Future Needs of the PNW Hydropower System

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Grades or Range: 6-8th grade

Unit Summary	
Description:	Students will evaluate the arguments for breaching the snake river dams, and the arguments against the breach. They will assess cost/benefit assessments, stakeholder positions, and possible solutions.
Learning Goals:	- Students will be able to determine the different factors that need to be considered when problem solving in real world situations - Students will assess the implications of human impact on the ecosystem as it relates to human needs and ecological needs.
Performance Expectation/ Learning Objectives:	- Students will develop an argument for or against breaching the dams. - Students will be able to explain how human impacts affect the ecosystem. - Students will assess how the health of the chinook salmon population is directly connected to the health of the southern resident orcas.
Unit Sequence:	Part 1: One to two 45-min class periods Part 2: Two 45-min class periods Part 3: Two 45-min class periods

Evidence/Monitoring Student Progress:	- Each part will have a corresponding formative assessment as a part of the activity. - Part two, which will involve role playing, will allow for both oral and written arguements
Phenomenon	The anchoring phenomenon that these lessons will be based around is the plight of the southern resident whale and the impact of the snake river dams on the chinook salmon population. The story of Tahlequah, the bereaved SRKW, who carried her deceased calf for 17 days in the summer of 2018. Prior to Tahlequah's looks, the SRKW population in the Salish sea had been struggling, reaching a 30 year low, of just 75 whales among three pods. The primary food source of the SKRW are chinook salmon, which had been dwindling due to the dams on the snake river which close off precious breeding grounds for the chinook.
Essential questions	How can humans repair the ecosystem they have damaged to help improve both the chinook salmon population and the Southern Resident Killer Whale population?
*Subject Matter Integration:	- Social Science - Debate/Language Arts

Lesson Progression (Jump to individual lesson)

- **Lesson 1: Environmental Challenges to PNW Keystone Species**
- **Lesson 2: Ecological Interactions Between PNW Keystone Species**
- **Lesson 3: Evaluating River Restoration Impacts**
- **Lesson 4: Who Makes Decisions About Dams? Stakeholder Role Play**

Lesson 1: Environmental Challenges to PNW Keystone Species	
Lesson Preparation	Students learn about the dwindling orca population, and the contributing factors. One of which is the decline of chinook salmon and how the loss of this keystone species is impacting the SRKW populations. Videos: Case Study: Orcas and Dams Recovering the Southern Resident Killer Whale Articles: Southern resident orca whale population dwindle Powerpoint: The Southern Resident Orca Whale in the Salish Sea

Lesson Sequence	Watch the video: The orca that carried her dead calf - Brain Storm student questions Watch the video on recovering the SRKW Define key threats: (in pairs or table groups) 1. Prey availability 2. Contaminants 3. Vessel Presence and Noise 4. Human Development Discuss their territory and what that tells us about the diets and behaviors of the SRKW. Have students read and discuss SRKW population dwindle (articles linked in Artifacts) Students complete the worksheet and read the attached articles. In a traditional classroom, this can be done as part of the lesson rather than as homework.

Lesson 2: Ecological Interactions Between PNW Keystone Species	
Lesson Preparation	Lesson Goal: Students will examine the decline in chinook salmon and how the loss of this keystone species is impacting the SRKW populations. Videos: The History of Salmonoids on the Columbia River (Part 1) Ecological Interactions Between PNW Keystone Species Review the Foodweb in the Powerpoint from lesson 1.
Lesson Sequence	Start with a class discussion, reviewing the threats that face the SRKW. Students should have small group discussions in table groups drawing links between how the decline in the salmon population can impact the SRKW Students will watch the videos and complete the worksheet with questions and models (See examples of student work here) Introduce the Snake River dams with an emphasis on the energy produced (perhaps slides or infographics - would be good to find some data of energy production) Northwest energy solution: Regional power benefits of the Snake River dams Introduce the idea of removal.

	Create a pros and cons list based on the articles and info shared. Create possible solutions - no removal or modifications - modifications to the dams - partial removal - complete removal Together, read: Dam Politics

Lesson 3: Evaluating River Restoration Impacts	
Lesson Preparation	Part three will introduce the role of the Snake River dams and the impacts they have on the Chinook population. Students will examine the pros and cons of various scenarios that have been presented by research scientists. Videos: Evaluating Hydropower Projects Articles: • Dam Politics • Federal report recommends removing dams • An Economic Analysis of the Costs and Benefits of Removing the Four Dams on the Lower Snake River • Removing Snake River dams is bad for economy and salmon • The Pros and Cons of Dam Removal • More Articles on Pros and Cons of Removing the Dams Pre-lesson preparation: Photocopy one copy of each of the Evaluation Hydropower Projects Worksheet for students to fill in with the respective pros and cons. You can have the students read articles online, or I made enough copies for half of the class to read the articles that skewed pro, and the other half to read the articles that skewed con, and then had them swap halfway through the class.
Lesson Sequence	Begin the lesson with the Should the Snake River Dams Stay or Go? Video. Split students into groups, explain that they will tease out arguments for and against breaching the dams. Students get 20 minutes to read and note both sides of the argument. Students can read independently, divide up the readings, or read as a group. In a traditional classroom, you will likely want to spend another class session on this lesson.

	This additional session would be to identify some arguments and counter-arguments. Then give students the outline to pick one stance and develop an argument for the solution they see most fit on the template provided. (See examples of student work here: Sample 1, Sample 2, Sample 3) It is helpful to give some examples of an argument and counter-argument. For example, if they picked the cost of maintaining the dams as a reason for breaching, a counter-argument would identify the costs of removing the dams and future restoration efforts.

Lesson 4: Who Makes Decisions About Dams? Stakeholder Role Play	
Lesson Preparation	Part four will get into the stakeholders who are at play. Through role-playing, students will learn about the varied opinions regarding the dam removal and will ultimately have to reach a compromise as a class after a mock public forum. Photocopy one or two sets of the 16 role-playing cards. It might be helpful to photocopy these on colored paper. The 16 cards represent the voices of the stakeholders in and around the Snake River Dams. Students will also need a Scenario Pro/Con Chart worksheet (in artifacts).
Lesson Sequence	Students will be randomly assigned roles. Distribute copies of the Scenario Pro/Con Chart to each student. Give them a background statement (Come up with something to recap the concerns and interests of the general public). Ensure students understand their responsibility to review each scenario your character would most likely choose and defend during a public hearing. Give students one class to come up with their arguments. (See student examples here) In the second class, they can go over their salient points and hold a public forum. The public forum should be entirely student-run, with the Congress Members calling on students and facilitating the discussion using the script provided.

	In the end, the congress members should decide on the scenario they think best serves the greater community.
Additional Links from the Elwha Tribe's Science Outreach Coordinator	LINKS: https://www.elwha.org/departments/natural-resources/fisheries/ http://www.thememoryoffish.com/#intro StoryMaps: A river reborn (arcgis.com) The Elwha River (arcgis.com) This bibliography of all of the published literature on Elwha river research is a great database to find specific items. Also, I know you are focusing on Chinook with respect to resident orca populations, but this short documentary about steelhead on the Elwha is promising for other species that have yet to demonstrate the same level of recovery (https://youtu.be/9t_m1myVBBQ). If you have not yet watched the Memory of Fish, it is a bit outdated now but I think could be useful if you are addressing stakeholders in your curriculum. Additional articles: https://snakerivercanyonspark.com/acitivities/exploring/ https://fisheries.org/policy-media/recent-policy-statements/statement-of-the-american-fisheries-society-afs-and-the-western-division-afs-wdafs-about-the-need-to-breach-the-four-dams-on-the-lower-snake-river/