Experiment
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PRELIMINARY ACTIVITY FOR

Wind Energy

Power from the wind has become an increasingly popular option for electricity generation. Unlike traditional energy sources such as coal, oil, and gas that contribute large quantities of carbon dioxide to the atmosphere, wind power relies on a non-polluting, renewable, ever-present resource—the wind. In recent years, the cost of harnessing energy from the wind has become more affordable making it a viable alternative for many communities.

A wind turbine generally consists of a two- or three-bladed propeller made of aluminum or fiberglass mounted on the top of a tall tower. It converts energy from the mechanical energy of moving air to electrical energy by means of a generator. The wind causes the shaft of the turbine to spin which in turn causes a generator to produce electricity.

In the Preliminary Activity, you will determine the power output of a wind turbine that you build. You will use a small motor as a generator and a pinwheel as the turbine. The power output of the pinwheel can be determined by measuring the current and voltage produced by the motor. Power is determined using the relationship

$$P = V I$$

Power = voltage × current

Where power has units of watts (W), voltage has units of volts (V), and current has units of amperes (A).

After completing the Preliminary Activity, you will first use reference sources to find out more about wind power before you then choose and investigate a researchable question. Some topics to consider in your reference search are:

- wind energy
- wind turbines
- renewable energy

PROCEDURE

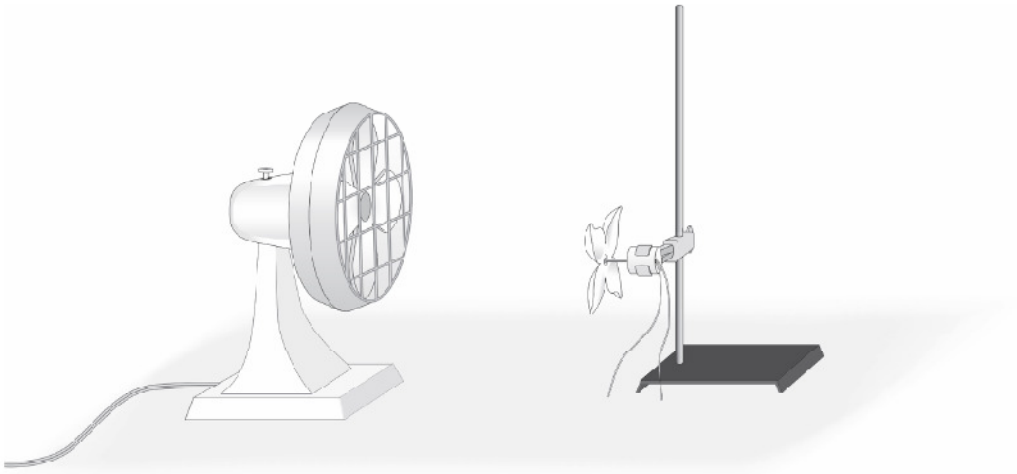

Figure 1

1. Cut out the square pinwheel design by cutting along all of the lines on the template. Cut out the hole in the center of the pinwheel and on the end of each of the blades using the 1-hole punch. Push the straw through the center of the pinwheel. Carefully bring each of the blades in toward the center of the pinwheel and thread the straw through each of the blades. Be careful not to tear the paper. Place a bit of clay on the end of the straw to keep the blades from spinning off the straw. Put a piece of tape or a plastic tubing clamp on the straw behind the pinwheel to keep the paper from sliding.
2. Put the propeller shaft adapter on the shaft of the motor. Insert the propeller shaft adapter into the end of the straw. You may wish to use a plastic tubing clamp to secure the straw to the shaft. Secure the motor to the ring stand using a utility clamp as shown in Figure 1.
3. Connect a Current Probe and a Voltage Probe to the data-collection interface.
4. Connect the motor, 1-Ω resistor, wires, and clips as shown in Figure 2. Take care that the red lead from the motor and the red terminal of the Current Probe are connected.
5. Since the direction of spin of the pinwheel depends on its design, you will need to check to see that both the current and voltage readings are positive.

   a. Blow on the pinwheel.

b. Look at the live readouts and note whether either reading is negative or zero.
c. If the current reading is negative, disconnect the alligator clips from the wires on the motor and switch them.
d. If the voltage reading is negative or zero, unclip the voltage probe clips and switch them.

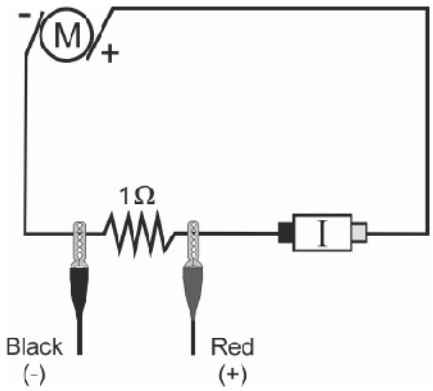

Figure 2

6. Zero both probes by choosing Zero from the Experiment menu of Logger *Pro* or Zero from the Setup menu of EasyData. This sets the zero for both probes with no current flowing and no voltage applied.
7. Place the pinwheel about 15 cm in front of the fan. Turn on the fan to the high setting. Wait for 60 seconds until the fan reaches a constant velocity.
8. Start data collection.
9. Stop data collection after about 30 seconds.
10. Use the Statistics function to determine the mean current and mean voltage readings. Record these values.

QUESTIONS

1. Calculate the power output of the turbine (in W) using the equation given in the introduction above.

2. What are some characteristics of an ideal location to build a *wind farm*, a grouping of many wind turbines? What makes these characteristics ideal?

3. What are some advantages of using wind power over power from traditional means such as fossil fuels? What are some disadvantages?

4. List at least one researchable question for this experiment.

Vernier Lab Safety Instructions Disclaimer

THIS IS AN EVALUATION COPY OF THE VERNIER STUDENT LAB.

This copy does not include:

- **Safety information**
- **Essential instructor background information**
- **Directions for preparing solutions**
- **Important tips for successfully doing these labs**

The complete *Investigating Environmental Science through Inquiry* lab manual includes 34 inquiry-based labs and essential teacher information. The full lab book is available for purchase at:
www.scientrific.com.au