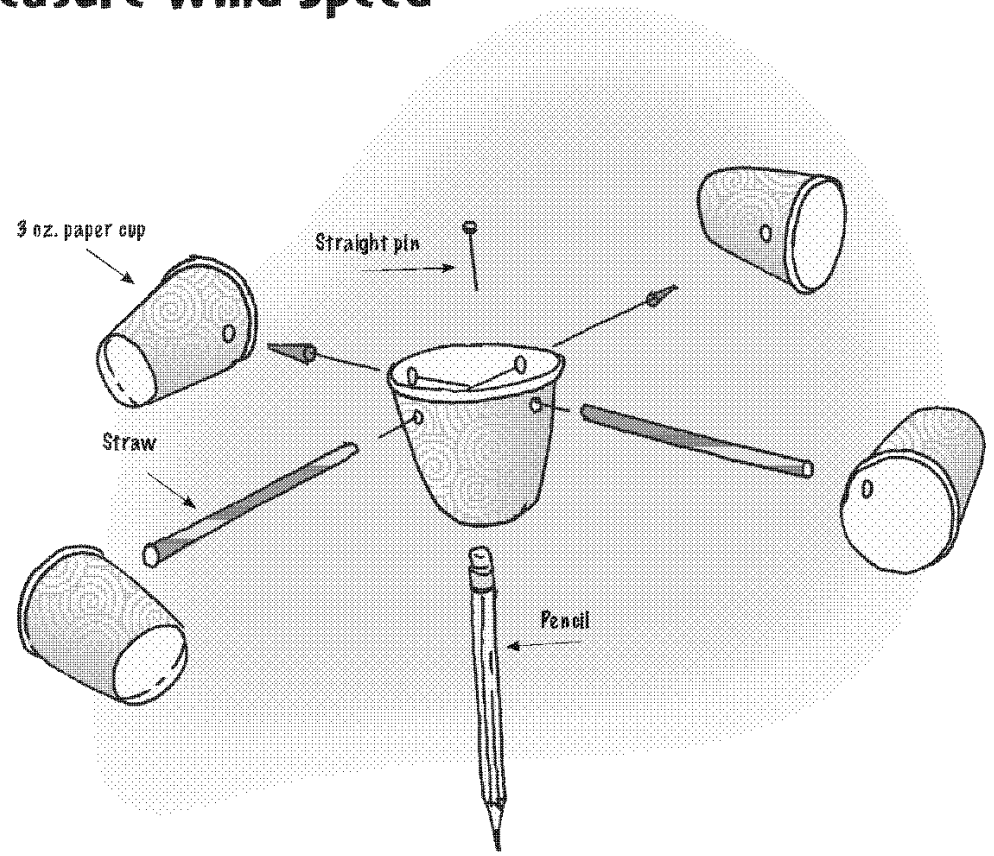
Build an Anemometer to Measure Wind Speed

What You Will Need

- ❒ Five paper cups - Three ounce size
- ❒ Two straight plastic soda straws
- ❒ Straight pin
- ❒ Paper punch
- ❒ Stapler
- ❒ Sharp pencil with eraser
- ❒ Felt tip marker
- ❒ Watch or timer

Warning

Be careful with the straight pin!



How to Do It:

1. Using a paper punch, punch a hole in four paper cups about 1/2-inch below the rim of the cups.

2. Punch four equally spaced holes in a fifth paper cup about 1/4-inch below the rim, and a fifth hole in the center of the bottom of the cup (you will probably need to use the pencil to make the hole in the bottom).

3. Push a soda straw through the hole in one of the first four cups. Flatten the end of the straw and staple it to the side of the cup opposite the hole. Repeat this step with the other straw and another of the first four cups.

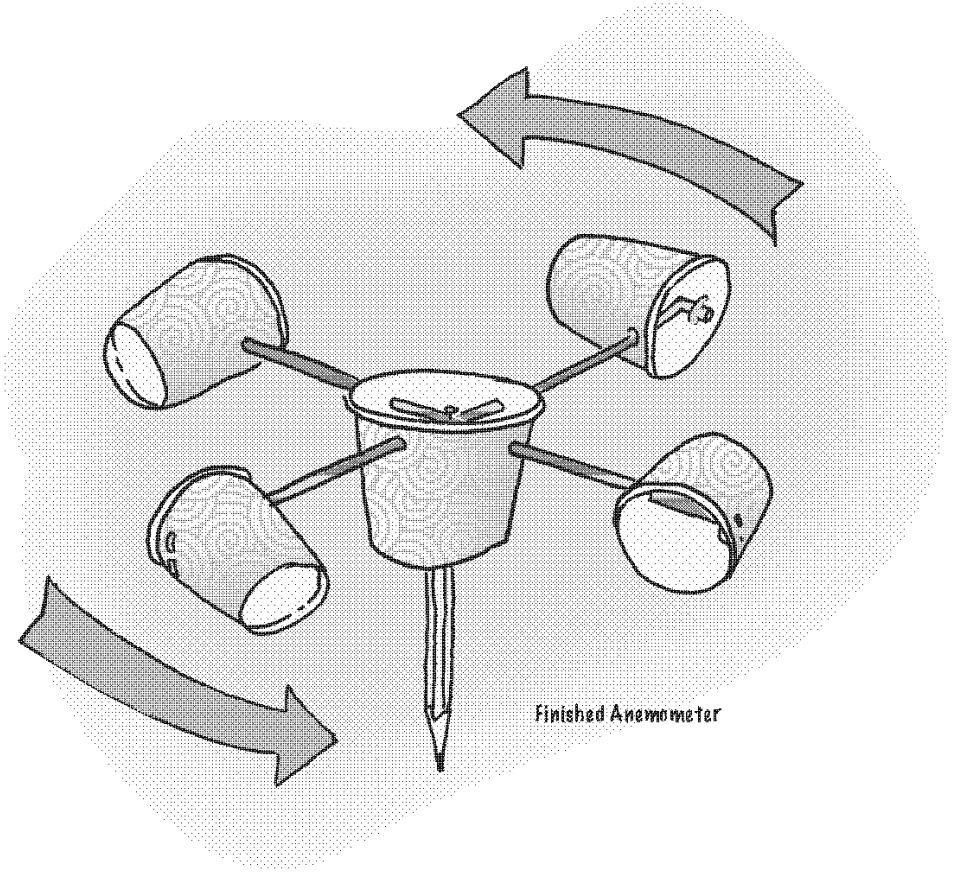
4. Slide one of the cup and straw assemblies through two opposite holes in the side of the fifth cup. Push another one-hole cup onto the straw, and turn this cup so that the open ends of the two cups on the straw face in opposite directions. Flatten the end of the straw, and staple it to the side of the second cup. Measure the distance between the centers of the two cups. This is the diameter of your anemometer.

5. Repeat Step 4 with the remaining cup and straw assembly and the remaining one-hole cup. Before stapling the end of the straw to the last cup, turn the cups so that the open end of each cup faces the closed end of the next cup.

6. Adjust the cup and straw assemblies so that they are centered inside the fifth cup. Push the straight pin through the two straws where they intersect.

7. Push the eraser end of the pencil through the hole in the bottom of the fifth cup, and push the straight pin into the eraser as far as it will go. Now your anemometer is ready to use.

8. To use the anemometer, hold the pencil vertically in a wind, and count the number of revolutions per minute (use the felt tip marker to make a mark on one cup so that you can easily see when the cup has travelled through one complete revolution). To convert revolutions per minute (rpm) into approximate wind speed:



Finished Anemometer

a. Multiply rpm by the diameter (in inches) of your anemometer (measured in Step 4)
b. Multiply the result by 0.003. This is the approximate wind speed in miles per hour.

This calculation does not give exact wind speed, because drag, friction, and other forces also affect the speed at which your anemometer rotates.

CALCULATING WIND POWER

PURPOSE: To calculate wind power

MATERIALS: fan, wind gauge, turbine with benchmark blades, meter stick

FORMULA: Power = ½ $\rho A V^3$, where ρ = air density, A = swept area ($A = \pi r^2$), V = velocity ($\pi = 3.1416$)

$$\text{Watts} = \tfrac{1}{2}\left(\frac{\text{kg}}{\text{m}^3}\right) \times \left(\text{m}^2\right) \times \left(\frac{\text{m}}{\text{s}}\right)^3$$

($\rho \approx 1.2$ kg/m^3 at standard ambient temperature and pressure)

PROCEDURE:

1. Measure the radius of the turbine blade assembly and calculate the area swept by the blades ($A = \pi r^2$)

2. Use the wind gauge to measure the wind velocity at a distance of 1 meter from the fan on low and high speeds. Convert the measurements from miles per hour to meters per second (mps). (1 mile = 1609.344 meter)

   Wind Velocity at Low Speed - 1 meter: _____ mph = _____ mps

   Wind Velocity at High Speed - 1 meter: _____ mph = _____ mps

3. Use the formula above to calculate the power of the wind at both fan speeds.

   Wind Power at Low Speed - 1 meter: _____ W

   Wind Power at High Speed - 1 meter: _____ W

4. Vary the distance from the fan and calculate the power on low and high speeds.

   Wind Power at _____ m (distance A) on Low Speed: _____ W

   Wind Power at _____ m (distance A) on High Speed: _____ W

   Wind Power at _____ m (distance B) on Low Speed: _____ W

   Wind Power at _____ m (distance B) on High Speed: _____ W

RESULTS: Compare the power at different distances from the fan and on different fan speeds.

CONCLUSION: Explain the relationships between the different variables and the power produced.