**Introduction to the gas laws**

Name :

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Period :

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Date :

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

In this virtual lab you will observe the behavior of gases when different variables are changed. The variables that we will be changing and measuring are temperature, pressure, volume and number of molecules.

**Getting to know the system:**

1. Open the Gas Properties HTML5 simulation.

2. Spend a few minutes just playing with the controls to see what happens.

3. Notice the effect of changing the Constant Parameter.

**Activity #1**

1. Reset the system and make sure the Constant Parameter button is set to None.

2. Pump 50 heavy molecules and 50 light molecules in the container.

How do the velocities of the heavy molecules compare to those of the light molecules?

The heavy molecules are slower than the light molecules.

3. Use the Heat Control to add energy.

Notice that the thermometer shows an increasing temperature.

What happens to the velocities of the molecules?

The velocities are increasing.

4. Use the Heat Control to remove energy.

What happens to the velocities of the molecules?

The velocities are decreasing.

**Activity #2**

1. Reset the system.

2. Add 200 light molecules.

3. Set the Constant Parameter button to Volume.

4. Record the temperature and pressure..

Temperature: \_\_\_\_\_\_\_\_\_\_\_\_\_ K

Pressure: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Atm

5. Add heat using the Heat Control.

6. What happens to the temperature and pressure?

The temperature and the pressure are increasing.

7. Record the temperature and pressure.

Temperature: \_\_\_\_\_\_\_\_\_\_\_ K

Pressure: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Atm

8. What is the relationship between temperature and pressure? (direct or inverse)

The relationship between the temperature and the pressure is a direct relationship.

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

p = constant.T

p/T = constant

Gay-Lussac

**Activity #3**

1. Reset the system.

2. Add 200 light molecules.

3. Set the Constant Parameter button to Pressure.

4. Record the temperature and volume..

Temperature: \_\_\_\_\_\_\_\_\_\_\_ K

Volume: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ nm A

5. Add heat using the Heat Control.

6. What happens to the volume of the container?

Notice the way the vertical lid moves to maintain the same pressure.

The volume is increasing.

7. What happens to the temperature?

The temperature is increasing.

8. Record the temperature and volume.

Temperature: \_\_\_\_\_\_\_\_\_\_\_ K

Volume: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ nm A

9. What is this relationship between temperature and volume? (direct or inverse)

The relationship between the temperature and the volume is a direct relationship.

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

V = constant.T

V/T = constant

Charles

**Activity #4**

1. Reset the system.

2. Add 200 light molecules.

3. Set the Constant Parameter button to Temperature.

4. Record the pressure and volume..

Pressure: \_\_\_\_\_\_\_\_\_\_\_ K

Volume: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ nm A

5. Move the Vertical Lid so that the volume of the container is smaller.

6. What does the Heat Control do?

The Heat Control removes energy and the temperature stays constant.

7. What happens to the pressure?

The.pressure is increasing.

8. Record the ptessure and volume of the system.

Pressure: \_\_\_\_\_\_\_\_\_\_\_ Atm

Volume: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ nm A

9. What is this relationship between the pressure and the volume? (direct or inverse)

The relationship between the pressure and the volume is a inverse relationship.

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

p = constant/V

pV = constant

Boyle

**Activity #5**

1. Reset the system.

2. Add 50 light molecules.

3. Set the Constant Parameter button to Temperature.

Also the Pressure has to be constant.

4. Record the number of molecules and volume.

Number of molecules: \_\_\_\_\_\_\_\_\_\_\_\_\_\_

Volume : \_\_\_\_\_\_\_\_\_\_\_\_\_\_ nm A

5. Add another 50 light molecules.

7. What happens to the volume?

The volume is increasing.

8. Record the number of molecules and volume.

Number of molecules: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Volume : \_\_\_\_\_\_\_\_\_\_\_\_\_\_ nm A

9. What is this relationship between the number of molecules and volume? (direct or inverse)

The relationship between the volume and the number of molecules is a direct relationship.

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

V = constant.N

V/N = constant

Avogadro

**Activity #6**

1. Redo Activities 2 - 3 - 4 - 5.

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.

Charles Law

Constant pressure

Variables temperature and lenght

Data 1 300 K 15.0 nm

Data 2 250 K 12.5 nm

Data 3 200 K 10.0 nm

Data 4 150 K. 7.5 nm

Data 5. 100 K. 5.0 nm

Gay - Lussac Law

Constant volume

Variables temperature and pressure

Data 1 300 K 3.9 atm

Data 2 250 K 3.2 atm

Data 3 200 K 2.6 atm

Data 4 150 K 2.0 atm

Data 5 100 K 1.3 atm

Boyle Law

Constant temperature

Variables pressure and lenght

Data 1. 4.0 atm 15.0 nm

Data 2. 4.8 atm 12.5 nm

Data 3. 6.0 atm 10.0 nm

Data 4 7.9 atm. 7.5 nm

Data 5 11.0 atm. 5.0 nm

Avogadro Law

Constants: temperature and pressure

Variables: number of molecules and lenght

 (volume = lenght . area)

Data 1 50 5.0 nm

Data 2. 75 7.5 nm

Data 3 100 10.0 nm

Data 4 125 12.5 nm

Data 5 150 15.0 nm