BOYLE'S LAW

Materials needed:

- One large syringe with end cap
- 3 books of the same kind

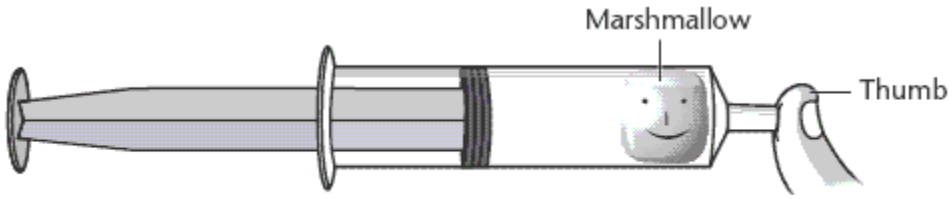
1. Withdraw the plunger of the syringe to a specific position, such as 100-mL.
2. Place the end cap on the syringe and support the syringe in an upright position (plunger on top).
3. Place a weight or book on the top of the plunger. Read the volume of the air trapped in the syringe and record it.
4. Repeat this procedure with a second book. You may have to hold this book (and the next one) in place.
5. Repeat with a third book.
6. Graph the results using the volume of the gas on the x-axis and the number of books, or weights, on the y-axis.

Materials needed:

- One large syringe with end cap
- Small marshmallow
- Marker
- Small amount of dish washing liquid in a Dixie cup

1. Draw a face on the marshmallow.
2. Pull the plunger all the way out of the syringe.
3. Drop the marshmallow into the syringe.
4. Insert the plunger until the rubber gasket is just inside the syringe. Put the cap on the end of the syringe.
5. Stand the syringe up so the plunger is on top.
6. Push down on the syringe. BE CAREFUL not to push down so hard that the cap becomes stuck. Observe what happens to the marshmallow.
7. Remove the cap. Push the plunger down until it is almost touching the marshmallow. Replace the cap.
8. Pull the plunger up as far as you can without removing it. Observe what happens to the marshmallow.

- If you don't have a cap, just press your finger to the end of the syringe.



1. With the plunger in place and the cap (or your finger) on the end of the syringe tip, the system inside the syringe was closed: nothing could get in, nothing could get out. As the plunger was pulled outward, did the number of air molecules increase, decrease, or stay the same?

2. What happened to the distance between the air particles when the plunger was pulled?

3. What happened to the air pressure inside the tube as the plunger was pulled?

4. What happened to the marshmallow as the plunger was pulled?

5. As the plunger was pushed in, did the number of air molecules increase, decrease, or stay the same?

6. What happened to the distance between the air particles when the plunger was pushed in?

7. What happened to the air pressure inside the tube as the plunger was pushed in?

8. What happened to the marshmallow as the plunger was pushed in?

ANSWERS

1. With the plunger in place and the cap (or your finger) on the end of the syringe tip, the system inside the syringe was closed: nothing could get in, nothing could get out. As the plunger was pulled outward, did the number of air molecules increase, decrease, or stay the same?
   They stayed the same.

2. What happened to the distance between the air particles when the plunger was pulled?
   The distance between the air particles increased.

3. What happened to the air pressure inside the tube as the plunger was pulled?
   The air pressure decreased

4. What happened to the marshmallow as the plunger was pulled?
   Student answers will vary but should indicate the marshmallow grew larger

5. As the plunger was pushed in, did the number of air molecules increase, decrease, or stay the same?
   They stayed the same.

6. What happened to the distance between the air particles when the plunger was pushed in?
   The distance between the air particles decreased.

7. What happened to the air pressure inside the tube as the plunger was pushed in?
   The air pressure increased

8. What happened to the marshmallow as the plunger was pushed in?
   Student answers will vary but should indicate the marshmallow shrunk

Background

Boyle's Law states that when temperature is held constant, the volume— the amount of space occupied by matter—of a gas is inversely proportional to its pressure, the force per unit area. This simply means that if the pressure increases and temperature remains the same, the volume decreases. The opposite is also true (if the pressure decreases and the temperature remains the same, the volume increases).

Drawing the face on the marshmallow doesn't have any real scientific value. It does, however, allow the students to see the change even more easily. Besides, it's fun.

If your students are like mine were, they may try to shoot the caps at each other. This doesn't work very well.

The plunger may be hard for some students to manipulate. If this happens, pull the plunger all the way out and rub a little dishwashing liquid around the rubber gasket. Do not use Vaseline or any other kind of petroleum jelly. These products may eat away the gasket.