Winding Up With Wind

Unit III Matter & Energy

Name: _____

Date: _____

Per: _____

Pre-Lab Discussion

Wind power is an ancient energy source. The earliest ships used the wind to carry them across seas. The first windmills were built in Persia (now Iran) in the sixth century A.D. They raised water from rivers. Later, windmills were used to run a large stone wheel that round grains.

Today, huge windmills, or wind turbines, generate electricity. The wind turbines are grouped in clusters called wind farms. Most wind farms are in California, located in windy mountain passes. California wind farms produce enough electricity to power all the homes of San Francisco. By the middle of the twenty-first century, experts think wind power could supply up to one-fifth of the electricity used in the United States.

In this investigation, you will design blades for a windmill, build a model windmill, and measure its power output.

1. What kind of energy does wind have? Give reasons for your answer.
   _____
2. How do you calculate Power? May have to refer to text!
   _____

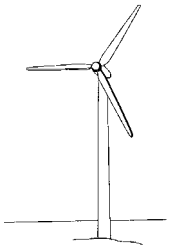
Problem: How can you design a windmill and test its power output?

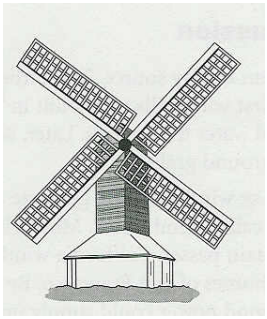
Materials: Windmill base, paper, cardboard, white glue, scotch tape, pushpins, string, thread, paper clips, stop watch, meter stick, balance, plastic straw.

Procedure:

Part A: Design Blades

1. Brainstorm a list of features that you need to consider in designing windmill blades. Look at pictures of different types of windmills, both old and modern in design.
2. Choose the materials you will use for your windmill blades.
3. On a separate sheet of paper, draw and describe how you will construct the blades and attach them to the windmill base. Have the teacher approve your design. (Hint: consider the tilt of your blades.)
4. Construct your windmill blades and attach them to the base.
5. Try, using an electric fan for wind. Hold the windmill about 30 cm from the fan.





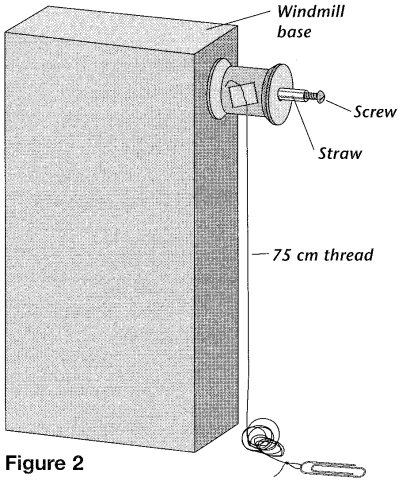


Figure 2

Part B: Measure Power Output

1. Tape a piece of thread, about 75 cm long, on you windmill's spool. Attach a paper clip to the other end of the string, as shown in the picture.
2. Place your windmill at the edge of your lab bench so that the paper clip is suspended in air. See if your windmill can lift the paper clip by winding up the thread on the spool.
3. Add more paper clips until you reach the maximum capacity for your windmill.
4. Measure the length of the thread, from the spool to the top of the paper clips. Record this length in the data table on the next page. Use a stopwatch to time how long it takes to loft the paper clips. Record the time.
5. Remove the paper clips and find their mass. Record the mass in the Data Table.

Data Table:

Length of Thread (cm)	
Time for paper clips to be lifted (s)	
Mass of Paper Clips (g)	

Analyze & Conclude:

1. Calculate the potential energy that the paper clips gained when they were lifted. Use the formula:
   Gravitational Potential Energy = **Mass** (g) x **Gravitational acceleration** (980 cm/s^2) x **Height** (cm)

   _____

   Divide your results by 10,000 and the units of your result will be mJ (millijoule, a thousandth of a joule).

   _____

2. Calculate the power that gave the paper clips this energy. Use the formula:

   Power = **Work** (mJ) / **Time** (s)

   The units of your result will be **mW** (milliwatt, a thousandth of a watt)

   _____

3. Did your design work well? Which features of your design do you think were most important?
   _____
   _____
   _____

4. Was gravitational potential energy the only kind of energy that the paper clips got from the windmill? Give a reason for your answer.
   _____
   _____
   _____
   _____

5. Look at the fan you used in the investigation, especially at its blades. Could it be used for a windmill? How could you prove this?
   _____
   _____
   _____

6. In terms of energy conversion, what is the difference between an electric fan and a windmill that generates electricity?
   _____
   _____
   _____
   _____