Name _____

States of Matter

Learning Goal:

Students will be able to demonstrate their knowledge of the states of matter through illustrations and descriptions. These illustrations and descriptions should include:

- How the molecules in a solid, liquid and gas compare to each other.
- How temperature relates to the kinetic energy of molecules.

Procedure:

- Open the internet browser and enter the address: http://phet.colorado.edu
- Click on "Play with Sims" and select "Chemistry" from the menu on the left.
- Open the "States of Matter" Simulation and select "Run Now"

Investigation:

1. Predict what the molecules of a solid, liquid and gas look like. Illustrate your prediction with a drawing.

   Definition:

   Solid

   _____

   _____

   Liquid

   _____

   _____

   Gas

   _____

   _____

   Illustration

   Solid Liquid Gas

2. Complete the table below by exploring the "Solid, Liquid, Gas" tab in the simulation. **Test** your predictions and record your observations by recording the temperature and illustrations of each substance in the three states of matter.

Substances	**Observations**		
	Solid	**Liquid**	**Gas**
Neon	Temperature: Illustration:	Temperature: Illustration:	Temperature: Illustration:
Argon	Temperature: Illustration:	Temperature: Illustration:	Temperature: Illustration:
Oxygen	Temperature: Illustration:	Temperature: Illustration:	Temperature: Illustration:
Water	Temperature: Illustration:	Temperature: Illustration:	Temperature: Illustration:

3. Sketch a graph of Kinetic Energy vs. Temperature. Use this graph to describe the relationship between the two concepts.

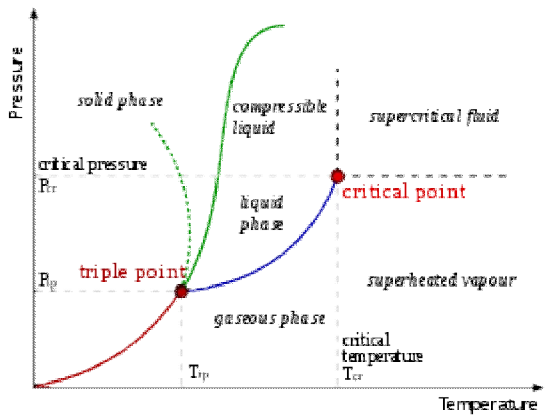
4. Write a summary paragraph, which includes drawings, to demonstrate you have mastered the learning goal. Be sure to incorporate both concepts of the learning goal:
   - How the molecules in a solid, liquid and gas compare to each other.
   - How temperature relates to the kinetic energy of molecules.

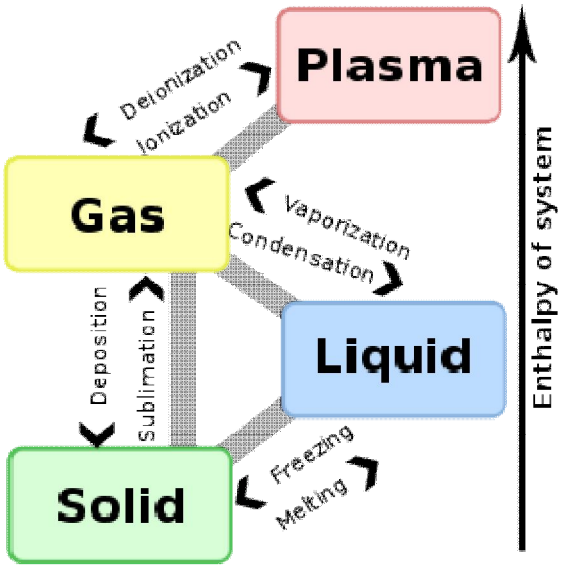
5. Explain how a change in temperature affects the pressure inside a container.

6. Explain this phase diagram by relating what you know about temperature, states of matter and pressure.

   At the **triple point**, all three phases can coexist.

   In the diagram, the line between the triple point and the critical point is marking the boundary between liquid and gas does not continue indefinitely, but terminates at a point called the **critical point**. As the temperature and pressure approach the critical point, the properties of the liquid and gas become progressively more similar. At the critical point, the liquid and gas become indistinguishable. Above the critical point, there are no longer separate liquid and gas phases: there is only a generic fluid phase referred to as a **supercritical fluid**.





Interfacial phenomena

Between two phases in equilibrium there is a narrow region where the properties are not that of either phase. Although this region may be very thin, it can have significant and easily observable effects, such as causing a liquid to exhibit surface tension. In mixtures, some components may preferentially move toward the interface. In terms of modeling, describing, or understanding the behavior of a particular system, it may be efficacious to treat the interfacial region as a separate phase.

7.
8. Fill in the following table using the "Phase Changes" tab of the simulation
   a. Starting with the initial situation, state the following for each
      i. Temperature
      ii. Pressure
      iii. Movement of molecules
      iv. Distance between molecules
   b. Add heat until at least 8 molecules begin to freely move around. Fill in the second column.
   c. Push down on the lid until it is slightly above the hose for the pump. Fill in the information in the third column.
   d. Do 10 complete pumps with the handle of the pump. Each pump will add 4 molecules of the substance. Fill in the fourth column of the chart.
   e. Repeat steps a – d for each of the other three gases. Remember to first click the **Reset All** button.
   f. Choose one of the gases and remove the heat. Describe below the effect it has on the molecules.

Gas tested _____

Effect _____

_____

_____

_____

	Observations			
	Initial Sample	**Heat added to some molecules moving freely**	**Lid Pushed down**	**After 10 pumps**
Neon	Temperature: Pressure: Movement: Distance Diagram	Temperature: Pressure: Movement: Distance Diagram	Temperature: Pressure: Movement: Distance Diagram	Temperature: Pressure: Movement: Distance Diagram
Argon	Temperature: Pressure: Movement: Distance Diagram	Temperature: Pressure: Movement: Distance Diagram	Temperature: Pressure: Movement: Distance Diagram	Temperature: Pressure: Movement: Distance Diagram
Oxygen	Temperature: Pressure: Movement: Distance Diagram	Temperature: Pressure: Movement: Distance Diagram	Temperature: Pressure: Movement: Distance Diagram	Temperature: Pressure: Movement: Distance Diagram
Water	Temperature: Pressure: Movement: Distance Diagram	Temperature: Pressure: Movement: Distance Diagram	Temperature: Pressure: Movement: Distance Diagram	Temperature: Pressure: Movement: Distance Diagram

Questions:

1. State in words and formula the Ideal Gas Law.

2. What state is the matter in when all molecules are just vibrating around?

3. Why do some molecules begin sticking together when you add in more molecules?

4. State the difference between heat and thermal energy.

5. State the difference between heat and temperature.