How can you tell the speed of the wind?

Teaching and Learning Focus

In this investigation, your students will begin to develop their concept of how the interaction of moving air (wind) and water can affect heat transfer:

- Water will evaporate more quickly when air is moving rapidly over its surface.
- When water evaporates from a surface (such as your hand), heat is also removed from that surface.

Materials Needed

For each student pair:

- large glass or metal tumbler
- water
- container of water large enough to put a hand inside
- battery-operated fan

For you to demonstrate to students:

- two alcohol thermometers (can be the blank thermometers used in Investigation 2)
- masking tape
- absorbent cotton
- dropper
- glass marking pen

Safety

This investigation is considered generally safe to do with students, but you will need to make sure that the containers they use for water are unbreakable and that you tape the thermometers securely to the wall when you do the demonstration. Please review the investigation for your specific setting, materials, students, and conventional safety precautions.

Setting the Scene

Ask students which of them has gone swimming on a cool and breezy day. What did they feel like when they got out of the water? Were they warmer when they got out of the water than when they went in? What made the difference in how they felt? Take some of their answers and record these on the board or a flipchart. Let students know that they will be investigating how moving air, water and heat work together to drive the "weather machine." Revisit their ideas from this first discussion at the end of the investigation.

Presenting the Investigation Question

Introduce your students to the investigation question: "*How can wind and water affect temperature?*"
Have your students discuss the question in pairs, then in groups, and then as a whole class. Record their answers on the flipchart.
Have your students brainstorm ideas about how this investigation question could be investigated.

1. Design an experiment that could be used to test the investigation question.
2. What materials would be needed?
3. What would you have to do?

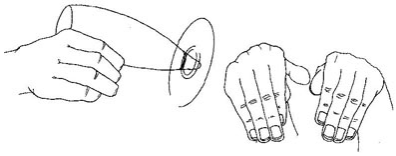
4. What would be measured?
5. How long would the experiment take?

Assessing What Your Students Already Know

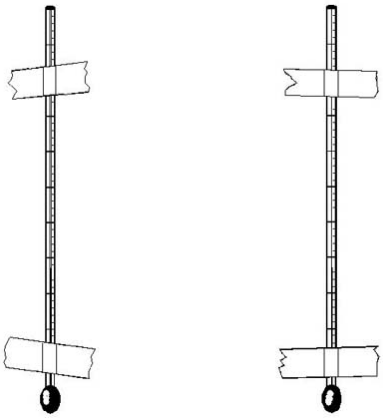
Before beginning this set of investigations, review with your students the properties of air and the concepts they have developed in the earlier investigations. Recall that they learned about air pressure from the first activity when they noticed that air filled a balloon and made it feel firm and temperature from the second investigation when they learned to measure air temperature with a thermometer. Remind students about air or wind speed and direction from the third investigation.
Tell your students that in this investigation they will learn how air and water acting together can affect temperature.

Exploring the Concept

1. Ask students to work in pairs. One student should wet one hand with water and leave the other dry. This student then places both hands in front of him or her. The student's partner then directs the fan on both hands at once for about 30 seconds.



2. After the first student's hands are dry, the students change places and repeat the hand wetting and drying under the fan. Ask the student pairs to talk about their observations of how their hands felt and record them in a few sentences. Ask students to try to explain what they observed. Ask: What do you think would have been the result if you had taken the temperature of each hand after you dried it?
3. **It is safest to do this next part of the investigation as a demonstration, as you will be taping thermometers to the wall.** Tape two thermometers securely to the wall, side by side. You could also tape the thermometers to a cookie sheet or the side of a box. If the thermometers are unmarked, make a small mark directly on each stem with a glass marking pen at the level of the liquid inside the tube. (*If the thermometers are graduated in degrees, students can record the initial temperature registered by each thermometer*).



4. Cover the bulb of one thermometer with absorbent cotton and tape it in place. Now, direct air from the battery-operated fan at the two thermometers at once. At the end of one minute, ask a student volunteer to check the levels of liquid in each thermometer. Did the temperature change in either one? Ask students to record this result. (*At this point, the thermometers will probably continue to register the same temperature.*)
5. Using the dropper filled with water, soak the cotton on the base of the thermometer. (*Ask students to think about their experiences with the wet hand. Ask for a prediction of what will happen when you direct the fan on the two thermometers.*) Repeat using the battery-operated fan from Step 2. After one minute, mark or record the temperature in each thermometer. Ask students: Did the temperatures remain the same? (*This time, students will probably notice that the dry thermometer stayed the same and the thermometer with wet cotton registered a lower temperature.*)
6. Ask students to write a few sentences or draw a picture of what they observed in this experiment with the two thermometers.

Applying Students' Understanding

Ask the students why they think that their wet hand felt cooler when the wind (air) blew. Their explanation will probably simply restate the fact that the wind was blowing. You will need to ask: "What happened to the water that was on your hand?" ("It disappeared" is the most likely response.) Help students to refine this response to one that explains that liquid water can become part of the air by the process called evaporation. In this investigation, we found that as liquid evaporates, it removes heat from the surface, lowering the temperature. (A sophisticated explanation involving the energy required for the breaking of hydrogen bonds between water molecules is well beyond the scope of elementary learning goals.) With the evaporation model in mind, students can think about sweating on a hot day, dogs panting to cool their wet tongues, and even the fact that it is not possible to make a fire with wood or paper that is soaking wet.

Next, encourage your students to explain their observations of the two thermometers in the second part of the investigation. Why did the thermometer with the wet cotton on its base show a cooler temperature when the fan blew on it? They should be able to connect what they have learned about evaporation to these observations.

Revisiting Investigation Question 1

Complete this investigation by asking your students to reflect on this question and how their ideas, which you recorded at the beginning of this investigation, may have changed.

Weather Unit Sections

Introduction
Air
Temperature
Wind
Clouds
Weather
How can you tell the speed of the wind?
How does temperature affect air pressure?
Revisit the concept of Weather