Name: _____Date: _____ Period: _____ Score: _____

It's A Gas!

Introduction to Pressure[1]

Pressure is: _____

1. How does a bed of nails demonstrate pressure? _____
   _____
2. How would stepping on a one nail compare to stepping on a whole bed (of 500 nails!)?
   _____
3. How does pressure vary with elevation? _____
4. How is air pressure measured? (Draw a simple barometer) _____
   _____

5. What are the **values and units** for standard atmospheric pressure? _____
   _____
6. What is the effect of decreasing air pressure on various objects?
   a. Describe your observations of the following:
      i. Place a beaker of water in the vacuum chamber. Pump the vacuum chamber and write down observations of what is happening.

      ii. Put a partially inflated balloon inside the vacuum chamber. Pump the vacuum chamber and write down observations about what is occurring

      iii. Repeat the experiment with a marshmallow. Write down observations of what is happening.

7. ***Review Problems regarding pressure. Please show your work for all problems!***

a. A bookcase with a weight of 456 Newton sits on the floor. The length of the bookcase is 1.5 meters and the width is 0.50 meters. What is the pressure that the bookcase exerts on to the floor? Use the units of **Pascals** (Pa). 1 Pa = 1 N/m^2.

b. A small teenager with a weight of 120 lbs. stands on one foot. Suppose the area of this person's foot is 0.025 m^2. Calculate the pressure on this person's foot in **Pascals.** (4.448 N = 1 pound)

c. Convert 552 mm Hg into **kPa**.

[1] Introduction to pressure activity adapted from Maria Tait

d. Convert 100 kPa to **atm**.

e. An average spring day has an air pressure of 30.00 inches of mercury. How many **torr** is this equivalent to?

Lab Station One

Part A. Pour some water into a paper/plastic cup. Use a **CLEAN/NEW** straw to suck up some water. What is occurring that lets this happen? _____
Now suck up some water in the straw and put your index finger over it, and lift the straw out of the cup. What happens? What causes the water to remain in the straw? _____
_____

Part B. Fill the baby food jar brim full (overflowing) and place an index card securely on top. Make sure there is good contact between the card and lip of cup. Now, gently turn the cup sideways. What happens to the water? _____

Now, gently turn the cup upside down and carefully let go of the card. What happens to the water now? How is this possible? Think about atmospheric pressure. _____
_____

Lab Station Two

Put the flask with the balloon on the hot plate and let the water boil. What happens to the balloon? Why? Explain in words and pictures. Think about the relationship between temperature and volume.

Now put the flask in the ice bath and let it cool. Now what does the balloon do? Why? Explain in words and pictures. Think about the relationship between temperature and volume. **What gas law does this demonstrate?** _____

Lab Station Three

Cartesian Diver (*the "diver" is a little tube half-filled with water inside the large plastic bottle*)
Note the position of the little tube inside the large plastic bottle as it sits on the table - **write the relative position here:**

Squeeze the plastic bottle and write down what happens to the diver here: _____

Take your hands off the bottle. What does the diver do now? _____
_____

What do you think causes the diver to behave this way? Explain in words and pictures. Really pay attention to the water level inside the tube and think about pressure versus volume! **What gas law does this demonstrate?** _____

_____

Lab Station Four

Wrap your hand around one of the duster cans. Make sure your palm is in complete contact with the can. Now, depress the nozzle.

Questions:

What do you feel? Why? _____

Shake the can. What do you notice? _____

Try to explain what happens when you depress the nozzle paying particular attention to pressure and temperature. **What gas law does this demonstrate?** _____

SDS for 1,1 –difluoroethane *(the chemical inside the duster can): contact with liquid may cause frostbite. Excessive intentional inhalations may cause respiratory tract irritations and central nervous system effects (headache, dizziness). Vapors may cause dizziness or suffocation. Prolonged or repeated exposer can cause drying, defatting and dermatitis. Symptoms may include redness, edema, drying, defatting and cracking of the skin.*

Introduction to the Gas Laws with pHet[2]

Getting to know the system:

1. Open the "Gas Properties" pHet simulation and select "Run Now!"
2. Spend a few minutes just messing with the controls to see what happens.
3. Notice the effect of changing the constant variable from "None" to something else like volume, pressure, or temperature.

Activity #1

1. Reset the system and make sure the constant parameter button is set to "None."
2. Use the molecule counters in the "Gas in Chamber" box, to add 50 heavy species molecules and 50 light species molecules. How do the velocities of the two molecules compare?

3. Use the heat control to add energy. Notice that the thermometer shows an increasing temperature. What happens to the velocities of the molecules?

4. Use the heat control again, to remove energy. What happens to the velocities of the molecules?

[2] Thomas Isaac, South Fayette High School, 5/9/17

Activity #2

1. Reset the system again.
2. Add 200 light molecules.
3. Set the Constant Parameter button to "Volume."
4. Record the temperature and pressure of the system.

Temperature: _____ K Pressure: _____ Atm

5. Add heat to the system using the heat control.
6. What happens to the temperature and pressure?

7. Record the temperature and pressure of the system again.

Temperature: _____ K Pressure: _____ Atm

8. What is the mathematical relationship between temperature and pressure, direct or inverse?

9. Write the mathematical equation for this relationship and the name of the scientist credited with its discovery.

Activity #3

1. Reset the system again.
2. Add 200 light molecules. Notice the way the little man moves to maintain the same pressure.
3. Set the Constant Parameter button to "Pressure."
4. Record the temperature and pressure of the system.

Temperature: _____ K Pressure: _____ Atm

5. Add heat to the system using the heat control.
6. What happens to the volume of the chamber?

7. What happens to the temperature and pressure?

8. Record the temperature and pressure of the system again.

Temperature: _____ K Pressure: _____ Atm

9. What is this mathematical relationship between the temperature and the volume, direct or inverse?

10. Write the mathematical equation for this relationship and the name of the scientist credited with its discovery.

Activity #4

1. Reset the system again.
2. Add 200 light molecules.
3. Set the Constant Parameter button to "Temperature."

4. Record the temperature and pressure of the system.

   Temperature: _____ K Pressure: _____ Atm
5. While you are watching the heat control, move the little man so that the volume of the chamber is smaller.
6. What does the heat control do when you move the little man?

7. What happens to the temperature and pressure?

8. Record the temperature and pressure of the system again.

   Temperature: _____ K Pressure: _____ Atm
9. What is this mathematical relationship between the pressure and the volume, direct or inverse?

10. Write the mathematical equation for this relationship and the name of the scientist credited with its discovery.

Activity #5

1. Reset the system using the "Reset" button. Set the constant parameter to "None."
2. Using the molecule counters again, add 100 heavy molecules to the chamber and watch the gas molecules move.
   a. Describe their motion.

   b. Do all the molecules move at the same velocity?

   c. Record the temperature _____ K.

3. Slide the lid to make a small opening and notice the rate of effusion. Try to count the number of heavy molecules that leave the chamber in 30 seconds.

   a. Record your answer here: _____ heavy molecules /30 seconds.

4. Reset the activity and add 100 light molecules.
   a. How do the velocities of the light molecules compare to the velocities of the heavy molecules that you had in the chamber?

   b. Record the temperature of chamber: _____ K.

   c. What is the relationship between the velocities of the small molecules vs. the velocities of the large molecules at the same temperature?

5. Slide the lid to make a small opening again and notice the rate of effusion. Try to count the number of light molecules that leave the chamber in 30 seconds.
   a. Record your answer here: _____ light molecules /30 seconds.

b. You should recall that the rate of effusion is inversely related to the molar mass. Are your effusion rates reasonable? Discuss why or why not.

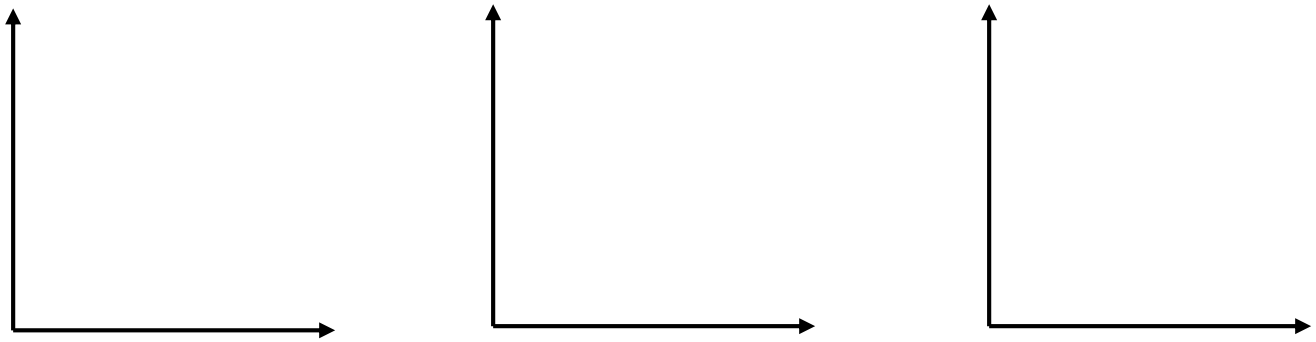
Activity #6

1. Redo Activities 2 - 4 again.
2. Collect five data points on the parameters that vary.
3. Make a data table of the variable parameters for each parameter that is held constant.
4. Use this data to make a graph of each relationship. The graph needs to include axis labels and units.
5. Describe the relationship.

Data Table:

Name	Gay-Lussac's Law		Charles's Law		Boyle's Law	
Constant	#2 Constant Volume		#3 Constant Pressure		#4 Constant Temperature	
Variables	Temperature	Pressure	Temperature	Volume	Pressure	Volume
Data 1						
Data 2						
Data 3						
Data 4						
Data 5						

Graphs of relationships



Describe the relationships:

SCUBA DIVING (*check out this website to answer the following questions:*
https://www.thoughtco.com/depth-and-pressure-scuba-diving-2963200!)
Every additional 33 feet of sea water adds another _____ pounds of _____!
Why should you never hold your breath while SCUBA diving? Be specific and **thorough in explaining why**! *Explain when problems can be more severe; i.e. upon **descending** or **ascending.***