UNIT 5D. PHYSICAL STRUCTURE OF STREAMS

ACTIVITY	TIME	LEVEL
Stream Structure & Fish Habitat	45 minutes	Introductory
Fish Habitat Needs Vocabulary	35 minutes	Advanced

BENCHMARKS	
Next Generation Science Standards	MS-LS2-1 MS-ESS3-5 MS-LS2.A MS-ESS3.C HS-LS2.C
Science & Engineering Practices	-Planning and carrying out investigations. -Analyzing and interpreting data -Using mathematics and computational thinking -Engaging in argument from evidence
Common Core State Standards-ELA/Literacy	CCRA.R.1 CCRA.R.4 CRA.R.7
Common Core State Standards-Speaking & Listening	CRA.SL.1
Common Core State Standards – Mathematics	MP.2

INTRODUCTION

If the water is the "neighborhood" where a salmon grows up and lives, then the physical structure of the stream is the neighborhood's streets, roads, houses and parks. The physical structure, which you observe, is developed by forces, which originate outside the "neighborhood," much like development in our own areas is generated by forces outside the neighborhood. What is the nature of these forces? How do they affect the stream in front of you? How does the stream affect spawning salmon? This section provides some answers to these questions. The answers will affect your students' perceptions of their field trip site.

In this section, we study the needs of salmon and the properties of streams that meet salmons' needs. Students learn how the stream provides riffles and pools, and how these affect the salmon. They prepare themselves for the questions they will ask on the field trip: Where will we observe spawning when we go on our field trip? Where will the adult salmon prefer to be? Would fry prefer to be there also? What are a fry's requirements for life?

OBJECTIVE:

- Students will identify, know and understand the physical characteristics of streams and their effect on salmonids.

KEY QUESTIONS:

- ➔ What are the parts of the physical structure of streams? How are these parts organized?
- ➔ How is this related to spawning salmon?
- ➔ How is this related to the needs of salmon fry?

MATERIALS

- reference materials
- STUDENT HANDOUT 5D-1: Stream Structure and Fish Habitat
- STUDENT HANDOUT 5D-2: Fish Habitat Needs Vocabulary
- drawing materials

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

riffle	carrying capacity	eddies
porous	sediment-free	stream gradient
stable	substrate	debris
scouring	root wad	riparian

PROCEDURE

1. Engage students in a discussion in which they recall what they have learned about salmon habitat needs during the life cycle of a salmon. Then hand out copies of the STUDENT HANDOUT 5D-1: Stream Structure & Fish Habitat.

2. Ask your students to read STUDENT HANDOUT 5D-1. Use a strategy of your choosing for this text reading. Have them work in small groups to answer the reading questions as they encounter them.

3. This is a homework assignment. The student reads STUDENT HANDOUT 5D-1: Stream Structure and Fish Habitat and STUDENT HANDOUT 4A-1: The Journey of Wild Pacific Salmon, then, working from the STUDENT HANDOUT 5D-2: Fish Habitat Needs Vocabulary List, write the term and the definition vocabulary using the following format: They read the sentence where the word is found, and write a definition for each term. Remind them not to use a dictionary. They should try to find the meaning from context instead. Students leave a blank line below the definition to revise or clarify it after reading the whole article and talking about the subject. If the students have worked to learn these words, then they will have a useful vocabulary to employ on the field trip.

4. Assign groups of students to describe the three recommended habitat by a combination of written descriptions and drawings to show desired conditions. Have them present and explain these to the class.

EVALUATION

Evaluate this work by requiring its completion, then by evaluating students' field records after the field trip. They should use many of these descriptive terms knowledgeably and include appropriate observations.

EXTENSION ACTIVITIES

1. While an ideal course would include a complete set of observations on the streambed and waters which flow through it, our time limits what we can learn about the structure of streams. The unit, Riparian Areas, Stream Scene, pp. 41-64, provides a minimal background for the student. In it, students learn how the riparian area of a stream is compartmentalized, and the part it plays in the life in a stream.

2. Fish Habitat Needs, Stream Scene, pp. 181-208, explores fish habitats in the Northwest. It uses prior understandings about stream structure and water quality, and then relates them to stages in the life cycle of salmon. The unit begins with spawning habitats, so would be a good one to consider in order to prepare your students for the field trip. (Note: This extends learning from Riparian Areas, above.)

EXTENSION CURRICULUM

1. Hands On Streams & Rivers, Save Our Streams, pp. 2 - 10, outlines a program for describing a stream channel from in situ measurements. Students measure channel area, monitor channel movement, and determine channel gradient. They observe stream flow, sediments and temperature. These observations are then compared with land uses and ecological relationships of organisms inhabiting the stream. It can be taught in this section as well as in the Salmon and Humans and the Environment units.

2. California's Salmon and Steelhead, Our Valuable Natural Heritage, pp. 100-110, supplements the Stream Scene Riffles and Pools section. In this section, students use a game format involving a map of a stream and "critters" hidden in the stream, to reinforce learnings about habitat requirements. Pages. 133-135 teach how to make physical measurements of a stream, and would be a good preparation for the field trip. Pages. 94-99 teach about life cycles and habitat requirements via a "rummy" card game.

INTERDISCIPLINARY INTEGRATION IDEA

During steps 4 and 5 in the Core Curriculum procedures, have an art teacher emphasize nature drawing. For each term which students define, they also make a drawing. The drawings must graphically describe the term they illustrate, and include a salmon during some stage in its life cycle. Review this section with the art teacher, and then integrate the work that you will do. Students should learn how to shade, draw elevation vs. plan views, scale, annotate drawings, and make thematic illustrations showing good/bad habitat. This work relates well to the field trip, where students often journal and/or illustrate their field logs.

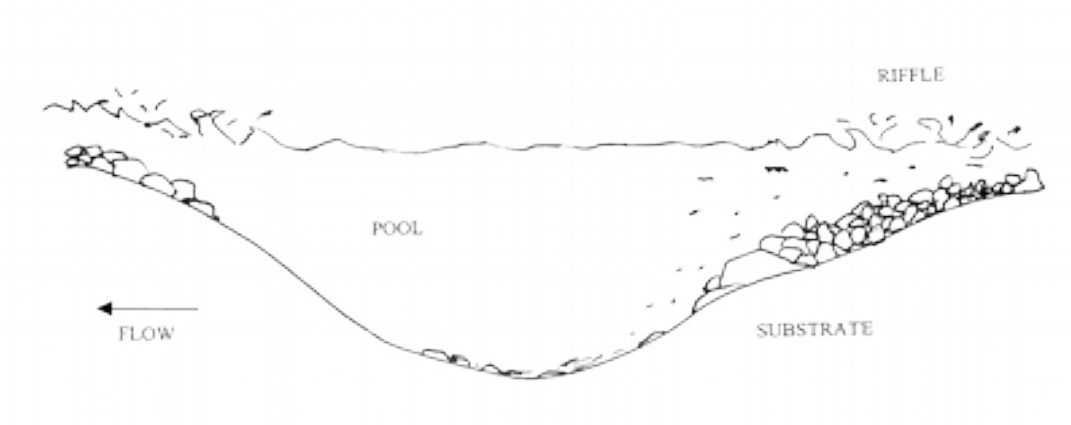
STUDENT HANDOUT 5D-1

Stream Structure and Fish Habitat

Streams are unique, constantly changing environments that support an array of aquatic life. The organisms that live in a stream are adapted to the changes and fluctuations that occur in a stream over time. Here we will discuss the structure of a stream and how aquatic animals, such as insects and fish, use the stream to their advantage.

Stream Structure

The way water moves through a stream is heavily influenced by the land that is surrounding and underneath the stream channel. The stream channel or bed consists of the area that cradles the water. If this area is narrow the water moves quickly, if it is wide the water slows down. The depth of the stream also influences water movement, and the reverse is also true: the water alters the depth of the stream. The stream bed itself is constantly changing. When the water level is high and the stream is moving quickly, rocks and soil in the stream bed are easily moved. Banks can be carved away or gravel can be scoured out. When the water slows, rocks and soil are deposited at the bottom of the stream.



The land at the bottom of the stream is called the stream substrate. Examples of substrate are bedrock, gravel, or silt. When you look at a river bottom you can see the substrate change in relationship to the movement of the water. Where the water is moving quickly there is usually more rock and where the water slows you see finer particles like sand and silt.

As the water moves through the stream channel, it changes its speed, depth, and temperature depending upon the surrounding conditions. When water enters an area that is deep and wide, it spreads out and slows down as it fills the channel. This area is called a pool. When the channel narrows and is shallow, the water moves swiftly, forming small waves or white water. This area is called a riffle.

A Chain Reaction

If we look at how the structure of the stream bed influences the movement of the water and how the water influences the stream channel, we can see that there is a chain reaction that occurs when a change takes place in a stream. When the bank of a stream gives way, the soil falls into the water. The water carries the soil particles downstream to a slow moving section of the river where the particles drift to the bottom, becoming substrate. This new substrate makes the stream bed shallower. The water begins to move a little more quickly in the shallow area. As the water moves more quickly, some of the deposited soil is stirred up and carried further downstream. The area where the bank originally eroded also widens the stream channel, slowing the water a bit as it passes.

Fish Habitat

Their riffles, pools, different substrates help to characterize streams. If we think about the needs of fish like salmon and trout, we can identify what stream characteristics they need. Fish need oxygen to breathe. They don't breathe oxygen from the air like we do; they breathe it from the oxygen in the water called dissolved oxygen. Oxygen can be added to the water when it interacts with air.

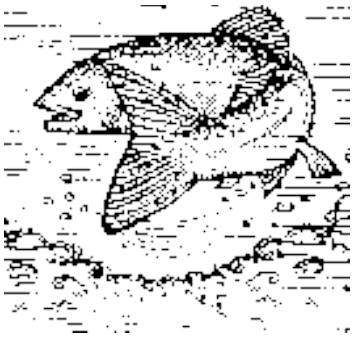
Question: Does the water mix more with the air in a riffle or a pool?

The "white water" of a riffle adds fresh oxygen to the water, so our fish need streams with riffles and adequate dissolved oxygen. Salmon and trout are also in need of cool water. The speed or velocity of the water in a stream helps keep it cool as does the depth.

Question: Would shallow or deep water warm up more quickly in the summer sun?

When the water level in a stream goes down in the late summer, the temperature goes up. Shallow water warms up more quickly than deep water. Our fish need cool water so they need streams that have deep pools to keep the water cool and that have water moving all summer long. In addition, shade from the plants along the bank of a stream keeps the temperature down. These plants in the riparian area (the area along the stream) are important not only for shade but also to help stabilize the bank and provide a food source for aquatic insects.

Salmon and trout also need places in the stream to lay their eggs. Like birds, these fish build nests or redds, to protect their eggs while they develop. The eggs need cool water and oxygen to develop.



Question: Think about the substrate of a stream. Where would you want to hide your eggs? Where will they get cool water and oxygen? Where will predators not find them and they won't wash away?

Salmon use gravel as the substrate for their nests. They dig a depression in the small rocks, lay their eggs, and cover them up with gravel. Gravel allows water to circulate through the rocks bringing oxygen to the eggs. It also hides the eggs from predators and keeps the eggs from drifting downstream.

The best location for their redds is found at the end of a riffle where the water is beginning to slow down as it enters a pool but is oxygen rich. It is also in this area where aquatic insects hide, the future food source for young salmon.
Juvenile salmon spend time in the stream eating and growing before heading to the ocean. These small fish need to protect themselves from predators and from strong currents that might push them downstream.

Question: Where in the stream can a young fish hide? Where will food be found?

Young salmon vary in the use of the stream depending upon species. In general, young salmon stay close to the banks or near fallen logs or rocks to hide from predators. They find their food, aquatic insects, drifting in the current. As the salmon get bigger they venture into faster water to find more insects being carried downstream.

Salmonids and Physical Stream Characteristics

Physical stream characteristics useful in differentiating habitat preferences of salmonids.

	SPECIES			
Habitat preference	**Coho**	**Chinook**	**Steelhead**	**Cutthroat**
% pools	50–80	50–100	< 50	40–60
% gradient	<3	< 2	>1–5	1–20
Stream order	2–5	≥ 5	2–5	> 2
Maximum temperature	<65°F 18°C	< 68°F 20°C	< 73°F 23°C	< 65°F 18°C

Physical stream characteristics useful in evaluating stream quality preferences for salmonids.

Characteristics				
Cover	woody structure	pool depth	boulders & wood	wood, volume, boulders
Channel profile	flat	moderately flat	steep	undercut banks
Riparian	Presence of riparian vegetation important for all species. Vegetation type (fir, alder) and age of vegetation determine quality.			

Stream Scene, Oregon Dept. of Fish & Wildlife, 1992

STUDENT HANDOUT 5D-2

Name _____

Fish Habitat Needs Vocabulary

DIRECTIONS:

1. Read Stream Structure and Fish Habitat (5D-1)

2. On a separate sheet of paper, write definitions for the terms below, using the following guidelines:

- Read the sentence where the term is found.
- Write a definition for the term. Do not use a dictionary. Instead, try to find the meaning from context.
- Leave a blank line below the definition to revise or clarify it after reading the whole article and talking about the subject.
- Find examples of these words in your neighborhood. Name and describe them.
- Where appropriate make and label a sketch to illustrate the concept.

3. The terms are:

riffle
stable
porous
sediment-free
stream channel
substrate debris
litter
dissolved oxygen
pool
root wad
riparian
carrying capacity