Science Unit: ***The Journey of the Pacific Salmon***

Lesson 10: ***Salmon Migration: Changing Appearances***

School Year:	2010/2011
Developed for:	Thunderbird Elementary School, Vancouver School District
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Grade level:	Presented to grade 5/6; appropriate for grades 3 – 7 with age appropriate modifications
Duration of lesson:	2 hours
Notes:	Pacific Salmon Posters can be obtained from Fisheries and Ocean's Canada. Many posters can be obtained free of charge from either your local Community Advisor or Education Coordinator for Salmonids in the Classroom. See contact information here: http://www.pac.dfo-mpo.gc.ca/education/index-eng.htm. Economically priced handheld spring scales can be purchased from Fisher Scientific.

Objectives

1. Observe the changes in salmon anatomy that occur with maturation in preparation for spawning.
2. Contrast the changes in anatomy with the anatomy observed in lesson 7 in this science unit.
3. Conduct an experiment to determine how physical changes (size, shape, weight) can affect a fish's ability to swim. As part of this activity students will gain experience conducting and designing an experiment.

Background Information

Salmon undergo a variety of physical and physiological changes in preparation for spawning. One of the most obvious changes is the dramatic change in physical appearance seen in some species. Many species, such as sockeye salmon, change color while others exhibit dramatic changes in shape. For example, a pink salmon getting ready to spawn develops a prominent humped back and many species develop a hooked jaw also known as a kype.

Vocabulary

Spawn:	When salmon release eggs and milt and the fertilized eggs are deposited in a redd.
Natal stream:	The stream where a salmon was born and where it returns to spawn.
Redd:	A small depression or nest in the gravel created by a female salmon to incubate her eggs.
Milt:	The milky fluid released by a spawning male salmon that contains sperm cells.
Gonads:	The reproductive organs of the fish, either the egg sac or testes (the testes may also be referred to as the milt sac).
Kype:	Hooked jaw seen in many species of salmon when they are ready to spawn.

Materials

- modeling clay
- hooks or paper clips
- fishing line
- 5 gallon bucket (1 per group)
- spring scales (1 per group)
- preserved fish hearts (optional)
- worksheets and pencils
- posters comparing the regular adult and spawning adult forms of Pacific salmon
- Salmon Life Cycle Poster

In the Classroom

Introductory Discussion

1. Let's look at our Life Cycle Poster. Last lesson we learned about some of the hazards migrating adult salmon face on the way to their spawning ground. Who can remember that far back? Today we are going to learn some more about spawning.
2. How does a mature salmon, returning to spawn (a spawning salmon) differ from a mature ocean living salmon? Looking at the anatomy drawing you made during your field trip to the Capilano River Hatchery, and the salmon posters what differences do you see in the spawning salmon? (brainstorm on board)
    - External anatomy
        - Changes in color
        - Changes in shape – hump, hooked jaw (kype), teeth, fish are older and thus bigger
        - Males and females look different

- Let's talk about the changes in color. Which salmon do you think is going to be easier for predators to see in the water? (Can add a blue tinted transparency over the poster) If being red is dangerous why do you think some salmon change color when they mature?
    - Males and females look different
    - Species recognition
    - Competition for mates
- What other species "dress up" to help them secure a mate? (Peacocks, lions, people etc.)
- Let's talk about the changes in shape. How would you describe the shape of a non-spawning salmon? (torpedo) Draw on board. Thinking about where and how the salmon lives, why do you think it is shaped that way? Do you think a salmon shaped like this would be as successful? (draw a more blocky salmon). Why not? Let's think of the shape of some other objects – boat, plane, torpedo, swimmer etc.
- How would you describe the differences in the shape of a spawning salmon compared to an ocean-living salmon? Have outlines available on worksheet or to draw. (fatter, hump, wider)
- How do you think shape is going to affect the salmon's ability to swim? Will being bigger and fatter make it easier or harder to move through the water?
- Let's find out!

3. Briefly describe science experiment/activity.

- Students will conduct an experiment to determine how changes in body morphometrics (size, shape, weight) affect the force required to move through the water.
- Each student will create their own fish to test from modeling clay.

4. For this activity students will focus on all of the processes of science involved in conducting an experiment. They will formulate hypotheses, make observations, record their observations and results and discuss experimental conclusions as a class. Students will also gain practice designing their own experiment by selecting their own test variables for the second part of the activity.
5. Briefly describe safety guidelines.
   - Wash your hands and wipe your desk when you are finished handling the modeling clay.
   - Treat the scales with respect; they are delicate scientific instruments. Do not yank hard on the spring mechanism and do not drop them into the buckets of water.

Science Experiment

Experiment Title: How does shape affect the ability to move through water?

Purpose of Experiment: To determine how changes in body morpometrics affect a fish's ability to move through the water.

Experimental Treatments: Students will begin by comparing how shape affects the force required to move their clay "fish" through the water. The two shapes that will be tested initially are streamlined (torpedo) and blob-like (short and fat). For the second part of the experiment students will be asked to design their own comparison.

Prediction or Hypothesis: Before starting the experiment students will record their hypothesis on their worksheet. The hypothesis will take on the following format: I predict that the _____ shape will be easier to move through the water.
Methods and Instructions:
Set-up prior to experiment: Fill a 5 gallon bucket with water for each group – if groups are small two groups can share a bucket. For younger students pieces of fishing line can be pre-tied to the hooks or bent paperclips. Older students can do this step themselves.

Brief description of how students will work in groups or pairs: Students will work in small groups 3-5 but each student will test their own clay fish. For the second part of the activity students will design an experimental comparison as a group but each have a turn performing the tests.

1. Today we are going to do an experiment to compare how easily different shapes of "fish" can move through the water.
2. Each scientist is going to make their own fish to test but each group is going to share one "stream" (hold up container for water).
3. We are going to compare how easy it is to move different shapes of "fish" through the water. All of your observations will be recorded on your science worksheets.
4. So the first thing we need to do is decide what shapes of fish we are going to test. We are going to start with a torpedo shape which is how you described a typical fish's shape. (Draw on board – have students draw and label on worksheet). Draw and label this shape on your worksheet.
5. Our first fish might look something like this (make fish from clay).
6. We are going to make our fish out of modeling clay. We will use the same piece of modeling clay to make each fish. Why do you think we need to make sure we use the same size piece of clay for each

fish? What if we used this piece (small) for one fish and compared it to a fish made from this piece? (heavier piece might be harder to move, affects results).

7. Now let's imagine we have a really fat fish……squish the clay into a short, fat disk. This is an exaggeration of what a fat fish would look like but we want to start out by testing the most extreme difference – why? (easier to see differences).
8. We are going to compare torpedo shaped fish and short, fat fish first. Let's record our hypothesis.
9. Pass out modeling clay.
10. First roll your clay into a torpedo shape. Stick a hook into the front of the fish to help you move it through the water.
11. We will move the fish through the water like this. What if I move one like this (fast) and one like this (slow). Is that a good comparison? Why not?
12. Our second fish will be short and fat, like this (large flat blob).
13. Compare the ease with which the torpedo-shaped and fat "fish" move through the water. Which fish seemed to move easier? Have students repeat the experiment with the scale and record their results.

Part 2 – Group activity

14. Have each group decide upon an additional comparison to test. They can test fish as a group (this will allow them to combine clay and test larger fish if desired) but each student should run one replicate of the test.
15. Have the students clean up and return to their seats.

Closure Discussion

1. Discuss and compare the force measurements made by the students.
2. Do you think spawning salmon find it easier or harder to swim through the water compared with regular adult salmon? What consequences might this have?
    a. Harder to escape predators
    b. Requires more energy to swim
3. Compare the ease with which large and small fish move through the water (this is usually the most popular comparison). Which fish moved easier?
4. Do you think bigger fish find it easier or harder to swim through the water? What advantage might bigger spawning salmon have versus smaller ones? (Out compete smaller rivals for mates or nesting sites).
5. Ask additional questions to spark discussion of the other comparisons that students tested.

Extension of Lesson Plan

Changes in internal anatomy with spawning.

1. What changes do you think are occurring to the internal anatomy of the salmon?
2. Hold up two preserved salmon hearts. In Lesson 1 we dissected a salmon and learned about salmon anatomy. Does anyone recognize this organ? (If no answers give a hint). Can everyone see how one of these hearts is much bigger than the other one? What if I told you that these hearts came from fish that were exactly the same size…?

3. Why would one be so much bigger than the other?
4. Discuss how migrating salmon need to work harder to swim against the current and how athletes have bigger hearts – oxygen/blood delivery implications etc.
5. What other organs increase in size in spawning salmon? (gonads) what consequences will this have on a fish's ability to swim?
6. What other changes occur with spawning?
    - Fish no longer feed
    - Lots of mucus covering – increases susceptibility to disease, fungi and parasites
    - Scales are reabsorbed
    - Fish are moving from seawater to freshwater and thus changes in osmoregulation need to occur (the opposite of what was discussed in Lesson 9).

Lesson 10: Changing Appearances

Name:_____

Date:_____

HOW DOES SHAPE AFFECT THE ABILITY TO MOVE THROUGH WATER?

Materials & Methods

List the materials used for this experiment:

_____

_____

Draw and label a picture of each of the fish shapes you will test.

Describe the process you will use to conduct your tests:

_____

_____

_____

The two shapes that I will compare first are _____ and _____.

Hypothesis: I predict that the _____ shape will be easier to move through the water.

Describe how each fish moved the water. Which shape was easiest to move?

_____

_____

_____

Repeat your experiment using the scale and record your observations.

Shape (record each shape)	Force required to move it (N)
1.	
2.	

Do you think that spawning salmon (especially pink salmon) find it harder to swim to their spawning grounds when compared with non-spawning adults? List two consequences this might this have.

_____

_____

_____

Design your own shape comparison experiment (Group experiment)

The shapes that we will compare are _____ and _____.

Hypothesis: _____

Record your group's observations.

Shape (record each shape)	Force required to move it (N)
1.	
2.	

Discuss your results with the class.