Hole in Your Hand

What happened to your whole hand?

You have two eyes, yet you see only one image of your environment. If your eyes receive conflicting information, what does your brain do?

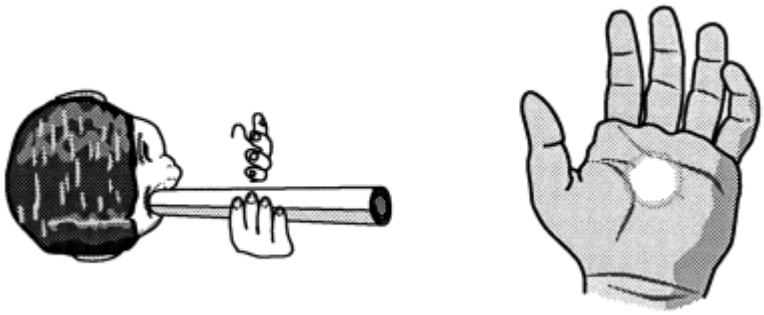
Assembly

Roll the sheet of paper lengthwise into a tube 11 inches (28 cm) long and about 1/2 inch (1.25 cm) in diameter. Use tape to keep it from unrolling.

To Do and Notice

Take the tube in your right hand. Hold it up to your right eye and look through the tube, keeping both eyes open. You should be able to see the inside of the tube as well as what's around the tube.

Now place your left hand, fingers pointing up and palm facing you, against the left side of the tube, about halfway down (click to enlarge the diagram below). Notice that your hand appears to have a hole in it.



What If…

Try switching your hands and your eyes. Hold the tube in your left hand, up to your left eye, and bring your right palm up against the tube, keeping both eyes open. Does it look the same?

What's Going On?

One of your eyes sees a hole, the other sees a hand. Your eyes and brain add the two images together, creating a hand with a hole in it!

Some people find that this effect is stronger with one eye compared to the other. That's because one eye is likely dominant, which means your brain has a slight preference for visual information from that eye over the other. This is similar to being left- or right-handed, although your eye and hand preference don't necessarily match!

Bernoulli's Principal

When you blow on a paper from the side, it moves sideways. When you blow downward the paper falls faster. But, it you blow above the paper, when holding it like the picture above, the paper will "fly". Why?

Assembly

Cut a 2" strip off of a regular piece of paper.

To Do and Notice

Holding the paper like the picture above, place it below your mouth with the edge touching your chin, right below your bottom lip. Blow gently across the top of the paper. What happens?

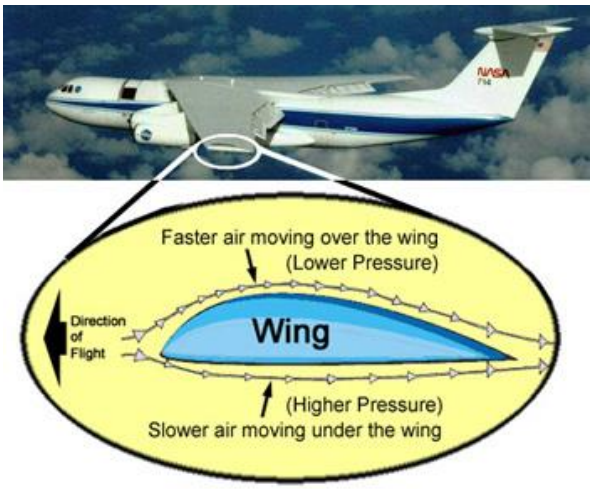
What If…

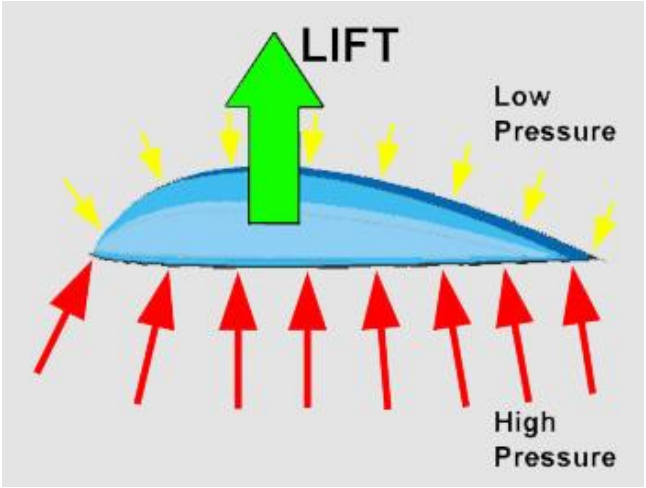
Does anything change if you blow harder? Softer?

The Secret Behind the Science

What's Going On?...

A stream of air over the paper creates a low pressure zone which lifts the paper due to the pressure difference: higher pressure under the paper and lower pressure over the paper. This levitates the paper in the air. This is how airplanes stay in the air. If the air pressure stayed the same, the plane would not be able to fly.



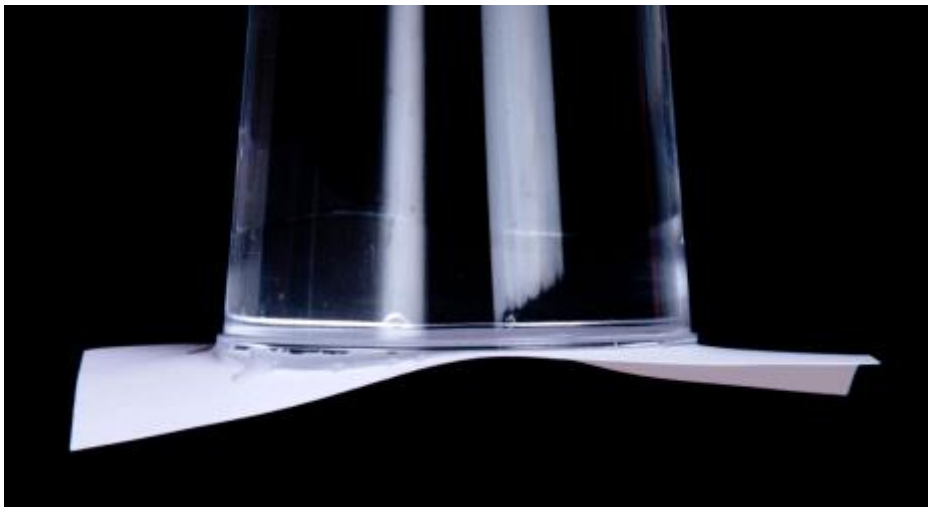


Activity idea taken from:
https://www.teachengineering.org/lessons/view/cub_airplanes_lesson02

Floating Water

Turn the glass over and nothing spills.

Is it really possible to fill a glass with water and turn it upside down without spilling? This clever science trick is a popular after-dinner science stunt, but make sure there's a bowl close by to catch your mistakes.



Step 1: Before you get started, make sure the index card or playing card is large enough to completely cover the mouth of the glass. Fill the glass or plastic cup about half full with water.

Step 2: Cover the cup with a piece of cardstock or an old playing card, making sure that the card completely covers the mouth of the container.

Step 3: Keep your hand on the card and turn the cup upside down. Hold the cup over the bowl just in case you accidentally spill.

Step 4: Slowly take your hand away and the card will stay in place . . . and so should the water (keep your fingers crossed).

Step 5: Don't press your luck too far. Put your hand back on the card and return the cup to its upright position.

Step 6: The temptation is just too great, and you know you're going to do it again. Just make sure the card doesn't become completely soaked and accidentally fall apart. This could be a huge surprise for everyone!

What If……

Repeat the experiment but this time change the amount of water in the cup. Does it make any difference? What about if you switch the container? Will a wider cup hold the card better than a narrower cup? Does the temperature of the water have any effect on the water staying inside the cup?

Try the experiment using a paper cup or plastic cup but this time, using a thumbtack, poke a small hole in the bottom of the cup. What do you predict will happen if air is allowed to sneak into the cup?

The Secret Behind the Science

The secret is right in front of your nose—it's the air that we breathe. Air molecules in the atmosphere exert pressure on everything. Scientists know that at sea level air molecules in the atmosphere exert almost 15 pounds of pressure (okay, 14.7 pounds if you want to be exact) per square inch of surface area. Your body is used to feeling this kind of air pressure, so you don't notice it.

When you first turn the cup upside down, the pressure of the air inside the cup and the air pressure outside the cup are equal. If you look closely, however, you'll notice that just a little water leaks out between the card and the cup. This happens because the force of gravity naturally pulls down on the water. When some of the water escapes, this causes the volume of air (the space above the water inside the cup) to increase slightly. Even though the amount of air above the water stays the same, the volume occupied by the air is now greater and the air pressure inside the cup decreases. The pressure of the air outside the cup is now greater than the pressure inside the cup and the card stays in place. All of this is possible because the water creates an airtight seal between the rim of the cup and the card.

When the seal is broken (even a *tiny* bit), air enters into the cup, equalizes the pressure, and gravity pushes the water out. Poking a thumbtack-size hole in the cup allows air to seep into the cup from the outside. The pressure of the air molecules both inside and outside the cup stays the same, gravity takes over, the card falls, and the water spills. Watch out for the carpet!

Activity idea taken from:
http://www.stevespanglerscience.com/lab/experiments/floating-water-mystery/

In 4th Grade Language- After filling the cup with water and trapping the air inside with the card, the air pressure is the same inside the cup as it is outside the cup. After turning the up upside down, a tiny bit of water leaks out around the rim of the cup. Because air is lighter than water, the air stayed on top of the water, even when you turned the cup over. The amount of air is the same as when you started, but there is more space (just a little bit, because a tiny amount of water escaped when you flipped the cup over). This creates a difference in air pressure inside the cup versus outside the cup. For those of you in 5th grade, think of your 4th grade WEATHER unit in science. If this is still confusing to the rest of you, wait until you study WEATHER in 4th grade. You will learn about air, that it takes up space, and that it can change pressure.