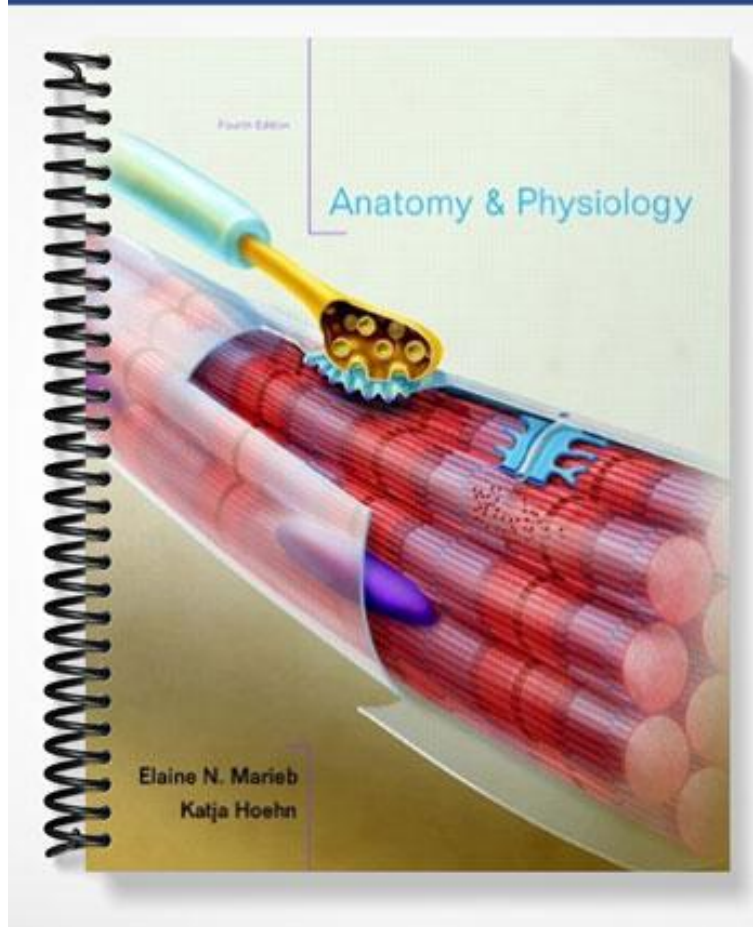


# SOLUTIONS MANUAL



# Instructor Resource Guide

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# Anatomy & Physiology

Fourth Edition

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This Instructor Resource Guide is adapted  
from the *Human Anatomy & Physiology*, Eighth Edition  
Instructor Guide to Text and Media by Theresa Bissell and Laura Steele.

**Benjamin Cummings**

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# Preface

This Instructor Resource Guide has been updated and revised to accompany *Anatomy & Physiology*, Fourth Edition, by Elaine N. Marieb and Katja Hoehn. Each chapter has been outlined in a way that we hope benefits you in your use of the text and instruction of your classes. At the beginning of each chapter is a list of chapter objectives that correspond with those listed in each section of the chapter. A detailed Suggested Lecture Outline is provided for each chapter to aid you in developing your own course outline. Additionally, there are Cross References that point you to concepts in other chapters of the text to facilitate integration of other information. Each chapter contains Lecture Hints and Activities/Demonstrations that may be beneficial in presenting material in a way that makes it more meaningful for students. There are also Critical Thinking/Discussion Topics, as well as Library Research Topics, to be used in class discussion or as outside assignments that may enhance your students' understanding of the lectured material.

A number of resources are listed in the chapters of this instructor guide that may be useful in making your presentations more engaging or effective. Laboratory Correlations, Multimedia in the Classroom and Lab (including descriptive listings of videos and software as well as online resources for students), and Lecture Enhancement Materials (transparency acetates and images found on the Instructor Resource DVD) are available to coordinate with your lecture. A Suggested Reading list includes articles relevant to the system covered by the chapter. In addition, Answers to End-of-Chapter Short Essay Questions are provided with page references pointing to the main text.

Appendix A is a guide to audiovisual distributors and their contact information. Appendix B contains Interactive Physiology® Exercise Sheets, created by Dr. Shirley White-scarver and Brian Witz, for use with the *Interactive Physiology® 10-System Suite*. Answers to these Exercise Sheet questions can be found in Appendix C. Finally, Appendix D includes a Correlation Guide between selected review questions from the main text and the A.D.A.M.® Interactive Anatomy (AIA) CD-ROM, version 4.0. This helps students find the most relevant view to help them answer questions that require critical reasoning.

An electronic version of this guide and other instructor supplements are available to download at the Pearson Higher Education-Benjamin Cummings catalog page. Visit [www.pearsonhighered.com](http://www.pearsonhighered.com) and select instructor resources for *Anatomy & Physiology*, Fourth Edition, by Elaine Marieb and Katja Hoehn.

The Internet is a tremendous resource for you and your students to find additional information on A&P topics. For a general listing of A&P websites, search for "anatomy" or "physiology" on search engines such as Google or Yahoo. Here are a few websites that you might find useful, but keep in mind that we cannot guarantee that these links will remain active.

**[www.medtropolis.com](http://www.medtropolis.com)** The Virtual Body includes interactive presentations on various body systems, including animations, narrations, and quizzes.

**[www.nlm.nih.gov](http://www.nlm.nih.gov)** The U.S. National Library of Medicine includes general health information as well as the Visible Human Project, which creates anatomical images of the male and female human body.

**www.nlm.nih.gov/medlineplus** Medline is a health database maintained by the National Institutes of Health's National Library of Medicine.

**www.nih.gov** The National Institutes of Health is an excellent resource for general health information; a good source of research topics.

**www.npac.syr.edu** The Northeast Parallel Architectures Center at Syracuse University has created the Visible Human Viewer (based on the Visible Human Project), which allows you to examine a cadaver layer by layer from different views.

Anatomy and physiology are fascinating disciplines that students are always enriched by. We hope that you find this guide a valuable partner in your teaching effort, and that the resources listed within allow you to present an effective and enjoyable learning experience for your students. Comments and suggestions are always welcome. They may be sent care of Benjamin Cummings, 1301 Sansome Street, San Francisco, CA, 94111.

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# What's New: Chapter-by-Chapter Changes in *Anatomy & Physiology*, Fourth Edition

## Chapter 1 The Human Body: An Orientation

- New separate section for each different survival need
- New style introduced for homeostatic imbalance figures, carried throughout the book

## Chapter 2 Chemistry Comes Alive

- A new tabbed head format has been added to selected molecular figures throughout this chapter, allowing for comparison of different types of molecules and reactions. Comparison examples include:
  - New figure comparing three basic types of mixtures, with photos (Figure 2.4)
  - New figure comparing dehydration synthesis and hydrolysis (Figure 2.14)
- Updated information on molecular chaperones<sup>1</sup>

## Chapter 3 Cells: The Living Units

- Figures have been reconceptualized and text has been added to provide steps that guide students through challenging cellular processes:
  - New step art for exocytosis (Figure 3.14)
  - Updated discussion of types of endocytosis accompanied by new endocytosis step art (Figure 3.12)
  - New figure provides a comparison of three types of endocytosis (Figure 3.13)
  - A new student-friendly explanation of how G proteins regulate cellular activities and their mechanisms of action, accompanied by new step art (Figure 3.16)
  - New figure on the signaling mechanism for targeting new proteins to the ER (Figure 3.20)
- New Focus Figures in this chapter guide students through the key concepts that are most difficult to grasp:
  - Focus on Primary Active Transport: The Na<sup>+</sup>-K<sup>+</sup> Pump (Figure 3.10)
  - Focus on G Proteins (Figure 3.16)
  - Focus on Mitosis (Figure 3.33)
- New figures and photos:
  - New diagrams accompany photos in figure, showing the effects of varying tonicity on living red blood cells (Figure 3.9)
  - New photomicrographs accompany cell organelle illustrations
- New information on the origin of peroxisomes based on recent research:<sup>2</sup>
  - New figure on microvilli features photomicrograph (Figure 3.28). New section on microvilli in Cellular Extensions section.
  - New overview of three stages of transcription, structuring text description to match Figure 3.35; rearranged and revised text discussion and Figure 3.37 on translation for clarity

## Chapter 4 Tissue: The Living Fabric

- New Figure 4.1, Overview of Four Tissue Types, provides overview before getting into the details
- New photomicrographs for pseudostratified ciliated columnar epithelium (Figure 4.3d), goblet cells (Figure 4.4), and elastic connective tissue (Figure 4.8f)
- New Table 4.1 compares four main classes of connective tissue

## Chapter 5 The Integumentary System

- New Figure 5.3, Two Regions of the Dermis, with three new photomicrographs
- New Figure 5.4, Dermal Modifications Result in Characteristic Skin Markings, with new photomicrograph
- New paragraph covers how changes in nail color help to diagnose certain conditions
- New photos show partial-thickness and full-thickness burns (Figure 5.10)

## Chapter 6 Bones and Skeletal Tissues

- New Figure 6.4 shows comparative morphology of bone cells, comparing osteogenic cells, osteoblasts, osteocytes, and osteoclasts
- New Figure 6.14 explains how vigorous exercise can lead to large increases in bone strength
- Updated information on homocysteine as a marker of low bone mass density and bone frailty
- Added detail on age-related bone changes and treatments

## Chapter 7 The Skeleton

- This chapter features all-new bone art with realistic color and texture, with many new bone photos incorporated for side-by-side comparisons with the illustrations:
  - New photos for inferior and superior views of the skull (Figures 7.6b, 7.7b)
  - New photo of midsagittal section of the skull (Figure 7.5c)
  - New photos of the sphenoid bone, superior and posterior views (Figure 7.9)
  - New photo of right lateral view of the maxilla in figure of detailed anatomy of the mandible and maxilla (Figure 7.11)
  - New MRI of lumbar region in sagittal section showing herniated disc (Figure 7.17)
  - New photo of midsagittal section of the thorax (Figure 7.22)
  - New X-ray of the foot (Figure 7.34)
  - New figure and photo of the C-shaped spine of a newborn infant (Figure 7.37)
  - New Homeostatic Imbalance: xiphoid process projecting posteriorly
  - Added instructions for palpating the jugular notch
  - Added two new illustrations/views to the figure on the radius and ulna: proximal portion of ulna, lateral view, and distal ends of the radius and ulna at the wrist (Figure 7.27)
  - Bones of the left hand: added illustration of posterior view (Figure 7.28)

## Chapter 8 Joints

- Figure 8.1 expanded to show a comparison of different types of fibrous joints; added gomphosis
- Added a sixth distinguishing characteristic of synovial joints: nerves and blood vessels

- Added new part to figure on knee joint relationships: illustration of superior view of the right tibia in the knee joint (Figure 8.8b)
- Added two new parts to figure on the shoulder joint: illustration of frontal section through shoulder joint and accompanying cadaver photo (Figure 8.10)
- Added a superior view of the mandible to the figure on the temporomandibular joint (Figure 8.13)

## Chapter 9 Muscles and Muscle Tissue

- Chapter 9 features all of the physiological concepts of skeletal muscle fibers, including generation of the action potential, excitation-contraction coupling, and the cross bridge cycle. The concepts have been rewritten using more explanatory language that closely aligns the text and figures and breaks the text into steps and numbered lists. Accompanying the new explanations are several new Focus Figures:
  - Focus on Events at the Neuromuscular Junction (Figure 9.8)
  - Focus on Excitation-Contraction Coupling (Figure 9.11)
  - Focus on the Cross Bridge Cycle (Figure 9.12)
- This chapter also features many new and reconceptualized figures to illustrate the key concepts:
  - Figures describing the composition of thick and thin filaments (Figure 9.3) and the pathways for regenerating ATP during muscle activity (Figure 9.19) both incorporate a new tabular style for ease of comparison
  - New photomicrographs showing the transition between stages in the sliding filament theory of contraction; corresponding stage numbers added to text (Figure 9.6)
  - New flowchart summarizing the phases leading to muscle fiber contraction (Figure 9.7)
  - For simplicity, deleted permeability curves from figure showing action potential; added points of depolarization and repolarization to the action potential curve (Figure 9.10)
  - New figure comparing short-duration and prolonged-duration exercise (Figure 9.20)
  - New photomicrograph showing cross section of the three types of fibers in skeletal muscle (Figure 9.24)
  - New figure showing formation of a multinucleate skeletal muscle fiber by fusion of myoblasts (Figure 9.30)

## Chapter 10 The Muscular System

- In Chapter 10, changes allow for easier navigation and understanding; highlighting in the muscle gallery tables identifies the primary action item of muscles, enabling students to easily locate this key information.
- The chapter also features new high-quality, side-by-side cadaver photos with illustrations for easy comparison: the anterior and lateral regions of the neck (Figure 10.9c), superficial muscles of the thorax (Figure 10.13b), muscles crossing the shoulder and elbow joint (Figure 10.14d), and superficial muscles of the superior gluteal region (Figure 10.20b).

## Chapter 11

### Fundamentals of the Nervous System and Nervous Tissue

- Chapter 11 features three new Focus Figures, walking students step-by-step through the toughest topics essential to understanding the nervous system:

- Focus on Resting Membrane Potential (Figure 11.8)
- Focus on Action Potential (Figure 11.11)
- Focus on Chemical Synapse (Figure 11.17)
- Updated and expanded content reflects current research in the field:
  - Satellite cell role updated according to recent research
  - Updated discussion of nitric oxide and carbon dioxide to reflect current research
  - Added paragraph on new class of neurotransmitter endocannabinoid recently discovered, to reflect current research<sup>3</sup>
  - Updated the roles of neurotrophins in signaling the growth cone during neuronal development
  - Updated information on neurotransmitters (histamine, somatostatin, substance P, CCK) in Table 11.3 to reflect current research
- New figures and content:
  - New figure addressing the spread and decay of a graded potential (Figure 11.10)
  - New figure explaining how myelin speeds action potential propagation (Figure 11.15)
  - New photo of a neuronal growth cone (Figure 11.24)
  - All-new organization and structure for Table 11.2, with art added, comparing main features of action potentials and graded potentials

## Chapter 12 The Central Nervous System

- Chapter 12 features many updated discussions per current research:
  - Updated location of cortex receiving vestibular input based on new fMRI studies
  - New Homeostatic Imbalance on brain tumors in different regions of the brain: the anterior association area and the posterior parietal region
  - Regulation of respiratory rhythm in the medulla updated to reflect current research
  - Updated occurrence of theta waves in adult electroencephalogram
  - Updated the mechanisms of onset of sleep and wakefulness. Updated the role of orexins (hypocretins) in narcolepsy. Added recent finding that orexin antagonists promote sleep in humans.
  - Updated information on survival of strokes and stroke treatment
  - Updated research on cause and treatment of Parkinson's disease
  - Updated treatments for Alzheimer's disease
  - Updated discussion of sensory and motor pathways; reorganized for clarity and to match order of Table 12.2
  - Updated information on folic acid intake and incidence of spina bifida
- This chapter also features several new photos:
  - New photo of frontal section of brain (Figure 12.10)
  - New photo of inferior view of the brain showing the regions of the brain stem (Figure 12.14)
  - New figure on the cerebellum, featuring a new photo and accompanying new illustration (Figure 12.17)
  - New photo of EEG (Figure 12.20)

## Chapter 13 The Peripheral Nervous System and Reflex Activity

- Updated discussions per current research:
  - Axon regrowth and treating spinal cord injuries to reflect current research
  - Homeostatic Imbalance on cause and treatment of trigeminal neuralgia
  - Origin and course of the accessory nerves (CN XI)<sup>4</sup>
- This chapter also features a new Focus Figure, Focus on the Stretch Reflex (Figure 13.17), as well as all-new realistic nerve art for the nerve tables. We also have incorporated two new cadaver photos for the brachial plexus (Figure 13.9) and the sacral plexus (Figure 13.11). We've added a new Homeostatic Imbalance on hyperalgesia and phantom limb pain.
- This chapter features content updates per current research in the following areas:
  - Laser procedures to correct myopia
  - The mechanism of light adaptation in rods<sup>5</sup>
  - Odor signal processing<sup>6</sup>
  - Taste cell specificity: The current view is that there is no overlap in taste modalities in a taste cell (each taste cell conveys only one modality), but rather taste buds respond to all five modalities.
  - The mechanism of transduction for all five taste modalities<sup>7</sup>

## Chapter 14 The Autonomic Nervous System

- New Homeostatic Imbalance on autonomic neuropathy
- Updated parasympathetic effects on liver in Table 14.4
- Updated treatment of spinal cord injury in end-of-chapter problem

## Chapter 15 The Endocrine System

- Additional top-level headers in Chapter 15 allow for easier navigation of the chapter.
- New figures and photos:
  - New Figure 15.7 on regulation of thyroid hormone secretion emphasizes the fundamental hierarchy of hormonal control from hypothalamus to anterior pituitary to target organ and the associated negative feedback
- Updated information:
  - Updated information about hormones released by the thymus and by adipose tissue
  - Added new information about incretins and osteocalcin

## Chapter 16 Blood

- Updated information:
  - Updated discussion of erythropoietin per current research, with new understanding of how hypoxia induces erythropoiesis<sup>8</sup>
  - Updated discussion of treatment of sickle-cell anemia, with new drug clotrimazole
  - Updated role of eosinophils per current research<sup>9</sup>
- The reorganized and clarified discussion of platelet plug formation now includes bullet points for chemical messengers. The section on coagulation has been rewritten and tightened with added bullet points comparing intrinsic and extrinsic



pathways in phase 1. A new walk-through guide is provided for a more simplified figure on intrinsic and extrinsic pathways of coagulation:

- Table 16.3 has been shortened and simplified and includes a separate column for the source of each blood clotting factor.

## Chapter 17 The Cardiovascular System: The Heart

- Several new photos have been added to this chapter, including a new cadaver photo of a posterior surface view of the heart (Figure 17.4) and a new photomicrograph of cardiac muscle (Figure 17.11).
- New step text has been added to many figures in this chapter with corresponding steps in the text discussion for easier understanding of these difficult topics, including:
  - Action potential of contractile cardiac muscle cells (Figure 17.12); clarified and simplified text walk-through to match figure
  - Pacemaker and action potentials of autorhythmic cells of the heart with corresponding text description (Figure 17.13)
  - Sequence of depolarization and repolarization of the heart with added color key distinguishing the two phases (Figure 17.17)

## Chapter 18 The Cardiovascular System: Blood Vessels

- Updated information:
  - Updated function of pericytes based on new research
  - Updated discussion on relationship between obesity and hypertension per current research
  - Updated discussion of development of arteries and veins per current research
  - Summarized new research that indicates that systolic BP is a better predictor of complications of hypertension in those older than 50
  - Updated section about hypertension and its treatment, mentioning angiotensin II receptor blockers

## Chapter 19

### The Lymphatic System and Lymphoid Organs and Tissues

- We have added *Interactive Physiology*® references to the end-of-chapter Chapter Summary for the new Immune module.
- Updated information on Hassall's corpuscles per current research<sup>10</sup>

## Chapter 20

### The Immune System: Innate and Adaptive Body Defenses

- Updated information:
  - Added dermcidin as an important antimicrobial in human sweat
  - Updated number of types of human TLRs from ten to eleven per current research
  - Updated information to reflect new finding that dendritic cells can obtain foreign antigens from infected cells through gap junctions<sup>11</sup>
  - Updated role of the T<sub>H</sub>2 type of helper T cells in immunity
  - Updated statistics on HIV/AIDS
  - Updated information on treatments of autoimmune diseases and multiple sclerosis

- New figures, photos, and content:
  - New photomicrograph of phagocytosis as well as new accompanying art (Figure 20.2)
  - New SEM of a dendritic cell (Figure 20.10)
  - New flowchart comparing active and passive humoral immunity (Figure 20.13)
  - New computer-generated image of an antibody (Figure 20.14)
  - New Homeostatic Imbalance on parasitic worms
- New *Interactive Physiology* references for the new Immune module added to the end-of-chapter Chapter Summary

## Chapter 21 The Respiratory System

- New photomicrograph showing a portion of the tracheal wall (Figure 21.6)
- Described role of alveolar type II cells in innate immunity<sup>12</sup>
- Updated discussion of the mechanism for hypercapnia following administration of oxygen to patients with COPD
- Updated discussion of therapy for cystic fibrosis

## Chapter 22 The Digestive System

- New photos:
  - New X ray of the mouth of a child showing the permanent incisors forming deep to the deciduous incisors (Figure 22.10)
  - New photomicrograph of small intestine villus (Figure 22.22)
  - New photo of a peptic ulcer lesion and SEM of *H. pylori* bacteria (Figure 22.16)
- Updated information:
  - Updated discussion of the process of HCl formation within the parietal cells
  - Updated and expanded section on histology of the small intestine wall; added function of Paneth cells' secretions
  - Added art to Table 22.2, Overview of the Functions of the Gastrointestinal Organs

## Chapter 23

### Nutrition, Metabolism, and Body Temperature Regulation

- Chapter 23 features all-new vitamin and mineral tables that have been simplified for ease of student learning. New headers and sections to this chapter have been incorporated for easier navigation through the material, including:
  - New sections and coverage of obesity and short- and long-term regulation of food intake and additional regulatory factors<sup>13</sup>
  - New photo, Atomic Force Microscopy Reveals the Structure of Energy-Converting ATP Synthase Rotor Rings (Figure 23.10)

## Chapter 24 The Urinary System

- New photos:
  - New photo of kidney frontal section (Figure 24.3)
  - New photomicrograph of cut nephron tubules in new figure of renal cortical tissue and renal tubules (Figure 24.6)
  - New intravenous pyelogram (Figure 24.19)

- Updated information and content, and text reorganization:
  - Updated structure and possible function of extraglomerular mesangial cells
  - Rearranged text and placed information about urea recycling and the medullary osmotic gradient in a separate section for better understanding
  - Rearranged section on formation of dilute or concentrated urine for clarity
  - New Homeostatic Imbalance on chronic renal disease and renal failure
  - Reconceptualized figure on control of micturition—simplified in a flowchart; rewrote section on micturition for clarity and to match new figure
  - Table 24.1, Reabsorption Capabilities of Different Segments of the Renal Tubules and Collecting Ducts, now an illustrated table with diagrams of nephrons highlighting the descriptions

## Chapter 25 Fluid, Electrolyte, and Acid-Base Balance

- Reorganized section on Fluid Movement Among Compartments to match new figure on exchange of gases, nutrients, water, and wastes between the three fluid compartments of the body
- Added clarification of difference between edema and hypotonic hydration
- New paragraph on angiotensin II

## Chapter 26 The Reproductive System

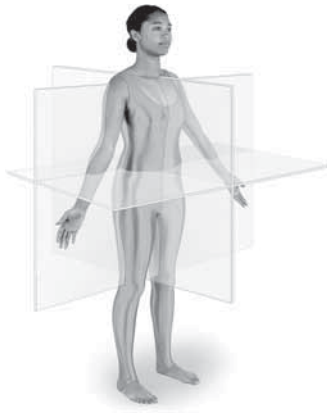
- Updated information:
  - Added new section on erectile dysfunction
  - Added update on new human papillomavirus vaccine
  - Expanded discussion of interactions along the hypothalamic–pituitary–ovarian axis with reconceptualized figure
  - Updated information on transmission of herpes virus
  - Updated discussion of descent of the testes
  - Updated information on hormone replacement therapy for women
- New photos:
  - New SEM of sperm (Figure 26.8)
  - New photomicrograph of ovary showing follicles of different developmental phases (Figure 26.11)
  - New photomicrograph of the endometrium and its blood supply (Figure 26.13)
  - New photo of mammogram procedure, plus new photos of a normal mammogram compared with one showing a tumor (Figure 26.16)
  - Added step text to figure and text description of follicular phases; added six new photomicrographs showing stages of follicular development (Figure 26.18)

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# The Human Body: An Orientation

## Objectives

### An Overview of Anatomy and Physiology

1. Define anatomy and physiology and describe their subdivisions.
2. Explain the principle of complementarity.

### Levels of Structural Organization

3. Name the different levels of structural organization that make up the human body, and explain their relationships.
4. List the 11 organ systems of the body, identify their components, and briefly explain the major function(s) of each system.

### Maintaining Life

5. List the functional characteristics necessary to maintain life in humans.
6. List the survival needs of the body.

### Homeostasis

7. Define homeostasis and explain its importance.
8. Describe how negative and positive feedback maintain body homeostasis.
9. Describe the relationship between homeostatic imbalance and disease.

### The Language of Anatomy

10. Describe the anatomical position.
11. Use correct anatomical terminology to describe body directions, body regions, and body planes or sections.
12. Locate and name the major body cavities and their subdivisions and associated membranes, and list the major organs contained within them.
13. Name the four quadrants or nine regions of the abdominopelvic cavity and list the organs they contain.

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## Suggested Lecture Outline

### *I. An Overview of Anatomy and Physiology (pp. 1–3)*

- A. Anatomy is the study of the structure of body parts and their relationships to each other, and physiology is the study of the function of body parts (p. 2).
- B. Topics of Anatomy (p. 2)
  1. Gross (macroscopic) anatomy is the study of structures large enough to be seen with the naked eye.
    - a. Regional anatomy is the study of all body structures in a given body region.
    - b. Systemic anatomy is the study of all structures in a body system.
    - c. Surface anatomy is the study of internal body structures as they relate to the overlying skin.

2. Microscopic anatomy is the study of structures that are too small to be seen with the naked eye.
    - a. Cytology is the study of individual cells.
    - b. Histology is the study of tissues.
  3. Developmental anatomy is the study of the change in body structures over the course of a lifetime; embryology focuses on development that occurs before birth.
  4. Specialized Branches of Anatomy
    - a. Pathological anatomy is the study of structural changes associated with disease.
    - b. Radiographic anatomy is the study of internal structures using specialized visualization techniques.
    - c. Molecular biology is the study of biological molecules.
  5. Essential tools for studying anatomy are the mastery of medical terminology and the development of keen observational skills.
- C. Topics of Physiology (p. 2)
1. Physiology has several topics, most of which consider the function of specific organ systems.
  2. Physiology often focuses on cellular and molecular events.
- D. Complementarity of Structure and Function (pp. 2–3)
1. The principle of complementarity of structure and function states that function is dependent on structure, and that the form of a structure relates to its function.

## **II. Levels of Structural Organization (p. 3; Figs. 1.1, 1.3)**

- A. The chemical level is the simplest level of organization (Fig. 1.1).
  1. Atoms, tiny building blocks of matter, combine to form molecules.
  2. Molecules combine in specific ways to form organelles, which are the basic unit of living cells.
- B. The cellular level is the smallest unit of life, and varies widely in size and shape according to the cells' function.
- C. The tissue level is groups of cells having a common function.
- D. The organ level is made up of discrete structures that are composed of at least two groups of tissues that work together to perform a specific function in the body.
- E. The organ system level is a group of organs that work closely together to accomplish a specific purpose (Fig. 1.3).
- F. The organismal level is the total of all structures working together to promote life.

## **III. Maintaining Life (pp. 4–8; Fig. 1.2)**

- A. Necessary Life Functions (pp. 4–8; Fig. 1.2)
  1. Maintaining boundaries allows an organism to maintain separate internal and external environments, or separate internal chemical environments.
  2. Movement allows the organism to travel through the environment, and allows transport of molecules within the organism.
  3. Responsiveness, or irritability, is the ability to detect changes in the internal or external environment and respond to them.