Free Energy

Enthalpy and Entropy

1)Reactions tend to proceed in the direction that lowers the energy of the system (H, enthalpy).

and,

2)Reactions tend to proceed in the direction that increases the disorder of the system (S, entropy).

Enthalpy and Entropy are the two "drivers" to every equation.

- If they both AGREE the reaction should be spontaneous, IT WILL be spontaneous at all temperatures, and you will not be able to stop the reaction without separating the reactants
- If they both AGREE that the reaction should NOT be spontaneous, it will NOT work at ANY temperature, no matter how much you heat it, add pressure, or anything else!

Enthalpy and Entropy

- The size and direction of enthalpy and entropy changes <u>together</u> determine whether a reaction is spontaneous
- If the two drivers disagree on whether or not it should be spontaneous, a third party (Gibb's free energy) is called in to act as the "judge" about what temperatures it will be spontaneous, and what the temp is to be nonspontaneous
  - But, it WILL work and be spontaneous at some temperature!

Spontaneity of Reactions

Reactions proceed spontaneously in the direction that lowers their Gibb's free energy, G.

$\Delta G = \Delta H - T\Delta S$ (T is kelvin temp.)

If ΔG is negative, the reaction is spontaneous. (system loses free energy)

If ΔG is positive, the reaction is NOT spontaneous. **(requires work be expended)**