

# 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 26
- PANEL 1-2 Cell Architecture 27
- How We Know: Examining Life's Common Mechanisms 33
- TABLE 1-2 Some Model Organisms and Their Genomes 38

## CHAPTER 2 Chemical Components of Cells 43

- TABLE 2-1 Length and Strength of Some Chemical Bonds 53
- TABLE 2-2 The Chemical Composition of a Bacterial Cell 56
- How We Know: The Discovery of Macromolecules 64
- PANEL 2-1 Chemical Bonds and Groups 70
- PANEL 2-2 The Chemical Properties of Water 72
- PANEL 2-3 The Principal Types of Weak Noncovalent Bonds 74
- PANEL 2-4 An Outline of Some of the Types of Sugars 76
- PANEL 2-5 Fatty Acids and Other Lipids 78
- PANEL 2-6 The 20 Amino Acids Found in Proteins 80
- PANEL 2-7 A Survey of the Nucleotides 82

## CHAPTER 3 Energy, Catalysis, and Biosynthesis 85

- TABLE 3-1 Relationship Between the Standard Free-Energy Change,  $\Delta G^\circ$ , and the Equilibrium Constant 99
- PANEL 3-1 Free Energy and Catalysis 100
- How We Know: "High-Energy" Phosphate Bonds Power Cell Processes 107
- TABLE 3-2 Some Activated Carriers Widely Used in Metabolism 113

## CHAPTER 4 Protein Structure and Function 121

- PANEL 4-1 A Few Examples of Some General Protein Functions 122
- PANEL 4-2 Making and Using Antibodies 144
- TABLE 4-1 Some Common Classes of Enzymes 146
- TABLE 4-2 Historical Landmarks in Our Understanding of Proteins 163
- How We Know: Harnessing Enzyme Performance for Human Benefit 165
- PANEL 4-3 Cell Breakage and Initial Fractionation of Cell Extracts 170
- PANEL 4-4 Protein Separation by Chromatography 172
- PANEL 4-5 Protein Separation by Electrophoresis 173
- PANEL 4-6 Protein Structure Determination 174

## CHAPTER 5 DNA and Chromosomes 179

- How We Know: Genes Are Made of DNA 203



## **CHAPTER 6 DNA Replication and Repair 209**

**How We Know:** The Nature of Replication 212

**TABLE 6-1** Proteins Involved in DNA Replication 223

**TABLE 6-2** Error Rates 228

## **CHAPTER 7 From DNA to Protein: How Cells Read the Genome 237**

**TABLE 7-1** Types of RNA Produced in Cells 242

**TABLE 7-2** The Three RNA Polymerases in Eukaryotic Cells 245

**How We Know:** Cracking the Genetic Code 257

**TABLE 7-3** Antibiotics That Inhibit Bacterial Protein or RNA Synthesis 267

**TABLE 7-4** Biochemical Reactions That Can Be Catalyzed by Ribozymes 272

## **CHAPTER 8 Control of Gene Expression 277**

**How We Know:** Gene Regulation—The Story of Eve 290

## **CHAPTER 9 How Genes and Genomes Evolve 307**

**TABLE 9-1** Viruses That Cause Human Disease 328

**TABLE 9-2** Some Vital Statistics for the Human Genome 333

**How We Know:** Counting Genes 336

## **CHAPTER 10 Analyzing the Structure and Function of Genes 345**

**How We Know:** Sequencing the Human Genome 360

## **CHAPTER 11 Membrane Structure 381**

**TABLE 11-1** Some Examples of Plasma Membrane Proteins and Their Functions 391

**How We Know:** Measuring Membrane Flow 400

## **CHAPTER 12 Transport Across Cell Membranes 405**

**TABLE 12-1** A Comparison of Ion Concentrations Inside and Outside a Typical Mammalian Cell 408

**TABLE 12-2** Some Examples of Transmembrane Pumps 420

**How We Know:** Squid Reveal Secrets of Membrane Excitability 430

**TABLE 12-3** Some Examples of Ion Channels 438

## **CHAPTER 13 How Cells Obtain Energy from Food 445**

**TABLE 13-1** Some Types of Enzymes Involved in Glycolysis 449

**PANEL 13-1** Details of the 10 Steps of Glycolysis 456

**PANEL 13-2** The Complete Citric Acid Cycle 460

**How We Know:** Unraveling the Citric Acid Cycle 463

## **CHAPTER 14 Energy Generation in Mitochondria and Chloroplasts 473**

**TABLE 14-1** Mitochondrial Functions 478

**TABLE 14-2** Product Yields from Glucose Oxidation 487

**PANEL 14-1** Redox Potentials 490

**How We Know:** How Chemiosmotic Coupling Drives ATP Synthesis 494

## **CHAPTER 15 Intracellular Compartments and Protein Transport 515**

**TABLE 15-1** The Main Functions of the Membrane-enclosed Organelles of a Eukaryotic Cell 517

**TABLE 15-2** The Relative Volumes and Numbers of the Major Membrane-enclosed Organelles in a Liver Cell (Hepatocyte) 518



<b>TABLE 15-3</b>	Some Typical Signal Sequences	522
<b>TABLE 15-4</b>	Some Types of Coated Vesicles	535
<b>How We Know:</b>	Tracking Protein and Vesicle Transport	541

## **CHAPTER 16 Cell Signaling 553**

<b>TABLE 16-1</b>	Some Examples of Signal Molecules	556
<b>TABLE 16-2</b>	Some Foreign Substances That Act on Cell-Surface Receptors	564
<b>TABLE 16-3</b>	Some Cell Responses Mediated by Cyclic AMP	570
<b>TABLE 16-4</b>	Some Cell Responses Mediated by Phospholipase C Activation	572
<b>How We Know:</b>	Untangling Cell Signaling Pathways	584

## **CHAPTER 17 Cytoskeleton 595**

<b>TABLE 17-1</b>	Drugs That Affect Microtubules	609
<b>How We Know:</b>	Pursuing Microtubule-associated Motor Proteins	612
<b>TABLE 17-2</b>	Drugs That Affect Filaments	618

## **CHAPTER 18 The Cell Cycle 635**

<b>TABLE 18-1</b>	Some Eukaryotic Cell-Cycle Durations	637
<b>How We Know:</b>	Discovery of Cyclins and Cdks	641
<b>TABLE 18-2</b>	The Major Cyclins and Cdks of Vertebrates	643
<b>PANEL 18-1</b>	The Principal Stages of M Phase in an Animal Cell	656

## **CHAPTER 19 Sexual Reproduction and Genetics 677**

<b>PANEL 19-1</b>	Some Essentials of Classical Genetics	702
<b>How We Know:</b>	Using SNPs to Get a Handle on Human Disease	710

## **CHAPTER 20 Cell Communities: Tissues, Stem Cells, and Cancer 717**

<b>TABLE 20-1</b>	A Variety of Factors Can Contribute to Genetic Instability	748
<b>TABLE 20-2</b>	Examples of Cancer-critical Genes	755
<b>How We Know:</b>	Making Sense of the Genes That Are Critical for Cancer	757