

Preface

Welcome to the ninth edition of *Hole's Essentials of Human Anatomy and Physiology*. We continue our commitment to introduce the structure and function of the human body in an interesting and highly readable manner.

Many of you are planning careers in health care, athletics, science, or education. We understand that you face the challenge of balancing family, work, and academics. This text provides you with many helpful tools that will prepare you for success in the study of human anatomy and physiology.

Extra Help When You Need It.

Student Study Guide *to accompany*
Hole's Essentials of Human Anatomy and Physiology, Ninth Edition
By Nancy Ann Sickles Corbett
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The study guide chapters correspond to the chapters in
Hole's Essentials of Human Anatomy and Physiology, Ninth Edition
by Shier, Butler, and Lewis.

Climb to the top of the class using study tools provided for every chapter:

1. **Overviews** offer a rationale for studying the chapter.
2. **Chapter Objectives** guide your study of the chapter.
3. **Focus Questions** help you focus your study of the chapter.
4. **Mastery Tests** are for “your information” to help you learn where to concentrate your learning efforts.
5. **Study Activities** help facilitate the study of the principal ideas of each chapter.

How Can I Succeed in This Class?

An important step to effective learning begins with a solid study strategy. Many first year students feel overwhelmed by the amount of material in Anatomy and Physiology. Be assured that you can do the work, and you can be successful. Practice, diligence, and perseverance will pay off. Professor Susan Allen of North Harris College, Houston, Texas, offers the following study tips to assist you in preparation for the ride ahead.

1. Go over your notes and handouts *everyday*.

- Review material in the first 24 hours after class. You will learn faster and remember longer.
- Go over your notes at least once a day.
- Read over all notes taken to date, and read the notes out loud. Seeing, saying, and hearing helps.
- Record the lectures (after getting permission), and listen to them.

2. Rewrite your notes.

- Use block letters and an outline form.
- Put a small amount of material on each page and illustrate facts with drawings. A picture is worth a thousand words.
- Color code headings.

3. Read each chapter or unit before going to class.

- Use the SQ3R method when you read: Survey, Question, Read, Recite, Review.
- Use the chapter outline at the chapter ends.
- Answer the end-of-chapter questions.
- Pay particular attention to the diagrams and charts.

4. Form study groups.

- Plan regular times to meet and go over the material.
- Explain the material to someone else.
- Talk through a concept to gain a thorough understanding.
- Make up an exam for the material.

5. Use the Cornell Method of note taking.

- Organizing the material will cut down on your study time.
- For further information on this great method of note taking, refer to the study tips page under Biology on the North Harris College Web Page: <http://science.nhmccd.edu/biol>

6. Budget your time.

- Study for short periods of time with breaks in between. Short repeated study sessions are much more effective than one long session.
- For every hour you are in class, spend two to three hours studying outside of class.

7. Make flashcards for terms and definitions.

- Make up meaningful acronyms and word combinations to help you remember information.
- Sound out difficult words and practice spelling them.
- Learn the meanings of the prefixes and suffixes of words. Check out the Appendix for meanings of these words.

8. Use effective ways to learn terminology.

- Look at the word.
- Say the word out loud and repeat the word often during the day.
- Touch the area on a model or torso, or touch the area on your own body (when possible).
- Write the words.
- Color the region represented by the term in an Anatomy Coloring Book.

9. Make models of the chemical structures in chapter 2.

- Use gumdrops, marshmallows, toothpicks, etc.
- Look at a diagram and build a model. It will help you learn the material faster and remember it longer.

10. Use additional study aids that are available:

- Student Study Guide
- The Dynamic Human CD-Rom
- Essential Study Partner found on the Online Learning Center (OLC)
- Film clips and videos recommended by the professor

Welcome to the journey through the human body!

David Shier

Jackie Butler

Ricki Lewis

chapter 6

Unit 2 Support and Movement

Skin and the Integumentary System



THE ORIGIN OF HAIR. Hairs are extensions of specialized cells in the outer skin layer that some of us spend enormous amounts of time washing, drying, curling, straightening, styling, coloring, plucking, and shaving. Yet, compared to other mammals, we humans appear relatively hairless. Appearances are deceiving—we actually have as many hair follicles per square inch as a chimpanzee. The chimp's hairs, however, are longer, thicker, and darker than ours.

All of the 5 million hair follicles of an adult human form during the fifth month of prenatal development, coating the fetus with a downy layer called lanugo. In most newborns, the lanugo has receded beneath the skin surface, perhaps leaving a bit of fuzziness on the ear tips or elsewhere. Persistence of this early hair accounts for much of the difference in hairiness between us and other primates. In a very rare inherited condition in humans called hypertrichosis, some of the lanugo remains and grows long. In less sensitive times, people with severe cases were exhibited in circuses as ape-men or werewolves.

In other mammals, hair provides warmth. It is absent in aquatic mammals such as whales and manatees, and reduced in their semiaquatic cousins, such as hippos, presumably because a furry coat would impair swimming. What advantages might lighter coats have afforded our ancestors that can explain why this almost uniquely human trait has persisted?

One theory maintains that less hair enabled us to successfully conquer grasslands. Furry, four-footed animals can run fast for a short time, and then slow down due to heating up. With hair dense only atop the head, protecting against sunburn, two-footed humans could run for longer times, enabling them to hunt. The lack of hair enabled our sweat glands to efficiently cool the body. Our hair has also persisted in places where our individual scents cling, which is essential for reproduction and offspring-parent bonding. Yet another explanation for our less hairy appearance is the "parasite-reduction hypothesis": Fur entraps fleas, lice, and ticks, which spread infectious disease. Shed the fur, and we shed the parasites.

Chapter Objectives

After studying this chapter, you should be able to do the following:

6.1 Skin and Its Tissues

1. Describe the structure of the layers of the skin. (p. 113)

2. List the general functions of each layer of skin. (p. 114)
3. Summarize the factors that determine skin color. (p. 116)

6.2 Accessory Organs of the Skin

4. Describe the accessory organs associated with the skin. (p. 117)

6.3 Regulation of Body Temperature

5. Explain how the skin helps regulate body temperature. (p. 120)

6.4 Healing of Wounds

6. Describe the events that are part of wound healing. (p. 120)

Aids to Understanding Words

cut- [skin] subcutaneous: Beneath the skin.

derm- [skin] dermis: Inner layer of the skin.

epi- [upon] epidermis: Outer layer of the skin.

follicle- [small bag] hair follicle: Tubelike depression in which a hair develops.

kerat- [horn] keratin: Protein produced as epidermal cells die and harden.

melan- [black] melanin: Dark pigment produced by certain cells.

seb- [greasy] sebaceous gland: Gland that secretes an oily substance.

What Every Student Needs to Know!

Many study tools have been integrated into your text:

VIGNETTES take the lead to chapter content. They connect you to many areas of health care including technology physiology, medical conditions, historical perspectives, and careers.

CHAPTER OBJECTIVES help you stay on course as you master the information within the narrative. Use them as guides to identify important chapter topics.

AIDS TO UNDERSTANDING WORDS increase your pace in understanding and remembering scientific word meanings. Examine root words, stems, prefixes, suffixes, pronunciations and build a solid A&P vocabulary.



Figure 7.31 The talus moves freely where it articulates with the tibia and fibula.

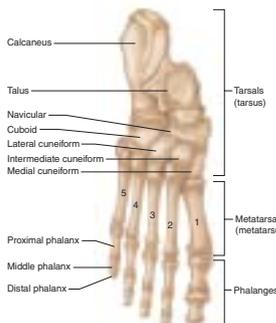


Figure 7.32 The right foot, viewed superiorly.

metatarsals are arranged and bound by ligaments to form the arches of the foot. A longitudinal arch extends from the heel to the toe, and a transverse arch stretches across the foot. These arches provide a stable, springy base for the body. Sometimes, however, the tissues that bind the metatarsals weaken, producing fallen arches, or flat feet.

The **phalanges** of the toes, which are similar to those of the fingers, align and articulate with the metatarsals. Each toe has three phalanges—a proximal, a middle, and a distal phalanx—except the great toe, which lacks a middle phalanx.

CHECK YOUR RECALL

1. Locate and name each of the bones of the lower limb.
2. Explain how the bones of the lower limb articulate with one another.
3. Describe how the foot is adapted to support the body.

7.13 Joints

Joints (articulations) are functional junctions between bones. They bind parts of the skeletal system, make possible bone growth, permit parts of the skeleton to change shape during childbirth, and enable the body to move in response to skeletal muscle contractions. Joints vary considerably in structure and function. If classified according to the degree of movement they make possible, joints can be immovable, slightly movable, or freely movable. Joints also can be grouped according to the type of tissue (fibrous, cartilaginous, or synovial) that binds the bones together at each junction. Currently, this structural classification by tissue type is more commonly used.

There are 230 joints in the body.

Fibrous Joints

Fibrous (fi'brus) **joints** lie between bones that closely contact one another. A thin layer of dense connective tissue joins the bones at such joints, as in a *suture* between a pair of flat bones of the skull (fig. 7.33). No appreciable movement takes place at a fibrous joint. Some fibrous joints, such as the joint in the leg between the distal ends of the tibia and fibula, have limited movement.

Attack the chapter content with:

CHECK YOUR RECALL QUESTIONS attack the material covered in major sections by testing your understanding of key concepts.

FACTS OF LIFE go all out with amazing bits of anatomy and physiology trivia, adding a touch of wonder to chapter topics.

Pull concepts together with real-life:

CLINICAL TERMS help you sprint ahead in understanding medical terminology. Lists of related terms often used in clinical situations are found at the end of several chapters.

CHAPTER 14 Lymphatic System and Immunity 381

Clinical Terms Related to the Lymphatic System and Immunity

allograft (al'ō-graft) Transplantation of tissue from an individual of one species to another individual of that species.

asplenia (ah-splē'ne-ah) Absence of a spleen.

autograft (aw'tō-graft) Transplantation of tissue from one part of the body to another part of the same body.

immunocompetence (im'yū-no-kom'pe-tens) Ability to produce an immune response to antigens.

immunodeficiency (im'yū-no-de-fish'en-se) Inability to produce an immune response.

lymphadenectomy (lim-fad'ē-nek'tō-me) Surgical removal of lymph nodes.

lymphadenopathy (lim-fad'ē-nop'ah-the) Enlargement of lymph nodes.

lymphadenotomy (lim-fad'ē-not'ō-me) Incision of a lymph node.

lymphocytopenia (lim'fō-si'tō-pe'ne-ah) Too few lymphocytes in the blood.

lymphocytosis (lim'fō-si'tō-sis) Too many lymphocytes in the blood.

lymphoma (lim-fō'mah) Tumor composed of lymphatic tissue.

lymphosarcoma (lim'fō-sar-ko'mah) Cancer within the lymphatic tissue.

splenectomy (splē-nek'tō-me) Surgical removal of the spleen.

splenitis (splē-ni'tis) Inflammation of the spleen.

splenomegaly (splē'no-meg'ah-le) Abnormal enlargement of the spleen.

splenotomy (splē-not'ō-me) Incision of the spleen.

thymectomy (thi-mek'tō-me) Surgical removal of the thymus.

thymitis (thi-mi'tis) Inflammation of the thymus.

xenograft (zen'ō-graft) Transplantation of tissue from one species into a recipient of another species.

Clinical Connection

Some disorders thought to be autoimmune may have a more bizarre cause—fetal cells persisting in a woman's circulation, for decades. In response to an as yet unknown trigger, the fetal cells, perhaps "hiding" in a tissue such as skin, emerge and stimulate antibody production. Without knowing the fetal cells were there, the resulting antibodies and symptoms appear to be an autoimmune disorder. This mechanism, called microchimerism ("small mosaic"), may explain the higher prevalence of autoimmune disorders among women. It was discovered in a disorder called scleroderma, which means "hard skin."

Patients describe scleroderma, which typically begins between ages forty-five and fifty-five, as "the body turning to stone." Symptoms include fatigue, swollen joints, stiff fingers, and a masklike face. The hardening may affect blood vessels, the lungs, and the esophagus, too. Clues that scleroderma is a delayed response to persisting fetal cells include the following observations:

- It is much more common among women.
- Symptoms resemble those of graft-versus-host disease (GVHD), in which transplanted tissue produces chemicals that destroy the body. Antigens on cells in scleroderma lesions match those involved in GVHD.
- Both mothers who have scleroderma and their sons have cell surfaces that are more similar than those of unaffected mothers and their sons. Perhaps the similarity of cell surfaces enabled the fetal cells to escape destruction by the woman's immune system. (Female fetal cells can theoretically cause scleroderma too, but they are harder to detect because male cells can be distinguished by the Y chromosome.)

Perhaps other disorders considered autoimmune actually reflect an immune system response to lingering fetal cells.

SUMMARY OUTLINE

14.1 Introduction (p. 000)
The lymphatic system is closely associated with the cardiovascular system. It transports excess fluid to the bloodstream, absorbs fats, and helps defend the body against disease-causing agents.

14.2 Lymphatic Pathways (p. 000)

- Lymphatic capillaries
 - Lymphatic capillaries are microscopic, closed-ended tubes that extend into interstitial spaces.
 - They receive lymph through their thin walls.
- Lymphatic vessels
 - Lymphatic vessels have walls similar to those of veins, only thinner, and possess valves that prevent backflow of lymph.
 - Larger lymphatic vessels lead to lymph nodes and then merge into lymphatic trunks.
- Lymphatic trunks and collecting ducts
 - Lymphatic trunks lead to two collecting ducts—the thoracic duct and the right lymphatic duct.
 - Collecting ducts join the subclavian veins.

14.3 Tissue Fluid and Lymph (p. 000)

- Tissue fluid formation
 - Tissue fluid originates from blood plasma.
 - It generally lacks large proteins, but some smaller proteins leak into interstitial spaces.
 - As the protein concentration of tissue fluid increases, colloid osmotic pressure increases.

CLINICAL CONNECTIONS

help you go even further by "pulling the chapter concepts together." These short vignettes at the end of the chapter give you a real-life connection to the material covered. Short paragraphs in colored boxes also apply ideas and facts in the narrative to clinical situations.

TOPICS OF INTEREST are proven performers in presenting disorders, physiological responses to environmental factors, and other topics of general interest.

178 UNIT 2 Support and Movement

Topic of Interest

STERIODS AND ATHLETES—AN UNHEALTHY COMBINATION

In the 1988 summer Olympics held in Seoul, South Korea, Canadian Ben Johnson flew past his competitors in the 100-meter run. But seventy-two hours later, officials rescinded the gold medal he won for his record-smashing time of 9.79 seconds, after a urine test revealed traces of the drug stanozolol, a synthetic stand-in for the steroid hormone testosterone (fig. 8A). Johnson's natural testosterone level was only 15% of normal—evidence of negative feedback acting because of an outside supply of the hormone. Yet Johnson's experience was soon forgotten. In the 1992 summer games in Barcelona, Spain, several athletes were dismissed for using drugs that they thought would have steroidlike effects. In the 2000 summer games, a urine test on U.S. shotputter C.J. Hunter revealed 1,000 times the allowable limit of nandrolone, a testosterone metabolite. In 2003, several members of the Oakland Raiders football team were caught using tetrahydrogestrinone (THG). They at first claimed it was a "food supplement" and therefore not subject to drug restrictions. However, the Food and Drug Administration quickly discovered that THG is a "designer" synthetic steroid, made by slightly altering either of two banned steroid drugs. Steroid use among high school and college athletes is on the increase, according to the American College of Sports Medicine.

Athletes who abuse steroids do so to take advantage of the hormone's ability to increase muscular strength. But improved performance today may have consequences tomorrow. Steroids hasten adulthood, stunting height and causing early hair loss. In males, excess steroid hormones lead to breast development, and in females to a deepened voice, hairiness, and a male physique. The kidneys, liver, and heart may be damaged, and atherosclerosis may develop because steroids raise LDL and lower HDL—the opposite of a healthy cholesterol profile. In males, the body mistakes the synthetic steroids for the natural hormone and lowers its own production of testosterone—as Ben Johnson found out. Infertility may result. Steroids can also cause psychiatric symptoms, including delusions, depression, and violence.

Steroid abuse began in Nazi Germany, where Hitler used the drugs to fashion his "super race." Ironically, steroids were also used shortly after to build up the emaciated bodies of concentration camp survivors. In the 1950s, Soviet athletes began using steroids in the Olympics, and a decade later, U.S. athletes did the same. In 1976, the International Olympic Committee banned steroid use and required urine tests for detecting the drugs.

Anabolic steroids were created for medical purposes. They were first used clinically in the 1930s to treat underdevelopment of the testes and the resulting deficit in testosterone. In the 1950s, physicians used anabolic steroids to treat anemia and muscle-wasting disorders, and to bulk up patients whose muscles had atrophied due to extended bed rest. In the 1960s, anabolic steroids were used to treat some forms of short stature and dwarfism, a practice that was discontinued when pure preparations of human growth hormone became available through recombinant DNA technology. Today, anabolic steroids are used to treat wasting associated with AIDS.



Figure 8A
Canadian track star Ben Johnson ran away with the gold medal in the 100-meter race at the 1988 Summer Olympics—but then had to return the award when traces of a steroid drug showed up in his urine. Drug abuse continues to be a problem, among amateur as well as professional athletes.

CHAPTER 8 Muscular System 183

Genetics Connection **INHERITED DISEASES OF MUSCLE**

A variety of inherited conditions affect muscle tissue. These disorders differ in the nature of the genetic defect, the type of protein that is abnormal in form or function, and the particular muscles in the body that are impaired.

The Muscular Dystrophies—Missing Proteins
A muscle cell is packed with filaments of actin and myosin. Less abundant, but no less important, is a protein called *dystrophin*. It literally holds skeletal muscle cells together by linking actin in the cell to glycoproteins (called *dystrophin-associated glycoproteins*, or DAGs) that are part of the cell membrane. This helps attach the cell to the surrounding extracellular matrix. Missing or abnormal dystrophin or DAGs cause muscular dystrophies. These illnesses vary in severity and age of onset, but in all cases, muscles weaken and degenerate. Eventually, fat and connective tissue replace muscle.

Duchenne muscular dystrophy (DMD) is the most severe type of the illness (fig. 8B). Symptoms begin by age five and affect only boys. By age thirteen, the person cannot walk, and by early adulthood he usually dies from failure of the respiratory muscles. In DMD, dystrophin is often missing. In Becker muscular dystrophy, symptoms begin in early adulthood, are less severe, and result from underproduction of dystrophin. Limb-girdle muscular dystrophy causes weakness in the upper limbs, usually noticeable in a person's thirties. This form of muscular dystrophy is often the result of a missing or abnormal DAG, which causes the other DAGs to be duplicated.

Charcot-Marie-Tooth Disease—A Duplicate Gene
Charcot-Marie-Tooth disease causes a slowly progressing weakness in the muscles of the hands and feet and a decrease in tendon reflexes in these parts. In this illness, an extra gene impairs the insulating sheath around affected nerve cells, so that nerve cells cannot adequately stimulate the involved muscles. Symptoms resemble those of diverse other conditions, including AIDS, alcoholism, vitamin B₁₂ deficiency, diabetes mellitus, and heavy metal poisoning. Physicians perform two tests—electromyography and nerve conduction velocities—to diagnose Charcot-Marie-Tooth disease. It is also possible to test for the gene mutation to establish a diagnosis.

Myotonic Dystrophy—An Expanding Gene
Myotonic dystrophy delays muscle relaxation following contraction (myotonia), which causes facial and limb weakness, cataracts, and an irregular heartbeat. It is caused by inheriting either of two "expanding genes" that actually grow with each generation. As the gene enlarges, symptoms increase in severity or begin at an earlier age. For example, a grandfather might experience only mild weakness in his forearms, but his daughter might have more noticeable arm and leg weakness. By the third generation, affected children might suffer severe muscle impairment. For many years, physicians attributed the worsening of symptoms over generations to psychological causes. We now know there is a physical basis for the phenomenon. The expanded genes are transcribed into messenger RNA molecules that are too large to leave the nucleus, so that the proteins they encode are not synthesized.

Hereditary Idiopathic Dilated Cardiomyopathy—A Tiny Glitch
This very rare inherited form of heart failure usually begins in a person's forties and is lethal in 50% of cases within five years of diagnosis, unless a heart transplant can be performed. The condition is caused by a tiny genetic error in a form of actin found only in cardiac muscle, where it is the predominant component of the thin filaments. A change in a single DNA building block (nucleotide base) apparently disturbs actin's ability to anchor to the Z lines in heart muscle cells. The mutation prevents actin from effectively transmitting the force of contraction, which gradually causes the heart chambers to enlarge and eventually to fail to function.

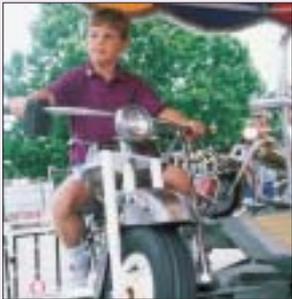


Figure 8B
This young man has Duchenne muscular dystrophy. The condition has not yet severely limited his activities, but he shows the hypertrophied (overdeveloped) calf muscles that result from his inability to rise from a sitting position the usual way—an early sign of the illness.

GENETICS CONNECTIONS lead the standings by exploring the molecular underpinnings of familiar as well as not so familiar illnesses. Read about such topics as ion channel disorders, muscular dystrophies, and cystic fibrosis.

Prepare for top performance with:

CHAPTER SUMMARY OUTLINES prepare you for another top performance by helping you review the chapter's main ideas.

REVIEW EXERCISES and CRITICAL THINKING QUESTIONS have been updated and check your understanding of the chapter's major ideas. Critical thinking questions encourage you to apply information to clinical situations.

THE GLOSSARY has been rewritten for clarity and to minimize redundancy.

CHAPTER 8 Adaptation and Coordination

SUMMARY OUTLINE

8.1 Introduction (p. 132)
Individual bones are the organs of the skeletal system. If bones contain any organic tissues:

8.2 Bone Structure (p. 132)
Bone structure reflects its function

1. Cells of a long bone
 - a. Epiphyses at each end are covered with articular cartilage and articulate with other bones.
 - b. The shaft of a bone is called the diaphysis.
 - c. To meet for the articular cartilage, a bone is covered by a periosteum.
2. Membrane structure
 - a. Compact bone contains concentric lamellae.
 - b. Spongy bone from the surface of the shaft, bony plates surround the shaft of spongy bone.
3. Bone Development and Growth (p. 134)
 1. Endochondral bones
 - a. In a vertebrate, bones develop from layers of cartilage tissues.
 - b. Osteons within the endochondral layer form bone tissue.
 - c. Many bone cells are called osteocytes.
 2. Intramembranous bones
 - a. Endochondral bones develop first as hyaline cartilage, which later is replaced by bone tissue.
 - b. The epiphyseal disks are responsible for lengthening.
 - c. Growth in thickness is due to intramembranous ossification beneath the periosteum.

REVIEW EXERCISES

Part A

1. Sketch a typical long bone, and label its epiphyses, diaphysis, medullary cavity, periosteum, and articular cartilage. (p. 132)
2. Distinguish between spongy and compact bone. (p. 132)
 - a. Endochondral bones develop first as hyaline cartilage, which later is replaced by bone tissue.
 - b. The epiphyseal disks are responsible for lengthening.

Part B

36. Define home (p. 130)
37. List six types of synovial joints, and name an example of each type. (p. 133)

Part B
Match the research outcome with the mechanism in column B.

CRITICAL THINKING

1. How does the structure of a bone make it strong yet lightweight?
2. If a 70-year-old woman were to take action to lower her risk of developing the bone-weakening condition?
3. What steps do you think should be taken to reduce the chances of people accumulating foreign metallic elements, such as lead or radium, in their bones?
4. Why are women at an increased risk of developing osteoporosis than men? What steps might reduce the risk of developing this condition?

WEB CONNECTIONS

The idea behind tissue engineering is to create and a replacement part that is similar enough to its real counterpart to function in the body, but not so similar that it triggers the immune system to reject it.

<http://www.bone-tissue-engineering.com/>

Student

file missing

Organization

ENDOCRINE SYSTEM



Glands secrete hormones that have a variety of effects on cells, tissues, organs, and organ systems.

Integumentary System



Melanocytes produce skin pigment in response to hormonal stimulation.

Lymphatic System



Hormones stimulate lymphocyte production.

Skeletal System



Hormones act on bones to control calcium balance.

Digestive System



Hormones help control digestive system activity.

Muscular System



Hormones help increase blood flow to exercising muscles.

Respiratory System



Decreased oxygen causes hormonal stimulation of red blood cell production; red blood cells transport oxygen and carbon dioxide.

Nervous System



Neurons control the secretions of the anterior and posterior pituitary glands and the adrenal medulla.

Urinary System



Hormones act on the kidneys to help control water and electrolyte balance.

Cardiovascular System



Hormones are carried in the bloodstream; some have direct actions on the heart and blood vessels.

Reproductive System



Sex hormones play a major role in development of secondary sex characteristics, egg, and sperm.

ORGANization ILLUSTRATIONS found at the end of selected chapters conceptually link the highlighted body system to every other system and reinforce the dynamic interplays between groups and organs. These illustrations help you review chapter concepts and reinforce the “big picture” in learning and applying the principles of anatomy and physiology.

REFERENCE PLATES continue to offer vibrant detail of body structures.

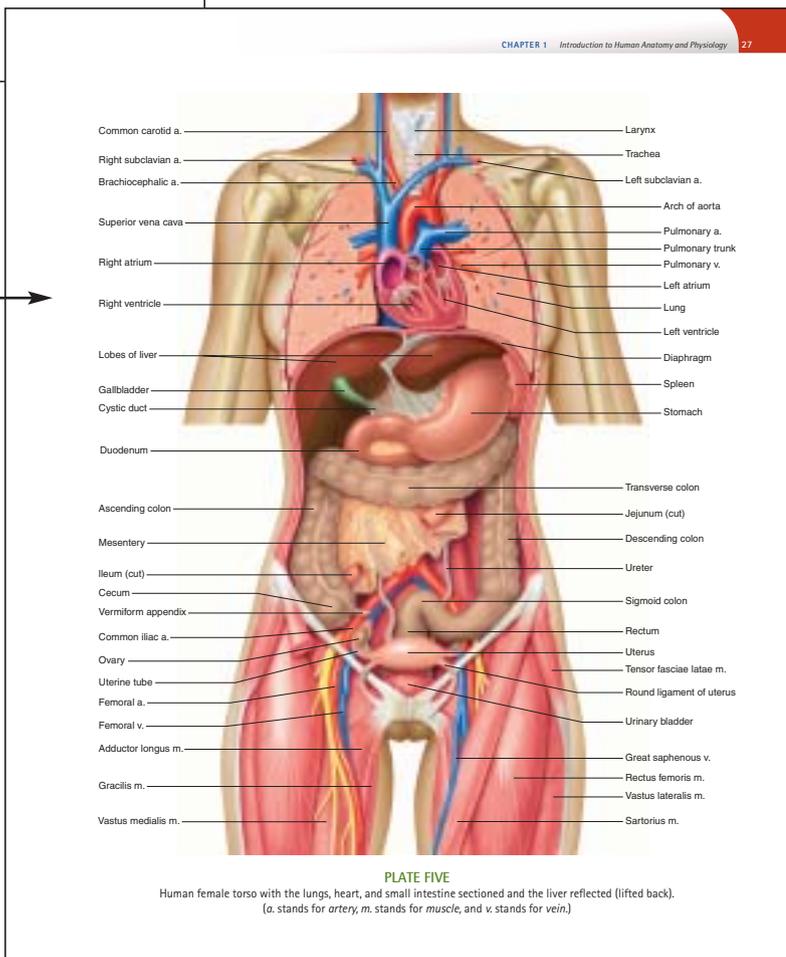
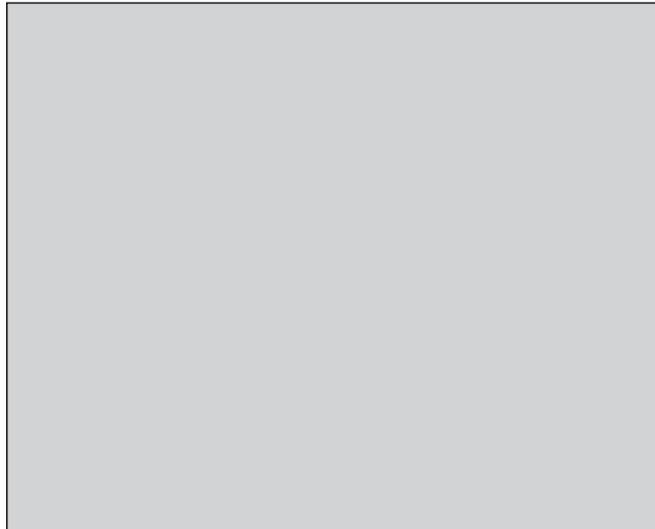


PLATE FIVE

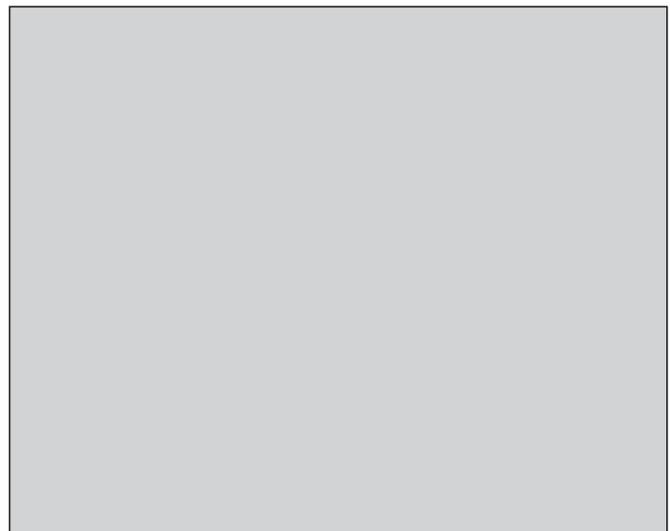
Human female torso with the lungs, heart, and small intestine sectioned and the liver reflected (lifted back).
(a. stands for artery, m. stands for muscle, and v. stands for vein.)

Online Learning Center (OLC)

The OLC offers an extensive array of learning and teaching tools. The site includes quizzes for each chapter, links to websites related to each chapter, supplemental reading lists, clinical applications, interactive activities, art labeling exercises, and case studies. Students can click on a diagram of the human body and get case studies related to the regions they select.



- **Essential Study Partner (ESP).** The ESP contains 120 animations and more than 800 learning activities to help your students grasp complex concepts. Interactive diagrams and quizzes will make learning stimulating and fun for your students. The Essential Study Partner can be accessed via the Online Learning Center.
- **Quizzing** for each chapter
 - multiple choice
 - essay questions
 - labeling exercises
 - flashcards
 - crossword puzzles
 - concentration game



What Every Instructor Needs to Know!

The human body is a complex yet efficient machine whose parts both complement and coordinate in response to input from the outside and within. Similarly, this ninth edition of *Hole's Essentials of Human Anatomy and Physiology* reflects a group effort that is sensitive to, and molded by, the input of generations of students and instructors.

This new edition continues our commitment to introduce the structure and function of the human body in an interesting and highly readable manner. New content is either integrated into the overarching theme of homeostasis, or explains an aspect of anatomy or physiology at a newly-discovered cellular or molecular level.

Given the eclectic population of most universities and colleges, particularly two-year and community colleges, readability of this text is a top priority, while at the same time enhancing and updating the physiology coverage. We have accomplished this through thoughtful changes in the text and art, carefully created and implemented pedagogical features, and a wide choice of ancillaries designed to review and augment both in-class and out-of-class student activities.

The level of this text is geared toward students in one-semester courses in anatomy and physiology who are pursuing careers in allied health fields and who have minimal background in physical and biological sciences. The first four chapters cover the chemistry and processes. Students who have studied this material previously will view it as a welcomed review, but newcomers will not find it intimidating.

General Themes

Commitment to Readability

Even the most basic concepts of human anatomy and physiology can be challenging to the uninitiated, and most of the students in introductory anatomy and physiology courses fall into this category. Students and instructors face an enormous amount of material to cover in a short period of time.

Clear, concise, and consistent use of language is key to efficient learning and that is what we focus on. In this edition, definitions are clearer than ever; topic sentences and transitions are perfected to ease the narrative flow; and consistency is meticulously maintained between the text and the art, and from chapter to chapter.

Clear Application of Concepts

The content carefully balances structure and function to provide an integrated view of how the human body works, and recognizes the greater emphasis on physiology across the board in the health care professions. All physiological concepts are tied to some level of body structure and organization and presented in a student-accessible way. Numerous practical applications and everyday examples appear in small boxes, in chapter opening vignettes, and in “Topic of Interest,” “Clinical Connection,” and “Genetics Connection” boxes.

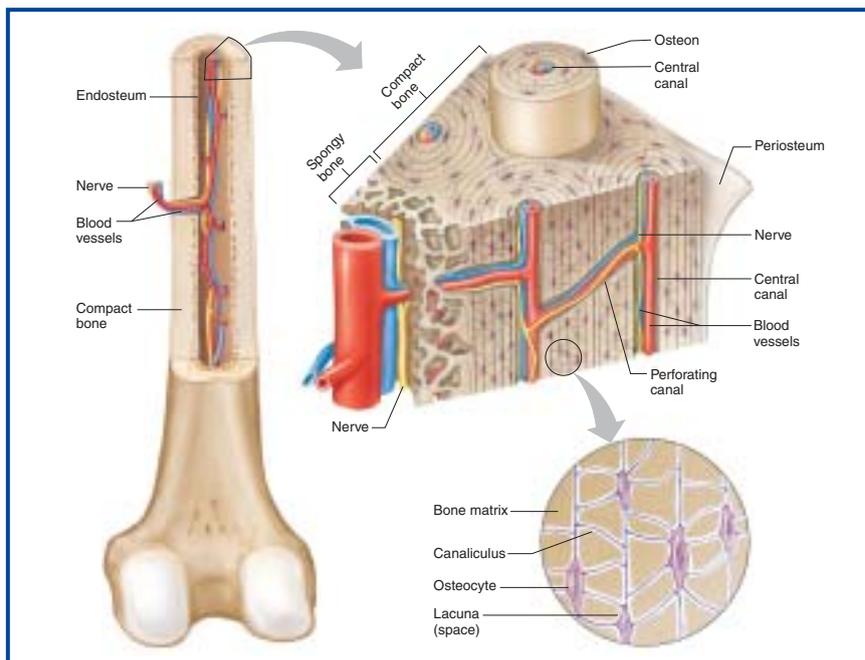
Emphasis of the Interrelatedness and Interdependency of Organ Systems

Chapter 1 introduces the concept of the internal environment, along with homeostasis, the mechanism that keeps the internal environment relatively constant. The book reinforces this theme throughout, most strikingly in the end-of-chapter “ORGANization” figures that hammer home the interrelatedness and interdependency of organ systems.

Enhancing the Text with Consistent Illustrations

Detail, clarity, accuracy, and consistency prevail, with frequent use of icons for orientation and to establish a sense of scale. Color is consistent from chapter to chapter—a cell is not blue in one chapter, orange in another.

The art program is designed to support the text and beyond. Labels and legends go only as far as the text itself. However, the detail of the figures is accurate enough to support more detailed discussion.



What's New?

- The font size used in all tables has been increased
- Added current coverage of stem cells throughout
- Genetics coverage: molecular in Chapter 4, Mendelian in Chapter 20

Chapter 3

- Cell differentiation—stem and progenitor cells, with great new art
- Updated vignette on Dolly's death and subsequent cloning efforts

Chapter 5

- New vignette—"Stem Cells Restore Sight, But Not Vision" (man who lost vision as 3-year-old regains sight thanks to stem cells)
- "Extracellular matrix" introduced here and carried through subsequent chapters as appropriate
- New table added summarizing connective tissue cell types and fibers
- Moved membranes from Chapter 6 to Chapter 5



Chapter 6

- New vignette—"The Origin of Hair"
- Added Topic of Interest box on "Burns"

Chapter 7

- Updated vignette "Clues From Skeletons Past" to include fossil discovery of most recent human ancestor

- Figures changed to all right side views for consistency
- Explanation of bone mineral density measurement

Chapter 9

- Updated explanation of importance of neuroglia
- Improved comparison of muscle fiber and nerve fiber

Chapter 10

- New explanation of motion sickness
- Updated sections on molecular bases of smell and taste

Chapter 11

- Rewritten Topic of Interest on diabetes mellitus to include pre-diabetes
- Clinical Connection—Post-traumatic Stress Disorder
- Updated steroid abuse examples

Chapter 12

- "Blood Substitutes" vignette updated
- Topic of Interest box on "Leukemia" rewritten and updated
- New figure on blood composition

Chapter 13

- New vignette—"Cardiovascular Defibrillators"
- Added information on stents and statins, stem cells to heal heart attacks

Chapter 14

- New vignette—"Peanut Allergy"
- Genetics Connection on inherited immunodeficiency updated.
- Topic of Interest "Immunity Breakdown: AIDS" rewritten to include new drugs and vaccine challenges

Chapter 15

- New vignette—"Hepatitis From Salsa"
- Moved teeth functions to a summary table 15.1
- Small box on virtual CT colonoscopy.
- Total rewrite of section on USDA food pyramid and stress on a diet rich in carbohydrates, in response to evidence from millions of people who lost weight on low carb diets. New figure shows four different food pyramids. New table and Topic of Interest compare low carb to low fat diets.
- Added body mass index so students can calculate it

Chapter 16

- New vignette—"Urban Aerosols from the September 11 Attacks"

Digital Content Manager (DCM)

This multimedia collection of visual resources allows instructors to utilize artwork from the text in multiple formats to create customized classroom presentations, visually-based tests and quizzes, dynamic course website content, or attractive printed support materials. The digital assets on this cross-platform CD-ROM are grouped by chapter within the following easy-to-use folders.

Active Art Library Key figures from the text are saved in layers that can be manipulated which can be isolated and customized to meet the needs of the lecture environment.

Animations Library Numerous full-color animations of key physiological processes are provided. Harness the visual impact of processes in motion by importing these files into classroom presentations or course websites.

Art Libraries Full-color digital files of all illustrations in the book, plus the same art saved in unlabeled and gray scale versions, can be readily

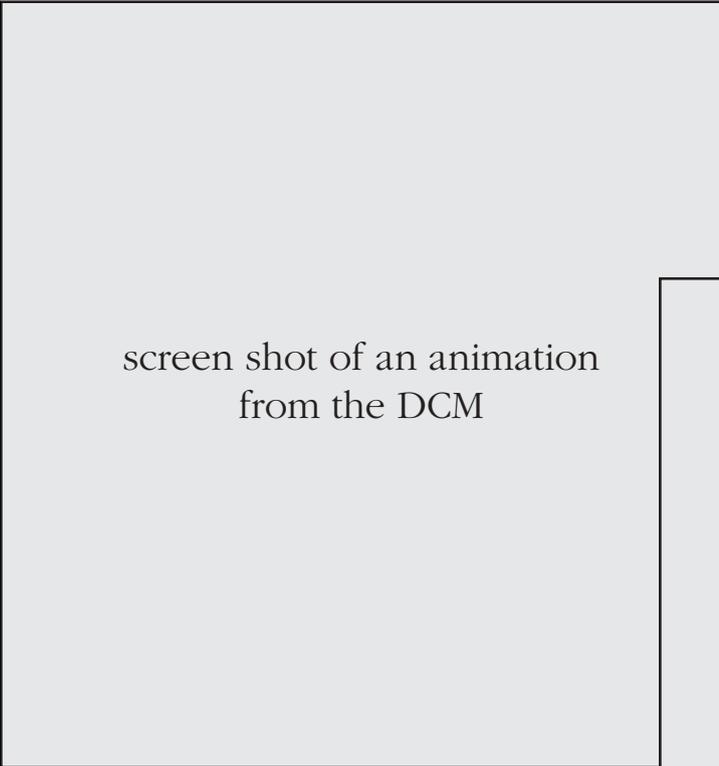
incorporated into lecture presentations, exams, or custom-made classroom materials. These images are also pre-inserted into blank PowerPoint slides for ease of use.

Photo Libraries Digital files of instructionally significant photographs from the text—including cadaver, bone, histology, and surface anatomy images—can be reproduced for multiple classroom uses.

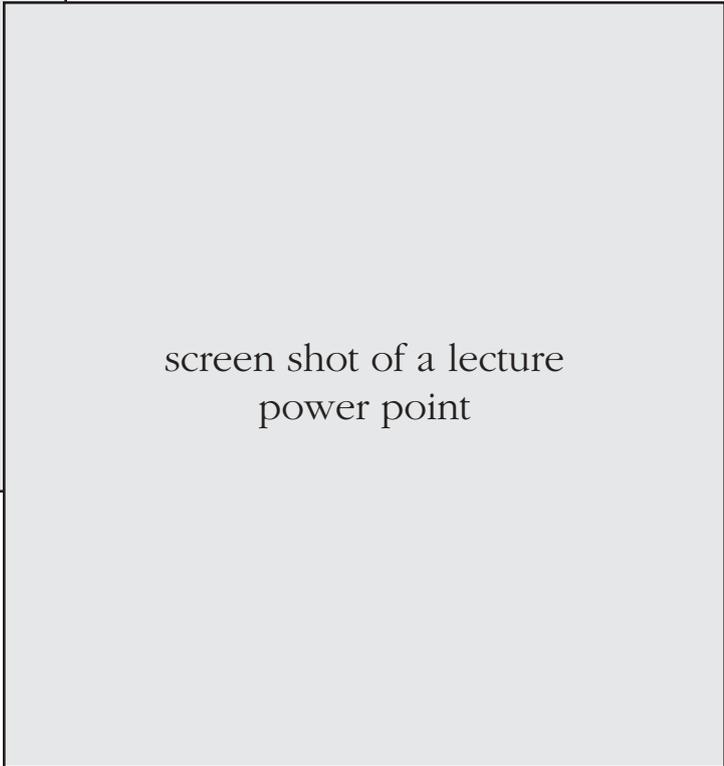
PowerPoint Lectures Ready-made presentations that combine art and lecture notes have been specifically written to cover each of the 20 chapters of the text. Use the PowerPoint lectures as they are, or tailor them to reflect your preferred lecture topics and sequences.

Tables Library Every table appearing in the text is provided in electronic form.

You can quickly preview images and incorporate them into PowerPoint or other presentation programs to create your own multimedia presentations. You can also remove and replace labels to suit your own preferences in terminology or level of detail.



screen shot of an animation
from the DCM



screen shot of a lecture
power point

Teaching and Learning Supplements

Media:

Online Learning Center (OLC)

(<http://www.mhhe.com/shieress9>) The OLC offers an extensive array of learning and teaching tools. Instructor resources include:

- lecture outlines,
- supplemental reading lists,
- technology resources,
- clinical applications, and
- case studies.

The Instructor's Manual is available online through the Instructor Resources on the OLC.

Instructor's Testing and Resource CD-ROM is a computerized test generator free upon request to qualified adopters and contains the complete test item file on CD-ROM. These additional questions are found in a computerized test bank utilizing testing software to quickly create customized exams. This user-friendly program allows instructors to sort questions by format; edit existing questions or add new ones; and scramble questions for multiple versions of the same test.

McGraw-Hill provides more than 400 **Overhead Transparencies** of all text line art, including fully labeled and many unlabeled.

MediaPhys CD-ROM combines incredible multimedia and powerful visuals with in-depth

textual content. This interactive program allows you to visualize physiological processes and their relationships

Ph.I.L.S. Physiology Interactive Lab Simulations

CD-ROM, comprehensive CD-ROM, may be used to supplement or substitute for wet labs. Students can use Ph.I.L.S. to adjust variables, view outcomes, make predictions, and draw conclusions. It includes many interactive lab simulations covering Skeletal Muscle Function, Electrocardiogram and Heart Function, Respiration and Basal Metabolic Rate.

Virtual Anatomy Dissection Review helps students easily identify and review the corresponding structures and functions between the cat and the human body.

Print:

Student Study Guide, 0-07-285288-7, by Nancy A.

Sickels Corbett offers chapter overviews, chapter objectives, focus questions, mastery tests, study activities, and mastery test answers.

Anatomy and Physiology Laboratory Manual—

Fetal Pig, 0-07-243814-2, by Terry R. Martin, Kishwaukee College, provides excellent full-color photos of the dissected fetal pig with corresponding labeled art. It includes World Wide Web activities for many chapters.

Laboratory Manual for Hole's Essentials of

Human Anatomy and Physiology, 0-07-285287-9, by Terry R. Martin, Kishwaukee College, is designed to accompany the ninth edition of *Hole's Essentials of Human Anatomy and Physiology*.

New to the 9th edition's *Laboratory Manual for Hole's Essentials of Human Anatomy and Physiology* is a chemistry lab. This lab will fill the void of many A&P lab manuals. As in all the laboratory exercises, it contains:

- Materials Needed
- Safety
- Introduction
- Purposes of the Exercise
- Learning Objectives
- Procedure
- Laboratory Reports

screen shot of 1st page of
exercise 3 in the lab manual
(new chemistry lab)

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*David Shier
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