Lab: The Growing Marshmallow

FOR THE TEACHER

Summary
In this lab, students will investigate the relationship between volume and pressure of a gas, using a plastic syringe and a marshmallow.

Grade Level
Elementary and Middle School

Objectives
By the end of this lab, students should be able to
- Analyze a scenario involving changing variables.
- Understand that changes in the pressure of a gas affect the volume of the gas in a closed container.
- Understand that changes in the volume of a gas affect the pressure of the gas in a closed container.
- Recognize that there is empty space between the particles in a gas.

Chemistry Topics
This lab supports students’ understanding of
- Gases
- Gas Laws
- Volume
- Pressure

Time
Teacher Preparation: 20 minutes
Lesson: 1-2 hours

Materials
- 1-2 small marshmallows per student
- 1 plastic syringe with lid per student or pair of students

Safety
- Always wear safety goggles when handling chemicals in the lab.
- Students should wash their hands thoroughly before leaving the lab.
- When students complete the lab, instruct them how to clean up their materials and dispose of any chemicals.
- Food in the lab should be considered a chemical not for consumption.

Teacher Notes
- This lab can also be done by a simple teacher-lead class demonstration.
- For a lab, it is best to have 1 plastic syringe per student, or one syringe between a pair of students. Larger syringes may be used as an alternative.
Marshmallows of any size will work; they just need to fit in the syringe. Peeps candy can also be used as a substitute.

Make sure to remind students that they cannot eat the marshmallows.

Important concepts for students to understand:
- Gas molecules move freely and will occupy the space of their container.
- Gases will spread out and expand in a given volume; there is empty space between the actual particles of the gas.
- Advanced topic (older students): Gas pressure can be thought of as the number of times the particles in a gas sample collide with each other and the walls of their container.

In this lab students will see the interaction between the volume and pressure of a gas is indirectly related. When the volume (space) of a gas is small, the pressure (collisions) will be high. When the pressure (collisions) is low, the volume (space) must be large. **Note:** This is assuming the container is closed, and the temperature remains the same.

For younger students the concept of pressure can be omitted. Teachers can simply focus on volume change. When the plunger is pulled, there is a large volume in the syringe, so the gas particles will spread out, and the marshmallow will grow since there is more empty space. When the plunger is pushed, the volume decreases, so the gas particles will get closer together, this will compress the marshmallow.

This lab is intended for upper level elementary students, and/or middle school students.

**FOR THE STUDENT**

**Lab**

**The Growing Marshmallow**

**Prelab Questions**
1. In your own words describe a gas:

2. Draw a picture of a solid, liquid and gas below:

| Solid | Liquid | Gas |

3. What does the word volume mean?

**Materials**
- 1 Mini Marshmallow
- 1 Plastic syringe with lid

**Safety**
- Always wear safety goggles when handling chemicals in the lab.
- Wash your hands thoroughly before leaving the lab.
- Follow your teacher’s instructions for cleanup of your materials.
- Food in the lab should be considered a chemical not for consumption.
Procedure
1. Remove the lid from the syringe and pull the plunger out of the syringe casing.
2. Put the plunger back into the casing, and push the plunger all the way into the casing.
3. Both steps 1 and 2 should be easy and there shouldn’t be any resistance.
4. Put the plunger approximately halfway into the syringe casing.
5. Put the lid back onto the tip of the syringe. This is now a closed container. The air inside is trapped in the syringe.
6. Pull the syringe plunger. Record your observation in the data table below.
7. Place one hand over the lid of the syringe, securing it in place. With your other hand attempt to push the plunger. Record your observation in the data table below.
8. Remove the lid, and pull the plunger out of the casing.
9. Place the marshmallow in the syringe casing and put the plunger about 2/3 of the way into the casing.
10. Put the lid on the syringe.
*See photos below for steps 8, 9, and 10.

11. Now you will pull the plunger. Pay special attention to the marshmallow as you pull on the plunger. Record your observations in the data table below.
12. Place one hand over the lid of the syringe, securing it in place. At the same time, with the other hand, push the plunger. Pay special attention to the marshmallow as you push on the plunger. Record your observations in the data table below.

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<tr>
<th>Procedure Step</th>
<th>Observations</th>
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Analysis
1. Why do you think it is more difficult to push and pull on the plunger when the lid is on the plastic syringe?

2. When the lid is on the syringe the air inside cannot leave the syringe. However it can move around.
   a. What happened to the particles of air in the syringe when the lid was on it and the plunger was *pulled*? Draw a sketch to help explain your answer.

   b. What happened to the particles of air in the syringe when the lid was on it and the plunger was *pushed*? Draw a sketch to help explain your answer.

Conclusion
Considering your answers to questions 1 & 2 above, summarize what you learned. Make sure to reference the marshmallow.