The Greenway Education Program is supported in part by:

Lake Washington · Cedar Sammamish · Watershed

Washington State Parks

The Russell Family Foundation

Grousemont Foundation

King County
Department of
Natural Resources and Parks
Wastewater Treatment Division

King County Flood Control District

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Mountains to Sound Greenway

Forests and Fins

Science Journal

This journal belongs to:

_____

My teacher is:

_____

My school is:

_____

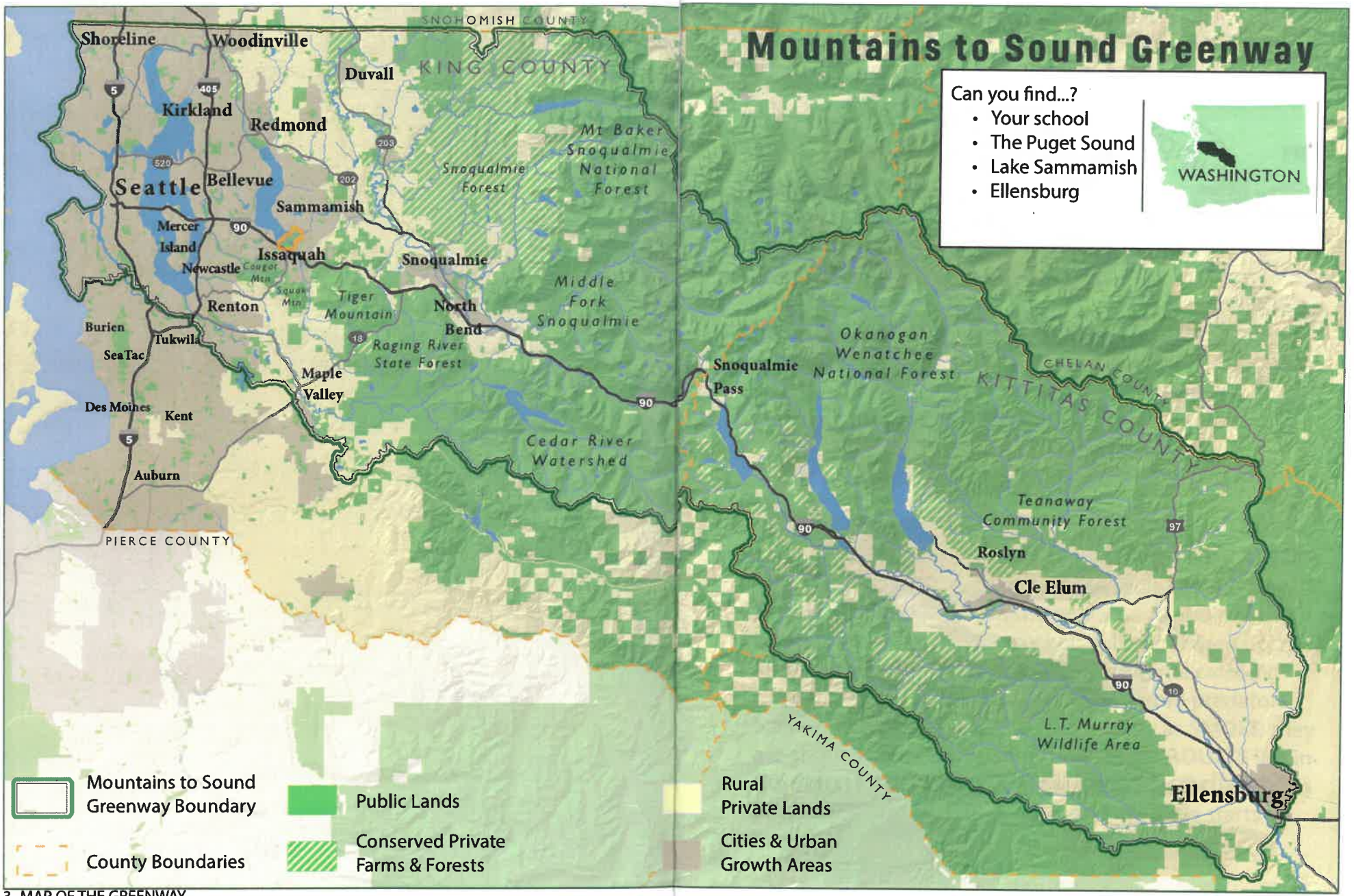
PICTURE THIS!

Draw the healthiest salmon stream habitat you can imagine. Label your drawing. Use both pages.

Feel free to look back in your journal!

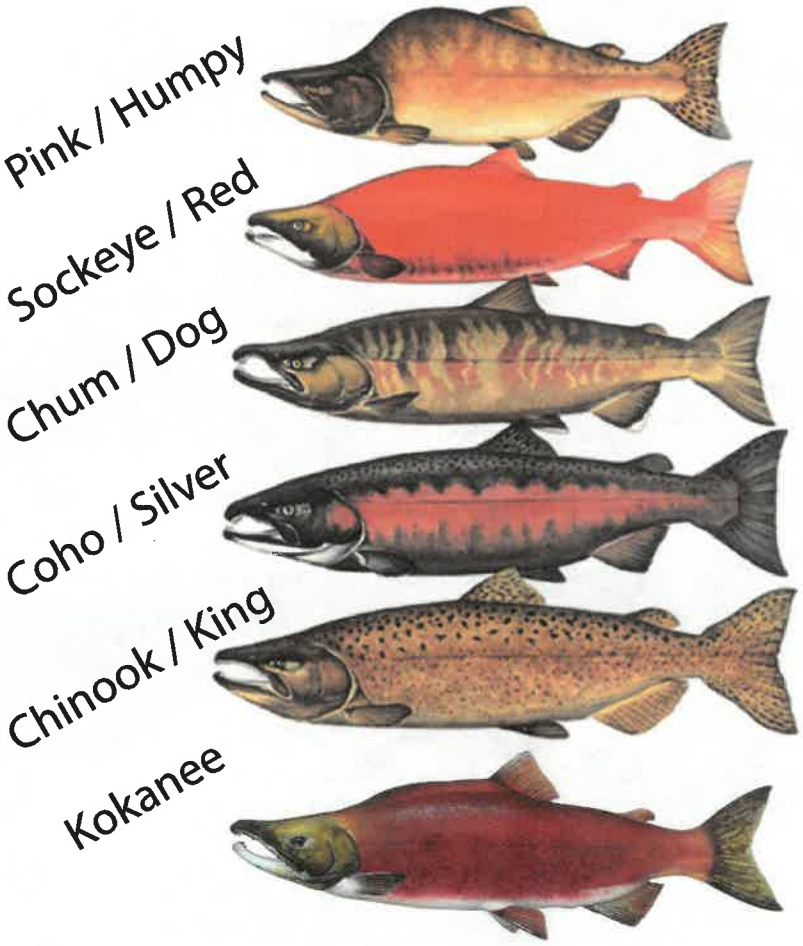
Date: _____

Welcome to the Greenway!



PNW Salmon Species

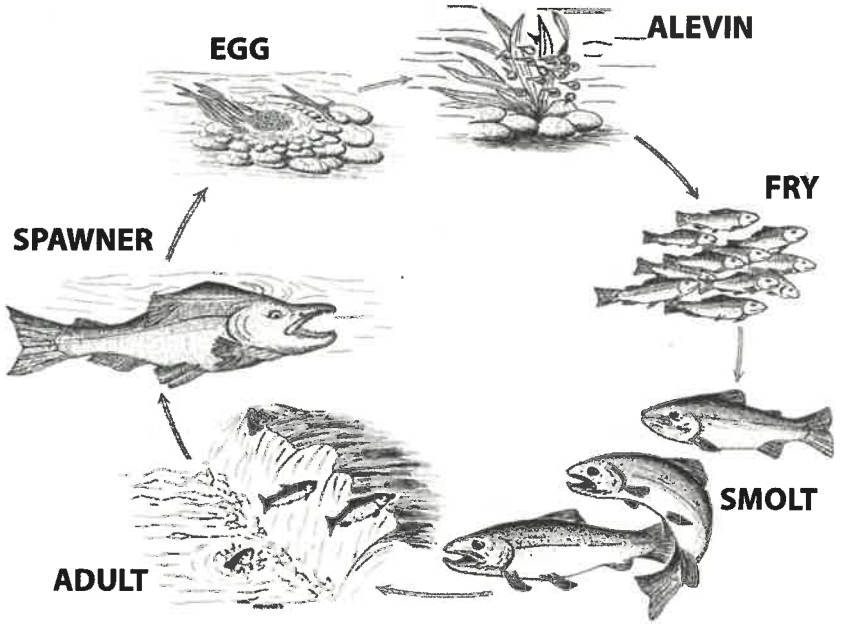
Ask your Greenway Educator how to remember the species using your hand.



Steelhead Trout

Cutthroat Trout

Salmon Life Cycle



Salmon begin their life as **EGGS** in a freshwater stream. The baby fish that hatch from the eggs are called **ALEVIN**. They get all their nutrients from their yolk sac and stay in their nest (redd), safe in the gravel and cobble at the bottom of the stream. When their yolk sac is used up, they leave their redd as **FRY** and spend their time catching macro-invertebrates (bugs) and hiding from predators. Salmon swim downstream to the estuary as **SMOLT**; they are about 5 inches long, shiny and silvery. **ADULTS** live in the ocean for 2-5 years. Then they return to the stream as **SPAWNERS,** lay their own eggs, and the cycle starts all over again!

MACRO-INVERTEBRATES
Background Info

Macro-invertebrates are small animals that are big enough to see without a microscope (*macro* = "big") and that have no backbone (*invertebrate* = "no backbone"). Macro-invertebrates include snails, insects, worms, crayfish, and leeches.

One way we can determine the health of the stream is by studying what kinds of macro-invertebrates live in the stream. They are called an **indicator species** because their presence shows how healthy the stream is. Some kinds of macro-invertebrates can live in polluted water and some can only live in very clean water.

Group 1 macro-invertebrates can only live in very clean water. They cannot live in polluted water.


STONEFLY (nymph)


CADDISFLY (larva)


MAYFLY (nymph)


SNAIL (right opening)

Group 2 macro-invertebrates can live in clean water, but they can also handle some pollution.


SOWBUG


SCUD


CRAYFISH


DOBSONFLY (larva)


WATER BOATMAN

Group 3 macro-invertebrates can live in a wide range of water quality, from very clean to very polluted.


MIDGE (larva)


AQUATIC WORMS


SNAIL (left opening)

MACRO-INVERTEBRATES
Directions

Remember: You are measuring the health of the stream habitat, not the health of the bugs.

1. First, you are going to **practice** sorting macro-invertebrates.

   Take out the deck of cards and the "Macro Mania" poster from your Greenway backpack.

   This is a matching game. As a group, **match** the macro-invertebrates on the cards with the correct group on the poster: Group 1, Group 2 or Group 3.

   How many bug cards are in each group? Talk about what that tells you about the health of the stream they came from.

2. **Ask** your Greenway Educator where and how you should collect real macro-invertebrates from the stream.

3. **Collect** macro-invertebates from the stream. Do your best to **figure out** what they are called and **use tally marks under Question 1** on page 9 to record how many you find. (There are helpful resources in your Greenway backpack).

4. **Count the number** of macro-invertebrates you found in each group and **copy** that number into the "Quantity" column in Question 2 on page 9. Then **multiply** as instructed by the table. We multiply our counts because some macro-invertebrate groups tell us more information than others. For example, Group 1 macro-invertebrates tell us the water must be clean, while Group 3 macro-invertebrates tell us the water could be clean or very polluted. **Sum** up your results to get your stream's score.

5. Work as a group to **answer** the **Thinking Questions** on page 10 and **practice** your group presentation.

MACRO-INVERTEBRATES
Data Analysis

Stream: _____ **Date:** _____

1. **Use tallies to record** how many macro-invertebrates you found:

   Group #1 _____ Examples: _____

   Group #2 _____ Examples: _____

   Group #3 _____ Examples: _____

2. **Use** the table below to analyze your data:

	Quantity	Multiply
Group 1		x3=
Group 2		x2=
Group 3		x1=
	Total	

3. Based on your data, the water quality of the stream is (circle one):

EXCELLENT (total=22+) **MEDIUM** (total=11-21) **POOR** (total<11)

4. Work as a group to **answer** the **Thinking Questions** on page 10 and **practice** your group presentation.

MACRO-INVERTEBRATES
Thinking Questions

1. What is a macro-invertebrate?

_____

_____

2. Explain the difference between Group 1, Group 2, and Group 3 macro-invertebrates.

_____

_____

_____

3. Why are macro-invertebrates called an indicator species?

_____

_____

_____

4. Based on your data, is the water quality of this stream excellent, medium, or poor?

_____

5. What factors might be affecting the water quality of the stream today? (Think about what is upstream, the weather, etc.)

_____

_____

_____

RIPARIAN ZONE
Background Info

A **riparian** (rie-PARE-ee-en) **zone** is the area next to a stream or lake. A healthy riparian zone might look like this:

In a healthy riparian zone, **native trees and shrubs** hang over the edge of the water. This is important because:

- Plant roots hold soil in place and prevent erosion (Extra soil in the stream can smother salmon eggs)
- When it rains, plant roots collect and hold water like a sponge and prevent flooding
- Trees and shrubs hanging over the side of the stream provide shade and cool down the water temperature

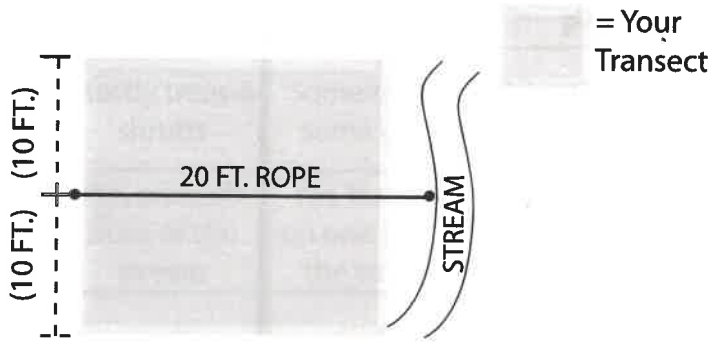
Logs and sticks that fall into the water are called **woody debris** (duh-BREE). Healthy streams have about 17 pieces of large (>4 in. thick) woody debris per 100 feet. Woody debris is important because it:

- Provides shade and shelter for young salmon
- Decomposes and adds nutrients to the water
- Interrupts water flow and forms pools and riffles. The pools provide a place for salmon to rest and the riffles pull oxygen into the water.

An unhealthy riparian zone may have **non-native invasive plants** in it. Non-native plants come from a different ecosystem. Invasive plants outcompete native plants for water, nutrients, and sunlight.

RIPARIAN ZONE
Directions

1. Use the 20-foot long rope in your Greenway backpack to **set up** a transect line so that it matches the diagram below. Try to not step on plants!



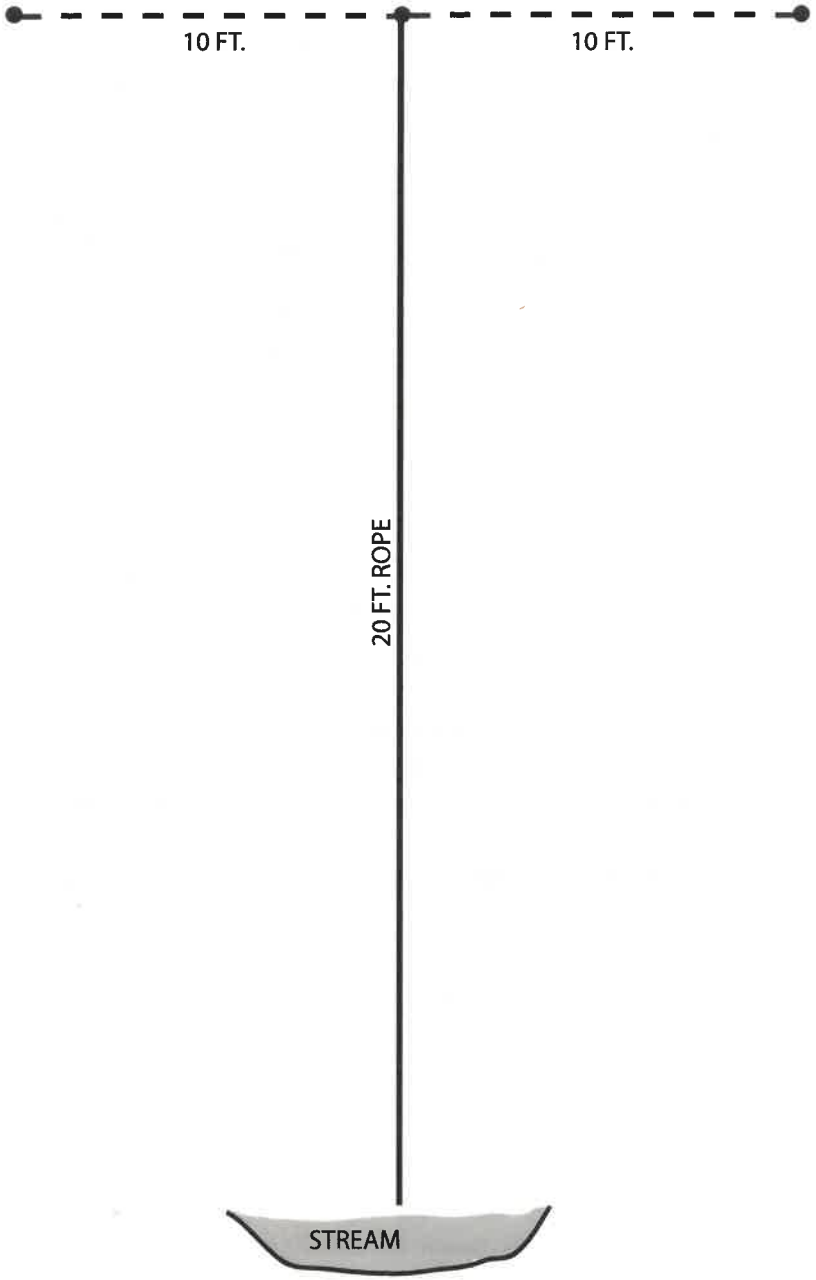
2. **Draw a map** of the plants in your transect (any plants in the shaded area). Take about 10 minutes to do this and then move on to the rest of the activity.

3. **Take out** the native plant ID book and the non-native invasive plants sheet from your Greenway backpack. Use these to **identify** the plants found in your transect. **Label** the plants on your map.

4. **Complete** the **Data Analysis** on page 14 to determine the quality of this riparian zone.

5. Work as a group to **answer** the **Thinking Questions** on page 15 and **practice** your group presentation.

RIPARIAN ZONE
Drawing



Draw the plants in your area of study. Be sure to label them!

RIPARIAN ZONE
Data Analysis

Stream: _____ **Date:** _____

1. Circle the choices that best fit your stream survey results:

	EXCELLENT	MEDIUM	POOR
a) Native plants growing along stream bank:	Mostly trees & shrubs	Some trees & some grass	All grass or bare soil
b) Trees & shrubs hanging over the stream	Yes, on both sides of the stream	Yes, but only on one side of the stream	No
c) Amount of woody debris in the stream:	Many pieces	A few pieces	None
d) Invasive species growing near the stream bank	None	A few	Lots

2. Based on your data, the quality of this riparian zone is (circle one):

   EXCELLENT **MEDIUM** **POOR**

3. Work as a group to **answer** the **Thinking Questions** on page 15 and **practice** your group presentation.

RIPARIAN ZONE
Thinking Questions

1. Why are non-native invasive plant species a problem for the ecosystem?

_____

_____

2. Why are trees and shrubs hanging over the stream important for salmon habitat and stream health?

_____

_____

_____

3. Name at least 3 reasons that woody debris ("duh-bree") is important for salmon habitat and stream health:

- _____
- _____
- _____

4. Based on your data, is the quality of this riparian zone excellent, medium, or poor?

_____

5. Describe what could improve this riparian zone.

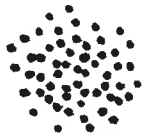
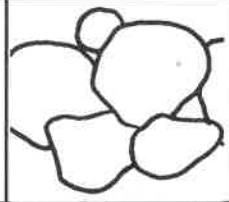
_____

_____

_____

STREAM CHANNEL
Background Info

There are different sizes of rocks on the bottom of a stream. Here are what some of them look like:

Silt	Sand	Gravel	Cobble
			
Very small	< 0.1 inch	0.1 - 2 inches	2-10 inches
(shown real size)	(shown real size)	(shown 1/4 size)	(shown 1/4 size)

Riffles ("RIFF-ulz") are small rapids in the stream where water moves quickly and bubbles over big rocks, logs, and sticks. The fast-moving water cleans small particles from the stream bed and adds oxygen to the water for salmon and their eggs to breathe.

Pools are deep places in the stream where water moves slowly. Salmon fry live in the pools after they leave their nest (redd) in the gravel bed. Fry can hide from predators in pools and find food.

Woody debris ("duh-BREE") are the logs, branches, and sticks that fall into the stream from streamside plants. They help create pools and riffles, and they provide food for the stream insects that salmon eat.

The **velocity** of a stream is how fast the water is moving. If the water is flowing too quickly, spawning salmon might not be able to swim upstream, or their eggs could be washed away. If it is too slow, silt and sand could bury the eggs and suffocate them.

Erosion carries sediment from the stream bank into the stream, making the water cloudy and burying salmon redds. **Gullies**, or small ditches worn into the stream bank, are one sign of erosion.

STREAM CHANNEL
Directions

Stream: _____ **Date:** _____

Use the box below to draw the shape of your stream channel.

1. Add any woody debris you see.
   Is there.... ❑ A lot ❑ A little ❑ None
2. Draw any pools and riffles you see. How many are there?
   Pools: _____ Riffles: _____
3. Do you see any human-built structures? Draw them!
4. Can you see the bottom? Draw how big the sediment is.
5. Are the banks eroding? Add signs of erosion to your drawing.
   Do you see: ❑ Gullies ❑ Collapsing banks ❑ Roots
6. Which way is the stream flowing? How fast? Add arrows to your drawing to show the direction of flow.

STREAM CHANNEL
Data Analysis

1. Find the "Velocity" directions card in your Greenway backpack and measure the velocity as a group 3 times:

Velocity 1: _____ Velocity 2: _____ Velocity 3: _____

2. Circle the choices that best fit your stream survey results:

	EXCELLENT	MEDIUM	POOR
a) Shape:			
b) Woody debris:	>1000 pieces	500-1000 pieces	<500 pieces
c) Count pools and riffles?	Equal number	Close to equal	Many more of one than the other
d) Stream bottom	Mostly cobble	Close to equal cobble/gravel/ sand	Mostly sand
e) Erosion	No gullies, banks stable	Some gullies or collapsing banks	Many gullies, banks collapsing
f) Built structures	No dam/culvert	------	Dam or culvert
g)Velocity	2 - 3 feet/second	1 - 2 feet/second	0 - 1 or >3 ft/sec

Based on your data, the quality of this stream channel is (circle one):

EXCELLENT **MEDIUM** **POOR**

Work as a group to **answer** the **Thinking Questions** on page 19 and **practice** your group presentation.

STREAM CHANNEL
Thinking Questions

1. Why is it important for salmon to have a curvy stream?

2. Name 1 reason that woody debris is important for salmon habitat and stream health:

3. Why is it important to have an equal number of pools and riffles?

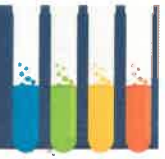
4. How could dams and culverts cause problems for salmon?

5. Why do you think it is better for salmon to lay their eggs in gravel and cobble instead of sand?

6. Based on your data, is the quality of this stream channel excellent, medium, or poor?

7. Describe what could improve this stream channel.

WATER QUALITY
Background Info



Water Temperature - Fish are ectothermic animals. This means they are the same temperature as the water they live in, so if the water temperature of their stream gets colder or warmer, so do they. Salmon need cold water so they don't get too hot, and because it has lots of oxygen in it.

What is pH? - When we measure pH of a liquid, we are measuring how acidic or basic it is. pH is measured on a scale from 0 to 14, where 0 is the most acidic (like lemon juice) and 14 is the most basic (like bleach). Our blood has a pH of about 7, which is neutral. Salmon need to live in water that is neutral with a pH between 6.5 and 8.5.

What is Dissolved Oxygen (DO)? - We breathe oxygen from the air using our lungs. Salmon breathe oxygen dissolved (DO) in the water using their gills. DO levels in stream water increase where the water bubbles over small rapids called riffles. Colder and fast-moving water has more oxygen in it than warmer water.

What is Phosphate? - Phosphate is a nutrient that all plants and animals need to grow. It is added naturally from decomposing plants and animals. Sometimes, though, too much phosphate enters streams from sewage leaks or from fertilizers running into streams from people's lawns or farms. Too much phosphate in stream water can reduce the amount of dissolved oxygen in the water that is available to salmon.

What is Turbidity? - The turbidity of water is how clear or cloudy it is. The cloudier the water, the more turbid it is. The cloudiness is caused by little particles of soil and plants in the water. The particles makes it harder for fish to breathe (imagine trying to breathe in a sandstorm). particles that settle on the stream bottom can smother fish eggs and macro-invertebrates (stream bugs). Don't confuse water color with turbidity: water can be a dark color and be clear.

What is ppm? ppm, or parts per million, is a way to measure how much of a nutrient is present in the water. For example, if we find 10 ppm of phosphate, that means there are 10 drops of phosphate in every million drops of stream water.

WATER QUALITY
Directions

1. **You will be given a water quality testing kit.** Circle what your team is going to measure:
   Temperature
   pH
   Dissolved oxygen (DO)
   Phosphate
   Turbidity

2. **Temperature Team:**
   - Right away! **Collect** water from the stream using the white canister in the Greenway backpack.
   - **Distribute** the water to your teammates, and then hand off the white canister to the Turbidity Team.
   - Now you can **read** your yellow directions card and take your measurements.

   All other teams: Follow the directions on your yellow card to make your measurements, using the water that the Temperature Team collected.

3. While you are waiting for your results, **study** the information on the back of your yellow card. You will need to explain this information to your team and to the class.

4. **Record** all teams' measurements on page 22.

5. When all the teams have finished their measurements, work together to **answer** the **Thinking Questions** on page 23 and **practice** your presentation.

WATER QUALITY
Data Analysis

Stream: _____ **Date:** _____

1. Record your team's data:
   - Temperature: _____ °C
   - Dissolved Oxygen: _____ ppm
   - pH: _____
   - Phosphate: _____ ppm
   - Turbidity: _____ NTU

2. Circle the choices that best fit your stream survey results:

	EXCELLENT	MEDIUM	POOR
a) Temperature	5-12°C	13-20°C	Above 20°C
b) DO (Dissolved Oxygen)	More than 9 ppm	6-8 ppm	Less than 6 ppm
c) pH	6.5-8.5	4.5-6.4 or 8.5-10	Less than 4.5 or higher than 10
e) Phosphate	0-2 ppm	3-4 ppm	Above 4 ppm
f) Turbidity	0-50 NTU	51-100 NTU	Above 100 NTU

ppm= parts per million

3. Based on your data, the water quality of this stream is:

   EXCELLENT **MEDIUM** **POOR**

4. Work as a group to **answer** the **Thinking Questions** on page 23 and **practice** your group presentation.

WATER QUALITY
Thinking Questions

1. What does ppm stand for?

2. Why do salmon prefer cold water?

3. When you measure the pH of water, what are you measuring?

4. Name one way that dissolved oxygen gets into the water.

5. Based on your data, is the water quality of the stream excellent, medium, or poor?

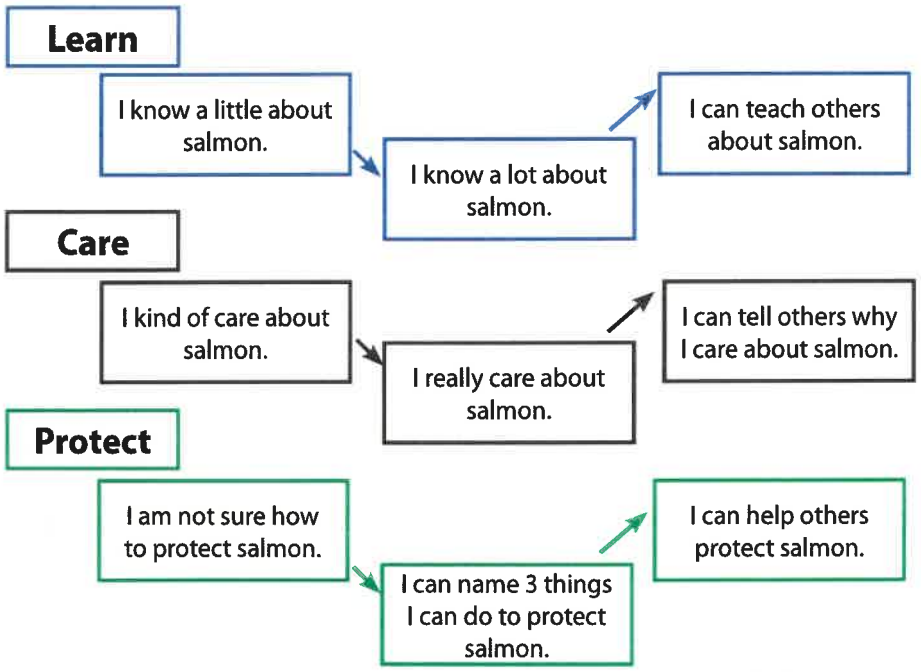
6. Describe what could improve the water quality.

Reflect on the Field Trip

1. What did you most enjoy on your field trip?

2. What questions do you still have about salmon?

Mark the box that best describes you.



PICTURE THIS!

Draw the healthiest salmon stream habitat you can imagine. Label your drawing. Use both pages.

Feel free to look back in your journal!

Date: _____