

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 in pairs with laptops, 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 **Heat and Thermo** on the left side.
Click on **Gas Properties**.

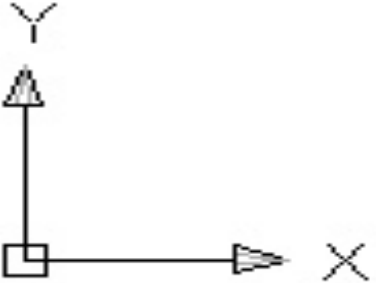
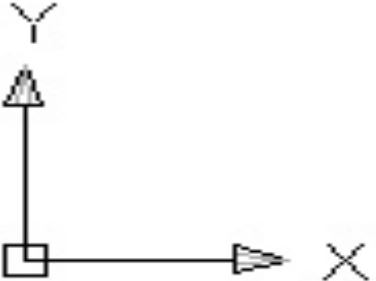
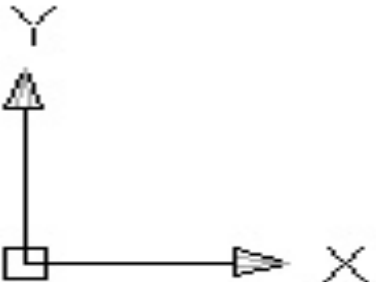


Gas Properties

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. Make a chart like the one below in your lab notebook. Without using the simulation, sketch what you think the graphs would look like using one of your colored pencils. **Note: Be sure to label your x and y axes.**

<p>Volume-Pressure graph</p> 	<p>Explain your reasoning for the graph's appearance</p>
<p>Volume -Temperature graph</p> 	<p>Explain your reasoning for the graph's appearance</p>
<p>Temperature-Pressure graph</p> 	<p>Explain your reasoning for the graph's appearance</p>

3. Using the simulation, verify or correct your graphs and reasoning using a different colored pen or pencil.

Prediction color _____

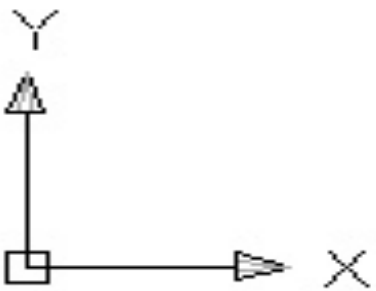
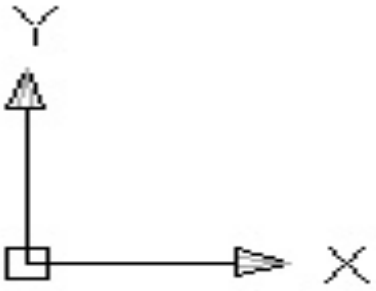
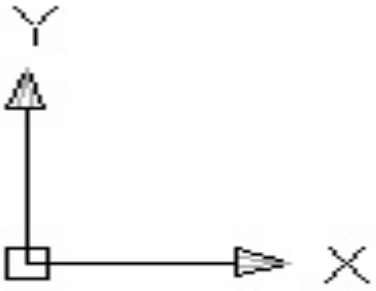
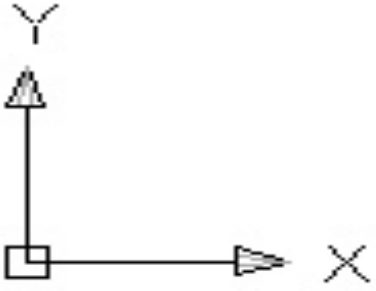
Correction color _____

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

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

6. Using the data chart below, make 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. Explain why bicycle tires seem higher in the summer than in winter.
 - b. Explain why a can of soda pop explodes if left in the hot sun.
 - c. 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?
 - d. 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 of your reasoning
a. Bicycle tire		
b. Soda pop in sun		
c. Container in ice		
d. Infected tooth		

7. What other experiments would you like to try using this simulation?

