

Hands-On Activity

Modeling a Water Turbine

In this activity, students will demonstrate the following Inquiry Skills:

- Design Investigations
 - Design and conduct investigations using:
 - Independent variable—the one variable the investigator chooses to change.
 - Dependent variables—what changes as a result of, or in response to, the change in the independent variable.
 - Make or use models that:
 - Function exactly like or similarly to the real thing.
 - Practice lab safety by:
 - Following lab safety procedures.
- Gather Data
 - Choose appropriate tools to conduct an investigation
 - Clock/stopwatch
 - Use senses to observe
 - Seeing (i.e., color, shape, size, texture, motion)
 - Use the appropriate format to record data
 - Writing (e.g., journal, worksheet, electronic text)
- Engineering and Technology
 - Use of technology:
 - Each part of a mechanical device contributes to the purpose of that device.
 - Engineers, architects, and others who engage in design and technology use scientific knowledge to solve practical problems.

Materials

For each group:

- two containers* of at least gallon capacity, one of which is filled with water
- flexible tube about a meter long
- pinwheel
 - manila folder
 - scissors
 - tape
 - pencil
- plastic cup or beakers*

* Safety note: Glass containers and beakers **should not be used** for this activity.

Demonstrate for students how a siphon works. (See directions in the [Notes to Teacher](#) section.) Display a pinwheel. Ask a student to blow on it so that it spins. Ask students if they recall from their explorations of the materials, the main way energy is obtained from natural resources (i.e., *converting the energy in the resources into energy of motion to drive generators*). Suggest that the pinwheel represents a generator and ask how they might get this pretend generator to spin in order to produce electricity. Someone will no doubt suggest putting the pinwheel in the stream of water coming from the siphon. If you plan to have groups of students do this activity, don't do this yourself, but tell students that they will get the opportunity to spin a pinwheel using water from a siphon. If you are going to do this as a demonstration, ask a few students to set up and start the siphon with another student holding the pinwheel. As the pinwheel spins, remind students that in a real generator, a spinning shaft rotates a coil of wire in a magnetic field, which in turn causes electrons to flow through the wire. We know this as electricity.

If you chose to have your students do this activity in groups, give them the materials and instructions and let them begin. Monitor the activity and assist as needed. Some groups might need your help in getting the siphon started. Keep a towel or mop handy to take care of water spills. **Caution students to be careful around any spilled water, since the floor might be slippery.**

When the water runs out, the pinwheel will stop spinning. Ask students, whether in groups or with you at the demonstration, what this would imply if this were a real generator supplying electricity for people. (*There would be no more electricity produced.*) Refer to the water in the container(s) as a resource that has been used to produce energy. How would we describe the water that was originally in the upper container? (*It was a limited or nonrenewable energy resource.*) What could be done to keep the generator (i.e., pinwheel) spinning? (*Put more water in the upper container and start it flowing again.*)

If you are demonstrating this activity, start the siphon again. Once the lower container begins to fill up, produce a cup and ask a student to scoop some water from the lower container and pour it back into the upper container. Have the student continue this transfer for a while. Point out that you now have a system that can replenish itself, and as long as there is water in the upper container, the generator (i.e., pinwheel) will continue to spin and produce electricity. In this case, the water could be considered a renewable resource. If students are doing this activity in groups, after they empty the upper container of water the first time, provide them with cups and instructions about how to transfer water from the lower container into the upper container. After students have been able to keep their pinwheels spinning for a while with this renewing system, have them stop. Give them instructions about how to clean up the materials. **Again, students should use caution when working around wet floors.**

Modification to add more inquiry to the activity: Either as a demonstration or with students working in groups, measure and record the time it takes a set amount of water to drain out of the upper container into the lower container. Lower the height of the upper container relative to the lower container and, again, measure and record the time it takes to empty all the water out of the upper container. If possible, raise the upper container even higher than it was raised in the original trial and compare the time it takes to empty the container. (*You will find that the higher the upper container, the shorter the time it will take to empty the container. As the two containers are brought to the same level, the time will*

grow increasingly longer, until no water will flow between the two containers if they are at the same height.)