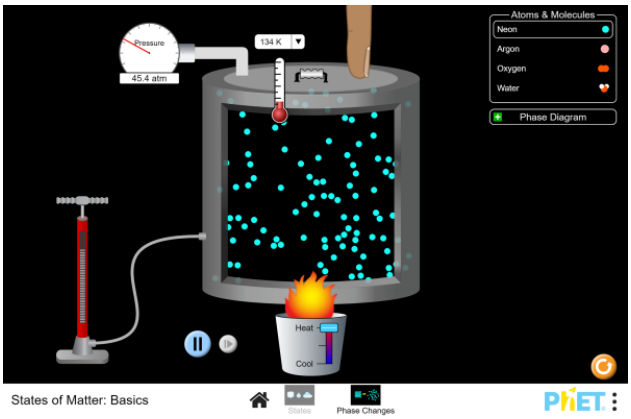
Name: _____ Date: _____

Unit 8 - States of Matter & Gas Laws Simulation Lab



Directions

- Go to Phet.colorado.edu
- Search for the "States of Matter: Basics" simulation.
- Click on the "States of Matter" icon.
- Select "Oxygen."

1. The simulation shows a quantity of oxygen molecules. What state of matter is this? Draw a picture.

2. How do you know?

3. Heat the oxygen to about 67 K. What state of matter is this? Draw a picture.

4. How did you know?

5. Heat the oxygen to about 150 K. What state of matter is this? Draw a picture

6. How do you know?

To do these experiments – click on the "Phase Changes" icon. Select "Oxygen"

Experiment 1: Constant Volume.

- Leave the oxygen at 150 K. In the table below, record the pressure and temperature of the oxygen in the first row.
- Heat the oxygen to about 450 K.
- Record the new temperature and pressure in the second row of the table.
- Heat the oxygen to about 900 K.
- Record the new temperature and pressure in the third row of the table.

Temperature vs. pressure at constant volume	
Temperature (K)	**Pressure (atm)**

7. Write a statement describing how the temperature of a quantity of a gas is related to its pressure at constant volume. What is the formula that relates temperature and pressure?

8. Draw a graph illustrating this relationship, with temperature on the x-axis and pressure on the y-axis. Label the axes and give the graph a title. You do not have to scale the axes.

Experiment 2: Constant Temperature.

- Reset the simulation and choose oxygen.
- Heat the oxygen to 450 K.
- We will call the current volume of the oxygen "1 container." In the table below, record the volume and pressure of the oxygen in the first row.
- Drag the finger down to decrease the volume to 1/2 of a container. Cool the oxygen to 450 K. Record the new volume and pressure in the second row of the table.
- Drag the finger down to decrease the volume to 1/4 of a container. Cool the oxygen to 450 K. (This may take a while. Be patient!) Record the new volume and pressure in the third row of the table.

Volume vs. pressure at constant temperature	
Volume (containers)	**Pressure (atm)**

9. Write a statement describing how the volume of a quantity of a gas is related to its pressure at constant temperature. What is the formula that relates volume andpressure?

10. Draw a graph illustrating this relationship, with volume on the x-axis and pressure on the y-axis. Label the axes and give the graph a title. You do not have to scale the axes.

Experiment 3: Constant Pressure.

- Reset the simulation and choose oxygen.
- Drag the finger down until the pressure is about 100 atm. (The pressure will not change at first. Experiment!)
- In the table below, record the temperature and volume of the oxygen in the first row. (Estimate the volume as a fraction of a container.)
- Drag the finger upward to increase to volume to 1/2 a container. Heat the oxygen until the pressure is once more at 100 atm. (Be patient!) Record the new temperature and volume in the second row of the table.
- Drag the finger upward to increase to volume to 1 container. Heat the oxygen until the pressure is once more at 100 atm. (Be *very* patient!) Record the new temperature and volume in the third row of the table.

Temperature vs. volume at constant pressure	
Temperature (K)	**Volume (container)**

11. Write a statement describing how the temperature of a quantity of a gas is related to its volume at constant pressure. What is the formula that relates volume and temperature?

12. Draw a graph illustrating this relationship, with temperature on the x-axis and volume on the y-axis. Label the axes and give the graph a title. You do not have to scale the axes.

Extension question

13. What did the bicycle pump do in these experiments? Why didn't we use it?