LESSON 65
LAB

Take a Breath
Ideal Gas Law

Name _____

Date _____ Period _____

Purpose

To determine the number of moles of air particles in an average breath and to explore the ideal gas law.

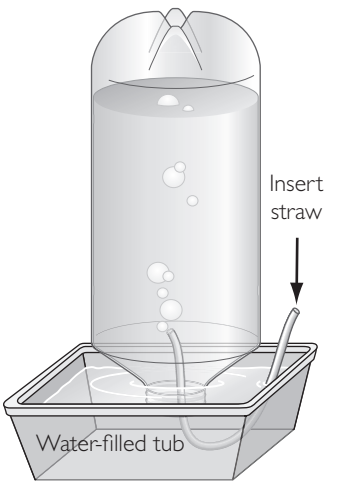
Materials

- 2 L plastic soft drink bottle with cap
- sink or other large container
- tap water
- 3 ft of flexible tubing
- 4 drinking straws
- marker
- 250 mL or 500 mL graduated cylinder

Part 1: Volume of a Breath of Air

The goal of this part of the lab is to determine the volume of one normal breath of air for each person in your group. The outline for a procedure is given below. Your group will need to decide how you will figure out the air volume.

Procedure



1. Fill a larger container or tub about half full with tap water.
2. Fill a 2 L plastic soft drink bottle with tap water. Put the cap on loosely.
3. Carefully turn the bottle upside down without spilling any water.
4. Put the bottle into the large container of water so that the mouth of the bottle is underwater. Remove the cap underwater.
5. Feed the flexible tubing under the water so that one end goes inside the bottle.
6. Put your straw into the other end of the tubing. Do not share straws.
7. When it is your turn, exhale into the straw to collect the air of one normal breath.
8. With a marking pen, mark the volume of air on the soft drink bottle.
9. Figure out the volume of the air trapped inside the bottle. Record this volume.
10. Repeat the procedure for each person in the group. Replace the straw for each new person.

Part 2: Analysis

Use the volume you determined for one breath for your calculations in Questions 1 and 2. Also use the ideal gas law described by $PV = nRT$ where $R = 0.082$ L · atm/mol · K.

1. **Moles in a Breath at Sea Level.** Suppose you take a breath at sea level where the air pressure is 1.0 atm and the temperature is 25 °C. Use the ideal gas law to determine the number of moles of air molecules in one breath.

2. **Moles in a Breath on a Mountaintop.** Suppose you take a breath on a mountaintop at altitude 10,000 ft where the air pressure is 0.75 atm and the temperature is 20 °C. Use the ideal gas law to determine the number of moles of air molecules in one breath.

3. There are 602 sextillion, or 602,000,000,000,000,000,000,000, gas molecules in 1 mole. Calculate the number of gas molecules in a breath at sea level. Calculate the number of gas molecules in a breath on a mountaintop. (Show your work.)

4. Based on your calculations in Question 3, what is the difference between the number of molecules in one normal breath at sea level and the number at 10,000 ft?

5. The air in airplanes is "pressurized." What do you think this means?

6. **Making Sense** Explain what the ideal gas law can help you figure out. What must you know before you can use the ideal gas law?

7. **If You Finish Early** Use the ideal gas law and your breath volume to figure out how many moles of air molecules would be in one breath at the top of Mount Everest. Air pressure at 29,000 ft is 0.30 atm. The temperature at the summit at the warmest time of the year is −19 °C.