

# Why does the wind blow?

A laboratory experiment from the  
Little Shop of Physics at  
Colorado State University



## Overview

Wind is simply moving air. If there wasn't any wind, weather reports wouldn't be very interesting, as there would be little change in day-to-day weather. Wind is produced by pressure differences. In this activity, students will produce a region of high pressure and then see how this high pressure causes air to flow to a region of low pressure—they will make the wind blow!

## Theory

Above the earth, an "ocean of air" surrounds us. The **air pressure** from the air above us produces large forces on all objects. The force of normal atmospheric pressure in Colorado on one side of a typical office door is about 15 tons! But there is an equal force on both sides, meaning the **net force**, or total force, is zero. Now, if the pressure is larger on one side than the other, there will be a force.

## Necessary materials:

*This activity can be performed as a demonstration, but is much more effective if students can see, feel, and hear the experiment while working in small groups.*

- 1 clean and dry 1 liter bottle
- Styrofoam packing peanuts
- 1 Fizz Keeper pump cap
- 1 small piece of masking or duct tape

Prepare your experiment by punching a hole in the side of the 1 liter bottle toward the bottom. Cover the hole with the piece of tape. Fill the bottle with styrofoam packing peanuts and then put the special Fizz Keeper pump cap on the bottle. If you don't have styrofoam packing peanuts, mini-marshmallows can be used.



*The styrofoam peanuts can compress to half their size and help students see the effect of high pressure in the bottle.*

In the atmosphere, the pressure isn't constant. This is primarily because the sun heats the earth's surface unevenly. As heat is transferred to the air, we get regions of warm and cool air which can turn into regions of low and high pressure. This difference in pressure makes a force that causes the wind to blow.

On a large scale, the rotation of the earth and other factors can make the source of the pressure differences that drive the wind hard to determine, but on small scales the sources are easier to determine. If you live near the ocean, you have noticed that, in the summer, the land will be warmer than the ocean during the day. Warmed air will rise over the land, leading to a low pressure region; high

pressure air over the ocean will cause a wind to blow toward the shore—a welcome sea breeze. At night, the ocean stays warm longer than the land, so we get the reverse—a land breeze.

On the front range of Colorado, we see a similar effect. In the morning, the eastward-facing foothills warm first; the air here warms and rises, and the higher-pressure region on the plains causes the wind to blow toward the foothills. At night, the eastward-facing foothills lose the light first, and so cool down first. The process is reversed, and the wind blows from the mountains. You may have noticed this before; if not, pay attention on your morning and evening commute! It's not always true that the wind blows west in the mornings and east in the evenings, but it's true more often than not.

## **Doing the Experiment**

Hold a brainstorming session with your class to elicit their ideas about the wind and what causes it to blow. Ask them to tell you if they have noticed any trends. What direction is the wind blowing when they walk to school? When they walk home?

Follow this with a brief explanation or review of the differential heating of the earth that leads to pressure differences in the atmosphere, then proceed as follows:

- Tell your students that in this experiment, they will make a high-pressure system that will then flow to an area of low pressure, causing wind to blow. This experiment will also help them see, feel, and hear the effects of air pressure.
- Show students the supplies they have for the experiment and ask them to identify the two main ingredients of the styrofoam peanuts, a plastic foam concoction of plastic and air. (If you are using marshmallows, the main ingredients are sugar and air.)
- Explain that the Fizz Keeper is a special cap that can put more air molecules into the bottle. Ask them not to pump it yet. Have them squeeze the bottle and note how it feels. Then listen as they shake the bottle, and note what they hear. Ask them what they think will happen if they pump a lot of air molecules into the bottle.
- Have one student hold his/her thumb over the taped hole, while another student pumps the cap as much as he/she can. Squeeze the bottle. How does it feel? Has the temperature changed at all? What's happening to the styrofoam peanuts? Now carefully shake the bottle, keeping the hole covered. Does it sound any different than before?
- Have students predict what will happen when they take the tape off the hole.
- Before removing the tape, tip the bottle horizontally and shake the peanuts evenly over the surface.
- Remove the tape and have them discuss and explain what they observed. (When you add more air molecules to the bottle, the air pressure increases, compressing the air in the styrofoam peanuts. The bottle feels solid, and the peanuts may sound noisy as you shake the bottle. When you release the tape over the hole, the high pressure moves horizontally to an area of lower pressure, creating a wind. The air pressure in the bottle equalizes, and the packing peanuts return to their original size.)

## **Summing Up**

This is a nice demonstration of how wind is created as air moves horizontally from regions of high pressure to low pressure.

## **For More Information**

CMMAP, the Center for Multi-Scale Modeling of Atmospheric Processes: <http://cmmmap.colostate.edu>

Little Shop of Physics: <http://littleshop.physics.colostate.edu>