Oh Salmon

Subject
- Biological Evolution: Unity and Diversity
- Earth and Human Activity
- Grade Focus: 3rd/4th Grade

Objectives
Humans directly impact salmon habitat and rearing success. Different models of restoration have been undertaken as a way to combat previous impacts to local streams. Students will gain understanding of how historical uses of Whatcom Creek have impacted salmon and will brainstorm potential impacts of climate change and human activities on streams and salmon of the future.

Materials
- Portable white board or sheet of paper for recording numbers
- Graph paper for groups
- 2 lengths of rope for both team sides
- Print out of the history of Whatcom Creek (or the creek you're focusing on)

Size/Setting/Duration
- At least 12 participants and one narrator
- Open Field
- 30 minutes - 1 hour

Background
Salmon are **anadromous** species that live and grow in salt water, then return to ancestral freshwater spawning grounds when mature. Salmon travel immense distances on the life's migration to the sea and back. The king or chinook salmon of Idaho swim west to the central Aleutian Islands where they mature. They then travel 2,500 miles (4,023.4 kilometers) back to spawn in the headwater of the Snake and Columbia Rivers. Pacific salmon, such as the king, chum, and red or sockeye salmon, die once they spawn. Some Atlantic salmon survive to spawn again. There are even some landlocked salmon that live their entire lives in freshwater.

No one knows for sure how the salmon navigate to make their epic migrations. They may follow the sun, moon or stars. Some hypothesize that they orient according to salinity, temperature, the unique odor and chemistry of water in their home streams or from some primal memory of how to reach these ancient sites of their origins. One theory surmises that enough salmon survive to assure that enough reach home to spawn just through random migration toward that general coastal area.

Once in their home river systems salmon demonstrate an intense desire to move upstream - leaping up to 10 feet (3 meters) high over waterfalls and rapids. **Spawning** salmon do not eat along their journey.

An average sized (22 pounds or 10 kilograms) king or chinook salmon lays around eight thousand eggs. The salmon eggs are laid and fertilized in the water. Seasonal temperatures are an important factor in initiating spawning and in the successful development of the eggs. Salmon deposit eggs into gravel of a particular size that does not crush the delicate eggs, but hides them from predators. Without adequate gravel and healthy streams, egg spawning has a much lower rate of success.

Alevin is the life stage of a salmonid between egg and fry. An alevin looks like a fish with a huge pot belly, which is the remaining egg sac. Alevins remain protected in the gravel riverbed, obtaining nutrition from the egg sac until they are large enough to fend for themselves in the stream. A **fry** is a juvenile salmonid that has absorbed its egg sac and is rearing in the stream. From this stage, the fry then grows into a **parr**, also known as a fingerling and then a **smolt**, a juvenile salmonid which has reared in-stream and is preparing to enter the ocean. This is the stage of development when some salmonid species start heading downstream to find refuge in the **estuary,** a transition zone between fresh and saltwater. This transition zone provides protection and food in the form of unique vegetation. Once they have grown to maturity, smolts enter the ocean and exchange the spotted camouflage of the stream for the chrome coloring of the ocean (State of Washington Salmon Facts by Washington Department of Fish and Wildlife).

Salmon and other fish face many threats to their well-being besides extreme hunting pressures. **Dams** present obstacles that block migration upstream. **Water pollution** stresses and weakens the health of migrating fish and masks the natural odors by which salmon recognize their home streams on the return spawning runs. Severe water pollution along a stretch of river can create zones that are so deadly to fish that they cannot be traversed, and so act as barriers to migration. Polluted water can adversely affect the development of fish eggs and young. **Acid rain** has created numerous bodies of water that are devoid of fish life. Toxic elements in many aquatic ecosystems are causing severe and widespread disease among fish populations, such as birth defects, tumors and many other forms of cancer.

Fortunately, over time, some of the dams that once blocked the flow of many rivers are being fitted with fish passage facilities, such as fish ladders and elevators. And many polluted lakes, ponds and rivers have gradually been cleaned up over the past few decades. There is however, a long way to go in North America before our waterways are restored to a level of cleanliness and ecological health benefiting the amazing fish that inhabit them.

Salmon are significant to the indigenous peoples of the Pacific Northwest as not only a food source, but also is a cornerstone of the culture of many indigenous groups in this area. Seek out specific meaning and connection with your local tribal community members or relevant organizations (Keepers of the Animals by Joseph Bruchac and Michael J. Caduto).

Check on the health of your local streams to learn the history of development and restoration. For more information on Whatcom Creek, check out the following websites:

- https://www.cob.org/services/environment/restoration/pages/whatcom-creek.aspx
- http://www.historylink.org/File/5399
- https://www.portofbellingham.com/314/Early-History-of-the-Area
- http://www.washington.edu/diversity/files/2013/03/treaty-point-elliott.pdf
- https://www.historylink.org/File/7327

Procedure

1. Begin lesson by going into an open field and explaining how the game will be played.

    a. *What do salmon need to survive?*

    There are three resources matched with motions that both teams need to know: Food (shown by putting hand on stomach), Water (shown by putting hand to mouth), Shelter (shown by holding hands above head at a point like a house).

    b. Separate class into two teams, one salmon team and one resource team, place the teams about 20 or 30 feet apart from each other facing away from the other team.

    c. Practice Round - In their own heads, each student will decide which resource they want to be, food, water, or shelter. On the count of three they will turn to face each other holding up the resource they had picked.

    d. The salmon will then run to the resource team, grabbing a resource that matches the one they are holding up, and bring them back to the salmon team.

    e. Any resource without a match, will stay on the resource team. Any salmon without a match then dies and joins the resource team. If you have some extra time, do a few runs of each round to see if the salmon populations change any more due to the amount of resources available.

    f. When each round is complete, the narrator/teacher will ask the students how many salmon are leftover and will compile the data for students to graph back in the classroom.

2. Each round of the game will be prefaced with a point in history of the creek you are focusing on. At the beginning of each round, the narrator will go to the resources team and give them new instructions/question them on what resources are or aren't available. See prompts for resources available in *italics.* Use the following questions to further discussion after each round:

    a. What kind of adaptations would salmon need to have developed very quickly in order survive after this historical event?

    b. Why were some of the resources not available this round?

    c. What are some predictions you have of what will happen in the next round?

3. Each round explained - For the purpose of the context of Bellingham, we will use the history of Whatcom Creek.

    a. Round 1 - First Nations / pre-colonial settlement

        i. Native Americans inhabit the land, they live with salmon as a part of their culture, of their family. Salmon play a central role in the food systems of the Lummi, the Nooksack and many other Coast Salish peoples of the Pacific Northwest. They treat salmon with respect, only taking what they need to feed their family so bears and other creatures can feed their families as well, while salmon families still thrive and return to Whatcom Creek each year.

        All resources are available

    b. Round 2 - Arrival of colonial settlers to the area (1700's)

i.   Henry Roeder and his partner J.E. Peabody arrived along the shores of Whatcom Creek after coming up with a plan to rebuild San Francisco after a devastating fire that happened in the early 1850's. They raced up the coast of Washington in search of a logging area only to find that others had beaten them to the best spots. Finally they came upon the previously 'un-claimed' Whatcom Creek (Although it was still home to many Lummi and Nooksack people). The combination of dense forests, a sheltered bay and the falls at Whatcom Creek attracted the first settlers to the area in 1852 and 1853. Roeder and Peabody built the first saw mill near the present site of the Prospect street bridge. Water from Whatcom Creek powered the mill and the trees that were once so thick that all but the small beach was nearly unwalkable by foot, quickly disappeared from the banks of the stream as their logging began.

Less shelter, all other resources available

c.   Round 3 - [Point Elliot Treaty of 1855](#), [Pacific Northwest Indian Treaty Fishing Rights](#), [Narrative of Time Period](#) and the growth of fisheries

i.   Due to the Point Elliott treaty and a series of other treaties, Native peoples were removed from their traditional homelands and forcibly relocated to reservations. As the 19th century came to a close, more and more settlers crowded into the Washington Territory. Non-indigenous commercial fisheries began taking more and more salmon as the technology of gas and diesel powered trolling boats grew among non-indian fishers. Canning technology allowed the fish to be preserved, while transportation improvements allowed the fish to be sent around the world. Competition was high among fishers as technology allowed them to take more fish, faster. At the same time, logging, agricultural and other impacts began to take their toll on salmon habitat. Between the increased non-indigenous harvests and the destruction of salmon habitat in the watersheds, the salmon in streams around the Pacific Northwest began to decline steadily.

Minimal water and shelter - those who don't get a resource due to low availability will die dramatically at the beginning of the round. Include a wild card (one of the resources becomes a fisher who will try to grab as many salmon swimming across as possible) - explain this to the group before the round begins

d.   Round 4 - Growth of the three towns (Bellingham, Fairhaven, Sehome) (the early 1900's)

i.   In 1883, Roeder gave 4.5 acres of undeveloped land (now a part of Maritime Heritage Park) to the city of Whatcom now known as Bellingham. While that land was to have been used as a park, it quickly became the garbage dump for the community. Residents simply tossed unwanted items, channeled sewers toward the creek, and turned their backs on Whatcom Creek. White City Amusement Park was built along the shores in the Silver Beach area and recreation in the form of naphtha and gasoline powered boats became popular on Lake Whatcom. The Amusement Park's waste ran down the slope, into Lake Whatcom, and then down Whatcom Creek to Bellingham Bay. Scarcely anything of importance happened in or near Bellingham that did not drain into

the much-burdened Whatcom Creek. From time to time, boys and men joined together to voluntarily hack back the advancing blackberries and other shrubs to clear small portions of the land at Maritime Heritage for baseball games. In 1901, the Ladies Cooperative Society raised enough funds to build a bandstand, later convincing the city to plant trees, shrubs, and grass. While the baseball diamond and later the bandstand tamed a small portion of the lands near Whatcom Creek, the remainder continued as the community's dumping grounds. Throughout this time period Lummi fishers continued to camp along the beach to take fish, but the runs steadily decreased over the years. Debris and refuse piled up at every turn of the creek and each turn in the river collected all this garbage. By 1906, the relatively new city of Bellingham (made up of Bellingham, Fairhaven, and Sehome), ran a sewer line across the stream blocking salmon from their spawning grounds between today's I-5 and Alabama Hill. Water quality in Lake Whatcom decreased so dramatically that swimming was no longer allowed.

One clean water, one food, one shelter

e. Round 5 - Car Dealerships and the Flooding of Merchandise (the mid-1900's)

   i. In reaction to a series of flooding along Alabama Hill and Iowa Street (many car lots were affected) the city decided to reroute Whatcom Creek and build a concrete channel to prevent flooding from continuing. The rerouting ultimately straightened the creek, removing any trace of what a natural stream habitat should look like. The banks of Whatcom creek were overrun with blackberries and concrete slabs channeled the water into a fast flowing stream without any trees lining the banks.

   No Shelter, no food, one water (those who don't have a designation die dramatically at start of round)

f. Round 6 - Ecological consciousness and restoration (Present)

   i. The salmon continued to come up stream but in drastically lower amounts, so low that some years you didn't even see salmon swim up Whatcom Creek. Those who tried, didn't make it past the fast flowing water and couldn't find beds to spawn in due to the straightening of the river and lack of gravel. Native people had been taking notice of the decrease in salmon each year affecting their livelihoods and way of being. Fisheries and canneries were also being affected by the low catches every year. Eventually there was a growing realization that Whatcom Creek was being abused and recovery efforts started to take place in the form of re-planting native species on the banks of the creek, removing the concrete channels, and cleaning up sewage waste from the creek.

   One or two of each resource available

4. Once the narrator has come to present day, students will come together into small groups (2-4 students) to graph their journey as salmon in Whatcom Creek and discuss potential future implications on the salmon population based on prompts given (see below for prompts). Their group responses can be presented to the class.

Prompts for the Future Salmon Population Impacts

- A fifth grade class writes a letter to their Governor in support of a new law protecting Orca whales in the Puget Sound.

- A family walks by a park where they see a group of people working together to plant trees, spread mulch. They ask someone from the group how they can get involved.

- A large landslide fills local streams with large amounts of sediment right at the time that salmon are swimming upstream to lay their eggs.

- A train headed to Cherry Point crashes and spills 100s of gallons of crude oil into Bellingham Bay.

- The new Governor of Washington State imposes stricter fishing laws on all registered fishing licences The rights of Native Americans on fishing and harvesting are not affected by this new law.

Next Generation Science Standards

Performance Expectation: Biological Evolution: Unity and Diversity
3-LS4-3: Construct and argument with evidence that in a particular habitat some organisms can survive well, some less well, and some not survive at all. **3-LS4-4:** Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.

Science and Engineering Practices	Disciplinary Core Ideas	Cross Cutting Concepts
Analyzing and Interpreting Data Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used. Analyze and interpret data to make sense of phenomena using logical reasoning. (3-LS4-1) **Engaging in Argument from Evidence** Engaging in argument from evidence in 3–5 builds on K–2 experiences and progresses to critiquing the scientific explanations or solutions proposed by peers by citing relevant evidence about the natural and designed world(s). Construct an argument with evidence. (3-LS4-3) Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem. (3-LS4-4)	**LS2.C: Ecosystem Dynamics, Functioning, and Resilience** When the environment changes in ways that affect a place's physical characteristics, temperature, or availability of resources, some organisms survive and reproduce, others move to new locations, yet others move into the transformed environment, and some die. (secondary to 3-LS4-4) **LS4.C: Adaptation** For any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all. (3-LS4-3) **LS4.D: Biodiversity and Humans** Populations live in a variety of habitats, and change in those habitats affects the organisms living there. (3-LS4-4)	**Cause and Effect** Cause and effect relationships are routinely identified and used to explain change. (3-LS4- 2),(3-LS4-3) **Systems and System Models** A system can be described in terms of its components and their interactions. (3-LS4-4)

NGSS Lead States. 2013. Next Generation Science Standards: For States, By States. Washington, DC: The National Academies Press.

Extensions

- Build your own salmon habitat model. What makes a healthy and an unhealthy salmon habitat? Show how can you protect that habitat.
- In small groups, task students to come up with potential restoration projects for local streams and connect with organizations currently doing restoration projects in the area
  - Potential to explore success of fish ladders/byways
- Continue connecting to your local stream through water quality testing throughout the year
- How do salmon and climate change connect?

- Write a letter in support or against recent state legislation to a state official.

Resources/Reference

- Initiative 1631: https://www.sos.wa.gov/_assets/elections/initiatives/finaltext_1482.pdf

- https://cedar.wwu.edu/cgi/viewcontent.cgi?article=1550&context=wwuet

- Historical Resource of Bellingham: https://heritageresources.omeka.net/exhibits/show/centennial/industry/timber

- Current Water Quality Test Results: http://whatcomwatch.org/index.php/article/lake-whatcom-update-decline-of-water-quality-accelerates/

- Report on Lake Whatcom History: https://www.cob.org/documents/pw/lw/lake-whatcom-history.pdf

- Holly Street Landfill: https://fortress.wa.gov/ecy/gsp/Sitepage.aspx?csid=253

- Whatcom Creek History: https://bellinghamblog.files.wordpress.com/2014/05/geology-ecology-of-whatcom-creek.pdf

- Boldt Decision: https://www.culturalsurvival.org/publications/cultural-survival-quarterly/unintended-consequences-boldt-decision

Community Connections

- Nooksack Salmon Enhancement Association https://www.n-sea.org/

- Re-Sources http://www.re-sources.org/

- Garden of the Salish Seas Curriculum http://www.gardensalishsea.org/

- Wild Whatcom www.wildwhatcom.org

- Lummi Nation (Department of Natural Resources) https://www.lummi-nsn.gov/Website.php?PageID=1

- Since Time Immemorial Curriculum http://www.indian-ed.org/

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