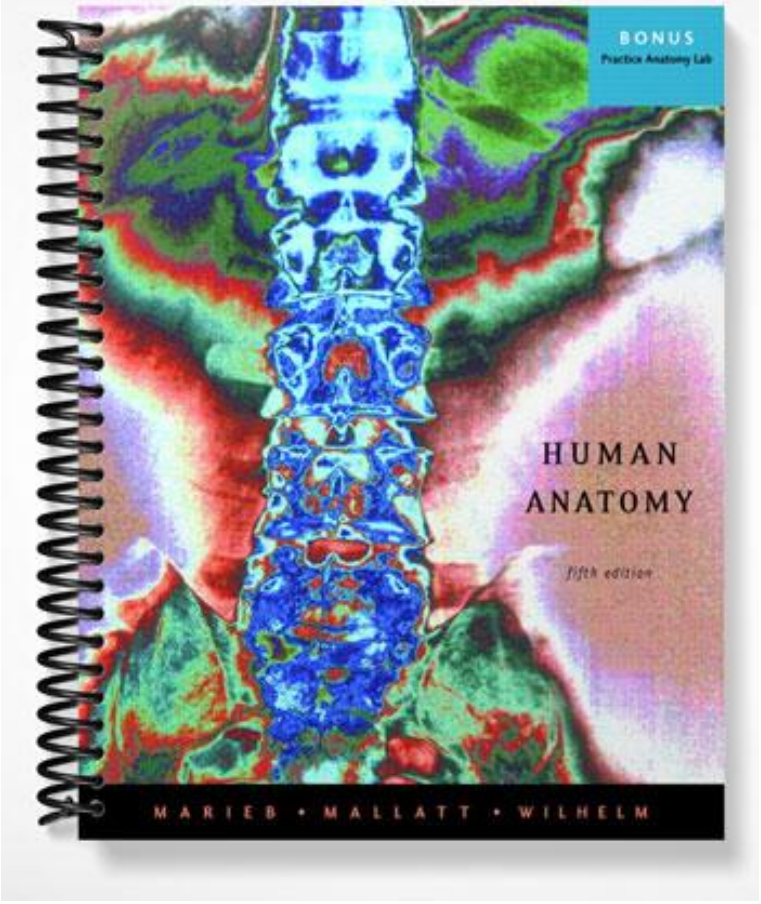
SOLUTIONS MANUAL



Instructor Resource Guide

Human Anatomy

Fifth Edition

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Preface

This *Instructor Resource Guide* accompanies the textbook *Human Anatomy*, Fifth Edition, by Elaine N. Marieb, Jon Mallatt, and Patricia Brady Wilhelm, and is devoted solely to supplying teaching suggestions and resources that augment the use of the textbook in the classroom.

ORGANIZATION AND FEATURES

The *Instructor Resource Guide* follows the organization of *Human Anatomy*, Fifth Edition, chapter for chapter. Within each chapter you will find the following new and revised resources grouped in five sections: (1) Lecture and Demonstration, (2) Art Resources, (3) Supplemental Course Materials, (4) Answers to Textbook Questions, and (5) Supplemental Student Materials.

- **Lecture and Demonstration** The opening section of each chapter in the *Instructor Resource Guide* is devoted to helping you structure and augment your classroom lectures and activities. Five features are offered.

  Objectives The objectives focus on the principal themes and topics that should be covered for each chapter.

  Suggested Lecture Outline The outlines generally correspond to the sequence of headings that appear in each textbook chapter. Key page, figure, and table numbers appear next to most of the entries in each outline.

  Lecture Hints This feature is composed of a list of key lecture points, which follows the order of the suggested lecture outline. In addition to calling attention to the main concepts of each chapter, the lecture hints identify ideas or topics that students may have difficulty mastering in their reading or during lecture.

  Classroom Discussion Topics and Activities This popular feature from the last edition consists of activities, demonstrations, and discussion topics that can be used to augment and enliven your anatomy lectures and laboratories.

  Clinical Questions This section of each chapter provides additional clinically focused, critical reasoning questions like those that appear at the end of each textbook chapter. The answers follow each question.

- **Art Resources** This section is provided to help you utilize the greatly improved illustration program in the Fifth Edition of *Human Anatomy* in your classroom teaching. This section includes:

  Transparency Index/Media Manager This list details which figures in the chapter are available on the Media Manager and the color transparency package. (Call your Benjamin Cummings representative for information about how to obtain these supplements.) The transparency package includes enlarged and color-enhanced versions of all the illustrations and photos in the textbook.

Teaching with Art This section is designed to facilitate your lecture presentations about key figures in each chapter, and it is also aimed at encouraging students to become actively engaged with the textbook illustrations in order to strengthen their understanding of major topics. Each *Teaching with Art* section consists of a checklist of major discussion points about a figure and a list of concepts that students sometimes find difficult to understand or fail to perceive when they interpret a figure on their own. Finally, this section includes an art-based exercise that is designed to help students to better understand the anatomy depicted in a figure. *Teaching with Art* concludes with a visual critical reasoning challenge in which students are asked to synthesize a response based on the visual evidence presented in a figure.

- **Supplemental Course Materials** This section of each chapter of the *Instructor Resource Guide* consists of materials that you may use to augment your classroom presentations or assign for student completion. This section consists of:

  Library Research Topics These term paper or report topics can be assigned for extra credit or to help deepen students' understanding of anatomy.

  Media Revised and updated, this section lists videos and software in addition to those offered by Benjamin Cummings. A key to the abbreviations used to identify the audiovisual and electronic media distributors in each list can be found in Appendix B.

  Suggested Readings Revised and updated for this edition, this feature lists classic readings, advanced anatomy textbooks, and current journal articles. This bibliography can be used to introduce your students to scientific literature and to the research process in addition to enhancing their knowledge of human anatomy.

- **Answers to Textbook Questions** This section provides answers to the Short Answer and Essay Questions section and the Critical Reasoning and Clinical Applications Questions section, both located at the end of each textbook chapter.
- **Supplemental Student Materials** This feature consists of a student-oriented introduction to the mission of each chapter and a description of the practical importance of its coverage. An extended series of learning checkpoints follows that students may use to chart their progress while reading the chapter. This feature is formatted to be easily photocopied and distributed to your students.

GUIDE TO SUPPLEMENTS ACCOMPANYING THE TEXTBOOK

The suite of supplementary materials developed by Benjamin Cummings for the fifth edition of *Human Anatomy* is more innovative and thorough than ever before—in print, on CD-ROM, and on the Web—for you and your students alike. Here is a description of the new electronic and printed supplements that are specifically dedicated to the textbook.

Electronic Media Supplements

MyA&P™ From the home page of MyA&P™ (www.myaandp.com), you and your students can access the companion web site for *Human Anatomy*, Fifth Edition, which features the following resources and activities:

- *Chapter Guides* organize all chapter materials on one convenient page.
- *Chapter review self-study quizzes* include questions with textbook figures, expanded feedback, and a personal gradebook.

- New *anatomy animation quizzes* correspond to the new anatomy animations to test students' understanding of difficult topics.
- *Learning Activities* offer labeling exercises, crossword puzzles, animations, and video.
- *Practice Anatomy Lab* makes it easier for students to study outside the lab with self-review activities, self-study quizzes, and gradable lab practical exams. Using its organization by systems, students can access images of human cadavers, histology slides, anatomical models, cat dissections, and fetal pig dissections.
- *Get Ready for A&P* helps students get up to speed with basic study skills, math skills, anatomical terminology, basic chemistry, cell biology, and other basics of the human body.
- *Study Tools* include interactive flashcards, bone review, muscle review, case studies, web links, and glossary.
- *Ask an Expert* allows students to e-mail their questions for answers from the author.
- The password-protected *instructor resource section* contains materials from the Media Manager.

A free 12-month subscription to this powerful web site is included with each new student copy of the text. An Instructor Resource section (available only to instructors) includes an electronic version of the Instructor Resource Guide for *Human Anatomy*, as well as JPEG and PowerPoint® files of art from the text. A 3-day trial option is also available at the web site. Access directions, along with student access codes, are attached inside the front cover.

MyA&P with Course Compass™ MyA&P with CourseCompass™ combines the strength of Benjamin Cummings content with state-of-the-art eLearning tools. CourseCompass™ is a nationally hosted, dynamic, interactive online course management system powered by Blackboard, leaders in the development of Internet-based learning tools. This easy-to-use and customizable program enables professors to tailor content and functionality to meet individual course needs. The course includes all of the content found on the MyA&P web site. Visit www.coursecompass.com for more information or to see a demo.

Media Manager (0-8053-2868-0) These powerful classroom presentation CD-ROMs contain all of the text's illustrations, photos, and illustrated tables, both with and without labels and in JPEG and PowerPoint® format. Also included are fully customizable lecture slides in PowerPoint with text and art integrated for each chapter, as well as all of the photos from *A Brief Atlas of the Human Body,* Second Edition.

Computerized Test Bank (0-8053-0096-1) The Test Bank that accompanies the Fifth Edition features questions in multiple formats, including figure, multiple-choice, matching, true/false, short answer, and essay questions. Page references to the main text and difficulty levels are provided for each question. All of the questions are available electronically on a cross-platform TestGen CD-ROM that allows instructors to generate tests via a user-friendly interface where it is easy to view, edit, sort, and add questions.

A.D.A.M.® Interactive Anatomy Student Package (with Windows DVD: 0-8053-7232-6; with Windows CD-ROM: 0-8053-9574-1) *A.D.A.M.® Interactive Anatomy (AIA),* version 4.0, is now available packaged with Lafferty and Panella's *A.D.A.M.® Interactive Anatomy Student Lab Guide,* Third Edition (0-8053-5911-7) for a special reduced price. With over 20,000 dissectible, atlas, and 3-D anatomy images, AIA also features female and male anatomical structures, cadaver dissections, and 3-D models of the heart, skull, and lungs. AIA icons appearing within most of the

textbook's end-of-chapter summaries provide specific directions for locating related images on the A.D.A.M.® Interactive CD-ROM. Ask your Benjamin Cummings representative for more information about this special package.

Course Management Systems and Special Student Services

WebCT and Blackboard Both course management systems are useful for developing and managing on-line distance learning courses. They are available by themselves or packaged with the textbook. The content provided with either system includes selections from *The Anatomy Place* as well as the entire computerized test bank. Contact your Benjamin Cummings representative for more information about how to link your course to WebCT or Blackboard.

The Tutor Center Free tutoring is available to students who purchase a copy of *Human Anatomy,* Fifth Edition. The Tutor Center is staffed by qualified anatomy instructors who can tutor students on all the material covered in the textbook, including the art and the multiple-choice/matching questions at the end of each chapter. Tutoring content is restricted to textbook material, and tutors will only discuss answers that are provided in the textbook. Students can contact the Tutor Center by phone, fax, or e-mail Sunday through Thursday, between 5:00 PM and 12:00 AM EST. You must authorize access to the Tutor Center for your students. To do so, please contact your local Benjamin Cummings sales representative for information or visit the Tutor Center web site at www.aw-bc.com/tutorcenter.

Revised Printed Supplements

Full-color Transparency Acetates (0-8053-3157-3) The transparency acetates package has been expanded to include all of the photos from the text, in addition to all of the illustrations and illustrated tables—approximately 800 images in all. The colors in all of the illustrations have been enhanced, and all of the labels have been enlarged for easy viewing in the classroom or lecture hall. The transparency acetate package is available free to adopters of the text.

A Brief Atlas of the Human Body, **Second Edition** (0-8053-7373-X) This full-color atlas includes 107 bone and 47 soft-tissue photographs with easy-to-read labels. This new edition of the atlas contains a brand new comprehensive histology photomicrograph section featuring over 50 slides of basic tissue and organ systems. The atlas superbly compliments the Fifth Edition, is referenced in appropriate figure legends throughout the text, and is packaged free with each new copy of the text.

Human Anatomy Laboratory Manual with Cat Dissections, **Fifth Edition** (0-8053-3856-X) Elaine N. Marieb's widely used laboratory manual, Fifth Edition (2008), accompanies this textbook. The manual contains 29 gross anatomy and histology exercises for all major body systems. Illustrated in full color, with a convenient spiral binding, the lab manual has an accompanying *Instructor Resource Guide* by Susan Baxley of Troy University, Montgomery Campus.

Additional Supplements Available from Benjamin Cummings

For the Classroom and Laboratory:

Histology Slides for the Life Sciences by Bell and Eroshenko (0-8053-4410-1)

Human Cadaver Dissection Videos by Rose Leigh Vines, et. al.

Human Musculature Video (0-8053-0106-2)
Human Cardiovascular System: The Heart Video (0-8053-4289-3)
Human Cardiovascular System: Blood Vessels Video (0-8053-4297-4)
Experiments on Hormonal Action Video (0-8053-4155-2)
Human Digestive System Video (0-8053-4823-9)
Human Reproductive System Video (0-8053-4914-6)
Human Urinary System Video (0-8053-4915-4)
Human Respiratory System Video (0-8053-4822-0)
Human Nervous System: Human Brain and Cranial Nerves Video (0-8053-4012-2)
Human Nervous System: The Spinal Cord and Nerves Video (0-8053-4013-0)

Student Video Series for Anatomy and Physiology, Volume I (0-8053-4110-2)

Student Video Series for Anatomy and Physiology, Volume II (0-8053-6115-4)

For Your Students:

The Anatomy Coloring Book, Third Edition by Kapit and Elson (0-8053-5086-1)

Bassett Atlas of Human Anatomy by Robert Chase (0-8053-0118-6)

A Color Atlas of Histology by Dennis Strete (0-673-99190-3)

I offer thanks and sincere appreciation to Annie Bleecker at Benjamin Cummings. Throughout the editing and updating of the Instructor Resource Guide for *Human Anatomy,* Fifth Edition, Annie has been enthusiastic, kind, patient, humorous, and professional. It is refreshing to work with someone so down-to-earth, intelligent, intense, and dedicated. I know that Annie is an asset to Benjamin Cummings.

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University of Alabama at Birmingham

1 The Human Body: An Orientation

LECTURE AND DEMONSTRATION

Objectives

1. Define *anatomy* and describe the subdivisions of anatomy.
2. Define *physiology* and explain how physiology complements anatomy.
3. Identify the levels of increasing complexity in the human body from chemical to organismal.
4. List the organ systems of the body, naming major structures and describing main functions.
5. Emphasize the importance of the metric system in understanding the relative and actual size of cells, tissues, and organs. Encourage students to use Appendix A in the main text regularly.
6. Describe the body in anatomical position and explain why it is important as a visual reference.
7. Define standardized terms of direction, regional terms, and planes of the body.
8. Describe why humans are vertebrates sharing several basic features with animals such as fish, birds, amphibians, and mammals.
9. Distinguish the dorsal body cavity from the ventral body cavity.
10. Contrast each of the serous cavities: pericardial, pleural, and peritoneal.
11. Describe relationships of ventral cavity membranes to each other, the body wall, and associated organs.
12. Describe the organization of the abdominopelvic cavity into regions and quadrants, and identify some of the major viscera.
13. Distinguish among light microscopy, electron microscopy, and scanning electron microscopy.
14. Describe the conventional use of X rays and advanced X-ray techniques, such as computed tomography (CT) and digital subtraction angiography (DSA), to visualize structures in the body.

Suggested Lecture Outline

I. An Overview of Anatomy (pp. 2–6)

A. Anatomical Terminology (p. 2)

1. Ancient Greek and Latin provide the origins for most anatomical terms.

B. Branches of Anatomy (pp. 2–3)

1. *Gross anatomy* studies the human body structures with the naked eye and dissection as the major technique. Regional, systemic, and surface anatomy are the major approaches.
2. *Microscopic anatomy* uses the microscope to study specially prepared tissue slides (also called histology).
3. *Developmental anatomy* explores how body structures form, grow, and mature throughout the life span.
4. *Embryology* is the study of how the human body structures form and develop before birth.

C. The Hierarchy of Structural Organization (p. 3; Figs. 1.1–1.2)

1. Structural Organization (p. 3)
   a. The levels of structural organization from the simplest to the most complex are: chemical, cellular, tissue, organ, organ system, and the human organism itself.
   b. Organ systems are organs working closely together to accomplish a common function. Organ systems will be studied in detail in succeeding chapters. Briefly, systems include integumentary, skeletal, muscular, nervous, endocrine, cardiovascular, lymphatic, immune, respiratory, digestive, urinary, and reproductive.

D. Scale: Length, Volume, and Weight (pp. 3–6)

1. The metric system provides precision for the measurements of the dimensions of cells, tissues, and organs.

II. Gross Anatomy: An Introduction (pp. 6–14)

A. The Anatomical Position (p. 6; Fig. 1.3)

1. Learning the anatomical position is essential because most of the directional terminology used in anatomy refers to the body in this position.

B. Directional and Regional Terms (p. 7; Table 1.1; Fig. 1.4)

1. Regional terms name the specific body areas.
2. The standardized terms of direction are: superior/inferior, anterior (ventral)/posterior (dorsal), medial/lateral, superficial/deep.

C. Body Planes and Sections (pp. 7–10; Figs. 1.5–1.7)

1. The body and/or organs are cut into sections along a flat surface called a plane.
2. Planes are identified as sagittal, frontal (coronal), transverse (horizontal), and oblique.
3. Sagittal planes are midsagittal (median) planes or parasagittal planes.

D. Anatomical Variability (p. 10)

1. Anatomical structures do not always match the textbook descriptions.

E. The Human Body Plan (pp. 11–12; Fig. 1.8)

1. Tube-within-a-tube
2. Bilateral symmetry
3. Dorsal hollow nerve cord
4. Notochord and vertebrae
5. Segmentation
6. Pharyngeal pouches

F. Body Cavities and Membranes (pp. 11–14; Figs. 1.9–1.11)

1. The dorsal body cavity is subdivided into the cranial cavity and the vertebral cavity.
   a. The cranial cavity houses the brain.
   b. The vertebral cavity runs through the vertebral column and encloses the spinal cord.
3. Three serous cavities are all enclosed body cavities with no openings to the external surface of the body.
   a. The pericardial cavity surrounds the heart.
   b. The pleural cavity surrounds the lung.
   c. The peritoneal cavity surrounds abdominopelvic viscera.
4. Several smaller cavities of various types are located mostly in the head. (p. 14)
   a. The oral and nasal cavities with openings to the external surface of the body are lined with mucous membranes.
   b. Orbital cavities house the eyeballs.
   c. Middle ear cavities are located within the temporal bones of the skull and house the tiny ear ossicles.
   d. Synovial cavities are joint cavities.

G. Abdominal Regions and Quadrants (p. 14; Fig. 1.12)

1. The abdomen is divided into nine regions: the right and left hypochondriac region, the epigastric region, the right and left lumbar regions, the umbilical region, the right and left iliac region, and the hypogastric region.

III. Microscopic Anatomy: An Introduction (pp. 15–17, Fig. 1.13)

A. Microscopy is the examination of the fine structure of organs, tissues, and cells. (pp. 14–15)

B. Preparing Human Tissue for Microscopy (pp. 16–17)

1. Specimens for LM or TEM must be fixed (preserved) and then cut into sections (slices) thin enough to transmit light or electrons.

C. Scanning electron microscopy provides three-dimensional pictures of whole, unsectioned surfaces. (p. 16)

D. When preserved tissue has been exposed to many procedures this can cause minor distortions called artifacts. (pp. 16–17)

IV. Clinical Anatomy: An Introduction to Medical Imaging Techniques (pp. 17–21)

A. X-Ray Imaging (pp. 17–18; Fig. 1.14)

1. Traditional X-ray images continue to play a major role in medical diagnoses involving bone and abnormal dense structures such as a tumor.

B. Advanced X-Ray Techniques (p. 18; Figs. 1.15–1.19)

1. Computed tomography (CT) or computed axial tomography (CAT) produces improved X-ray images that are computer enhanced for clarity.
2. Dynamic spatial reconstruction (DSR) produces three-dimensional images of body organs that can be rotated.

3. Xenon CT is used to diagnose a stroke (a blockage or cutting off of blood flowing to the brain).
4. Digital subtraction angiography imaging (DSA) produces sharp images of blood vessels injected with a contrast medium.

C. Positron emission tomography tracks radioisotopes in the body, locating areas of high energy consumption and high blood flow. (p. 19; Fig. 1.17)

D. Sonography (ultrasound imaging) provides sonar images of developing fetuses and internal body structures, such as an enlarged liver. (pp. 19–20; Fig. 1.18)

E. Magnetic resonance imaging (MRI) subjects the body to strong magnetic fields and radio waves, producing high-contrast images of soft body parts. (pp. 20–21; Fig. 1.19)

Lecture Hints

1. Discuss the terms *anatomy* and *physiology.* Describe how scientists use these terms, and how the terms complement each other.
2. Explain the relationship of structure to function in the study of anatomy.
3. Describe advancements in each of the branches of anatomy. Offer examples of specific careers among the branches.
4. Describe *systemic anatomy* and *regional anatomy.* Certain professions use one or the other approach to studying the human body. Note that professional texts usually take a regional approach, while undergraduate studies usually take a systemic approach to anatomy.
5. Establish the significance of anatomical terminology at the beginning of the course. Students must understand they are learning a "new language" and will be successful academically in anatomy if they master this language.
6. Teach students word origins (Greek and Latin roots) as much as possible. Use terms with which they are familiar, for example: "hand" > *manus* > "manual." Emphasize the use of dictionaries as well as the glossary and word root origins summary from the text.
7. Point out that the language of anatomy is redundant and that multiple terms exist for some anatomical structures (e.g., eustachian tube, auditory tube, pharyngotympanic tube, otopharyngeal tube). Explain that some anatomical terms are structural designations while others are functional. Finally, explain that some terms are eponyms that denote the discoverer's name (e.g., Bartholin's gland).
8. Point out that a system is an artificial grouping of structures that works toward a common goal. Explain how organs and systems interact together to form the entire organism, the human body.
9. Caution students that there is a difference between the "cardiovascular system" and "circulatory system." Explain the difference and their relationship to the lymphatic system.
10. Explain to students how the terms *superior/inferior, anterior/posterior,* and *dorsal/ventral* refer to different body areas for humans versus four-legged animals. Point out that more than one word can be used to correctly describe the position of a structure.
11. Stress to students that most body cavities are potential spaces filled with viscera, tissues, and fluids.

12. In addition to the dorsal and ventral body cavities, cite other cavities such as the oral cavity, the nasal cavity, and the pericardial cavity.
13. Contrast the types of images obtained with X-ray machines, CT scans, MRI scans, and ultrasonography. Show actual examples of X rays, if possible, and keep in mind the potential use of X rays to demonstrate anatomy in other chapters.

Classroom Discussion Topics and Activities

1. Reinforce concepts of structure and function by asking students to explain the relationships between muscle and bone, circulatory system and respiratory system, and muscles and nerves.
2. Have students discuss the relative vulnerability of the organs in the dorsal and ventral body cavities by asking, "Why do you think a dog instinctively curls over and protects its abdomen when that body region is threatened by a blow or even during play?"
3. Ask students to write down 12 body parts that consist of three letters (e.g., eye, ear, leg). Follow up with the anatomical term for each part (e.g., "arm"—"brachium"). Alternatively, have students use the index in the text and simply search for three-letter words. This at least gets them to open the text. And tell them to keep it clean!
4. Demonstrate preserved human specimens if available. A simple statement, "This is a heart (or kidney or brain or bone)" is all that is necessary. Ask the class what the specimens have in common. Muscles? Nerves? Blood?
5. Assume the anatomical position and ask the students how that position differs from the "usual" standing position. Ask students to explain the importance of the anatomical position with regard to their studies.
6. Call out regional terms (e.g., buccal, femoral) and have the students (as a group) point out the named regions on their own bodies.
7. Ask students to describe the purpose of directional terms. Why are these terms used in pairs? Ask students to demonstrate their understanding; "My elbow is _____ to my shoulder." Get the students to act these out as a group or choose a volunteer to demonstrate at the front of the classroom.
8. Placing a chair in front of the class, ask a volunteer to show how the chair would be cut along the sagittal, frontal, and transverse planes. Ask the volunteer to choose which of these planes would yield a usable seat.
9. Use a dissectible model of a human torso to point out the dorsal and ventral body cavities and the main organs in each cavity.
10. Remove all the viscera from the ventral body cavity of a model of the human torso. Ask for volunteers or assign students to return the viscera to their proper anatomical locations. As each organ is properly repositioned, the rest of the students are to call out its name and to identify its organ system.
11. Demonstrate plastinated sections of the human body, which are available for purchase. Or project sections on an overhead projector for viewing by the entire class.
12. Thrust your fist into an inflated balloon to illustrate the two layers of the serous membrane.

13. Explain to the class how tissues are cut into thin sections for microscopic viewing. This can be explained in a general way or by obtaining a microtome and demonstrating how a paraffin-embedded rat liver is sectioned. Remind students that their glass slides possess only a small, thin slice of an organ.
14. Obtain slides to show the types of stains used for light microscopy, such as hematoxylin and eosin, Sudan black B, and methylene blue.
15. Show the class transmission electron micrographs, scanning electron micrographs, and light micrographs. Have the students explain how to tell these apart.
16. Offer examples of medical conditions and have the students explain which medical imaging technique they would use to diagnose that condition.

Clinical Questions

1. A surgeon removed a section of tissue along a transverse plane for microscopic examination. What would the section be called?

   Answer: A cross section.

2. Which medical imaging technique has been studied most extensively for its effects on human health?

   Answer: The traditional X-ray technique, because it has been used the longest. MRI and ultrasound are such new techniques that long-term studies of their effects have not yet been possible.

ART RESOURCES

To view thumbnails of all the images in Chapter 1, see Appendix A.

Transparencies Index/Media Manager

Figure 1.1 Levels of structural complexity.
Figure 1.2 Summary of the body's organ systems.
Figure 1.3 The anatomical position.
Figure 1.4 Regional terms: names of specific body areas.
Figure 1.5 Planes of the body.
Figure 1.6 Oblique section through the trunk.
Figure 1.7 Objects can look odd when viewed in section.
Figure 1.8 Basic human body plan, indicated by structures shared with all vertebrates.
Figure 1.9 Dorsal and ventral body cavities and their subdivisions.
Figure 1.10 The serous cavities: pericardial, pleural, and peritoneal.
Figure 1.11 Other body cavities.
Figure 1.12 The nine abdominal regions and the four abdominal quadrants.
Figure 1.13 Cells viewed by three types of microscopy.
Figure 1.14 An X-ray image (radiograph) of the chest.
Figure 1.15 Computed tomography (CT).

Figure 1.16 Digital subtraction angiography (DSA).

Figure 1.17 Positron emission tomography (PET).

Figure 1.18 Ultrasound image of a fetus in the uterus.

Figure 1.19 Magnetic resonance image (MRI) of the head in sagittal section.

Table 1.1 Orientation and Directional Terms

Teaching with Art

Figure 1.10a–d The serous cavities: pericardial, pleural, and peritoneal.

Textbook p. 13; transparencies; Media Manager.

Checklist of Key Points in the Figure

- In each part, indicate that the visceral layer is in direct contact with the surface of an organ and that the parietal layer is in contact with the wall of the body cavity.
- Comment on the function of fluid in the cavities.
- Describe the relationship of the pericardium to the heart, the pleura to the lungs, and the peritoneum to the abdominal organs.
- Explain how the visceral peritoneum and parietal peritoneum form a framework of double-layer folds called mesenteries.

  Display Figure 22.6d, Sagittal section of abdominal cavity of a male. Demonstrate mesenteries.
- In (d) explain how mesenteries support abdominal organs.

Common Conceptual Difficulties Interpreting the Art

- Explain the differences between mucous membranes and serous membranes.
- Explain why the pleural and pericardial cavities are "potential spaces." Tell students that the art exaggerates the space between the membranes and that, in a healthy body, only a thin layer of fluid separates the two membranes.
- In (d) explain the difference between an abdominal and retroperitoneal organ.

  Display Figure 22.5a,b, The peritoneum and peritoneal cavity, to demonstrate how organs become retroperitoneal. Display Figure 23.2a, Position of the kidneys within the posterior abdominal wall, for a detailed view of retroperitoneal organs.

Art Exercise

To help students understand the continuity of the parietal and visceral peritoneum, ask students to trace a continuous line around the serous membrane in (d). The same demonstration is possible using the overhead transparency with an overlay and colored marker. In theory, the marker remains in continuous contact with the drawing of the line.

Critical Reasoning

Pleurisy is an inflammation of the pleural layers characterized by the abnormal production of pleural fluid. Referring to Figures 1.9 and 1.10, ask students where they think the excess pleural fluid might collect.

Answer: The pleural fluid collects by gravity in the space between the diaphragm and the rib cage called the costodiaphragmatic recess. Medical professionals can extract the excess fluid using a syringe.

SUPPLEMENTAL COURSE MATERIALS

Library Research Topics

1. Research the historical development of gross anatomy.
2. Research the historical development of the techniques of microscopy and histology.
3. Explore the modern-day definitions of life and death.

Media

See Appendix B of the Instructor Resource Guide for Key to Audiovisual Distributors.

Video

1. *The Human Body: Systems Working Together* (WNSE; 16 min., 1993). Animation, X rays, motion pictures, and micrographs help explain the workings of the human body. Students learn that some organs belong to more than one system, and that all of the systems must work together to support all of their activities.
2. *The Incredible Human Machine* (CBS; 60 min., 1992). Sophisticated photographic techniques show the wonders of the body's internal world.
3. *The Universe Within* (CBS; 60 min., 1995). NOVA takes viewers on an incredible voyage into the microworld of the human body. The coordination of muscles, bones, heart, and circulatory systems is revealed by microphotography.

Software

1. *A.D.A.M.® Interactive Anatomy® 4.0* (ADAM; Win/Mac). Comprehensive, precise, and anatomically correct database of the human body gives the student an opportunity to explore human systems and structures within the context of the whole body.
2. *A.D.A.M.® MediaPro* (ADAM; Win/Mac). Provides clinical illustrations for classroom curriculum and presentations. Contains more than 2000 images in JPEG format.
3. *Bodyworks* (WNSE; Windows). An economical CD of anatomy and physiology, which includes lesson plans and quizzes that can be printed.
4. *Explorations in Human Biology* (WNSE; Win/Mac). This CD contains a set of 15 animated, interactive lessons. It features clearly written topic information, colorful graphics, and animated illustrations.
5. *The Ultimate Human Body* (CBS; Win/Mac). A blend of high-quality 3-D images, animation, sounds, and text. Students can explore the body through three search paths: "The Body Machine," "The Body Organs," and "The Body Systems."

Suggested Readings

Birnholz, J.C., and E. Farrell. Ultrasound images of human fetal development. *American Scientist* 72 (1984): 608–613.

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ANSWERS TO TEXTBOOK QUESTIONS

Answers for multiple-choice and matching questions 1–13 are located in Appendix B of the textbook.

Short Answer and Essay Questions

14. In the anatomical position the body stands erect, the arms hang at the sides, the palms face anteriorly, the thumbs point away from the trunk, and the feet are flat on the ground with toes forward. It is necessary to use this standard position because most directional terms refer to the body in this position, regardless of its actual position. (p. 6)

15. (a)The thymus, thyroid, ovary, and pancreas have endocrine system components. (b) The nasal cavity, larynx, bronchi, and lungs are parts of the respiratory system. (c) The kidney, ureter, and urethra are components of the urinary system. (Figure 1.2)

16. (a) Bilateral symmetry means that the structures on the right half of the body are essentially mirror images of those in the left half. (b) Examples of segmentation in the human are the repeating vertebrae of the vertebral column, the many pairs of nerves from the spinal cord, the ribs, and the muscles between the ribs. Note that all these are repeating units along the length of the body. (c) Dissection is exposing the internal structures of the body, mostly by removing the connective tissue that holds adjacent organs together. (pp. 2, 11–12)

17. (a) Only CT uses X rays. (b) MRI uses magnetic fields and radio waves. (c) PET uses radioisotopes. (d) CT, PET, sonography, and MRI display body regions in sections; DSA, which is based on traditional X-ray images, does not use sections. (pp. 18–20)

18. (a) arm–brachium. (b) chest–thorax. (c) groin–inguinal region. (d) armpit–axilla. (Figure 1.4)

19. All the photos were taken through a light microscope. This is demonstrated by the fact that they are colored. Also, they show many cells grouped into tissues, so they are low-magnification pictures—the specialty of light microscopy. (p. 15 and Chapter 4)
20. Liver, stomach, intestines, pancreas, spleen.
21. Here are some examples: The toes are inferior to the knee. The back of the neck is dorsal to the nose. The navel is ventral to the buttocks. The loin is medial to the upper extremity. The thumb is lateral to the little finger. The skin is superficial to almost everything. The intestines are deep to the ventral body cavity.
22. Here are some examples: abdominal cavity—small intestine, stomach, liver; pelvic cavity—bladder, some sex organs, rectum. (pp. 12–14)
23. Your injuries occurred in your armpit, base of the skull, or finger (or toe). (p. 7)
24. Three organs that are part of the inner tube are any of the digestive organs, such as the stomach, esophagus, and small intestine. Components of the outer tube show evidence of segmentation, such as the bony vertebral column, ribs, and muscles between the ribs. (p. 11)

Critical Reasoning and Clinical Applications Questions

1. MRI is very effective at peering through bones and at distinguishing tumors from surrounding tissues on the basis of their water content. (CT scans also are used to find tumors.) (p.20)
2. The abdominal organs are susceptible to injury because the walls of the abdomen are not protected by bone as are the thoracic organs (by ribs) and the pelvis (protected by the hip bones). In the automobile accident described here, the seat belts squeezed the children's abdominal viscera upon impact, harming these organs. (p. 12)
3. The inguinal region is the groin, or most inferior part of the anterior abdomen just above the thigh. The lumbar region is the loin or back of the abdomen. The perineum is the region around the anus and external genitalia. (p. 7)
4. The axillary region is the armpit. The coxal region is the hip. The sacral region is in the lower back between the hips. The acromial region is the top point of the shoulder. The peroneal region is the lateral part of the leg. (p. 7)
5. The spinal column and spine are the same thing (i.e., the bony vertebral column). The spinal cord, by contrast, is the nerve cord that runs through the vertebral canal.
6. (1) The meanings of the following root: super- = above/upon; contra- = against; para- = next to, beside, near; ante- = preceding, before; mamm- = breasts; epi- = over, above, on top of; peri- = around; -graph = instrument for recording data or writing; trans- = across, through.

   (2) Examples of terms used in Chapter 1 derived from each root listed: superior or superficial, contralateral, parasagittal, anterior, mammary, epigastric, perineum, micrograph, and transverse.

   (3) Definitions of words based on the meaning of the root word: superior = above the point of reference; contralateral = the other side; parasagittal = adjacent to the midsagittal plane; anterior = in front of the point of reference; mammary = pertaining to the breast; epigastric = above the gastric region; perineum = around the anus; micrograph = picture of a small structure; transverse = a plane crossing the body from side-to-side.

SUPPLEMENTAL STUDENT MATERIALS to Human Anatomy, Fifth Edition

Chapter 1: The Human Body: An Orientation

To the Student

The concepts in this chapter will orient you to the human body and introduce you to the science of anatomy. Mastering the vocabulary in this chapter will help you to understand basic anatomical relationships and help you to communicate effectively with anatomists and those working in the health care professions.

Step 1: Learn the organ systems of the human body.

- ☐ Name the 12 basic organ systems.
- ☐ Give examples of organs for each system.
- ☐ Which organ systems are located in the head? Thorax? Abdominal cavity? Lower extremity?
- ☐ Do you perceive one system as more important than another? Why or why not?

Step 2: Master the professional vocabulary of the science of anatomy.

- ☐ Describe how a man sitting with hands on his lap moves his body into anatomical position.
- ☐ Using the regional terms and names of specific body areas in Figure 1.4, write comparative statements for the following directional terms: superior/inferior, anterior/posterior, ventral/dorsal, medial/lateral, and proximal/distal. (e.g., "The fingers are distal to the shoulders.")
- ☐ Demonstrate the difference between frontal, transverse, and sagittal planes using your own body.
- ☐ Make vocabulary flash cards.
- ☐ Make copies of text figures without labels for review and test preparation.

  Note: Your instructor can print any illustration in the text without labels using the Media Manager that comes with the instructor's copy of the textbook.

Step 3: Differentiate the major and minor body cavities.

- ☐ Name two major body cavities.
- ☐ List the subdivisions of each cavity.
- ☐ Name the organs associated with each subdivision.
- ☐ Referring to Figure 1.9, identify the distinctive structure that separates the abdominal cavity. from the thoracic cavity.
- ☐ Relate serous membranes and fluids to the subdivisions of the ventral body cavity,
- ☐ Name five minor (smaller) cavities. Which ones are located in the head? Which one has a specialized fluid associated with it?

2 Cells: The Living Units

LECTURE AND DEMONSTRATION

Objectives

1. Define *cell* and comment on the difference between an animal cell and the generalized cell.
2. Describe the basic cellular activities required to sustain life.
3. Identify and describe the structure and function of the three main regions of a cell: plasma membrane, cytoplasm, and nucleus.
4. Explain how molecules move across the plasma membrane.
5. Describe the cytosol.
6. Compare the structure and function of ribosomes and endoplasmic reticulum.
7. Explain the relationship between the Golgi apparatus and rough endoplasmic reticulum.
8. Compare and contrast lysosomes with peroxisomes.
9. Describe the structure and function of the cytoskeleton.
10. Explain how microtubules relate to the centrosome and centrioles.
11. Explain the structure of glycosomes and lipid droplets.
12. Describe the structure and function of the nucleus and nuclear envelope.
13. Identify the relationship between chromatin and chromosomes.
14. Explain the function of nucleoli.
15. Identify some specific cell types and explain the relationship of cell shape to cell function.
16. Explain the cyclic relationship between interphase and cell division.
17. Define and describe interphase and its subphases. Include a key event for each subphase.
18. Define and describe mitosis and its stages, including key events for each stage.
19. Discuss cell differentiation and explain the major theories of aging.

Suggested Lecture Outline

I. Introduction to Cells (pp. 26–27; Fig. 2.1)

A. Revolutionary discoveries in the 1800s overturned the theory of spontaneous generation. Scientists assert that organisms are composed of cells and cells arise from other cells.

B. The cell is the basic structural and functional unit of all living things.

1. Major cellular regions are the plasma membrane, the cytoplasm, and the nucleus.

2. Most cell types contain each of the requisite organelles, but in differing abundances based upon the cell's type and its function.

II. The Plasma Membrane (Plasmalemma) (pp. 27–29)

A. Structure (pp. 27–28; Fig. 2.2)

1. Double layer, or bilayer, of lipid molecules (phospholipids, cholesterol, and glycolipids) with protein molecules dispersed within it.

B. Functions (pp. 28–29; Figs. 2.3–2.4)

1. Separates two major fluid compartments: the *intercellular fluid* within the cells and the *extracellular fluid* that lies outside and between cells.
2. Some membrane proteins act as receptors and are part of the body's cellular communication system.
3. Substances that enter and leave the cell are determined by the plasma membrane.
   a. Two types of *bulk (vesicular) transport* called *endocytosis* and *exocytosis* transport the largest macromolecules and largest solid particles.
   b. Clathrin is a protein found on the cytoplasmic side of the plasma membrane. It aids in deforming the plasma membrane to form vesicles.
   c. Three types of endocytosis are recognized: phagocytosis, pinocytosis, and receptor-mediated endocytosis.
   d. Viruses and some toxins use receptor-mediated endocytosis to enter cells.

III. The Cytoplasm (pp. 30–38)

A. The three major elements of the cytoplasm are the cytosol, organelles, and inclusions.

B. Cytosol (also termed cytoplasmic matrix) is the jelly-like fluid that suspends cytoplasmic elements.

C. Cytoplasmic organelles perform different cellular survival functions. (Figs. 2.5–2.12; Table 2.1)

1. Ribosomes are the sites of protein synthesis.
2. Endoplasmic reticulum makes proteins (rough ER) and is the site of lipid and steroid synthesis (smooth ER).
3. Golgi apparatus packages and modifies proteins.
4. Mitochondria synthesize ATP.
5. Lysosomes are the sites of intracellular digestion.
6. Peroxisomes detoxify toxic substances.
7. Cytoskeleton supports cellular structures.
8. Centrioles act in forming cilia and flagella, and organize microtubule networks during mitosis.

D. Inclusions are not permanent structures in cells; examples are food storage units for fats and sugars, as well as pigments.

IV. The Nucleus (pp. 38–39, Figs. 2.13–2.15)

A. The nucleus is the control center of the cell; it contains the DNA that directs protein synthesis.

B. Two parallel membranes separated by a fluid-filled space form the nuclear envelope that surrounds the nucleus.

C. Nucleoli contain parts of several chromosomes and assist in assembling ribosomal subunits.

D. Chromatin is composed of DNA and histones located in the nucleus.

1. The DNA molecule is a double helix made up of four types of nucleotides with bases of adenine, thymine, guanine, and cytosine.

V. Cellular Diversity (pp. 40, 44–45, Fig. 2.16)

A. The shape of human cells and the relative abundance of their organelles relate to the function of the trillions of cells that compose the body.

VI. The Cell Life Cycle (p. 42, Figs. 2.17–2.18)

A. The two major divisions of the cell cycle are *interphase* and *cell division* (*mitotic phase*). Cytokinesis occurs at the end of the M (mitotic) phase of the cell life cycle.

B. Interphase is divided into G_1, S, and G_2 subphases with DNA replication occurring during the S subphase.

C. During G_1 and G_2 of interphase, "checkpoints" evaluate cellular activity. G_1 checkpoint assesses cell size and G_2 checkpoint verifies accuracy of replication.

D. Nuclear material divides during mitosis.

E. Division of an entire cell into two daughter cells occurs during cytokinesis.

VII. Developmental Aspects of Cells (pp. 43–45)

A. Cell differentiation is the development of specific and distinctive features of human body cells.

B. Evidence supports aging occurs because mitochondria are damaged by free radicals and/or genetically influenced processes.

Lecture Hints

1. Explain why the cell in Figure 2.1 is described as a "generalized" cell. Emphasize that many body cells have a different structure and relate shape to function. (Example: Mature red blood cells are *anucleate*, and skeletal muscle cells are *multinucleate*. RBCs are biconcave discs that lack organelles and are packed with hemoglobin for oxygen transport.)
2. Display slides of electron micrographs to augment text diagrams. Comment on preparation of animal tissues for microscopy and on different types of microscopes.
3. Relate the function of the plasma membrane to its location at the interface between the cell's interior and exterior.
4. Describe the structure and functions of integral and peripheral proteins.
5. Explain diffusion and osmosis. Comment on how diffusion and osmosis differ from active transport mechanisms, such as exocytosis, endocytosis, and phagocytosis.

6. Describe the roles of *v*-SNARES and *t*-SNARES in exocytosis. Note that SNARE is an acronym for a group of proteins known as "*s*oluble *N*SF *a*ttachment *r*eceptors."
7. Explain the characteristics and content of cytoplasm and distinguish it from cytosol.
8. Discuss the specific roles of cytoplasmic organelles and inclusions.
9. Present a summary list of cellular organelles organized as membranous, microtubular, or "other," and briefly comment on functions of each organelle.
10. Explain the role of mitochondria as the source of most cellular energy. Refer to Figure 2.10.
11. Relate a molecule of glucose (food energy) to ATP production.
12. Using specific cellular examples, comment on why some cells have larger numbers of mitochondria and some have fewer mitochondria.
13. Discuss protein synthesis within cells. Refer to Figure 2.6.
14. Correlate the role of the nucleus as the source of information for protein synthesis with the ribosome as the site of protein synthesis and the Golgi apparatus as the site of packaging and delivery of proteins within cells.
15. Trace the flow of membrane components from the rough ER to the plasma membrane to explain why the rough ER is considered the cell's "membrane factory."
16. List components of the cytoskeleton.
17. Explain how the various elements of the cell's skeleton differ from each other in structure and function.
18. Discuss the role of the nucleus as the control center of the cell.
19. Explain the importance of DNA and describe the design of the double helix. Tell students they will not confuse complementary base pairing if they simply remember "A-T" as the only word possible from the base symbols, G, C, A, and T.
20. Describe the relationship of the nuclear envelope to rough ER.
21. Explain differences between chromatin and chromosomes.
22. Describe the structures and functions of the nucleus and nucleolus. Stress that the two are different entities within the cell.
23. Introduce the concept of cellular diversity by relating the shape of a cell to its function. Figure 2.16 is excellent for this concept.
24. Emphasize the cell cycle as a continuous process using the stages as discrete events.
25. Contrast cellular changes during interphase with changes during mitosis.
26. Describe the functions of "checkpoints" during interphase of the cell cycle.
27. Ask students why telophase is the reverse of prophase.
28. Explain cytokinesis and clearly distinguish it from mitosis.
29. Point out that mitosis is possible without cytokinesis, using multinucleated skeletal muscle cells for an example.
30. Make sure students understand the difference between genes, chromatin, chromosomes, DNA, and proteins.
31. Discuss the free-radical and mitochondrial theories of aging in relation to environmental pollution and the current craze for ingesting antioxidants such as vitamins C and E.

32. Discuss telomeres and telomerase in reference to the genetic theory of aging.
33. Distinguish apoptosis from senescence.

Classroom Discussion Topics and Activities

1. Using Plastilene™ (a reusable modeling clay available in many colors) and contrasting paper, organize students into groups of three with instructions to model the plasma membrane. Using text Figure 2.2, p. 27, instruct students to include phospholipids, cholesterol, glycocalyx, and one membrane protein. Then have brief group presentations covering the structure and functions of the chosen proteins.
2. Illustrate a cell by using a hypothetical Jell-O® fruit salad. The Jell-O® is the cytosol; an orange is the nucleus; and nuts, raisins, and other fruits are the organelles.
3. Ask students to name common examples of diffusion, osmosis, and filtration.
4. Use a model of an animal cell to demonstrate the various organelles and other cell features.
5. Instruct students to list all parts of a generalized cell that are involved in the following functions: respiration, digestion, excretion, transportation, reproduction, food acquirement, energy production, protein formation, and internal support.
6. Instruct the students to construct a chart that lists the membrane-bound organelles in one column, and in another column, the organelles that are not membrane-bound.
7. Use a Slinky™ to demonstrate the helical nature of DNA. Demonstrate the relationship between chromatin and the chromosome states by stretching or tightly coiling the Slinky™.
8. Beginning with a typical diploid human body cell containing 46 chromosomes, have students identify the number of chromosomes and chromatids present in each stage of mitosis.
9. Use models of chromosomes with detachable chromatids to illustrate mitotic phases. (Make simple models using strands of colored yarn with sewn-on snaps or colored pipe cleaners.)
10. Assign the following questions to be answered at the next class meeting:
    a. Why is damage to the heart or brain more damaging than injury to the liver?
    b. Why is precise division of the chromosomes during metaphase of mitosis so important?
    c. Is mitosis without cytokinesis possible? What would be the result?
11. Discuss why certain body cells (e.g., muscle and nerve cells) "lost" their ability to divide.
12. Ask students why they survive despite loss of billions of cells daily.
13. Ask students to consider possibilities of growing organs from "scratch." What ethical issues of tissue engineering and regenerative medicine are involved? Supplemental video: *Spare Parts: Growing Human Organs* (FHS; 28 min., 1999)
14. Pique students' interest by discussing topics such as the cell biology of cancer or theories on aging.
15. Describe telomeres as "pencil erasers"; once the "eraser" is gone, the cell undergoes senescence.

Clinical Questions

1. A patient receiving treatment for testicular cancer was told that the chemotherapy drug he received inhibits the division of cancer cells. What could the drug be, and how would it stop cell division?

Answer: One chemotherapy drug considered in this chapter, vinblastine, inhibits the formation of microtubules and mitotic spindles required for cell division. Since cancer cells divide rapidly, the drug will preferentially affect these cells. Unfortunately, normal cells that divide rapidly will also be affected.

2. A small boy received a cut on his arm and his mother applied hydrogen peroxide to the wound. The wound bubbled! Why?

   Answer: The hydrogen peroxide was degraded to water and oxygen (which bubbled off) by the action of the intracellular enzymes in peroxisomes. (Bacteria in the cut produce a similar enzyme.)

ART RESOURCES

To view thumbnails of all the images in Chapter 2, see Appendix A.

Transparencies Index/Media Manager

Figure 2.1 Structure of a generalized cell.

Figure 2.2 The plasma membrane.

Figure 2.3 Two types of endocytosis: phagocytosis and receptor-mediated endocytosis.

Figure 2.4 Exocytosis.

Figure 2.5 The endoplasmic reticulum (ER) and ribosomes.

Figure 2.6 Assembly of proteins at the rough endoplasmic reticulum.

Figure 2.7 Golgi apparatus.

Figure 2.8 Role of the Golgi apparatus in packaging the products of the rough ER for use in the cell and secretion.

Figure 2.9 Lysosomes.

Figure 2.10 Mitochondria.

Figure 2.11 The cytoskeleton.

Figure 2.12 Centrosome and centrioles.

Figure 2.13 The nucleus.

Figure 2.14 Molecular structure of DNA.

Figure 2.15 Chromatin.

Figure 2.16 Cellular diversity.

Figure 2.17 The cell cycle.

Figure 2.18 The stages of mitosis.

Table 2.1 Parts of the Cell: Structure and Function

Teaching with Art

Figure 2.2 The plasma membrane.

Figure 2.3 Two types of endocytosis: phagocytosis and receptor-mediated endocytosis.

Figure 2.4 Exocytosis.

Textbook pp. 27–30; transparencies; Media Manager.

Checklist of Key Points in the Figure

- Explain the "fluid" nature of the fluid mosaic model.
- Explain why the fluid mosaic model is a "mosaic."
- Define *intracellular* fluid and *extracellular* fluid.
- Correlate Figures 2.2, 2.3, and 2.4 to differentiate bulk transport concepts, exocytosis, and endocytosis. Students often do not understand the importance endocytosis is taking in the dissolved solutes in the fluid, rather than the solvent itself.
- Explain the terms "cell eating" and "cell-drinking."
- Describe the difference between nonselective pinocytosis and highly selective receptor-mediated endocytosis.
- Illustrate the importance of phagocytosis using white blood cells.
- Illustrate exocytosis with the production of salty, protein-containing solution by cells in tear glands when weeping occurs.

Common Conceptual Difficulties Interpreting the Art

- Remind students that Figure 2.2 focuses on the molecular level.
- Cellular components are recycled and reused.
- Energy is required. Where does it come from?
- Point out relationship of plasma membrane to vesicle formation during endocytosis and exocytosis.
- Point out that because the membrane is "highly selective" in receptor-mediated endocytosis, this does not mean harmful substances such as toxins and viruses are kept out of the cell.

Art Exercise

Using Figure 2.3 for reference, instruct students to represent phagocytosis with a simple drawing. Follow a highlighted segment of plasma membrane to its incorporation into a phagosome. Add lysosomes to the drawing. Ask students where the highlighted membrane finally ends up. A similar demonstration is possible using Figure 2.3 with an overlay and colored marker.

Critical Reasoning

Ask students why lymph nodes become swollen and tender when there is an infection in the body.

Answer: Lymphocytes are white blood cells that fight infections in the body. A swollen node means a proliferation of lymphocytes and is evidence of the body's fight against infection.

SUPPLEMENTAL COURSE MATERIALS

Library Research Topics

1. Can protein molecules move within the cell membrane? What research supports your findings?
2. Receptor-mediated endocytosis is a highly selective mechanism to ingest molecules. How can it be used to kill cancer cells?
3. Do chemical carcinogens cause all cancers? What other things cause cancer?

4. Review the evidence for and against the theory that mitochondria evolved from bacteria that came to live within primitive eukaryotic cells.
5. Read about the newest research on aging.
6. Research current use of tissue engineering and regenerative medicine.

Media

See Appendix B of the Instructor Resource Guide for Key to Audiovisual Distributors.

Slides

1. *Cell Structure Set* (CBS)
2. *Onion Mitosis 35mm Slides Set* (CBS)

Video

1. *The Aging Process* (FHS; 19 min.). This program explains the effects of aging on the mind and body, and explores the theories about why cells wear out.
2. *Cancer* (FHS; 23 min.). Provides a look at how cancers form and some of the weapons used in the fight against them. Some of the treatments demonstrated include: chemotherapy, radiation therapy, surgery, photochemotherapy, and monoclonal antibodies.
3. *An Introduction to the Living Cell* (CBS; 30 min.). This program takes students on a visual tour of a cell. Subcellular organelles are shown working together. Computer animation and microscopic images are used to visualize the complexities of the cell. This is an excellent program for lecture presentation.
4. *A Journey Through the Cell* (IM; 25 min. each, 1997). Contains computer graphics and animations, and includes presentations by scientists introducing ideas central to understanding cells.

Software

1. *Animal and Plant Mitosis SMARTSlides* (WNSE; Win/Mac). Your classroom computer becomes a microscope with a library of 20 prepared slides. The program presents all phases of plant and animal mitosis.
2. *The Cell: Structure, Function, and Process* (IM; Win/Mac). Introduces the microscopic world of the cell and explores various cell processes.
3. *Exploration of Cell Process* (IM; Win/Mac). Helps students to visualize and understand essential cell processes.
4. *The Plasma Membrane and Cellular Transport* (CBS; Win/Mac). This CD provides a detailed study of membranes and cell motility. Introduces the fluid mosaic model. Students can explore cell biology at their own pace.

Suggested Readings

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ANSWERS TO TEXTBOOK QUESTIONS

Answers for multiple-choice and matching questions 1–12 are located in Appendix B of the textbook.

Short Answer and Essay Questions

13. Membrane-lined organelles: mitochondria, rough ER (and nuclear envelope), smooth ER, Golgi apparatus, lysosomes, and peroxisomes (nucleus too). Organelles that have no membrane: centrioles and centrosomes, microtubules, microfilaments, and intermediate filaments. (p. 35)
14. A nucleolus is a dark-staining structure within a nucleus, much smaller than the nucleus itself. While the nucleus contains many chromosomes, the nucleolus consists of parts of several of these chromosomes that work together to manufacture the basic subunits of ribosomes. (pp. 38–39)

15. Mitochondria are the only organelles that have a complex, double-unit membrane, and their own DNA and genes. (Although it was not mentioned, mitochondria also contain their own ribosomes and RNA.) (p. 34)
16. A chromosome is one of 46 long, single molecules of DNA (with the associated protein) in the nucleus of typical human cells. When a cell is dividing, its chromosomes are maximally coiled, so they appear as thick rods. In nondividing cells, the chromosomes are partially uncoiled for transcription (see Figure 2.15).

Critical Reasoning and Clinical Applications Questions

1. Experiments on rats and other animals indicate that slightly underweight and undernourished animals have prolonged life spans. (p. 45) (See "Aging," Chapter 2.)
2. *Hyperplasia* means the cells have proliferated into a thick layer of structurally normal cells; *dysplasia* means that a few of the cells show abnormal size or shape; *lack of neoplasia* means that the cells were not proliferating uncontrollably (no tumor or cancer was evident). Therefore, Kareem did not have cancer of the mouth. (p. 48)
3. G_1, S, G_2, and M are all phases of the cell life cycle (Figure 2.17). G_1 is a growth phase followed by S, the phase in which DNA is replicated in preparation for cell division. G_2 is when the final preparations for cell division are made, and M is the mitotic phase leading to division of the nucleus. Clearly, the tumor-suppressor genes are halting various phases of the cell life cycle in precancer cells that would otherwise multiply uncontrollably. (p. 48)
4. Peroxisomes. (p. 34)
5. Long-term use of phenobarbital causes proliferation of smooth endoplasmic reticulum in the liver because the smooth ER acts to detoxify poisons and drugs. Proliferation of smooth ER is necessary because, as phenobarbital is repeatedly ingested, the body must manufacture more smooth ER in order to combat the poison. In the user, this is perceived as "tolerance" to the drug and the user needs higher doses of the drug to achieve the original result. (pp. 31–32; Table 2.1))
6. Without microtubules, the mitotic spindle cannot form, and without the mitotic spindle, mitosis and cell division are impossible. (pp. 36–37)
7. Describing cellular structures in terms of their roles in a "manufacturing factory" gives the following results:
    a. Plasma membrane—allows only specific substances into the manufacturing factory.
    b. Mitochondria—provides energy for the factory.
    c. Nucleus—the manager/leader of the factory.
    d. Golgi apparatus—shipping and receiving in the factory.
    e. Ribosomes—makes the products in the factory.
    f. Lysosomes—the "demolition crew" of the factory.
    g. Peroxisomes—toxic waste removal system of the manufacturing factory.

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