Table of Contents - Lesson Plans with a Tank

Introduction

Summary

The lessons in this unit are designed to be used before, during and after salmon have been raised in the classroom with the Clear Creek Salmon in the Classroom Program or a similar program. **However**, these lessons may also be used to teach students about salmon if it is not possible to raise salmon in a tank in the classroom.

Through their investigations with these NGSS-aligned lessons, students develop an understanding of salmon life cycles; internal and external structures that function to support survival, growth, behavior, and reproduction; different inherited traits; and that the environment can also affect the traits that these fish develop. In addition, evidence is studied around how variations in characteristics among individuals in the same species may provide advantages in surviving. Students will consider ideas that when the environment changes, some salmon survive and reproduce, some move to new locations, some move into the transformed environment, and some die. Impacts of the uses of energy and fuels derived from natural resources on the environment are also addressed. When experiencing these lessons in conjunction with raising salmon in the classroom, students are provided in-class reference for the subject material whose focus is on the connection between salmon and their habitat. In addition, students generate a high level of interest in the investigations and develop a sense of place because they connect locally to environmental stewardship, community involvement, and interaction with salmon, an icon species in the Northwest and a policy-relevant topic.

Depending on whether you will be raising salmon or not, throughout the course of your salmon unit students may be working with and listening to guest speakers; working indoors and outdoors; working in groups; using scientific tools; gathering data; recording evidence accurately; using science, reading, writing and math skills; and sharing information with each other, the class and others in their school and at home. Share your expectations with them for the work ahead.

Standards

Next Generation Science Standards

3-LS1-1 From Molecules to Organisms: Structures and Processes

Develop models to describe that organisms have unique and diverse life cycles but all have in common birth, growth, reproduction, and death.

3-LS3-1 Heredity: Inheritance and Variation of Traits

Analyze and interpret data to provide evidence that plants and animals have traits inherited from parents and that variation of these traits exists in a group of similar organisms.

3-LS3-2 Heredity: Inheritance and Variation of Traits

Use evidence to support the explanation that traits can be influenced by the environment.

3-LS4-2 Biological Evolution: Unity and Diversity

Use evidence to construct an explanation for how the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing.

3-LS4-3 Biological Evolution: Unity and Diversity

Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.

4-LS1-1 From Molecules to Organisms: Structures and Processes

Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.

4-LS1-2 From Molecules to Organisms: Structures and Processes

Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways.

4-ESS3-1 Earth and Human Activity

Obtain and combine information to describe that energy and fuels are derived from natural resources and that their uses affect the environment.

Common Core State Standard (CCSS) Connections

Refer to each NGSS Standard above for a complete list of connections to Common Core State Standards for ELA and math that support the work in the standard. For example, in this unit there are opportunities to utilize the mathematical skills found in "M.P.2: Reason abstractly and quantitatively." Additionally, opportunities are present to use the writing skills such as those found in "W.3.2 Write informative/explanatory texts to examine a topic and convey ideas and information clearly."

How to Use this Curriculum

This curriculum is designed to be used while raising salmon in a tank in the classroom. However, if that is not possible, many of the lessons can still be used in the classroom. Each scenario is summarized in the following paragraphs. Please be sure to review the *Overview* and the *Suggested Timeline* for your situation.

The program begins with a formative assessment probe, allowing teachers to gauge student knowledge about what makes a healthy salmon stream. The units and lessons are designed to be sequential, building on student knowledge. Blackline Masters for copying are provided for each lesson.

Resources, including vocabulary, books, video links, and links to the locally developed *Salmon Field Guide, Kitsap Edition,* are provided in the Resources section.

Curriculum Overview – No Salmon Tank

Although this curriculum is designed to be used while raising salmon in a tank in the classroom, many of the lessons can still be used if you do not have a tank. The *Suggested Timeline, No Salmon Tank* provides an overall view of the curriculum.

Unit 1 provides an opportunity to assess what students know, introduces the phenomenon, and allows students to develop some investigative questions. Units 2 and 3 offer students an opportunity to learn all about salmon and their habitat needs. Students design their own salmon stream, sharing their designs through a gallery walk, then complete the virtual scavenger hunt to see some habitat features "in real life". In Unit 4, they revise their stream designs based on what they have learned about habitat. As a Summative Assessment, they develop a Wanted Poster summarizing what they have learned throughout all the units. Opportunities may be available to have some of these Wanted Posters displayed in kiosks near streams around Kitsap County.

Curriculum Overview – With a Salmon Tank

The *Suggested Timeline, With a Salmon Tank* includes lessons as well as various tasks associated with raising salmon, organized in chronological order. Any lessons or tasks associated with raising salmon are coded with RS; those associated with a field trip are coded RS-FT. These lessons and tasks are interspersed throughout the *Suggested Timeline* based on when they should be introduced or completed. The other units are the same for those raising salmon and those that are not raising salmon.

PLEASE NOTE: Students raising salmon should be given the Formative Assessment Probe, Lesson 1-1, before they even see the tank.

The first section of the *Suggested Timeline, With a Salmon Tank,* includes Getting Ready and Tank Monitoring lessons. Tank temperature and several other parameters need to be monitored regularly and by involving students, you will provide them with opportunities for independent work as well as incorporating math and graphing, if desired.

Unit 1 provides an opportunity to assess what students know, introduces the phenomenon, and allows students to develop some investigative questions. Units 2 and 3 offer students an opportunity to learn all about salmon and their habitat needs. Students design their own salmon stream, sharing their designs through a gallery walk, then either attend a field trip or complete the virtual scavenger hunt to see some habitat features "in real life". In Unit 4, they revise their stream designs based on what they have learned about habitat. As a Summative Assessment, they develop a Wanted Poster summarizing what they have learned throughout all the units. Opportunities may be available to have some of these Wanted Posters displayed in kiosks near streams around Kitsap County.

Kitsap County Public Works (KCPW) and the Clear Creek Task Force (CCTF) are partners along with several other community agencies in the Clear Creek Salmon in the Classroom Program. KCPW protects people, property, and the environment in many ways. They offer education programs that help us understand what happens to the water where we live. CCTF's mission is to create and maintain a community wide network to mobilize support, educate and focus actions to preserve, protect and restore the Clear Creek ecosystem. Share with students that representatives from these groups will be working with you to share and help you investigate real-life, local experiences with one of our valuable local resources, salmon. You will be working together to gain an understanding of salmon and the connections to their habitat.

Blackline Masters

The Blackline Masters referred to in the Materials sections are located at the end of the curriculum. Because some Blackline Masters are used in multiple lessons, they are listed in alphabetical order.

Suggested Timeline

Choose the *Suggested Timeline* that best fits your situation—whether you have a tank and are raising salmon or you do not have a tank and are not raising salmon. While all the lessons are not required to be taught, students will have the best learning experience if all the lessons are taught in sequence.

Vocabulary

See Teacher Resources at the end of this curriculum for a list of vocabulary words compiled from KCPW program goals and OSPI NGSS Vocabulary used in the Washington Comprehensive Assessment of Science (WCAS) in grade 5, in alignment with this unit.

SUGGESTION: write words on cards and tape them to where the word is found in the room or around the tank.

Getting Ready

- If raising salmon in a tank in your classroom:
    - Do not give students access to the salmon tank until after they have responded to the probe used in Lesson 1-1 so that no clues are given to guide their responses (ex. refrigeration = cold water is needed for salmon). This first response, based solely on prior experiences, will help guide your instruction in the following lessons.
    - Discuss with co-teacher(s) who is participating in raising salmon; who will be the lead; and how the lead will communicate program information to other teachers.
    - Register for the raising salmon program, if necessary, when information is received (for the Clear Creek Salmon in the Classroom Program, registration information is sent by October each year.)
    - Follow the Outline and Schedule and the steps in the Salmon in the Classroom Aquarium Maintenance Manual (or a similar one for your program) to clean, check and prepare your salmon tank.

    - Coordinate with co-teachers to determine an estimated timeline for your salmon curriculum based on receiving eggs in January.
- If not raising salmon in your classroom, coordinate with co-teacher(s) to determine when this topic best fits your curriculum.

Acknowledgments

The lessons in this curriculum were developed or modified by Lori Reynolds, Instructional Design and Development, and Pat Kirschbaum, Kitsap County Public Works (KCPW). These lessons are designed to support Next Generation Science Standards (NGSS), Common Core State Standards (CCSS), and meet the goals of the Kitsap County Public Works Stormwater Program.

The Clear Creek Salmon in the Classroom Program was started by the Central Kitsap Kiwanis Club in 1988. It is now a partnership with the Clear Creek Task Force, Kitsap County Public Works, Suquamish Tribe, Silverdale Kiwanis Club, Kitsap Public Utility District, United Van Lines, Air Management Solutions, community volunteers, and over 30 local classrooms with the shared goal of enhancing the salmon population in Clear Creek and educating students on the importance of ecosystems. For more information on this program, visit *https://www.clearcreektrail.org/* and click on Salmon under the Stewardship tab.

RS-1 Program Registration and Aquarium Use Agreement

Method
Teacher Only

Time Required
30 minutes

Objective
- For the Clear Creek Salmon in the Classroom Program, complete necessary steps to participate in the program.

Materials
- Program Registration Information email
- Aquarium Use Agreement

Procedures
To participate in the Clear Creek Salmon in the Classroom Program:

1. Review the Program registration information sent by email in late September/early October.
2. Consult with co-teachers to confirm participation in the Program.
3. Respond to the email to register for the Program and provide all required information.
4. Sign and submit (by mail or email) the Aquarium Use Agreement sent with the email.
5. If you are new to the program and have not received the program registration email, contact Kitsap1, *help@kitsap1.com*, 360-337-5777.

If you participate in another program to raise salmon in your classroom, follow the registration procedure for that program.

RS-2 Aquarium Prep

Method
Teacher only

Time Required
60 – 120 minutes (more if a teacher workshop is offered)

Objective
- Ensure the salmon aquarium is in working order.
- Request service, if needed.
- Attend trainings when scheduled to learn more about raising salmon and additional curriculum or support available.

Materials
- Aquarium Maintenance Manual found in the Resources section
- Equipment and Supplies listed in the Aquarium Maintenance Manual

Procedures
1. Follow the steps in the Aquarium Maintenance Manual, pages 2 – 4, to take inventory, inspect and set up your aquarium, and complete an operational check.
2. Follow procedures to request service, if needed, as indicated in the Operational Check section of the Aquarium Maintenance Manual.
3. Attend trainings when offered.

RS-3 Aquarium Readiness to Accept Eggs

Method
Teacher only

Time Required
60-120 minutes

Objective
Ensure the salmon aquarium is ready to accept salmon eggs

Materials
- Aquarium Maintenance Manual found in the Resources section
- All equipment and supplies listed in the Salmon Aquarium Maintenance Manual

Background Information
The aquarium must be **at temperature** and ready to accept eggs in early January, usually the first week back from Winter Break. Be sure to **have the tank full and operating at least 2 days before eggs arrive** to ensure proper temperature.

Procedures
1. Follow the steps in the Aquarium Readiness section of the Aquarium Maintenance Manual to ensure the aquarium is ready for salmon eggs when they are delivered.

RS-4 Pick Up Salmon Eggs

Method
Teacher Only

Time Required
60-120 minutes

Objective
- Transfer salmon eggs from Grovers Creek Hatchery to classroom tank within 1 hour.

Materials
- Aquarium Maintenance Manual found in the Resources section
- Depending on the school, a teacher or parent volunteer may need to drive to the hatchery or another location to pick up salmon eggs.
- All materials for transporting salmon eggs will be provided—cups and covers, damp paper towels, eggs. You may want to have a small box or cup holder to hold the cup.

Background Information
Salmon eggs for the Clear Creek Salmon in the Classroom Program, and many other Salmon in the Classroom Programs in Kitsap County, are donated by the Suquamish Tribe's Grovers Creek Fish Hatchery in Indianola. Each tank receives approximately 100 salmon eggs along with fish food to feed the salmon once they are free-swimming. Pickup dates are usually in early January. Eggs are to be picked up by the teacher or a parent volunteer at the hatchery unless other arrangements have been made. Eggs need to be transferred to the classroom aquarium within one hour of leaving the hatchery water.

Central Kitsap School District teachers **MAY** have the option of picking up their eggs at the CKSD Science Kit Center at the Operations and Maintenance Service Center or at the TLC.

Procedures
1. Determine who will pick up salmon eggs. Provide them the hatchery address: Grovers Creek Fish Hatchery, 23175 Indianola Road, NE, Poulsbo, WA.
2. Contact the school office staff to ensure whoever is delivering the salmon eggs has access to the classroom and tank as soon as they arrive at the school.
3. Follow the procedures in the Egg Pickup and Placement section of the Aquarium Maintenance Manual.
4. Determine how students will know the eggs are coming and if you will have a special welcoming ceremony or celebration.

1-1 Formative Assessment Probe

Method

Teacher led in class
If raising salmon, complete before students see the salmon tank

Time Required

Approximately 45 minutes

Objective

- Define and explain the parameters of a good salmon stream based on evidence and reasoning from prior knowledge

Materials

Provided by classroom teacher

- Copies from provided blackline masters of:
  - Probe, What Makes a Good Salmon Stream?, 1 per student

Procedures

- Administer the probe, What Makes a Good Salmon Stream? Read the probe to students as they follow along before they respond independently.
- Collect the probes, review them, and save them for Lesson 1-2.

*NOTE: The KCPW Educator will want copies of these probes at the **end** of your salmon unit. Please copy and mail or scan and email copies of the **post** assessment to Stormwater Educator, Kitsap County Public Works, 614 Division Street, MS-26A, Port Orchard, WA 98366 or* help@kitsap1.com.

If students are not sure what a word in a response means and don't know if they should mark it as part of their claim about what makes a good salmon stream, have them mark that choice with a question mark and circle the word in question. This will give you additional valuable formative information about which words and concepts will need particular focus as you move forward with instruction. What connections are students making between salmon needs and their stream habitat in their responses? Assure students that they will work with and "own" these concepts and words as you work through the investigations together.

The correct responses:

- *shade* - keeps water cool
- *deep pools and ponds* – places for salmon to hide and rest

- *loose gravel* (about 1" diameter) – provides a place for salmon to spawn
- *beaver dams* – slows water and creates good rearing habitat for juvenile salmon
- *cold water* – necessary for salmon survival
- *places to hide* – protection from predators
- *clean water* – many salmon can't survive in polluted water
- *clear water* – silty water can clog gills
- *meandering stream* – helps slow the flow of water and moves nutrients through the stream system
- *rocks* – can slow water, create pools to hide and rest and gravel is needed for spawning
- *consistent water* – water levels are consistent throughout the year
- *riffles* – movement of water over rocks adds oxygen to the water
- *air (oxygen)* – salmon filter oxygen from the water through their gills
- *free-flowing rivers* – man-made dams can block salmon's migration
- *fallen trees* – provide places to hide, resting areas and trap gravel for spawning
- *boulders* – provide hiding places and stabilize banks, preventing erosion.
- *wood & vegetation along streambank* – provide cover, temperature regulation, and food for invertebrates
- *food* – juvenile salmon need food while living in the stream

Items on the probe that DO NOT make a good salmon stream

- *culverts* – pipes, open on both sides. Direct streams or drainages under roads and driveways. Culverts force the stream flow into a small area (the pipe), increasing the flow. The increased flow makes it hard for salmon to swim through the culvert. The focused flow can also create a hole and eventually a waterfall on the downstream side of the culvert, making it difficult for salmon to swim upstream.
- *Human-made dams* – Usually built for irrigation or power generation, they can block juvenile and adult salmon migration and cover spawning habitat. Some have fish ladders, but even these are sometimes challenging for salmon.
- *Excess mud, sand, and/or silt from erosion* – while some natural erosion in streams is good because it moves nutrients through the system, excess erosion from human activity creates silt—small particles of dirt that can settle between rocks, making it difficult for salmon to dig their redd. This silt can also settle on the redd itself, suffocating the eggs that have been laid, or can clog gills.

There will be opportunities for future reference and use, including summative assessment, in later lessons, so be sure to retain your students' probes.

1-2 Formative Assessment Probe Review

Method
Teacher Led

Time Required
30 minutes

Objective
- Discuss probe responses

Materials
Provided by the classroom teacher

- Be sure students have their completed copy of the Probe from Lesson 1-1, What Makes a Good Salmon Stream?
- Poster paper

Procedures
- On a piece of poster paper, with students referencing their responses to the probe from Lesson 1-1, call on students and capture student ideas about which elements they think make a good salmon stream and any questions they have.
- Collect and save the probes and poster for future reference.

NOTE: From here on in this unit, this probe can be revisited multiple times as students' conceptual understanding evolves. This revisiting can give you and your students valuable information about their conceptual development—do students understand the connections between salmon and their habitat? Are they including information they have learned throughout their investigations? This probe will be revisited in Lesson 4-3 and can be used as a summative assessment of student understanding.

For productive discourse here and in following discussions, give time to think and then ask questions such as: Can you give an example?, Who can repeat what was just said or put it in their own words?, Why do you think that?, What's your evidence?, Does anyone want to respond to that idea?

1-3 Phenomenon and Investigative Question

Method
Teacher Led and Student Discussion

Time Required
30 minutes

Objective
- Make predictions about the impact of a salmon's habitat on its survival
- Develop an investigative question

Materials
The phenomenon can be introduced as a photo or video, whichever works best for your students.

Provided by the classroom teacher

- Copies from provided blackline masters of:
    - Phenomenon for Salmon and Their Habitat (the image of salmon spawning) 1 per student or team, or projected to whole class

      OR
- You Tube video of Chinook salmon spawning, https://www.youtube.com/watch?time_continue=434&v=vBME9YT3N2M&feature=emb_logo or Google search the text Chinook Salmon Spawning Act3 2016. The female begins digging the redd at about minute 5:40 with actual spawning happening about minutes 6:40 – 8:26. The video provides an opportunity for students to gather auditory as well as visual evidence to develop their sense making.

Procedures
- Show students the image of salmon spawning or the video segment.
- Explain to them that this is an image of two adult Chinook salmon spawning. The female releases eggs into the gravel in a river bottom and the male fertilizes those eggs with what's called milt. Their gaping mouths indicate spawning; milt from the male can be seen as a cloud in the water. In the video, you can watch as the female digs the redd; the male crosses over to indicate he is ready; the gaping mouths and releasing milt can be seen and, as the female uses her tail to cover the eggs with gravel, some are kicked up from the gravel and can be seen floating in the water behind her tail. These eggs may settle back into the gravel and get covered with

subsequent movements by the female, or they may lay in the gravel to become food for other aquatic life.

- Ask students to think back to their response to the probe, any tank observations they may have made, and images in this photo or video and share what things in a salmon's habitat they think a salmon would interact with that could impact their survival for good or bad.
- Explain that before digging into investigations to help us understand connections between salmon and their habitat, we need to develop an investigative question. Salmon need certain things in their habitat in order for them to survive. Brainstorm questions with students. Some examples include,
    - What are the connections between salmon and their habitat?
    - What do salmon need to survive?
    - When _____ happens to a salmon's habitat, what is the impact on the salmon? (Let your students fill in what they think could have an impact.)
    - What makes a good salmon stream?
- Capture your class' question by either posting it in the classroom or, if your students use science notebooks, have them record it in there. As you work through the lessons in this unit, refer back to this question and talk with students about what they're thinking.

RS-5 Tank Checklist

Method

Student groups with adult supervision (teacher or parent volunteer)

NOTE: If students are not actively participating in all tank monitoring, all the steps in this lesson must still be completed by the teacher or a parent volunteer to ensure salmon survival.

Time Required

20-30 minutes for Checklist monitoring; longer when changing tank water

Objective

- Engage students to ensure tank is operating properly (can also be used by teacher)
- Collect and use data as evidence of proper tank operation or potential issues
- Monitor feeding of salmon fry

Materials

- Salmon in the Classroom Tank Checklist (Form 7079) laminated and posted on your tank (this may already be on your tank)
- Salmon Tank Checklist Weekly Monitoring Summary (optional), 1 copy at the tank weekly
- Salmon Tank with all supplies
- Dry erase marker
- Aquarium Maintenance Manual available in the Resources section
- Ruler (Optional. Be sure nothing on the ruler could contaminate the tank water)
- For feeding salmon:
    - Salmon food
    - 1/8 tsp measuring spoon
    - small container
    - popsicle stick
    - 1-minute timer
- For changing tank water:
    - one (1) 5-gallon bucket with water sitting for 24 hours in a cool place
    - one (1) 5-gallon bucket empty
    - siphon tube or small container

Background Information

Proper aquarium function is critical to the survival of salmon that are raised in the classroom. Students can participate in monitoring the function of the aquarium to ensure the tank is functioning properly and the salmon are being taken care of. Regular monitoring helps to identify any problems quickly so they can be addressed and resolved before there are any major impacts to salmon. If students will not be involved in this, the steps in this lesson must be completed by a teacher or a parent volunteer to ensure salmon survival.

Getting Ready

- Attach the Tank Checklist to the tank and find a place near the tank for the dry erase marker or attach it to the tank as well.
- If using the Weekly Monitoring Summary, find a location for that near the tank.
- Identify a cool, protected area to store the bucket of water while it off-gases for 24 hours

***NOTE**: It may be easier to show students the parts of the aquarium before winter break when it will be empty, then show them again just before or just after the eggs have arrived. Be sure to administer the Probe from Lesson 1-1 before students see the tank.*

Procedures

- Assign 1-2 students to complete the Tank Checklist each day. One option is to add this job to your classroom Weekly Jobs rotation.
- The Tank Number should already be filled out for your tank.
- Project the Tank Checklist so it can be seen by all students.
- Complete all the steps on the checklist with the class and explain to students how they will evaluate each item when it is their turn to monitor. You may want to only introduce a few of these at a time while you or a parent volunteer complete the others. Once students are comfortable monitoring the items you've introduced, you can add additional items.
- Date: students should enter the current date each time they monitor, erasing the old one when needed.
- Water is at least one inch above the top of the cooling tube.
    - Explain to students they will be learning that salmon need cold water to survive. This cooling tube keeps the water in the tank at the proper temperature. For the cooling tube to function properly, the water level needs to be at least 1" above the tube.
    - Show students where the cooling tube is in the tank.
    - Provide a way for students to estimate that the water is at least 1" above the cooling tube (ruler, mark on tank, etc.). Make sure nothing that goes into the water is contaminated with anything.

  - Determine what students should do if the water level is below the mark.
  - Show students where to check this off on the Tank Checklist.
- The temperature is between 45˚F and 48˚F (7˚C and 9˚C)
  - Remind students they will be learning that salmon need cold water to survive. Monitoring the water temperature in the tank to ensure it is between this temperature range will help ensure the salmon have the right habitat to survive.
  - Show students where the thermometer is located on the tank.
  - Note the scale of your class's thermometer—F or C.
  - Explain to students how to read the thermometer on your tank.
  - Determine what students should do if the temperature is not within this range.
  - Show students where to check this off on the Tank Checklist.

  NOTE: The temperature can then be recorded on the Monitoring Calendar if using. (see Lesson RS-6)
- There is not excessive icing on the cooling tube
  - When too much ice forms on the cooling tube, it can interfere with the function of the tube. Checking the tube regularly allows you to identify potential problems before they become deadly to your salmon.
  - Show students where the cooling tube is located.
  - Discuss what excessive icing may look like—see your Aquarium Maintenance Manual, P. 12, Issue: Ice forming on cooling tube, for a photo.
  - Determine what students should do if there is excessive icing on the tube.
  - Show students where to check this off on the Tank Checklist.
- The airstone is bubbling
  - Explain to students they will be learning that salmon need oxygen to survive, just like people. However, salmon do not get their oxygen from air; they filter oxygen that's dissolved in the water. The bubbles from the airstone help to move water around in the tank and add dissolved oxygen to the water. The bubbles also help to keep ice from forming on the cooling tube.
  - Show students where the airstone is located.
  - Show them where the bubbles are coming out of the airstone.
  - Explain that the airstone should bubble continuously across the entire length.
  - Determine what students should do if there are not enough bubbles coming out of the airstone.
  - Show students where to check this off on the Tank Checklist.
- The cooling compressor is cycling on and off throughout the day
  - Whenever possible throughout the day, when you hear the cooling compressor come on, point that out to students so they know what it sounds like. When it turns off, point that out as well.
  - The compressor may not turn on/off while the students are completing this check, so it may be something to monitor throughout the day.

  - Determine what students should do if they think the compressor has not been turning on/off during the day.
  - Show students where to check this off on the Tank Checklist.
- When fry begin swimming, if students are feeding the fish:
  - Show them how to measure the food and feed the fish. (See P. 8 in your Aquarium Maintenance Manual). Alternatively, the teacher could do the measuring and feed the fish while students observe for 1 minute.
  - As the food is sprinkled into the tank, have students start a 1-minute timer and observe how much food settles to the bottom of the tank. If it is a lot, feed less. If no food settles to the bottom, consider feeding a little more next time, but be sure to monitor so you are not overfeeding.
  - Show students where to enter the time of each feeding during the day on the Tank Checklist. If the fish are not being fed yet, have the students put "n/a" on each line so they are in the habit of marking that section.

  NOTE: overfeeding can lead to water quality issues that could cause fish to die.

- Water is changed daily to every three days
  - Explain to students that these tanks do not have filters, so it is important to change the water regularly to remove egg casings and any toxins from excess food or fish waste. In a healthy stream, the natural water flow does this.
  - Have students check the date of the last water change. Determine at what point you want to be reminded that water needs to be changed—daily; every 2 days; or every 3 days.
  - If the water is being changed, erase the previous date and enter the current date. If the water is not being changed, leave the date from the last change.
  - Share with students that a lot of our tap water has chlorine, which can be toxic to fish. However, chlorine will evaporate from water, so you need to always have a 5-gallon bucket of water "off-gassing" in a cool, protected area.
  - You can demonstrate for students how water will be changed, even if you or a parent will be the ones doing it. See your Aquarium Maintenance Manual, P. 7 for instructions. Students can help before or after school when possible.

  ***NOTE**: If students are monitoring pH and using the Monitoring Calendar in Lesson RS-6, have them measure the pH after changing the water.*

  - Be sure to monitor the water temperature and pH after changing the water. If it is too warm, see the Troubleshooting Section of the Aquarium Maintenance Manual beginning on Page 12.

- Optional: You can use the Salmon Tank Checklist Weekly Monitoring Sheet to keep track of your daily monitoring data each week to compare over time. You can also graph results with your students.

Example Salmon Tank Checklist Monitoring Summary (half sheet masters are available in the blackline masters)

Salmon Tank Checklist Monitoring					
Item	**Date and Result**				
Water 1" above tube (Yes/no)					
Water Temperature (actual temp)					
Excessive icing on cooling tube (yes/no)					
Airstone bubbling (yes/no)					
Compressor cycling on and off (yes/no)					
Feeding (times or amount/day)					
Water Changed (yes/no)					

NOTE: Your classroom salmon tank is a system. You can use this as an example when teaching this concept to your students. What happens if the airstone stops working (the cooling tube ices); if the compressor stops working (the temperature gets too high), etc.

RS-7 When Will They Hatch

Method

Teacher led; group work

Time Required

30-60 minutes

Objective

- Calculate daily Thermal Units (TUs) accumulated by eggs
- Predict approximately when salmon eggs will hatch to alevin based on TUs accumulated daily

Materials

- Copies from provided blackline masters of either:
  - When Will They Hatch Worksheet, 1 per student
  - When Will They Hatch Calendar (optional), 1 per student
- Thermal Unit Chart, projected for class to see
- Thermometer
- Calendar
- Calculator

Background Information

Salmon and trout eggs develop at a rate that is partially determined by water temperature. Water at temperatures preferred by salmon may feel cold to us, but it still contributes thermal energy (energy generated and measured by heat) to the developing embryo. This energy is measured in Thermal Units (TUs). When the embryo has accumulated enough thermal units, it hatches. The number of thermal units it needs depends on the average water temperature. Eggs in very cold water will take considerably longer to develop because there is less heat energy available and because they must accumulate more heat energy (thermal units) overall to hatch. Note that the temperature range is limited. Optimal temperatures are about 40-55 degrees F. Eggs will survive temperatures close to freezing but develop very slowly. If the water is too warm, the eggs die.

1 Thermal Unit (TU) = 1˚F above freezing (32˚) for 24 hours

Example: At 52˚F 20 TUs will be accumulated in one day; 100 TUs over 5 days:

52˚ – 32˚ = 20 TUs
20 TUs will accumulate each day (24 hours)
Over a 5-day period, 5 x 20 = 100 TUs will accumulate.

NOTE: Temperature data from the hatchery is measured in degrees Fahrenheit. If the thermometer in your tank measures temperature in degrees Celsius, you'll need to convert to degrees Fahrenheit before performing any calculations.

The following data is needed to predict the approximate hatch date. See the blackline master When Will They Hatch worksheet.

- the total TU required for hatching (provided in the table below)
- the average hatchery water temperature (provided after egg pickup)
- the date the eggs were fertilized (provided after egg pickup)
- the date they arrived in your classroom (provided by you and your students)
- the total days spent at the hatchery (calculated by you and your students)
- The total TU accumulated per day at the hatchery (calculated by you and your students)
- The total amount of TU accumulated at the hatchery (calculated by you and your students)
- TUs still needed (calculated by you and your students)
- the average water temperature in your classroom tank (provided by you and your students)
- The number of TUs per day that will accumulate in your classroom tank (calculated by you and your students)
- Number of days until hatching (calculated by you and your students)

Thermal Unit (TU) Chart TUs needed by chum salmon from Grovers Creek Hatchery	
Stage	**Thermal Units (TUs) Needed**
Eye Up (stage when picked up)	750
Hatch	950 – 1100
Emergence (Swimming)	1600

Procedures

1. Ask students what factors might influence when the eggs will hatch. They will probably think of temperature. Students may be aware that birds sit on their eggs to make them hatch. Body heat is a form of energy and energy is needed for growth. Discuss how fish also get energy from their immediate surroundings - the water. Challenge students to think of how they could predict when their fish eggs will hatch.
2. Students will probably offer comments like "When they get warm enough (get enough heat) they will hatch". Discuss the temperature of your aquarium. You have probably been monitoring this daily during the week prior to getting the eggs. How could water temperature affect egg hatching?
3. Explain to students that salmon eggs need energy—heat or thermal energy—to develop and hatch. The more heat they get, the faster they develop. This heat is measured in Thermal Units or TUs. Show students the Thermal Unit Chart and distribute the When Will They Hatch worksheet. Work as a class or in small groups to determine what information is needed to predict exactly when hatching will occur.
4. Students should write down the information and the steps they will take to get their predictions. Help them do this by writing all the relevant information for the whole class to see - the date fish were spawned, the average water temperature at the hatchery, the average water temperature in your aquarium and the number of TU's required for hatching.
5. Ensure you have collected all the data needed for your calculations.
6. Complete the When Will They Hatch worksheet or have students devise their own way of presenting the information.
7. Each day record the water temperature. If it changes at all during the day, take two readings and find the average temperature. Make a chart to show the number of TU's that accumulate each day or use the When Will They Hatch Calendar provided.
8. After hatching, compare predictions to what actually happened. If the fish did not hatch on the predicted day, discuss what factors might have been involved—temperature variations throughout the day, using average temperature, miscalculations, etc.

RS-FT-1 Submit Field Trip Request Form

Method
Teacher Only

Time Required
10 minutes plus coordination time with teaching partners

Objective
- For the Clear Creek Salmon in the Classroom Program, gather information from participating teachers to best schedule all classes for a field trip.

Materials
- Field Trip email sent to lead teacher

Background Information
Each year, 15-20 two-hour field trips are made available to teachers participating in the Salmon in the Classroom program at Clear Creek. Every attempt is made to provide your class with one of your preferred choices. However, the goal is to provide a field trip experience for all interested classes, so teachers may be contacted to see if alternate dates and times would work.

Procedures
- Review the Clear Creek Salmon in the Classroom Program field trip emails sent to the lead teacher in January.
- Coordinate with teaching partners to determine the 3 best dates/times for your school's field trip
- Submit the on-line field trip request form by the date indicated in the email
- Communicate field trip information to teaching partners

2-1 Life Cycles

Method
Teacher led in class; individual or group work

Time Required
Approximately 45 minutes for reading and instruction; up to several days for illustrations and coloring

Objective
- Combine information from multiple sources to complete a salmon life cycle

Materials
Provided by the classroom teacher

- Copies from provided blackline masters of:
  - Pacific Salmon Species Fact Sheets (5 total), available for student reference*
  - Salmon Head and Tail for folding salmon life cycle display, 1 per student:
    - copy of salmon head
    - copy of salmon tail
  - Salmon ID Poster 11 x 17, available for student reference
  - Salmonid Life Cycle Diagram, 1 per student or team, or projected to whole class
- 18" x 6" piece of white construction paper, 1 per student
- Salmon Field Guide, Kitsap Edition available for student reference:
  - One copy is provided with salmon tank.
  - An online version is available, *https://extension.wsu.edu/kitsap/water-stewardship/kitsap-salmon-tours/*
  - A class set can be checked out by contacting Kitsap County Public Works, help@kitsap1.com *or 360-337-5777*
- Good Fit books available for student reference. Suggestions available in the Resources section.
- Scissors
- Glue
- Colored pencils, markers, or crayons

**Images included with permission from Students for Salmon, Nooksack Salmon Enhancement Association, 2016*

Background Information

There are five Pacific salmon species. They belong to the genus Oncorhynchus (pronounced äŋkōˈriŋkəs) and are part of a larger Salmonidae family that include other salmon and trout species. We will focus on the five Pacific salmon species: Chinook, chum, coho, pink and sockeye.

NOTE: Chinook is the only salmon name capitalized. It is a proper noun because the name came from the indigenous Chinook Tribe of the Columbia River (Washington and Oregon).

The salmon life cycle is similar for all salmonids, but the length of time spent in freshwater and saltwater does vary for each species. Salmon are anadromous. This means that they are born in freshwater, spend most of their life in the ocean, and return to freshwater to spawn.

Salmon return from the ocean and enter the stream in the summer or fall to spawn. When they are spawning, females lay their eggs in the streambed and the male fertilizes the eggs with milt (sperm). The eggs are laid in a gravel nest called a redd (from Old English "to make ready"). The redd hides them from predators and direct sunlight. A female deposits a total of about 3,000 eggs in the gravel. Males compete and fight against each other to be the one to fertilize the eggs, which must happen within milliseconds of the eggs hitting the water before the shells harden. The female then covers the eggs with gravel and moves to lay additional eggs. This process may take 1-2 days for all eggs to be laid and fertilized.

After spawning is complete, the male and female will guard their redd until they die. The eggs remain hidden in the streambed for about two to four months before they "hatch" into alevins. Alevins get their nutrients from the yolk sacs that are attached to their bodies. They grow rapidly in the gravel for one to three months. It is important during the egg and alevin stages of the salmonids' life cycle to have clean, clear, cold, flowing water and clean gravel. This gravel is small—about 1" in diameter—so salmon can move it with their tails. If there is too much suspended sediment in the stream, the eggs and alevins will suffocate. If the water flow is too heavy, they could become dislodged from the redd and die.

When the alevins have absorbed their yolk sacs, they surface from the gravel in spring and early summer as fry. They nourish themselves by feeding on plankton and small insects (macroinvertebrates) in the stream. During this stage of life, it is important for the fry to have adequate streamside cover for protection from predators and to keep water temperatures cool. Large boulders in the stream and alongside the banks can provide cover as can trees, bushes and shrubs along the bank. These features also help to stabilize stream banks and prevent erosion. Fry also need oxygen, which they filter from the water. As the water runs over rocks of varying sizes, riffles are created which add oxygen to the water. Different species spend differing amounts of time in freshwater streams. Chum salmon, the

most abundant species found in Kitsap County streams and most likely the species you are raising in your classroom, migrate to the ocean very soon after emerging from the gravel. Pink salmon also migrate to the ocean immediately after emerging from the gravel, although only a few pink salmon are found in Kitsap streams. Coho salmon, also found in Kitsap streams and possibly the species you are raising, remain in the stream for one to two years before migrating to the ocean. Sockeye salmon usually spend one to three years in lakes before migrating via tributaries to the ocean but are seen only occasionally in Kitsap streams. Chinook are in the stream for three to eighteen months as juveniles before migrating towards the ocean. Although many Chinook salmon use Kitsap's nearshore to forage, those found in Kitsap streams are most likely from fish hatcheries at Gorst, Grovers, and Dogfish Creeks.

The juvenile salmon, after spending time in fresh water, head downstream and undergo changes that allow them to live in saltwater—they lose their parr marks, become more silvery looking, and their kidneys change so they can excrete salt. The young salmon, called smolts, acclimate to the saltwater by staying in the estuary for one to three months. They feed on zooplankton, insects, shrimp and small fish in the estuary. Once they have adjusted from fresh water to saltwater, the smolts move into the open ocean. Ocean life for salmonids lasts one to seven years, depending on the species, and they can travel hundreds or even thousands of miles. During this stage, the sea-run adults grow large and feed on zooplankton, insects, and small fish such as herring.

When they are fully mature (2-5 years depending on species), Pacific salmon migrate from the ocean back to the stream where they were born using the Earth's magnetic field and their sense of smell. A salmon's sense of smell is thousands of times better than a dog's sense of smell! When they have returned to the freshwater streams they are called spawning adults. Their colors change to attract a mate and many times to better match the stream. Males develop hooked noses, or kypes, which help them fight other males to spawn. They swim upstream to reproduce, and the cycle begins again. Salmon usually spawn within 100 yards of the redd that they hatched from.

When the salmon have spawned, they die. Their bodies decompose and give nutrients to animals and plants along the stream. The nutrients they leave behind, many of which are only found in the ocean, are very important to the health of the riparian zone. Research completed by Washington Departments of Fish and Wildlife and Natural Resources in 2000 found that more than 137 species depend on salmon in some way for their survival.

Videos

During this lesson, there are several videos you can share with your students.

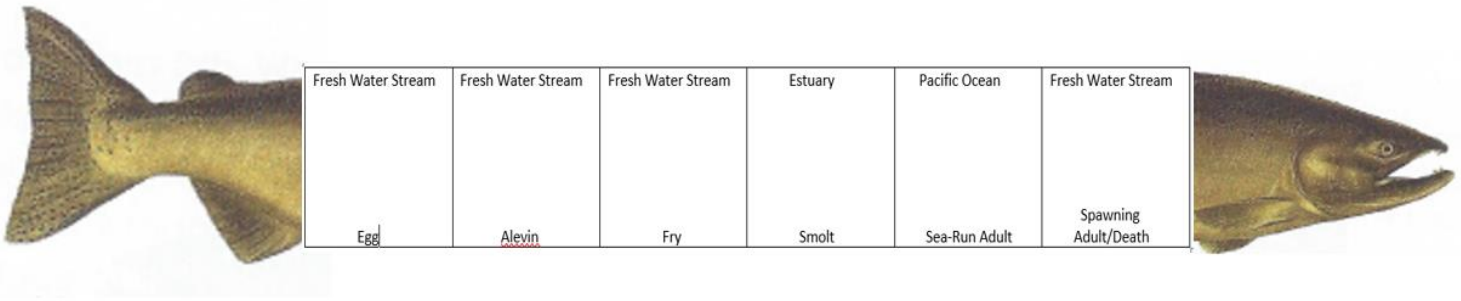
- This 30 second video from US Fish and Wildlife Service, taken at the Quilcene, WA, Fish Hatchery, shows salmon eggs hatching to alevin. *https://www.youtube.com/watch?v=dnX4ZKvYTHs*.
- These short videos from the Deep Look Series by KQED and PBS take a VERY close look at several things in nature that relate to salmon and streams. Additional videos are listed in the Resources section:
    - *There's Something Very Fishy About These Trees, 5 minutes,* *https://www.youtube.com/watch?v=rZWiWh5acbE&feature=youtu.be* Take a close look at how salmon impact the vegetation all around streams.
    - *Sticky. Stretchy. Waterproof. The Amazing Underwater Tape of the Caddisfly, 4 minutes,* https://www.youtube.com/watch?v=Z3BHrzDHoYo&list=PLdKlciEDdCQDxBs0SZgTMqhszst1jqZhp&index=82&t=0s. Take a REALLY close look at how these stream critters (macroinvertebrates) that salmon may eat build their homes.
    - *A Baby Dragonfly's Mouth Will Give You Nightmares, 4 minutes,* https://www.youtube.com/watch?v=EHo_9wnnUTE. Learn about the unique parts of a dragonfly nymph's mouth and watch it in action. (Another stream critter (macroinvertebrate) salmon may eat!)

Procedures

- Cut enough pieces of 18" x 24" white construction paper to make one 18" x 6" piece for each of your students.
- Project the Salmon Life Cycle Diagram so all students can see. Using the information about salmon life cycles in the background information above, demonstrate the salmon life cycle. Have your students take notes.
- If raising salmon, point out the name of the type of salmon you will be raising.
- For an additional, engaging way (especially for the musical learners in your room) to learn about the salmon life cycle you could also share the video of the salmon life cycle in this link, sung to the song "I Will Survive", *https://www.youtube.com/watch?v=qV30UZ9aF04* .
- Pass out one 18" x 6" piece of white construction paper to each student.
- Instruct students to fold the paper into six equal parts, accordion style, about 3" wide. See image below.
- Starting with the egg stage, have students label each life cycle stage on the bottom (egg, alevin, fry, smolt, sea-run adult, spawning adult/death). Be sure to leave plenty

of room above for illustrating. Next, starting again with the egg stage, have students list the habitat for each stage at the top of each section (egg, alevin, fry- freshwater stream, smolt-estuary, sea-run adult-Pacific Ocean, spawning adult/death-freshwater stream). Again, be sure to leave plenty of room for illustrating below. Students are then ready to illustrate each stage of the salmon life cycle. Leave extra room on the first and last rectangle for gluing on the head and tail.

- Have students use the references listed in the Materials section to guide them. Having books on hand from the Good Fit Books suggested in the Resources section or projecting the Salmon ID Poster 11 x 17 will also give students pictures to reference to help them with the accuracy of their illustrations. If you are raising salmon, first-hand observations can also be made of the salmon in their tank for one of the stages!
- Next, distribute copies of the salmon head and tail from the blackline masters. Have students color the head and tail of their salmon. The Pacific Salmon Species Fact Sheets and the Salmon ID 11 x 17 Poster can be great references for salmon colors. Once colored, students cut out the head and tail and glue them onto each end of the life cycle stages.
- These make a great wall or hallway display.
- Be sure to ask your students what they are thinking about their investigative question now that they have learned about a salmon's life cycle.



2-2 Structure Function and Information Processing

Method

Teacher Led, group work optional

Time Required

60 – 90 minutes

Objective

- Identify the five types of Pacific salmon
- Describe the name, weight, length, and interesting facts of the five types of Pacific Salmon
- Identify and label salmon body parts
- Describe salmon body parts in terms of their function as part of a system

Materials

Provided by the classroom teacher

- Copies from provided blackline masters of:
    - Helpful Hints to Remember our Pacific Salmon, 1 per student or team, or projected to whole class
    - Pacific Salmon Species Chart*, 1 per student
    - Pacific Salmon Species Fact Sheets*, 1 per student or team, or posted for whole class viewing
    - Salmon Body Parts, 1 per student

**Images included with permission from Students for Salmon, Nooksack Salmon Enhancement Association, 2016*

Background Information

After learning about the salmon's anadromous life cycle, students are ready to learn about the differences between the five local Pacific salmon species; their appearance, habitat requirements, and how the structure, function and information processing of internal and external body parts help them survive.

Procedures

- Use the Helpful Hints to Remember Pacific Salmon sheet to help students remember the five Pacific salmon.
- Next, to familiarize themselves with details about Pacific salmon, have students read the Pacific Salmon Species Fact Sheets and complete the Pacific Salmon Species Chart.
- These should be retained for reference throughout this unit.

- For a general introduction to the anatomy of fish (salmon) and how those parts work together as a system, read the following to your students and have them complete their own Outline of a Salmon on their Salmon Body Parts handout as you demonstrate on a projected image of the same. Use the diagram provided as a guide.
    - First, briefly discuss the vocabulary term *scientific diagram* and how scientists use this skill frequently in their studies to capture observations and information. Stress that accuracy is the focus not artistic embellishment. See the completed example provided here.
    - With students following along on their copy of Salmon Body Parts, point out the body outline shape and say, "Salmon are streamlined to move easily through water."
    - Fins: "Salmon have eight fins including the tail. The fins are embedded in their muscle and not linked to other bones. This gives salmon a lot of flexibility and ability to maneuver. Each fin has a different function."
        - *Caudal Fin*: Model drawing on the left side of the fish, a tail fin and label it Caudal Fin. "The caudal or tail fin, is the largest and most powerful. It pushes from side to side and moves the fish forward in a wavy path. This fin is also used for jumping."
        - *Adipose Fin*: On the top of the fish, toward the tail, draw and label the adipose fin. "The adipose fin has no known function. It is sometimes clipped off in hatchery fish to help identify fish when they return or are caught."
        - *Dorsal Fin*: Draw the dorsal fin. "The dorsal fin keeps the fish upright, and it also controls the direction the fish moves in."
        - *Anal Fin*: Draw and label the anal fin. "The anal fin helps keep the fish stable and upright."
        - *Pelvic and Pectoral Fins*: Draw and label the pelvic and pectoral fins. "The pelvic and pectoral fins come in pairs (one on each side of the fish) and are used for steering and balance. They can also move the fish up and down in the water."
    - On the "face", add a mouth, eyes, nostrils, gill cover and gills and label these parts.
        - *Mouth*: "A salmon's mouth contains needle-like teeth, which they use to grab their prey. Salmon do not chew their food. Salmon also use their mouth to breathe by gulping water through it and then closing their mouth and throat. The water is then forced through the opening in the back of their throat that is lined with gills. The water passes through the gills."
        - *Gills*: "These are thin pieces of skin that take oxygen from the water. The gill cover is tightly closed when it takes in the oxygen. To exhale, the fish closes its mouth and lets the water out of its gills."
        - *Eyes*: "Salmon eyes can see in all directions. To help them see in front and behind them, salmon can move each eye in different directions at

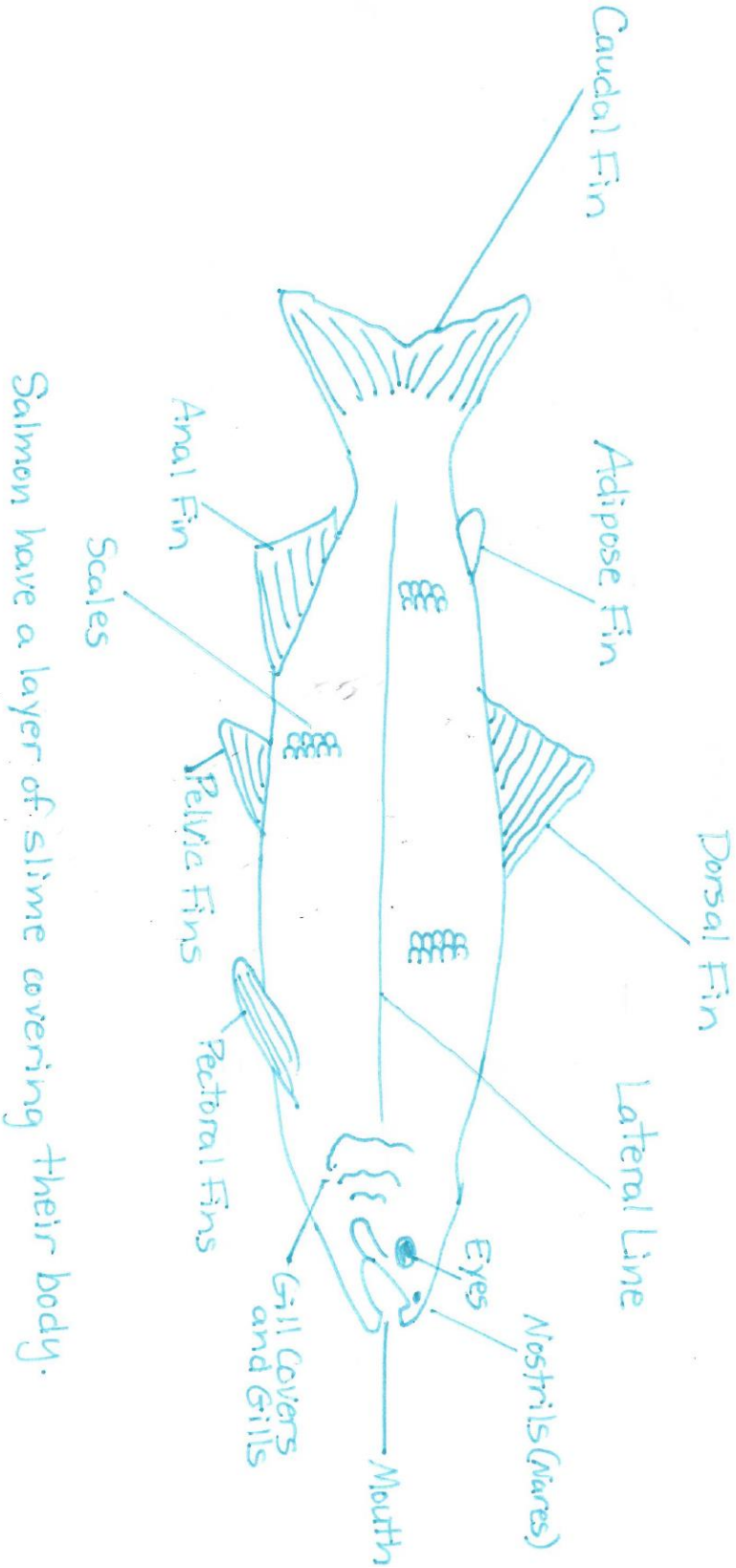
the same time. They do not have eyelids or tear glands because the water keeps their eyes clean."

- *Nostrils (nares)*: "Salmon have nostrils above their mouth, but no nose. They are called nares. They do not breathe through their nostrils. They are used for smelling not breathing. Scientists believe that salmon use smells to recognize their way home from the ocean to spawn. Salmon's sense of smell is hundreds of times better than a dog's!"

- *Lateral Line*: Draw and label the lateral line. "The lateral line functions sort of like an ear. It detects vibrations and pressure waves in the water. The lateral line can be used to tell distance/depth. Salmon do not have ears like humans. Sound waves travel through the water and through their body to the otolith bones in their inner ear. Scientists can tell how old fish are from their otoliths."
- *Parr Marks (young only)*: If you are drawing a young, or juvenile, salmon, be sure to include the parr marks—about 8-10—and they do not extend below the lateral line. "Parr marks act as camouflage, helping the fry blend into the stream and hide from predators."
- *Scales:* Add scales to the drawing and a label. "Salmon have a layer of scales covering their skin, like most fish. They are small, hard plates, like fingernails that cover the body for protection. They overlap to form a flexible armor plating to protect them from predators and bruising. They are born with a set number of scales that begin to grow at the fry stage. The scales start small and continue to grow throughout their life. If a salmon loses a scale, it will grow a new one.
- *Slime*: Underneath the diagram model have students write, *Salmon have a layer of slime covering their body*. "The slime layer helps salmon to: slip away from predators, like bears; slip over rocks to avoid injuries; slide easily through water when swimming; and to protect them from fungi, parasites, disease and pollutants in the water."

- To help students think scientifically about how these parts work together as a system discuss what would happen if a part was missing or did not work properly; What would a salmon be unable to do well with a damaged caudal fin? (jump or swim quickly), What would happen to a salmon that lost the use of its nares? (It may not be able to "smell" its way home and spawn.), etc. When used together, what do a salmon's mouth, gill cover and gills help it do? If you are raising salmon, have students observe salmon in the tank and how their parts work together as a system.

- Be sure to ask your students what they are thinking about their investigative question now that they have learned about salmon body parts.


Caudal Fin
Adipose Fin
Anal Fin
Scales
Salmon have a layer of slime covering their body.
Pelvic Fins
Dorsal Fin
Pectoral Fins
Lateral Line
Eyes
Nostrils (Nares)
Gill Covers and Gills
Mouth

2-3 Salmon Traits

Method
Teacher Led; group work optional

Time Required
Approximately 120 minutes

Objective
- Read text about animal traits
- Define traits
- Apply text concepts to salmon
- Collect, organize, identify relationships in and interpret data about salmon traits
- Compare variations in traits in a grouping of similar organisms
- Discuss how the traits they observed might give salmon advantages in surviving, finding mates and reproducing

Materials
Provided by the classroom teacher

- Copies from provided blackline masters of:
  - Pacific Salmon Species Fact Sheets (5 total) available for reference (if raising salmon, post the Fact Sheet of the type of salmon you are raising near the tank)
  - Puppies and Their Parents ReadWorks article 1 per student
  - Salmon ID Poster 11 x 17, available for student reference
  - Salmon Trait Data Collection Sheet 1 per student
  - Salmonid Life Cycle Diagram, for reference
- Students' Salmon Body Part Diagram (completed in Lesson 2-2)
- Optional: observations of your in-class salmon tank

**Images included with permission from Students for Salmon, Nooksack Salmon Enhancement Association, 2016*

Background Information
Parents pass their physical characteristics, or traits, to their offspring. Offspring are the children of animal parents (humans too). When baby animals are formed, some of the traits from the mom and some of the traits from the dad are combined to create a baby that is unique. Sometimes traits can skip a generation. That's why you might be the only one in your family with freckles like your grandmother's. If you have siblings, you might have some of the same traits. However, other traits may be different, like your hair color or height. You cannot

have all of your mom's traits and all of your dad's traits. It's always a mixture. Babies get some traits from each parent.

Animals of the same kind share a common set of physical traits. For example, all salmon can be expected to have caudal fins. Animals also have common behavioral traits. We can expect that all salmon will return to their home stream to spawn.

Similarities in traits between parents and offspring, and between siblings, provides evidence that traits are inherited.

Differences in traits between parents and offspring, and between siblings, provides evidence that inherited traits can vary.

Variation in inherited traits results in a pattern of variation in traits in groups of organisms that are of a similar type.

Procedures

- Have your students read the Puppies and Their Parents ReadWorks article.

NOTE: Can I make photocopies of ReadWorks' materials? Yes. From ReadWork's website: Absolutely! Our curriculum was developed for use by teachers in their classrooms, to be shared broadly. You do have the right to copy the materials for use in your classroom with your students, and on behalf of teachers as long as they will be using the materials with their students in their classrooms as well. The Terms of Use are intended to protect the content from being changed or used for purposes outside of classroom use.

- Ask the following questions:
    - What is this passage mostly about? (Dogs and the traits that make them similar to or different from each other.)
    - Find the following in the article, "Puppies are usually like their parents. Chihuahuas have small puppies and German Shepherds have bigger puppies. This is because puppies inherit many **traits** from their parents." What does the word "traits" mean? (Physical features or qualities.) Do you think salmon have traits similar to their parents?
    - Puppies are similar to their parents, yet they are not exactly the same. Do you think salmon can have differences from their parents?
- Choose one salmon species for students to focus on for this lesson. If raising salmon in the classroom, choose the species you are raising.
- Model for your students how they are going to use the Salmon Trait Data Collection sheet, reference materials and, if available, salmon raised in the classroom tank, to
    - collect data about the traits of **salmon fry** (offspring) in your focus species and their parents

  - identify variations in traits of the **other four types of Pacific salmon**
  - identify relationships in patterns, similarities, and differences in traits between parents, offspring, and siblings
  - interpret what this data all means in terms of inherited traits and how they can vary.
- Point out that it is not possible for them to compare salmon fry (offspring) to their parents directly, so they will be gathering evidence and completing comparisons about salmon traits from printed materials and, if available, the salmon in the classroom tank. They may not be able to come to full conclusions about everything on the Salmon Trait Data Collection sheet. Encourage them to conclude what they can based on available evidence and have them suggest what a scientist would do to fully conclude this trait investigation. This sheet can be completed individually, in teams or whole class. It would also be a good idea for students to have their salmon body parts diagram that they drew earlier for reference of physical traits.
- Be sure to take time to share conclusions as a group.
- What are they thinking about their investigative question now that they have learned about salmon traits?
- Take it a step further and ask students how the traits they observed might give salmon advantages in surviving, finding mates and reproducing.

3-1 You Ain't Nothing but a Hound Dog

Method
Teacher Led, group or independent work

Time Required
45-60 minutes

Objective
- Read text about the effect of environment on traits
- Analyze the cause and effect relationship between environmental factors and variations in inherited traits

Materials
Provided by the classroom teacher

- Copies from provided blackline masters of:
  - Scaffold - Environmental Effects on Inherited Traits (Optional scaffold to use/project)
  - You Ain't Nothing but a Hound Dog ReadWorks article, 1 per student

Background Information
Some traits are influenced by the environment. We are all born with the information that will determine our traits. However, different factors in a living thing's environment can influence the trait. For example, if a person is born with the potential to grow very tall, but they didn't get proper nutrition growing up, it is unlikely they will be tall.

The use of energy and fuels that are derived from natural resources can also affect the environment and in turn the organisms that live in it.

All these things contribute to habitats where some organisms can survive well, some survive less well, and some cannot survive at all.

This activity and several that follow will help your students bring their thinking full circle. They will use what they have learned about salmon and apply it to show the connections salmon have to their habitat.

Procedures

- Have your students read the ReadWorks article, You Ain't Nothing but a Hound Dog.
- Ask the following questions:
    - Besides its parents, what can determine the traits an animal develops? Give examples from the text. (Answers will vary but should come from the passage. They should focus on the idea that an animal's environment can also determine the traits an animal develops.)
    - When it comes to salmon, what traits do you think can be influenced by their environment (both in a stream and in the tank, if raising in class)?
- Use the *Scaffold – Environmental Effects on Inherited Traits* to help students frame their thinking. Here's an example:
    - Phenomenon: underweight salmon moving sluggishly
    - Variation in Inherited Trait (effect): salmon are underweight and sluggish
    - Environmental Factor (cause): water temperature increased due to removal of trees from streambank which destroyed most of the food source.
- Lead students as a class or have them work in small groups or independently, to come up with several other phenomenon, the cause, and the effect.

RS-FT-2 Engineering Activity – Salmon Release Tool (optional)

Method
Teacher led; group work

Time Required
Several days, concurrent with other lessons

Objective
- Using engineering principles students design, create, test, and improve a tool to assist with the release of salmon fry that meet the Criteria and Constraints.
- The tool created must meet the following Criteria and Constraints. The tool must be able to:
    - be easily transported by car or bus
    - hold a 12 oz. plastic cup
    - support 8 oz. of water and 3-4 salmon fry in the cup
    - reach approximately 4 feet from the stream bank to within 4 inches of the stream surface
    - be operated easily so water can be poured into stream to release salmon
    - be reused by each release team in your class
    - be operated without the need for any electrical power
    - complete the process of pouring the water, start to finish, in **1 minute or less**

Materials
Provided by the classroom teacher
- Copies from provided blackline masters of:
    - Phenomenon: Salmon Release Site Photo, projected for all students
    - Salmon Release Tool Challenge, one per student or Design Group
- Building materials. Some suggestions include:
    - PVC pipe
    - Rubber bands
    - Paper clips
    - Binder clips
    - String or yarn
- Optional Math Integration: assign a cost to each supply (can vary or be a fixed price per supply) and provide students a budget they must work within.

NOTE: CKSD teachers may have materials available through the Teaching and Learning Center

Background Information

You and your class have raised salmon to be released into the Clear Creek Ecosystem. The salmon fry need to be released within 3-4" of the surface of the water to avoid physical stress to the fry. Due to critical riparian habitat and stream levels that vary with rainfall, it may be difficult to get close enough to the stream during your field trip to safely release your salmon. This activity allows students to apply what they've learned about the engineering design process to develop a tool they and their classmates may use in real life.

Procedures

- Gather enough materials for all students in your classroom
- If using the Optional Math Integration, develop a price list and worksheet for students
- Project the *Phenomenon: Salmon Release Site Photo* for students to view. Ask students how easy they think it would be to release a salmon fry in this location:
    - Is there vegetation in the way?
    - Could the water level vary from day to day?
    - Are there any concerns with people standing right at the water's edge?
    - Is the water at the edge deep enough for salmon?
    - Student answers will vary, but should include concerns about erosion; damage to vegetation; unpredictable water level due to rain, or lack of; low water level may make it too silty to release salmon at the edge; students may fall in if reaching further to release salmon, etc.
- Distribute copies of the *Salmon Release Tool Challenge*
- Work together as a class to define the problem.
- Review the Criteria and Constraints with students.
- Work together as a class or divide into Design Groups so students can apply the Science and Engineering Practices to:
    - design and build a solution
    - test their solution
    - modify their solution, if time
    - Re-test if modified
    - as a class, vote on which two (2) Salmon Release Tools best fit the criteria and constraints and are successful. Those are the tools that should be brought to the field trip.
- Have each student practice how to use the tool in class so they are familiar with it and can use it quickly and efficiently at the field trip.

***NOTE**: one of the most critical criteria is that the tool must be functional and be able to release the water and salmon **within one minute or less** due to time constraints at the field trip.*

3-3 Performance Task: Saving Our Salmon: Clean Water

Method
Teacher Led

Time Required
Part 1: 60-90 minutes

Part 2: 70 minutes

Objective
- Identify information from text and media sources to support a topic
- Explain in an essay or speech why clean water is important to the life cycle of salmon and what humans can do to make a difference

Materials
Provided by the classroom teacher

- Copies from provided blackline masters of:
    - Task: Saving Our Salmon: Clean Water, Pacific Education Institute (PEI), 1 per student. (11 pages, including rubric. See Resources for information about and access to other free resources from PEI.)

Procedures

- Read through the entire performance task before sharing with students. Notice the Teacher Note and the rubric provided.
- Make necessary copies for students.
- Have source information listed in the task ready to share with students.
- Follow the directions in the performance task.

3-4 Salmon Stream Design

Method
Teacher led; group work

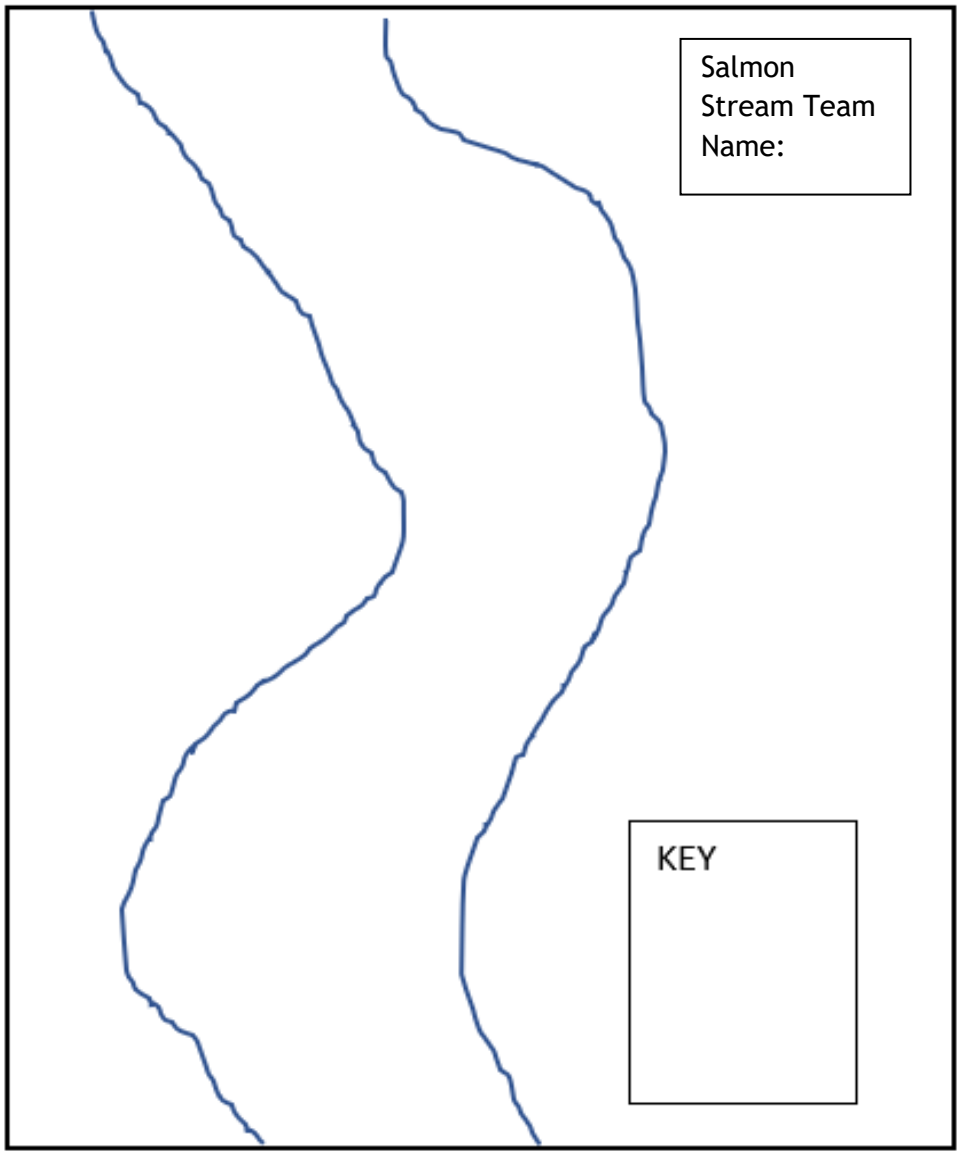
Time Required
150 minutes over multiple days

Objective
- Analyze and combine information learned throughout this unit to design a good salmon stream

Materials
Materials provided by classroom teacher:
- Copies from provided blackline masters of:
  - Probe - What Makes a Good Salmon Stream? Blank copies, 1 per team
  - Salmon Stream Design Gallery Walk Feedback, half sheets, 1 half sheet per student for each stream design
- Large poster size pieces of sturdy white paper, 1 per team
- Markers, crayons, colored pencils, pencils

Background Information
Students have spent the past several weeks learning about salmon, their life cycle, salmon body parts and function, salmon traits, and what salmon need to survive. This lesson provides students an opportunity to apply what they have learned and develop their own version of what a healthy stream for salmon looks like. It is also an opportunity to apply map development and reading skills.

Procedures
- Copy and cut enough Salmon Stream Design Gallery Walk Feedback sheets so each student has one for each Salmon Stream Design. (ie, if there are 5 stream designs, then each student should have 5 half sheets. Names of students providing feedback on these sheets is optional).
- Divide students into Salmon Stream Teams (3-4 per team); have them pick a team name.
- Be sure each team has a blank copy of the probe What Makes a Good Salmon Stream? and one piece of the large white paper.



- Model for teams how to draw their stream outline and start a key for the items they will be adding to their stream.
- Tell students that their job as members of a Salmon Stream Team is to design a stream that contains the parameters necessary for salmon survival.
- Have students refer to the probe What Makes a Good Salmon Stream? and as a team add the parameters, based on what they have learned throughout this unit, that they think

should be part of a good salmon stream. Encourage students to take time to understand the role each parameter on the probe plays in supporting or inhibiting salmon survival. They can refer to their previously completed probe to support their thinking. (Tell students to not worry about making revisions to their probe at this time. You will give them time to do that in Unit 4.)

- If a consensus cannot be reached on a parameter, provide resources to allow further research to decide on that parameter. For example, if students can't agree whether beaver dams are beneficial or harmful to salmon, this 4 ½ minute, 360-degree video from Olympic College about beavers in Chico Creek in Bremerton may provide some information. (Be sure to have students use their mouse to move the camera view around) https://www.youtube.com/watch?v=Ive-QiJyQ5U&feature=youtu.be https://www.youtube.com/watch?v=Zm6X77ShHa8.
- As teams make decisions about what to add to their stream, circulate and promote discussion with questions like: So, let me see if I've got what you're saying. Are you saying…? (always leave space for the student to agree or disagree and say more) Can you say more about that? Why do you think that? What's your evidence? How does that idea square with Sonia's example? Do you agree/disagree and why? Does anyone want to respond to that idea?
- When ready, hang each salmon stream design around the room.
- Distribute copies of the Salmon Stream Design Gallery Walk Feedback sheet—one half sheet to each student for each stream design in the class.
- Allow students to take a gallery walk of the stream designs either individually or with their group to complete the feedback form. Have students:
    - write the group's name at the top of the rating sheet
    - identify at least one thing they liked about each stream design
    - provide one suggestion for improvement they may have
    - be prepared to share their feedback verbally with the class **OR**
    - have them place their Feedback sheet in a teacher-provided container at each stream design
- After the gallery walk, provide time for the Salmon Stream Teams to regroup; gather the feedback about their stream design; discuss the feedback from the gallery walk; and make any desired revisions to their salmon stream.
- Wrap up by referring students to the investigative question for this unit and where their thinking is now.
- Post the streams, if space allows, and save students completed probes for use in Unit 4.

3-5 Virtual Scavenger Hunt

Method
Teacher led; individual student or partners

Time Required
15 minutes for scavenger hunt; 15 minutes for discussion

Objective
- Identify and explain good salmon stream habitat in a local stream
- Provide an alternative for those that cannot attend a field trip

Materials
Provided by the classroom teacher:

- Copies from the blackline masters of:
  - Virtual Scavenger Hunt, 1 copy per student
  - Virtual Scavenger Hunt Key, teacher only
- 1 pencil per student

Background Information
Students have learned a lot about salmon. While it's important that students understand a habitat feature and its function, it is also important that they can identify that feature in an actual stream. This lesson provides an opportunity for students that cannot attend a field trip to apply the knowledge they have learned in the classroom to identify good habitat in a local stream. However, those that have attended a field trip may also benefit from this lesson.

Procedures
- Distribute the Virtual Scavenger Hunt – Good Salmon Habitat to students.
- Tell students this is a photo of an actual stream in Kitsap County—Clear Creek near Sunde and Winter Creek Roads in Silverdale.
- Following directions, have students look for each of the habitat elements that are listed below the photo.
- Some elements may be found in more than one place. Have students identify at least one square where an element is found. For example, *Vegetation Along Streambank* is found in the C-1 square. However, it can also be found in the E-1 or E-2 square as well as several others.
- Give students time to complete the Virtual Scavenger Hunt on their own or with a partner. You may want to consider having students complete this on their own, then

provide them with an opportunity to meet with their Salmon Stream Team to discuss their results.

- Circulate among students as they're completing the Hunt to answer questions and provide feedback.
- Once all students have completed their Virtual Scavenger Hunt, gather students together and review the answers together. Be sure all students are able to idenfity at least one location where each element is found.
- As you discuss where each element is found, ask students why that element is important for the stream. Remember some of the questions from Lesson 3-4, Salmon Stream Design, So, let me see if I've got what you're saying… Are you saying….? Can you say more about that? Why do you think that? What's your evidence? How does that idea square with Sonia's example? Do you agree/disagree and why? Does anyone want to respond to that idea?
- Using the key provided, ensure students have found all the elements in at least one location. Also ensure they have not incorrectly identified the location of an element. For example, the sun in the creek in square D-4 may look like a rock, but is actually loose gravel.

NOTE: The key provides one square where each element can be found, but there can be other squares where that same element may be found.

RS-FT-3 Salmon Release Field Trip

Method

Field Trip; Volunteer and staff-led

Estimated cost: transportation expenses

Time Required

2 hours plus transportation time to and from field trip location

Objective

Clear Creek field trips usually consist of 4 stations: Salmon Release, Stream Bugs, Water Quality, and Habitat. Objectives may vary depending on field trip stations but usually include:

- Release salmon raised in the classroom into Clear Creek
- Apply concepts learned in the classroom to a local stream
- Identify good habitat features for salmon
- Identify 3 stream bugs that are sensitive to pollution changes
- Explain how pollution can impact salmon's migration

Materials

- Teacher emails explaining logistics for the day of the field trip
- Any materials your school district requires for field trips
- Salmon in a bucket of tank water
- Materials specific to field trip stations will be provided at the field trip

Procedures

When raising salmon in your classroom, this is a good point to stop in your curriculum until your salmon are released. The eggs that were donated to your classroom, most likely by the Suquamish Tribe's Grovers Creek Hatchery, are covered under a permit that specifies into what creek those juvenile salmon are to be released.

- The release can happen in several ways:
    - If you participate in the Clear Creek Salmon in the Classroom Program, your salmon need to be released into Clear Creek. You have the option of signing up for a 2-hour field trip with your students. Information about this field trip is sent to program participants in mid-late January.

  - If you raise salmon in your classroom on your own or through another program, you can setup a field trip with your students to release your salmon. Just be sure to release them in the permit-specific creek.
  - You as the teacher can release the salmon into the stream on your own. Be sure to release them in the permit-specific creek and take photos and videos you can share with your students back in class.

- Follow instructions in your Clear Creek Salmon in the Classroom manual or from the group that sponsors your program to collect and transport your salmon from your classroom to the stream and to provide a count of the number of salmon released.
- Once your salmon have been released, follow instructions in Lesson R-8 and your manual to properly clean and store your aquarium for next year.

NOTE: Some equipment in the aquarium is breakable. Please be sure to store safely to ensue all equipment is ready to go for next year.

RS-8 Tank Cleanup and Storage

Method
Teacher only

Time Required
30-60 minutes

Objective
- Empty, clean, and store tank and all equipment safely for use next year

Materials
- Aquarium Maintenance Manual found in the Resources section
- Materials listed in Aquarium Maintenance Manual under Cleaning the Aquarium and Equipment
- Bubble wrap or towels to safely store equipment

Procedures
- Follow the procedures in the maintenance manual for your aquarium to:
    - Empty all water
    - Clean and dry the aquarium and all equipment
    - Store the aquarium and all equipment safely for use next year

4-1 Revisit and Revise: Salmon Stream Design

Method
Teacher led; group work

Time Required
60 minutes

Objective
- Analyze, review, and revise the Salmon Stream Design completed in Lesson 3-4 based on information learned during the field trip or Virtual Scavenger Hunt lesson. Has student thinking about what makes a good salmon stream changed?

Materials
Provided by the classroom teacher

- Copies from provided blackline masters of:
  - Blank copies of the probe What Makes a Good Salmon Stream? 1 per team
- Student Salmon Stream Designs created in Lesson 3-4, Salmon Stream Design
- Reference material:
  - Any notes students took on their salmon field trip **OR**
  - Student completed Virtual Scavenger Hunt from Lesson 3-5
- Markers, crayons, colored pencils, pencils

Procedures
- Divide students into their Salmon Stream Teams from Lesson 3-4, Salmon Stream Design
- Give each team their original Salmon Stream Design and a blank copy of the probe What Makes a Good Salmon Stream?
- Be sure each student has their reference materials
- Remind students their job as members of a Salmon Stream Team was to design a stream that contains the parameters necessary for salmon survival.
- Have students revisit each of the parameters listed on the probe What Makes a Good Salmon Stream. As a team, students should add or remove parameters from their design based on what they've learned throughout this unit and at the field trip about what makes a good salmon stream. Remind students to take time to understand the role each parameter on the probe plays in supporting or inhibiting salmon survival. They can refer to their reference materials to support their thinking. As in the original

lesson, as teams make decisions about what to add to or remove from their stream, circulate and promote discussion with questions like: So, let me see if I've got what you're saying. Are you saying…? (always leave space for the student to agree or disagree and say more), Can you say more about that? Why do you think that? What's your evidence?, How does that idea square with Sonia's example? Do you agree/disagree and why? Does anyone want to respond to that idea?

- When ready, begin a class discussion on changes each group made and why. What evidence have they collected that supported that change? If there were no changes, why did they choose not to make any changes?
- Wrap up by referring students to the investigative question for this unit and where their thinking is now.

4-2 Wanted Poster

Method
Teacher led, individual work

Time Required
Approximately 30-60 minutes for instructions
Multiple days for project development

Objective
- Summarize information learned throughout this unit to design and create a poster about salmon traits, needs, environmental impacts and how humans can help

Materials
- Each student should have access to the information they gathered throughout their study of salmon—scientific illustrations, notes, etc.
- Reference materials from the blackline masters:
    - Pacific Salmon Species Fact Sheets
    - Salmon ID poster 11 x 17
    - Salmonid Life Cycle Diagram
    - Wanted Poster Guide, 1 copy to project to the class (optional—also included at the end of this lesson)
- Salmon Field Guide: Kitsap Edition:
    - One copy is provided with salmon tank.
    - An online version is available, https://extension.wsu.edu/kitsap/water-stewardship/kitsap-salmon-tours/
    - A class set can be checked out by contacting Kitsap County Public Works, help@kitsap1.com or 360-337-5777
- Other field guides, good fit books. Suggestions available in the Resources section.
- Writing, drawing, coloring instruments
- Glue
- Large colored construction paper in various colors for the background (12” x 18” or 18” x 24”)
- White paper cut into various sizes for each part of the poster (see following example)

Background Information
In the lessons in this unit students learned about salmon and their connections with their habitat. The Wanted Poster is a way for students to put all the pieces together and show what

they have learned. To do this, each student will develop a Wanted Poster. Some students may want to create an Appreciated For… rather than a Wanted Poster and write about what they have come to appreciate about the salmon they have chosen to represent on their poster. Refer back to your investigative question as part of this work.

Consider how you will share these posters with others in your school: present them to a buddy class, post them in the hallway or school library, do a gallery walk in class or with other classes, etc.

An option to display small versions of some of the posters on trail kiosks around Kitsap County may be available. Contact Kitsap County Public Works, help@kitsap1.com, or 360-337-5777, to inquire about this option.

This is an engaging application of the NGSS Science and Engineering Practice of Obtaining, Evaluating, and Communicating Information, and many other NGSS and CCSS standards. It is also an opportunity for assessment of these same standards. Remember that observable features of student performance found in NGSS evidence statements will help you know what to look for when assessing and should be used to create a rubric specific to your grade level to guide completion of and assessment of the final product. The components of the Wanted Poster shared here were based on the evidence statements from the NGSS standards listed in the Introduction section of this curriculum. CCSS standards that you plan to assess should be added to the rubric as well.

Procedures

- Develop a rubric appropriate for your grade level
- Collect a supply of colored construction paper
- Cut white paper into appropriate sizes for each part of the poster
- Go over your rubric with your students and how you plan to share the completed posters.
- Demonstrate how students will use the materials to create a finished product and share a completed Wanted Poster. Be sure to address gluing FINISHED pieces on the background only when pieces are complete and student is happy with the layout.
- Have each student choose *one type* of Pacific salmon and *one stage* of that salmon's life cycle to guide their content.
- Use the following guide for what students must include on their Wanted Posters. A copy of the layout is provided at the end of this lesson and is also available in the Blackline Masters:
    - *Title:* Wanted (or Appreciated For…) Surviving in the Wild. Student name can be included here or at the bottom of the poster.

NOTE: If Wanted posters will be located on park kiosks, have students only include their first name or school and/or teacher name on the front of the poster.

  - *Student Illustration*: Scientifically accurate illustration of the salmon at the chosen stage of life cycle (profile). Include common name, scientific name, aliases/nicknames and the featured stage of life cycle.
  - *Age and Size*: Scientific illustration of the full life cycle of the chosen salmon with all stages labeled. The featured stage chosen for poster should be highlighted. List age, average length, and weight for the featured stage.
  - *Distinguishing Feature and Behavior*: One notable internal or external feature for the featured stage of life cycle, its primary function, and an illustration of the feature.
  - *Last Seen Looking For*: Illustration and description of one element of a good habitat for the featured stage of life cycle and how that element meets the needs of the salmon.
  - *How You Can Help*: Choose a cause and effect relationship in a salmon's habitat for the chosen life cycle stage. Describe the relationship between the causal environmental factor, the effect on the habitat and the ultimate impact on the salmon. Describe ways people can help. Include an illustration.
- Once posters are complete, share them in the way you chose previously. Be sure students have their names on their poster or just their school and/or teacher name if posted publicly.
- Assessment: conference with students and use the rubric you created to assess their completed posters.

NOTE: This lesson is adapted from Pacific Education Institute's Guide, Fostering Outdoor Observation Skills. For access to this and other free, downloadable guides from PEI visit https://pacificeducationinstitute.org/work/fieldstem-resources/#fieldstem-guides.

WANTED (or Appreciated)

for Surviving in the Wild! (student name optional)

Student Illustration

Common name, scientific name, aliases/nicknames, and stage

Age and Size

Student Illustration

Age:

Length:

Weight:

Distinguishing Feature and Behavior

Student Illustration

Primary function:

Last Seen Looking For

Student Illustration

Description of habitat feature and how it meets salmon's needs

How You Can Help

Student Illustration goes here

Description of relationship between the causal environmental factor, the effect on the habitat and the ultimate impact on the salmon, including ways people can help.

4-3 Revisiting the Probe

Method
Teacher led, class discussion

Time Required
30 minutes

Objective
- Define and explain the parameters of a good salmon stream based on evidence and reasoning from information learned throughout this unit

Materials
Provided by classroom teacher

- Copy of each students' completed Formative Assessment Probe from Lesson 1-1, What Makes a Good Salmon Stream?

Procedures
- Revisit the probe What Makes a Good Salmon Stream? given in Lesson 1-1. Have students review their initial response to the probe and ask them if they have any new thinking they would like to capture or any new questions.
- No need for a new copy of the probe. Explain first to students that scientists never erase any of their notes, they might become important evidence later. It's not about getting something wrong; it's about capturing the thinking at the time. Students can draw a line where their thinking left off last time (a "line of learning") and continue with capturing their current thinking. Another strategy is to add new information in a different color pencil or pen.
- Collect the probes. Revisiting the probe can give you and your students valuable information about their conceptual development toward a learning target. In the case of this probe, do students understand the connections between salmon and their habitat? Are they including information they have learned throughout their Salmon in the Classroom investigations? At this point in the unit this probe could be used as a summative assessment.
- Please share feedback about student growth by sending copies of your students' pre and post probes to the KCPW Educator. This data helps improve the programs provided to local schools. Probes can be copied and mailed or scanned and emailed to Stormwater Educator, Kitsap County Public Works, 614 Division Street, MS-26A, Port Orchard, WA 98366 or *help@kitsap1.com*.