

MoLE Gas Laws Activities

To begin this assignment you must be able to log on to the Internet using Internet Explorer (Microsoft) 4.5 or higher. If you do not have the current version of the browser, go to <http://www.microsoft.com/downloads> and follow the instructions on the page. You will need Internet Explorer for your particular operating system. If you have any difficulties contact your instructor.

Once the browser is running, type the following address into the location-input line near the top of the Internet Explorer window:

<http://cheminfo.chem.ou.edu/faculty/mra/mra/GLP.HTM>

This should load the Gas Simulation. Once you have the simulation running your screen should look like what is shown in Figure I. below.

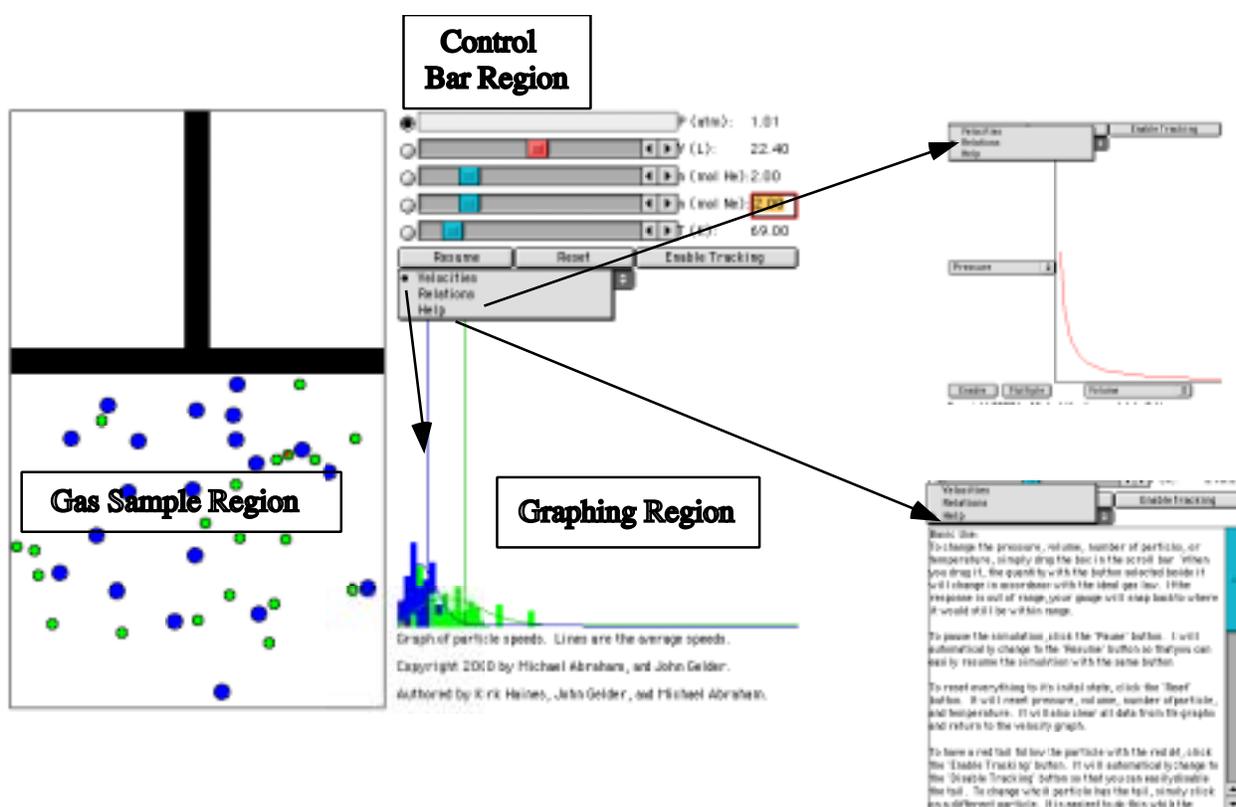


Figure I.

There are three important regions that require some discussion. The Gas Sample Region has the most activity. It is a container with a plunger. To explore the behavior of the gas sample you can change the variables located in the Control Bar Region. The Control Bar Region shows five scrollbars bars, one for pressure (in units of atmospheres), one for volume (in units of liters), two for mol of gas (one for He gas and the other for Ne gas), and one for temperature (in units of Kelvins). To the left of each scrollbar is a radio button. When selected, that particular variable

(called the dependent variable) is calculated based on the value of the other four variables. In the default mode the pressure scrollbar's radio button is selected so the pressure of the gas sample is being calculated.

As a simple exploration try moving each of the scrollbars and observe the effect on the gas sample. These effects will be addressed in more detail in this experiment. You can click the mouse on the Reset button located below the temperature scrollbar to return to the original conditions. The Pause button will suspend the motion in the gas sample while the Enable Tracking button will turn the red tracking line on and off.

Below the Pause Button is a fourth button different from the previous three in that it is a dropdown button. Clicking and holding the mouse button will reveal three choices: velocity (default); Relations (graphing); and Help.

The default mode is Velocities. The Velocity Distribution Region shows a plot of the velocity distribution in the gas sample. Observe the behavior of this region while changing each of the variables in the Control Bar Region.

The Relations view reveals an xy graph with a popup menu on each axis. Selecting the popup menu on either axis provides a list of the variables shown in the Control Bar Region. The two buttons, Enable and Multiple are used when plotting pairs of variables. For example, in Figure II pressure has been selected on the y -axis and $1/\text{volume}$ is selected on the x -axis.

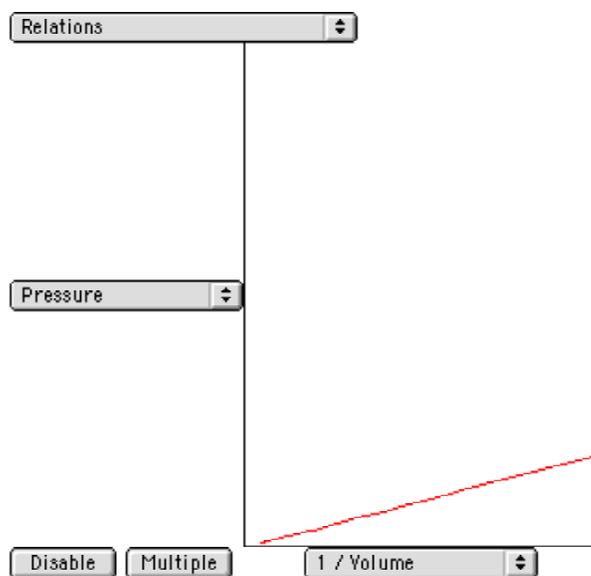


Figure II.

Clicking on the Enable button causes a change in the Control Bar Region, activating the pressure and volume scrollbars, and deactivating the mol and temperature scrollbars. Moving either the pressure or volume scrollbar will generate a plot of those two variables in the Plotting Region. What kind of plot is shown? The Multiple button allows two or more plots to be superimposed.

When you are finished exploring this plotting feature click the buttons until they read Enable and Multiple.

Got the hang of it? If you have any questions check with another student in the class, your instructor.

Gas Pressure and Volume Relationships

Exp. Computer Simulation -A

Name _____ Lab Section _____

Problem Statement: How are the pressure and volume of a gas sample related?

I. Data Collection:

A. Open the Gas Law Simulation program and observe and describe, in the space below, the activity in the Gas Sample window. Consider using the some or all of the following terms in your description: particles, atoms, molecules, collisions, velocity, energy, force.

B. One of the objects in the window is colored differently than the others. Enable the tracking function and trace the path of a particle from one side of the screen to the other in the space below. Explain any changes in velocity or direction that you observe.



C. Record the values for pressure, volume and temperature on the digital read-outs of the Control Bar window.

D. Using the controls, fix Pressure as a dependent variable by clicking on its radio button. Change the volume of the container using the Volume slider bar and observe what happens to the pressure of the system. Explain how the activity in the Gas Sample window accounts for your pressure observations.

E. Collect five additional observations of volume/pressure relationships and record all of your data in the following table.

Data Table

Pressure	Volume
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

Gas Pressure and Temperature Relationships

Exp. Computer Simulation -B

Name_____ Lab Section_____

Problem Statement: How are the pressure and temperature of a gas sample related?

I. Data Collection:

A. Record the values for pressure, volume and temperature on the digital read-outs of the Controls window.

B. Using the controls, change the temperature in the container and observe what happens to the pressure of the system. Explain how the activity in the Gas Law window accounts for your pressure observations.

C. Collect five additional observations of pressure/temperature relationships and record all of your data in the following table.

Data Table

Pressure	Temperature
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

II. Data Analysis:

A. What patterns are shown in these data? It might be helpful to graph the data. Try to come up with an algebraic equation that expresses the pattern you found.

III. Interpretation and Conclusions:

A. How are the pressure and temperature of a gas sample related?

B. Relate what you observed concerning the motion of objects in this activity with your observations in experiment E-1 B of your *Inquiries into Chemistry* laboratory manual.

C. Using your data, predict the pressure of a gas sample at a temperature of 10 Kelvins. Show how you made your prediction.

Gas Systems

Open Inquiry Laboratory

Computer Simulation

System 1

Investigate the relationship between the volume and temperature of a gas sample at constant pressure and amount.

System 2

Investigate how the number of gas particles effects the pressure of a gas sample.

System 3

Compare and interpret pressure vs. volume relationships of gas samples at different temperatures. (You can plot multiple graphs in the plotting window by clicking on the multiple button.)

System 4

Investigate the average speed (distance per unit time) of particles in a gas as a function of pressure, volume, amount, or temperature. (You can expose the path traveled by a particle during a time interval by activating the "enable tracking" button in the Control Bar window, and then clicking on a particle.)

System 5

Investigate the average number of collisions between particles or with the container walls in a gas sample as a function of pressure, volume, amount, or temperature. (You can expose the path traveled by a particle during a time interval by activating the "enable tracking" button in the Control Bar window, and then clicking on a particle.)

System 6

Investigate any of the above systems using different kinds of particles or combinations of particles.

System 7

Investigate any other gas system or investigate a modification of any of the above systems.

Research Statements

Use evidence from the MoLE simulation to prove or disprove the following assertions.

1. The pressure exerted by a combination of gases is equal to the sum of the pressure exerted by the individual gases.
2. The speed of a gas particle increases with increasing pressure when the volume is decreased.
3. The pressure exerted by a gas depends on its molar mass.
4. The speed of a gas particle depends on its molar mass.
5. The kinetic energy of a gas particle depends on its molar mass.
6. The collision of a gas particle with the walls of its container does not effect its speed.
7. The collision of a gas particle with another gas particle does not effect its speed.
8. The average speed of two like gas particles before a collision is equal to the average speed after the collision.
9. The average speed of two unlike gas particles before a collision is equal to the average speed after the collision.