

OBJECTIVES

1. Use the particle model to explain air molecules and the effects of temperature on air pressure
2. Learn how a partial vacuum is created



BACKGROUND INFORMATION

This is a classic science experiment that everyone has heard of, but how many people have managed to get the egg back out of the bottle? The objective of this experiment is to get the egg into the bottle without harming the egg. This experiment uses air pressure to force the egg both into and out of the bottle.

The particle model can be used to explain the science behind this experiment. All substances are made of tiny particles too small to be seen, including air. These particles are constantly in motion and have varying amount of space between them. In a solid state these particles are closely packed together, in a liquid state they can easily slip past each other and in the gas state they have lots of space between them. When heat is added to a substance the particles move faster and when heat is lost they move slower. The motion of particles increases when the temperature increases and the motion decrease when the temperature decreases.

In this experiment the heat from the burning paper placed in the bottle causes the air molecules to move faster, forcing them to move further apart. When the flame goes out, the molecules of air in the bottle cool down and move back closer together, thus creating a partial vacuum. Now that there is more room in the bottle for more molecules of air, the air from the outside would normally come rushing back in, however we have put an egg in the way. The pressure of the air molecules trying to enter from outside the bottle is so great that it literally pushes the egg into the bottle.

By heating the bottle back up we are once again increasing the air pressure within the bottle and the air molecules are wanting to move further apart and out of the bottle. This pressure of air forces the egg back out of the bottle even when you put the bottle upright the forces of gravity cannot stop it.

WHAT YOU NEED

- A wide mouth glass bottle with the opening just a little smaller than the egg eg. juice bottle
- 1 hard boiled egg (boiled in vinegar to help you peel it)
- Water or vegetable oil
- Several strips of paper (~1cm x 10cm depending on depth of bottle)
- Matches
- Heat gun
- Tea towel or oven glove

WHAT TO DO

1. Peel the boiled egg carefully.
2. Slightly moisten the inside of the bottle with water or a little vegetable oil to help the egg glide in.
3. Light a strip of the paper and place flame down into the bottle.
4. Now quickly place the egg smaller side down on the top of the bottle sealing the air inside the bottle.

EGG IN A BOTTLE

5. Watch and listen to what happens.
6. Now to get the egg to come back out. Put on your oven gloves or use a tea towel to protect your hands as you are going to be heating the bottle with the heating gun.
7. Hold the bottle upside down and heat the bottle until the egg is less than half way out the opening of the bottle.
8. Now place the bottle right side up on the bench and see the egg push itself out of the bottle.

QUESTIONS

1. What is air? *Air is the mix of gases in our atmosphere.*
2. What is air pressure? *Air pressure is the pressing, forcing, and moving of air as it interacts with things around it.*
3. What happens when air is heated up? *When air gets warmer, it expands and takes up more space.*
4. At what stage do you think the air pressure in the bottle was reduced? *As the lit paper extinguished and the air began to cool.*
5. How did heating the bottle help us get the egg back out of the bottle? *Heating the bottle caused the air molecules to move away from each other increasing the pressure inside the bottle and forcing the egg to come out.*
6. Why would an empty plastic bottle sealed at a height of 2000 metres collapse when it was brought back to 0 meter altitude? *The air at higher altitude has a lower air pressure therefore bringing the sealed bottle back to 0 metre altitude would cause the bottle to collapse from the larger pressure exerted on the outside of the bottle.*



REAL WORLD APPLICATIONS OF AIR PRESSURE

Predicting weather: Atmospheric air pressure is measured to help forecast changes in weather.

Inflating tyres: Pressurised air is used to inflate tyres.

Paintball sport: Pressurised air is used to propel the paint pellets used in paintball.

CURRICULUM CONCEPTS ADDRESSED

Essential Learnings: Natural and processed materials

End of year 5

-Properties of materials are affected by processes of change.

End of year 7

-Physical change produces no new substances.

End of year 9

-Changes in physical properties of substances can be explained using the particle model.

RESOURCES USED TO DEVELOP THIS ACTIVITY

1. *Egg drop and egg pressure.* (2005). Retrieved October 30, 2008, from <http://www.reachoutmichigan.org/funexperiments/agesubject/lessons/egg.html>
2. Science Focus Topic 3 Notes: The particle model, temperature & thermal energy. Retrieved October 30, 2008, from <http://www.edquest.ca/content/view/144/>

Images courtesy of: http://en.wikipedia.org/wiki/Earth's_atmosphere