Basic Thermodynamics

system - a reaction or process being studied

surroundings - everything outside of the system

energy - capacity of a system to do work or supply heat
(newton (N) = $kg \bullet m \bullet s^{-2}$; joule (J) = $kg \bullet m^2 \bullet s^{-2}$)

heat (**q**) - energy transferred as a result of a temperature difference between system and surroundings

work (**w**) - the energy expended during the act of moving an object against an opposing force; force times distance or external pressure times volume ($-P\Delta V$); 1 $L \bullet atm$ = 101.325 J; 1 m^3 = 1000 L; 1 pascal = $kg \bullet m^{-1} \bullet s^{-2}$; 1 atm = 101,325 Pa

internal energy (**E**) - total energy of a system, $\Delta E = q + w$; if volume stays constant then $\Delta E = q$

enthalpy (**H**) - sum of the internal energy and the product of PV for a system, $H = E + PV$; if pressure stays constant then $\Delta H = q$

entropy (**S**) - measure of the randomness of a system; the heat reversibly added to a system or surroundings divided by its temperature

Gibbs free energy (**G**) - energy of a system that is free to do useful work at constant temperature and pressure; $\Delta G = \Delta H - T\Delta S$

state of a system - pressure, volume, temperature and moles of substances of the system

state function - function that only depends on the state of the system

standard state - pure element or substance at one atmosphere pressure and at some temperature (usually 25.00 °C = 298.15 K)

<u>Δ or Changes</u>:

increase E or H » T rises
increase w » increase ΔV
increase S » melt solid, vaporize liquid, make a solution, reaction where number of moles of gas increases, add heat, increase volume

For what?

all engines and motors operate on energy transfer (mechanical engineers)
nature depends on transfer of energy from the Sun (meteorology, geology, biochemistry)
chemical synthesis, manufacturing

"A theory is the more impressive the greater the simplicity of its premises is, the more different kinds of things it relates, and the more extended is its area of applicability. Therefore, the deep impression that classical thermodynamics made upon me. It is the only theory of universal content concerning which I am convinced that, within the framework of the applicability of its basic concepts, it will never be overthrown." Albert Einstein