FOSS WATERWAY
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Salish Salmon Collaborative Teacher Overview

Introduction:

Welcome to the Salish Salmon Collaborative! We are a partnership between Foss Waterway Seaport and Pierce Conservation District as well as other South Sound community organizations to facilitate Salmon in the Classroom for 5th grade classes at several Tacoma Public Schools.

We are providing instruction and support for setting up and maintaining a salmon tank in each participating school, including facilitating salmon eggs acquisition, salmon care, and salmon release. We are augmenting the Explore the Salish Sea Curriculum by providing lessons to facilitate students engaging with their salmon, choosing the location to release their salmon, and communicate what they've learned to the wider community. Student experience will culminate in a community event as well as a field trip to Swan Creek for students to participate in a miniature stream survey and release their salmon.

Schedule Overview:

October 2021

- Teacher workshop 1: Program Intro

November 2021

- Salmon Tank Distribution
- Partner School Visit to Assist with Tank set-up

Late November/Early December 2021

- Schools pick up Salmon Eggs

December 2021 - March 2022

- Salmon Tank Lessons

February/March 2022

- Partner Classroom Lesson 1: Introduce stream data to help students choose a release stream
- Partner Classroom Lesson 2: Release Field Trip Preparation
- Student Art Project

March 26, 2022 (Saturday)

- Community Event to celebrate salmon release and creek clean up

March 25 - April 1, 2022

- Schools will stagger field trips to Swan Creek for student stream survey and salmon release (two schools per day)

April - June 2022

- Student art displayed at the Seaport

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Salmon Tank Teacher Curriculum

Lesson #	Title	Timing
	Pre-Assessment	Early November (Before eggs arrive)
1	Tank is a stream model	Late November (When eggs arrive)
2	Predict a Hatch Date (ATU)	A week after eggs arrive
3	Egg Observations	Early December (Before eggs hatch)
4	Alevin Observations	Late December
5	Types of Salmon & Salmon Life Cycle	Flexible
6	Salmon's Many Habitats	Flexible
7	Fry Observations	January
8	Dream Stream	February
9	Healthy Stream Requirements	February
Partner Visit	Data to Choose a Stream	March
Partner Visit	Release Field Trip Prep	March
10	Salmon Art	March
	Release Field Trip	March 25 - April 1
	Post-Assessment	At end of Field Trip

Please begin each salmon lesson with an appropriate land acknowledgement. Even if you already have a practice of daily land acknowledgement in your classroom, please remind students that the salmon you care for have been donated by Puyallup Tribal Salmon Hatcheries, at the beginning of any salmon lesson (after Lesson 1 where this is initially discussed).

If you need to create a land acknowledgement for your classroom, please see the following from the Puyallup Tribe of Indians website:
http://puyallup-tribe.com/ourtribe/Land%20Acknowledgement.php

"***Where to start:***

We encourage you to personalize statements to align with the mission and values of your organization. Be mindful, though, not to stray too far from the core intention and message. It's also important to recognize that some areas may be shared between multiple tribes. At times it's appropriate to acknowledge multiple tribes, or to recognize the "Coast Salish tribes" as a whole.

However, before incorporating tribal perspective be sure to contact official representatives from that/those tribe(s).

Here are some examples that can serve as starting points, or final versions, for your organization's land acknowledgement:

- *We acknowledge that we are on the traditional homelands of the Puyallup Tribe. The Puyallup people have lived on and stewarded these lands since the beginning of time, and continue to do so today. We recognize that this land acknowledgement is one small step toward true allyship and we commit to uplifting the voices, experiences, and histories of the Indigenous people of this land and beyond.*
- *ʔukʷədiid čəɬ ʔuhigʷəd txʷəl tiiɬ ʔa čəɬ ʔal tə swatxʷixʷtxʷəd ʔə tiiɬ puyaləpabš. ʔa ti dxʷʔa ti swatxʷixʷtxʷəd ʔə tiiɬ puyaləpabš ʔəsɬaɬɬil tulʼal tudiʔ tuhaʔkʷ. didiʔɬ ʔa həlgʷəʔ ʔal ti sləxil. dxʷəsɬaɬɬils həlgʷəʔ gʷəl ƛ̓uyayus həlgʷəʔ gʷəl ƛ̓uƛ̓aǰʷad həlgʷəʔ tiiɬ bədədəʔs gʷəl tixdxʷ həlgʷəʔ tiiɬ ʔiišəds həlgʷəʔ gʷəl ƛ̓uʔalalus həlgʷəʔ gʷəl ƛ̓utxʷəlšucidəb. x̌ʷəla···b ʔə tiiɬ tuyəlʼyəlabs. We gratefully honor and acknowledge that we rest on the traditional lands of the Puyallup People. The Puyallup people have lived on this land since the beginning of time. They are still here today. They live, work, raise their children, take care of their community, practice their traditional ways and speak the Twulshootseed language – just as their ancestors did."*

Pre-Assessment

Timing: Prior to eggs being picked up or students completing any lessons

Before your school picks up your salmon eggs, please have your students take the following pre-assessment at the link shared in Teams. Students will take the same assessment at the end of the program to measure their growth. The questions are below:

Student Survey: Salmon in Schools Pre-Program

Student name:

School:

County:

Grade Level:

1. Salmon have 5 stages in their life cycle, can you name any? Y N

If so, which ones:

2. Salmon live in 3 habitats, can you name any? Y N

If so, which ones:

3. There are 5 species of salmon. Which ones can you name?

4. How are salmon connected to your local community?

5. What significance do salmon play in Washington State?

Source: Pacific Northwest Salmon Center

Lesson 1: Tank is a Stream Model

Timing: When eggs arrive

1. Engagement for Aquarium Observations
   Before starting aquarium observations it is a good idea to give students an overview of what they will be learning about over the next 4 months. Students will use the salmon tank for learning and reinforcing life science concepts.
   a. Tell students that the school will be using the salmon aquarium with salmon eggs to observe over the next 4 months to watch the salmon develop from eggs into fry and then to release them into a creek they choose together.
   b. Explain to students that the eggs have been donated from Puyallup Tribal Salmon Hatcheries. Share with them the stated goal of the hatcheries: “The Puyallup Tribe’s restoration goal is to rebuild depressed Chinook and steelhead stocks and remove them from ESA [endangered species act] listing by limiting harvest, using acclimation ponds, and making substantial gains in habitat restoration.” http://puyallup-tribe.com/fisheries/hatchery.html.
   c. Tell students that the aquarium is a model of the stream habitat where salmon eggs develop into fry before heading to the ocean. As a model, the aquarium simulates the needs (conditions) that salmon eggs require (depend on) to develop into alevin and then fry. We then release the salmon fry into a stream so they can finish their life cycle in the Salish Sea and ocean before returning to spawn in the stream. Scientists use models to study systems when they are too large to study directly and to understand some aspect of the natural world. Tell students that just like scientists they will be using the salmon aquarium to learn about salmon development needs and the salmon life cycle.
   d. Tell students that over the next 4 months they will be:
      i. Making general observations of the aquarium
      ii. Measuring temperature daily and water quality parameters regularly (Decide with partner teachers how this will be handled)
      iii. Observing salmon when they are eggs, alevin, and fry and reading about their habitat needs.
      iv. Releasing salmon into a local stream they help decide on based on what they learn about habitat requirements
2. The Salmon Aquarium as a System
   a. On day 1 when the salmon arrive, have students fill out the cover of their journal with the information you have. Then take the water temperature in degrees C. Plan on how temperature will be taken each day so it can be done the same way each time. (controlled variable) Have students record the temperature on the current day of the Salmon and Temperature Interaction calendar in their journal. Continue to take temperature every day and record. They will use the data in Lesson 2 to predict when the eggs will hatch.
   b. Demonstrate taking the other regular water quality measurements and how to record that information on the tank log. Discuss with your partner teachers how

you can involve students in the daily/weekly tank checks (rotate classroom chores, etc.)

c. Soon after the salmon eggs arrive, students draw and label the tank and system on the Salmon Aquarium System journal page. The list of parts students should identify is in the table on the following page. Have students list inputs and outputs and answer all seven Salmon Aquarium System questions . Note: for any system, inputs are matter and energy that are entering the system and outputs are matter and energy leaving or changing in the system. (If students have not had the Ecosystems science unit yet, consider checking out books about salmon from the library for students to use as resources.)
d. Discuss with students their answers to the questions and check for understanding of the aquarium as a system and any problems seeing the aquarium as a system.

Adapted from https://sisseattle.org/wp-content/uploads/Salmon-Logs-1.pdf

Lesson 2: Predicting Salmon Hatch

Timing: Temperature readings begin at egg arrival. Using those readings begins several days after eggs arrive

Background for Accumulated Thermal Units:

In many species, including birds and fish, the amount of heat that eggs receive is the most important factor in determining when the eggs will hatch. While birds get the heat needed from the parent's bodies, salmon get the heat they need from the water. In salmon and other fish when eggs hatch is determined by heat accumulated over time and is measured in units called accumulated thermal units (ATUs). Different types of salmon require different amounts of accumulated thermal units. An ATU is the sum of water temperatures over a period of time. For example, if the first day of incubation occurred when the water was 8 °C, the second at 7 °C and the third at 9 °C, then the ATUs at the end of day three is 24, the cumulative total.

Lesson Outline:

1) Begin monitoring temperature as soon as the eggs are in your school aquarium and continue until all the viable eggs have hatched. Obtain the number of Accumulated Thermal Units when the salmon eggs arrived.
2) Ask students to suggest reasons for birds sitting on their eggs before they hatch. Then explain that a parent bird's body provides heat which eggs need to develop. Explain that in many species, including birds and fish, the amount of heat that eggs receive is the most important factor in determining when the eggs will hatch. While birds get the heat needed from the parent's bodies, salmon get the heat they need from the water. In salmon and other fish when eggs hatch is determined by heat accumulated over time and is measured in units called accumulated thermal units (ATUs). Different types of salmon require different amounts of accumulated thermal units. An ATU is the sum of water temperatures over a period of time. For example, if the first day of incubation occurred when the water was 8 °C, the second at 7 °C and the third at 9 °C, then the ATUs at the end of day three is 24, the cumulative total. Explain to students the needs of their type of salmon eggs (Coho).

Accumulated Temperature units (ATU's) required to reach important development stages in 3 types of salmon.		
Species	**Stage**	**ATUs in °C**
Chinook	To hatch	480-540
	To emergence (fry)	900-1000

Chum Salmon	To hatch	475-525
	To emergence (fry)	900-1000
Coho Salmon	To hatch	400-500
	To emergence (fry)	700-800

3) Have students record the hatchery ATUs in the space on the calendar journal page. Begin taking temperature readings and recording them on the calendars provided in the journal.
4) After a few days, have students take out their calendar journal pages. Demonstrate adding each day's temperature to the number from the hatchery to calculate the ATUs. Have students do a couple of days on their own.
5) Practice prediction.
    a) Use the **practice copy** of the calendar journal page. 2 weeks of aquarium temperature readings varying from 7-9 °C are filled in on the practice calendar log page.
    b) Start with the ATUs when the salmon eggs arrived.
    c) Have students add each day's temperature to the ATU from the day before and record each day's ATU until the 2 weeks of data have been added to calculate the total ATUs.
    d) Compare this number to the number of ATUs needed for their type of salmon to hatch in the table above. Ask students, "Will this be enough for eggs to hatch?" (No it won't). What if the next 2 weeks added the same number of Thermal Units? Example: Starting with 200 ATU's for 14 days let's say we added 112 ATUs (8°C aver per day) then we would have a total 312 ATU Celsius (-not enough to hatch). After another similar 14 days the total would be 424 ATUs. This would be enough for Coho Salmon to start hatching, but not the other species

6) Make a prediction for your aquarium. Start with the number of ATUs from the hatchery. Measure the water temperature for a few days. Find the average daily aquarium temperature. Subtract start ATUs from the needed ATUs for hatching. Take this number and divide by the number of the daily average ATUs. This should be a prediction of the number of days until hatching.

$$\frac{\text{ATUs needed to hatch - ATUs (start) from hatchery}}{\text{Average daily temperature °C}} = \text{Number of days until hatching}$$

Have students count the number of days on their log calendar and put their prediction in red.

Example:

$$\frac{\text{480 ATUs (for Chinook to hatch)-200 ATUs from Hatchery}}{\text{8 °C}} = \text{35 days}$$

If eggs came on January 9, 35 days later would be February 13. So you would expect eggs to start hatching around February 13.

7) After the eggs have hatched, discuss with students how close their predictions were. Explain that these predictions are a best guess using data for what will happen.
8) Now have students predict fry emergence in a similar manner and mark on their calendars.

$$\frac{\text{ATUs needed for fry to emerge - ATUs (start) from hatchery}}{\text{Average daily temperature °C}} = \text{Number of days until emerging}$$

9) Continue measuring temperature until the alevin become fry and check predictions

Adapted from https://sisseattle.org/wp-content/uploads/Salmon-Logs-1.pdf

Lesson 3: Salmon Egg Observation

Timing: Early December (before eggs hatch)

Use the Salmon Egg Observations pages in their student journals. Discuss observational skills with students as needed to prepare them.

1) Allow students plenty of time to draw and label the salmon eggs as well as describe the eggs in the aquarium.
2) Have students spend some time using the sentence starters to be more descriptive.
3) Go over estimating how many eggs are in the aquarium and the fraction that seems to be moving.
4) Go over how many eggs have died (they have turned white) and have students record what fraction of the eggs have died.
5) Back in the classroom, as a class or individually, read Article 1 about salmon eggs, available in Schoology and the student journal.
6) Have students find the 3 needs of salmon eggs shared in the reading. Have students share out and record them on a chart. Have students turn to the Salmon Dependence on Habitat page in their journals. Have them underline the 3 needs just listed on the board in the table for eggs
7) Discuss with students how these needs of the eggs are met in the aquarium and write them in the table and display overhead. Have students record in the table on eggs.
8) Remind them that the aquarium is a model of the stream habitat. Ask students to think about how the needs of eggs are met in the stream habitat. Have them record those in the table and share out.
9) Brainstorm what threats there are to salmon eggs while they are in streams and record them in the table.

Source: https://sisseattle.org/wp-content/uploads/Salmon-Logs-1.pdf

Lesson 4: Salmon Alevin Observations

Timing: late December (after eggs hatch)

Use the Salmon Alevin Observation pages in their student journals.

1) Have students put the day number and date on the Salmon Alevin Observation pages.
2) Allow students plenty of time to draw and label the alevin as well as describe the alevin in the aquarium.
3) Have students spend some time using the sentence starters to be more descriptive.
4) Discuss where the alevin get their food (chemical) energy to grow. (It was already in the egg).
5) Shine the flashlight on the alevin. What happens? Have students record. Discuss what happens when you shine the flashlight. Ask students why they think the alevin respond that way.
6) Have students read the handout Article 2 about alevin, available in Schoology or the student journal
7) Have students look for the needs salmon alevin have for development in the reading. Have students share out and record on a chart or use another book or resource to provide information about salmon alevin.
8) Go to the Salmon Dependence on Habitat page of the journal
9) Have students think about how those needs are met in the salmon stream and record those on the table. Discuss with students about the needs of the alevin in the aquarium from the article you just read. Remind them that the aquarium is a model of the stream habitat. Have students share out how salmon alevin needs are met in the tank. On the chart, record how the salmon alevin needs are met in the aquarium and have students record them on their table in the journal.
10) Brainstorm what threats there are to salmon alevin while they are in streams and have students record those in the table as well.

Source: https://sisseattle.org/wp-content/uploads/Salmon-Logs-1.pdf

Lesson 5: Types of Salmon & Salmon Lifecycle

Timing: Flexible. Any time prior to Lesson 8 and following

Lessons 5 & 6 are adapted from the Explore the Salish Sea curriculum, Ch. 7 Lesson 2, Sessions 1 & 2. Feel free to use any prior experience with this curriculum to teach it in a way that works for you. A slideshow with just the relevant slides and presenter notes for these lessons will be available in Teams. The slide references have been updated for this condensed slideshow.

1. Show slide 2 and ask if anyone recognizes each type of salmon in the photos. Let students explore the Know the Salmon High Five journal page, practice, and test one another for fun. Provide colored pencils or markers and have students follow the video instruction to create their own salmon high five art on the Draw the Salmon High Five journal page.
2. Use slide 4 to go over the stages of the salmon lifecycle. Guide the Salmon ID activity which uses the Know Your Salmon journal pages. Assign half of the students to Chinook and the other half to pink (don't reveal which is which). Distribute lifecycle cards (below for copies to be made) to each student. Challenge students to identify their mystery salmon using the dichotomous key on the Know Your Salmon: Identification journal page and the lifecycle cards. Put up slide 5 so students can see a color picture of their salmon, which is important for the key. Show slide 4 or refer to a classroom poster to review then have students glue or tape their lifecycle stage cards in order of events on the Know Your Salmon journal page that matches their species. Finally, have students join with a student who had the other species and share the differences and similarities between the two species' lifecycles. Ask them what these differences mean for habitat needs.

Eggs incubate in gravel.

Juveniles hatch and spend 1-2 years in streams eating invertebrates.

At 1-2 years, juveniles migrate to the ocean and grow.

Fish mature into adults in the ocean.

Adults return to their home freshwater stream to spawn

Eggs incubate in gravel.	
Juveniles hatch and migrate directly to sea.	
Juveniles eat and grow in the ocean for 1 year.	
Fish mature into adults in the ocean.	
Adults return to their home streams to spawn.	

Adapted from Explore the Salish Sea - https://www.juniorseadoctors.com/ch-7-migration

Lesson 6: Salmon's Many Habitats

Timing: Flexible. Any time after Lesson 5 and prior to Lesson 8 and following

1. Show slide 7 (salmon habitats). Have students sketch and label what each habitat on a salmon's migration should include on the Salmon's Many Habitats journal page. Make sure they include river, tidal marsh, open ocean, and eelgrass meadow, one for each stage.
2. Show slides 8-9, explain rules, then play the Hooks and Ladders obstacle course game. Modify if necessary. Hold a class discussion to share triumphs and challenges. Invite them to reflect on their experience by answering the questions on the Hooks and Ladders journal page.

Hooks & Ladders:

Materials

- Wadded up newspapers (gravel red)
- A jump rope (10 – 15 feet long)
- About 500 feet of surveyors flagging (or something to designate playing area boundaries)
- Traffic cones (optional)
- 2 cardboard boxes or rubber bins
- 100 tokens (poker chips)
- One tub of dry beans (eggs)
- One empty tub, labeled "redd"
- Plush toy animals to represent predators

Large playing area (100 feet x 50 feet)

Size/Setting/Duration

Whole Class/Playing Field/~1 hour

Background

Many fish live part of their lives in one habitat and then migrate to another habitat. Some make their migratory journeys to mature and reproduce. Pacific salmon are an example of one of the most spectacular of the migrating species.

Pacific salmon are destined to spawn only once in their lifetime. Within their genetic fiber is an encoded instinct that drives them along a monumental journey from their freshwater spawning beds downstream into the sea. Once in the sea, they spend several years reaching the maturity

needed for their single return journey to their original hatching ground. Once there, the salmon spawn and die.

Salmon must face a myriad of hazards that serve as limiting factors in the completion of their life cycle. Limiting factors are factors that reduce the populations of living organisms. Sometimes the limiting factors are natural and sometimes they result from human intervention with natural systems.

The female Pacific salmon deposits 1,500 to 7,000 eggs in her freshwater spawn. The eggs are deposited in a shallow gravel depression scooped out by the female called a redd. Once deposited, the male fertilizes the eggs and then both fish nudge the gravel back over the eggs to offer as much protection as possible. Within a few days both the female and male salmon have completed their reproduction and soon die.

The eggs, before and after hatching, are susceptible to many limiting factors. Smothering silt can be washed in suddenly from watersheds damaged by a variety of land-use practices and events – including erosion following some road building, logging, and fires. Predators can eat some of the eggs and damage hatching populations. Dropping water levels can isolate salmon offspring in streamside depressions and cause them to remain isolated and die. After hatching, the small fish – called “alevins” – spend their first two weeks hiding in the gravel. Gradually they absorb their yolk sac and become known as “fry.” If they survive the first two weeks, then they begin their journeys. Some swim directly to sea.

Depending on the species, young salmon may spend several months to as much as a year or more in the river before migrating to the estuary and then to the open ocean.

The small ocean-bound salmon, now called “smolts,” are at once confronted by hazards on their downstream journey. Examples are dams; low water in streams; and predatory birds, mammals, and larger fish. Up to 90% of the salmon that hatch never reach the sea.

When in the ocean, the salmon grow rapidly by feeding on the ocean’s rich food supply. Predators such as sharks, killer whales, and other marine mammals take their toll. In addition, humans fish for salmon commercially and for personal reasons, including food and recreation.

In two to five years, the Pacific salmon start the journey that will guide them back to the rivers and streams leading to their own hatching site. The upstream migration from the ocean is also a series of hazards. For example, dams hinder their journey and would block it completely if fish ladders were not installed. Fish ladders are water filled staircases that allow the migrating fish to swim upstream, around the dam. Humans who fish, bears, and other predatory mammals also reduce the numbers along the way to the spawning ground. Sometimes landslides and logjams provide unexpected new barriers. So too do the natural waterfalls and rapids that the now weighty salmon must overcome. Once back at the spawning ground the life cycle of the Pacific salmon begins anew. To maintain the Pacific salmon population, some biologists believe that only one pair of fish must return to deposit and fertilize the eggs.

All possible conditions are not covered by the design of this activity. However, the activity does serve simply and effectively to illustrate three important concepts – life cycle, migration, and limiting factors.

The major purpose of this activity is for students to gain an understanding of some of the complex characteristics of the life cycle of one representative aquatic species, the Pacific salmon.

Activity

1. This is a physically involving activity! Set up a playing field as shown in the attached diagram, including spawning grounds, downstream, upstream, and ocean (if space is limited, the same stretch of playing area can be both the downstream and upstream channels). The area must be about 100 feet by 50 feet. Set up a gravel redd with the wadded newspapers at the start. Assign roles to each of the students. Some will be salmon; others will be potential hazards to the salmon. Assign the students roles as follows.

· Choose two students to be the turbine team. These students will operate the jump rope, which represents the turbines in hydroelectric dams. Later in the simulation, when all the salmon have passed the turbine going downstream, these students move to the upstream side to become the waterfall-broad jump monitors.

· Choose two students to be predatory wildlife. At the start of the simulation the predators will be below the turbines where they catch salmon headed downstream. Later in the activity when all the salmon are in the sea, these same two predators will patrol the area above the "broad jump" waterfalls. There they will feed on salmon just before they enter the spawning ground.

· Choose two students to be human fishing boats catching salmon in the open ocean. These students in the fishing boats must keep one foot in a cardboard box to reduce their speed and maneuverability.

· All remaining students are salmon. They can begin a few at a time, laying under the balled up newspaper gravel of the redd.

NOTE: these figures are based on a class size of 25 – 30. If the group is larger or smaller, adjust the number of people who are fishing and predatory wild animals accordingly.

3. Begin the activity with all the salmon in the spawning ground. The salmon then start their journey downstream. The first major hazard is the turbines at the dam. At most dams there are escape weirs to guide migrating salmon past the turbines. The student salmon cannot go around the jump rope swingers, but they can slip under the swingers' arms if they do not get touched while doing so. A salmon dies if the turbine (jump rope) hits it. The turbine operators may change the speed at which they swing the jump rope. NOTE: Any salmon that "dies" at any time in this activity must immediately become part of the human-made ladders now used by migrating salmon to get past the barriers such as dams. The students who are the fish ladder kneel on the ground on their hands and knees with a body-wide space between them.

4. Once past the turbines, the salmon must get past some predatory wildlife. The predators below the turbine must catch the salmon with both hands – tagging isn't enough. Dead salmon are escorted by the predator to become part of the fish ladder. NOTE: Later the salmon that survive life in the open ocean will use the structure of the fish ladder -- by passing through it – to return to the spawning ground. NOTE: Both the predators in the last downstream area and the people fishing in the open ocean must take dead salmon to the

fish ladder site. This gets the predators and the fishing boats off the field regularly, helping to provide a more realistic survival ratio.

5. Once in the open ocean, fishing boats can catch the salmon. The salmon must move back and forth across the ocean area in order to gather four tokens and one handful of eggs (beans). Once each fish has four tokens (four years' growth) and eggs, that fish can begin migration upstream. The tokens can only be picked up one token at a time on each crossing. Remember that the salmon must cross the entire open ocean area to get a token. The "four years" these trips take make the salmon more vulnerable to and thus the fishing boats more readily catch them. For purposes of this simulation, the impact of this limiting factor creates a more realistic survival ration in the population before the salmon begin the return migration upstream.

6. Once four of the year tokens are gathered, the salmon can begin to upstream. The salmon must walk through the entire pattern of the fish ladder. This enforced trip through the fish ladder gives the students a hint of how restricting and tedious the upstream journey can be. In the fish ladder, predators may not harm the salmon.

7. Once through the ladder, the salmon faces the broad jump waterfall. The waterfall represents one of the natural barriers the salmon must face going upstream. Be sure the jumping distance is challenging but realistic. The two former turbine students will monitor the jump. The salmon must jump the entire breadth of the waterfall to be able to continue. If the salmon fails to make the jump, then it must return to the bottom of the fish ladder and come through again.

8. Above the falls, the two predators who started the simulation as the predators below the turbines are now the last set of limiting factors faced by the salmon. They represent bears – one example of predatory wildlife. Again, remember that the predators must catch the salmon with both hands. If they do catch a salmon, they must then take the student they caught to become part of the fish ladder.

9. The activity ends when all the salmon are gone before the spawning ground is reached – or when all surviving salmon reach the spawning ground. This is where they will deposit their eggs in the "redd".

10. Next engage the students in a discussion. Explore such topics as:

- The apparent survival-mortality ration of salmon
- The students' feelings throughout the activity
- The role of the barriers
- The role of the predatory wildlife and the people fishing
- Where the losses were the greatest
- Where the losses were least
- What the consequences would be if all the eggs deposited made the journey successfully

- What seemed realistic about this simulation and what did not

11. Ask the students to summarize what they have learned about the life cycle of salmon, the salmon's migration, and limiting factors that affect salmon. Make sure the students have a clear working definition of limiting factors. Encourage the students to make the generalization that all animals – not just the Pacific salmon – are affected by limiting factors. Ask the students to give examples. They might mention availability of suitable food, water, shelter, and space; disease; weather; predation; and changes in land use as well as other human activities.

SUGGESTIONS

- Allow at least fifteen minutes for set-up.
- Try to play two rounds of the activity. During the first, limit the barriers and limiting factors to those found in nature only (predators, waterfalls, etc). In the second round, add in human limiting factors (turbines, fishing boats, fish ladders, etc).
- At least during the first round of play, have all the salmon stop and wait after passing each hazard stretch. This way the salmon get a chance to regroup and contemplate the next barrier.
- Add an estuary area as a "holding area" for the salmon that have made it downstream to the ocean entrance and for those ready to head upstream to spawn.

Adapted from Explore the Salish Sea - https://www.juniorseadoctors.com/ch-7-migration

Lesson 7: Salmon Fry Observations

Timing: January, after fish develop and feeding begins

Use the Salmon Fry Observation pages in their student journals.

1) Have students put the day number and date on the Salmon Fry Observation pages.
2) Allow students plenty of time to draw and label the fry as well as describe the fry in the aquarium.
3) Have students describe fry behavior in the tank.
4) Discuss how fry behave when fed. How is their behavior similar to their behavior looking for food in streams?
5) Discuss what happens when you shine the flashlight. Ask students why they think the fry respond that way. Discuss their ideas of how the fry behavior helps them survive in their stream habitat. Have students record in their log.
6) Have students read Article 3 about salmon fry available in Schoology and the student journal
7) Go to the Salmon Dependence on Habitat page of the journal
8) Have students think about how those needs are met in the salmon stream and record those on the table. and discuss with students about the needs of the fry in the aquarium from the page you just read. Remind them that the aquarium is a model of the stream habitat. Have students share out how salmon fry needs are met in the aquarium. In the table have students write down how the salmon fry needs are met in the aquarium.
9) Brainstorm what threats there are to salmon fry while they are in streams and record.
10) Answer the questions 1-3 on the next page either individually or as a class.

Source: https://sisseattle.org/wp-content/uploads/Salmon-Logs-1.pdf

Lesson 8: Dream Stream

Timing: February, before first scheduled partner visit

Lessons 8 & 9 are adapted from the Explore the Salish Sea curriculum, Ch. 7 Lesson 2, Sessions 3 & 4 and Lesson 3, Season 1. Feel free to use any prior experience with this curriculum to teach it in a way that works for you that includes Through Salmon Eyes.

1. Play the video Through Salmon Eyes, slide 11, by the NW Indian Fisheries Commission, shared in the STI curriculum. This story is shared with permission from the NWIFC. Have students share their reflections on this salmon story and the Billy Frank Jr. quote on the Coast Salish Connection journal page .
2. Narrow the habitat research down to home stream habitat by showing the Riparian Zone video, slide 12. All this background research has prepped them to become a salmon fry and create their Dream (or Nightmare) Stream! This can be done on the Dream Stream journal page or on a salmon-shaped paper cut-out with colored pencils, markers, paints, etc.
3. Show slide 14 and invite small groups to list all the species they can that depend on salmon to survive. Give a small prize to the group that comes closest to 137!

Adapted from Explore the Salish Sea - https://www.juniorseadoctors.com/ch-7-migration

Lesson 9: Healthy Stream Requirements

Timing: February, before first scheduled partner visit

1. Ask students if they are ready to put science to work to measure their stream for salmon safety. Let them know they will divide into research teams by stream survey component (slide 16). Go over all survey components using slides 17 - 37.
2. Provide printed or electronic salmon habitat research articles to each team, according to their survey topic (some articles will be provided in Teams; feel free to use others as well). Divide background research resources equitably amongst teams, considering varying reading levels and conduct a Team Read, slide 38. Divide each relevant article into sections for each team or give one, whole article to each student. Ask a team member to share out the background research results (article summaries) with the class.
3. Show the coho video clip, slide 39. Have students Team Read the Article 4 about coho available in Schoology and the student journal, slide 40, then share what is happening to coho. Conduct a Team Talk to discuss connections between their background research and the struggling coho salmon.

Source: Explore the Salish Sea - https://www.juniorseadoctors.com/ch-7-migration

Lesson 10: Reflection Art Project

Timing: March, after previous lessons and prior to release field trip

As a way for students to reflect on what they learned, students will create art on templates provided to teachers by SSC. More detailed instructions will accompany the templates. Teachers should collect student art and bring it to the stream on the release day field trip to give to a designated person from Foss Waterway Seaport.

The student art from all the TPS Salmon in the Classroom schools will be combined into an art installation at the Seaport that will be publicly available for viewing through June 2022. This is students' opportunity to share what they've learned about salmon with the community

Post Assessment

Timing: After release field trip

Students will take the same Student Survey that they did as a pre-assessment, now as a post-assessment to measure learning.