Habitat Sense

Introduction

Habitat Sense is the analysis of a stream reach s physical qualities. Students survey a pool, riffle, or glide, and look at substrate, vegetation cover, woody debris, and other factors that determine the suitability of a site for aquatic life.

“I observe the swift movement
of water through the nation
of fish at my feet.
I wonder privately if there are
for them, as there are for me,
moments of faith.”

Barry Lopez

Teacher Section

Objectives

Students will be able to:
1) List steps of stream habitat survey methods
2) Discuss the features a healthy stream must have to support aquatic life
3) Sketch a reach of stream in all its complexities

WA SCIENCE Academic Learning Requirements (EALRs): 1.2, 1.3, 2.1, 2.2

Concepts

- Use of survey instruments to measure habitat
- Habitat components: pools, riffles, and glides
- Stream complexity as a sign of suitable habitat

Study Site Description

The site has examples of pools, riffles, and glides. Students meet and do an activity in the water as a group. They are divided into three groups to collect habitat data and draw maps of each stream reach. In the last 10 minutes, they reconvene to compare information.

Vocabulary

(Definitions can be found in the Glossary)

Embeddedness	Pool tail-crest
Erosion	Riffle
Glide	Stream reach
Pocket pool	Substrate
Pool	Turbulence

Classroom Pre-work

MINIMUM PRE-WORK NECESSARY FOR FIELD STUDY: *Dynamic Water, Ring Around the Rock, and Stream Mapping* to understand survey methods and importance to stream analysis (2 hours). Post-work activities: connecting fish to the ecosystem and processing field data.

Classroom Pre-work
continued

Questions to open the section:

- ❑ What do fish like native bull trout need in order to live?
  They need what their food sources need. A clean, cool, well-oxygenated habitat with lots of shelter and food.

- ❑ What are the components of fish habitat?
  Water, food, shelter, space

- ❑ In what stream habitat types do fish dwell?
  Pools, riffles, glides

- ❑ What could threaten healthy water quality?
  A change in the environment as detailed in the What s in That H20 section.

- ❑ What are some warning signs to indicate that an aquatic system is stressed besides how the water tests?
  Declining numbers of sensitive aquatic insects, fish, and amphibians; a decrease in water clarity and/or an increase in sediments.

- ❑ Give some examples of protective cover, or shelter used by fish.
  Overhanging riparian vegetation, aquatic vegetation, undercut banks, water turbulence, water depth, and boulders.

"The river's language arose principally from two facts: the slightest change in its depth brought it into contact with a different portion of the stones along its edges and the rocks and boulders mid-stream that lay in its way, and so changed its tone; and although its movement around one object may seem uniform at any one time it is in fact changeable. Added to these major variations are the landings of innumerable insects on its surface, the breaking of its waters by fish, the falling into it of leaves and twigs, the slooshing of raccoons, the footfalls of deer; ultimately these are only commentary on the river's endless reading of the surface of the earth over which it flows."

Barry Lopez

Dynamic Water

(30 minute activity)

Objectives

Students will be able to:
1) List habitat components of pools, riffles, and glides
2) Describe fish use of these habitats

Materials

- ❑ Substrate in different sizes
- ❑ Sticks
- ❑ A large, sturdy, rectangular cardboard box or a small snow sled

Background

As a background, study the hydrologic cycle in *What s in That H20*, and the importance of watershed and riparian areas (*Watershed Wonders* and *Riparian Rx* portions of this curriculum).

Fish dwell in three different habitat types: **pools**, **riffles**, and **glides**. See illustrations in Figure 1.

> A *pool* is generally deeper than the surrounding area with slower water flowing through it. It has a scoured out area and a *pool tail-crest* at the lower end holding the water. Pools can be created by the scour around boulders, woody debris, or other obstructions in the stream.
>
> A *riffle* can be shallow or deep with swift water flowing over different sized *substrate*. Steeper areas produce faster flows. Rapids and cascades are types of riffles.
>
> *Glide* areas are gently moving, usually over a uniform stream bottom.

Our finned friends use different parts of the river for a multitude of purposes. For example, with adequate cover, juvenile fish rest in slower side channels and pools searching for insects. Adult fish such as bull trout and redband trout may be behind boulders in *pocket pools* or undercut banks, catching food that drifts down the adjacent riffle. The faster the water, the greater the food availability. Fish conserve energy by holding in slow areas next to faster waters. They dart out into the faster water to capture food. The area downstream from the *pool tail-crest* and glides often provide excellent spawning gravel for salmon and steelhead.

Riffle, Pool, Glide

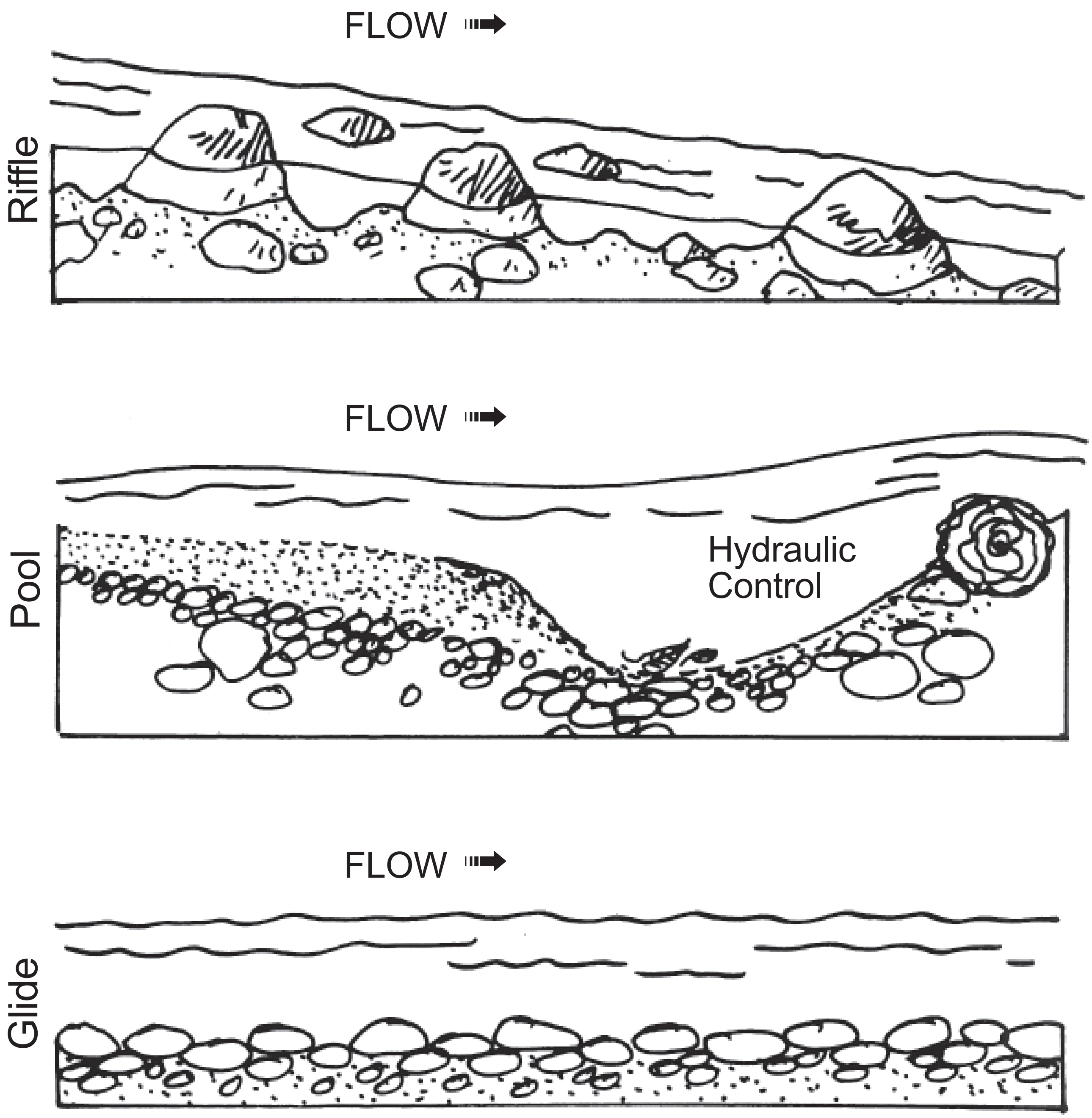


Figure 1.

Procedure

1. Toss a leaf into local creek or river. Watch it move. Does it slow behind rocks? Does it move faster in riffles or glides? Watch the current and how it flows. Imagine an aquatic insect or small fish being swept into the riffle and into a trout s mouth as it darts out of a pocket pool into the swifter water.

2. If no flowing water is nearby, create your own system with a large, sturdy, rectangular cardboard box (Figure 2). Ask students to collect rocks in a variety of sizes to fit the box. Cut a V shape in the two smaller panels at either end, allowing for the flow of water. Place rocks in sections along the bottom according to their sizes; first-gravel, then medium and larger rocks. Prop the box up on one end, creating a gradient. Pour water from the box s upper end and watch how water runs over the substrate sizes differently. Now mix all the substrate together. Add sticks and woody debris to create larger pools. Pour water again. What habitat types have been created in both scenarios? Try changing the gradient. How does the flow change?

Try arranging the rocks in a way to display examples of pools, riffles and glides.

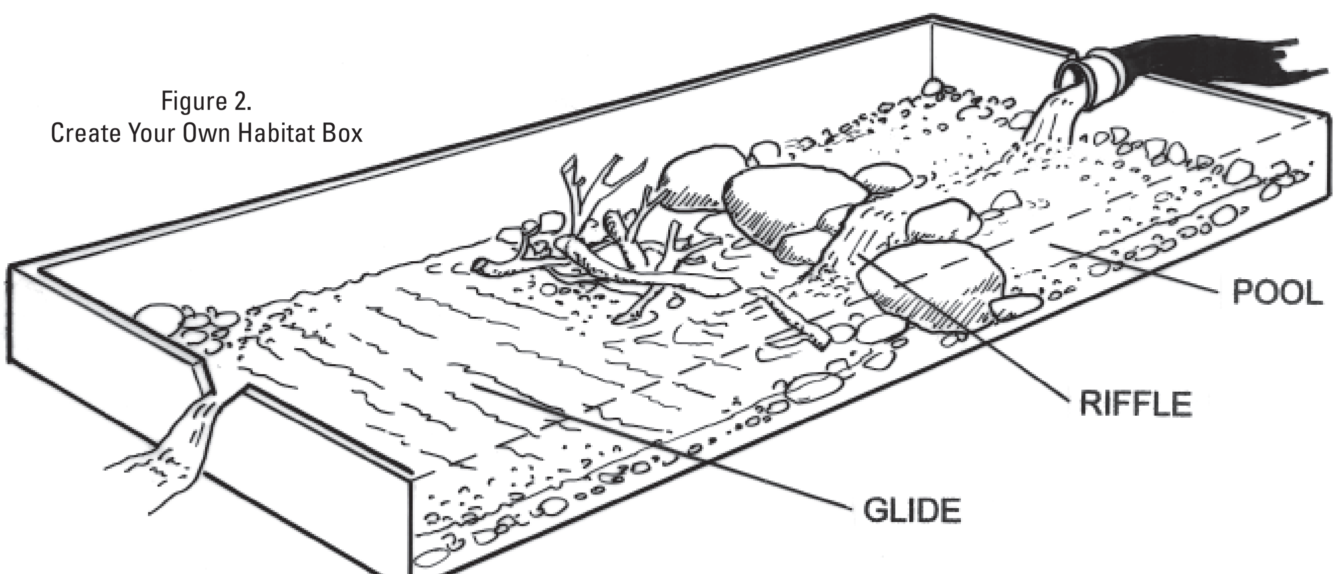


Figure 2.
Create Your Own Habitat Box

****Note**: a plastic snow sled works well for this also, because it s possible to get a longer stream and repeat the process as often as needed (no soggy box).This can be performed indoors at a sink with a long counter, if necessary, because the bottom will not leak. The flow simply must be controlled at the lower end. When the experiment is over, the materials can be returned to their source in the sled for easier cleanup.

Assessment

Have students illustrate the cross section of a river with pools, riffles, and glides. Indicate the sites where fish most likely would feed.

Ring Around the Rock

(20 minute activity)

Objectives

Students will be able to:

1) Explain the concept of embeddedness and the way it can affect aquatic life

Materials

- ❑ Rocks (from previous activity)
- ❑ Plastic tub
- ❑ Half a bucket of soil
- ❑ Water

Background

Aquatic life is challenged when an over abundance of silt is present, reducing the quality and quantity of spawning areas. If there is too much sediment, fish cannot spawn. Sediment can also suffocate developing fish eggs. Many aquatic insects need well oxygenated water in order to breathe. A common test performed by field fisheries biologists is measuring the *embeddedness,* the degree that larger rock particles are surrounded by silt. If 35% or more of each rock is covered with sediment, it raises a red flag about the quality of a *stream reach*. Substrate or rocky particles on a stream s bottom are classified as: **sand** which is <2 mm (<.08 - 2), **gravel** that ranges from 2-64 mm (.08"), **cobble** measured at 64 - 256 mm (2.5"-10") and **boulders**, 256-1024 mm (15 -40).

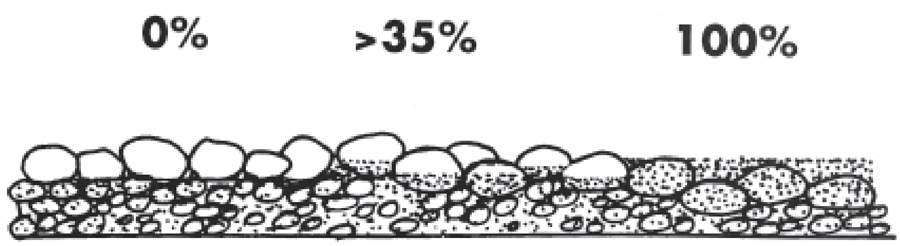


Figure 3. Embeddedness

Procedure

1. Place substrate in the plastic box.

2. Pour soil over the substrate, distributing it unevenly.

3. Add enough water to soak the soil. Keep the box flat. Check the rocks in a week. There will be a line around the rocks created by the silt. The longer the rocks soak, the clearer the mark will be.

4. Add water to the substrate before presenting to students to simulate a stream.

5. Ask students to measure the level of embeddedness and to classify the rock size in proportion to the size of the stream in the box. Cobble may represent boulders, for example. Is the amount safe or in the danger zone for aquatic life?

Assessment

Ask students to:

- ❑ List the ways silt finds its way into a stream or creek.
- ❑ Discuss the effects of embeddedness on fish and macroinvertebrate habitats.
- ❑ Ask the students to bring in examples of substrate particle sizes such as sand (sugar, salt), gravel (peas), cobbles (tennis balls), and boulders (basketballs) and provide the technical substrate names for them.
- ❑ Using examples of sand, gravel, cobbles, and boulders, ask the students to demonstrate where the embeddedness line would be for 25%, 35%, 50%, etc., and for the percent (35%) that raises a red flag about a possible sedimentation problem.

Stream Mapping

(20 minute activity)

Objectives

Students will be able to:

1) Discuss the components of a stream reach
2) Illustrate and map an imaginary reach or the school grounds

Materials

- ❑ Paper
- ❑ Pencil

Background

Cover offers complexity to a stream. The more complexity, the greater the aquatic wildlife and opportunity for protection and food. Mapping is part of the *Habitat Sense* station. Students map the reach of the river or creek. The sketch should contain everything visible to the eye, including cover and habitat types. All features must be labeled. See the Resource Specialist section for more details.

Ask students: what are important sources of cover or shelter that a creek environment provides?

- ❑ Boulder or cobble
- ❑ Woody debris such as brush or logs in the stream or leaning across it
- ❑ Riparian vegetation on stream banks
- ❑ Overhanging vegetation close to the surface of the water
- ❑ Aquatic vegetation growing in the water
- ❑ Undercut banks created by water pressure that sometimes leaves tree roots to hide in
- ❑ *Turbulence* on the surface created by an obstruction such as woody debris or substrate; waterfalls and a change in gradient may also cause turbulence
- ❑ Depth of water; deep enough to hide fish

Procedure

1. Ask students to draw an imaginary stream reach that includes representations of cover. They must be specific and name the aquatic vegetation, riparian vegetation, and substrate classification. Make a second sketch like the first or copy the original for activity #2. On the first drawing, add and label the fish and macroinvertebrates (from *Invert Investigator*) in their appropriate habitats.

Procedure continued

2. Practice stream mapping, using the extra copy from activity #1. The cover should already be labeled; students next label the habitats. When mapping during the *Kids in the Creek* program, they will not be including fish or macroinvertebrates, unless they can see them from the bank. The finished product will resemble the map students will draw at the field study site.

3. Ask students to map the school grounds or classroom, labeling features. What would be important information the map needs to convey?

4. During the *Habitat Sense* station, students will also be filling out a *Stream Habitat Survey Form* (Student Section) on a reach of river. This form is a realistic version of what scientists use in the field. It asks for survey data and has very specific protocols. See the Resource Specialist section for the details of this team assignment. Preview the form with students and ask: What is the survey asking them to do? What do the terms mean? Why is it important to know this information? Mapping and stream surveying are part of a fishery biologist s job during field season.

Assessment

Ask the students to:

- ❑ List attributes of poor habitat and the components necessary for a healthy stream ecosystem.
- ❑ Map their living rooms or backyards, giving attention to details.

Extensions

If there is easy stream or river access from school, practice mapping and the use of the *Stream Survey Form* (Student Section) with the class. If not, students could be given a homework assignment to map and survey a creek near their homes. Photos or videos of streams may provide opportunities for practice as well.

- ❑ Familiarize students with station equipment listed in the Resource Specialist section.
- ❑ Give students copies of *Stream Habitat Survey Forms and Stream Habitat Survey Definition and Help Sheet* (on waterproof paper, if available).
- ❑ Provide a blank sheet of paper (preferably waterproof) with no lines for the mapping exercise, one per student.

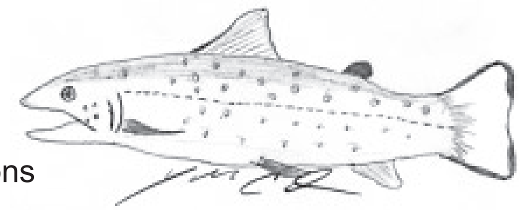
Fish: One-of-a-kind Animals

(30 minute activity)

Objectives

Students will be able to:
1) List what makes a fish a fish
2) Compare the internal and external anatomy of fish and humans

Materials



- ❑ Paper
- ❑ Pencil
- ❑ Marking pens or crayons
- ❑ Transparencies
- ❑ Overhead projector
- ❑ Optional: picture of a fish, fish skeleton, fish model, picture containing a body of water (all contained in the *Fin Bin**)

Background

Fish come in all shapes and sizes, just like people, but have been around much longer. They date back to the Paleozoic Era over 400 million ago, vs. humans appearing 3 million years ago during the Cenozoic Era *(see Figure 6)*. Fish are a very diverse group. There are four classes of fish compared to one class each of mammals, birds, and amphibians. There are exceptions to most standards relating to internal and external anatomy, but generally in order to be a fish, an animal must:

- ✓ Have scales
- ✓ Live in water
- ✓ Be cold-blooded
- ✓ Have fins
- ✓ Have back vertebrae
- ✓ Use gills to breathe

"I have known you in your streams and rivers where your fish flashed and danced in the sun, where the waters said come, come and eat of my abundance."

Chief Dan George

For location of anatomical features, please see *Internal and External Anatomy* diagrams *(Figures 4 & 5)* diagrams

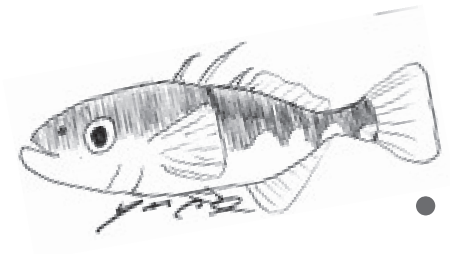
External Anatomy

- Scales are a fish s armor and protective covering. Some species have heavy thick scales while others have thin and flexible scales. A scale may be read like a cross-section of a tree trunk, counting the rings that indicate age. Slime on the outside of the fish s body provides protection and allows it to easily glide through the water. It also protects skin from bacteria and parasites.

*Items available in the USFWS Fin Bin Education Trunk; call (509)548-7641 for information.

- Gills oxygenate the blood. They are a fish s lung system.

- Operculum is a plated gill cover, and acts as a valve that allows only the exit of water from the gill chambers.



- Fins are the fish s arms and legs. They give balance and steering abilities. They are identified as pelvic, dorsal, adipose, pectoral, anal and caudal. See their locations on the external fish anatomy drawing (Figure 4) at the end of this section. Fin rays support the structures of each fin.

- Lateral line is visible from a fish s head to its tail. It is a grouping of pores leading to sensory organs that assist in detecting external stimuli. Some species have many lateral lines.

Internal Anatomy

The internal organ systems of a fish are similar to those of other vertebrates. Important organs to know are:

- Heart: Generally has two chambers and is located beneath the pharynx. The heart pumps blood through blood vessels transporting essential products to the cells and carrying waste products from the cells.

- Stomach: Most fish have a stomach that varies in size according to the food ingested.

- Intestine: An organ that assists with digestion and absorption of nutrients. Fish that are herbivores have comparatively long intestines, carnivores, short, and omnivores of medium length. Herbivores have longer intestines because more area is needed to digest the fiber found in plant materials. Organs associated with the intestine are the pyloric caeca, liver, pancreas, and air bladder.

- Pyloric caeca: these fingerlike projections are located near the upper end of the intestines, close to the stomach. Their size varies. The function is to serve as a temporary storage space for food and to aid in absorption.

- Liver: A large gland in fish that usually lies over or partially surrounds the stomach; manufactures bile, a greenish substance that emulsifies fat. It secretes digestive enzymes.

- Pancreas: Secretes enzymes used in digestion.

- Swim Bladder (air bladder): Responsible for a fish s buoyancy; the fish secretes a gas (mostly oxygen) into the bladder to rise and absorbs gas from it to sink.

- Spleen: A dark red gland located on or behind the stomach; a storage site for blood and some blood formation occurs there. It helps remove waste products from the blood.

- Kidney: A dark red band located above the stomach, just beneath and along the backbone. It removes excess water and minerals out of the body.

- Gonads: The reproductive organs; in females called ovaries, and testes in males.

Like the macroinvertebrates they eat, different fish species have varying levels of tolerance to environmental changes. Sensitivity to environmental differences is dependent on the species of the fish. For example, the salmonid species like spring Chinook salmon are sensitive, unlike carp, which are more tolerant of poor water quality.

Procedure

1. Discuss with students what every fish must have to be a fish by using a poster that shows a body of water, thermometer, fish skeletal model or picture, and a fish anatomical model or picture.* Study the anatomy of fish by making overhead transparencies (Figures 4 & 5). Associate body parts with those of a human for comparison. Ask a hatchery near you if there are any extra fish for dissection purposes to check out the real thing. If you prefer not to do the dissection, ask a resource specialist to visit your class.

2. Study the *Fish Family Tree* (Figure 6) and then ask students to select and classify a fish, from kingdom to species (Figure 7). What are the attributes of a given species of fish? What distinguishes the families? How do ancient species differ from more contemporary types? Additional resource materials may be needed.

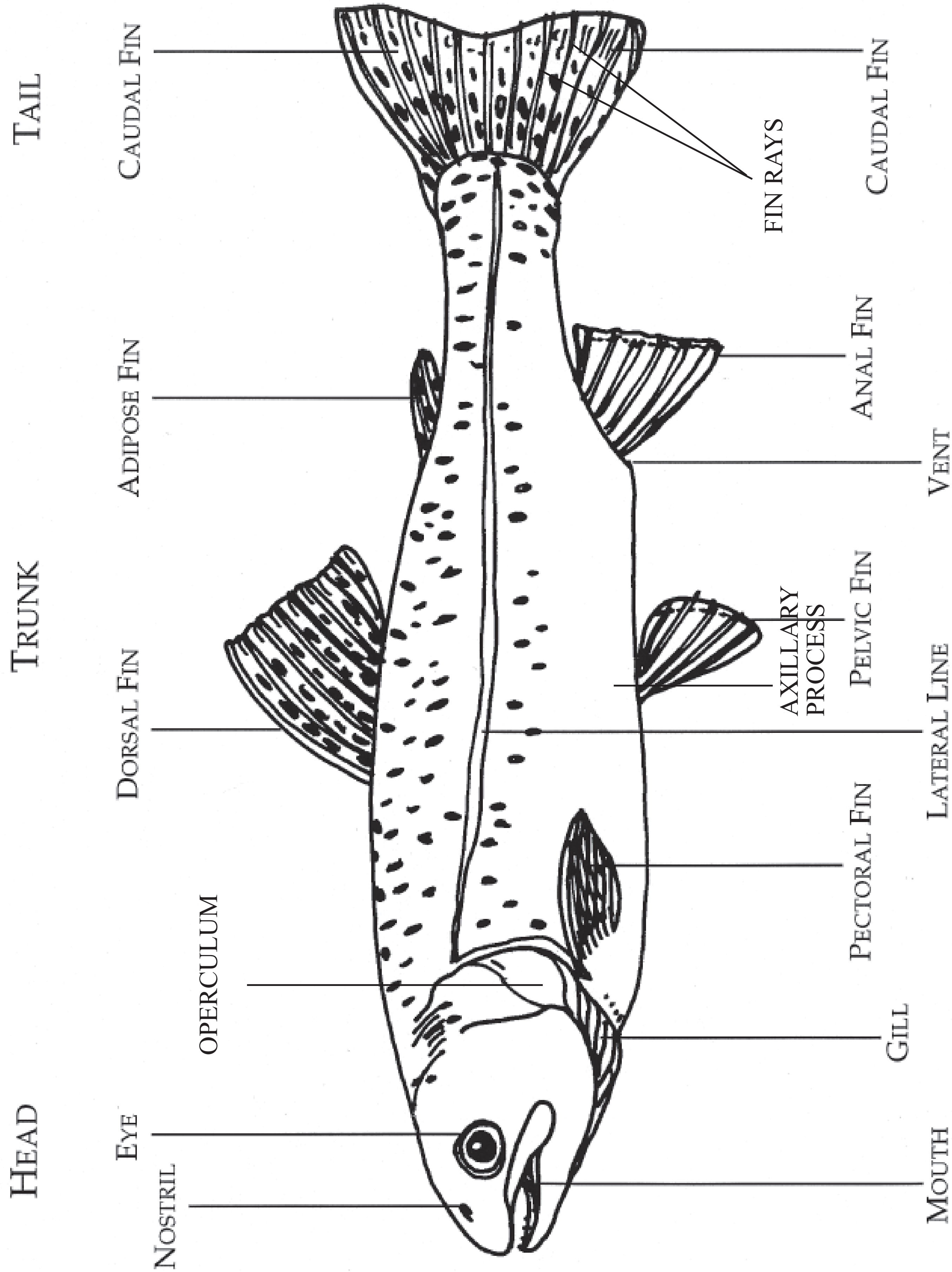


Figure 4. External Trout Anatomy

Name

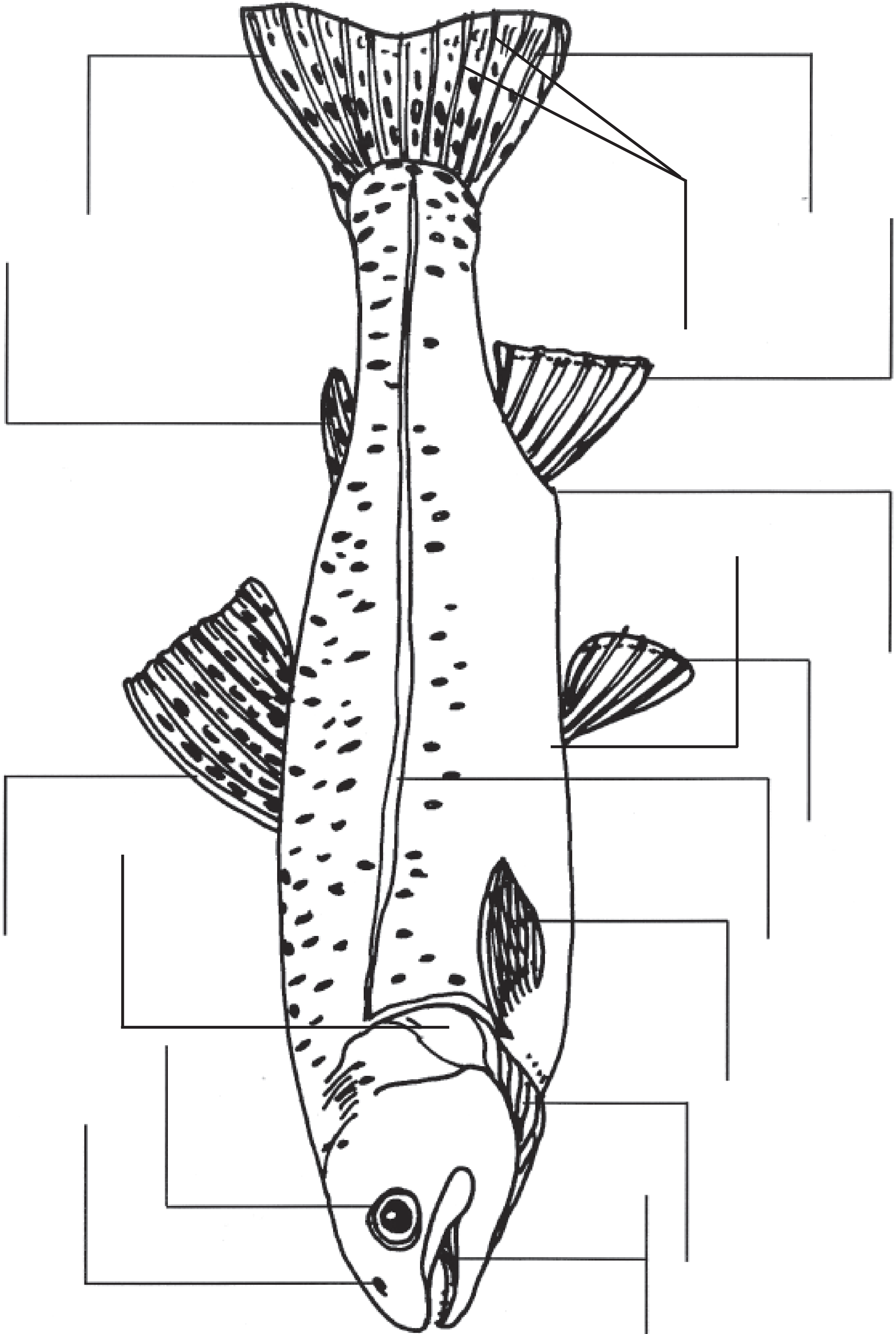


Figure 4A. External Trout Anatomy

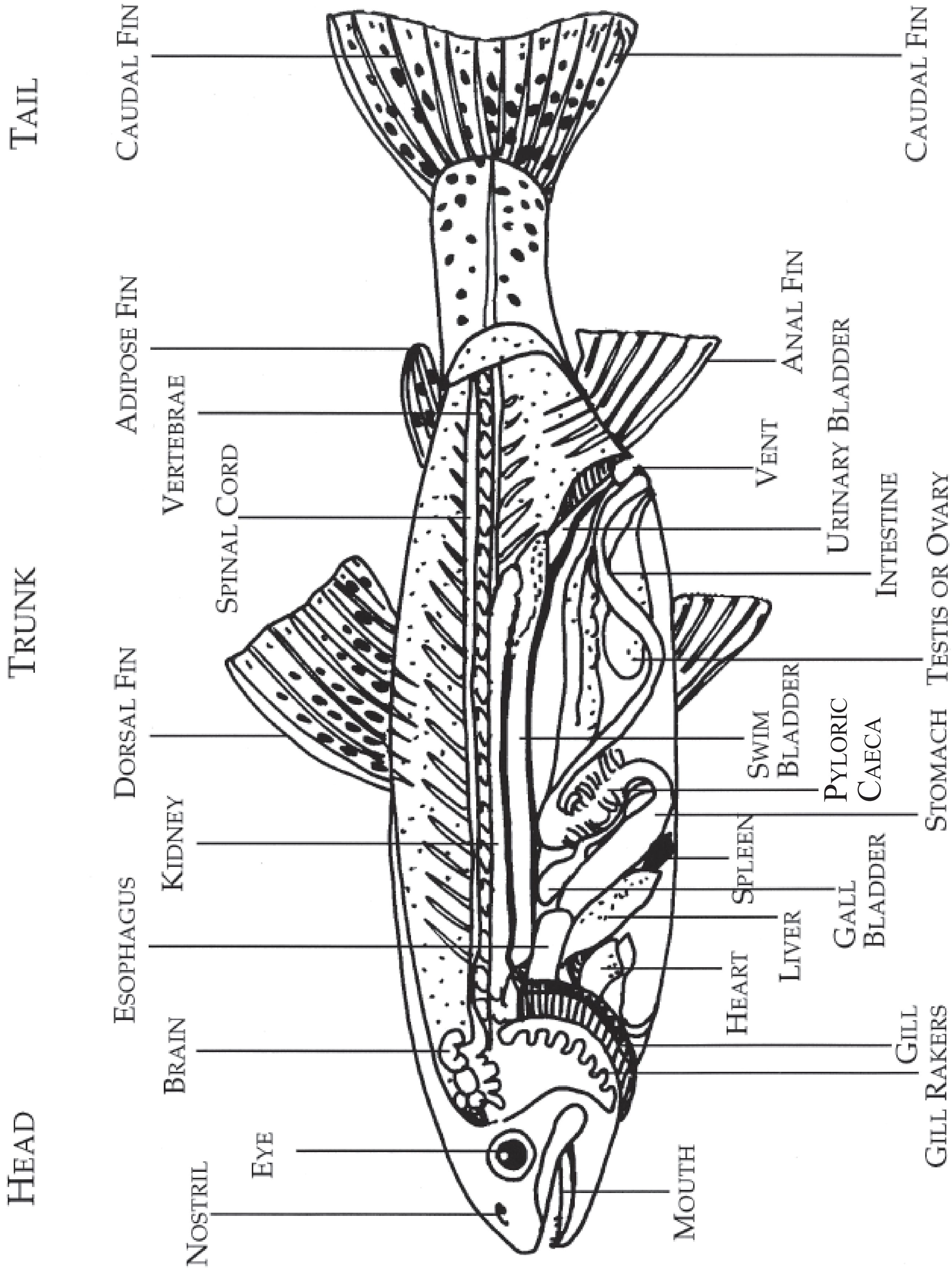


Figure 5. Internal Trout Anatomy

Name

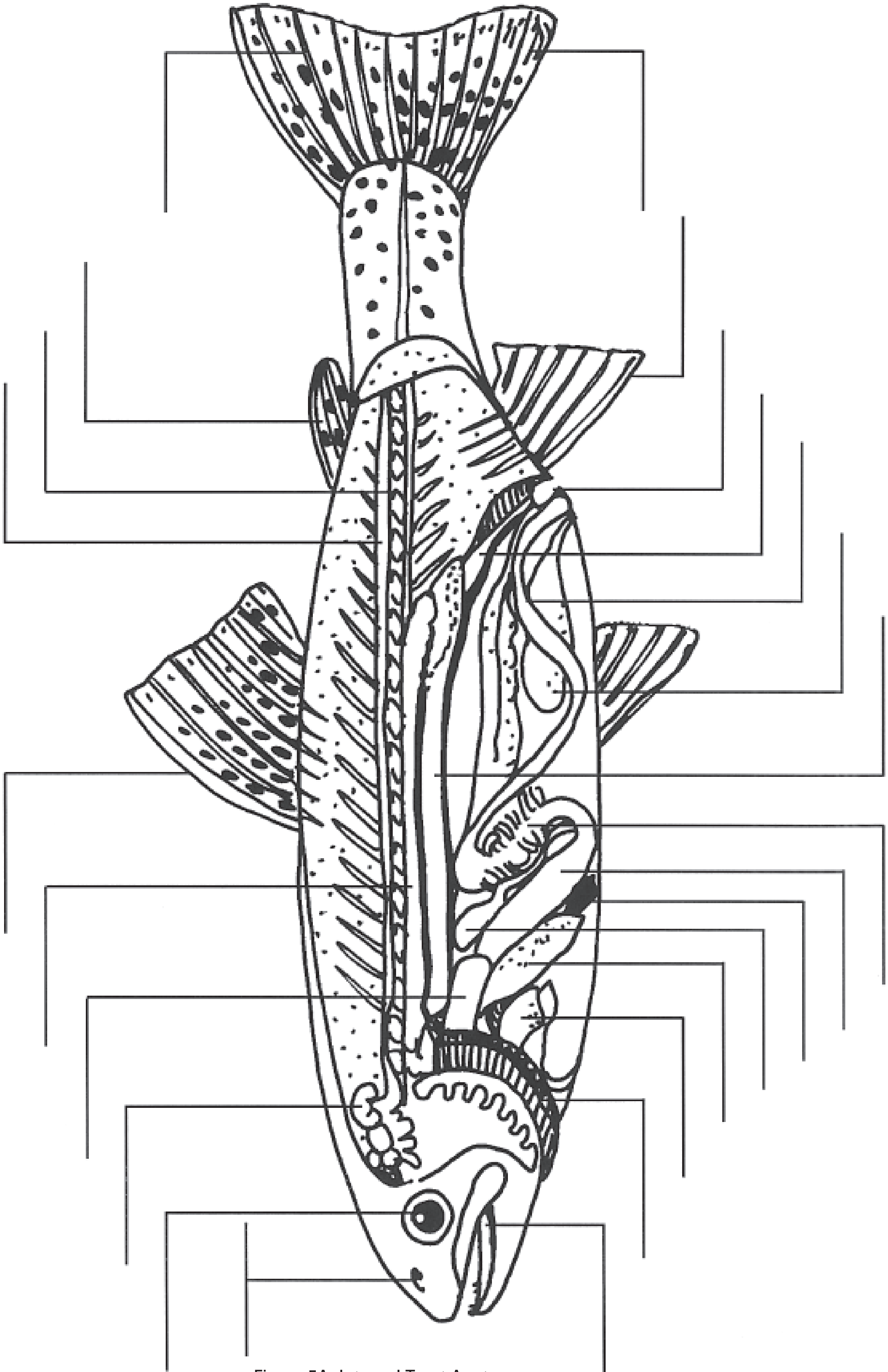


Figure 5A. Internal Trout Anatomy

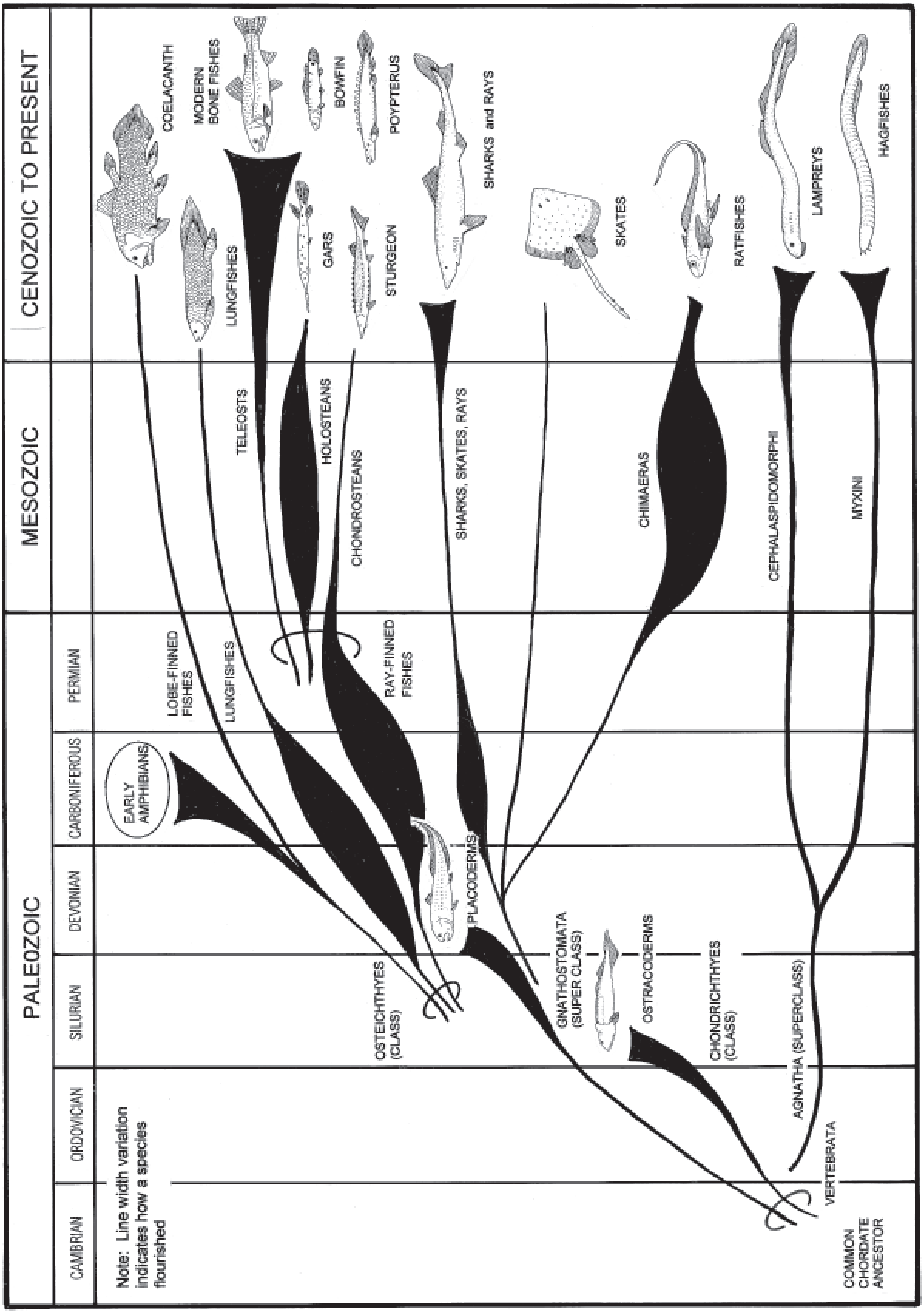


Figure 6. Fish Family Tree

SPECIES CLASSIFICATION SYSTEM

Kingdom

Phylum

Class

Order

Family

Genus

Species

There are super and sub classifications for many of the classifications.
Genus names are always capitalized and the species names are in lower case letters.
Both are italicized. See the example of the classification system below for steelhead.

Example:

Kingdom: Animalia
Phylum: Chordata
Subphylum: Vertebrata
Class: Osteichthyes (bony fishes)
Subclass: Actinopterygii (higher bony fishes)
Order: Salmoniformes
Family: Salmonidae
Genus: *Oncorhynchus* (hooked nose)
Species: *mykiss*

Figure 7. Species Classification System (Carolus Linnaeus, 1700's)

Be a Biologist... Back in the Office

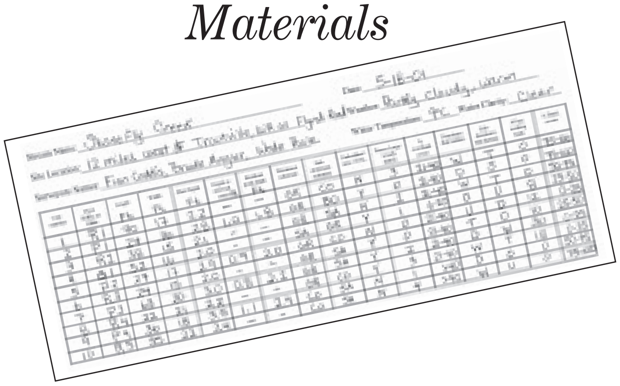
(30 minutes - three hour activity)

Objectives

Students will be able to:

1) Analyze a completed stream survey
2) Interpret the results
3) Write an authentic stream survey report
4) Draw conclusions about the health of a surveyed stream

Materials



- ❑ Pencils
- ❑ Calculators
- ❑ Copies of *Be A Biologist Student Worksheet* and *Data Summary Form, Stonefly Creek Survey* and *Key, Stream Data Survey Form* (Student Section)
- ❑ Computer spreadsheet program (optional)

Background

There are standard protocols implemented by scientists when conducting surveys to gain more information about fisheries, geology, archaeology, wildlife, soils, etc. Students practiced those skills during the *Kids in the Creek Program*, and used survey methods common for fishery biologists. Correctly taken information is critical when determining management strategies.

Procedure

1. Have students connect their mathematics and analytical skills with a data sample written by local fisheries biologists. Directions for students and the data sheet are in the Student Section.

   Open the discussion by informing students they will analyze stream survey data from a reach of Stonefly Creek. Why do scientists conduct studies of this nature? *Because they need to get a picture of the condition of the stream*. Discuss survey methods practiced during the *Kids in the Creek* Program because the same protocols have been followed by the biologists who conducted the survey in the Student Section.

2. Assign students to be responsible for one of the three tasks or levels that are detailed in the directions. Each level requires more time and work than the previous. Give them copies of the completed *Stonefly Creek Field Survey Form* and *Key*, from the Student Section. Ask students to follow the instructions using the *Data Summary Form* and interpret the results.

For **Level A**, filling in the data summary form might take 30 minutes to one hour, depending on whether the calculations are performed with a calculator or a computer spreadsheet program. Writing up results, **Level B**, may take an additional 30 minutes to one hour. The report from **Level B** and **C** 2-3 hours more. If they do not write a report, share the following sample *Stream Survey Report* written by a fishery biologist.

Stream Survey Report — Stonefly Creek

Introduction

Stonefly Creek was surveyed on May 18, 2001 by Finn Caddis, Brooke Angler, and Wade Poole. The creek is located 12 miles west of Troutville, Washington on Flyrod Road. The stream was surveyed to get a general picture of its condition and an assessment of its suitability for fish.

Methods

The stream was surveyed starting from a downstream point and working upwards. The stream was delineated into pools, riffles, and glides. Each unit was measured to determine its length, width, and maximum depth. The pool tail-crest of the pools was also measured so that the residual depth of the pool could be calculated by subtracting the pool tail-crest depth from the maximum depth. We visually estimated what substrate types were dominant and subdominant in each habitat unit. We visually estimated whether substrate was more or less than 35% embedded in each unit. We assessed the percentage of the unit that would provide overhead cover for fish. We determined the types of habitat features to be the dominant and subdominant cover types for fish in each unit. We measured the number of feet of eroding bank. For each unit we estimated the percent of the streambank that had vegetative cover.

Results

The reach we surveyed was 391 ft. in length or 0.074 miles. Average stream width was 17.7 ft and average stream depth 2.5 ft. In pools the average residual depth was 2.1 ft. Half of the units were riffles, and there were 40% pools and 10% glides. See Tables 1 and 2.

Table 1. Stream dimensions

Stream dimension	Measurement
Total reach length in feet	391 feet
Total reach length in miles (5,280 ft/mile)	0.074 miles
Average stream width	17.7 feet
Average stream depth	2.5 feet
Average residual pool depth	2.1 feet

Table 2. Habitat unit types

Unit type	Number	Percent
Pools	4	40%
Riffles	5	50%
Glides	1	10%

Gravel was the dominant substrate in 70% of the units and subdominant in the other 30%. Cobble dominated 20% of the units and sub-dominates 30%. Sand/silt/clay dominated 10% of the units and sub-dominate 30%. Boulder was the only subdominant in 10% of the units. See Table 3.

Table 3. Substrate composition

Substrate type	No. of units dominant in	% of units dominant in	No. of units sub-dominant in	% of units sub-dominant in
(Sa) Sand/Silt/Clay (<2 mm)	1	10%	3	30%
(Gr) Gravel (2-64 mm)	7	70%	3	30%
(Co) Cobble (64-256 mm)	2	20%	3	30%
(Bo) Boulder (>256 mm)	0	0%	1	10%

Wood was found in 70% of the units with 16 pieces counted. Expanding the number would yield an average of 216 pieces of wood per mile. See Table 4.

Table 4. Woody debris, >4 inches diameter and >6 ft. in length

Parameter	Answer
Number and percent of units with one or more pieces of wood:	7 units, 70%
Total number of pieces of wood:	16
Number of pieces of wood per mile:	216 pieces per mile

Seventy percent of the units had 21-40% fish cover, 20% more than 40%, and 10% have 6-20%. Wood material was the dominant cover type in 40% of the units and subdominant in 10%. Depth dominated 30% and sub-dominated in 10%. Turbulence dominated in 10% and sub-dominated in 30% of the units. Undercut banks and overhanging vegetation both dominated in 10% of the units and sub-dominated in 20%. Substrate sub-dominated in 10% of the units. See Tables 5 and 6.

Table 5. Fish habitat cover

Cover Category	Number	Percent
0-5% cover:	0	0%
6-20% cover:	1	10%
21-40% cover:	7	70%
>40% cover:	2	20%

Table 6. Dominant and subdominant fish habitat cover types

Fish habitat cover type	No. of units dominant in	% of units dominant in	No. of units sub-dominant in	% of units sub-dominant in
U = Undercut banks	1	10%	2	20%
S = Substrate	0	0%	1	10%
D = Depth	3	30%	1	10%
O = Overhanging vegetation	1	10%	2	20%
W = Wood material	4	40%	1	10%
T = Turbulence	1	10%	3	30%
A = Aquatic/emergent vegetation	0	0%	0	0%

We measured 78 ft. of eroding bank which is almost 9% of the streambanks in the unit. Thirty percent of the banks had 0-25% bank cover, making them susceptible to erosion. Twenty percent of the banks have 26-50% cover, 20%, 51-75% cover, and 30%, 76-100% cover. See Tables 7 and 8.

Table 7. Embeddedness and bank erosion

Parameter	Answer
Number and percent of units that are >35% embedded	5 units, 50%
Total number of feet of eroding bank:	78 ft
Percentage of bank eroding (remember that since the stream has 2 sides you need to multiply the stream length by 2 to get the total length of streambank)	9%

Table 8. Amount of streambank with cover

% Streambank cover by Category	Number	Percent
0-25% cover:	3	30%
26-50% cover:	2	20%
51-75% cover:	2	20%
76-100% cover:	3	30%

Discussion

Stonefly Creek is a smaller size trout stream with average width near 18 feet and deeper areas of 2 to 3.5 feet. There were several pools which provide holding areas for fish, especially when water depths decrease. Riffles provide good areas for insect production. Fish often utilize riffles for feeding and can find shelter from the current behind larger substrate or behind wood or near streambanks. Glides may also provide spawning areas. The reach had many areas with gravel as the dominant or subdominant substrate. This could indicate that there was spawning habitat in the reach. Larger cobbles and boulders help provide areas for fish to hide and for insect production. However, half of the units were >35% embedded. This could signal problems in the stream. Embeddedness reduces the suitability of areas for spawning. Sediment that is embedded in larger substrate reduces the interstitial spaces used for insect production and used by fish for cover. There was an abundance of woody debris in this reach and 70% of the units had wood. The wood indicates there is a healthy source of it in the adjacent and upstream riparian areas. Wood is important for providing fish cover, creating pools, and protecting streambanks from erosion. Wood, depth, and turbulence are the most common fish habitat cover types. There was a variety of fish cover types. Almost all units have at least 21-40% overhead fish cover. There were eroding banks within five adjacent units. It is of concern that almost 9% of the banks were eroding. The areas with eroding banks had 0-25% or 26-50% bank cover. Lack of vegetation on the banks could be contributing to the bank erosion. Units with no erosion had 51-75% or 76-100% bank cover. The vegetative cover in these units appeared to be protecting the banks from erosion. The erosion may be contributing to the embeddedness as four of the five units with erosion had over 35% embeddedness. It would be worthwhile to investigate the reasons the banks are eroding. There could be land management practices on this stream that are leading to instability of the banks. The stream may require some restoration work to reduce the erosion such as planting of riparian vegetation.

It would be good to know year-round stream flows and temperatures in this creek and the size and type of riparian vegetation that predominates the area. An aquatic invertebrate survey is recommended to determine the species of insects and their abundances in the stream. It would also be worthwhile to survey the fish population by snorkeling, electro-fishing, or by rod and reel sampling.

Wrap Up

Stimulate discussion with the following questions: What is the significance of the stream size? What are the importance of pools, riffles, and glides for providing fish cover, food production, and for different size classes of fish? What types of activities do the different substrate sizes tend to provide for spawning, fish hiding, insect production, pool formation? What does the embeddedness mean for spawning, insect production, and fish hiding? What function does woody debris provide? What is the importance of cover? What does the quantity of bank erosion say about the stream s health? What does the amount of bank cover say? Thinking about other stations at *Kids in the Creek*, what other information would you want to know about this stream?

Assessment

Ask students to:

- ❑ Explain the components necessary for healthy stream habitat.
- ❑ List the components that may be influenced by land management activities.
- ❑ Debate the many ways of looking at the evidence.
- ❑ Compare stream structure and gradient information of different creeks to the *Stream Habitat Survey Form* filled out on the field trip. What differences are noticeable? Rate the quality of each habitat and predict what fish and macroinvertebrates could live there.
- ❑ Discuss the answers relating to *Habitat Sense* from the *Kids in the Creek Scavenger Hunt.*

Extensions

- ❑ Enter the *Habitat Sense* student data into spreadsheets or onto the blank *Data Summary Form* (Student Section). Summarize and analyze it. Write a brief report with the following headings: introduction, study area, methods, results, and discussion.
- ❑ Take a survey of a local creek, using the blank *Stream Habitat Survey* or the *Stream Survey Data Forms* (similar to the Stonefly Creek form) to fill in the appropriate information; use the *Data Summary Form* to create a report. All three are in the Student Section.

Student Section

Stream Habitat Survey Form

Fill out the form below, utilizing the information you learned back in the classroom.

Name ______________________________ Date __________

Stream ____

Location ________________________ Water Temperature ______ Air Temperature ______

Weather ____

Valley Form (circle): \/ __/ ______/

1. Habitat Type: Pool, Riffle, or Glide .... ______________
2. Unit Length: Estimated .... ______________
3. Unit Width: Estimated .... ______________
4. Maximum Depth: Estimated ....1) _______ 2) _______ 3) _______ Mean:_________
5. Unit Length: Measured .... ______________
6. Mean Width: Measured.. ______________
7. Maximum Depth: Measured... ______________

   If pool, complete #8 and #9. Otherwise, skip to #10.

8. Depth at Pool Tail-Crest .... ______________
9. Residual Depth of Pool (Maximum depth less depth at Pool Tail-Crest) . ______________
10. Dominant Substrate: sand, gravel, cobble, or boulder .... ______________
11. Sub-Dominant Substrate: sand, gravel, cobble, or boulder .... ______________
12. Embeddedness: >35% Yes or No .... ______________
13. # Pieces Large Woody Debris (over 1cm or 0.5 inch diameter and sizes)______________
14. Dominant Cover: .... ______________
15. Sub-Dominant Cover: .... ______________

16. % Total Cover: 0-5%, 6-20%, 21-40%, or >40% .... ______________

17. Length of actively eroding streambank .... ______________

18. % Bank Cover (0-24%, 25-40%, 50-74%, 75-100%) .... ______________

Pebble Count

The pebble count method is used to obtain information on stream substrate composition, bedload movement, channel substrate stability, and channel roughness.

Pebble counts are done in riffles or glides and are done along transects going up, down, or across the stream. Normally 100 bed particles are measured, but we will strive to do 20, if you can do more, great.

- The sampler picks up a particle at each pace or stride by reaching down with a finger and picking the first particle touched. To avoid bias, avert or close your eyes when reaching down.
- Measure the intermediate axis of the substrate (not the longest or shortest). If the rock is too large to move, measure it in place.
- Note if there are any macroinvertebrates on the substrate and note if it is cemented (if it is hard to pick up).

INCHES	PARTICLE	MM	PARTICLE COUNT	TOTAL #	# WITH MACRO	#CEMENTED
<.08	Sand	<2	________	________	________	_________
Gravel						
.08 - .31	Fine	2 - 8	________	________	________	_________
.31 - .63	Medium	8 - 24	________	________	________	_________
.63 - 1.26	Coarse	24 - 64	________	________	________	_________
Cobble						
2.5 - 5.0	Small	64 - 128	________	________	________	_________
5.0 - 10	Large	128-256	________	________	________	_________
Boulders						
10 - 20	Small	256-512	________	________	________	_________
20 - 40	Medium	512-1024	________	________	________	_________
>40	Large	>1024	________	________	________	_________
		Totals:	________	________	________	_________

To nearest 10% what are the Percentages of:

__________% Sand __________% Gravel __________% Cobble __________% Boulder

What are the Dominant and Subdominant Substrates?

____

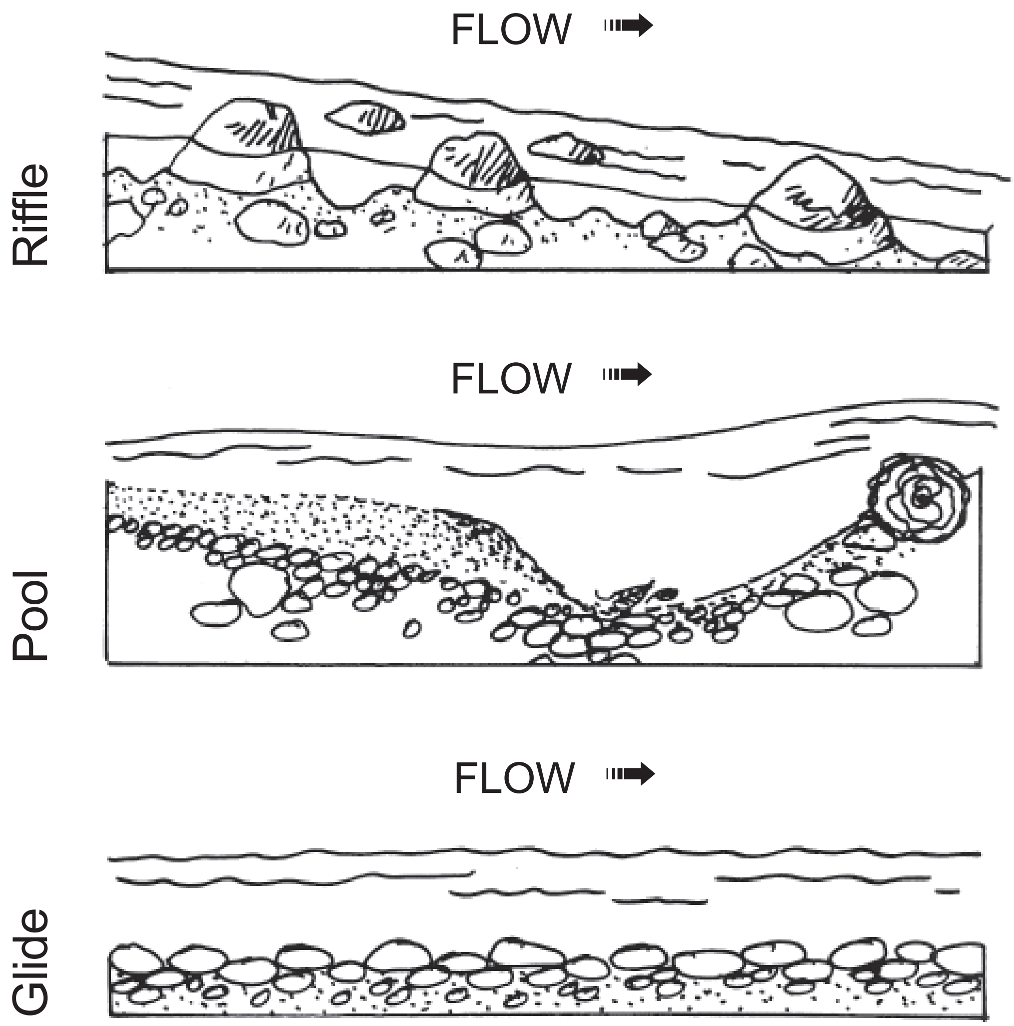
Stream Mapping

Draw a map of your stream reach on this page.

Stream Habitat Survey

Form Definitions and Help Sheet

1. Pool, Riffle, Glide: See Figure 1 below. A pool has slow water, riffles and glides have fast moving water; riffles have turbulence and glides are non-turbulent.
   # 10 and #11: Dominant and Subdominant Substrate



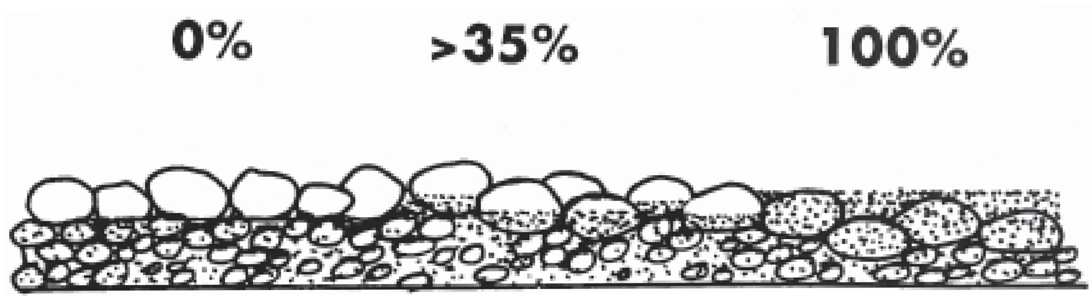
Sand/Silt/Clay: < 2mm less than pea size

Gravel: 2-64 mm, 0.6-2.5", pea size to hardball

Cobble: 64-256 mm, 2.5-10", hardball to basketball size

Boulder: 256-1024mm, > 10", bigger than a basketball

12. EMBEDDEDNESS: The percentage of larger substrate particles that are surrounded by sand/silt/clay. If embeddedness is greater that 35 percent, then it is embedded. Embeddedness reduces the usability of gravels for spawning, and reduces interstitial spaces that can be used by fish for cover or for invertebrate production.



13. Pieces of larger woody debris that are more than 1cm or 0.5 inch in diameter.

14 and 15. Dominant and Subdominant Fish Habitat Cover:

U = Undercut Banks: Banks that are undercut provide hiding places and protection for fish.
S = Substrate: Larger substrate such as cobble and boulder provide cover.
D = Depth: Deeper areas provide cover.
O = Overhanging Vegetation within 10" above the water surface.
W = Wood material: What you counted as large woody debris and other wood in the stream provides cover.
T = Turbulence: The swirling and bubbling areas of the stream hide fish underneath.
A = Aquatic/Emergent Vegetation: Provides hiding areas.

16. Percent of Overhead Fish Cover: Imagine you are an eagle. How much of the stream would provide cover for a small fish from the overhead (0-5%; 6-20%; 21-40%; or >40%)?

17. # Feet Eroding Banks: This is the number of feet of actively eroding streambank.

18. % Bank Cover: The percentage of the streambank is covered with vegetation (0-25%; 26-50%; 51-75%; 75-100%).

Stream Bank Cover

Code	Percent	Description
4	**75-100**	Over 75% of the streambank surface is covered by vegetation in vigorous condition or by boulders and rubble. If the streambank is not covered by vegetation, it is protected by materials that do not allow bank erosion.
3	**50-74**	50-74% of the streambank surface is covered by vegetation or by gravel or larger material. Those areas not covered by vegetation are protected by materials that allow only minor erosion.
2	**25-49**	25-49% of the streambank surface is covered by vegetation or by gravel or larger material. The area not covered by vegetation is covered by materials that give limited protection.
1	**0-24**	*n put in the blank Stream Survey Data Form found next)*

Stream Survey Data Form

From your day in the field for *Kids in the Creek*, have different groups fill in the spreadsheet with data they collected.

Stream Name: ____ Date: ______________

Site Location: __________________________________ Weather: ___________________

Surveyors Names: ____

Water Temperature: _______________ Water Clarity: _______________________________

Unit Number															
Pool, Riffle, or Glide															
Length															
Width															
Max. Depth															
Depth at pool tail crest															
Residual pool depth															
Dominant substrate															
Subdominant substrate															
Embedded-ness >35%															
Pieces Large woody debris															
% overhead cover															
Dominant fish habitat															
Subdominant fish habitat															
# feet eroding bank															
% bank cover															

Be a Biologist... Back in the Office

Student Worksheet

Name(s): ____ Date: _____________

You will be given data from a reach of Stonefly Creek that was surveyed using the habitat survey methods you learned at *Kids in the Creek*. Fisheries biologists typically collect this type of information and then summarize the data and include it in a stream report. You will be assigned to either just summarize the data as described in Level A, to summarize the results in report format as described in Level B, or to write a complete report as described in Level C. The stream is surveyed starting at the downstream end and working upstream, thus unit #1 is at the bottom and #10 at the upper end.

Level A: Complete the *Data Summary Form*. You may either do the calculations with a calculator or enter the data into a computer spreadsheet to do the calculation.

Level B: Complete the *Data Summary Form*. Then summarize the results in a report format. Write about the results. You may use text, tables, or figures to report your results.

Level C: Write a complete report with an Introduction, Methods, Results, and Discussion.

Introduction The **what** and **why** of the report.
What: Discuss how this report is about a stream survey of one reach of the study stream. Include the name of the stream and its location.
Why: Stream survey done to get a picture of the condition of the stream.

Methods The **how** of the report. We used a modified standard stream survey method. From the Kids in the Creek curriculum and your memory of the stream survey, briefly describe methods.

Results Use text to describe the information on the tables you created in the Data Summary. Refer to the tables where appropriate.

Discussion Interpret your results.

Data Summary Form

Table 1. Stream dimensions

Stream dimension	Measurement
Total reach length in feet:	___________
Total reach length in miles (5,280 ft/mile):	___________
Average stream width:	___________
Average stream depth:	___________
Average residual pool depth:	___________

Table 2. Habitat unit types

Unit type	Number	Percent
Pools:	_______	_______
Riffles:	_______	_______
Glides:	_______	_______

Table 3. Substrate composition

Substrate type	Number of units dominant in	Percent of units dominant in	Number of units sub-dominant in	Percent of units sub-dominant in
Sand / Silt / Clay (<2 mm)	__________	__________	__________	__________
Gravel (2-64 mm)	__________	__________	__________	__________
Cobble (64-256 mm)	__________	__________	__________	__________
Boulder (>256 mm)	__________	__________	__________	__________

Table 4. Woody debris.

Parameter	Answer
Number and percent of units with one or more pieces of wood:	______
Total number of pieces of wood:	______
Number of pieces of wood per mile:	______

Table 5. Fish habitat cover

Cover Category	Number	Percent
0-5% cover:	___________	___________
6-20% cover:	___________	___________
21-40% cover:	___________	___________
>40% cover:	___________	___________

Table 6. Dominant and sub-dominant fish habitat cover type

Fish habitat cover type	Number of units dominant in	Percent of units dominant in	Number of units sub-dominant in	Percent of units sub-dominant in
U = Undercut banks	___________	___________	___________	___________
S = Substrate	___________	___________	___________	___________
D = Depth	___________	___________	___________	___________
O = Overhanging vegetation	___________	___________	___________	___________
W = Wood material	___________	___________	___________	___________
T = Turbulence	___________	___________	___________	___________
A = Aquatic/emergent vegetation	___________	___________	___________	___________

Table 7. Embeddedness and bank erosion

Parameter	Answer
Number and percent of units that are >35% embedded:	________________________________
Total number of feet of eroding bank:	________________________________
Percentage of bank eroding (remember that since the stream has 2 sides you need to multiply the stream length by 2 to get the total length of streambank)	________________________________

Table 8. Amount of streambank with cover

% Streambank cover by Category	Number	Percent
0-25% cover:	___________	___________
26-50% cover:	___________	___________
51-75% cover:	___________	___________
76-100% cover:	___________	___________

Stream Name: Stonefly Creek Date: 5-18-01

Site Location: 12 miles west of Troutville, WA on Flyrod Road Weather: Partly cloudy, warm

Surveyors Names: Finn Caddis, Brooke Angler, Wade Poole Water Temperature: 9°C Water Clarity: Clear

Unit number	Pool, Riffle, or Glide	Length Ft	Width Ft	Max Depth Ft	Depth at pool tail crest Ft	Residual pool depth Ft	Dominant substrate	Sub-dominant substrate	Embeddedness >35%	Pieces Large woody debris	% overhead cover	Dominant fish habitat	Sub-dominant fish habitat	# Feet eroding bank	% Bank cover
1	R1	70	17	2.2	–	–	GR	CO	N	3	21-40	W	T	0	75-100
2	P1	24	16	2.8	1.0	1.8	GR	BO	Y	0	21-40	D	S	0	75-100
3	R2	38	15	2.1	–	–	GR	SA	N	2	21-40	W	T	0	50-75
4	G1	52	16	2.0	–	–	SA	GR	Y	1	6-20	O	U	8	25-50
5	P2	27	17	2.9	0.9	2.0	GR	CO	N	0	21-40	U	D	12	0-25
6	R3	24	15	2.0	–	–	GR	SA	Y	0	21-40	T	O	10	25-50
7	P3	63	20	3.0	0.8	2.2	GR	SA	Y	2	21-40	D	W	30	0-25
8	R4	22	21	2.2	–	–	GR	CO	Y	3	21-40	W	T	18	0-25
9	P4	36	18	3.5	1.1	2.4	CO	SA	N	1	>40	D	O	0	50-75
10	R5	35	22	2.4	–	–	CO	SA	N	4	>40	W	U	0	75-100

Figure 8. Stonefly Creek Data Form

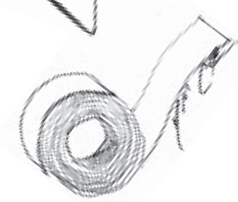
Resource Specialist Section

1. Review *Tips and Tricks for Resource Specialists* in the Appendix.

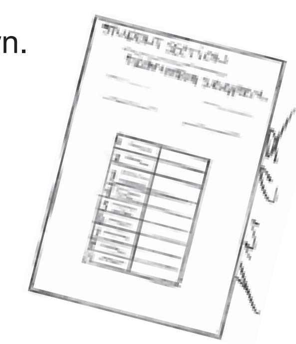
2. Read the entire *Habitat Sense* section to become familiar with the pre-work. Then you will have an idea of what the student knows. Always praise the classroom teacher for prepared and attentive students!

3. Checklist of equipment necessary for this station:


   - ❑ Three 100 ft./meter measuring tapes
   - ❑ Bright flagging to indicate 3 reaches to be studied
   - ❑ Popcorn and/or potassium permangenate solution to indicate flow
   - ❑ 3-5' measuring stick for depth
   - ❑ 2 Long rubber gloves to handle substrate (optional)



   - ❑ Student field worksheets (see student section) provided by the teacher; you might have extra worksheets for the survey and blank paper for the mapping exercise using write-in-the rain paper just in case.
   - ❑ Waders for yourself and students. You are only responsible for providing your own.
   - ❑ Thermometer
   - ❑ Metric rulers for pebble count



4. Procedure
   Gather students and ask:
   - Predict what fish live in the nearby creek?
   - What habitat features would a fish need to live there?
   - What habitat types do you see before you?
   - What is the valley type? What type of channel do fish prefer? (B or C: Refer to the Rosgen Chart of Major Stream Types in *Riparian Rx*)
   - How do stream gradient and elevation affect fish populations?
   - Tell them they are going to become fish and to station themselves in the water where fish would likely be feeding. Pour the potassium permangenate in a line across the stream so they can see how the current moves in the pools, riffles, and glides. Throw the popcorn and see who the most successful feeder is! Ask students about the stream velocity where they are located as indicated by the potassium permangenate or popcorn movement. How much energy would a fish need to maintain its position there? How does a fish optimize its holding position and feeding efficiency?

5. Habitat Measuring
   - Find a stream reach with a pool, riffle, and glide.
   - Divide students into three equal groups. Each group goes to a pool, riffle, or glide (if they are available). Make certain each group has a different habitat.
   - One specialist accompanies each group.
   - Have students estimate dimensions *before* measuring.
   - Ask student leaders to assign a recorder for the *Stream Habitat Inventory Form*, those analyzing the habitats. Students may take turns at different tasks.
   - Distribute equipment. *Set the students loose on the tasks!* In student directed learning, you are not the informer, but rather the guide. Be there to answer questions. One sure to be asked is about the pool tail-crest. Remind students that their worksheets must return to school with them for use back in the classroom.
   - After filling out the form, students sketch a map of the stream reach containing the habitats they and other teams measured.
6. Teachable moments to share: Point out fish or other wildlife or if a reach has something they may not notice. Discuss that there may be special species living there. Bull trout are listed as threatened, spring Chinook salmon and summer steelhead are now listed as endangered, and a petition has been filed for the westslope cutthroat trout.

7. Unless students are ready earlier, reconvene the group in the final 15 minutes. Students report findings and compare habitats. Discuss the habitat use by different age classes of fish and species. Link to the *Riparian Rx* section about the cover riparian provides, to *Invert Investigator* about specific insects fish prefer, and with *What s in That* H_2*0* about fish tolerance/intolerance to water quality changes.

   Ask why some fish species are listed or proposed as threatened or endangered in this area. Look around and point out evidence of human influences on habitat, if any are visible. Time permitting, if you have an authentic survey form from a previous survey to share, please do! They will feel like real scientists!