**Lab #20: Phase Changes of Water (Investigation 4A)**

The chemical water (H2O) can be a solid (ice), a liquid (water), or a gas (steam). Solid, liquid and gas are the three phases of matter. Water, oxygen, iron and every other chemical can exist in any of these three phases. In this investigation you will find out exactly how to change water from one phase to another. You will also discover why you don’t often find solid oxygen and gaseous iron on Earth.

*Materials*

* Hot Plate
* temperature probe
* Crushed Ice
* beaker
1. *How do you change ice to water or water to steam?*
2. *What is happening to the molecules when they start to boil?*
3. *Draw the three states of matter at the molecular level.*

*Solid Liquid Gas*

1. *Rank the three states of matter from lowest intermolecular forces to strongest intermolecular forces.*

**Part 1: Setting up**

1. Fill a beaker about half full of crushed ice and a little water.
2. Record the temperature of the ice water in the table below. This is the temperature at 0 minutes.
3. Put the beaker on the hot plate and begin to heat it up.

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| --- |
| **Table 1:** |
| Time (min) | Temperature (°C) |
| 0 |  |
| 0:30 |  |
| 1:00 |  |
| 1:30 |  |
| 2:00 |  |
| 3:00 |  |
| 4:00 |  |
| 5:00 |  |
| 6:00 |  |
| 7:00 |  |
| 8:00 |  |
| 9:00 |  |
| 10:00 |  |
| Keep taking data until it boils… |  |

1. Stir the beaker **constantly** but **gently**.
2. **Watch carefully and note the time when all the ice has melted.**

Time: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. **Watch carefully and note the time when the water starts to boil.**

Time: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Part 2: Analyzing the data**

1. When the experiment is done, transfer time and temperature data for the times indicated on table 1. Plot your own graph of temperature versus time using the data from Table 1.

SCALE YOUR AXIS!!!!!!!!!!!

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| Temperature (°C) |  |  |  |  |  |  |  |  |  |  |  |
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|  |  |  | Time (sec) |  |  |  |  |  |  |  |  |

**Part 3: Thinking about what you observed**

1. Looking at your graph and thinking about how the water atoms are absorbing energy what is the story your graph tells. What is happening!?
2. Was heat energy being transferred from the heater to the water the whole time or did the energy transfer stop at some point? Use evidence to support your reasoning.
3. Why didn’t the temperature rise while there was ice in the test tube? This is a hard question! Talk with your group and the class before writing your answer!
4. What was the highest reading you saw on the temperature probe? What was the water doing at that time?
5. Why did the temperature stop rising when the water started boiling? This is a hard question! Talk with your group and the class before writing your answer!

**Part 4: Making connections**

1. A chemistry book writes H2O (s); H2O (l) and H2O (g). What do the letters in parentheses mean?
2. At ordinary atmospheric pressure, what is the highest temperature that liquid water can reach before it boils? Use your data from Table 1 to help you determine this value. Compare your results with the rest of the class and figure out the average value.
3. What is the highest temperature that ice cream reaches before it melts? Use your data from Table 1 to help you find this answer. Compare your results with the rest of the class and figure out the average value.
4. These two temperatures are known as the boiling point and the melting point of water. Every chemical has its own melting point and boiling point. Knowing this why don’t you see solid oxygen and gaseous iron as often as you see ice and steam?