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!

Mountains to Sound Greenway

Can you find...?
- Your school
- The Puget Sound
- Lake Sammamish
- Ellensburg

WASHINGTON

Mountains to Sound Greenway Boundary
Public Lands
Conserved Private Farms & Forests
Rural Private Lands
Cities & Urban Growth Areas

PIKE COUNTRY

3- MAP OF THE GREENWAY

MAP OF THE GREENWAY - 4
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 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)

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-invertebrates 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:

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Multiply</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>x3=</td>
</tr>
<tr>
<td>Group 2</td>
<td>x2=</td>
</tr>
<tr>
<td>Group 3</td>
<td>x1=</td>
</tr>
<tr>
<td>Total</td>
<td></td>
</tr>
</tbody>
</table>

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 not to 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.
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:

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

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:

<table>
<thead>
<tr>
<th>Size</th>
<th>Silt</th>
<th>Sand</th>
<th>Gravel</th>
<th>Cobble</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very small</td>
<td>&lt; 0.1 inch</td>
<td>0.1 - 2 inches</td>
<td>2 - 10 inches</td>
<td>(shown 1/4 size)</td>
</tr>
<tr>
<td>(shown real size)</td>
<td>(shown real size)</td>
<td>(shown 1/4 size)</td>
<td>(shown 1/4 size)</td>
<td></td>
</tr>
</tbody>
</table>

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.
   - ❑ 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:

<table>
<thead>
<tr>
<th>a) Shape:</th>
<th>EXCELLENT</th>
<th>MEDIUM</th>
<th>POOR</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><img src="image" alt="Wave" /></td>
<td><img src="image" alt="Wave" /></td>
<td><img src="image" alt="Wave" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>b) Woody debris:</th>
<th>&gt;1000 pieces</th>
<th>500-1000 pieces</th>
<th>&lt;500 pieces</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>c) Count pools and riffles?</th>
<th>Equal number</th>
<th>Close to equal</th>
<th>Many more of one than the other</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>d) Stream bottom</th>
<th>Mostly cobble</th>
<th>Close to equal cobble/gravel/sand</th>
<th>Mostly sand</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>e) Erosion</th>
<th>No gullies, banks stable</th>
<th>Some gullies or collapsing banks</th>
<th>Many gullies, banks collapsing</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>f) Built structures</th>
<th>No dam/culvert</th>
<th>------</th>
<th>Dam or culvert</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>g) Velocity</th>
<th>2 - 3 feet/second</th>
<th>1 - 2 feet/second</th>
<th>0 - 1 or &gt;3 ft/sec</th>
</tr>
</thead>
</table>

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 make 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:

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

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.

Learn
- I know a little about salmon.
- I know a lot about salmon.
- I can teach others about salmon.

Care
- I kind of care about salmon.
- I really care about salmon.
- I can tell others why I care about salmon.

Protect
- I am not sure how to protect salmon.
- I can name 3 things I can do to protect salmon.
- I can help others protect salmon.
Draw the healthiest salmon stream habitat you can imagine. Label your drawing. Use both pages. Feel free to look back in your journal!

Date: __________