So You Want to Be a Salmon?

GOAL

To role play the life-cycle of local salmon and steelhead in order to understand the difficulties that they encounter during their migrations.

To become aware of how Portland's drinking water system and our personal use of that water impact these fish.

SUBJECT AREAS

Biology, Ecology, Mathematics

TIME

Game set up - 15 minutes
Game duration - 20 minutes
Results Analysis - 15 minutes

Note: Time for preparing your students will vary depending on the detail covered.

SKILLS

Role-play, Analyze, Evaluate

CIM CORRELATION

Science

Common Curriculum Goal: Describe how daily choices of individuals, taken together, affect global resource cycles, ecosystems and natural resource supplies.

Common Curriculum Goal: Use analysis and interpretation to formulate explanations and draw reasonable conclusions based on the results of an investigation.

Common Curriculum Goal: Understand the characteristics, structure and functions of organisms.

MATERIALS ✓

- Large playing area
- 3 stream cards (sample cards included, you may want to enlarge for actual use)
- 8 traffic cones (or masking tape if indoors)
- Jump rope
- 3 different spices (suggestions: cinnamon, garlic powder, clove)
- 3 cups (of same type and color) for spices
- 3 thin napkins to cover spice cups
- 3 rubberbands to hold napkins
- 18 blue poker chips
- 40-50 ocean cards (copy sheet included)
- 2 cardboard boxes (large enough for a student to put one or both feet in)
- Bull Run watershed brochure/map
- Bull Run watershed system map

Kit available for checkout.
Contact the Portland Water Bureau.

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RATIONALE

Even if students know where their drinking water comes from, they may not understand the impact that our drinking water use has on local fish populations. By learning about the complex life-cycle of salmon and steelhead and role playing their migration, students will gain a better understanding of the many difficulties faced by these fish and the role that we each play in helping or hindering their survival. Providing details about Portland's water system and its seasonal supply and demand challenge will allow students to determine specific ways that they can work to improve fish habitat in the lower Bull Run River, especially for those fish listed under the Endangered Species Act.

PREPARATION

1. Introduce students to the local water system: show Conserving Portland's Water Supply video or call the Water Bureau to see if other presentations are available. Make sure that students understand the concepts in the text box below:

   - Most of the drinking water in the Portland metro area comes from the Bull Run watershed and the Columbia South Shore Wellfield. (Some students may live in other water provider districts and get water from another source or combination of sources.)
   - Bull Run drinking water is stored in two large reservoirs formed by dams on the Bull Run River.
   - These dams on the Bull Run River do not have fish passage.
   - There are 6 miles of river below the dams that are still accessible to anadromous fish. These 6 miles are referred to as the "Lower Bull Run River".
   - Flow in the Bull Run River is low during the dry summer/fall months when the area receives little to no precipitation.
   - During these dry summer/fall months, all Bull Run water users rely on Bull Run reservoir storage for their drinking water supply. This has limited stream flow in the lower Bull Run River during the dry season.
   - Low flow can mean higher temperatures and less dissolved oxygen, which can be bad for fish.
   - To help provide more suitable conditions for fish, the Portland Water Bureau has been releasing reservoir water into the lower Bull Run River during critical dry periods.
   - These releases are possible because of additional water supply made available because of community water conservation practices, and sometimes from Portland's groundwater system.

2. Discuss which local fish species students are familiar with. Do any of these local fish migrate? Which ones? In this activity, students will learn about some of the characteristics of Pacific salmon and steelhead. These fish species are anadromous, meaning that they start their life cycle in fresh water, migrate to the ocean and return to fresh water to spawn. Use the life cycle diagram (choose diagram to use) included to review the life cycle of Pacific salmon and steelhead and survival rates.

GAME OVERVIEW

In this activity, students play various roles of the salmon life cycle. Starting as fry in one of three streams of origin, they move downstream, through dam turbines and into the ocean. They must spend four "years" in the ocean dodging predators and other hazards. If they survive their ocean time, they head back upstream, up a fish ladder at the dam and back to their stream of origin. How do they know which stream they started out in? Just like the salmon do . . . by smell, of course!

PHYSICAL GAME SET-UP

Set up the playing field as shown on the attached diagram. This can be done indoors or outdoors, but remember that this is a physically active game! Allow enough room to make it a safe activity. Introductory discussions from the "Preparation" section can be held in the classroom prior to the activity or out on the playing field. It can be helpful to have the students sitting on the playing field while discussing the anadromous fish life cycle so you can use the playing field as a visual reference.

PLAYING THE GAME

1. Who's who? Assign roles to each of the students. Most of the students will be salmon, but a few will act as potential hazards to the salmon. If you have adult helpers, assign them the hazard roles first and then use students if necessary. Give out nametags or signs to hang around their necks for the following hazard roles:

   - 2 turbine operators. They will swing the jump rope which represents the turbines in hydroelectric dams. Later in the simulation, when all the salmon have passed through the turbine, these individuals can facilitate the fish ladder as the salmon return to their breeding grounds.

   - 2-3 predators. One can "hunt" in the river below the turbine before salmon get out to the ocean, the other two will be out in the ocean. You can let the students decide what predators they would like to be but make sure they are appropriate for the location. The mobility of predators should be determined by the available space. It should be difficult but not impossible for salmon to get past predators. The lower river predator might kneel in place if space is tight, or stand in place or pivot on one foot. Similarly, the ocean predator(s) can put one foot in a box to limit mobility, be able to pivot on one foot only, or be completely stationary.

     Salmon Snippet:
     River predators could include eagles, osprey, bear, fisherpeople, etc; while ocean predators could include commercial fishing boats, sea otters, seals, sharks, eagles, terns, etc. You could also adapt the game to include such hazards as pollution or sedimentation which also "predate" on salmon.

   - All remaining students are salmon (until they are killed by predators or other hazards and become part of the fish ladder).

Note: The number of predators and the associated "rules" for predators can be changed depending on what seems most appropriate for the size of the group and the size of the space in which you play the game. The numbers above are based on a class size of 25-30.

2. "Welcome Salmon! You have just been born to the Bull Run River!" Begin with all the salmon lined up at the three rivers. Their "river" will have a stream 1, 2 or 3 sign next to each of the spice cups. Start with close to equal numbers of students in each river. They will take turns smelling their "river" (spice cup) to pick up the scent of their river (without talking or consulting about what they are smelling!). Note which stream matches each scent on a separate piece of paper shielded from the students. Make sure the cups are set up so that the students don't know what spices were placed in which cups. They will need to remember the scent to find their way back to their spawning ground. Once they have picked up the scent, they head downstream.

3. Dam Trouble The first hazard the student-salmon encounters downstream will be the turbine at the dam. Students must go through the turbine without going around the rope swingers. If at any time the student gets touched by the rope, that salmon dies. All dead salmon must step to the side of the playing field and wait until all students have passed through the turbine.

4. Salmon Recycling Any salmon that dies at any point throughout the game will become part of the fish ladder. The fish ladder is what the salmon use to get past the dam on their way upstream. When all students have passed through the turbine, have one or both of the rope swingers set the rope aside and start organizing the fish ladder where the turbine was. To form the fish ladder, students stand arms length apart with their hands on the shoulders of the person in front of them. Keep the fish ladder "busy" with fish/water trivia or a line to chant or sing while they wait.

5. Upstream Prep While the fish ladder is being formed, switch the spice cups around so they are no longer in the same place, thus requiring students to use only the scent to find their river. Spread the blue oxygen chips on the ground just upstream of the stream cards and spice cups.

6. Predator vs. Prey While #4 and #5 are happening, the live salmon are continuing downstream toward the ocean. They must avoid getting tagged by the predator(s) waiting below the turbines. The predator(s) must catch the salmon with both hands and escort them to the fish ladder. Tagging is not enough.

7. Ocean Survival Once salmon reach the open ocean, the salmon can be caught by fishing boats or other predators. Salmon are "caught" when they are tagged by one or more hands. Salmon must "swim" across the ocean from one side to the other. They will pick up one ocean card each time they cross the ocean to represent one year of survival (make sure they only pick up one card at each crossing). They then cross the ocean again to get their second card, then third, and finally fourth. So they will cross the entire ocean 4 times, to get four cards, representing four years survival in the ocean.

8. Climbing the Ladder With their 4 ocean cards, the salmon begin their journey back upstream. Salmon must weave their way in between each of the students in the fish ladder.

Salmon Snippet:
In this game, climbing the fish ladder is tedious and tiring but not dangerous, so there are no predators at the fish ladder. In real fish ladders some predators (eagles, osprey, bears, etc.) may have access to the fish, depending upon the design of the fish ladder. Some predators hunt at fish ladders to take advantage of the fact that salmon can be tired and/or confused at fish ladders. Adding predators here could be part of a new scenario you could choose to create if you play the game several times.

9. Homeward Bound Once they successfully complete the fish ladder, each salmon should identify the scent that they "recorded" from the beginning of the game. This is their home stream.

> Salmon Snippet:
> When they are ready to spawn, most salmon return to the stream where they were born. They use their sense of "smell" or "taste" to find their way to this very stream. Salmon can "smell" or "taste" 1,000 times better than a bear, which can smell/taste 1,000 times better than a dog, which can smell/taste 1,000 times better than we can!

10. Out of Oxygen? At this point each student needs to pick up 4 blue oxygen chips to survive. There may not be enough oxygen chips for all student-salmon.

> Salmon Snippet:
> The blue chips represent the amount of dissolved oxygen in the water. A high level of dissolved oxygen is necessary for salmon to survive. Salmon eggs require an even higher dissolved oxygen level than adults. The dissolved oxygen available to fish becomes limited as water becomes more shallow and the water temperature rises.

11. Home Sweet Home Once all the living salmon have made it back to their streams, they should wait at their stream with or without the 4 oxygen chips.

WRAP-UP: WHAT ABOUT THE FISH?

- Death Toll - While live salmon are waiting at their streams, gather the rest of the students (dead salmon) together near the streams so you can review the results. Begin by asking how students felt about the activity. Did they think it was realistic? Why or why not? Did they think it was fair? Total the following categories:
  - How many salmon were killed at the turbine?
  - By the predator below the turbine?
  - By predators/fisherpeople in the ocean?
  - Others?

- Salmon Live to Spawn! Next, discuss the survivors. How many surviving salmon total? How many in Stream 1? Stream 2? Stream 3? At each stream ask, "Can these salmon successfully spawn?" If there is not a male and a female salmon, then there will be no successful spawning.

- Or do they Spawn to Live? Each female salmon or steelhead can lay 1,000-7,000 eggs. Of all these eggs, it is not unusual for only 2-4 individuals to survive all the way to spawning. With this in mind, 0-3 survivors for a group of 30 are fairly high survival results. Have students brainstorm about some of the many obstacles that salmon are faced with that were not included in this game. Discuss how the survival results would be changed if all of these obstacles were included.

WRAP-UP: WHAT CAN YOU DO?

Ask students how many salmon got their 4 ocean cards and made it all the way up the river but found there was not enough oxygen in the river? Review the reasons for the reduced oxygen level in the Lower Bull Run River. (Water Is reserved for public drinking water supply, not released downstream for fish.) Ask students how we can personally help to make sure there is more oxygen in the Lower Bull Run River for fish?

If people use less water in the dry summer/fall months, this leaves more water in the Bull Run reservoirs. If there is more water in the Bull Run reservoirs, the Water Bureau has more water that they can release downstream for fish. The Water Bureau is now committed to releasing water for fish, but the amount of water that fish get depends on how much demand there is on the water supply. The more water people conserve, the more water the Water Bureau can release for fish.

More water means colder water, which means more dissolved oxygen, which means healthier fish.

What are some specific examples of ways that you can help to conserve water so that we can all work together to share the water with the fish? Discuss specific water conservation techniques.

RESOURCES

Portland Water Bureau Web Site,
www.water.ci.portland.or.us

Water Bureau Video: Conserving Portland's Water Supply (free)

EXTENSION IDEAS

- Replay the game to test theories you have developed from playing the first time. Watch for trends and patterns that emerge and note differences. Try changing one condition at a time, removing an obstacle, adding an obstacle, etc., to see how it impacts the results. Graph these results to demonstrate visually changes and to compare one scenario to another.

- Play other physical or board game versions of the salmon life cycle game. Or have your students build their own salmon life-cycle game.

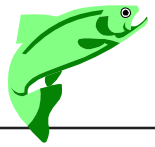
- Encourage students to research the specific life histories of the different salmon and steelhead species in the region. Have them write or visually represent what they have learned and present the information so that they can learn what the species have in common and how each species is different from the other.

- Do the Home Water Audit activity in this guide. This activity can help students track their water use and identify new ways to conserve water.

- Arrange for your class to go on a tour of the Bull Run watershed with Portland Water Bureau staff to learn more about your drinking water system, (503) 823-7407.

- Visit the Bonneville Dam to see salmon/steelhead on their migration. See a real fish ladder and how it works.

- Have students research the difference between wild and hatchery salmon/steelhead. Visit a fish hatchery to see how they are managed.



*Adapted from Aquatic Project Wild: Aquatic Education Activity Guide, Hooks and Ladders, 1987, Western Regional Environmental Education Council.