Experiment 9
HEAT TRANSFER

EQUIPMENT

Thermistor	*Water*
Hot Plate	*Styrofoam*
Thermo Program	*Aluminum Plate*

CAUTION: Handle hot water and hot equipment with care throughout the experiment.

The purpose of this experiment is to investigate the nature of heating and cooling.

Heat Transfer

Heat transfer between two objects always occurs from the object of higher temperature to the object of lower temperature. The mechanisms for heat transfer are conduction, convection, and radiation. The effectiveness of heat transfer depends on how well the medium between the two objects conducts heat.
In this lab you will be using the computer and some temperature probes called thermistors to observe temperature changes. Cooling curves will be constructed so that you can compare how different conditions affect heat transfer and how temperature and boiling are related. A cooling curve is simply a graph of temperature versus time. The slope (steepness) of the line fitting the data is an indication of how quickly the temperature changes. You will investigate how conduction and convection affect the rate of heat transfer. You will also observe that boiling is a cooling process.

PROCEDURE

A. Water Boiling Demonstration

Boiling is a cooling process characterized by the formation of vapor bubbles within the liquid phase as a substance changes from a liquid to a gas. Your instructor will give a demonstration of the temperature curve as water is heated.

B. Cooling by Natural Convection

1. Open the Thermo program in the Physical Science folder.
2. Your instructor will bring you approximately 100ml of boiling water. Note the time on the wall clock when he removes it from the hot plate. Place the water on the Styrofoam and stir the water with the thermistor. When 30-seconds has elapsed from when the water was removed from the hot plate, press collect in the Thermo program. The computer will take temperature readings for 10-minutes.
3. After the readings are completed change the title of the graph to Temperature vs. Time (Convection) followed by the names of the people at your table.

C. Cooling by Forced Convection

4. Repeat Part B, but now fan the water with a notebook as it cools.
5. Print the graph as before, but instead of "Convection" put "Forced Convection".

D. Cooling by Conduction

6. Acquire boiling water and place it on the Styrofoam and stir as before. When 30-seconds has elapsed move the water to the Aluminum plate and press collect.
7. Print the graph as before, but instead of "Forced Convection" put "Conduction".

TERMS

Heat — Molecular energy that is transferred from one thing to another because of a temperature difference.

Conduction — The transfer of heat energy from an object of higher temperature to one of lower temperature by means of physical contact.

Convection — Heat transfer by the actual motion of a gas or liquid.

Radiation — Electromagnetic waves emitted by all objects at any temperature.

Phase Change — Changing from one form of matter (liquid, solid, or gas), into another.

Experiment 9
DATA SHEET

Name: _____

Section: _____

QUESTIONS

1. In Part A, why did the temperature of the boiling water not rise to the higher temperature of the hot plate?

2. Look at the graphs containing the cooling data. Which method of cooling worked best?

3. Give an everyday example of cooling by conduction, by convection, by forced convection.

4. Why didn't you start collecting data as soon as you put the thermistor in the water?

5. Why did you wait the same amount of time before collecting data when comparing cooling methods?

6. Was the heat loss in part D only by conduction? Explain.