Measuring the Wind

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Purpose: To learn about wind and how scientists accurately describe it

Learning Objectives:
1. Learn that wind is air moving from one place to another
2. Explore how wind moves objects
3. Understand the two variables used to describe wind
4. Understand that the direction of wind is labeled based on the direction the wind is coming from

Next Generation Science Standards (est. 2013):
- PS2.A: Forces and Motion (partial)
- PS3.C Relationship Between Energy and Forces
- ESS3.A: Natural Resources (partial)

Suggested Previous Activity:
What’s Up with Weather Part 1 and 2

Grade Level: 3-8

Time: 45 min

Materials:
- Tag board or manila file folder (or scissors and weather vane cutouts)
- T-pins (office supply store) or straight pins
- Unsharpened pencils with new erasers
- Drinking straws
- Ruler
- Modeling clay or play dough
- Paper plate
- Magnetic compass
- Small piece of paper (~8cm x 8cm)
- Electric Fan
- Optional- Small hand-held fan
- Small paper or plastic cups
- Scissors
- Masking tape
- Optional- String

Safety:
When using the electric fan, make sure students are careful not to get fingers, long hair or other loose items caught in the blade. None of the objects or body parts used in this activity should be close than 6” to the fan at any time. Younger students may also need to have an adult help them with the pins.
Pre-Activity Preparation:
Cut out arrow points that are 5cm long and arrow tails that are 7cm long (see drawing below) Optional- draw arrow point and tail on manila folders for students to cut out.

![Figure 1](image)

Flatten the straw and cut 1cm slits through the entire straw on both ends, centered in the middle of the straw. Make sure these slits are as close to parallel as possible so the arrow point and tail line up when you slide them in.

Introduction:
Wind is moving air. Because air is made up of gases (remember, gases are matter) moving air can displace objects. We can use this fact to measure the direction and speed of wind, based on how it moves something. When meteorologists (scientists who study and predict the weather) describe wind, they start with the direction the wind is coming from. For example a “northerly” wind pushes in air that was previously located to the north. In Wisconsin, if there is a northerly wind that means the air is generally being pushed in from Canada across Lake Superior or the upper peninsula of Michigan.

Procedures:
1. Weather Vane
   a. Give students a pre-cut arrow point and an arrow tail (optional- have them cut these out themselves) and pre-cut straw. Have the students slide the point and tail into the slits on each end.
   b. Tell the students to find the center of the straw using a ruler and have them place a pin through the center parallel to the arrow point/tail (see figure 1 above).
   c. Hand out a pencil to each student and ask him or her to place the pin into the eraser of the pencil. Have them blow on the weather vane to make sure it spins freely. If it doesn’t, they should stretch the holes where the pin sticks through the straw.
   d. Ask them if they can make the weather vane stay parallel to the fan while only holding the pencil (rather than spinning or perpendicular). Allow them to test with their weather vane. They will not be able to do this. To understand
why, hand the students a piece of paper and have them take turns holding it at least 6 inches away from the fan:

i. First, parallel to the front of the fan

ii. Secondly, perpendicular to the front of the fan

e. Have students compare how much the paper bent in the two setups. Which way was it easier to hold? Ask the students what is pushing against their paper (molecules in the air). Help them figure out why the weather vane will eventually stop spinning and stay perpendicular to the fan. Note, students may find it easier to get the weather vane to work if they are further away from the fan.

f. Have the students put the weather vane down.

g. Hand each person a paper plate and a ruler; ask him or her to draw lines on the plate to divide it into quarters (draw lines so it looks like a pizza split into 4 slices).

h. Students should place large piece of clay or play dough in the center of the plate, push the weather vane in the clay and make sure it stands upright.

i. Place the weather vane in front of the fan and ask the students where the wind is coming from. Is it north, south, west, east? Most likely they will not know the wind direction. Point out how meteorologists cannot say “the wind is coming from there” (pointing with their hands), they need to be able to give a direction. If the students know the where the cardinal point are, find out how they know and what they would do if they didn’t know. If they don’t know where wind is coming coming from ask them if they can think of a way of finding out.

j. Have the students put the weather vane down and look at the map on their worksheet. Point out the unlabeled compass in the corner (called a compass rose). Ask them if they can name any directions (you can use hints like, Santa Claus lives in the ______ pole, or the Wizard of Oz has the wicked witch of the _______ and ______.).

k. Let them know that maps usually (but don’t always) have the arrow that points to the top of the page be north. Help them fill in all 4 directions: north (top), south (bottom), west (left) and east (right). For older students, explain that the space in between directions is named after the 2 closest directions (i.e. northwest is between north and west).

l. Give the students a magnetic compass. Have they seen a compass before? What do you think they are used for? Tell them the compass needs to be held parallel to the ground; flat in the palm of the hand or on the table works well. Ask them what letters they see in the compass? What might they represent? The North Pole and South Pole of the earth are magnetic and the compass has a magnet in it with a “north” end (which is attracted to the Earth’s North Pole) and a “south” end. By having the magnet either float
freely or attached loosely to a pinhead, depending on the type of compass you have, the compass is able to align itself to point in the correct direction.

m. Ask the students to set their compass on the worksheet and have them compare the compass’s directions to the worksheets cardinal points. Are they the same or different? If they’re different, how would they have to rotate their paper to make it line up with the compass? Once it is lined up have them point in the direction of things labeled on the map, for example, have them point in the direction of Canada (north).

n. Tell them to get the plate with weather vane and label where the 4 lines reach the edge of the plate with the cardinal directions (N, S, W, E). Make sure the lines are labeled correctly.

o. Repeat placing the weather vane in front of the fan and asking the students where the wind is coming from. Is it north, south, west, east? How can they figure out the cardinal points now that they have compass? Guide them to use the compass to align the weather vane with the correct cardinal points. Make sure students understand the reading from their plate will ONLY be correct if they first make sure the north line is pointing north, south line south, etc.

p. Optional: Take the weather vane outside. Find a relatively open location that doesn’t have buildings or structures blocking the wind. Have the students place the paper plate on the ground and rotate it so that it is aligned with the readings on a compass. One student will hold the paper plate steady while another student stands above it and notes what direction the wind is coming from (the direction the arrow of the weather vane faces). The student on the ground may need to adjust their body so they don’t block the wind. This real-life experience may be difficult as wind can change direction or it may not be strong enough to spin the weather vane.

q. Optional: Students can challenge each other’s skills. One person will play the role of “wind” and the other will be the “meteorologist.” Set the weather vane in the middle of the table and align its directions using a compass. Have the “meteorologist” move away from the table and close his or her eyes. Using a small hand-held fan, “wind” should pick a location on any side of the weather vane and turn the fan on briefly until the weather van has rotated. Then he or she should turn off the fan and return to his or her original seat bringing the fan with him or her. The “meteorologist” returns to the table and needs to figure out what direction the wind was coming from by reading the weather vane. Then trade places and try again.

2. Wind Speed
   a. Direction is one way of describing the wind but often it is helpful to know how strong the wind is as well. Devices that spin in the wind can be useful to show how fast the wind is. The faster the wind blows, the more times an object which can “catch” the wind will spin in given time (for example 10 spins per minute in a light breeze versus 60 spins per minute in a strong
Wind). Meteorologists use a device called an anemometer to measure the speed of wind. An anemometer converts the number of spins it makes per minute to the speed of the winds. Students will be making an instrument that is similar to an anemometer.

b. Give each student the following supplies: unsharpened pencil, 2 straws, 4 small cups, 1 T-pin and tape. Challenge them to make a device that will spin when placed in front of a fan. Ask them which of the objects in front of them will do the best job of “catching” air inside it (the cups). Have the students create an X with the 2 straws and attach them together with a small amount of tape. They should then attach this to the eraser with the pin where the straws intersect (just like the wind vane) and tape the cups so they hang below the ends of the straws. The below drawing is this design shown from above. For younger students, you may want to show them the picture to get them started. Note: allow students to work through the placement of the cups that does the optimum job of “catching” air. In order to visualize the air being caught, you can turn off the fan, attach a piece of string to its face and then turn it on again. Students will then be able to see whether the string is being blown into the cup (along with the air).

c. Have the students place the anemometer in front of a fan and note the difference in rotational speed between the lowest and highest setting on the fan. Ask them if they can make it rotate even slower (they can do this by gently blowing on the anemometer). Reinforce the idea that the reason the anemometer is spinning is because air molecules are getting trapped inside the cup and pushing it backwards. When one cup is pushed backwards, another is pushed forwards and starts catching the wind inside of it. A faster spin means the wind is blowing faster. If there is time, take the anemometer outside and see what it does in the actual wind. In the real world, the wind speed changes often.

Discussion:
Wind is an important piece of information for meteorologists as well as for the average person, for example, strong winds can make a cold day feel even colder (wind chill) in the winter. If your group has created a weather station, add the weather vane to your supplies and take daily readings of wind direction. After you have multiple days or weeks’ worth of readings, look for patterns. What does a strong north wind tend to indicate? (dropping temps) When are winds highest? (when the pressure is changing rapidly, especially when
it is dropping quickly) You can look up additional local wind information on the website of the National Weather Service. www.weather.gov

**Evaluation:**
Set up a weather vane using a magnetic compass to make sure the paper plate directions are accurate. Turn the arrow to point in one of the cardinal directions. Ask the student you are evaluating to tell you what direction the wind would be coming from if the weather vane was pointed in the direction you’ve set. Change the direction for each child. Alternately, you can ask students what makes the wind vane or anemometer spin.

Activities adapted from:
http://scigirlsconnect.org/page/twirling-in-the-breeze