HYDROELECTRIC LESSON PLAN

Summary: Students will observe a model waterwheel to investigate the transfer of energy in a water turbine. Students will use household materials to develop their own versions of water turbines while managing resources like time and materials in their design.

Learning Objectives

- Identify dams as a source of power
- Explain the advantages and disadvantages of human-made dams
- Explain how engineers design and redesign water power technology

Materials Needed (to build one water wheel)

- 1 empty, clean 2-liter plastic soda bottle (or a 20-oz bottle, depending on availability) with holes drilled in the cap and the bottom of the bottle so that a wooden dowel fits through the length of the bottle like an axle
- 1 pair of scissors
- duct tape
- wooden dowel (inch diameter and longer than the soda bottle length)
- string
- fin material, such as cardboard, index cards, straws, toothpicks, popsicle sticks, walls of plastic bottles, etc., that students can use to make turbine fins
- water-proofing materials (such as aluminum foil, plastic wrap, etc.) to wrap over any paper fins to keep them from disintegrating in the water
- water
- sink tap and drain access
- Stopwatch
- Small weights

MATERIALS IN ECO-KIT

- Wooden Dowel
- String

- Fin Material
- Waterproofing material

Outline of *Water Power* Lesson

1. Introduction (Teacher)
2. Introduction to lesson
3. Discussion where students discuss what they already know about water power
4. Demonstration and testing of the model water wheel
5. Challenge students to make a more powerful water wheel
6. Test student water wheels
7. Give students opportunity to make their wheels better(given time)
8. Post activity reflection

Background:

Humans have been using water for power for a long time. More than 2,000 years ago, farmers used waterwheels to grind wheat into flour. A waterwheel spins as a stream of water, which is being pulled down by gravity, hits its blades. The gears of the wheel drive heavy, flat, rotating stones that grind the wheat into flour. Hydropower plants use the same action of falling water to generate electricity. A turbine and a generator convert the energy from the falling water to mechanical and then electrical energy. The biggest advantages of using hydropower for electricity are that it is a renewable resource and it does not give off air pollution during operation.

Dams also use the waterwheel concept for generating electricity. Dams are some of the largest human-made structures on Earth. In fact, the Hoover Dam on the Colorado River in Nevada is 221 meters high, 379 meters long and 14 meters wide at the top. That is pretty big! It has 17 electric generators and provides electricity for about 500,000 homes in Nevada, Arizona and California.

Engineers design and improve dams in order to capture energy from a renewable source—water. Using dams is a way to generate electricity without burning fossil fuels. Engineers also re-design existing dams to be friendlier for fish and to work better at making hydroelectric power.

Before the activity:

- Build a model water wheel

- The hardest part will be drilling hole in bottom and cutting openings in sides
- Better not to do in front of kids

Building Water Wheel:

1. Introduce waterwheels to the students and give them some background on how they are used today
2. Discuss what students already know about water power technology possibly through these questions
   (a) True of False: Hydropower dams reduce pollution (Answer: True)
   (b) True or False: Hydropower dams are cheap to build (Answer: False; they can be very expensive to build)
   (c) True or False: Hydropower dams rarely interfere with natural wildlife (Answer: False: dams can disrupt migratory fish patterns and spawning habits, especially for species like salmon. This can have devastating effects on both the fish population and people whose livelihoods depend on these fish.)
3. Demonstrate the model water wheel by putting weight on the end of the string and finding the maximum amount of weight that a water wheel can pull up towards itself.
4. Challenge students to make a water wheel that pulls more weight than the model
5. Have students sketch designs and decide on materials for fins.
6. Build the water wheels
   (a) Use scissors to cut slits in the bottle for fins
   (b) Have students build and waterproof fins for their water wheels
   (c) Insert fins into the slits cut into the bottle
   (d) Insert dowel through the bottom of the bottle out through the neck
   (e) Attach string to the neck of the bottle
   (f) Attach weight or coins of some kind to the string.
7. Test the student water wheels
   (a) Attach a small amount of weight to the string
   (b) Direct a stream of water onto the water wheel so that it catches the fins and rolls the string up with the weight attached.

(c) Increase weight until the water wheel is no longer able to spool.

(d) Have students record their highest weight.

8. Give students the option to improve their wheels, given time. Encourage them to strengthen the fins
9. Post learning activity

Special Needs: You will need access to running water. The activity can be done outside although a sink would be much cleaner.

Post Learning Activity

Divide students into groups and tell them that they are working for H2O Solutions, an engineering design firm that works mostly with waterwheels and water energy. The city has asked them to design a more efficient watermill. The firm has been split into several engineering teams (student groups). Tell the teams that they must design a functioning waterwheel that turns and their constraint is to use only the materials provided for their designs. Ask them to sketch their new designs and test their designs. Have a few groups present their designs to the rest of the class indicating what elements worked well and what they could improve on.