NAME: CLASS PERIOD: DATE:

UNIT 5 - RENEWABLES
SECTION 2 - HYDROPOWER

Investigation

WATER WHEEL

Background Information

Water that is elevated has more gravitational potential energy than water at a lower level. As water flows from a higher level to a lower level, its potential energy changes to kinetic energy. The kinetic energy of the moving water can be made to turn a bladed wheel to produce mechanical energy.

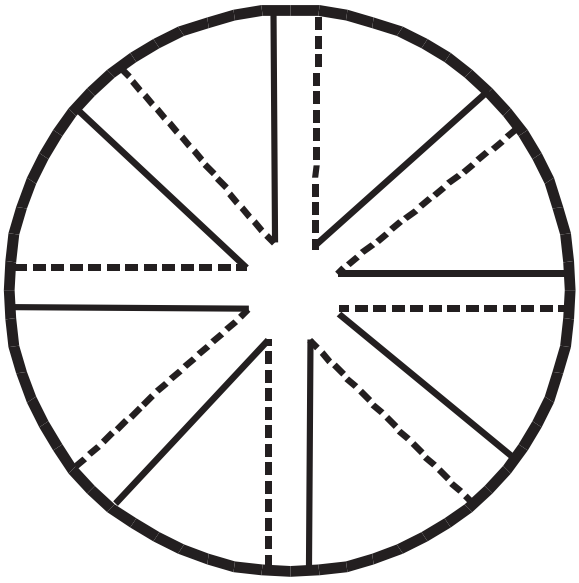
The shaft of the bladed wheel is usually attached through gears to other mechanical devices such as electric generators. In the past, mechanical energy from water wheels was used to grind grain and saw timber. Today, moving water is used primarily to generate electricity.

Power plants are built at the foot of high dams. Powerful jets of falling water shoot through pipes from the reservoir behind the dam. The water hits the blades of dozens of specialized water wheels called turbines, making them turn hundreds of times per minute. These turbines then turn electric generators.

In this activity, you will make a small water wheel that provides enough energy to lift a small weight.

Materials

Aluminum foil pie plate
Scissors
Pencil
Tape
Piece of string about 45 cm long
Eraser
Nut, bolt, or other small weight
Source of running water



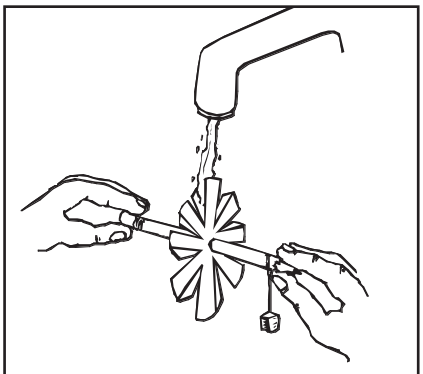
Pie plate illustration

NAME: CLASS PERIOD: DATE:

WATER WHEEL INVESTIGATION CONT.

Procedure

1. Cut out the circular bottom of an aluminum foil pie plate. Make eight equally spaced cuts toward the center of the foil circle. End each cut about 2 cm from the center.
2. Use a ruler to fold one edge of each section of the plate (solid lines in illustration) to make small ledges.
3. Punch a hole in the center of the plate and push a pencil through it. The pencil should fit snugly in the hole. Secure the pencil to the wheel with tape.
4. Hold the wheel under a slow stream of water such as a faucet. Position the wheel so the water hits the blades. Let the ends of the pencil rest lightly between your thumbs and index fingers. The wheel should wind the string onto the pencil, lifting the weight.
5. Vary the speed of the water flowing over the water wheel and observe.
6. Vary the amount of weight attached to the pencil and repeat experiment.



Water-wheel illustration

Observations

1. What happens to the wheel when the water flows quickly? _____

   _____

2. What happens when the rate of flow is reduced? _____

   _____

3. What happens when the weight attached to the pencil is increased? _____

   _____

4. Discuss three things that affect the amount of weight that can be lifted (i.e., the amount of work done) by the water wheel. _____

   _____

   _____

   _____

WATER WHEEL INVESTIGATION CONT.

Conclusion

1. How does this model serve as a model for electric generation through hydropower?

   _____

   _____

2. How could the model be improved? _____

   _____

   _____

3. What energy transformations occurred in this demonstration? _____

   _____

Application

1. Once built, hydropower plants have low maintenance and operational costs compared to other types of power production. So why is such a small amount of hydropower used to generate electricity in some states?

   _____

   _____

2. The world's largest dam, Three Gorges Dam, is under construction in China. The proposed completion date is 2009. The dam will create a 350-mile reservoir and save millions of people from the constant threat of flooding. However, there are problems in relocating the 1.2 million people that live in the area. Give two challenges involved in relocating 1.2 million people.

   _____

   _____

NAME: CLASS PERIOD: DATE:

WATER WHEEL INVESTIGATION CONT.

3. Give two environmental problems that flooding a 350-mile area and establishing a reservoir may cause. _____

_____

Going further

1. In the early 1930s President Franklin D. Roosevelt needed innovative solutions to lift the nation out of the depths of the Great Depression. The Tennessee Valley Authority (TVA) was one of his solutions. By 1942 the TVA had 12 hydroelectric projects under construction, had become the nation's largest electricity supplier, and had employed thousands of workers. TVA dams harnessed rivers, protected the surrounding areas from flooding, improved navigation, made farms more productive, supplied fresh water and drew industries into areas where electricity was provided by the dams. Today there is an outcry among environmentalists in some communities to remove dams. Considering this success story, what environmental and economic reasons can you give for dam removal?

_____

_____

_____

_____