
Updated Feb. 25, 2009

Recommended for Grades:

K-3 (note specific adaptations for K-1 vs. 2-3, listed in the lesson)

Alaska Content Standards

Science C2, C3 (major concepts include habitats, adaptations, human impact on environment, predator/prey relationships)

Nutshell

Students will experience the life cycle of salmon, from life in the redd to navigating back upstream to find their home.

Concepts

- Salmon have a complex life cycle that carries them through several aquatic/marine environments.
- Salmon eggs & fry need a high quality habitat to survive.
- Salmon use their sense of smell to find the way to their home stream.

Objectives

Students will be able to:

- Describe the life cycle of an Alaskan salmon.
- Identify two characteristics of a healthy salmon spawning stream.
- Describe how salmon use their sense of smell to find their home spawning stream.

Materials

- Salmon Life Cycle poster (or white board to draw it, PowerPoint image, flash cards of life stages, or any other materials to illustrate egg-alevin-fry-smolt-ocean phase-spawning adult)
- 6-8 flat trays (cafeteria trays work great)
- Pieces of fabric to cover trays
- Red beads (to represent salmon eggs)
- Gravel
- Grass, sticks, twigs, any natural material that can be used to represent stream vegetation
- Trash, preferably collected on/near the school grounds (a large handful is plenty)
- Film canisters (about 40 for a class of 32 students)
- 10-12 varieties of spices (or other strong smelling substances that will retain their scent over time)
- Small fabric pouches to contain scents
- Several lengths of blue tape, fabric, rope, ribbon yarn or other material to represent streams
- Ocean scene felt board, plus felt ocean animals (especially prey & predators of salmon)

Background

The life cycle of Pacific salmon is fascinating, beginning with thousands of eggs laid in a small, clear stream (often only a few inches deep). The eggs lie buried in the gravel until they hatch into alevins with partial yolk sacs still attached. Once the alevins have absorbed their yolks, they are called fry. The fry emerge from the gravel bed and begin to feed on available prey, including many types of macroinvertebrates. Depending on the species, the fry may spend anywhere from a few hours to a few years in fresh water before swimming downstream to the ocean. The physiological transition from fresh to salt water may take several days, so the young salmon (now called smolt) spend that time in the estuary where they are able to adjust gradually to the marine environment. Once in the ocean, the “ocean phase” salmon feed on a variety of prey and grow rapidly. After 1-3 years in the ocean, the salmon return to their natal stream as spawning adults. Using their sense of smell (and possibly other navigational aids) they return to the same location where they were born and bury their own eggs in the gravel. After spawning, the adult salmon all die in the stream, thus delivering valuable nutrients from the ocean up into the terrestrial ecosystem. This complex life cycle takes Pacific salmon through a wide variety of ecosystems where the salmon directly impact the diets of over a hundred other species along the way.

In order for salmon to complete this life cycle, every habitat they encounter must be high quality. In particular, the stream where the eggs are laid must be clear and cool with adequate shelter to hide from predators, as well as clear passage from the spawning area to the ocean and back. Pollution and urban development greatly impact these stream qualities, so it’s important for Alaskans to keep a sharp eye on our small streams. This program takes a brief look at the salmon life cycle and the habitat qualities that salmon need to survive, grow & reproduce.

Lesson Outline

5 min.	Introduction/Salmon Eggs
10 min.	To Build a Redd
5 min.	Downstream Migration & Smoltification
5 min.	Life in the Ocean
10 min.	Returning Home
5 min.	Healthy Habitats & Stream Restoration

(Note: for grades 2-3 this lesson can be extended to 55 minutes by adding the clay salmon fry activity, which takes about 15 minutes to complete.)

The Lesson

Introduction

Introduce yourself and the rules for the class. Ask students how many of them like to eat fish, especially salmon. And what kind of salmon is your favorite? Who knows what the five types of Pacific salmon? That’s right – King (Chinook), Silver (Coho), Red

(Sockeye), Chum (Dog), and Pink (Humpy). And each type of salmon is a little bit different from the others. They look different, they taste different, and they use different habitats. Which ones get the biggest? (*the kings, because they live the longest*) Which are the smallest? (*the humpies*) Salmon are especially important to Alaska, not just because we like to eat them but because a lot of other animals (& plants too) rely on them for survival. So it's our job as good keepers of the environment to try & understand what salmon need in their habitat and help ensure that they stay happy & healthy.

It sounds like you all know a lot about salmon, so let's get started. Today we're going to become Alaskan salmon, and we're going to follow their life from start to finish. So where do salmon begin their life? In a freshwater stream, sometimes up in the mountains, other times right near the ocean. And how do they start life – are they born alive or hatched from eggs? (*they hatch from eggs*) <Show picture of egg/eyed egg>, and those eggs develop right down in the bed of the stream. Let's look more closely at that stream bed and learn what makes a healthy stream for salmon eggs.

To Build a Redd

So what would you find in the bottom of that stream? (*rocks, gravel, logs, sand/mud, plants, etc.*) That's right, and a very important thing for the salmon eggs is the gravel in the stream. It has to be the right size, and nice & clean for the salmon eggs to be healthy. The adult female salmon digs a nest, called a redd, in the gravel bed. Down in the gravel, the eggs are protected, and they still get lots of nice fresh water to keep them healthy. Today we're going to make a little redd for our own salmon eggs, and when we're all done with that we're going to hatch & develop just like salmon do. Break the class into groups of 3-4, depending on the size of the class and the resources you have available. *Remember that you will need one extra tray to represent the polluted stream in the end, and each tray will need its own scent as well. So for every tray that is used, you need one scent to stay with the tray and one scent for each student in the group.*

First we need to create some nice, healthy streams to build our redds. <Distribute a prepped tray (with a small pile of gravel in it) to each group.> *Make the other materials available, including sticks to represent woody debris and grass/leaves to represent streamside vegetation. Allow them to be creative, but remind them that they need to have a nice protected bed of gravel for the eggs to develop as well as areas for the young salmon to hide after they hatch. You can talk with them about the importance of the vegetation and woody debris as they work.*

<Once each group has built a redd, give them a handful of eggs to put into the gravel.> As these eggs develop in the stream, the water in the stream nourishes them. So even before it hatches from its egg, a salmon's home stream is a critical part of its early life. How many of you grew up right here in _____ (local town/state where the students are). Those of you who did not grow up here, what do you remember about where you grew up? Special foods you ate? Special places you liked to see? Special friends you had there? Those are all part of your home, and I bet if I blindfolded you & took you home that you could tell me when you were home. How would you know you were home if

you couldn't see? (*sounds, smells, etc.*) How many of you think you could recognize the smell of your home? Maybe a certain night of the week when your family cooks pizza? I bet it smells pretty good. Well these little salmon get to know the smell of their home stream very well, and we're going to see if you can do the same thing. I'm going to hand each group a set of stream scents, and each one of you will get to learn the smell of your stream. One of the containers will stay with the stream itself, so leave that one on your tray somewhere. *<Distribute a set of scent containers to each group (one per student, plus 1 more for the tray), making sure that the group keeps its scents together.>* Now, without taking anything out of the container, open it and see how it smells. Do you think you'll be able to recognize your home stream based on this scent? Scientists have found that salmon use their sense of smell to find their way home, so let's see if we can do it too.

Downstream Migration & Smoltification

Just after salmon hatch from their eggs, what are they called? *<Show picture of alevin>* Alevins, that's right – little baby salmon that still have a little egg yolk attached to their belly. It's like a portable meal, always giving them food when they need it. So the alevins don't need to eat quite yet. But once their yolk sac is used up, those little salmon need to start eating. Who knows what the baby salmon are called now, after they've used up their yolk sacs? They're called fry, and older fry are sometimes called parr because of the dark spots on their sides (called parr marks). *<Show picture of fry with parr marks>* Why do you think they have those markings on their sides? It's for camouflage, to protect them from predators while they're living in the lakes & streams.

The salmon fry may spend up to two years or more in fresh water, or they may swim straight downstream, depending on the species of salmon they are. And where are those fry headed when they swim downstream? (*the ocean*) That's right, and before they reach the ocean they have to make a change. They become smolts, and they have to adjust to the water in the ocean. Is that water going to be fresh or salty? (*salty*) Is salt water good to drink? No, not for us, and it's not necessarily good for fish either, so they have to wait until their bodies can adjust to that salt. This takes a little time, so the smolts wait in the estuary (the place where a river meets & mixes with the ocean) until they're ready to move on.

<Once students have left their redds, have an adult volunteer (teacher if possible) rearrange the location of each tray. Also create a polluted stream with the last remaining tray and the trash collected from the school grounds (you can prep this ahead of time so your volunteer just has to lay it out). Cover each tray completely with a piece of fabric, then lay out strips of blue ribbon or fabric to represent rivers leading to the ocean (where students are now). Keep track of the scent container associated with each tray, and place the scent for each tray on the floor at the "mouth" of the appropriate river. Leave enough space between the rivers so students can group together and try each scent as they're preparing to head back upstream. All of this should happen while the instructor is leading the class through the "Life in the Ocean" portion of the lesson.>

Life in the Ocean

This portion of the program will use a felt board with an ocean scene on it, plus felt animals representing some of the predators & prey that salmon encounter in the ocean. So why do salmon swim to the ocean? What's there? (lots of food) Aren't there a lot of predators in the ocean too? There sure are, but there is so much food & so much space that it's a great place to eat a lot & grow a lot. The small streams where the salmon hatched just can't support nearly as much food as the ocean, so salmon swim there to eat for 1-3 years so they can grow. What types of food do they eat in the ocean? (smaller fish, krill, plankton) And what other animals might be out there? Anything that might like to eat salmon? <add prey/predator felt animals to felt board during this brief discussion> So that's the life of a salmon out in the ocean, eat & try not to be eaten. <make sure your volunteer has finished the rearranging and stream layout> Now it's time for our salmon to find their way back home. How will you know which stream is yours? (scent) That's right, so school together with your group and see if you can locate your home stream. Once you find the stream that you think is your own, go ahead and swim upstream and sit next to the tray but do not uncover it – we'll all do that at once after all the salmon have found their way home. <Encourage students to sample all of the streams if possible, to make sure they have the right one. Try to keep them in schools by holding a scent from the river in your own hand while each student in the group smells it. Watch for groups that may have chosen the wrong stream, as that will confuse other groups who might be looking for that scent.>

Once all of the groups have found their stream and sat down next to the trays, have them uncover the tray to see if it was the right one. *Hopefully they were all correct. There should be one leftover tray – the polluted stream. Once the excitement dies down from the students finding their home streams, get everyone's attention to look at the unused tray (still covered at this point). Why would one stream not have any salmon in it? There could be lots of reasons, dams, high waterfalls, pollution, drought, no historic salmon run, etc. <Now uncover the polluted tray> Would you like to put your eggs in this stream? No, with this pollution a stream is not healthy for the developing eggs or the fry. Explain to students where you found the trash (near the school somewhere) and ask them where that trash would go if no one picked it up (to the stream, then to the ocean). Ask for some student volunteers to do a stream restoration project on your polluted tray, then after it is cleaned up ask if it looks like a nice place for salmon to lay their eggs. Then ask students what they will do if they see trash lying around the school grounds or their homes. Hopefully they'll be encouraged to pick it up, and encourage other people to do the same. Great job! This helps not only the salmon but all the animals that live in the stream, plus the animals in the ocean because all streams eventually flow to the ocean.*

Research Ties

The ASLC/Marical research project has studied the process of smoltification. You can discuss this time of a salmon's life and talk about how difficult it must be to change from

salt water to fresh water. Ask students if they think they could survive without fresh water, and have them think about how salmon do it.

Other Optional Activities

Clay salmon fry (recommended for grades 2-3) – these should take at least 15 minutes to do. It's a great way to reinforce parr marks & freshwater habitat needs & adaptations.

Follow-up writing activity – Discuss the fact that Pacific salmon are terminal spawners, so they have no way to care for their young after they hatch. That's one of the big reasons why salmon need such a high quality environment! As an alternative exercise, have students imagine that they are new salmon “parents” with the opportunity to write a letter to their unhatched fry to let them know how they feel about them, what they'll need to survive, etc. Have students think about what might be the most important “life lessons” the young fry will need after they hatch & head to the sea, and relate those ideas to the lesson as much as possible.

Wrap up and Conclusion

Ask students a few questions to see if they learned anything during the lesson.

Resources

Alaska Dept. of Fish and Game, Commercial Fisheries: Salmon Species Descriptions
<http://www.cf.adfg.state.ak.us/geninfo/finfish/salmon/salmspecies.php>

This site has information on the different kinds of salmon as well as links to additional resources. Each species description leads to the Alaska Department of Fish and Game Wildlife Notebook Series page.

Alaska Dept. of Fish and Game: Wildlife Notebook Series
<http://www.adfg.state.ak.us/pubs/notebook/notehome.php>

This is the homepage to the Alaska Department of Fish and Game Wildlife Notebook Series. Listed on this page are the different animals that can be found in Alaska. Each animal has a link to an informational page about that animal.

Salmonids: In Troubled Waters
<http://library.thinkquest.org/05aug/00548/Intro--All%20Games.html>

This site has a variety of games that are designed to help students familiarize themselves with salmon and their habitat.

Alaska's Wild Salmon: Teacher's Guide
<http://www.sf.adfg.state.ak.us/statewide/AquaticEd/adfgteacherguide/home.html>

This site is a teacher's guide to teaching about salmon. It is sponsored by the Alaska Department of Fish and Game and is set up just like a book with resources, concepts and objectives, and chapters.