2007

How Fast Does the Wind Blow?

STORM Project

Activity 9
How Fast does the Wind Blow?
Level 1

Objectives:

- The student will construct an anemometer and calculate the wind speed.
- The student will examine a weather map to determine wind speed and wind direction using the weather station model.

National Science Standards: All students should develop an understanding of: abilities necessary to do scientific inquiry, properties of objects and materials, position and motion of objects, properties of earth materials, and changes in earth and sky.

Teacher Background:
Access the website at http://www.uni.edu/storm/activities/level1/. See the activities "Weather Station Plots" and "Which Way Does the Wind Blow?" for additional information before introducing this lesson. Also see the Science Background section at the end of this lesson.

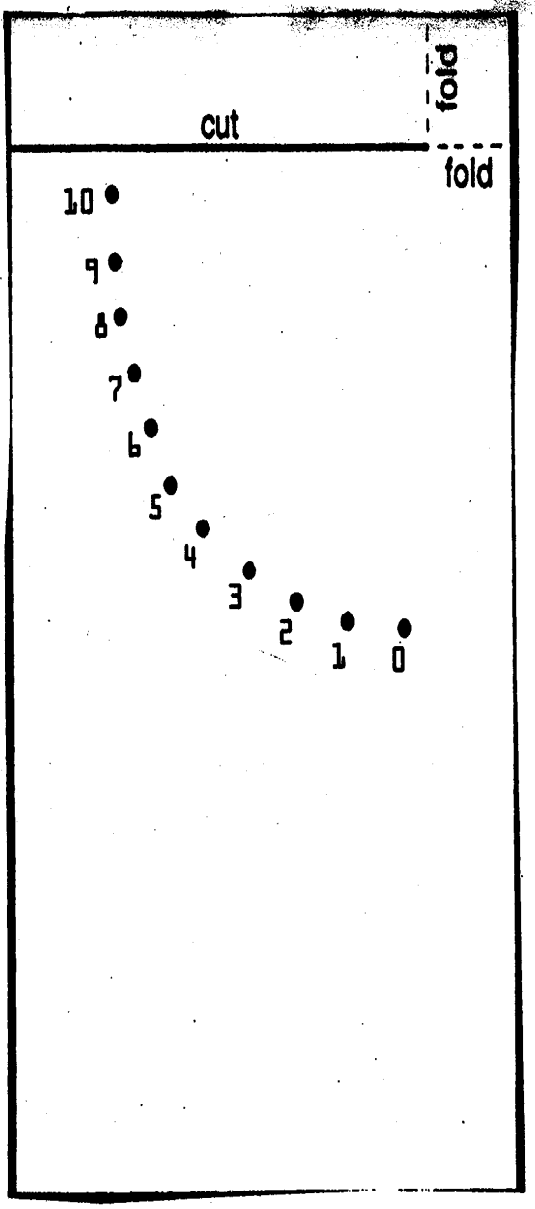
Engage:
Discuss what and how things move with the wind. A good way to start is to look outside at the flagpole or tree branches. Take the students outside and have them observe other signs of wind. Discuss their findings with the class.

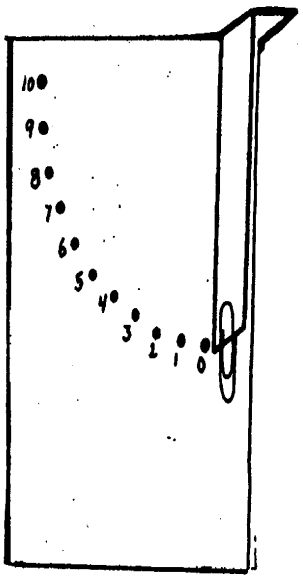
Engage: Part 2 (If your students have never made a wind detector, here is a good activity for them)
Have students make wind speed detectors so they can measure wind speed.

Materials: heavy card stock paper, paper clips
Directions:

1. Copy the wind speed detector on to the card stock paper, one for each student.
2. Cut out the solid line that says "cut".
3. Fold along the two lines marked "fold".
4. Place a paper clip at the end of the cut strip where there are no fold lines. The fold should line up with "0".
5. Go outside to test the wind detector. Hold the meter facing the wind. The paper-clip point will move and show the speed of the wind. Have the students record the speed of the wind in various places.

Tell your students that the faster the wind blows, the farther up the number scale the paperclip pointer moves. The Beaufort Wind Force Scale is used to gauge wind speeds using observations of the wind's effect on trees and other objects. It is often used in monitoring projects because it doesn't require fancy equipment.





BEAUFORT WIND FORCE SCALE: In 1806, Sir Francis Beaufort developed a rating system for accurate recording of wind speed. This system was developed for sailors, but has since been modified for use on land.

BEAUFORT SCALE				
BEAUFORT NUMBER	NAME	WIND SPEED		DESCRIPTION
		MPH	KPH	
0	calm	<1	<1	calm; smokes rises vertically
1	light air	1-3	1-5	direction of wind shown by smoke but not by wind vanes
2	light breeze	4-7	6-11	wind felt on face; leaves rustle; wind vane moves
3	gentle breeze	8-12	12-19	leaves and small twigs in constant motion; wind extends light flag
4	moderate breeze	13-18	20-28	wind raises dust and loose paper; small branches move
5	fresh breeze	19-24	29-38	small-leaved trees begin to sway; crested wavelets form on inland waters
6	strong breeze	25-31	39-49	large branches move; overhead wires whistle; umbrellas difficult to control
7	moderate gale *or* near gale	32-38	50-61	whole trees sway; walking against wind is difficult
8	fresh gale *or* gale	39-46	62-74	twigs break off trees; moving cars veer
9	strong gale	47-54	75-88	slight structural damage occurs; shingles may blow away
10	whole gale *or* storm	55-63	89-102	trees uprooted; considerable structural damage occurs
11	storm *or* violent storm	64-72	103-117	widespread damage occurs
12	hurricane*	>72	>117	widespread damage occurs

*The U.S. uses 74 mph as the speed criterion for a hurricane.

Explore:

1. From the activity website, print off, or display the U.S. Surface Wind-Speed map.
    a. Have your students circle areas of our country that have higher wind speeds, and several areas that have low wind speeds.
2. Also print off or display the US sky cover and winds map.
    a. Have students compare this map to the surface wind speed map.
    b. What do they notice about the number of lines at the end of the wind shaft in areas of lower wind speeds and areas of higher wind speeds? (Some students should observe that in areas of high wind speeds, there are more lines at the end of the wind shaft on the station model. Some will observe that some of the lines are longer than others.)

Explain:

Tell your students that the number of lines at the end of the wind shaft on the station models is an indication of how fast the wind is blowing at that location. On some occasions, the wind direction shaft might even have a triangle on the end. The following chart shows the values associated with the 'wind flags' at the end of the wind shaft. Explain the chart to your class.

Wind speed - A combination of long/short barbs and pennants indicate the speed of the wind in station weather plots rounded to the nearest 5 knots. A large circle drawn around the sky cover symbol indicates a calm wind.

One long barb is used to indicate each 10 knots with the short barb representing 5 knots. At 50 knots, the barbs change to a pennant. For wind speeds higher than 50 knots, long and short barbs are used again in combination with the pennant(s). Study the chart on the next page.

Knots Versus Miles per Hour

Knots is the unit used to express how the speed of wind, aircraft and boats is measured. It is based on naval or nautical terms. Both miles per hour and knots are a speed which is the number of units of distance that is covered for a certain amount of time.

1 mph =1 mile per hour = 5280 feet per hour

1 knot = 1 nautical mile per hour = 6076 feet per hour

1 knot = 1.15 miles per hour

Observed wind speed	Rounded to the nearest 5	Plotted as	Observed wind speed	Rounded to the nearest 5	Plotted as
0-2 knots (0-2 mph)	0 kts		38-42 knots (44-48 mph)	40 kts	
3-7 knots (3-8 mph)	5 kts		43-47 knots (50-54 mph)	45 kts	
8-12 knots (9-14 mph)	10 kts		48-52 knots (55-60 mph)	50 kts	
13-17 knots (15-20 mph)	15 kts		53-57 knots (61-66 mph)	55 kts	
18-22 knots (21-25 mph)	20 kts		58-62 knots (67-71 mph)	60 kts	
23-27 knots (26-31 mph)	25 kts		63-67 knots (73-77 mph)	65 kts	
28-32 knots (32-37 mph)	30 kts		98-102 knots (113-117 mph)	100 kts	
33-37 knots (38-43 mph)	35 kts		102-107 knots (119-123 mph)	105 kts	

1. Have your students compare the two maps again. Have them try to read the wind speeds from the weather model map.
2. Compare these to the wind speeds on the first map. They should be fairly close, but not necessarily exactly the same because the station model indicates a range of wind values.

Extend:

1. Wind streamers show the direction of air movements. These are relatively inexpensive and can be made quickly.
2. You will also need 1 straw or new unsharpened pencil, 2- 4 feet of "1/4" inch wide ribbon, tack or stapler.
3. Staple or tack the ribbon onto the pencil or straw.
4. Go outside and mark the directions "N', "S", "E", and "W" on the sidewalk.
5. Have the students stand outside with the streamer to decide which direction the air is coming from and which direction the air is going.

Evaluate:

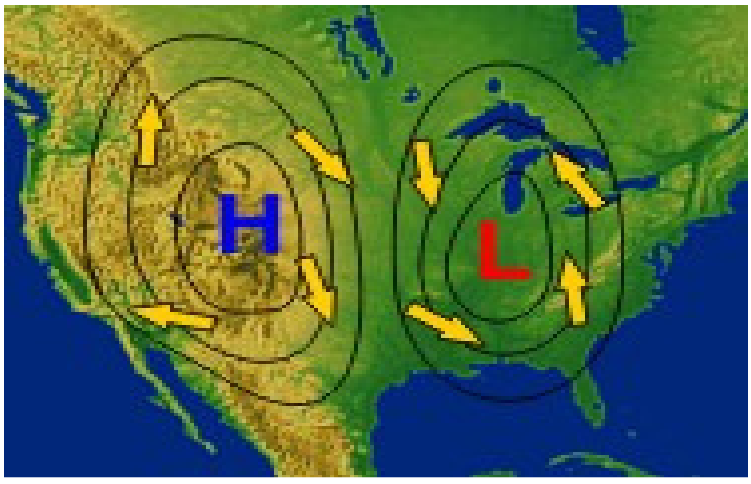
1. Review the station model symbols – especially wind.
2. Log on to the activity website and display the station model map.
    a. Have students figure out wind speeds and directions in several locations by interpreting the symbols.
3. What area of the United States is the windiest? What area has the lowest wind speeds?
4. Display a US Surface Wind-Speed map. Have students select two different sites.
    a. Have students draw a wind shaft with wind flags at the end to indicate the wind speeds.
    b. Record the wind speed for two sites and draw a picture that represents those speeds of wind.

For Further Inquiry:

Ask students how they think wind speeds might change across the country from early morning to the afternoon. Have them design an investigation to answer this or any other question they might have about wind speeds.

Science Background:

You have probably seen a newspaper surface map marked with H's and L's which indicate high and low pressure centers. Surrounding these "highs" and "lows" are lines called isobars. "Iso" means "equal" and a "bar" is a unit of pressure – so an isobar means equal pressure. We connect these areas of equal pressure with a line. Everywhere along each line is constant pressure. The closer the isobars are packed together the stronger the pressure gradient is.



Pressure gradient is the *difference* in pressure between high and low pressure areas. Wind speed is *directly proportional* to the pressure gradient. This means the strongest winds are in the areas where the pressure gradient is the greatest.

Also, notice that the wind direction (arrows) is clockwise around the high pressure system and counter-clockwise around the low pressure system. In addition, the direction of the wind is across the isobars slightly, away from the center of the high pressure system and toward the center of the low pressure system.

