

## MiSP Phase Changes Worksheet #2a L2

Name \_\_\_\_\_

Date \_\_\_\_\_

### Key Question:

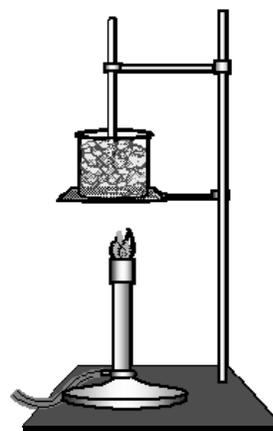
How does the temperature change as water gains heat and boils?

### Safety:

- Wear goggles.
- Use caution—the hot plate, Bunsen burner, and heated water will be very hot.

### Materials:

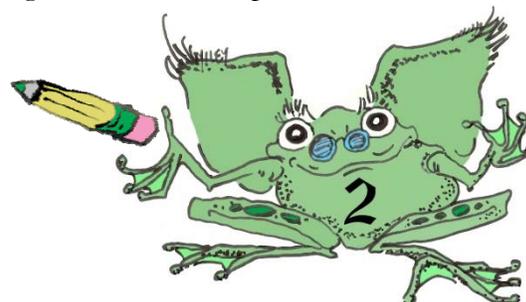
- 250 ml beaker
- Bunsen burner or hot plate (if using a Bunsen burner, you will need:
  - ring stand and
  - iron ring wire gauze)
- thermometer and clamp
- goggles



### Procedure:

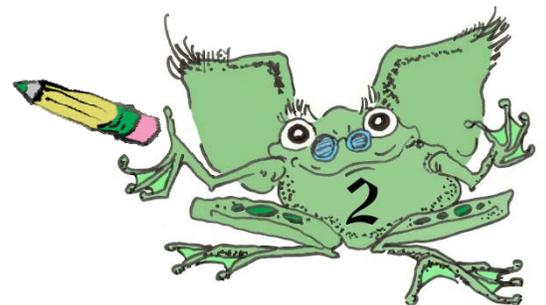
Check off each step as you complete it.

- 1. Prepare a heating setup: EITHER a Bunsen burner, ring stand, iron ring, and wire gauze OR a hot plate. Your teacher will tell you which setup to prepare and give any special instructions needed. Put on goggles.
- 2. Put 200 ml of cold tap water into a beaker.
- 3. Take the temperature of the water immediately and record that reading as the temperature at time 0 (zero) on the data chart.
- 4. Begin heating the water with the Bunsen burner or hot plate. ONCE YOU START HEATING, DO NOT CHANGE THE SETTING ON THE BUNSEN BURNER OR THE HOT PLATE. THE EXPERIMENT MUST HAVE A CONSTANT AMOUNT OF HEAT BEING ADDED. Take the temperature every 1 minute while you are heating the water. Stir the water with the thermometer before each reading and take the temperature in



the middle of the water in the beaker. Write each reading on the data chart and note when the water begins to boil rapidly (comes to a “rolling” boil).

- 5. After the water begins to boil rapidly, continue taking the temperature at 1-minute intervals for 5 more minutes. Write this data on the data chart.
- 6. At the end of the 5 minutes, shut off your burner. Let the setup cool. Your teacher will tell you how to clean up your lab materials.





Empty rectangular box at the top of the page.

Large grid area for calculations or drawing, consisting of 20 columns and 30 rows of small squares.

Vertical empty rectangular box on the left side of the grid.

Empty rectangular box at the bottom of the grid.

**Discussion Questions:**



1. Water has a boiling point (temperature) of  $100^{\circ}\text{C}$  at sea level. According to your thermometer (school thermometers are often inaccurate), what is the boiling point of the water in your experiment? Look at your data chart and graph, too.

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2. Which line on the graph (liquid heating OR boiling) has the steepest slope (the greatest angle)?

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3. In which part of the graph (liquid heating OR boiling) did the temperature change (increase) the most?

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4. The temperature of your Bunsen burner or hot plate was  $200^{\circ}\text{C}$  or more. Yet once the water was boiling, the temperature changed little, if at all. So, at the boiling temperature, what is the heat that is still being added to the water doing?

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5a. Your teacher will give you Phase Changes Worksheet #2b. It has a labeled ideal graph that shows the heating curve (from solid to gas) of any substance. How does your graph compare to the liquid heating (warming) to boiling part of the ideal graph?

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5b. From the labeled graph on Worksheet #2b, what happens to the temperature of a substance when it is gaining heat and changing from a

solid to a liquid (melting)? \_\_\_\_\_

liquid to a gas (boiling)? \_\_\_\_\_



5c. According to the labeled ideal graph on Worksheet #2b, what happens to the temperature of a substance when it is gaining heat in the

solid state (phase)? \_\_\_\_\_

liquid state (phase)? \_\_\_\_\_

gas state (phase)? \_\_\_\_\_

6. Look at the graph you drew. Notice that as time passed and heat was added to the water, the temperature changed. You will compare the changes in temperature in the two regions of the graph (liquid heating AND boiling) by calculating the unit rates of change (slopes). Use the best-fit lines. (*When using best-fit lines, the ordered pairs to determine unit rates of change (slopes) must be from the best-fit lines, not from your data chart.*)

$$\text{Unit Rate of Change} = \frac{\Delta \text{Temperature } ^\circ\text{C}}{\Delta \text{Time (minutes)}} = \frac{\Delta y}{\Delta x} = \frac{(y_2 - y_1)}{(x_2 - x_1)}$$

<u>Section of graph</u>	$\Delta$ Temperature $^\circ\text{C}$ $\Delta y$	$\Delta$ Time (minutes) $\Delta x$	<b>Unit Rate of Change (slope)</b> $\Delta y / \Delta x$
Ordered Pair used for calculation $(x_1, y_1)$ $(x_2, y_2)$			
<b><u>Liquid Heating</u></b>			
<b><u>Boiling</u></b>			

7a. How do the unit rates of change (slopes) for the two sections of the graph compare? Discuss numerical values and signs (positive/+ or negative/-).

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7b. According to the unit rates of change, in which section of the graph was the temperature changing most rapidly?

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7c. Look at the ideal graph on Worksheet #2b. What is the unit rate of change (slope) when a substance melts (changes from a solid to a liquid) and boils (changes from a liquid to a gas)?

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7d. Look at the ideal graph on Worksheet #2b. When heating a pure solid, liquid, or gas, is the slope positive (+) or negative (-)? Explain your answer.

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