

WATER TURBINE

BENCHMARKS and TASKS

SC.B.1.2.2 The student recognizes various forms of energy (e.g., heat, light, and electricity).

SC.B.1.2.4 The student knows the many ways in which energy can be transformed from one type to another.

SC.B. 2.2.2 The student recognizes the costs and risks to society and the environment posed by the use of nonrenewable energy.

SC.B.2.2.3 The student knows that the limited supply of usable energy sources (e.g., fuels such as coal or oil) places great significance on the development of renewable energy sources.

- The student defines energy as the ability to do work or to exert a force and recognizes that work is done every time a force is used to move something.
- The student describes energy as stored energy (potential) or energy of motion (kinetic).
- The student discovers through experiences ways that energy can be transformed from one form to another (e.g., electricity to light, light to heat, mechanical to heat, potential to kinetic).
- The student classifies resources as renewable or nonrenewable.
- The student recognizes that the limited supply of usable energy sources (e.g., fuels such as coal or oil) places great significance on the development of renewable energy sources.
- The student explores the development of alternative energy sources (e.g., solar energy, winds, synthetic fuels, geothermal energy).

KEY QUESTION

How can water, a renewable resource, be used to produce energy?

BACKGROUND INFORMATION

Without an adequate **energy** supply, our society would drastically change. Our supply of **nonrenewable resources** is finite. **Renewable resources**, such as water, solar energy, and wind replenish themselves in a short period of time.

In hydroelectric power stations the power of flowing water is used to produce electricity. When water is stored, it has gravitational potential energy (stored energy). The water held back by the dam has **potential energy**. When the water is released and begins to flow downhill through pipes to the power station, it has **kinetic energy** (energy of movement). The water rushes over large wheels called turbines and makes them turn. The turbines turn the generators, which change the energy of moving water into electrical energy. Hydroelectricity provides over six percent of the energy used in the world today. Since water comes from rain or melting ice, it never runs out.

The water turbine works because of Bernoulli's Principle, which states: The pressure in a fluid decreases as the speed of the fluid increases. As water begins to flow through the turbine holes, its speed increases. As soon as the water flow begins to increase in speed, the internal pressure in the turbine decreases

MATERIALS

Teacher

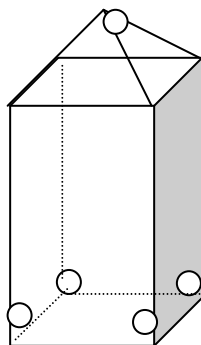
1 half-gallon milk or juice carton
1 metric ruler
duct tape
1 nail

Per group

water
masking tape
1 half-gallon milk carton,
with 5 holes pre-punched by the teacher
string
scissors

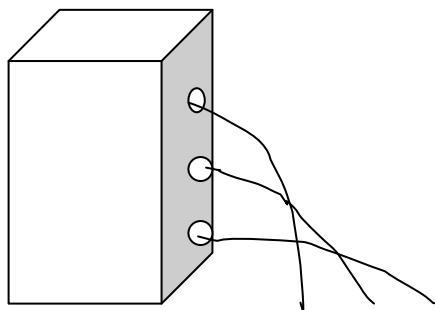
TEACHING TIPS

1. In advance, use a nail to punch three holes of the same size in a milk carton in a vertical line about 4 cm apart from the bottom of the container up the side to the top. Cover the holes with one long strip of tape. (See illustration in the Engage section.)
2. In advance, complete the first two steps of the milk carton preparation for each group:
 - Using the nail, punch a hole in the bottom right corner of each side of the milk carton.
 - Another hole should be punched in the middle of the top section of the carton.



ENGAGE (Teacher Demonstration)

1. Take the class outdoors. Fill the milk carton with water, but keep the holes covered. Ask: *After I remove the tape, from which hole will the water flow the farthest?*



2. Discuss the students' ideas.
3. Remove the tape and observe what happens.
4. Discuss:
 - Which stream of water is shooting out the least? (the hole near the top of the can)*
 - Which stream of water is shooting out the farthest? (the hole on the bottom)*

Why does the water shoot out the farthest from the bottom hole? (The weight of the water and air above the opening is pressing down and making the water flow out the farthest. Water pressure increases with depth.)

EXPLORE

1. Distribute the prepared milk cartons (see Teaching Tips) and string to the groups.
2. Fill the milk carton with water.
3. Have students thread the string through the top hole of the carton and tie it securely so the carton will hang from the string.
4. Tape over each hole with duct tape.
5. Go outside and hang the milk carton from a branch or other sturdy structure.
6. Remove the tape from one corner and watch what happens.
7. Remove the tape from all the corners and watch what happens!

EXPLAIN

What happened when you removed the tape from one hole? (The water poured out of the hole and pushed the carton in the opposite direction, making it turn.)

What happened when you removed the tape from all the holes? (The more holes there were, the faster the carton turned.)

How is this like a turbine? (Some turbines use water or steam that is forced at a high speed through many small holes to turn them around.)

When did the water have potential energy? (when it was stored in the milk carton)

When did the water have kinetic energy? (when the water flowed from the carton, causing it to turn)

Is water a renewable or nonrenewable resource? Why? (Water is renewable because of the continuous water cycle.)

Why is it more beneficial to use water rather than coal or oil to produce energy? (Many of our energy sources are nonrenewable [e.g., fossil fuels like coal and oil]. They cannot be replaced by nature as quickly as they are used so it is important that we use renewable energy sources when possible.)

Why is it important to develop and use alternative energy sources, like water? (We are exhausting our energy resources at an alarming rate, so scientists must continue exploring alternative fuel sources that are efficient and affordable. Also, alternative energy sources are far less polluting than traditional fuels.)

If energy is defined as the ability to do work and work is done every time a force is used to move something, was any work done? (The water was a force that caused the turbine to move, so work was done.)

EXTEND/APPLY

Explain to students that hydroelectricity provides over six percent of the energy used in the world today. Water is a renewable resource, because of the continuous water cycle and it never runs out.

Ask: *Why is it important for our country to further develop alternative sources of energy?* Students should research to find out more about how alternative energy sources are being explored.