Name _____ Class _____ Date _____

Skills Practice Lab **OBSERVATION**

Converting Water Power into Electricity

Moving water provides mechanical energy that can be used to generate electrical energy, or electricity. In this laboratory activity, you will construct two devices—a galvanometer and a generator. A **galvanometer** is a device that is used to detect small electrical currents. Some galvanometers also measure the amount of electrical current flowing through them. A **generator** is a device that changes mechanical energy into electrical energy through the use of a turbine, an engine, or some other source of mechanical energy. A generator has two main parts: a magnet and coils of wire. The magnetic field of the magnet exerts a force on the coils of wire. Electrical current is then induced in the wire. Once you have constructed the galvanometer and the generator, you will attach a pinwheel to the generator and connect the galvanometer to the generator to demonstrate how energy can be converted.

OBJECTIVES

Construct a simple galvanometer and a simple generator.

Demonstrate how the mechanical energy of moving water can be used to generate an electrical current.

Communicate how the experimental setup showed how energy can be converted from one form to another.

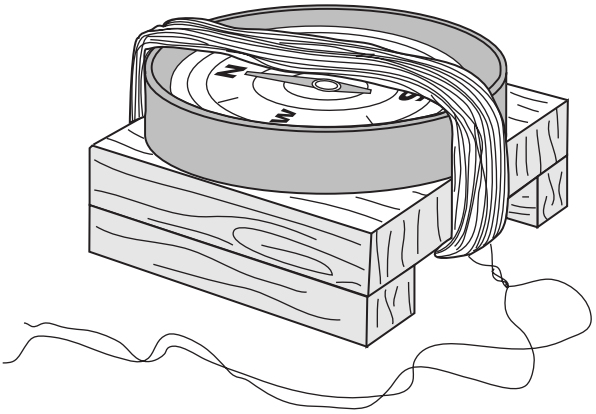
MATERIALS

- bar magnet, small, approximately 2.54 cm long
- cardboard, corrugated
- light-emitting diode (LED)
- directional compass
- dowel, lightweight wood, $\frac{1}{4}$ inch diameter
- glue, waterproof
- hammer
- lab apron
- magnetic wire, #28 or finer, insulated (small spool)
- metric ruler or meter stick
- nail, large, 3-inch (1)
- nails, small, 1-inch (2)
- pinwheel, large, plastic, with handle
- scissors
- tape, double-sided
- tape, transparent
- thumbtacks (4)
- transparency film, sheet (optional)
- water spigot
- wire cutters
- wire strippers
- wood, rectangular, approximately 12 cm x 40 cm
- wood, square, approximately 5 cm x 5 cm
- wood, strips (2), approximately 5 cm x 1 cm each

Procedure

PART I—CONSTRUCTING A SIMPLE GALVANOMETER

1. Use the double-sided tape to securely affix the directional compass to the square of wood. Tape the two wood strips to the other side of the wood square to elevate the wood block.
2. Measure about 10 cm of magnetic wire, but leave it on the spool.
3. Leave the first 10 cm of wire hanging freely as you wrap additional magnetic wire parallel to the north-south axis of the compass, as shown in the figure below. Make about 100 coils of the wire around the block.
4. Use the wire cutters to snip the wire from the spool, again leaving about 10 cm of wire free. Use the wire stripper to carefully strip the insulation from these 10-cm lengths of wire. Twist the bare wires together as shown in the figure below.



PART II—CONSTRUCTING A GENERATOR

5. Glue the bar magnet to one end of the dowel. Allow the glue to dry completely.
6. Wrap the other large nail with approximately 1000 turns of the magnetic wire. Leave the nail head, as well as the bottom centimeter of the nail, unwrapped, as shown in the figure on the next page. Again, leave about 10 cm of wire free on either end of your coil. Strip and twist the free ends of wire as you did for the galvanometer.
7. Use the hammer to drive this coil into the center of the wood rectangle. Hammer the two small nails about 5 cm from the coil as shown in the figure.
8. Wrap the free ends of the wire around the two small nails and secure the light-emitting diode between them as shown. The diode will light up when a current flows through it.
9. When the glue holding the magnet to the end of the dowel has completely dried, remove the wheel of the pinwheel and glue it securely to the other end of the dowel. Secure the wheel and the magnet with a small piece of tape, if necessary.

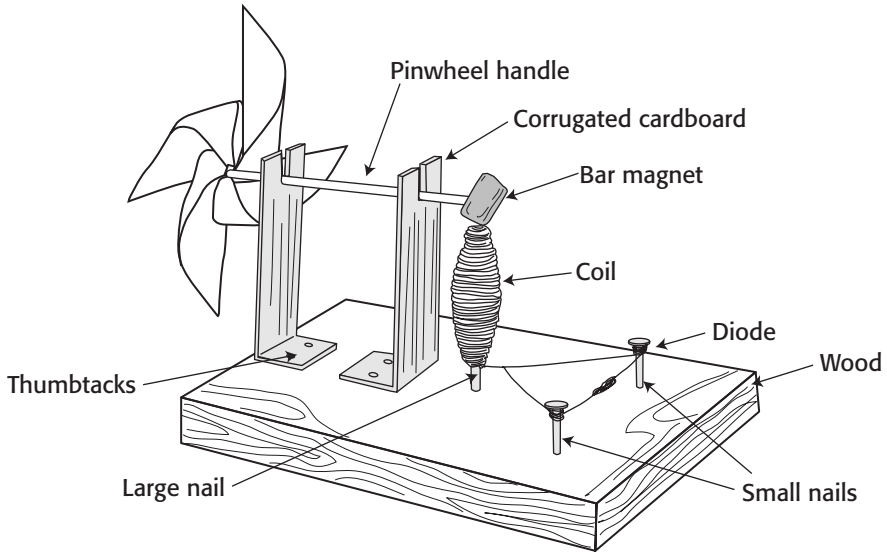
10. Carefully put the pinwheel-dowel shaft aside.

11. Cut two 20-by-5 cm strips of corrugated cardboard.

12. Use the scissors to cut a small notch into one end of each corrugated cardboard strip as shown in the figure below.

13. Bend the other end of each strip of cardboard to form an L. Use the pinwheel-nail shaft to determine where to bend the cardboard. Note that the magnet on the end of the shaft must be as close as possible to the coil, but must be able to turn freely.

14. Use the thumbtacks to secure the cardboard strips onto the wood rectangle as shown.



PART III—PUTTING IT ALL TOGETHER

15. Connect the free ends of the galvanometer wires to the two small nails of the generator, making sure that the compass is about 35 cm from the magnet.

16. Align the north-south axis of the compass with the coil of the generator.

17. Insert the pinwheel shaft into the notches of the cardboard strips, making sure that the magnet is directly above the coil and free to turn, as shown in the figure.

18. Secure the shaft between the cardboard strips with transparent tape. Put one piece of tape around the shaft on either side of the cardboard notches.

19. With a partner, take your entire setup to the sink. Have a third student turn on the spigot to produce a steady, moderate stream of water. Put the pinwheel under the spigot and note what happens to the compass needle.

Note: If your generator does not produce any electrical current, check to see that all of the wires are correctly and securely connected. If your setup still doesn't work after you have checked all of the wires, consult with your teacher.

Analysis

1. **Describing Events** How was electricity generated in this experiment?

2. **Describing Events** How do you know that your setup generated electricity?

Conclusions

4. **Applying Conclusions** How would increasing the flow of water over the pinwheel affect the amount of electricity generated?

5. **Evaluating Methods** Would your results have differed if the coil rather than the magnet were the rotating part of your generator? Explain.

6. **Drawing Conclusions** Write a paragraph that explains, in terms of energy, how electricity was generated and detected in this activity.