Discovering Hydropower Energy

Program Purpose
Through interactive activities introduce alternative energy concepts and their relation to students' everyday lives.

Length of Program: 1 ½ - 2hrs

Age: Grades 9-12

Maximum Number of Participants: 24

Objectives:
After completion of all activities, students will be able to:

- Define Energy
- Understand that the sun also gives us wind energy
- Able to list at least three renewable energy sources
- Understand how hydroelectricity functions
- Build and test a water turbine
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Preparation:
Before the class arrives:

- Locate the program box in the work room
- Decide which activities to use based on age appropriateness

Materials:
Small spool magnetic wire (#28 of finer, insulated)
Glue
12-1inch nails
12-3inch nails
6-1inch bar magnets
6 Germanium Diodes (1N34A)
12 1.5" x 4" metal strips from a tin can
Electrical Tape
6- 3"x5" Wood Blocks
48 3" Tinker toy spokes
6 Round Tinker Toys
48 Small Paper Cups
6 Scissors
Galvanometer
Generate Your Own Hydropower Worksheet

Outline:
I. Introduction
II. Water Energy Sources
III. Hydroelectric Power
IV. Generate your Own Hydropower
V. Energy Bike
VI. Conclusion

Introduction:
Introduce yourself to the class and explain that we will be talking about energy. What is energy, and where does it come from?

Energy is defined as the ability to do work. Energy can be chemical, like that stored in food, light, sound, electrical and mechanical. We are going to focus on electricity. Where does electric energy come from? Not all electricity is created the same way. It can come from wind, water, sun, natural gas, oil and coal. Some energy is always there for our use, like the sun. More energy is produced from the sun in one day than humans have ever used! Other examples of renewable energy sources are water and wind. But sometimes the energy we use comes from deep within the Earth; fossil fuels are often hard to get to and produce pollution and greenhouse gases as they are burned. Pollution makes it hard for animals to breathe and for plants to grow. These hard to find resources are nonrenewable. It takes millions of years to make them and there is a limited supply. That's why we are trying to use more renewable energy sources, like water power.

Water Energy Sources
Water energy can come from both fresh and saltwater sources. The first energy source is the oceans' waves. It can only be used efficiently between the 40-60° latitudes because they have the most concentrated wave action. One design is tethered to the ocean floor and looks like a series of buoys that are linked together. When a wave lifts a buoy it forces oil to turn a turbine and generate electricity. This design is just as efficient as wind energy. The other design called the limpet is placed on a rocky shore line. Energy is created when the wave crashes on the limpet and force air through a turbine. Since both use waves, which are always available, they are very efficient and clean to use. However they are expensive to build and can be damaged by ships and very strong wave action like those of a hurricane. The second source is the oceans' tides. Usually the oceans tides are between 6 and ten feet but can be as much as 56 feet in the Bay of Fundy in Canada. The first design is a tidal barrage and works just like a hydroelectric dam, flowing water turns a turbine which create electricity. The second design, called tidal turbine, is placed on the ocean floor and looks like an underwater wind turbine. The most common water energy source is from hydroelectric dams.

Hydroelectric Power
Hydroelectric power is the most commonly used renewable energy source. On average the United States gets 10% of its energy form water. However, some states like Washington get over 80% of their electricity from hydroelectric dams. The very first one was created on the Fox River in Appleton, WI in 1882. It was able to power a house and a few lights in a factory.

Hydroelectric dams can only be used in freshwater, but there are two designs. The first type uses a wide slow moving river. The large quantity of water compensates for the speed. The second type requires much less water but an increased height. When the water falls it uses gravity to increase its speed. Either way the force of the water flow turns the blades of a turbine, which in turn causes a rotor to turn. When the rotor turns it passes magnets and makes electrons flow. This flow is electricity which then goes to a transformer to increase the flow and push energy long distances. Scientists are currently in a debate whether dams are a better source of energy than other sources. To create the dam land has to be flooded which displaces many people and animals. Often times this land has prime farming soil. The added weight on the tectonic plates may cause earthquakes in some geologic areas. They can also concentrate pollution which may change or destroy habitats. On the flip side hydroelectric dams create clean power, help to slow silt build up and prevent flooding down stream. Hydroelectric dams do not use fossil fuels, have very low operating costs, and are the cheapest way to create energy.

Generate your Own Hydropower
Divide the class into groups of no more than 4 participants. Distribute materials and Generate Your Own Hydropower worksheets.

Now that students have seen how much goes into generating power it is time to conserve it.

Energy Bike
Light Bulb or Heat Bulb?

Students will use the energy bike to determine what type a light bulb is more energy efficient and cost effective. An incandescent bulb is much harder to pedal and draws four times more current than a compact fluorescent bulb, but is no brighter. Where is all that pedaling energy going? Don't touch the bulbs to find out! The cyclist's legs feel what the current meter shows - that four fluorescent bulbs can be lit with the same amount of power that it takes to light a single incandescent bulb.

All Motors Created Equal?

Students will determine when an appliance uses the most energy. Watching the current meter as they pedal, students see that when the fan is switched on, there is a brief surge as the motor starts. The current then settles to a lower, steady run value, which is pretty easy to pedal, and cyclists enjoy the cooling breeze. Switch off the fan and switch on the hair dryer. Whoa! Why is it so hard to pedal when it doesn't blow nearly as much air as the fan? Students are amazed at the effort needed for such a small amount of heat.

Review and Conclusion:
Ask the students to list ways that they can save energy in their own lives. Have them list off at least three ways that they can save energy! What are some of the sources of energy, and are they renewable or non-renewable sources? Is all water energy good? Are water power sources available in all areas? What can you do at home to reduce your energy usage and efficiency? Again touch on the benefit that renewable energy is having on the plants and animals, including us humans!!! "The plants, animals, and Mother Earth say, thank you!!!"

References:

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Tennessee Valley Authority. *Energy Sourcebook: High School Unit.* September, 1990. [www.tvakids.com/teachers/pdf/highschool_sourcebook.pdf] November, 2009.