

## Boyle's Law Computer Activity

Follow instructions from your teacher to access and open the *Gas Properties Simulation*. Or you can go to <http://phet.colorado.edu/simulations/> and find the simulation link in the "Chemistry" simulations.

Open the simulation.

Click on the "Measurement Tools" button. Click on the *Ruler*. This will cause a ruler to appear. The ruler's units are in nanometers (nm) but we are going to use the ruler to give us an estimated measurement of volume. You will use the ruler to measure the width of the box. We will then change the units of measurement to *liters*. For example: initially the box should have a width of 6.6 nm which will be recorded in your data table as 6.6 L (liters). When you are asked to change/measure the volume of the box, use the ruler to do so.

What are the graduations on the ruler? (How much is each notch worth?) \_\_\_\_\_

First, you need to add a gas to your container. Click on the handle of the pump, and add ONE PUMPFUL of gas to your container. Locate the "Gas in Chamber" data on the right.

How many gas particles did you add to your container? \_\_\_\_\_

What type of gas did you add? \_\_\_\_\_

Describe the motion of the particles: \_\_\_\_\_

Boyle's Law looks at the relationship between volume and pressure when there is a constant temperature. You must set your container to constant temperature. Click on the *Temperature* button in the "Constant Parameters" on the upper right corner. This will cause the temperature to automatically adjust to whatever the initial value is set at.

Set your temperature to constant. What is the temperature of your box? \_\_\_\_\_

You are going to adjust the volume of the container by clicking on the handle on the left side of the container and dragging it to various widths.

Dramatically change the volume of the container to a smaller size. Initially, what happens to the temperature of the box? \_\_\_\_\_

What does the simulation automatically do to your container to achieve constant temperature? \_\_\_\_\_

**Change the gas to 100 molecules of the HEAVY species by manually setting this in the right box.**

According to the Kinetic Molecular Theory, what action causes *pressure* on the inside of the container?

*Hypothesize*: If you will make the container smaller, how will this affect the answer to the previous question?

If you make it larger? \_\_\_\_\_

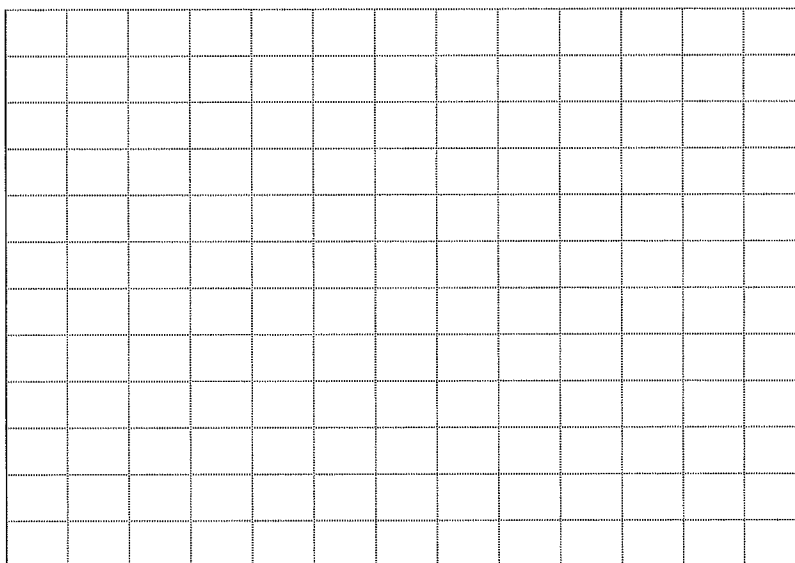
Fill in the following chart by selecting various *Volumes*. Measure the volume of the container using the ruler. Calculate the values as indicated in the other columns.

Trial	Volume (V)	Pressure (P)	Calculate $k_1 = (P \times V)$	Calculate $k_2 = \frac{P}{V}$
Trial 1				
2				
3				
4				
5				
6				

Which variable did you control (independent)? \_\_\_\_\_

Which variable is the dependent variable? \_\_\_\_\_

Graph Pressure vs. Volume in the following graph. Use proper scaling. Label the graph appropriately. Draw a curved line best connecting all of the points.



Looking at your data and graph, describe the relationship between volume and pressure.

\_\_\_\_\_

As the volume gets larger, what happens to the pressure of the gas?

\_\_\_\_\_

Which value remains consistent in the data table?  $k_1$  or  $k_2$

This  $k$ -value is constant; the ratio between volume and temperature of any point on the graph will be the same. Pick any two points from the graph or table:

Point #1

$V_1 =$

$P_1 =$

Point #2

$V_2 =$

$P_2 =$

Show the  $k$ -value calculation:

Write an equation for **Boyles's Law**:

We can use this formula to predict the pressure ( $P_2$ ) or volume ( $V_2$ ) of any gas. Use this formula to complete the following calculations. Show your work.

1. If a gas has a volume of 1.25 L and a pressure of 1.75 atm, what will the pressure be if the volume is changed to 3.15 L?
2. If a gas has a volume of 3.67 L and a pressure of 790 mm Hg, what will the pressure be if the volume is compressed to 2.12 L? What is the pressure in atmospheres (atm)? *Convert pressure units.*
3. A container has a volume of 5.85 L and a pressure of 4.25 atm. What will the volume be if the container's pressure is changed to 2.75 atm?
4. A container has a volume of 2.79 L and a pressure of 5.97 atm. If the pressure changes to 1460 mm Hg, what is the container's new volume? *Convert pressure units.*

