

Egg in a Bottle

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Activity Length:

10 mins.

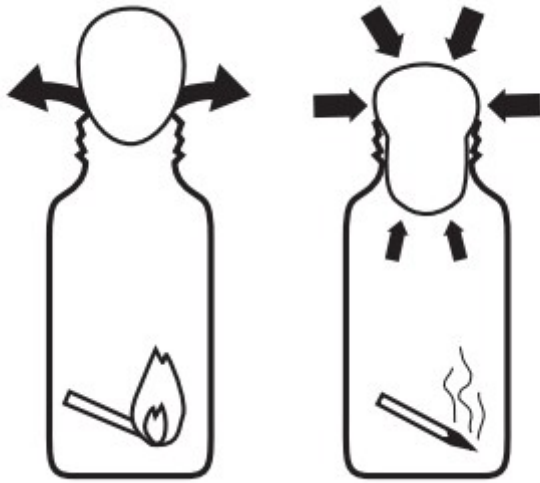
Introduction

In this demonstration, students will use differences in air pressure to force an egg into a bottle.

Air expands when it is heated. If air is heated in a container that prevents expansion, the pressure of the gas increases. When the heat source is removed, the air will contract and decrease in pressure. In a container, this causes the outside air particles to push into the container to equalize the pressure inside and out. Air always flows from a high-pressure system to a low-pressure system ("air flows from high to low").

The lit matches heat the air inside the bottle. When air is heated it expands and some of it escapes out the bottle. When the matches go out, the air inside the bottle cools and contracts (takes up less space), thus creating a lower air pressure area inside the bottle than outside. Normally, the higher-pressure air outside the bottle would come rushing in to equalize the lower-pressure air in the bottle. The problem is that the egg is in the way. The air molecules on the outside of the bottle push the egg into the bottle.

Teacher note: The air pressure does not decrease due to the burning of the oxygen inside the bottle. It is due to the air expanding and contracting. If students believe 'using up oxygen' is what causes the egg to be sucked into the bottle challenge them to design an experiment to prove or disprove this theory.



Objectives:

- Describe the characteristics of air.
- Explain how air pressure works.
- Discuss how air pressure affects our daily lives.

Materials:

- 1 glass bottle with the opening slightly smaller than the hardboiled egg (milk or juice bottles work well)
- 1 peeled hard-boiled egg
- matches
- vegetable oil (optional)

What To Do:

Preparation

1. Hard boil a medium sized egg and peel it.
2. Grease the mouth of the bottle with vegetable oil (optional).

Demo

1. Place the glass bottle on the table.
2. Set the egg on the neck of the bottle to demonstrate that the egg cannot be pushed into the bottle (this is because the air inside is trapped).
3. Light 3 matches at once and drop them into the bottle.
4. Quickly place the egg over the mouth of the bottle. The egg will get sucked into the bottle.
5. To get the egg out of the bottle, turn the bottle upside down and blow into it, so that the egg acts as a one-way valve. The increased air pressure in the bottle will cause the egg to pop back out. A demo can be found on Steve Spangler's Science Website.

Teacher Tips:

- Water can be used on the bottle's mouth instead of oil, but ensure that the inside of bottle isn't wet though, as this will put out the flame.

Key Questions:

- How can we get the egg into the bottle without chopping it up?
- Why is an egg suitable for this experiment? Could we use a ping-pong ball or a golf ball?
- Does the egg get "sucked" into the bottle? Why or why not?
- How else could you change the pressure of the air inside the bottle?
- How will we get the egg out? How do we increase the pressure inside the bottle?

- Instead of lighting a match, you can roll up one sheet of paper towel into a stick/tube shape. Then, light one end of the "stick" with a match and drop it into the bottle.
- During step 2 be careful not to break the egg as then air will be able to escape (you can substitute the egg for a small balloon to allow kids to really try to push a balloon into a bottle)

Extensions:

- Repeat this experiment with an "upside-down twist":
 1. Carefully hold the wider end of the egg in one hand and slowly push two birthday candles into the narrow end of the egg.
 2. Light the candles and sing happy birthday to the egg.
 3. Turn the bottle upside-down and slowly move it into position above the flaming candles.
 4. Allow the flames to heat up the air inside the bottle for just a few seconds and then place the bottle down over the candles. The candles will go out and the egg will squeeze up into the bottle with a "Pop!"
- Repeat this experiment with boiling water (a good way to prove that 'using up oxygen' is not the cause):
 1. Pour the boiling water into the bottle.
 2. Carefully roll the water around in the bottle and then pour it out.
 3. Quickly put the egg back on the neck of the bottle and wait for it to get pushed into the bottle.
- Draw a diagram of the setup 1) before the matches were lit, 2) after the matches were dropped, and 3) after the matches went out. Indicate the relative areas of high and low pressure. Show with arrows the flow of high-pressure air trying to equalize low-pressure air.

Other Resources:

Science World Resources | Full Unit |
Eggstraordinary Eggsperiments
Science World Resources | Full Unit | Air