BCH 4053—Summer 2001—Chapter 1 Lecture Notes

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Syllabus Information

- Course Description
- Prerequisites
- Grading
  - Three hour tests
  - Final exam
  - Optional web tests
  - Group problems
- Email communication
- Class Web Page
- Study Suggestions

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Review

- Organic Functional Groups
- General Chemistry Concepts and Calculations
  - Stoichiometry
  - Acid-Base, pH
  - Thermodynamics; Free Energy and Entropy
- Biology
  - Cell Structure

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Biochemistry

- Explain Life with chemical and physical principles
  - composition
  - reactions
  - interactions and regulation
  - energy flow
  - information flow
  - NO VITAL FORCE
  - Unity principle

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Biochemistry

- 20TH Century Science
  - 1894 Emil Fisher—Enzymes
  - 1897 Buchner Brothers—Zymase
  - 1926 Sumner crystallization of urease identifying enzymes as proteins
  - First half of century-structure and reactions
    - isolation and structure of cellular constituents
    - vitamins
    - major metabolic pathways

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Biochemistry, con't.

- Middle of century merging with genetics
  - Garrod—alkaptonuria—inherited diseases
  - Beadle and Tatum—mutations = loss of enzyme
  - Ingram 1956 showed sickle cell Hemoglobin was different by only 1 AA
  - Identification of DNA as genetic material (Watson and Crick)

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Biochemistry,con't

- Latter part of century—technology developments
  - Development of x-ray crystallography, and structure determination of macromolecules
  - Sequencing proteins and nucleic acids
  - Recombinant DNA technology

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Chapter One Topics to Review

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Properties of Living Systems

- complicated and highly organized
- functional role of biological structures
- energy flow through living systems
  - order at the expense of energy—steady state
- self replication through structural complementarity

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Biomolecules

- Elemental composition
- Versatility of Carbon
- Biomolecular Heirarchy
  - monomer→polymer→supramolecular structure
  - directional sense of building blocks
- Molecular and Cellular Dimensions
  - Table 1.2
  - Figure 1.8
- Membranes

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Weak Chemical Forces
non covalent bonds

- Van der Waals forces (0.4-4 kJ/mol)
  - dipole-dipole ($1/r^3$ dependance of energy)
  - dipole-induced dipole ($1/r^5$ dependance of energy)
  - induced dipole-induced dipole (dispersion) ($1/r^6$ dependance of energy)
  - repulsive forces at close distance ($1/r^{12}$ dependance of energy) (see Figure 1.13)

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Weak Chemical Forces
non covalent bonds con't.

- Hydrogen bonds (12-30 kJ/mol)
  - Between F, O, and N (see Figure 1.14)
- Ionic (coulombic) interaction (20 kJ/mol)
  - $F = q_1q_2/Dr^2$, where D is dielectric constant
  - Energy falls off as 1/r
- Hydrophobic interactions (<40 kJ/mol)

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Biomolecular Interactions and Recognition

- Sum of many weak interactions
- Complementarity of interacting structures
- Narrow range of environmental conditions

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Metabolism

- Totality of chemical reactions occurring in the cell
- Reactions catalyzed by enzymes
  - Recent exception—RNA catalyzed reactions

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Organization and Structure of Cells

- Prokaryotic cell (eubacteria, archaebacteria) (Fig. 1.21)
- Eukaryotic cells
  - Animal cell (Fig. 1.22)
  - Plant cell (Fig. 1.23)
- Viruses (Fig. 1.25)