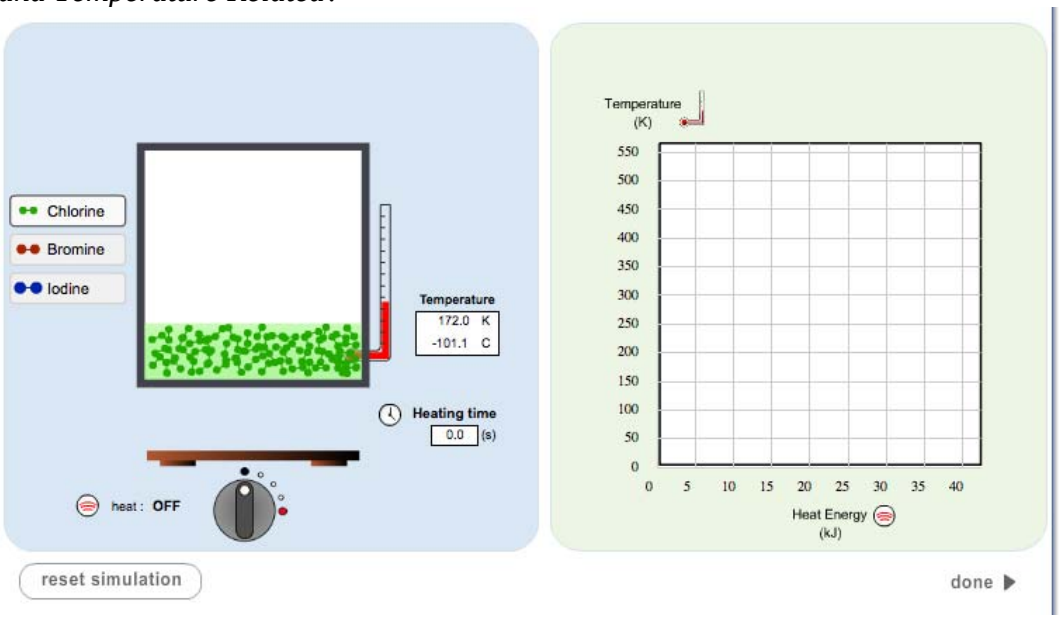
PHASE CHANGE: Simulation worksheet

Name: _____ Date: _____ Class: _____

Phase Change Worksheet Concept of Variation during Phase Change: How are internal energy and Temperature Related?



Vocabulary list:

Manipulated: Changed, or modified
Chlorine: It is a molecule or substance that is always paired up, it looks like this: 00
Bromine: It is a molecule or substance that is always paired up. It has more mass and it is bigger than chlorine.
Iodine: It is a molecule or substance that is always paired up. It has more mass and it is bigger than bromine.

Explain, USING COMPLETE SENTENCES, why Gabriella is 'beasting' or 'tripping'? (Tell me why she is complaining).

_____

_____

Is heat matter or non-matter? _____

Heat is a process for _____ energy.

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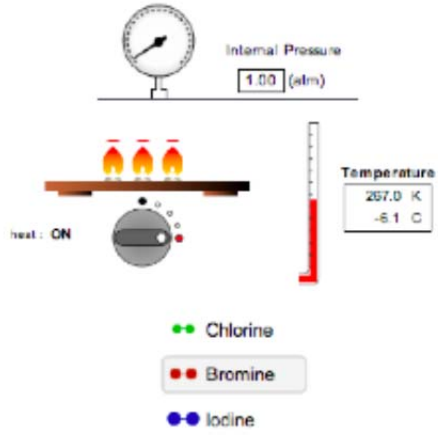
How to Use the Phase Change program

The following screens show samples of different liquid substances in a rigid container. This program allows you to explore the relationship between heat, size of molecules, and temperature in a phase change between liquid and gas.

You will see how in a liquid the forces between particles are overcome by heat.



The **internal pressure** of the gas is measured in **atmospheres (atm)**.

Heat is measured in **kilojoules (kJ)** and can be turned on or off by using the dial. Adding heat increases the temperature. Temperature is measured in **Kelvins (K)** or **degrees Celsius (C)**.

The particles in this program are molecules that contain two atoms. You can choose to examine the effect of heat on molecules of different mass from chlorine (the lightest) to iodine (the heaviest).

What 3 variables will you be studying in this simulation? _____ _____ _____

What are the units of heat? (What is heat measured in?) _____ (write out the whole word).

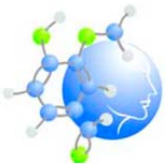
What 3 elements are we using in this simulation? _____ _____ _____

Phase Change simulation (25 minutes)

Which element is composed of molecules with the smallest mass? _____

Which element is composed of molecules with the largest mass? _____

Before you answer any further questions, please turn on the heat and watch the molecules and the graph. Think about the definitions of the different phases of matter (solid, liquid, gas).



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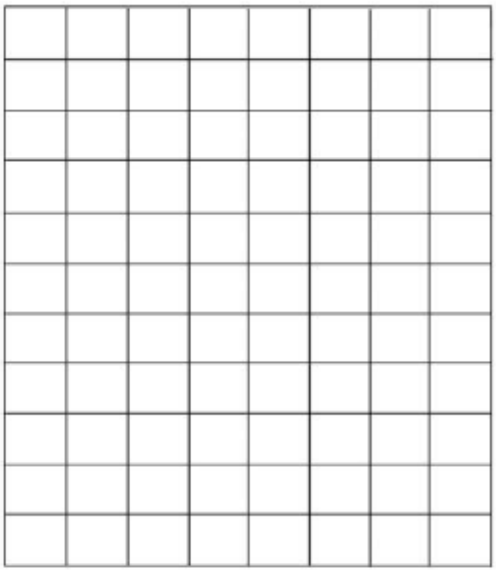
Chlorine (the "green" molecule)

1. What is the temperature before you turn on the flame? _____ K and _____ °C
2. What phase is the molecule in? _____ (solid, liquid, or gas)
3. How many seconds does it take for the molecule to reach its boiling point? _____ seconds
4. What is the temperature when the molecule reaches its boiling point? _____ K and _____ °C
5. How much heat was put into the container to make the liquid boil? _____ Kj
6. What is happening to the molecules as the temperature on the graph stays the same?

   _____

   _____
7. What happens to the pressure when all the molecules are in the gas phase?

   _____
8. How much heat was put into the container once the phase change is over? _____Kj
9. Please copy the graph **including scale and labels for both X and Y axis. Add a title!**



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Bromine (the "red" molecule)

1. What is the temperature before you turn on the flame? _____ K and _____°C
2. What phase is the molecule in? _____ *(solid, liquid, or gas)*
3. How many seconds does it take for the molecule to reach its boiling point? _____ seconds
4. What is the temperature when the molecule reaches its boiling point? _____ K and _____°C
5. How much heat was put into the container to make the liquid boil? _____ Kj
6. What is happening to the molecules as the temperature on the graph stays the same?

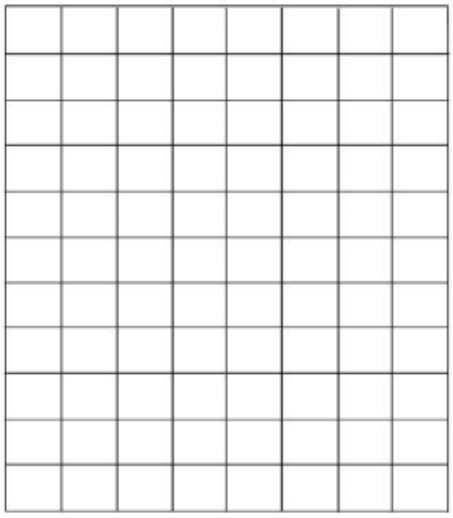
   _____

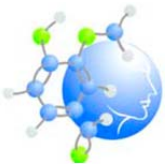
   _____

7. What happens to the pressure when all the molecules are in the gas phase?

   _____

8. How much heat was put into the container once the phase change is over? _____ Kj
9. Please copy the graph **including scale and labels for both X and Y axis. Add a title!**





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Iodine (the "yellow" molecule)

1. What is the temperature before you turn on the flame? _____ K and _____ °C
2. What phase is the molecule in? _____ (solid, liquid, or gas)
3. How many seconds does it take for the molecule to reach its boiling point? _____ seconds
4. What is the temperature when the molecule reaches its boiling point? _____ K and _____ °C
5. How much heat was put into the container to make the liquid boil? _____ Kj
6. What is happening to the molecules as the temperature on the graph stays the same?

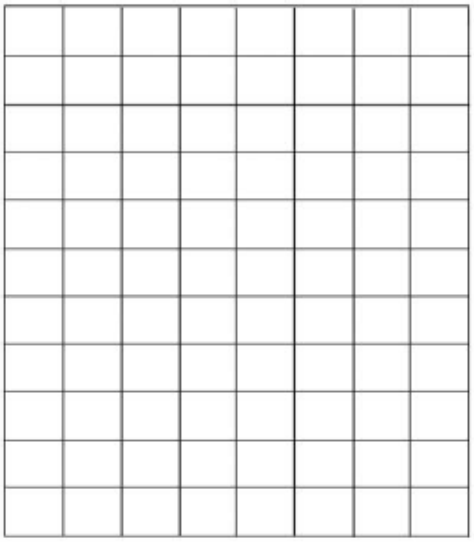
   _____

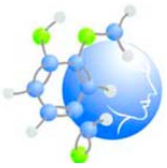
   _____

7. What happens to the pressure when all the molecules are in the gas phase?

   _____

8. How much heat was put into the container once the phase change is over? _____ Kj
9. Please copy the graph including scale and labels for both X and Y axis. **Add a title!**





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Bringing it all together: Screen 4 (15 minutes)

1. Explain why there wasn't enough water in the saucepan for Gabriella to make hot chocolate

_____

_____

2. How is the water Tac was heating **like** the liquids you used in the program?

_____

_____

How is the water Tac was heating **different from** the liquids you used in the program?

_____

_____

SUMMARY

1. What phase change were you observing in the program?

_____

_____

2. In the simulation, bromine was shown as yellow molecules, chlorine as green molecules, and iodine as red molecules. Are the molecules **really** those colors? Explain.

_____

_____

_____

3. Looking at your graphs, tell me what was the relationship between heat and temperature?

_____

_____

4. You should have observed that as you heated the molecules of chlorine, bromine and iodine they moved faster. We say that have more kinetic (movement) energy, which we could tell because the temperature (average kinetic energy of the molecules) increased. BUT as the phase change took place the temperature of the element did not change even though we continued to heat the element. What was happening?

_____

_____

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Lesson Plan: Lauric Acid Lab

Aim: Can you recreate the phase change graph in the real world?

Your Name: _____ Date: _____

Lab Partners: _____

Introduction: You know that matter can exist in one of three physical states—solid, liquid, or gas. For a pure substance, changes in state occur at a definite temperature, which is a physical property of that substance. Water, for example, changes from a solid to a liquid at 0(C.

In a solid, the particles are arranged in an orderly, repeating, three-dimensional pattern. As the solid is heated, the energy of the particles increases. Eventually, at some temperature, which is called the melting point, the molecules overcome the forces of attraction holding the particles together, and the substance changes to a liquid. At another temperature, called the boiling point, molecules in the liquid state overcome the forces of attraction between them and the substance changes from a liquid to a gas.

When a liquid is cooled, the reverse process occurs. The temperature of the gas decreases until the condensation point is reached and the gas becomes a liquid. Only after the gas has completely changed to a liquid will the temperature decrease again. The temperature of the liquid decreases further until the freezing point is reached. Only after the liquid is completely changed to a solid will the temperature begin to decrease further.

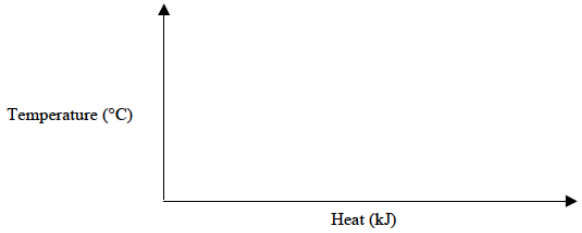
Purpose: Changes of state (phase changes) occur in the change between solid and liquid and liquid and gas. In the phase change simulation you observe a change between liquid and gas. In this activity, you will observe what happens as lauric acid (C12H24O2) melts. You will measure the temperature at timed intervals as the lauric acid is heated to determine its melting point experimentally (What other strategies could you use to find out a temperature for the melting point of lauric acid? Why are both useful?)

Pre-Lab:

1. What phase is the lauric acid in at the beginning of the lab? _____

2. What will be the next phase the acid changes to when you add heat? _____

3. Based on the simulations we did yesterday, predict the shape of its heating curve:



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4. What are the independent and dependent variables?

Independent: _____ Dependent: _____

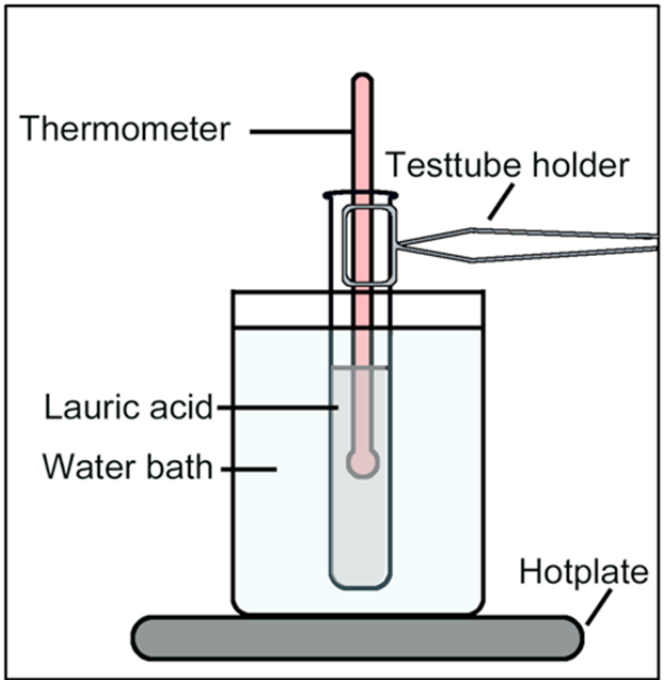
5. What do you always need to wear while chemicals are on the lab tables? Why?

_____

Materials:

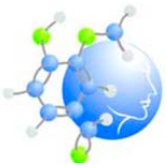
goggles

lauric acid test tube
2 beakers, 400 mL
thermometers
hot plate
tap water
ice for ice bath



Procedure:

1. Put on goggles.
2. Fill one 400 mL beaker _ full of tap water and heat it on the hot plate. Turn the hot plate all the way to 10. Once you see tiny bubbles, turn it down to 6. CAUTION: Do not touch the hot plate or beaker.
3. At the same time make an ice bath using a 400 mL beaker and ice from the front desk.
4. Get a large test tube of lauric acid and hold it with a test tube holder. Place it in the hot water bath. (You need to melt the lauric acid so you can insert the thermometer into the acid)
5. As the solid begins to melt, place a thermometer into the test tube, once you are able to insert the thermometer (see diagram on previous page), use the test tube holder to place the test tube in an ice water bath. Stop once the temperature reaches about 30(C.
6. Carefully place the test tube containing the lauric acid back into the hot water bath (it should NOT be boiling).
7. Immediately begin to take temperature readings every 30 seconds. Record your temperatures and time in the data table provided.
8. Begin stirring gently as soon as you are able to move the thermometer easily. Continue to



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measure and record the temperature until the lauric acid is at approximately 55(C.
9. Turn off the hot plate. Remove the thermometer from the lauric acid and return test tube to your teacher.
10. Clean up your work station and wash your hands.

Observations:

Approximate melting point of lauric acid _____

Describe the changes you witnessed?

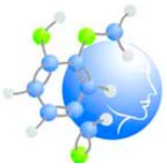
_____

_____

_____

Could you see the actual molecules? Why or why not?

_____



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Data Table:

Title: _____

Time (min)	Temperature (°C)
0 (right when you put the test tube in hot water)	
0.5 (30 seconds)	
1.0	
1.5	
2.0	
2.5	
3.0	
3.5	
4.0	
4.5	
5.0	
5.5	
6.0	
6.5	
7.0	
7.5	
8.0	
8.5	
9.0	
9.5	
10.0	
10.5	
11.0	
11.5	
12.0	

Why do you need to record so many points?

_____

_____

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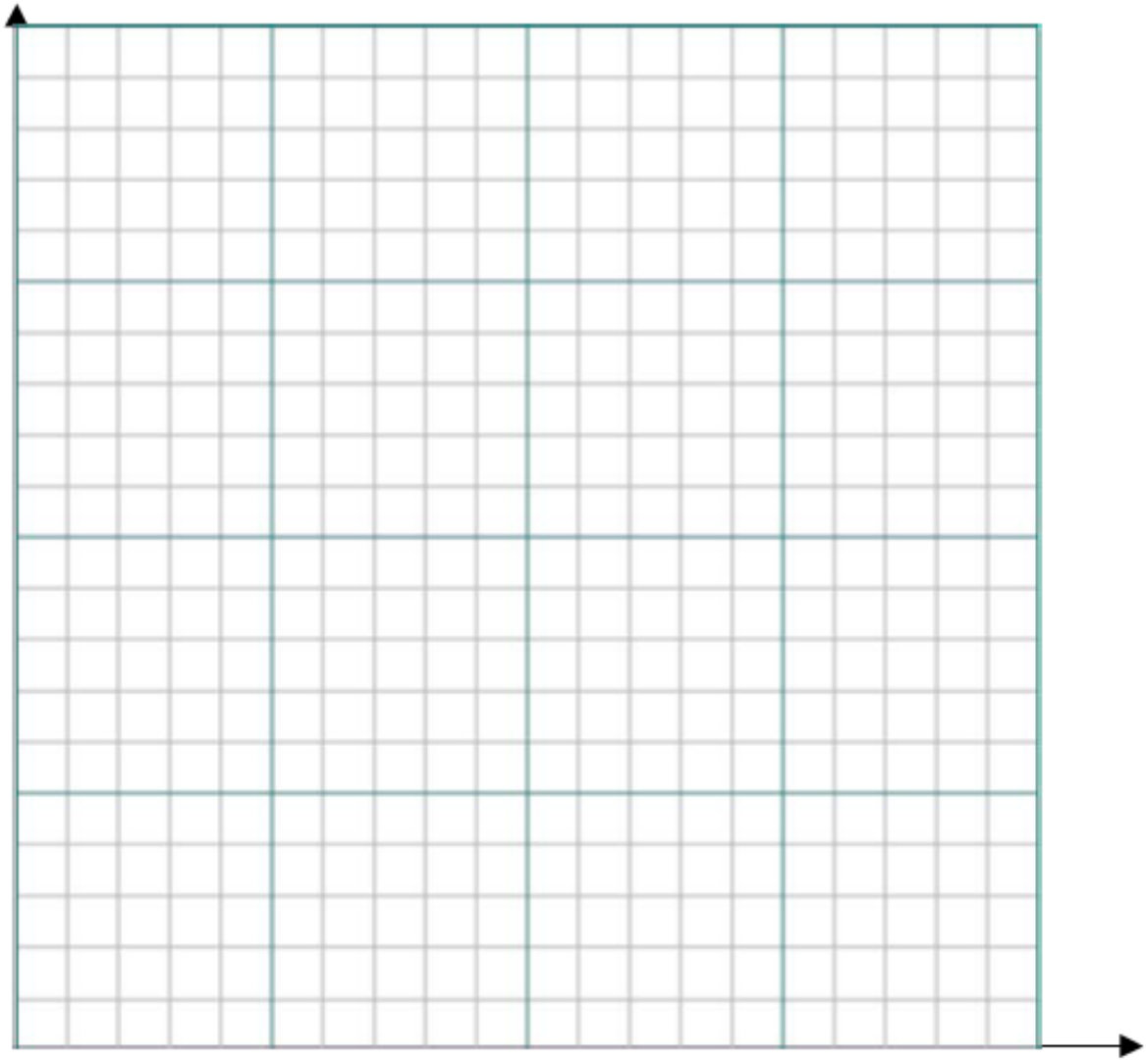
Draw a graph representing the table on the previous page. You MUST label all axes, put in the scale, and write a title.

Title: _____



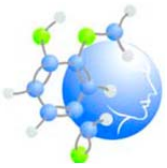
Think About it:

1. Did you prediction match your actual data? _____ Why do you think it was the same or different?

_____

_____

_____



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2. What was difficult about the procedure (measuring the temperature, keeping the time, etc...)?

_____

_____

3. How can you explain the fact that at its melting point the temperature of the lauric acid did not change even though you were still adding heat? What is happening to the heat energy you are putting into the lauric acid:

When it is a solid?

_____

_____

When it is changing from solid to liquid? [What is happening to the forces of attraction between the lauric acid molecules?]

_____

_____

When it is a liquid?

_____

_____

4. What were the similarities and differences between what we did in the simulation yesterday and the lab we did today?

_____

_____

_____

5. How did the simulation help you understand what is happening to the lauric acid as it melts? Give specific details

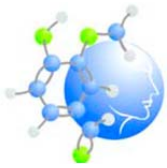
_____

._____

_____

6. The simulation you did yesterday is a model that explains the relationship between heat and temperature during a phase change. Why do you think scientists need to test things theoretically and also do actual experiments?

_____



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7. Draw particle diagrams of what you think the molecules will look like as a solid and as a liquid:

Solid	During Melting	Liquid