The Highs and Lows of Air Pressure

What happens when air is "under pressure"?

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What is air pressure?

There's air surrounding us everywhere, all at the same pressure of 1 atmosphere or 14.7 pounds per square inch (psi). You feel this force on your skin all the time whether you're on the floor, under the bed or in the shower. Its stronger than you think too, a typical car tire is inflated to only twice this pressure (>30 psi). Air pressure is determined by the following 3 factors:

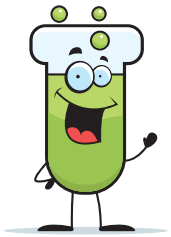
Temperature: As air gets warmer, it expands. This expansion causes the density of the air to decrease, which results in lower pressure. When air gets colder, on the other hand, it shrinks. This shrinking causes the air to become denser, which leads to higher pressure.

Altitude: The higher you are above sea level, the less dense the air is. As less dense air weighs less, it produces lower air pressure, which is why your ears will pop when you're going up or down a mountain in a car – your inner ear has air trapped in it, and as the air pressure outside decreases, the air trapped in your ear will cause the eardrums to push outward. This expansion is what causes the "pop."

Moisture: The amount of moisture in the air also affects the density of the air and, therefore, the air pressure. Water vapor is a light gas compared to the gases that make up the atmosphere, which is primarily oxygen and nitrogen. So when the moisture in the atmosphere increases, the amount of nitrogen and oxygen decreases per unit of volume, which causes the density of the air to decrease.

Safety tip!

Do not perform these experiments without adult supervision.



MATERIALS

- Drinking glass
- An index card, or craft card (approximately 4 x 6")
- Cold water
- Heat resistant strong glass bottle
- Balloon
- Bowl/pan of hot water **with adult supervision*
- Bowl of ice-cold water
- Banana

INSTRUCTIONS – EXPERIMENT 1

1. Partially fill the glass with cold water.
2. Place the card over top of glass and hold tight with your hand.
3. Turn over the glass keeping your hand in place.
4. "Slowly" remove your hand from the paper.

HOW IT WORKS

The air pressure around us is much stronger than you think! Gravity is trying to make the water fall out of the glass, but the pressure of the air is pressing the card onto the glass. In this case the air pressure is stronger than gravity.

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INSTRUCTIONS – EXPERIMENT 2

1. Put the balloon over the neck of the bottle.
2. Place the bottle sealed with the balloon into the hot water.
3. Watch what happens.
4. Remove the bottle from the pan and let it cool for about 30 seconds. It should not be too hot.
5. Make sure to cool the bottle before you add it to the ice bath to ensure the bottle will not break. Place the bottle into the iced water bowl.
6. Watch what happens. You can always "encourage" the balloon a little...

HOW IT WORKS

At room temperature (around 20 °C/68 °F) the air around us is at a certain pressure (called 1 atmosphere). When you heat up the molecules of air above this, they get energy and start moving around faster, as a result the same amount of air expands to fill more space. When you cool the air down below room temperature the molecules slow down and take up less space.

If you could cool the air down even further eventually the molecules will stop having enough energy to stay as a gas and the molecules in the air would turn into a liquid.

INSTRUCTIONS – BONUS EXPERIMENT

1. Take the glass bottle from Experiment 2 with the balloon removed.
2. Cut up the banana and stuff it into the bottle.
3. Replace the balloon over the neck of the bottle and leave it in a warm place.
4. Record what happens to the balloon over a few days. Be patient depending on the weather it could take 3–4 days for a significant change.

HOW IT WORKS

A banana contains lots of things including, sugar, water, fat, protein, and bacteria. When you leave a banana unpeeled the bacteria starts to eat the banana. As the bacteria does this, they produce a waste gas, called ethylene gas, and as this happens, this extra gas increases the pressure in the bottle that makes the balloon expand.

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