**Gas Law Laboratory Experiment**

**This activity supports the following unit and course objectives:**

(CLO4) Demonstrate knowledge of basic laboratory skills and operations in the areas of safety, measurement, chemical and physical properties of matter, atomic and molecular structure, chemical reactions, reactivity, structure, periodicity, and bonding.

Gas Pressure (8.1)

* (8.1.1) Define the property of pressure (CLO1)(CLO3)

Relating Pressure, Volume, Amount, and Temperature: The Ideal Gas Law (8.2)

* (8.2.1) Identify the mathematical relationships between the various properties of gases (CLO1)(CLO2)
* (8.2.2) Use the ideal gas law, and related gas laws, to compute the values of various gas properties under specified conditions (CLO1)(CLO2)

**In addition to the unit and course objectives, this activity supports the following activity objectives:**

* Describe the relationship between particle-wall collisions and pressure (8.1.1)
* Predict how changing temperature will affect the speed of molecules (8.2.1) (8.2.2)

**Overview**

In this lab you will investigate the ideal gas law by measuring the gas pressure as different amounts of gas are added to a container. Pay close attention to how the experimental results connect to the concept of the ideal gas law.

**Procedure**

1. Open the [Gas Laws Simulator](https://phet.colorado.edu/sims/html/gases-intro/latest/gases-intro_en.html)
2. Prepare a table in your laboratory notebook or a document that contains two columns labeled **A)** # of particles and **B)** pressure (atm).
3. Use your mouse to drag the handle of the bicycle pump up and then pull it quickly all the way down. This will introduce gas into the container.
4. Drag the control for the heat/cool apparatus and lower the temperature of the container to 300 K.
5. Click the Width check box in the upper right-hand corner.
6. Record the initial data in your notebook: temperature, container width, height = 10nm, and length = 3.5 nm. The container width is indicated at the bottom of the container if you have checked the “width” box.
7. You should now be ready to take data to understand how the moles of gas in the container affects the pressure. Start by clicking the eraser tool at the bottom of the container. Record, the # of gas particles and pressure in your notebook.
8. Add particles using one cycle of the bicycle pump. Record the new # of particles and pressure in your notebook.
9. Repeat step 9 until you have 10 separate sets of # of particles and pressure data.
10. Copy the data into Microsoft Excel and make a plot of the data. Use a scatter plot.
11. Right click on the data in the graph and choose “Add a trend line”, then click “Show Equation on Graph”. Click on “Set intercept” and set the intercept to 0.0
12. Click the eraser tool to remove the gas particles from the container. Drag the handle on the left side of the container to reduce the width of the container to 5nm. Repeat steps 7-11 for this new container volume.

**Questions and Calculations**

1. Explain why the shape of the curve you obtained agrees with the ideal gas equation.

$$p = \frac{n R T}{V}$$

1. Looking at the above equation, identify the slope of the curve in a plot of p vs n.
2. Use the data you recorded in your notebook to prove that the slope of the curve in your excel plot agrees with the prediction of the slope from the ideal gas equation. Hint: (1) You will need to calculate the moles of gas from the number of gas particles. (2) You will have to calculate the volume using the width, height, and length of the container in meters the convert from m3 to liters.
3. Repeat step 3 for the data you obtained with the 5nm container width.
4. Explain why the slope of the curve in step 5 is larger than in step 4. Your explanation should discuss why the slope is larger based on the behavior of the particles in the container. If you don’t know the answer, go back and rerun the simulation and watch what happens to the behavior of the particles as you slowly reduce the width of the container.