Changing Pressure

Suggested Grades: K–8

Activity Overview
In the following activities, you will see how moving air changes the pressure that affects objects. This is known as the Bernoulli principle, and is what creates the upward force of lift on airplane wings.

Time: 45 minutes

Materials:

- One straight straw
- One flexible straw
- One piece of paper (3.5 inch x 4 inch)
- Two empty soda cans
- One cheese puff

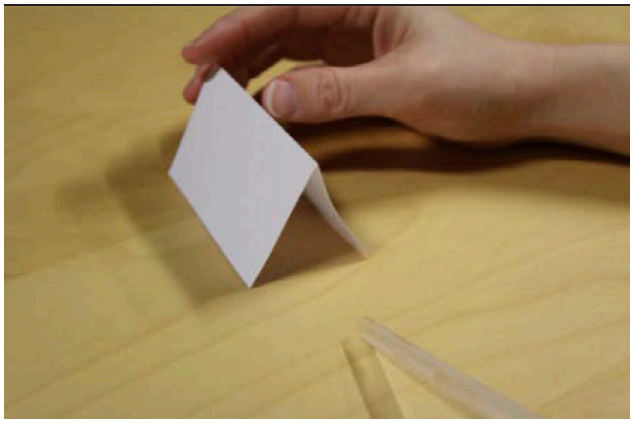
STEPS

PAPER TENT

1. Fold the paper in half to make a paper tent.

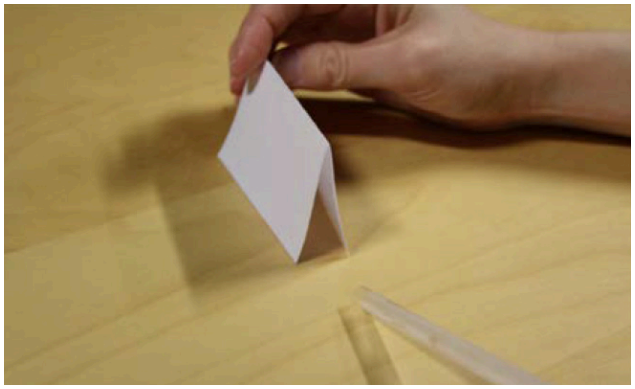
2. Place the paper tent on a flat surface such as a table or a desk.

3. Position the straw about 2 inches away from the paper tent so that you will be able to blow a steady stream of air across the surface of the table or desk and through the tent.



4. Observe what happens.

5. Now, blow harder and observe what happens.

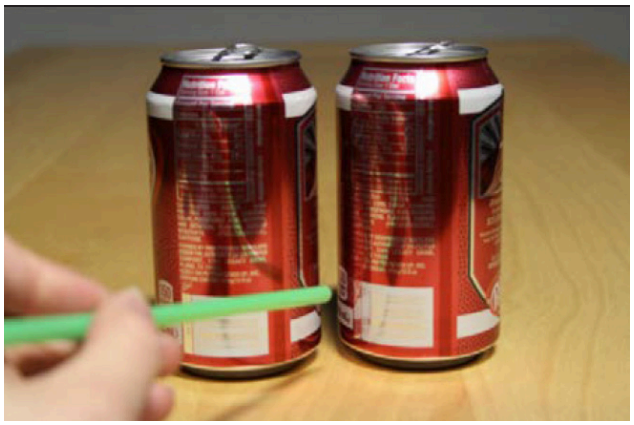


You should see the edges of the card pulling together. If not, you may have the end of your straw too close to or too far away from the paper tent, or you may not be blowing hard enough.

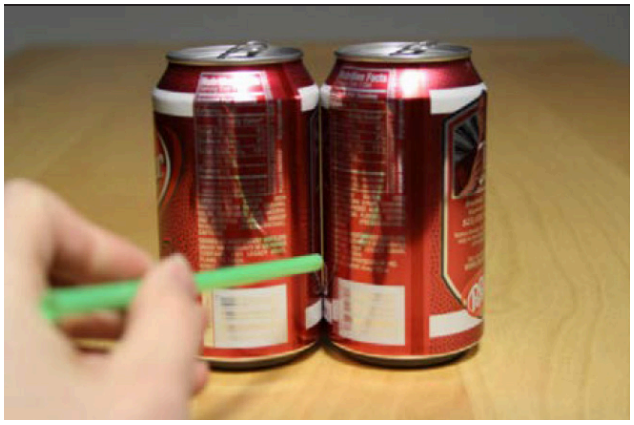
FLIGHT LOG ENDORSEMENT CODE: BERNOPR

MAGICAL SODA CANS

1. Place the two empty soda cans parallel to one another and ¾ of an inch apart on a flat surface such as a table or desk.
2. Use a straw to blow between the two cans about 1¼ inches above the surface of the table or desk. Be sure that the open end of the straw is in front of the cans and not between them.



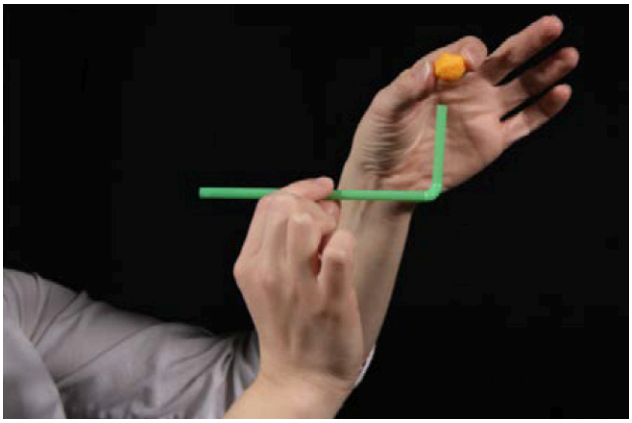
3. Observe what happens.

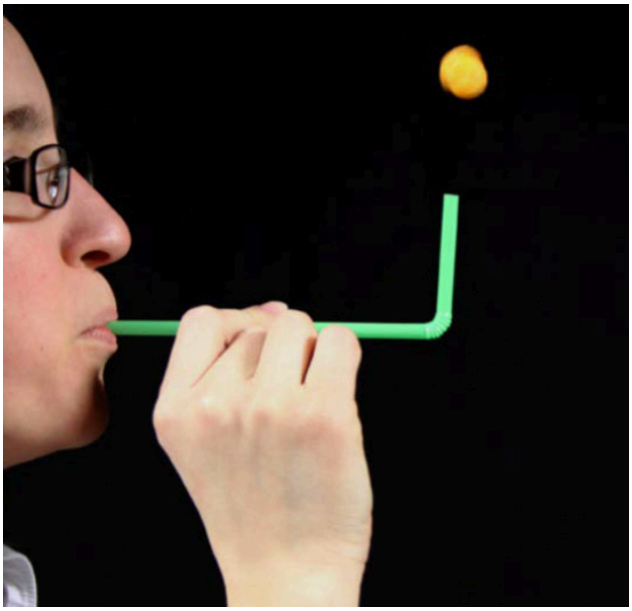


The cans should move together when you blow. If not, you may have the cans too far apart, the straw may be too close or too far away from the cans, or you may not be blowing forcefully enough through the straw.

BALANCING CHEESE PUFF

1. Bend your straw into an “L”.
2. Place the long end of the straw in your mouth, with the short end pointing upwards.
3. Take a deep breath and blow steadily through the straw.
4. Try to balance the cheese puff in the stream of air coming out of the end of the straw.





5. Now tilt your straw and try to complete the activity.
6. Observe what happens.

The cheese puff should stay in the stream of air when the straw is pointed upwards, and also hover above the straw when at an angle until a certain point. If not, you may not be blowing forcefully enough through the straw, or you may be blowing with too much irregularity (The cheese puff may also be an irregular shape.). A steady stream works best. One technique to try is to get the cheese puff to spin slightly, which can help with any irregularities in its shape.

Background Information

When we think of fluids, we usually think of a liquid such as water. Air, however, is also considered a fluid because it flows and can take on different shapes. As fluids flow (or move) they have certain properties that we can observe.

The Bernoulli Principle

A Dutch-born scientist named Daniel Bernoulli claimed that as a fluid moves faster, it produces less pressure, and conversely, slower moving fluids produce greater pressure. This idea is known as the Bernoulli principle, and is what you saw in the experiments you just conducted.

In the paper tent experiment, the sides of the card should pull towards one another when you blow air between them. The reason for this outcome is that the faster moving air under the card creates relatively lower pressure compared to the air over the card, and as a result, the card bends toward the table or desk. According to the Bernoulli principle, higher pressure air pushes toward lower pressure air.

In the magic soda can experiment, the two cans move together when air is blown between them. The reason for this is that the air blowing through the straw will be faster moving than the air on any other side of the cans. Thus, according to the Bernoulli principle, the faster moving air exerts lower pressure and the two cans draw toward each other.

In the balancing cheese puff experiment, the cheese puff balances itself in the steady stream of air coming from the short end of the straw. This happens because the air coming out of the straw is moving fast, so the faster moving air has less pressure than the slower moving or still air around the cheese puff. If the cheese puff starts to move away from the air stream, it experiences pressure from the still or slower moving air, which pushes the cheese puff back in place. If, however, the straw is tilted, the force produced by the stream of air will no longer be sufficient to keep the cheese puff afloat because the force of gravity will then take over.

How does the Bernoulli principle help airplanes fly?

The force that pushes upward on an airplane is called lift and is created by the movement of air over the wing. Because of the shape of an airplane's wing, called an airfoil, the air into which the airplane flies is split at the wing's leading edge, passing above and below the wing at different speeds so that the air will reach the same endpoint along the trailing edge of the wing at the same time. In general, the wing's upper surface is curved so that the air rushing over the top of the wing speeds up and stretches out, which decreases the air pressure above the wing. In contrast, the air flowing below the wing moves in a straighter line, thus, its speed and pressure remain about the same. Since high pressure always moves toward low pressure, the air below the wing pushes upward toward the air above the wing. The wing, in the middle, is then lifted by the force of the air perpendicular to the wing. The faster an airplane moves, the more lift there is. When the force of lift is greater than the force of gravity, the airplane is able to fly.

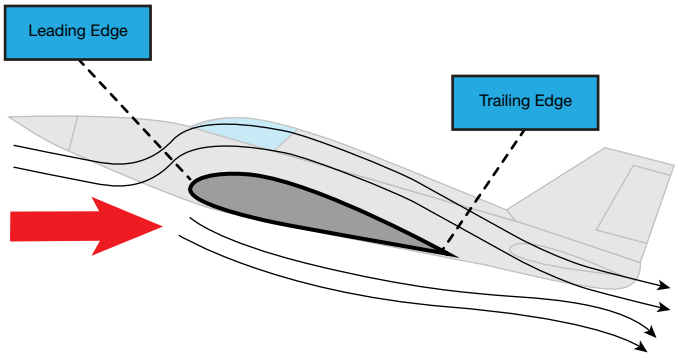


Figure 1. The movement of air over an airfoil

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