Energy

Reading:	Ch 10 sections 1 - 5	Homework:	10.1, questions 4, 6 10.2, question 10* 10.5 question 22, 24, 28, 32*

* = 'important' homework question

Temperature and Energy

Discussion: What is heat, what is energy? How are these things related to temperature?

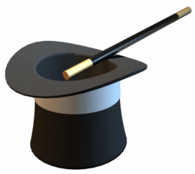
Recall: *Energy Content of Foods* Lab. The heat energy (-q) lost by food (when burnt) = heat energy (+q) gained by water in the soda can.

i.e. $$-q_{\text{(food)}} = +q_{\text{(water)}}$$

Notes: The sign (+ or -) indicates where the energy was lost (-) and where it was gained (+), in other words when it went 'from' (-) and 'to'(+). **The numerical value of q is the *same*, regardless of +/- signs, as the energy is *transferred* from the food to the water.**

Remember: q is measured in ________ , the S.I. unit of energy.

Task: What is an average person's daily Calorie requirement? A 'Big Mac' and large fries contains ~ 1100 calories - How many Big Mac extra value meals is can a person eat per day *and* stay within their recommended calorie limit (assume a diet coke!)? How many kJ is this equivalent to?



To Convert J to Calories (the 'Jenny Craig unit of energy'), the following conversion identity must be used:

$$1 \text{ Cal} = 4.184 \text{ kJ}$$

Specific Heat Capacity (C_p)

Definition: *The amount of heat energy required to raise the temperature of one gram of a substance by one degree Celsius*

In ‘English’:

Table of Specific heat Capacities

Substance	Sp. Ht. Cap. ($J/g^{o}C$)	Substance	Sp. Ht. Cap. ($J/g^{o}C$)
Water (l)	4.18	Mercury (l)	0.14
Water (s)	2.03	Carbon (s)	0.71
Aluminum	0.89	Silver (s)	0.24
Iron (s)	0.45	Gold (s)	0.13

Discussion: Would a material with a high or low heat capacity be best suited for use as radiator coolant? What other factors influence such a choice?

Relating Energy (q), heat capacity (C_p) and temperature change (ΔT)

Recall: **Temperature is an *intensive* property** – it DOES NOT depend on the amount of material (a glass of water and a swimming pool full of water can have the same temperature).

Energy is an *extensive* property – it DOES depend on the amount of material (a glass of water and a swimming pool full of water contain very different amounts of energy at, say, room temperature).

Discussion: What properties of a material determine how much energy it can absorb before undergoes a change of state (e.g. factors influencing how *fast* a liquid boils)? Are these extensive or intensive properties?

	Property	Effect and Reasoning	Intensive or Extensive?	Symbol
1				
2				
3				

The amount of heat energy transferred to or from any material or object can be found if its HEAT CAPACITY (C_p), MASS (g) and observed TEMPERATURE CHANGE, ΔT (^{o}C or K), it undergoes are known:

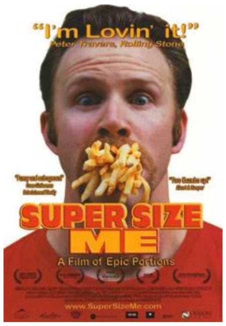
$$q = C_p \times m \times \Delta T$$

<u>Questions</u>:

1. How much heat energy is needed to raise the temperature of 25 g water by $15^{o}C$?

2. How much heat energy is needed to raise the temperature of 25 g solid iron by $15^{o}C$?

3. How much heat energy would be needed to boil a 330 mL glass of water that is initially at room temperature (25 ^{o}C)? How many Cal. Is this? Density H_2O (l) = 1.00 g/mL



<u>Questions of the week</u>: A certain Prof. was told that to lose weight he must consume no more than 1300 Cal per day and exercise for at least 60 minutes per week.

1. If the Prof. eats nothing but Big Mac value meals, how many can he eat per week and remain within his Cal per day limit?

2. The Prof's exercises for 90 minutes per week on his favorite exercise machine, which burns off 725 Cal/hr. In terms of energy, how many Big Mac value meals is this amount of weekly exercise equivalent to?