<table>
<thead>
<tr>
<th>PART I</th>
<th>INTRODUCTION TO THE ANATOMY AND PHYSIOLOGY LABORATORY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chapter 1</td>
<td>The Laboratory Environment  1</td>
</tr>
<tr>
<td>Chapter 2</td>
<td>Orientation to the Human Body  27</td>
</tr>
<tr>
<td>Chapter 3</td>
<td>The Microscope  43</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PART II</th>
<th>ORGANIZATION OF THE HUMAN BODY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chapter 4</td>
<td>Cell Structure and Membrane Transport  57</td>
</tr>
<tr>
<td>Chapter 5</td>
<td>Histology  91</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PART III</th>
<th>SUPPORT AND BODY MOVEMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chapter 6</td>
<td>Integument  123</td>
</tr>
<tr>
<td>Chapter 7</td>
<td>The Skeletal System: Bone Structure and Function  143</td>
</tr>
<tr>
<td>Chapter 8</td>
<td>The Skeletal System: Axial Skeleton  161</td>
</tr>
<tr>
<td>Chapter 9</td>
<td>The Skeletal System: Appendicular Skeleton  195</td>
</tr>
<tr>
<td>Chapter 10</td>
<td>Articulations  229</td>
</tr>
<tr>
<td>Chapter 11</td>
<td>The Muscular System: Muscle Structure and Function  247</td>
</tr>
<tr>
<td>Chapter 12</td>
<td>The Muscular System: Axial Muscles  283</td>
</tr>
<tr>
<td>Chapter 13</td>
<td>The Muscular System: Appendicular Muscles  311</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PART IV</th>
<th>COMMUNICATION AND CONTROL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chapter 14</td>
<td>Nervous Tissues  345</td>
</tr>
<tr>
<td>Chapter 15</td>
<td>The Brain and Cranial Nerves  371</td>
</tr>
<tr>
<td>Chapter 16</td>
<td>The Spinal Cord, Spinal Nerves, and Reflexes  419</td>
</tr>
<tr>
<td>Chapter 17</td>
<td>The Autonomic Nervous System  443</td>
</tr>
<tr>
<td>Chapter 18</td>
<td>General and Special Senses  459</td>
</tr>
<tr>
<td>Chapter 19</td>
<td>The Endocrine System  501</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PART V</th>
<th>MAINTENANCE AND REGULATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chapter 20</td>
<td>The Cardiovascular System: Blood  523</td>
</tr>
<tr>
<td>Chapter 21</td>
<td>The Cardiovascular System: The Heart  545</td>
</tr>
<tr>
<td>Chapter 22</td>
<td>The Cardiovascular System: Vessels and Circulation  579</td>
</tr>
<tr>
<td>Chapter 23</td>
<td>The Lymphatic System and Immunity  627</td>
</tr>
<tr>
<td>Chapter 24</td>
<td>The Respiratory System  651</td>
</tr>
<tr>
<td>Chapter 25</td>
<td>The Urinary System  685</td>
</tr>
<tr>
<td>Chapter 26</td>
<td>The Digestive System  715</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PART VI</th>
<th>REPRODUCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chapter 27</td>
<td>The Reproductive System and Early Development  751</td>
</tr>
</tbody>
</table>
CHRISTINE MARIE ECKEL received her B.A. in integrative biology and M.A. in human biodynamics from the University of California, Berkeley, and her Ph.D. in neurobiology and anatomy at the University of Utah School of Medicine. Christine is associate professor of biology at Carroll College in her hometown of Helena, Montana, where she teaches the two-semester anatomy and physiology course for pre-nursing and pre-health science majors, and an advanced dissection course for premedical students. She also serves as the faculty advisor for pre-physical therapy and pre-physician assistant students. Prior to her position at Carroll College, Christine was associate professor and course director for medical gross anatomy and medical microanatomy at West Virginia School of Osteopathic Medicine (WVSOM). In the 14 years prior to her position at WVSOM, Christine taught undergraduate human anatomy and human physiology courses at Salt Lake Community College and the University of California, Berkeley. She earned outstanding teaching awards at all three of these institutions.

Christine is the author of Human Anatomy Laboratory Manual, second edition (McGraw-Hill Education). In addition, her cadaver dissections and photographs are featured in several textbooks, including this laboratory manual.

With over 25 years of experience engaging with students at all levels, including community college students, medical students, and surgical residents, Christine has a unique appreciation for the learning challenges experienced by students at each level. Christine’s passions for anatomy and physiology, teaching, dissection, and photography are evident throughout the pages of this laboratory manual. In her spare time, Christine loves to mountain bike, skate ski, and explore the great Montana outdoors with her camera in hand.

KYLA TURPIN ROSS received her undergraduate degree from Louisiana State University in biological and agricultural engineering and her Ph.D. in biomedical engineering from Georgia Institute of Technology and Emory University. Kyla then served as a postdoctoral fellow in the Fellowships in Research and Science Teaching (FIRST) program at Emory University, an NIH-funded program that provides training in both research and teaching. Kyla is now senior academic professional at Georgia State University (GSU), where she teaches and manages the introductory and graduate human anatomy and physiology courses. Kyla has extensive experience developing lecture and laboratory curricula, and incorporates active learning in the classroom as a method to reinforce difficult physiological concepts. In addition, Kyla plays an active role in mentoring GSU faculty and teaching assistants and planning and hosting an annual teaching assistant workshop. She is involved in STEM initiatives at GSU, and serves as the faculty advisor for the Department of Biology Tutorial Center. She has served as a reviewer for numerous publications, and has authored a custom laboratory manual for GSU’s human anatomy and physiology course. She is active in several committees within the Human Anatomy & Physiology Society (HAPS). In addition to academic endeavors, Kyla serves on the Decatur Family YMCA board of directors.

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# Contents

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preface</td>
<td></td>
<td>xiv</td>
</tr>
<tr>
<td><strong>Part I</strong></td>
<td>Introduction to the Anatomy and Physiology Laboratory</td>
<td>1</td>
</tr>
<tr>
<td><strong>Chapter 1</strong></td>
<td>The Laboratory Environment</td>
<td>1</td>
</tr>
<tr>
<td><strong>Gross Anatomy</strong></td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>The Scientific Process of Discovery</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>EXERCISE 1.1 The Scientific Method</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>EXERCISE 1.2 Presenting Data</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Measurement in Science</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>EXERCISE 1.3 Units of Measurement</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Laboratory Equipment</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>EXERCISE 1.4 Identification of Common Dissection Instruments</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>EXERCISE 1.5 Proper Disposal of Laboratory Waste</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Dissection Techniques</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>EXERCISE 1.6 Placing a Scalpel Blade on a Scalpel Blade Handle</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>EXERCISE 1.7 Dissecting with a Scalpel</td>
<td>19</td>
<td></td>
</tr>
<tr>
<td>EXERCISE 1.8 Dissecting with Scissors</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>EXERCISE 1.9 Blunt Dissection Techniques</td>
<td>22</td>
<td></td>
</tr>
<tr>
<td><strong>Chapter 2</strong></td>
<td>Orientation to the Human Body</td>
<td>27</td>
</tr>
<tr>
<td><strong>Gross Anatomy</strong></td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>Anatomic Terminology and the Anatomic Position</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>Anatomic Planes and Sections</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>EXERCISE 2.1 Anatomic Planes and Sections</td>
<td>31</td>
<td></td>
</tr>
<tr>
<td>Directional Terms</td>
<td>33</td>
<td></td>
</tr>
<tr>
<td>EXERCISE 2.2 Directional Terms</td>
<td>33</td>
<td></td>
</tr>
<tr>
<td>Regional Terms</td>
<td>34</td>
<td></td>
</tr>
<tr>
<td>EXERCISE 2.3 Regional Terms</td>
<td>35</td>
<td></td>
</tr>
<tr>
<td><strong>Chapter 3</strong></td>
<td>The Microscope</td>
<td>43</td>
</tr>
<tr>
<td><strong>Histology</strong></td>
<td>46</td>
<td></td>
</tr>
<tr>
<td>The Compound Microscope</td>
<td>46</td>
<td></td>
</tr>
<tr>
<td>Caring for the Compound Microscope</td>
<td>46</td>
<td></td>
</tr>
<tr>
<td>EXERCISE 3.1 Parts of a Compound Microscope</td>
<td>47</td>
<td></td>
</tr>
<tr>
<td>Focus and Working Distance</td>
<td>49</td>
<td></td>
</tr>
<tr>
<td>EXERCISE 3.2 Viewing a Slide of the Letter e</td>
<td>49</td>
<td></td>
</tr>
<tr>
<td>Diameter of the Field of View</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>EXERCISE 3.3 Measuring the Diameter of the Field of View</td>
<td>51</td>
<td></td>
</tr>
<tr>
<td>EXERCISE 3.4 Estimating the Size of a Specimen</td>
<td>51</td>
<td></td>
</tr>
<tr>
<td>Depth of Field</td>
<td>52</td>
<td></td>
</tr>
<tr>
<td>EXERCISE 3.5 Determining Depth of Field</td>
<td>52</td>
<td></td>
</tr>
<tr>
<td>Finishing Up</td>
<td>52</td>
<td></td>
</tr>
<tr>
<td><strong>Gross Anatomy</strong></td>
<td>53</td>
<td></td>
</tr>
<tr>
<td>The Dissecting Microscope</td>
<td>53</td>
<td></td>
</tr>
<tr>
<td>EXERCISE 3.6 Parts of a Dissecting Microscope</td>
<td>54</td>
<td></td>
</tr>
<tr>
<td><strong>Part II</strong></td>
<td>Organization of the Human Body</td>
<td>57</td>
</tr>
<tr>
<td><strong>Chapter 4</strong></td>
<td>Cell Structure and Membrane Transport</td>
<td>57</td>
</tr>
<tr>
<td><strong>Histology</strong></td>
<td>61</td>
<td></td>
</tr>
<tr>
<td>Structure and Function of a Generalized Animal Cell</td>
<td>61</td>
<td></td>
</tr>
<tr>
<td>EXERCISE 4.1 Observing Cellular Anatomy with a Compound Microscope</td>
<td>63</td>
<td></td>
</tr>
</tbody>
</table>
Contents

PART III SUPPORT AND BODY MOVEMENT 123

Chapter 6
Integument 123

HISTOLOGY 126

The Epidermis 126
EXERCISE 6.1 LAYERS OF THE EPIDERMIS 127
EXERCISE 6.2 FINGERPRINTING 128
EXERCISE 6.3 PIGMENTED SKIN 129

The Dermis 130
EXERCISE 6.4 LAYERS OF THE DERMIS 130
EXERCISE 6.5 MEROCRINE (ECCRINE) SWEAT GLANDS AND SENSORY RECEPTORS 131
EXERCISE 6.6 THE SCALP—HAIR FOLLICLES AND SEBACEOUS GLANDS 133
EXERCISE 6.7 AXILLARY SKIN—APOCRINE SWEAT GLANDS 135
EXERCISE 6.8 STRUCTURE OF A NAIL 136

GROSS ANATOMY 137

Integument Model 137
EXERCISE 6.9 OBSERVING CLASSROOM MODELS OF INTEGUMENT 137

Chapter 7
The Skeletal System: Bone Structure and Function 143

HISTOLOGY 146

Bone Tissue 146
EXERCISE 7.1 COMPACT BONE 147
EXERCISE 7.2 SPONGY BONE 148
EXERCISE 7.3 ENDOCHONDRAL BONE DEVELOPMENT 149

GROSS ANATOMY 151

Classification of Bones 151
EXERCISE 7.4 IDENTIFYING CLASSES OF BONES BASED ON SHAPE 152

Structure of a Typical Long Bone 152
EXERCISE 7.5 COMPONENTS OF A LONG BONE 153
EXERCISE 7.6 COW BONE DISSECTION 154

Survey of the Human Skeleton 156
EXERCISE 7.7 THE HUMAN SKELETON 156

Chapter 5
Histology 91

Histology Slides 94

HISTOLOGY 94

Epithelial Tissue 94
EXERCISE 5.1 IDENTIFICATION AND CLASSIFICATION OF EPITHELIAL TISSUE 97

Connective Tissue 103
EXERCISE 5.2 IDENTIFICATION OF EMBRYONIC CONNECTIVE TISSUE 104
EXERCISE 5.3 IDENTIFICATION AND CLASSIFICATION OF CONNECTIVE TISSUE PROPER 105
EXERCISE 5.4 IDENTIFICATION AND CLASSIFICATION OF SUPPORTING CONNECTIVE TISSUE 110
EXERCISE 5.5 IDENTIFICATION AND CLASSIFICATION OF FLUID CONNECTIVE TISSUE 113

Muscle Tissue 113
EXERCISE 5.6 IDENTIFICATION AND CLASSIFICATION OF MUSCLE TISSUE 115

Nervous Tissue 116
EXERCISE 5.7 IDENTIFICATION AND CLASSIFICATION OF NERVOUS TISSUE 117

Chapter 6
Integument 123

HISTOLOGY 126

The Epidermis 126
EXERCISE 6.1 LAYERS OF THE EPIDERMIS 127
EXERCISE 6.2 FINGERPRINTING 128
EXERCISE 6.3 PIGMENTED SKIN 129

The Dermis 130
EXERCISE 6.4 LAYERS OF THE DERMIS 130
EXERCISE 6.5 MEROCRINE (ECCRINE) SWEAT GLANDS AND SENSORY RECEPTORS 131
EXERCISE 6.6 THE SCALP—HAIR FOLLICLES AND SEBACEOUS GLANDS 133
EXERCISE 6.7 AXILLARY SKIN—APOCRINE SWEAT GLANDS 135
EXERCISE 6.8 STRUCTURE OF A NAIL 136

GROSS ANATOMY 137

Integument Model 137
EXERCISE 6.9 OBSERVING CLASSROOM MODELS OF INTEGUMENT 137

Chapter 7
The Skeletal System: Bone Structure and Function 143

HISTOLOGY 146

Bone Tissue 146
EXERCISE 7.1 COMPACT BONE 147
EXERCISE 7.2 SPONGY BONE 148
EXERCISE 7.3 ENDOCHONDRAL BONE DEVELOPMENT 149

GROSS ANATOMY 151

Classification of Bones 151
EXERCISE 7.4 IDENTIFYING CLASSES OF BONES BASED ON SHAPE 152

Structure of a Typical Long Bone 152
EXERCISE 7.5 COMPONENTS OF A LONG BONE 153
EXERCISE 7.6 COW BONE DISSECTION 154

Survey of the Human Skeleton 156
EXERCISE 7.7 THE HUMAN SKELETON 156
Chapter 8
The Skeletal System: Axial Skeleton 161

GROSS ANATOMY 164

Bone Markings 164

The Skull 165
EXERCISE 8.1 ANTERIOR VIEW OF THE SKULL 168
EXERCISE 8.2 ADDITIONAL VIEWS OF THE SKULL 173
EXERCISE 8.3 SUPERIOR VIEW OF THE CRANIAL FLOOR 176
EXERCISE 8.4 BONES ASSOCIATED WITH THE SKULL 178

The Fetal Skull 178
EXERCISE 8.5 THE FETAL SKULL 179

The Vertebral Column 180
EXERCISE 8.6 VERTEBRAL COLUMN REGIONS AND CURVATURES 182
EXERCISE 8.7 STRUCTURE OF A TYPICAL VERTEBRA 183
EXERCISE 8.8 CHARACTERISTICS OF INDIVIDUAL VERTEBRAE 184

The Thoracic Cage 188
EXERCISE 8.9 THE STERNUM 189
EXERCISE 8.10 THE RIBS 190

Chapter 9
The Skeletal System: Appendicular Skeleton 195

GROSS ANATOMY 198

The Pectoral Girdle 198
EXERCISE 9.1 BONES OF THE PECTORAL GIRDLE 199

The Upper Limb 201
EXERCISE 9.2 BONES OF THE UPPER LIMB 203
EXERCISE 9.3 SURFACE ANATOMY REVIEW—PECTORAL GIRDLE AND UPPER LIMB 209

The Pelvic Girdle 210
EXERCISE 9.4 BONES OF THE PELVIC GIRDLE 211

The Lower Limb 214
EXERCISE 9.5 BONES OF THE LOWER LIMB 216
EXERCISE 9.6 SURFACE ANATOMY REVIEW—PELVIC GIRDLE AND LOWER LIMB 223

Chapter 10
Articulations 229

GROSS ANATOMY 232

Fibrous Joints 232
EXERCISE 10.1 FIBROUS JOINTS 232

Cartilaginous Joints 233
EXERCISE 10.2 CARTILAGINOUS JOINTS 234

Synovial Joints 235
EXERCISE 10.3 GENERAL STRUCTURE OF A SYNOVIAL JOINT 235
EXERCISE 10.4 CLASSIFICATION OF SYNOVIAL JOINTS 236
EXERCISE 10.5 PRACTICING SYNOVIAL JOINT MOVEMENTS 238
EXERCISE 10.6 THE KNEE JOINT 239

Chapter 11
The Muscular System: Muscle Structure and Function 247

HISTOLOGY 250

Skeletal Muscle Tissue 250
EXERCISE 11.1 HISTOLOGY OF SKELETAL MUSCLE FIBERS 252
EXERCISE 11.2 CONNECTIVE TISSUE COVERINGS OF SKELETAL MUSCLE 253

The Neuromuscular Junction 253
EXERCISE 11.3 THE NEUROMUSCULAR JUNCTION 255

Cardiac Muscle Tissue 255
EXERCISE 11.4 CARDIAC MUSCLE TISSUE 255

Smooth Muscle Tissue 256
EXERCISE 11.5 SMOOTH MUSCLE TISSUE 256

GROSS ANATOMY 257

Gross Anatomy of Skeletal Muscles 257
EXERCISE 11.6 NAMING SKELETAL MUSCLES 257
EXERCISE 11.7 ARCHITECTURE OF SKELETAL MUSCLES 260

Organization of the Human Musculoskeletal System 261
EXERCISE 11.8 MAJOR MUSCLE GROUPS AND FASCIAL COMPARTMENTS OF THE LIMBS 262
Contents

PHYSIOLOGY 264

Force Generation of Skeletal Muscle 264
EXERCISE 11.9 MOTOR UNITS AND MUSCLE FATIGUE (HUMAN SUBJECT) 265
EXERCISE 11.10 CONTRACTION OF SKELETAL MUSCLE (WET LAB) 266
EXERCISE 11.11 Ph.ILS. LESSON 4: STIMULUS-DEPENDENT FORCE GENERATION 270
EXERCISE 11.12 Ph.ILS. LESSON 7: THE LENGTH-TENSION RELATIONSHIP 271
EXERCISE 11.13 Ph.ILS. LESSON 8: PRINCIPLES OF SUMMATION AND TETANUS 274
EXERCISE 11.14 Ph.ILS. LESSON 9: EMG AND TWITCH AMPLITUDE 275
EXERCISE 11.15 BIOPAC ELECTROMYOGRAPHY (EMG) 276

Chapter 12
The Muscular System: Axial Muscles 283

GROSS ANATOMY 286

Muscles of the Head and Neck 286
EXERCISE 12.1 MUSCLES OF FACIAL EXPRESSION 286
EXERCISE 12.2 MUSCLES OF MASTICATION 289
EXERCISE 12.3 MUSCLES THAT MOVE THE TONGUE 290
EXERCISE 12.4 MUSCLES OF THE PHARYNX 291
EXERCISE 12.5 MUSCLES OF THE NECK 292

Muscles of the Vertebral Column 296
EXERCISE 12.6 MUSCLES OF THE VERTEBRAL COLUMN 296

Muscles of Respiration 300
EXERCISE 12.7 MUSCLES OF RESPIRATION 300

Muscles of the Abdominal Wall 303
EXERCISE 12.8 MUSCLES OF THE ABDOMINAL WALL 303

The Rectus Sheath, Inguinal Ligament, and Inguinal Canal 305
EXERCISE 12.9 THE RECTUS SHEATH, INGUINAL LIGAMENT, AND INGUINAL CANAL 305

Chapter 13
The Muscular System: Appendicular Muscles 311

GROSS ANATOMY 314

Muscles That Act About the Pectoral Girdle/Glenohumeral Joint 314
EXERCISE 13.1 MUSCLES THAT ACT ABOUT THE PECTORAL GIRDLE/GLENOHUMERAL JOINT 314

Upper Limb Musculature 317
EXERCISE 13.2 COMPARTMENTS OF THE ARM 317
EXERCISE 13.3 COMPARTMENTS OF THE FOREARM 320
EXERCISE 13.4 INTRINSIC MUSCLES OF THE HAND 325

Muscles That Act About the Hip Joint/Thigh 327
EXERCISE 13.5 MUSCLES THAT ACT ABOUT THE HIP JOINT/THIGH 329

Lower Limb Musculature 331
EXERCISE 13.6 COMPARTMENTS OF THE THIGH 332
EXERCISE 13.7 COMPARTMENTS OF THE LEG 335
EXERCISE 13.8 INTRINSIC MUSCLES OF THE FOOT 338

PART IV COMMUNICATION AND CONTROL 345

Chapter 14
Nervous Tissues 345

HISTOLOGY 348
EXERCISE 14.1 GRAY AND WHITE MATTER 348

Neurons 349
EXERCISE 14.2 GENERAL MULTIPOLAR NEURONS—ANTERIOR HORN CELLS 350
EXERCISE 14.3 CEREBRUM—PYRAMIDAL CELLS 350
EXERCISE 14.4 CEREBELLUM—PURKINJE CELLS 351

Glia Cells 352
EXERCISE 14.5 ASTROCYTES 352
EXERCISE 14.6 EPENDYMAL CELLS 353
EXERCISE 14.7 NEUROLEMmOCYTES (SchWANN CELLS) 354
EXERCISE 14.8 SATELLITE CELLS 354

Peripheral Nerves 355
EXERCISE 14.9 COVERINGS OF A PERIPHERAL NERVE 356

PHYSIOLOGY 356

Resting Membrane Potential 356
EXERCISE 14.10 Ph.ILS. LESSON 10: RESTING POTENTIAL AND EXTERNAL [K+] 357
EXERCISE 14.11 Ph.ILS. LESSON 11: RESTING POTENTIAL AND EXTERNAL [Na+] 359

Action Potential Propagation 360
EXERCISE 14.12 Ph.ILS. LESSON 12: THE COMPOUND ACTION POTENTIAL 362
EXERCISE 14.13 Ph.ILS. LESSON 13: CONDUCTION VELOCITY AND TEMPERATURE 364
EXERCISE 14.14 Ph.ILS. LESSON 14: REFRACTORY PERIODS 365
Chapter 15
The Brain and Cranial Nerves  371
GROSS ANATOMY  374
The Meninges  374
EXERCISE 15.1 CRANIAL MENINGES  374
Ventricles of the Brain  378
EXERCISE 15.2 BRAIN VENTRICLES  379
EXERCISE 15.3 CIRCULATION OF CEREBROSPINAL FLUID (CSF)  380
The Human Brain  381
EXERCISE 15.4 SUPERIOR VIEW OF THE HUMAN BRAIN  384
EXERCISE 15.5 LATERAL VIEW OF THE HUMAN BRAIN  385
EXERCISE 15.6 INFERIOR VIEW OF THE HUMAN BRAIN  386
EXERCISE 15.7 MIDSAGITTAL VIEW OF THE HUMAN BRAIN  387
Cranial Nerves  388
EXERCISE 15.8 IDENTIFICATION OF CRANIAL NERVES ON A BRAIN OR BRAINSTEM MODEL  388
The Sheep Brain  390
EXERCISE 15.9 SHEEP BRAIN DISSECTION  390
PHYSIOLOGY  398
Testing Cranial Nerve Functions  398
EXERCISE 15.10 TESTING SPECIFIC FUNCTIONS OF THE CRANIAL NERVES  400
Testing Brain Function  407
EXERCISE 15.11 BIOPAC ELECTROENCEPHALOGRAPHY (EEG)  408
EXERCISE 15.6 IDENTIFYING COMPONENTS OF A REFLEX ON A CLASSROOM MODEL  436
Chapter 16
The Spinal Cord, Spinal Nerves, and Reflexes  419
HISTOLOGY  422
Spinal Cord Organization  422
EXERCISE 16.1 HISTOLOGICAL CROSS SECTIONS OF THE SPINAL CORD  422
GROSS ANATOMY  425
The Spinal Cord  425
EXERCISE 16.2 GROSS ANATOMY OF THE SPINAL CORD  426
Peripheral Nerves  427
EXERCISE 16.3 THE CERVICAL PLEXUS  428
EXERCISE 16.4 THE BRACHIAL PLEXUS  429
EXERCISE 16.5 THE LUMBAR AND SACRAL PLEXUSES  432
Somatic Reflexes  435
EXERCISE 16.6 PATELLAR REFLEX  437
EXERCISE 16.8 WITHDRAWAL AND CROSS-EXTENSOR REFLEX  438
EXERCISE 16.9 PLANTAR REFLEX  438
Chapter 17
The Autonomic Nervous System  443
GROSS ANATOMY  446
Autonomic Nervous System  446
EXERCISE 17.1 PARASYMPATHETIC DIVISION  447
EXERCISE 17.2 SYMPATHETIC DIVISION  449
PHYSIOLOGY  451
Autonomic Reflexes  451
EXERCISE 17.3 PUPILLARY REFLEXES  451
EXERCISE 17.4 BIOPAC GALVANIC SKIN RESPONSE  452
Chapter 18
General and Special Senses  459
HISTOLOGY  462
General Senses  462
EXERCISE 18.1 TACTILE (MEISSNER) CORPUSCLES  462
EXERCISE 18.2 LAMELLATED (PACINIAN) CORPUSCLES  463
Special Senses  464
EXERCISE 18.3 GUSTATION (TASTE)  464
EXERCISE 18.4 OLFACTION (SMELL)  466
EXERCISE 18.5 VISION (THE RETINA)  467
EXERCISE 18.6 HEARING  470
GROSS ANATOMY  472
General Senses  472
EXERCISE 18.7 SENSORY RECEPTORS IN THE SKIN  473
Special Senses  474
EXERCISE 18.8 GROSS ANATOMY OF THE EYE  474
EXERCISE 18.9 EXTRINSIC MUSCLES OF THE EYE  478
EXERCISE 18.10 COW EYE DISSECTION  479
EXERCISE 18.11 GROSS ANATOMY OF THE EAR  481
Chapter 19
The Endocrine System  501

HISTOLOGY  504
Endocrine Glands  504
EXERCISE 19.1 THE HYPOTHALAMUS AND PITUITARY GLAND  504
EXERCISE 19.2 THE PINEAL GLAND  507
EXERCISE 19.3 THE THYROID AND PARATHYROID GLANDS  508
EXERCISE 19.4 THE ADRENAL GLANDS  509
EXERCISE 19.5 THE ENDOCRINE PANCREAS—PANCREATIC ISLETS (OF LANGERHANS)  511

GROSS ANATOMY  513
Endocrine Organs  513
EXERCISE 19.6 GROSS ANATOMY OF ENDOCRINE ORGANS  513

PHYSIOLOGY  516
Metabolism  516
EXERCISE 19.7 PH.I.L.S. LESSON 19: THYROID GLAND AND METABOLIC RATE  516
EXERCISE 19.8 A CLINICAL CASE IN ENDOCRINE PHYSIOLOGY  518

PART V  MAINTENANCE AND REGULATION  523

Chapter 20
The Cardiovascular System: Blood  523

HISTOLOGY  526
EXERCISE 20.1 IDENTIFICATION OF FORMED ELEMENTS ON A PREPARED BLOOD SMEAR  526
EXERCISE 20.2 IDENTIFICATION OF MEGAKARYOCYTES ON A BONE MARROW SLIDE  530

GROSS ANATOMY  531
EXERCISE 20.3 IDENTIFICATION OF FORMED ELEMENTS OF THE BLOOD ON CLASSROOM MODELS OR CHARTS  531

PHYSIOLOGY  531
Blood Diagnostic Tests  531
EXERCISE 20.4 DETERMINATION OF LEUKOCYTE COUNTS  533
EXERCISE 20.5 DETERMINATION OF HEMATOCRIT  534
EXERCISE 20.6 DETERMINATION OF HEMOGLOBIN CONTENT  535
EXERCISE 20.7 DETERMINATION OF COAGULATION TIME  536
EXERCISE 20.8 DETERMINATION OF BLOOD TYPE  537
EXERCISE 20.9 DETERMINATION OF BLOOD CHOLESTEROL  539
EXERCISE 20.10 DETERMINATION OF BLOOD GLUCOSE  540

Chapter 21
The Cardiovascular System: The Heart  545

HISTOLOGY  548
EXERCISE 21.1 CARDIAC MUSCLE  548
EXERCISE 21.2 LAYERS OF THE HEART WALL  549

GROSS ANATOMY  550
EXERCISE 21.3 LOCATION OF THE HEART AND THE PERICARDIUM  550
EXERCISE 21.4 GROSS ANATOMY OF THE HUMAN HEART  551
EXERCISE 21.5 THE CORONARY CIRCULATION  556
EXERCISE 21.6 SUPERFICIAL STRUCTURES OF THE SHEEP HEART  558
EXERCISE 21.7 CORONAL SECTION OF THE SHEEP HEART  561
EXERCISE 21.8 TRANSVERSE SECTION OF THE SHEEP HEART  562

PHYSIOLOGY  563
Electrical Conduction Within the Heart  563
EXERCISE 21.9 ELECTROCARDIOGRAPHY USING STANDARD ECG APPARATUS  565
EXERCISE 21.10 BIOPAC LESSON 5: ELECTROCARDIOGRAPHY I  566
### Chapter 22
The Cardiovascular System: Vessels and Circulation

**Blood Vessel Wall Structure**

- **EXERCISE 22.1** Blood Vessel Wall Structure

**Elastic Arteries**

- **EXERCISE 22.2** Elastic Artery—The Aorta

**Muscular Arteries**

- **EXERCISE 22.3** Muscular Artery

**Arterioles**

- **EXERCISE 22.4** Arteriole

**Veins**

- **EXERCISE 22.5** Vein

**Capillaries**

- **EXERCISE 22.6** Observing Electron Micrographs of Capillaries

### Chapter 23
The Lymphatic System and Immunity

**Lymphatic Vessels**

- **EXERCISE 23.1** Lymphatic Vessels

**Mucosa-Associated Lymphatic Tissue (MALT)**

- **EXERCISE 23.2** Tonsils
- **EXERCISE 23.3** Peyer Patches
- **EXERCISE 23.4** The Vermiform Appendix

**Lymphatic Organs**

- **EXERCISE 23.5** The Thymus
- **EXERCISE 23.6** Lymph Nodes
- **EXERCISE 23.7** The Spleen

**GROSS ANATOMY**

- **EXERCISE 23.8** Gross Anatomy of Lymphatic Structures

**PHYSIOLOGY**

- **EXERCISE 23.9** A Clinical Case Study in Immunology

### Chapter 24
The Respiratory System

**Pulmonary Circuit**

- **EXERCISE 24.1** Pulmonary Circuit

**Systemic Circuit**

- **EXERCISE 24.2** Circulation to the Head and Neck
- **EXERCISE 24.3** Circulation to the Brain
- **EXERCISE 24.4** Circulation to the Thoracic and Abdominal Walls
- **EXERCISE 24.5** Circulation to the Abdominal Cavity
- **EXERCISE 24.6** Circulation to the Upper Limb
- **EXERCISE 24.7** Circulation to the Lower Limb

**Fetal Circulation**

- **EXERCISE 24.8** Fetal Circulation

**Blood Pressure and Pulse**

- **EXERCISE 24.9** Blood Pressure and Pulse

**Upper Respiratory Tract**

- **EXERCISE 24.10** Olfactory Mucosa

**Lower Respiratory Tract**

- **EXERCISE 24.11** The Trachea
- **EXERCISE 24.12** The Bronchi and Bronchioles

**Lungs**

- **EXERCISE 24.13** The Lungs

**GROSS ANATOMY**

- **EXERCISE 24.14** Sagittal Section of the Head and Neck

**Lower Respiratory Tract**

- **EXERCISE 24.15** The Larynx
Chapter 27
The Reproductive System and Early Development  751

HISTOLOGY  754

Female Reproductive System  754
EXERCISE 27.1 HISTOLOGY OF THE OVARY  754
EXERCISE 27.2 HISTOLOGY OF THE UTERINE TUBES  758
EXERCISE 27.3 HISTOLOGY OF THE UTERINE WALL  760
EXERCISE 27.4 HISTOLOGY OF THE VAGINAL WALL  761

Male Reproductive System  761
EXERCISE 27.5 HISTOLOGY OF THE SEMINIFEROUS TUBULES  761
EXERCISE 27.6 HISTOLOGY OF THE EPIDIDYMS  763
EXERCISE 27.7 HISTOLOGY OF THE DUCTUS DEFERENS  765
EXERCISE 27.8 HISTOLOGY OF THE SEMINAL VESICLES  766
EXERCISE 27.9 HISTOLOGY OF THE PROSTATE GLAND  767
EXERCISE 27.10 HISTOLOGY OF THE PENIS  768

GROSS ANATOMY  769

Female Reproductive System  769
EXERCISE 27.11 GROSS ANATOMY OF THE OVARY, UTERINE TUBES, UTERUS, AND SUPPORTING LIGAMENTS  769
EXERCISE 27.12 GROSS ANATOMY OF THE FEMALE BREAST  772

Male Reproductive System  774
EXERCISE 27.13 GROSS ANATOMY OF THE SCROTUM, TESTIS, SPERMATIC CORD, AND PENIS  775

PHYSIOLOGY  777

Reproductive Physiology  777
EXERCISE 27.14 A CLINICAL CASE IN REPRODUCTIVE PHYSIOLOGY  781

Fertilization and Development  783
EXERCISE 27.15 EARLY DEVELOPMENT: FERTILIZATION AND ZYGOTE FORMATION  783
EXERCISE 27.16 EARLY DEVELOPMENT: EMBRYONIC DEVELOPMENT  784

Appendix A-1
Credits C-1
Index I-1
Human anatomy and physiology is a complex yet fascinating subject, and is perhaps one of the most personal subjects a student will encounter during his or her education. It is also a subject that can create concern for students because of the sheer volume of material, and the misconception that "it is all about memorization." The study of human anatomy and physiology really comes to life in the anatomy and physiology laboratory, where students get hands-on experience with human cadavers and bones, classroom models, preserved and fresh animal organs, histology slides of human tissues, and explore the process of scientific discovery through physiology experimentation. Yet, most students are at a loss regarding how to approach the anatomy and physiology laboratory. For example, students are often given numerous lists of structures to identify, histology slides to view, and wet labs to conduct, but are given comparatively little direction regarding how to recognize structures, or how to relate what they encounter in the laboratory to the material presented in the lecture. In addition, most laboratory manuals on the market contain little more than material repeated from anatomy and physiology textbooks, which provides no real benefit to a student.

This laboratory manual takes a very focused approach to the laboratory experience, and provides students with tools to make the subject matter more relevant to their own bodies and to the world around them. Rather than providing a recap of material from classroom lectures and the main textbook for the course, this laboratory manual is much more of an interactive workbook for students: a "how-to" guide to learning human anatomy and physiology through touch, dissection, observation, experimentation, and critical thinking exercises. Students are guided to formulate a hypothesis about each experiment before beginning physiology exercises. Diagrams direct students in how to perform experiments, and don’t just show the end results. The text is written in a friendly, conversational tone to put students at ease as they discover, organize, and understand the material presented in each chapter.

**Organization**

Because observation of histology slides, human cadavers or classroom models, and wet lab experiments are usually performed in separate physical spaces or at specific times within each laboratory classroom, chapters in this laboratory manual are similarly separated into three sections: Histology, Gross Anatomy, and Physiology. Each exercise within these chapter sections has been designed with the student’s actual experience in the anatomy and physiology laboratory in mind. Thus, each exercise covers only a single histology slide, classroom model, region of the human body, or wet lab experiment. At the same time, within-chapter "Concept Connection" and "Clinical View" boxes provide an opportunity to integrate the material from all three sections of each chapter. "Learning Strategies" boxes provide mnemonics, study tips, and other helpful hints to assist students in recall of pertinent information. In addition, "Can You Apply What You’ve Learned?" and "Can You Synthesize What You’ve Learned?" questions in Post-Laboratory Worksheets provide further opportunities for students to integrate the information and apply it to clinically relevant and practical situations. Organization of each chapter into a series of discreet exercises makes the laboratory manual easily customizable to any anatomy and physiology classroom, allowing an instructor to assign certain exercises, while telling students to ignore other exercises. Post-Laboratory Worksheets are also organized by exercise and are coded to Learning Objectives within the chapter, which makes it easy for an instructor to assign questions that relate only to the exercises and/or Learning Objectives covered in their classroom.

**Changes to the Second Edition**

*Anatomy & Physiology: An Integrative Approach Laboratory Manual*, second edition, continues to serve as a resource for students both in and out of the lab, providing a "how to" guide for learning anatomy and physiology. The interactive pages within serve as a stand-alone manual, while also complementing the textbook, McKinley/O’Loughlin/Bidle: *Anatomy & Physiology: An Integrative Approach*, second edition. Certain changes to the second edition of this lab manual have been applied throughout all chapters.

- Word origins have been added to tables, where relevant.
- Chapter opening pages now include a list of reference tables.
- Ph.I.L.S. exercises throughout the manual have been updated to correlate with Ph.I.L.S. Version 4.0, including new screen captures to illustrate the software.
- Pre-Laboratory Worksheets and Post-Laboratory Worksheets include a broader variety of question types.
- Drawing circles have been enlarged throughout to allow more space for student drawings.
- Tables have been reorganized to include headings and subheadings for ease of learning.
- Chapters 25 and 26 have been reordered so that the urinary system is presented prior to the digestive system, in alignment with the McKinley/O’Loughlin/Bidle textbook.
- Safety icons have been added throughout the manual to alert students to potential hazards in the lab.
- New content has been added in numerous places throughout the manual, including:
  - three new clinical case studies
  - four new BIOPAC exercises
  - seven additional new exercises
  - thirteen new Concept Connection boxes
  - thirty new Clinical View boxes
  - thirty new Learning Strategy boxes

**Changes by Chapter**

The following is a list of the most significant changes by chapter in the second edition of this lab manual.

**Chapter 1**

- New Learning Strategy on studying anatomy and physiology
- Safety icons emphasizing safe dissection techniques

**Chapter 2**

- New Figure 2.1 The Anatomic Position, Body Planes, and Directional Terms
- New Exercise 2.1B Sectioning a Specimen
- New Figure 2.3 Sections Through a Sheep Heart
Chapter 3
- New Figure 3.3 Loading a Microscope Slide
- Revised Figure 3.5 Estimating Specimen Size
- Revised Concept Connection on the structure and function of cells
- New Clinical View: Nail Fungus

Chapter 4
- Revised Exercise 4.2 Observing Mitosis in a Whitefish Embryo to include space for students to sketch the phases of mitosis
- Revised Figure 4.3 Classroom Model of a Generalized Animal Cell
- Revised Exercise 4.3 Observing Classroom Models of Cellular Anatomy to include space for students to sketch a generalized cell with organelles
- Moved Exercise 4.6 Ph.I.L.S. Lesson 1: Osmosis and Diffusion: Varying Extracellular Concentration to immediately follow laboratory exercises on osmosis and diffusion
- New Learning Strategy on active and passive transport mechanisms

Chapter 5
- New Clinical View: Histopathology
- New Table 5.1 Classification of Epithelial Tissue by Number of Cell Layers
- New Learning Strategy on identifying a histological slide of pseudostratified ciliated columnar epithelial tissue

Chapter 6
- New Exercise 6.2 Fingerprinting
- New Clinical View: Fingerprinting
- Revised Figure 6.11 Classroom Model of the Integument
- New Concept Connection on apocrine sweat glands

Chapter 7
- Revised Concept Connection on bone density to include the influence of pregnancy on calcium deposition
- New Learning Strategy on the zones of the epiphyseal plate and bone growth
- New Concept Connection on the influence of hormones on bone formation
- Revised Clinical View: Bones and Mechanical Stress to include quadriplegics and their struggle with bone density loss due to a lack of stress and loading

Chapter 8
- New introductory text on bone markings
- New Table 8.1 Bone Markings
- New Learning Strategy on relating skeletal structure to function
- New Learning Strategy on the word origins of bones and bone markings
- Revised Table 8.2 The Axial Skeleton: Skull Bones and Important Bony Landmarks to include word origins
- Revised Table 8.3 The Axial Skeleton: Anterior View of the Skull to include word origins
- New Learning Strategy on visualizing structures as they travel through the foramina of the skull

Chapter 9
- Revised Figure 8.12 The Hyoid Bone
- Revised Table 8.4 The Axial Skeleton: Vertebral Column to include word origins
- New Learning Strategy on learning the number of vertebrae in each region of the vertebral column
- Replaced Clinical View: Spina Bifida with new Clinical View: Spondylolisthesis
- New Concept Connection on the atlas and axis
- New Learning Strategy on identifying vertebrae from each region of the vertebral column
- Revised Table 8.5 The Axial Skeleton: Sternum and Ribs to include word origins
- Revised Figure 8.23 A Typical Rib

Chapter 10
- Revised introduction to more clearly explain joint classification
- Reorganized Exercise 10.1 Fibrous Joints to be consistent with Table 10.2 Classification of Fibrous Joints
- Revised Table 10.4 Components of Synovial Joints to include most relevant terms
- Revised Exercise 10.4 Classification of Synovial Joints to include more detailed description of each type of synovial joint
- New Learning Strategy on distinguishing synchondroses and synovial joints
- New Learning Strategy on the structural classification of synovial joints
- New Clinical View: Bursitis
- Revised Concept Connection on movement of synovial joints to include the relationship between mobility and stability in a synovial joint
- New Clinical View: Low Back Pain

Chapter 11
- Revised introduction to more concisely summarize the muscular system and chapter organization
- New Concept Connection on comparing the three types of muscle tissue
- New Clinical View: Muscular Dystrophies
Chapter 12
- Reorganized Exercise 12.1 Muscles of Facial Expression
- New Concept Connection on the facial nerves
- Moved Exercise 12.3 Extrinsic Eye Muscles to Chapter 18
- New Clinical View: Dysphagia
- New Concept Connection on pulmonary ventilation
- New Learning Strategy on learning the external and internal oblique muscles
- New Clinical View: Athletic Pubalgia

Chapter 13
- Revised Gross Anatomy introductory text: Muscles That Act About the Pectoral Girdle/Glenohumeral Joint
- Revised Table 13.1: Muscles That Act About the Pectoral Girdle
- Revised Exercise 13.1: Muscles That Act About the Pectoral Girdle/Glenohumeral Joint to include Exercise 13.1A: Muscles That Act About the Pectoral Girdle and Exercise 13.1B: Muscles That Act About the Glenohumeral Joint
- New Clinical View: Winged Scapula
- Revised Table 13.2: Muscles That Act About the Glenohumeral Joint
- New Learning Strategy for remembering muscles in the forearm
- Reorganized Table 13.6: Posterior (Extensor) Compartment of the Forearm
- Revised Gross Anatomy introductory text: Muscles That Act About the Hip Joint/Thigh
- New Learning Strategy to remember muscles in medial compartment of the thigh
- Revised Table 13.8: Muscles That Act About the Hip Joint/Thigh
- Revised Exercise 13.10: Anterior Compartment of the Hip Joint
- Revised Table 13.9: Anterior Compartment of the Thigh
- New Table 13.10: Posterior Compartment of the Thigh
- New Clinical View: Graciloplasty

Chapter 14
- New Concept Connection on somatic motor neurons
- New Concept Connection on the excitability and conductivity of nervous tissue
- Revised Table 14.3 Glial Cells to include headings for the central nervous system and peripheral nervous system
- New Clinical View: Peripheral Nerve Injury
- New Learning Strategy on membrane potential

Chapter 15
- New Clinical View: Meningiomas
- New Exercise 15.3 Circulation of Cerebrospinal Fluid (CSF)
- New Figure 15.5 Cerebrospinal Fluid (CSF) Production and Circulation
- Reorganized Table 15.3 Brain Structures Visible in Superficial Views of Whole or Sagittally Sectioned Brains
- New Clinical View: Vasovagal Syncope
- New Clinical View: Cranial Nerve Assessment
- New Exercise 15.11 BIOPAC Electroencephalography (EEG), and corresponding figures for experiment setup and data collection

Chapter 16
- Chapter renamed The Spinal Cord, Spinal Nerves, and Reflexes
- Revised Table 16.1 Regional Characteristics of the Spinal Cord to include word origins
- Reorganized Table 16.2 Histology of the Spinal Cord in Cross Section
- Reorganized Table 16.5 Major Nerves of the Brachial Plexus
- Revised Exercise 16.5 The Lumbar and Sacral Plexuses
- Reorganized original Table 16.6 into Table 16.6 Major Nerves of the Lumbar Plexus and Table 16.7 Major Nerves of the Sacral Plexus
- New Gross Anatomy section on somatic reflexes
- New Exercise 16.6 Identifying Components of a Reflex on a Classroom Model (moved from chapter 17)
- New section on Reflex Physiology
- New Exercise 16.7 Patellar Reflex (moved from chapter 17)
- New Clinical View: Babinski Reflex (moved from chapter 17)
- New Exercise 16.8 Withdrawal and Crossed-Extensor Reflex
- New Exercise 16.9 Plantar Reflex (moved from chapter 17)

Chapter 17
- Chapter renamed The Autonomic Nervous System
- New Learning Strategy on the two divisions of the autonomic nervous system
- Revised introductory text for the Gross Anatomy of the Autonomic Nervous System
- Revised Figure 17.2 Overview of the Parasympathetic Division of the ANS
- New Clinical View: Pheochromocytoma
- New Exercise 17.4 BIOPAC Galvanic Skin Response, and corresponding figures for experiment setup and data collection

Chapter 18
- Revised Table 18.2 Cells Associated with Taste Buds to include word origins
- New Concept Connection on olfaction and the ethmoid bone
- Revised Figure 18.10 Skin
- Revised Exercise 18.8 Gross Anatomy of the Eye to include Exercise 18.8A Accessory Structures of the Eye and Exercise 18.8B Internal Structures of the Eye
- Revised Figure 18.11 Accessory Structures of the Eye (a) Classroom model
- Revised Figure 18.12 Classroom Model of the Internal Eye
- New Exercise 18.9 Extrinsic Eye Muscles (moved from Chapter 12)
New Learning Strategy on remembering extrinsic eye muscle innervation
Revised Figure 18.13 Extrinsic Eye Muscles
New Clinical View: Pressure Changes in the Middle Ear
New Exercise 18.17D Color Blindness
Reorganized Exercise 18.18 Hearing Tests and Exercise 18.19 Equilibrium Tests

Chapter 19
New Learning Strategy on hormones secreted by the anterior pituitary gland
New Concept Connection on hormones secreted by the pituitary gland
Revised Figure 19.6 Adrenal Glands
New Clinical View: Anabolic Steroids
New Exercise 19.8 A Clinical Case in Endocrine Physiology

Chapter 20
Reoriented Table 20.3 Leukocyte Characteristics for better readability
Revised Blood Diagnostic Tests to provide introductory text with each physiology exercise
Revised Figure 20.6 Separation of a Whole Blood Sample by Centrifugation
New Table 20.4 Normal Ranges for Laboratory Blood Tests
New Learning Strategy for learning the relative abundance of leukocytes in the blood
New Clinical View: Blood Type Abundance
New Exercise 20.10 Determination of Blood Glucose
New Figure 20.12 Blood Glucose Testing
New Clinical View: Hemoglobin A1c (Glycated Hemoglobin)

Chapter 21
Revised Exercise 21.3 Location of the Heart and the Pericardium
New Learning Strategy on remembering the atrioventricular valves on the right versus the left side of the heart
Reorganized Table 21.3 Arterial Supply to the Heart
New Clinical View: Myocardial Infarction
New Exercise 21.9 Electrocardiography Using Standard ECG Apparatus
New Figure 21.19 Interpreting an ECG Tracing
New Exercise 21.10 BIOPAC Lesson 5: Electrocardiography I, and corresponding figures for experiment setup and data collection

Chapter 22
New Concept Connection on endothelium
New Clinical View: Great Saphenous Vein and Varicose Veins
New Clinical View: Atherosclerosis in the Internal Carotid Artery
Revised Figure 22.11 Circulation to the Thoracic and Abdominal Walls
New Clinical View: Cardiac Catheterization via the Femoral Artery

Chapter 23
Reorganized the order of chapter topics and exercises: thymus, lymph nodes, and the spleen
New Clinical View: Appendicitis

Chapter 24
New Learning Strategy on structure and function of the trachea
New Clinical View: Tuberculosis
New Learning Strategy to remember the lobes of the right versus the left lung
Revised Exercise 24.12 Pulmonary Function Tests to include Exercise 24.12A Wet Spirometry and Exercise 24.12B BIOPAC Lesson 12: Pulmonary Function Tests

Chapter 25
Reorganized Table 25.1 Histological Features of the Kidney to include headings and subheadings
New Clinical View: Glomerulonephritis

Chapter 26
New Learning Strategy on distinguishing between gastric pits and gastric glands
New Learning Strategy on distinguishing the three parts of the small intestine
Revised Figure 26.5 The Small Intestine
New Learning Strategy on histology of the pancreas
New Exercise 26.8 Overview of the GI Tract
New Figure 26.10 Overview of the Digestive System
Reorganized Table 26.6 Gross Anatomic Regions and Features Associated with the Stomach
Revised Figure 26.12 Classroom Model of the Stomach
Reorganized Table 26.7 Gross Anatomic Features of the Liver, Gallbladder, Pancreas, and Their Associated Ducts
Reorganized Table 26.9 The Cecum, Large Intestine, Rectum, and Anus
New Figure 26.17 The Cecum, Large Intestine, and Rectum
Revised Learning Strategy to a Concept Connection on motility in the GI tract
New Exercise 26.15 A Clinical Case Study in Digestive Physiology

Chapter 27
New Learning Strategy on recognizing follicles in various developmental stages
Reorganized Table 27.4 Components of the Uterine Tube
Reorganized Table 27.5 Phases of the Menstrual Cycle
New Clinical View: Erectile Dysfunction
New Concept Connection on lactation
Revised Table 27.14 Pre-Embryonic Period
Revised Table 27.15 Stages of Embryonic Development
The Eckel/Ross/Bidle: Anatomy & Physiology Laboratory Manual works well as a complement to the McKinley/O’Loughlin/Bidle: Anatomy & Physiology: An Integrative Approach textbook, or to accompany any other anatomy and physiology text. Each chapter opener includes an outline that lists a set of learning objectives for the chapter.

- A chapter introduction opens with a real-life scenario that emphasizes the section of the body covered in the chapter, to connect the anatomy of our bodies with the physiology that helps us to perform day-to-day activities.

- The laboratory manual exhibits the highest-quality photographs and illustrations of any laboratory manual on the market.

**Features**

Introduction opens with a real-life scenario that emphasizes the section of the body covered in the chapter, to connect the anatomy of our bodies with the physiology that helps us to perform day-to-day activities.

The laboratory manual exhibits the highest-quality photographs and illustrations of any laboratory manual on the market.
The content of the laboratory manual is informed by the textbook, and both the textbook and the laboratory manual share similar pedagogic elements: Concept Connection, Learning Strategy, and Clinical View features from the text are also employed in the laboratory manual.

- **Integrate: Concept Connection** boxes draw concepts from the classroom into the laboratory for a real-time review of how previously covered concepts relate to body systems.
- **Integrate: Learning Strategy** boxes offer tried-and-tested learning strategies that consist of everyday analogies, mnemonics, and useful tips to aid understanding and memory.
- **Integrate: Clinical View** sidebars reinforce facts through a clinical discussion of what happens when the body doesn’t perform normally.

---

**Concept Connection**

Recall that the gray matter of the spinal cord contains primarily neuron cell bodies, dendrites, and unmyelinated axons. In addition, gray matter also contains various types of neurons (e.g., motor neurons, somatic sensory neurons), which are typically confined within a defined area of the gray matter. Motorsom somatic motor neurons become “excited” within the anterior horn of gray matter within the spinal cord, and its axon exits the central nervous system through the anterior root. It then joins a spinal nerve and ultimately travels to individual muscle fibers within a skeletal muscle. An action potential traveling along a somatic motor neuron will excite the muscle fibers, causing an increase in force in the thoracic autonomic e system by lateral rotation of the thigh is stronger than the gluteus medius and gluteus minimus muscles (which are responsible for medial rotation of the thigh).

---

**Learning Strategy**

To identify superficial muscles and tendons, place your left palm on the medial epicondyle of your right humerus. In this position, the order of the muscles on your right forearm, from lateral to medial, is:

1. Index finger—pronator teres (PT)
2. Middle finger—flexor carpi radialis (FCR)
3. Ring finger—flexor digitorum superficialis (FLS)
4. Pinky finger—flexor carpi ulnaris (FCU)
5. Palmaris longus (PL)
6. Pronator teres (PT)
7. Flexor digitorum profundus (FDP)
8. Flexor carpi ulnaris (FCU)
9. Flexor carpi radialis (FCR)
10. Palmaris longus (PL)

---

**Clinical View**

The piriformis muscle is a “pear-shaped” muscle that lies in close proximity to important structures within the gluteal region, such as the sciatic nerve, and the gluteal arteries and nerves. Piriformis syndrome is a painful condition that results from inflammation or overuse of the piriformis muscle. The incidence of piriformis syndrome is relatively common in athletes such as runners and cyclists, who may develop an imbalance in the strength of the piriformis muscle as compared to the gluteal muscles. Specifically, the syndrome occurs when the piriformis muscle (which laterally rotates the thigh) is stronger than the gluteus medius and gluteus minimus muscles (which are responsible for medial rotation of the thigh).

As the piriformis muscle becomes inflamed or experiences spasms, it may also compress the underlying sciatic nerve, resulting in sciatica. Sciatica is a tingling, painful, or even numbing sensation that travels down the path of the sciatic nerve. Patients complain of shooting pain that runs from the gluteal region down the lateral aspect of the thigh, and toward the leg. Often the pain may be exacerbated when the body is held in certain positions, such as prolonged sitting or standing. The symptoms of piriformis syndrome can be reduced with the administration of anti-inflammatory drugs and through stretching exercises.

---

**Pre-Laboratory Worksheets** at the start of each chapter consist of important refresher points to provide students with a “warm-up” before entering the laboratory classroom. Some questions pertain to previous activities that are relevant to upcoming exercises, while others are basic questions that students should be able to answer if they have read the chapter from their lecture text before coming into the laboratory classroom. The goal of completing these worksheets is to have students arrive at the laboratory prepared to deal with the material they will be covering, so valuable laboratory time isn’t lost in reviewing necessary information. All Pre-Laboratory Worksheet questions are assignable within Connect.
In-chapter activities offer a mixture of labeling exercises, sketching activities, table completion exercises, data recording and analysis, palpation of surface anatomy, and other sources of learning. In the gross anatomy exercises of this manual, structures such as cranial bones and muscles of the body are not always presented as labeled photos, since students already have labeled photos provided in their anatomy and physiology textbook. Instead, images are presented as labeling activities with a checklist of structures. The checklists serve two purposes: (1) they guide students to items they should be able to identify on classroom models, fresh specimens, or cadavers (if the laboratory uses human cadavers), and (2) they double as a list of terms students can use to complete the labeling activities. Answers to the labeling activities are provided in the Appendix. Thus, if a student does not know what a leader line is pointing to, or cannot remember the correct term, the Appendix serves as a resource for locating the correct answer.

Anatomy & Physiology Revealed® (APR) correlations, indicated by the APR logo, direct students to related content in this cutting-edge software.

Each chapter contains numerous tables, which concisely summarize critical information and key structures and serve as important points of reference while in the laboratory classroom. Most tables contain a column that provides word origins for each structure listed within the table. These word origins are intended to give students continual exposure to the origins of the language of anatomy and physiology, which is critical for learning and retention.

Numerous Physiology Interactive Lab Simulations® (Ph.I.L.S.) 4.0 exercises throughout the laboratory manual make otherwise difficult and expensive experiments a breeze, and offer additional opportunities to aid student understanding of physiology.

BIOIPAC® exercises are included in chapters 11, 15, 17, 21, 22, and 24.

Post-Laboratory Worksheets at the end of each chapter serve as a review of the materials just covered, and challenge students to apply knowledge gained in the laboratory. The Post-Laboratory Worksheets contain in-depth critical thinking question types, and are perforated so they can be torn out and handed in to the instructor, if so desired. Assessment questions are organized by exercise, and are keyed to the Learning Objectives from the chapter opener outline.

*Do You Know the Basics?* questions quiz students on the material they have just learned in the chapter, using a variety of question formats including labeling, table completion, matching exercises, and fill-in-the-blank.

*C an You Apply What You’ve Learned?* questions are often clinically oriented and expose health-sciences students to problem solving in clinical contexts.

*C an You Synthesize What You’ve Learned?* questions combine concepts learned in the chapter to ensure student understanding of each chapter’s objectives.
Teaching Supplements

Answers to the Pre-Laboratory and Post-Laboratory Worksheets can be found within the Instructor’s Manual for this Laboratory Manual within Connect, by accessing the McKinley/O’Loughlin/Bidle: Anatomy & Physiology, 2nd edition Instructor Resources. Image files for use in presentations and teaching materials are also provided for instructor use at this location.

Anatomy & Physiology Revealed®:
An Interactive Cadaver Dissection Experience

Available online at www.aprevealed.com, and as an APR application on Apple® and Android™ tablets, this amazing multimedia tool is designed to help students learn and review human anatomy using cadaver specimens. Detailed cadaver photographs blended with a state-of-the-art layering technique provide a uniquely interactive dissection experience. This easy-to-use program features the following sections:

- **Dissection**: Peel away layers of the human body to reveal the structures beneath the surface. Structures can be pinned and labeled, just as in a real dissection lab. Each labeled structure is accompanied by detailed information and an audio pronunciation. Dissection images can be captured and saved.

- **Animation**: Compelling animations demonstrate muscle action, clarify anatomical relationships, and explain difficult concepts.

- **Histology**: Labeled light micrographs presented with each body system allow students to study the cellular detail of tissues at their own pace.

- **Imaging**: Labeled X-ray, MRI, and CT images familiarize students with the appearance of key anatomical structures as seen through different medical imaging techniques.

- **Self-test**: Challenging exercises let students test their ability to identify anatomical structures in a timed practical exam format or with traditional multiple choice questions. A results page provides an analysis of test scores plus links back to all incorrectly identified structures for review.

- **Anatomy Terms**: This visual glossary of general terms includes directional and regional terms, as well as planes and terms of movement.

Instructors may customize APR 3.0 to their course by selecting the specific structures they require in their course, and APR 3.0 does the rest. Once the structure list is generated, APR highlights these selected structures for students. APR contains all the material covered in an A&P course, including these three new modules:

- **Body Orientation**
- **Cells and Chemistry**
- **Tissues**

APR is now available in two new versions!

Anatomy & Physiology Revealed | Cat® and Anatomy & Physiology Revealed | Fetal Pig® are online interactive cat dissection and fetal pig dissection experiences that use cat photos or fetal pig photos, combined with a layering technique that allows you to peel away layers to reveal structures beneath the surface. Both Anatomy & Physiology Revealed | Cat and Anatomy & Physiology Revealed | Fetal Pig offer animations, histologic and radiologic imaging, audio pronunciations, and comprehensive quizzing.
Physiology Interactive Lab Simulations© (Ph.I.L.S.) offers 42 lab simulations that may be used to supplement or substitute for wet labs. Users may adjust variables, view outcomes, make predictions, draw conclusions, and print lab reports.

McGraw-Hill LearnSmart Labs™
THE Virtual Lab Experience

Based on the same world-class super-adaptive technology as LearnSmart, McGraw-Hill’s LearnSmart Labs™ are must-see, outcomes-based lab simulations. LearnSmart Labs assess a student’s knowledge and adaptively correct deficiencies, allowing the student to learn faster and retain more knowledge with greater success.

First, a student’s knowledge is adaptively leveled on core learning outcomes: questioning reveals knowledge deficiencies that are corrected by the delivery of content that is conditional on a student’s response. Then, a simulated lab experience requires the student to think and act like a scientist: recording, interpreting, and analyzing data using simulated equipment found in labs and clinics. The student is allowed to make mistakes—a powerful part of the learning experience! A virtual coach provides subtle hints when needed, asks questions about the student’s choices, and allows the student to reflect upon and correct those mistakes. Whether your need is to overcome the logistical challenges of a traditional lab, provide better lab prep, improve student performance, or make your online experience one that rivals the real world, LearnSmart Labs accomplishes it all.

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To the users of this laboratory manual: We sincerely hope we have created a learning resource that not only will excite you about the study of anatomy and physiology, but also will actively engage you in the laboratory as you learn about the wonders of the human body. We welcome your thoughts and suggestions for improvements.

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