

MiSP Thermal Conduction Worksheet #1 L2

Name _____

Date _____

HEAT TRANSFER

Introduction

Areas that have heat energy are called *heat sources*. Areas that have little or less heat energy are called *heat sinks*.

In this lab activity you will determine the direction in which heat energy flows between a heat source and a heat sink, and you will determine how the temperature changes.

Problems

- In which direction does heat energy flow: *from source to sink* or *from sink to source*?
- What happens to the temperature of hot and cold water connected with an aluminum bar?

Hypothesis

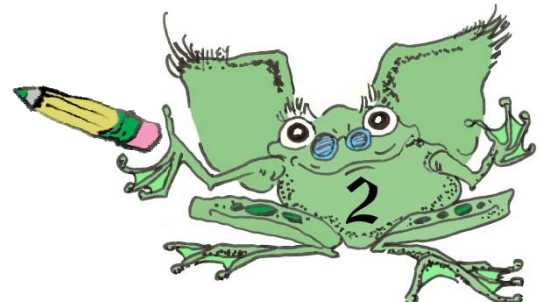
If a container of hot water (the heat source) is connected to a container of cold water (the heat sink) with an aluminum bar, the heat will transfer from the **heat source** / **heat sink** (*circle one*) to the **heat source** / **heat sink** (*circle one*).

Materials:

- goggles
- 2 insulated containers with lids and an aluminum connecting bar
- warm water (approximately 100°C)
- cold water
- 2 thermometers
- color pencils
- timer

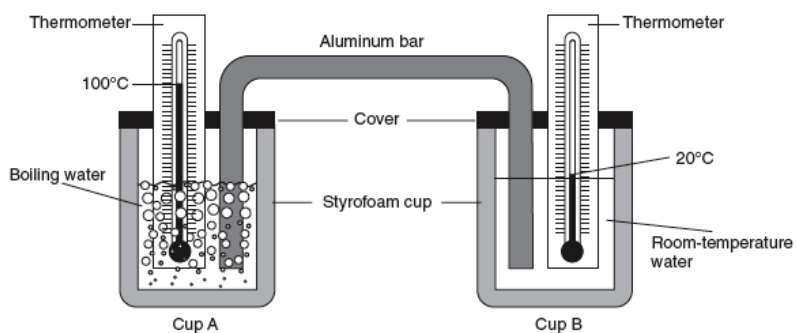
Safety:

- Wear goggles.
- Use caution when handling the hot water.



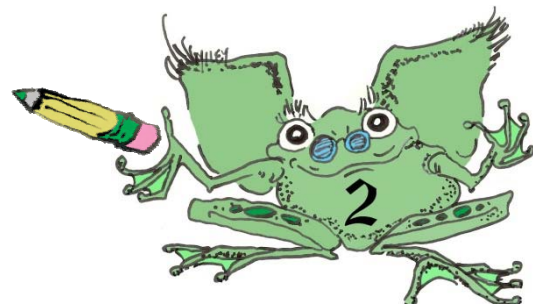
Procedure:

(Note: Your teacher may supply water with temperatures different than those in this diagram.)



Check off each step as you complete it.

- Set up the heat transfer kit as in the diagram above. The thermometer bulbs and the bottoms of the aluminum bar should be near the bottom but NOT touching the bottom of each Styrofoam insulated container.
- Measure 150 ml of hot water and the same amount of cold water, and add the hot water to one insulated cup and the cold water to the other.
- Gently place the lids with aluminum bar and thermometers on the cups at the same time. (Be careful not to submerge the lids.)
- Wait 15 seconds for the thermometer to get a reading. Then record the initial temperature (time 0) of the water in each cup on the data table.
- Continue to record in the data table temperatures for both cups each minute for 15 minutes (or longer if your teacher indicates a different time).



Record your data:

Record in the data table the temperatures for both cups each minute.

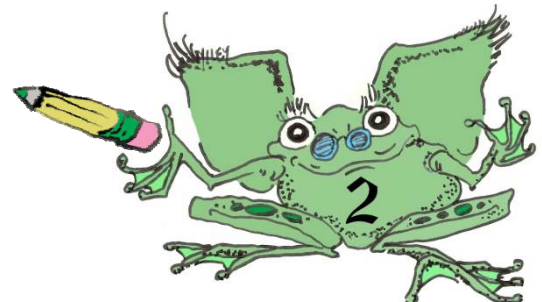
Data Table Temperatures

Time (minutes)	Temperature °C Hot water cup	Temperature °C Cold water cup
0		
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		

Graph your data:

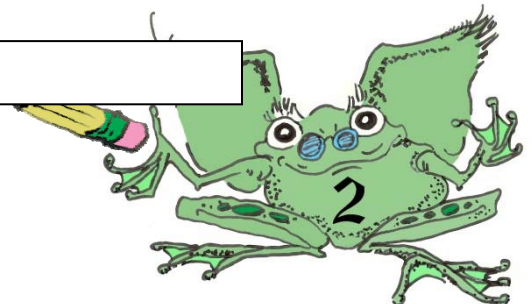
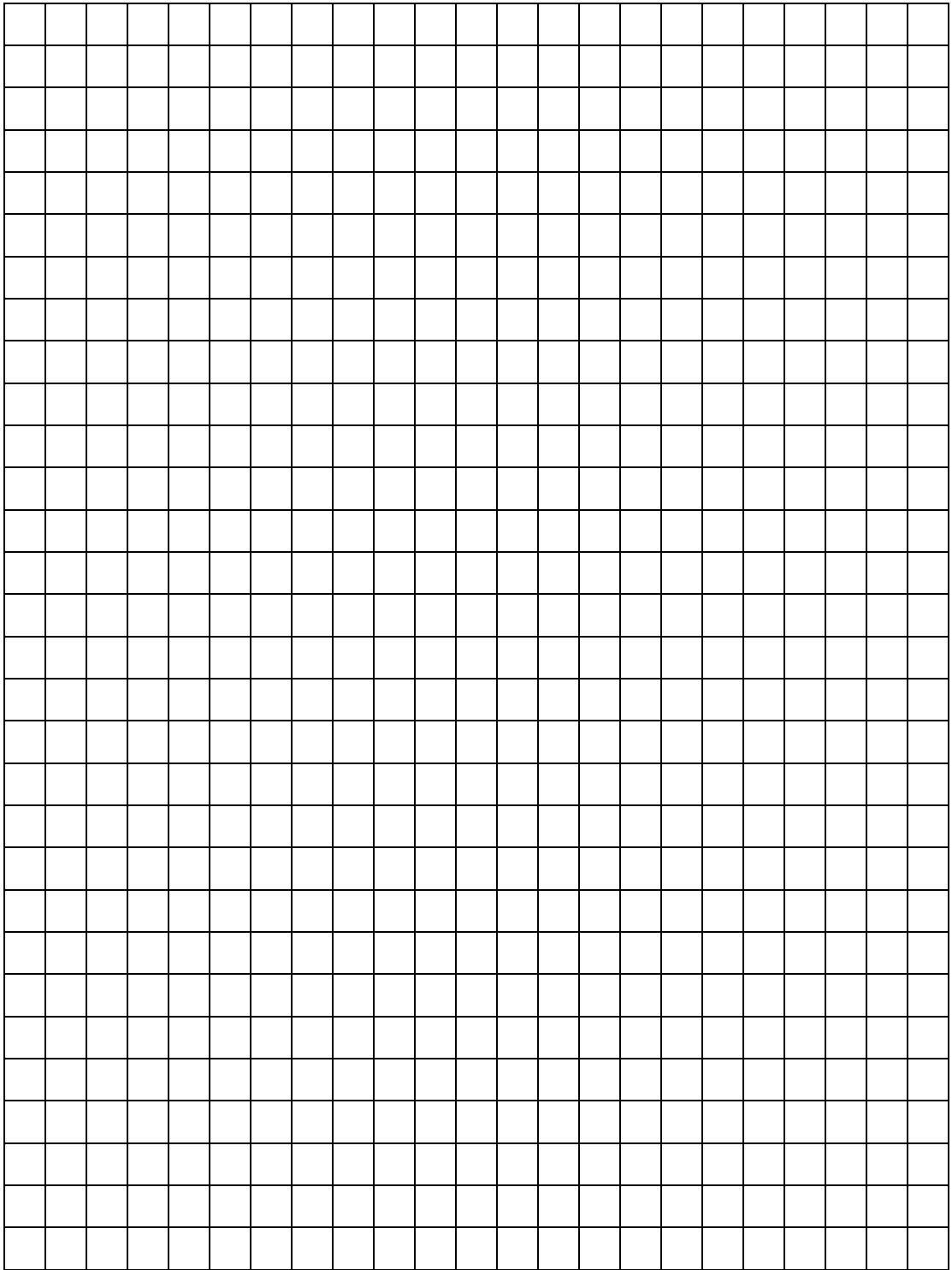
Graph the above data on the next page to show the relationship between time (minutes) and the temperature (°C) in each cup.

- Label the x -axis.
- Label the y -axis.
- Connect the dots for each cup's data set (hot water cup, cold water cup). Use two different colors and write a key for the graph.



Title: _____

Key
Warm water line:
Cold water line:



Discussion Questions:

Answer each of the following questions.

1. Which container is the heat source? _____

2. Which container is the heat sink? _____

3a. Which container “lost” heat energy? _____

3b. Since energy is never lost or created, where did the heat energy go?

4. In this experiment, the heat energy moved from the _____ container to the _____ container or from the **heat source** / **heat sink** (*circle one*) to the **heat source** / **heat sink** (*circle one*).

5. What method of energy transfer occurred in this experiment? (*Circle one.*)

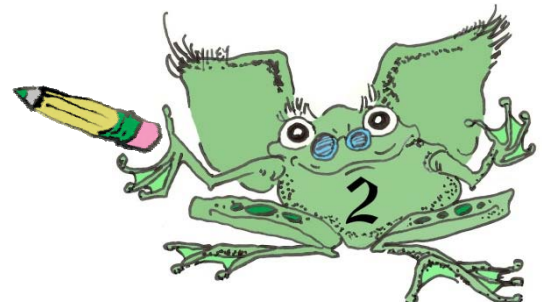
Conduction

Convection

Radiation

6. How did the graph of the cold water cup temperatures compare to the graph of the hot water cup temperatures?

7. Predict how the temperature in the cold water cup would compare to the temperature in the hot water cup if the experiment was allowed to continue for a longer time.



8. Look at the graph you drew. Notice that as time passed, the temperature in each cup changed. You will compare the temperature changes in the second five minutes (from 5 to 10 minutes) of the experiment in the hot water cup and the cold water cup by calculating the unit rate of change (slope) of each line. Use the information from the graph to calculate the unit rates of change (slopes) for the cold water data and the hot water data on the heat transfer graph. If your data points from 5 to 10 minutes all lie on a line, determine the unit rates of change (slopes) of the lines. If your data points do not produce lines, determine the unit rates of change (slopes) of best-fit lines from 5 to 10 minutes. *(If you use best-fit lines, the ordered pairs to determine the unit rates of change [slopes] must be from the best-fit line, not from your data chart.)*

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

Graphed Data Best-Fit Line	Ordered Pair used for calculation (x_1, y_1) (x_2, y_2)	Δ Temperature $^{\circ}\text{C}$ Δy	Δ Time (minutes) Δx	Unit Rate of Change (slope) $\Delta y / \Delta x$
Cold water data from 5 to 10 minutes				
Hot water data from 5 to 10 minutes				

- 9a. How do the unit rates of change (slopes) for the two sets of data on the graph compare? Discuss numerical value and sign (positive/+ or negative/-).

- 9b. Which set of data had a negative/- unit rate of change (slope)? What does that tell you about the changes in temperature as time passes?



9c. Which set of data had a positive/+ unit rate of change (slope)? What does that tell you about the changes in temperature as time passes?

