

Lesson Plan: Chemical Demonstrations

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Age Group: Grades 4 - 5

Area: Chemistry

Included in this lesson plan are two chemical demonstrations that can be conducted as one lesson or as separate lessons. If only one demonstration is performed, it should be accompanied by a longer lesson because each of these demonstrations is about ten to fifteen minutes in length.

Demonstration #1 – The Collapsing Can (Version A)

Objective: To observe how air can crush aluminum cans in two different methods.

Supplies:

- 200 mL tap water
- Collapsible metal can
- Iron tripod with wire gauze
- Burner, Bunsen or Meker (or hot plate)
- Insulated gloves
- Solid rubber stopper to fit mouth of can

Procedure:

- 1) Pour 100 mL of water into the can.
- 2) Place the wire gauze on the tripod.
- 3) Set the can on top of the gauze.
- 4) Light the burner, and place it beneath the can.
- 5) Heat the can until the water inside of it boils vigorously and until the cloud of condensed water vapor escapes from the mouth of the can for at least 30 seconds.
- 6) Turn off the burner, and, wearing insulated gloves, seal the can firmly with the rubber stopper.
- 7) Set the can on the table top and watch it collapse as it cools and the water vapor within it condenses.

8) Remove the stopper from the collapsed can, and pour another 100 mL of water into the can.

9) Securely seat the stopper in the mouth of the can.

10) Place the can on the tripod and reheat it.

11) As the water inside begins to boil, the can will expand again to near its original shape.

Demonstration #1 – The Collapsing Can (Version B)

Supplies:

- 15 mL tap water
- 12-ounce size Aluminum soft-drink can, empty
- Iron tripod with wire gauze
- Burner, Bunsen or Meker (hot plate)
- Tongs
- Beaker, 600 mL or larger, filled with cold tap water

Procedure:

1) Pour 15 mL of water into the can.

2) Place the wire gauze on the tripod or ring stand, and set the can on top of the gauze.

3) Light the burner, and place it beneath the can.

4) Heat the can until the water inside of it boils vigorously and until the cloud of condensed water vapor escapes from the mouth of the can for about 20 seconds.

5) Using tongs, quickly lift the can from the burner and invert it in the beaker of cold water. The can will collapse instantaneously as the water vapor within it condenses.

Follow-up:

- What observations were observed in the two methods for the collapsing can? **Explain - When water is heated it boils and forms vapors (Vapors were seen escaping the can). When the can is filled with water vapor, the vapors in the can cool off when the rubber stopper is put into the can or when the can is inverted into the water. Cooling the can causes the water vapor in the can to condense, which creates a partial vacuum. The extremely low pressure of the partial vacuum inside the can makes it possible for the pressure of the air outside the can to crush it.**

- Why did the cans collapse in both demonstrations? **Explain that normally the**

pressure inside the can and outside the can are equal. When air pressure is greater on the outside of the can than the inside, the can is able to be crushed. The air is driven out of the can and replaced by water vapor. When the water vapor condenses, the pressure inside the can becomes much less than the air pressure outside. Then the air outside crushes the can. The can that is inverted into the water cannot be filled up with water because the air crushes the can before the water can flow into it.

- Why did the can in the first demonstration expand again? **When the water is heated inside the can, the water boils and the vapor inside the can is able to make the can expand.**

Demonstration #2 – Thermal Expansion of Gases

Objective: To introduce simple gas laws by observing an egg sucked into an Erlenmeyer flask.

Supplies:

- Petroleum or stopcock grease
- Hard-boiled egg, shelled, slightly larger in diameter than mouth of Erlenmeyer flask
- 1-liter Erlenmeyer flask
- Stand, with clamp for flask
- Bunsen burner
- Ice-water bath large enough to accommodate the Erlenmeyer flask

Procedure:

- 1) Lightly grease the inside of the neck of the 1-liter Erlenmeyer flask with petroleum (e.g., Vaseline) or stopcock grease.
- 2) Clamp the flask onto the stand.
- 3) Light the Bunsen burner and adjust it to produce a luminous flame.
- 4) Gently warm the 1-liter Erlenmeyer flask with the Bunsen burner for about 1 minute.
- 5) While the flask is warm, seat the egg, narrow end down, in the mouth of the flask.
- 6) Unclamp the flask and immerse it in the ice-water bath. The egg will pop into the flask.
- 7) Grasp the flask by the neck and invert it so the egg lodges in its neck. Gently

heat the side of the flask with the burner and rotate the flask to avoid scorching the egg. The egg will be forced from the flask.

Follow-up:

- What observations can be made from this demonstration?

- Why did the egg pop into the flask when the flask was put in the ice-water bath?

Explain that when the fire heats the flask, it warms the air inside the flask and pushes some of the air out. When the air is cooled in the ice-water bath, the lower pressure inside the flask causes the egg to be sucked in.

- Why was the egg able to be forced out of the flask after heating? **By heating the flask once the egg is inside, the air inside the flask becomes warm and creates higher pressure in the flask, which forces the egg out.**

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