Name: ____________________ **Table:** ______

Exploring Heat

In this experiment you will use water, a metal block, two Styrofoam cups, and two temperature probes to explore the transfer of heat energy between two objects.

Introduction:

Science is knowing what to do when you do not have an answer. There is no single thinking strategy used by all scientists, however good scientific investigations are not haphazard. They all use a systematic approach to seek explanations based on evidence. When teaching students science, it is helpful to provide them with a framework for thinking that supports inquiry.

Use the laboratory investigation below to seek an explanation to the following question:

"What determines how much energy is transferred in a system?"

As you do the lab, use the fundamental questions of inquiry to organize your thoughts.

- What are the components (elements) that make up the system?
  - What are the properties of the components?
- What is the context or background space of the system: temperature (average kinetic energy of molecules)
- What are the rules of interaction among the components of the system?

After you finish the lab, use systems analysis to describe the heat exchange system that you used and to summarize your explanation of the essential question, ""What determines how much energy is transferred in a system?"

PROCEDURE

Part I – Equal amounts of water. In this part of the lab, you will mix equal amounts of water at different temperatures and observe the final temperature. Specifically, you'll use 150 g of hot water, and 150 g of water at room temperature.

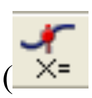
Question 1: What will the final temperature of the mixture be?

[ ] close to room temperature

[ ] halfway between room temperature and the temperature of the hot water

[ ] close to the temperature of the hot water

Explain your choice for the final temperature:

1. Measure and record the mass of each of your Styrofoam cups.
2. Put 150 g of tap water (from the beaker) in one cup and put one temperature probe in the cup.
3. Put an equal mass of hot water from the kettle in the other cup. (Since the density of liquid water is 1g/ml, the easiest way to do this is to put 150 ml of hot water in a beaker, and pour it all in the Styrofoam cup and record the mass). Put the other temperature probe in this cup.
4. Click the collect button in Logger Pro, then pour the room temperature water into the hot water cup, and move the temperature probe from the room-temperature water into the combined water cup.
5. Once the data collection has stopped, click on the "Examine Data" button in Logger Pro (). This will show the temperature readings of each probe as you move the mouse back and forth along the graph. Use this to fill in your data table below:

Data Table 1: Equal amounts of water			
	Mass (g)	Initial temperature (°C)	Final temperature (°C)
Hot water			
Cool water			

Question 2: Does your data support your prediction? What factors can you identify that affect the final temperature of the mixture?

Stop here – we will discuss the results so far as a group.

Part II – Unequal amounts of water. In this part of the lab you will mix unequal amounts of water at different temperatures and observe their final temperature. Specifically, you'll use 200 g of room-temperature water, and 100 g of hot water.

Question 3: What will the final temperature of this mixture be?

[ ] close to room temperature

[ ] halfway between room temperature and the temperature of the hot water

[ ] close to the temperature of the hot water

Explain your choice for the final temperature:

6. Dump out all the water from your Styrofoam cups.

7. Repeat steps 2-5 above, except use 200 g of tap water and 100 g of hot water. Record your data in the table below:

Data Table 2: Unequal amounts of water			
	Mass (g)	Initial temperature (°C)	Final temperature (°C)
Hot water			
Cool water			

Question 4: Does your data support your prediction? Can you identify any additional factors that affect the final temperature of the mixture?

Part III – Equal amounts of water and metal. In this part of the lab, you will add a hot metal block to an equal mass of room-temperature water.

Question 5: What will the final temperature of this mixture be?

[ ] close to the temperature of the water

[ ] halfway between the temperature of the water and the temperature of the metal

[ ] close to the temperature of the metal

Explain your choice for the final temperature:

8. As before, dump out all water from your Styrofoam cups.

9. Measure and record the mass of the metal block, and what type of metal it is, in Data Table 3 below.

10. Pour an equal mass of water into a Styrofoam cup and put in a temperature probe.

11. Put the metal block in a Styrofoam cup, and pour hot water from the kettle into the cup to heat up the block.

12. Put a temperature probe into the cup with the metal block. We will assume that after the block has been in the water for about a minute, the temperature of the water and the temperature of the block are equal.

13. Click the collect button on Logger Pro. Use the tongs to move the metal block from the hot water to the room-temperature water. Move the temperature probe from the cup with the block to the other Styrofoam cup when you move the block.

14. Stir the water slightly with the two temperature probes to make sure that there aren't hot or cool areas in the cup.

15. As before, use the "Examine Data" button to fill in the rest of the data table.

Data Table 3: Metal block and water			
	Mass (g)	Initial temperature (°C)	Final temperature (°C)
Metal block (metal:)			
Water			

Question 6: Does your data support your prediction?

Question 7: Where did the energy come from to heat up the water? If you wanted to quantify that energy, what quantities would you need to measure?

Explanation:

Our primary question in this lab was: "What determines how much energy is transferred in a system?" Using your data, identify the components of the systems in this experiment. Using the interactions you observed, identify the important properties of the components that determine the amount of energy transferred.