

Contents

About the Author viii

Preface viii

CHAPTER 1

The Human Organism

- 1.1 Anatomy and Physiology 2
- 1.2 Structural and Functional Organization 2
- 1.3 Characteristics of Life 7
- 1.4 Homeostasis 7
- 1.5 Terminology and the Body Plan 11

CHAPTER 2

The Chemical Basis of Life

- 2.1 Basic Chemistry 22
- 2.2 Chemical Reactions 27
- 2.3 Acids and Bases 31
- 2.4 Inorganic Chemistry 33
- 2.5 Organic Chemistry 33

CHAPTER 3

Cell Structures and Their Functions

- 3.1 Cell Organization and Functions 46
- 3.2 Plasma Membrane 46
- 3.3 Movement Through the Plasma Membrane 49
- 3.4 Cytoplasm 58
- 3.5 The Nucleus and Cytoplasmic Organelles 59
- 3.6 Protein Synthesis 66
- 3.7 Cell Division 68
- 3.8 Differentiation 72

CHAPTER 4

Tissues, Glands, and Membranes

- 4.1 Tissues and Histology 78
- 4.2 Germ Layers 78

- 4.3 Epithelial Tissue 78
- 4.4 Connective Tissue 86
- 4.5 Muscle Tissue 93
- 4.6 Nervous Tissue 95
- 4.7 Membranes 96
- 4.8 Inflammation 96
- 4.9 Tissue Renewal and Repair 97
- 4.10 Tissues and Aging 102

CHAPTER 5

Integumentary System

- 5.1 Functions of the Integumentary System 107
- 5.2 Skin 107
- 5.3 Subcutaneous Tissue 113
- 5.4 Accessory Skin Structures 113
- 5.5 Summary of Integumentary System Functions 117
- 5.6 The Integumentary System as a Diagnostic Aid 119
- 5.7 Skin Cancer 119
- 5.8 Effects of Aging on the Integumentary System 120

CHAPTER 6

Histology and Physiology of Bones

- 6.1 Functions of the Skeletal System 126
- 6.2 Cartilage 126
- 6.3 Bone Histology 127
- 6.4 Bone Anatomy 131
- 6.5 Bone Development 133
- 6.6 Bone Growth 135
- 6.7 Bone Remodeling 138
- 6.8 Bone Repair 141
- 6.9 Calcium Homeostasis 142
- 6.10 Effects of Aging on the Skeletal System 143

CHAPTER 7

Anatomy of Bones and Joints

- 7.1 General Considerations of Bones 150
- 7.2 Axial Skeleton 150
- 7.3 Appendicular Skeleton 167
- 7.4 Joints 177
- 7.5 Types of Movement 183
- 7.6 Description of Selected Joints 186
- 7.7 Effects of Aging on the Joints 191

CHAPTER 8

Histology and Physiology of Muscles

- 8.1 Functions of the Muscular System 198
- 8.2 Properties and Types of Muscle 198
- 8.3 Skeletal Muscle Structure 199
- 8.4 Sliding Filament Model 202
- 8.5 Physiology of Skeletal Muscle Fibers 204
- 8.6 Physiology of Skeletal Muscle 211
- 8.7 Types of Skeletal Muscle Fibers 218
- 8.8 Muscular Hypertrophy and Atrophy 219
- 8.9 Effects of Aging on Skeletal Muscle 220
- 8.10 Smooth Muscle 220
- 8.11 Cardiac Muscle 224

CHAPTER 9

Gross Anatomy and Functions of Skeletal Muscles

- 9.1 General Principles 230
- 9.2 Head and Neck Muscles 234
- 9.3 Trunk Muscles 241

- 9.4 Scapular and Upper Limb Muscles 246
9.5 Hip and Lower Limb Muscles 255

CHAPTER 10 Functional Organization of Nervous Tissue

- 10.1 Functions of the Nervous System 268
10.2 Parts of the Nervous System 268
10.3 Cells of the Nervous System 269
10.4 Organization of Nervous Tissue 273
10.5 Electric Signals 273
10.6 The Synapse 285
10.7 Neuronal Pathways and Circuits 294

CHAPTER 11 Central and Peripheral Nervous Systems

- 11.1 Spinal Cord 300
11.2 Reflexes 304
11.3 Nerves 309
11.4 Brain 316
11.5 Brainstem 316
11.6 Cerebellum 318
11.7 Diencephalon 319
11.8 Cerebrum 321
11.9 Meninges, Ventricles, and Cerebrospinal Fluid 324
11.10 Blood Supply to the Brain 329
11.11 Cranial Nerves 329

CHAPTER 12 Integration of Nervous System Functions

- 12.1 Sensation 344
12.2 Control of Skeletal Muscles 352
12.3 Other Brain Functions 358
12.4 Effects of Aging of the Nervous System 362

CHAPTER 13 The Special Senses

- 13.1 Olfaction 370
13.2 Taste 371

- 13.3 Visual System 372
13.4 Hearing and Balance 389
13.5 Effects of Aging on the Special Senses 401

CHAPTER 14 Autonomic Nervous System

- 14.1 Contrasting the Somatic Motor and Autonomic Nervous Systems 408
14.2 Anatomy of the Autonomic Nervous System 409
14.3 Physiology of the Autonomic Nervous System 413
14.4 Regulation of the Autonomic Nervous System 418
14.5 Functional Generalizations About the Autonomic Nervous System 420

CHAPTER 15 Endocrine System

- 15.1 Overview of the Endocrine System 426
15.2 Pituitary Gland and Hypothalamus 435
15.3 Thyroid Gland 441
15.4 Parathyroid Glands 446
15.5 Adrenal Glands 446
15.6 Pancreas 453
15.7 Hormonal Regulation of Nutrients 456
15.8 Testes and Ovaries 456
15.9 Pineal Body 457
15.10 Other Endocrine Organs 458
15.11 Hormonelike Substances 458
15.12 Effects of Aging on the Endocrine System 458

CHAPTER 16 Blood

- 16.1 Functions and Composition of Blood 467
16.2 Plasma 467
16.3 Formed Elements 467
16.4 Preventing Blood Loss 475
16.5 Blood Grouping 478
16.6 Diagnostic Blood Tests 482

CHAPTER 17 The Heart

- 17.1 Functions of the Heart 491
17.2 Location, Shape, and Size of the Heart 492
17.3 Anatomy of the Heart 492
17.4 Histology of the Heart 499
17.5 Electrical Activity of the Heart 500
17.6 Cardiac Cycle 506
17.7 Mean Arterial Blood Pressure 511
17.8 Regulation of the Heart 512
17.9 The Heart and Homeostasis 513
17.10 Effects of Aging on the Heart 516

CHAPTER 18 Blood Vessels and Circulation

- 18.1 Functions of the Peripheral Circulation 523
18.2 General Features of Blood Vessels 523
18.3 Pulmonary Circulation 527
18.4 Systemic Circulation: Arteries 527
18.5 Systemic Circulation: Veins 536
18.6 Physiology of Circulation 546
18.7 Control of Blood Flow 552
18.8 Regulation of Mean Arterial Pressure 554
18.9 Examples of Cardiovascular Regulation 561

CHAPTER 19 Lymphatic System and Immunity

- 19.1 Lymphatic System 570
19.2 Immunity 576
19.3 Immune Cells 578
19.4 Innate Immunity 580
19.5 Adaptive Immunity 584
19.6 Immunological Tolerance 594
19.7 Immunotherapy 594
19.8 Acquired Immunity 598
19.9 Effects of Aging on the Lymphatic System and Immunity 599

CHAPTER 20

Respiratory System

- 20.1 Functions of the Respiratory System 607
- 20.2 Anatomy and Histology of the Respiratory System 607
- 20.3 Ventilation 618
- 20.4 Measurement of Lung Function 622
- 20.5 Gas Exchange in the Lungs 624
- 20.6 Oxygen and Carbon Dioxide Transport in the Blood 625
- 20.7 Regulation of Ventilation 631
- 20.8 Respiratory Adaptations to Exercise 636
- 20.9 Effects of Aging on the Respiratory System 638

CHAPTER 21

Digestive System

- 21.1 Functions of the Digestive System 645
- 21.2 Histology of the Digestive Tract 645
- 21.3 Peritoneum 647
- 21.4 Oral Cavity 647
- 21.5 Pharynx 651
- 21.6 Esophagus 652
- 21.7 Swallowing 653
- 21.8 Stomach 653
- 21.9 Small Intestine 661
- 21.10 Liver and Gallbladder 664
- 21.11 Pancreas 670
- 21.12 Large Intestine 672
- 21.13 Digestion, Absorption, and Transport 675
- 21.14 Effects of Aging on the Digestive System 683

CHAPTER 22

Nutrition, Metabolism, and Temperature Regulation

- 22.1 Nutrition 690
- 22.2 Metabolism 699
- 22.3 Carbohydrate Metabolism 700
- 22.4 Lipid Metabolism 707
- 22.5 Protein Metabolism 708
- 22.6 Interconversion of Nutrient Molecules 708
- 22.7 Metabolic States 711
- 22.8 Metabolic Rate 712
- 22.9 Body Temperature Regulation 713

CHAPTER 23

Urinary System and Body Fluids

- 23.1 Functions of the Urinary System 722
- 23.2 Kidney Anatomy and Histology 722
- 23.3 Urine Production 728
- 23.4 Hormonal Regulation of Urine Concentration and Volume 738
- 23.5 Urine Movement 743
- 23.6 Effects of Aging on the Kidneys 746
- 23.7 Body Fluids 747
- 23.8 Regulation of Intracellular Fluid Composition 748
- 23.9 Regulation of Body Fluid Concentration and Volume 748
- 23.10 Regulation of Specific Electrolytes in the Extracellular Fluid 753
- 23.11 Regulation of Acid–Base Balance 755

CHAPTER 24

Reproductive System

- 24.1 Functions of the Reproductive System 770
- 24.2 Meiosis 771
- 24.3 Anatomy of the Male Reproductive System 773
- 24.4 Physiology of Male Reproduction 780
- 24.5 Anatomy of Female Reproduction 785
- 24.6 Physiology of the Female Reproductive System 793
- 24.7 Effects of Aging on the Reproductive System 801

CHAPTER 25

Development and Genetics

- 25.1 Prenatal Development 809
- 25.2 Labor 829
- 25.3 The Newborn 831
- 25.4 Lactation 834
- 25.5 Genetics 834

Appendices

- A** Periodic Table of the Elements A-1
- B** Scientific Notation A-2
- C** Solution Concentrations A-3
- D** pH A-4
- E** Answers to Review and Comprehension Questions A-5
- F** Answers to Critical Thinking Questions A-6
- G** Answers to Predict Questions A-18

Glossary G-1

Credits C-1

Index I-1