

## CHAPTER 2

### THE CHEMICAL BASIS OF LIFE

**CHAPTER OVERVIEW:** This chapter briefly reviews all of the fundamental chemistry knowledge required to understand the physiological mechanisms and cellular structures presented later in the text. Chemical symbols, atomic structures, types of bonds, nature of solutions, and types of chemical reactions are discussed. The relation of energy to chemical processes is touched on. The four major classes of macromolecules are introduced. The structure, properties, and biological importance of each of these molecules is discussed

**OUTLINE** (one or two fifty-minute lectures)  
Seeley, A&P, 5/e

<b>Chapt.</b>	<b>Topic Outline, Chapter 2 Object.</b>	<b>Figures &amp; Tables</b>	<b>Transparency Acetates</b>
1	I. Basic Chemistry, p. 24		
	A. Matter and Elements		
	1. Mass v. Weight	Predict Quest. 1	
	2. Common Elements	Table 2.1, p.25	
1	B. Atoms		
2	1. Atomic Structure	Fig. 2.1, p.26	TA-16
	a. Nucleus		
	1). Protons		
	2). Neutrons		
	b. Electrons		
	1). Orbitals		
	2). Electron Shells		
	2. Atomic Number and Mass Number	Fig. 2.2, p.27	TA-17
		Table 2.1, p. 26	
		Predict Quest. 2	
		Predict Quest. 3	
3	3. Isotopes and Atomic Mass	Fig. 2.3, p. 27	TA-18
	4. The Mole and Molar Mass		
	C. Electrons and Chemical Bonding, p. 26		
	1. Chemical Bonds and Molecules		
4	2. Ionic Bonds	Fig. 2.4, p. 27	TA-19
	a. Ions	Table 2.2, p. 28	

Chapt. Object.	Topic Outline, Chapter 2	Figures & Tables	Transparency Acetates
	b. Electrolytes		
4	3. Covalent Bonds	Fig. 2.5, p. 28	TA-20
	a. Single v. Double Bonds		
	b. Polar v. Non-polar Bonds	Fig. 2.6, p. 29	TA-21
	4. Metallic Bonding		
5	D. Molecules and Compounds		
	1. Molecules and molecular formula	Table 2.3	
	2. Compound		
	3. Formula Unit		
	4. Molecular Mass		
	E. Intermolecular Forces		
	1. Hydrogen Bonds	Fig. 2.7, p. 30	TA-22
		Table 2.4	
5	2. Solubility and Dissociation	Fig. 2.8, p. 32	TA-23
5	3. Electrolytes, nonelectrolytes		
	II. Chemical Reactions, p. 31	Fig. 2.9, p.34	TA-24
	A. Metabolism		
6	1. Synthesis Reactions & Anabolism	Fig. 2.10a, p. 34	TA25
6	2. Decomposition Reactions & Catabolism	Fig. 2.10b, p. 34	TA-25
	B. Exchange Reactions		
	1. Dehydration Reaction	Fig. 2.10a, p. 34	TA-25
	2. Hydrolysis Reaction	Fig. 2.10b, p. 34	TA-25
	3. Oxidation-Reduction Reaction	Predict Quest. 5	
	C. Reversible Reactions		
	1. Chemical Equilibrium - General		
	2. Carbonic Anhydrase System	Predict Quest. 6	
7	D. Rate of Chemical Reactions		
	1. Reactants and Reactivity		
	2. Concentrations		
	3. Temperature		

**Chapt. Topic Outline, Chapter 2**  
**Object.**

**Figures & Tables Transparency**  
**Acetates**

	4. Enzymes as Catalysts		
8	III. Energy, p. 35		
	A. Kinetic v. Potential Energy		
	B. Forms of Energy		
	1. Electrical Energy		
	2. Electromagnetic Energy		
	3. Chemical Energy		
	a. Chemical Bonds as Potential Energy		
9	b. Metabolism	Fig. 2.11, p. 37	TA-26
9	c. Photosynthesis		
	4. Mechanical Energy		
	5. Heat Energy	Predict Quest. 7	
	IV. Inorganic Chemistry, p. 37		
10	A. Water	Fig. 2.6, 2.7, p. 29, 30	TA-21,22
	1. Structural Body Constituent		
	2. Functional Roles		
	a. Stabilizing Temperature		
	b. Protection - Lubricant		
	c. Reactant in Chemical Reactions	Fig. 2.10, p. 34	TA-25
	d. Mixing Medium		
	1). Solutions		
	2). Suspensions		
	3). Colloids		
11	B. Solute Concentration		
	1. Solvents and Solutes - Define		
	2. Standard Units of Concentration		
	a. % by Weight (Mass)		
	b. Osmolality (Milliosmoles)		
12	C. Acids and Bases		
	1. General Definitions		

Chapt. Object.	Topic Outline, Chapter 2	Figures & Tables	Transparency Acetates
13	2. The pH Scale	Fig. 2.12, p. 39 Clinical Note, p.39	
	a. Neutral = pH of 7.0		
	b. Acidic = pH < 7.0		
	c. Basic (Alkaline) = pH > 7.0		
13	3. Salts		
	4. Buffers	Predict Quest. 8	
14	D. Oxygen		
14	E. Carbon Dioxide		
	V. Organic Chemistry, p. 40		
15	A. Carbohydrates		
	1. Monosaccharides and Disaccharides - The Sugars	Fig. 2.13, p. 41 Fig. 2.14a, p. 42	TA-27 TA-28
	2. Polysaccharides - Starch & Glycogen	Fig. 2.14b, p. 42 Table 2.5, p. 43	TA-28
16	B. Lipids or Fats		
	1. Triacylglycerols	Fig. 2.15, p. 43	TA-29
	a. Saturated Fatty Acids	Fig. 2.16a, p. 44 Fig. 2.16b, p. 44	TA-30 TA-30
	b. Unsaturated Fatty Acids		
	3. Phospholipids	Fig. 2.17, p. 44	TA-31
	4. Fatty Acid Derivatives - Prostaglandins, Thromboxanes & Leukotrienes		
	5. Cholesterol Derivatives - The Steroids	Fig. 2.18, p. 45	TA-32
	6. Fat-soluble Vitamins	Table 2.6, p. 45	
	C. Proteins		
17	1. Protein Structure		
	a. Primary Structure	Fig. 2.21a, p. 47	TA-35
	1). Amino Acids	Fig. 2.19, p. 46	TA-33
	2). Peptide Bonds	Fig. 2.20, p. 46	TA-34
	b. Secondary Structure	Fig. 2.21b p. 47	TA-35
	c. Tertiary Structure	Fig. 2.21c, p.47	TA-21

**Chapt. Topic Outline, Chapter 2**  
**Object.**

**Figures & Tables**   **Transparency**  
**Acetates**

	d. Quaternary Structure	Fig. 2.21d, p.47	TA-21
	2. Relation of Structure to Function & Denaturation of Proteins		
17	3. Enzymes		
	a. Activation Energy	Fig. 2.22, p. 48	TA-36
	b. Specificity of Active Sites		
	1). Lock & Key Model	Fig. 2.23, p. 49	TA-37
		Predict Quest. 9	
	2). Induced Fit Model		
	c. Cofactors and Coenzymes	Table 2.7, p. 49	
	D. Nucleic Acids		
	1. Nucleotides	Fig. 2.24, p. 50	TA-38
	a. Phosphate Group		
	b. Monosaccharide Group		
	1). Deoxyribose	Fig. 2.24, p. 50	TA-38
	2). Ribose	Fig. 2.24, p. 50	TA-38
	c. Nitrogenous Base	Fig. 2.25, p. 50	TA-39
	1). Purines		
	a). Adenine		
	b). Guanine		
	2). Pyrimidines		
	a). Thymine (pairs w/ adenine in DNA only)		
	b). Uracil (pairs w/ adenine in RNA only)		
	c). Cytosine (in both)		
18	2. Deoxyribonucleic Acid (DNA)	Fig. 2.26, p. 51	TA-40
	a. Double Helix		
	b. Histones and Chromatin		
	c. Chromosomes		
	3. Modified Nucleotides		
19	a. Adenosine Triphosphate (ATP) as important energy intermediate	Fig. 2.27, p. 52	TA-41

**Chapt. Topic Outline, Chapter 2**  
**Object.**

**Figures & Tables Transparency**  
**Acetates**

b. Cyclic Monophosphates  
(cAMP, cGMP) as important  
intracellular messengers

**IMPORTANT CONSIDERATIONS:** If material is to be covered in only one lecture, one has to be highly selective in choosing what to include. The concept of energy and the relation between chemical bonds and potential energy may be more important for those students poorly trained in chemistry than the actual structure of the macromolecules.

If one can take two lecture periods to cover the material, a nice conceptual break occurs between the general chemistry and the organic/biologically important molecules and their functions in living things. As always it is the interrelation of structure and function, which should be stressed.

**SEE INSTRUCTOR'S MANUAL AND COURSE SOLUTIONS MANUAL FOR ADDITIONAL RESOURCES.**