EXPLORING GASES

AN INTRODUCTION TO THE GAS LAWS

Each of the following activities deals with the properties of gases. You will be investigating three variables that can affect the behavior of a gas; pressure, volume, and temperature.

In each activity first determine which variable (pressure, volume, temperature) is not being changed or manipulated then determine the relationship between the other two variables. For example, if the temperature is kept constant, what relationship exists between pressure and volume.

Draw diagrams of what happens in each activity to refer to later and answer the questions at the end of each activity. Observe carefully and try to explain the results of each activity in terms of our kinetic theory of gases.

AND I'LL HUFF...AND I'LL PUFF...

PROCEDURE

1. Obtain a set of two prepared plastic bottles labeled A and B.
2. Attempt to blow up the balloon in bottle A. Record your results.
3. Attempt to blow up the balloon in bottle B. Record your results.

QUESTIONS

1. Explain your observations for bottles A, B.
2. Which variables are changing? Which is kept constant?
3. What is the relationship between the changing variable?
4. What is happening at the molecular level?

BALLOON THERMOMETER

PROCEDURE

1. Add about 50 ml of water to an Erlenmeyer flask.
2. Heat the flask until the water just starts to boil.
3. Carefully remove the flask from heat and place a stretched balloon over the mouth of the flask.
3. Heat the flask with the balloom attached until the water boils and continue heating until there is a noticeable change in the balloon.
4. Stop heating after the change has been observed. Using tongs remove the flask from the ringstand and place into an ice water bath. Allow to sit for 3-4 minutes and observe what happens.

QUESTIONS

1. Record and diagram what happens to the balloon when the flask is heated and then cooled.
2. Which variables are changing in the activity? Which variable is being kept constant?
3. What is the relationship between the variables that are changing?
4. What is happening at the molecular level?

ARE YOU A WARM BODY?

PROCEDURE

1. Place your hand over one end of the pulse glass and observe what happens.

2. Have your lab partner hold the other end at the same time and observe what happens.

3. Run cold water over one end of the glass and observe what happens.

4. Run hot water over one end of the glass and observe what happens.

QUESTIONS

1. Which variables are changing? Which variable is staying the same?

2. What is the relationship between the variables that are changing?

3. What is happening at the molecular level?

BOOKPRESS

PROCEDURE

1. Carefully insert the plunger into the cylinder. Gently push down on the platform over the plunger until the bottom of the plunger is at the graduation marked 30. Hold the plunger in that position for a second or two, and then let go. What happens? Why?

2. Remove the plunger from the cylinder. With the wire running straight down alongside of the plunger, put the wire into the top of the cylinder first, and then begin pushing the bottom of the plunger into the cylinder. The wire will open up a space in the gasket so that air can escape from the cylinder as you push downward. Stop when the bottom of the plunger reaches the 30-mL mark. While holding the plunger at the 30-mL mark, pull the wire out of the cylinder. When you remove your hand, the bottom of the plunger should remain at the 30-mL mark.

3. Add a text book to the platform and record the reading on the plunger. Continue adding books and recording the plunger reading until you have added a total of 4 books.

4. Remove the books one at a time and record the plunger reading after each book is removed. Compare your results to those from step three. Are they the same or different? Explain.

QUESTIONS

1. Record your data. Make graphs of pressure (number of books) versus volume and pressure versus 1/V. Intrepret your graphs.

2. Which variables are changing? Which variable is being kept constant?

3. What is the relationship between the changing variables?

4. What is happening at the molecular level?

CARTESIAN DIVER

PROCEDURE

1. Obtain a cartesian diver bottle (a bottle of water with two eyedroppers in it).

2. Note that one eyedropper is positioned at the bottom of the bottle and has a wire loop attached. The other eyedropper is near the top and has a hook attached to it. The challenge is to use the top eyedropper to go down and retrieve the one at the bottom.

3. Make careful observations of each dropper as they are moved up and down. Pay special attention to the amount of air in each one.

QUESTIONS

1. Describe the steps needed to cause the hooked-dropper to sink, rise.

2. What happens to the air in the dropper in each case?

3. Why does the bottom dropper stay at the bottom? Why does the top dropper float?

3. Which variables are being changed? Which are being kept constant?

4. What is the relationship between the variable that are being changed?

5. What is happening at the molecular level?

TUG-OF-WAR

PROCEDURE

1. Obtain a pair of small "suction" cups. Press them together tightly and then release them. They should "stick" together. Make sure the outer edges are flush.

2. Have one lab partner pull on one "suction" cup and one partner pull on the other. What degree of effort is required to pull them apart?

3. Calculate the area of "suction" cup. Remember the area of a circle is given by $A = \pi r^2$.

4. If the air pressure in the room is 14.7 lbs/sq.in., calculate the total pressure acting on one "suction" cup.

QUESTIONS

1. Why was it so difficult to pull the "suction" cups apart?

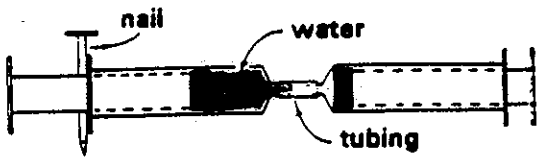
2. What pressure did air exert on each cup?

3. If air can apply so much pressure to two small "suction" cups, consider the how much it must exert on the human body. Why don't we feel it?

SYRINGES

PROCEDURE

1. Obtain a pair of syringes as shown below.



2. Note that one syringe contains colored water and the other is empty. Try to get the water into the empty syringe.

QUESTIONS

1. What techniques did not work? Suggest reasons why?
2. What technique did work? Why?
3. Which variables are changing? Which is kept constant?
4. What is the relationship between the changing variables?
5. What is happening at the molecular level?

DEATH OF A POP CAN

PROCEDURE

1. Fill a pan 3/4 full of cold water and set to the side.
2. Add about 5-10 ml of water to an empty pop can.
3. Using tongs to hold the pop can, heat the pop can over an open flame until you see steam coming out the top.
4. Immediately remove the pop can from the flame and invert it into the container of cold water.

QUESTIONS

1. Record your observations.
2. Which variables are being changed? Which variable is kept constant?
3. What is the relationship between the changing variables?
4. Will the same thing happen if you do not put water in the can? Try it. Explain your results.
5. What is happening at the molecular level?

Gas Law Demonstrations

Record your observations for each teacher demonstration listed below. Draw diagrams in each case.

1. Marshmallow Inflation -

2. Balloon Growth -

3. Potato gun/Nerf gun -

4. Shaving cream -

5. Water fountain -

6. Balloon "tug-o-war" -

7. Candles with a jar -

8. Dry ice and candles -

9. Acetylene cannon -

10. Grain explosion -

11. Magic extinguisher -

12. Balancing bags -

13. Vacuum packed student -

1. **For each demonstration, identify which variables are changing and which variable is being kept constant.**
2. **For each demonstration, describe the relationship between the changing variables.**
3. **What is happening at the molecular level in each case?**