

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

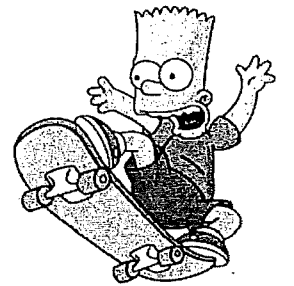
Oceans are absorbing most of Earth's extra heat. This heat is then transferred back to the air and vice versa. Understanding how heat flows between materials is critical to understanding the Earth's heat balance.

**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 three times, using three 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°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 10<sup>th</sup> 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

Oh yeah!



Art by [unclear].cs

Record data here:

	Trial 1	Trial 2	Trial 3
Mass of cold water			
Starting temp of cold water			
Mass of bolt			
Temp of hot water bath (that the bolt was sitting in)			
Final temperature of water and bolt once they have reached thermal equilibrium			

More on the back!

The specific heat equation

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

Trial number	Determine the heat gained Q, by the water here.	Using the heat gained by water = heat lost by the metal, determine the specific heat capacity $C_p$ , of the metal sample.
1		
2		
3		
Determine the average $C_p$ for the three metal samples here. Compare to what your commander in chief suggests is the accepted value for your metal and determine your percent error.		

Deliverable to Clark.

Students, working in groups of no more than three (3), will write up a short (2-4 page) report describing the following (not necessarily in this order).

1. How heat is measured and the overall concept of Specific Heat Capacity
2. How the worlds oceans are absorbing most of the excess heat and, on a related note, why living close to the ocean (and bay( as we do, allows us to have generally warmer winters and cooler summers than the rest of the state.
3. How we constructed the experiment to determine what the specific heat capacity of the metal samples must be (including data and math to determine)

Due date for report: Thurs/Fri October 6/7.