

LIST OF CHAPTERS and SPECIAL FEATURES

CHAPTER 1 Cells: The Fundamental Units of Life 1

- PANEL 1-1 Microscopy 12
- TABLE 1-1 Historical Landmarks in Determining Cell Structure 24
- PANEL 1-2 Cell Architecture 25
- How We Know: Life's Common Mechanisms 30
- TABLE 1-2 Some Model Organisms and Their Genomes 35

CHAPTER 2 Chemical Components of Cells 39

- TABLE 2-1 Length and Strength of Some Chemical Bonds 48
- TABLE 2-2 The Chemical Composition of a Bacterial Cell 52
- How We Know: The Discovery of Macromolecules 60
- PANEL 2-1 Chemical Bonds and Groups 66
- PANEL 2-2 The Chemical Properties of Water 68
- PANEL 2-3 The Principal Types of Weak Noncovalent Bonds 70
- PANEL 2-4 An Outline of Some of the Types of Sugars 72
- PANEL 2-5 Fatty Acids and Other Lipids 74
- PANEL 2-6 The 20 Amino Acids Found in Proteins 76
- PANEL 2-7 A Survey of the Nucleotides 78

CHAPTER 3 Energy, Catalysis, and Biosynthesis 81

- PANEL 3-1 Free Energy and Biological Reactions 94
- TABLE 3-1 Relationship Between the Standard Free-Energy Change, ΔG° , and the Equilibrium Constant 96
- How We Know: "High-Energy" Phosphate Bonds Power Cell Processes 102
- TABLE 3-2 Some Activated Carriers Widely Used in Metabolism 109

CHAPTER 4 Protein Structure and Function 117

- PANEL 4-1 A Few Examples of Some General Protein Functions 118
- PANEL 4-2 Making and Using Antibodies 140
- TABLE 4-1 Some Common Functional Classes of Enzymes 142
- How We Know: Measuring Enzyme Performance 144
- TABLE 4-2 Historical Landmarks in Our Understanding of Proteins 160
- PANEL 4-3 Cell Breakage and Initial Fractionation of Cell Extracts 164
- PANEL 4-4 Protein Separation by Chromatography 166
- PANEL 4-5 Protein Separation by Electrophoresis 167
- PANEL 4-6 Protein Structure Determination 168

CHAPTER 5 DNA and Chromosomes 173

- How We Know: Genes Are Made of DNA 193

CHAPTER 6 DNA Replication and Repair 199**How We Know:** The Nature of Replication 202**TABLE 6-1** Proteins Involved in DNA Replication 213**TABLE 6-2** Error Rates 218**CHAPTER 7 From DNA to Protein: How Cells Read the Genome 227****TABLE 7-1** Types of RNA Produced in Cells 232**TABLE 7-2** The Three RNA Polymerases in Eukaryotic Cells 235**How We Know:** Cracking the Genetic Code 246**TABLE 7-3** Antibiotics That Inhibit Bacterial Protein or RNA Synthesis 256**TABLE 7-4** Biochemical Reactions That Can Be Catalyzed by Ribozymes 261**CHAPTER 8 Control of Gene Expression 267****How We Know:** Gene Regulation—The Story of *Eve* 280**CHAPTER 9 How Genes and Genomes Evolve 297****TABLE 9-1** Viruses That Cause Human Disease 318**TABLE 9-2** Some Vital Statistics for the Human Genome 322**How We Know:** Counting Genes 324**CHAPTER 10 Analyzing the Structure and Function of Genes 333****How We Know:** Sequencing the Human Genome 348**CHAPTER 11 Membrane Structure 365****TABLE 11-1** Some Examples of Plasma Membrane Proteins and Their Functions 375**How We Know:** Measuring Membrane Flow 384**CHAPTER 12 Transport Across Cell Membranes 389****TABLE 12-1** A Comparison of Ion Concentrations Inside and Outside a Typical Mammalian Cell 391**TABLE 12-2** Some Examples of Transmembrane Pumps 403**How We Know:** Squid Reveal Secrets of Membrane Excitability 412**TABLE 12-3** Some Examples of Ion Channels 419**CHAPTER 13 How Cells Obtain Energy from Food 427****TABLE 13-1** Some Types of Enzymes Involved in Glycolysis 431**PANEL 13-1** Details of the 10 Steps of Glycolysis 436**PANEL 13-2** The Complete Citric Acid Cycle 442**How We Know:** Unraveling the Citric Acid Cycle 444**CHAPTER 14 Energy Generation in Mitochondria and Chloroplasts 455****TABLE 14-1** Product Yields from Glucose Oxidation 469**PANEL 14-1** Redox Potentials 472**How We Know:** How Chemiosmotic Coupling Drives ATP Synthesis 476**CHAPTER 15 Intracellular Compartments and Protein Transport 495****TABLE 15-1** The Main Functions of Membrane-enclosed Organelles of a Eukaryotic Cell 497**TABLE 15-2** The Relative Volumes and Numbers of the Major Membrane-enclosed Organelles in a Liver Cell (Hepatocyte) 498

- TABLE 15-3** Some Typical Signal Sequences 502
TABLE 15-4 Some Types of Coated Vesicles 513
How We Know: Tracking Protein and Vesicle Transport 520

CHAPTER 16 Cell Signaling 533

- TABLE 16-1** Some Examples of Signal Molecules 536
TABLE 16-2 Some Foreign Substances That Act on Cell-Surface Receptors 544
TABLE 16-3 Some Cell Responses Mediated by Cyclic AMP 550
TABLE 16-4 Some Cell Responses Mediated by Phospholipase C Activation 552
How We Know: Untangling Cell Signaling Pathways 563

CHAPTER 17 Cytoskeleton 573

- TABLE 17-1** Drugs That Affect Microtubules 584
How We Know: Pursuing Microtubule-associated Motor Proteins 588
TABLE 17-2 Drugs That Affect Filaments 594

CHAPTER 18 The Cell-Division Cycle 609

- TABLE 18-1** Some Eukaryotic Cell-Cycle Durations 611
How We Know: Discovery of Cyclins and Cdks 615
TABLE 18-2 The Major Cyclins and Cdks of Vertebrates 617
PANEL 18-1 The Principal Stages of M Phase in an Animal Cell 628

CHAPTER 19 Sexual Reproduction and Genetics 651

- PANEL 19-1** Some Essentials of Classical Genetics 675
How We Know: Using SNPs to Get a Handle on Human Disease 684

CHAPTER 20 Cell Communities: Tissues, Stem Cells, and Cancer 691

- TABLE 20-1** A Variety of Factors Can Contribute to Genetic Instability 721
TABLE 20-2 Examples of Cancer-critical Genes 728
How We Know: Making Sense of the Genes That Are Critical for Cancer 730