

## Summer Camp 2015

### Phase Change "Solid, Liquid, and Gas"

#### Introduction:

Gas, liquid, and solid are known as the three states of matter or material, but each of solid and liquid states may exist in one or more forms. Thus, another term is required to describe the various forms, and the term phase is used. Each distinct form is called a phase, but the concept of phase defined as a homogeneous portion of a system, extends beyond a single material, because a phase may also involve several materials. For example, a homogeneous solution of any number of substances is a one-phase system. Phase is a concept used to explain many physical and chemical changes (reactions).

Phase changes happen when certain points are reached. Sometimes a liquid wants to become a solid. Scientists use something called a freezing point or melting point to measure the temperature at which a liquid turns into a solid.

Generally, solids are denser than liquids because their molecules are closer together. The freezing process compacts the molecules into a smaller space.

There are always exceptions in science. Water is special on many levels. It has more space between its molecules when it is frozen. The molecules organize in a specific arrangement that takes up more space than when they are all loosey-goosey in the liquid state. Because the same number of molecules takes up more space, solid water is less dense than liquid water.

### Objectives:

- Students will be able to identify and describe the difference between solids, liquids, and gasses
- Students will be able to recognize the different phases of matter
- Students will be able to identify and describe the different phase changes associated with matter
- Students will be able to use math to correctly measure out ingredients
- Students will be able to brainstorm to develop hypothesis about how phase change will affect physical properties of matter

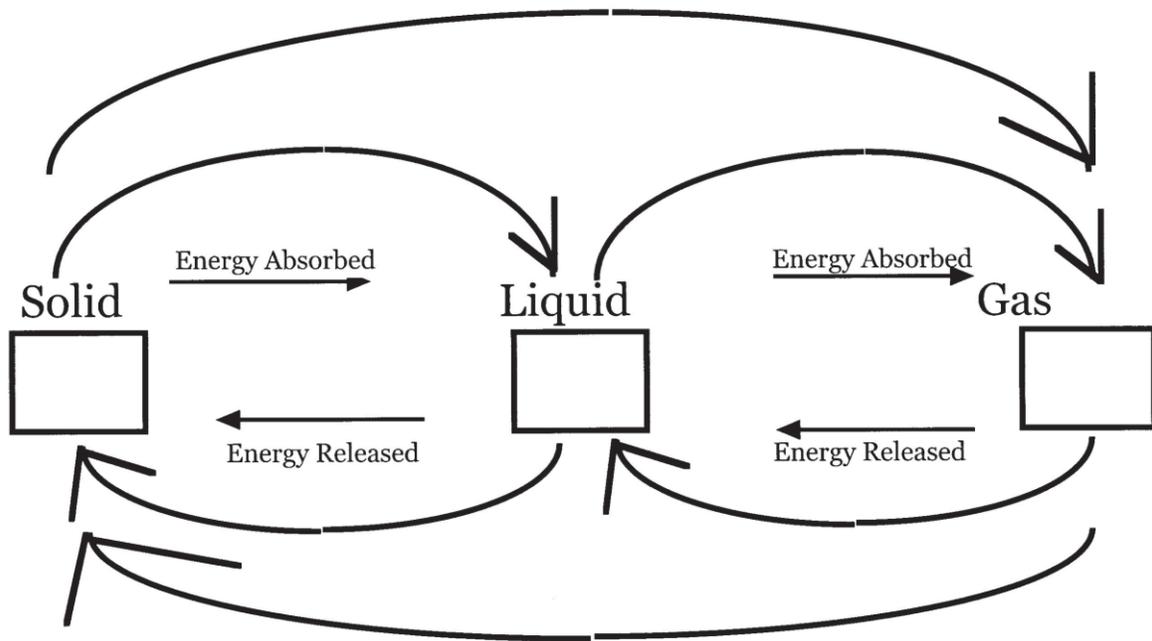
### Standards Covered:

- 9-10.1.1 Explain how models can be used to illustrate scientific principles
- 11-12.2.2 Select and use appropriate instruments, measuring tools, and units of measure to improve scientific investigations
- 11-12.2.4 Formulate and revise explanations based upon scientific knowledge and experimental data

### Session Organization:

- 9:00 - 9:30 Cultural Connection and General Organization
- 9:30 - 10:00 Power Point part 1 (background information and Activity 1)
- 10:00 - 10:15 Activity 1: Phase change diagram and discussion
- 10:15 - 11:00 Activity 2: Pressure change in balloons
- 11:00 - 11:30 Activity 3: Phase change study guide
- 11:30 - 12:00 Activity 2: Recheck measurements
- 12:00 - 12:45 Lunch
- 12:45 - 1:30 Activity 2: Final Check at room Temperature, graph and report results
- 1:30 - 2:15 Activity 4: Make Ice Cream and brain "freezer"
- 2:15 - 3:00 Wrap up, clean up, and closing discussion

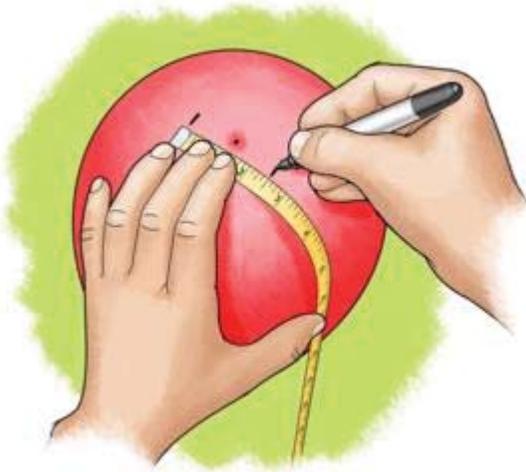
Activity One: Directions: Label the phase change of each arc. Brainstorm at least one example for each phase change and write it under each phase change. In the boxes under the phases draw a small picture of how the molecules are arranged.



## Activity Two: Pressure change in balloons

In groups of 2, give each group 3 balloons and a 2-3 foot piece of string.

1. Each group should blow up one balloon until it is almost full and tie a knot in the balloon.
2. Using the string, students should measure the circumference of the balloon at its widest point. Students will then measure the string to find the actual circumference in centimeters.
3. Inflate the 2<sup>nd</sup> balloon but **DO NOT TIE IT YET**. Pinching the end so air cannot escape, check the circumference of balloon #2. Adjust accordingly until the circumference is equal to the first balloon. When the circumferences are equal tie off the end of the balloon.
4. Repeat step 3 for balloon 3
5. Looking at the top of the balloon you will see a darker spot. Using a permanent marker, put a mark on the dark spot. Using that spot as the midpoint, draw a line 3 centimeters on each side of the midpoint. (Using a ruler place the midpoint at 3 centimeters. Draw a line at 0 cm and 6 cm. Measure the distance between the outside of the lines to get an accurate distance.



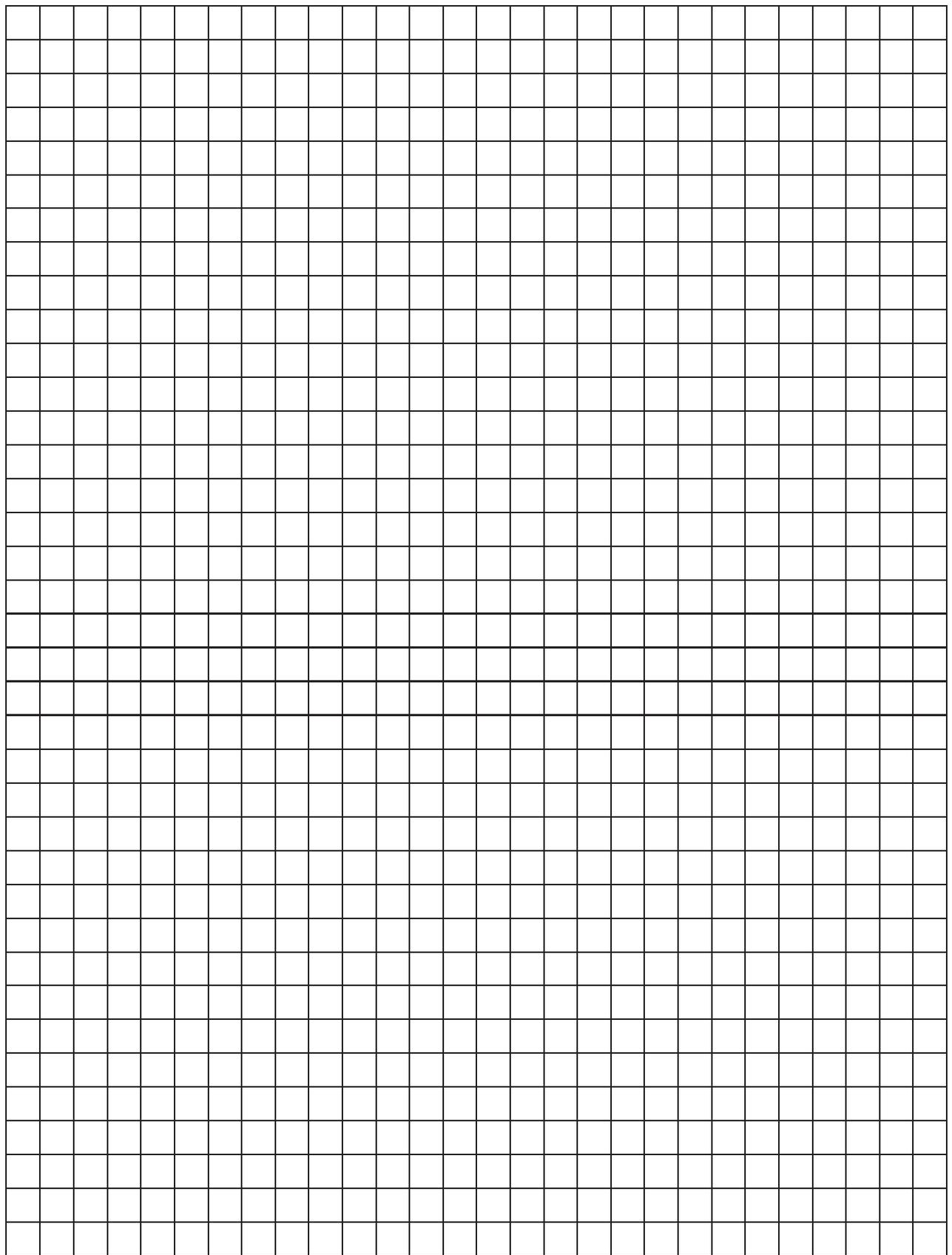
6. Repeat for balloons 2 and 3.

7. Label the balloons 1, 2, and 3. Place balloon 1 in the freezer, balloon 2 somewhere warm (inside a car, greenhouse, etc.), and leave balloon 3 at room temperature.
8. Go on to activity 3
9. After activity 3 (45 minutes) we will now measure the distance between the lines and the circumference of the 3 balloons. Leave the 3 balloons at room temperature during lunch and we will take final measurements when we return from lunch.
10. Take the final measurements after returning from lunch.
11. Complete the table and calculate the percent increase/decrease between measurement 1 and measurement 2.
12. Use the grid on the following page to create a bar graph demonstrating your three measurements.

	Balloon 1	Balloon 2	Balloon 3
Circumference 1			
Distance 1			
Circumference 2			
Distance 2			
Difference C1-C2			
Difference D1-D2			
Percent +/- C1 & C2			
Percent +/- D1 & D2			
Circumference 3			
Distance 3			

$$\text{Percent +/-} = [(C1-C2)/C1] * 100$$

Positive answer is Percent increase, negative is Percent decrease



Activity Three: Phase Change Study Guide

1. An ice cube is in the \_\_\_\_\_ phase.

2. Solids have a \_\_\_\_\_ shape and \_\_\_\_\_ volume.

3. Describe how the molecules are arranged and moving in the solid phase. Include a picture with your description.

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4. What are some unique properties about ice that differ from liquid water or water vapor?

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5. The phase change from a solid to a liquid is called \_\_\_\_\_.

6. Describe how the structure of the molecules in a solid change as it becomes a liquid.

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7. A glass of water is in the \_\_\_\_\_ phase.

8. Liquids have a definite \_\_\_\_\_ but not a definite \_\_\_\_\_.

9. Describe how the molecules are arranged and moving in the liquid phase. Include a picture with your description.

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10. In order to get liquid water to become water vapor energy must be \_\_\_\_\_ to the liquid water.

11. The phase change from liquid to gas is called vaporization. There are two types of vaporization. \_\_\_\_\_ which occurs only at the surface while \_\_\_\_\_ occurs anywhere within the liquid.

12. Gases have no definite \_\_\_\_\_ and no definite \_\_\_\_\_.

13. Describe how the molecules are arranged and moving in the gas phase. Include a picture with your description.

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14. As we changed from an ice cube to water vapor how did the structure of the water molecules change and what properties changed.

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15. The phase change from a gas back to a liquid is called \_\_\_\_\_.

16. During this phase change energy is \_\_\_\_\_ by the gas molecules as they slow down and rearrange into liquid molecules.

17. Describe how taking a shower in a bathroom is an example of condensation.

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18. The phase change from a liquid back to solid is called \_\_\_\_\_.

19. Dry ice turning directly into a gas is an example of what kind of phase change? \_\_\_\_\_

20. On a cold winter morning when you go out to a car and there is frost all over the windows where did the ice come from?

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21. Frost is an example of what phase change? \_\_\_\_\_

22. Pretend you are a molecule of ice. Write a paragraph about how your structure and properties change as you move from solid ice to liquid water, and ending with the gas water vapor.

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#### Activity Four: Homemade Ice Cream

Working in groups of 2-3, each group will need two quart size freezer bags and one gallon size freezer bag. In a quart size bag, combine 1 cup of milk, 2 tablespoons of sugar and 1 teaspoon of vanilla. Get as much air as possible out of the bag and seal it tight. Place the combined ingredients into the other quart size freezer bag, again releasing as much air as possible and sealing it. In the gallon size freezer bag place 4-6 cups of ice and  $\frac{1}{2}$  cup of rock salt. Place the double bagged ingredients into the gallon bag and release as much air as possible before sealing. Carefully shake the bags for 5-8 minutes checking occasionally to see how the mixture is changing phases.

As you are enjoying your ice cream think about this Brain "Freezer":

A group of children went to Holman's Dairy to buy ice cream cones. Each child bought a double scoop cone with two flavors of ice cream. None of the children chose the same combination of flavors. Holman's Dairy has nine different flavors of ice cream: Vanilla, Maple, Chocolate, Toffee, Raspberry, Strawberry, Mocha, Nutcracker, and Almond. How many children are there?