Measuring the Wind

Estimated Time: 60 minutes

SUMMARY
In this activity, students build their own weathervanes and a tool to measure wind speed, called an anemometer. This activity has students explore engineering design skills to add a home weather monitoring station.

WHAT YOU'LL LEARN

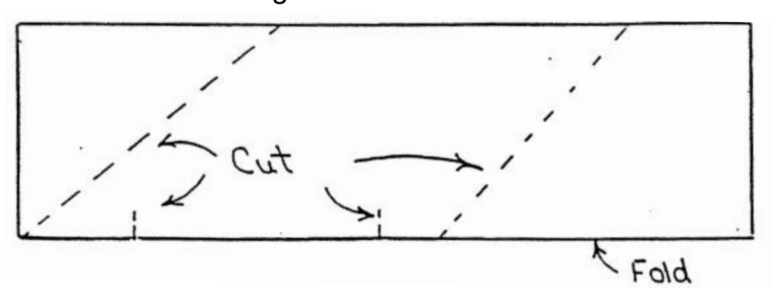
- Basics of the engineering design process
- How to build tools to track air direction and speed

Materials Used	Resources Used
Weather Vane ● 1 index card ● 1 plastic straw ● Scissors ● 1 pencil ● 1 paper clip ● 1 straight pin or tack Anemometer ● 4 plastic straws ● 4 small cups (Dixie cups work great) ● 1 straight pin or tack ● Tape ● 1 pencil	● A related how-to for anemometers: https://www.youtube.com/watch?v=Af0LB3abBsk ● More on the Beaufort Scale: https://www.youtube.com/watch?v=WwDNWm6IEVw ● National Weather Service's official Beaufort Scale: https://www.weather.gov/mfl/beaufort

WHAT TO DO

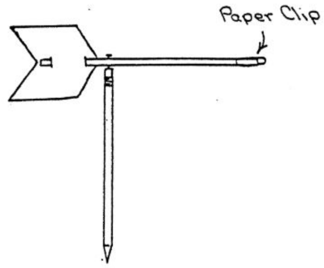
Making a Weathervane

1. Cut the index card into an arrowhead shape. This can be done by folding the card in half lengthwise (hot dog style) and cutting diagonally twice as seen below. Note the 2 additional cuts on the folded edge.



2. Unfold the card and slide the straw through the slits.
3. Attach the paper clip to the end opposite the card on the straw.
4. Balance the straw on your finger. When you find the balance point, push the pin through the spot where your finger was.

5. Push the pin into the eraser of the pencil. Your final product should look like the diagram below. Turn your weathervane so it is pointing in the direction of the wind.



Making an Anemometer

1. Arrange four (4) plastic drinking straws to form a cross, overlapping about an inch, and tape them together at the center.
2. Attach the top side of one drinking cup to the end of each straw with either a staple or tape so the open ends of the cups all face the same direction with respect to the straws (facing right of the straw it is attached to).
3. Push a straight pin through the center of the straws into an eraser on the end of a pencil. This provides the axle, just like it did with the weathervane.
4. Mark one of the cups; this will be the one they use for counting when the anemometer spins.
5. Blow on the anemometer or turn an electric fan on low to make sure that it spins easily.
6. Use the Beaufort chart on the last page of this activity to determine the approximate wind speed in knots. This scale was developed by Sir Francis Beaufort of the United Kingdom Royal Navy in 1805.
7. To measure wind speed with the anemometer, hold the anemometer in a place that has full access to the wind from all directions. Count the number of complete rotations the anemometer completes in one minute by counting the number of times the specially-colored cup goes around. For this type of anemometer, 10 rotations in a minute is about 1 Knot, so 30 rotations in a minute would be about 3 Knots.
8. If possible, repeat the above steps several times, and then determine the average (mean) number of spins per minute to get a more reliable measurement.

TIPS

- For both tools, slightly widening the hole where the pin is pushed through the straws will allow them to rotate more freely.
- Try making different shapes for the back of the weathervane. They work best with card stock paper with some flat space, but it’s pretty easy to slide different papers onto the straw, so give it a try!
- For older students, once they learn the basics of making an anemometer, they can try a variety of shapes and designs. To figure out the number of rotations per Knot, use the original version as the standard. For example, if the original measures 25 rotations in a minute and the new one measures 10, then 10 rotations is 2.5 Knots and each Knot is 10/2.5 = 4 rotations in a minute per Knot.
- If you are tracking weather data (more on this in Temperature and Solar Stills), wind speed and direction can be included in your weather tracking data. Measurements can take the form of Knots, the Beaufort Scale classifications, or the number of rotations to keep track of relative wind speed.

Force	Wind (Knots)	WMO Classification	Appearance of Wind Effects	
			On the Water	On Land
0	Less than 1	Calm	Sea surface smooth and mirror -like	Calm, smoke rises vertically
1	1–3	Light Air	Scaly ripples, no foam crests	Smoke, drift indicates wind direction, still wind vanes
2	4–6	Light Breeze	Small wavelets, crests, glassy, no breaking	Wind felt on face, leaves rustle, vanes begin to move
3	7–10	Gentle Breeze	Large wavelets, crests begin to break, scattered whitecaps	Leaves and small twigs constantly moving, light flags extended
4	11–16	Moderate Breeze	Small waves 1–4 ft. becoming longer, numerous whitecaps	Dust, leaves, and loose paper lifted, small tree branches move
5	17–21	Fresh Breeze	Moderate waves 4–8 ft. taking longer form, many whitecaps, some spray	Small trees in leaf begin to sway
6	22–27	Strong Breeze	Larger waves 8–13 ft., whitecaps common, more spray	Larger tree branches moving whistling in wires
7	28–33	Near Gale	Sea heaps up, waves 13–19 ft., white foam streaks off breakers	Whole trees moving, resistance felt walking against wind
8	34–40	Gale	Moderately high (18–25 ft.) waves of greater length, edges of crests begin to break into spindrift, foam blown in streaks	Twigs breaking off trees, generally impedes progress
9	41–47	Strong Gale	High waves (23–32 ft.), sea begins to roll, dense streaks of foam, spray may reduce visibility	Slight structural damage occurs, slate blows off roofs
10	48–55	Storm	Very high waves (29–41 ft.)with overhanging crests, sea white with densely blown foam, heavy rolling, lowered visibility	Seldom experienced on land, trees broken or uprooted, “considerable structural damage”
11	56–63	Violent Storm	Exceptionally high (37–52 ft.) waves, foam patches cover sea, visibility more reduced	
12	64 or greater	Hurricane	Air filled with foam, waves over 45 ft., sea completely white with driving spray, visibility greatly reduced	