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.