Lab: *Hot* bolt into *cold* water: *(different materials conduct heat differently!)*

Heat flow is one of the most critical and interesting phenomena in science. Heat flow drives ocean currents, atmospheric weather patterns, is fundamental to creating and moving energy and electricity and drives so many processes around us. Understanding heat flow is based on several key factors including how materials absorb heat and the conditions under which heat will move from one place to another. In this lab, we attempt to understand heat as a form of energy which can be measured and how an object Temperature will change based on heat flow (note: Heat is NOT Temperature!)..

Big picture: If a hot, metal bolt is placed into cold water.. the bolt will cool down and the water will warm up.. with both stabilizing at the same temperature (they have achieved thermal equilibrium). More importantly, the energy lost by the bolt, will be picked up by the water *which is measurable* because we know the behavior of water (i.e., that water requires 4.2 joules per gram per degree Celsius)

The following procedure should be done at least twice, using two different sized samples of metal.

1. Locate an insulated container for this experiment (i.e., a Styrofoam cup) Fill with a sample of COLD water (from the tap) and determine the mass of the water in the cup. (hint: place the cup on the scale first and 'zero it out').

2. Record the initial temperature of the water.
3. Locate a sample of metal (nuts? Bolts, Weights?) and weigh, to the nearest tenth of a gram.

4. Place the metal samples in the hot water bath (at least 90^{o}C!) and allow warm up (equilibrate to the bath.. 30 seconds is fine)

5. Once the metal piece has warmed up, use tongs to remove from the hot water bath and place quickly into the cold water bath.

6. Let the two materials equilibrate (30 seconds is fine), give it a stir, then record the new temperature of the water. (it should be hotter!) to the nearest 10th of a degree C.

7. Use the specific heat equation below to determine how much heat the water gained in this trial.

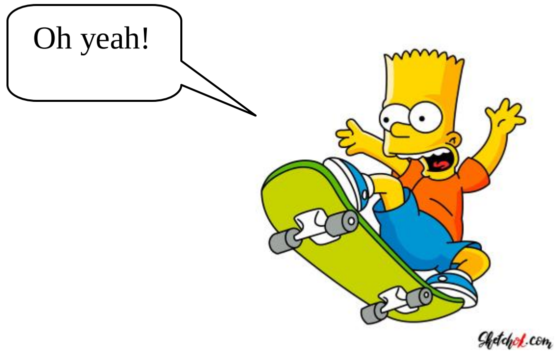
8. Use the specific heat equation to determine the specific heat of the sample of metal.

9. Average the result of the three trials and determine your percent error based on the 'accepted values' of Cp provided by your incredible (and good looking!) instructor

<u>Record data here:</u>

	Trial 1	Trial 2
Mass of cold water		
Starting temp of cold water		
Mass of metal chunk (grams)		
Temp of hot water bath (that the bolt was sitting in (℃)		
Final temperature of water and bolt once they have reached thermal equilibrium		

Math page!



The specific heat equation

$$Q = (m) \times (\Delta T) \times (Cp)$$

<table>
<tr><td>Trial number</td><td>Determine the heat gained Q, by the water here.</td><td>Using the heat gained by water = heat lost by the metal, determine the specific heat capacity <u>Cp</u>, of the metal sample.</td></tr>
<tr><td>1</td><td></td><td></td></tr>
<tr><td>2</td><td></td><td></td></tr>
<tr><td colspan="3">Determine the average Cp for the two metal samples here.
Compare to what your commander in chief suggests is the accepted value for your metal and determine your percent error.</td></tr>
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