

Experiment 1: Bottled Balloons

*Challenging balloons demonstrate
changes in air pressure*

THE SET UP

1. Summary

Challenge a volunteer to inflate a balloon inside a plastic bottle. Your volunteer will find this impossible as they have to overcome the air pressure inside the bottle, but the hole present in only your bottle allows you to inflate the balloon. Reveal the hole to the class and demonstrate the strength of air pressure by using it to squirt water from the balloon.

2. Context

This experiment is suitable for demonstrating air pressure and the movement of air molecules. The challenge aspect is effective for capturing students' attention and interesting for parents during open days.

3. Apparatus

- 3 x large balloons (one spare to demonstrate air particle movement)
- 2 x two-litre plastic bottle
- A skewer to make a discreet hole in one of the bottles.

4. Preparation

Carefully make a discreet hole in the bottom of one of the plastic bottles that can be sealed with your finger. Wet the inside of both bottles. Lower a balloon into the prepared bottle and pull its mouth over the bottle's rim so you can inflate it inside the bottle.

If inflating the balloon is too difficult you can make the discreet hole bigger, as long as you can still seal it with your finger. The inflated balloon will not deflate while your finger is covering the hole.

5. Safety

Take care when making the hole in the bottle. Apart from the unpredictability of squirting water from the balloon, there are no major safety implications, so keep the bottle pointing away from electrical sockets and keep a towel nearby.

THE DEMONSTRATION

1. Procedure

- Demonstrate how air pressure can propel a balloon through the air by inflating it and letting go
- Challenge a volunteer to blow up a balloon inside a bottle larger than you
- Reveal the secret hole in your own bottle and explain why air pressure makes the challenge so difficult
- Fill your balloon with air and out seal the hole with your finger. Fill the balloon with water and pass it to your volunteer. When you uncover the hole, the air will rush into the bottle and squirt all the water up into the air

2. Suggested Script Ideas

"I challenge any volunteer to beat me in a balloon-blowing competition.

How did I win?

My bottle had a hole in the base, so when I blew up the balloon the bottled air was able to escape. Without a hole in the bottle the trapped air has nowhere to go, and as the air pressure becomes too great for your blowing to compress it, your balloon doesn't inflate."

THE CONCLUSION

1. Explanation

Covering the hole keeps the pressure constant in the inflated balloon, so it doesn't deflate. If the balloon is filled with water and you uncover the hole, the balloon is able to deflate -as the pressure difference causes the air particles rush into the hole and force the water out.

2. Useful Questions and Answers

Q) What causes air pressure?

A) Air is a gas made up of about 80% Nitrogen, 18% Oxygen and the rest Carbon Dioxide, water vapour and other substances. These molecules are all moving very quickly and when they bounce off something they exert a force on it. Multiply all of these forces by all of the molecules hitting the object and you have a large pressure.

Q) Why can't we blow up a balloon in a bottle?

A) The air outside the balloon is trapped in the bottle and so to inflate the balloon we must blow with enough force to compress that trapped air, which our lungs are not capable of. With a hole in the bottle, the trapped air is released and so we don't have to compress the gas in the bottle and so the balloon will inflate.

Q) Why does the balloon remain inflated when you cover the hole?

A) The pressure inside the balloon is balanced: there is the same pressure in the balloon as my trapped air in the bottle. As I uncover the hole, the air pressure on the outside is greater than inside and so air rushes into the bottle and the balloon deflates – this is powerful enough to empty the balloon even if it is filled with water.