Contents

lapter i Celiular Organization. Prokaryotes	Chapter 2 Cellular Chemistry. Organic Molecules 2
d Eukaryotes 3	Chemical Bonds 28
Historical Background 4	Covalent Bonds 29
Microscopy and the Cell Theory 4	Weak Chemical Bonds 29
Genetic and Biochemical Aspects of the Cell 7	Water 31
Cell Structural Organizations 9	Properties of Water 31
Prokaryotic Cell Organization 9	The pH Scale 32
Eukaryotic Cell Organization 11	The Chemistry of Carbon Atoms 33
Evolutionary Relationships 21	Carbon Atom Interactions 33
Viruses 23	Isomers 34
Summary 24	Biologically Important Carbon Compounds 35
Study Questions 26	Carbohydrates 35
Suggested Readings 26	Monosaccharides 36

Polysaccharides 37	The Fluid Mosaic Model 87
Lipids 39	Movement of Substances Across Membranes 90
Fatty Acids 40	Free Diffusion 91
Neutral Fats (Glycerides) 40	Transport Mechanisms 93
Phospholipids 42	Transport by Vesicle Formation 97
Sphingolipids and Glycolipids 42	Intercellular Communication Through Junctions 98
Steroids and Terpenes 43	Ion and Metabolite Exchange 100
Proteins 45	Intercellular Adhesion 105
Amino Acids 45	Cells and Cell Systems 106
Polypeptides 48	Summary 106
Protein Structure 48	Study Questions 108
Nucleotides and Nucleic Acids 51	Suggested Readings 108
The DNA Double Helix 55	
Summary 56	Chapter 5 Cellular Energy Transformations:
Study Questions 57	Mitochondria and Chloroplasts 110
Suggested Readings 57	Aerobic Respiration 111
	The Krebs Cycle 114
	The Electron Transport Chain 116
Chapter 3 Cellular Metabolism: Energy	Oxidative Phosphorylation 118
and Enzymes 59	Coupling Mechanisms 119
Cellular Energetics 59	Overall Energetics of Glucose Oxidation 123
Measurement of Free Energy 60	Form and Structure of the Mitochondrion 124
Open Systems and Steady States 62	Inner Membrane Subunits 125
Coupled Metabolic Reactions 62	Size, Shape, and Number 129
The Role of ATP in Energy Transfer 62	Chloroplasts 130
Oxidation-Reductions in Energy Transfer 65	Structure of Eukaryote Chloroplasts 131
The Role of NAD+/NADH in Energy Transfer 66	Thylakoids in Prokaryotes 132
Enzymes: Catalysts of Life 67	Photosynthetic Pigments 133
Enzyme Activity 68	Overall Reactions in Photosynthesis 135
Substrate Specificity 69	Photoexcitation of Molecules 139
Self-Regulation 72	Separability of Light and Dark Reactions 140
Genetic Regulation of Enzyme Synthesis 74	The Light Reactions of Photosynthesis 141
Glucose Breakdown by Glycolysis 76	Photosystems I and II 141
The Sequence of Reactions 77	Electron Flow in Chloroplasts 142
Regulation of the Rate of Glycolysis 80	Photophosphorylation 144
Summary 81	The Dark Reactions of Photosynthesis 145
Study Questions 82	Fixation of Carbon Dioxide 146
Suggested Readings 83	The Hatch-Slack Cycle 148
	Biogenesis of Chloroplasts and Mitochondria 150
Chapter 4 Cellular Membranes: Dynamic Barriers 84	Chloroplasts and Proplastids 150 Mitochondrial Biogenesis 152
Structural Models 84	Summary 154
Danielli and Davson Model 85	Study Questions 156
The Robertson Unit Membrane Model 85	Suggested Readings 158

Chapter 6 Cellular Packaging: The ER and	Chapter 8 Cellular Genetics: DNA, RNA, Protein 222
Its Derivatives 159	DNA: The Genetic Material 222
The Endoplasmic Reticulum 160	The Double Helix 225
The Golgi Apparatus 162	
Ultrastructural Organization 162	
Functions of the Golgi Apparatus 166	
Cell Secretion 167	The Genetic Code 230
Lysosomes 172	Co-linearity of Gene and Protein 231
Formation and Function 172	Regulation of Gene Expression 233
Lysosomes and Disease 175	The Operon Concept 233
Microbodies 177	Operators and Promoters 235
Occurrence and Identification 178	Ribosomes and Protein Synthesis 236
Coordination Among Organelles 181	Ribosomes 236
Membrane Transformations 182	Polysomes 238
Summary 184	Amino Acids and Transfer RNA 240
Study Questions 186	Polypeptide Chain Elongation 242
Suggested Readings 186	Polypeptide Chain Initiation 246
	Polypeptide Chain Termination 248
Chapter 7 Cellular Movements: Microtubules and	Overall View 249
Microfilaments 188	Summary 249
Muscle Fibers 189	Study Questions 251
Myofibril Ultrastructure and Chemistry 191	Suggested Readings 252
Coupled Excitation and Contraction 195	
Troponin and Tropomyosin: Regulatory	
Proteins 197	Chapter 9 Cell Control Center: The Nucleus 254
Centrioles 198	Nuclear Organization 254
Centriole Formation 198	The Nuclear Envelope 255
Centriolar Functions 199	Nuclear Pore Complexes 255
Cilia and Flagella 203	The Nucleolus 257
Structure and Chemistry 204	Chromosomes 262
Ciliary Movement: Sliding	Chemistry and Structure of the
Microtubule Mechanism 205	Chromatin Fiber 262
Modified Cilia and Flagella 207 Bacterial Flagella 208	Number of Chromatin Fibers
The Mitotic Apparatus 209	Per Chromosome 267
Structure 209	The Centromere 269 Heterochromatin and Euchromatin 271
Spindle Function 210	
	Chromosome Banding 274
Anaphase Movement of Chromosomes 211 Microfilaments and Nonmuscle Movements 212	Repetitious DNA 275 Polytene Chromosomes 277
Movements of Protoplasm 214 Displacement of Cells 215	Puffing and Gene Expression 278
Displacement of Cells 215 Summary 219	Regulation of Puffing 280
Study Questions 220	Summary 281
	Study Questions 282
Suggested Readings 221	Suggested Readings 283

Chapter 10 Cellular Reproduction:	The Cytoskeletal Framework 326
Mitosis and Meiosis 284	The Immune Systems 326
The Cell Cycle 286	T Cells and B Cells 328 Interferon 331
Variations in Cell Cycle Phases 287	The Cancer Cell: Cell-Surface Modifications 334
Replication of DNA 288	
Mitosis 290	Summary 336
Stages of Mitosis 292	Study Questions 337
Consequences of Mitosis 293	Suggested Readings 338
Modifications of Mitosis 293	
Cytokinesis 295	
Meiosis 296	Chapter 12 Cellular Evolution:
The Two Divisions of Meiosis 297	From Chemicals to Life 339
Meiosis as a Source of Variability 305	Origin of Life 339
Crossing Over 306	Abiogenic Synthesis 340
Summary 310	Coacervates and Proteinoid Microspheres 341
Study Questions 310	The First Life Forms 342
Suggested Readings 311	Modifications in Nutrition 343
	Eukaryotes from Prokaryotes 346
Chapter 11 Cell Biology in Medicine 312	Origin of the Eukaryotic Cell 346
Human Chromosome Studies 312	Endosymbiosis 347
The Human Chromosome Complement 313	Internalized Membrane Differentiation 349
Sex Chromosome Anomalies 313	Different Origins for Chloroplasts and
Autosomal Anomalies 318	Mitochondria? 350
Prenatal Diagnosis 319	Summary 351
Amniocentesis 320	Study Questions 352
Detection of Chromosome Damage 322	Suggested Readings 352
	Glossary 353
Genetic Counseling 324 Cell Surface Studies 325	Index 363
	Abbreviations Used in Text (endpaper)
Organization of the Cell Surface 325	