



8th EDITION

MEDICAL TERMINOLOGY for **HEALTH PROFESSIONS**

Ann Ehrlich
Carol L. Schroeder
Laura Ehrlich
Katrina A. Schroeder

8th EDITION

MEDICAL TERMINOLOGY for HEALTH PROFESSIONS

paraffin
supination
idiopathic
intracranial
osteostomy
arthroscopy
apathy
hypertension
intravenous
ophthalmoscope
lacrima
paralysis
paralysis
analysis
paralysis



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for **HEALTH
PROFESSIONS**

Ann Ehrlich
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Australia • Brazil • Mexico • Singapore • United Kingdom • United States

***Medical Terminology for Health Professions,
Eighth Edition***

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Laura Ehrlich, Katrina A. Schroeder**

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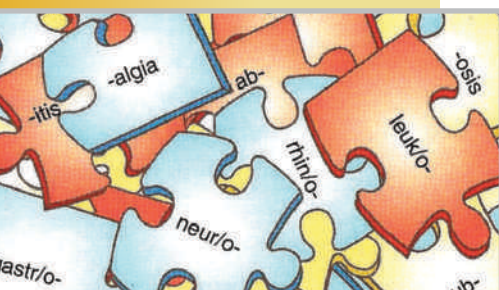
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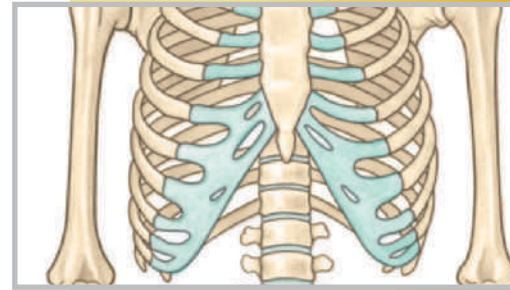
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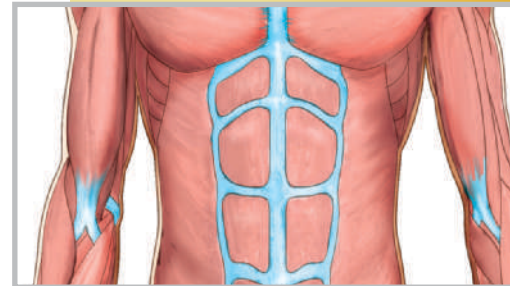
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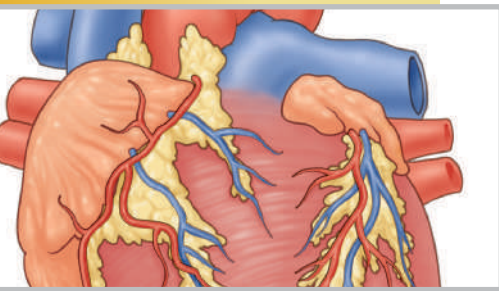
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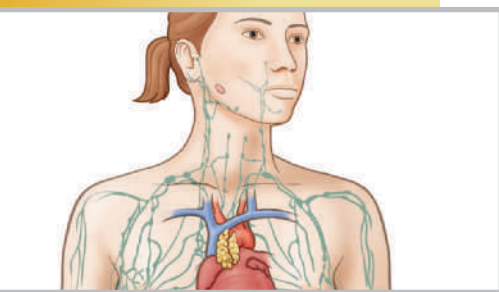
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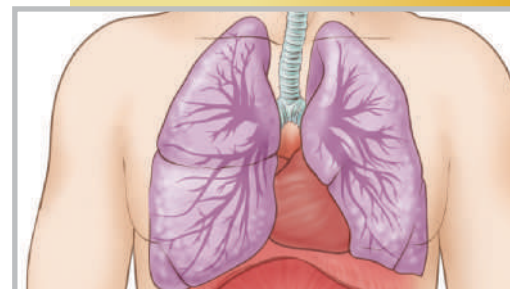


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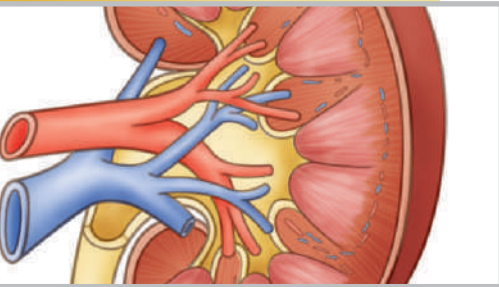
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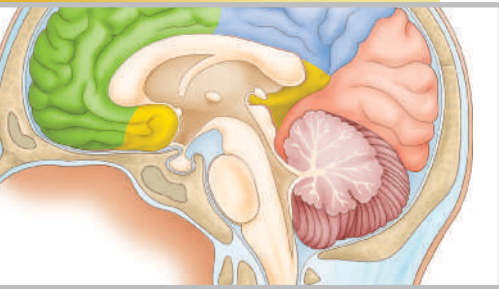




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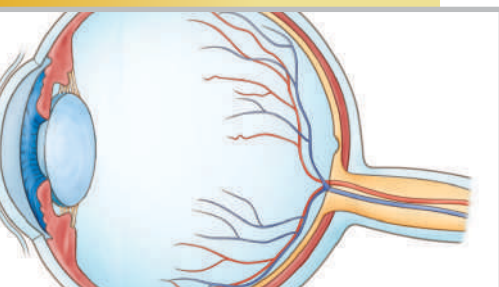
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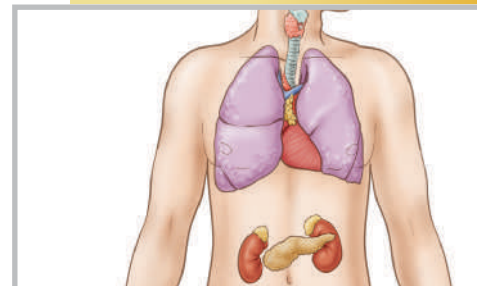
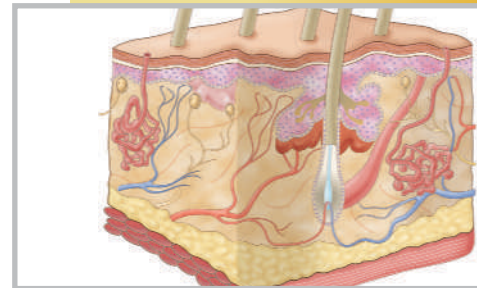
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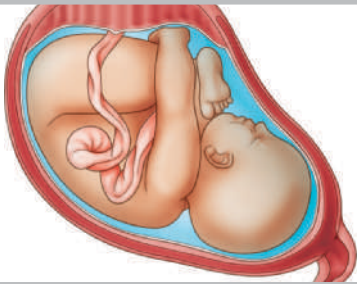


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A

a-	no, not, without, away from
-a	noun ending
ab-	away from, negative, absence of
abdomin/o	abdomen
-able	capable of, able to
abort/o	premature expulsion of fetus

PREFACE

TO THE LEARNER

Welcome to the world of medical terminology! Learning this special language is an important step in preparing for your career as a health care professional. Here's good news: learning medical terms is much easier than learning a foreign language because you are already familiar with quite a few of the words, such as *appendicitis* and *tonsillectomy*. Understanding new words becomes easier with the discovery that many of these terms are made up of interchangeable word parts that are used in different combinations. Once you understand this, you'll be well on your way to translating even the most difficult medical terms, including words you have never seen before. You'll be amazed to see how quickly your vocabulary will grow!

This book and the accompanying learning materials are designed to make the process as simple as possible. Review the "How to Use This Book" section so you can find your way around easily. Once you become comfortable with the format, you'll discover you are learning faster than you ever imagined possible.

CHAPTER ORGANIZATION

The text is designed to help you master medical terminology. It is organized into 15 chapters, three appendices, and an index. To gain the most benefit from your use of this text, take advantage of the many features, including the "Human Touch" stories and discussion questions that are included at the end of each chapter.

Primary terms are the most important terms in a chapter. When first introduced, the term appears in boldface and, if appropriate, is followed by the "sounds-like" pronunciation. Only primary terms are used as correct answers in the exercises and tests.

Secondary terms appear in *cyan* italics. These terms, which are included to clarify the meaning of a primary term, are sometimes used as distracters, but not as correct answers, in exercises or tests.

Each chapter begins with a **vocabulary list** consisting of 15 word parts and 60 medical terms selected from among the primary terms in the chapter. *Note:* If your instructor is using the **Simplified Syllabus** version of this course, these are the terms that you will be expected to learn for all quizzes, tests, and exams.

Introductory Chapters

Chapters 1 and 2 create the foundation that enables you to master the rest of the book. Chapter 1 introduces key word parts—the building blocks of most medical terms.

Chapter 2 introduces more word parts and provides an overview of basic terms used throughout the medical field, as well as some of the many career options open to you in health care.

Body System Chapters

Chapters 3 through 14 are organized by body system. Because each body system stands alone, you can study these chapters in any sequence. Each chapter begins with an overview of the structures and functions of that system so you can relate these to the medical specialists, pathology, diagnostics, and treatment procedures that follow.

Chapter 15 introduces basic diagnostic procedures, examination positions, imaging techniques, laboratory tests, nuclear medicine, and pharmacology. It also includes a section on alternative and complementary medicines. This chapter can be studied at any point in the course.

Appendices

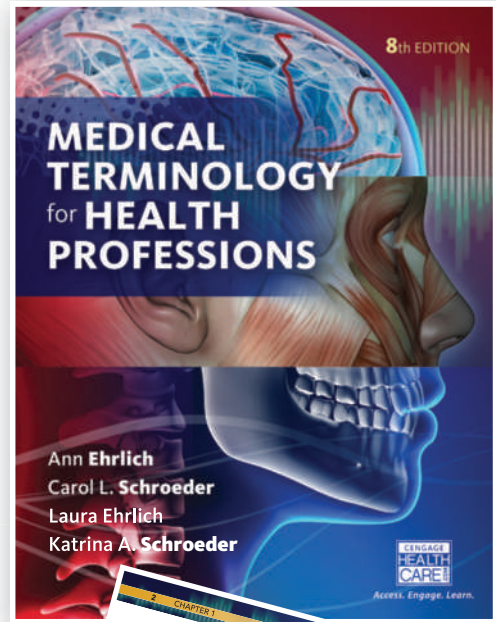
Appendix A: Prefixes, Combining Forms, and Suffixes is a convenient alphabetic reference for the medical word parts. When you don't recognize a word part, you can look it up here.

Appendix B: Abbreviations and Their Meanings is an extensive list of commonly used abbreviations and their meanings. Abbreviations are important in medicine, and using them *accurately* is essential!

Appendix C: Glossary of Pathology and Procedures gives the definitions of all the primary terms in the text relating to diagnosis, pathology, and medical procedures.

Workbook

The *Medical Terminology for Health Professions*, Eighth Edition workbook contains a chapter to accompany each textbook chapter, with exercises to help you master the terms and word parts on the vocabulary list at the beginning of each chapter. In addition to the review exercises, there is a crossword puzzle to provide you with a change of pace as you study.



Online Resources

Online resources are available to accompany this new textbook, including slide presentations created in PowerPoint® and 3-D animations.

To access the online resources:

1. Go To: <http://www.CengageBrain.com>.
2. Register as a new user or log in as an existing user if you already have an account with Cengage Learning or CengageBrain.com

CHANGES TO THE EIGHTH EDITION

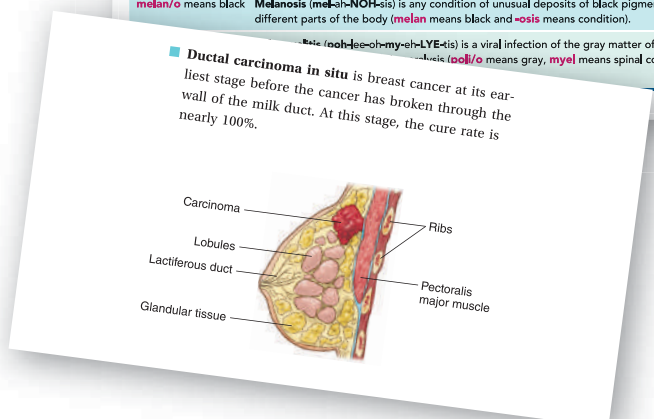
A detailed conversion guide that helps you make the change from the seventh to the eighth edition is included in the Instructor Resource Center at <http://www.cengage.com>. A brief summary of some of the changes follows:

- Added eleven new, full-color photos
- Chapter 1: Further clarified combining forms
- Chapter 1: Updated use of medical dictionary to include online resources
- Chapter 1: Updated “Do Not Use” abbreviations
- Chapter 2: Expanded section on health care professions
- Chapter 5: Added nutritional changes under treatments
- Chapter 6: Updated definitions of lymphomas
- Chapter 6: Expanded material on breast cancer
- Chapter 8: Expanded dental section and virtual colonoscopy
- Chapter 9: Added nutrition to treatment procedures
- Chapter 10: Expanded coverage of mental health
- Chapter 15: Updated section on nuclear medicine



TABLE 1.2
Word/Roots/Combining Forms Indicating Color

cyan/o means blue	Cyanosis (sigh-ah-NOH-sis) is a blue discoloration of the skin caused by a lack of adequate oxygen (cyan means blue and -osis means condition).
erythr/o means red	Erythrocytes (eh-RITH-roh-sights) are mature red blood cells (erythr/o means red and cytes means cells). Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed diam nonummy nibh euismod tincidunt ut laoreet dolore magna aliquam erat volutpat. Lorem ipsum dolor sit amet.
leuk/o means white	Leukocytes (LOO-koh-sights) are white blood cells (leuk/o means white and -cytes means cells).
melan/o means black	Melanosis (mel-eh-NOH-sis) is any condition of unusual deposits of black pigment in different parts of the body (melan means black and -osis means condition).
	Encephalomyelitis (en-see-oh-my-eh-LYE-tis) is a viral infection of the gray matter of the brain and spinal cord. (encephal/o means gray, myel means spinal cord, and -itis means inflammation).



ACKNOWLEDGMENTS

It is a pleasure to introduce Katrina A. Schroeder, RD, and Laura Ehrlich, RN, as our new co-authors of *Medical Terminology for Health Professions*. They bring a fresh and professional perspective to this textbook as it enters its third decade. As always, we are very grateful for the input of the many reviewers, and instructors who volunteer feedback, who are an invaluable resource in guiding this book as it evolves. Their insights, comments, suggestions, and attention to detail are very important in making the text, and its many resources, up-to-date and accurate.

Thanks also to the editorial and production staff of Cengage Learning for their very professional and extremely helpful assistance in making this revision possible, especially our editors, Deb Myette-Flis and Laura Stewart. Deb Myette-Flis deserves special recognition for her steadfast support for this project throughout the past five editions.

Please note that a portion of the royalties for this textbook provide scholarships for lymphedema therapists, helping to address a nation-wide shortage in this field.

*Ann Ehrlich and
Carol L. Schroeder*

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HOW TO USE THIS BOOK

Medical Terminology for Health Professions, Eighth Edition, is designed to help you learn and remember medical terms with surprising ease. The key lies in the following features.

BODY SYSTEM OVERVIEW

The first page of each body system chapter is a chart giving an overview of the structures, related combining forms, and functions most important to that system.

VOCABULARY LIST

The second page of each chapter is a 75-item vocabulary list. This list includes 15 key word parts with their meanings and 60 important terms for the chapter with their pronunciations. This immediately alerts you to the key terms in the chapter and acts as a review guide. Next to each term is a box so you can check off each term when you've learned it.

LEARNING OBJECTIVES

The beginning of each chapter lists learning objectives to help you understand what is expected of you as you read the text and complete the exercises. These objectives are set off with a colored bar for easy identification.

ART PROGRAM

Our art program includes hundreds of photos and full-color illustrations that help clarify the text and contain important additional information. Review each illustration and read its caption carefully for easy and effective learning.

Overview of INTRODUCTION TO MEDICAL TERMINOLOGY	
Word Parts Are the Key!	Introduction to word parts and how they create complex medical terms.
Word Roots	The word parts that usually, but not always, indicate the part of the body involved.
Combining Forms	Word roots plus a vowel (usually the letter <i>i</i>) added to the end. This form is used when connecting word roots or when the word root is joined to a suffix that begins with a consonant.
Suffixes	The word parts that usually, but not always, indicate the procedure, condition, disorder, or disease.
Prefixes	The word parts that usually, but not always, indicate location, time, number, or status.
Determining Meanings on the Basis of Word Parts	Use knowledge of word parts to decipher medical terms.
Medical Dictionary Use	Guidelines to make the use of a medical dictionary easier.
Pronunciation	Learn the correct pronunciation of medical terms.
Spelling Is Always Important	Learn the correct spelling of medical terms.

This list contains essential word parts and medical terms for this chapter. These terms are pronounced on the student StudyWARE™ CD-ROM and Audio CDs that are available for use with this text. These CDs and the other important **primary terms** are shown in boldface throughout the chapter. **Secondary terms**, which appear in *orange italics*, clarify the meaning of primary terms.

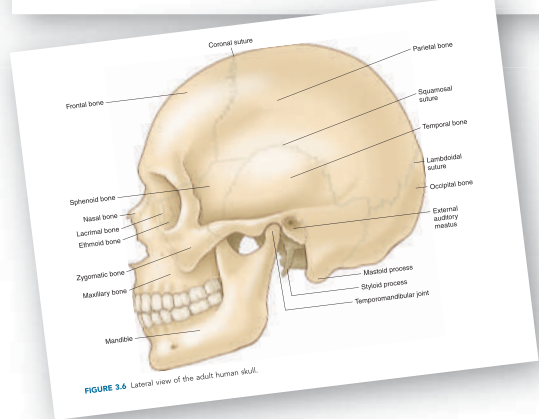
Word Parts	Meaning	Example
<input type="checkbox"/> -algia	pain, painful condition	neuralgia
<input type="checkbox"/> -dys-	bad, difficult, or painful	dysphagia
<input type="checkbox"/> -ectomy	surgical removal, cutting out	tonsillectomy
<input type="checkbox"/> -hyper-	excessive, increased	hyperthermia
<input type="checkbox"/> -hypo-	deficient, decreased	hypothermia
<input type="checkbox"/> -itis	inflammation	pharyngitis
<input type="checkbox"/> -oma	tumor, swelling, disease	adenoma
<input type="checkbox"/> -ostomy	artificial opening	colostomy

<input type="checkbox"/> fistula (FIS-you-lah)	<input type="checkbox"/> gastralgia (gas-TRAL-jee-ah)
<input type="checkbox"/> gastritis (gas-TRY-tis)	<input type="checkbox"/> gastritis (gas-TRY-tis)
<input type="checkbox"/> gastritis (gas-TROH-sis)	<input type="checkbox"/> gerontologist (jer-on-TOL-oh-jist)
<input type="checkbox"/> gerontologist (jer-on-TOL-oh-jist)	<input type="checkbox"/> hemorrhage (HEM-or-idj)
<input type="checkbox"/> hemorrhage (HEM-or-idj)	<input type="checkbox"/> hepatomegaly (hep-ah-toh-MEG-ah-lee)
<input type="checkbox"/> hepatomegaly (hep-ah-toh-MEG-ah-lee)	<input type="checkbox"/> hypertension (high-per-TEN-shun)
<input type="checkbox"/> hypertension (high-per-TEN-shun)	<input type="checkbox"/> hypotension (high-poh-TEN-shun)
<input type="checkbox"/> hypotension (high-poh-TEN-shun)	<input type="checkbox"/> ileum (ILL-ee-um)
<input type="checkbox"/> ileum (ILL-ee-um)	<input type="checkbox"/> inflammation (in-flah-MAY-shun)
<input type="checkbox"/> inflammation (in-flah-MAY-shun)	<input type="checkbox"/> interstitial (in-ter-STISH-ial)
<input type="checkbox"/> interstitial (in-ter-STISH-ial)	<input type="checkbox"/> intramuscular (in-trah-MUS-kyou-lar)
<input type="checkbox"/> intramuscular (in-trah-MUS-kyou-lar)	<input type="checkbox"/> melanoma (mel-ah-NOH-sis)
<input type="checkbox"/> melanoma (mel-ah-NOH-sis)	<input type="checkbox"/> mycosis (my-KOH-sis)
<input type="checkbox"/> mycosis (my-KOH-sis)	<input type="checkbox"/> myelopathy (my-eh-LOP-ah-thee)
<input type="checkbox"/> myelopathy (my-eh-LOP-ah-thee)	<input type="checkbox"/> myopathy (my-OP-ah-thee)
<input type="checkbox"/> myopathy (my-OP-ah-thee)	<input type="checkbox"/> myorrhexis (my-oh-RECK-sis)
<input type="checkbox"/> myorrhexis (my-oh-RECK-sis)	<input type="checkbox"/> myorrhexis (my-oh-nay-TOL-oh-jee)

OBJECTIVES

On completion of this chapter, you should be able to:

1. Identify the roles of the four types of word parts in forming medical terms.
2. Analyze unfamiliar medical terms using your knowledge of word parts.
3. Describe the steps in locating a term in a medical dictionary.
4. Define the commonly used prefixes, word roots, combining forms, and suffixes introduced in this chapter.
5. Pronounce medical terms correctly using the "sounds-like" system.
6. Recognize the importance of always spelling medical terms correctly.
7. State why caution is important when using abbreviations.
8. Recognize, define, spell, and pronounce the medical terms in this chapter.



“SOUNDS-LIKE” PRONUNCIATION SYSTEM

The sounds-like pronunciation system makes pronunciation easy by respelling the word with syllables you can understand—and say—at a glance. Simply pronounce the term just as it appears in parentheses, accenting the syllables as follows:

- **Primary** (strongest) **accent**: capital letters and bold type
- **Secondary accent**: lowercase letters and bold type

PRIMARY AND SECONDARY TERMS

- **Primary terms** are the most important medical words in a chapter. When first introduced, the term appears in **boldface** and, if appropriate, is followed by the sounds-like pronunciation. These are the words students need to concentrate on learning. Only primary terms are used as correct answers in the exercises and tests.
- **Secondary terms** appear in *cyan* italics. These terms are included to clarify the meaning of a primary term. Although used as distracters in exercises, the secondary terms are not used as correct answers in exercises or tests.

CAREER OPPORTUNITIES

As you learn medical terminology, you will want to give some thought as to what career you might want to pursue after graduation. This section, near the end of each chapter, will give you some ideas to consider.

HEALTH PROFESSION PROFILE

Read the real-life experiences of health care professionals to find out how they selected their career, what they do, and how they like it. Their words may inspire your own career choice!

Cartilaginous Joints

Cartilaginous joints (**kar-tih-LADJ-ih-nus**) allow only slight movement and consist of bones connected entirely by cartilage. For example:

- Where the ribs connect to the sternum (breast bone), shown in Figure 3.8, these joints allow movement during breathing.
- The **pubic symphysis** (**PEW-bick SIM-fih-sis**) allows some movement to facilitate childbirth. This joint is located between the pubic bones in the anterior (front) of the pelvis as shown in Figure 3.12.

The Spinal Column

- A **herniated disk** (**HER-nee-ayt-ed**), also known as a *slipped or ruptured disk*, is the breaking apart of an intervertebral disk that results in pressure on spinal nerve roots (Figure 3.18B).
- **Lumbago** (**lum-BAY-goh**), also known as *low back pain*, is pain of the lumbar region of the spine (**lumb** means lumbar, and **-ago** means diseased condition).
- **Spondylolisthesis** (**spoh-dih-loh-liss-THEE-sis**) is the forward slipping movement of the body of one of the lower lumbar vertebrae on the vertebra or sacrum below it (**spondyl/o** means vertebrae, and **-listhesis** means slipping).

CAREER OPPORTUNITIES

In addition to the medical specialties already discussed, some of the health occupations involving the treatment of the digestive system include:

- **Dental hygienist**: works under the supervision of a dentist, is licensed to remove stains and deposits from the teeth, exposes and develops x-rays, and assists the patient in learning about and maintaining good dental health.
- **Dental assistants** work under the supervision of a dentist, preparing patients for examinations, passing instruments during procedures, exposing and developing x-rays, sterilizing instruments, and performing receptionist and practice management duties.
- **Dental laboratory technician**: following a written prescription from a dentist, fabricates and repairs dental appliances such as crowns, bridges, and orthodontic appliances.
- **Registered dietitian (RD)** or **registered dietitian nutritionist (RDN)**: a specialist in food and nutrition licensed to assess patients' dietary needs, provide medical nutritional therapy, manage food service systems, and supervise and train personnel. Some specialties include:

HEALTH PROFESSION PROFILE REGISTERED DIETITIAN

Nicole Cormier is a registered dietitian and local foods enthusiast. I didn't know where my career as a dietitian would take me, but I knew I had a passion for food and health. I've worked at several hospitals and medical centers acquiring skills, ranging from weight management programs to medical nutrition therapy. However, I found my niche as a dietitian when I began connecting organic farming to nutrition counseling.

I've owned my private practice for over 5 years, and I work one-on-one with each patient to manage his or her energy and life in a way that creates positive relationships with food. I specialize in weight loss, family nutrition, food allergies and intolerance, diabetes, high cholesterol, IBS and gastrointestinal issues, and sports nutrition. I also am the Student Ambassador Advisor for Green Schools, a non-profit whose mission is to create greener and healthier learning environments through education and awareness.



STUDY BREAK

Put down your pencil—there is no quiz on this one. The Study Break is a brief and amusing pause in your studies before you go on to review the important information in the chapter.

REVIEW TIME

At the end of each chapter, there is a review exercise section with five questions. Each requires a written response and a discussion response. These review exercises give you opportunities to practice communicating with patients (using lay terms) and communicating with other health care professionals (using correct medical terminology). As you progress through the text these exercises become increasingly challenging.

OPTIONAL INTERNET ACTIVITY

There are also two Internet exercises at the end of each chapter. One requires you to go to a specific website. The other requires you to search a particular topic relating to the chapter.

THE HUMAN TOUCH: CRITICAL THINKING EXERCISE

A real-life short story that involves patients and pathology, along with related critical thinking questions, at the end of each chapter helps you apply what you are learning to the real world. There are no right or wrong answers, just questions to get you started thinking about and using the new terms you have learned.

CHAPTER 8 STUDY BREAK

An **eponym** is a term derived from someone's name. Many people believe that a common slang word associated with **defecation**, or the elimination of solid waste products, comes from the name of the inventor of the toilet, Thomas Crapper.

This is only partially true. There was indeed a Thomas Crapper, an English inventor and plumber of the nineteenth century who set about to improve the bathroom, or as it was known back then, water closet (WC), which was already in common use at the time. Ironically, although he did hold nine patents of his own, he bought the patent for a device allowing a toilet to flush more effectively from its actual inventor, Albert Giblin. But the name of Crapper's company, T. Crapper—Chelsea, was emblazoned on new, improved toilets throughout England.

When American soldiers passed through England during World War I, they picked up the habit of using "crapper" as a slang term for the WC. Thomas Crapper thus achieved a dubious place in our language through an eponym that is frowned upon, but still in use, today.

REVIEW TIME

Write the answers to the following questions on a separate piece of paper or in your notebook. In addition, be prepared to take part in the classroom discussion.

- Written Assignment:** What is done during a dental prophylaxis?
Discussion Assignment: Why is it important to have this done regularly?
- Written Assignment:** Using terms a patient would understand, describe how hepatitis A virus (HAV) and hepatitis B virus (HBV) are transmitted.
Discussion Assignment: Why is being immunized against hepatitis B of particular importance for health care professionals?
- Written Assignment:** Using terms a physician would understand, describe the differences between a colonoscopy and a colostomy.
Discussion Assignment: Mr. Hernandez has a colostomy. Describe how fecal matter is removed from his body.
- Written Assignment:** Using terms a patient could understand, describe celiac disease.
Discussion Assignment: Think about how a patient might feel about having to change his or her entire diet. Describe the types of foods that a patient with celiac disease can still enjoy.

OPTIONAL INTERNET ACTIVITY

The goal of this activity is to help you learn more about medical terminology as it applies to the "real world." Select one of the two options below and follow the instructions.

- To learn more about **dysphagia**, do a search to find out why a person might have trouble swallowing. Write a brief (one- or two-paragraph) report on something new you learned about what someone with dysphagia can eat and include the address of the website where you found this information.
- To learn more about the many types of **hepatitis**, go to the website of the World Health Organization (WHO). Write a brief (one- or two-paragraph) report on something new you learned about any one type of hepatitis.

The Human Touch

CRITICAL THINKING EXERCISE

The following story and questions are designed to stimulate critical thinking through class discussion or as a brief essay response. There are no right or wrong answers to these questions.

Baylie Hutchins sits at her kitchen table with her medical terminology book opened to the first chapter, highlighter in hand. Her two-year-old son, Mathias, plays with a box of Animal Crackers in his highchair, some even finding his mouth. "Arteri/o, ather/o, and arthr/o," she mutters, lips moving to shape unfamiliar sounds. "They're too much alike and they mean totally different things." Mathias sneezes loudly, and spots of Animal Cracker rain on the page, punctuating her frustration.

"Great job, Thias," she says wiping the text with her finger. "I planned on using the highlighter to mark with, not your lunch." Mathias giggles and peeks through the tunnel made by one small hand.

"Mucous and mucus," she reads aloud, each sounding the same. Then she remembers her teacher's tip for remembering the difference, "The long word's the membrane and the short one's the secretion."

Mathias picks up an Animal Cracker and excitedly shouts "Tiger, Mommy! Tiger!" "That's right, Thias. Good job!"

*Turning back to the page she stares at the red words **-rrhagia**, **-rrhaphy**, **-rrhea**, and **-rrhexis**. Stumbling over the pronunciation, Baylie closes her eyes and tries to silence the voices in her head. "You can't do anything right," her ex-husband says. "Couldn't finish if your life depended on it," her mother's voice snaps.*

Baylie keeps at it. "Rhini/o means nose," highlighting those three words, "and a rhinoceros has a big horn on his nose."

"Rhini!" Mathias shouts, holding up an Animal Cracker. Baylie laughs. We both have new things to learn, she realizes. And we can do it!

Suggested Discussion Topics:

- Baylie needs to learn medical terminology if she wants a career in the medical field. What study habits would help Baylie accomplish this task?
- A support group could help empower Baylie to accomplish her goals. What people would you suggest for this group and why?
- How can this textbook and other resource materials help her (and you) learn terminology?
- Discuss strategies the instructor could use, and has already used, to help Baylie improve her terminology skills.
- Discuss how previous educational or learning experiences influence a student's approach to learning a new skill or subject.

INTRODUCTION TO MEDICAL TERMINOLOGY

Overview of INTRODUCTION TO MEDICAL TERMINOLOGY

Primary Medical Terms	Primary terms enable you to give priority to the most important words in your study of medical terminology. These terms are shown in black boldface .
Word Parts Are the Key	An introduction to word parts and how they are used to create complex medical terms.
Word Roots	The word parts that usually, but not always, indicate the part of the body involved.
Combining Form	A word root that has a vowel, usually the letter “o,” put on the end before the addition of another word root or a suffix.
Suffixes	The word part attached at the end of a word that usually, but not always, indicates the procedure, condition, disorder, or disease.
Prefixes	The word part attached at the beginning of a word that usually, but not always, indicates location, time, number, or status.
Determining Meanings on the Basis of Word Parts	Knowledge of word parts helps decipher medical terms.
Medical Dictionary Use	Guidelines to make looking up a term easier.
Pronunciation	Learn how to pronounce words correctly using the “sounds-like” pronunciation system and audio files.
Spelling Is Always Important	A single spelling error can change the entire meaning of a term.
Singular and Plural Endings	Unusual singular and plural endings used in medical terms.
Basic Medical Terms	Terms used to describe disease conditions.
Look-Alike, Sound-Alike Terms and Word Parts	Clarification of confusing terms and word parts that look or sound similar.
Using Abbreviations	Caution is always important when using abbreviations.

Vocabulary Related to **THE INTRODUCTION TO MEDICAL TERMINOLOGY**

This list contains essential word parts and medical terms for this chapter. These and the other important **primary terms** are shown in **boldface** throughout the chapter. *Secondary terms*, which appear in *cyan* italics, clarify the meaning of primary terms.

Word Parts

- algia** pain, suffering
- dys-** bad, difficult, or painful
- ectomy** surgical removal, cutting out
- hyper-** excessive, increased
- hypo-** deficient, decreased
- itis** inflammation
- osis** abnormal condition, disease
- ostomy** the surgical creation of an artificial opening to the body surface
- otomy** cutting, surgical incision
- plasty** surgical repair
- rrhage** bleeding, abnormal excessive fluid discharge
- rrhaphy** surgical suturing
- rrhea** flow or discharge
- rrhexis** rupture
- sclerosis** abnormal hardening

Medical Terms

- abdominocentesis** (ab-dom-ih-noh-sen-TEE-sis)
- acronym** (ACK-roh-nim)
- acute**
- angiography** (an-jee-OG-rah-fee)
- appendectomy** (ap-en-DECK-toh-mee)
- arteriosclerosis** (ar-tee-ree-oh-skleh-ROH-sis)
- arthralgia** (ar-THRAL-jee-ah)
- colostomy** (koh-LAHS-toh-mee)
- cyanosis** (sigh-ah-NOH-sis)
- dermatologist** (der-mah-TOL-oh-jist)
- diagnosis** (dye-ag-NOH-sis)
- diarrhea** (dye-ah-REE-ah)
- edema** (eh-DEE-mah)
- endarterial** (end-ar-TEE-ree-al)
- eponym** (EP-oh-nim)

- erythrocyte** (eh-RITH-roh-sight)
- fissure** (FISH-ur)
- fistula** (FIS-chuh-lah)
- gastralgia** (gas-TRAL-jee-ah)
- gastritis** (gas-TRY-tis)
- gastroenteritis** (gas-troh-en-ter-EYE-tis)
- gastrosis** (gas-TROH-sis)
- hemorrhage** (HEM-or-idj)
- hepatomegaly** (hep-ah-toh-MEG-ah-lee)
- hypertension** (high-per-TEN-shun)
- hypotension** (high-poh-TEN-shun)
- infection** (in-FECK-shun)
- inflammation** (in-flah-MAY-shun)
- interstitial** (in-ter-STISH-al)
- intramuscular** (in-trah-MUS-kyou-lar)
- laceration** (lass-er-AY-shun)
- lesion** (LEE-zhun)
- malaise** (mah-LAYZ)
- mycosis** (my-KOH-sis)
- myelopathy** (my-eh-LOP-ah-thee)
- myopathy** (my-OP-ah-thee)
- myorrhexis** (my-oh-RECK-sis)
- natal** (NAY-tal)
- neonatology** (nee-oh-nay-TOL-oh-jee)
- neurorrhaphy** (new-ROR-ah-fee)
- otorhinolaryngology** (oh-toh-rye-noh-lar-in-GOL-oh-jee)
- palpation** (pal-PAY-shun)
- palpitation** (pal-pih-TAY-shun)
- pathology** (pah-THOL-oh-jee)
- phalanges** (fah-LAN-jeez)
- poliomyelitis** (poh-lee-oh-my-eh-LYE-tis)
- prognosis** (prog-NOH-sis)
- pyoderma** (pye-oh-DER-mah)
- pyrosis** (pye-ROH-sis)
- remission**
- sign**
- supination** (soo-pih-NAY-shun)
- suppuration** (sup-you-RAY-shun)
- supracostal** (sue-prah-KOS-tal)
- symptom** (SIMP-tum)
- syndrome** (SIN-droh-m)
- tonsillitis** (ton-sih-LYE-tis)
- trauma** (TRAW-mah)
- triage** (tree-AHZH)
- viral** (VYE-ral)

LEARNING OBJECTIVES

On completion of this chapter, you should be able to:

1. Identify the roles of the four types of word parts used in forming medical terms.
2. Use your knowledge of word parts to analyze unfamiliar medical terms.
3. Describe the steps in locating a term in a medical dictionary or online resource.
4. Define the commonly used word roots, combining forms, suffixes, and prefixes introduced in this chapter.
5. Use the “sounds-like” pronunciation system and audio files to correctly pronounce the primary terms introduced in this chapter.
6. Recognize the importance of spelling medical terms correctly.
7. State why caution is important when using abbreviations.
8. Recognize, define, spell, and correctly pronounce the primary terms introduced in this chapter.

PRIMARY MEDICAL TERMS

In this book, you will be introduced to many medical terms; however, mastering them will be easier than you anticipate because this book has many features to help you learn.

- **Primary terms** appear in **boldface**. Learning these terms should be your highest priority as only primary terms are used as correct answers in the Learning Exercises and tests.
- A **vocabulary list** with 15 essential word parts and 60 key primary terms (and their pronunciations) is at the beginning of each chapter.

- **Secondary terms** appear in *cyan* italics. Some of these terms are the “also known as” names for conditions or procedures. Other secondary terms clarify words used in the definitions of primary terms.

WORD PARTS ARE THE KEY

Learning medical terminology is much easier once you understand how word parts work together to form medical terms (Figure 1.1). This book includes many aids to help you reinforce your word-building skills.

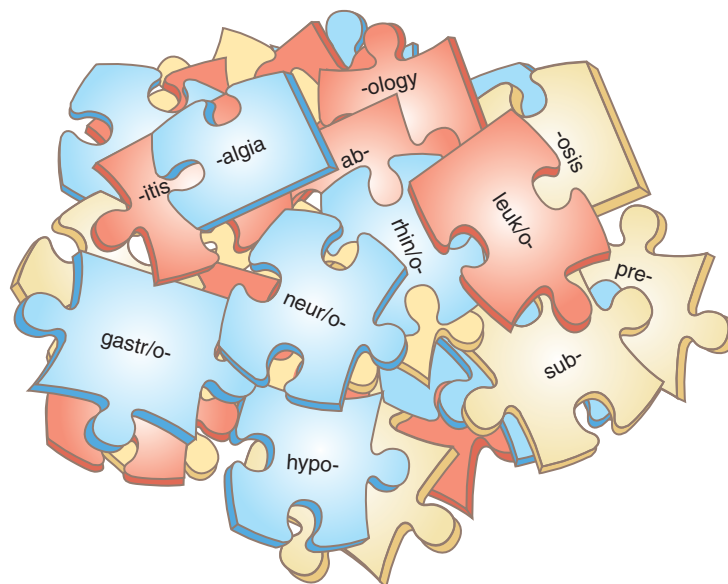


FIGURE 1.1 Word parts (word roots, combining forms, suffixes, and prefixes) make up most medical terms.

- The types of word parts and the rules for their use are explained in this chapter. Learn these rules and follow them.
- When a term is made up of recognizable word parts, these word parts and their meanings are included with the definition of that term. These word parts appear in **magenta**.
- The majority of the word parts used in medical terminology are of Latin origin, some are derived from Greek, and a few are from other languages.

The Four Types of Word Parts

The four types of word parts used to create many medical terms are word roots, combining forms, suffixes, and prefixes. Guidelines for their use are shown in Table 1.1.

1. A **word root** contains the basic meaning of the term. In medical terminology, this word part usually, *but not always*, indicates the involved body part. For example, the word root meaning stomach is **gastr-**.
2. A **combining form** is a word root with a combining vowel added at the end, used when two word roots are combined or when a suffix beginning with a consonant is added. When a combining form appears alone, it is shown with a back slash (/) between the word root and the combining vowel. For example, the combining form of the word root **gastr** is **gastr/o**. *Note: a, e, i, o, u, and sometimes y are vowels. All the other letters in the alphabet are consonants.*

TABLE 1.1

Word Part Guidelines

1. A word root cannot stand alone. A suffix must always be added at the end of the word to complete the term.
2. The rules for creating a combining form by adding a vowel apply when a suffix beginning with a consonant is added to a word root.
3. If a prefix is added, it is *always* placed at the beginning of the word.

3. A **suffix** usually, *but not always*, indicates the procedure, condition, disorder, or disease.
 - A suffix always comes at the end of the word.
 - You'll know a word part is a suffix when it is shown with a hyphen (-) preceding it. For example, the suffix **-itis** means inflammation.
4. A **prefix** usually, *but not always*, indicates location, time, number, or status.
 - A prefix always comes at the beginning of a word.
 - You'll know a word part is a prefix when it is shown followed by a hyphen (-). For example, **hyper-** means excessive or increased.

WORD ROOTS

Word roots act as the foundation for most medical terms. They usually, *but not always*, describe the part of the body that is involved (Figure 1.2). As shown in Table 1.2, some word roots indicate color.

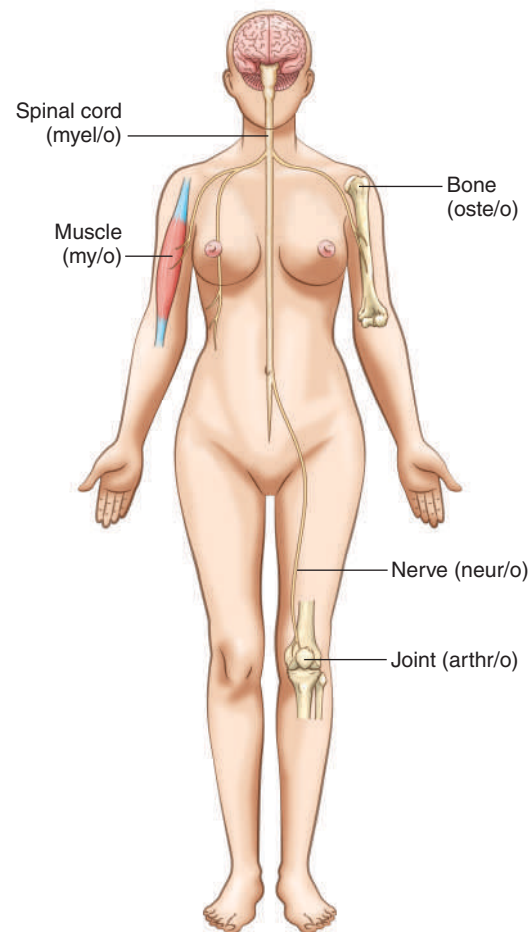


FIGURE 1.2 Word roots, shown here as combining forms, usually indicate the involved body part.

TABLE 1.2

Word Roots and Combining Forms Indicating Color

cyan/o means blue	Cyanosis (sigh-ah-NOH-sis) is blue discoloration of the skin caused by a lack of adequate oxygen in the blood (cyan means blue, and -osis means abnormal condition or disease).
erythr/o means red	An erythrocyte (eh-RITH-roh-sight) is a mature red blood cell (erythr/o means red, and -cyte means cell).
leuk/o means white	A leukocyte (LOO-koh-sight) is a white blood cell (leuk/o means white, and -cyte means cell).
melan/o means black	Melanosis (mel-ah-NOH-sis) is any condition of unusual deposits of black pigment in body tissues or organs (melan means black, and -osis means abnormal condition or disease).
poli/o means gray	Poliomyelitis (poh-lee-oh-my-eh-LYE-tis) is a viral infection of the gray nerve tissue of the spinal cord (poli/o means gray, myel means spinal cord, and -itis means inflammation).

Combining Forms Vowels

A combining form includes a vowel, usually the letter **o**, added to the end of a word root. It is usually added to make the resulting medical term easier to pronounce. The rules for the use of a combining vowel are as follows:

- When two word roots are joined, a combining vowel is always added to the first word root. A combining vowel is used at the end of the second word root *only if the suffix begins with a consonant*.
- For example, the term **gastroenteritis** combines two word roots with a suffix: when **gastr** (stomach) is joined with the word root **enter** (small intestine), a vowel is used to make the combining form **gastr/o**.
- The word root **enter** is joined to **-itis** *without a combining vowel* because this suffix begins with a vowel. **Gastroenteritis** (**gas-troh-en-ter-EYE-tis**) is an inflammation of the stomach and small intestine.

SUFFIXES

A suffix is *always* added at the end of a word to complete that term. In medical terminology, suffixes usually, *but not always*, indicate a procedure, condition, disorder, or disease.

A combining vowel is used when the suffix begins with a consonant. For example, when **neur/o** (nerve) is joined with the suffix **-plasty** (surgical repair) or **-rrhaphy** (surgical suturing), the combining vowel **o** is used because **-plasty** and **-rrhaphy** both begin with a consonant.

- **Neuroplasty** (**NEW-roh-plas-tee**) is the surgical repair of a nerve.
- **Neurorrhaphy** (**new-ROR-ah-fee**) is suturing together the ends of a severed nerve.

A combining vowel is *not* used when the suffix begins with a vowel. For example, the word root **tonsill** means tonsils. No combining vowel is needed when adding either **-itis** (inflammation) or **-ectomy** (surgical removal) to **tonsill**, because they both start with a vowel (Figure 1.3). These suffixes complete the term and tell us what is happening to the tonsils.

- **Tonsillitis** (**ton-sih-LYE-tis**) is an inflammation of the tonsils.
- A **tonsillectomy** (**ton-sih-LECK-toh-mee**) is the surgical removal of the tonsils.

Suffixes as Noun Endings

A **noun** is a word that is the name of a person, place, or thing. In medical terminology, some suffixes change the word root into a noun. For example, the **cranium** (**KRAY-nee-um**) is the portion of the skull that encloses the brain

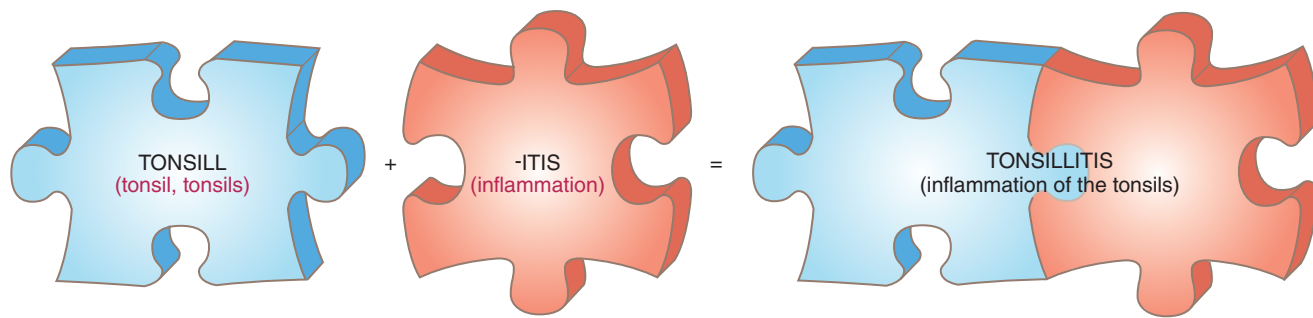


FIGURE 1.3 The term *tonsillitis* is created by adding the suffix **-itis** to the word root **tonsill**.

(**crani** means skull, and **-um** is a noun ending). Suffixes that are commonly used as noun endings are shown in Table 1.3.

Suffixes Meaning “Pertaining To”

An *adjective* is a word that defines or describes. In medical terminology, many suffixes meaning “pertaining to” are used to change the meaning of a word root into an adjective. For example, the word root **cardi** means heart, and the suffix **-ac** means pertaining to. Once combined, they form the term **cardiac** (**KAR**-dee-ack), an adjective that means pertaining to the heart. Commonly used suffixes meaning pertaining to are shown in Table 1.4.

TABLE 1.3

Suffixes as Noun Endings

-a	-um	-y
-e	-us	

TABLE 1.4

Suffixes Meaning “Pertaining to”

-ac	-eal	-ior
-al	-ical	-ory
-an	-ial	-ous
-ar	-ic	-tic
-ary	-ine	

Suffixes Meaning “Abnormal Condition or Disease”

In medical terminology, many suffixes, such as **-osis**, mean “abnormal condition or disease.” For example, **gastrosis** (gas-**TROH**-sis) means any disease of the stomach (**gastr** means stomach, and **-osis** means abnormal condition or disease). Commonly used suffixes meaning abnormal condition or disease are shown in Table 1.5.

Suffixes Related to Pathology

Pathology (pah-**THOL**-oh-jee) is the study of all aspects of diseases (**path** means disease, and **-ology** means study of). Suffixes related to pathology describe specific disease conditions.

- **-algia** means pain and suffering. **Gastralgia** (gas-**TRAL**-jee-ah), also known as a *stomachache*, means pain in the stomach (**gastr** means stomach, and **-algia** means pain).
- **-dynia** is another suffix meaning pain. **Gastrodynia** (gas-troh-**DIN**-ee-ah) also means pain in the stomach (**gastr/o** means stomach, and **-dynia** means pain). Although **-dynia** has the same meaning as **-algia**, it is not used as commonly (Figure 1.4).
- **-itis** means inflammation. **Gastritis** (gas-**TRY**-tis) is an inflammation of the stomach (**gastr** means stomach, and **-itis** means inflammation).

TABLE 1.5

Suffixes Meaning “Abnormal Condition”

-ago	-iasis	-osis
-esis	-ion	
-ia	-ism	



iStockphoto/Catalin Perolea

FIGURE 1.4 *Gastralgia* and *gastrodynia* are both terms meaning stomach pain.

- **-megaly** means enlargement. **Hepatomegaly** (hep-ah-toh-MEG-ah-lee) is abnormal enlargement of the liver (**hepat/o** means liver, and **-megaly** means enlargement).
- **-malacia** means abnormal softening. **Arteriomalacia** (ar-tee-ree-oh-mah-LAY-shee-ah) is the abnormal softening of the walls of an artery or arteries (**arteri/o** means artery, and **-malacia** means abnormal softening). Notice that **-malacia** is the opposite of **-sclerosis**.
- **-necrosis** means tissue death. **Arterionecrosis** (ar-tee-ree-oh-neh-KROH-sis) is the tissue death of an artery or arteries (**arteri/o** means artery, and **-necrosis** means tissue death).
- **-sclerosis** means abnormal hardening. **Arteriosclerosis** (ar-tee-ree-oh-skleh-ROH-sis) is the abnormal hardening of the walls of an artery or arteries (**arteri/o** means artery, and **-sclerosis** means abnormal hardening). Notice that **-sclerosis** is the opposite of **-malacia**.
- **-stenosis** means abnormal narrowing. **Arteriostenosis** (ar-tee-ree-oh-steh-NOH-sis) is the abnormal narrowing of an artery or arteries (**arteri/o** means artery, and **-stenosis** means abnormal narrowing).

Suffixes Related to Procedures

Some suffixes identify the procedure that is performed on the body part indicated by the word root.

- **-centesis** is a surgical puncture to remove fluid for diagnostic purposes or to remove excess fluid. **Abdominocentesis** (ab-dom-ih-noh-sen-TEE-sis) is the surgical puncture of the abdominal cavity to remove fluid (**abdomin/o** means abdomen, and **-centesis** means a surgical puncture to remove fluid).
- **-graphy** means the process of producing a picture or record. **Angiography** (an-jee-OG-rah-fee) is the process of producing a radiographic (x-ray) study of blood vessels after the injection of a contrast medium to make these blood vessels visible (**angi/o** means blood vessel, and **-graphy** means the process of recording).
- **-gram** means a picture or record. An **angiogram** (AN-jee-oh-gram) is the resulting film that is produced by angiography (**angi/o** means blood vessel, and **-gram** means a picture or record).
- **-plasty** means surgical repair. **Myoplasty** (MY-oh-plas-tee) is the surgical repair of a muscle (**my/o** means muscle, and **-plasty** means surgical repair).
- **-scopy** means visual examination. **Arthroscopy** (ar-THROS-koh-pee) is the visual examination of the internal structure of a joint (**arthr/o** means joint, and **-scopy** means visual examination).

The “Double R” Suffixes

Medical terminology suffixes beginning with two of the letter *r*, often referred to as the *double Rs*, can be particularly confusing. These word parts are of Greek origin. They are grouped together here to help you understand them and to remember the differences.

- **-rrhage** and **-rrhagia** mean bleeding; however, they are most often used to describe sudden, severe bleeding. A **hemorrhage** (HEM-or-idj) is the loss of a large amount of blood in a short time (**hem/o** means blood, and **-rrhage** means abnormal excessive fluid discharge).
- **-rrhaphy** means surgical suturing to close a wound and includes the use of sutures, staples, or surgical glue. **Myorrhaphy** (my-OR-ah-fee) is the surgical suturing of a muscle wound (**my/o** means muscle, and **-rrhaphy** means surgical suturing).
- **-rrhea** means flow or discharge and refers to the flow of most body fluids. **Diarrhea** (dye-ah-REE-ah) is the frequent flow of loose or watery stools (**dia-** means through, and **-rrhea** means flow or discharge).

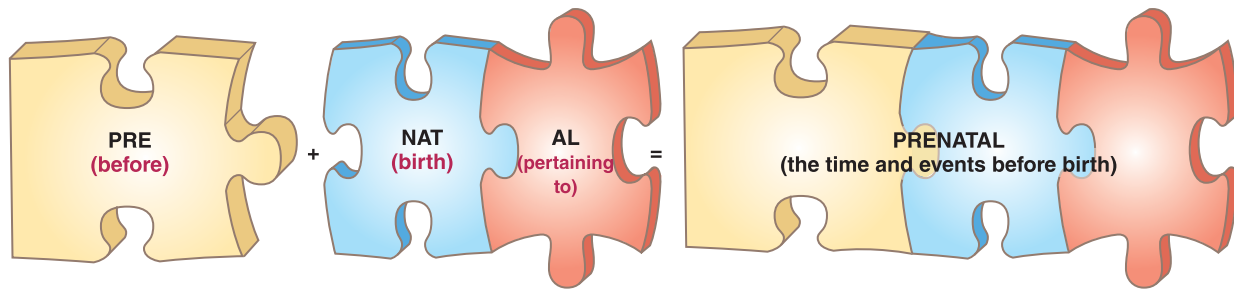


FIGURE 1.5 The term *prenatal* is created by joining the suffix *-al* to the word root *nat* and then adding the prefix *pre-*.

- **-rrhexis** means rupture. **Myorrhexis** (**my**-oh-**RECK**-sis) is the rupture of a muscle (**my/o** means muscle, and **-rrhexis** means rupture).

PREFIXES

A prefix is sometimes added to the beginning of a word to influence the meaning of that term. Prefixes usually, *but not always*, indicate location, time, or number. See Table 1.6 for a list of prefixes describing direction, quantity, size, and amount. The term **natal** (**NAY**-tal) means pertaining to birth (**nat** means birth, and **-al** means pertaining to). The following examples show how prefixes change the meaning of this term (Figures 1.5–1.8).

- **Prenatal** (**pre**-**NAY**-tal) means the time and events before birth (**pre-** means before, **nat** means birth, and **-al** means pertaining to).
- **Perinatal** (**pehr**-ih-**NAY**-tal) refers to the time and events surrounding birth (**peri-** means surrounding,



FIGURE 1.6 The *prenatal* development of a fetus (baby).



FIGURE 1.7 A *perinatal* event of the umbilical cord being cut immediately after the baby is born.

TABLE 1.6

Prefixes Describing Direction, Quantity, Size, and Amount

ab- away from, negative, absent	ad- toward, to, in the direction of
dextr/o right side	sinistr/o left side
ex- out of, outside, away from	in- in, into, not, without
macro- large, abnormal size, or long	micr/o, micro- small
mega-, megal/o large, great	olig/o scanty, few
pre- before	post- after, behind



FIGURE 1.8 A happy *postnatal* moment as the parents bond with their new baby.

nat means birth, and **-al** means pertaining to). This is the time just before, during, and just after birth.

- **Postnatal** (pohst-NAY-tal) refers to the time and events after birth (**post-** means after, **nat** means birth, and **-al** means pertaining to).

Contrasting and Confusing Prefixes

Some prefixes are confusing because they are similar in spelling but opposite in meaning. The more common prefixes of this type are summarized in Table 1.7.

Media Link

Watch an animation on **How Word Parts Work Together** on the Online Resources.

DETERMINING MEANINGS ON THE BASIS OF WORD PARTS

Knowing the meaning of the word parts often makes it possible to figure out the definition of an unfamiliar medical term.

Taking Terms Apart

To determine a word's meaning by looking at the component pieces, you must first separate it into word parts.

- Always start at the end of the word, with the suffix, and work toward the beginning.

- As you separate the word parts, identify the meaning of each. Identifying the meaning of each part should give you a definition of the term.
- Because some word parts have more than one meaning, it also is necessary to determine the context in which the term is being used. As used here, **context** means to determine which body system this term is referring to.
- If you have any doubt, use your medical dictionary or a trusted online source to double-check your definition.
- Be aware that not all medical terms are made up of word parts.

An Example to Take Apart

Look at the term **otorhinolaryngology** (oh-toh-rye-noh-lar-in-GOL-oh-jee) as shown in Figure 1.9. It is made up of two combining forms, a word root, and a suffix. This is how it looks when the word parts have been separated by working from the end to the beginning.

- The suffix **-ology** means the study of.
- The word root **laryng** means larynx or throat. The combining vowel *is not used* here because the word root is joining a suffix that begins with a vowel.
- The combining form **rhin/o** means nose. The combining vowel *is used* here because the word root **rhin** is joining another word root beginning with a consonant.
- The combining form **ot/o** means ear. The combining vowel *is used* here because the word root **ot** is joining another word root beginning with a consonant.

TABLE 1.7

Contrasting Prefixes: Opposites

ab- means away from.

Abnormal means not normal or away from normal.

dys- means bad, difficult, or painful.

Dysfunctional means an organ or body part that is not working properly.

hyper- means excessive or increased.

Hypertension is higher-than-normal blood pressure.

inter- means between or among.

Interstitial means between, but not within, the parts of a tissue.

sub- means under, less, or below.

Subcostal means below a rib or ribs.

ad- means toward or in the direction of.

Addiction means being drawn toward or having a strong dependence on a drug or substance.

eu- means good, normal, well, or easy.

Eupnea means easy or normal breathing.

hypo- means deficient or decreased.

Hypotension is lower-than-normal blood pressure.

intra- means within or inside.

Intramuscular means within the muscle.

super-, supra- mean above or excessive.

Supracostal means above or outside the ribs.

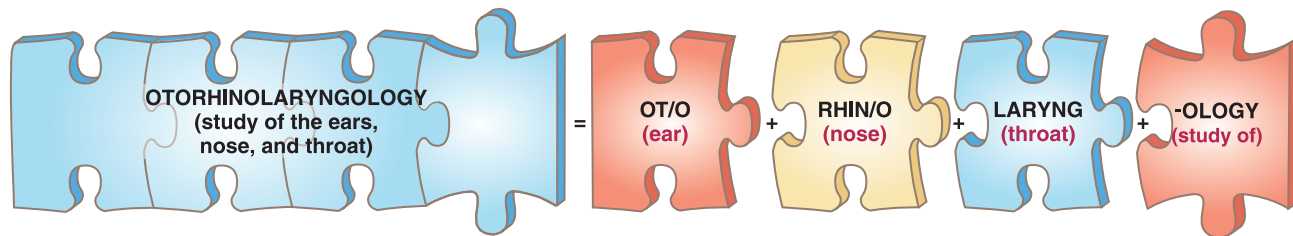


FIGURE 1.9 To determine the meaning of a medical term, the word parts are separated working from the end of the word toward the beginning.

- Together they form *otorhinolaryngology*, which is the study of the ears, nose, and throat (**ot/o** means ear, **rhin/o** means nose, **laryng** means throat, and **-ology** means study of). *Note:* **Laryng/o** also means larynx and is discussed in Chapter 7.
- Because this is such a long term, this specialty is frequently referred to as **ENT** (ears, nose, and throat).
- A shortened version of this term is **otolaryngology** (**oh-toh-lar-in-GOL-oh-jee**), which is the study of the ears and larynx or throat (**ot/o** means ears, **laryng** means larynx, and **-ology** means study of).

Media Link

Watch the **Combining Word Roots** animation on the Online Resources.

Guessing at Meanings

When you are able to guess at the meaning of a term on the basis of its word parts, you must always double-check for accuracy because some terms have more than one meaning. For example, look at the term **lithotomy** (**lih-THOT-oh-mee**):

- On the basis of word parts, a **lithotomy** is a surgical incision for the removal of a stone (**lith** means stone, and **-otomy** means a surgical incision). This meaning is discussed further in Chapter 9.
- However, **lithotomy** is also the name of an examination position in which the patient is lying on her back with her feet and legs raised and supported in stirrups. The term is used to describe this position because in the early days, this was the preferred position for lithotomy surgery. This term is discussed further in Chapter 15.
- This type of possible confusion is one of the many reasons why a medical dictionary is an important medical terminology tool.

MEDICAL DICTIONARY USE

Learning to use a medical dictionary and other resources to find the definition of a term is an important part of mastering the correct use of medical terms. The following tips for dictionary use apply whether you are working with a traditional book-form dictionary or with electronic dictionary software, websites, or applications on your computer or handheld device.

If You Know How to Spell the Word

When starting to work with a printed dictionary, spend a few minutes reviewing its user guide, table of contents, and appendices. The time you spend reviewing now will be saved later when you are looking up unfamiliar terms.

- On the basis of the first letter of the word, start in the appropriate section of the dictionary. Look at the top of the page for clues. The top left word is the first term on the page. The top right word is the last term on that page.
- Next, look alphabetically for words that start with the first and second letters of the word you are researching. Continue looking through each letter until you find the term you are looking for.
- When you think you have found it, check the spelling very carefully, letter by letter, working from left to right. Terms with similar spellings have very different meanings.
- When you find the term, carefully check *all* of the definitions.

If You Do Not Know How to Spell the Word

Listen carefully to the term, and write it down. If you cannot find the word on the basis of your spelling, start looking for alternative spellings based on the beginning sound as shown in Table 1.8. *Note:* All of these examples are in this textbook. However, you could practice looking them up in the dictionary!

TABLE 1.8**Guidelines to Looking Up the Spelling of Unfamiliar Terms**

If it sounds like	It may begin with	Example
F	F PH	flatus (FLAY-tus), see Chapter 8 phlegm (FLEM), see Chapter 7
J	G J	gingivitis (jin-jih-VYE-tis), see Chapter 8 jaundice (JAWN-dis), see Chapter 8
K	C CH K QU	crepitus (KREP-ih-tus), see Chapter 3 cholera (KOL-er-ah), see Chapter 8 kyphosis (kye-FOH-sis), see Chapter 3 quadriplegia (kwad-rih-PLÉE-jee-ah), see Chapter 4
S	C PS S	cytology (sigh-TOL-oh-jee), see Chapter 2 psychologist (sigh-KOL-oh-jist), see Chapter 10 serum (SEER-um), see Chapter 5
Z	X Z	xeroderma (zee-roh-DER-mah), see Chapter 12 zygote (ZYE-goht), see Chapter 14

Look Under Categories

Most printed dictionaries use categories such as *Diseases* and *Syndromes* to group disorders with these terms in their titles. For example:

- *Sexually transmitted disease* would be found under *Disease, sexually transmitted*.
- *Fetal alcohol syndrome* would be found under *Syndrome, fetal alcohol*.
- When you come across such a term and cannot find it listed by the first word, the next step is to look under the appropriate category.

Multiple-Word Terms

When you are looking for a term that includes more than one word, begin your search with the last term. If you do not find it there, move forward to the next word.

- For example, *congestive heart failure* is sometimes listed under *Heart failure, congestive*.

Searching for Definitions on the Internet

Internet search engines are valuable resources in finding definitions and details about medical conditions and

terms; however, it is important that you rely on a site, such as the National Institutes of Health (NIH) website (<http://www.nih.gov>), which is known to be a reputable information source.

- For better results, an Internet search should include visits to at least two reputable sites. If there is a major difference in the definitions, go on to a third site. Sometimes search engine results will include a site that is not necessarily trustworthy but has paid for good placement.
- Beware of suggested search terms. If you do not spell a term correctly, a website may guess what you were searching for. Make sure to double-check that the term you are defining is the intended term.

The same caution applies to medical dictionary applications on handheld devices. Make sure that the application comes from a reputable source, and always double-check that this definition is for the term that you intended to look up.

PRONUNCIATION

A medical term is easier to understand and remember when you know how to pronounce it properly. To help you master the pronunciation of new terms, a commonly

accepted pronunciation of that word appears in parentheses next to the term.

The sounds-like pronunciation system is used in this textbook. Here the word is respelled using normal English letters to create sounds that are familiar. To pronounce a new word, just say it as it is spelled in the parentheses.

- The part of the word that receives the primary (most) emphasis when you say it is shown in uppercase boldface letters. For example, **edema** (eh-DEE-mah) is swelling caused by an abnormal accumulation of fluid in cells, tissues, or cavities of the body.
- A part of the word that receives secondary (less) emphasis when you say it is shown in boldface lowercase letters. For example, **appendicitis** (ah-pen-dih-SIGH-tis) means an inflammation of the appendix (**appendic** means appendix, and **-itis** means inflammation).

A Word of Caution

Frequently, there is more than one correct way to pronounce a medical term.

- The pronunciation of many medical terms is based on their Greek, Latin, or other foreign origin. However, there is a trend toward pronouncing terms as they would sound in English.
- The result is more than one “correct” pronunciation for a term. The text shows the most commonly accepted pronunciation.
- If your instructor prefers an alternative pronunciation, follow the instructions you are given.

SPELLING IS ALWAYS IMPORTANT

Accuracy in spelling medical terms is extremely important!

- Changing just one or two letters can completely change the meaning of a word—and this difference literally could be a matter of life or death for the patient.
- The section “Look-Alike, Sound-Alike Terms and Word Parts” later in this chapter will help you become aware of some terms and word parts that are frequently confused.
- The spelling shown in this text is commonly accepted in the United States. You may encounter alternative

spellings used in other English-speaking countries such as England, Australia, and Canada.

SINGULAR AND PLURAL ENDINGS

Many medical terms have Greek or Latin origins. As a result of these different origins, there are unusual rules for changing a singular word into a plural form. In addition, English endings have been adopted for some commonly used terms.

- Table 1.9 provides guidelines to help you better understand how these plurals are formed.
- Also, throughout the text, when a term with an unusual singular or plural form is introduced, both forms are included. For example, the **phalanges** (fah-LAN-jeez) are the bones of the fingers and toes (singular, *phalanx*) (Figure 1.10).

BASIC MEDICAL TERMS TO DESCRIBE DISEASES

Some of the medical terms that are used to describe diseases and disease conditions can be confusing. Some of the most commonly confused terms are described in Table 1.10. You will find that studying the groups of three as they are shown in the table makes it easier to master these terms.

LOOK-ALIKE, SOUND-ALIKE TERMS AND WORD PARTS

This section highlights some frequently used terms and word parts that are confusing because they look and sound alike. However, their meanings are very different. It is important that you pay close attention to these terms and word parts as you encounter them in the text.

arteri/o, ather/o, and arthr/o

- **arteri/o** means artery. **Endarterial** (end-ar-TEE-ree-al) means pertaining to the interior or lining of an artery (**end-** means within, **arteri** means artery, and **-al** means pertaining to).
- **ather/o** means plaque or fatty substance. An **atheroma** (ath-er-OH-mah) is a fatty deposit within the wall of an artery (**ather** means fatty substance, and **-oma** means tumor).

TABLE 1.9

Guidelines to Unusual Plural Forms

Guideline	Singular	Plural
If the singular term ends in the suffix -a , the plural is usually formed by changing the ending to -ae .	bursa vertebra	bursae vertebrae
If the singular term ends in the suffix -ex or -ix , the plural is usually formed by changing these endings to -ices .	appendix index	appendices indices
If the singular term ends in the suffix -is , the plural is usually formed by changing the ending to -es .	diagnosis metastasis	diagnoses metastases
If the singular term ends in the suffix -itis , the plural is usually formed by changing the -is ending to -ides .	arthritis meningitis	arthritides meningitides
If the singular term ends in the suffix -nx , the plural is usually formed by changing the -x ending to -ges .	phalanx meninx	phalanges meninges
If the singular term ends in the suffix -on , the plural is usually formed by changing the ending to -a .	criterion ganglion	criteria ganglia
If the singular term ends in the suffix -um , the plural usually is formed by changing the ending to -a .	diverticulum ovum	diverticula ova
If the singular term ends in the suffix -us , the plural is usually formed by changing the ending to -i .	alveolus malleolus	alveoli malleoli

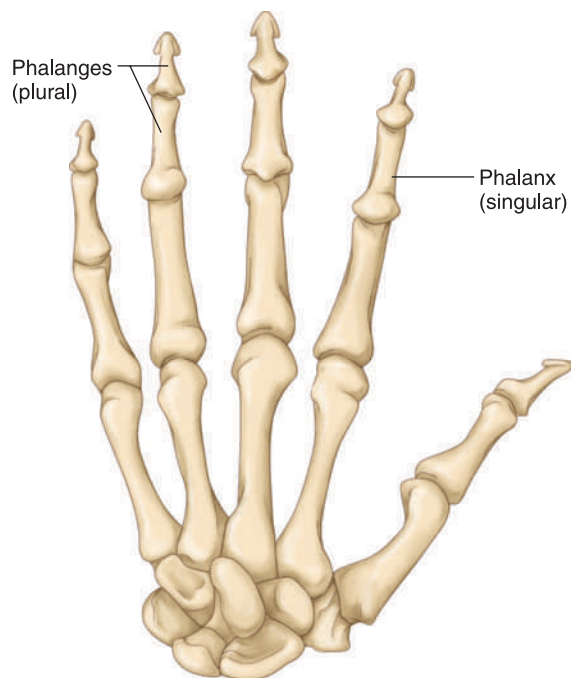


FIGURE 1.10 Singular and plural endings. A phalanx is one finger or toe bone. Phalanges are more than one finger or toe bones.

- **arthr/o** means joint. **Arthralgia** (ar-**THRAL**-jee-ah) means pain in a joint or joints (**arthr** means joint, and **-algia** means pain).

-ectomy, -ostomy, and -otomy

- **-ectomy** means surgical removal. An **appendectomy** (ap-en-**DECK**-toh-mee) is the surgical removal of the appendix (**append** means appendix, and **-ectomy** means surgical removal).
- **-ostomy** means the surgical creation of an artificial opening to the body surface. A **colostomy** (koh-**LAHS**-toh-mee) is the surgical creation of an artificial excretory opening between the colon and the body surface (**col** means colon, and **-ostomy** means the surgical creation of an artificial opening).
- **-otomy** means cutting or a surgical incision. A **colotomy** (koh-**LOT**-oh-mee) is a surgical incision into the colon (**col** means colon, and **-otomy** means a surgical incision).

TABLE 1.10

Basic Medical Terms to Describe Disease Conditions

A **sign** is objective evidence of disease, such as a fever. *Objective* means the sign can be evaluated or measured by the patient or others.

A **symptom** (**SIMP**-tum) is subjective evidence of a disease, such as pain or a headache. *Subjective* means that it can be evaluated or measured only by the patient.

A **syndrome** (**SIN**-drohm) is a set of signs and symptoms that occur together as part of a specific disease process.

A **diagnosis** (**dye**-ag-**NOH**-sis) (DX) is the identification of a disease (plural, *diagnoses*). To *diagnose* is the process of reaching a diagnosis.

A **differential diagnosis** (D/DX), also known as a *rule out* (R/O), is an attempt to determine which one of several possible diseases is causing the signs and symptoms that are present.

A **prognosis** (prog-**NOH**-sis) is a prediction of the probable course and outcome of a disease (plural, *prognoses*).

An **acute** condition has a rapid onset, a severe course, and a relatively short duration.

A **chronic** condition is of long duration. Although such diseases can be controlled, they are rarely cured.

A **remission** is the temporary, partial, or complete disappearance of the symptoms of a disease without having achieved a cure.

A **disease** is a condition in which one or more body parts are not functioning normally. Some diseases are named for their signs and symptoms. For example, *chronic fatigue syndrome* is a persistent, overwhelming fatigue of unknown origin (see Chapter 4).

An **eponym** (**EP**-oh-nim) is a disease, structure, operation, or procedure named for the person who discovered or described it first. For example, *Alzheimer's disease* is named for German neurologist Alois Alzheimer (see Chapter 10).

An **acronym** (**ACK**-roh-nim) is a word formed from the initial letter of the major parts of a compound term. For example, the acronym **laser** stands for *light amplification by stimulated emission of radiation* (see Chapter 12).

Fissure and Fistula

- A **fissure** (**FISH**-ur) is a groove or crack-like sore of the skin (see Chapter 12). This term also describes normal folds in the contours of the brain.
- A **fistula** (**FIS**-chuh-lah) is an abnormal passage, usually between two internal organs or leading from an organ to the surface of the body. A fistula may be due to surgery, injury, or the draining of an abscess.

Ileum and Ilium

- The **ileum** (**ILL**-ee-um) is the last and longest portion of the small intestine. *Memory aid:* *ileum* is spelled with an *e* as in *intestine*.
- The **ilium** (**ILL**-ee-um) is part of the hip bone. *Memory aid:* *ilium* is spelled with an *i* as in *hip* (Figure 1.11).

Infection and Inflammation

- Although the suffix **-itis** means inflammation, it also is commonly used to indicate infection. An example is **meningitis** (**mening** means the meninges and **-itis** means inflammation), in which the cause of the inflammation is an infection. Another example is **tendinitis** (**tendin** means tendon and **-itis** means inflammation). The inflammation of tendinitis is usually caused by overuse rather than infection.
- An **infection** (in-**FECK**-shun) is the invasion of the body by a pathogenic (disease-producing) organism. The infection can remain localized (near the point of entry) or can be systemic (affecting the entire body). Signs and symptoms of infection include malaise, chills and fever, redness, heat and swelling, or exudate from a wound.

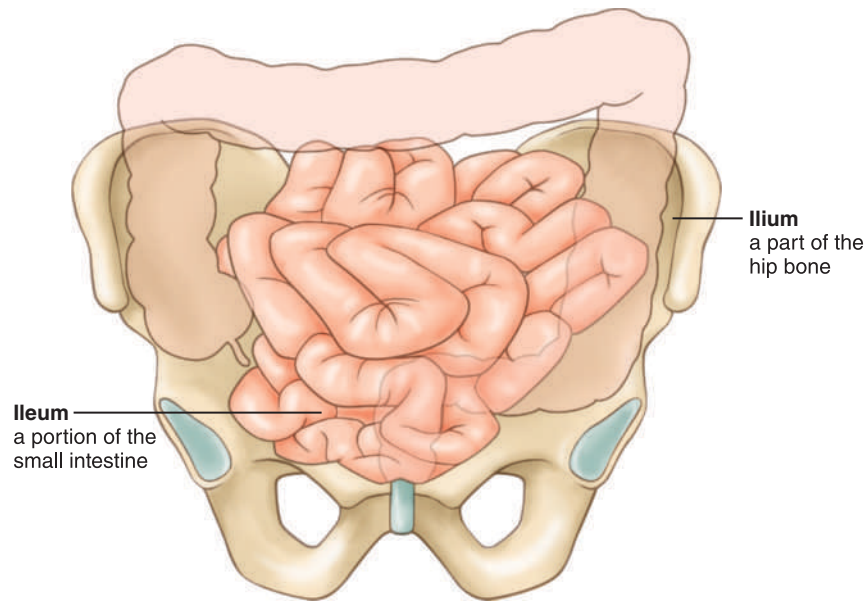


FIGURE 1.11 There is only one letter difference between *ileum* and *ilium*, but they are very different parts of the body.

- **Malaise** (mah-LAYZ) is a word of French origin referring to a feeling of general discomfort or uneasiness that is often the first indication of an infection or other disease.
- An **exudate** (ECKS-you-dayt) is a fluid, such as pus, that leaks out of an infected wound.
- **Inflammation** (in-flah-MAY-shun) is a localized response to an injury or to the destruction of tissues. The key indicators of inflammation are (1) *erythema* (redness), (2) *hyperthermia* (heat), (3) *edema* (swelling), and (4) *pain*. These are caused by extra blood flowing into the area as part of the healing process.

Laceration and Lesion

- A **laceration** (lass-er-AY-shun) is a torn or jagged wound or an accidental cut.
- A **lesion** (LEE-zhun) is a pathologic change of the tissues due to disease or injury.

Mucous and Mucus

- The adjective **mucous** (MYOU-kus) describes the specialized membranes that line the body cavities.
- The noun **mucus** (MYOU-kus) is the name of the fluid secreted by these mucous membranes.

myc/o, myel/o, and my/o

- **myc/o** means fungus. **Mycosis** (my-KOH-sis) describes any abnormal condition or disease caused by a fungus (**myc** means fungus, and **-osis** means abnormal condition or disease).
- **myel/o** means bone marrow *or* spinal cord. The term **myelopathy** (my-eh-LOP-ah-thee) describes any pathologic change or disease in the spinal cord (**myel/o** means spinal cord or bone marrow, and **-pathy** means disease).
- **my/o** means muscle. The term **myopathy** (my-OP-ah-thee) describes any pathologic change or disease of muscle tissue (**my/o** means muscle, and **-pathy** means disease).

-ologist and -ology

- **-ologist** means specialist. A **dermatologist** (der-mah-TOL-oh-jist) is a physician who specializes in diagnosing and treating disorders of the skin (**dermat** means skin, and **-ologist** means specialist).
- **-ology** means the study of. **Neonatology** (nee-oh-nay-TOL-oh-jee) is the study of disorders of the newborn (**neo-** means new, **nat** means birth, and **-ology** means study of).

Palpation and Palpitation

- **Palpation** (pal-PAY-shun) is an examination technique in which the examiner's hands are used to feel the texture, size, consistency, and location of certain body parts.
- **Palpitation** (pal-pih-TAY-shun) is a pounding or racing heart.

pyel/o, py/o, and pyr/o

- **pyel/o** means renal pelvis, which is part of the kidney. **Pyelitis** (pye-eh-LYE-tis) is an inflammation of the renal pelvis (**pyel** means renal pelvis, and **-itis** means inflammation).
- **py/o** means pus. **Pyoderma** (pye-oh-DER-mah) is any acute, inflammatory, pus-forming bacterial skin infection such as impetigo (**py/o** means pus, and **-derma** means skin).
- **pyr/o** means fever or fire. **Pyrosis** (pye-ROH-sis), also known as *heartburn*, is discomfort due to the regurgitation of stomach acid upward into the esophagus (**pyr** means fever or fire, and **-osis** means abnormal condition or disease).

Supination and Suppuration

- **Supination** (soo-pih-NAY-shun) is the act of rotating the arm so that the palm of the hand is forward or upward.
- **Suppuration** (sup-you-RAY-shun) is the formation or discharge of pus.

Triage and Trauma

- **Triage** (tree-AHZH) is the medical screening of patients to determine their relative priority of need and the proper place of treatment (Figure 1.12).
- **Trauma** (TRAW-mah) means wound or injury. These are the types of injuries that might occur in an accident, shooting, natural disaster, or fire.

Viral and Virile

- **Viral** (VYE-ral) means pertaining to a virus (**vir** means virus or poison, and **-al** means pertaining to).
- **Virile** (VIR-ill) means having the nature, properties, or qualities of an adult male.



FIGURE 1.12 Triage describes the process through which emergency personnel arriving on an accident scene identify which of the injured require care first and where they can be treated most effectively.

USING ABBREVIATIONS

Abbreviations are frequently used as a shorthand way to record long and complex medical terms; Appendix B contains an alphabetized list of many of the more commonly used medical abbreviations.

- Abbreviations can also lead to confusion and errors! Therefore, it is important that you use caution when using or interpreting an abbreviation.
- For example, the abbreviation *BE* means both “below elbow” (when describing an amputation) and “barium enema.” Just imagine what a difference a mix-up here would make for the patient!
- Most clinical agencies have policies for accepted abbreviations. It is important to follow this list for the facility where you are working.
- If there is any question in your mind about which abbreviation to use, always follow this rule: *When in doubt, spell it out.*

The Joint Commission (JC), an organization founded in 1910 to standardize medical practices, has published a list of commonly confused “Do Not Use” abbreviations to prevent potentially fatal medical errors. The full list is available at http://www.jointcommission.org/facts_about_the_official/ (see Table 1.11 for examples). Many medical facilities have their own suggested “Do Not Use” abbreviation list.

TABLE 1.11**Examples of "Do Not Use" Abbreviations**

Abbreviation	Potential Problem
MS	can mean either morphine sulfate or magnesium sulfate
QD and QOD	mean daily and every other day, respectively; sometimes mistaken for each other
U	means unit, sometimes mistaken for 0 or 4

Workbook Practice

Go to your workbook and complete the exercises for this chapter.



CAREER OPPORTUNITIES: SETTING YOUR GOALS

Learning about medical terminology is essential to a wide range of health occupations, from transplant surgeon to dance therapist. As you learn about the different body systems and fields of medical care, think about which jobs sound most appealing to you. Look in the library and online for detailed information about careers you might want to pursue.

Some health occupations require only a high school diploma and a willingness to learn on the job, whereas others require a college degree and many years of postgraduate study. Table 1.12 can help you plan your future in the health occupation you choose.

In the chapters to come, there will be many career ideas for you to consider. While most involve direct contact with patients, others deal with vital behind-the-scenes work, such as keeping accurate medical records and maintaining complex life-saving equipment. A few examples of these careers are:

- **Administrative medical assistant:** works in a physician's office or clinic as a receptionist or office manager.
- **Health unit clerk:** performs administrative and secretarial tasks in a health care facility such as a hospital, clinic, or nursing home.
- **Insurance underwriter or assistant:** analyzes information to process insurance applications and evaluate claims for medical treatment and disability coverage.
- **Medical records administrator:** plans and maintains systems for storing and obtaining medical records.
- **Medical records or health information technician:** organizes and codes patient records, gathers statistical or research data, and records information.
- **Medical records clerk:** files and retrieves patient records.
- **Medical billing clerk:** sends invoices to patients and insurance companies, listing the procedures and tests that have been performed.
- **Medical illustrator, photographer, or writer:** helps create books, newspaper and magazine articles, informational brochures for patients, and other print and Internet materials in the medical field.
- **Mortuary worker:** prepares bodies for burial or cremation, plans funeral services, and helps console the bereaved.

TABLE 1.12
Education and Levels of Training

Career Level	Educational Requirement	Examples
Aide or Assistant	One or more years of course study and/or on-the-job training	<ul style="list-style-type: none"> • Dental assistant • Medical assistant • Nursing assistant
Nurse (LPN, LVN) or Technician	Two-year associate degree, special health occupations education, or 3–4 years of on-the-job training	<ul style="list-style-type: none"> • Dental hygienist • Medical laboratory technician • Surgical technologist • Physical therapy assistant
Registered Nurse (RN) or Technologist	Four-year college bachelor's degree	<ul style="list-style-type: none"> • Medical laboratory technologist • Registered nurse
Therapist or Professional	Postgraduate education in medical specialty (master's or doctorate degree)	<ul style="list-style-type: none"> • Dentist • Medical doctor • Occupational therapist • Psychologist • Speech therapist • Nurse practitioner

HEALTH PROFESSION PROFILE

REGISTERED NURSE

Anna Choi is a registered nurse in a hospital emergency department.

Being a nurse means a lot to me. I get to be there for people when they are born and when they die. I love meeting new patients, helping them, comforting them, and teaching them about their health.

In a normal shift, I triage patients who come in by ambulance or on foot, start IVs, and give medications and fluids as ordered by the doctor. I also advocate for my patients and monitor vital signs. A few times, I have had to try to save someone's life using CPR and medications.

Working in the ER can be a difficult and challenging job, both physically and emotionally, but I love it. The feeling of doing something that actually matters in this world is amazing. I go home knowing that I made a difference in my patients' lives.



CHAPTER 1 STUDY BREAK

Once you've learned the word parts that make up a term, you can use your new skills to understand the majority of complicated medical terms, even the one reported to be the longest word in any English dictionary: "**pneumonoultramicroscopicsilicovolcanoconiosis**."

It won't be hard for you to take even this 45-letter word apart and define it as a lung disease caused by inhaling very fine ("ultramicroscopic") volcanic ash and sand dust—in other words, silicosis. But here's an inside tip: this famously long medical term is a fake. The truth of the matter is that it was coined in 1935 at a meeting of the National Puzzlers League in order to claim the title of the longest English word.

REVIEW TIME

Write the answers to the following questions on a separate piece of paper or in your notebook. In addition, be prepared to take part in the classroom discussion.

1. *Written Assignment:* Describe the differences between a sign and a symptom.

Discussion Assignment: Why are both types of observations important in determining medical treatment?

2. *Written Assignment:* Use your own words to define the term triage.

Discussion Assignment: What are the kinds of situations in which triage would be important?

3. *Written Assignment:* Use your word part skills to determine the meaning of the term cardiopulmonary (**pulmon/o** means lungs), and then state the definition and identify the word parts that make up this term.

Discussion Assignment: What rules relating to the use of combining vowels are used in this term?

4. *Written Assignment:* Use your medical dictionary to research the eponym Graves' disease, and report on the name and dates of the physician for whom this disease is named.

Discussion Assignment: What is an eponym?

5. *Written Assignment:* Compare the terms diagnosis and prognosis.

Discussion Assignment: How is information about both the diagnosis and prognosis important to the patient and to his or her family?



OPTIONAL INTERNET ACTIVITY

The goal of this activity is to help you learn more about medical terminology as it applies to the “real world.” Select one of the two options below and follow the instructions.

1. Search for information about the Health Occupations Students of America (HOSA-Future Health Professionals). Write a brief (one- or two-paragraph) report on something new you learned here and include the address of the website where you found this information.
2. The U.S. Department of Labor Bureau of Labor Statistics maintains a website (<http://www.bls.gov>) that provides the *Occupational Outlook Handbook*, which features training requirements and opportunities for many different health occupations. Select a health occupation of interest to you, and write a brief (one- or two-paragraph) report on something new you learned here. Be certain to include in your report the name of the occupation you researched.

The Human Touch

CRITICAL THINKING EXERCISE

The following story and questions are designed to stimulate critical thinking through class discussion or as a brief essay response. There are no right or wrong answers to these questions.

Baylie Hutchins sits at her kitchen table, highlighter in hand, with her medical terminology book opened to the first chapter. Her 2-year-old son, Mathias, plays with a box of animal crackers in his high chair, some even finding his mouth. “Arteri/o, ather/o, and arthr/o,” she mutters, lips moving to shape unfamiliar sounds. “They’re too much alike, and they mean totally different things.” Mathias sneezes loudly, and spots of animal cracker rain on the page, punctuating her frustration.

“Great job, Thias,” she says wiping the text with her finger. “I planned on using the highlighter to mark with, not your lunch.” Mathias giggles and peeks through the tunnel made by one small hand.

“Mucous and mucus,” she reads aloud, each sounding the same. Then she remembers her teacher’s tip for remembering the difference, “The long word is the membrane, and the short one is the secretion.”

Mathias picks up an animal cracker and excitedly shouts, “Tiger, Mommy! Tiger!” “That’s right, Thias. Good job!”

Turning back to the page she stares at the red word parts *-rrhagia*, *-rrhaphy*, *-rrhea*, and *-rrhexis*. Stumbling over the pronunciations, Baylie closes her eyes and tries to silence the voices in her head. “You can’t do anything right,” her ex-husband says. “Couldn’t finish if your life depended on it,” her mother’s voice snaps.

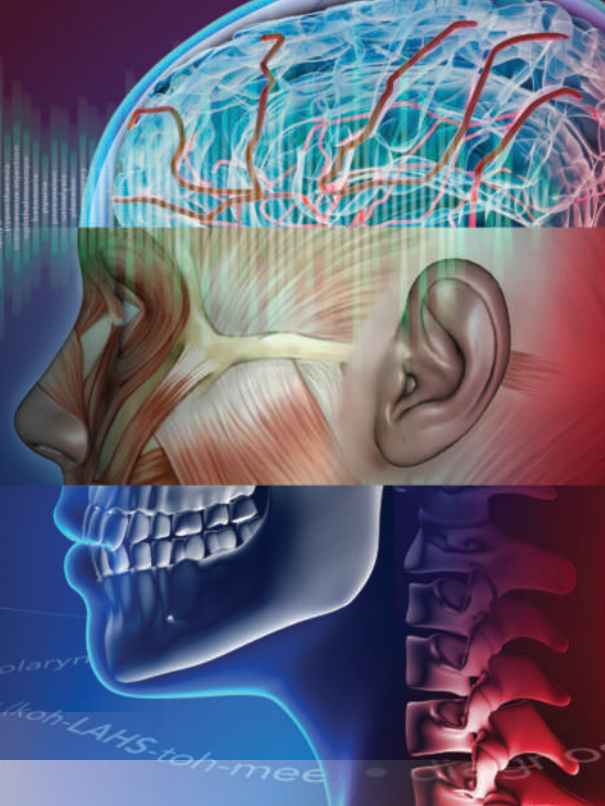
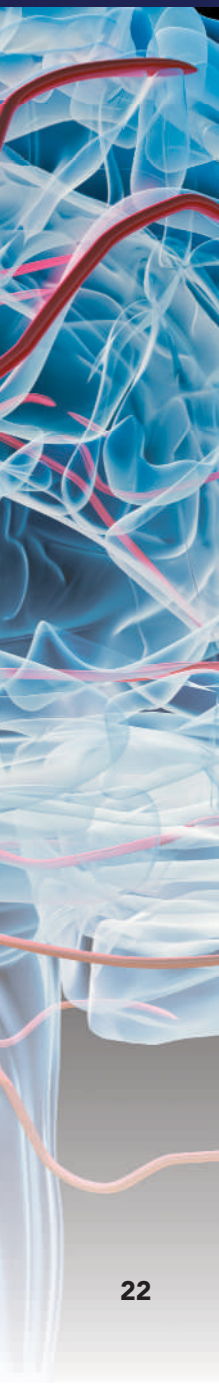
Baylie keeps at it, “*Rhin/o* means nose,” as she highlights those three words, “and a rhinoceros has a big horn on his nose.”

“Rhino!” Matthias shouts, holding up an animal cracker. Baylie laughs. We both have new things to learn, she realizes. And we can do it!

Suggested Discussion Topics

1. Baylie needs to learn medical terminology because she wants a career in the medical field. What study habits would help Baylie accomplish this task?
2. A support group could help empower Baylie to accomplish her goals. What people would you suggest for this group and why?
3. How can this textbook and other resource materials help her, and you, learn medical terminology?
4. Discuss strategies that the instructor could use and has already used to help Baylie improve her medical terminology skills.

THE HUMAN BODY IN HEALTH AND DISEASE



Overview of **THE HUMAN BODY IN HEALTH AND DISEASE**

Anatomic Reference Systems	Terms used to describe the location of body planes, directions, and cavities.
Structures of the Body	The cells, tissues, and glands that form the body systems that work together to enable the body to function properly.
Genetics	The genetic components that transfer characteristics from parents to their child.
Tissues	A group of similarly specialized cells that work together to perform specific functions.
Glands	A group of specialized cells that is capable of producing secretions.
Body Systems and Related Organs	Organs are somewhat independent parts of the body that perform specific functions. Organs with related functions are organized into body systems.
Pathology	The study of the nature and cause of disease that involve changes in structure and function.

Vocabulary Related to THE HUMAN BODY IN HEALTH AND DISEASE

This list contains essential word parts and medical terms for this chapter. These and the other important **primary terms** are shown in **boldface** throughout the chapter. *Secondary terms*, which appear in *cyan* italics, clarify the meaning of primary terms.

Word Parts

- aden/o** gland
- adip/o** fat
- anter/o** before, front
- caud/o** lower part of body, tail
- cephal/o** head
- cyt/o, -cyte** cell
- end-, endo-** in, within, inside
- exo-** out of, outside, away from
- hist/o** tissue
- ologist** specialist
- ology** the science or study of
- path/o, -pathy** disease, suffering, feeling, emotion
- plas/i, plas/o, -plasia** development, growth, formation
- poster/o** behind, toward the back
- stasis, -static** control, maintenance of a constant level

Medical Terms

- abdominal cavity** (ab-**DOM**-ih-nal)
- adenectomy** (ad-eh-**NECK**-toh-mee)
- adenocarcinoma** (ad-eh-noh-**kar**-sih-**NOH**-mah)
- adenoma** (ad-eh-**NOH**-mah)
- adenomalacia** (ad-eh-noh-mah-**LAY**-shee-ah)
- adenosclerosis** (ad-eh-noh-skleh-**ROH**-sis)
- anaplasia** (an-ah-**PLAY**-zee-ah)
- anatomy** (ah-**NAT**-oh-mee)
- anomaly** (ah-**NOM**-ah-lee)
- anterior** (an-**TEER**-ee-or)
- aplasia** (ah-**PLAY**-zee-ah)
- bloodborne transmission**
- caudal** (**KAW**-dal)
- cephalic** (seh-**FAL**-ick)
- chromosome** (**KROH**-moh-sohme)

- communicable disease** (kuh-**MEW**-nih-kuh-bul)
- congenital disorder** (kon-**JEN**-ih-tahl)
- cytoplasm** (**SIGH**-toh-plazm)
- distal** (**DIS**-tal)
- dorsal** (**DOR**-sal)
- dysplasia** (dis-**PLAY**-see-ah)
- endemic** (en-**DEM**-ick)
- endocrine glands** (EN-doh-krin)
- epidemic** (ep-ih-**DEM**-ick)
- epigastric region** (ep-ih-**GAS**-trick)
- etiology** (ee-tee-**OL**-oh-jee)
- exocrine glands** (**ECK**-soh-krin)
- functional disorder**
- genetic disorder**
- geriatrician** (jer-ee-ah-**TRISH**-un)
- hemophilia** (hee-moh-**FILL**-ee-ah)
- histology** (hiss-**TOL**-oh-jee)
- homeostasis** (hoh-mee-oh-**STAY**-sis)
- hyperplasia** (**high**-per-**PLAY**-zee-ah)
- hypertrophy** (high-**PER**-troh-fee)
- hypogastric region** (**high**-poh-**GAS**-trick)
- hypoplasia** (**high**-poh-**PLAY**-zee-ah)
- iatrogenic illness** (eye-**at**-roh-**JEN**-ick)
- idiopathic disorder** (id-ee-oh-**PATH**-ick)
- infectious disease** (in-**FECK**-shus)
- inguinal** (**ING**-gwih-nal)
- medial** (**MEE**-dee-al)
- mesentery** (**MESS**-en-**terr**-ee)
- midsagittal plane** (mid-**SADJ**-ih-tal)
- nosocomial infection** (nahs-oh-**KOH**-mee-al in-**FECK**-shun)
- pandemic** (pan-**DEM**-ick)
- pelvic cavity** (**PEL**-vick)
- peritoneum** (pehr-ih-toh-**NEE**-um)
- peritonitis** (pehr-ih-toh-**NIGH**-tis)
- phenylketonuria** (fen-il-**kee**-toh-**NEW**-ree-ah)
- physiology** (fiz-ee-**OL**-oh-jee)
- posterior** (pos-**TEER**-ee-or)
- proximal** (**PROCK**-sih-mal)
- retroperitoneal** (ret-roh-**pehr**-ih-toh-**NEE**-al)
- stem cells**
- thoracic cavity** (thoh-**RAS**-ick)
- transverse plane** (trans-**VERSE**)
- umbilicus** (um-**BILL**-ih-kus)
- vector-borne transmission**
- ventral** (**VEN**-tral)

LEARNING OBJECTIVES

On completion of this chapter, you should be able to:

1. Define *anatomy* and *physiology* and the uses of anatomic reference systems to identify the anatomic position plus body planes, directions, and cavities.
2. Recognize, define, spell, and pronounce the primary terms related to cells and genetics.
3. Recognize, define, spell, and pronounce the primary terms related to the structure, function, pathology, and procedures of tissues and glands.
4. Identify the major organs and functions of the body systems.
5. Recognize, define, spell, and pronounce the primary terms used to describe pathology, the modes of transmission, and the types of diseases.

ANATOMIC REFERENCE SYSTEMS

Anatomic reference systems are used to describe the locations of the structural units of the body. The simplest anatomic reference is the one we learn in childhood: our right hand is on the right, and our left hand on the left.

In medical terminology, there are several additional ways to describe the location of different body parts. These anatomical reference systems include:

- Body planes
- Body directions
- Body cavities
- Structural units

When body parts work together to perform a related function, they are grouped together and are known as a body system.

Anatomy and Physiology Defined

- **Anatomy** (ah-NAT-oh-mee) is the study of the structures of the body.
- **Physiology** (fiz-ee-OL-oh-jee) is the study of the functions of the structures of the body (**physi** means nature or physical, and **-ology** means study of).

The Anatomic Position

The **anatomic position** describes the body standing in the standard position. This includes:

- Standing up straight so that the body is erect and facing forward.
- Holding the arms at the sides with the hands turned so that the palms face toward the front.

The Body Planes

Body planes are imaginary vertical and horizontal lines used to divide the body into sections for descriptive purposes (Figure 2.1). These planes are aligned to a body standing in the anatomic position.

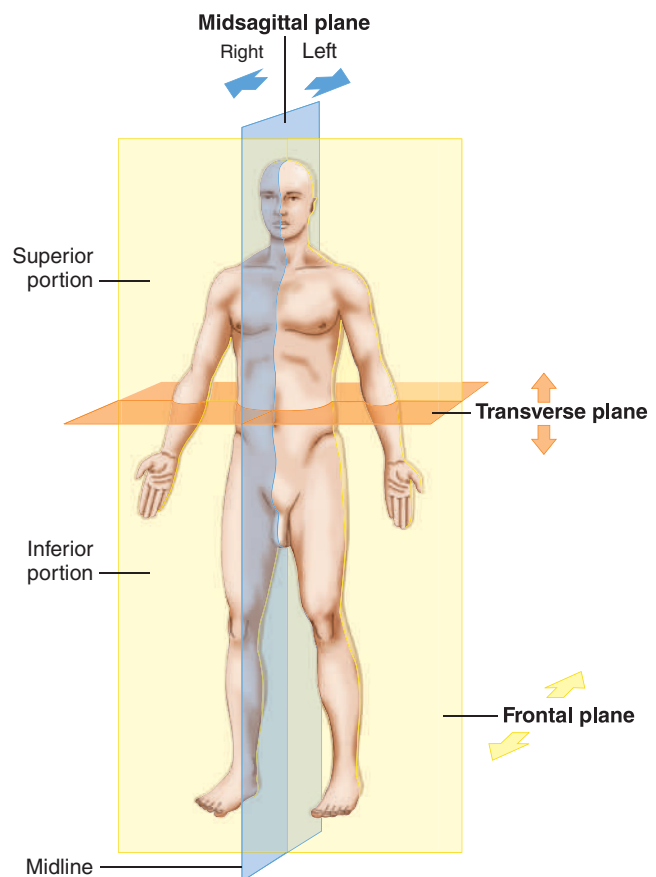


FIGURE 2.1 Body planes: the midsagittal plane divides the body into equal left and right halves. The transverse plane divides the body into superior (upper) and inferior (lower) portions. The frontal plane divides the body into anterior or ventral (front) and posterior or dorsal (back) portions.

The Vertical Planes

A **vertical plane** is an up-and-down plane that is at a right angle to the horizon.

- A **sagittal plane** (**SADJ**-ih-tal) is a vertical plane that divides the body into *unequal* left and right portions.
- The **midsagittal plane** (mid-**SADJ**-ih-tal), also known as the **midline**, is the sagittal plane that divides the body into *equal* left and right halves (Figure 2.1).
- A **frontal plane** is a vertical plane that divides the body into anterior (front) and posterior (back) portions. Also known as the **coronal plane**, it is located at right angles to the sagittal plane (Figure 2.1).

The Horizontal Plane

A **horizontal plane** is a flat, crosswise plane, such as the horizon.

- A **transverse plane** (trans-**VERSE**) is a horizontal plane that divides the body into superior (upper) and inferior (lower) portions. A transverse plane can be at the waist or at any other level across the body (Figure 2.1).

Media Link

Watch the **Body Planes** animation on the Online Resources.

Body Direction Terms

The relative location of sections of the body or of an organ can be described through the use of pairs of contrasting body direction terms. These terms are illustrated in Figures 2.2 and 2.3.

- **Ventral** (**VEN**-tral) refers to the front, or belly side, of the organ or body (**ventr** means belly side of the body, and **-al** means pertaining to). *Ventral* is the opposite of *dorsal*.
- **Dorsal** (**DOR**-sal) refers to the back of the organ or body (**dors** means back of the body, and **-al** means pertaining to). *Dorsal* is the opposite of *ventral*.

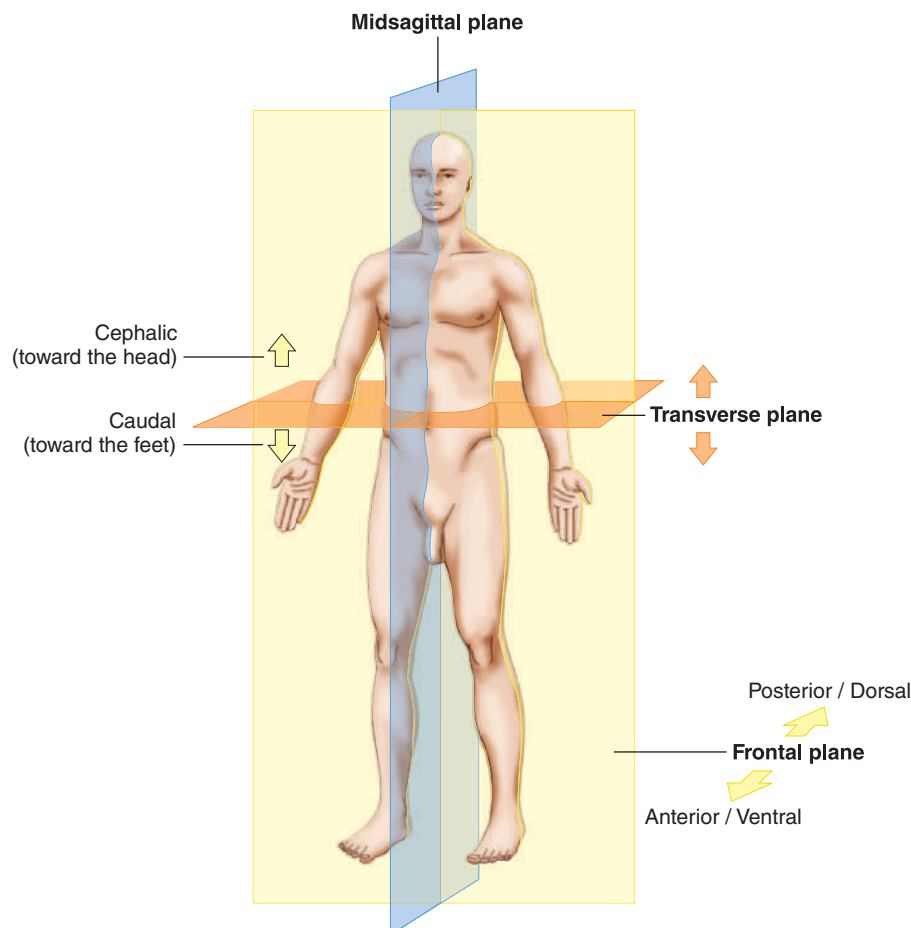


FIGURE 2.2 Body directions: *Cephalic* means toward the head, and *caudal* means toward the feet. *Anterior* means toward the front, and the front of the body is known as the ventral surface. *Posterior* means toward the back, and the back of the body is known as the dorsal surface.

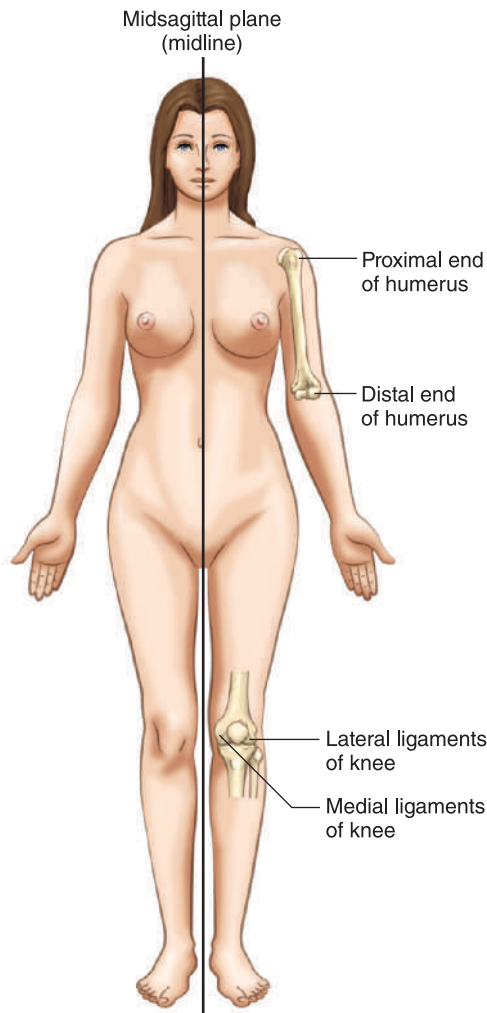


FIGURE 2.3 Body directions: *Proximal* means situated nearest the midline, and *distal* means situated farthest from the midline. *Medial* means toward or nearer the midline, and *lateral* means toward the side and away from the midline.

- **Anterior** (an-TEER-ee-or) means situated in the front. It also means on the front or forward part of an organ (**anter** means front or before, and **-ior** means pertaining to). For example, the stomach is located anterior to (in front of) the pancreas. *Anterior* is also used in reference to the ventral surface of the body. *Anterior* is the opposite of *posterior*.
- **Posterior** (pos-TEER-ee-or) means situated in the back. It also means on the back part of an organ (**poster** means back or toward the back, and **-ior** means pertaining to). For example, the pancreas is located posterior to (behind) the stomach. The term *posterior* is also used in reference to the dorsal surface of the body. *Posterior* is the opposite of *anterior*.
- **Superior** means uppermost, above, or toward the head. For example, the lungs are located superior to

(above) the diaphragm. *Superior* is the opposite of *inferior*.

- **Inferior** means lowermost, below, or toward the feet. For example, the stomach is located inferior to (below) the diaphragm. *Inferior* is the opposite of *superior*.
- **Cephalic** (seh-FAL-ick) means toward the head (**cephal** means head, and **-ic** means pertaining to). *Cephalic* is the opposite of *caudal*.
- **Caudal** (KAW-dal) means toward the lower part of the body (**caud** means tail or lower part of the body, and **-al** means pertaining to). *Caudal* is the opposite of *cephalic*.
- **Proximal** (PROCK-sih-mal) means situated nearest the midline or beginning of a body structure. For example, the proximal end of the humerus (bone of the upper arm) forms part of the shoulder. *Proximal* is the opposite of *distal*.
- **Distal** (DIS-tal) means situated farthest from the midline or beginning of a body structure. For example, the distal end of the humerus forms part of the elbow (Figure 2.3). *Distal* is the opposite of *proximal*.
- **Medial** (MEE-dee-al) means the direction toward, or nearer, the midline. For example, the medial ligament of the knee is near the inner surface of the leg (Figure 2.3). *Medial* is the opposite of *lateral*.
- **Lateral** means the direction toward, or nearer, the side of the body, away from the midline. For example, the lateral ligament of the knee is near the side of the leg. *Lateral* is the opposite of *medial*. **Bilateral** means relating to, or having, two sides.

Major Body Cavities

The two major **body cavities**, which are the dorsal (back) and the ventral (front) cavities, are spaces within the body that contain and protect internal organs (Figure 2.4).

The Dorsal Cavity

The **dorsal cavity**, which is located along the back of the body and head, contains organs of the nervous system that coordinate body functions and is divided into two portions:

- The **cranial cavity**, which is located within the skull, surrounds and protects the brain. **Cranial** means pertaining to the skull.
- The **spinal cavity**, which is located within the spinal column, surrounds and protects the spinal cord.

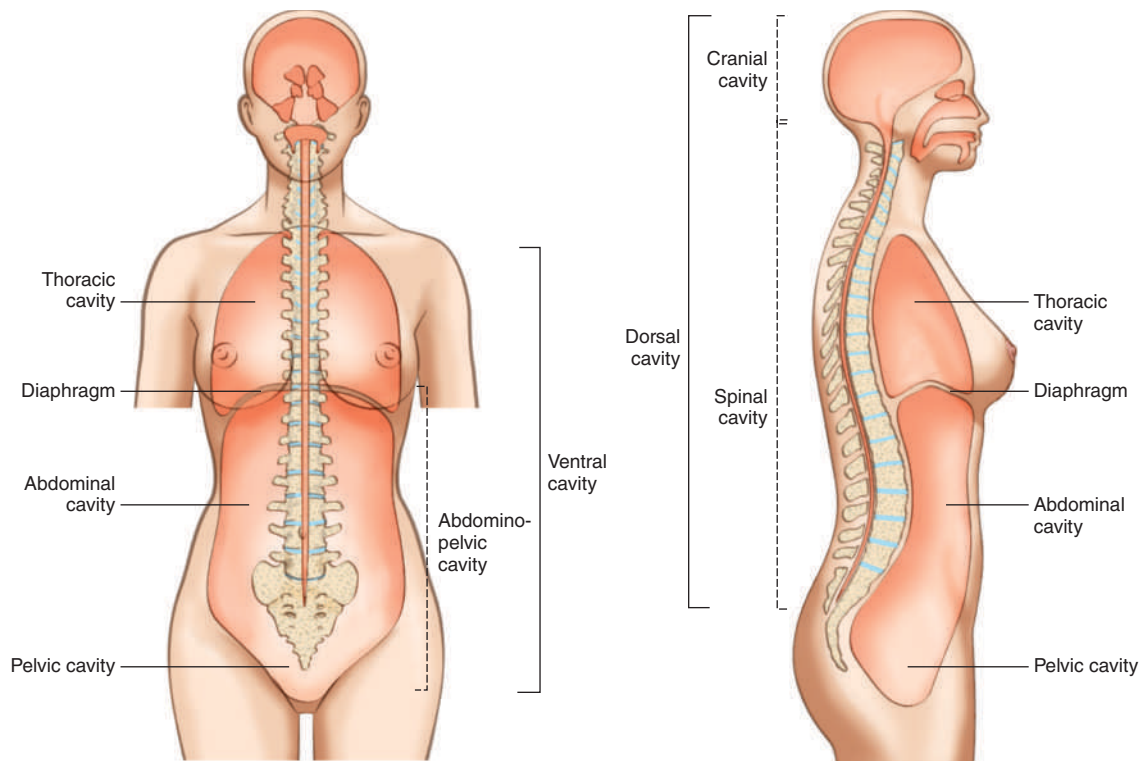


FIGURE 2.4 The major body cavities.

The Ventral Cavity

The **ventral cavity**, which is located along the front of the body, contains the body organs that sustain homeostasis. **Homeostasis** (**hoh-mee-oh-STAY-sis**) is the processes through which the body maintains a constant internal environment (**home/o** means constant, and **-stasis** means control). The ventral cavity is divided into the following portions:

- The **thoracic cavity** (**thoh-RAS-ick**), also known as the **chest cavity** or **thorax**, surrounds and protects the heart and the lungs. The **diaphragm** is a muscle that separates the thoracic and abdominal cavities.
- The **abdominal cavity** (**ab-DOM-ih-nal**) contains the major organs of digestion. This cavity is frequently referred to simply as the **abdomen** (**AB-doh-men**).
- The **pelvic cavity** (**PEL-vick**) is the space formed by the hip bones and contains the organs of the reproductive and excretory systems.

There is no physical division between the abdominal and pelvic cavities. The term **abdominopelvic cavity** (**ab-dom-ih-noh-PEL-vick**) refers to these two cavities as a single unit (**abdomin/o** means abdomen, **pelv** means pelvis, and **-ic** means pertaining to).

The term **inguinal** (**ING-gwih-nal**), which means relating to the groin, refers to the entire lower area of the abdomen. This includes the **groin**, which is the crease at the junction of the trunk with the upper end of the thigh.

Regions of the Thorax and Abdomen

Regions of the thorax and abdomen comprise a descriptive system that divides the abdomen and lower portion of the thorax into nine parts (Figure 2.5). These parts are:

- The **right and left hypochondriac regions** (**high-poh-KON-dree-ack**) are covered by the lower ribs (**hypo-** means below, **chondr/i** means cartilage, and **-ac** means pertaining to). As used here, the term **hypochondriac** means below the ribs. This term also describes an individual with an abnormal concern about his or her health.
- The **epigastric region** (**ep-ih-GAS-trick**) is located above the stomach (**epi-** means above, **gastr** means stomach, and **-ic** means pertaining to).
- The **right and left lumbar regions** (**LUM-bar**) are located near the inward curve of the spine (**lumb** means lower back, and **-ar** means pertaining to). The term **lumbar** describes the part of the back between the ribs and the pelvis.

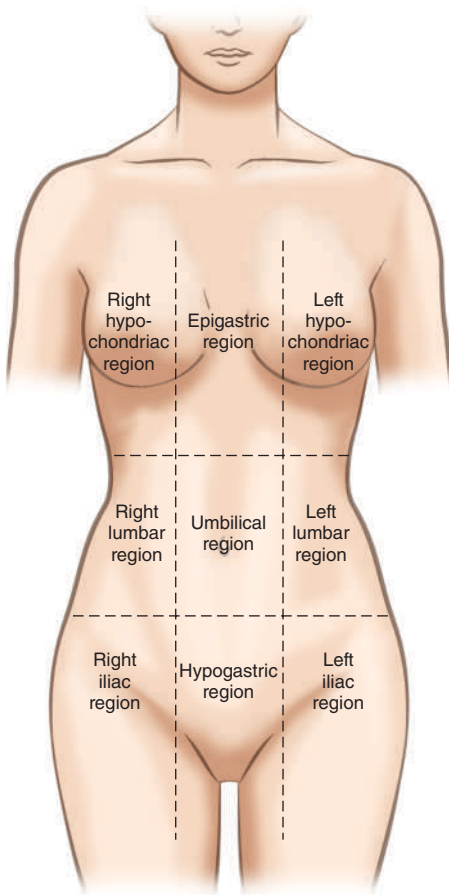


FIGURE 2.5 Regions of the thorax and abdomen.

- The **umbilical region** (um-BILL-ih-kal) surrounds the **umbilicus** (um-BILL-ih-kus), which is commonly known as the *belly button* or *navel*. This pit in the center of the abdominal wall marks the point where the umbilical cord was attached before birth.
- The **right and left iliac regions** (ILL-ee-ack) are located near the hip bones (**ili** means hip bone, and **-ac** means pertaining to).
- The **hypogastric region** (high-poh-GAS-trick) is located below the stomach (**hypo-** means below, **gastr** means stomach, and **-ic** means pertaining to).

Quadrants of the Abdomen

Describing where an abdominal organ or pain is located is made easier by dividing the abdomen into four imaginary quadrants. The term **quadrant** means divided into four. As shown in Figure 2.6, the quadrants of the abdomen are as follows:

- Right upper quadrant (RUQ)
- Left upper quadrant (LUQ)

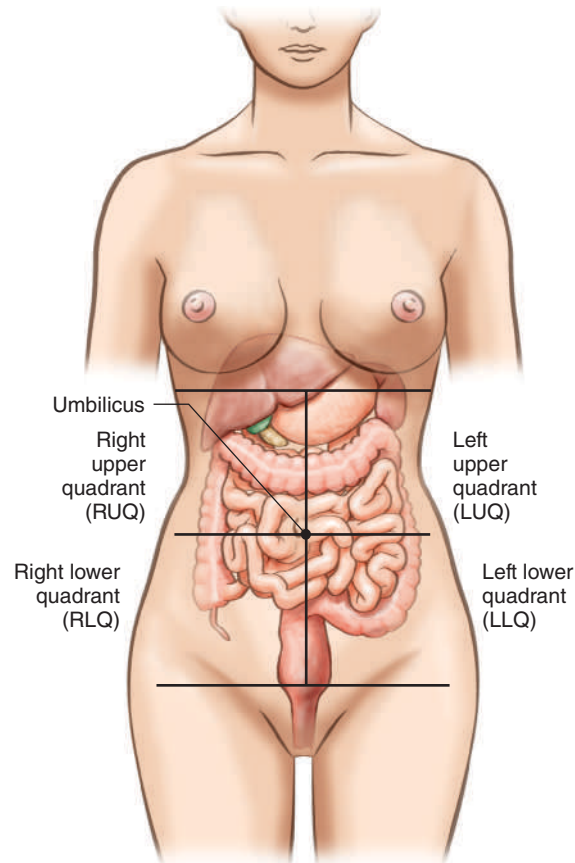


FIGURE 2.6 Division of the abdomen into quadrants.

- Right lower quadrant (RLQ)
- Left lower quadrant (LLQ)

The Peritoneum

The **peritoneum** (pehr-ih-toh-NEE-um) is a multilayered membrane that protects and holds the organs in place within the abdominal cavity. A **membrane** is a thin layer of tissue that covers a surface, lines a cavity, or divides a space or organ.

- The **parietal peritoneum** (pah-RYE-eh-tal pehr-ih-toh-NEE-um) is the outer layer of the peritoneum that lines the interior of the abdominal wall. *Parietal* means cavity wall.
- The **mesentery** (MESS-en-terr-ee) is a fused double layer of the parietal peritoneum that attaches parts of the intestine to the interior abdominal wall.
- The **visceral peritoneum** (VIS-er-al pehr-ih-toh-NEE-um) is the inner layer of the peritoneum that surrounds the organs of the abdominal cavity. *Visceral* means relating to the internal organs.

Retroperitoneal (ret-roh-pehr-ih-toh-NEE-al) means located behind the peritoneum (**retro-** means behind, **periton** means peritoneum, and **-eal** means pertaining to). For example, the location of the kidneys is retroperitoneal with one on each side of the spinal column. **Peritonitis** (pehr-ih-toh-NIGH-tis) is inflammation of the peritoneum.

STRUCTURES OF THE BODY

The body is made up of increasingly larger and more complex structural units. From smallest to largest, these are cells, tissues, organs, and body systems (Figure 2.7). Working together, these structures form the complete body and enable it to function properly.

CELLS

Cells are the basic structural and functional units of the body. Cells are specialized and grouped together to form tissues and organs.

- **Cytology** (sigh-TOL-oh-jee) is the study of the anatomy, physiology, pathology, and chemistry of the cell (**cyt** means cell, and **-ology** means study of).
- A **cytologist** (sigh-TOL-oh-jist) is a specialist in the study and analysis of cells (**cyt** means cell, and **-ologist** means specialist).

The Structure of Cells

- The **cell membrane** (MEM-brain) is the tissue that surrounds and protects the contents of a cell from the external environment (Figure 2.8).
- **Cytoplasm** (SIGH-toh-plazm) is the material within the cell membrane that is *not* part of the nucleus (**cyt/o** means cell, and **-plasm** means formative material of cells).
- The **nucleus** (NEW-klee-us), which is surrounded by the nuclear membrane, is a structure within the cell. It has two important functions: it controls the activities of the cell, and it helps the cell divide.

Stem Cells

Stem cells differ from other kinds of cells in the body because of two characteristics:

- **Stem cells** are unspecialized cells that are able to renew themselves for long periods of time by cell division. This is in contrast to other types of cells that have a specialized role and die after a determined life span.
- Under certain conditions, stem cells can be transformed into cells with special functions, such as the cells of the heart muscle that make the heartbeat possible or the specialized cells of the pancreas that are capable of producing insulin.

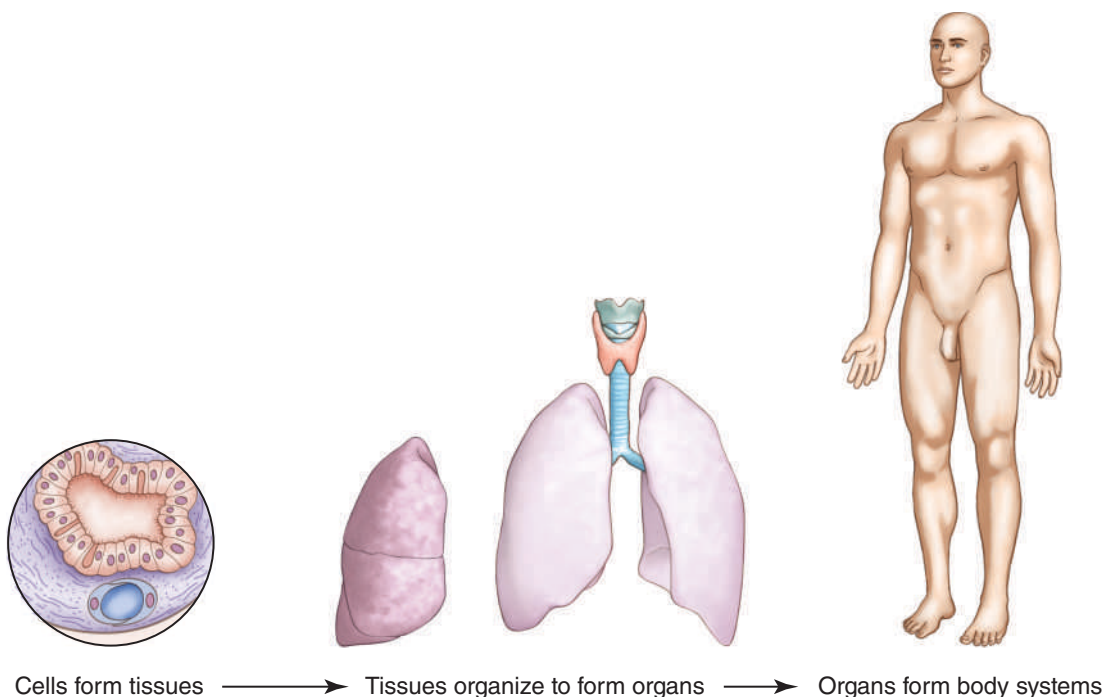


FIGURE 2.7 The human body is highly organized, from the single cell to the total organism.

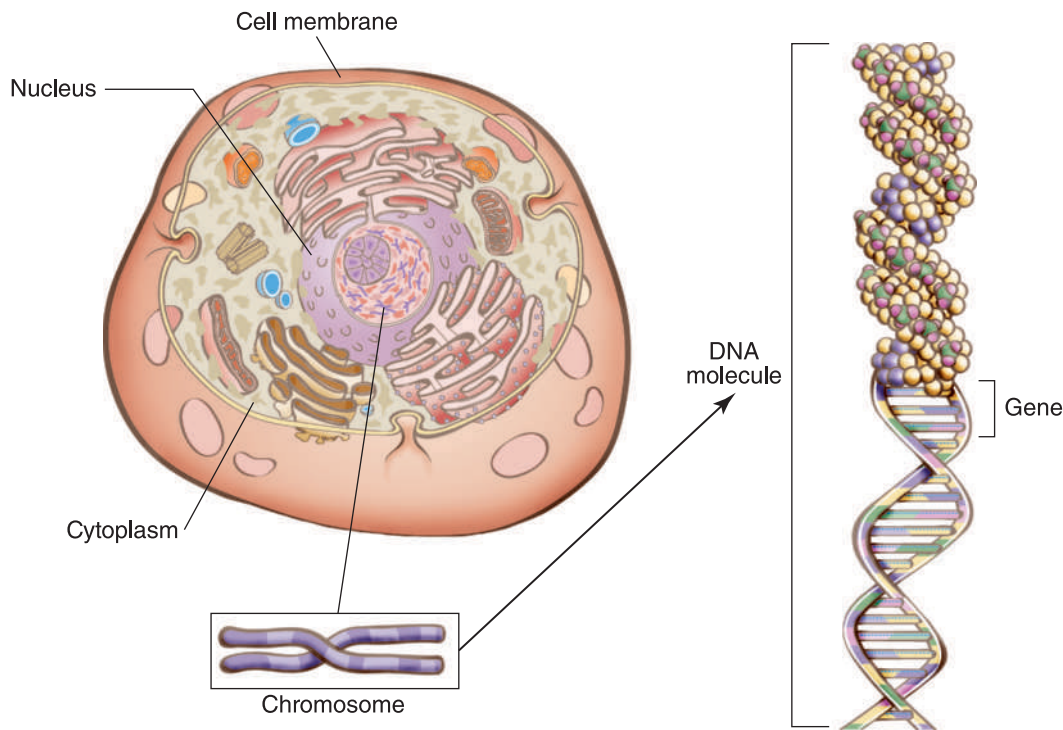


FIGURE 2.8 A basic cell and DNA molecule.

Adult Stem Cells

Adult stem cells, also known as *somatic stem cells*, are undifferentiated cells found among differentiated cells in a tissue or organ. Normally the primary role of these cells is to maintain and repair the tissue in which they are found. The term *undifferentiated* means not having a specialized function or structure. In contrast, the term *differentiated* means having a specialized function or structure.

Stem cells potentially have many therapeutic uses, including being transplanted from one individual to another. Cells for this purpose are harvested from the *hemopoietic* (blood forming) tissue of the donor's bone marrow. However, unless there is an excellent match between the donor and recipient, there is the possibility of rejection, known as *graft-versus-host disease*.

Embryonic Stem Cells

Embryonic stem cells (**em-bree-ON-ik**) are undifferentiated cells that are unlike any specific adult cell; however, they have the important ability to form *any* adult cell. Embryonic means referring to an *embryo*, a developing child during in its first eight weeks in the womb (**embryo/o** means fertilized ovum, and **-nic** means pertaining to).

- These cells can proliferate (grow rapidly) indefinitely in a laboratory and could therefore potentially provide a source for adult muscle, liver, bone, or blood cells.
- Because these cells are more primitive than adult stem cells, an embryonic stem cell transplant does not require as perfect a match between the patient and donor as the transplantation of adult stem cells.
- Embryonic stem cells come from the *cord blood* found in the umbilical cord and placenta of a newborn infant. Embryonic stem cells from cord blood can be harvested at the time of birth without danger to mother or child. These cells are kept frozen until needed for treatment purposes.
- Embryonic stem cells can also be obtained from surplus embryos produced by in vitro (test tube) fertilization. With the informed consent of the donor couple, stem cells obtained in this manner can be used for medical and scientific research.

GENETICS

A **gene** is a fundamental physical and functional unit of heredity. Genes control hereditary disorders and all physical traits such as hair, skin, and eye color.

Genetics is the study of how genes are transferred from parents to their children and the role of genes in health and disease (**gene** means producing, and **-tics** means pertaining to). A specialist in this field is known as a **geneticist** (jeh-NET-ih-sist).

Dominant and Recessive Genes

Each newly formed individual receives two genes of each genetic trait: one from the father and one from the mother.

- When a **dominant gene** is inherited from either parent, the offspring *will* inherit that genetic condition or characteristic. For example, freckles are a physical trait that is transmitted by a dominant gene. So, too, is the hereditary disorder Huntington's disease.
- When the same **recessive gene** is inherited from both parents, the offspring *will have* that condition. For example, **sickle cell anemia** is a group of inherited red blood cell disorders that are transmitted by a recessive gene. When this gene is transmitted by both parents, the child *will have* sickle cell anemia.
- When a **recessive gene** is inherited from only one parent, and a normal gene is inherited from the other parent, the offspring *will not have* the condition. Although this child will not develop sickle cell anemia, he or she will have the *sickle cell anemia trait*. People with this trait can transmit the sickle cell gene to their offspring.

The Human Genome

A **genome** (JEE-nohm) is the complete set of genetic information of an organism. The Human Genome Project studied this genetic code for individual people and found that it is more than 99 percent identical among humans throughout the world. The first complete mapping of the *human genome*, which took 13 years to complete, was published in 2003.

Having access to this data is a very important step in studying the use of genetics in health and science. Scientists have begun to take the next step: attempting to understand the proteins encoded by the sequence of the 30,000 genes.

Chromosomes

A **chromosome** (KROH-moh-sohme) is a genetic structure located within the nucleus of each cell (Figure 2.8). These chromosomes are made up of DNA molecules

containing the body's genes. Packaging genetic information into chromosomes helps a cell keep a large amount of genetic information neat, organized, and compact. Each chromosome contains about 100,000 genes.

- A **somatic cell** is any cell in the body except the gametes (sex cells). **Somatic** means pertaining to the body in general. Somatic cells contain 46 chromosomes arranged into 23 pairs. There are 22 identical pairs of chromosomes, plus another pair. In a typical female, this remaining pair consists of XX chromosomes. In a typical male, this pair consists of an XY chromosome pair. This chromosome pair determines the sex of the individual.
- A **gamete** (sperm or egg), also known as a **sex cell**, is the only type of cell that *does not* contain 46 chromosomes. Instead, each ovum (egg) or sperm has 23 single chromosomes. In a female, one of these will be an X chromosome. In a male, one of these will be either an X or a Y chromosome. When a sperm and ovum join, the newly formed offspring receives 23 chromosomes from each parent, for a total of 46.
- It is the X or Y chromosome from the father that determines the gender of the child.
- A defect in chromosomes can lead to birth defects. For example, individuals with Down syndrome have 47 chromosomes instead of the usual 46.

DNA

The basic structure of the **DNA** molecule, which is located on the pairs of chromosomes in the nucleus of each cell, is the same for all living organisms. Human DNA contains thousands of genes that provide the information essential for heredity, determining physical appearance, disease risks, and other traits (Figure 2.8).

- DNA is packaged in a chromosome as two spiraling strands that twist together to form a double helix. A **helix** is a shape twisted like a spiral staircase. A **double helix** consists of two of these strands twisted together.
- DNA, which is an abbreviation for *deoxyribonucleic acid*, is found in the nucleus of all types of cells except erythrocytes (red blood cells). The difference here is due to the fact that erythrocytes do not have a nucleus.
- The DNA for each individual is different, and no two DNA patterns are exactly the same. The only exception to this rule is identical twins, which are formed from

one fertilized egg that divides. Although their DNA is identical, these twins do develop characteristics that make each of them unique, such as fingerprints.

- A very small sample of DNA, such as from human hair or tissue, can be used to identify individuals in instances such as criminal investigations, paternity suits, or genealogy research.

Genetic Mutation

A **genetic mutation** is a change of the sequence of a DNA molecule. Potential causes of genetic mutation include exposure to radiation or environmental pollution.

- A **somatic cell mutation** is a change within the cells of the body. These changes affect the individual but *cannot* be transmitted to the next generation.
- A **gametic cell mutation** is a change within the genes in a gamete (sex cell) that *can* be transmitted by a parent to his or her children.
- **Genetic engineering** is the manipulating or splicing of genes for scientific or medical purposes. The production of human insulin from modified bacteria is an example of one result of genetic engineering.

Genetic Disorders

A **genetic disorder**, also known as a **hereditary disorder**, is a pathological condition caused by an absent or defective gene. Some genetic disorders are obvious at birth. Others may manifest (become evident) at any time in life. The following are examples of genetic disorders:

- **Cystic fibrosis** (CF), a genetic disorder that is present at birth and affects both the respiratory and digestive systems (see Chapter 7).
- **Down syndrome** (DS), a genetic variation that is associated with a characteristic facial appearance, learning disabilities, developmental delays, and physical abnormalities such as heart valve disease (Figure 2.9).
- **Hemophilia** (**hee-moh-FILL-ee-ah**), a group of hereditary bleeding disorders in which a blood-clotting factor is missing. This blood coagulation disorder is characterized by spontaneous hemorrhages or severe bleeding following an injury.
- **Huntington's disease** (HD), a genetic disorder that is passed from parent to child. Each child of a parent with the gene for Huntington's disease has a 50–50 chance of inheriting this defective gene. This condition causes nerve degeneration with symptoms that most



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FIGURE 2.9 Down syndrome is a genetic disorder usually caused by the presence of a third copy of the 21st chromosome. For this reason it is also known as *trisomy 21*.

often appear in midlife. (**Degeneration** means worsening condition.) This damage eventually results in uncontrolled movements and the loss of some mental abilities.

- **Muscular dystrophy** (**DIS-troh-fee**), a group of genetic diseases that are characterized by progressive weakness and degeneration of the skeletal muscles that control movement (see Chapter 4).
- **Phenylketonuria** (**fen-il-kee-toh-NEW-ree-ah**) (PKU), a rare genetic disorder in which the essential digestive enzyme *phenylalanine hydroxylase* is missing. PKU can be detected by a blood test performed on infants at birth. With careful dietary supervision to limit phenylalanine, found mostly in foods that contain protein, children born with PKU can lead normal lives. Without early detection and treatment, PKU causes severe intellectual disability (formerly referred to as mental retardation).

TISSUES

A **tissue** is a group or layer of similarly specialized cells that join together to perform certain specific functions. **Histology** (**hiss-TOL-oh-jee**) is the microscopic study of the structure, composition, and function of tissues (**hist** means tissue, and **-ology** means a study of). A **histologist** (**hiss-TOL-oh-jist**) is a non-physician specialist who

studies the microscopic structure of tissues (**hist** means tissue, and **-ologist** means specialist).

The four main types of tissue are as follows:

- Epithelial tissue
- Connective tissue
- Muscle tissue
- Nerve tissue

Epithelial Tissue

Epithelial tissue (ep-ih-**THEE**-lee-al) forms a protective covering for all of the internal and external surfaces of the body. These tissues also form glands.

- **Epithelium** (ep-ih-**THEE**-lee-um) is the specialized epithelial tissue that forms the epidermis of the skin and the surface layer of mucous membranes (see Chapter 12).
- **Endothelium** (en-doh-**THEE**-lee-um) is the specialized epithelial tissue that lines the blood and lymph vessels, body cavities, glands, and organs.

Connective Tissue

Connective tissues support and connect organs and other body tissues. The four kinds of connective tissue are as follows:

- **Dense connective tissues**, such as bone and cartilage, form the joints and framework of the body.
- **Adipose tissue**, also known as *fat*, provides protective padding, insulation, and support (**adip** means fat, and **-ose** means pertaining to).
- **Loose connective tissue** surrounds various organs and supports both nerve cells and blood vessels.
- **Liquid connective tissues**, which are blood and lymph, transport nutrients and waste products throughout the body.

Muscle Tissue

Muscle tissue contains cells with the specialized ability to contract and relax.

Nerve Tissue

Nerve tissue contains cells with the specialized ability to react to stimuli and to conduct electrical impulses.

Pathology of Tissue Formation

Disorders of the tissues, which are frequently due to unknown causes, can occur as the tissues form before birth or appear later in life.

Incomplete Tissue Formation

- **Aplasia** (ah-**PLAY**-zee-ah) is the defective development, or the congenital absence, of an organ or tissue (**a-** means without, and **-plasia** means formation). Compare aplasia with *hypoplasia*.
- **Hypoplasia** (high-poh-**PLAY**-zee-ah) is the incomplete development of an organ or tissue usually due to a deficiency in the number of cells (**hypo-** means deficient, and **-plasia** means formation). Compare hypoplasia with *aplasia*.

Abnormal Tissue Formation

- **Anaplasia** (an-ah-**PLAY**-zee-ah) is a change in the structure of cells and in their orientation to each other (**ana-** means backward, and **-plasia** means formation). This abnormal cell development is characteristic of tumor formation in cancers. Contrast anaplasia with *hypertrophy*.
- **Dysplasia** (dis-**PLAY**-see-ah) is the abnormal development or growth of cells, tissues, or organs (**dys-** means bad, and **-plasia** means formation).
- **Hyperplasia** (high-per-**PLAY**-zee-ah) is the enlargement of an organ or tissue because of an abnormal increase in the number of cells in the tissues (**hyper-** means excessive, and **-plasia** means formation). Contrast hyperplasia with *hypertrophy*.
- **Hypertrophy** (high-PER-troh-fee) is a general increase in the bulk of a body part or organ that is due to an increase in the size, but not in the number, of cells in the tissues (**hyper-** means excessive, and **-trophy** means development). This enlargement is not due to tumor formation. Contrast hypertrophy with *anaplasia* and *hyperplasia*.

GLANDS

A **gland** is a group of specialized epithelial cells that are capable of producing secretions. A **secretion** is the substance produced by a gland. The two major types of glands are as follows (Figure 2.10):

- **Exocrine glands** (ECK-soh-krin) secrete chemical substances into ducts that lead either to other organs or out of the body, such as sweat glands (**exo-** means out of, and **-crine** means to secrete) (see Chapter 12).
- **Endocrine glands** (EN-doh-krin), which produce hormones, do not have ducts (**endo-** means within, and **-crine** means to secrete). These hormones are secreted directly into the bloodstream and are then transported to organs and structures throughout the body (see Chapter 13).

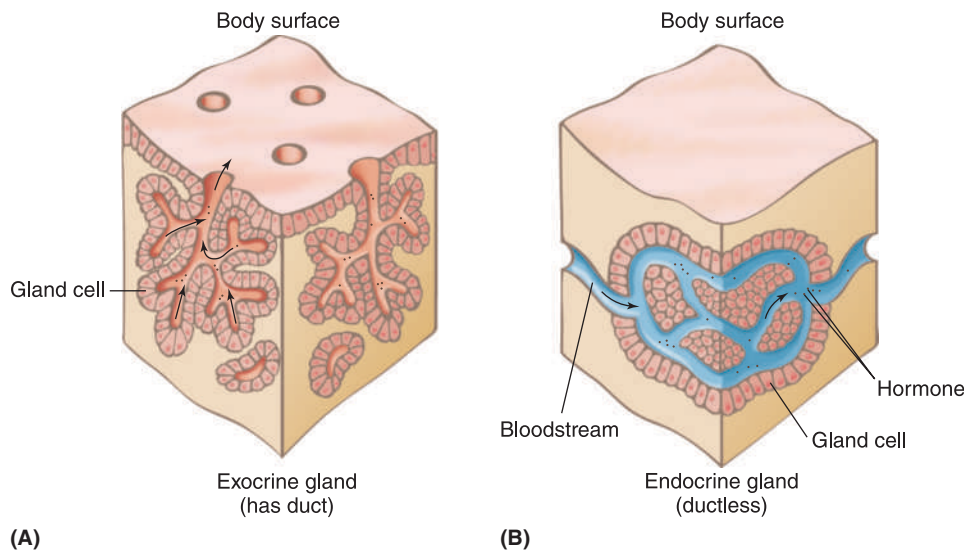


FIGURE 2.10 (A) Exocrine glands secrete their chemical substances into ducts that lead either to other organs or out of the body. (B) Endocrine glands pour their secretions directly into the bloodstream.

Media Link

Watch the **Exocrine and Endocrine Glands** animation on the Online Resources.

Pathology and Procedures of the Glands

The word root **aden** means a gland. Note that the term **adenoids**, however, refers to a mass of gland-like lymphoid tissue at the back of the upper pharynx (see Chapter 6).

- **Adenitis** (**ad**-eh-**NIGH**-tis) is the inflammation of a gland (**aden** means gland, and **-itis** means inflammation).
- An **adenocarcinoma** (**ad**-eh-noh-**kar**-sih-**NOH**-mah) is a malignant tumor that originates in glandular tissue (**aden/o** means gland, **carcin** means cancerous, and **-oma** means tumor). *Malignant* means harmful, capable of spreading, and potentially life threatening.
- An **adenoma** (**ad**-eh-**NOH**-mah) is a benign tumor that arises in or resembles glandular tissue (**aden** means gland, and **-oma** means tumor). *Benign* means not life threatening.
- **Adenomalacia** (**ad**-eh-noh-mah-**LAY**-shee-ah) is the abnormal softening of a gland (**aden/o** means gland, and **-malacia** means abnormal softening). *Adenomalacia* is the opposite of *adenosclerosis*.
- **Adenosis** (**ad**-eh-**NOH**-sis) is any disease or condition of a gland (**aden** means gland, and **-osis** means an abnormal condition or disease).
- **Adenosclerosis** (**ad**-eh-noh-skleh-**ROH**-sis) is the abnormal hardening of a gland (**aden/o** means gland,

and **-sclerosis** means abnormal hardening). *Adenosclerosis* is the opposite of *adenomalacia*.

- An **adenectomy** (**ad**-eh-**NECK**-toh-mee) is the surgical removal of a gland (**aden** means gland, and **-ectomy** means surgical removal).

BODY SYSTEMS AND RELATED ORGANS

A body **organ** is a somewhat independent part of the body that performs a specific function. For purposes of description, the related tissues and organs are described as being organized into *body systems* with specialized functions. These body systems are explained in Table 2.1.

PATHOLOGY

Pathology (pah-**THOL**-oh-jee) is the study of disease: its nature and cause as well as the produced changes in structure and function. *Pathology* also means a condition produced by disease. The word root (combining form) **path/o** and the suffix **-pathy** mean disease; however, they also mean suffering, feeling, and emotion.

- A **pathologist** (pah-**THOL**-oh-jist) is a physician who specializes in the laboratory analysis of diseased tissue samples to confirm or establish a diagnosis (**path** means disease, and **-ologist** means specialist). These tissue specimens can be removed in biopsies, during operations, or in postmortem examinations.

TABLE 2.1**Major Body Systems**

Body System	Major Structures	Major Functions
Skeletal System (Chapter 3)	Bones, joints, and cartilage	Supports and shapes the body. Protects the internal organs. Forms some blood cells and stores minerals.
Muscular System (Chapter 4)	Muscles, fascia, and tendons	Holds the body erect. Makes movement possible. Moves body fluids and generates body heat.
Cardiovascular System (Chapter 5)	Heart, arteries, veins, capillaries, and blood	Blood circulates throughout the body to transport oxygen and nutrients to cells, and to carry waste products to the kidneys where waste is removed by filtration.
Lymphatic System (Chapter 6)	Lymph, lymphatic vessels, and lymph nodes	Removes and transports waste products from the fluid between the cells. Destroys harmful substances such as pathogens and cancer cells in the lymph nodes. Returns the filtered lymph to the bloodstream where it becomes plasma again.
Immune System (Chapter 6)	Tonsils, spleen, thymus, skin, and specialized blood cells	Defends the body against invading pathogens and allergens.
Respiratory System (Chapter 7)	Nose, pharynx, trachea, larynx, and lungs	Brings oxygen into the body for transportation to the cells. Removes carbon dioxide and some water waste from the body.
Digestive System (Chapter 8)	Mouth, esophagus, stomach, small intestine, large intestine, liver, and pancreas	Digests ingested food so it can be absorbed into the bloodstream. Eliminates solid waste.
Urinary System (Chapter 9)	Kidneys, ureters, urinary bladder, and urethra	Filters blood to remove waste. Maintains the electrolyte and fluid balance within the body.
Nervous System (Chapter 10)	Nerves, brain, and spinal cord	Coordinates the reception of stimuli. Transmits messages throughout the body.
Special Senses (Chapter 11)	Eyes and ears	Receive visual and auditory information and transmit it to the brain.
Integumentary System (Chapter 12)	Skin, sebaceous glands, and sweat glands	Protects the body against invasion by bacteria. Aids in regulating the body temperature and water content.
Endocrine System (Chapter 13)	Adrenal glands, gonads, pancreas, parathyroids, pineal, pituitary, thymus, and thyroid	Integrates all body functions.
Reproductive Systems (Chapter 14)	<i>Male:</i> penis and testicles; <i>Female:</i> ovaries, uterus, and vagina	Produces new life.

- **Etiology** (**ee-tee-OL-oh-jee**) is the study of the causes of diseases (**eti-** means cause, and **-ology** means study of).

Disease Transmission

A **pathogen** is a disease-producing microorganism such as a virus. **Transmission** is the spread of a disease. **Contamination** means that a pathogen is possibly present. Contamination occurs through a lack of proper hygiene standards or by failure to take appropriate infection control precautions.

- A **communicable disease** (**kuh-MEW-nih-kuh-bul**), also known as a **contagious disease**, is any condition that is transmitted from one person to another either directly or by indirect contact with contaminated objects. **Communicable** means capable of being transmitted. Some diseases, such as measles, are capable of being transmitted through multiple methods.
- **Indirect contact transmission** refers to situations in which a susceptible person is infected by contact with a contaminated surface. Frequent hand washing is essential for the prevention of disease transmission.
- **Bloodborne transmission** is the spread of a disease through contact with infected blood or other body fluids that are contaminated by infected blood. Examples include human immunodeficiency virus (HIV), hepatitis B, and most sexually transmitted diseases (STDs).
- **Droplet transmission** is the spread of diseases such as measles, cold, and flu through large respiratory droplets sprayed by coughing or sneezing onto a nearby person or object. The use of a facemask as a precaution helps limit this type of transmission, which is a primary cause of nosocomial (hospital acquired) infections.
- **Airborne transmission** occurs through contact with germs floating in the air. When someone coughs or sneezes, certain pathogens can remain airborne for a long period of time, infecting someone even after the sick person is gone. Examples include tuberculosis, measles and chicken pox.
- **Food-borne and waterborne transmission**, also known as **fecal-oral transmission**, is caused by eating or drinking contaminated food or water that has not been properly treated to remove contamination or kill any pathogens present.
- **Vector-borne transmission** is the spread of certain disease due to the bite of a vector. As used here, the term **vector** describes insects or animals such as flies, mites, fleas, ticks, rats, and dogs, that are capable of transmitting a disease. Mosquitoes are the most

common vectors, and the diseases they transmit include malaria and West Nile virus.

Outbreaks of Diseases

An **epidemiologist** (**ep-ih-dee-mee-OL-oh-jist**) is a specialist in the study of outbreaks of disease within a population group (**epi-** means above, **dem/i** means population, and **-ologist** means specialist).

- **Endemic** (**en-DEM-ick**) refers to the ongoing presence of a disease within a population, group, or area (**en-** means within, **dem** means population, and **-ic** means pertaining to). For example, the common cold is endemic because it is always present within the general population.
- An **epidemic** (**ep-ih-DEM-ick**) is a sudden and widespread outbreak of a disease within a specific population group or area (**epi-** means above, **dem** means population, and **-ic** means pertaining to). For example, a sudden widespread outbreak of measles is an epidemic.
- **Pandemic** (**pan-DEM-ick**) refers to an outbreak of a disease occurring over a large geographic area, possibly worldwide (**pan-** means entire, **dem** means population, and **-ic** means pertaining to). For example, the worldwide spread of acquired immunodeficiency syndrome (AIDS) is pandemic.

Types of Diseases

- A **functional disorder** produces symptoms for which no physiological or anatomical cause can be identified. For example, a panic attack is a functional disorder (see Chapter 10).
- An **iatrogenic illness** (**eye-at-roh-JEN-ick**) is an unfavorable response due to prescribed medical treatment. For example, severe burns resulting from radiation therapy are iatrogenic.
- An **idiopathic disorder** (**id-ee-oh-PATH-ick**) is an illness without known cause (**idi/o** means peculiar to the individual, **path** means disease, and **-ic** means pertaining to). **Idiopathic** means without known cause.
- An **infectious disease** (**in-FECK-shus**) is an illness caused by living pathogenic organisms such as bacteria and viruses (see Chapter 6).
- A **nosocomial infection** (**nahs-oh-KOH-mee-al in-FECK-shun**) is a disease acquired in a hospital or clinical setting. For example, multidrug-resistant *Staphylococcus aureus* (MRSA) infections are often spread in hospitals (see Chapter 6). *Nosocomial* comes from the Greek word for hospital.

- An **organic disorder** (or-GAN-ick) produces symptoms caused by detectable physical changes in the body. For example, chickenpox, which has a characteristic rash, is an organic disorder caused by a virus (see Chapter 6).

Congenital Disorders

A **congenital disorder** (kon-JEN-ih-tahl) is an abnormal condition that exists at the time of birth. *Congenital* means existing at birth. These conditions can be caused by a developmental disorder before birth, prenatal influences, premature birth, or injuries during the birth process.

Developmental Disorders

A **developmental disorder**, also known as a *birth defect*, can result in an anomaly or malformation such as the absence of a limb or the presence of an extra toe. An **anomaly** (ah-NOM-ah-lee) is a deviation from what is regarded as normal.

- The term **atresia** (ah-TREE-zee-ah) describes the congenital absence of a normal body opening or the failure of a structure to be tubular. For example, anal atresia is the congenital absence of the opening at the bottom end of the anus; pulmonary atresia is the absence of a pulmonary valve.

Prenatal Influences

Prenatal influences are the mother's health, her behavior, and the prenatal medical care she does or does not receive before delivery.

- An example of a problem with the mother's health is a *rubella* infection (see Chapter 6). Birth defects often develop if a pregnant woman contracts this viral infection early in her pregnancy.
- An example of a problem caused by the mother's behavior is **fetal alcohol syndrome (FAS)**, which is caused by the mother's consumption of alcohol during the pregnancy. This resulting condition of the baby is characterized by physical and behavioral traits, including growth abnormalities, mental retardation, brain damage, and socialization difficulties.
- Examples of problems caused by lack of adequate prenatal medical care are premature delivery or a low birth-weight baby.

Premature Birth and Birth Injuries

- *Premature birth*, which is a birth that occurs earlier than 37 weeks of development, can cause serious health problems because the baby's body systems have not

had time to form completely. Breathing difficulties and heart problems are common in premature babies.

- *Birth injuries* are congenital disorders that were not present before the events surrounding the time of birth. For example, *cerebral palsy*, which is the result of brain damage, can be caused by premature birth or inadequate oxygen to the brain during the birth process.

AGING AND DEATH

Aging is the normal progression of the life cycle that will eventually end in death. During the latter portion of life, individuals become increasingly at higher risk of developing health problems that are chronic or eventually fatal. As the average life span becomes longer, a larger portion of the population are affected by such disorders related to aging.

- The study of the medical problems and care of older people is known as **geriatrics** (jer-ee-AT-ricks) or *gerontology*.
- *Postmortem* means after death. A postmortem examination is also known as an **autopsy** (AW-top-see).

HEALTH CARE PROFESSIONALS

Health care professionals caring for the wellbeing of patients during their lifetime include doctors, nurses, administrative staff, and allied health professionals. *Allied health professions* include roles outside of medicine, nursing, and pharmacy. Allied health professionals are an essential part of health care teams, and include dental hygienists, emergency medical technicians (EMTs), medical interpreters, nutritionists, physical therapists, mental health practitioners, phlebotomists (see Chapter 15), radiology technicians, and respiratory therapists.

In many medical office or clinic settings, the following health care specialists work as a **primary care provider (PCP)**:

- A **general practitioner (GP)**, or *family practice physician*, provides ongoing care for patients of all ages.
- An **internist** is a physician who specializes in diagnosing and treating diseases and disorders of the internal organs and related body systems.
- A **pediatrician** (pee-dee-ah-TRISH-un) is a physician who specializes in diagnosing, treating, and preventing disorders and diseases of infants and children. This specialty is known as *pediatrics*.



FIGURE 2.11 A geriatrician specializes in problems related to aging and in the diagnosis, treatment, and prevention of disease in older people.

- A **geriatrician** (**jer-ee-ah-TRISH-un**), or **gerontologist**, is a physician who specializes in the care of older people (Figure 2.11).
- A **nurse practitioner** (NP) is a nurse with graduate training who often works as a primary care provider.
- A **physician assistant** (PA) is a licensed professional who works under the supervision of a physician. NPs and PAs also work in hospital and other health care settings and usually have a master's degree.

Other health care professionals in a clinic or medical office setting include:

- A **medical receptionist** schedules and registers patients for appointments and may also work as a medical assistant.
- A **medical assistant** or **clinical medical assistant** performs administrative and clinical tasks in a doctor's office, such as coding patients' medical information, measuring a patient's vital signs, administering injections and drawing blood. Medical assistants also work in long-term care facilities caring for the elderly. A **certified medical assistant** (CMA) is a medical assistant certified through the American Association of Medical Assistants.

- A **medical coder** reviews patients' medical records and assigns appropriate codes for treatment and services provided to each patient based on codes for medical diagnoses, equipment, and procedures.

In a hospital setting, different departments and specialists care for patients.

- The **emergency room** (ER), also called an **emergency department**, focuses on diagnosing and treating life-threatening emergency medical conditions. Patients are triaged on arrival (see Chapter 1) and seen by an emergency physician.
 - An **emergency physician** is a doctor who specializes in high-acuity medicine in the ER. **Acuity** refers to the level of severity of an illness.
 - An **emergency medical technician** (EMT) is a licensed health care professional who works in a pre-hospital setting on an ambulance, or in an emergency room.
- A **registered nurse** (RN) is a licensed health care professional who works in a variety of health care settings. RNs assess patients and provide care following a doctor's orders.
- A **licensed vocational nurse** (LVN), also known as a **licensed practical nurse** (LPN) in certain states, works

under the supervision of a doctor or RN to provide basic patient care.

- A **certified nursing assistant** (CNA) works under the supervision of a RN to provide basic patient care.
- A **pharmacist** is a licensed medical professional who dispenses prescribed medication to patients (see Chapter 15).
- The **intensive care unit** (ICU), or **critical care unit**, provides continuously monitored care for critically ill patients. Some hospitals have specialized ICUs for burn and trauma patients, cardiac patients, or neurological patients.
- An **intensivist** is a physician specializing in the care of critically ill patients hospitalized in the ICU.
- A **hospitalist** is a physician focusing on the general medical care of hospitalized patients.
- A **telemetry** (teh-LEM-eh-tree) unit provides continuous cardiac monitoring for patients with heart problems not requiring intensive care (**tele** means distant; **-metry** means to measure). The term *telemetry* refers to the electronic transmission of data about the patient's heart rhythm.

- A **medical/surgical** unit (med/surg) provides nursing care for lower-acuity patients who are recovering from surgery or require continued drug therapy or monitoring.

ABBREVIATIONS RELATED TO THE HUMAN BODY IN HEALTH AND DISEASE

Table 2.2 presents an overview of the abbreviations related to the terms introduced in this chapter. *Note:* To avoid errors or confusion, always be cautious when using abbreviations.

Workbook Practice

Go to your workbook and complete the exercises for this chapter.



TABLE 2.2

Abbreviations Related to the Human Body in Health and Disease

anatomy and physiology = A & P	A & P = anatomy and physiology
communicable disease = CD	CD = communicable disease
chromosome = CH, chr	CH, chr = chromosome
deoxyribonucleic acid = DNA	DNA = deoxyribonucleic acid
epidemic = epid	epid = epidemic
general practitioner = GP	GP = general practitioner
Huntington's disease = HD	HD = Huntington's disease
left lower quadrant = LLQ	LLQ = left lower quadrant
left upper quadrant = LUQ	LUQ = left upper quadrant
physician assistant = PA	PA = physician assistant
right lower quadrant = RLQ	RLQ = right lower quadrant
right upper quadrant = RUQ	RUQ = right upper quadrant

CAREER OPPORTUNITIES

In addition to the medical specialties discussed in this chapter, there are a broad range of health professions available at different levels of education and training within the medical field. Some of these jobs specialize primarily with one body system, such as a dental assistant or a respiratory therapist. (These are listed at the end of each of the body system chapters.) Others treat the patient's general health care needs, including:

- **Nursing assistant, nurse's aide, patient care technician (PCT), or orderly:** provides basic and essential patient care such as bathing, bed making, and feeding.
- **Registered nurse (RN), licensed practical nurse (LPN), and licensed vocational nurse (LVN):** is state licensed to provide and manage patient care. An RN is authorized to provide specialized services, including administering medications, teaching, and supervising other staff members. An LPN or LVN provides for patients' needs under the supervision of an RN or physician. There are many nursing specialties, including:

Community health nurse	IV therapy nurse
Critical care nurse	ER nurse
Flight nurse	Private duty nurse
Hospice nurse	School nurse
Infectious disease nurse	Surgery scrub nurse

- **Advanced practice nurse:** an APN requires a master of science in nursing degree or a doctorate of nursing practice. An APN can become a **nurse practitioner (NP)**, an RN with advanced training in the diagnosis and treatment of illness who provides primary care for patients, often in collaboration with a physician, a nurse-midwife, a clinical nurse specialist, or a certified nurse anesthetist.
- **Medical translator:** provides bilingual assistance for accurate communication between health care providers and non-English-speaking patients. A medical translator must know medical terminology in English and a second language.
- **Genetics counselor:** has a master's degree in genetics counseling from an accredited program. Once certified, they can counsel patients about the genetic link in certain conditions and give information to help patients and their families understand and adapt to their condition. They may also perform genetic research.

HEALTH PROFESSION PROFILE

MEDICAL INTERPRETER

Jose Parra is a Spanish-to-English medical interpreter.

When I moved from Colombia to the United States, I didn't understand a word people were saying. After getting my English as a Second Language degree and working in culinary arts, I saw a need in the community: children were doing the interpreting for their mothers and fathers. Because I like to help people, I decided to go back to school to become a medical interpreter.

It can be scary for patients in a hospital who not only are sick but also don't understand the language. There is a feeling of relief for both patient and provider when the interpreter arrives. My job is to be a bridge between the patient and the doctor, bringing the message across without adding or omitting anything, as exact as can be. It's challenging because different Spanish-speaking cultures have different ways of phrasing things, but I enjoy it because I am helping others and also learning a lot about various fields of medicine.



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CHAPTER 2 STUDY BREAK

What is the most common infectious disease on earth? Hint: You would have to live in a small, very isolated community or perhaps in the frozen wastelands of Antarctica to avoid it, and yet no one has ever found a cure.

Answer: the **common cold**. We do know that this contagious condition can be caused by over 100 types of rhinovirus (**-rhino** means "nose," plus **virus**) and that it spreads through sneezing, coughing, and inadequate hand washing.

The common cold is sometimes confused with the flu (influenza), which can be fatal. In the deadliest flu outbreak on record, over 21 million people died worldwide in just 2 years (1918 and 1919). The flu is a viral infection characterized by a fever in addition to cold-like symptoms. It is very contagious and usually occurs in epidemics rather than isolated cases.

REVIEW TIME

Write the answers to the following questions on a separate piece of paper or in your notebook. In addition, be prepared to take part in the classroom discussion.

1. **Written Assignment:** Using terms a layperson would understand, state the differences between congenital and genetic disorders and give an example of each.

Discussion Assignment: How do you think genetic counseling would affect a young couple at risk for transmitting cystic fibrosis to their children?

2. **Written Assignment:** What is the difference between an organic disorder and an idiopathic disorder?

Discussion Assignment: Give two examples of idiopathic disorders.

3. **Written Assignment:** What is the difference between an iatrogenic illness and a nosocomial infection?

Discussion Assignment: Describe the differences between the causes of these conditions.

4. **Written Assignment:** Using your own words, describe the differences between the midsagittal and transverse planes.

Discussion Assignment: Where are each of these planes located?

5. **Written Assignment:** Identify the two dorsal and three ventral body cavities.

Discussion Assignment: How would you describe to a patient which organs are protected by each cavity?



OPTIONAL INTERNET ACTIVITY

The goal of this activity is to help you learn more about medical terminology as it applies to the “real world.” Select one of the two options below and follow the instructions.

1. Search for and make a list of diseases that are **bloodborne**. Now do the same for diseases that are **communicable**. Write a brief (one- or two-paragraph) report on the differences you see between the two lists.
2. Find an **epidemic** from history that resulted in over 5,000 deaths. Write a brief (one- or two-paragraph) report on what the disease was and how it was transmitted.



The Human Touch

CRITICAL THINKING EXERCISE

The following story and questions are designed to stimulate critical thinking through class discussion or as a brief essay response. There are no right or wrong answers to these questions.

The sign in the fifth-floor restroom read, “Dirty hands spread disease. Always use soap.” Dave rinsed his hands with water, quickly ran his fingers through his hair, and then rushed into the hallway, already late for biology class.

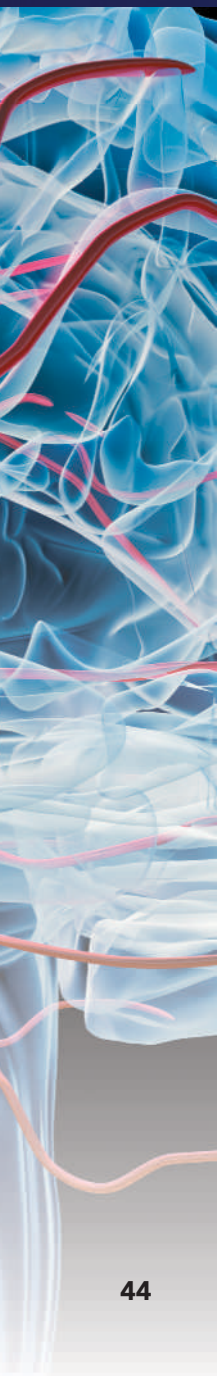
There was an overwhelming smell as he entered the classroom, and he could immediately tell why: on each counter was sitting the day’s project, a fetal pig. “Do these things have to stink?” he asked his teacher. “Well, Dave, if they didn’t ‘stink’ of the formaldehyde, they would be rotting and could be spreading diseases. Now let’s get started,” the teacher said. At the end of class period, they were told, “Be sure to wash your hands thoroughly before leaving this classroom.”

This reminded Dave of the lectures they had earlier in the semester about diseases caused by pathogens and how these diseases are spread. As he looked around the classroom, Dave was aware of the other students. Most were gathering up their books to go directly to lunch without washing their hands, Gail and Susan were sharing a bottle of water, Beth was rubbing her eyes, and Jim was coughing without covering his mouth! Suddenly, Dave had a mental image of pathogens everywhere: lying on hands and countertops, floating in the air—and all of these pathogens were looking for someone to infect! Dave shook his head to get rid of this mental image. Then he went to the sink and carefully washed his hands again—this time with soap.

Suggested Discussion Topics

1. Identify and discuss the examples of the potential disease transmission methods that are included in Dave’s story, and describe what should have been done to eliminate these risks.
2. Describe how bloodborne, airborne, and food-borne diseases are transmitted, and give an example of each type of transmission.
3. Discuss what might happen in a school if a cafeteria worker has a food-borne disease and after a trip to the lavatory does not wash his or her hands. Instead, the worker goes right back to work without putting on gloves—preparing salads and putting out fresh fruit for lunch.
4. When treating a bloody wound, the caregiver is required to wear protective gloves. Discuss the possible reasons for this. Is this step taken to protect the patient against diseases on the caregiver’s hands? Is this step required to protect the caregiver from a bloodborne disease that the patient might have?

THE SKELETAL SYSTEM



Overview of STRUCTURES, COMBINING FORMS, AND FUNCTIONS OF THE SKELETAL SYSTEM

Major Structures	Related Combining Forms	Primary Functions
Bones	oss/e, oss/i, oste/o, ost/o	Act as the framework for the body, protect the internal organs, and store calcium.
Bone Marrow	myel/o (also means spinal cord)	Red bone marrow helps form red blood cells. Yellow bone marrow stores fat.
Cartilage	chondr/o	Creates a smooth surface for motion within the joints and protects the ends of the bones.
Joints	arthr/o	Work with the muscles to make a variety of motions possible.
Ligaments	ligament/o	Connect one bone to another.
Synovial Membrane	synovi/o, synov/o	Forms the lining of synovial joints and secretes synovial fluid.
Synovial Fluid	synovi/o, synov/o	Lubricant that makes smooth joint movements possible.
Bursa	burs/o	Cushions areas subject to friction during movement.

Vocabulary Related to THE SKELETAL SYSTEM

This list contains essential word parts and medical terms for this chapter. These and the other important **primary terms** are shown in **boldface** throughout the chapter. *Secondary terms*, which appear in *cyan* italics, clarify the meaning of primary terms.

Word Parts

- ankyl/o** crooked, bent, stiff
- arthr/o** joint
- burs/o** bursa
- chondr/i, chondr/o** cartilage
- cost/o** rib
- crani/o** skull
- desis** to bind, tie together
- kyph/o** bent, hump
- lord/o** curve, swayback, bent
- lysis** loosening or setting free
- myel/o** spinal cord, bone marrow
- oss/e, oss/i, ost/o, oste/o** bone
- scoli/o** curved, bent
- spondyl/o** vertebrae, vertebral column, backbone
- synovi/o, synov/o** synovial membrane, synovial fluid

Medical Terms

- acetabulum** (ass-eh-TAB-you-lum)
- allogenic** (al-oh-JEN-ick)
- ankylosing spondylitis** (ang-kih-LOH-sing spon-dih-LYE-tis)
- arthrodesis** (ar-throh-DEE-sis)
- arthrolysis** (ar-THROL-ih-sis)
- arthroscopy** (ar-THROS-koh-pee)
- autologous** (aw-TOL-uh-guss)
- avascular necrosis**
- chondromalacia** (kon-droh-mah-LAY-shee-ah)
- comminuted fracture** (KOM-ih-newt-ed)
- compression fracture**
- costochondritis** (kos-toh-kon-DRIGH-tis)
- craniostenosis** (kray-nee-oh-steh-NOH-sis)
- crepitation** (krep-ih-TAY-shun)
- dual x-ray absorptiometry** (ab-sorp-shee-OM-eh-tree)
- gout** (GOWT)
- hallux valgus** (HAL-uks VAL-guss)

- hemarthrosis** (hem-ar-THROH-sis)
- hemopoietic** (hee-moh-poy-ET-ick)
- internal fixation**
- juvenile rheumatoid arthritis** (ROO-mah-toyd ar-THRIGH-tis)
- kyphosis** (kye-FOH-sis)
- laminectomy** (lam-ih-NECK-toh-mee)
- lordosis** (lor-DOH-sis)
- lumbago** (lum-BAY-goh)
- malleolus** (mah-LEE-oh-lus)
- manubrium** (mah-NEW-bree-um)
- metacarpals** (met-ah-KAR-palz)
- metatarsals** (met-ah-TAHR-salz)
- myeloma** (my-eh-LOH-mah)
- open fracture**
- orthopedic surgeon** (or-thoh-PEE-dick)
- orthotic** (or-THOT-ick)
- osteitis** (oss-tee-EYE-tis)
- osteoarthritis** (oss-tee-oh-ar-THRIGH-tis)
- osteochondroma** (oss-tee-oh-kon-DROH-mah)
- osteoclasia** (oss-tee-OCK-lah-sis)
- osteomalacia** (oss-tee-oh-mah-LAY-shee-ah)
- osteomyelitis** (oss-tee-oh-my-eh-LYE-tis)
- osteopenia** (oss-tee-oh-PEE-nee-ah)
- osteoporosis** (oss-tee-oh-poh-ROH-sis)
- osteoporotic hip fracture** (oss-tee-oh-pah-ROT-ick)
- osteorrhaphy** (oss-tee-OR-ah-fee)
- Paget's disease** (PAJ-its)
- pathologic fracture**
- percutaneous vertebroplasty** (per-kyou-TAY-nee-us VER-tee-broh-plas-tee)
- periostitis** (pehr-ee-oss-TYE-tis)
- podiatrist** (poh-DYE-ah-trist)
- polymyalgia rheumatica** (pol-ee-my-AL-jee-ah roo-MA-tih-kah)
- prosthesis** (pros-THEE-sis)
- rheumatoid arthritis** (ROO-mah-toyd ar-THRIGH-tis)
- rickets** (RICK-ets)
- scoliosis** (skoh-lee-OH-sis)
- spina bifida** (SPY-nah BIF-ih-dah)
- spiral fracture**
- spondylolisthesis** (spon-dih-loh-liss-THEE-sis)
- spondylosis** (spon-dih-LOH-sis)
- subluxation** (sub-luck-SAY-shun)
- synovectomy** (sin-oh-VECK-toh-mee)
- vertebrae** (VER-teh-bray)

LEARNING OBJECTIVES

On completion of this chapter, you should be able to:

1. Identify and describe the major functions and structures of the skeletal system.
2. Describe three types of joints.
3. Differentiate between the axial and appendicular skeletons.
4. Identify the medical specialists who treat disorders of the skeletal system.
5. Recognize, define, spell, and pronounce the primary terms related to the pathology and the diagnostic and treatment procedures of the skeletal system.

STRUCTURES AND FUNCTIONS OF THE SKELETAL SYSTEM

The skeletal system consists of the bones, bone marrow, cartilage, joints, ligaments, synovial membranes, synovial fluid, and bursae. This body system has many important functions:

- Bones act as the framework of the body.
- Bones support and protect the internal organs.
- Joints work in conjunction with muscles, ligaments, and tendons, making possible the wide variety of body movements. (Muscles and tendons are discussed in Chapter 4.)
- Calcium, a mineral required for normal nerve and muscle function, is stored in bones.
- Red bone marrow, which plays an important role in the formation of blood cells, is located within spongy bone.

The Formation of Bones

A newborn's skeleton begins as fragile membranes and cartilage, but after three months it starts turning into bone in a process called **ossification** (**oss-uh-fih-KAY-shun**), which continues through adolescence.

Even after growth is completed, this process of new bone formation continues as **osteoclasts** break down old or damaged bone and **osteoblasts** help rebuild the bone. Ossification repairs the minor damage to the skeletal system that occurs during normal activity and also repairs bones after injuries such as fractures.

THE STRUCTURE OF BONES

Bone is the form of connective tissue that is the second hardest tissue in the human body. Only dental enamel is harder than bone.

The Tissues of Bone

Although it is a dense and rigid tissue, bone is also capable of growth, healing, and reshaping itself (Figure 3.1).

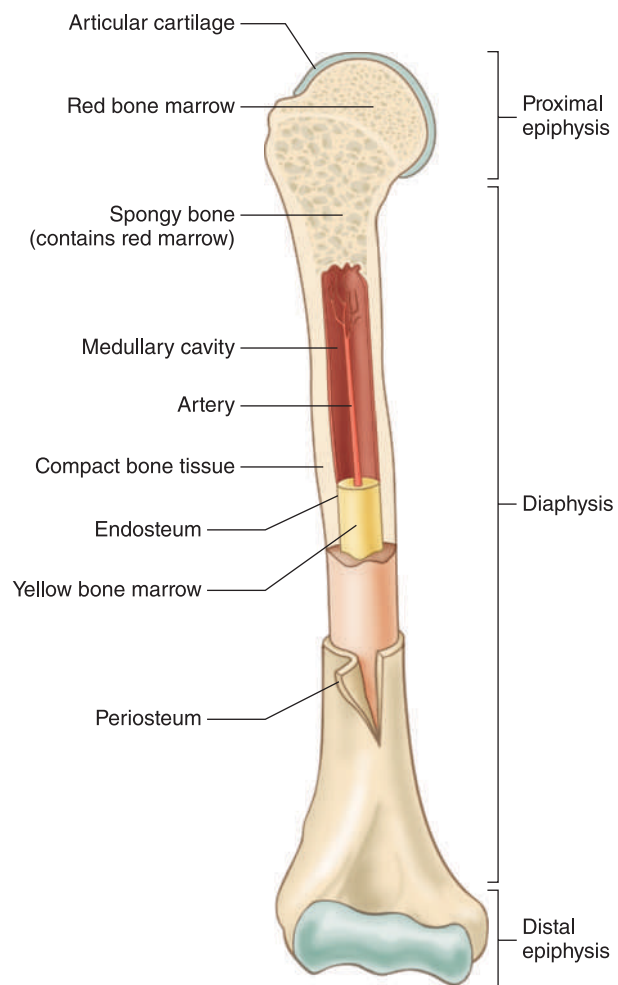


FIGURE 3.1 Anatomic features of a typical long bone.

- **Periosteum** (**pehr-ee-OSS-tee-um**) is the tough, fibrous tissue that forms the outermost covering of bone (**peri-** means surrounding, **oste** means bone, and **-um** is a noun ending).
- **Compact bone**, also known as **cortical bone**, is the dense, hard, and very strong bone that forms the protective outer layer of bones. When measured by weight, compact bone accounts for more than 75% of the body's bone matter.
- **Spongy bone**, also known as **cancellous bone**, is porous ("sponge-like"), which makes it lighter and weaker than compact bone.
 - Red bone marrow is often located within this spongy bone, which is commonly found in the ends and inner portions of long bones as well as in the pelvic bones, ribs, and the vertebrae of the spinal column. *The femur and humerus are examples of long bones.*
- Bones with a large percentage of spongy bone are weaker and more susceptible to fractures.
- The **medullary cavity** (**MED-you-lehr-ee**) is the central cavity located in the shaft of long bones, where it is surrounded by compact bone. It is here that red and yellow bone marrow are stored. **Medullary** means pertaining to the inner section.
- The **endosteum** (**en-DOS-tee-um**) is the tissue that lines the medullary cavity (**end-** means within, **oste** means bone, and **-um** is a noun ending).

Bone Marrow

- **Red bone marrow**, which is located within the spongy bone, is a hemopoietic tissue that manufactures red blood cells, hemoglobin, white blood cells, and thrombocytes. These types of cells are discussed in Chapter 5.
- **Hemopoietic** (**hee-moh-poy-ET-ick**) means pertaining to the formation of blood cells (**hem/o** means blood, and **-poietic** means pertaining to formation). This term is also spelled **hematopoietic**.
- **Yellow bone marrow** functions as a fat storage area. It is composed chiefly of fat cells and is located in the medullary cavity of long bones. Most bone marrow is red from birth through early adolescence, after which about half of it is gradually replaced by yellow bone marrow.

Cartilage

- **Cartilage** (**KAR-tih-lidj**) is the smooth, rubbery, blue-white connective tissue that acts as a shock absorber between bones. Cartilage, which is more elastic than

bone, also makes up the flexible parts of the skeleton such as the outer ear and the tip of the nose.

- **Articular cartilage** (**ar-TICK-you-lar KAR-tih-lidj**) covers the surfaces of bones where they **articulate**, or come together, to form joints. This cartilage makes smooth joint movement possible and protects the bones from rubbing against each other (Figures 3.1 and 3.3).
- The **meniscus** (**meh-NIS-kus**) is the curved, fibrous cartilage found in some joints, such as the knee and the temporomandibular joint of the jaw (Figure 3.3).

Anatomic Landmarks of Bones

- The **diaphysis** (**dye-AF-ih-sis**) is the shaft of a long bone (Figure 3.1).
- The **epiphyses** (**ep-PIF-ih-seez**) are the wider ends of long bones such as the femurs of the legs (singular **epiphysis**). Each epiphysis is covered with articular cartilage to protect it. The **proximal epiphysis** is the end of the bone located nearest to the midline of the body. The **distal epiphysis** is the end of the bone located farthest away from the midline of the body.
- A **foramen** (**foh-RAY-men**) is an opening in a bone through which blood vessels, nerves, and ligaments pass (plural, **foramina**). For example, the spinal cord passes through the **foramen magnum** of the occipital bone at the base of the skull.
- A **process** is a normal projection on the surface of a bone that most commonly serves as an attachment for a muscle or tendon. For example, the **mastoid process** is the bony projection located on the temporal bones just behind the ears (Figure 3.6).

JOINTS

Joints, which are also known as **articulations**, are the place of union between two or more bones. Joints are classified either according to their construction or based on the degree of movement they allow.

Fibrous Joints

Fibrous joints, consisting of inflexible layers of dense connective tissue, hold the bones tightly together. In adults these joints, which are also known as **sutures**, do not allow any movement (Figure 3.6). In newborns and very young children, some fibrous joints are movable before they have solidified.

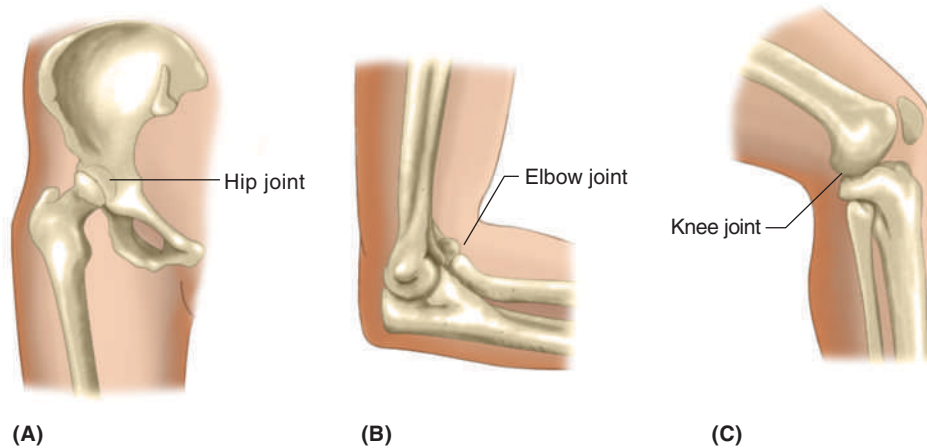


FIGURE 3.2 Examples of *synovial joints*. (A) Ball-and-socket joint of the hip. (B) Hinge joint of the elbow. (C) Hinge joint of the knee.

- The **fontanelles** (**fon-tah-NELLS**), also known as the *soft spots*, are normally present on the skull of a newborn. These flexible soft spots facilitate the passage of the infant through the birth canal. They also allow for the growth of the skull during the first year. As the child matures, and the sutures close, the fontanelles gradually harden.

Cartilaginous Joints

Cartilaginous joints (**kar-tih-LADJ-ih-nus**) allow only slight movement and consist of bones connected entirely by cartilage. For example:

- Where the ribs connect to the sternum (breast bone), shown in Figure 3.8, these joints allow movement during breathing.
- The **pubic symphysis** (**PEW-bick SIM-fih-sis**) allows some movement to facilitate childbirth. This joint is located between the pubic bones in the anterior (front) of the pelvis as shown in Figure 3.12.

Synovial Joints

A **synovial joint** (**sih-NOH-vee-al**) is created where two bones articulate to permit a variety of motions. As used here, the term *articulate* means to come together. These joints are also described based on their type of motion (Figure 3.2).

- **Ball-and-socket joints**, such as the hips and shoulders, allow a wide range of movement in many directions (Figure 3.2A).
- **Hinge joints**, such as the knees and elbows, are synovial joints that allow movement primarily in one direction or plane (Figure 3.2B and C).

Components of Synovial Joints

Synovial joints consist of several components that make complex movements possible (Figure 3.3).

- The **synovial capsule** is the outermost layer of strong fibrous tissue that resembles a sleeve as it surrounds the joint.
- The **synovial membrane** lines the capsule and secretes synovial fluid.
- **Synovial fluid**, which flows within the synovial cavity, acts as a lubricant to make the smooth movement of the joint possible.

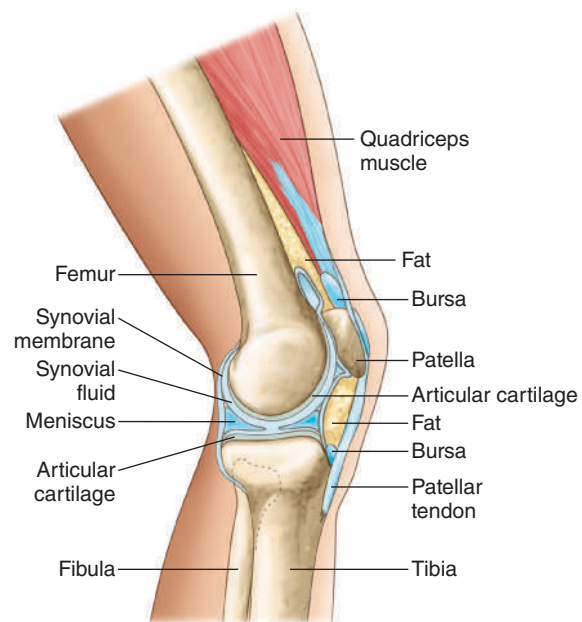


FIGURE 3.3 A lateral view of the knee showing the structures of a *synovial joint* and *bursa*.

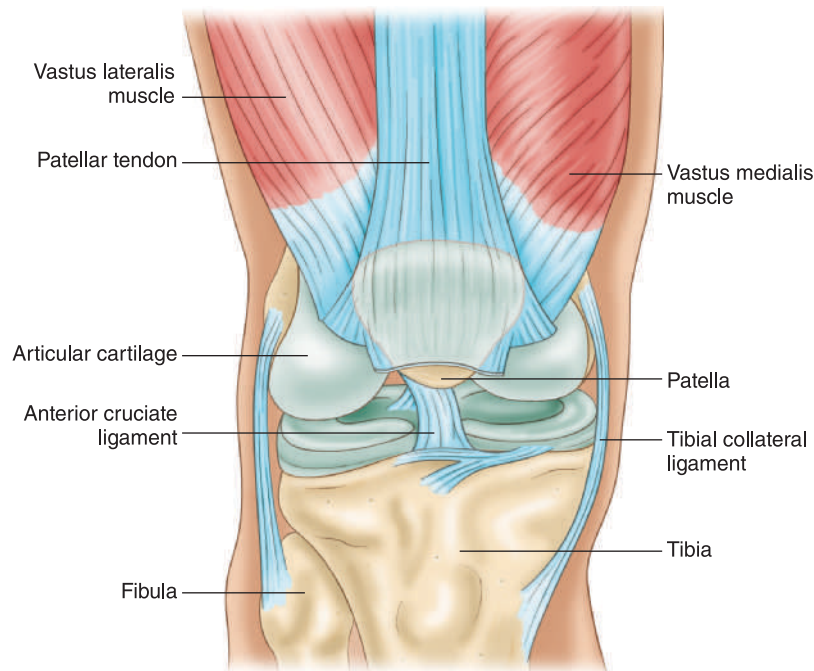


FIGURE 3.4 Major ligaments of the knee. This anterior view of the knee shows the complex system of ligaments that make its movements possible.

■ **Ligaments (LIG-ah-mentz)** are bands of fibrous tissue that form joints by connecting one bone to another bone or by joining a bone to cartilage. Complex hinge joints, such as the knee as shown in Figures 3.2 and 3.3, are made up of a series of ligaments that permit movement in different directions.

■ A **bursa (BER-sah)** is a fibrous sac that acts as a cushion to ease movement in areas that are subject to friction, such as in the shoulder, elbow, and knee joints where a tendon passes over a bone (plural, *bursae*).

THE SKELETON

The typical adult human skeleton consists of approximately 206 bones, as shown in Figure 3.5. Depending upon the age of the individual, the exact number of bones ranges from 206 to 350. For descriptive purposes, the skeleton is divided into the axial and appendicular skeletal systems.

Axial Skeleton

The **axial skeleton** protects the major organs of the nervous, respiratory, and circulatory systems. In the human, the axial skeleton consists of the 80 bones of the head and

body that are organized into five parts. These are (1) the bones of the skull; (2) the ossicles (bones) of the middle ear; (3) the hyoid bone, located on the throat between the chin and the thyroid; (4) the rib cage; and (5) the vertebral column.

Appendicular Skeleton

The **appendicular skeleton** makes body movement possible and also protects the organs of digestion, excretion, and reproduction. In the human, the appendicular skeleton consists of 126 bones that are organized into (1) the **upper extremities** (shoulders, arms, forearms, wrists, and hands) and (2) the **lower extremities** (hips, thighs, legs, ankles, and feet).

An **appendage** is anything that is attached to a major part of the body and the term **appendicular** means referring to an appendage. An **extremity** is the terminal end of a body part such as an arm or leg.

Bones of the Skull

The **skull** consists of the 8 bones that form the cranium, 14 bones that form the face, and 6 bones in the middle ear. As you study the following bones of the skull, refer to Figures 3.6 and 3.7.

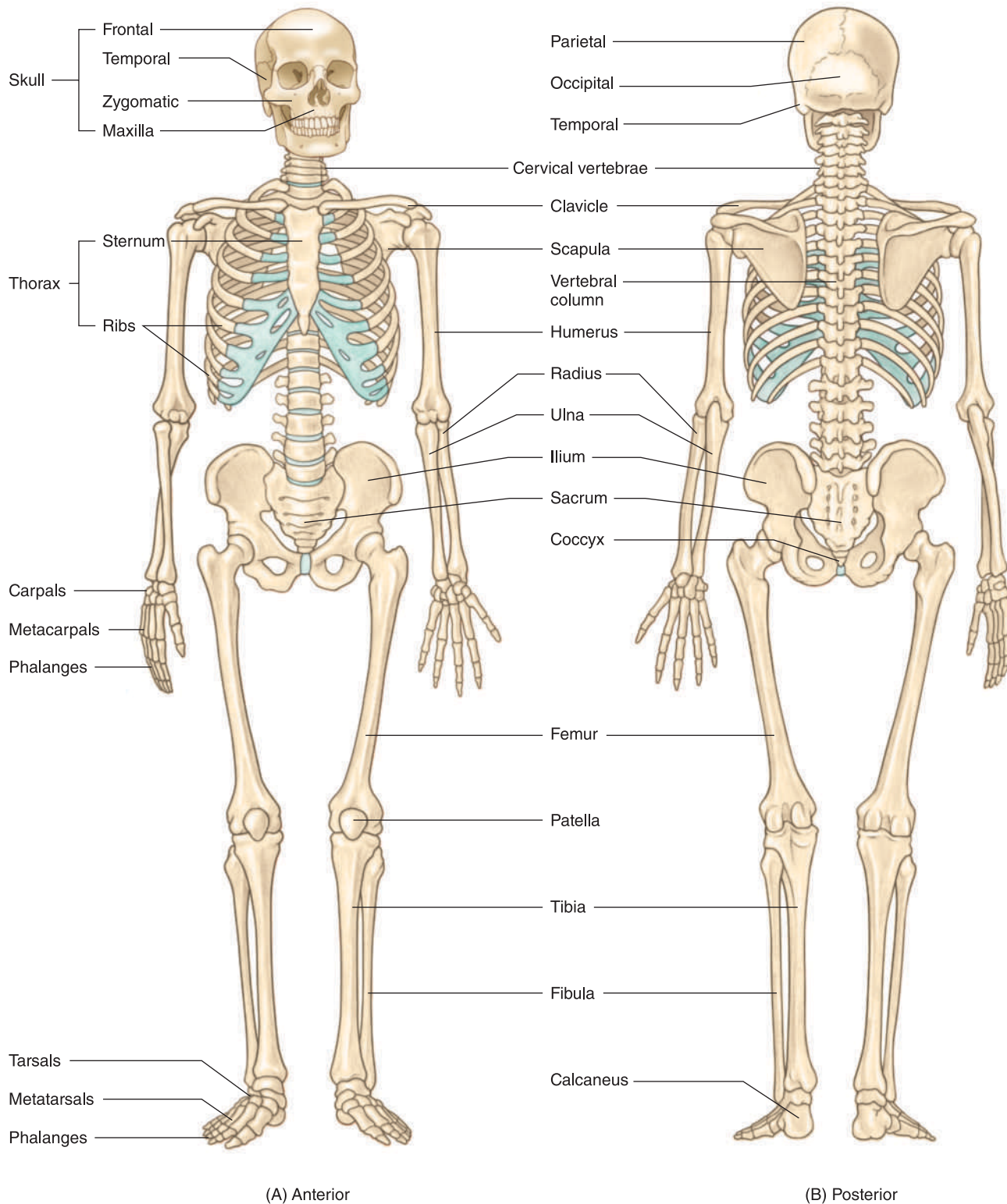


FIGURE 3.5 Anterior and posterior views of the human skeleton.

The Bones of the Cranium

The **cranium** (**KRAY**-nee-um), which is made up of the following eight bones, is the portion of the skull that encloses

and protects the brain (**crani** means skull, and **-um** is a noun ending). The cranial bones are joined by jagged fibrous joints that are often referred to as sutures.

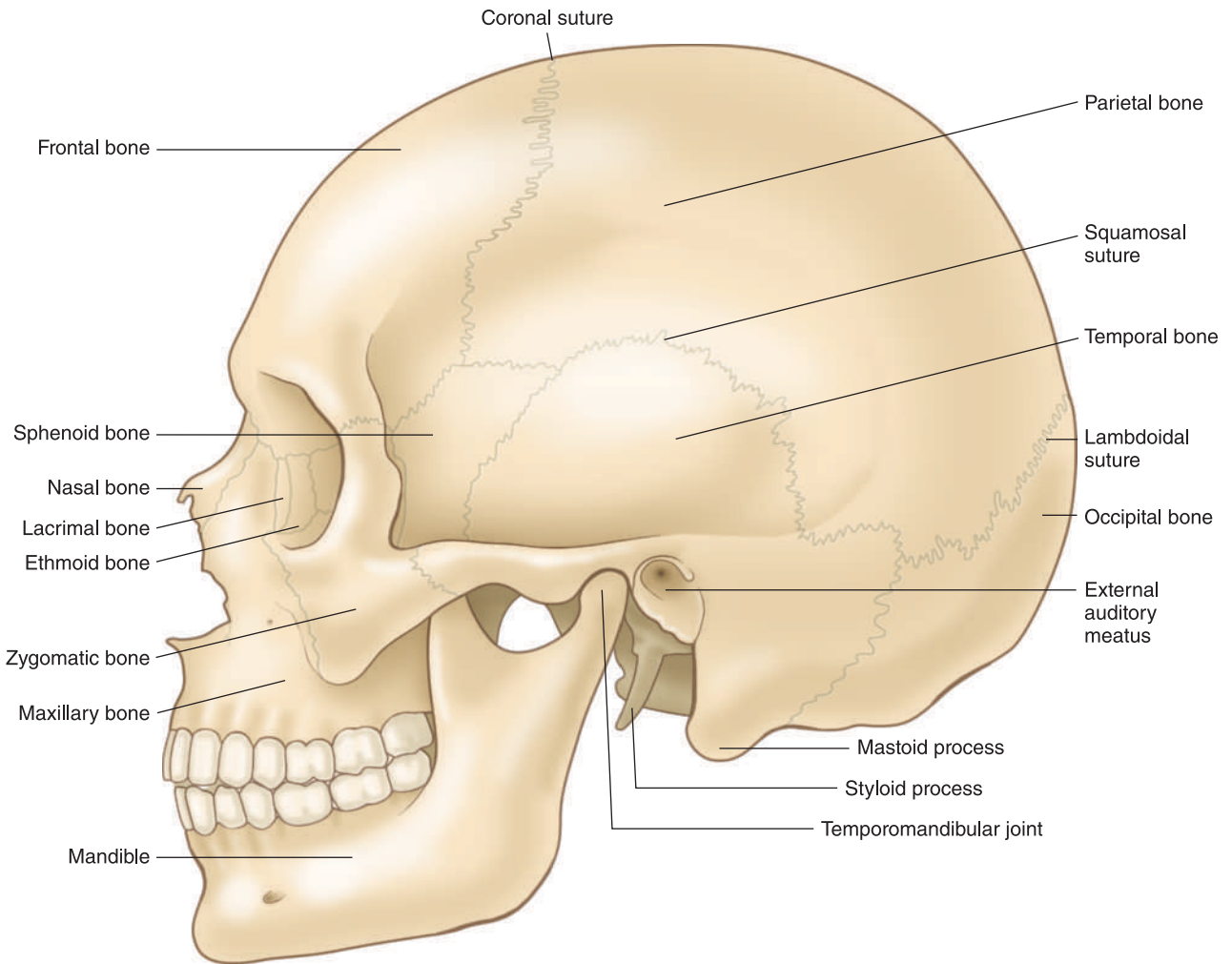


FIGURE 3.6 Lateral view of the adult human skull.

- The **frontal bone** is the anterior portion of the cranium that forms the forehead. This bone houses the frontal sinuses and forms the roof of the ethmoid sinuses, the nose and part of the socket that protects the eyeball.
- The **parietal bones** (pah-RYE-eh-tal) are two of the largest bones of the skull. Together they form most of the roof and upper sides of the cranium.
- The **occipital bone** (ock-SIP-ih-tal) forms the back part of the skull and the base of the cranium.
- The two **temporal bones** form the sides and base of the cranium.
- The **external auditory meatus** (mee-AY-tus) is the opening of the external auditory canal of the outer ear. This canal is located within the temporal bone on each side of the skull. A **meatus** is the external opening of a canal.
- The **sphenoid bone** (SFEE-noid) is an irregular, wedge-shaped bone at the base of the skull. This bone makes contact with all of the other cranial bones and helps

form the base of the cranium, the sides of the skull, and the floors and sides of the eye sockets.

- The **ethmoid bone** (ETH-moid) is light, spongy bone located at the roof and sides of the nose. Here it separates the nasal cavity from the brain, and it also forms a portion of each orbit. An **orbit** is the bony socket that surrounds and protects each eyeball.

The Auditory Ossicles

The **auditory ossicles** (OSS-ih-kulz) are the three tiny bones located in each middle ear. These bones, known as the **malleus**, **incus**, and **stapes**, are discussed in Chapter 11.

The Bones of the Face

- The face is made up of the following 14 bones. Some of these bones contain air-filled cavities known as sinuses. Among the purposes of these sinuses is to lighten the weight of the skull. These sinuses are discussed in Chapter 7.

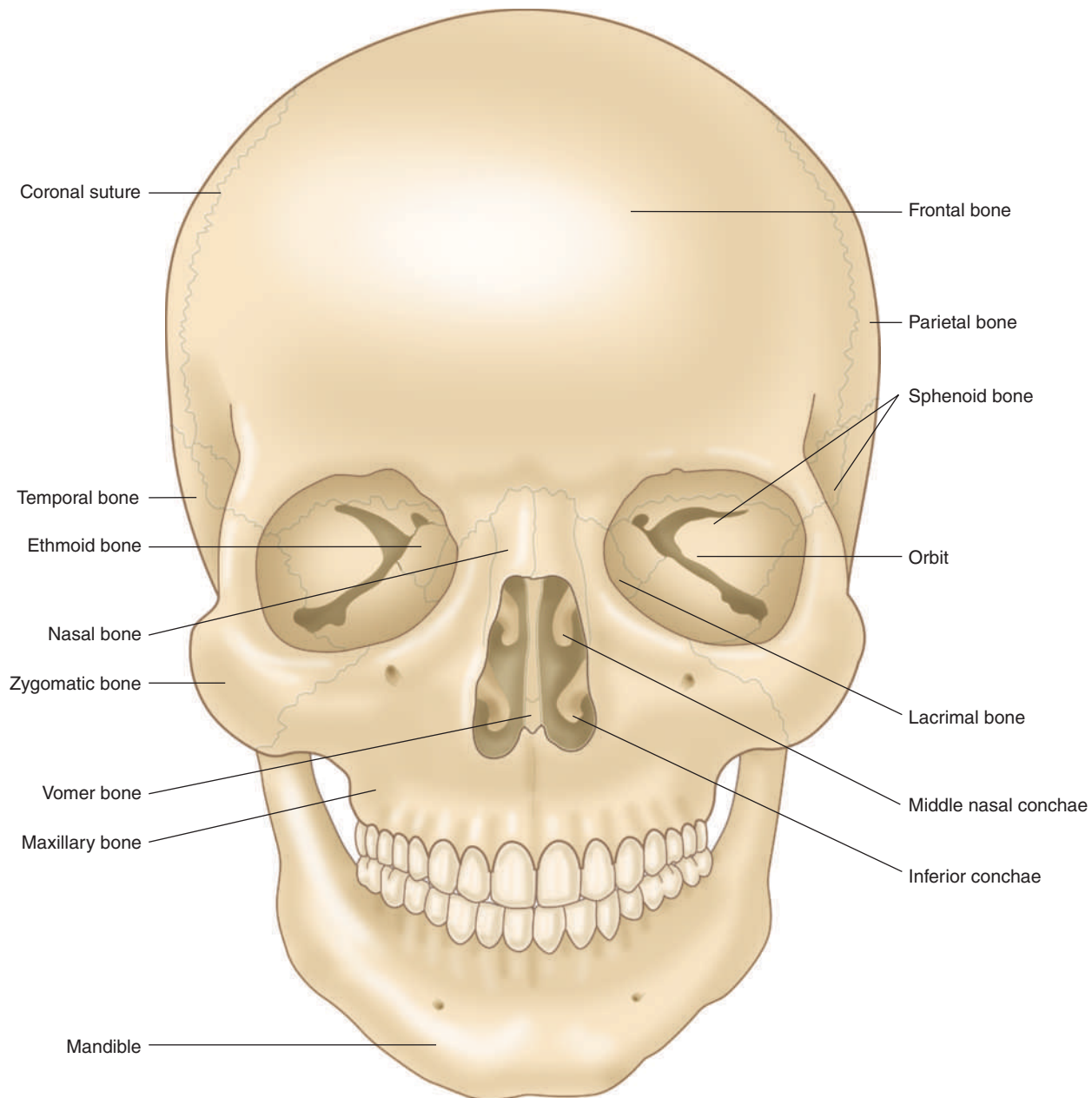


FIGURE 3.7 Anterior view of the adult human skull.

- The two **nasal bones** form the upper part of the bridge of the nose.
- The two **zygomatic bones** (**zye-goh-MAT-ick**), also known as the **cheekbones**, articulate with the frontal bone that makes up the forehead.
- The two **maxillary bones** (**MACK-sih-ler-ee**) form most of the upper jaw (singular, **maxilla**). These bones are also known as the **maxillae**.
- The two **palatine bones** (**PAL-ah-tine**) form the anterior (front) part of the hard palate of the mouth and the floor of the nose.
- The two **lacrimal bones** (**LACK-rih-mal**) make up part of the orbit (socket of the eye) at the inner angle.
- The two **inferior conchae** (**KONG-kee or KONG-kay**) are the thin, scroll-like bones that form part of the interior of the nose (singular, **concha**).
- The **vomer bone** (**VOH-mer**) forms the base for the nasal septum. The **nasal septum** is the cartilage wall that divides the two nasal cavities.
- The **mandible** (**MAN-dih-bul**), also known as the **jawbone**, is the only movable bone of the skull. The mandible is attached to the skull at the **temporomandibular joint** (**tem-poh-roh-man-DIB-you-lar**), which is commonly known as the **TMJ** (Figure 3.6).

Thoracic Cavity

The **thoracic cavity** (thoh-RAS-ick), also known as the **rib cage**, is the bony structure that protects the heart and lungs. It consists of the ribs, sternum, and upper portion of the spinal column extending from the neck to the diaphragm, but not including the arms.

The Ribs

The 12 pairs of **ribs**, which are also known as **costals**, attach posteriorly to the thoracic vertebrae (**cost** means rib, and **-al** means pertaining to) (Figure 3.8).

- The first seven pairs of ribs are called **true ribs**, and they attach anteriorly to the sternum.
- The next three pairs of ribs are called **false ribs**, and they attach anteriorly to cartilage that connects them to the sternum.
- The last two pairs of ribs are called **floating ribs**, because they are only attached posteriorly to the vertebrae but are not attached anteriorly.

The Sternum

The **sternum** (STER-num), which is also known as the **breast bone**, is a flat, dagger-shaped bone located in the middle of

the chest. By joining with the ribs, it forms the front of the rib cage. This is divided into three parts (Figure 3.8).

- The **manubrium** (mah-NEW-bree-um) is the bony structure that forms the upper portion of the sternum.
- The **body of the sternum**, also known as the **gladiolus**, is the bony structure that forms the middle portion of the sternum.
- The **xiphoid process** (ZIF-oid) is the structure made of cartilage that forms the lower portion of the sternum. *Xiphoid* comes from the Greek word for a straight sword.

The Shoulders

The shoulders form the **pectoral girdle** (PECK-toh-rahhl), which supports the arms and hands. This is also known as the **shoulder girdle**. As used here, the term *girdle* refers to a structure that encircles the body. As you study the bones of the shoulder, refer to Figures 3.5 and 3.8.

- The **clavicle** (KLAV-ih-kul), also known as the **collar bone**, is a slender bone that connects the manubrium of the sternum to the scapula.
- The **scapula** (SKAP-you-lah) is also known as the **shoulder blade** (plural, *scapulae*).
- The **acromion** (ah-KROH-mee-on) is an extension of the scapula that forms the high point of the shoulder.

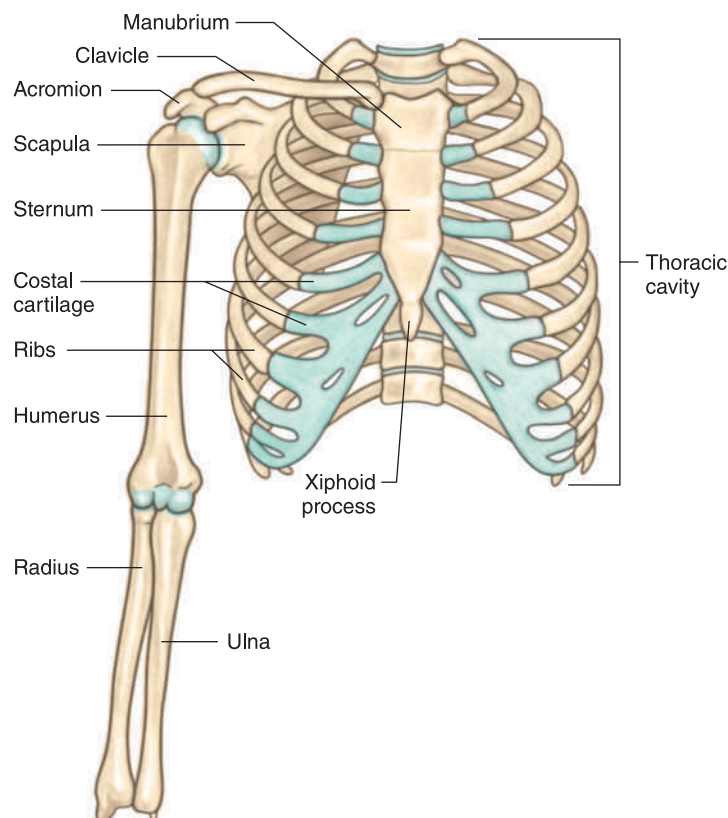


FIGURE 3.8 Anterior view of the ribs, shoulder, and arm. (Cartilaginous structures are shown in blue.)

The Arms

- As you study the bones of the arms, refer to Figures 3.5 and 3.8.
- The **humerus** (**HEW**-mer-us) is the bone of the upper arm (plural, *humeri*).
- The **radius** (**RAY**-dee-us) is the smaller and shorter bone in the forearm. The radius runs up the thumb side of the forearm (plural, *radii*).
- The **ulna** (**ULL**-nah) is the larger and longer bone of the forearm (plural, *ulnae*). The proximal end of the ulna articulates with the distal end of the humerus to form the elbow joint.
- The **olecranon process** (oh-**LEK**-rah-non), commonly known as the *funny bone*, is a large projection on the upper end of the ulna. This forms the point of the elbow and exposes a nerve that tingles when struck.

The Wrists, Hands, and Fingers

As you study these bones, refer to Figure 3.9.

- The eight **carpals** (**KAR**-palz) are the bones that form the wrist (singular, *carpal*). These bones form a narrow bony passage known as the *carpal tunnel*. The median nerve and the tendons of the fingers pass through this tunnel to reach the hand. *Carpal tunnel syndrome* is described in Chapter 4.
- The **metacarpals** (met-ah-**KAR**-palz) are the five bones that form the palms of the hand.
- The **phalanges** (fah-**LAN**-jeez) are the 14 bones of the fingers (singular, *phalanx*). The bones of the toes are also known as phalanges.
- Each of the four fingers has three bones. These are the distal (outermost), middle, and proximal (nearest the hand) phalanges.
- The thumb has two bones. These are the distal and proximal phalanges.

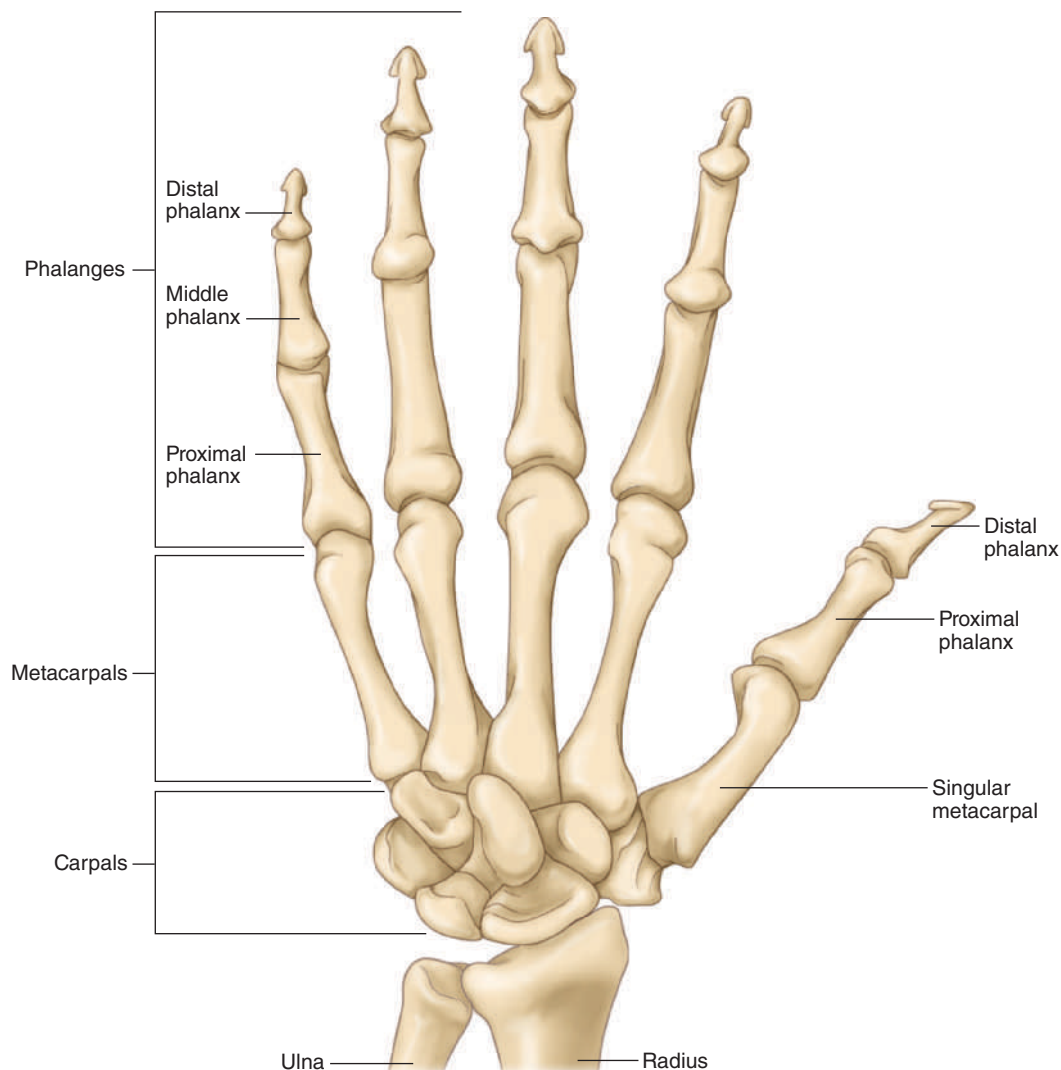


FIGURE 3.9 Superior view of the bones of the lower left arm, wrist, and hand.

The Spinal Column

The **spinal column**, which is also known as the **vertebral column**, protects the spinal cord and supports the head and body. The spinal column consists of 26 **vertebrae** (VER-teh-bray). Each of these bony units is known as a **vertebra** (VER-teh-bruh), and the term **vertebral** means pertaining to the vertebrae.

The Structures of Vertebrae

As you study the structures of a vertebra, refer to Figure 3.10.

- The anterior portion of the vertebra is solid to provide strength and is known as the **body of the vertebra**.
- The posterior portion of a vertebra is known as the **lamina** (LAM-ih-nah) (plural, *laminae*). The transverse and spinous processes extend from this area and serve as attachments for muscles and tendons.
- The **vertebral foramen** is the opening in the middle of the vertebra. This opening allows the spinal cord to pass through and to protect the spinal cord.

Intervertebral Disks

Intervertebral disks (in-ter-VER-teh-bral), which are made of cartilage, separate and cushion the vertebrae from each other. They also act as shock absorbers and allow for movement of the spinal column (Figure 3.18A).

The Types of Vertebrae

As you study the types of vertebrae, refer to Figures 3.11A and 3.11B.

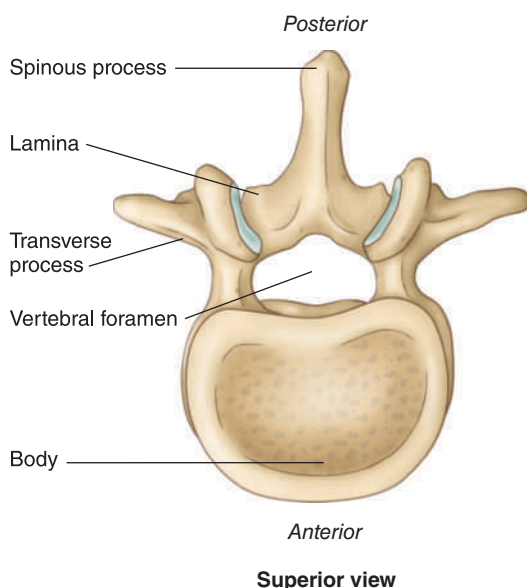
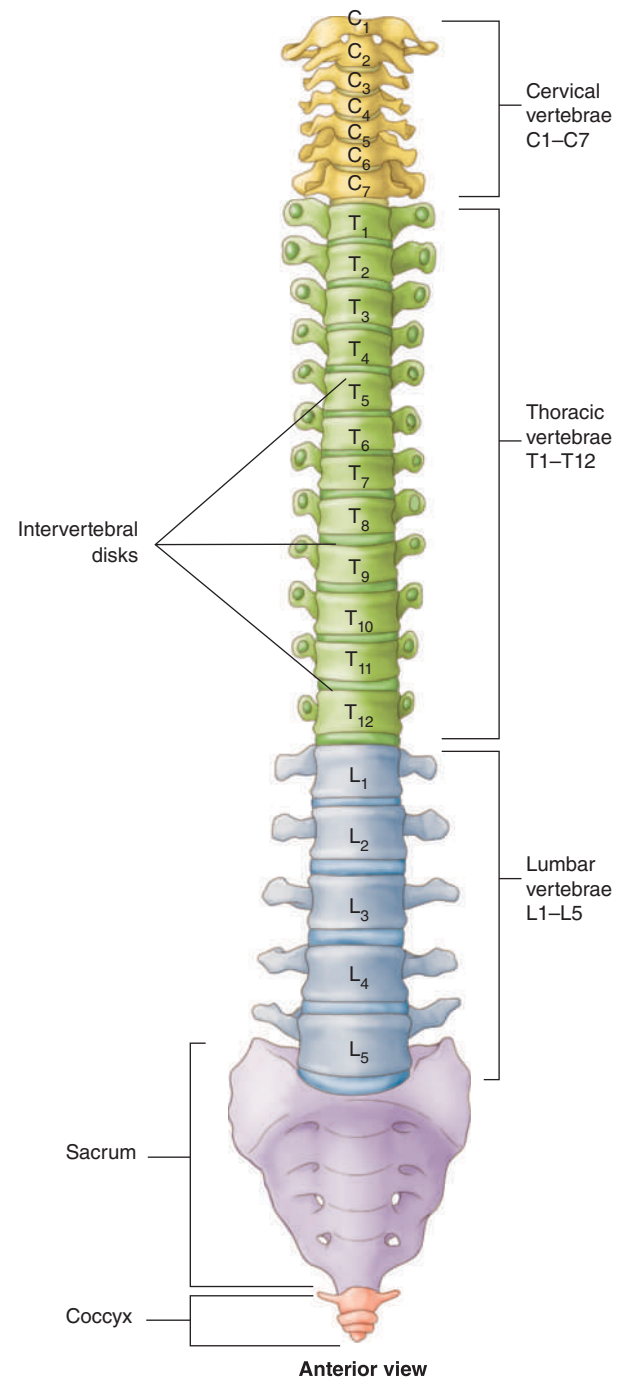


FIGURE 3.10 Characteristics of a typical vertebra.

- The **cervical vertebrae** (SER-vih-kal) are the first set of seven vertebrae, and they form the neck. The term **cervical** means pertaining to the neck, and these vertebrae are also known as **C1** through **C7**.
- The **thoracic vertebrae** (toh-RASS-ick), known as **T1** through **T12**, are the second set of 12 vertebrae. Each of these vertebrae has a pair of ribs attached to it, and together they form the outward curve of the spine. **Thoracic** means pertaining to the thoracic cavity.



(A)

FIGURE 3.11A Anterior view of the vertebral column.

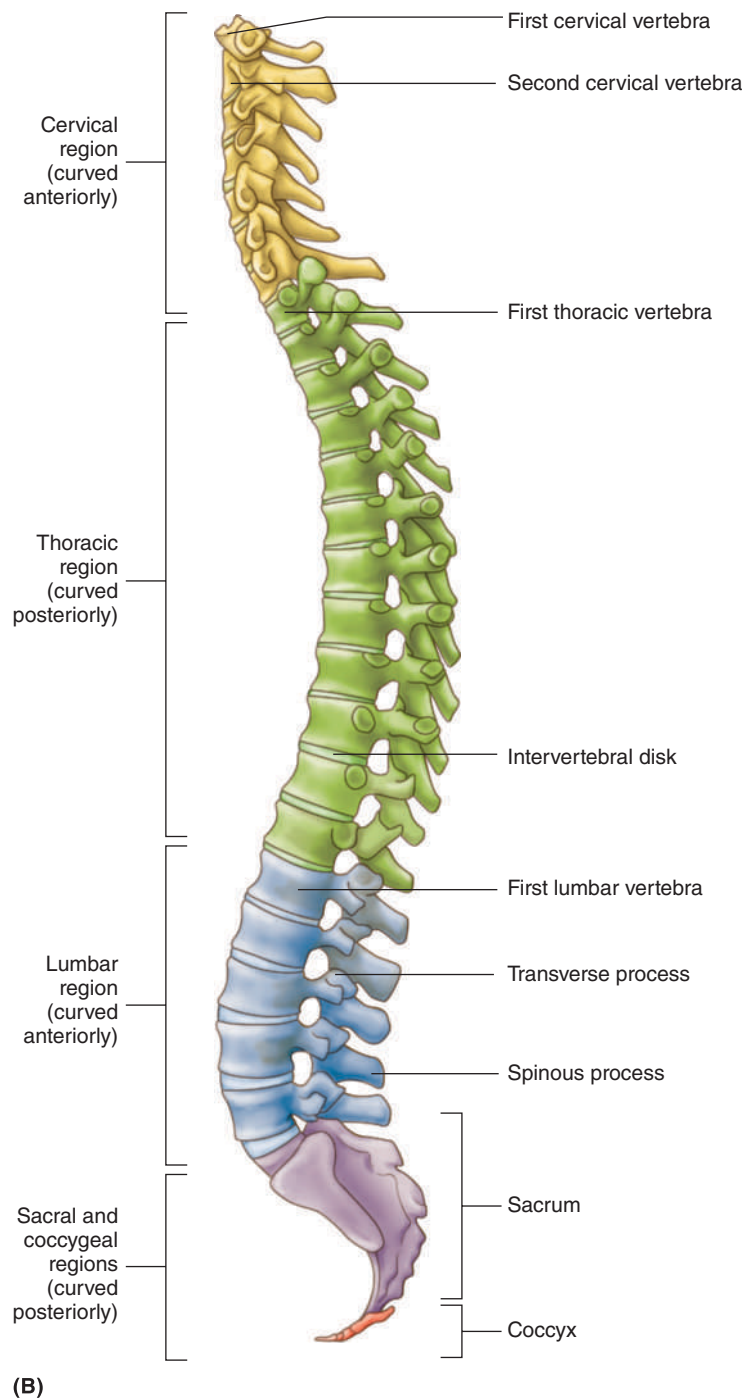


FIGURE 3.11B Lateral view of the vertebral column.

■ The **lumbar vertebrae** (**LUM**-bar), known as **L1** through **L5**, make up the third set of five vertebrae, and together they form the inward curve of the lower spine. These are the largest and strongest of the vertebrae, and they bear most of the body's weight.

Lumbar means relating to the part of the back and sides between the ribs and the pelvis.

The remaining two vertebrae are the sacrum and the coccyx. As you study these structures, refer to Figures 3.11A and 3.11B.

■ The **sacrum** (**SAY**-krum) is the slightly curved, triangular-shaped bone near the base of the spine that forms the lower portion of the back. At birth, the sacrum is composed of five separate bones; however, in the young child, they fuse together to form a single bone.

■ The **coccyx** (**KOCK**-sicks), which is also known as the **tailbone**, forms the end of the spine and is actually made up of four small vertebrae that are fused together. The term *coccyx* comes from the Greek for word for cuckoo, because it was thought that its shape resembled a cuckoo's beak.

The Pelvis

The **pelvis**, also known as the **bony pelvis**, protects internal organs and supports the lower extremities. In addition to the sacrum and coccyx, it includes the **pelvic girdle**, a cup-shaped ring of bone at the lower end of the trunk consisting of the *ilium*, *ischium*, and *pubis* (Figures 3.12 and 3.14).

- The **ilium** (**ILL**-ee-um) is the broad, blade-shaped bone that forms the back and sides of the pubic bone.
- The **sacroiliac** (**say**-kroh-**ILL**-ee-ack) is the slightly movable articulation between the sacrum and posterior portion of the ilium (**sacr/o** means sacrum, **ili** means ilium, and **-ac** means pertaining to).
- The **ischium** (**ISS**-kee-um), which forms the lower posterior portion of the pubic bone, bears the weight of the body when sitting.
- The **pubis** (**PEW**-bis), which forms the anterior portion of the pubic bone, is located just below the urinary bladder.
- At birth the *ilium*, *ischium*, and *pubis* are three separate bones. As the child matures, these bones fuse to form the left and right **pubic bones**, which are held securely together by the pubic symphysis. A **symphysis** is a place where two bones are closely joined.
- The **pubic symphysis** (**PEW**-bik **SIM**-fih-sis) is the cartilaginous joint that unites the left and right pubic bones. A **cartilaginous joint** allows slight movement between bones.

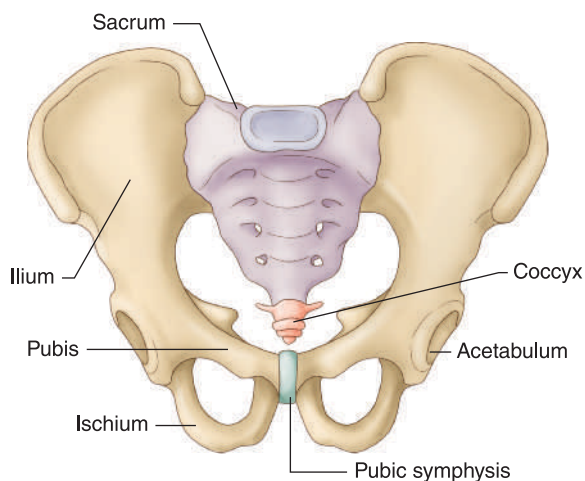


FIGURE 3.12 Anterior view of the pelvis.

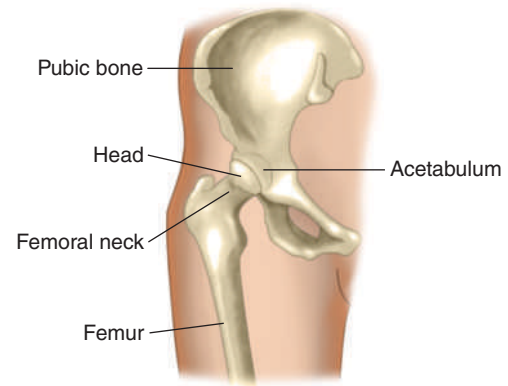


FIGURE 3.13 Structures of the proximal end of the femur and the acetabulum (hip socket).

- The **acetabulum** (**ass**-eh-**TAB**-you-lum), also known as the **hip socket**, is the large circular cavity in each side of the pelvis that articulates with the head of the femur to form the hip joint (Figures 3.12 and 3.14).

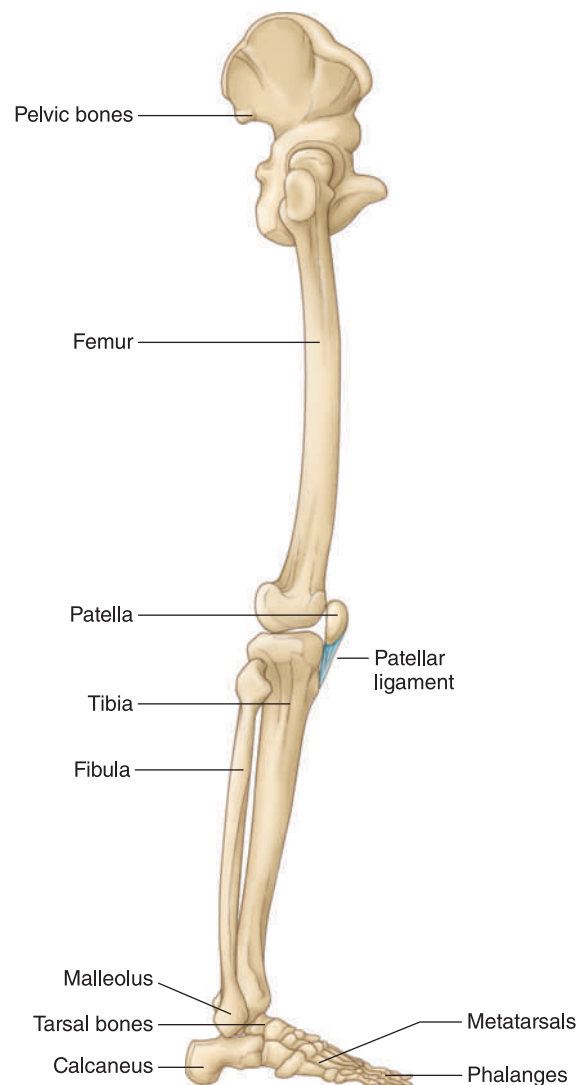


FIGURE 3.14 Lateral view of bones of the lower extremity.

The Legs and Knees

As you study these bones, refer to Figures 3.13 and 3.14.

The Femurs

- The **femurs** (FEE-murz) are the largest bones in the body. *Femoral* means pertaining to the femur.
- These bones are also known as *thigh bones*.
- The *head of the femur* articulates with the acetabulum (hip socket).
- The *femoral neck* is the narrow area just below the head of the femur.

The Knees

- The **patella** (pah-TEL-ah), also known as the *kneecap*, is the bony anterior portion of the knee.
- The term **popliteal** (pop-LIT-ee-al) describes the posterior space behind the knee where the ligaments, vessels, and muscles related to this joint are located.
- The **cruciate ligaments** (KROO-shee-ayt), which are shown in Figure 3.4, make possible the movements of the knee. These are known as the *anterior* and *posterior cruciate ligaments* because they are shaped like a cross.

The Lower Legs

The lower leg is made up of the *tibia* and the *fibula* (Figure 3.14).

- The **tibia** (TIB-ee-ah), also known as the *shinbone*, is the larger anterior weight-bearing bone of the lower leg.
- The **fibula** (FIB-you-lah) is the smaller of the two bones of the lower leg.

The Ankles

- The **ankles** are the joints that connect the lower leg and foot and make the necessary movements possible.
- Each ankle is made up of seven short **tarsal** (TAHR-sal) bones. These bones are similar to the bones of the wrists; however, they are much larger in size (Figure 3.15).
- The **malleolus** (mah-LEE-oh-lus) is a rounded bony projection on the tibia and fibula on the sides of each ankle joint (plural, *malleoli*).
- The **talus** (TAY-luss) is the ankle bone that articulates with the tibia and fibula (Figures 3.15 and 3.17).
- The **calcaneus** (kal-KAY-nee-uss), also known as the *heel bone*, is the largest of the tarsal bones (Figures 3.14 and 3.15).

The Feet and Toes

The feet and toes are made up of the following bones as shown in Figure 3.15.

- The five **metatarsals** (met-ah-TAHR-salz) form that part of the foot to which the toes are attached.
- The **phalanges** are the bones of the toes. The great toe has two phalanges. Each of the other toes has three phalanges. The bones of the fingers are also called phalanges.

MEDICAL SPECIALTIES RELATED TO THE SKELETAL SYSTEM

- A **chiropractor** (KYE-roh-prack-tor) holds a Doctor of Chiropractic (DC) degree and specializes in the manipulative treatment of disorders originating from misalignment of the spine. *Manipulative treatment* involves manually adjusting the positions of the bones.
- An **orthopedic surgeon** (or-thoh-PEE-dick), also known as an *orthopedist*, is a physician who specializes in diagnosing and treating diseases and disorders involving the bones, joints, and muscles.
- An **osteopath** (oss-tee-oh-PATH) holds a Doctor of Osteopathy (DO) degree and uses traditional forms of medical treatment in addition to specializing in treating health problems by spinal manipulation (**oste/o** means bone, and **-path** means disease). This type of medical practice is known as *osteopathy*; however, that term is also used to mean any bone disease.
- A **podiatrist** (poh-DYE-ah-trist) holds a Doctor of Podiatry (DP) or Doctor of Podiatric Medicine (DPM) degree and specializes in diagnosing and treating disorders of the foot (**pod** mean foot, and **-iatrist** means specialist).
- A **rheumatologist** (roo-mah-TOL-oh-jist) is a physician who specializes in the diagnosis and treatment of arthritis and disorders such as osteoporosis, fibromyalgia, and tendinitis that are characterized by inflammation in the joints and connective tissues.

PATHOLOGY OF THE SKELETAL SYSTEM

Joints

- **Ankylosis** (ang-kih-LOH-sis) is the loss or absence of mobility in a joint due to disease, injury, or a surgical procedure (**ankyl** means crooked, bent, or stiff, and **-osis** means abnormal condition or disease). *Mobility* means being capable of movement.

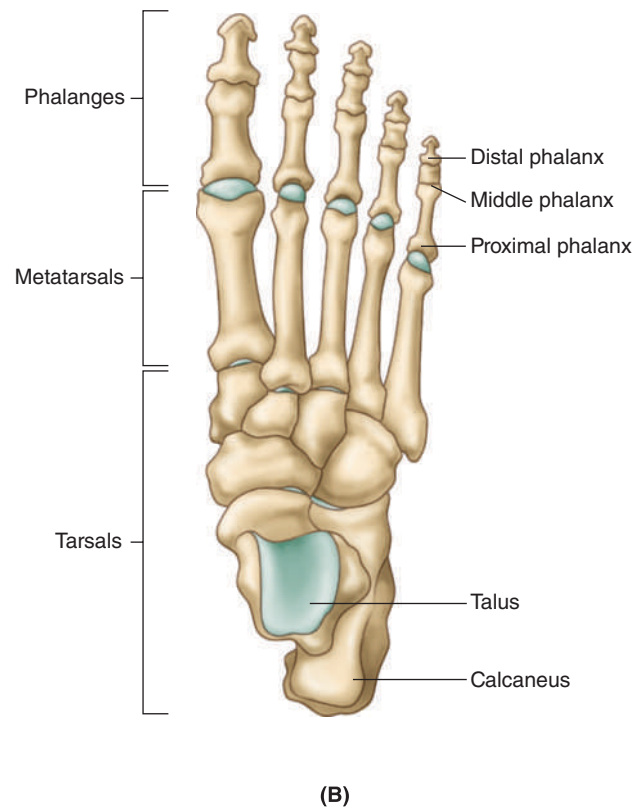
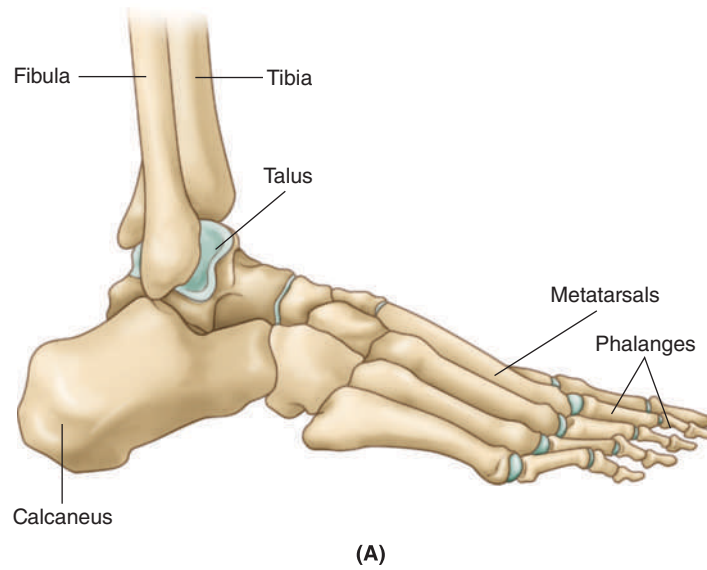


FIGURE 3.15 Bones of the right ankle and foot. (A) Lateral view. (B) Superior view.

- **Adhesive capsulitis** (ad-**HEE**-siv **kap**-suh-**LIE**-tis), also known as *frozen shoulder*, is painful ankylosis of the shoulder (**capsul** means little box, and **-itis** means inflammation). It is caused by *adhesions* (see Chapter 4) forming in the synovial capsule surrounding the shoulder, making the joint become thicker and tighter.
- **Arthrosclerosis** (ar-throh-skleh-**ROH**-sis) is stiffness of the joints, especially in the elderly (**arthr/o**

means joint, and **-sclerosis** means abnormal hardening).

- A **Baker's cyst**, also known as a *popliteal cyst*, is a fluid-filled sac behind the knee. This usually results from a condition such as rheumatoid arthritis triggering the production of excess synovial fluid. The condition is named for British surgeon William Baker.

- **Bursitis** (ber-SIGH-tis) is an inflammation of a bursa (**burs** means bursa, and **-itis** means inflammation).
- **Chondromalacia** (kon-droh-mah-LAY-shee-ah) is the abnormal softening of cartilage (**chondr/o** means cartilage, and **-malacia** means abnormal softening).
- **Costochondritis** (kos-toh-kon-DRIGH-tis) is an inflammation of the cartilage that connects a rib to the sternum (**cost/o** means rib, **chondr** means cartilage, and **-itis** means inflammation).
- **Hallux valgus** (HAL-uks VAL-guss), also known as a **bunion**, is an abnormal enlargement of the joint at the base of the great toe (*hallux* is Latin for big toe, and *valgus* means bent).
- **Hemarthrosis** (hem-ar-THROH-sis) is blood within a joint (**hem** means blood, **arthr** means joint, and **-osis** means abnormal condition or disease). This condition is frequently due to a joint injury. It also can occur spontaneously in patients taking blood-thinning medications or those having a blood clotting disorder such as hemophilia (see Chapters 2 and 5).
- **Polymyalgia rheumatica (PMR)** (pol-ee-my-AL-jee-ah roo-MA-tih-kah) is an inflammatory disorder of the muscles and joints characterized by pain and stiffness in the neck, shoulders, upper arms, and hips and thighs (**poly-** means many, **my** means muscle, and **-algia** means pain). *Rheumatica* is the Latin word for *rheumatism*, an obsolete term for arthritis and other disorders causing pain in the joints and supporting tissue.
- A **sprain** occurs when a ligament that connects bones to a joint is wrenched or torn (see Chapter 4).
- **Synovitis** (sin-oh-VYE-tiss) is inflammation of the synovial membrane that results in swelling and pain of the affected joint (**synov** means synovial membrane, and **-itis** means inflammation). This condition can be

caused by arthritis, trauma, infection, or irritation produced by damaged cartilage.

Dislocation

- **Dislocation**, also known as **luxation** (luck-SAY-shun), is the total displacement of a bone from its joint (Figure 3.16).
- **Subluxation** (sub-luck-SAY-shun) is the partial displacement of a bone from its joint.

Arthritis

- **Arthritis** (ar-THRIGH-tis) is an inflammatory condition of one or more joints (**arthr** means joint, and **-itis** means inflammation). There are more than 100 types of arthritis with many different causes. Some of the more common types of arthritis follow.

Osteoarthritis

Osteoarthritis (oss-tee-oh-ar-THRIGH-tis), (OA) also known as **wear-and-tear arthritis**, is most commonly associated with aging (**oste/o** means bone, **arthr** means joint, and **-itis** means inflammation) (Figure 3.17).

- OA is known as a **degenerative joint disease** because it is characterized by the wearing away of the articular cartilage within the joints. **Degenerative** means the breaking down or impairment of a body part.
- It is also characterized by hypertrophy of bone and the formation of **osteophytes** (OSS-tee-oh-fites), also known as bone spurs.
- **Spondylosis** (spon-dih-LOH-sis) is also known as **spinal osteoarthritis**. This degenerative disorder can cause the loss of normal spinal structure and function (**spondyl** means vertebrae, and **-osis** means abnormal condition or disease).

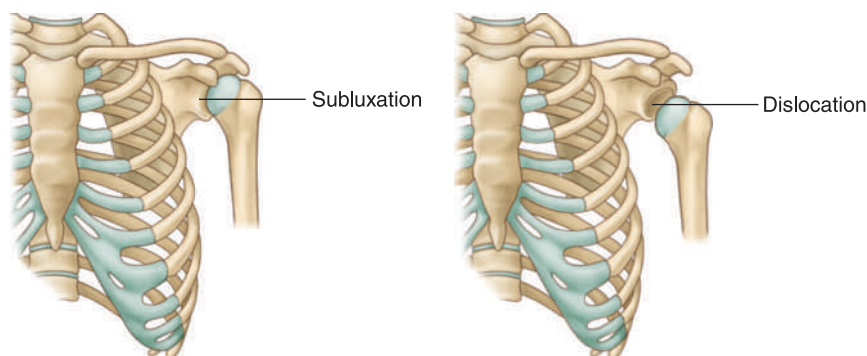


FIGURE 3.16 Subluxation and dislocation shown on an anterior view of the left shoulder. Subluxation is a partial dislocation.

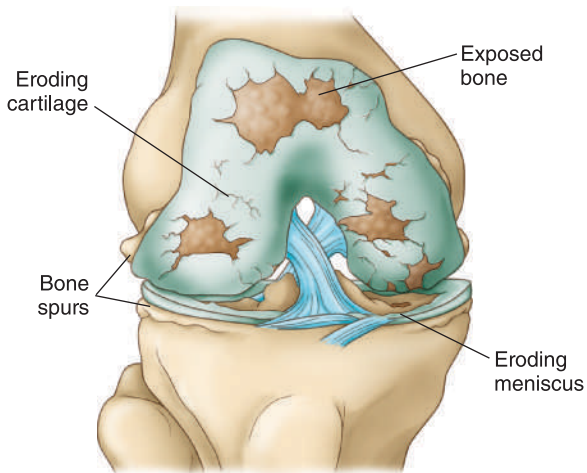


FIGURE 3.17 Damage to the knee joint caused by osteoarthritis.

Gout

Gout (GOWT), also known as *gouty arthritis*, is a type of arthritis characterized by deposits of uric acid crystals in the joints, usually beginning with the big toe. Joints affected by gout are typically warm, red, and excruciatingly sensitive.

Rheumatoid Arthritis

Rheumatoid arthritis (ROO-mah-toyd ar-THRIGH-tis), commonly known as *RA*, is a chronic autoimmune disorder in which the joints and some organs of other body systems are attacked. *Autoimmune disorders* are described in Chapter 6.

- As RA progressively attacks the synovial membranes, they become inflamed and thickened so that the joints are increasingly swollen, painful, and immobile.

Ankylosing Spondylitis

Ankylosing spondylitis (ang-kih-LOH-sing spon-dih-LYE-tis) (AS) is a form of rheumatoid arthritis that primarily causes inflammation of the joints between the vertebrae (**ankylosing** means the progressive stiffening of a joint or joints, **spondyl** means vertebrae, and **-itis** means inflammation). This type of chronic inflammatory back disorders is collectively called *spondyloarthropathies*.

Juvenile Rheumatoid Arthritis

Juvenile rheumatoid arthritis (JRA) is an autoimmune disorder that affects children ages 16 years or younger, with symptoms that include stiffness, pain, joint swelling, skin rash, fever, slowed growth, and fatigue. Many children with JRA outgrow it.

The Spinal Column

- A **herniated disk (HER-nee-ayt-ed)**, also known as a *slipped* or *ruptured disk*, is the breaking apart of an intervertebral disk that results in pressure on spinal nerve roots (Figure 3.18B).
- **Lumbago (lum-BAY-goh)**, also known as *low back pain*, is pain of the lumbar region of the spine (**lumb** means lumbar, and **-ago** means diseased condition).
- **Spondylolisthesis (spon-dih-loh-liss-THEE-sis)** is the forward slipping movement of the body of one of the lower lumbar vertebrae on the vertebra or sacrum below it (**spondyl/o** means vertebrae, and **-listhesis** means slipping).

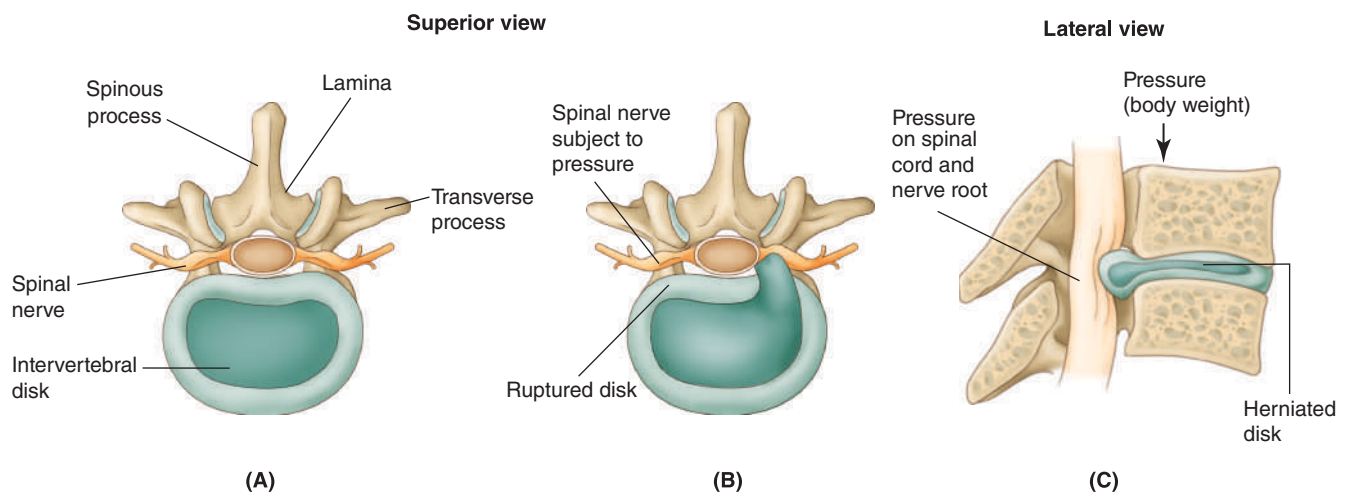


FIGURE 3.18 (A) Superior view of a normal intervertebral disk. (B) Superior and (C) lateral views of a ruptured disk causing pressure on a spinal nerve.

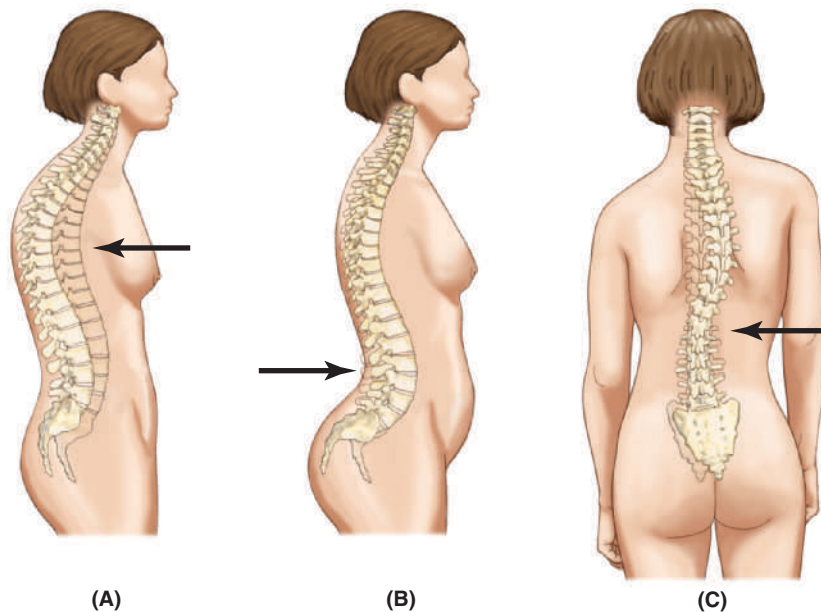


FIGURE 3.19 Abnormal curvatures of the spine. (A) Kyphosis. (B) Lordosis. (C) Scoliosis. (Normal curvatures are shown in shadow.)

- **Spina bifida** (SPY-nah BIF-ih-dah) is a congenital defect that occurs during early pregnancy when the spinal canal fails to close completely around the spinal cord to protect it. *Spina* means pertaining to the spine. *Bifida* means split. Some cases of spina bifida are due to a lack of the nutrient folic acid during the early stages of pregnancy.

Curvatures of the Spine

- **Kyphosis** (kye-FOH-sis) is an abnormal increase in the outward curvature of the thoracic spine as viewed from the side (**kyph** means hump, and **-osis** means abnormal condition or disease). This condition, also known as *humpback* or *dowager's hump*, is frequently associated with aging (Figure 3.19A).
- **Lordosis** (lor-DOH-sis) is an abnormal increase in the forward curvature of the lumbar spine (**lord** means bent backward, and **-osis** means abnormal condition or disease). This condition is also known as *swayback* (Figure 3.19B).
- **Scoliosis** (skoh-lee-OH-sis) is an abnormal lateral (sideways) curvature of the spine (**scoli** means curved, and **-osis** means abnormal condition or disease) (Figure 3.19C).

Media Link

View the **Curvatures of the Spine** animation on the Online Resources.

Bones

- **Avascular necrosis**, also known as *osteonecrosis*, is an area of bone tissue death caused by insufficient blood flow (**a-** means without, **vascul** means blood vessels, and **-ar** means pertaining to; and **necrosis** means tissue death). It most commonly occurs in the hip joint, and often requires a hip replacement.
- **Craniosostenosis** (kray-nee-oh-steh-NOH-sis) is a malformation of the skull due to the premature closure of the cranial sutures (**crani/o** means skull, and **-stenosis** means abnormal narrowing).
- **Osteitis** (oss-tee-EYE-tis), also spelled *ostitis*, is an inflammation of a bone (**oste** means bone, and **-itis** means inflammation).
- **Osteomalacia** (oss-tee-oh-mah-LAY-shee-ah), also known as *adult rickets*, is abnormal softening of bones in adults (**oste/o** means bone, and **-malacia** means abnormal softening). This condition is usually caused by a deficiency of vitamin D, calcium, and/or phosphate. Compare with *rickets*, below.
- **Osteomyelitis** (oss-tee-oh-my-eh-LYE-tis) is an inflammation of the bone marrow and adjacent bone (**oste/o** means bone, **myel** means bone marrow, and **-itis** means inflammation). The bacterial infection that causes osteomyelitis often originates in another part of the body and spreads to the bone via the blood.
- **Paget's disease** (PAJ-its) is a chronic bone disease of unknown cause named for Sir James Paget. The condition is characterized by the abnormal breakdown of bone, usually in the pelvis, skull, spine and legs,

followed by abnormal bone formation. The new bone is often structurally enlarged, misshapen and weak.

- **Periostitis** (**pehr-ee-oss-TYE-tis**) is an inflammation of the periosteum (**peri-** means surrounding, **ost** means bone, and **-itis** means inflammation). This condition is often associated with shin splints, which are discussed in Chapter 4.
- **Rickets** (**RICK-ets**) is a deficiency disease occurring in children. This condition is characterized by defective bone growth resulting from a lack of vitamin D necessary for the body to maintain calcium and phosphorus levels in the bones. Although rickets is uncommon in the United States, its incidence is increasing.
- **Short stature**, formerly known as *dwarfism*, is a condition resulting from the failure of the bones of the limbs to grow to an appropriate length compared to the size of the head and trunk. More than 200 different conditions can cause short stature, which is defined as an average adult height of no more than 4 feet 10 inches. Some adults of short stature prefer to be referred to as *little people*.
- The term **talipes** (**TAL-ih-pee-z**), which is also known as *clubfoot*, describes any congenital deformity of the foot involving the talus (ankle bones).

Bone Tumors

- **Primary bone cancer** is a relatively rare malignant tumor that originates in a bone. *Malignant* means becoming progressively worse and life-threatening. For example, *Ewing's sarcoma* is a tumor that occurs in the bones of the upper arm, legs, pelvis, or rib. The peak incidence for the development of this condition is between ages 10 and 20 years.
- The term **secondary bone cancer** describes tumors that have metastasized (spread) to bones from other organs such as the breasts and lungs. Malignancies, sarcomas, and tumors are further discussed in Chapter 6.
- A **myeloma** (**my-eh-LOH-mah**) is a type of cancer that occurs in blood-making cells found in the red bone marrow (**myel** means bone marrow, and **-oma** means tumor). This condition can cause pathologic fractures and is often fatal.
- An **osteochondroma** (**oss-tee-oh-kon-DROH-mah**) is a benign bony projection covered with cartilage (**oste/o** means bone, **chondr** means cartilage, and **-oma** means tumor). *Benign* means something that is not life-threatening and does not recur. This type of tumor is also known as an *exostosis* (plural, *exostoses*).

Osteoporosis and Osteopenia Compared

Osteoporosis (**oss-tee-oh-poh-ROH-sis**) (OP) is a marked loss of bone density and an increase in bone porosity that is frequently associated with aging (**oste/o** means bone, **por** means small opening, and **-osis** means abnormal condition or disease).

Osteopenia (**oss-tee-oh-PEE-nee-ah**) is thinner-than-average bone density (**oste/o** means bone, and **-penia** means deficiency). This term is used to describe the condition of someone who does not yet have osteoporosis but has a greater-than-average chance of developing it. Risk factors for osteopenia include aging, smoking, drinking, and a lack of calcium in the diet. Young females who do not consume enough calories may also develop the condition.

Osteoporosis-Related Fractures

Osteoporosis is primarily responsible for three types of fractures:

- A **compression fracture**, also known as a *vertebral crush fracture*, occurs when the bone is pressed together (compressed) on itself. These fractures are sometimes caused by the spontaneous collapse of weakened vertebrae or can be due to an injury. This results in pain, loss of height, and development of the spinal curvature known as *dowager's hump*.
- A **Colles' fracture**, which is named for the Irish surgeon Abraham Colles, is also known as a *fractured wrist*. This fracture occurs at the lower end of the radius when a person tries to stop a fall by landing on his or her hands. The impact of this fall causes the bone weakened by osteoporosis to break (Figure 3.20).



FIGURE 3.20 A Colles' fracture of the left wrist.

- An **osteoporotic hip fracture** (oss-tee-oh-pah-ROT-ick), also known as a **broken hip**, is usually caused by weakening of the bones due to osteoporosis and can occur either spontaneously or as the result of a fall. Complications from these fractures can result in the loss of function, mobility, and independence, or death. *Osteoporotic* means pertaining to or caused by the porous condition of bones.

Fractures

A **fracture**, which is a **broken bone**, is described in terms of its complexity. As you study this section, follow Figure 3.21.

- A **closed fracture**, also known as a **simple fracture** or a **complete fracture**, is one in which the bone is broken, but there is no open wound in the skin (see also Figure 3.22).
- An **open fracture**, also known as a **compound fracture**, is one in which the bone is broken and there is an open wound in the skin.
- A **comminuted fracture** (KOM-ih-newt-ed) is one in which the bone is splintered or crushed. Comminuted means crushed into small pieces.
- A **greenstick fracture**, or **incomplete fracture**, is one in which the bone is bent and only partially broken. This type of fracture occurs primarily in children.
- An **oblique fracture** occurs at an angle across the bone.
- A **pathologic fracture** occurs when a weakened bone breaks under normal strain. This is due to bones being



FIGURE 3.22 A radiograph showing an anteroposterior (AP) view of a closed fracture of the femur.

weakened by osteoporosis or a disease process such as cancer.

- A **spiral fracture** is a fracture in which the bone has been twisted apart. This type of fracture occurs as the result of a severe twisting motion such as in a sports injury.
- A **stress fracture**, which is an overuse injury, is a small crack in the bone that often develops from chronic,

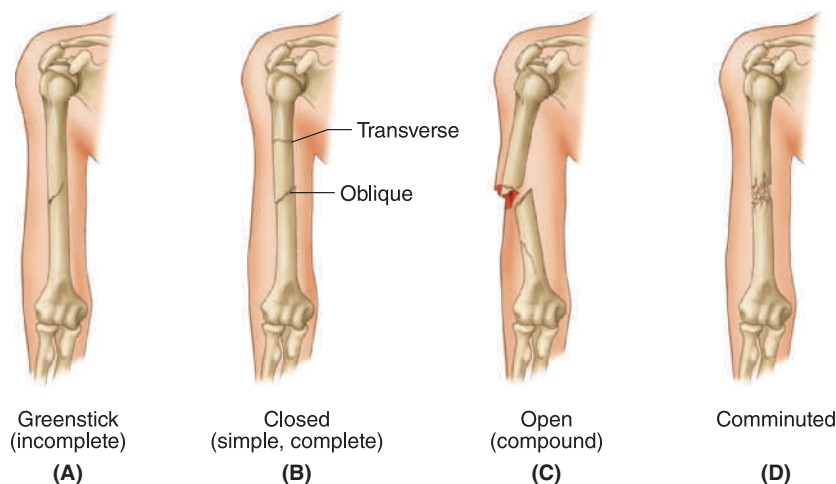


FIGURE 3.21 Types of bone fractures. (A) Greenstick (incomplete). (B) Closed (simple, complete). (C) Open (compound). (D) Comminuted.

excessive impact. Additional overuse and sports injuries are discussed in Chapter 4.

- A **transverse fracture** occurs straight across the bone.

Additional Terms Associated with Fractures

- A **fat embolus** (EM-boh-lus) can form when a long bone is fractured and fat cells from yellow bone marrow are released into the blood. An **embolus** is any foreign matter circulating in the blood that can become lodged and block the blood vessel.
- **Crepitation** (krep-ih-TAY-shun), also known as **crepitus**, is the grating sound heard when the ends of a broken bone move together. This term refers to any unusual crackling sound or sensation within the body. It is frequently used to describe the popping or clicking sound heard in the movements of some joints.
- As the bone heals, a **callus** (KAL-us) forms as a bulging deposit around the area of the break. This tissue eventually becomes bone. A **callus** is also a thickening of the skin caused by repeated rubbing.

DIAGNOSTIC PROCEDURES OF THE SKELETAL SYSTEM

- A **radiograph**, also known as an **x-ray**, is the use of x-radiation to visualize bone fractures and other abnormalities (Figure 3.22). An x-ray might be done on a child to determine bone age, which can help diagnose a growth problem.
- **Arthroscopy** (ar-THROS-koh-pee) is the visual examination of the internal structure of a joint (**arthr/o** means joint, and **-scopy** means visual examination) using an **arthroscope**.
- A **bone marrow biopsy** is a diagnostic test that may be necessary after abnormal types or numbers of red or white blood cells are found in a complete blood count test.
- **Bone marrow aspiration** is the use of a syringe to withdraw tissue from the red bone marrow. This procedure is used to obtain tissue for diagnostic purposes or to collect bone marrow for medical procedures such as stem cell transplantation.
- **Magnetic resonance imaging** (MRI) is used to image soft tissue structures such as the interior of complex joints. It is not the most effective method of imaging hard tissues such as bone.

- **Bone scans** and **arthrocentesis**, which are additional diagnostic procedures, are discussed in Chapter 15.

Bone Density Testing

Bone density testing (BDT) is used to determine losses or changes in bone density. These tests are used to diagnose conditions such as osteoporosis, osteomalacia, osteopenia, and Paget's disease.

- **Ultrasonic bone density testing** is a screening test for osteoporosis or other conditions that cause a loss of bone mass. In this procedure, sound waves are used to take measurements of the calcaneus (heel) bone. If the results indicate risks, more definitive testing is indicated.
- **Dual x-ray absorptiometry** (ab-sorp-shee-OM-eh-tree) (DXA) is a low-exposure radiographic measurement of the spine and hips to measure bone density. This test produces more accurate results than ultrasonic bone density testing.

TREATMENT PROCEDURES OF THE SKELETAL SYSTEM

Bone Marrow Transplants

A **bone marrow transplant** (BMT) is used to treat certain types of cancers, such as leukemia and lymphomas, which affect bone marrow. Leukemia is discussed in Chapter 5, and lymphomas are discussed in Chapter 6.

- In this treatment, initially both the cancer cells and the patient's bone marrow are destroyed with high-intensity radiation and chemotherapy.
- Next, healthy bone marrow stem cells are transfused into the recipient's blood. These cells migrate to the spongy bone, where they multiply to form cancer-free red bone marrow. **Stem cells** produced by the bone marrow eventually develop into blood cells. See Chapter 2 for more information on stem cells.

Types of Bone Marrow Transplants

An **allogenic bone marrow transplant** uses healthy bone marrow cells from a compatible donor, often a sibling. However, unless this is a perfect match, there is the danger that the recipient's body will reject the transplant. **Allogenic** (al-oh-JEN-ick) means originating within another.

In an **autologous bone marrow transplant**, the patient receives his or her own bone marrow cells, which have been harvested, cleansed, treated, and stored before

the remaining bone marrow in the patient's body is destroyed. **Autologous** (aw-TOL-uh-guss) means originating within an individual.

Medical Devices

- An **orthotic** (or-THOT-ick) is a mechanical appliance, such as a shoe insert, leg brace, or a splint, which is specially designed to control, correct, or compensate for impaired limb function.
- A **prosthesis** (pros-THEE-sis) is a substitute for a diseased or missing body part, such as a leg that has been amputated (plural, *prostheses*).

Joints

- **Arthrodesis** (ar-throh-DEE-sis), also known as *surgical ankylosis*, is the surgical fusion (joining together) of two bones to stiffen a joint, such as an ankle, elbow, or shoulder (**arthr/o** means joint, and **-desis** means to bind, tie together). This procedure is performed to treat severe arthritis or a damaged joint. Compare with *arthrolysis*.
- **Arthrolysis** (ar-THROL-ih-sis) is the surgical loosening of an ankylosed joint (**arthr/o** means joint, and **-lysis** means loosening or setting free). *Note:* The suffix **-lysis** also means breaking down or destruction and may indicate either a pathologic state or a therapeutic procedure. Compare with *arthrodesis*.

- **Arthroscopic surgery** (ar-throh-SKOP-ick) is a minimally invasive procedure for the treatment of the interior of a joint. For example, torn cartilage can be removed with the use of an arthroscope and instruments inserted through small incisions (Figure 3.23).
- **Chondroplasty** (KON-droh-plas-tee) is the surgical repair of damaged cartilage (**chondr/o** means cartilage, and **-plasty** means surgical repair).
- A **synovectomy** (sin-oh-VECK-toh-mee) is the surgical removal of a synovial membrane from a joint (**synov** means synovial membrane, and **-ectomy** means surgical removal). One use of this procedure, which can be performed endoscopically, is to repair joint damage caused by rheumatoid arthritis.

Joint Replacements

Based on its word parts, the term **arthroplasty** (AR-throh-plas-tee) means the surgical repair of a damaged joint (**arthr/o** means joint, and **-plasty** means surgical repair); however, this term has come to mean the surgical placement of an artificial joint. These procedures are named for the involved joint and the amount of the joint that is replaced (Figures 3.24 and 3.25).

- The joint replacement part is a prosthesis that is commonly referred to as an *implant*.



FIGURE 3.23 During arthroscopic surgery, the physician is able to view the interior of the knee on a monitor.

- A **total knee replacement** (TKR) means that all of the parts of the knee were replaced. This procedure is also known as a **total knee arthroplasty** (Figure 3.24).
- A **partial knee replacement** (PKR) describes a procedure in which only part of the knee is replaced.
- A **total hip replacement** (THR), also known as a **total hip arthroplasty**, is performed to restore a damaged hip to full function. During the surgery, a plastic lining is fitted into the acetabulum to restore a smooth surface. The head of the femur is removed and replaced with a metal ball attached to a metal shaft that is fitted into the femur (see Figure 3.25). These smooth surfaces restore the function of the hip joint.
- **Hip resurfacing** is an alternative to removing the head of the femur. Function is restored to the hip by placing a metal cap over the head of the femur to allow it to move smoothly over a metal lining in the acetabulum.
- **Revision surgery** is the replacement of a worn or failed implant.

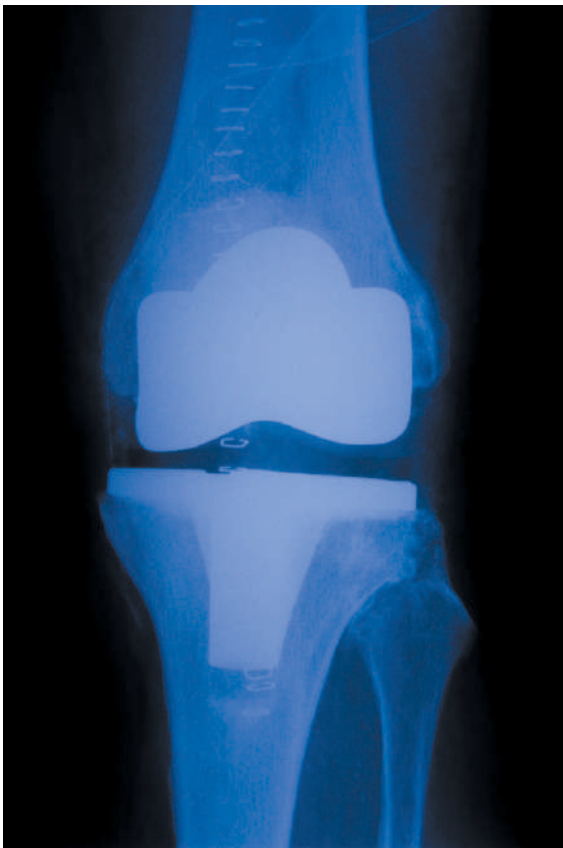


FIGURE 3.24 Radiograph (x-ray) of a total knee replacement. On the film the metallic components appear lighter than the bone.

Spinal Column

- A **percutaneous discectomy** (**per**-kyou-TAY-nee-us **dis**-KECK-toh-mee) is performed to treat a herniated intervertebral disk. In this procedure, a thin tube is inserted through the skin of the back to suction out the ruptured disk or to vaporize it with a laser. **Percutaneous** means performed through the skin.
- **Percutaneous vertebroplasty** (**per**-kyou-TAY-nee-us **VER**-tee-broh-**plas**-tee) is performed to treat osteoporosis-related compression fractures (**vertebr/o** means vertebra, and **-plasty** means surgical repair). In this minimally invasive procedure, bone cement is injected to stabilize compression fractures within the spinal column.
- A **laminectomy** (**lam**-ih-NECK-toh-mee) is the surgical removal of a lamina or posterior portion of a vertebra (**lamin** means lamina, and **-ectomy** means surgical removal).
- **Spinal fusion** is a technique to immobilize part of the spine by joining together (fusing) two or more vertebrae. **Fusion** means to join together.

Bones

- A **craniectomy** (**kray**-nee-EK-toh-mee) is the surgical removal of a portion of the skull (**crani** means skull, and **-ectomy** means surgical removal). This procedure is performed to treat craniostenosis or to relieve increased intracranial pressure due to swelling of the

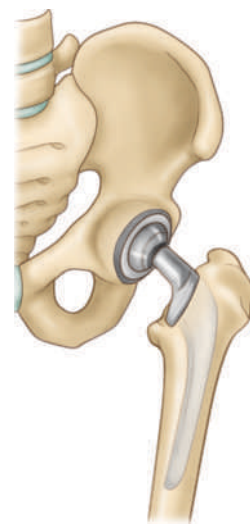


FIGURE 3.25 Total hip replacement (THR).

brain. The term *intracranial pressure* describes the amount of pressure inside the skull.

- A **craniotomy** (**k**ray-nee-**OT**-oh-mee) is a surgical incision or opening into the skull (**crani** means skull, and **-otomy** means a surgical incision). This procedure is performed to gain access to the brain to remove a tumor, to relieve intracranial pressure, or to obtain access for other surgical procedures.
- A **cranioplasty** (**K**RAY-nee-oh-**plas**-tee) is the surgical repair of the skull (**crani/o** means skull, and **-plasty** means surgical repair).
- **Osteoclasis** (**oss**-tee-**O**CK-lah-sis) is the surgical fracture of a bone to correct a deformity (**oste/o** means bone, and **-clasis** means to break).
- An **ostectomy** (**oss**-**TE**CK-toh-mee) is the surgical removal of bone (**ost** means bone, and **-ectomy** means the surgical removal).
- **Osteorrhaphy** (**oss**-tee-**OR**-ah-fee) is the surgical suturing, or wiring together, of bones (**oste/o** means bone, and **-rrhaphy** means surgical suturing).
- **Osteotomy** (**oss**-tee-**OT**-oh-mee) is the surgical cutting of a bone (**oste** means bone, and **-otomy** means a surgical incision). This may include removing part or all of a bone, or cutting into or through a bone.
- A **periosteotomy** (**pehr**-ee-**oss**-tee-**OT**-oh-mee) is an incision through the periosteum to the bone (**peri**- means surrounding, **oste** means bone, and **-otomy** means surgical incision).

Treatment of Fractures

- **Closed reduction**, also known as *manipulation*, is the attempted realignment of the bone involved in a fracture or joint dislocation. The affected bone is returned to its normal anatomic alignment by manually applied force and then is usually immobilized to maintain the realigned position during healing.
- When a closed reduction is not practical, a surgical procedure known as an *open reduction* is required to realign the bone parts.

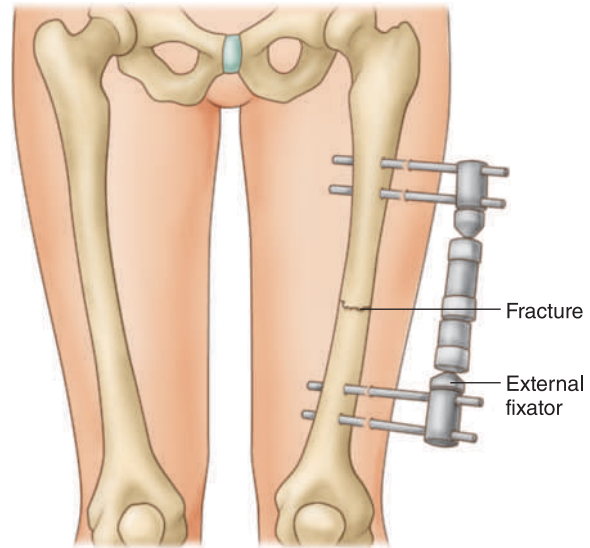


FIGURE 3.26 External fixation of the femur stabilizes the bone and is removed after the bone has healed.

- **Immobilization**, also known as *stabilization*, is the act of holding, suturing, or fastening the bone in a fixed position with strapping or a cast.
- **Traction** is a pulling force exerted on a limb in a distal direction in an effort to return the bone or joint to normal alignment.

External and Internal Fixation

- **External fixation** is a fracture treatment procedure in which pins are placed through the soft tissues and bone so that an external appliance can be used to hold the pieces of bone firmly in place during healing. When healing is complete, the appliance is removed (Figure 3.26).
- **Internal fixation**, also known as *open reduction internal fixation* (ORIF), is a fracture treatment in which a plate or pins are placed directly into the bone to hold the broken pieces in place. This form of fixation is *not* usually removed after the fracture has healed (Figure 3.27).

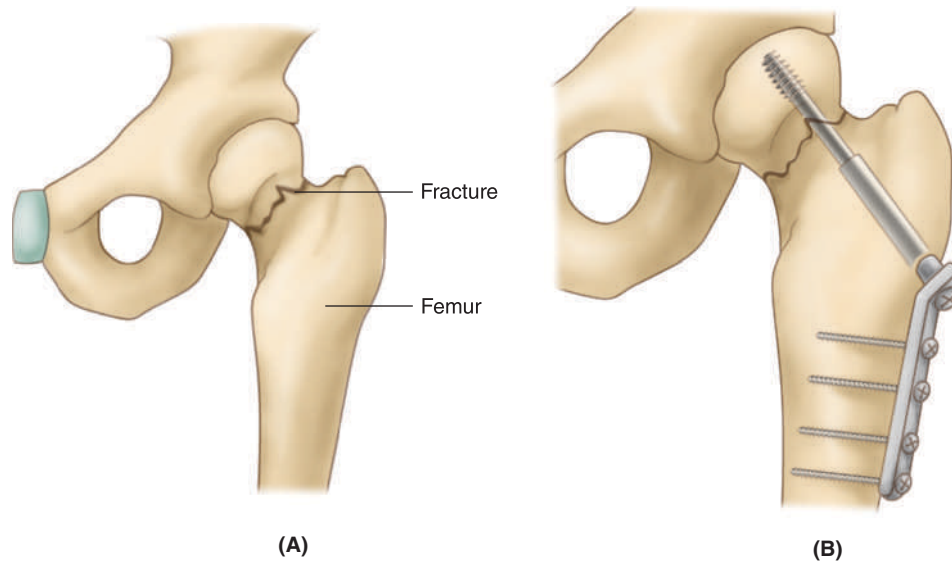


FIGURE 3.27 Internal fixation of fractured hip. (A) Fracture of the femoral neck. (B) Internal fixation pins are placed to stabilize the bone. These pins are not removed after the bone has healed.

ABBREVIATIONS RELATED TO THE SKELETAL SYSTEM

Table 3.1 presents an overview of the abbreviations related to the terms introduced in this chapter. *Note:* To avoid errors or confusion, always be cautious when using abbreviations.

Workbook Practice

Go to your workbook and complete the exercises for this chapter.



TABLE 3.1

Abbreviations Related to the Skeletal System

bone density testing = BDT	BDT = bone density testing
closed reduction = CR	CR = closed reduction
fracture = Fx	Fx = fracture
osteoarthritis = OA	OA = osteoarthritis
osteoporosis = OP	OP = osteoporosis
partial knee replacement = PKR	PKR = partial knee replacement
polymyalgia rheumatica = PMR	PMR = polymyalgia rheumatica
rheumatoid arthritis = RA	RA = rheumatoid arthritis
total hip arthroplasty = THA	THA = total hip arthroplasty
total knee arthroplasty = TKA	TKA = total knee arthroplasty

CAREER OPPORTUNITIES

In addition to the medical specialties already discussed, some of the health occupations involving the treatment of the skeletal system are:

- **First responder:** an emergency service worker extensively trained in first aid procedures, but without the specialized skills of an EMT.
- **Emergency medical technician (EMT):** responds to 911 calls, assesses, stabilizes, and transports patients to the hospital. EMTs provide emergency treatment of injuries such as bones broken in accidents or falls, as well as many other medical crises.
- **Paramedic (EMT-P):** an EMT with additional training, authorized to provide advanced pre-hospital treatment such as in-depth patient assessment, EKG interpretation, and drug administration.
- **Prosthetist:** creates artificial substitutions for external body parts such as an arm, a foot, or an eye.
- **Pedorthist:** a specialist in using shoe modifications, foot orthotics, and other pedorthic devices to solve problems in or related to the foot and lower leg (ped/o means “foot”).
- **Podiatric medical assistant:** makes castings of feet, takes x-rays, and assists the podiatrist in surgery.
- **Orthopedic assistant:** works under the supervision of a physician or therapist in the field of sports medicine or orthopedics, performing diagnostic tests and treating injuries with bandaging, casting, and rehabilitation exercises.

HEALTH PROFESSION PROFILE PARAMEDIC

Brian P. Smith, NREMT-P, is a Paramedic.

I have been in emergency medical services for over two decades. After I obtained my EMT-Basic certification, I began volunteering as a reserve medic. After 6 months, I got my first job in EMS and have been working ever since. I obtained Emergency Technician Intermediate certification a year later and fell in love with emergency medicine as a career. The next step was to enroll in a program to become a nationally registered EMT-Paramedic.

I have worked for Piedmont Medical Center EMS for 16 years and have had the opportunity to take advantage of higher level training. The thing I like most about EMS is that no day is exactly like the previous day, so this continuing education is invaluable. There are many different avenues for an EMT or Paramedic to obtain employment. As a Paramedic I also work for International Speedway Corporation as a supervisor at Darlington Raceway. Having the ability to help people makes this career very fulfilling.



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CHAPTER 3 STUDY BREAK

Do you know anyone who can bend his or her thumbs back to the wrist? Who can lie flat on the floor with both knees bent backward? We would usually say that these people are *double jointed*, although of course they don't have two joints instead of one. These few individuals simply have limb and finger joints that are much more flexible than most people's. The medical term **hypermobility**, made up of the word part **hyper-** (meaning "excessive") added to the word **mobility** is sometimes used to describe this syndrome.

However, being double-jointed is not really excessive or even really a syndrome. It simply means that a person naturally has a greater range of joint movement than most others. Some people are born with a tendency toward hypermobility. This tendency can be either ignored or strengthened through exercise and stretching for certain types of gymnastic and dance performances.

REVIEW TIME

Write the answers to the following questions on a separate piece of paper or in your notebook. In addition, be prepared to take part in the classroom discussion.

1. **Written Assignment:** Describe the primary characteristics of these types of fractures: (1) **comminuted**, (2) **compression**, and (3) **pathologic**.

Discussion Assignment: Give two examples of situations when a pathologic fracture might occur.

2. **Written Assignment:** Describe the difference between **osteopenia** and **osteoporosis**.

Discussion Assignment: Use your knowledge of word parts to explain how you can see the difference between these two words.

3. **Written Assignment:** Describe the type of arthritis that is an autoimmune disorder rather than one associated with aging.

Discussion Assignment: Describe the type of arthritis associated with aging.

4. **Written Assignment:** Describe the two types of bone marrow transplant, **allogenic** and **autologous**, in terms a patient will understand.

Discussion Assignment: What are some of the benefits of using the patient's own bone marrow?

5. Mrs. Valdez has a compression fracture of her spine. Her doctor has decided to do a **percutaneous vertebroplasty**.

Written Assignment: Explain this procedure in terms that Mrs. Valdez and her family will understand.

Discussion Assignment: What does the term **percutaneous** refer to?



OPTIONAL INTERNET ACTIVITY

The goal of this activity is to help you learn more about medical terminology as it applies to the “real world.” Select one of the two options below and follow the instructions.

1. Search for information about **osteopenia**. Write a brief (one- or two-paragraph) report on the importance of early detection and the prevention of this disorder, and include the address of the website where you found your information.
2. To learn more about the 100 forms of **arthritis**, go to the website of the Arthritis Foundation. Write a brief (one- or two-paragraph) report on at least two forms of arthritis that are not mentioned in your text.



The Human Touch

CRITICAL THINKING EXERCISE

The following story and questions are designed to stimulate critical thinking through class discussion or as a brief essay response. There are no right or wrong answers to these questions.

Dr. Johnstone didn't like what he saw. The x-rays of Gladys Gwynn's hip showed a fracture of the femoral neck and severe osteoporosis of the hip. Mrs. Gwynn had been admitted to the orthopedic ward of Hamilton Hospital after a fall that morning at Sunny Meadows, an assisted-living facility. The accident had occurred when Sheri Smith, a new aide, lost her grip while helping Mrs. Gwynn in the shower.

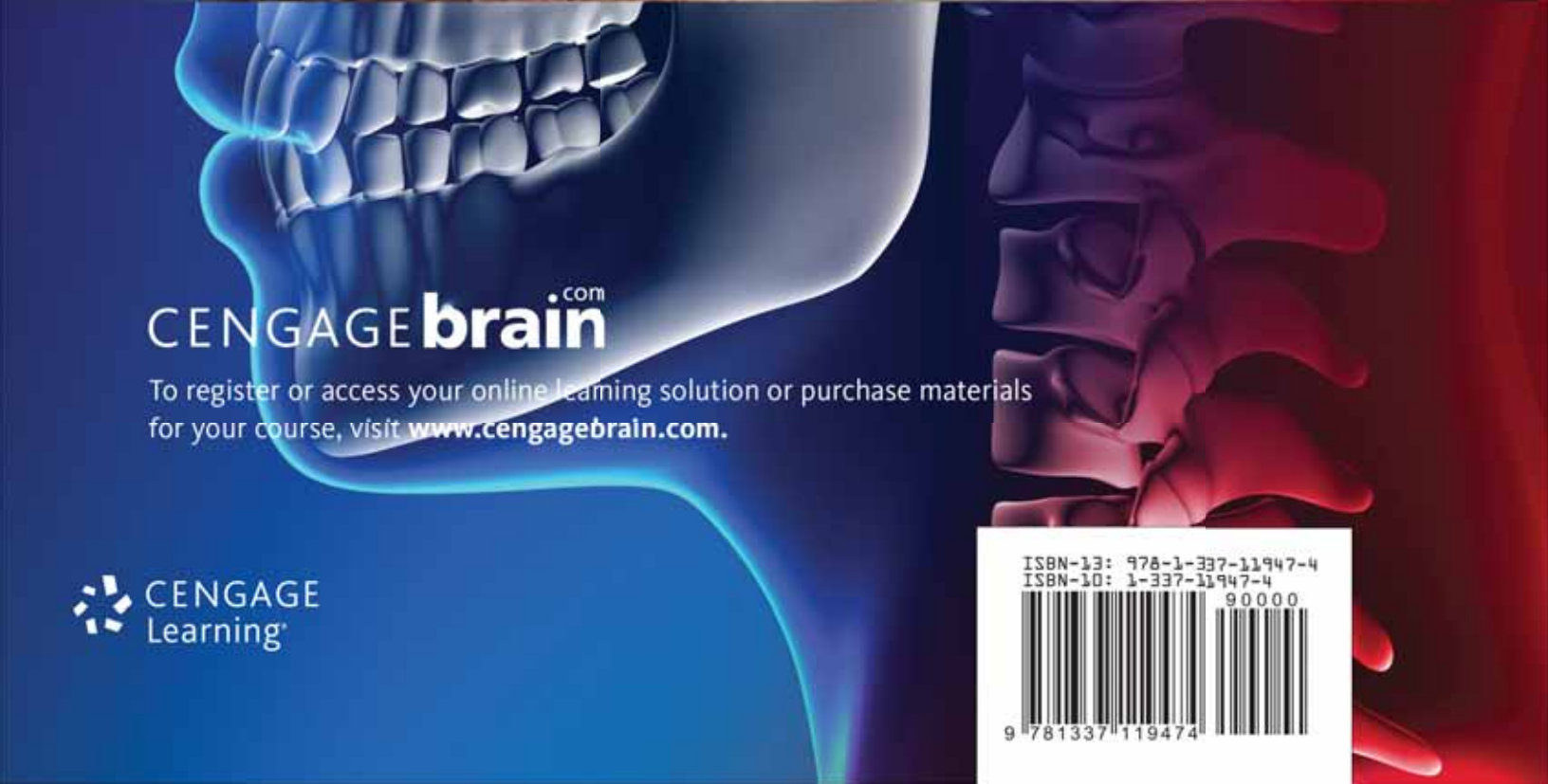
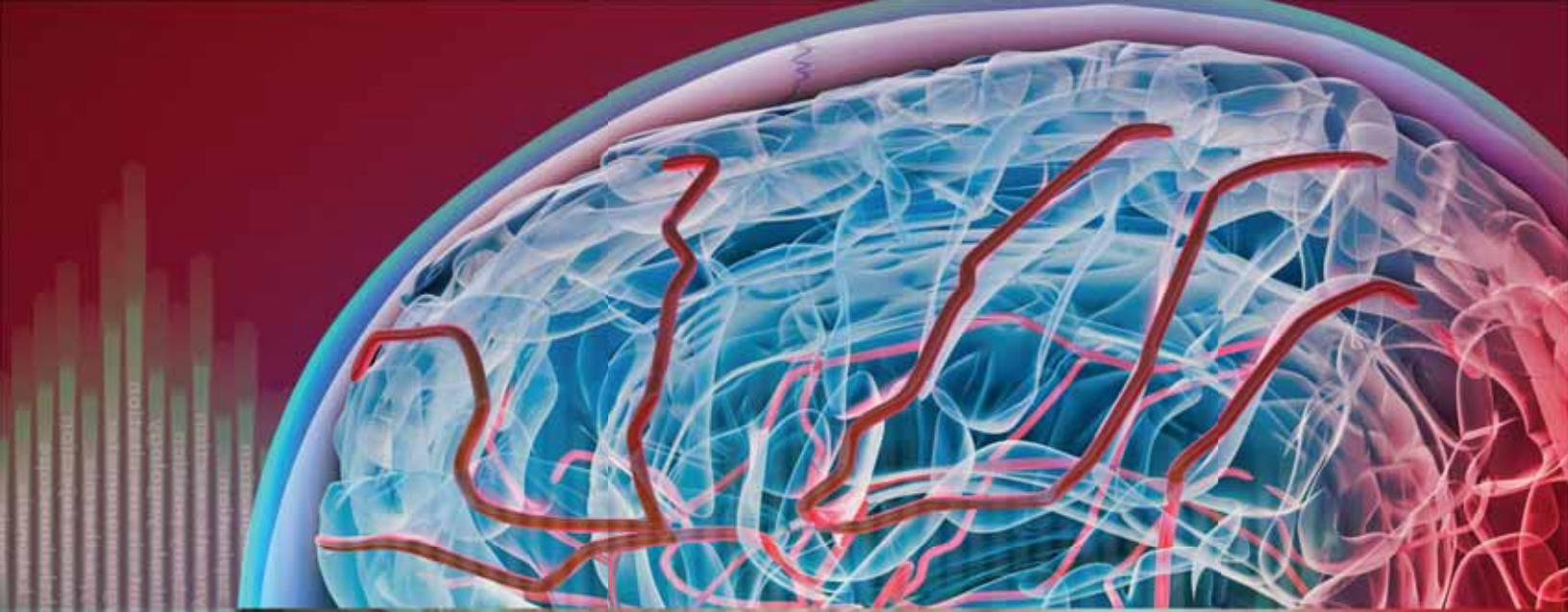
A frail but alert and cheerful woman of 85, Mrs. Gwynn has osteoarthritis and osteoporosis that have forced her to rely on a walker. Although her finances were limited, she has been living at Sunny Meadows since her husband's death four years ago. Dr. Johnstone knew that she didn't have any close relatives, and he did not think that she had signed a Health Care Power of Attorney designating someone to help with medical decisions like this.

A total hip replacement would be the logical treatment for a younger patient because it could restore some of her lost mobility. However, for a frail patient like Mrs. Gwynn, internal fixation of the fracture might be the treatment of choice. This would repair the break but not improve her mobility.

Dr. Johnstone needs to make a decision soon, but he knows that Mrs. Gwynn is groggy from pain medication. With one more look at the x-ray, Dr. Johnstone sighs and walks toward Mrs. Gwynn's room.

Suggested Discussion Topics

1. Because of the pain medication, Gladys Gwynn may not be able to speak for herself. Since she has no relatives to help, is it appropriate for Dr. Johnstone to make the decision about surgery for her? Given these circumstances, is it possible that when Gladys moved into Sunny Meadows they had her sign a Health Care Power of Attorney to someone at the facility?
2. Because the accident happened when Sheri Smith was helping Mrs. Gwynn, do you think Sheri should be held responsible for the accident? Since Sheri is an employee of Sunny Meadows, should that facility be held responsible?
3. The recovery time for internal fixation surgery is shorter than that following a total hip replacement. The surgery is also less expensive and has a less strenuous recovery period; however, Mrs. Gwynn probably will not be able to walk again. Given the patient's condition, and the limited dollars available for health care, which procedure should be performed?
4. Would you have answered Question 3 differently if Mrs. Gwynn were your mother?



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