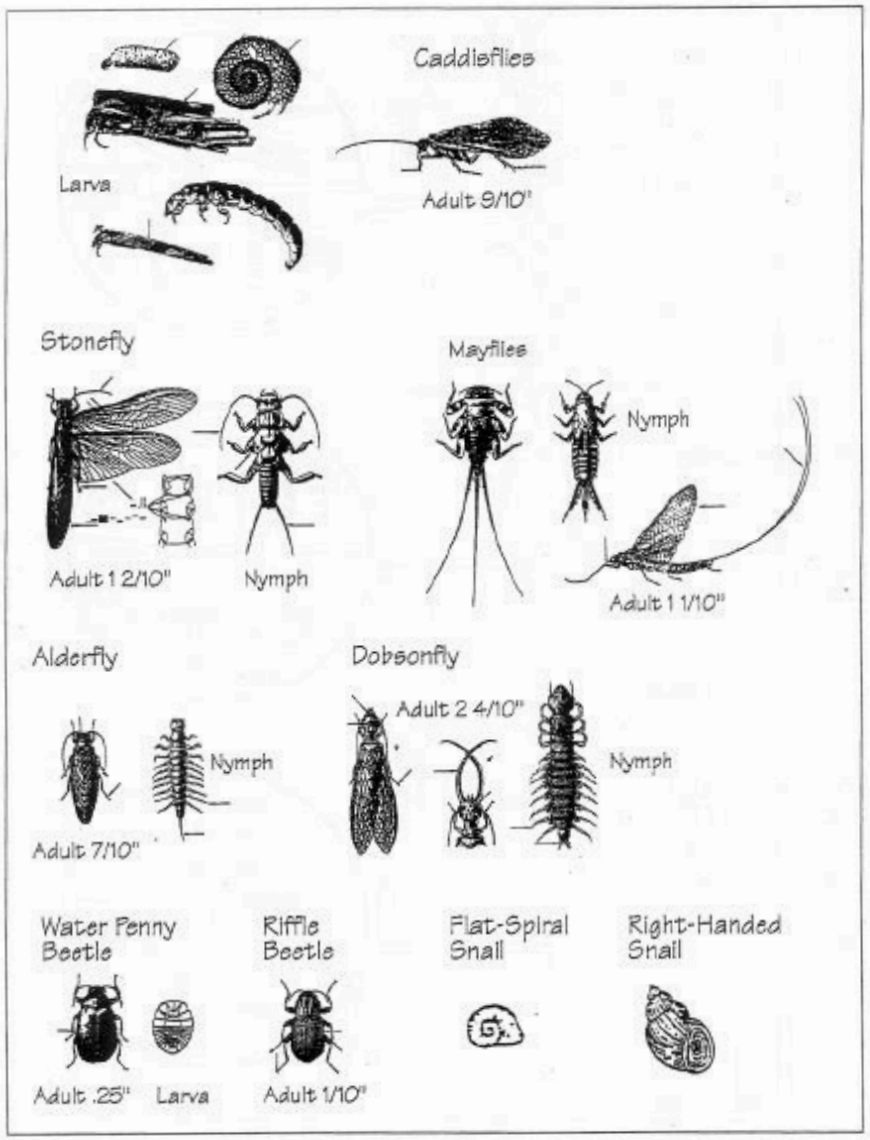
Predators

- **Food:** Feed on living animals; may swallow smaller prey whole, tear pieces out of larger prey, or suck out body fluids.
- **Examples:** Predaceous diving beetles, dragonfly larvae, common stoneflies.
- **Found in:** They eat everyone else so they are in all habitat types
- **To collect:** These are likely to be collected incidentally when collected the other functional feeding groups.

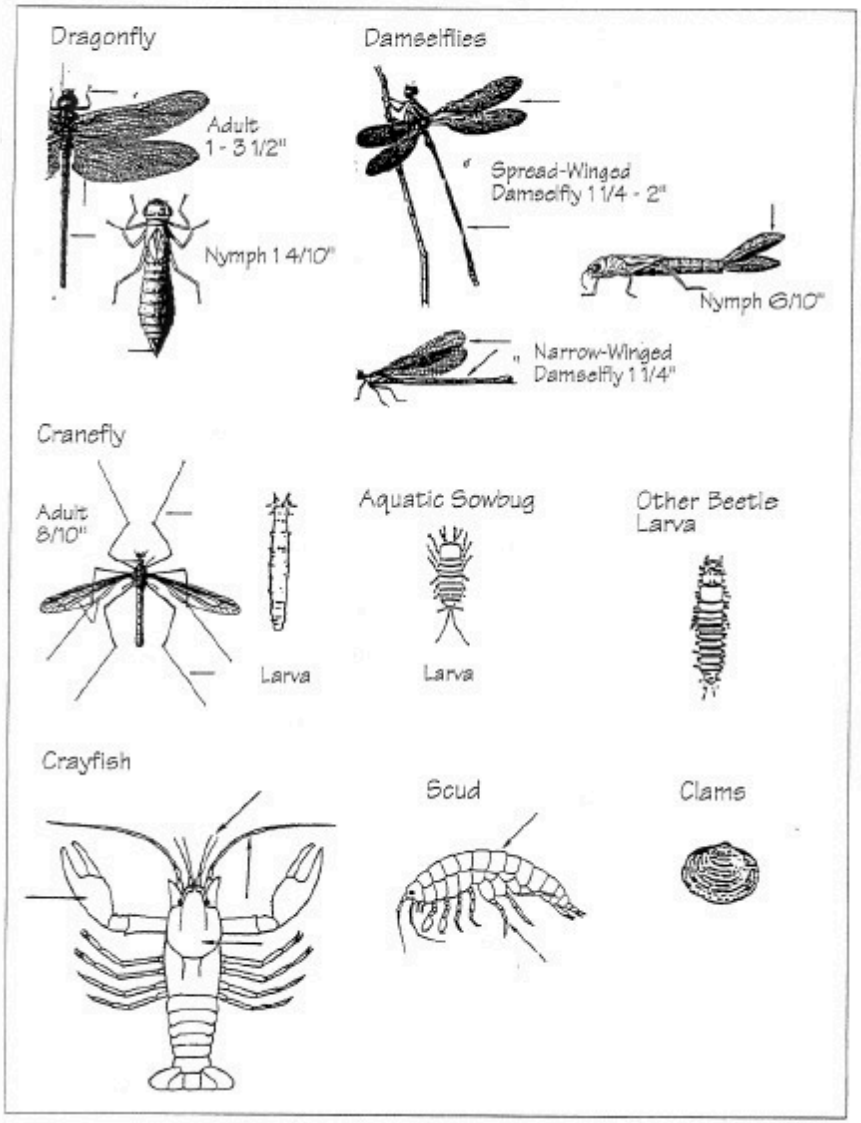
Other: Pollution Tolerant Macros

- **Fact:** They often have adaptations that allow them to survive in low quality water.
- **Examples:** Worms, leeches, black fly larvae, midges.
- **Found in:** Shallow, stagnant areas with low to no flow, high sediment loads.
- **To collect:** Collect rocks, leaf packs, and use D-nets to collect from stagnant, murky areas.

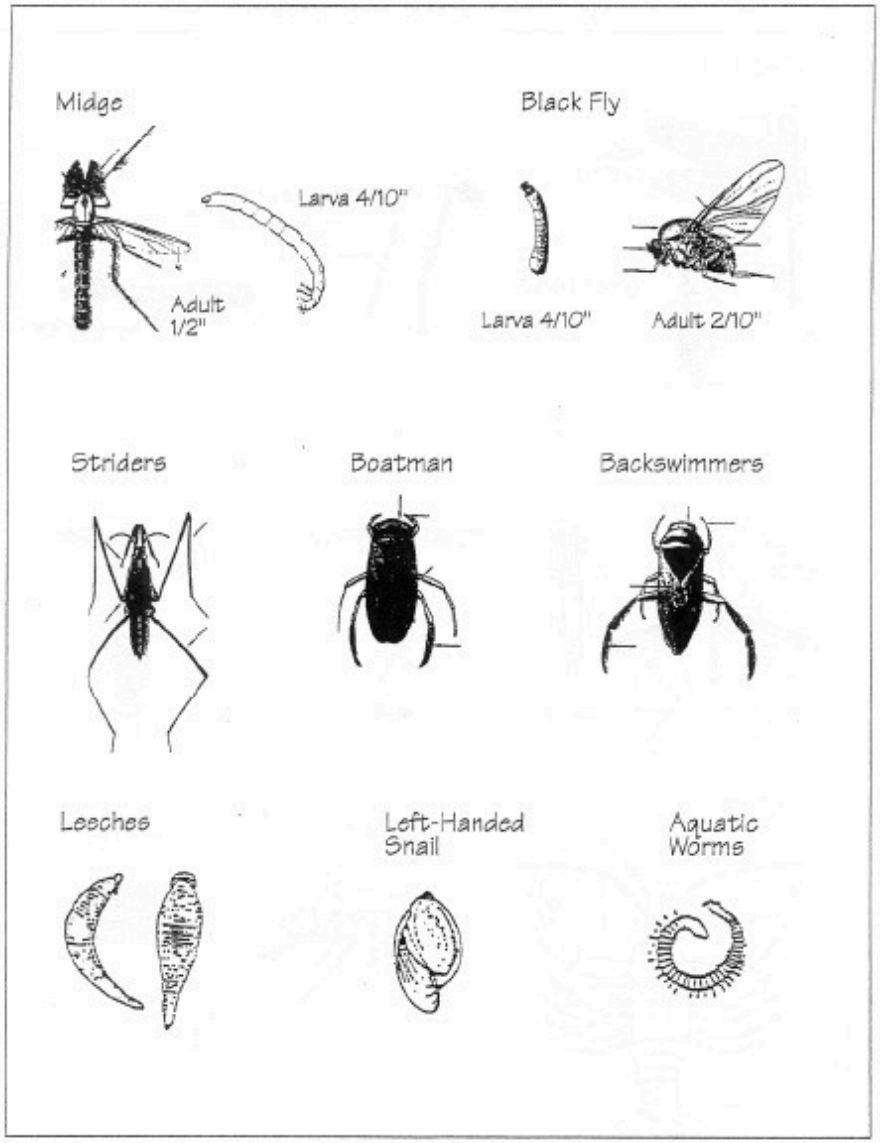
Group 1: Intolerant
These organisms are sensitive to pollution.
Their dominance generally suggests good water quality.



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



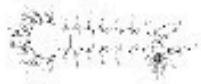
Group 3: Tolerant
These organisms are generally tolerant of pollution. Their dominance suggests poor water quality.

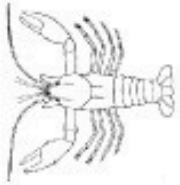


QUICK REFERENCE GUIDE TO AQUATIC INVERTEBRATES

Name	Distinguishing Characteristics	Where Found	How Oxygen is Obtained	Food Gathering	Things To Look For
Stonefly Nymph 	2 tails, 2 sets wing pads, (wing pads not always noticeable)	Cold running water	Through body surface; some small gills; does "pushups to increase oxygen flow	Predator or herbivore	Streamlined body for crawling on rocks; requires high oxygen levels
Mayfly Nymph 	3 tails (sometimes 2); 1 set wing pads.	Cool or cold running water	Through gills along abdomen; may wave gills in water to increase oxygen flow	Herbivore or scavenger	Requires high to medium oxygen levels
Caddisfly Larva 	Most species build cases or nets soft body, some free living	Cool or cold running water; ponds	Through body surface; some finger-like gills	Filter feeder, herbivore, predator	Builds cases of heavy material (rocks) to avoid being swept away by fast-flowing streams; uses grass and plants to make cases as well
Water Penny Larva 	Round, flat, segmented, disk-like body	Cold running water	Usually through gills on underside	Herbivore—grazes on algae	Flattened body resists pull of current
Predaceous Diving Beetle Larva 	Up to 6 cm long; robust jaws	Most still and moving water habitats	Through body surface	Voracious predator	Special channels in jaws to suck body fluids of prey

Name	Distinguishing Characteristics	Where Found	How Oxygen is Obtained	Food Gathering	Things To Look For
Whirligig Beetle 	Black; congregates in schools	Surface of quiet water	From atmosphere	Predator or scavenger	Has two pairs of eyes to see above and below water's surface; has type of "radar" to locate object in water; secretes white odorous substance to deter predators
Black Fly Larva 	Small body; small hooks at end of abdomen attach to rocks	Cold running water	Through body surface; small gills	Filter feeder	Anchors to rocks with silk; only needs medium to high oxygen levels
Dragonfly Nymph 	Stout body; arm-like grabbing mouthpart	Cool still water	Dissolved oxygen, through gills in internal body chamber	Active predator	Clings to vegetation or hides in clumps of dead leaves or sediment
Damselfly Nymph 	3 leaf-like gills at end; arm-like grabbing mouthpart	Cool still water	Through gills at end of abdomen	Active predator	Clings to vegetation or hides in clumps of dead leaves or sediment
Hellgrammite (Dobsonfly, Alderfly or fishfly Larva 	Up to 9 cm. Long	Cool or cold, slow to fast moving water	Through gills along side of abdomen; some fish flies have breathing tubes	Active predator	Can swallow prey without chewing

Name	Distinguishing Characteristics	Where Found	How Oxygen is Obtained	Food Gathering	Things to Look For
Water Strider Adult 	Skates on water's surface	Ponds or still pools of stream	From atmosphere	Active predator	Can stay on water's surface because feet have small surface area and are water repellant
Water Boatman Adult 	Long swimming hairs on legs	Ponds or still pools of stream	From atmosphere, by carrying air bubble from water's surface on body	Omnivore, herbivore, or scavenger	Has swimming hairs on legs that act as oars
Backswimmer Adult 	Light-colored underside; swims on back	Ponds or still pools of streams	From atmosphere, by carrying air bubble from water's surface on body	Predator	Swim on back, sleek body shape
Cranefly Larva 	Cylindrical body; often has lobes at hind end, may have small soft legs	Bottoms of streams and ponds in sediment and algae	From atmosphere through spiracles (openings) at hind end	Active predator, herbivore, or omnivore	Species that eat woody decaying matter have gut bacteria to digest cellulose
Mosquito Larva 	Small body; floats at surface	Cool to warm still water	From atmosphere through breathing tube, on hind end as a larva and front end as pupa	Scavenger —feeds on micro-organisms	Swims or dives when disturbed

Name	Distinguishing Characteristics	Where Found	How Oxygen is Obtained	Food Gathering	Things to Look For
Aquatic Sowbug 	Flattened body, top to bottom; 7 pairs legs	Shallow freshwater, among rocks and dead leaves	Through body surface on legs	Scavenger —eats decaying matter---or omnivore	Male clasps female under it during mating; female then sheds half of exoskeleton, which becomes case into which fertilized eggs are placed
Crayfish 	5 pairs of legs, first pair often robust; looks like small lobster	Under rocks or in burrows in shallow freshwater	Through gills under body	Scavenger or omnivore	Crawls backwards when disturbed; males display some courtship behavior to reduce female aggressiveness
Scud 	Flattened body, side to side swims on side	Bottom of lakes, streams or ponds, or streams	Through gills under body	Scavenger or omnivore	Male carries female on its back during mating; female then sheds half of exoskeleton, which becomes case into which fertilized eggs are placed
Midge Larva 	Small thin body with a hard head and small legs on the hind end	Most still and moving water habitats	Through body surface, small gills	Predator, herbivore, or omnivore	Extremely common; sometimes red because they have hemoglobin in their blood to help transport oxygen; wiggle actively
Rat-Tailed Maggot Larva 	Cylindrical body; tail-like breathing tube	Cool to warm water with low oxygen levels	From atmosphere through breathing tube	Scavenger —eats decaying matter and sewage	Can survive low oxygen levels fatal to most invertebrates

StreamWebs

Student Stewardship Network

Macroinvertebrate Sampling

Share your field data quickly and easily using StreamWebs. Find out what the macroinvertebrates you found say about your stream, keep track of your photopoints, graph water quality data, upload a video, and much more.

www.streamwebs.org

Name:_____

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

Water Quality Station

OBJECTIVES

Students will learn to:

- Perform 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 and other station topics.

MATERIALS

- LaMotte pH kit
- LaMotte DO test kit
- Air/water thermometer with string attached
- Turbidity tube & sampling bottle
- Waste container
- Gloves & used glove bag
- Goggles
- Laminated directions & charts: Temperature, Dissolved Oxygen, pH, Turbidity
- Images of pollution in waterways
- Rag or paper towels
- Data collection sheet

VOCABULARY

- Water quality
- pH
- Acid/acidity
- Base/alkalinity
- Dissolved oxygen
- Turbidity
- Turbidimeter
- Temperature
- Lethal limits

STATION PREPARATION

1. Set up your table on a flat area close to the water.
2. Set out all of the water quality test equipment and check that you have all the chemicals needed.
3. Review instructions for each of the 4 tests the students will conduct (pH, Dissolved oxygen, Turbidity, and Air/Water Temperature).

LESSON

Explain to students that water quality is a measurement of how clean or polluted the water is for the people or wildlife that need to use it. For example cold-water fish, such as salmon and trout, need water to be cooler than and dissolved oxygen levels above 11 mg/l for some life stages.

A good way to describe water quality is to use one of the following metaphors:

- 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. Have students brainstorm tests that are done at doctor's office.
- 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.

Salmon need the water to be **Cold, Clear,** and **Clean**. They also need enough oxygen to respire. We will take four measurements today:

- **Temperature** - Salmon need water to be **Cold**: cooler than 64° F or they find it hard to survive and thrive. What makes the water cold? (*1- Shade; 2- Deep water is colder than shallow water, 3- Fast moving water is colder than stagnant, still water.*)
- **Turbidity** - Have you ever driven over the river in the winter and it looks like chocolate milk? What is that actually? (*sediment/mud/soil*) Show picture of confluence of turbid and clean streams. How does the sediment get into the stream? (*Erosion - explain what might cause erosion.*) Turbidity a measure of how much 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 smoky or dusty. That sediment can also smother and kill salmon eggs. What helps keep sediment out of the water? (*Streamside vegetation and roots that hold the soil in place.*)
- **pH** - We measure pH as an indication of how **Clean** the water is. When we say clean, we mean no chemical pollution. How do chemicals get into the stream? (*From: vehicles - oil, antifreeze, tire chemicals..., parking lots, fertilizers and pesticides, livestock waste, and factories.*) pH tells us how acidic or basic the water is. The pH scale goes from 0 to 14. At the low end of the scale are the acids. Acids taste sour. A lemon, which is very acidic, has a pH of 3. At the high end of the scale are the bases. Have you ever had soap or shampoo in your mouth? Those are bases, they taste bitter. Salmon need water with a pH between 6.5 and 8.
- **Dissolved oxygen** - Do you know how much oxygen is in the air we breathe? (*Take guesses.*) It's actually 21%, so out of 100 parts of air, 21 of those parts are oxygen that we need to breathe. 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. How much dissolved oxygen do you think is in a healthy stream? (*Take guesses.*) Ok, it's actually 12...parts per MILLION. So out of a million parts of water, only 12 of those are going to be oxygen in a healthy body of water. We need to make sure there is enough dissolved oxygen for the fish to breathe.

Show the students the equipment and provide the whole group an overview of how to use the equipment. The **thermometer:** demonstrate and stress how it important it is to NEVER LET GO of the string attached to the thermometer, and to carry it carefully and place it gently into the water. The **turbidimeter:** show the group the black and white "pie" at the bottom and describe how to fill the tube and what to look for. The **pH kit:** do not get pH solution on your skin. Remind them that waste water with chemicals should always be emptied into the waste container after everyone has had a chance to see the results.

Most of the students can be sent to the stream with a chaperone and directions sheets to take turns (in mini-groups) with pH, turbidity, and temperature. Select the most attentive students to do the **Dissolved Oxygen** test with you. By the time you are at the titration phase of the DO test, students should have had a chance to try the three other tests and should return to the table to "witness the magic of science." Allow the students to pass the sample vial and each add one drop of sodium thiosulphate, swirl, and watch for color change. Be sure they are careful to **ONLY ADD ONE DROP** at a time so they don't miss the end point. Do NOT count drops, as this confuses them and is irrelevant.

DISCUSSION

Appoint someone to record the group's findings on the data sheet.

When all tests are complete, let each mini-group report the results of the first test they were assigned to. Ask: Based on the results of this water quality test, is this stream a suitable habitat for salmon? Why/why not? What are some of the things we can do to help reduce our impact on streams?

***Note**: Caution should be taken when handling and disposing of chemicals. Waste chemicals should be poured into the waste container provided in the equipment tub. Always wash your hands if you come into contact with testing chemicals*

pH Test

Materials

- LaMotte Precision pH Test Kit

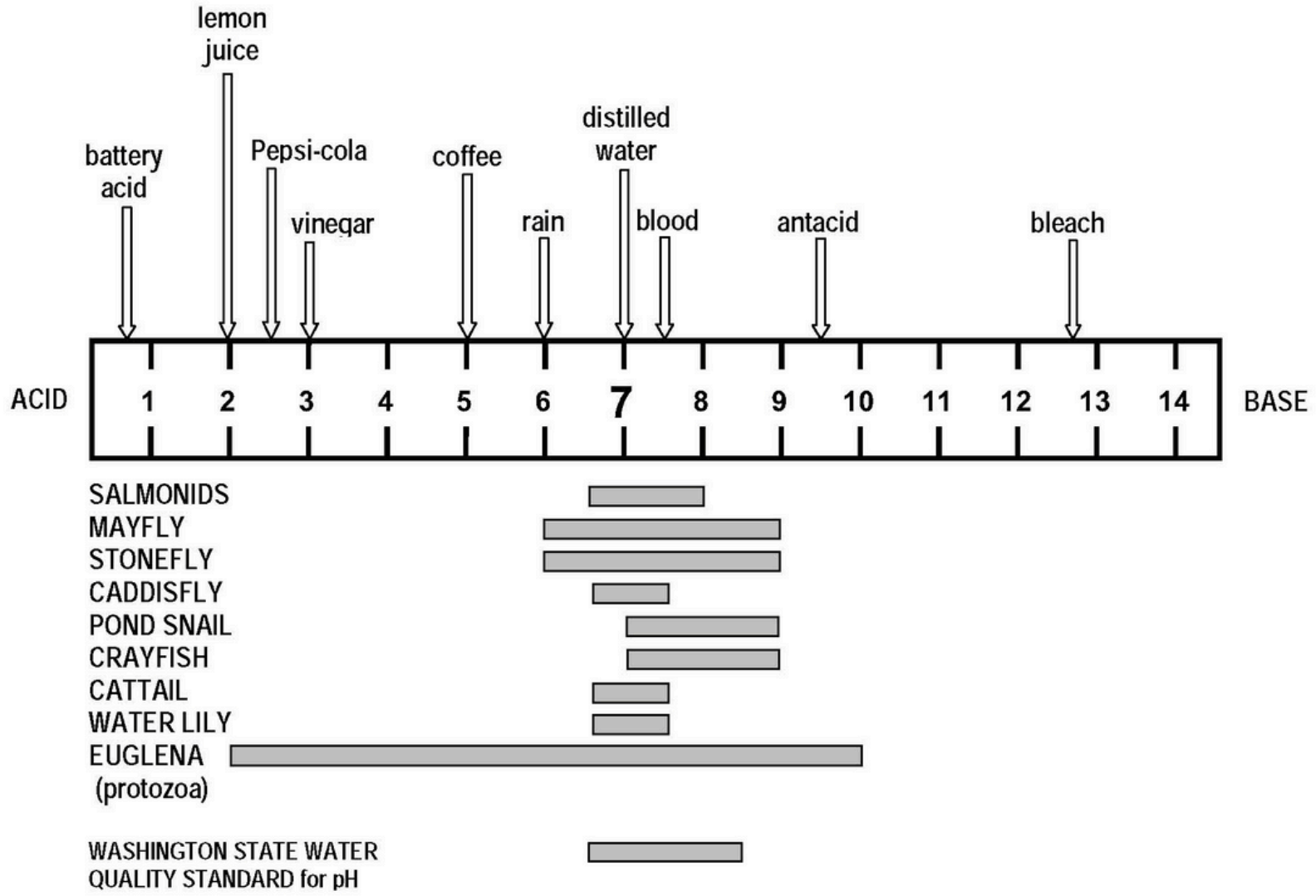
Procedure

1. Fill a test tube to the 10 mL line with sample water.
2. Add 10 drops of Wide Range pH Indicator.
3. Cap and invert three times to mix.
4. Insert Wide Range pH Octa-Slide 2Bar into the Octa-Slide 2 Viewer.
5. Insert test tube into Octa-Slide 2 Viewer.
6. With light streaming through from behind, match sample color to a color standard.
7. If necessary, switch the scale slide to find the best color match.
8. Record pH.

WARNING! This set contains chemicals that may be harmful if misused. Read cautions on individual containers carefully. Not to be used by children except under adult supervision.

Discussion

- Does the pH of the water that you tested fall within the lethal limits for aquatic organisms?
- What other liquids have a pH that is similar to the water you tested?
- What are we measuring when we test pH?
- Why does pH matter?
- How does water get more acidic/alkaline?
- How can we make sure that water doesn't get too acidic/alkaline?



LETHAL pH LIMITS FOR AQUATIC ORGANISMS

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

pH BACKGROUND INFORMATION

The concentration of hydrogen ions in a solution is called pH and determines whether a solution is acidic 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.

Water contains both H+ (hydrogen) ions and OH- (hydroxyl) ions. The pH test measures the H+ ion concentration of liquids and substances. Each measured liquid or substance is given a pH value on a scale that ranges from 0 to 14. Pure, de-ionized water contains equal numbers of H+ and OH- ions and is considered neutral (pH 7), neither acidic or basic. lf the sample being measured has more H+ than OH- ions, it is considered acidic and has a pH less than 7. lf the sample contains more OH- ions than H+ ions, it is considered basic, with a pH greater than 7.

The pH scale is logarithmic so a change of one pH unit means a tenfold change in acid or alkaline concentration. Water with a pH of five is ten times more acidic than water with a pH of 6 and 100 times more acidic than water with a pH of 7. 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 them 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. In eastern Oregon, where many soils have a high alkaline content, pH levels of some water bodies can rise above 10. Forest soils tend to be slightly acid and many lakes or streams in forested regions of Oregon can approach a pH of 6. The age of a lake can also influence pH. Young lakes are often basic. As organic materials build up, the process of decomposition forms organic acids and releases carbon dioxide. Carbon dioxide mixed with water forms carbonic acid, making the lake more acidic.

When rain falls through the atmosphere, the gases it comes in contact with come into solution. As rain absorbs carbon dioxide it becomes slightly acidic, but reaches a natural lower limit of pH 5.6. Air pollution, primarily from automobile exhaust and fossil fuel burning, has increased concentrations of sulfur and nitrogen oxides in the air. These fall with rain as weak sulfuric and nitric acids causing an "acid rain." Currently in portions of the eastern United States, the mean pH for rainfall is 4.3, approximately ten times more acidic than normal. Rainfall measuring just under pH 2.0 fell on Wheeling, West Virginia, in 1978. This was approximately 5,000mtimes the acidity of normal rainfall and is the most acidic rainfall on record.

Increased acidity has caused pH to exceed lethal levels for fish in many lakes. A U.S. government study estimated that 55 percent of the lakes and 42 percent of stream miles in the eastern United States are currently being subjected to acidic deposition, which will eventually lead to their deterioration. In addition, acid build-up in soils can has detrimental effects on forests and crops, and hinders natural nutrient recycling processes.

Because rain can fall a considerable distance from a pollution source, acid rain is a regional and global problem. Factors that determine the pH of a body of water can be far removed from a particular site, making it difficult to directly manage the pH. Because pH is a limiting factor, it is important to have a measurement to determine which organisms can survive and prosper. This measurement also serves as a baseline measurement and can assist in the monitoring of future changes.

Dissolved Oxygen Test

Materials

- LaMotte D.O. titration kit
- Goggles
- Gloves
- Rag or paper towels
- Waste container

Procedure

1. Participants don gloves and goggles.
2. Rinse and fill Water Sampling Bottle. Submerge bottle and hold upright under water. Place cap on while under water. Turn filled bottle upside down to make sure there are no air bubbles.
3. Bring to table and quickly uncap and add 8 drops of Manganous Sulfate Solution.
4. Immediately add 8 drops of Alkaline Potassium Iodide Azide.
5. Recap and mix thoroughly. Chunky precipitate forms.
6. Allow precipitate to settle below bottle shoulder.
7. Uncap and add 8 drops of Sulfuric Acid (red cap).
8. Cap and mix until reagent and precipitate dissolve.
9. Fill test tube to the 20 mL line with test solution.
10. Add 8 drops of Starch Indicator and cap. Swirl. Solution turns black/purple.
11. Fill titrator (syringe) with Sodium Thiosulfate to the zero line.
12. Titrate by adding one drop at a time and swirling until blue color disappears and solution is colorless. This happens suddenly so be careful not to overshoot the endpoint.
13. Read the number at the bottom of the titration plunger. This number equals the ppm of Dissolved Oxygen in the water sample.
14. Read result in ppm Dissolved Oxygen.

Note: Biological activity may cause rapid oxygen depletion. Dipping and pouring operations should be performed with as little agitation as possible.

Alternate Test: Chemets

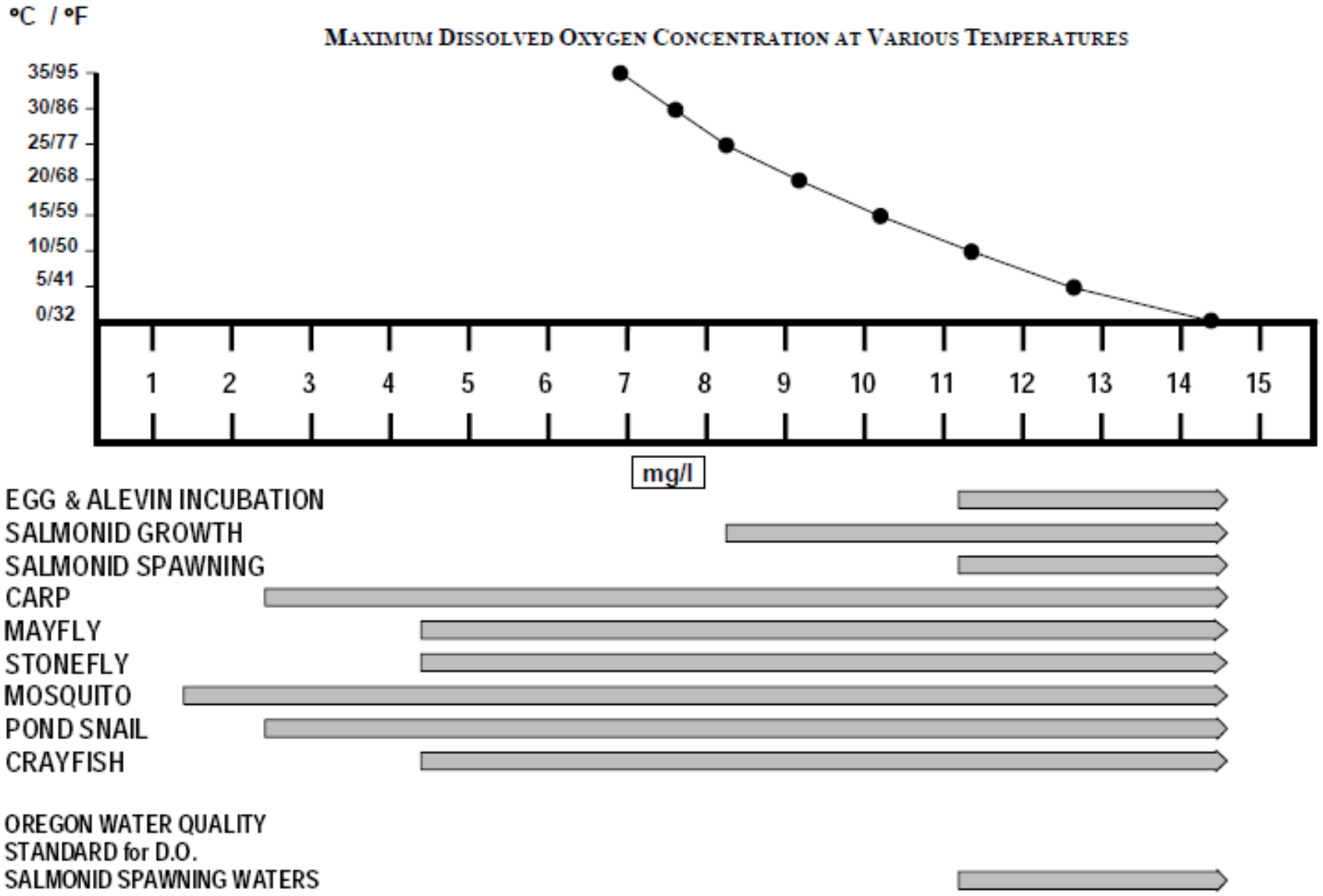
(not preferred - for when you are short on time.)

Procedure

1. Fill the sample cup to the 25 mL mark with the sample to be tested.
2. Place the ampoule, tip first, into the sample cup. Snap the tip. The ampoule will suck water up.
3. To mix the ampoule, invert it several times, allowing the bubble to travel from end to end.
4. Dry the ampoule and wait 2 minutes for color development.
5. Obtain a test result by placing the ampoule between the color standards until the best color match is found.

Discussion

- How is the amount of dissolved oxygen in the water that you tested compare to the optimum amounts of dissolved oxygen for different aquatic organisms?
- How does oxygen get in the water?
- What can affect levels of dissolved oxygen? (*Temperature, time of year, time of day, depth, plant growth)*
- How do animals breathe in the water?
- What are some anthropogenic (human-made) activities that can affect DO levels?



OPTIMUM DISSOLVED OXYGEN LIMITS FOR AQUATIC ORGANISMS

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

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, (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.

Effects of temperature on DO

Temperature directly affects the amount of oxygen in water-the colder the water, the more oxygen it can hold. Bodies of water with little shade can experience a drop in DO during periods of warm weather. Thermal pollution, the discharge of warm water used to cool power plants or industrial processes, can reduce DO levels. The area immediately downstream from the entry of warm water can be altered drastically. Thermal pollution generally occurs in larger streams. However, dilution will temper these effects as warm water mixes with colder water downstream. At higher altitude (elevation), the dissolved oxygen saturation point is lower than under the same conditions at lower altitude. Shown below are maximum amounts, or saturation levels, of dissolved oxygen (in ppm) in fresh water at sea level for different temperatures:

DO ppm	5	6	7	8	9	10	11	12	13	14	15
Temp °F	117	92	90	77	68	59	50	45	39	36	32

When aeration is high, DO levels can temporarily be higher than the saturation level. This extra oxygen is not stored in the water.

Photosynthesis, Oxidation, and Decomposition

Oxygen can also be added to water as a result of plant photosynthesis. During the day, plants can produce oxygen faster than aquatic animals can use it- This surplus is temporarily available throughout the night for plant and animal respiration. Depending on individual stream conditions, high daytime DO levels and low nighttime DO levels can occur.

Sediments can inhibit photosynthesis. Suspended sediments make water look murky or cloudy and block or reflect much of the sunlight that would otherwise be available for photosynthesis. Sediments can also settle onto the leaves of plants, further blocking their efficiency as oxygen producers.
The chemical oxidation and decomposition of dissolved, suspended and deposited sediments remove oxygen from the water. The amount of oxygen needed for these processes is called biochemical oxygen demand (BOD) and is oxygen that is unavailable for aquatic life. If the quantity of these sediments is large, remaining oxygen can be insufficient to support many forms of aquatic life.

Most DO problems in Oregon streams occur when temperatures are at their highest and streamflows at their lowest. Salmon and trout are especially at risk during this time. Fry are often limited to small spawning streams during these "pinch periods" and DO is critical to their development. While a juvenile Salmonid can withstand 1-2 ppm of DO for short periods, its growth rate drops sharply below 5 ppm, especially if the temperature is high.

Fish die-off in shallow, warm ponds is a fairly common occurrence during the Summer. During a long period of warm sunshine, algae grow profusely. A summer storm can result in several days of cloudy weather. The reduced sunlight can cause a massive die-off of the algal bloom. As dead algae decompose, available oxygen is depleted. The amount of DO drops to lethal levels, causing subsequent die-off of fish and other aquatic organisms.

Maintaining Productive DO Levels
To maintain productive DO levels in a stream, shade should be provided to keep water temperatures cool. The presence of in-stream structures ensures mixing of water and air. Materials that can increase BOD, such as manure from feedlots or untreated municipal waste, should not be introduced.

Testing Dissolved Oxygen
Oxygen enters the water from the atmosphere and from photosynthesizing plants in the water column. Its concentration in the stream is dependent upon ambient temperature and atmospheric pressure, but is usually within 6-10 ppm (parts per million). Concentrations can greatly exceed this within dense algae growths. Large amounts of dead and decomposing organic material can reduce dissolved oxygen levels below 5 ppm, and this places great stress on salmon.

Turbidity Test

Materials

- Turbidimeter (turbidity tube)
- Water sampling bottle
- Directions and chart

Procedure

1. Make sure bottom is sealed (closed), then fill clean turbidity tube to top with stream water using the water sampling bottle.
2. Stand with your back to the light (e.g. sunlight).
3. Hold tube vertically in front of you, not at your side, perpendicular to the ground with base resting on the ground.
4. Stand upright and look down into the turbidimeter. Do not bend down.
5. If black and white circle is visible, take reading.
6. If black and white parts of circle cannot be distinguished, press down to release water until they can be. Then take reading.
7. Use the conversion chart (below) to convert the reading (in cm) to NTUs.
8. Use the Optimum Turbidity for Aquatic Organisms Chart to interpret the results.
9. If time allows, check turbidity in different parts of the stream and compare.

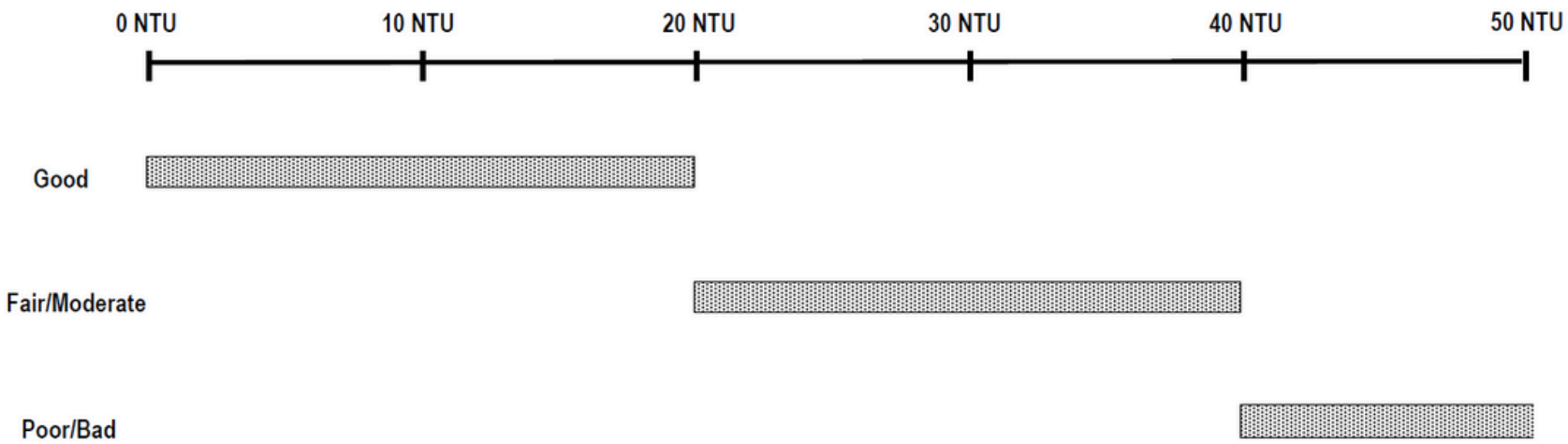
Discussion

Turbidity relates to how clear the water is. If you are getting a high turbidity reading, i.e. exceeding the limits for a healthy salmon stream (see chart), what do you think might be the source of the turbidity? Is this a natural occurrence? Describe the impact/activity (i.e. natural or human) that might be contributing to your high reading. What, if anything, could be done to try to decrease the turbidity at this site?

Length to Turbidity Conversion Chart

cm	NTU	cm	NTU
< 6	> 240	31 to 34	21
6 to 7	240	34 to 36	19
7 to 8	185	36 to 39	17
8 to 9	150	39 to 41	15
9 to 10	120	41 to 44	14
10 to 12	100	44 to 46	13
12 to 14	84	46 to 49	12
14 to 16	60	49 to 51	11
16 to 19	48	51 to 54	10
19 to 21	40	54 to 57	9
21 to 24	35	57 to 60	8
24 to 26	30	60 to 70	7
26 to 29	27	70 to 85	6
29 to 31	24	> 85	< 5

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

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, shift 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.

Sediment Types

Bedload sediments are too heavy to be constantly suspended. They are rolled and bounced along the bottom of a stream. The size of a particle of bedload sediment will vary with the volume and speed of the water. Spawning gravel is often transported as bedload sediment during high winter streamflow. Periodic fluctuations in the amount of sediment and bedload being transported are natural occurrences. Suspended sediments are those carried in suspension. Rapidly flowing water can carry more suspended sediments than slow-moving water.

A gradient of deposition exists and is determined by stream flow velocity, volume, and sediment size. Heavier sediments settle out first, followed by successively lighter materials. As velocity decreases, as from the center of the stream out toward its edges, or slow water area, the finest sediments settle to the bottom, no longer suspended by the action of water.

Total suspended sediment (TSS) is a measure of how much sediment a stream is carrying. Suspended sediments can give water a murky or cloudy appearance by reducing light penetration. Turbidity is the term used to describe and measure the degree to which light is blocked.

Helpful and Harmful Sediments

Sediments dissolved in water can be beneficial or harmful to the aquatic community. Some are nutrients essential to life. Others can be minerals or salts that change water pH or are poisonous to life. The measure of solids dissolved in water is called total dissolved solids (TDS). TDS levels higher than 500 ppm make water unfit for consumption. In western Oregon, 200 communities get at least part of their water supply from municipal watersheds. Currently, because of its high quality, little treatment is needed to make most of this water fit for domestic use.

Manufacturing of high-quality paper products and beer depend on availability of clear, clean water. High concentrations of sediments make water unfit for these processes without expensive filtering. Suspended sediments can block or reflect sunlight before it reaches aquatic plants. Heavier sediments can cover leaves, inhibiting photosynthesis, or even bury plants. Sediments affect insect life in a body of water. Large amounts of sediments can smother some species. A change in the bottom material and the type, number, and health of plants changes the habitat, and therefore, the species composition of the insect community.

Today, although industrial and municipal wastes receive more attention, sediments are the nation's primary water pollutants. Erosion is the source of most sediment. Agriculture is responsible for more erosion than any other single activity, but road construction and use, timber harvest, forest fires, and other sources contribute. Heavy concentrations of sediments increase the cost of municipal water treatment, can be harmful or fatal to aquatic life, and are indicators of excessive erosion.

High sediment levels also adversely affect fish. Very high concentrations of suspended sediments

can irritate and actually clog gill filaments, causing fish to suffocate. Bedload sediments deposited in the channel change the composition of gravel beds used for spawning. This can reduce the amount of oxygen available to the eggs by blocking water circulation, trap fry in the gravel, or reduce the amount and types of food needed during different stages of development.

Importance of Vegetation

Excessive sedimentation and the problems it causes can be controlled by reducing erosion. Surface runoff is the primary cause of erosion and can be prevented with adequate plant cover during periods of runoff. Plants and the organic material they add to t soil lessen the force of falling rain, add structure to the soil, and increase the soil's ability to absorb and hold water. When surface runoff does take place, leaves and stems of plants trap debris and sediment that would otherwise be carried into streams.

As a stream meanders across a floodplain, it moves sediments and deepens its channel. Riparian vegetation is especially important in the control of these sediments. Plants along streams help prevent bank erosion.

Testing Turbidity

Turbidity will be discussed as it relates to sediment load in a stream. Choose several areas of the stream to check for turbidity.

Temperature Test

Materials

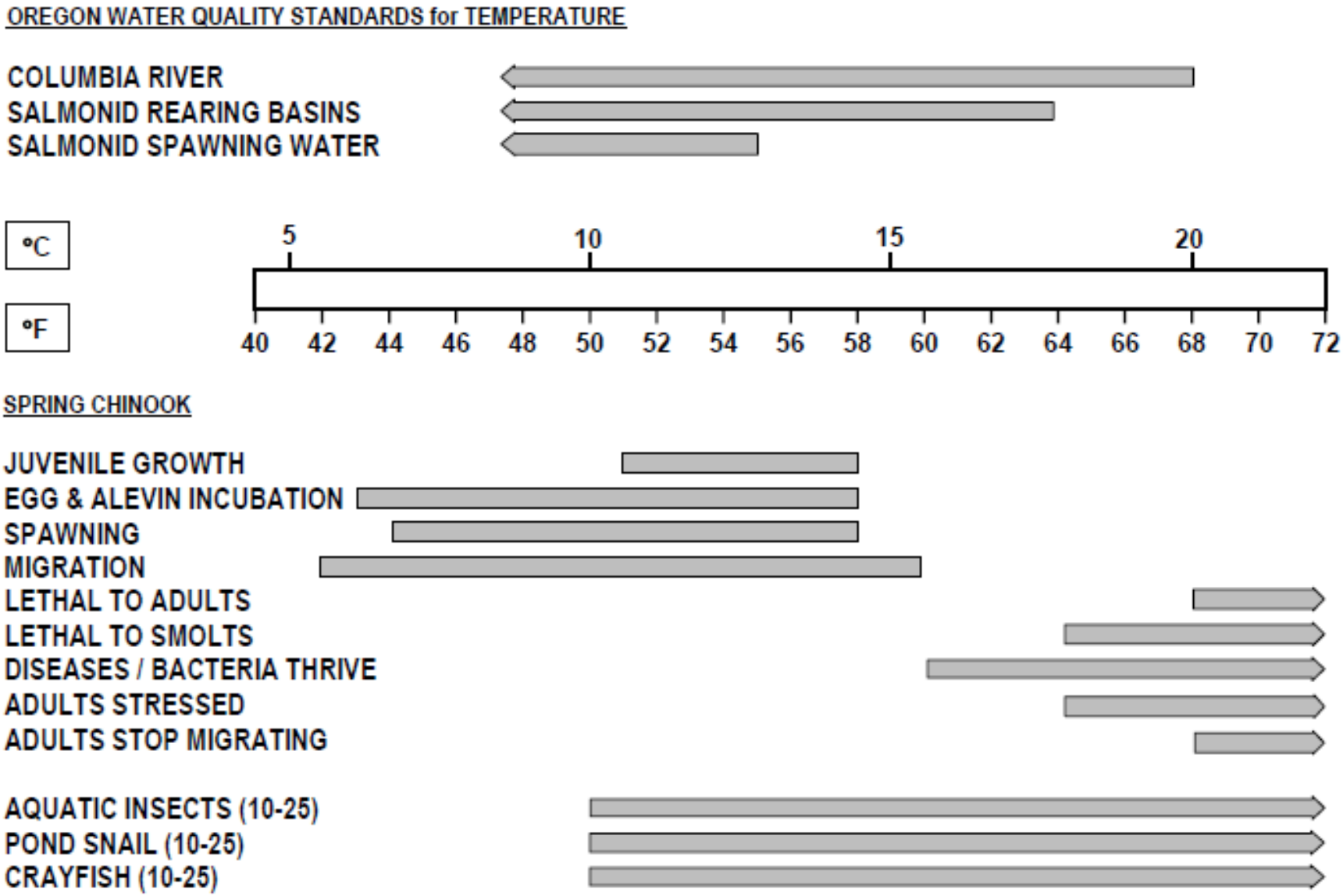
- Armored thermometer on string or plastic ribbon (flagging tape)
- Directions and temperature chart

Procedure

1. Take air temperature first. Make sure thermometer is in the shade, not direct sun. Wait 3 minutes before taking reading.
2. Take water temperature. While continuously holding onto the string attached to the thermometer, gently place the thermometer into the water. NEVER release the string. NEVER toss or swing the thermometer.
3. Wait about 3 minutes for thermometer to reach equilibrium before taking reading. If possible, take the reading while the thermometer is submerged in the water.
4. Record results
5. If time permits, take reading in multiple locations.

Discussion

- Why should we care about water temperature?
- What would happen to animals if the water was too cold or too warm? To plants? To nutrients?
- How does the water in this stream get to be this temperature?
- How does the water stay cool?
- How does the water get too warm for fish to survive?
- How are temperature and dissolved oxygen related?



Optimum Temperature Limits for Aquatic Organisms

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

TEMPERATURE BACKGROUND INFORMATION

Water Temperature
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.

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. 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 a stream 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 water.

Air Temperature and 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 will be. 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 stream flow (volume of water) 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 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.

Water temperature is crucial for salmon survival. Salmon can survive in water ranging in temperature from 42-77 degrees Fahrenheit, but do best in water around 55° F. A chart is provided that illustrates the Optimum Temperature Limits for Aquatic Organisms.

StreamWebs

Student Stewardship Network

WATER QUALITY DATA FORM

Share your field data quickly and easily using StreamWebs. Find out what the macroinvertebrates you found say about your stream, keep track of your photopoints, graph water quality data, upload a video, and much more.

www.streamwebs.org

School: _____

Teacher: _____

Date: _____ Time: _____

Stream/Site Name:_____Lat_____Long_____

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

TEST	Sample 1	Sample 2	Sample 3	Sample 4
Water temperature ☐°C ☐of				
Equipment used?	Vernier ☐ Manual ☐	Vernier ☐ Manual ☐	Vernier ☐ Manual ☐	Vernier ☐ Manual ☐
air temperature ☐°C ☐of				
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 ☐

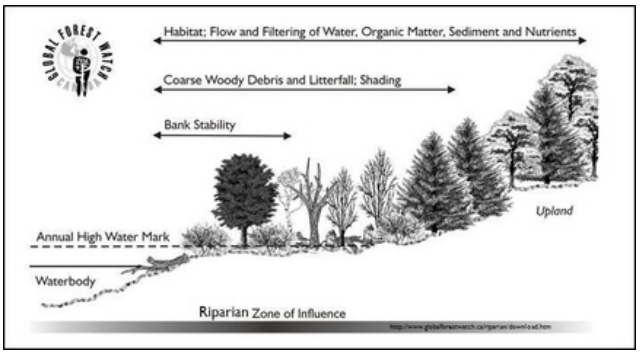
Adapted from: Environmental Services City of Portland

Riparian Ecology

OBJECTIVES

Students will learn:

- The basic definition of a riparian area.
- The condition of any riparian area greatly affects the water quality and aquatic habitat of the water body it surrounds.
- Riparian areas provide functions or 'jobs' in the watershed, but only if they are in healthy, functioning condition.
- The four main functions of riparian areas.
- Many aspects of the riparian area AND the stream channel must be studied to understand conditions and make management decisions.



MATERIALS

- BINGO Cards with functions on back
- Native & invasive plant cards
- Scientist data sheets: Aquatic Biologist, Botanist, Geologist, and Forest Biologist
- Measuring tape
- Field ID guides
- Flora & Fauna Riparian Survey

INTRODUCTION

A riparian area is the area of land surrounding a water body. We also call them stream banks and river banks, or shores. All water bodies have riparian areas, even puddles, oceans, wetlands, rivers and lakes etc. *Show riparian area cross section sheet and ask students to pair share about what they see in the picture. Ask for volunteers to share observations back to group.* Do all riparian areas have trees? No, some riparian areas have been modified into parking lots or buildings, but they are still riparian areas. Riparian areas are important to know about because *healthy* riparian areas serve several *functions* in the watershed. Functions are like jobs or services that nature does to help keep the watershed healthy. Riparian functions include: **bank stability, shade, water storage and filtering, and wildlife habitat**. *Laminated signs are displayed for riparian cross section and each function.*

Bank Stability (or erosion control) Lots of roots hold the soil in place, especially during winter floods. Erosion is the separation of soil particles by water or wind. Some erosion is natural, but too much erosion is a form of pollution. A mix of native trees, shrubs, and grasses is best for stabilizing stream banks. Willow trees are really good at holding soil in place because their roots grow so fast and the trees don't mind being broken by floods, they just keep growing. Turbidity is a measure of how much fine soil (or sediment) particles are in the water. Fine soil particles can suffocate fish eggs and clog the gills of fish. Students may have measured turbidity already at the water quality station.

Shade is another important function of healthy riparian areas. What makes a riparian area shady? Tall trees! Shade helps keep the water cool in the stream, which is really important to salmon and trout because cooler water holds more oxygen, and fish need dissolved oxygen to survive. Ask if they tested for dissolved oxygen in the water quality station. Warm water is actually a pollutant and is a problem in our watersheds.

Water Storage and Filtering. When water flows over the ground it is called runoff. It picks up pollution and carries it to the nearest water body. This occurs during heavy rains and excess irrigation. The pollution might be animal waste from pets or livestock, loose soil at a construction site, or litter and oil on the road. Ask if students can think of other types of pollution. Runoff can be

slowed down by riparian vegetation and allowed to infiltrate the soil below, which stores and cleans the water.

Wildlife Habitat. Riparian areas are places where wildlife can find food, shelter, and a safe place to rear their young. Riparian areas have water on one side and uplands on the other side, which creates habitat diversity. Native plants, such as trees, shrubs, and flowering plants, provide important food for insects, birds, and other wildlife. Aquatic organisms benefit from riparian vegetation as well. Macroinvertebrates eat the leaves and wood that drops into the stream. Insects and other macroinvertebrates then get eaten by fish and fish become food for humans or other wildlife, or they die and become fertilizer for riparian plants. When trees fall into the stream they help create important habitat structure for salmon by forming pools, little water falls, and places for young fish to hide from predators.

LESSON OPTIONS

We have created several options so you can pick and choose the activities that work best for you and for the age you are teaching.

Option 1: Riparian BINGO (Best for elementary and middle school): Students work in small teams to look for the elements listed on the Riparian BINGO cards. The instructor can walk the whole group around and point things out or allow the teams to wander on their own (within sight of the instructor).

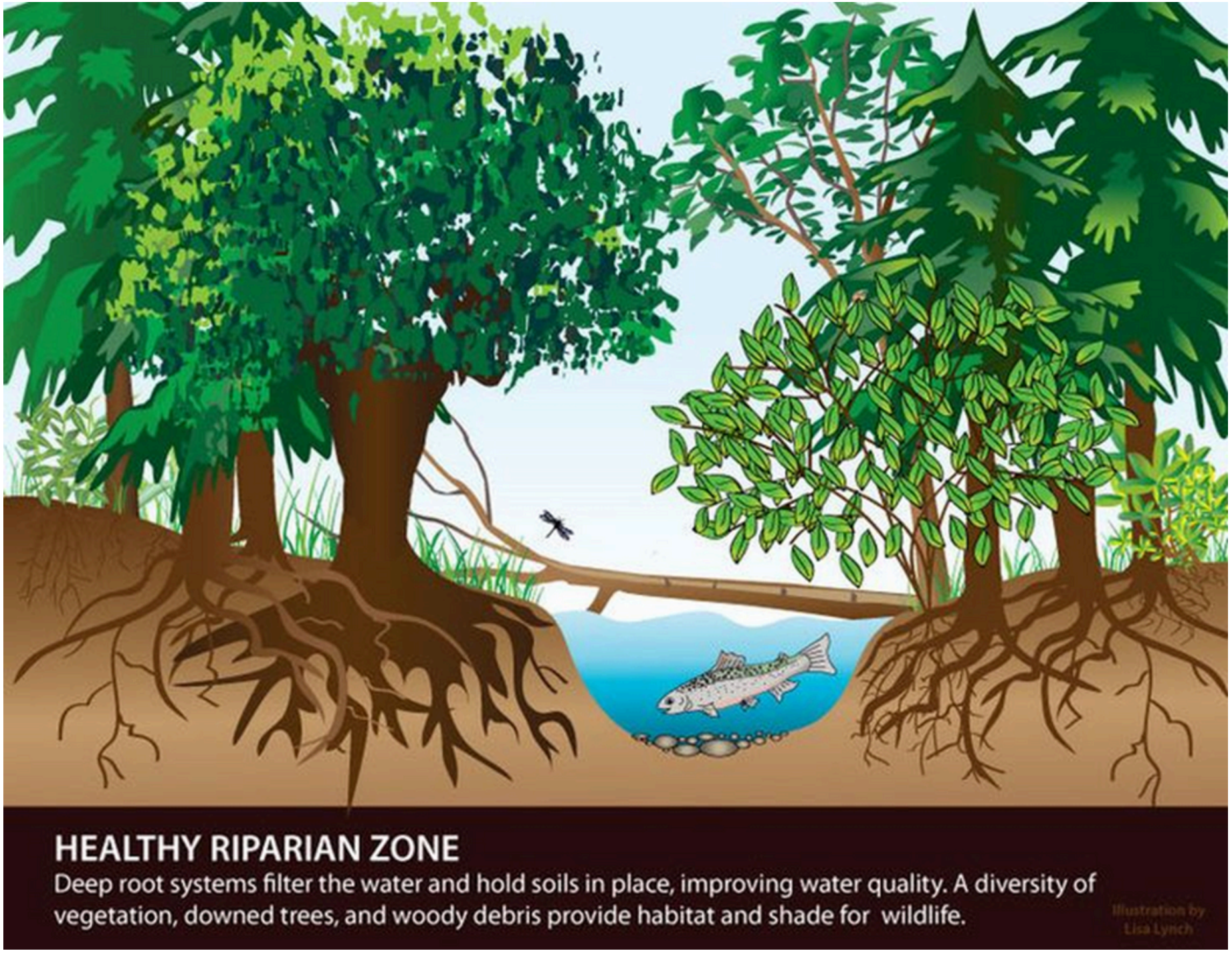
Option 2: Flora and Fauna Survey (Best for elementary and middle): Students can work as small teams or with the whole group + instructor to survey for the elements in the Flora and Fauna Survey. Calculate health of riparian area on the back side of the survey.

Option 3: Scientist Surveys (Best for high school or independent learning): Students perform the duties of different types of scientists. They will conduct a quick assessment of the riparian area. They break into small groups to act as Forest Biologists, Aquatic Biologists, Geologists, and Botanists. Directions are provided on the data sheets so they can complete tasks with minimal supervision, but always within view of the instructor.

Supplemental: **Native & Invasive Plant Cards** (can be used to augment option 1-3 above): Cards can be handed out to students for them to point out when they see that plant as the group walks around. Alternatively, the instructor can place the cards around the park at the base of plants that are represented, then have students pick them up and share about the plants when you see them. A third option is to hand out the cards to the students at the beginning of the session and introduce themselves to each other (as that plant), or have students find 2-3 things their plant has in common with another student's plant. Or they can be useful in helping students doing the Scientist Surveys to identify plant species in their survey plot.

DISCUSSION

- Ask students if they think this is a healthy riparian area based on what their teams found.
- Ask students if they think this riparian area can support salmon.
- Wrap up with discussion on how the riparian area supports each of the functions.
- Ask / remind students what the 4 functions are.



HEALTHY RIPARIAN ZONE

Deep root systems filter the water and hold soils in place, improving water quality. A diversity of vegetation, downed trees, and woody debris provide habitat and shade for wildlife.

Illustration by Lisa Lynch

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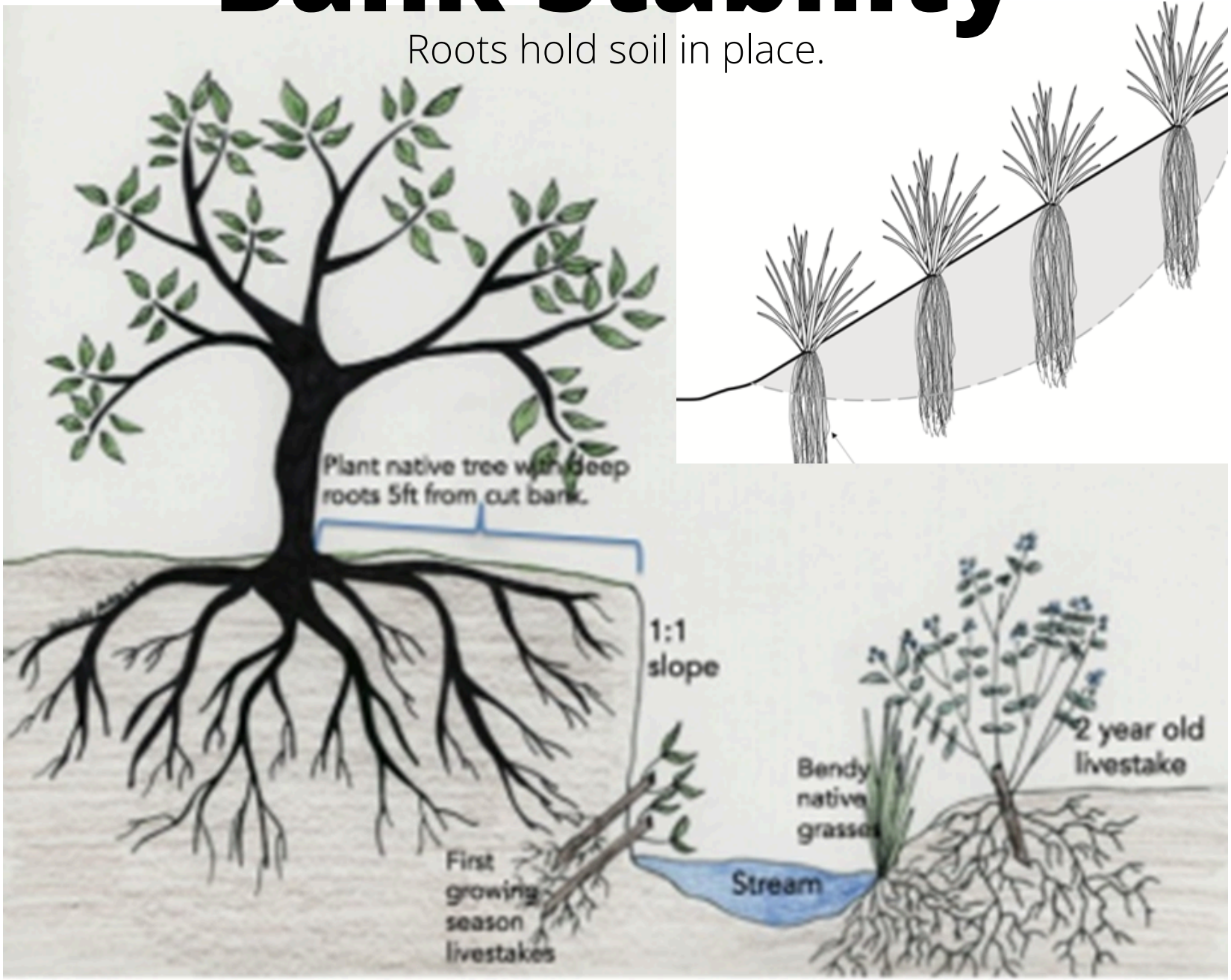
Shade

Shade keeps water cool; colder water holds more dissolved oxygen.

Bank Stability

Roots hold soil in place.

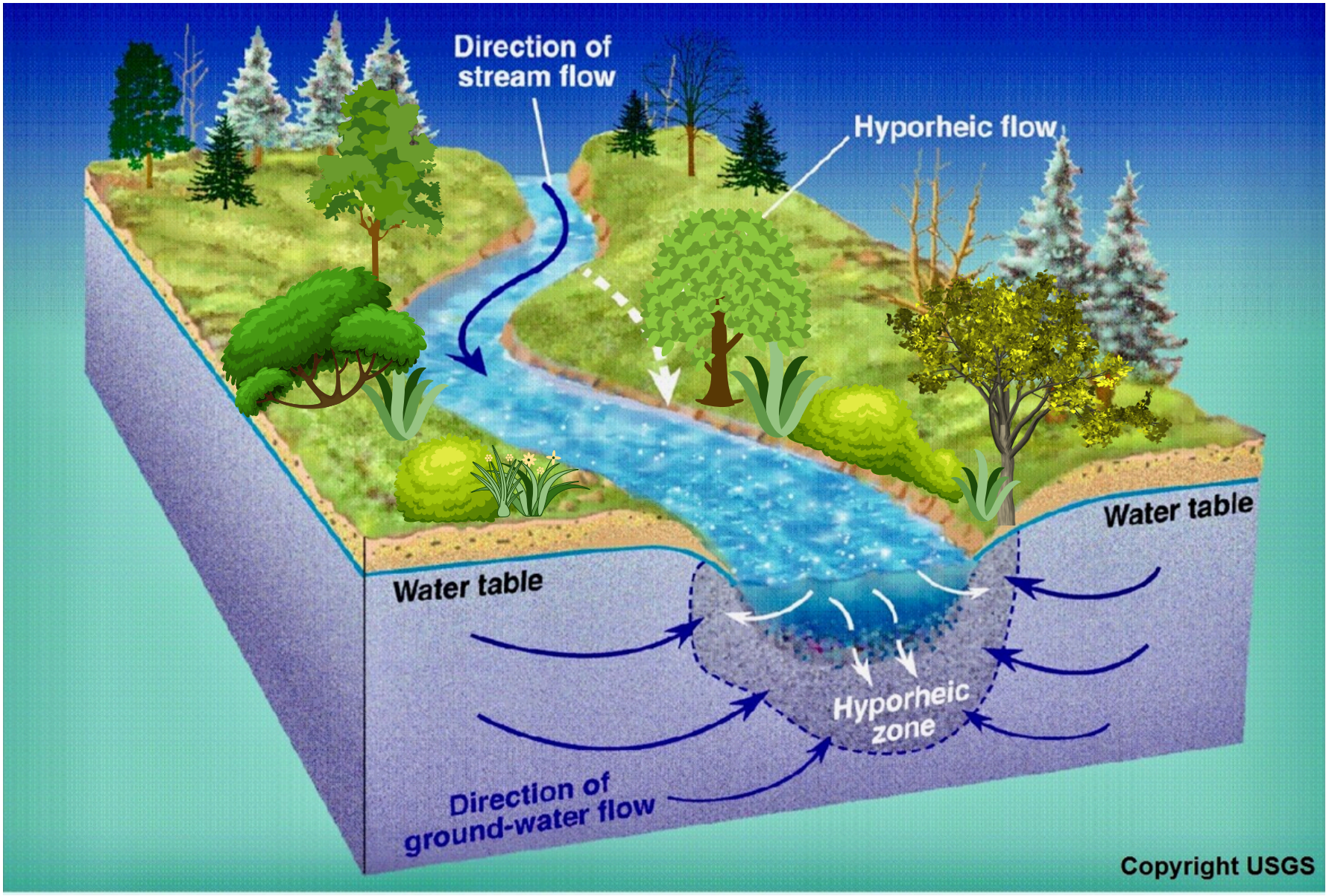


Wildlife Habitat

Vegetation provides food, nesting materials, and shelter.

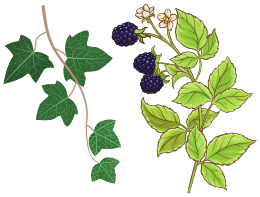
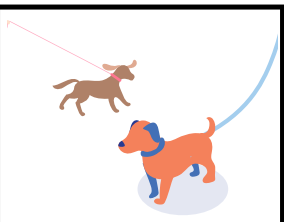
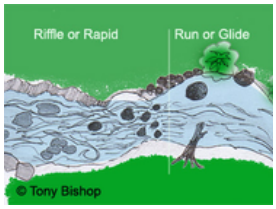
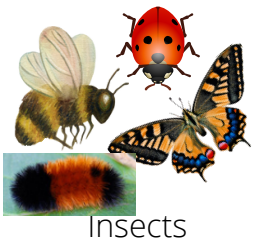
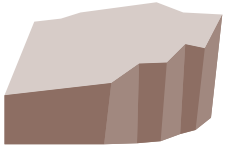
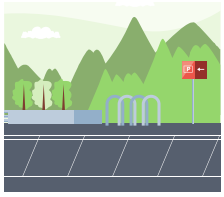
Water Storage and Filtering

Vegetation slows down runoff; soil soaks up water, then filters out pollutions and releases it slowly to the stream.



RIPARIAN BINGO

4 Riparian Functions
- Wildlife Habitat
- Shade
- Bank Stability
- Water Storage & Filtering

Substrate	Plants	Negative Impacts	Animals	Stream Parts
 Some Bare Soil for ground-nesting bees	 Low-growing Plants	 Invasive Plants	 Dogs	 Woody Debris
 Pebbles blueberry to kiwi size	 Ferns	 Erosion	 Birds Dipper, Kingfisher	 Leaf Packs
 Cobbles lemon to cantaloupe size	 Salal	FREE	 People	 Riffles &/or Runs
 Boulders watermelon or bigger	 Oregon Grape	 Litter	 Insects	 High Water Marks
 Bedrock	 Shrubs - Snowberry, etc	 Pavement	 Wildlife Signs	 High Water Marks

FLORA AND FAUNA SURVEY

A healthy riparian zone needs many types of flora (plants) and fauna (animals from deer to insects). A riparian area with high biodiversity (variety of life forms) can indicate a healthy forest and river. Sometimes invasive species and human impacts have negative impacts on riparian health.

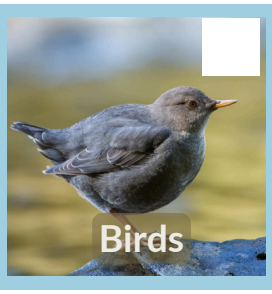
Use this guide to check off items as you find them. Then answer the questions on the back side to determine the health of this riparian area.

NATIVE PLANTS

+1 each

ANIMALS

+1 each



OTHER

+1 each

INVASIVE PLANTS

-1 each

HUMAN IMPACTS

-1 each

RIPARIAN HEALTH SCORE CALCULATION

1. Count the number of items in the Native Plants Group that you found: _____
2. Count the number of items in the Animals Group that you found:_____
3. Count the number of items in the Other Group that you found:_____
4. **Add up the above 3 numbers and write the total here:**_____
5. Count the number of items in the Invasive Plants group that you found:_____
6. Count the number of items in the Human Impacts Group that you found:_____
7. **Add the above 2 numbers and write the total here:**_____
8. **Subtract line 7 from line 4 and write the total here:**_____

RIPARIAN HEALTH SCORE KEY		
8-10	**4-7**	**0-3**
Healthy	**Somewhat Healthy**	**Needs Improvement**

DISCUSSION

- Did you find more native plants or more invasive plants? Why do 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?

SCIENTIST SURVEYS

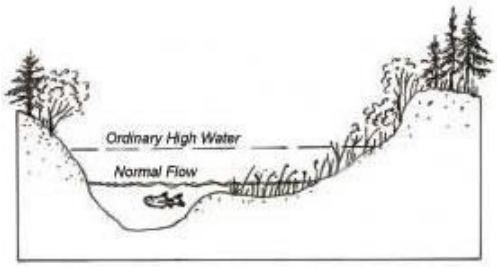
Students perform the duties of different types of scientists. They will conduct a quick assessment of the riparian area. In the professional world, scientists study many different things in and surrounding a riparian area to understand how healthy it is. Then they make recommendations about how to improve the function of the riparian area. This is much like a doctor uses test data to understand how healthy your body is, and then prescribes a treatment, if needed.

Split group into 4 small teams, preferably each with an adult. Each team receives the corresponding data sheet, a clipboard, and pencil or wet erase marker. Materials for each team are listed on the instruction sheet. Each team will appoint a recorder. Remind students they have less than 20 minutes to complete the survey, so they must use the time efficiently!

SITE PREPARATION

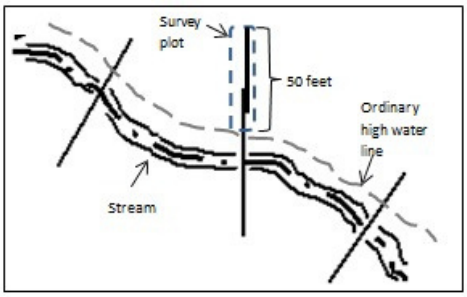
Geologist and Habitat Biologist Stations

1. Use a tape measure to measure out a 100 ft line along the stream.
2. Place cones or pin flags along the line to divide it into 4 equal sections.



Botanist Station

1. Start at the water's edge and look away from the stream. Find the **ordinary high water line**, or where most of the plants begin growing on the bank.
2. Measure or estimate 50 feet from this line up into the riparian area. Visualize a 10 foot wide strip along this 50 foot line. That is your survey plot. (If available, use second measuring tape and 10 ft rope to delineate survey area.)



ACTIVITY

1. **Botanists** use the Botanist data sheet to study vegetation types and riparian width.
2. **Aquatic biologists** use the Aquatic biologist data sheet to conduct a stream survey and an instream habitat survey.
3. **Forest biologists** use the canopy cover data sheet to conduct a canopy cover survey.
4. **Geologists** use the Geologist data sheet to conduct a substrate survey (rocks and sediment that cover the ground).

CONCLUSION

Each team reports on what they found. **The group totals all station scores to get a RIPARIAN HEALTH score**. Use this for final discussion.

BOTANISTS

SURVEY METHODS

1. Observe your survey plot and place an “X” in the box that corresponds to each vegetation type you see.
2. Then record the total number of vegetation types you observed by placing an “X” in the corresponding box of the Vegetation Cover data table. Circle the score.
3. Using the same survey plot, observe how far back the plants and trees are growing from the edge of the stream bank. For our purposes, this will represent the extent of the riparian area. Compare the width of the riparian area to the width of the stream behind you. Record your guesstimate by placing an “X” in the corresponding box on the Riparian Area Width data table. Circle the score.
4. In the Plants Identified data table, write the name of any plants or trees you can identify, such as willow or Oregon ash or Reed canarygrass, and write about its role in the health of the riparian area for discussion purposes. See data table for examples.

ANALYSIS

- Did you find all vegetation types in your plot or just one or two? The more types you found, the better diversity you have which is good for riparian function. Bare ground or gravel does not count as a vegetation type.
- Of the vegetation you found, was there a lot of each type? This would be good.
- Was there a lot of bare ground? The soil could easily erode into the stream. Bare ground also means there aren’t as many plants for wildlife habitat.
- Is the riparian area at least as wide as the stream width? This would be good. A wider riparian area can better provide functions for the watershed. Is this riparian area providing these functions? Riparian functions: erosion control, shade to the channel, filtering runoff, providing habitat.

CONCLUSION

- How healthy is this riparian area?
- How could this riparian area be improved?
- What would you plant and why?
- Would you preserve it the way it is?

BOTANIST DATA SHEET

School: _____ Date: _____

Stream Name: _____ Weather: _____

MATERIALS field guides, data sheet and instructions, clipboard, wet erase marker

Vegetation Type	Shrubs & Short trees	Coniferous canopy trees	Deciduous canopy trees	Grasses & Ferns	Small Plants	Gravel	Bare Soil
Place an **X** in the box for each vegetation type observed							

Vegetation Diversity	4-5 vegetation types present, cover dense	4-5 vegetation types present, cover sparse	1-3 vegetation types present	Bare ground and gravel >30% of plot	Bare ground and gravel >50% of plot
Place an **X** in the corresponding box					
	10	7	4	2	0
SCORE	Excellent	Healthy	Fair	Unhealthy	Poor

Riparian Area Width	Greater than 1 stream width	Approximately equal to the stream width	Less than 1/2 the stream width
Place an **X** in the corresponding box			
	10	7	5
SCORE	Excellent	Healthy	Fair

Plant Species Identified	**Significance to riparian area** *(e.g., low habitat value, outcompetes natives, provides food, provides shelter, erosion control)*

BOTANY SCORE 1 (Vegetation Diversity) _____

BOTANY SCORE 2 (Riparian Area Width) _____

AQUATIC BIOLOGISTS

Survey Methods

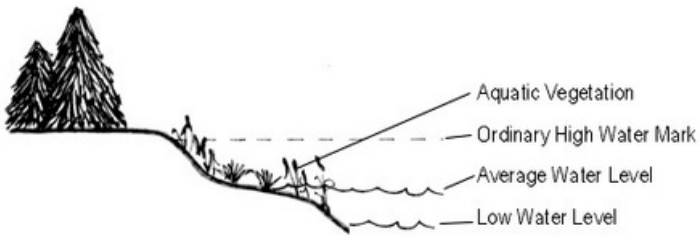
1. Survey along the 100 ft line, which is broken into 4 equal sections, or reaches, marked by cones or pin flags.
2. Note whether the number of pools and riffles are equal, close to equal or unequal by placing an X in the corresponding box on the Pools & Riffles data table. Circle your score.
3. Walk your reach again, noting the presence or absence of the habitat types listed on the Instream Habitat Assessment data table. Count every habitat type observed between the ordinary high water marks on either bank. Place an "X" in the box for each habitat type found.
4. Tally how many types were found overall. Circle the score that corresponds to the number of habitat types found.

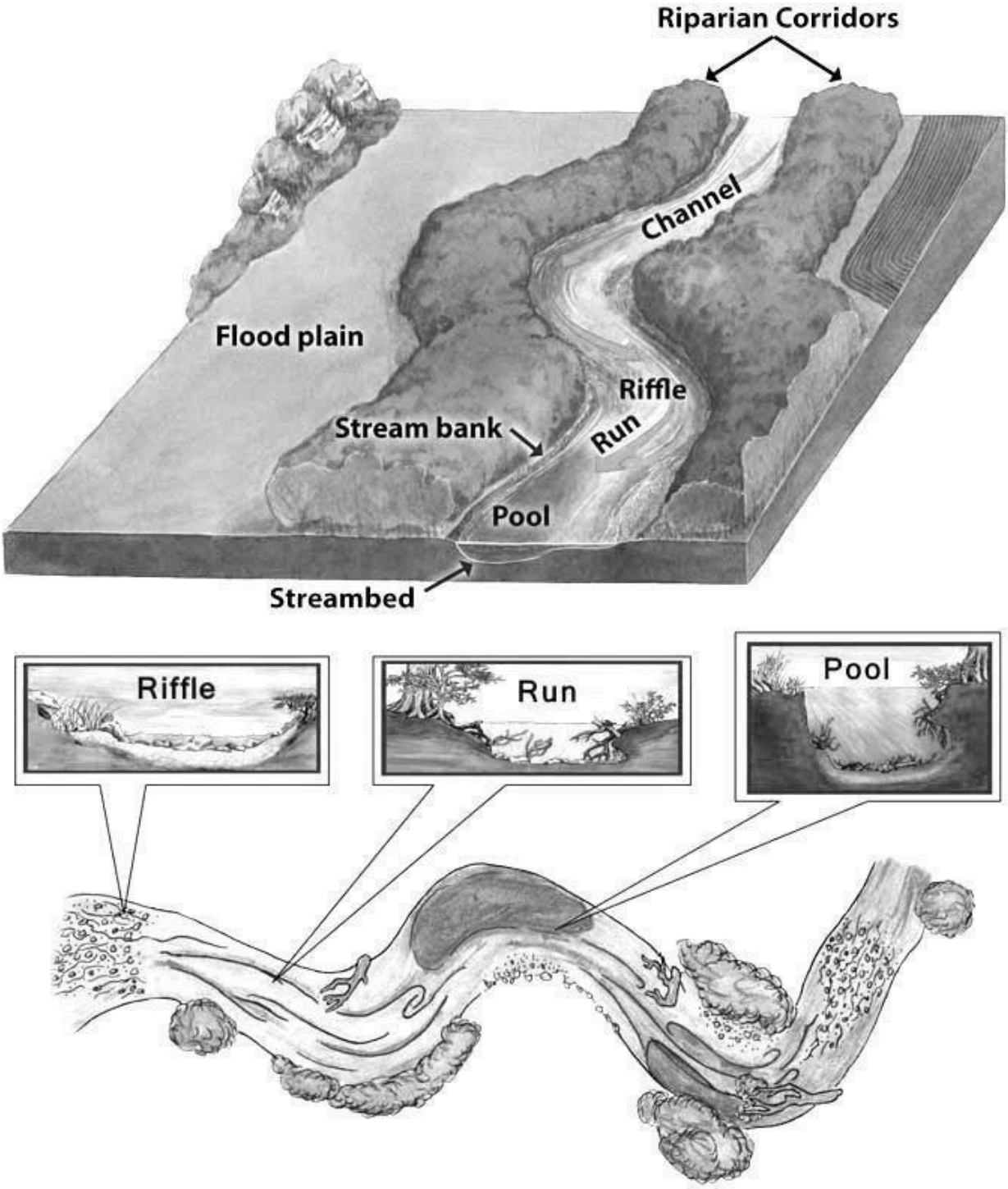
Analysis

- Riffles or rapids add dissolved oxygen to the water. The best habitat for salmon has 1/3 or more riffle area in the stream. Do you see many riffles in the reach?
- What would happen to the riffles if there was a landslide or lots of erosion upstream? They might fill in with sediment and become smooth.
- Did you see all eleven habitat types? Habitat diversity is important for a healthy stream. Having habitat diversity means that more animals (fish, macroinvertebrates, etc.) can utilize the riparian and stream habitats.

Conclusions

- What would you recommend for management?
- How would you create more pools in the stream, if needed?
- Will large wood naturally fall into the stream or should it be placed there?
- By looking at your stream reach, do you see signs of erosion upstream, or erosion in the reach?





RIFFLE: Shallow water; fast current' turbulent surface; substrate gravel to boulders. In big rivers these are called rapids.

RUN: Deeper than a riffle, with moderate to fast current; surface not as turbulent; substrate small gravel to rubble.

POOL: deep, slow-moving water with a flat surface; substrate usually silt, sand or small gravel.

AQUATIC BIOLOGIST DATA SHEET 1 (POOLS and RIFFLES)

School: _____ Date: _____

Stream Name: _____ Weather: _____

Materials Measuring tape, Clipboard / pencil

Stream Survey	Reach 1	Reach 2	Reach 3	Reach 4	Total
# of riffles					
# of pools					
# of runs					
Comments/ Notes					

Pools & Riffles	Equal number of pools & riffles.	Close to equal # of pools & riffles.	Many more of one or the other.	No pools or riffles
Place an **X** in the corresponding box				
	10	7	3	0
SCORE	Excellent	Healthy	Unhealthy	Poor

AQUATIC BIOLOGY SCORE 1 (Pools & Riffles) _____

AQUATIC BIOLOGIST DATA SHEET 2
(INSTREAM HABITAT)

Instream Habitat Assessment	Reach 1	Reach 2	Reach 3	Reach 4
Small Woody Debris – 6-12 inch diameter and over 10 feet long. Count all pieces, above and below the water, from high water line to high water line.				
Logs / Large Woody Debris – Over 24 inch diameter and over 35 feet long. Count all pieces, above & below the water, from high water line to high water line.				
Pools – Smooth, undisturbed surface, slow current.				
Riffles – Broken water surface, rocky or firm substrate, moderate to swift current.				
Overhanging Vegetation – Trees, shrubs, vines, or other plants hanging immediately over the stream surface.				
Boulders/Cobbles – Boulders are larger than a bowling ball, cobbles are baseball to bowling ball sized.				
Undercut Banks – Eroded areas extending horizontally beneath the surface of the bank forming underwater pockets.				
Thick Root Mats – Dense mats of roots and rootlets at or beneath the surface of the water form invertebrate habitat and fish cover.				
Thick Stands of Water Plants – Beds of emergent, floating, or submerged aquatic plants provide invertebrate habitat and fish cover.				
Disconnected Pools or Side Channels– Pools that have been cut off from the main stem of the stream provide macroinvertebrate habitat.				
Leaf Packs – Floating and submerged packs of leaves provide habitat for macroinvertebrates and fish cover.				

Instream Habitat	9-11 habitats present	7–9 habitats present	5–6 habitats present	3–4 habitats present	1–2 habitats present
Place an **X** in the corresponding box					
	10	7	5	3	1
SCORE	Excellent	Healthy	Fair	Unhealthy	Poor

AQUATIC BIOLOGY SCORE 2 (Instream Habitat) _____

FOREST BIOLOGISTS - CANOPY COVER

Materials

spherical densiometer, canopy cover data sheet, wet erase marker

Survey Methods

1. With a partner take one sample of canopy cover in each cardinal direction.
2. Imagine your spherical densiometer (SD) has letters in each square proceeding alphabetically
3. corresponding to the data sheet.
4. Standing at the edge of the water, hold the SD 12" – 18" in front of your body at elbow height so that your head is just outside of the grid area. Do your best to keep the SD steady.
5. Facing the stream, tell your partner which lettered boxes to fill in based on the boxes that are 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.)
6. Repeat step 3 while facing away from the stream, downstream and upstream.
7. Add shaded boxes for all directions to get your estimated canopy cover percentage.
8. Place an "X" in the corresponding box of the data table to indicate the amount of canopy cover you estimated and record this score as the FOREST BIOLOGY SCORE below the table.

Analysis

- Was the area at least 75% shaded?
- Why is this important? *By keeping the sun's rays from reaching the surface of the water, shade helps keep water temperatures down. Salmon are cold water fish, and can only survive and breed in cool water.*

Conclusion

- Is there sufficient shade along the stream?
- What would you recommend for management?
- What would happen if trees were cut down along the stream?

FOREST BIOLOGIST DATA SHEET

OSU Oregon State University Extension Service **StreamWebs**™

Student Stewardship Network

Canopy Cover Survey

Share your field data quickly and easily using StreamWebs. Find out what the macroinvertebrates you found say about your stream, keep track of your photopoints, graph water quality data, upload a video, and much more.

www.streamwebs.org

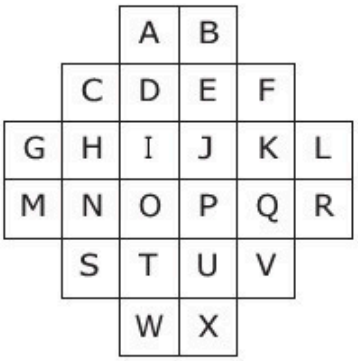
Name: _____

School: _____

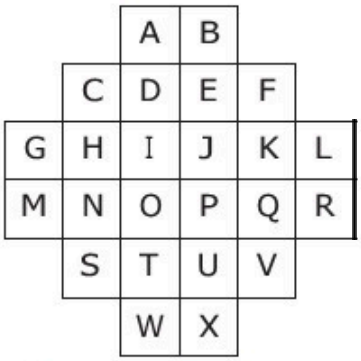
Teacher: _____

Date: _____ Time: _____

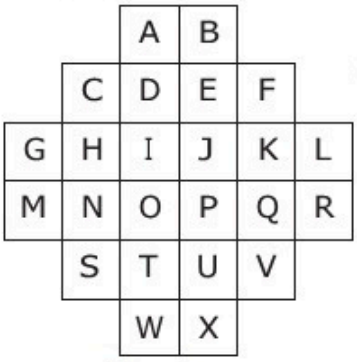
Stream/Site Name: _____ Weather: _____



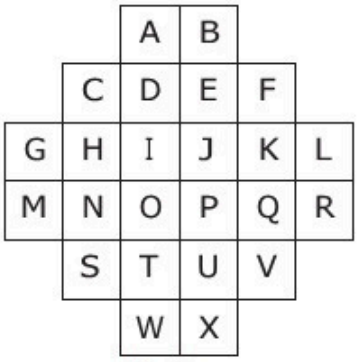
Facing stream
Shaded Boxes _____



Facing away from stream
Shaded Boxes _____



Downstream
Shaded Boxes _____



Upstream
Shaded Boxes _____

_____	+	_____	+	_____	+	_____	=	_____
Facing stream		**Away from stream**		**Downstream**		**Upstream**		***Estimated %***

Canopy Cover	**> 75% shaded**	**50 – 75% shaded**	**20% – 50% shaded**	**< 20% shaded**
Place an **X** in the corresponding box				
	10	7	3	1
SCORE	Excellent	Healthy	Unhealthy	Poor

FOREST BIOLOGY SCORE_____

GEOLOGISTS

SURVEY METHODS

1. This survey will study the substrate on the channel bottom between the high water marks. If water is too high, too fast, or too cloudy to see through, this survey cannot be performed.
2. You will survey along the 100 ft line, which is broken into 4 equal sections, or reaches, marked by cones or pin flags.
3. Take a moment to observe the whole unit and determine which types of substrate are present.
4. Make estimates of the percentage of each substrate type on the data sheet. Percentages in the column for each stream unit should equal 100. Use the pictures above the data table to help with percentage estimates.
5. Note if there is any erosion observed in or near the stream reach or if there are areas of the reach that are not visible. Do not go into the water above mid-calf. Record your observations in the comments section of the Substrate Type data table.
6. Note whether gravel and cobble make up 80% or more of the total reach area (all four reaches), and the percentage of silt observed. Record your answers in the data table by placing an "X" in the corresponding box and circle your score. Record the score as the GEOLOGY SCORE at the bottom of the data sheet.

ANALYSIS

- Did you see very much silt or fine sediment? Where do you think it came from? Is this a good thing? *Fine sediment is natural, but too much can clog fish gills and suffocate fish eggs.*
- Describe in what parts of the stream you found the smaller particles like silt and sand. Where were the larger particles like cobble and boulders? How did they get there? How is this placement related to the amount of stream flow?
- If there was more large wood in the stream, how would the substrate change? *Large wood helps slow down the water, so smaller substrate can fall out of suspension upstream of the large wood. It may also scour out the finer sediments downstream of the large wood as water spills over the large wood and picks up speed.*
- Do you think salmon would want to spawn here? *Salmon want to spawn in clean, cobbley and gravely riffles.*
- What does the substrate tell you about watershed conditions?
- Does the stream usually flow fast or slow here?

CONCLUSIONS

What would you recommend for management upstream, and what would you change in this reach to make better habitat?

GEOLOGIST DATA SHEET

School: _____ Date _____

Stream name: _____ Weather _____

MATERIALS

Measuring tape, boulders and substrate data sheet and instructions, clip board and pencil


10%


30%


50%


70%


90%

Substrate Type	Percent Substrate in Reaches (%)			
	1	2	3	4
Silt / organic matter (silt is smooth like mud)				
Sand (settles to the bottom when disturbed)				
Gravel (pea to baseball size)				
Cobble (baseball to bowling ball size)				
Boulders (larger than a bowling ball)				
Bedrock (solid rock)				
TOTAL (= 100%)				
Gravel + Cobble				

Substrate Suitability	Gravel + Cobble >80% in 3-4 reaches	Gravel + Cobble >80% in 2 reaches	Gravel + Cobble >80% in 1 reach	Gravel + Cobble >80% in no reaches
Place an **X** in the corresponding box				
	10	7	5	1
SCORE	Excellent	Healthy	Fair	Poor

Notes or Comments:

GEOLOGY SCORE: Substrate Suitability _____

OVERALL RIPARIAN HEALTH

Survey	Significance	Riparian Function	Score
Botany 1: Vegetation Diversity	Insects, birds, and animals use different plants for survival. The more types of native plants present, the more species can live here.	Bank Stability Shade Water Storage & Filtering Wildlife Habitat	
Botany 2: Riparian Area Width	The quality of the riparian zone increases with the width and complexity of the vegetation within it.	Bank Stability Shade Water Storage & Filtering Wildlife Habitat	
Aquatic Biology 1: Pools and Riffles	Pools: important resting & feeding sites. Riffles: critical for maintaining high species diversity and as spawning and feeding grounds.	Wildlife Habitat	
Aquatic Biology 2: Instream Habitat	A variety of in-stream habitats provide shade and cover, allowing fish to hide from predators and have enough oxygen throughout the year.	Shade Wildlife Habitat	
Forest Biology: Canopy Cover	The canopy shades the riparian area and water, helping to keep water cool and limit algal growth. Cold water can hold more oxygen than warm water.	Bank Stability Shade Water Storage & Filtering Wildlife Habitat	
Geology: Substrate Suitability	Salmon need gravel to cobble-sized rocks for their redds. Too much sediment can suffocate fish and eggs.	Wildlife Habitat	
TOTAL			

Riparian Health	Total ≥ 50	Total 35-49	Total 15-34	Total < 15
Enter your score in the corresponding box.				
Riparian Value	**Excellent**	**Healthy**	**Fair**	**Unhealthy/ Poor**
	This riparian area is very healthy and provides excellent erosion control, shade, habitat for wildlife, water storage and filtering.	This riparian area is healthy and provides adequate erosion control, shade, habitat for wildlife, water storage and filtering.	This riparian area could be in better condition. It provides some functions to some degree and may not provide one or more functions adequately.	This riparian area is not healthy, and does not provide some or any of the functions necessary to the watershed.

DISCUSSION

- Is our riparian area healthy?
- Does it provide the necessary conditions for a healthy watershed?

Opening Circle

Where are we?

Ask the students where we are, the name of the park, the name of the river. Then ask them if they know what a watershed is.

What is a watershed?

Get some responses. Then show them the watershed laminated drawing. Describe: A watershed is the area of land draining to a central water body. Any water that falls in the watershed will eventually wind up in a common drainage (this might be a lake or a river). Anything on the surface of the watershed can be picked up by the rain or run off and moved into the water body. So everything in the watershed is connected.

What watershed are we in?

We are in the North Santiam Watershed, which is part of the Willamette Watershed. Where does the North Santiam River flow into? The Willamette. Where does the Willamette flow into? The Columbia. Where does the Columbia flow into? The Pacific Ocean. The salmon that are born here in this river swim out to the Willamette, then the Columbia and then to the Pacific. They go all the way almost to Russia! Up past Alaska! They make a journey of over 3000 miles and today we will discover why they do that and why they come back here to complete their life cycle.

Tribal Connection

The North Santiam Watershed is the traditional homelands of the Kalapuya Peoples, who traditionally inhabited the Willamette Watershed. Today, the descendants of these peoples are members of the Confederated Tribes of the Grand Ronde and the Confederated Tribes of Siletz Indians. 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.

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

Here is a Kalapuyan legend about salmon: 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.

All of these animals have gifts and responsibilities to mother earth. They have been here since the beginning and honour their responsibilities every day. We also have responsibilities to the land, water and sky. While we are visiting our stations today, ask yourself what you can do as one person, and what we can do as a community, to stay in balance with the land, water, and sky? How can we act responsibly to care for this place we share with the other animals and plants?

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

Developing a Hypothesis

So, why are we here today? We are here to answer a question. The question is: is this a healthy place for salmon to spawn? (check for understanding on terminology). Asking a question is the first step in the scientific method.

The next step in the scientific method is to develop a hypothesis or educated guess. Give me a thumbs up if you think this is a healthy place for salmon to spawn. A thumbs down if you think this is not a healthy place for salmon to spawn. Thumbs sideways if you think it is in between.
Now that we have our hypotheses, we will move through four stations to collect data that will either support or refute our hypotheses. As you collect data, remember to talk about what human actions help or harm the health of this system. We will circle back up at the end of the day to discuss how our data supported or refuted our hypotheses.

If you have time...

On a final note, many forms of wildlife can be seen at Packsaddle Park. Here are two techniques to help maximize how much wildlife you observe today.

1. Fox Walk. (foxes are predators, they need to be stealthy to sneak up on there prey. Put your heel down, then the outer edge of your foot, then roll your whole foot down. Take a few steps like this to see how much quieter you can be. This will help you approach the salmon (and other species) without them swimming or flying away. Salmon are incredibly sensitive to vibration.
2. Deer Ears. Cup your hands around your ears and listen. Deer use their large ears to detect threats, like predators. Take 15 seconds to use your deer ears, you may hear even more if you close your eyes to help you focus. Slowly move your cupped hands away from your ears and then back around them and notice the difference. What did you hear with your deer ears?

Safety and Respect

- Leave sticks and rocks on the ground where you found them. Please don't pick them up today and do not throw them. We don't want to scare or harm the fish or each other.
- At macros you will be able to go in the water. Do not go in water past mid-calf.
- Never drink the water.
- Leave this place as good as or better than you found it.
- Treat fellow students, parent chaperones, teachers, and station leaders with kindness.

Now I am going to send the groups off with their instructors.

Closing Circle

The Hypothesis

Now you have visited all four stations and you have collected data and made observations that might support or refute your hypothesis. Do you remember what your hypothesis was this morning? Please raise your hand and tell us what your hypothesis was.

The Data

Did the data from the water quality support or refute the hypothesis? Was the water Cold, Clear, and Clean? Who remembers what the water temperature was? For spawning, salmon need water that is cold, clear, and clean… Water quality tests important components of a stream, which tell us what can and can't live there.

How about the riparian station? Is this a healthy riparian habitat? Riparian areas provide important functions (erosion control, water filtering and storage, habitat, and shade)

What macroinvertebrates did you find today? What do they tell us about the health of the river? Macroinvertebrates are indicators species—they are sensitive to their environment and their presence tells us something about the habitat they live in. Stoneflies, mayflies, caddis flies – indicate clean water.

And what did you see at the salmon biology station? Did you see salmon spawning? Salmon are keystone species (other species in the ecosystem depend on them and their functions), there presence tells us a lot about the health of a water body

How Can You Help?

Remember the Kalapuyan story I told at the beginning of the field trip? The salmon gave its body to the humans for food. And the humans have a responsibility to care for the salmon and the other animals in return. How can we help care for the animals, and the land and water?

Thank you for coming to Salmon Watch today. *(Have students help you clean up and carry items back to the parking area.)*


Shared Waters
WILLAMETTE VALLEY