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://intro.chem.okstate.edu/1314F00/Laboratory/GLP.htm

This will load the Gas Simulation. Once you have the simulation is running your screen will look like what is shown in left hand section of Figure I. below.
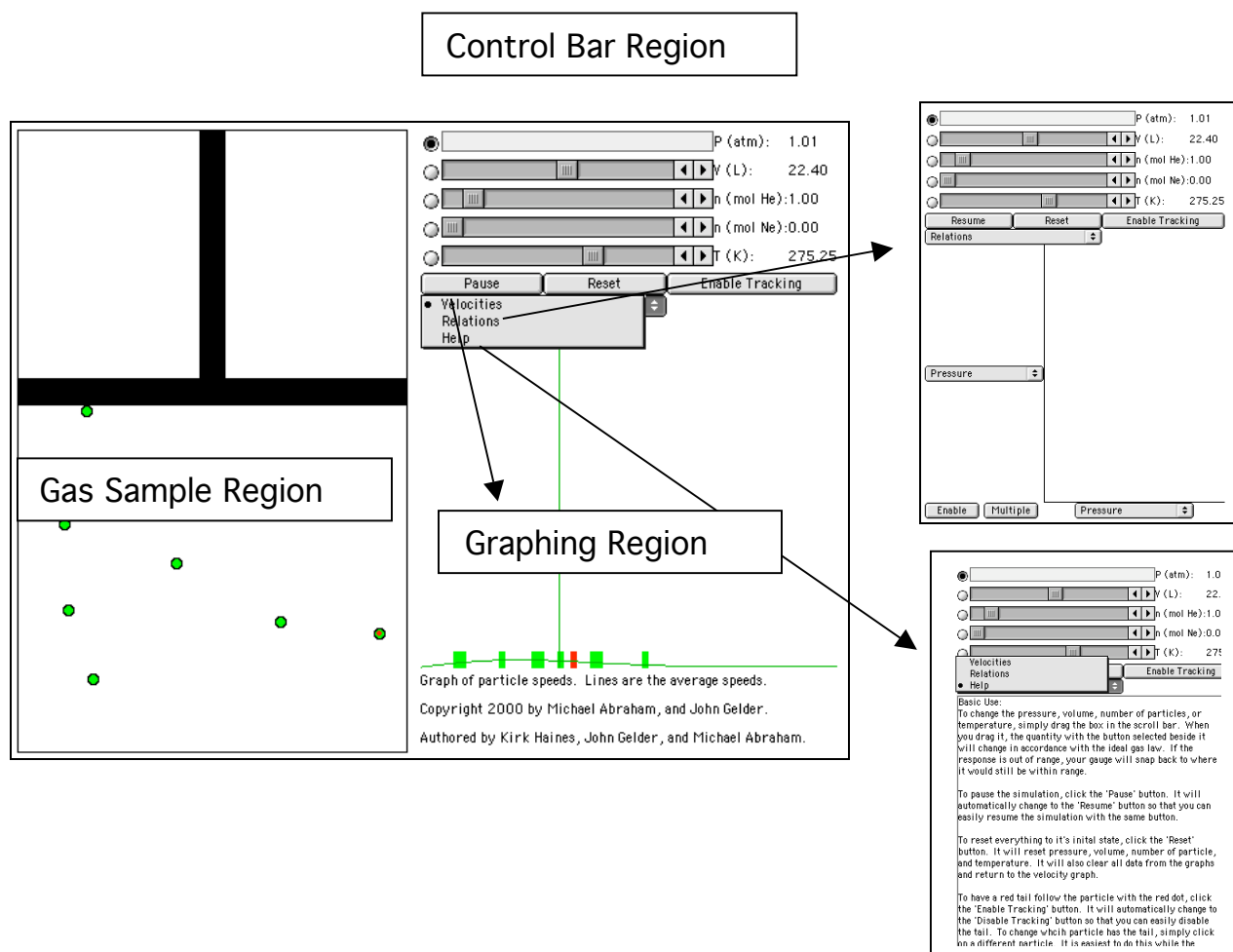

Figure I.

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: pressure (in units of atmospheres), volume (in units of liters), mol of gas (one for He gas and the other for Ne gas), and 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 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.

There are three buttons immediately below the Control Bar Region. The Pause button will suspend the motion in the gas sample, the Reset button returns the program to the default conditions, and the Enable Tracking button turns a 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 menu. Clicking and holding the mouse button will reveal three choices: Velocities (default); Relations (graphing); and Help.
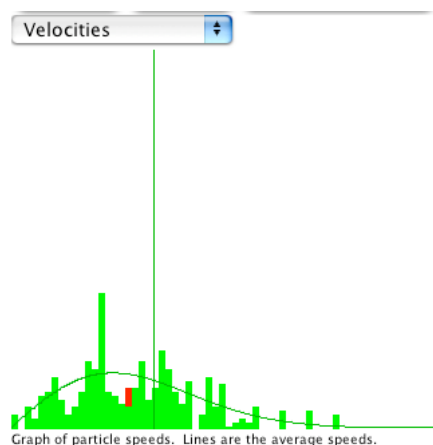

Figure II.

The default mode is Velocities. The Velocity Distribution Region shows a plot of the velocity distribution in the gas sample (see Figure II.). The y-axis of this plot represents the number of particles. The x-axis represents the range of velocities starting at zero. The bars in this plot represent the velocities of the particles in the Gas Sample Region. As the velocities of the particles change, the plot is redrawn. The smooth curved line in the plot represents the ideal distribution of the velocities for the gas sample. The vertical line represents the average (root-mean-square average) velocity of the sample. Observe the behavior of this region while changing each of the variables in the Control Bar Region. In the Gas Sample Region, one of the particles is labeled with a red dot. This same particle is identified in red in the velocity distribution plot. If you click on the enable tracking button, you can follow the path of the particle. The length of the tail represents a fixed unit of time, and consequently can be used as a measure of the velocity of the particle. If you pause the motion of the particles, you can click on different particles to get a measure of their velocity.

A second choice from the drop down menu is the Relations view. This choice reveals an x,y graph with a dropdown menu on each axis. Selecting the dropdown 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. If you select pressure for the y-axis and volume for the x-axis, and the click on "Enable," these same variables are activated in the Control Bar Region. By scrolling the volume slide bar in the Control Bar Region you will trace out a plot that will look similar to Figure III.
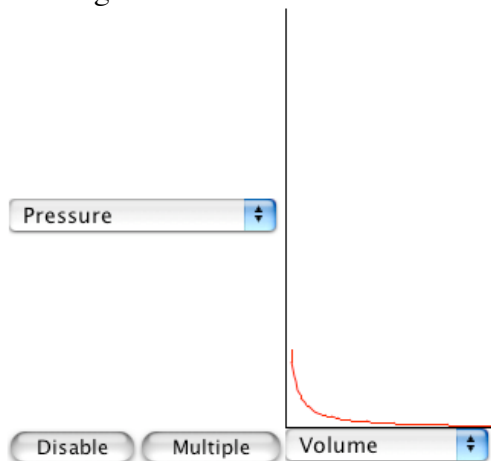
Figure III.

The Multiple Button allows two or more plots to be superimposed. Select Pressure and Volume as the variable to be plotted on your graph. Then click on the Multiple button and adjust the temperature to 400 K. Click on the Enable button and scroll the Volume slide bar. Click on the Disable button and change the temperature to 200 K. Click on the Enable button and scroll the Volume slide bar. Repeat this process for the minimum temperature. You will see a graph that looks similar to Figure IV.
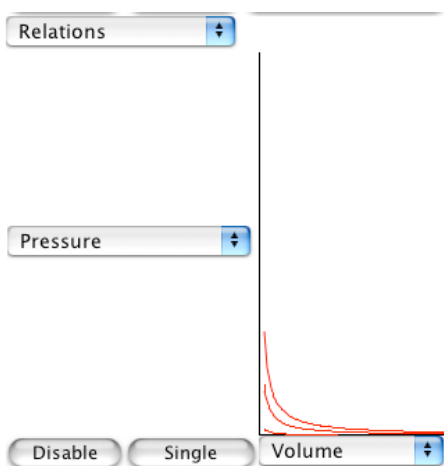
Figure IV.

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

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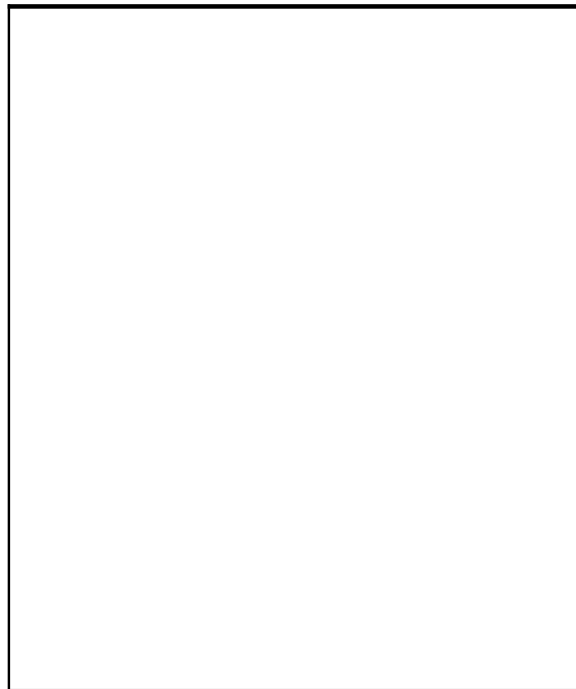
C. Record the values for pressure, volume and temperature on the digital read-outs of the Controls window.

D. Observe the action in the Velocity Distribution window. Relate what you see with the behavior of the objects in the Gas Sample window.

Click the Pause button and sketch and label the graph in the space below.

E. Using the controls in the Control Bar window, change the temperature in the container and observe what happens to the pressure of the system. Also observe what happens in the Velocity Distribution window. Explain how the activity in the Gas Sample window accounts for your observations.

F. 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. Mental Model - Draw a picture(s) that explains how the pressure and temperature of a gas sample are related at the level of atoms and molecules, and that illustrates the observations you made in the experiment. In words, explain how your picture(s) illustrate(s) this relationship.

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

Research Statements*

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

For the Research Statement your write up should include the research statement, a detailed description of the experiment you performed, the data you collected and your conclusion and how your data support your conclusion. This should be done on separate sheets of paper and added to the these pages.

1. The total pressure of a combination of gases is equal to the sum of the individual pressures exerted by each gas.

2. If you increase the pressure on a gas sample by decreasing the pressure, the gas particles will speed up.

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. Gas particles slow down when they collide with the walls of a container.

7. The speed of gas particles are not affected by collisions with other gas particles.

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.

Please take a moment to fill out a brief survey of your opinions of this activity at:
http://intro.chem.okstate.edu/NSFCCLI/GasLaw/BAROSU.htm