# TURBINE POWER

## TOPIC:

Harnessing Wind Power

## INTRODUCTION:

Windmills were once used to drive machinery for grinding corn and pumping water. Because they would not work when there was no wind, however, windmills were unpredictable and so were eventually replaced by steam engines and electric motors. Today, as sources of power such as gas and oil are being used up, renewable energy sources such as wind, wave, and solar power are increasingly being tapped. Wind power, in particular, is successfully being used for supplying electricity to remote areas and for small-scale users. In this project you will construct a model wind turbine.

## TIME NEEDED:

40 minutes

## MATERIALS:

4 in. x 6 in. index card
sharpened pencil
unsharpened pencil
2 clothespins with spring action
2 strong straight pins, at least 1½ in. long
modeling clay
30-cm length of thread
metric ruler
drafting compass
scissors
glue
hand-held hair dryer

*Safety Precautions*

Please click on above link to view our safety guidelines.

## PROCEDURE:

1. Draw a square 10 cm x 10 cm on the card. Then draw in the lines that bisect each side and the two diagonals.
2. Using the compass, draw a circle with a radius of 5 cm inside the square, and cut out the circle.
3. Draw a second circle with a radius of 2 cm in the center of the first circle.
4. With the point of the compass, make a hole in the center of the circle. Carefully push the sharpened pencil through this hole to enlarge it. (See figure 1a.)
5. Remove the pencil and cut along the radial lines on the circle of card to the edge of the inner circle.
6. Gently give each blade of the turbine wheel a slight twist so that the blades fan out. (See figure 1b.)
7. Tie a 30-cm length of thread to the unsharpened pencil and wind it around the pencil. Attach a small ball of modeling clay (about the size of a pea) to the free end of the thread.
8. Apply a thin layer of glue, about 1 cm long, around the shaft of the pencil at its midpoint. Immediately push the pencil back through the central hole of the pinwheel, so that the paper is in contact with the glued part of the pencil's surface, and hold it steady for a few minutes while it dries.

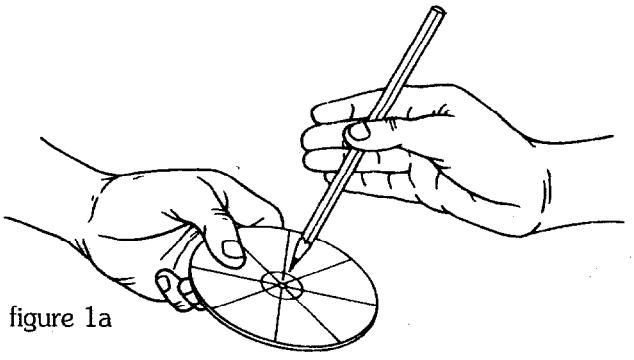

figure 1a

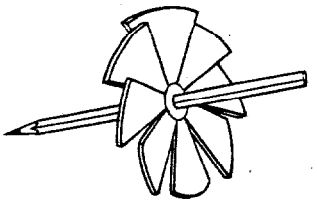

figure 1b

9. Carefully push a straight pin into each end of the pencil and secure the pins in the holes of the clothespins. (The straight pins should not be a tight fit; the clothespins must be able to revolve freely.) This will be your turbine. (See figure 2.)
10. Anchor the "legs" of the clothespins in pieces of modeling clay and set up the whole turbine near the edge of a table. (Press the modeling clay onto the table surface so that the turbine is securely attached.) Unwind the thread about halfway and let the clay "pea" at its end hang over the edge of the table.
11. With your lips approximately 10 cm from the turbine, blow gently on the turbine blades in one direction.
12. Repeat step 11 from the other side of the turbine.
13. Set the hair dryer to its lowest setting and switch it on. Carefully and gradually bring it up to the turbine blades at a slight angle until it blows on the blades. (See figure 3.)
14. Repeat step 13 from the other side of the turbine.

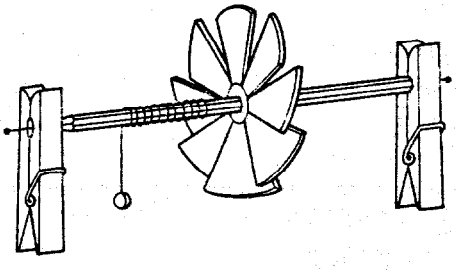

figure 2

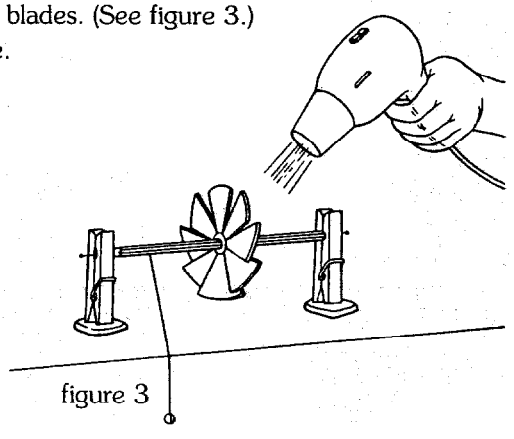

figure 3

# ANALYSIS:

1. What happened to the turbine when you blew on it in step 11? What happened to the clay "pea" at the end of the thread?
2. What happened to the turbine and the clay "pea" when you blew on it from the other side?
3. What happened to the turbine when you directed the hair dryer at it in step 13? What happened to the clay "pea" at the end of the thread?
4. What happened to the turbine and the clay "pea" when you directed the hair dryer at it from the other side?
5. Based on your answers to questions 1 to 4, what use do you think could be made of the power in the rotating shaft?
6. What advantages do you think wind power could have over other forms of power generation?
7. Can you think of any disadvantages of wind power?
8. If you could build a large wind turbine of this type, where would you locate it in order to generate the most power (*e.g.*, on a hill, on a beach, in a forest)? Why?

# OUR FINDINGS:

Click on above link to see what we found.

# Our Findings

## VII. ENERGY PROJECTS

### 7.003 Turbine Power

1. The turbine turned and the clay "pea" moved upwards as the thread coiled around the pencil.
2. The turbine turned in the opposite direction to that noted in 1. The clay "pea" moved downwards as the thread uncoiled around the pencil.
3. The same as in 1 except that the turbine moved faster and the clay "pea" was lifted more rapidly.
4. The same as in 2 except that the turbine moved faster and the clay "pea" was lowered more rapidly.
5. The power in the rotating shaft could be used to lift objects or, by connecting it to a generator, to produce electricity.
6. One advantage of wind power is that it has no impact on the environment apart from the presence of the turbines themselves—it does not produce any pollution or use any valuable fossil fuels. Another advantage is that it is renewable—it cannot be used up.
7. One disadvantage is that it depends on a constant "supply" of wind, and so is unpredictable.
8. A good location would be on a hill exposed to regular high winds.

# SPECIAL SAFETY NOTE TO EXPERIMENTERS

Each experiment includes a short list of special safety precautions that are relevant to that particular project. However, these do not include all of the basic safety precautions that are necessary whenever you are working on a scientific experiment. For this reason, it is absolutely necessary that you read, copy, and remain mindful of the General Safety Precautions that follow this note.

Experimental science can be dangerous, and good laboratory procedure always includes carefully following basic safety rules. Things can happen very quickly while you are performing an experiment. Things can spill, break, even catch fire. There will be no time after the fact to protect yourself. Always prepare for unexpected dangers by following basic safety guidelines the *entire* time you are performing the experiment, whether or not something seems dangerous to you at a given moment.

We have been quite sparing in prescribing safety precautions for the individual experiments. We made this choice for one reason: We want you to take very seriously every safety precaution that is printed in this book. If you see it written here, you can be sure that it is here because it is absolutely critical to your safety.

One further note—The book assumes that you will read the safety precautions that follow, as well as those at the head of each experiment you are preparing to perform, and that you will *remember* them. Except in rare instances, these precautions will not be repeated in the procedure itself. It is up to you to use your good judgment and pay attention when performing potentially dangerous parts of the procedure. Just because the book does not say BE CAREFUL WITH HOT LIQUIDS or DON'T CUT YOURSELF WITH THE KNIFE does not mean that you should be careless when simmering water or stripping an electrical wire. It does mean that when you see a special note to be careful, it is extremely important that you pay attention to it.

If you ever have a question about whether a procedure or material is dangerous, wait until you find out for sure that it is safe.

# GENERAL SAFETY PRECAUTIONS

Accidents caused by carelessness, haste, insufficient knowledge, or taking unnecessary risks can be avoided by practicing safety procedures and being alert while conducting experiments. Be sure to check the experiments in this book for additional safety regulations and adult supervision requirements. If you will be working in a lab, do not work alone.

PREPARE:
—Clear all surfaces before beginning experiments
—Read the instructions before you start
—Know the hazards of the experiments and anticipate dangers

PROTECT YOURSELF:
—Follow the directions step-by-step; do only one experiment at a time
—Locate exits, fire blanket and extinguisher, master gas and electricity shut-offs, eye wash, and first-aid kit
—Make sure there is adequate ventilation
—Do not horseplay
—Wear an apron and goggles
—Do not wear contact lenses, open shoes, loose clothing, or loose hair
—Keep floor and work space neat, clean, and dry
—Clean up spills immediately
—Never eat, drink, or smoke in laboratory or work space
—Do not eat or drink any substances tested unless expressly permitted to do so by a knowledgeable adult

USE EQUIPMENT WITH CARE:
—Set up apparatus far from the edge of the desk
—Use knives and other sharp or pointed instruments with caution
—Pull plugs, not cords, when removing electrical plugs
—Don't use your mouth to pipette; use a suction bulb
—Clean glassware before and after use
—Check glassware for scratches, cracks, and sharp edges
—Clean up broken glassware immediately
—Do not use reflected sunlight to illuminate your microscope
—Do not touch metal conductors
—Use only low voltage and current materials such as lantern batteries
—Be careful when using stepstools, chairs, and ladders

USING CHEMICALS:
—Never taste or inhale chemicals
—Label all bottles and apparatus containing chemicals
—Read labels carefully
—Avoid chemical contact with skin and eyes (wear goggles, apron, and gloves)
—Do not touch chemical solutions
—Wash hands before and after using solutions
—Wipe up spills thoroughly

HEATING SUBSTANCES:
—Use goggles, apron, and gloves when boiling water
—Keep your face away from test tubes and beakers
—Never leave apparatus unattended
—Use safety tongs and heat-resistant mittens
—Turn off hot plates, bunsen burners, and gas when you are done
—Keep flammable substances away from heat
—Have fire extinguisher on hand

GOING ON FIELD TRIPS:
—Do not go on a field trip by yourself
—Tell a responsible adult where you are going and maintain that route
—Know the area and its potential hazards, such as poison plants, deep water, and rapids
—Dress for terrain and weather conditions (prepare for exposure to sun as well as to cold)
—Bring along a first-aid kit
—Do not drink water or eat plants found in the wild
—Use the buddy system; do not do outdoor experiments alone

FINISHING UP:
—Thoroughly clean your work area and glassware
—Be careful not to return chemicals or contaminated reagents to the wrong containers
—Don't dispose of materials in the sink unless instructed to do so
—Wash your hands
—Clean up all residue and put in proper containers for disposal
—Dispose of all chemicals according to all local, state, and federal laws

BE SAFETY CONSCIOUS AT ALL TIMES