

Graduate Biochemistry 7.51: The Major Concepts

As you will see from the syllabus, the lectures in this course are drawn from a wide range of topics in biochemistry. However, nearly all of the science we discuss is based on a discrete number of fundamental concepts that are common to most biochemical approaches. A major goal of this course is to help you to master those concepts, and enable you to use them to approach both classical and novel biological problems. Below, we have listed the recurring elements we consider to be most important.

- 1) Analyzing reactions:
 - a) The properties of reactions
 - i) Thermodynamics: the relationships among free energy and equilibrium constant, entropy and enthalpy
 - ii) The driving force for unimolecular interactions
 - iii) The order of a reaction, and the relationship between the written statement of a reaction and its order
 - iv) Rate *versus* rate constant
 - b) Tests of reaction mechanism
 - i) Structural *versus* kinetic approaches
 - ii) Analyzing intermediates: populated *versus* unpopulated, kinetic significance
 - iii) The kinetics of catalyzed *versus* uncatalyzed reactions
 - c) Enzymatic *versus* non-enzymatic catalysis
 - i) Kinetic analysis: partition experiments, the rate-determining step
 - ii) Chemistry: reactive amino acid residues in active sites
 - iii) Relationships among binding, specificity and rate of enzyme-catalyzed reactions

- 2) Detecting and exploiting physical interactions
 - a) Interaction forces between molecules
 - b) Canonical structures in proteins
 - c) Assays of physical properties
 - i) Binding equilibria and concentration
 - ii) Turnover
 - iii) Molecular weight of native and denatured proteins
 - iv) Fluorescence and FRET.

3) **Biological implications**

- a) **Allosteric interactions**
- b) **Specific *versus* non-specific binding and distinguishing functional binding interactions**
- c) **High energy compounds: synthesis and hydrolysis**
- d) **Catalysis of vectorial reactions: motor functions, protein folding, pumps.**