Crush the Can Demonstration

Introduction

Here's a pressure-packed demonstration that will convince students that air exerts significant pressure!

Concepts

- Pressure differential
- Atmospheric pressure

Materials

Aluminum beverage can, 12-oz, several
Bunsen burner
Support stand and ring
Large bucket
Tap water
Tongs
Wire gauze square

Safety Precautions

Be careful of the hot can and the steam created by heating the water in the can. Wear goggles and protective gloves during the demonstration.

Procedure

1. Clear off the demonstration area; it may get wet.
2. Rinse out an empty 12-oz aluminum beverage can.
3. Set up a Bunsen burner underneath a ring and support stand.
4. Fill the bucket or large container with water so it is about half-full.
5. Add approximately 5–10 mL of tap water to the beverage can.
6. Place the wire gauze square on the ring and the aluminum beverage can on the wire gauze square. Heat the can until the water begins to boil.
7. Allow steam (or the condensed water vapor students associate with steam) to fill the can and begin to rise out of the can.
8. Let the steam escape from the can for about 1–2 minutes. Point out the steam to the students.
9. Turn off the heat.
10. Immediately, pick up the can using tongs and flip it upside-down into the bucket of water. This step may require some practice—the key is to seal off the opening of the can as quickly as possible with the water in the bucket.
11. The can will immediately be crushed, making a loud noise and sending water splashing out of the bucket.

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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-PS2 Motion and Stability: Forces and Interactions
- PS1.A: Forces and Motions
- PS1.B: Types of Interactions

Disciplinary Core Ideas: High School

HS-PS1 Matter and Its Interactions
- PS1.A: Structure and Properties of Matter

HS-PS2 Motion and Stability: Forces and Interactions
- PS1.A: Forces and Motion
- PS1.B: Types of Interactions

Science and Engineering Practices
- Asking questions and defining problems
- Constructing explanations and designing solutions
- Developing and using models

Crosscutting Concepts
- Cause and effect
- Systems and system models
- Structure and function

Tips

- Have several cans cleaned and ready to go—your students will want you to repeat this demonstration because it will happen so fast. They will also be amazed at how fast it occurs.
- Practice this demonstration first before showing it to the students. The noise and water splash may surprise you the first time.
- Make sure the water boils long enough to fill the can with water vapor.
- For a larger-scale *Crush the Can* demonstration, purchase Flinn's Collapsing Can Demonstration Kit, Catalog No. AP4695. This kit contains a large 1-gallon can that makes a more impressive demonstration.
- To demonstrate the magnitude of atmospheric pressure, consider purchasing Flinn's Atmosphere Bar, Catalog No. AP5882. The Atmosphere bar is a 1-in^2 by 52 inches long steel bar that weighs 14.7 lbs. Students will be amazed at how heavy the bar is when they try to lift it.

Discussion

The tremendous pressure required to crush the can comes from the differential in pressure that exists between the outside of the can (normal air pressure) and the partial vacuum created inside the can by the condensing water vapor. As soon as the can is inverted and placed into the water, the can becomes a closed system. The water vapor inside the can begins to condense due to the cold water entering the can. The pressure differential is caused by the condensation of the water vapor inside the closed system as the can cools. The pressure on the outside of the can remains at atmospheric pressure (14.7 lb/in^2) while the pressure inside the can is significantly reduced as the water vapor condenses. Remember that the can is not "sucked in"—it is the greater pressure on the outside of the can that pushes in on the can and crushes it. The total pressure exerted on the outside of the can may be calculated by determining the surface area of the outside of the can and multiplying this area by atmospheric pressure per unit area.

Materials for *Crush the Can Demonstration* are available from Flinn Scientific, Inc.

Catalog No.	Description
AP4695	Collapsing Can Demonstration Kit
AP5882	Atmosphere Bar
AP8350	Wire Gauze Squares, Steel, 4″ × 4″
AP8226	Support Stand, 4″ × 6″
AP8230	Support Ring with Rod Clamp, 2″

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