Anatomy and Physiology for Health Professionals

Jahangir Moini, MD, MPH
Professor of Allied Health Sciences
Everest University
Melbourne, Florida
This book is dedicated to
my granddaughter, Laila Jade Mabry.
# Brief Contents

## UNIT I  Levels of Organization  1

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Introduction to Human Anatomy and Physiology</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>Chemical Basics of Life</td>
<td>17</td>
</tr>
<tr>
<td>3</td>
<td>Cells</td>
<td>29</td>
</tr>
<tr>
<td>4</td>
<td>Cellular Metabolism</td>
<td>41</td>
</tr>
<tr>
<td>5</td>
<td>Tissues</td>
<td>53</td>
</tr>
</tbody>
</table>

## UNIT II  Support and Movement  67

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>Integumentary System</td>
<td>69</td>
</tr>
<tr>
<td>7</td>
<td>Skeletal System</td>
<td>81</td>
</tr>
<tr>
<td>8</td>
<td>Muscular System</td>
<td>105</td>
</tr>
</tbody>
</table>

## UNIT III  Control and Coordination  125

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>Nervous System</td>
<td>127</td>
</tr>
<tr>
<td>10</td>
<td>The Senses</td>
<td>153</td>
</tr>
<tr>
<td>11</td>
<td>Endocrine System</td>
<td>169</td>
</tr>
</tbody>
</table>

## UNIT IV  Transport  187

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>Blood</td>
<td>189</td>
</tr>
<tr>
<td>13</td>
<td>Cardiovascular System</td>
<td>207</td>
</tr>
<tr>
<td>14</td>
<td>Lymphatic System and Immunity</td>
<td>229</td>
</tr>
<tr>
<td>UNIT V</td>
<td>Environmental Exchange</td>
<td>245</td>
</tr>
<tr>
<td>---------</td>
<td>------------------------</td>
<td>-----</td>
</tr>
<tr>
<td>Chapter 15</td>
<td>Respiratory System</td>
<td>247</td>
</tr>
<tr>
<td>Chapter 16</td>
<td>Urinary System</td>
<td>263</td>
</tr>
<tr>
<td>Chapter 17</td>
<td>Fluid, Electrolyte, and Acid–Base Balance</td>
<td>277</td>
</tr>
<tr>
<td>Chapter 18</td>
<td>Digestive System</td>
<td>287</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>UNIT VI</th>
<th>Continuity of Life</th>
<th>315</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chapter 19</td>
<td>Reproductive System</td>
<td>317</td>
</tr>
<tr>
<td>Chapter 20</td>
<td>Pregnancy and Development</td>
<td>339</td>
</tr>
</tbody>
</table>
Contents

Preface xi
Acknowledgments xiii
About the Author xv
Reviewers xvii

UNIT I Levels of Organization 1

Chapter 1 Introduction to Human Anatomy and Physiology 3
Anatomy and Physiology Overview 4
Organization Levels of the Body 4
Essentials for Life 5
Organization of the Body 6
Summary 12

Chapter 2 Chemical Basics of Life 17
Atoms, Molecules, and Chemical Bonds 18
Chemical Constituents of Cells 22
Summary 25

Chapter 3 Cells 29
Structure of the Cell 30
Movements Through Cell Membranes 34
The Cell Life Cycle 36
Summary 37

Chapter 4 Cellular Metabolism 41
Metabolic Reactions 42
Control of Metabolic Reactions 44
Chemical Energy 45
Summary 47

Chapter 5 Tissues 53
Types of Tissues 54
Types of Membranes 63
The Effects of Aging on Various Tissues 63
Summary 63

UNIT II Support and Movement 67

Chapter 6 Integumentary System 69
Skin 70
Accessory Structures 73
Functions of the Skin 75
The Response of the Integument to Injuries and Wounds 75
The Effects of Aging on the Integumentary System 76
Skin Cancer 76
Burns 77
Summary 77

Chapter 7 Skeletal System 81
Classifications of Bones 83
Functions of Bones 84
Growth and Development of Bones 85
Bone Cells 86
Skeletal Organization 87
The Effects of Aging on the Skeletal System 100
Summary 102
### Contents

**UNIT III Control and Coordination 125**

**Chapter 9 Nervous System 127**
- Nervous System Functions 130
- Nerve Cells 130
- Neurons 131
- Synapses 133
- Cell Membrane Potential 133
- Nerve Impulses 134
- Synaptic Transmission 135
- Processing of Impulses 136
- Types of Nerves 137
- Nerve Pathways 137
- Meninges 138
- The Spinal Cord 138
- The Brain 140
- Peripheral Nervous System 142
- Autonomic Nervous System 145
- The Effects of Aging on the Nervous System 149
- Summary 149

**Chapter 10 The Senses 153**
- Types of Receptors 154
- The General Senses 155
- The Special Senses 156
- The Effects of Aging on the Senses 165
- Summary 166

**Chapter 11 Endocrine System 169**
- The Endocrine System 171
- Actions of Hormones 171
- Control of Hormones 173
- The Pituitary Gland 173
- The Thyroid Gland 177
- The Parathyroid Glands 178
- The Adrenal Glands 179

**UNIT IV Transport 187**

**Chapter 12 Blood 189**
- Red Blood Cells 190
- White Blood Cells 194
- Platelets 196
- Plasma 196
- Hemostasis 198
- Blood Types and Transfusions 200
- The Effects of Aging on the Blood 202
- Summary 202

**Chapter 13 Cardiovascular System 207**
- Structures of the Heart 209
- Functions of the Heart 212
- Blood Vessels 215
- Blood Pressure 217
- Blood Circulation 218
- The Arteries 219
- The Veins 221
- The Effects of Aging on the Cardiovascular System 223
- Summary 223

**Chapter 14 Lymphatic System and Immunity 229**
- Organization of the Lymphatic System 231
- Tissue Fluid and Lymph Formation 231
- Movement of Lymph 232
- Lymph Nodes 233
- The Thymus 233
- The Spleen 234
- Body Defenses and Fighting Infection 234
- Innate (Nonspecific) Defenses 234
- Immunity (Specific Defenses) 236
- The Effects of Aging on the Lymphatic System and Immunity 241
- Summary 242

**Chapter 8 Muscular System 105**
- Skeletal Muscles 106
- Contraction of Skeletal Muscles 109
- Smooth Muscles 118
- Cardiac Muscle 120
- The Effects of Aging on the Muscular System 122
- Summary 122

**The Pancreas 180**
- Other Glands 181
- Stress 182
- The Effects of Aging on the Endocrine System 184
- Summary 184
## UNIT V  Environmental Exchange 245

### Chapter 15  Respiratory System 247
- Organization of the Respiratory System 249
- Respiration 251
- Control of Breathing 255
- Gas Exchange 257
- Gas Transport 257
- The Effects of Aging on the Respiratory System 259
- Summary 259

### Chapter 16  Urinary System 263
- The Kidneys 264
- The Ureters 271
- The Urinary Bladder 272
- The Urethra 273
- The Effects of Aging on the Urinary System 273
- Summary 273

### Chapter 17  Fluid, Electrolyte, and Acid–Base Balance 277
- Body Fluid Distribution 278
- Fluid Balance 279
- Fluid Losses and Gains 280
- Electrolyte Balance 280
- Acid–Base Balance 281
- Imbalances 282
- The Effects of Water, Electrolyte, and Acid–Base Balance on Aging 283
- Summary 283

### Chapter 18  Digestive System 287
- The Alimentary Canal 290
- Functions of the Digestive System 291
- Movement of Digestive Materials 291

## UNIT VI  Continuity of Life 315

### Chapter 19  Reproductive System 317
- The Male Reproductive System 319
- The Female Reproductive System 324
- Birth Control 331
- Sexually Transmitted Diseases 333
- The Effects of Aging on the Reproductive System 334
- Summary 335

### Chapter 20  Pregnancy and Development 339
- Pregnancy 340
- Prenatal Development 341
- Postnatal Development 350
- Genetics 351
- Summary 355

## Glossary 359

## Answer Key 381

## Index 385

## Photo Credits 403
Preface

After 20 years of teaching anatomy and physiology, I have utilized numerous books related to this subject. Some of them were very high-level, and some were very low. I couldn’t find a “middle ground” book that really taught the subject to allied health students. Therefore, I undertook the writing of this book.

Anatomy and physiology are core areas of knowledge for allied health students. For them, the material must be easy to understand for the most part, yet still deal with information that their future careers will require. This textbook contains 20 chapters organized into 6 units. It features a complete glossary containing all of the key terms. Each chapter contains objectives that are answered as learning goals, Check Your Knowledge boxes, many tables and figures, critical thinking questions, relevant website addresses, and 15 multiple choice questions.

This book is also accompanied by extensive student resources. Visit http://go.jblearning.com/AandP to learn more.
Acknowledgments

I would like to acknowledge the following individuals for their time and efforts in aiding with their contributions to this book.

Morvarid Moini, Designer
University of Central Florida

Greg Vadimsky, Manuscript Assistant
Melbourne, Florida

I would like to thank the entire staff of Jones & Bartlett Learning, especially David Cella and Maro Gartside.

I would also like to thank the reviewers who gave their time and guidance in helping me to complete this book.
About the Author

Dr. Moini was assistant professor at Tehran University School of Medicine for nine years, where he taught medical and allied health students. The author is a professor and former director (for 15 years) of allied health programs at Everest University (EU).

Dr. Moini established several programs at EU’s Melbourne campus.

As a physician and instructor for the past 35 years, he advocates that all health professionals must understand the structures and functions of the human body. Other sciences such as pathology, pharmacology, and chemistry are correlated with the knowledge of anatomy and physiology.

Dr. Moini is actively involved in teaching and helping students prepare for service in various health professions. He has been an internationally published author of various allied health books since 1999.
Reviewers

Anne M. Burrows, PhD
Associate Professor
Duquesne University

Bruce W. Craig, PhD, FNCSA
Human Performance Laboratory
Ball State University

Mark H. Crosthwaite, MEd, CNMT, PET
Associate Professor and Program Director,
Nuclear Medicine Technology
Virginia Commonwealth University

Catherine C. Dawson, MPA, OTR/L
Assistant Professor
Tuskegee University

Grace Hardie, PhD, RN
Associate Professor
San Francisco State University
School of Nursing

Georgette Howard, RN, MN
Nursing Assistant Program Coordinator
Glendale Community College

Nancy Kupper, RN, MSN
Associate Professor
Tarrant County College, Department of Nursing

Jose M. Milan, PTA, BS
Physical Therapist Assistant Program
Austin Community College

© Jones & Bartlett Learning, LLC. NOT FOR SALE OR DISTRIBUTION