



Forests and Fins

Introductory Lesson

Duration

1-2 hours

Lesson at a Glance

Science Journals (5 min)

Pre-Program Assessment (30 min)

Salmon Life Cycle Video (15 min)

Salmon Life Cycle Wheel (45 min - 1 hour)

Learner Outcomes

Participants will:

- Gain awareness of the life cycle of Pacific salmon as it relates to habitat needs, threats, and diet.
- Collaborate in groups.

Materials

Items provided by the Greenway Trust:

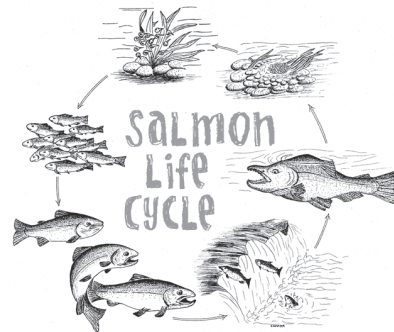
- Forests and Fins Science Journals (1 per student)
- Video links
- Pre-Program Assessment
- Life Stage worksheet key for teacher

Materials the classroom teacher will need to provide for students:

- Salmon Life Stage worksheet (1 per student)
- Salmon Life Cycle chart (1 per student)
- Background Reading (there are 6 options; print 1 set of 6 for each group)
- Scissors
- Glue or tape
- Salmon Life Cycle Song Worksheet (1 per student)

Science Journals (5 min)

1. Give each student a Science Journal. Ask them to write their name, teacher's name, and school on the front.
2. Tell them they will use this Science Journal in the classroom, on the field trip, and back in the classroom to record their observations, new knowledge, and reflections.



Pre-Program Assessment (30 min)

If you are short on time, please prioritize giving your students time to complete the pre-program assessment.

1. Provide each student with a pre-program assessment. Ensure they write their name and school where indicated.
2. Give your students 30 minutes to complete the pre-program assessment. On the side titled "Picture This!" they will make a drawing, and the other side they will answer some questions to see what they know. This will be repeated during the Reflective lesson with a Greenway Educator. Assure them that this is not a test! The Greenway

education team looks at these assessments to see what students are learning from us and to make any needed adjustments to our teaching materials.

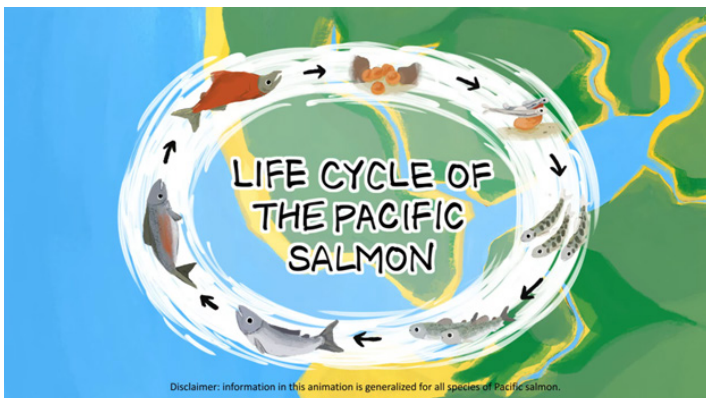
3. Collect the completed assessments to give to the Greenway Educator when they visit the classroom.

Salmon Life Cycle Video and Discussion (15 min)

1. Ask the students to describe what a salmon looks like. Ask, "have you ever seen one? Where did you see it?" Answers will vary from seeing salmon on their dinner plate or in the grocery store, to seeing a salmon in the wild. Ask if anyone can name the stages of the salmon life cycle in order.
2. Tell your students to listen for some key words while they watch the video. Write the key words on the board:

Keystone species
Egg
Redd
Alevin
Fry
Estuary
Smolt
Adult
Spawner

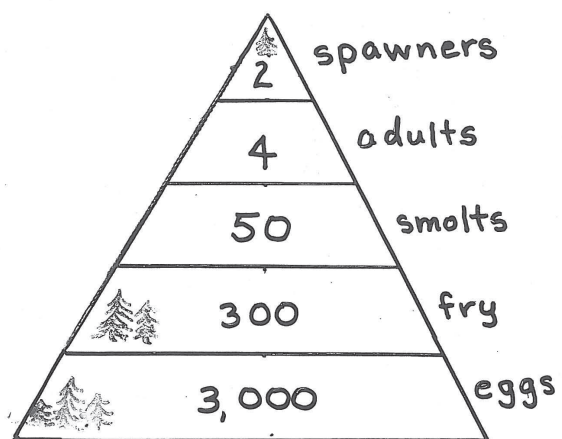
3. Watch the **"Life Cycle of the Pacific Salmon" video** (5:37 minutes): <https://www.youtube.com/watch?v=2xG6waimZnI>.



4. After watching the video, ask what the students learned about the salmon life cycle.

Review the life cycle stages. Identify at which stages the salmon might live in a forest – specifically, in a fresh water stream. (Answer: egg, alevin, fry, and spawning adult).

5. Tell students that the healthier and stronger salmon are when they leave their home stream as fry, the better chances they have of returning as spawning adults. It is important for us to know the characteristics of a healthy salmon stream so that we can help restore (fix) the habitat if something about it is unhealthy.
6. Explain to students that over the next 1-2 class periods, they will explore the role that forests play in protecting watershed habitats for salmon. Define habitat with the students as the natural home or environment of any animal, plant, or other organism.
7. Optional: Show your students the "Salmon Life Cycle Song" (3:40 minutes): <https://www.youtube.com/watch?v=qV30UZ9aF04>. If you'd like, use the "Salmon Life Cycle Worksheet" to help your students follow along with the lyrics.
8. Optional: share this chart with your students to show how few salmon make it to complete their life cycle. On average only 2 out of 3,000 eggs make it to become spawners.



One salmon
nest

Salmon Life Cycle Wheel Activity (45 min - 1 hour)

Your students will work together to create a wheel with six wedges where each wedge represents one salmon life cycle stage. They will start in pairs and end up in groups of six. You can see an example of a completed Life Cycle Wheel later in this curriculum.

Note: You may choose to adjust this activity (e.g., so that each student makes their own wheel over several class periods) depending on how much time you have and your students' existing knowledge about salmon.

1. Arrange your students in pairs and give each pair 2 blank Salmon Life Stage worksheets and 2 blank Salmon Life Cycle charts. Each pair will also need two Background Reading Sheets: Stages 1 & 2, or Stages 3 & 4, or Stages 5 & 6. (Notice that Stage 2 and Stage 4 are the shortest).
2. Instruct the pairs to take turns reading about their assigned life stages out loud and then work together to use the Life Stage Worksheets to organize the following information:
 - The salmon's habitat at that stage
 - The salmon's diet at that stage
 - The threats to a salmon at that stage
 - What the salmon looks like at that stage
3. Instruct students to use their Salmon Life Stage worksheets to then fill out the Salmon Life Cycle charts. They can write and/or draw the information on the charts, but they should do their best to write/draw clearly. Tell them they will share the charts with two other sets of pairs, gluing or taping them together to create a full life cycle wheel.
4. When the pairs are done creating their charts, join three sets of pairs together so that in

their group all six life stages are represented. Ask each student to share their Salmon Life Cycle Chart, starting with the Stage 1.

5. Instruct your students to cut out their chart and to be careful to not cut off the tabs on the sides. They should use glue or tape to connect all six charts together to make a complete life cycle wheel.
6. You will end up with 4-5 completed wheels. We encourage you to display these in your classroom! If it's easy, we would love to get copies/photos of your students' artwork: you can email images to education@mtsgreenway.org.

"Salmon Life Cycle Song" Worksheet

First I was an egg, I was petrified.
In a gravel redd, 3,000 siblings by my side.
It's nice and safe here in the dark
'cause I'm just so sensitive.
But I'll grow stronger, gonna show you how to live.
Gotta watch your back! Lots of dangers here...
Like changing temperatures and silt and floods
and predators we fear.
Gotta wait about three months
and then I'll hatch and grow
into an _____... I'm not just an embryo!
I'm gonna live. It's not a drag.
Imagine a fish that comes with its own lunch bag!
I'm the one who likes the dark and always hides.
I'm still fragile, but soon I'll be a _____!
Oh but I, I will survive!
As long as I know how to swim,
Now I'm swimming free, darting left and right.
No more living in the redd or hiding from the light.
I'm eating lots of little bugs and plankton from the stream.

It's eat or be eaten. Sometimes you just gotta be mean!
And so I'll grow. What'll be my fate?
One day, I might just end up on your dinner plate.
I've almost reached the estuary, I've heard.
Let's just hope that I don't get eaten by a bird!
'Cause now I've grown to be a _____.
I'd like to stick around and talk, but I've gotta bolt.
Pretty soon I'll be an _____ and full grown.
Make my way back to the only stream I've known.
Now I, I'll stay alive!
As long as I can lay my eggs, my species will survive.
A _____'s life is but a dream...
I'm just trying to swim upstream.
They will survive! They will survive!
...and the cycle starts all over again!
I know I'll stay alive.
I'm gonna get my life in motion,
gotta swim into the ocean.
I will survive. I will survive! Hey hey!

Salmon Life Stage:

Your job is to read the Background Information given to you and to fill out this worksheet with the facts you find and any important key terms you come across.

Habitat Facts	
Threat Facts	
Diet Facts	
Other Facts	
Key Terms	

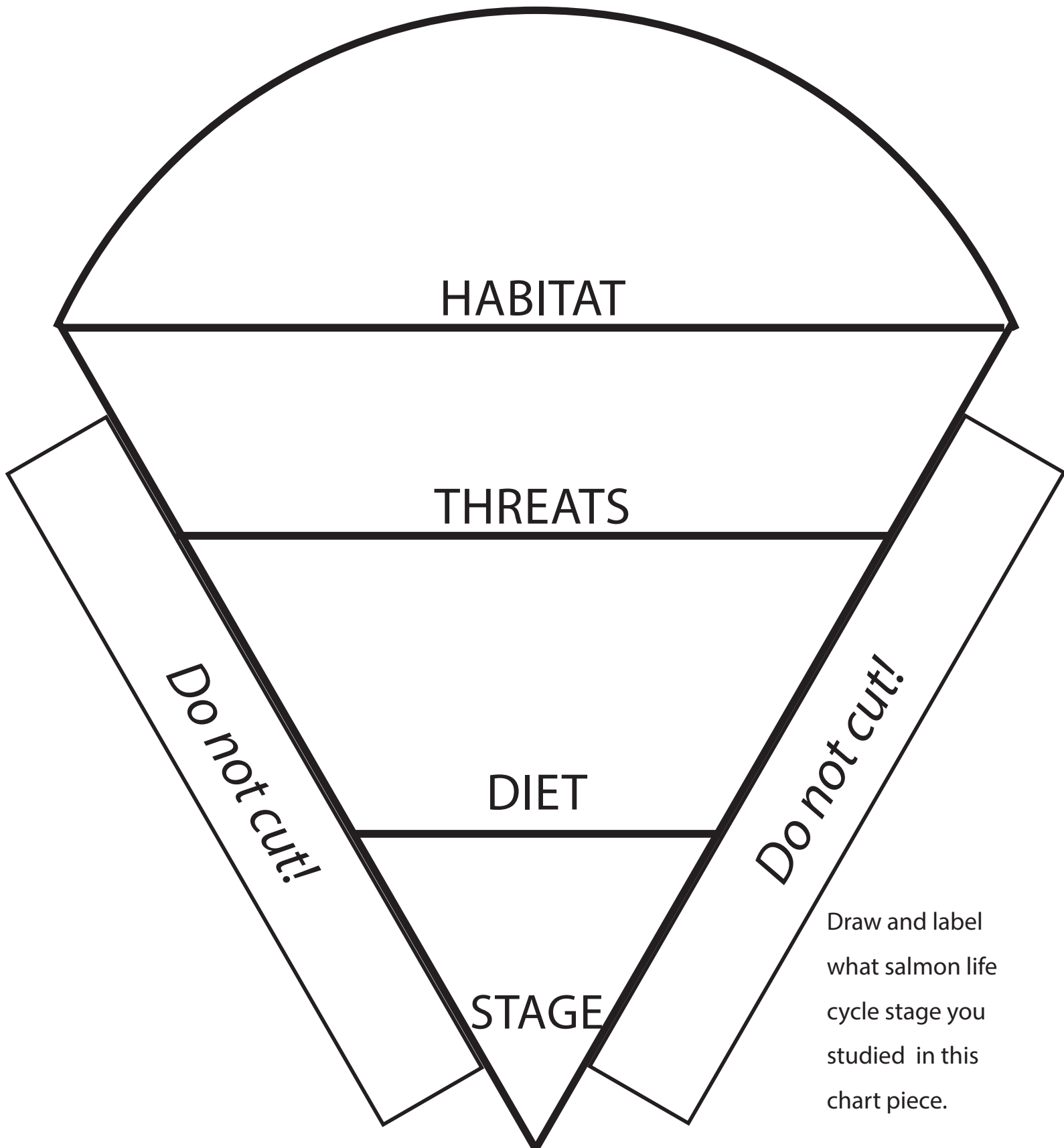
Salmon Life Stage Worksheet Key for Teacher

This is information that your students may include on their Life Stage worksheet:

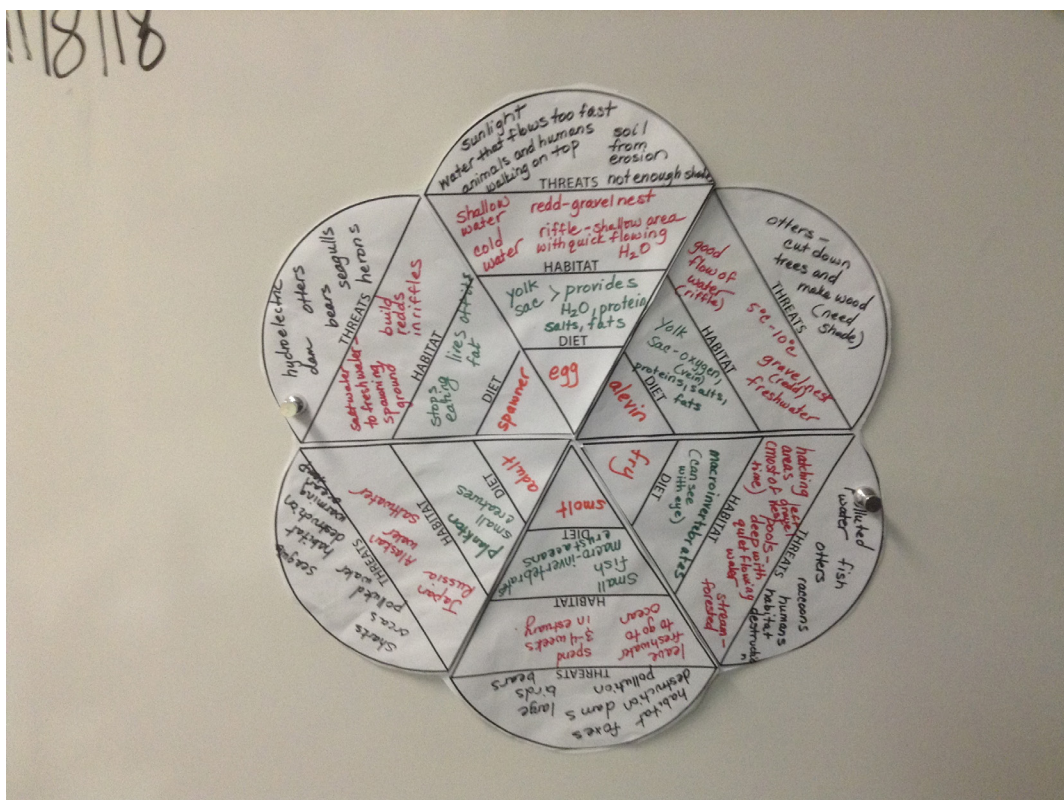
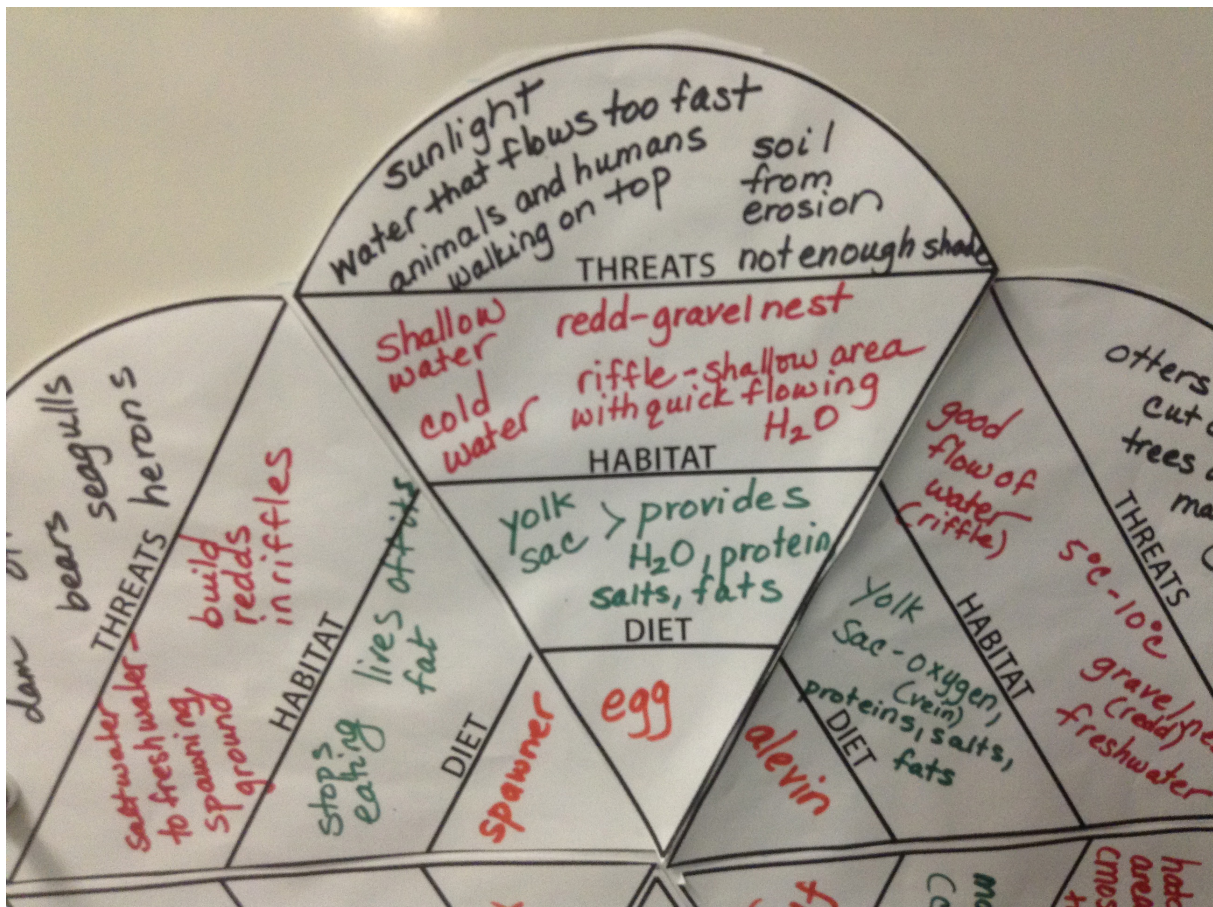
Salmon Life Stage	Habitat	Threats	Diet	Other Facts
Egg	Cold, shallow, freshwater stream in a forest. Redd/nest. Bed of gravel. Located in a riffle.	Smothered by soil, erosion. Crushed by humans stepping on them. Water that's too fast. Water that's too warm.	Yolk inside the egg (provides water, proteins, salts, and fats)	Eggs are the size of a pea. Nest is called a redd. Different species of salmon have different sizes of redds: 6 ft for Sockeye up to 16.7 ft for Chinook. Eggs are slightly sticky, keeps them fastened to gravel so they don't float downstream. Special chemical breaks down egg wall.
Alevin	Gravel redd/nest with pebbles. Cold, shallow stream. Riffles.	Habitat destruction: cutting down trees, building dams.	Yolk sac.	Hatch late winter or early spring. Measure 1.5 inches long. Orange yolk sac. Stay in gravel for 3-4 months. Pulls oxygen out of the water with a vein that runs up through the center of the yolk sac.
Fry	Deep pools in a forested stream. Shallow riffles. Good tree cover. Clean, cold water.	Forest predators (birds, large fish, wild animals such as raccoons). Habitat destruction (logging, dams, pollution).	Macro-invertebrates.	Measure 1.5-3 inches long. Emerge in late spring or early summer. 300 survive out of 3,000 eggs
Smolt	Forest stream, mouth of river, lakes to estuary (the Puget Sound).	Predators (bears, foxes, birds). Pollution. Dams, turbines. Habitat destruction. Cutting down trees.	Tiny shrimps and insects.	Smolting. Stay in estuary (Puget Sound) for 3-4 weeks. Measure about 5 inches long. 50 survive out of 3,000 eggs
Adult	Pacific Ocean.	Orcas, sharks, seals, sea birds, and overfishing.	Small sea creatures, plankton.	Spend 2-5 years in the ocean. Stays 7 meters below surface of water. Use sense of smell to return to their natal stream. About 4 make it back to natal stream.
Spawner	Freshwater streams. Spawning ground.	Wild animal such as bears. Dams.	Stops eating. Lives on its stored fats.	Lay 3,000 eggs. Build the redd. They decompose and release nutrients into the forest soil and water. Turn bright red or green. Develop hooked noses

Life Cycle Chart

Draw or write the different habitats, threats, and diets of the salmon stage you studied. Then cut out the shape to create a complete salmon life cycle chart in your groups.



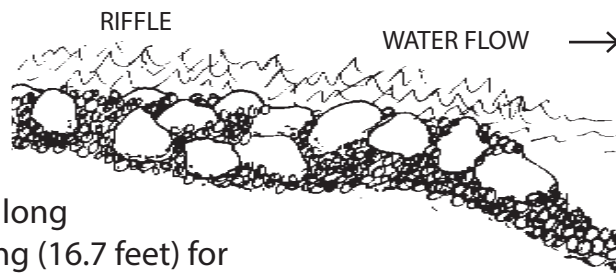
Life Cycle Chart



LIFE CYCLE OF A SALMON - BACKGROUND READING

STAGE 1: EGG

In the cold water of a shallow, freshwater stream in the forest, a female salmon lays about 3,000 eggs, each the size of a pea. These bright pink eggs are surrounded by a bed of gravel which protects them from predators and sunlight. Their gravel nest is called a redd and is located in a part of the stream called a riffle. A riffle is a shallow area in the stream that has quickly flowing water mixing with air, which provides oxygen to the eggs.



The nests can be between 1.8 meters long (5.9 feet) for Sockeye to 5.1 meters long (16.7 feet) for Chinook salmon. The female covers the eggs with 15-40 centimeters (.5 to 1.3 feet) of gravel after the eggs have been fertilized by the male salmon. The fertilized eggs are slightly sticky which keeps them fastened to the gravel around them so they don't float downstream.



After about 1 month, eyes begin to show in the egg. There is a yolk inside the thin transparent egg wall which provides a concentrated mixture of water, proteins, salts, and fats – food for the embryo moving around inside the egg. The eggs are very fragile now and can easily be smothered by soil covering them due to erosion from the stream bank. They can also be easily crushed by humans or animals walking on top of them.

The speed of the water flow is important too. It must be fast enough to provide oxygen to the fish. But if the flow is too fast, the eggs will break out of the redd and float downstream unprotected. The water must also remain cold enough to keep the eggs alive. Trees whose branches reach over the streams provide important shade to keep the stream cool and encourage other plant growth, attracting insects that will be needed later on. For many salmon species, these eggs are developing in the late fall. After 3-4 months, a special chemical breaks down the egg wall to allow the young fish to emerge or pop out.

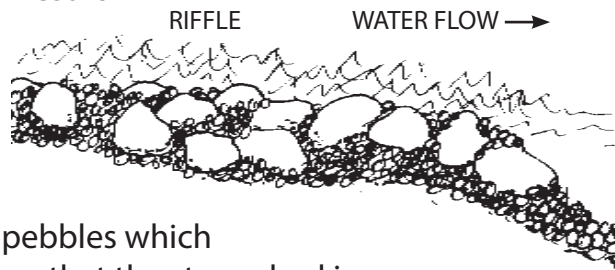
LIFE CYCLE OF A SALMON - BACKGROUND READING

STAGE 2: ALEVIN

The eggs typically hatch in late winter or spring, 3-4 month after being laid in the nest. The baby fish are now only about 4 centimeters long (1.5 inches) and have an orange yolk sac that hangs down from its belly. It has huge eyes and is called an alevin. This is still a very fragile stage of life for the salmon.

The alevin will remain in the gravel nest for 3-4 more months, feeding off of its yolk sac which will eventually disappear. It pulls oxygen out of the water with a vein that runs up through the center of the sac.

Alevin do best in gravel beds with pebbles which are similar in size. This usually means that the streambed is stable and allows oxygen from the air to percolate or filter through the water to encourage healthy growth of the alevin.



At this stage, the alevin need a good flow of pure water at a temperature between 5-10 degrees Celsius (41 – 50 F). They are still protected from predators, such as otters, at this point because they are inside their gravel nest called a redd. The redd is located in a part of the stream called a riffle. A riffle is shallow area in the stream that has quickly flowing water mixing with the air, which provides oxygen to the eggs.



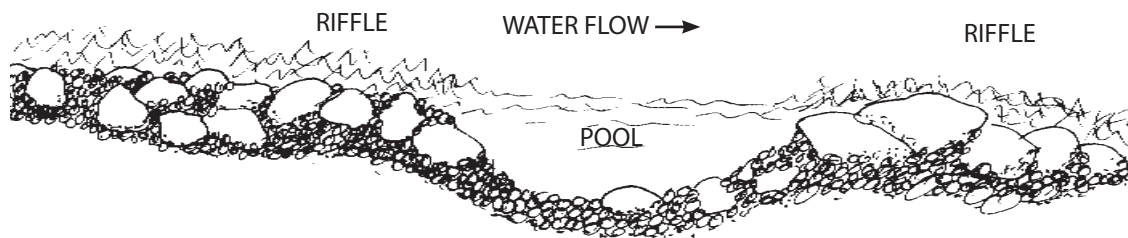
A major threat to the alevins is habitat destruction. Habitat destruction means that the place (habitat) the alevins live is damaged. In the Pacific Northwest the #1 cause of habitat destruction is cutting down trees along streams and rivers. Building dams on salmon bearing streams is another threat to all of the stages of salmon.

LIFE CYCLE OF A SALMON - BACKGROUND READING

STAGE 3: FRY

After the yolk sac has disappeared, the 4-8 centimeter fish (1.5 – 3 inches), now referred to as a fry, pokes its way out of the gravel in late spring or summer. They usually emerge at night to allow their eyes to become accustomed to light. Most of a fry's time is spent close to the hatching area in pools in a forested stream, waiting to catch macro-invertebrates (small bugs that are big enough to see without a magnifier).

Pools are deeper areas with quietly moving water which provide protection



from predators and currents. But it is the nearby shallow riffles which provide the habitat necessary for salmon food. Instead of using up calories chasing their food (bugs) the fry wait at the head of pools for the macro-invertebrates to drift downstream.

Good tree cover along the stream in the riparian zone, a steady flow of clean, cold water and plenty of food are important now.

The threats to fry are different than when they were eggs or alevins. Because they are swimming around without the protection of their gravelly nests, they are exposed to forest predators – large fish, birds and wild animals, such as raccoons. They do have markings along their sides to help them blend into their environment (camouflage) but this often proves unsuccessful.

A major threat to the fry is habitat destruction. Habitat destruction means that the place (habitat) the fry live is damaged. In the Pacific Northwest the #1 cause of habitat destruction is cutting down trees along streams and rivers. Building dams on salmon bearing streams is another threat to all of the stages of salmon.

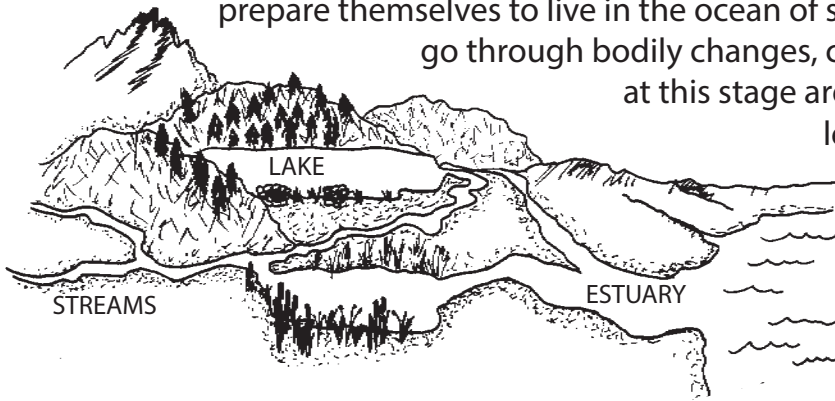
Polluted water is also harmful. Out of the 3,000 eggs laid (in each nest) only about 300 fry will make it to the next stage of a salmon's life.



LIFE CYCLE OF A SALMON - BACKGROUND READING

STAGE 4: SMOLT

Some species of salmon move very quickly downstream to head out to the ocean while others remain in freshwater streams or lakes for up to 3 years. To prepare themselves to live in the ocean of salt water, the salmon go through bodily changes, called smolting. The fish at this stage are called smolts. They



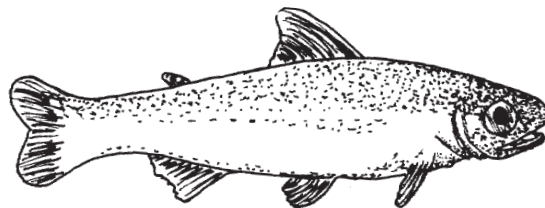
leave the forest habitat and find the mouth of a river which empties into the ocean. This area is called an estuary. An estuary has a mix of salt and fresh water. Smolts

may stay in an estuary up to 3-4 weeks getting ready to head out to sea.

The smolts are generally about 13 centimeters long (5 inches) now. They lose their side markings that hide them in the streams. Their coats are shiny and silvery. They swim in groups traveling to the sea. Smolts eat a mix of macro-invertebrates, smaller fish, and small crustaceans.

Many smolts will be eaten by hungry bears, wild foxes, or birds such as herons. Others will die in polluted waters. Dams built on rivers to produce hydroelectric power (energy generated by the movement of water) pose a huge danger to smolts as they head to the ocean. Smolts can get caught in the turbines (large engines) of the power plants or be pushed over the edge of the dam at high speeds which they cannot survive. Of the original 3,000 eggs laid in each nest, only about 50 smolts will survive.

A major threat to the smolt is habitat destruction. Habitat destruction means that the place (habitat) the smolt live is damaged. In the Pacific Northwest the #1 cause of habitat destruction is cutting down trees along estuaries, streams and rivers.



LIFE CYCLE OF A SALMON - BACKGROUND READING

STAGE 5: ADULT

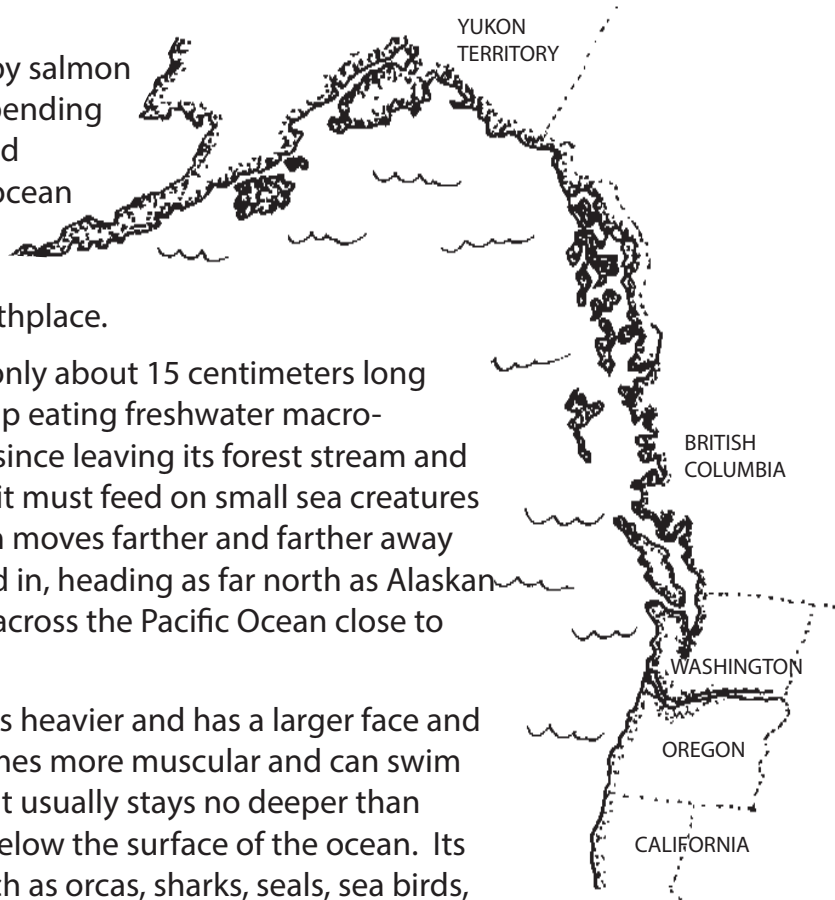
During this phase, the baby salmon will grow to an adult. Depending on the species, it will spend between 2-5 years in the ocean to get larger and stronger in preparation for its lengthy trip back to its birthplace.

The young salmon is still only about 15 centimeters long (6 inches) and must give up eating freshwater macro-invertebrates completely since leaving its forest stream and entering the ocean. Now it must feed on small sea creatures and plankton. The salmon moves farther and farther away from the stream it hatched in, heading as far north as Alaskan waters and at times even across the Pacific Ocean close to Russia and Japan!

The adult salmon becomes heavier and has a larger face and jaw than a smolt. It becomes more muscular and can swim much faster than before. It usually stays no deeper than about 7 meters (24 feet) below the surface of the ocean. Its enemies are predators such as orcas, sharks, seals, sea birds, and over-fishing.

Instinct tells the adult salmon when it is time to begin searching for the same river mouth it traveled down after it hatched from an egg. This usually happens in the early summer of their maturing year. Fish biologists think the salmon use their keen sense of smell to locate the mouth of the same river they left months, or years, before. The search will present many dangers and take a long time. Of the original 3,000 eggs from the same nest, only about 4 salmon will live to begin the long journey back to their spawning ground.

A major threat to the adult salmon is habitat destruction. Habitat destruction means that the place (habitat) the adult salmon live is damaged. In the oceans off the Pacific Northwest, pollution and warming ocean temperatures are the main causes of habitat destruction.



LIFE CYCLE OF A SALMON - BACKGROUND READING

STAGE 6: SPAWNER

As soon as the mature salmon reaches fresh water it stops eating and begins the difficult task of swimming against the current in search of its birthplace. It lives on its stored body fats. There are often many fish swimming together in search of the spot where they hatched out of their eggs. This is called a spawning ground and salmon at this stage are called spawners. Spawning salmon are typically seen in the streams in the fall.

The spawning salmon's body changes once again. Many species of salmon stop eating at this point and become bright red or green, as they enter freshwater streams. They also develop large, ferocious - looking hooked noses. The salmon travel upstream, jumping over logs and finding ways around human and beaver dams that may block their way. Some of these spawning salmon are captured and eaten by wild animals, such as bears. Only 2 salmon out of the original nest of 3,000 eggs will reach the place they were born, their spawning ground.

When the females reach their spawning ground they dig a 40 centimeter (1.3 foot) nest, called a redd. They prefer to lay their eggs in gravel (pebble-size rocks) or cobble which is about the size of your fist. This can be found in a part of the stream called a riffle where the water is shallow but dropping off into a quiet pool. The water runs swiftly in this area but because it is so close to a pool, the current is not too strong.

When the redd is ready the females will lay about 3,000 eggs (although some species may lay up to 10,000 eggs). A male fish will fertilize the eggs with a milky substance called "milt." Afterwards the female fish will use her tail to cover the fertilized eggs with 15-40 centimeters (.5 to 1.3 feet) of gravel or cobble to protect the eggs in the new redd.

Shortly after the nest has been covered, the male and female salmon die and their bodies drift downstream. Their bodies become food for scavenger animals and macro-invertebrates (which are later eaten by the young salmon). The decomposing salmon release nutrients into the forest soil and water.

