Unit 13: Chemical Thermodynamics

adapted from http://www.phschool.com/advanced/lesson_plans/chem_brown_2003/index.html

Objectives:

- Define entropy in terms of randomness or disorder, and state the second law of thermodynamics.
- Predict the sign of the entropy of a given process, and state the third law of thermodynamics.
- Describe the effect of temperature and state changes on entropy. Calculate $\Delta S°$ for a reaction using a table of absolute entropies, $S°$.
- Define free energy in terms of enthalpy and entropy and explain the relationship of the sign of ΔG, and the spontaneity of a reaction.
- Calculate $\Delta G°$ for a reaction using a table of $\Delta G_f°$ for the reactants and products.
- Describe the conditions of "standard" state for standard free energy.
- Interconvert $\Delta G°$ and K for a reaction.
- Describe the relationship between ΔG and work.
- Calculate the free energy change for a reaction at nonstandard conditions, ΔG, knowing $\Delta G°$, T, and the data needed to calculate Q.
- Predict how ΔG changes with T, given the signs of ΔH, and ΔS.
- Estimate $\Delta G°$ at any given temperature, given $\Delta H°$ and $\Delta S°$.

Key Words:

spontaneous
reversible process
entropy
2nd law of thermodynamics
3rd law of thermodynamics
standard molar entropy
Gibb's free energy
standard free energy of formation

Tips:

- $\Delta G_f°$ like ΔH_f is relative to formation from elements, giving elements a zero value. $S°$ is absolute entropy. A perfect crystal at absolute zero would have no entropy, thus have a zero value.
- The values given in the table of thermodynamic quantities are at 25°C (298.15 K). These values vary slightly with temperature.