

CHAPTER 8 BERG/STRYER 8e STUDY GUIDE

1. Homework: 1-4, 29, 35, 37, 38. Understand the general statements about enzymes on 215- 225: they are very **specific**; they can be **regulated** several ways (feedback/allosteric inhibition, regulatory proteins, covalent modification, and zymogen cleavage, as examples); they can **transform energy**; they **can't** move the **equilibrium point**; they stabilize the **transition state**; they have an **active site cleft**, and they often **change shape** in response to the "correct" substrate (Koshland's Induced Fit, Fig. 8.9). Note – 6 Enzyme classes "OTHLIL" Table 8.8 p. 245.

2. An important point in the chapter is the discussion of **Gibbs' Free Energy**, or ΔG . At equilibrium, the **enthalpy** change for a reaction will equal the **entropy** change times the absolute temperature, that is: $\Delta H = T\Delta S$. For reactions **not** at equilibrium, these two quantities differ, and the difference shows the available reaction energy, thus: $\Delta G = \Delta H - T\Delta S$. Defined this way – reactions at equilibrium have $\Delta G = 0$. Reactions which will move forward spontaneously have $\Delta G < 0$, i.e. negative. Reactions which will back up have $\Delta G > 0$. When standard conditions are applied, that is, all concentrations are set to [1 M], then the value of the free energy change will be ΔG° , the **Standard Free Energy Change**. Know the 5 statements listed on p. 218, and Equations (1) and (5) on 219. Be sure you understand Table 8.3. A difference in ΔG° of roughly 1.4 kcal/mol corresponds to a tenfold difference in the equilibrium constant. Thus, linking ATP hydrolysis to some reaction, which brings in -7.3 kcal/mol, ought to make something like a million-fold difference in the combined K_{eq} .

3. The single most important concept in this chapter is the **Michaelis Menten Equation**, p. 228 (eq. 26). You should memorize the equation in this form and be able to use it. You should also *understand* the derivation on 226-8. **Rate constants** (lowercase **k**) only "look" at a reaction in a single direction, whereas equilibrium constants (capital **K**) "look" at both directions. Rate constants fall out simply from the *Principle of Mass Action*. You should be able to figure out the dimensions (units) of the various rate constants in the M-M derivation. You should also know the underlying assumptions – mainly, "**Initial Rate**" (i.e. $[P] = \sim 0$) and "**Steady State**" ($[ES]$ is constant, so $V_{\text{fwd}} = V_{\text{back}}$). You should also understand that the Michaelis Menten Equation assumes a single active site and a single substrate, so that many enzymes fit *other* kinetic patterns. The Michaelis-Menten equation graphs as a *rectangular hyperbola* (like Myoglobin's oxygen binding curve). **Allosteric** enzymes, usually with multiple interacting active sites, graph as *sigmoidal* plots (Fig 8.13 p. 233, see also Ch. 10 Fig 10.14). Understand the **double reciprocal plot** shown in Fig. 8.12 (p. 229) but don't use equation (eq. 27) please.

4. Understand the significance of **K_M** , **V_{max}** and turnover number **k_2** (p. 229 ff). Notice that the K_M varies in Table 8.4 from 0.4 to 8000 μM . A "typical" K_M might be about 1 mM or 1000 μM . Discussing a "typical" V_{max} is rather meaningless since $V_{\text{max}} = k_2 [E_t]$, and the enzyme concentration can be nearly anything. Instead, the "**turnover number**" or **k_2** is often discussed – in Table 8.5, it varies from 0.5 to 600,000 per second. Once again, a "typical" number might be about 300/sec. A high turnover number means a "fast" enzyme. A low K_M means an enzyme binds tightly and specifically to its substrate. The term " **k_{cat}** " (same as k_2 , turnover number) is defined on 230, and mainly is used to discuss the maximum rates of more complicated, non-M- M enzymes. Be able to distinguish between **competitive**, **uncompetitive**, and **non-competitive** inhibition (p. 234 ff).

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