

## Hydroelectric Power and Dams- A look at the Environmental, Social and Economic

**Overview:** This lesson investigates the use of dams, and has students create a water wheel and explore various water flows and they're affect on the water whee.

**Keywords:** Hydroelectric dam, hydropower

**Age / Grade Range:** 7<sup>th</sup>-9<sup>th</sup>

**Background:** Hydroelectric dams have a long history in the Pacific Northwest. The first hydroelectric dam in the PNW was built in Washington in 1885. Today, 40% of electricity in this region comes from fourteen dams along the Columbia River and its tributaries. (<http://www.nwcouncil.org/history/Hydropower/>)

Eighty percent of the electricity in Idaho comes from hydroelectric power, more than in any other state, and allows Idaho to have some of the cheapest electricity prices. Idaho has few natural gas and oil reserves. Most of Idaho's largest hydroelectric power dams are built along the Snake River. (<http://www.instituteforenergyresearch.org/state-regs/pdf/Idaho.pdf>)

**Next Generation Science Standards & Common Core:**

**Core Idea PS3: Energy**

PS3.A: Definitions of Energy

PS3.B: Conservation of Energy and Energy Tranfer

PS3.C: Relationship Between Energy and Forces

**Core Idea ESS3: Earth and Human Activity**

ESS3.C: Human Impacts on Earth Systems

**Core Idea ETS2: Links Among Engineering, Technology, Science, and Society**

ETS2.A: Interdependence of Science, Engineering, and Technology

ETS2.B: Influence of Engineering, Technology, and Science on Society and the Natural World

**Goals:**

In this lesson, students will learn about the environmental, social, and economic factors associated with hydroelectric dams. Students will also create a mini water wheel from repurposed materials and observe how water flow creates electricity that powers a light bulb. Students will learn about the benefits and disadvantages of dams and will have the opportunity to teach their peers a unique perspective on this issue as well as debate the placement of a dam along a section of river.

**Essential Questions:**

- What is hydroelectric power?
- Why is hydroelectric power important in Idaho?
- What are some of the benefits of hydroelectric power?

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- What are some of the disadvantages of hydroelectric power?
- What factors must be taken into account to find the best placement for a dam along a section of river?

**Objectives:**

- Students will understand that hydropower is a major source of renewable energy in Idaho.
- Students will understand that while being a “green” energy source, hydroelectric power also has negative environmental impacts. These include blocking salmon migration, destroying ecosystems at reservoir sites, emitting greenhouse gases due to organic matter decay and increasing soil erosion, among others.  
Students will also understand that hydroelectric power dams can grow a local economy by providing jobs and recreational opportunities.
- Students will understand that dam selection needs to take into account not only geologic features, but environmental, social and economic factors as well.
- Students will better understand how dams generate electricity by building a water wheel that powers a light bulb.
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**Materials:**

- A small stepper motor as found in a printer (1 per group)
- Discarded CD-ROMs (2 per group)
- A foam tray (1 per group)
- A Long stick (1 per group)
- A LED (1 per group)
- 1-2 tie-wraps
- A small piece of scrap paper
- Hot melt glue
- Scissors
- Maps of a river section and informational sheets on advantages and disadvantages of dams (from <http://www.instructables.com/id/Hydropower-from-Reuse/>)

**Set up:**

Build and test a model water wheel before teaching it to students. Have all the materials for the water wheel prepared for the students to build.

**Classroom Time:**

1.5 hours. The lesson can be separated into individual mini lessons if time restricted

Ask the students:

**Introduction (Engage):**

- How does Idaho get most of its power?
- What is hydroelectricity?
- How is it produced?
- What are alternate uses of dams?

- Are dams a good thing?
- Has anyone been to a dam?
- What have you done there (field trip, recreation, etc)?

Generate a brief discussion about what the student's know about dams and hydroelectric power.

Tell the students that they will now mimic how dams take potential electricity (flowing water) and produce kinetic electricity (power a light bulb) by building a small water wheel.

Divide students into small groups and have each group build a water wheel from repurposed materials to power a light bulb. Instructions can be found here: <http://www.instructables.com/id/Hydropower-from-Reuse/>

### Activity (Explore):

Once the students build their water wheels, they can test them in various sections of river (or sink if there is no access to a river) to see how the speed and height of water flow affects electricity production. This can offshoot into a mini conversation about potential and kinetic energy if time permits.

The purpose of this activity is twofold. One, to demonstrate the basic concepts of how dams create electricity and to have the students model it. In this way, students will have an easier time "buying in" to the idea of what dams do. And two, to encourage continued teambuilding and communication among the students

Divide the students into two groups. One group will learn about the advantages of dams and the other group will learn about the disadvantages of dams. Tell the students that each group will learn about different issues related to dams, but don't let them know that they are learning about the advantages and disadvantages. This is so that they can discover this for themselves during the Elaboration section.

### Explanation

This can be taught in two ways. If there are two instructors, they can each take a group and teach the lesson in a mini lecture style. Alternatively, the information can be handed to the students and they can use a "think, pair, share" style of self-instruction.

The main advantages that should be taught are:

- Water is a renewable resource
- Water can be a cleaner energy source than natural gas/oil or coal
- Hydroelectric power encourages electric price stability
- Idaho has lots of rivers
- Dams reduce flooding

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- Dams store water
- Dams provide recreational and economic opportunities
- Cities near a dam benefit from tourism associated with recreational opportunities of dams

More can be found here:

<http://ga.water.usgs.gov/edu/hydroadvantages.html>

<http://www.envirothonpa.org/documents/19bHydropowerAdvantagesandDisadvantages.pdf>

<http://www.usbr.gov/uc/power/hydropwr/benefits.html>

The main disadvantages that should be taught are:

- Reduces or blocks Salmon migrations
- Can disrupt migrations of other species such as elk
- Changes sediment flow rates
- Displaces people and communities
- Affects ecosystems up and downstream
- Floods land at reservoir site
- Expensive
- Geological effects: earthquakes

More can be found here:

<http://www.envirothonpa.org/documents/19bHydropowerAdvantagesandDisadvantages.pdf>

[http://www.conserve-energyfuture.com/Disadvantages\\_HydroPower.php](http://www.conserve-energyfuture.com/Disadvantages_HydroPower.php)

<http://www.internationalrivers.org/frequently-asked-questions-large-dams>

Pair the students into groups of four. Two students that learnt about the advantages of dams paired with two students that learnt about the disadvantages of dams. Give each group of students a map of a river section with a background story. You can choose to give each group the same scenario or different scenarios.

**Elaboration:**

Examples of scenarios can include: a community alongside a low point in the river, salmon migrations, earthquake prone geology, a poor community, rising electricity prices, endangered species of plant along the river banks, recent cycle of drought, etc. Try to have the scenarios somewhat balanced in terms of advantages and disadvantages of a dam.

Tell each group that based on their newly acquired knowledge, they are now

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tasked with choosing the sight of a proposed dam along their section of river. They are not required to place a dam, but if they do, they must work as a team and be able to justify their location.

Once each group has chosen a site for a dam, the students should regroup as a class and present and justify their dam sites to the other students. If there is additional time, instead of only presenting, the instructor may encourage input from the other groups.

**Evaluation:**

**Additional resources:**

History of Hydropower in the PNW:

<http://www.nwcouncil.org/history/Hydropower/>

How Hydropower Plants Work:

<http://science.howstuffworks.com/environmental/energy/hydropower-plant1.htm>

Hydropower Stats in Idaho:

<http://www.instituteforenergyresearch.org/state-regs/pdf/Idaho.pdf>

Hydro Electric Power and Water:

<http://ga.water.usgs.gov/edu/wuhy.html>

Effects of Dams on Rivers:

<http://www.internationalrivers.org/frequently-asked-questions-large-dams>

Hydropower and the Environment:

[http://www.ieahydro.org/uploads/files/iea\\_aiii\\_st1\\_vol\\_i.pdf](http://www.ieahydro.org/uploads/files/iea_aiii_st1_vol_i.pdf)