Highlights Enzymes II

1. A "substrate" is a molecule bound by an enzyme which it catalyzes a reaction upon. Substrates bind specific binding sites on enzymes that resemble their structure. An "active site" of an enzyme is a site on an enzyme where the reaction it catalyzes occurs.

2. There are two models for enzyme action relevant for our consideration. The "lock and key" model proposes that enzymes act like a "lock" that only certain keys (substrates) fit. This model works well for describing the binding of substrates, but is not helpful (or accurate) for describing the mechanism of catalysis.

3. The "induced fit" model of enzyme action proposes that enzymes change in response to binding of substrate and that change is at least partly responsible for the catalysis that occurs on the substrate. Thus, the induced fit model says that enzymes change substrates (by catalysis) and that substrates change enzymes (enabling catalysis).

4. It is important to note that after catalysis occurs, the product is released and the enzyme is returned to its original state.

5. As one increases the amount of substrate for an enzymatic reaction, the velocity of the reaction (concentratioin of product made per time) increases. If one uses more enzyme, one produces a faster velocity.

6. An enzymatic reaction's maximum velocity (Vmax) is the limit (maximum) of a plot of the velocity versus the substrate concentration. Enzymatic reactions reach maximum velocity when the enzyme is saturated with substrate. Plots of enzyme velocities versus substrate concentration are called hyperbolic.

7. Some enzymes have their ability to catalyze a reaction affected by the presence of another molecule. If that molecule is the substrate, one obtains a sigmoidal plot like that of hemoglobin binding to oxygen. This type of plot is is evidence that the enzyme's activity is affected by the substrate. When the activity of an enzyme is affected by binding a small molecule, the enzyme is described as allosteric. Allosterism specifically means that binding of a small molecule to an enzyme affects the enzyme's activity.

8. A very important number that does NOT vary according to the quantity of enzyme used (that is to say that it is a constant for a given enzyme) is the Km (the Michaelis constant). Km turns out to be the concentration of substrate required to get an enzymatic reaction to half maximum velocity (slide 12). Km is a constant for any given enzyme and provides a measure of an enzyme's "affinity" for its substrate. An enzyme with a high Km has a low affinity for its substrate. An enzyme with a low Km has a high affinity for its substrate. Note that Km is NOT Vmax/2. Instead, it is the substrate concentration required to get a reaction to Vmax/2.

9. Another important parameter of enzymes is called Kcat (also called turnover number). Kcat is equal to Vmax/[Enzyme]. Because the concentration of enzyme is taken into account in this equation, Kcat does NOT vary with the amount of enzyme used and is therefore a constant for an enzyme. Kcat is equal to the number of molecules of product made per enzyme per unit time. A Kcat of 5/second means that that enzyme makes five molecules of product per molecule of enzyme per second.

10. Determining Vmax from a plot of V versus S is not easy. Consequently, an alteration of this plot is done to make the calculation simpler. The most common alteration is known as a Lineweaver-Burk (double-reciprocal) plot. In it, a double reciprocal plot is performed - 1/V versus 1/S. When this is plotted for an enzymatic reaction, a line is produced, with the x-intercept (place where the line intersects the x-axis)

equaling -1/Km and the y-intercept (place where the line intersects the y-axis) equaling 1/Vmax.