Name:_____
Lab #____ Behavior of Gases

PhET Simulation

Learning Goals:

- Explore the relationships between pressure, volume, and temperature.
- Create graphs based on predictions and observations.
- Make qualitative statements about the relationships between pressure, volume and temperature.

Background Information: Air is a gas. Gases have various properties that can be observed with our senses, including the gas pressure (P), temperature (T), and the volume (V), which contains the gas. Careful scientific observation has determined that these variables are related to one another. By understanding these relationships it is possible to explain how gases behave under certain conditions.

Set-Up: Students will be working at the computer lab for 1 period (min), 2 different colored pens or pencils.

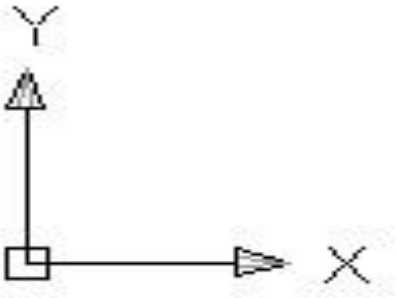
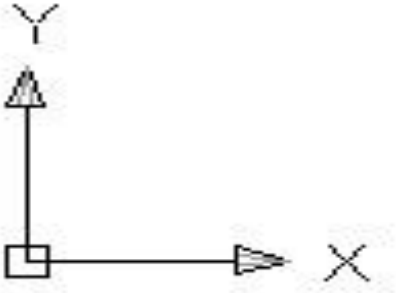
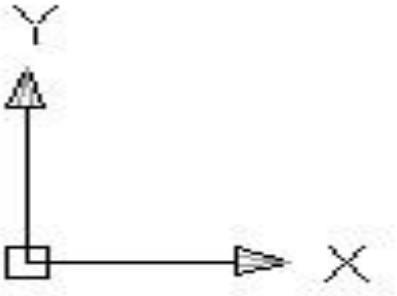
Procedure:

Open the PhET simulation "Gas Properties.".
Either type in: http://www.colorado.edu/physics/phet or Google "phet".
Click on **Play with Sims**, then click on **Chemistry** on the left side. Click on **Gas Properties**.

1. Investigate the simulation involving gas properties. Practice the following:
   - Adding air to the container
   - Changing the size of the container.
   - Adding and removing heat with the heat control.

NOTE: Be sure to keep the gravity and the type of the gas in the container constant (the same).

2. **(15 pts)** ***Before*** using the simulation, sketch what you think the graphs would look like using **one** of your colored pencils. Explain the reason for your prediction. **Note: Be sure to label your x and y axes.**

Volume-Pressure graph 	Before: Reasoning for prediction	After: If you were not correct, revise your reasoning:
Volume -Temperature graph 		
Temperature-Pressure graph 		

3. **(15 pts)** Using the simulation, verify or correct your graphs and reasoning using a **different** colored pen or pencil.
   - Set the third variable to "constant", e.g., if looking at T and P, set Volume to constant.
   - For Pressure vs. Volume, allow time for simulation to return temperature to start point.
   - For Pressure vs. Temperature, add or remove heat allowing time for pressure to return to start point.

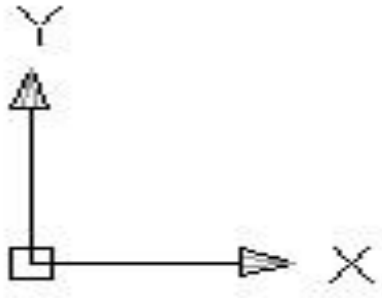
Prediction color_____
Correction color_____

4. **(5 pts)** Looking at your graphs, draw or write in your own words the relationship that exists between pressure and volume.

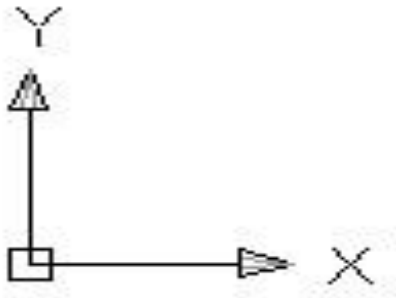
5. **(5 pts)** Looking at your graphs, draw or write in your own words the relationship that exists between temperature and volume.

6. ***READ THESE DIRECTIONS BEFORE ANSWERING THE QUESTIONS BELOW:*** **M**ake a prediction for each of the following scenarios. Predict what you think the graphs will look like, then using the simulation, verify or correct your graphs and reasoning with a **different** colored pen or pencil. Make sure you label your axes and include a key to the colors you used for your predictions and corrections.

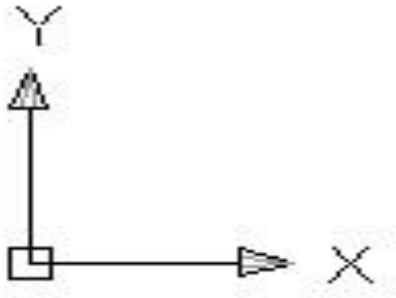
a. **(6 pts)** Explain why bicycle tires seem higher in the summer than in winter.

Scenario	Graph	Explanation of your reasoning
Bicycle tire		

b. **(6 pts)** Explain why a can of soda pop explodes if left in the hot sun.

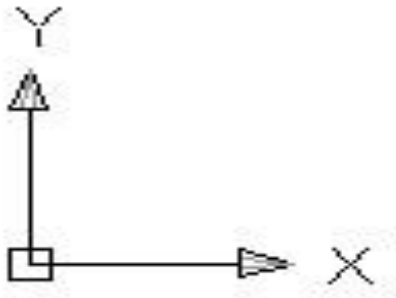
Scenario	Graph	Explanation
Soda pop in sun		

c. **(6 pts)** A rigid container filled with a gas is placed in ice (ex. nalgene bottle). What will happen to the pressure of the gas? What do you think will happen to the volume?

Scenario	Graph	Explanation
Container in ice		

d. **(12 pts)** An infected tooth forms an abscess* that fills with gas. The abscess puts pressure on the nerve of the tooth, causing a toothache. While waiting to see a dentist, the person with the toothache tried to relieve the pain by treating the infected area with moist heat. Will this treatment help? Why or why not?

*area of infected tissue

Scenario	Graph	Explanation
Infected tooth		

7. **(5 pts each)** Try the following explorations, keeping volume constant:

a. Pump particles into the chamber. Note temperature and pressure:

Using the pump, add particles to the chamber (double the number). What is the effect on temperature and/or pressure?

Using KMT, explain this change.

b. Using the "Gas in Chamber" counter on the right, insert 200 heavy particles. Note temperature and pressure. Now change the gas to 0 heavy and 200 light particles. Allow the simulation time to reach steady state. How do temperature and/or pressure vary from the heavy particles?

How does KMT support or refute this observation?

c. Using the "Gas in Chamber" counter, insert a mixture of heavy and light species (100 each). How does the behavior of the particles differ? Which particle moves faster?

Given that the particles are at the same temperature (same average kinetic energy), how can you account for the difference (HINT: recall the distinction between temperature and heat (energy))?

d. Using the gravity slider, turn gravity on. Observe the pressure (measured at the upper side of the container. Explain why atmospheric pressure on Earth decreases with altitude.