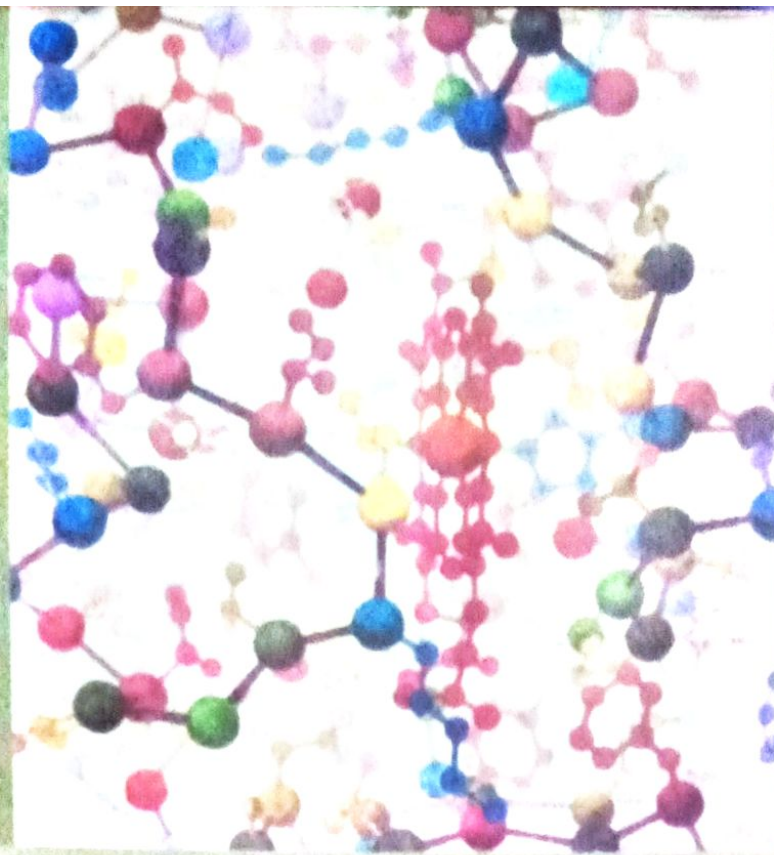
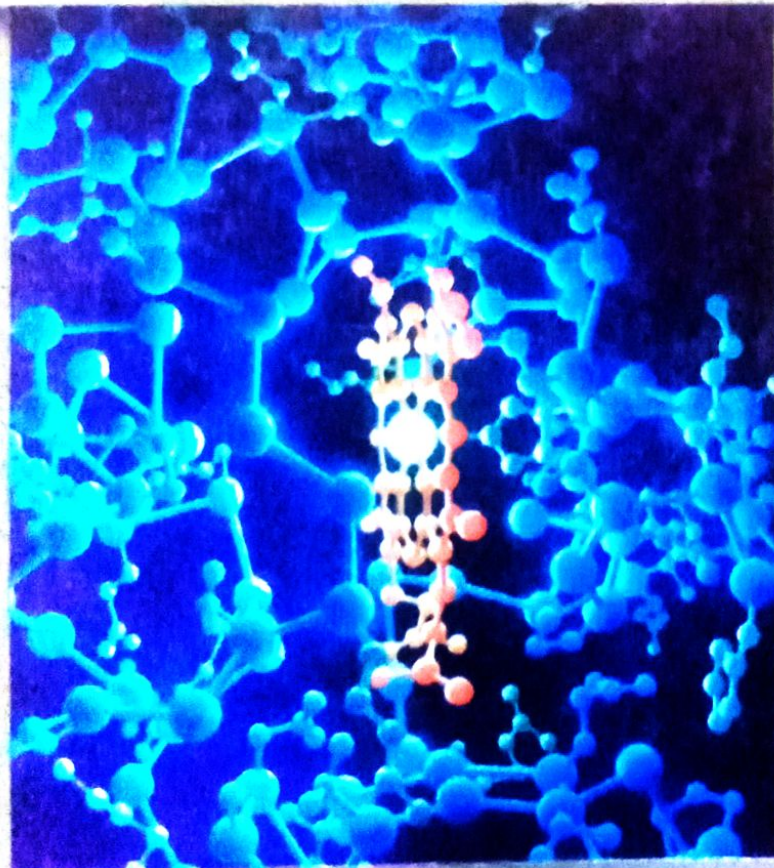




Seventh Edition, by David Voet and Judith G. Voet

Biochemistry



CONTENTS

Guide to Media Resources xvi

PART I

INTRODUCTION AND BACKGROUND 1

CHAPTER 1 Life 3

1. Prokaryotes 3
2. Eukaryotes 6
3. Biochemistry: A Prologue 14
4. Genetics: A Review 19
5. The Origin of Life 28
6. The Biochemical Literature 34

CHAPTER 2 Aqueous Solutions 40

1. Properties of Water 40
2. Acids, Bases, and Buffers 45

CHAPTER 3 Thermodynamic Principles: A Review 52

1. First Law of Thermodynamics: Energy Is Conserved 52
 2. Second Law of Thermodynamics: The Universe Tends Toward Maximum Disorder 54
 3. Free Energy: The Indicator of Spontaneity 57
 4. Chemical Equilibria 58
- APPENDIX: Concentration Dependence of Free Energy 61

PART II

BIOMOLECULES 65

CHAPTER 4 Amino Acids 67

1. The Amino Acids of Proteins 67
2. Optical Activity 73
3. "Nonstandard" Amino Acids 78

CHAPTER 5 Nucleic Acids, Gene Expression, and Recombinant DNA Technology 82

1. Nucleotides and Nucleic Acids 82
2. DNA Is the Carrier of Genetic Information 85
3. Double Helical DNA 88
4. Gene Expression and Replication:
An Overview 95
5. Molecular Cloning 104

CHAPTER 6 Techniques of Protein and Nucleic Acid Purifications 129

1. Protein Isolation 129
2. Solubilities of Proteins 133
3. Chromatographic Separations 135

4. Electrophoresis 146
5. Ultracentrifugation 152
6. Nucleic Acid Fractionation 156

CHAPTER 7 Covalent Structures of Proteins and Nucleic Acids 163

1. Primary Structure Determination of Proteins 164
2. Nucleic Acid Sequencing 176
3. Chemical Evolution 185
4. Bioinformatics: An Introduction 194
5. Chemical Synthesis of Polypeptides 205
6. Chemical Synthesis of Oligonucleotides 209

CHAPTER 8 Three-Dimensional Structures of Proteins 221

1. Secondary Structure 221
 2. Fibrous Proteins 232
 3. Globular Proteins 241
 4. Protein Stability 259
 5. Quaternary Structure 266
- APPENDIX: Viewing Stereo Pictures 271

CHAPTER 9 Protein Folding, Dynamics, and Structural Evolution 278

1. Protein Folding: Theory and Experiment 278
2. Folding Accessory Proteins 290
3. Protein Structure Prediction and Design 302
4. Protein Dynamics 306
5. Conformational Diseases: Amyloids
and Prions 309
6. Structural Evolution 316

CHAPTER 10 Hemoglobin: Protein Function in Microcosm 323

1. Hemoglobin and Myoglobin Function 323
 2. Structure and Mechanism 331
 3. Abnormal Hemoglobins 341
 4. Allosteric Regulation 347
- APPENDIX: Derivation of Symmetry Model
Equations 354

CHAPTER 11 Sugars and Polysaccharides 359

1. Monosaccharides 359
2. Polysaccharides 365
3. Glycoproteins 373

CHAPTER 12 Lipids and Membranes 386

1. Lipid Classification 386
2. Properties of Lipid Aggregates 393

3. Biological Membranes 399
4. Membrane Assembly and Protein Targeting 418
5. Lipoproteins 449

PART III

MECHANISMS OF ENZYME ACTION 467

CHAPTER 13 Introduction to Enzymes 469

1. Historical Perspective 469
2. Substrate Specificity 470
3. Coenzymes 473
4. Regulation of Enzymatic Activity 474
5. A Primer of Enzyme Nomenclature 479

CHAPTER 14 Rates of Enzymatic Reactions 482

1. Chemical Kinetics 482
 2. Enzyme Kinetics 487
 3. Inhibition 492
 4. Effects of pH 496
 5. Bisubstrate Reactions 497
- APPENDIX: Derivations of Michaelis-Menten Equation Variants 501

CHAPTER 15 Enzymatic Catalysis 506

1. Catalytic Mechanisms 506
2. Lysozyme 517
3. Serine Proteases 525
4. Drug Design 539

PART IV

METABOLISM 557

CHAPTER 16 Introduction to Metabolism 559

1. Metabolic Pathways 559
2. Organic Reaction Mechanisms 562
3. Experimental Approaches to the Study of Metabolism 569
4. Thermodynamics of Phosphate Compounds 578
5. Oxidation-Reduction Reactions 583
6. Thermodynamics of Life 586

CHAPTER 17 Glycolysis 593

1. The Glycolytic Pathway 593
2. The Reactions of Glycolysis 595
3. Fermentation: The Anaerobic Fate of Pyruvate 614
4. Metabolic Regulation and Control 619
5. Metabolism of Hexoses Other than Glucose 630

CHAPTER 18 Glycogen Metabolism 638

1. Glycogen Breakdown 638
2. Glycogen Synthesis 644
3. Control of Glycogen Metabolism 647
4. Glycogen Storage Diseases 666

CHAPTER 19 Signal Transduction 671

1. Hormones 671
2. Heterotrimeric G Proteins 688
3. Tyrosine Kinase-Based Signaling 699
4. The Phosphoinositide Cascade 725

CHAPTER 20 Transport through Membranes 744

1. Thermodynamics of Transport 744
2. Kinetics and Mechanisms of Transport 745
3. ATP-Driven Active Transport 758
4. Ion Gradient-Driven Active Transport 768
5. Neurotransmission 771

CHAPTER 21 Citric Acid Cycle 789

1. Cycle Overview 789
2. Metabolic Sources of Acetyl-Coenzyme A 792
3. Enzymes of the Citric Acid Cycle 806
4. Regulation of the Citric Acid Cycle 815
5. The Amphibolic Nature of the Citric Acid Cycle 817

CHAPTER 22 Electron Transport and Oxidative Phosphorylation 823

1. The Mitochondrion 823
2. Electron Transport 828
3. Oxidative Phosphorylation 845
4. Control of ATP Production 862

CHAPTER 23 Other Pathways of Carbohydrate Metabolism 871

1. Gluconeogenesis 871
2. The Glyoxylate Cycle 880
3. Biosynthesis of Oligosaccharides and Glycoproteins 880
4. The Pentose Phosphate Pathway 892

CHAPTER 24 Photosynthesis 901

1. Chloroplasts 901
2. Light Reactions 903
3. Dark Reactions 926

CHAPTER 25 Lipid Metabolism 940

1. Lipid Digestion, Absorption, and Transport 940
2. Fatty Acid Oxidation 945
3. Ketone Bodies 959
4. Fatty Acid Biosynthesis 961

5. Regulation of Fatty Acid Metabolism 973
6. Cholesterol Metabolism 975
7. Eicosanoid Metabolism: Prostaglandins, Prostacyclins, Thromboxanes, Leukotrienes, and Lipoxins 993
8. Phospholipid and Glycolipid Metabolism 1004

CHAPTER 26 Amino Acid Metabolism 1019

1. Amino Acid Deamination 1019
2. The Urea Cycle 1025
3. Metabolic Breakdown of Individual Amino Acids 1029
4. Amino Acids as Biosynthetic Precursors 1047
5. Amino Acid Biosynthesis 1064
6. Nitrogen Fixation 1078

CHAPTER 27 Energy Metabolism: Integration and Organ Specialization 1088

1. Major Pathways and Strategies of Energy Metabolism: A Summary 1088
2. Organ Specialization 1090
3. Metabolic Homeostasis: Regulation of Appetite, Energy Expenditure, and Body Weight 1095
4. Metabolic Adaptation 1101

CHAPTER 28 Nucleotide Metabolism 1107

1. Synthesis of Purine Ribonucleotides 1107
2. Synthesis of Pyrimidine Ribonucleotides 1114
3. Formation of Deoxyribonucleotides 1119
4. Nucleotide Degradation 1130
5. Biosynthesis of Nucleotide Coenzymes 1136

PART V

EXPRESSION AND TRANSMISSION OF GENETIC INFORMATION 1143

CHAPTER 29 Nucleic Acid Structures 1145

1. Double Helical Structures 1145
2. Forces Stabilizing Nucleic Acid Structures 1151
3. Supercoiled DNA 1158

CHAPTER 30 DNA Replication, Repair, and Recombination 1173

1. DNA Replication: An Overview 1173
2. Enzymes of Replication 1176

3. Prokaryotic Replication 1190
4. Eukaryotic Replication 1201
5. Repair of DNA 1213
6. Recombination and Mobile Genetic Elements 1225
7. DNA Methylation and Trinucleotide Repeat Expansions 1246

CHAPTER 31 Transcription 1260

1. The Role of RNA in Protein Synthesis 1260
2. RNA Polymerase 1265
3. Control of Transcription in Prokaryotes 1283
4. Post-Transcriptional Processing 1301

CHAPTER 32 Translation 1338

1. The Genetic Code 1338
2. Transfer RNA and Its Aminoacylation 1345
3. Ribosomes 1362
4. Control of Eukaryotic Translation 1398
5. Post-Translational Modification 1403
6. Protein Degradation 1408

***CHAPTER 33 Viruses: Paradigms for Cellular Function W-1**

1. Tobacco Mosaic Virus W-3
2. Icosahedral Viruses W-8
3. Bacteriophage λ W-20
4. Influenza Virus W-40

***CHAPTER 34 Eukaryotic Gene Expression**

1. Chromosome Structure
2. Genomic Organization
3. Control of Expression
4. Cell Differentiation

***CHAPTER 35 Molecular Physiology**

1. Blood Clotting
2. Immunity
3. Motility: Muscles, Vesicle Transport, Cilia, and Flagella

INDEX I-1

***Chapters 33, 34, and 35 are available on our book companion website, www.wiley.com/college/voet.**