**Equilibrium: The VERY Short Story**

*Covered in Chapter 15 of Brown et al.*

**Equilibrium**: The state that occurs when reactions are occurring in both forward & reverse directions at equal rates.

* Once a system or chemical reaction reaches equilibrium, the concentrations of reactants & products become constant.
* Although no change is occurring it is!
  + Forward & backward reactions both occur, but at identical rates.
* All biological systems strive to maintain equilibrium, aka “homeostatsis”.

**Equilibrium constant expression, Kc (or Keq)**

For the reaction: aA + bB cC + dD

Kc = [C]c[D]d

[A]a[B]b

* Kc is derived from reaction stoichiometry.
* Kc is a constant that is characteristic of each chemical reaction.
* Kc tells us whether reactants or products “predominate”.
  + Kc = 1 Concentrations of reactants = concentration of projects
  + Kc > 1 Products predominate
  + Kc < 1 Reactants predominate
* Once Kc has been calculated for a forward reaction, the Kc for the reverse reaction is its inverse:
  + Kc reverse = 1/Kc forward

**Le Châtelier’s Principle:** If a system at equilibrium is disturbed by a change in temperature, pressure or concentration, the system will shift to a new equilibrium position to counteract the disturbance. A new equilibrium state will be reached.

* **Amounts** of reactants or products?

Disturbance Change in equilibrium

* Adding reactant Shift right toward products
* Removing reactant Shifts left toward reactants
* Adding product Shifts left toward reactants
* Removing product Shifts right toward products
* **Temperature?** Whether changes in temperature shift equilibrium right or left depends on whether the reaction is endo- or exothermic.

Temperature change? Change in equilibrium

* Increase temp Shifts ***endo*** reactions right, toward products  
   Shifts ***exo*** reactions left, toward reactants
* Decrease temp Shifts ***endo*** reactions left, towards reactants  
   Shifts ***exo*** products right, towards products
* **Pressure & volume?** Equilibrium shift to try and keep pressure and volume constant. Direction of shift depends on stoichiometry; for gases, pressure depends on the number of molecules in a given volume.

Change in volume? Change in equilibrium

* Volume decreased Reaction shifts toward the side with fewer molecules
* Volume increased Reaction shifts toward the side with more molecules
* **Do catalysts affect equilibrium?** NO!!!