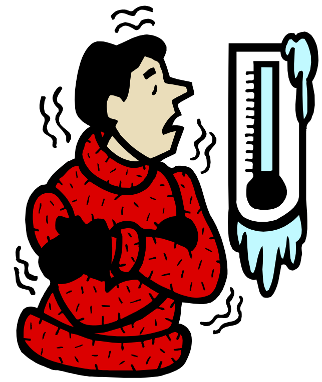
Name: ____ **Date:** ______________________

Heat Transfer: Hot Potato, Cold Foil Activity – As Cold as Ice Worksheet



Introduction

Different materials can hold different amounts of heat. For example, think of a baked potato wrapped in aluminum foil freshly removed from an oven. Initially, both the potato and the foil are at the same temperature, the oven temperature. However, after several minutes exposed to the room temperature air, there is a large temperature discrepancy between the foil and the potato. Although the potato is still very hot, the aluminum foil has already cooled to the ambient air temperature.

Why does this happen? There are many factors that contribute to this interesting phenomenon, but we are interested in the specific heat, or *heat capacity*. Heat capacity is the amount of energy a substance can absorb while increasing in temperature. Objects with a high heat capacity absorb a lot of energy before getting hotter, while things with a low heat capacity only need a little energy to change temperature. Since the aluminum has a lower heat capacity, it contains less energy and thus cools more quickly to room temperature. Our baked potato on the other hand has a higher heat capacity, and has a lot more energy to release before it has cooled down again. Engineers use their understanding of heat capacity to control the temperature of chemicals in a reactor as well as for predicting how quickly parts in an engine or machine will heat up and cool off. They might even use a substance with a low heat capacity to draw heat from one system and release it into the surroundings in order to cool the system. For this activity, you will determine the heat capacity of aluminum as well as copper and a substance of your choosing.

Calculations

In order to determine the heat capacity, we first need to know some important equations. First, the heat (Q) is related to the change in temperature (T) by the heat capacity (C_p) for a given number of moles (n). The equation we get is as follows:

$$Q = nC_P\Delta T$$

In this case, we want to use the heat, moles and temperature change of the water and the blocks to calculate C_p.

Preparation

One of the most important parts of preparation is simply reading the instructions beforehand. Understand what you will be doing so that you can move quickly and make fewer mistakes. Organization is also very important. Design a table to effectively organize your data. Be sure to include spaces in your table for mass, temperature, and type of object.

Before you cool your samples, weigh them and record the masses in your table. Then put them in the freezer. Make sure that the samples have been in the freezer for at least one hour. This way, you can be relatively sure that they have reached the freezer temperature. Additionally, you should write down the freezer temperature beforehand as it will be used as your initial temperature for your samples. For this exercise, we will assume the calorimeter effects are negligible. When you are transferring your sample, do NOT use your hands. Use the tongs provided. The heat from your hands raises the temperature of the sample prematurely, and will skew your calculations.

C_p Determination

1. Fill the calorimeter with 100ml of water.
2. Wait for the water to equilibrate with its surroundings and then record the system temperature.
3. Make sure to record the temperature of the freezer where your teacher is keeping your samples; you will need this value for calculations later.
4. Make sure to take the calorimeter cap off, and then quickly transfer your first sample, using your tongs, from the refrigerator to your calorimeter and quickly seal the system.
5. Watch as the temperature of the water decreases (should be very quickly) and record the lowest temperature the system reaches. This is your final temperature for all components of your system.
6. Record data in your table
7. Repeat this procedure for your other two samples.

Calculations

Use the following equations to determine the specific heat of your samples.

$$Q_{water} + Q_{sample} = 0$$

$$Q = mC_P\Delta T$$

Data Table

Draw your data table below.