

# Can wind be used as a source of energy?

**Overview:** Construct your own windmill and use it to collect paper clips under its own power. In the process you'll learn important concepts about alternative energy and the growing importance of renewable resources like wind power.

**What to Learn:** Pay attention to how the sun allows wind to form, and the importance of wind in our future's energy needs and consumption.

## Materials

- Pinwheel (can be purchased or made from construction paper)
- Paper clips
- Tape
- Small shoe box (children's size)
- Electric fan
- Lightweight string (about 4 feet long)
- Plastic straw (longer than the width of the shoe box)
- Hole punch

## Lab Time

1. Use a hole punch to punch holes in the opposite sides across the width of the cardboard shoe box. Use the narrow sides of the box so the two holes are less than 6 inches (15 centimeters) apart. Make sure the holes are directly opposite each other. Place a plastic straw through the holes. Enlarge the holes if you need to.
2. Use the blades from a pinwheel or cut and fold a square piece of construction paper into the shape of a pinwheel. Attach the blades to one end of the straw.
3. Partially unfold a small paper clip and insert it into the larger end of the straw. Push the straightened end of the paper clip through the center of the pinwheel. Bend this end of the paper clip and tape it to the outside of the pinwheel.
4. Set the fan on a table or countertop. Hold the shoebox so that the pinwheel is free to turn. Have an adult plug in and turn on the fan. Move the windmill box to direct the breeze from the fan toward the blades of the pinwheel. Move the box until you find the best angle of the fan to the pinwheel so that the blades turn freely.
5. Turn off the fan. Tape one end of the string to the side of the straw with no pinwheel just outside the box, and wrap the string around the straw a few times. Tie the other end of the string to a paper clip. Attach five other paper clips to the paper clip tied to the string. Allow the string to hang down so that the paper clips on the end of the string rest on the floor.
6. Now, you will test to see if your windmill can convert wind power to do work and lift the paper clips off the ground. Turn on the fan and hold the box where you did before to make the pinwheel turn. Record all your observations and data in the worksheet.

# Wind Energy Observations

1. Does the windmill turn the straw?
2. Does the string wrap around the straw as the straw turns?
3. What happens to the paper clips?
4. How is energy being converted by your windmill?

## Reading

One way to store the energy produced by a windmill is to lift a weight. When the weight is allowed to fall, work can be produced. Weights in a grandfather clock are used to store energy and can run a clock for a week or longer. A windmill's energy can be used to pump water to a storage area at a higher elevation. Later, this water can be allowed to fall through a turbine which turns a generator and produces electricity.

Electricity can also be produced directly from wind power. The shaft, or rod to which the windmill blades are attached, can be used to turn a generator. A generator or dynamo is used to convert mechanical energy into electrical energy. Power conversion units can change the direct current that wind generates to an alternating current. The alternating current can be fed directly into utility lines and used in our homes.

The sun is the original source of wind power. Without the sun to heat the earth, there would be no wind. The energy of the sun heats the earth, but all parts of the earth are not at the same temperature. These differences in temperature are responsible for global and local patterns of wind. For example, during the day a constant wind blows from the sea toward the land along coastal regions. Air above the hotter land rises and cooler, heavier air above the ocean moves in to take its place.

The power of the wind can be harnessed to do work. The wind has been used to move sailing ships. The wind has enough power to move ships across oceans and around the world. Windmills have been used for pumping water and turning stones to grind grain. Millions of windmills have been used on the plains of America, Africa, and Australia to pump water from deep wells for livestock and humans.

In this century, windmills or wind engines have been used to generate electricity. More than 15,000 wind engines were installed in California in the 1980s. These wind engines have the capability to produce up to 1.5 billion watts of electricity. In California in 1987, wind was used to produce as much electricity as the city of San Francisco uses in an entire year.

The United States has large reserves of coal, natural gas, and crude oil (which is used to make gasoline). However, the United States uses the energy of millions of barrels of crude oil every day, and it must import about half its crude oil from other countries.

Burning fossil fuels (oil, coal, gasoline, and natural gas) produces carbon dioxide gas. Carbon dioxide is one of the main greenhouse gases that may contribute to global warming. In addition, burning coal and gasoline can produce pollution molecules that contribute to smog and acid rain.

Using renewable energy--such as solar, wind, water, biomass, and geothermal--could help reduce pollution, prevent global warming, and decrease acid rain. Nuclear energy also has these advantages, but it requires storing radioactive wastes generated by nuclear power plants. Currently, renewable energy produces only a small part of the energy needs of the United States. However, as technology improves, renewable energy should become less expensive and more common.

Hydropower (water power) is the least expensive way to produce electricity. The sun causes water to evaporate. The evaporated water falls to the earth as rain or snow and fills lakes. Hydropower uses water stored in lakes behind dams. As water flows through a dam, the falling water turns turbines that run generators to produce electricity.

Currently, geothermal energy (heat inside the earth), biomass (energy from plants), solar energy (light from concentrated sunlight), and wind are being used to generate electricity. For example, in California there are more than 16,000 wind turbines that generate enough power to supply a city the size of San Francisco with electricity.

In addition to producing more energy, we can also help meet our energy needs through conservation. Conservation means using less energy and using it more efficiently.

**Exercises** Answer the questions below:

1. Name three sources of renewable energy:
  - a.
  - b.
  - c.
2. What does the sun have to do with wind?
3. Name three examples of wind power in historical or current usage:
  - a.
  - b.
  - c.

**Answers to Exercises: Can wind be used as a source of energy?**

1. Name three sources of renewable energy: (solar, hydropower, biomass, wind, geothermal)
2. What does the sun have to do with wind? (creates areas of higher and lower pressure air by heating them, which makes the air move as wind)
3. Name three examples of wind power in historical or current usage: (windmills, sailing, electricity)