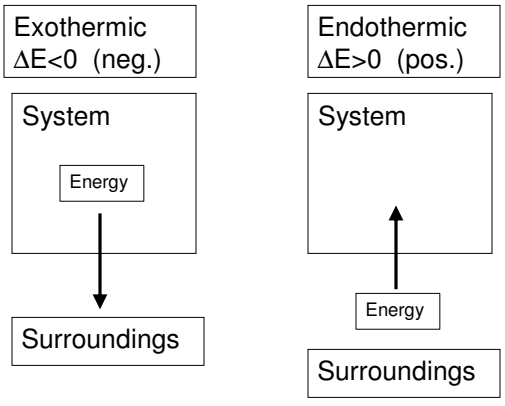
Thermodynamics

Units

- 1 calorie: energy required to heat one gram of water by one Celsius degree
- 1 Calorie = 1 kilocalorie (note the capital C, this is used mostly on food labels)
- 1 Joule = 0.2390 calories or 1 calorie = 4.184 Joules
- 1 kilocalorie = 4.184 kilojoules

Thermo Cont.

System Vs. Surroundings



Thermo Cont.

Transferring Energy: Work and Heat

- Work is the energy used to move an object against a force. $w = F \times d$ (d = distance)
- Heat is the energy transferred from a hotter object to a colder one.

Specific Heat

There is a difference between heat and temperature:

- Heat: is the flow of energy due to a temperature difference (measure of energy transferred from an object of high energy to an object of lower energy)
- Temperature: is a measure of the random motions of the components of a substance (average KE)

Specific Heat Cont.

Duluth, next to Lake Superior, stays cool in the summer and actually relatively warm in the winter. Why is this?

- Lake Superior, a depression in the land containing an immense amount of H2O lies just to the east and north of Duluth.
- H_2O is a substance that requires a large amount of energy to change its temperature.
- Thus, the lake stays cold in the summer and relatively warm in the winter

Specific Heat Cont.

- We call this property of resistance or willingness to change temperature *specific heat capacity*, with the symbol c_p (the p means "under constant pressure")
- More technically, specific heat capacity is the amount of energy required to change the temperature of one gram of a substance by one degree C.
- Water has a specific heat capacity of 4.184 J/g°C compared to iron with a specific heat capacity of 0.45 J/g°C. These are obtained only by experiment.
- The formula for change in heat/energy (ΔH, or sometimes Q) is as follows:
- $\Delta H = c_p$ (J/g°C) x m (g) x ΔT (°C)

Heats of Reaction

- There are different types of changes in heat (some listed below):
  - ΔH_{rxn} = heat of reaction (heat absorbed or released during a reaction
  - ΔH_f^0 = heat of formation (heat absorbed or released during synthesis of one mole at 298K and 1 atm of pressure)
  - ΔH_{sol} = heat of solution (heat absorbed or released when a substance dissolves)
  - ΔH_{comb} = heat of combustion (heat absorbed or released when a substance combusts)
  - ΔH_{vap} = heat of vaporization (energy needed to boil one mole
  - ΔH_{fus} = heat of fusion (energy needed to melt one mole)