# Phase Changes of Water

**Background:** Water can be found everywhere on the planet. About 70% of Earth's surface is covered with water. The oceans cover much of the surface of earth. The north and south poles are blanketed with water in the form of ice. And even the air we breathe contains water vapor. Water is the most abundant substance on Earth that is commonly found in all three phases: as a solid, liquid, and a gas!

Temperature is the main factor determining whether water exists as a solid, liquid, or gas. Liquid water freezes at 0° Celsius (32° Fahrenheit). Below that temperature fresh water exists as a solid in the form of ice. In turn ice melts at 0° Celsius (32° Fahrenheit). Water exists as a liquid between 0° Celsius and 100° Celsius. At 100° Celsius (212° Fahrenheit) liquid water boils, changing from a liquid to a gas.

In this activity you will observe and record the phase changes of water. You will record the temperature of water throughout these phase changes, and graph the temperature readings.

**Materials:** protective eye glasses or goggles, 250-ml beaker, hot plate, thermometer, crushed ice, stirring rod, beaker tongs

**Instructions:**

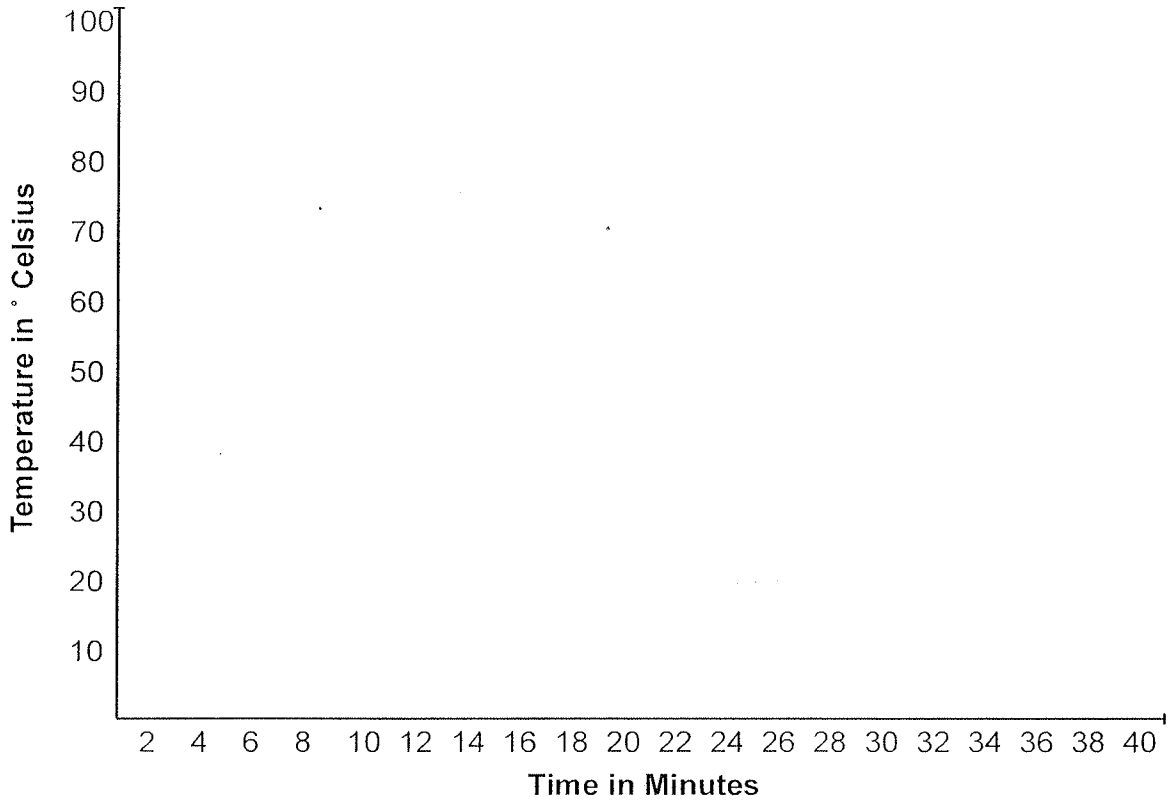
1. **Put on protective eye glasses or goggles. Keep this protective eyewear on during the course of the experiment.**
2. Your teacher will provide you with crushed ice. Fill the beaker up to the 150-mL mark with crushed ice.
3. Place a thermometer in the beaker of ice. Let it sit there for 1 minute. Record the temperature in the data table.
4. Carefully place the beaker on the hot plate. The thermometer should still be in it. Turn on the hot plate.
5. Record the temperature of the water every minute, and write the value in the data table. Also stir the mixture a little bit every 30 seconds. **Hold the beaker with the beaker tongs while stirring. Be very careful not to tip over the beaker!**
6. Continue to take readings every minute until the water boils. This may take 30 to 40 minutes.
7. Once the water has boiled turn off the hot plate.
8. Using the data in your table, create a line graph in the space provided.
9. Once you have completed your graph, answer the questions that follow.

# Phase Changes of Water (cont.)

Phase Change Data Table

| Minutes | Temperature in ° Celsius | Minutes | Temperature in ° Celsius |
|---|---|---|---|
| 1 | | 21 | |
| 2 | | 22 | |
| 3 | | 23 | |
| 4 | | 24 | |
| 5 | | 25 | |
| 6 | | 26 | |
| 7 | | 27 | |
| 8 | | 28 | |
| 9 | | 29 | |
| 10 | | 30 | |
| 11 | | 31 | |
| 12 | | 32 | |
| 13 | | 33 | |
| 14 | | 34 | |
| 15 | | 35 | |
| 16 | | 36 | |
| 17 | | 37 | |
| 18 | | 38 | |
| 19 | | 39 | |
| 20 | | 40 | |

# Phase Changes of Water (cont.)




**Questions:**

1. At what temperature did water exist as a solid?

2. At what temperature were the readings level early in your experiment?

3. Why did the temperature stay at 0° Celsius for many minutes?

4. What did you observe in the beaker at 100° Celsius?

5. Describe the two phase changes you observed in this activity.

6. Describe the phase changes that would occur if you reversed the process.

# Gas in Action

**Background:**

As you probably already know there are four phases of matter: solid, liquid, gas and plasma. The fourth phase of matter, plasma, is not very common on Earth. But it is commonly found in stars and in our sun. Solids, liquids, and gases are quite common on Earth. Water exists in all three of those phases. Solids, such as this piece of paper, have a definite shape and a definite volume. While liquids have a definite volume, they do not have a definite shape. They take on the shape of whatever container they are poured into. Gases are somewhat unique in that they do not have a definite shape and do not have a definite volume. This is what makes gases so interesting.

Gases take on the shape of their container. If you put a certain amount of a gas in a jar, it would fill the jar. When the same amount of gas is put into a box, it will take the shape of the box. What makes gases unusual is that their volume can also vary. Gases can readily expand or contract. Variations in temperature and pressure can affect the volume of a given amount of gas. In this experiment we will see how temperature and pressure can affect the volume of gas.

**Materials:** balloon, tape measure, light bulb or sunny windowsill, bell jar, thermometer

**Instructions:**

1. Obtain a balloon from your teacher. Blow up the balloon and tie it off.
2. Measure the circumference (distance around) of the balloon with a tape measure. Be sure to measure in the same place on the balloon each time this circumference is measured.
3. Measure the air temperature with a thermometer. Record the value in the data table.
4. Next, place the balloon in a freezer. Place a thermometer in the freezer at the same time.
5. Wait at least 30 minutes then open the freezer door and read the value on the thermometer. Record the temperature in the data table.
6. Next, take the balloon out of the freezer and measure its circumference with the tape measure. Work quickly so that it doesn't have time to warm up. Record the value in the data table.
7. Place the balloon under a warm light bulb or in a sunny window. Leave it there for at least 30 minutes.
8. Measure its circumference with a tape measure and record the temperature.
9. Now let's experiment how pressure can affect the volume of a gas.
10. Get a fresh balloon. Blow it up and tie it off.
11. With both hands, observe what happens when you slowly squeeze the balloon. Record your observations in the data table.
12. If a bell jar apparatus is available, place the balloon inside it. Turn on the motor and observe what happens to the balloon. Record your observations.

# Gas in Action (cont.)

**Data Table**

| | |
|---|---|
| Circumference of balloon at start<br>Temperature: _____° Celsius | |
| Circumference of balloon in freezer<br>Temperature: _____° Celsius | |
| Circumference of balloon in heat<br>Temperature _____° Celsius | |
| Observations of balloon when squeezed | |
| Observations of balloon in bell jar | |

**Questions:**

1. What happened to the size of the balloon after it was cooled?

2. What accounts for this decrease in size?

3. What happened to the balloon's circumference when it became warm?

4. What accounts for this increase in size?

5. What happened to the volume of the balloon when pressure is increased?

6. What happened to the volume of the balloon when pressure was decreased?

 Extra Credit

Name _____

# Vocabulary of "Solids, Liquids, and Gases"

**Directions:** Unscramble the vocabulary words in the first column. Match the words to the definitions in the second column.

_____ 1. tmreat _____

_____ 2. diuliq _____

_____ 3. sga _____

_____ 4. salmpa _____

_____ 5. ioysvstci _____

_____ 6. neimgtl _____

_____ 7. zfegrnei _____

_____ 8. ziarvaonopit _____

_____ 9. sdceonnitnoa _____

_____ 10. hpsesa _____

a. the fourth phase of matter, found in the sun and stars

b. a phase change from a liquid to a solid

c. a phase change from a solid to a liquid

d. a measure of a liquid's resistance to flow

e. occurs when a vapor cools and changes to a liquid

f. substance that takes the shape of its container but has definite volume

g. anything that takes up space and has mass

h. a phase change that creates vapor; it occurs when a liquid is boiled

i. the different forms matter can take; there are four

j. adjusts to fill the volume of whatever container it's in and has no definite volume