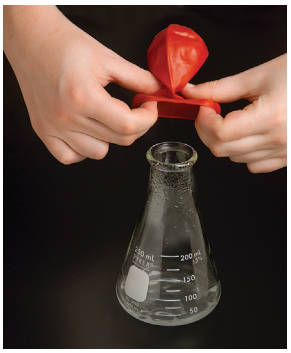
Balloon in the Bottle

Introduction

Heat some water in a flask, then attach a balloon, cool the flask, and watch as the balloon collapses into the flask. An easy-to-perform variation of the common *Crush the Can* demonstration of atmospheric pressure.

Concepts

- Pressure differential
- Vacuum



Materials

Erlenmeyer flask, borosilicate glass, 250-mL

Balloon, latex, 11-inch size (size to fit flask)

Hot plate or Bunsen burner

Ice bath or cold running water

Water, 25 mL

Safety Precautions

Always practice a demonstration before presenting it to students. Be careful of the hot glass and steam. Wear chemical splash goggles and heat-resistant gloves.

Procedure

1. Add approximately 25 mL of water to a 250-mL Erlenmeyer flask. Heat the water using a hot plate, Bunsen burner or other heat source.
2. As the water comes to a boil and steam begins to rise out of the flask, remove the flask from the heat. Quickly place the balloon over the mouth of the flask.
3. Place the flask under cold running water and the balloon will be pushed into the flask until it fills the entire flask. If the balloon stretches too much, it may break.

Tips

- Use a borosilicate (e.g., Pyrex®) flask with a heavy-duty rim. Do not use an economy-choice flask. Check the flask for chips or cracks before use.
- Stretch out the balloon by inflating and deflating it before using it.
- The demonstration works best if the balloon is centered on the opening when placed over the mouth of the flask. It also helps if the balloon is slightly pushed into the flask when it begins to collapse. If not, it may collapse onto itself and not get drawn into the flask. The demonstration will work without holding it under cold water, but it takes longer to cool the glass and condense the water vapor.
- A hard-boiled, shelled egg can also be used in place of the balloon. A larger flask may be needed depending on the size of the egg.

Discussion

The *Balloon in the Bottle* demonstration is an easy-to-perform variation of the common *Crush the Can* demonstration. Both demonstrations rely on the creation of a pressure differential caused by the condensation of water vapor inside a closed system. As the water vapor cools and condenses, the molecules move more slowly, and a partial vacuum is formed since no more air can enter the flask. The pressure outside the flask is still at atmospheric pressure (approximately 14.7 lb/in^2). This pressure difference will cause the balloon to be pushed into the flask. The balloon is not "sucked" into the flask—it is

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pushed in by the greater atmospheric pressure that exists outside the closed system. The balloon will continue to be pushed into the flask until the pressure inside the closed system is approximately equal to the atmospheric pressure.

NGSS Alignment

This laboratory activity relates to the following Next Generation Science Standards (2013):

Disciplinary Core Ideas: Middle School
- MS-PS1 Matter and Its Interactions
  - PS1.A: Structure and Properties of Matter
- MS-PS3 Energy
  - PS3.A: Definitions of Energy
  - PS3.B: Conservation of Energy and Energy Transfer

Disciplinary Core Ideas: High School
- HS-PS2 Motion and Stability: Forces and Interactions
  - PS2.A: Forces and Motion
- HS-PS3 Energy
  - PS3.A: Definitions of Energy
  - PS3.B: Conservation of Energy and Energy Transfer

Science and Engineering Practices
- Developing and using models
- Planning and carrying out investigations
- Constructing explanations and designing solutions

Crosscutting Concepts
- Cause and effect
- Scale, proportion, and quantity
- Energy and matter
- Stability and change

Reference

Shakhashiri, B. Z. *Chemical Demonstrations: A Handbook for Teachers in Chemistry;* University of Wisconsin: Madison; Vol. 2, pp 6–8.

Materials for *Balloon in the Bottle* are available from Flinn Scientific, Inc.

Catalog No.	Description
AP1900	Balloons, Latex, pkg/20
AP9802	Hot Plate, Flinn, 7″ × 7″
GP3045	Erlenmeyer Flask, Borosilicate Glass, 250-mL

Consult your *Flinn Scientific Catalog/Reference Manual* for current prices.

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