The Expanding Marshmallow

Introduction

Help students explore and understand Boyle's Law with this simple demonstration. See how a change in pressure affects the volume of marshmallow. Students will easily remember the relationship between pressure and volume after participating in this activity.

By simply placing a marshmallow inside a syringe and using the plunger to increase and decrease the pressure, your students can watch the marshmallow expand and shrink to get a clear understanding of Boyle's Law.

Concepts

- Pressure
- Volume
- Boyle's Law
- Gas laws

Materials

Syringe, without needle, plastic, 35-mL
Miniature marshmallow, fresh
Felt-tip pen (optional)
Syringe tip cap (optional)

Safety Precautions

This laboratory activity is considered nonhazardous. Follow all normal laboratory procedures.

Procedure

1. If desired, use a felt-tip pen to draw a happy face on the end of a miniature marshmallow.
2. Remove the end cap from the tip of a 35-mL plastic syringe.
3. Remove plunger from the syringe and insert the marshmallow into the syringe.
4. Place plunger back in syringe so the volume reading is approximately at the 15-mL mark.
5. Place a syringe tip cap over the tip of the syringe. Pull the plunger out—decreasing the pressure inside the syringe. The marshmallow should expand—it's volume increases.
6. Now push the syringe in—increasing the pressure inside the syringe. The marshmallow should shrink—its volume decreases.

Disposal

Please consult your current *Flinn Scientific Catalog/Reference Manual* for general guidelines and specific procedures governing the disposal of laboratory waste. The marshmallow should be removed from syringe and put into the trash according to Flinn Suggested Disposal Method #26a. Clean work area and wash hands thoroughly with soap and water before leaving the laboratory.

Tip

- A finger may be used to "seal" the syringe instead of a syringe tip cap, if needed.

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Discussion

When the syringe plunger is pulled out, the volume of the chamber increases but the amount of gas remains constant because it is in a closed system. The pressure inside the syringe chamber decreases. The lower pressure on the marshmallow causes its volume to increase according to Boyle's Law. The expansion is due to the many trapped air bubbles (like small "internal balloons") within the marshmallow that initially are at atmospheric pressure. As the pressure outside these air bubbles (within the chamber) is reduced, the bubbles will expand to many times the original volume in order to equilibrate the pressure on either side of the bubble wall. Thus as the pressure decreases ($P\downarrow$), volume increases ($V\uparrow$) in an inverse relationship according to the following equations.

$$PV = nRT \qquad \textit{Equation 1 – Ideal Gas Law}$$

$$P_1 \times V_1 = P_2 \times V_2 \qquad \textit{Equation 2 – Boyle's Law}$$

This increase in volume makes for a memorable visual event and a great stimulus for the discussion of the elements of Boyle's Law. Students can visualize the loss in pressure and easily see the increase in volume.

Connecting to the National Standards

This laboratory activity relates to the following National Science Education Standards (1996):

Unifying Concepts and Processes: Grades K–12
Evidence, models, and explanation
Constancy, change, and measurement
Content Standards: Grades 5–8
Content Standard B: Physical Science, properties and changes of properties in matter
Content Standards: Grades 9–12
Content Standard B: Physical Science, structure and properties of matter

Materials for *The Expanding Marshmallow* are available from Flinn Scientific, Inc.

Catalog No.	Description
AP1732	Syringe, 35 mL
AP1297	Felt-tip Pen, black
AP8958	Syringe tip cap

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