Wind

Introduction

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Before completing these investigations, complete lessons for students to understand air—a gas material that surrounds the Earth, fills space, exerts pressure on its surroundings, and moves. Based on observations of their surroundings and the behavior of a simple instrument they make themselves, students will learn to report two properties of moving air; wind speed and direction. Just as they did for temperature, they can record these observations on their Daily Weather Report.

Young children can easily infer the movement of air by observing its everyday effects on trees, smoke, flags and the ruffling of their hair or a cool breeze on their faces. They will have been familiar with wind from their earliest memories, but they may not necessarily associate this directly with moving air. The movement of large air masses across landscapes and oceans is invisible, but even if it were observable it covers too large an area for young children to actually see and understand.

The idea that air reaches us from different directions at different times may also be new to young children. While they know wind occurs from time to time, they may not notice the different wind directions. It is also unlikely that they will associate different wind speeds and directions with particular weather patterns. Do storms always come from the same direction? Do high winds mean the weather is going to change? Do winds bring hot weather or cold weather, or both? These are some of the questions that young children may have

never asked themselves because their focus in on how the wind is acting on them at a given moment, not over long periods of hours or days.

By the end of this section, students should be able to read much more into the air movements they experience than they do at the start of these investigations.

How can you tell the direction of wind?

Teaching and Learning Focus

To introduce students to ideas about wind and wind speed, they first need to understand that air can move from one place to another. It is easy to see this close up - just fanning the face, for example. Because air is invisible, getting some measure of wind speed is more complex. You can time a person running or read the speedometer of a car moving along a highway, but measuring wind speed requires some methods that are less familiar. For the purposes of formal weather forecasting, wind speed is measured using an anemometer (see below). The wind pushes the cups in a circle, and the number of turns corresponds to the wind speed.

One way to measure wind speed is by observing its effects on objects. In 1805, a British naval officer named Sir Francis Beaufort developed a wind speed scale that refers to the movement of objects. The Beaufort Scale is a good way to introduce students to the concept of wind speed. You may want to show students pictures of the instruments used by professional meteorologists as they collect weather data.
Ask students to recall how they found that air is a material that fills the spaces around us. Remind them that they saw how the air supported objects like small paper planes and how air filled a soft balloon, making it expand and grow harder to the touch.

Materials Needed
For each group of students:

- Clipboards and pencils
- Copies of the Beaufort Wind Scale

Safety

This investigation question is considered generally safe to do with students. Please review the investigation for your specific setting, materials, students, and conventional safety precautions.

Presenting the Investigation Question
Introduce students to the investigation question: "*How can you tell the speed of the wind?*" Have students discuss the question in pairs, then in groups, and then as a whole class. Record their answers on the flipchart.

Have students brainstorm ideas about how to investigate this question:

1. What materials would be needed?
2. What would you have to do?
3. What would be measured?
4. How long would the experiment take?

Assessing What Your Students Already Know

Have students discuss the investigation question, first in pairs, then groups, and then as a whole class:

- How much do they already seem to understand about wind speed?
- What ideas do they have about how the speed of wind could be measured?
- Which of these ideas can be tested?
- What are some of the ways you can make air move?
- How can you show that air moves? (*Students might suggest things like blowing a feather or fanning it with a piece of cardboard.*)
- If they can't see the air, how can we tell if it is moving quickly or slowly? (*After all, if you are running, I can see how quickly you are going.*)
- Provide a variable speed electric fan. Turn it on low, then medium, then high. Have students close their eyes and tell you how it feels on their faces at each setting.
- Next, ask students to open their eyes while you repeat the settings. What did they see? (*Hair blowing, clothes billowing, papers flying off desks, etc.*)
- Finally, ask students to imagine that they cannot hear or see the fan. What clues tell them where the fan is in the room? (*The direction in which objects were blowing*.)

Tell the students that in this investigation they are going to learn to describe the way air moves outside. Tell them they will be making observations of wind speed and direction, and that these are important when we describe the weather conditions. They will record both of these observations on the daily weather charts.

Exploring the Concept

1. Take the class outside to make observations about wind speed. (*You may have to wait for a windy day - or at least for a day with some air movement for this first field observation*). Have students make their observations at some distance from the building to minimize the building's effect on the flow of air.
2. Encourage the students to use the type of environmental descriptors given on the Beaufort Scale, but without making direct reference to the scale. (*If no column of smoke is available and the air feels very still, ask the students to suggest other indicators of calm or light air movements. Suggest looking at the school's flag or the way their loose clothing or long hair reacts. If wind chimes are available in the area, what do the students hear from the chimes? Ask if they feel air moving on their faces. Let them drop dry grass or bits of leaves to see how they are moved by the*

wind as they fall--don't use whole leaves as they will tend to flutter regardless of the wind speed and may be confusing. Tell the students that you will add these suggestions to the Wind Scale when you return to the classroom).

3. If there is a significant breeze, ask the students if it is constant or if it comes in gusts. Turn their attention to the behavior of the trees in particular. (*They will find that the wind often starts at a slow speed then accelerates. Scientists reporting wind speeds generally note the highest speeds observed. For example, "Wind gusts up to 20 miles per hour"*).
4. Ask the students about other things they observe when the wind is at the "moderate breeze" level. (*They might suggest how the flag flaps, how their clothing billows, how their faces feel cold, how the dust from the road blows, and so on.*)
5. Ask the students to imagine a very windy day, maybe even one where winds could damage things. How might they describe the movement of objects in the environment on such a day?
6. Return to the classroom and write some of their observations on sentence strips or large paper. Have the students suggest how those observations can be sequenced to show wind of increasing speed.
7. Have students study a copy of the Beaufort Wind Scale. They should quickly see that it provides an estimate of the wind speed using indicators like smoke columns and tree movements. Be sure that students understand the descriptions given on the table. Have the students add their own observations in the third column where they think they match the speed given on the Beaufort Wind Scale.

Applying Students' Understanding

To assess students understanding of wind speed, ask them to think of different wind situations:

- How can high wind speed can be a problem for humans? (*Students may cite tornadoes, hurricanes, or dust storms. Some may suggest situations where wind affects airplanes or sporting events that are difficult in strong winds*).
  Are there situations where too little or no wind is a problem for humans? If so, what examples can you give? (*Some students might suggest recreational activities that depend upon wind such as sailing, para-gliding or kite flying. Others may suggest that having little wind makes a hot summer day difficult to stand and is a sign that the weather will not be changing soon. Yet others may suggest that machines that depend upon wind, such as water windmills or wind energy generators, may not work*).

Revisiting Investigation Question 1

Complete this investigation question by asking students to reflect on "How can you tell the speed of the wind" and how their answers may have changed as a result of what they have learned.

How can you tell the speed of wind?

Teaching and Learning Focus

Understanding that air comes from different places at different times is quite difficult to appreciate. However, wind direction, like wind speed, is an important part of weather study and forecasting. In this investigation, students will design and build their own wind vane to help make observations about wind direction.

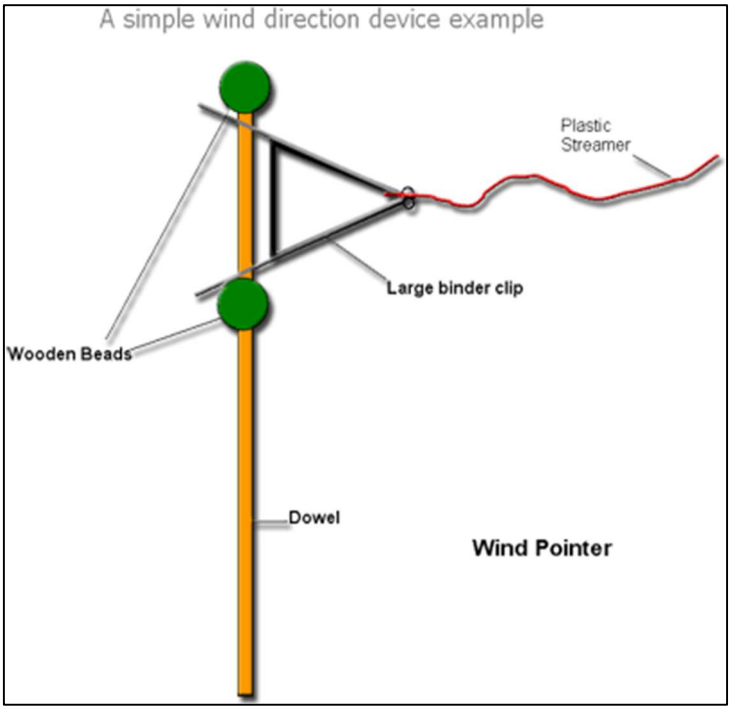
Materials Needed

For each student group:

For wind vane shown in diagram:

- Wooden dowel, about 1 meter (3 feet) long and 2.5 mm (¼ inch) diameter
- Wooden bead that slides onto the dowel, but stays in place*
- Wooden bead that fits snugly on the end of the dowel*
- Large binder clip
- 60 cm (2 feet) strip of lightweight plastic material cut from a plastic trash bag
- Wood glue to hold the beads in place
- A simple magnetic compass

  * tape, clay or glue can be used to adjust the fit of the beads if necessary
- Compass Diagram



For student designed wind vanes, a range of craft materials such as:

- String
- Safety scissors
- Masking tape
- Paper clips
- Construction paper
- Poster-board
- Aluminum foil
- Empty plastic bottles
- Cotton balls
- Small and medium plastic cups
- Thumb tacks
- Rubber bands

Safety

This investigation question is considered generally safe to do with students. Please review the investigation for your specific setting, materials, students, and conventional safety precautions.

Presenting the Investigation Question

Introduce students to the investigation question: "*Where is the wind coming from, and how can you tell?*" Have students discuss the question in pairs, then in groups, and then as a whole class. Record their answers on the flipchart.

Have students brainstorm ideas about how to investigate this question:

1. What materials would be needed?
2. What would you have to do?
3. What would be measured?
4. How long would the experiment take?

Assessing What Your Students Already Know

Have students discuss the investigation question first in pairs, then groups, then as a whole class:

- How much do they already seem to understand about wind direction?
- Do they understand that the wind they observe comes from somewhere and moves on to somewhere else? *(Some students may not have considered this possibility. They know there is wind, but not have thought about air traveling from place to place*).
- Are students aware that the winds they experience can come from different directions at different times? (*You cannot assume that all students know this. To some wind will simply be wind and they may not have ever noticed that it comes from different directions*).
- Have any students seen wind direction indicators or devices? (*Students whose families own and use sail boats may have seen the wind indicator flags at the top of the sail mast. Similarly, students with experience of light aircraft airports may have seen a windsock. Still others may connect this with flags or wind vanes, but most may never have noticed wind indicators*).
- Do students have a working understanding of compass directions? Do they know that North and South are opposites as are East and West? Do they know what a compass is and how to use it to identify directions? *(It may be that many of students have never seen or used a compass - those that are familiar have probably learned this through Boy and Girl Scouts and similar organizations. You may need to devote some time to ensure students gain this understanding*).

Exploring the Concept

1. Give students a copy of the compass diagram, which already shows where North is. Have them mark where they think South, East and West should be. (*This will show you how well, if at all, students understand compass directions. If some do not, then spend time helping them see how it works. You can use a globe to show the main four compass directions. You can also help them see that in the mornings we always*

see the Sun in the East, and at dusk it is in the West. If necessary, have them complete the compass diagram a second time to reinforce the concepts.)

2. Take students outside and, using a compass, have them figure out which direction is North (*you may be able to pick a landmark as a general guide for later reference*).
3. Once North is agreed upon, have students figure out which direction faces South, then East and West. (*You could mark this in the school playground or sidewalk using chalk*). Tell the students that wind direction is typically reported in terms of the direction it is blowing from rather than the direction it is blowing toward.
4. Back in the classroom, ask students to design a hand-held device that could be used to show the wind direction. They should sketch their idea, and then check it with you before making it. Ask them to be prepared to demonstrate their devices within a specified time period. (*You can let students go on this. It might be good to have them work in teams--like a science fair approach--and they could use homework time to plan and experiment with their designs. Ask them to show you their designs before they actually build their devices. This will give you an opportunity to assist them and also assess their thinking. If you want to introduce a slightly more complex challenge, tell them the device should also show where North is*).
5. Allow students to test their devices. They should strive to improve their designs through this testing phase. (*Your students may need to explore with their designs, to see what works and what does not. This, of course, is what scientists and engineers do in the real world*).
6. Have students prepare to demonstrate their devices. You can call it "The Wind Direction Device Challenge". Designers should prepare an explanation of how they developed their device (ideas, problems, solutions, etc.) to accompany their demonstration.

Applying Students' Understanding

You can use "The Wind Direction Device Challenge" for this purpose. Have groups stand widely spaced in the schoolyard, well away from building, while holding their wind pointing devices above their heads.

For each device, have students observe it in operation and ask these questions:

- What part of the device shows the wind direction?
- What will happen if the wind blows from a different direction?
- Can the device tell how strong the wind is?
- Does the device tell from which compass direction the wind is coming?
- How could the device be improved?
- How could ideas from this device be combined wit h those of other groups?
- How does the wind pointer device help to describe the wind speed? (*Students should be able to notice variations in how the device behaves in different wind speeds. They can draw what their pointer looks like in still air, moderate breeze,*

strong breeze and so on. You can now have students add another key observation to their Beaufort Wind Scale tables).

Using the Weather Station to Gather Data

Each day, students can add wind speed observations and wind direction observations to their weather charts along with temperature. Later they can add precipitation (rain, snow, sleet and hail) , cloud cover and cloud type to their weather charts. Help students understand the importance of collecting observations at the same time and in the same place each day.

Revisiting Investigation Question 2

Complete this investigation question by asking students to reflect on "How can you tell the direction of the wind" and how their answers may have changed as a result of what they have learned.

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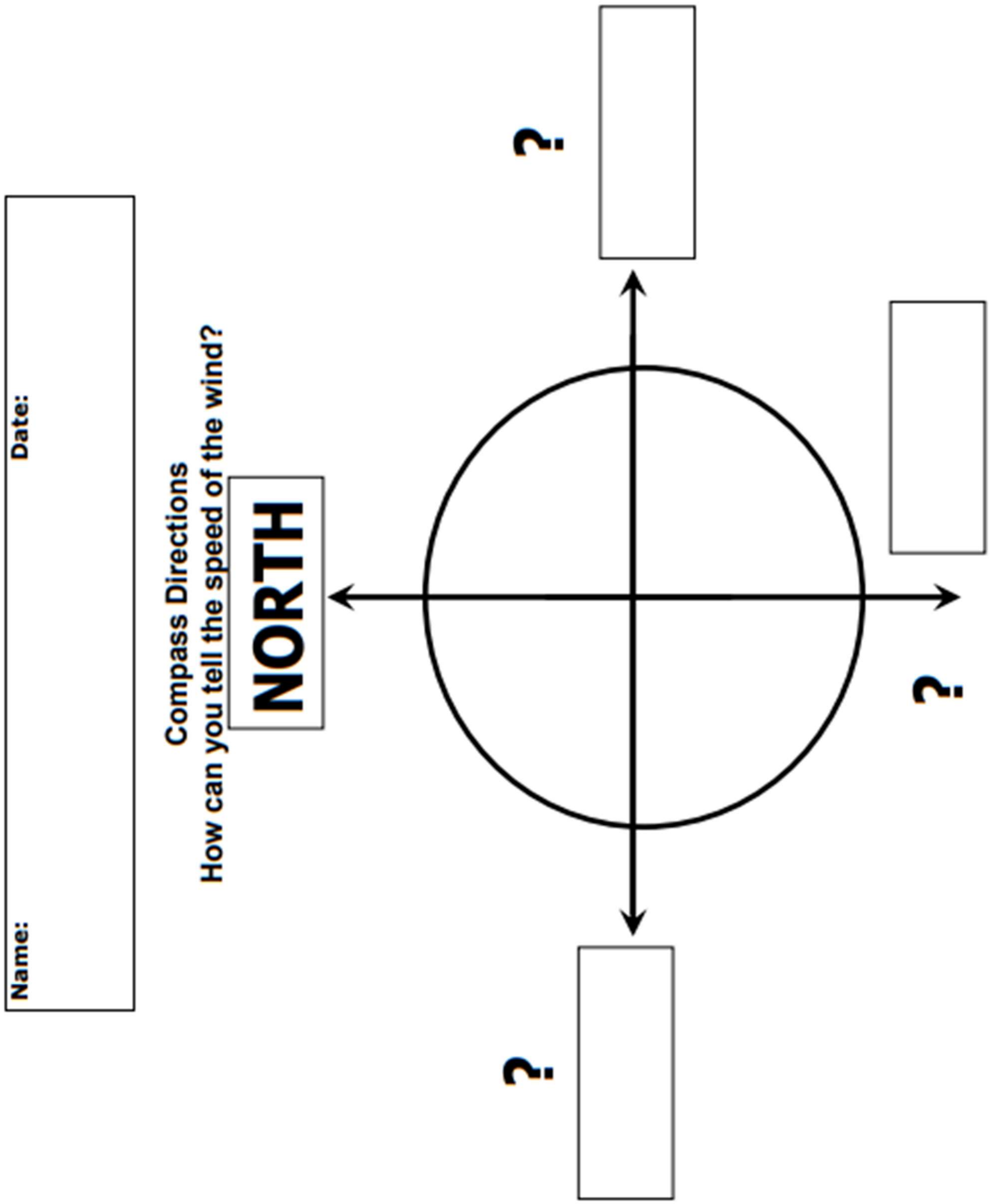
Compass Diagram



Revisiting the Concept of Wind

1. Immediately following the investigations above, ask students to review what they have done and what they have learned.
2. Begin with the wind speed investigation. What observations helped them to gauge the speed of the wind? How could they tell the differences between different wind strengths? What devices could be used to measure wind speed?
3. Have students reflect on wind direction. What is important to know to determine where the wind is coming from? What devices work well to show wind direction? Can one device measure both wind speed and direction?
4. Finally, ask students to consider how wind speed and direction play a part in weather conditions and weather patterns.

Linking to Weather

As a result of their observations and experiences, students should be ready to understand that wind is air "on the move" and that this air movement is a key component of weather. It is the movement of air masses that both causes and distributes weather conditions. That is why scientists measure and track wind as part of atmospheric conditions.

In further experiments, students will make other measurements and atmospheric observations similar to those used by scientists to make predictions about everyday weather.

Digging Deeper

The wind blows because air pressure is higher in one place than in another place. The air moves from areas of higher pressure to areas of lower pressure. Objects like buildings, trees, and hills affect the direction of the wind near the surface. To get the best idea of the wind direction, try to stand far away from such objects. A park or a playing field is the best place to observe the wind.

Wind speed is measured with an anemometer. Most anemometers have four horizontal shafts arranged like the spokes of a wheel. The end of each shaft is cup-shaped. The wind pushes the concave side of the cup more than the convex side, so the anemometer spins in the wind. The faster the anemometer is spinning, the stronger the wind.
You do not need an anemometer to estimate the wind speed. You can use a verbal scale, called the Beaufort scale, which describes the effect of the wind on everyday things like trees.

Wind direction is measured with a wind vane. One end of the vane has a small, heavy object, and the other end has a flat object with a large area. The wind pushes the flat object more than the small, heavy objects, so the vane swings around to be parallel to the wind. You can estimate the wind direction by yourself just by using your face as a "sensor." Face into the wind, and then record the direction you are facing, relative to north.