

Medical Terminology: An Interactive Approach

MEDICAL TERMINOLOGY: AN INTERACTIVE APPROACH

An Interactive Approach

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PREFACE

The Creation of This Book

This textbook was created as part of the Interactive OER for Dual Enrollment project, facilitated by [LOUIS: The Louisiana Library Network](#) and funded by a \$2 million [Open Textbooks Pilot Program grant from the Department of Education](#).

This project supports the extension of access to high-quality post-secondary opportunities to high school students across Louisiana and beyond by creating materials that can be adopted for dual enrollment environments. Dual enrollment is the opportunity for a student to be enrolled in high school and college at the same time.

The cohort-developed OER course materials are released under a license that permits their free use, reuse, modification and sharing with others. This includes a corresponding course available in [MoodleNet](#) and [Canvas Commons](#) that can be imported to other Learning Management System platforms. For access/questions, contact [Affordable Learning Louisiana](#).

If you are adopting this textbook, we would be glad to know of your use via this [brief survey](#).

This textbook offers students the ability to learn basic medical terminology to prepare them for education and a profession in the medical field. This text book has been adapted from the [Building a Medical Terminology Foundation](#) OER textbook by Kimberlee Carter and Marie Rutherford, which was adapted from the [OpenStax Anatomy and Physiology](#) textbook by Betts et al. Changes were made to the *Building a Medical Terminology Foundation* textbook to better suit the needs of our specific learners. These changes include the following:

- Some anatomy and physiology content was deemed excessive relative to the goals of a medical terminology textbook and was therefore removed.
- Interactive H5P elements that corresponded to this excessive anatomy and physiology content were also removed accordingly.
- The skeletal and muscular systems are combined into a single chapter.
- Separate chapter sections were created for structural terms and word parts, diseases and disorders, and medical, surgical & viewing terms and abbreviations. The word lists in these sections were also expanded from the original text.
- Individual chapters were divided and modularized on Pressbooks to reduce the need to scroll and to allow students to leave and return to the text as they need without losing their place in the text.
- When possible, images were replaced with images that provided a more diverse representation of people.

- The term “gender” was changed to “sex” (see the [University of Texas at Austin Dell Medical School Inclusive Language Guidelines](#) for more details on this decision).
- A short comparison of the male and female pelvic bones was added to inform the learner of the distinction between the two since the male skeleton is often presented as the universal form when it is not.

Despite these changes, we thank the original authors for all of their prestigious work.

Review Statement

This textbook and its accompanying course materials went through two review processes.

Peer reviewers, coordinated by Jared Eusea, River Parish Community College, used an online course development standard rubric for assessing the quality and content of each course to ensure that the courses developed through Interactive OER for Dual Enrollment support online learners in that environment. The evaluation framework reflects a commitment to accessibility and usability for all learners.

Reviewers:

- Constance Chemay
- Iris Henry
- Sarita James

The Institute for the Study of Knowledge Management in Education (ISKME) collaborated with LOUIS to review course materials and ensure their appropriateness for dual enrollment audiences. Review criteria were drawn from factors that apply across dual enrollment courses and subject areas, such as determining appropriate reading levels, assessing the fit of topics and examples for high school DE students; applying high-level principles for quality curriculum design, including designing for accessibility, appropriate student knowledge checks, and effective scaffolding of student tasks and prior knowledge requirements, addressing adaptability and open educational practices, and principles related to inclusion and representational social justice.

Reviewers:

- Adrienne Abel
- Eliska Davis

Book Citations

Betts, J.G., et al. (2013). *Anatomy and Physiology*. OpenStax. <http://cnx.org/content/col11496/latest/>

Carter, K., & Rutherford, M. (2020). *Building a Medical Terminology Foundation*. eCampus Ontario. <https://ecampusontario.pressbooks.pub/medicalterminology/>

INTRODUCTION

This textbook is designed to teach medical terminology, the language of medicine, in an engaging and meaningful way. Learning medical terminology will allow the learner to more easily understand the language of medicine and utilize this knowledge throughout their academic and medical-based career. While learning medical terms in this course, the learner will also learn basic anatomy and physiology, as well as basic diseases and professions dealing with each body system.

Chapters 1-3 introduce the learner to the way that word parts are put together and other relevant terminology. Chapters 4-17 review separate body systems and provide a brief overview of the anatomy and physiology of the system followed by word list sections. The body system chapters begin with a short video that will introduce the learner to the system. On some occasions, these videos are placed further in the chapter. Chapters also contain words in bold that are meant to catch the reader's eye, letting them know this is a new important term. Many of these words are mentioned later in the chapter as well. Each chapter concludes with a set of references used to create the chapter and a practice section containing interactive elements and practice exercises. The combination of word lists and their definitions with interactive content and real-world scenarios will aid the learner to understand, retain, and utilize the information within flashcards with audio options, images, drag-and-drop exercises, and more.

Upon completion of the textbook, students will be able to:

1. Analyze, build, and define medical terms correctly using knowledge of word parts
2. Demonstrate proper pronunciation and spelling of medical terminology
3. Utilize medical terminology on body systems
4. Decipher medical terms and abbreviations related to health professions
5. Select correct medical terms and basic medical terms to facilitate communication in the medical setting

In order to accomplish these outcomes, the authors recommend reading the chapter in full. Next, study the word parts and the full words related to the body system. Then complete practice exercises at the end of each chapter in order to test yourself. Creating note cards for each chapter is recommended.

PART I

INTRODUCTION TO WORD PARTS AND MEDICAL LANGUAGE RULES

Learning Objectives

When completing this chapter, the learner will be able to do the following:

- Identify the various word parts in medical terminology
- Divide words into prefixes, suffixes, combining forms, and combining vowels
- Apply spelling and pronunciation rules to creating words from prefixes, word roots, combining vowels, and suffixes
- List commonly used prefixes and suffixes and their meaning

Origins of Medical Terminology

Words used in medical terminology come from four different sources:

- Greek and Latin words
 - Examples: **osteoarthritis** from Greek; **arterial** from Latin
- Acronyms: terms that are built from the first letters of a phrase
 - Examples: **AIDS** from acquired immunodeficiency syndrome; **CT** from computed tomography
- Eponyms: terms named after a person or place
 - Examples: **Ebola virus** from the Ebola River; **Parkinson's disease** from James Parkinson, who first described the disease in medical literature

- Modern English
 - Examples: **peak flow meter; nuclear medicine scanner**

Of these four sources, the majority of words covered in this book will come from Greek and Latin word roots. As each body system is covered in this book, you will learn the important word roots for that system.

IDENTIFYING WORD PARTS IN MEDICAL TERMS AND LANGUAGE RULES

Language rules are the best place to start when building a medical terminology foundation. Many medical terms are built from word parts and can be translated literally. At first, literal translations sound awkward, but once you build a medical vocabulary and become proficient at using it, translation will get much easier.

Since you are at the beginning of building your medical terminology foundation, stay literal when applicable. It should be noted that as with all language rules, there are always exceptions, and we refer to those as “rebels.” So let’s begin by analyzing the language rules for medical terminology.

Combining Forms, Prefixes, and Suffixes

In each chapter of this book that covers a new body system, you will see lists of combining forms, prefixes, and suffixes before the new terms are introduced.

Combining forms are written with a word root followed by a slash mark (/) and combining vowel. The combining vowel is used to join word roots together and is sometimes used before suffixes to aid in pronunciation.

Examples

gastr/o, meaning “stomach”

Prefixes are sometimes added to the beginning of a medical term to make its meaning clear.

Examples

sub-, meaning “under”

Suffixes are sometimes added to the end of a medical term to make its meaning clear.

Examples

-logy, meaning “study of”

Language Rules for Building Medical Terms

Rule 1: When combining two combining forms, you keep the combining vowel.

Rule 2: When combining a combining form with a suffix that begins with a consonant, you keep the combining vowel.

Example

Gastr/o/enter/o/logy—The study of the stomach and the intestines

- Following rule 1, when we join the combining form gastr/o (meaning stomach) with the combining form enter/o (meaning intestines), we keep the combining vowel o.
- Following rule 2, when we join the combining form enter/o (meaning intestines) with the suffix -logy (that begins with a consonant and means the study of), we keep the combining vowel o.

Rule 3: When joining a combining form with a suffix that begins with a vowel, you drop the combining vowel.

Rule 4: A prefix goes at the beginning of the word, and no combining vowel is used.

Example

Intra/ven/ous—Pertaining to within the vein

- Following rule 3, notice that when joining the combining form ven/o (meaning vein) with the suffix -ous (that starts with a vowel and means pertaining to), we drop the combining vowel o.
- Following rule 4, the prefix intra- (meaning within) is at the beginning of the medical term with no combining vowel used.

Rule 5: When defining a medical word, start with the suffix first and then work left to right stating the word parts. You may need to add filler words. As long as the filler word does not change the meaning of the word, you may use it for the purpose of building a medical vocabulary. Once you begin to apply the word in the context of a sentence, deciding which filler word to use will become easier.

Example

Intra/ven/ous—pertaining to within the vein or pertaining to within a vein.

- Following rule 5, notice that we start with the suffix -ous (that means pertaining to) then we work left to right starting with the prefix intra- (meaning within) and the combining form ven/o (meaning vein).
- Notice that we have used two different filler words that have the same meaning.
- In these examples, we do not have the context of a full sentence. For the purpose of building a medical terminology foundation, either definition is accepted.

PREFIXES

Prefixes are located at the beginning of a medical term. The prefix alters the meaning of the medical term. It is important to spell and pronounce prefixes correctly.

Many prefixes that you find in medical terms are common English-language prefixes. A good technique to help with memorization is the following:

- Start by reviewing the most common prefixes.
- Consider common English-language words that begin with the same prefixes.
- Compare them to the examples of use in medical terms.

We will be seeing these prefixes mentioned again in this book, but they are presented here as a reference.

PREFIX	MEANING	EXAMPLE OF USE IN MEDICAL TERMS
a-, an	no, not, without, negates the meaning	atypical, anoxia
ab-	away from; from	abduction
ad-	toward, at, increase, on, toward	adduction
ante-	before	antepartum
anti-	against, opposing	antipsychotic
bi-, bin-	two, twice, double	bilateral, binocular
brady-	slow	bradycardia
de-	from, down, away from	dehydrate
dia-	through, complete	dialysis
dys-	painful, abnormal, difficult, labored	dysphagia
endo-	within, in	endotracheal
epi-	on, upon, over	epidermis
eu-	normal, good	eupnea
hemi-	half	hemicolectomy
hyper-	above, excessive	hyperthyroidism
inter-	between	intercostal
intra-	within, in	intramuscular
macro-	large, long	macrocephalus
meta-	after, beyond, change	metacarpals
micro-	small	microscope
multi-	many	multipara
neo-	new	neonate
nulli-	none	nulligravida
pachy-	thick, thickening, thickened	pachyderma
pan-	all, total	pancytopenia
para-	beside, beyond, around, abnormal	parathyroid glands
per-	through	percutaneous
peri-	surrounding (outer)	peripheral vision
poly-	many, much	polymyositis
post-	after	postpartum

PREFIX	MEANING	EXAMPLE OF USE IN MEDICAL TERMS
pre-	before	prenatal
pro-	before	prognosis
sub-	below, under	subcutaneous
supra-	above	suprascapular
sym-, syn-	together, joined	symphysis
tachy-	fast, rapid	tachycardia
trans-	through, across, beyond	transdermal
tri-	three	triceps
uni-	one	unilateral

SUFFIXES

Suffixes are word parts that are located at the end of words. Suffixes can alter the meaning of medical terms. It is important to spell and pronounce suffixes correctly.

Many suffixes in medical terms are common English-language suffixes. Suffixes are not always explicitly stated in the definition of a word. It is common that suffixes will not be explicitly stated when defining a medical term in the workplace. However, when transcribing or reading medical reports, the suffix is always clearly written. In order to properly spell and pronounce medical terms, it is helpful to learn the suffixes.

We will be seeing these suffixes mentioned again in this book, but they are presented here as a reference.

SUFFIX	MEANING	EXAMPLE OF USE IN MEDICAL TERMS
-a	noun ending, no meaning	leukoderma
-ac	pertaining to	cardiac
-ad	toward	dorsad
-algia	pain	myalgia
-amnios	amnion, amniotic fluid	oligohydramnios
-apheresis	removal	plasmapheresis
-ar	pertaining to	appendicular
-ary	pertaining to	coronary
-asthenia	weakness	myasthenia gravis
-carcinoma	cancerous tumor	adenocarcinoma
-cele	hernia, protrusion, swelling	hydrocele
-centesis	surgical puncture to aspirate fluid	amniocentesis
-crine	to secrete	exocrine
-cyesis	pregnancy	pseudocyesis
-cyte	cell	leukocyte
-desis	surgical fixation, fusion	arthrodesis
-drome	run, running	syndrome
-e	noun ending, no meaning	neonate
-eal	pertaining to	esophageal
-ectasis	stretching out, dilation, expansion	bronchiectasis
-ectomy	excision, surgical removal, cut out	gastrectomy
-emesis	vomiting	hematemesis
-emia	in the blood	anemia
-esis	condition	diuresis
-gen	substance or agent that produces or causes	teratogen
-genic	producing, originating, causing	carcinogenic
-gram	the record, radiographic image	electrocardiogram
-graph	instrument used to record; the record	electrocardiograph
-graphy	process of recording, radiographic imaging	electrocardiography
-ia	condition of, diseased state, abnormal state	tachycardia

SUFFIX	MEANING	EXAMPLE OF USE IN MEDICAL TERMS
-iasis	condition	choledocholithiasis
-iatrist	specialist	psychiatrist
-iatry	specialty, treatment	psychiatry
-ic	pertaining to	cardiac
-ictal	seizure, attack	postictal
-ior	pertaining to	anterior
-ism	state of	hyperthyroidism
-itis	inflammation	colitis
-logist	specialist who studies and treats	oncologist
-logy	study of	cardiology
-lysis	separating, loosening, dissolution	thrombolysis
-malacia	softening	chondromalacia
-megaly	enlarged, enlargement	gastromegaly
-meter	instrument used to measure	thermometer
-metry	measuring, process of measuring	spirometry
-oid	resembling	lipoid
-oma	tumor, swelling	melanoma
-opia	vision	diplopia
-opsy	viewing, process of viewing	biopsy
-osis	abnormal condition, increased number (blood)	erythrocytosis
-ous	pertaining to	intravenous
-paresis	slight paralysis	hemiparesis
-pathy	disease	polyneuropathy
-penia	abnormal reduction in number	erythrocytopenia
-pepsia	digestion	dyspepsia
-pexy	surgical fixation, suspension	colpopexy
-phagia	swallowing, eating	dysphagia
-phobia	aversion, abnormal fear	photophobia
-physis	growth	symphysis
-plasia	formation, development, growth	hyperplasia

SUFFIX	MEANING	EXAMPLE OF USE IN MEDICAL TERMS
-plasm	growth, substance, formation	cytoplasm
-plasty	surgical repair	rhinoplasty
-plegia	paralysis	ophthalmoplegia
-pnea	breathing	dyspnea
-poiesis	formation	leukopoiesis
-ptosis	prolapse, drooping	nephroptosis
-rrhage	excessive bleeding	hemorrhage
-rrhagia	condition of excessive bleeding	rhinorrhagia
-rrhaphy	repairing, suturing	cholecystorrhaphy
-rrhea	discharge, flow	rhinorrhea
-rrhexis	rupture	amniorrhexis
-salpinx	fallopian tube, uterine tube	pyosalpinx
-sarcoma	malignant tumor	rhabdomyosarcoma
-schisis	split, fissure	cranioschisis
-sclerosis	hardening	arteriosclerosis
-scope	instrument used for visual examination	hysteroscope
-scopic	pertaining to visual examination	pelviscopic
-scopy	process of visually examining	gastroscopy
-spasm	sudden, involuntary contraction of muscle	vasospasm
-stasis	stop, control, standing	hemostasis
-stenosis	constriction, narrowing	ureterostenosis
-stomy	creation of artificial opening	nephrostomy
-thorax	chest cavity, chest	hemothorax
-tocia	labor, birth	dystocia
-tome	instrument used to cut	dermatome
-tomy	incision, cut into	laparotomy
-tripsy	surgical crushing	cholecystolithotripsy
-trophy	nourishment, development	hypertrophy
-um	no meaning	endocardium
-uria	urine, urination	nocturia

SUFFIX	MEANING	EXAMPLE OF USE IN MEDICAL TERMS
-us	no meaning	microcephalus

REFERENCES

Unless otherwise indicated, this chapter contains material adapted from [Building a Medical Terminology Foundation](#) by Kimberlee Carter and Marie Rutherford and is used under a [CC BY 4.0 international license](#), which itself contained material adapted from [Anatomy and Physiology](#) (on OpenStax) by Betts, et al. and is used under a [CC BY 4.0 international license](#).

PRACTICE

The following activity will allow you to practice what you've learned in this chapter.

Knowledge Check

Click and drag each of the terms from the word bank to its correct place in this exercise.



An interactive H5P element has been excluded from this version of the text. You can view it online here:

<https://louis.pressbooks.pub/medicalterminology/?p=2086#h5p-1>

PART II

DIRECTIONAL TERMS AND ANATOMIC PLANES, REGIONS, AND QUADRANTS

Learning Objectives

When completing this chapter, the learner will be able to do the following:

- Identify anatomic position and its use in medical terminology
- Define, pronounce, and spell directional terms
- Define, pronounce, and spell anatomic planes
- Define, pronounce, and spell terms used to describe abdominal regions
- Interpret the meaning of abdominal quadrant abbreviations

Introduction

Anatomists and health care providers use terminology for the purpose of precision and to reduce medical errors. For example, is a scar “above the wrist” located on the forearm two or three inches away from the hand? Or is it at the base of the hand? Is it on the palm-side or back-side? By using precise anatomical terminology, we eliminate ambiguity. Anatomical terms derive from ancient Greek and Latin words. To further increase precision, anatomists standardize the way in which they view the body.

REGIONAL AND DIRECTIONAL TERMS

Anatomic Position

When describing anatomy, the anatomic position is used as a neutral, standard position of reference. The body is viewed standing upright, feet hip-width apart; standing on tip-toes, with hands by your side, palms facing out. The directional terms are the same whether the body is standing or lying down face up.

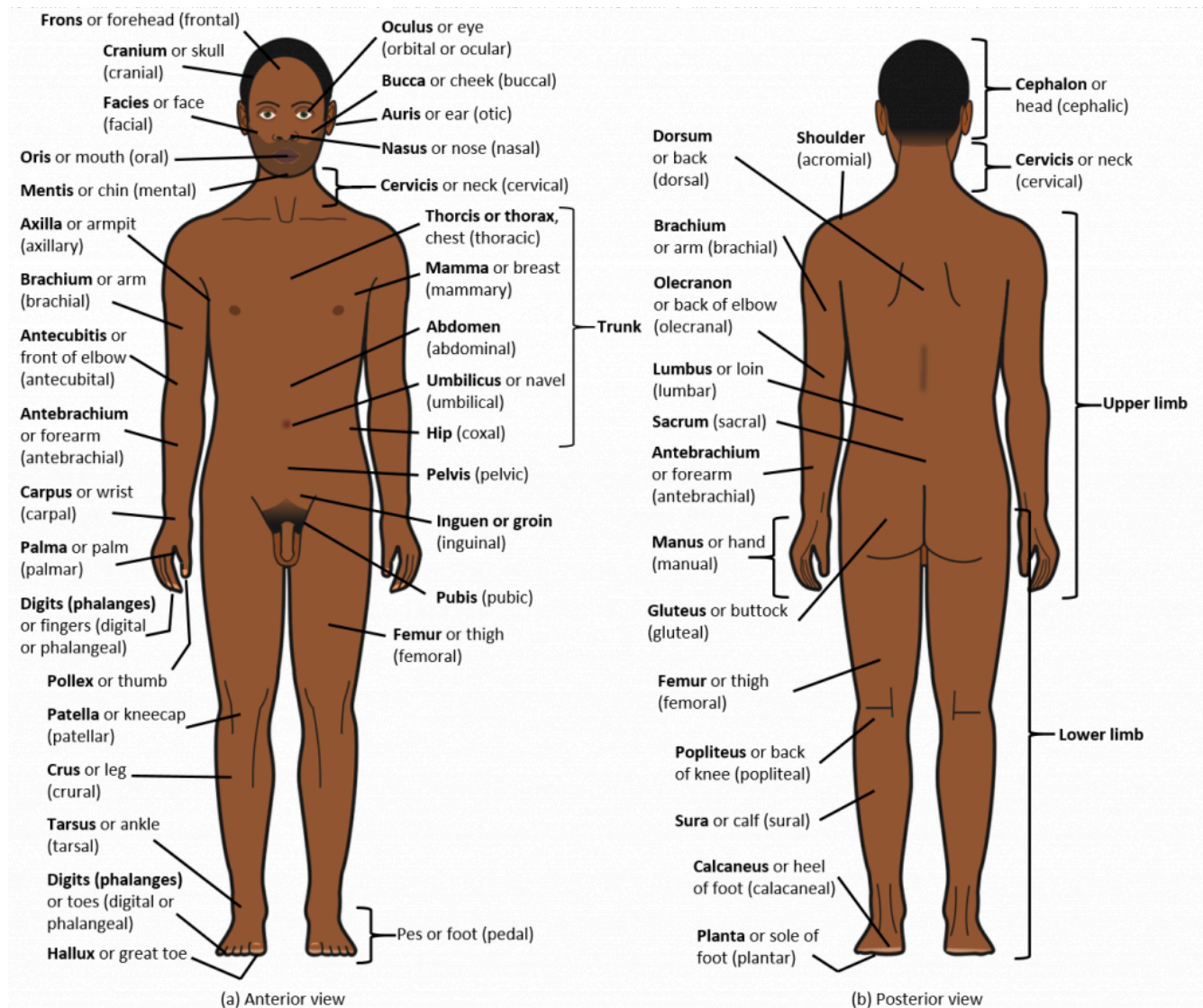


Figure 2.1 Body Parts and Regions. The human body is shown in anatomical position in an (a) anterior view and a (b) posterior view. The regions of the body are labeled in boldface. From [Jmarchn](#), 2016. Licensed under CC BY 3.0. [\[Image description.\]](#)

Regional Terms

The human body's numerous regions have specific terms to help increase precision. Notice that the term "brachium" or "arm" is reserved for the "upper arm," and "antebrachium" or "forearm" is used rather than "lower arm." Similarly, "femur" or "thigh" is correct, and "leg" or "crus" is reserved for the portion of the lower

limb between the knee and the ankle. You will be able to describe the body's regions using the terms from the anatomical position ([Figure 2.1](#)).

Directional Terms

Directional terms are essential for describing the relative locations of different body structures ([Figure 2.2](#)). For instance, an anatomist might describe one band of tissue as “inferior to” another, or a physician might describe a tumor as “superficial to” a deeper body structure. Below are terms, combining forms, definitions, and examples to help you learn and utilize directional terms.

Anterior (or Ventral)

Anter/o or **ventr/o** describes the front or direction toward the front of the body.

Example

“The toes are anterior to the foot.”

Posterior (or Dorsal)

Poster/o or **dors/o** describes the back or direction toward the back of the body.

Example

“The popliteus is posterior to the patella.”

Superior (or Cephalad)

Super/o describes a position above or higher than another part of the body proper.

Example

“The orbits are superior to the oris (muscles of the mouth).”

Inferior (or Caudal)

Infer/o or **caud/o** describes a position below or lower than another part of the body proper; near or toward the tail (in humans, the coccyx, or lowest part of the spinal column).

Example

“The pelvis is inferior to the abdomen.”

Lateral

Later/o describes the side or direction toward the side of the body.

Example

“The thumb is lateral to the digits.”

Medial

Medi/o describes the middle or direction toward the middle of the body.

Example

“The digits are medial to the thumb.”

Proximal

Proxim/o describes a position in a limb that is nearer to the point of attachment or the trunk of the body.

Example

“The humerus (upper arm) is proximal to the radius and ulna (lower arm).”

Distal

Dist/o describes a position in a limb that is farther from the point of attachment or the trunk of the body.

Example

“The ankle joint is distal to the hip joint.”

Superficial

Superficial describes a position closer to the surface of the body or above.

Example

“The skin is superficial to the bones.”

Deep

Deep describes a position farther from the surface of the body.

Example

“The brain is deep to the skull.”

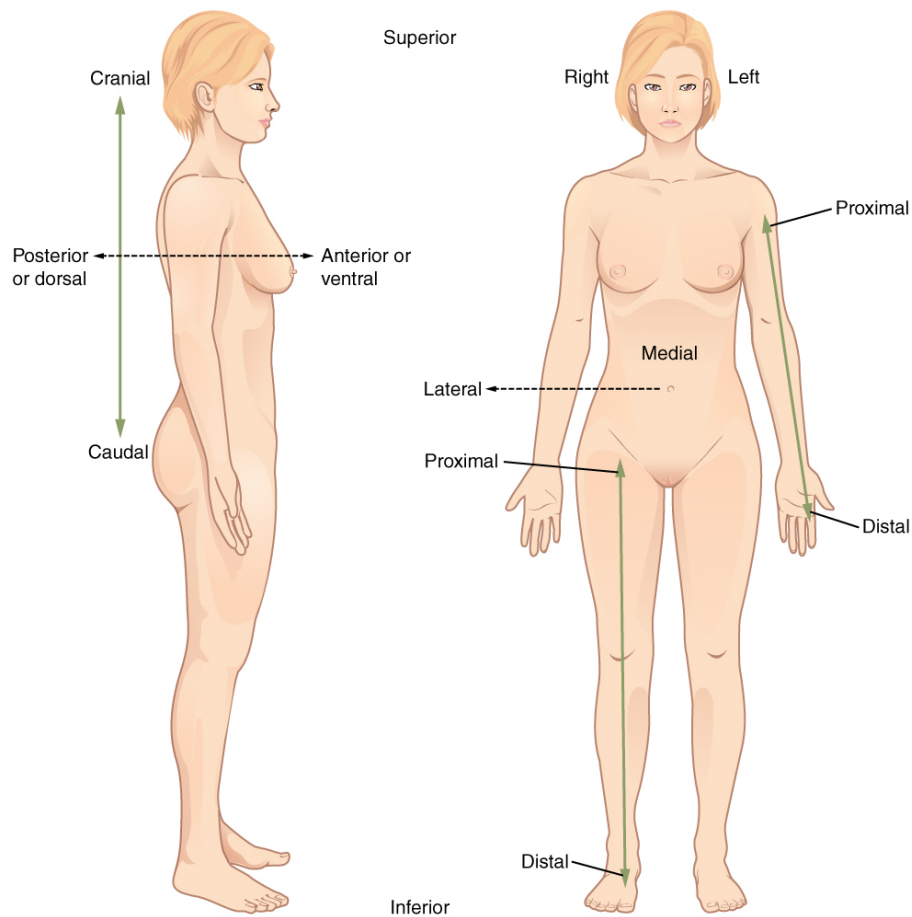


Figure 2.2 Directional Terms Applied to the Human Body. Paired directional terms are shown as applied to the human body. From Betts, et al., 2013. Licensed under [CC BY 4.0](#). [\[Image description.\]](#)

Image Descriptions

Figure 2.1 image description: This illustration shows an anterior and posterior view of the human body. The cranial region encompasses the upper part of the head, while the facial region encompasses the lower half of the head beginning below the ears. The eyes are referred to as the ocular region. The cheeks are referred to as the buccal region. The ears are referred to as the auricle or otic region. The nose is referred to as the nasal region. The chin is referred to as the mental region. The neck is referred to as the cervical region. The trunk of the body contains, from superior to inferior, the thoracic region encompassing the chest, the mammary region encompassing each breast, the abdominal region encompassing the stomach area, the coxal region encompassing the belt line, and the pubic region encompassing the area above the genitals. The umbilicus, or naval, is located at the center of the abdomen. The pelvis and legs contain, from superior to

inferior, the inguinal or groin region between the legs and the genitals, the pubic region surrounding the genitals, the femoral region encompassing the thighs, the patellar region encompassing the knee, the crural region encompassing the lower leg, the tarsal region encompassing the ankle, the pedal region encompassing the foot, and the digital/phalangeal region encompassing the toes. The great toe is referred to as the hallux. The regions of the upper limbs, from superior to inferior, are the axillary region encompassing the armpit, the brachial region encompassing the upper arm, the antecubital region encompassing the front of the elbow, the antebrachial region encompassing the forearm, the carpal region encompassing the wrist, the palmar region encompassing the palm, and the digital/phalangeal region encompassing the fingers. The thumb is referred to as the pollux. The posterior view contains, from superior to inferior, the cervical region encompassing the neck, the dorsal region encompassing the upper back, and the lumbar region encompassing the lower back. The regions of the back of the arms, from superior to inferior, include the cervical region encompassing the neck, acromial region encompassing the shoulder, the brachial region encompassing the upper arm, the olecranal region encompassing the back of the elbow, the antebrachial region encompassing the back of the arm, and the manual region encompassing the palm of the hand. The posterior regions of the legs, from superior to inferior, include the gluteal region encompassing the buttocks, the femoral region encompassing the thigh, the popliteus region encompassing the back of the knee, the sural region encompassing the back of the lower leg, and the plantar region encompassing the sole of the foot. Some regions are combined into larger regions. These include the trunk, which is a combination of the thoracic, mammary, abdominal, naval, and coxal regions. The cephalic region is a combination of all of the head regions. The upper limb region is a combination of all of the arm regions. The lower limb region is a combination of all of the leg regions. [\[Return to Figure 2.1\].](#)

Figure 2.2 image description: This illustration shows two diagrams: one of a side view of a female and the other of an anterior view of a female. Each diagram shows directional terms using double-sided arrows. The cranial-distal arrow runs vertically behind the torso and lower abdomen. The cranial arrow is pointing toward the head while the caudal arrow is pointing toward the tail bone. The posterior/anterior arrow is running horizontally through the back and chest. The posterior or dorsal arrow is pointing toward the back while the anterior, or ventral arrow, is pointing toward the abdomen. On the anterior view, the proximal/distal arrow is on the right arm. The proximal arrow is pointing up toward the shoulder while the distal arrow is pointing down toward the hand. The lateral-medial arrow is a horizontal arrow on the abdomen. The medial arrow is pointing toward the navel while the lateral arrow is pointing away from the body to the right. Right refers to the right side of the woman's body from her perspective while left refers to the left side of the woman's body from her perspective. [\[Return to Figure 2.2\].](#)

PLANES, REGIONS, AND QUADRANTS

Anatomic Planes

Modern medical imaging devices enable clinicians to obtain “virtual sections” of living bodies. We call these scans. Body sections and scans can be correctly interpreted, however, only if the viewer understands the plane along which the section was made. A plane is an imaginary two-dimensional surface that passes through the body. There are three planes commonly referred to in anatomy and medicine:

1. The **sagittal plane** is the plane that divides the body or an organ vertically into right and left sides.
 - If this vertical plane runs directly down the middle of the body, it is called the **midsagittal** or **median plane**.
 - If it divides the body into unequal right and left sides, it is called a **parasagittal plane**, or less commonly, a **longitudinal section**.
2. The **frontal plane** or **coronal plane** is the plane that divides the body or an organ into an anterior (front) portion and a posterior (rear) portion.
3. The **transverse plane**, **axial plane**, or **horizontal plane** is the plane that divides the body or organ horizontally into upper and lower portions.

Can you locate the planes?

Abdominal Regions and Quadrants

To promote clear communication—for instance, about the location of a patient’s abdominal pain or a suspicious mass—health care providers typically divide up the cavity into either nine regions or four quadrants.

Nine Regions with Pronunciations

- One **Umbilical region** around the navel (umbilicus).
- Two **Lumbar regions** to the right and left of the umbilical region, near the waist.
- One **Epigastric region** superior to the umbilical region.

- Two **Hypochondriac regions** to the right and left of the epigastric region.
- One **Hypogastric region** inferior to the umbilical region.
- Two **Iliac regions** or **inguinal regions** to the right and left of the hypogastric region, near the groin (a.k.a. inguinal regions).

Four Quadrants with Abbreviations

- **Right Upper Quadrant** (RUQ)
- **Left Upper Quadrant** (LUQ)
- **Right Lower Quadrant** (RLQ)
- **Left Lower Quadrant** (LLQ)

BODY POSITIONS

Body position terms are essential to communicate how the patient's body is placed for any medical examination, surgery, diagnostic procedure, treatment, or recovery. The most common body positions are listed below along with descriptions and accompanying images.

Fowler position: semi-sitting position with slight elevation of the knees



Figure 2.3 Fowler's Position. From Glynda Rees Doyle and Jodie Anita McCutcheon, 2015. Licensed under [CC BY 4.0](#).

Lateral recumbent position: side lying; right and left precede the term to indicate the patient's side

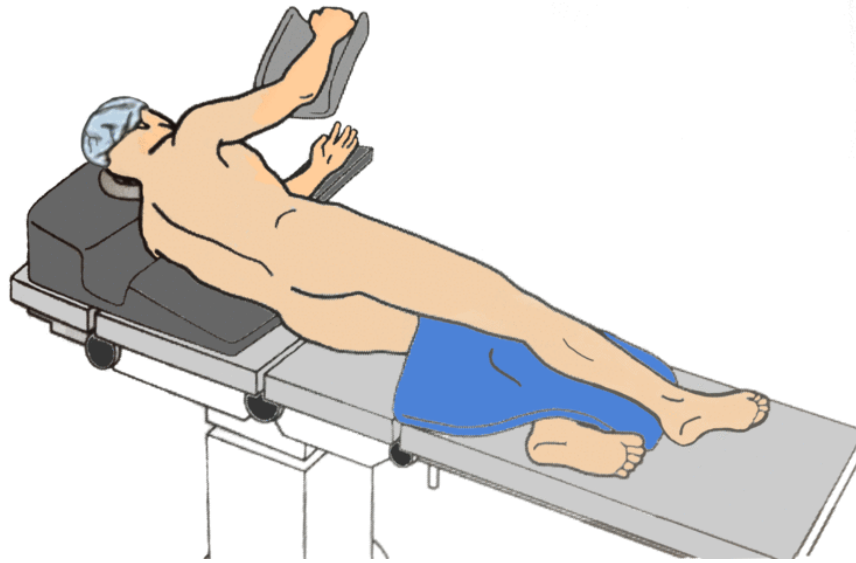


Figure 2.4 Lateral Position. From [Saltanat ebli](#), 2013. Image in the public domain.

Lithotomy position: lying on back with legs raised and feet in stirrups, both hips and knees flexed, and thighs abducted (away from the body) and externally rotated

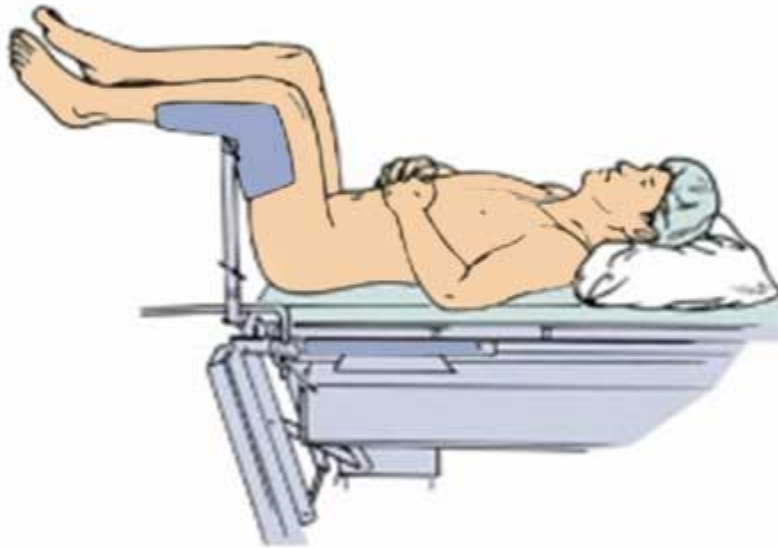


Figure 2.5 Lithotomy Position. From [Saltanat ebli](#), 2012. Image in the public domain.

Orthopneic position: sitting upright in a chair or in bed supported by pillows behind the back. Sometimes the patient tilts forward, resting on a pillow supported by an overbed table (also called orthopneic position).

Prone position: lying on abdomen, facing downward; head may be turned to one side; a.k.a. ventral recumbent



Figure 2.6 Prone Position. From [Saltanat ebli](#), 2013. Image in the public domain.

Recumbent position: lying down in any position; a.k.a. decubitus position

Semi-prone position: lying on side between a lateral and prone position with the upper knee drawn up toward the chest and the lower arm drawn behind parallel to the back. “Right” or “left” precedes the term to indicate the patient’s right or left side.

Supine position: lying on back, facing upward; a.k.a. dorsal recumbent position



Figure 2.7 Supine Position. From [Asanagi](#), 2012. Image in the public domain.

Trendelenburg position: lying on back with body tilted so that the head is lower than the feet



Figure 2.8 Trendelenburg Position. From Glynda Rees Doyle and Jodie Anita McCutcheon, 2015. Licensed under [CC BY 4.0](https://creativecommons.org/licenses/by/4.0/).

REFERENCES

Unless otherwise indicated, this chapter contains material adapted from [Building a Medical Terminology Foundation](#) by Kimberlee Carter and Marie Rutherford and is used under a [CC BY 4.0 international license](#), which itself contained material adapted from [Anatomy and Physiology](#) (on OpenStax) by Betts, et al. and is used under a [CC BY 4.0 international license](#).

PRACTICE

The following activities will allow you to practice what you've learned in this chapter.

Locate the Planes

Click and drag each term to the box corresponding with the anatomic structure, body part, body plane, or body region for that term.



An interactive H5P element has been excluded from this version of the text. You can view it online here:

<https://louis.pressbooks.pub/medicalterminology/?p=2089#h5p-3>

Locate the Abdominal Quadrant Regions

Click and drag each term to the box corresponding with the anatomic structure, body part, body plane, or body region for that term.



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<https://louis.pressbooks.pub/medicalterminology/?p=2089#h5p-5>

Directional Terms Reinforcement Activity

Click the term that correctly answers each question or completes each sentence.



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PART III

BODY STRUCTURE, COLOR, AND ONCOLOGY

Learning Objectives

- Connect medical language learning to the context of anatomy and physiology
- Introduce the basic architecture and levels of organization of the human body
- Describe body cavities and the functions of associated membranes
- Define and spell word parts related to color
- Define and spell word parts related to oncology

Introduction

As you memorize the language components of medical terminology, it is important to support that learning within the context of anatomy and physiology. Proceeding through the body system chapters, you will learn word parts, whole medical terms, and common abbreviations. It is important to put into context where in the body the medical term is referencing and then consider how it works within the body.

Anatomy focuses on structure, and physiology focuses on function. Much of the study of physiology centers on the body's tendency toward homeostasis.

Consider the structures of the body in terms of fundamental levels of organization that increase in complexity: subatomic particles, atoms, molecules, organelles, cells, tissues, organs, organ systems, and organisms ([Figure 3.1](#)).

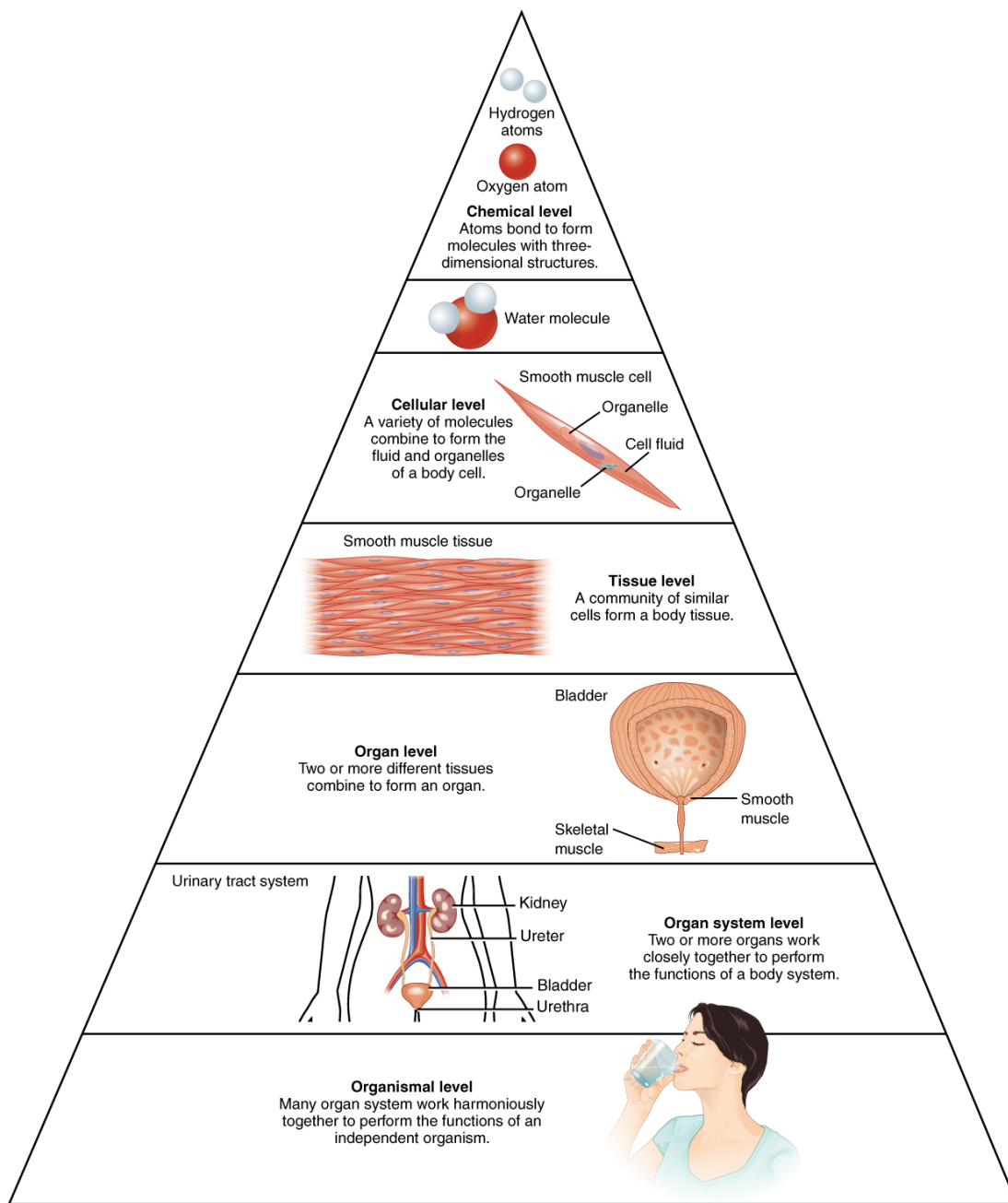


Figure 3.1 Levels of Structural Organization of the Human Body. The organization of the body often is discussed in terms of six distinct levels of increasing complexity, from the smallest chemical building blocks to a unique human organism. From Betts, et al., 2013. Licensed under [CC BY 4.0](https://creativecommons.org/licenses/by/4.0/). [\[Image description.\]](#)

Image Description

Figure 3.1 image description: This illustration shows biological organization as a pyramid. The chemical level is at the apex of the pyramid where atoms bond to form molecules with three-dimensional structures. An example is shown with two white hydrogen atoms bonding to a red oxygen atom to create water. The next level down on the pyramid is the cellular level, as illustrated with a long, tapered, smooth muscle cell. At this level, a variety of molecules combine to form the interior fluid and organelles of a body cell. The next level down is the tissue level. A community of similar cells forms body tissue. The example given here is a section of smooth muscle tissue, which contains many smooth muscle cells closely bound side by side. The next level down is the organ level, as illustrated with the bladder and urethra. The bladder contains smooth muscle while the urethra contains skeletal muscle. These are both examples of muscle tissues. The next level down is the organ system level, as illustrated by the entire urinary system containing the kidney, ureters, bladder, and urethra. At this level, two or more organs work closely together to perform the functions of a body system. At the base of the pyramid is the organismal level illustrated with a woman drinking water. At this level, many organ systems work harmoniously together to perform the functions of an independent organism. [\[Return to Figure 3.1\]](#).

LEVELS OF ORGANIZATION AND TISSUE TYPES

The Levels of Organization

All matter in the universe is composed of one or more unique pure substances called elements; familiar examples are hydrogen, oxygen, carbon, nitrogen, calcium, and iron.

The smallest unit of any of these pure substances (elements) is an **atom**. Atoms are made up of **subatomic particles** such as protons, electrons, and neutrons.

Two or more atoms combine to form a **molecule**, such as the water molecules, proteins, and sugars found in living things. Molecules are the chemical building blocks of all body structures.

A **cell** is the smallest independently functioning unit of a living organism. All living structures of human anatomy contain cells, and almost all functions of human physiology are performed in cells or are initiated by cells.

A human cell typically consists of flexible membranes that enclose cytoplasm, a water-based cellular fluid, together with a variety of tiny functioning units called organelles. In humans, as in all organisms, cells perform all functions of life.

A **tissue** is a group of many similar cells (though sometimes composed of a few related types) that work together to perform a specific function.

An **organ** is an anatomically distinct structure of the body composed of two or more tissue types. Each organ performs one or more specific physiological functions.

An **organ system** is a group of organs that work together to perform major functions or meet the physiological needs of the body.

Consider the breakdown of the human body into eleven distinct organ systems ([Figure 3.2](#) and [Figure 3.3](#)). Assigning organs to organ systems can be imprecise, since organs that “belong” to one system can also have functions integral to another system. In fact, most organs contribute to more than one system.

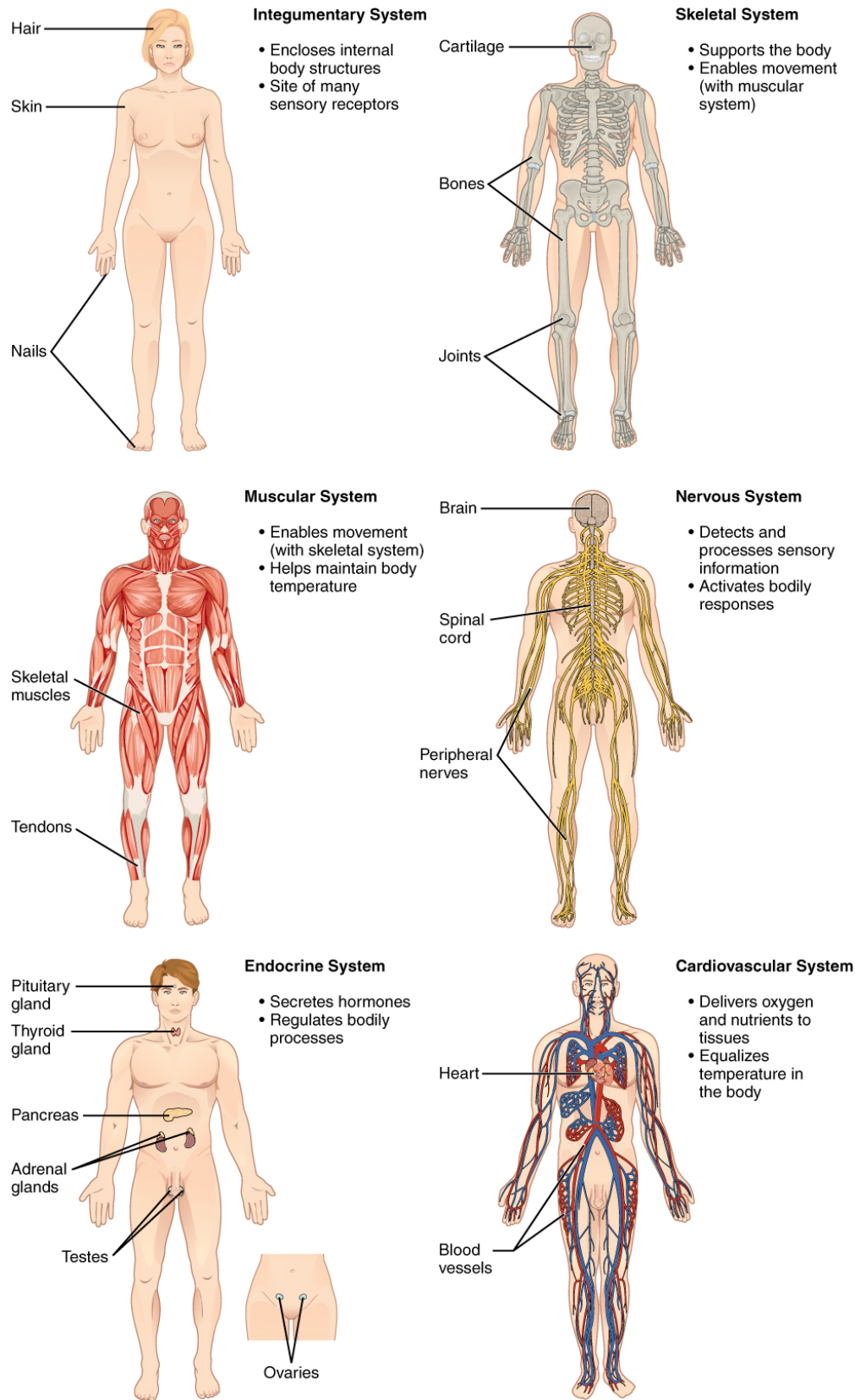
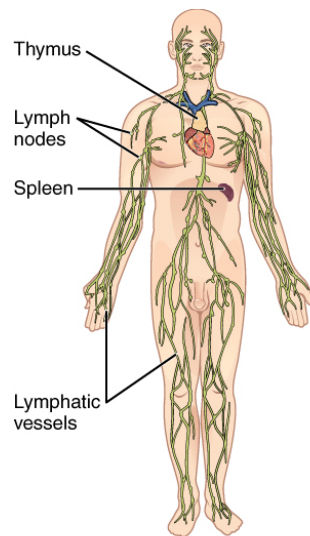
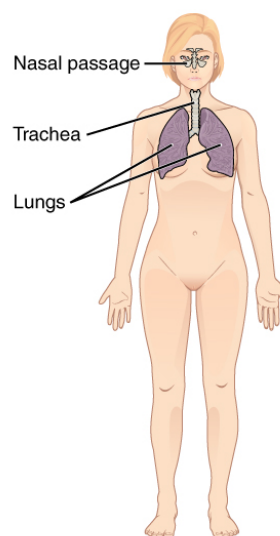


Figure 3.2 Organ Systems of the Human Body. Organs that work together are grouped into organ systems. From Betts, et al., 2013. Licensed under [CC BY 4.0](#) [Image description.]



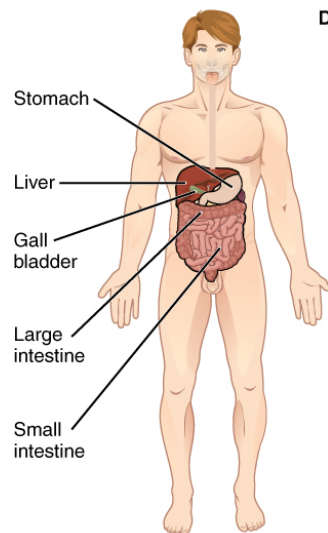
Lymphatic System

- Returns fluid to blood
- Defends against pathogens



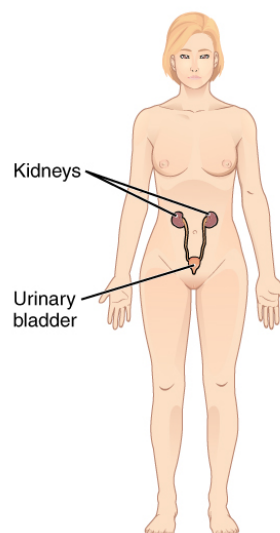
Respiratory System

- Removes carbon dioxide from the body
- Delivers oxygen to blood



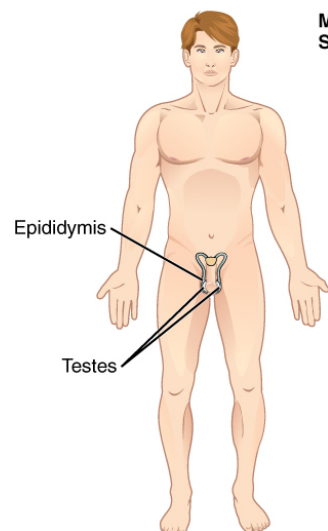
Digestive System

- Processes food for use by the body
- Removes wastes from undigested food



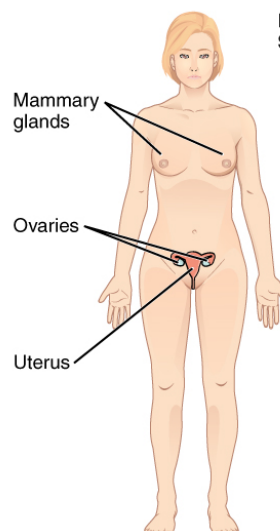
Urinary System

- Controls water balance in the body
- Removes wastes from blood and excretes them



Male Reproductive System

- Produces sex hormones and gametes
- Delivers gametes to female



Female Reproductive System

- Produces sex hormones and gametes
- Supports embryo/fetus until birth
- Produces milk for infant

Figure 3.3 Organ Systems of the Human Body (continued). Organs that work together are grouped into organ systems. From Betts, et al., 2013. Licensed under CC BY 4.0 [Image description.]

The **organism** level is the highest level of organization. An organism is a living being that has a cellular structure and that can independently perform all physiologic functions necessary for life. In multicellular organisms, including humans, all cells, tissues, organs, and organ systems of the body work together to maintain the life and health of the organism.

Watch this video:



One or more interactive elements has been excluded from this version of the text. You can view them online here: <https://louis.pressbooks.pub/medicalterminology/?p=1314#oembed-1>

*Media 3.1. Introduction to Anatomy & Physiology: Crash Course A&P #1 [Online video].
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Tissue Types

Although there are many types of cells in the human body, they are organized into four broad categories of tissues: epithelial, connective, muscle, and nervous. Each of these categories is characterized by specific functions that contribute to the overall health and maintenance of the body. A disruption of the structure is a sign of injury or disease. Such changes can be detected through histology, the microscopic study of tissue appearance, organization, and function.

Epithelial tissue, also referred to as epithelium, refers to the sheets of cells that cover exterior surfaces of the body, line internal cavities and passageways, and form certain glands. Connective tissue, as its name implies, binds the cells and organs of the body together and functions in the protection, support, and integration of all parts of the body. Muscle tissue is excitable, responding to stimulation and contracting to provide movement, and occurs as three major types: skeletal (voluntary) muscle, smooth muscle, and cardiac muscle in the heart. Nervous tissue is also excitable, allowing the propagation of electrochemical signals in the form of nerve impulses that communicate between different regions of the body ([Figure 3.4](#)).

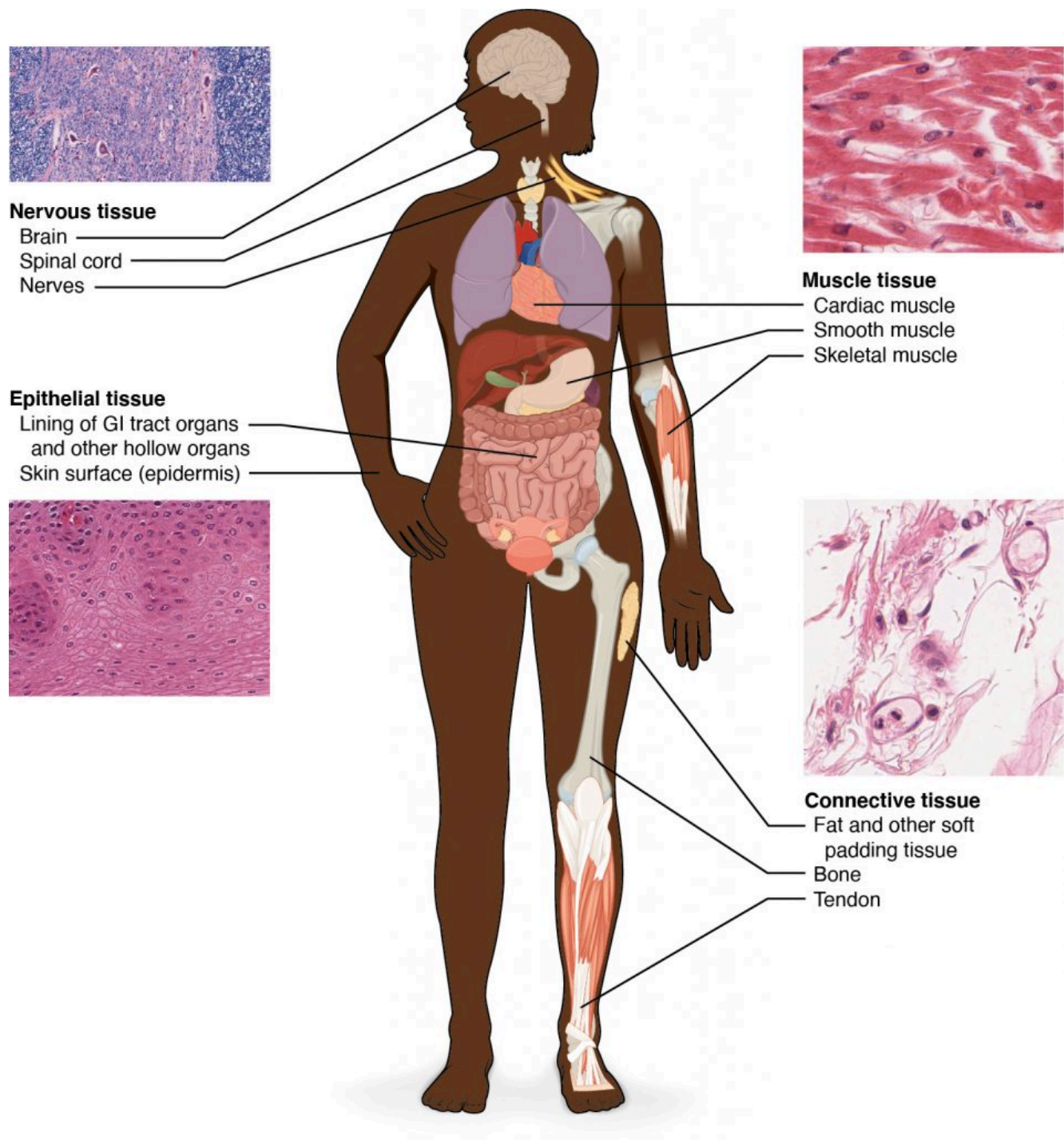


Figure 3.4 Four Types of Tissue: Body. The four types of tissues are exemplified in nervous tissue, stratified squamous epithelial tissue, cardiac muscle tissue, and connective tissue. (Micrographs provided by the Regents of University of Michigan Medical School © 2012) From Betts, et al., 2013. Licensed under [CC BY 4.0](#). [Image description.]

Image Descriptions

Figure 3.2 image description: This illustration shows eight silhouettes of a human female, each showing the components of a different organ system. The integumentary system encloses internal body structures and is the site of many sensory receptors. The integumentary system includes the hair, skin, and nails. The skeletal system supports the body and, along with the muscular system, enables movement. The skeletal system includes cartilage, such as that at the tip of the nose, as well as the bones and joints. The muscular system enables movement, along with the skeletal system, but also helps to maintain body temperature. The muscular system includes skeletal muscles, as well as tendons that connect skeletal muscles to bones. The nervous system detects and processes sensory information and activates bodily responses. The nervous system includes the brain, spinal cord, and peripheral nerves, such as those located in the limbs. The endocrine system secretes hormones and regulates bodily processes. The endocrine system includes the pituitary gland in the brain, the thyroid gland in the throat, the pancreas in the abdomen, the adrenal glands on top of the kidneys, and the testes in the scrotum of males as well as the ovaries in the pelvic region of females. The cardiovascular system delivers oxygen and nutrients to the tissues as well as equalizes temperature in the body. The cardiovascular system includes the heart and blood vessels. [\[Return to Figure 3.2\].](#)

Figure 3.3 image description: The lymphatic system returns fluid to the blood and defends against pathogens. The lymphatic system includes the thymus in the chest, the spleen in the abdomen, the lymphatic vessels that spread throughout the body, and the lymph nodes distributed along the lymphatic vessels. The respiratory system removes carbon dioxide from the body and delivers oxygen to the blood. The respiratory system includes the nasal passages, the trachea, and the lungs. The digestive system processes food for use by the body and removes wastes from undigested food. The digestive system includes the stomach, the liver, the gallbladder (connected to the liver), the large intestine, and the small intestine. The urinary system controls water balance in the body and removes and excretes waste from the blood. The urinary system includes the kidneys and the urinary bladder. The reproductive systems of males and females produce sex hormones and gametes. The male reproductive system is specialized to deliver gametes to the female while the female reproductive system is specialized to support the embryo and fetus until birth and produce milk for the infant after birth. The male reproductive system includes the two testes within the scrotum as well as the epididymis which wraps around each testis. The female reproductive system includes the mammary glands within the breasts and the ovaries and uterus within the pelvic cavity. [\[Return to Figure 3.3\].](#)

Figure 3.4 image description: This illustration shows the four primary tissue types in the human body. Epithelial tissue, also referred to as epithelium, refers to the sheets of cells that cover exterior surfaces of the body, line internal cavities and passageways, and form certain glands. Connective tissue, as its name implies, binds the cells and organs of the body together and functions in the protection, support, and integration of all parts of the body. Muscle tissue is excitable, responding to stimulation and contracting to provide movement, and occurs as three major types: skeletal (voluntary) muscle, smooth muscle, and cardiac muscle in the heart.

Nervous tissue is also excitable, allowing the propagation of electrochemical signals in the form of nerve impulses that communicate between different regions of the body. [\[Return to Figure 3.4\]](#).

BODY CAVITIES, SEROUS MEMBRANES, AND TISSUE MEMBRANES

Body Cavities and Serous Membranes

The body maintains its internal organization by means of membranes, sheaths, and other structures that separate compartments. The dorsal (posterior) cavity and the ventral (anterior) cavity are the largest body compartments (Figure 3.5). These cavities contain and protect delicate internal organs, and the ventral cavity allows for significant changes in the size and shape of the organs as they perform their functions. The lungs, heart, stomach, and intestines, for example, can expand and contract without distorting other tissues or disrupting the activity of nearby organs.

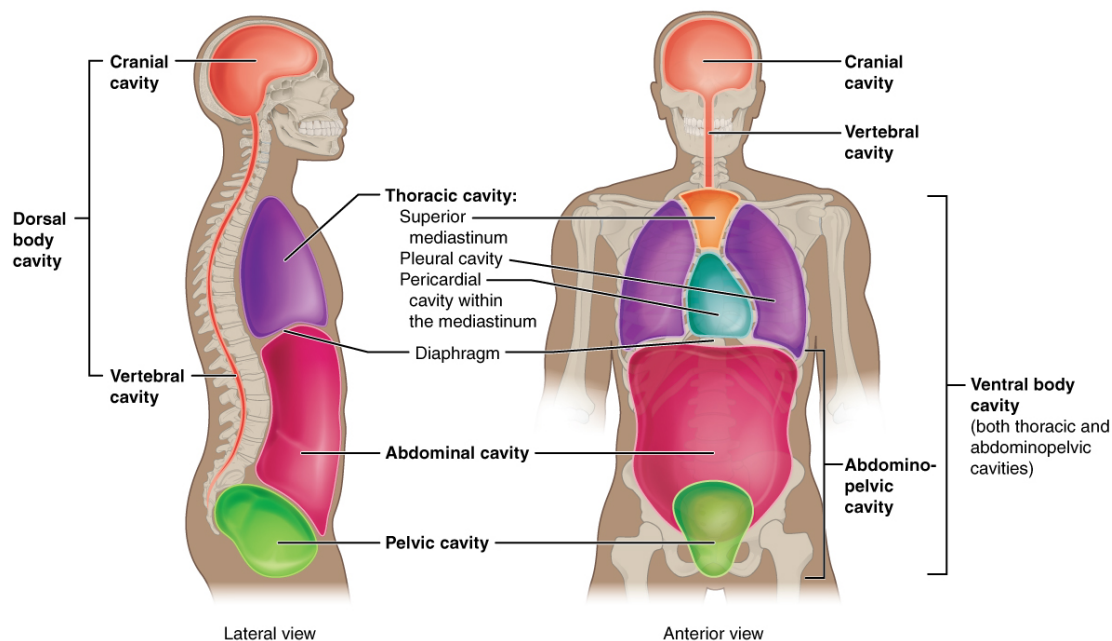


Figure 3.5 Dorsal and Ventral Body Cavities. The ventral cavity includes the thoracic and abdominopelvic cavities and their subdivisions. The dorsal cavity includes the cranial and spinal cavities. From Betts, et al., 2013. Licensed under [CC BY 4.0](#). [\[Image description.\]](#)

Subdivisions of the Posterior (Dorsal) and Anterior (Ventral) Cavities

The posterior (dorsal) and anterior (ventral) cavities are each subdivided into smaller cavities:

The posterior (dorsal) cavity has two main subdivisions:

- In the posterior (dorsal) cavity, the cranial cavity houses the brain.
 - Protected by the bones of the skull and cerebrospinal fluid
- The spinal cavity (or vertebral cavity) encloses the spinal cord.
 - Protected by the vertebral column and cerebrospinal fluid

The anterior (ventral) cavity has two main subdivisions:

- The thoracic cavity is the more superior subdivision of the anterior cavity, and it is enclosed by the rib cage.
 - The thoracic cavity contains the lungs and the heart, which is located in the mediastinum.
 - The diaphragm forms the floor of the thoracic cavity and separates it from the more inferior abdominopelvic cavity.
- The abdominopelvic cavity is the largest cavity in the body.
 - No membrane physically divides the abdominopelvic cavity.
 - The abdominal cavity houses the digestive organs.
 - The pelvic cavity is enclosed by the pelvic bones and houses some urinary organs, reproductive organs, and some structures of the digestive system.

***Practice locating cavities.

Tissue Membranes

A tissue membrane is a thin layer or sheet of cells that covers the outside of the body (for example, skin), the organs (for example, pericardium), internal passageways that lead to the exterior of the body (for example, abdominal mesenteries), and the lining of the movable joint cavities. There are two basic types of tissue membranes: connective tissue and epithelial membranes (Figure 3.6).

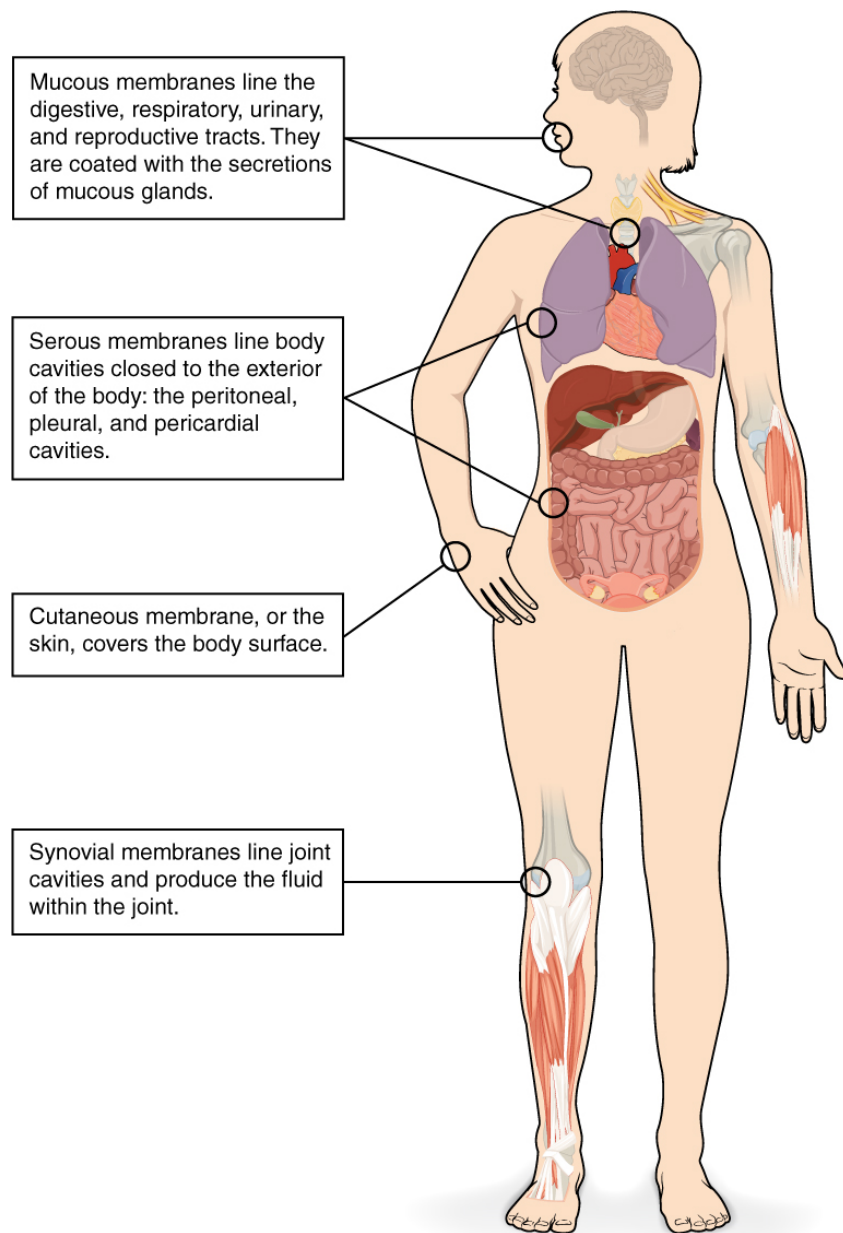


Figure 3.6 Tissue Membranes. The two broad categories of tissue membranes in the body are (1) connective tissue membranes, which include synovial membranes, and (2) epithelial membranes, which include mucous membranes, serous membranes, and the cutaneous membrane—in other words, the skin. From Betts, et al., 2013. Licensed under [CC BY 4.0](#). [\[Image description.\]](#)

Connective Tissue Membranes

- The connective tissue membrane is formed solely from connective tissue.
 - These membranes encapsulate organs, such as the kidneys, and line our movable joints.

- A synovial membrane is a type of connective tissue membrane that lines the cavity of a freely movable joint.
 - For example, synovial membranes surround the joints of the shoulder, elbow, and knee.

Epithelial Membranes

- An epithelial membrane is composed of epithelium attached to a layer of connective tissue.
- A mucous membrane is also a composite of connective and epithelial tissues.
- Sometimes called mucosae, these epithelial membranes line the body cavities and hollow passageways that open to the external environment and include the digestive, respiratory, excretory, and reproductive tracts.
- Mucus, produced by the epithelial exocrine glands, covers the epithelial layer.
- The underlying connective tissue, called the lamina propria (literally “own layer”), helps support the fragile epithelial layer.
- The skin is an epithelial membrane also called the cutaneous membrane.
- It is a stratified squamous epithelial membrane resting on top of connective tissue. The apical surface of this membrane is exposed to the external environment and is covered with dead, keratinized cells that help protect the body from desiccation and pathogens.

Membranes of the Anterior (Ventral) Body Cavity

A serous membrane (also referred to as serosa) is an epithelial membrane composed of mesodermally derived epithelium called the mesothelium that is supported by connective tissue.

These membranes line the coelomic cavities of the body, and they cover the organs located within those cavities. They are essentially membranous bags, with mesothelium lining the inside and connective tissue on the outside.

- Parietal layers: line the walls of the body cavity.
- Visceral layer: covers the organs (the viscera).

Between the parietal and visceral layers is a very thin, fluid-filled serous space.

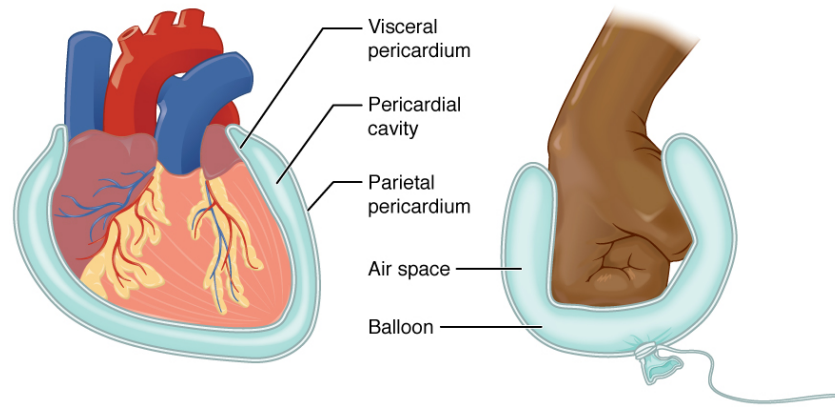


Figure 3.7 Serous Membrane. Serous membrane lines the pericardial cavity and reflects back to cover the heart—much the same way that an underinflated balloon would form two layers surrounding a fist. From Betts, et al., 2013. Licensed under [CC BY 4.0](#). [\[Image description.\]](#)

There are three serous cavities and their associated membranes. Serous membranes provide additional protection to the viscera they enclose by reducing friction that could lead to inflammation of the organs.

- Pleura: surrounds the lungs in the pleural cavity and reduces friction between the lungs and the body wall.
- Pericardium: surrounds the heart in the pericardial cavity and reduces friction between the heart and the wall of the pericardium.
- Peritoneum: surrounds several organs in the abdominopelvic cavity. The peritoneal cavity reduces friction between the abdominal and pelvic organs and the body wall.

***Test yourself

Image Descriptions

Figure 3.5 image description: This illustration shows a lateral and anterior view of the body and highlights the body cavities with different colors. The cranial cavity is a large, bean-shaped cavity filling most of the upper skull where the brain is located. The vertebral cavity is a very narrow, thread-like cavity running from the cranial cavity down the entire length of the spinal cord. Together the cranial cavity and vertebral cavity can be referred to as the dorsal body cavity. The thoracic cavity consists of three cavities that fill the interior area of the chest. The two pleural cavities are situated on both sides of the body, anterior to the spine and lateral to the breastbone. The superior mediastinum is a wedge-shaped cavity located between the superior regions of

the two thoracic cavities. The pericardial cavity within the mediastinum is located at the center of the chest below the superior mediastinum. The pericardial cavity roughly outlines the shape of the heart. The diaphragm divides the thoracic and the abdominal cavities. The abdominal cavity occupies the entire lower half of the trunk, anterior to the spine. Just under the abdominal cavity, anterior to the buttocks, is the pelvic cavity. The pelvic cavity is funnel shaped and is located inferior and anterior to the abdominal cavity. Together the abdominal and pelvic cavity can be referred to as the abdominopelvic cavity while the thoracic, abdominal, and pelvic cavities together can be referred to as the ventral body cavity. [\[Return to Figure 3.5\].](#)

Figure 3.6 image description: This illustration shows the silhouette of a human female from an anterior view. Several organs are showing in her neck, thorax, abdomen, left arm, and right leg. Text boxes point out and describe the mucous membranes in several different organs. The topmost box points to the mouth and trachea. It states that mucous membranes line the digestive, respiratory, urinary, and reproductive tracts. They are coated with the secretions of mucous glands. The second box points to the outside edge of the lungs as well as the large intestine and states that serous membranes line body cavities that are closed to the exterior of the body, including the peritoneal, pleural, and pericardial cavities. The third box points to the skin of the hand. It states that the cutaneous membrane, also known as the skin, covers the body surface. The fourth box points to the right knee. It states that synovial membranes line joint cavities and produce the fluid within the joint. [\[Return to Figure 3.6\].](#)

Figure 3.7 image description: This diagram shows the pericardium on the left next to an analogy of a hand punching a balloon on the right. The pericardium is a two-layered sac that surrounds the entire heart except where the blood vessels emerge on the heart's superior side. The pericardium has two layers because it folds over itself in the shape of the letter U. The inner layer that borders the heart is the visceral pericardium while the outer layer is the parietal pericardium. The space between the two layers is called the pericardial cavity. The heart sits in the cavity much like a fist punching into a balloon. The balloon surrounds the lower part of the fist with a two-layered sac, with the top of the balloon, where it contacts the fist, being analogous to the visceral pericardium. The bottom of the balloon, where it is tied off, is analogous to the parietal pericardium. The air within the balloon is analogous to the pericardial cavity. [\[Return to Figure 3.7\].](#)

COLOR AND ONCOLOGY

Color

You will learn words in later chapters that use color to describe a cell, a structure, or a disease state. Here are the combining forms for these colors.

chrom/o: color, colored

chlor/o: green

cyan/o: blue

erythr/o: red

leuk/o: white

melan/o: black

xanth/o: yellow

Oncology

You will learn terms in later chapters for various types of tumors and cancers. These are examples of **neoplasms**, or newly grown tissue in the body.

A tumor or cancer is classified as **benign** (noncancerous, or remaining within the tissue in which it developed) or **malignant** (cancerous, or capable of spreading to other tissues). Benign tumors don't always cause major health problems, but if they compress other tissue, nerves, or blood vessels, the patient may choose to get them surgically removed. Some benign tumors are considered precancerous and may develop into malignant tumors eventually, but this is not often the case. When a malignant tumor has spread to other tissues or organs, it is said to have **metastasized**.

A tumor or cancer is named after the type of tissue in which it originated and whether it is benign or malignant.

Word Roots

cancer/o, carcin/o: cancer

onc/o: tumor, mass

Suffixes

- oma:** tumor, swelling (noun); when used alone, it typically refers to a benign tumor
- carcinoma:** malignant tumor that originates in epithelium (noun)
- plasia:** process of formation/growth (noun)
- plasm:** substance, formation, growth, something that has grown (noun)
- sarcoma:** malignant tumor of bone, blood vessels, cartilage, nerves, muscles, fat, joints, tendons, and ligaments (noun)

Disease and Disorder Oncology Terms

- adenocarcinoma:** malignant tumor of glandular tissue
- adenoma:** benign tumor of glandular tissue
- epithelioma:** tumor composed of epithelial tissue
- fibroma:** benign tumor composed of fibrous tissue
- fibrosarcoma:** malignant tumor composed of fibrous tissue
- lipoma:** benign tumor composed of adipose tissue
- liposarcoma:** malignant tumor composed of adipose tissue
- myoma:** benign tumor composed of muscle tissue
- myosarcoma:** malignant tumor composed of muscle tissue
- neoplasm:** literally “new growth”; used to describe growth of abnormal tissue, either benign or malignant
- neuroma:** benign tumor composed of nerve tissue
- neurosarcoma:** malignant tumor composed of nerve tissue

Career Terms

- oncologist:** a physician who specializes in diagnosing, treating, and studying tumors and cancers
- oncology:** the study of tumors and cancers

REFERENCES

[“Tissue Types”](#) section contains material adapted from Betts, J.G., Young, K.A., Wise, J.A., Johnson, E., Poe, B., Kruse, D. H., Korol, O., Johnson, J.E., Womble, M. & DeSaix, P. (2013). *Anatomy and Physiology*. OpenStax. <http://cnx.org/content/col11496/latest/>

[CrashCourse]. (2015, January 6). [Introduction to anatomy & physiology: Crash course A&P #1](#) [Video]. YouTube. <https://youtu.be/uBG12BujkPQ>

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PRACTICE

The following activity will help you practice what you've learned in this chapter.

Locate the Cavities

Click and drag each term to the box corresponding with the anatomic structure, body part, body plane, or body region for that term.



An interactive H5P element has been excluded from this version of the text. You can view it online here:

<https://louis.pressbooks.pub/medicalterminology/?p=2185#h5p-4>

PART IV

MUSCULOSKELETAL SYSTEM

Learning Objectives

When completing this chapter, the learner will be able to do the following:

- Identify the anatomy of the musculoskeletal system
- Describe the main functions of the musculoskeletal system
- Spell the medical terms of the musculoskeletal system and use correct abbreviations
- Pronounce the medical terms of the musculoskeletal system and use correct abbreviations
- Identify the medical specialties associated with the musculoskeletal system
- Explore common diseases, disorders, and procedures related to the musculoskeletal system

Introduction

The skeletal system forms the framework of the body. It is the body system composed of bones, cartilage, and ligaments. Each bone serves a particular function and varies in size, shape, and strength. Bones are weight-bearing structures in your body and can therefore change in thickness as you gain or lose weight. The skeletal system performs the following critical functions for the human body:

- supports the body
- facilitates movement
- protects internal organs
- produces blood cells
- stores and releases minerals and fat

When most people think of muscles, they think of the muscles that are visible just under the skin, particularly of the limbs. These are skeletal muscles, so named because most of them move the skeleton. But there are two additional types of muscles that make up the muscular system: the smooth muscle and the cardiac muscle. The body has over 600 muscles, which contribute significantly to the body's weight.

BASIC ANATOMY & PHYSIOLOGY OF THE MUSCULOSKELETAL SYSTEM

The Skeletal System

The skeletal system includes all of the bones, cartilages, and ligaments of the body that support and give shape to the body and body structures. The **skeleton** consists of the bones of the body. For adults, there are 206 bones in the skeleton. Younger individuals have higher numbers of bones because some bones fuse together during childhood and adolescence to form an adult bone. The primary functions of the skeleton are to provide a rigid, internal structure that can support the weight of the body against the force of gravity and to provide a structure upon which muscles can act to produce movements of the body.

In addition to providing for support and movements of the body, the skeleton has protective and storage functions. It protects the internal organs, including the brain, spinal cord, heart, lungs, and pelvic organs. The bones of the skeleton serve as the primary storage site for important minerals such as calcium and phosphate. The bone marrow found within bones stores fat and houses the blood-cell-producing tissue of the body.

The skeleton is subdivided into two major divisions: the **axial** and **appendicular** (see [Figure 4.1](#)).

The **axial skeleton** forms the vertical, central axis of the body and includes all bones of the head, neck, chest, and back. It serves to protect the brain, spinal cord, heart, and lungs. It also serves as the attachment site for muscles that move the head, neck, and back and for muscles that act across the shoulder and hip joints to move their corresponding limbs.

The axial skeleton of the adult consists of 80 bones, including the **skull**, the **vertebral column**, and the **thoracic cage**. The skull is formed by 22 bones. Also associated with the head are an additional seven bones, including the **hyoid bone** and the **ear ossicles** (three small bones found in each middle ear). The vertebral column consists of 24 bones, each called a **vertebra**, plus the **sacrum** and **coccyx**. The thoracic cage includes the 12 pairs of **ribs** and the **sternum**, the flattened bone of the anterior chest.

Vertebral Column with Abbreviations:

- **Cervical:** C1 to C7; the first 7 vertebrae in the neck region
- **Thoracic:** T1 to T12; the next 12 vertebrae that form the outward curvature of the spine
- **Lumbar:** L1 to L5; the next 5 vertebrae that form the inner curvature of the spine
- **Sacrum:** the triangular bone at the base of the spine
- **Coccyx:** the tailbone

The **appendicular skeleton** includes all bones of the upper and lower limbs, plus the bones that attach each limb to the axial skeleton. There are 126 bones in the appendicular skeleton of an adult.

Most bones connect to at least one other bone in the body. The areas where bones meet bones or where bones meet cartilage are called **articulations**. Joints can be classified based on their ability to move. At **movable** joints, the articulating surfaces of the adjacent bones can move smoothly against each other. However, other joints may be connected to each other by connective tissue or cartilage. These joints are designed for stability and provide for little or no movement. Importantly, joint stability and movement are related to each other. This means that stable joints allow for little or no mobility between the adjacent bones. Conversely, joints that provide the most movement between bones are the least stable.

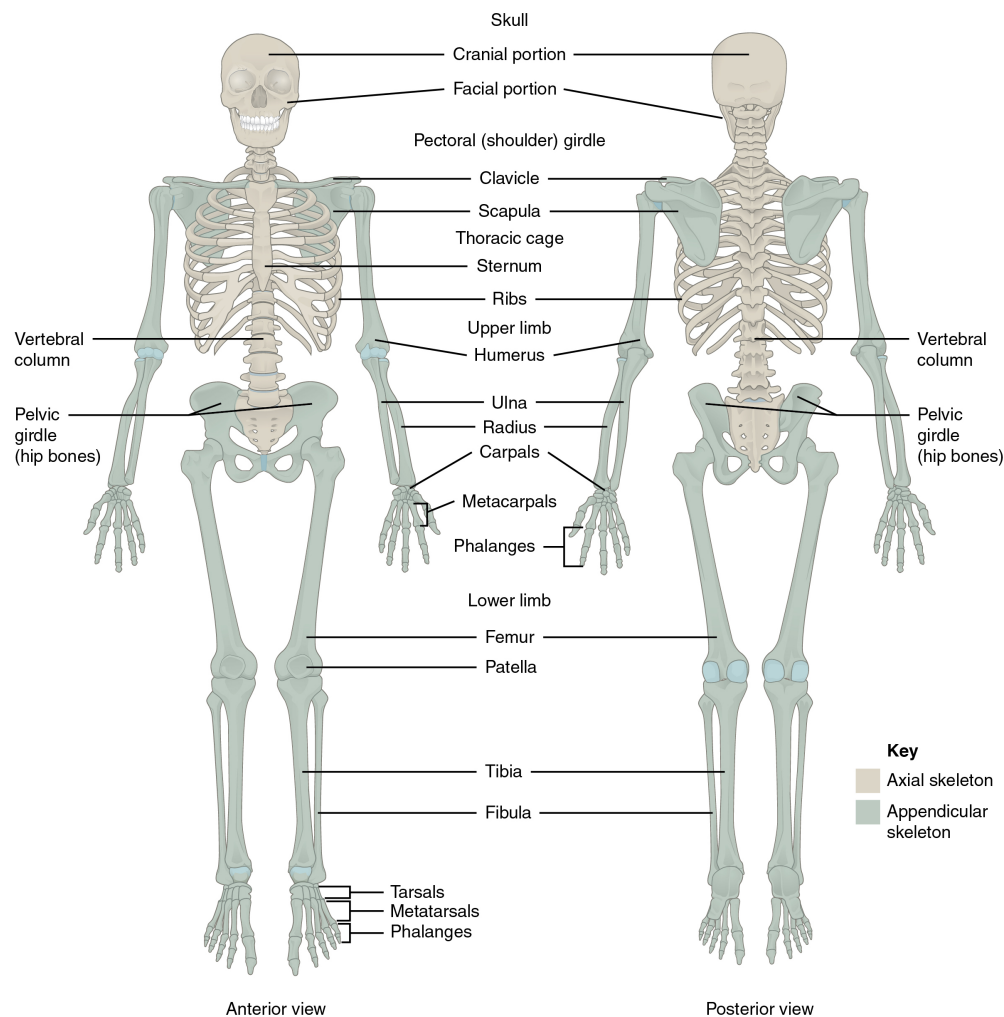


Figure 4.1 Axial and Appendicular Skeleton. The axial skeleton supports the head, neck, back, and chest and thus forms the vertical axis of the body. It consists of the skull, vertebral column (including the sacrum and coccyx), and the thoracic cage, formed by the ribs and sternum. The appendicular skeleton is made up of all bones of the upper and lower limbs. From Betts, et al., 2013. Licensed under CC BY 4.0. [\[Image description.\]](#)

It is important to note the difference between male and female anatomic structures. The pelvis is the only way to differentiate the sex of humans in the skeletal system.

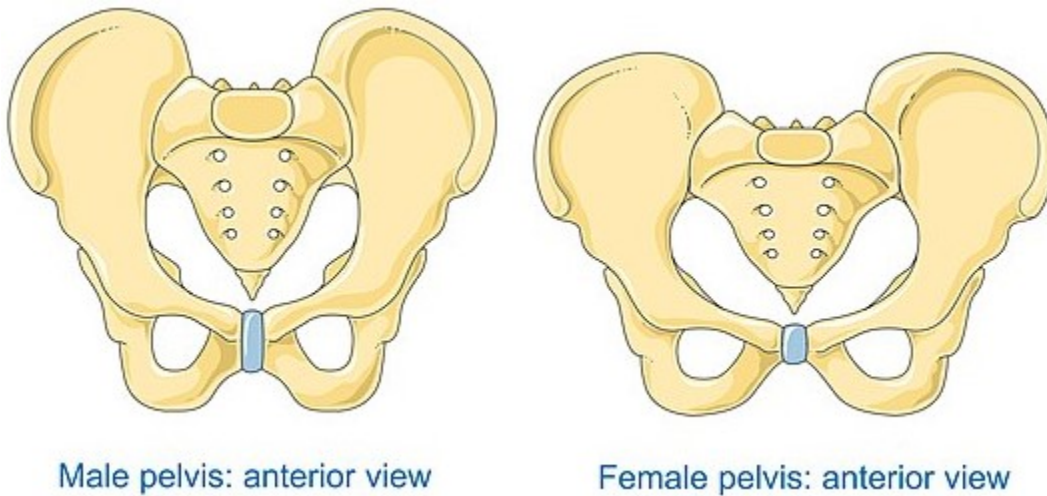


Figure 4.2 Comparison of Male and Female Pelvis. The male pelvis has a heavier bone structure, is narrower and deeper in shape, has a rounder inlet, and has a pubic arch with an acute angle. The female pelvis has a lighter bone structure, has a wider and shallower shape, has an oval-shaped inlet, and has a pubic arch with an obtuse angle. From Servier. Licensed [CC BY-SA 3.0](https://creativecommons.org/licenses/by-sa/3.0/).

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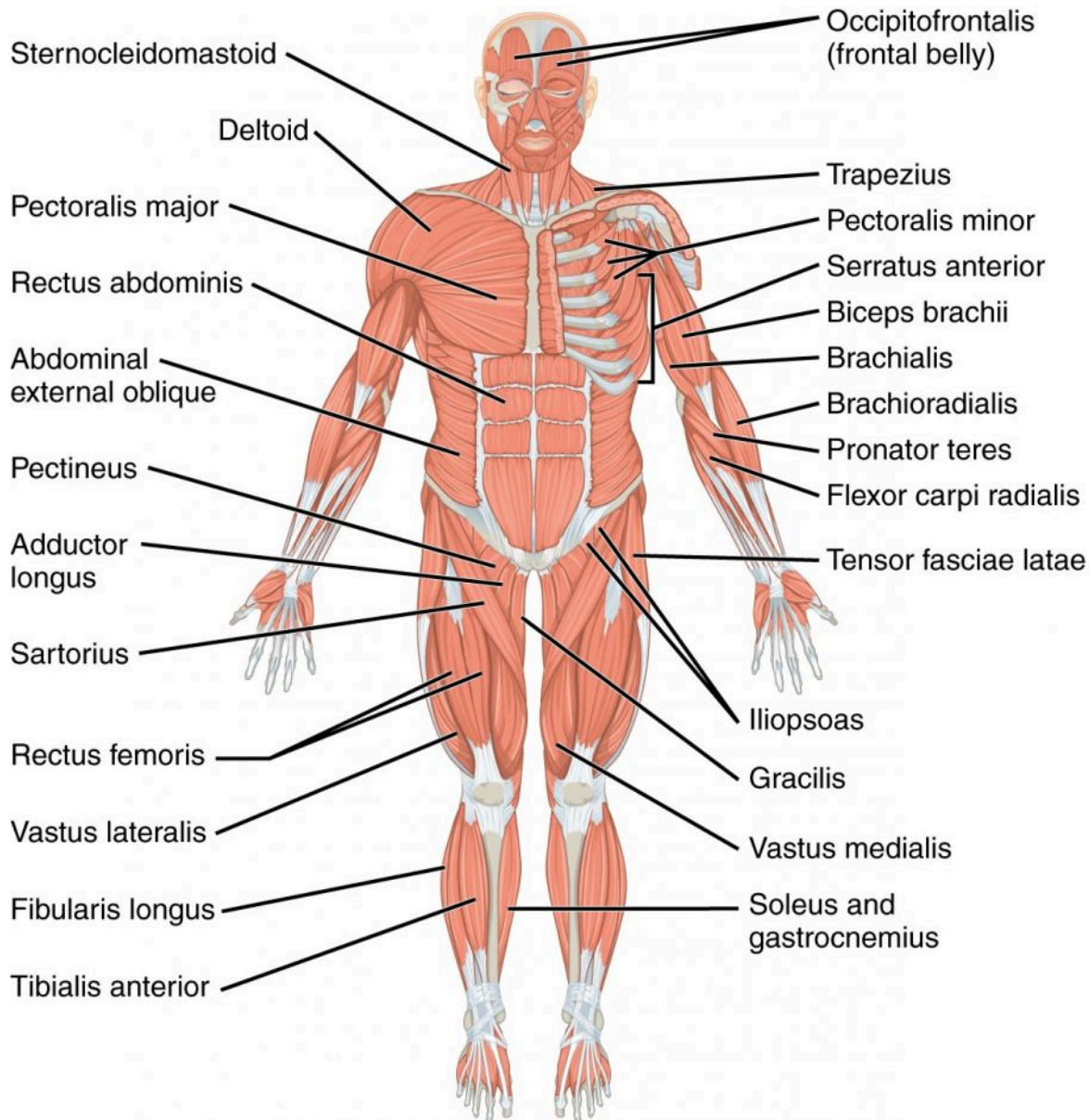


One or more interactive elements has been excluded from this version of the text. You can view them online here: <https://louis.pressbooks.pub/medicalterminology/?p=1907#oembed-1>

Media 4.1 [Bones, part 1, Crash Course A&P #19](#) [Online Video]. Copyright 2015 by [CrashCourse](#).

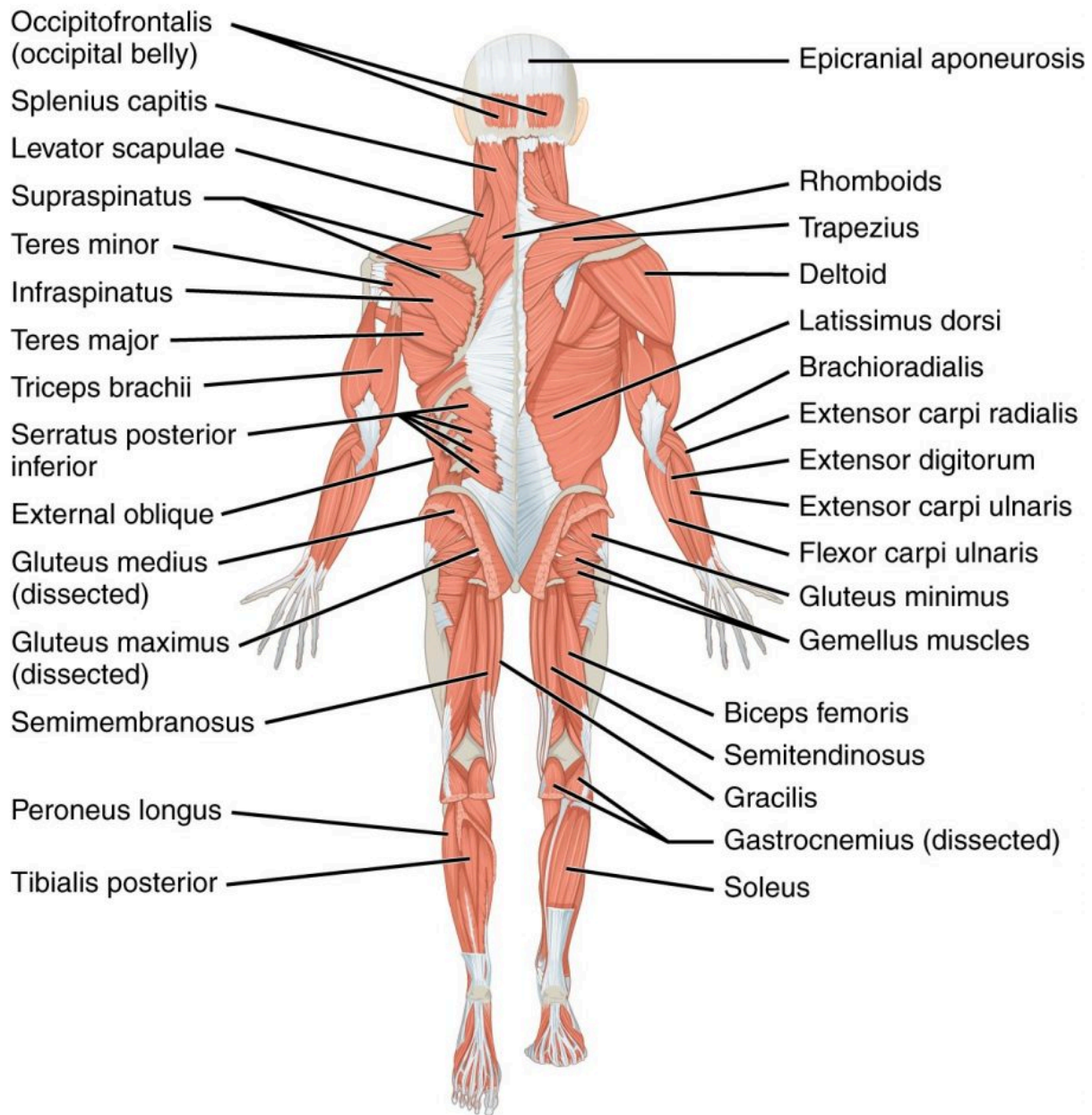
Muscles

Muscle is one of the four primary tissue types of the body. Muscle tissue covers the entire body (see [Figure 4.3](#) and [Figure 4.4](#)) and is made up of specialized cells called fibers.



Major muscles of the body.
Right side: superficial; left side: deep (anterior view)

Figure 4.3 Anterior View of the Muscle System. Superficial muscles (those at the surface) are shown on the right side of the body, while deep muscles (those underneath the superficial muscles) are shown on the left side of the body. Only the superficial muscles are shown for the legs in this figure. From Betts, et al., 2013. Licensed under [CC BY 4.0](#). [\[Image description.\]](#)



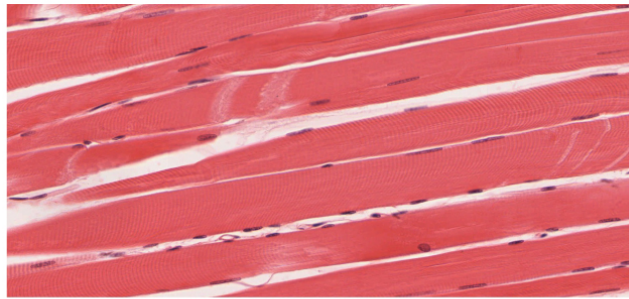
Major muscles of the body.
Right side: superficial; left side: deep (posterior view)

Figure 4.4 Posterior View of the Muscle System. Superficial muscles (those at the surface) are shown on the right side of the body, while deep muscles (those underneath the superficial muscles) are shown on the left side of the body. Both superficial and deep muscles are shown for the legs in this figure. From Betts, et al., 2013. Licensed under [CC BY 4.0](#). [Image description.]

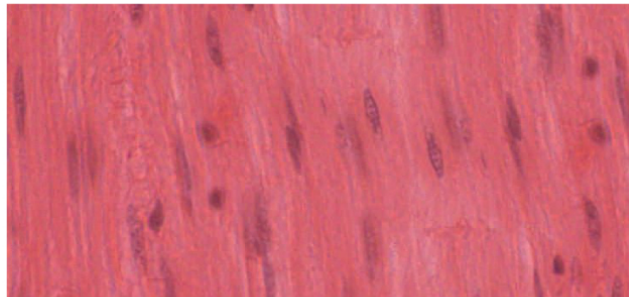
Types of Muscle Tissue

The body contains three types of muscle tissue: **skeletal muscle**, **cardiac muscle**, and **smooth muscle** (see [Figure 4.5](#)). All three muscle tissues have some properties in common; they all exhibit a quality called **excitability**, as their plasma membranes can change their electrical states (from polarized to depolarized) and send an electrical wave called an action potential along the entire length of the membrane. **Fascia** is fibrous connective tissue that encloses muscles.

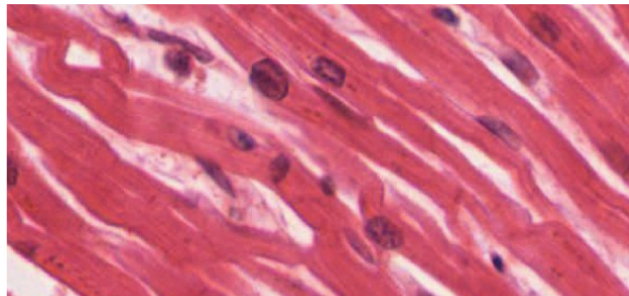
- **Skeletal**—closely associated with the skeletal system, they are striated muscles and are responsible for voluntary muscle movement—such as swallowing, etc.
- **Smooth**—mainly associated with the walls of the internal organs. Also known as visceral muscles and are responsible for involuntary muscle movement—such as breathing, etc.
- **Cardiac**—heart muscle or myocardium. Its striated appearance is similar to a skeletal muscle and is responsible for the pumping of blood. It gives the heartbeat.



(a)



(b)



(c)

Figure 4.5 The Three Types of Muscle Tissue. The body contains three types of muscle tissue: (a) skeletal muscle, (b) smooth muscle, and (c) cardiac muscle. (Micrographs provided by the Regents of University of Michigan Medical School © 2012.) From Betts, et al., 2013. Licensed under [CC BY 4.0](#).

Types of Body Movements

Body movement occurs when the bones, joints, and muscles work together (see [Figure 4.6](#) and [Figure 4.7](#)). The different types of movement are listed below:

- **abduction:** moving away from the midline
- **adduction:** moving toward the midline
- **inversion:** turning inward
- **eversion:** turning outward
- **extension:** movement in which a limb is placed in a straight position, increasing the angle between the bone and the joint
- **flexion:** movement in which a limb is bent, decreasing the angle between the bone and the joint
- **pronation:** movement that turns the palm down
- **supination:** movement that turns the palm up
- **rotation:** turning around its own axis

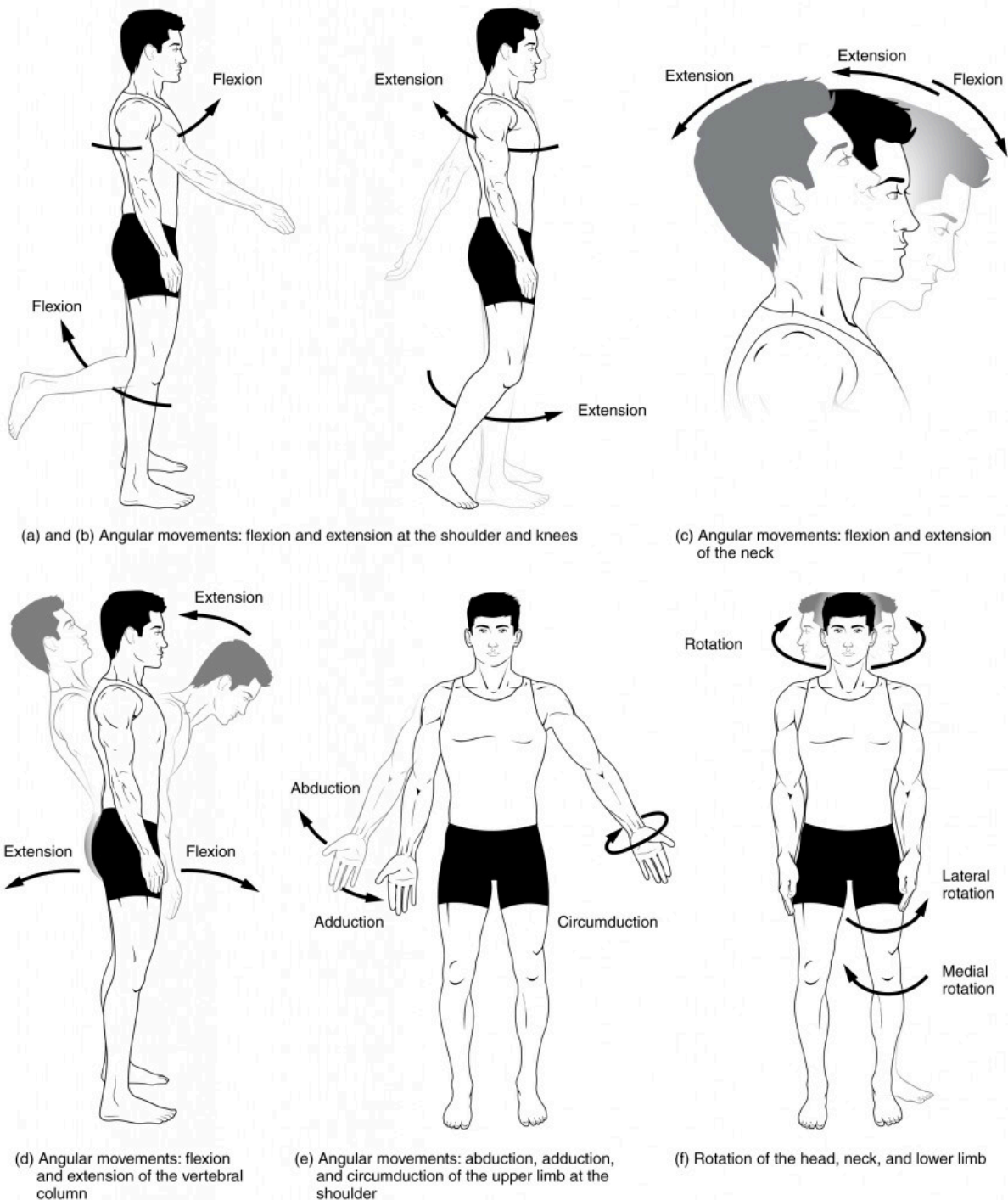


Figure 4.6 Movements of the Body, Part 1. Synovial joints give the body many ways in which to move. (a) and (b) Flexion and extension motions are in the sagittal (anterior and posterior) plane of motion. These movements take place at the shoulder, hip, elbow, knee, wrist, metacarpophalangeal, metatarsophalangeal, and interphalangeal joints. (c) and (d) Anterior bending of the head or vertebral column is flexion, while any posterior-going movement is extension. (e) Abduction and adduction are motions of the limbs, hand, fingers, or toes in the coronal (medial and lateral) plane of movement. Moving the limb or hand laterally away from the body, or spreading the fingers or toes, is abduction. Adduction brings the limb or hand toward or across the midline of the body or brings the fingers or toes together. Circumduction is the movement of the limb, hand, or fingers in a circular pattern using the sequential combination of

flexion, adduction, extension, and abduction motions. Adduction/abduction and circumduction take place at the shoulder, hip, wrist, metacarpophalangeal, and metatarsophalangeal joints. (f) Turning of the head side to side or twisting of the body is rotation. Medial and lateral rotation of the upper limb at the shoulder or lower limb at the hip involves turning the anterior surface of the limb toward the midline of the body (medial or internal rotation) or away from the midline (lateral or external rotation). From Betts, et al., 2013. Licensed under [CC BY 4.0](#). [[Image description](#).]

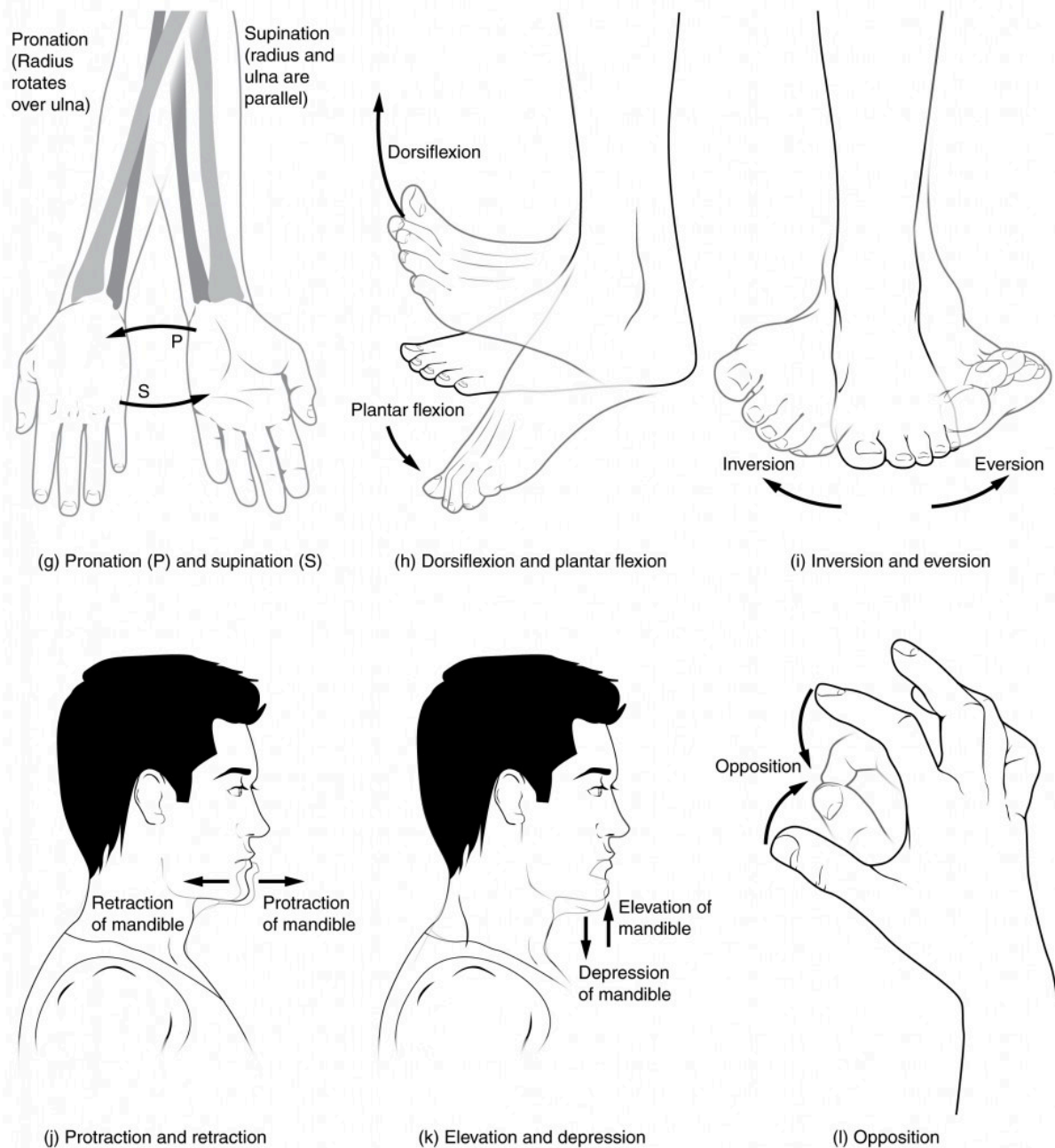


Figure 4.7 Movements of the Body, Part 2. (g) Supination of the forearm turns the hand to the palm forward position in which the radius and ulna are parallel, while forearm pronation turns the hand to the palm-backward position in which the radius crosses over the ulna to form an “X.” (h) Dorsiflexion of the foot at the ankle joint moves the top of the foot toward the leg, while plantar flexion lifts the heel and points the toes. (i) Eversion of the foot moves the bottom (sole) of the foot away from the midline of the body, while foot inversion faces the sole toward the midline. (j) Protraction of the mandible pushes the chin forward, and retraction pulls the chin back. (k) Depression of the mandible opens the mouth, while elevation closes it. (l) Opposition of the thumb brings the tip of the thumb into contact with the tip of the fingers of the same hand, and reposition brings the thumb back next to the index finger. From Betts, et al., 2013. Licensed under [CC BY 4.0](https://creativecommons.org/licenses/by/4.0/).

Image Descriptions

Figure 4.1 image description: This diagram shows the human skeleton and identifies the major bones. The left panel shows the anterior view (from the front) and the right panel shows the posterior view (from the back). Labels read (from the top of skull): skull (cranial portion, facial portion), pectoral shoulder girdle, clavicle, scapula, thoracic cage (sternum, ribs), upper limb (humerus, ulna, radius, carpals, metacarpals, phalanges), vertebral column, pelvic girdle (hip bones), lower limb (femur, patella, tibia, fibula, tarsals, metatarsals, phalanges). [\[Return to Figure 4.1\].](#)

Figure 4.3 image description: This diagram shows an anterior view of the muscle system. Labels on the right side of the body read (from top to bottom): sternocleidomastoid, deltoid, pectoralis major, rectus abdominis, abdominal external oblique, pectineus, adductor longus, sartorius, rectus femoris, vastus lateralis, fibularis longus, tibialis anterior. Labels for left side of the body read (from top to bottom): occipitofrontalis (frontal belly), trapezius, pectoralis minor, serratus anterior, biceps brachii, brachialis, brachioradialis, pronator teres, flexor carpi radialis, tensor fasciae latae, iliopsoas, gracilis, vastus medialis, soleus, and gastrocnemius. [\[Return to Figure 4.3\].](#)

Figure 4.4 image description: This diagram shows an anterior view of the muscle system. Labels on the left side of the body read (from top to bottom): occipitofrontalis (occipital belly), splenius capitis, levator scapulae, supraspinatus, teres minor, infraspinatus, teres major, triceps brachii, serratus posterior inferior, external oblique, gluteus medius (dissected), gluteus maximus (dissected) semimembranosus, peroneus longus, tibialis posterior. Labels for right side of the body read (from top to bottom): epicranial aponeurosis, rhomboids, trapezius, deltoid, latissimus dorsi, brachioradialis, extensor carpi radialis, extensor digitorum, extensor carpi ulnaris, flexor carpi ulnaris, gluteus minimus, gemellus muscles, biceps femoris, semitendinosus, gracilis, gastrocnemius (dissected), soleus. [\[Return to Figure 4.4\].](#)

Figure 4.6 image description: This multi-part image shows different types of movements that are possible by different joints in the body. Labels read (from top, left): (a) and (b) angular movements: flexion and extension at the shoulders and knees, (c) angular movements: flexion and extension of the neck (arrows pointing left and right to indicate movement). Labels (from bottom, left) read: (d) angular movements: flexion and extension of the vertical column, (e) angular movements: abduction, adduction, and circumduction of the upper limb at the shoulder, (f) rotation of the head, neck, and lower limb. [\[Return to Figure 4.6\].](#)

WORD PARTS AND STRUCTURAL TERMS

Combining Forms

ankyl/o: stiff, bent

aponeur/o: aponeurosis

arthr/o: joint

burs/o: bursa

carp/o: carpals, wrist

chondr/o: cartilage

clavic/o: clavicle, collarbone

clavicul/o: clavicle, collarbone

cost/o: ribs

crani/o: cranium

disk/o: intervertebral disk

femor/o: femur, upper leg bone

fibul/o: fibula, lower leg bone

humer/o: humerus, upper arm bone

ili/o: ilium

ischi/o: ischium

kinesi/o: movement, motion

kyph/o: increased convexity of the spine

lord/o: bent forward, increased concavity of the spine

lumb/o: loin, lumbar region of the spine

mandibul/o: mandible, lower jawbone

maxill/o: maxilla, upper jawbone

menisc/o: meniscus, crescent

myel/o: spinal cord

oste/o: bone

patell/o: patella, kneecap

pelv/i: pelvis, pelvic bone

pelv/o: pelvis, pelvic bone

petr/o: stone

phalang/o: phalanges, bones of finger and toes

pub/o: pubis

rachi/o: vertebral spine, vertebral column

radi/o: nerve root

scapul/o: scapula, shoulder blade

scoli/o: crooked, curved

spondyl/o: vertebra, spine, vertebral column

stern/o: sternum, breastbone

tars/o: tarsals, ankle bones

ten/o: tendon

tendin/o: tendon

tend/o: tendon

tibi/o: tibia, lower leg bone

uln/o: ulna, lower arm bone

vertebr/o: vertebra, spine, vertebral column

Prefixes

a-: absence of, without

ab-: away from

ad-: toward

brady-: slow

dys-: painful, difficult, abnormal, labored

hyper-: above, excessive

inter-: between

intra-: within, in

poly-: many, much

sub-: below, under

supra-: above

sym-: together, joined

syn-: together, joined

Suffixes

-al: pertaining to

- algia**: pain
- ar**: pertaining to
- asthenia**: weakness
- centesis**: surgical puncture to aspirate fluid
- clasia**: break
- clasis**: break
- clast**: break
- desis**: surgical fixation, fusion
- ectomy**: excision, surgical removal, cutting out
- gram**: the record, radiographic image
- graphy**: process of recording, radiographic imaging
- ic**: pertaining to
- itis**: inflammation
- lysis**: loosening, separating, dissolution
- malacia**: softening
- oid**: resembling
- oma**: tumor
- osis**: abnormal condition
- penia**: abnormal reduction
- physis**: growth
- plasty**: surgical repair
- rrhaphy**: suturing, repairing
- sarcoma**: malignant tumor
- schisis**: split, fissure
- scopy**: process of viewing, visual examination
- tomy**: incision, cut into
- trophy**: nourishment, development

Structural Terms Built from Word Parts

skull: bones of head, made up of cranium and facial bones

maxilla: upper jaw

mandible: lower jaw

vertebral column: made up of bones called vertebrae (pl.) or vertebra (s.) through which the spinal cord runs. The vertebral column protects the spinal cord, supports the head, and provides points of attachment for ribs and muscles.

clavicle: collarbone

scapula: shoulder blade

acromion process: extension of the scapula, which forms the superior point of the shoulder

sternum: breastbone

xiphoid process: lowest portion of sternum

ribs: 12 sets contained in the thoracic cage that protect the heart and lungs

humerus: bone in upper arm

radius: bone that runs thumb-side of the forearm

ulna: bone that runs on the side of the little finger of the forearm

carpals: wrist bones

metacarpals: bones in the palm of hand

phalanges: finger and toe bones

ilium: largest part of the hip bone; upper, wing-shaped part on each side of the pelvis

ischium: lower, posterior portion of the pelvis on which one sits

pubis: anterior portion of pelvis

pelvis: made up of three bones fused together (also called pelvic bones and hip bones)

acetabulum: large socket in the pelvic bones that holds the head of the femur

femur: thigh bone, also referred to as the upper leg bone; the longest and strongest bone in the human body

patella: kneecap

tibia: medial bone and main weight-bearing bone of the lower leg

fibula: lateral, smaller of the lower leg bone

metatarsals: foot bones

tarsals: ankle bones

calcaneus: heel bone of foot

DISEASES AND DISORDERS

Disease and Disorder Terms Built from Word Parts

ankylosis: abnormal condition of stiffness (often referring to fusion of a joint, such as the result of chronic rheumatoid arthritis)

arthritis: inflammation of the joint

bursitis: inflammation of the bursae

chondromalacia: softening of cartilage

chondrosarcoma: malignant tumor of cartilage

cranioschisis: fissure (split) of the cranium (congenital)

discitis: inflammation of the disc

fasciitis: inflammation of the fascia (connective tissue enclosing and separating muscle layers)

fibromyalgia: pain in the fibrous tissues and muscles (a common condition characterized by widespread pain and stiffness of muscles, fatigue, and disturbed sleep)

kyphosis: abnormal condition of a hump (in the thoracic spine; also called swayback)

lordosis: abnormal condition of bending forward (in the lumbar spine; also called swayback)

meniscitis: inflammation of the meniscus

myasthenia: muscle weakness

myeloma: tumor of the bone marrow (malignant)

osteitis: inflammation of the bone

osteoarthritis: inflammation of the bone and joint

osteochondritis: inflammation of the bone and cartilage

osteochondroma: tumor composed of bone and cartilage (benign)

osteomalacia: softening of the bone

osteomyelitis: inflammation of the bone and marrow (caused by bacterial infection)

osteonecrosis: abnormal condition of bone death (due to lack of blood supply)

osteopenia: abnormal reduction of bone mass (caused by inadequate replacement of bone lost to normal bone lysis and can lead to osteoporosis)

osteopetrosis: abnormal condition of stonelike bones (very dense bones caused by defective resorption of bone)

osteosarcoma: malignant tumor of the bone

polymyositis: inflammation of many muscles

rachischisis: fissure (split) of the vertebral column (congenital; also called spina bifida)

rhabdomyolysis: dissolution of striated muscle (caused by trauma, extreme exertion, or drug toxicity; in severe cases, renal failure can result)

sarcopenia: abnormal reduction of connective tissue (such as a loss of skeletal muscle mass in the elderly)

scoliosis: abnormal condition of (lateral) curved spine

spondyloarthritis: inflammation of the vertebral joints (also called spondyloarthropathy)

spondylosis: abnormal condition of the vertebrae (a general term used to describe changes to the spine from osteoarthritis or ankylosis)

synoviosarcoma: malignant tumor of the synovial membrane

tendinitis: inflammation of the tendon (also spelled tendonitis)

tenosynovitis: inflammation of the tendon and synovial membrane

Disease and Disorder Terms Not Built from Word Parts

ankylosing spondylitis: form of arthritis that first affects the spine and adjacent structures and that, as it progresses, causes a forward bend of the spine (also called Strümpell-Marie arthritis or disease or rheumatoid spondylitis)

bunion: abnormal prominence of the joint at the base of the great toe, the metatarsal phalangeal joint. It is a common problem, often hereditary or caused by poorly fitted shoes (also called hallux valgus).

carpal tunnel syndrome: common nerve entrapment disorder of the wrist caused by compression of the median nerve; symptoms include pain and tingling in portions of the hand and fingers

compartment syndrome: painful condition caused by increased pressure within a muscle that can lead to ischemia; acute compartment syndrome is a medical emergency and is caused by severe injury

dislocation: displacement of bones in a joint from their normal alignment (also called luxation)

exostosis: abnormal benign growth on the surface of a bone (also called spur)

fracture: broken bone

ganglion cyst: collection of jellylike fluid forming a benign mass arising from joints, most commonly appearing in the wrist, hand, and ankle

gout: disease in which an excessive amount of uric acid in the blood causes sodium urate crystals (tophi) to be deposited in the joints, producing arthritis. The great toe is frequently affected.

herniated disk: rupture of the intervertebral disk cartilage, which allows the contents to protrude through it, putting pressure on the spinal nerve roots (also called slipped disk, ruptured disk, herniated intervertebral disk, or herniated nucleus pulposus [HNP])

Lyme disease: infection caused by a bite from a deer tick infected with *Borrelia burgdorferi*. This bacterium provokes an immune response in the body, the symptoms of which can mimic several musculoskeletal diseases.

Patients may experience fever, headache, and joint pain. A rash (target lesion) may initially arise at the site of the tick bite.

muscular dystrophy: group of hereditary diseases characterized by degeneration of muscle and weakness

myasthenia gravis: chronic disease characterized by muscle weakness and thought to be caused by a defect in the transmission of impulses from nerve to muscle cell. The face, larynx, and throat are frequently affected; no true paralysis of the muscles exists.

osteoporosis: abnormal loss of bone density that may lead to an increase in fractures of the ribs, thoracic and lumbar vertebrae, hips, and wrists after slight trauma (occurs predominantly in postmenopausal women)

plantar fasciitis: inflammation of the connective tissue of the sole of the foot (plantar fascia) due to repetitive injury; common cause of heel pain

repetitive strain injury: cumulative damage to joint, muscle, or other tissue caused by movements performed over and over again; characterized by pain, swelling, numbness, and lack of strength and flexibility, most commonly affecting the hands, wrists, elbows, and shoulders

rheumatoid arthritis: chronic systemic disease characterized by autoimmune inflammatory changes in the connective tissue throughout the body

rotator cuff disease: damage to one or more of the four tendons stabilizing the shoulder joint due to injury or degeneration; symptoms may include pain, limited range of motion, and muscle weakness

spinal stenosis: narrowing of the spinal canal with compression of nerve roots. The condition is either congenital or due to spinal degeneration. Symptoms are pain radiating to the thigh or lower legs and numbness or tingling in the lower extremities.

spondylolisthesis: forward slipping of one vertebra over another

sprain: abnormal stretching or tearing of a ligament that supports a joint

strain: abnormal stretching and tearing of a muscle or tendon

subluxation: partial dislocation of bones and joints

tarsal tunnel syndrome: painful foot disorder caused by compression of the posterior tibial nerve as it passes through the ankle

MEDICAL, SURGICAL, & VIEWING TERMS AND ABBREVIATIONS

Medical Careers & Professional Terminology

radiologic technologist (RT): Creates images of patients' bodies using medical equipment. The images help doctors diagnose and treat diseases and injuries. Technologists assist physicians in procedures as well as prepare and administer contrast agents in order to better visualize the anatomy of interest. Rad Techs need to be licensed in many states in order to administer x-rays (x-radiation). Many schools offer degrees or certificates to achieve before taking your registry in order to become licensed.

specialized radiologic technologist: Radiologic technologists can specialize in Computed Tomography (CT); Magnetic Resonance Imaging (MRI); Bone Densitometry (D); Positron Emission Tomography (PET); Nuclear Medicine (NM); and Radiation Therapy (RT). These specialties could be completed while on the job or with an additional year of education depending on the area chosen. Technologists can become certified in multiple modalities by completing requirements and passing the registry for the specified modality of interest.

radiologist: A medical doctor that specializes in diagnosing and treating injuries and diseases using medical imaging procedures, or exams, from the Radiology Department. Procedures could include x-rays, Computed Tomography (CT), Magnetic Resonance Imaging (MRI), Nuclear Medicine (NM), Positron Emission Tomography (PET), and Ultrasound (Sonography). Radiologists complete at least 13 years of training, including medical school, a four-year residency, and most often, an additional one- or two-year fellowship of very specialized training, such as radiation oncology, pediatric radiology, or interventional radiology. They are certified by the American Board of Radiology, and they have exacting requirements for continuing medical education throughout their practicing years.

physical therapist assistant (PTA): Provides physical therapist services under the direction and supervision of a physical therapist. PTAs implement components of patient care, obtain data related to the treatments provided, and collaborate with the PT to modify care as necessary. They assist patients in recovery after injuries, postoperative care, and pain management through strategic exercises and therapeutic methods. PTAs have completed a minimal associate-level degree and passed a licensing exam.

physical therapist (PT): Physicians who diagnose and treat patients by prescribing exercises, hands-on care, and patient education. PTs are required to obtain a doctorate in physical therapy. This typically takes 3 years, and graduates must also pass a state licensure exam.

orthopedic surgeon: A medical doctor who completes an additional 5 years of specialized training in the prevention, diagnosis, treatment, and surgery of disorders and diseases related to the musculoskeletal systems.

neurologist: A medical doctor who completes an additional 5 years of specialized training in the prevention, diagnosis, and treatment of disorders and conditions related to the brain, spinal cord, nerves, and muscles.

kinesiologist: A regulated health care professional with a 4-year degree in kinesiology or a related discipline. Kinesiologists work in a variety of settings that assist people with pain management, injury prevention, and health promotion through biomechanics.

rheumatologist: A medical doctor who has additional training as an internist with a subspecialty in rheumatology. These doctors have special interests in autoimmune disorders and their impact on the musculoskeletal system.

doctor of chiropractic (DC)/chiropractor: A health care practitioner with 7 years of education, supervised internships, and national examinations. They are trained in prevention, assessment, and treatment of the spine, muscular system, and nervous system. Chiropractors focus on spinal adjustments, nutrition, and preventing injury without the use of pharmaceuticals or surgical procedures.

Imaging Techniques/Procedures for the Organ System Built from Word Parts

arthrography: radiographic imaging of a joint (with contrast media)

myelography: radiographic imaging of the spinal cord (with contrast media)

arthroscopy: visual examination of a joint

electromyogram: record of the (intrinsic) electrical activity in the (skeletal) muscle

Imaging Techniques/Procedures for the Organ System Not Built from Word Parts

dual x-ray absorptiometry (DXA): radiographic imaging, usually of the lumbar spine and hips, to measure bone loss and bone mineral density; the procedure utilizes low doses of radiation and is used in the diagnosis of osteoporosis and monitoring of treatment (also called dual-energy x-ray absorptiometry [DEXA], bone densitometry, and bone density test)

bone markers: blood and urine tests to determine the rate of bone turnover (resorption and formation); often used with DXA to diagnose and monitor treatment of osteoporosis and other bone disorders

muscle biopsy: removal of muscle tissue using a needle or small incision; used to assess musculoskeletal abnormalities involving weakness or pain such as muscular dystrophy, myasthenia gravis, and polymyositis

Diagnostic Imaging Procedures

bone densitometry: a method of determining the density of bone by radiographic techniques used to diagnose osteoporosis; dual x-ray absorptiometry (DXA) is commonly used for this test

bone scan: (nuclear medicine test) used to detect the presence of metastatic disease of the bone and to monitor degenerative bone disease

magnetic resonance: used to evaluate the bones and soft tissue of the shoulders, hips, elbows, knees, ankles, feet, and spinal cord for stenosis, spinal cord defects, and degenerative disk changes

radiography: (radiographic imaging) of the bones and joints is used to identify fractures or tumors, monitor healing, or identify abnormal structures.

single-photon emission computed tomography (SPECT): of the bone is an even more sensitive nuclear method for detecting bone abnormalities

Surgical Techniques/Procedures Used in the Organ System

arthrocentesis: surgical puncture to aspirate fluid from a joint

arthrodesis: surgical fixation of a joint (a.k.a. joint fusion)

arthroplasty: surgical repair of a joint

bursectomy: excision of a bursa

carpectomy: excision of a carpal bone

chondrectomy: excision of cartilage

chondroplasty: surgical repair of cartilage

costectomy: excision of a rib

cranioplasty: surgical repair of the skull

craniotomy: incision into the cranium (as for surgery of the brain)

discectomy: excision of an intervertebral disk (a portion of the herniated disk is removed to relieve pressure on nerve roots; uses a larger incision than microdiscectomy)

fasciotomy: incision into fascia (to relieve tension or pressure)

laminectomy: excision of a lamina (often performed to relieve pressure on the nerve roots in the lower spine caused by a herniated disk and other conditions)

maxillectomy: excision of the maxilla

meniscectomy: excision of a meniscus (performed for a torn cartilage)

microdiscectomy: small excision of an intervertebral disk (minimally invasive surgery to remove a portion of the herniated disk to relieve pressure on nerve roots)

myorrhaphy: suturing of a muscle

osteotomy: incision into the bone

phalangectomy: excision of a finger or toe bone

rachiotomy: incision into the vertebral column

spondylosyndesis: fusing together of the vertebrae (also called spinal fusion)

synovectomy: excision of the synovial membrane (of a joint)

tarsectomy: excision of (one or more) tarsal bones

tenomyoplasty: surgical repair of the tendon and muscle

tenorrhaphy: suturing of a tendon

vertebroplasty: surgical repair of a vertebra (usually performed for compression fractures due to osteoporosis)

Abbreviations Commonly Used with the Organ System

Disease and Disorders

CTS: carpal tunnel syndrome

Fx: fracture

HNP: herniated nucleus pulposus

MD: muscular dystrophy

MG: myasthenia gravis

OA: osteoarthritis

PM: polymyositis

RA: rheumatoid arthritis

RSI: repetitive strain injury

Diagnostic

DEXA: (spoken as a whole word): dual-energy x-ray absorptiometry

DXA: (spoken as a whole word): dual x-ray absorptiometry

EMG: electromyogram

Treatment

THA: total hip arthroplasty

TKA: total knee arthroplasty

Medical Specialties

DC: Doctor of Chiropractic

DO: Doctor of Osteopathy

Ortho: Orthopedics

Descriptive

C1-C7: cervical vertebrae

T1-T12: thoracic vertebrae

L1-L5: lumbar vertebrae

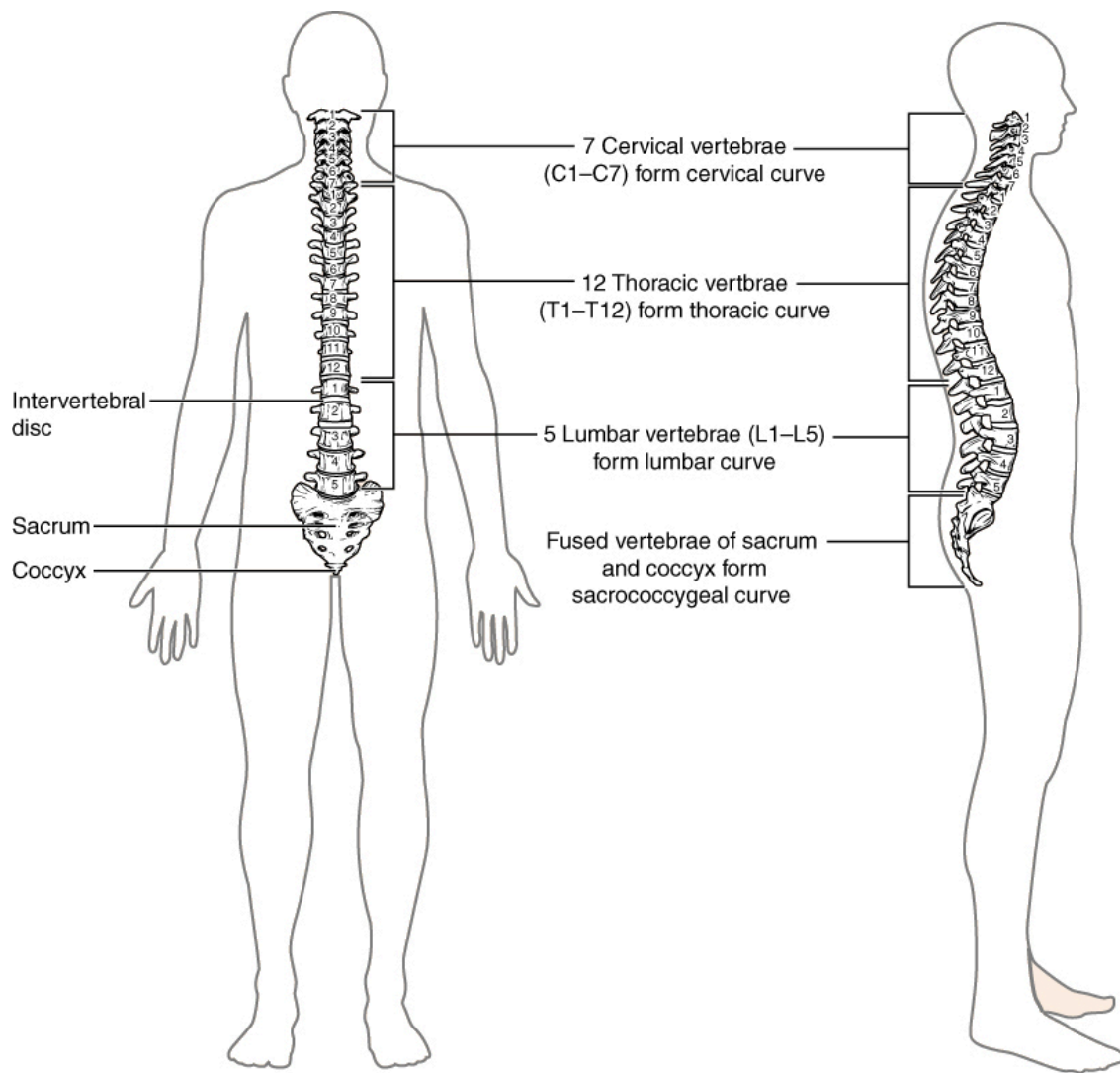


Figure 4.6 Vertebral Column. The adult vertebral column consists of 24 vertebrae, plus the sacrum and coccyx. The vertebrae are divided into three regions: cervical C1–C7 vertebrae, thoracic T1–T12 vertebrae, and lumbar L1–L5 vertebrae. The vertebral column is curved, with two primary curvatures (thoracic and sacrococcygeal curves) and two secondary curvatures (cervical and lumbar curves). From Betts, et al., 2013. Licensed under CC BY 4.0. [\[Image description.\]](#)

Medical Terms Practice

For each card, click the speaker icon to hear the correct pronunciation of the listed term. Practice saying the term to yourself, then attempt to define the term from memory. Click “Turn” to flip the card and see the definition. Use the right and left arrows to toggle through the cards in each set.



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Image Description

Figure 4.6 image description: This image shows the structure of the vertebral column. The left panel shows the front view of the vertebral column. Labels and the right panel show the side view of the vertebral column. labels read (from top): 7 cervical vertebrae (C1-C7) form cervical curve, 12 thoracic vertebrae (T1-T12) form thoracic curve, intervertebral disc, 5 lumbar vertebrae (L1-L5) form lumbar curve, Fused vertebrae of sacrum and coccyx form sacrococcygeal curve, sacrum, coccyx. [\[Return to Figure 4.6\]](#).

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PRACTICE

The following activities will help you practice what you've learned in this chapter.

Skeletal System Anatomy

Click and drag each term to the box corresponding with the anatomic structure, body part, body plane, or body region for that term.



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Operative Report—1



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Operative Report—2



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Referral Letter



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Vocabulary Reinforcement Activities

Click the term that correctly answers each question or completes each sentence.



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PART V

NERVOUS SYSTEM

Learning Objectives

When completing this chapter, the learner will be able to do the following:

- Identify the anatomy of the nervous system
- Describe the main functions of the nervous system
- Spell the medical terms of the nervous system and use correct abbreviations
- Identify the medical specialties associated with the nervous system
- Explore common diseases, disorders, and procedures related to the nervous system

Introduction

The picture you have in your mind of the nervous system probably includes the brain, the nervous tissue contained within the cranium, and the spinal cord, the extension of nervous tissue within the vertebral column. That suggests it is made of two organs—and you may not even think of the spinal cord as an organ—but the nervous system is a very complex structure. Within the brain, many different and separate regions are responsible for many different and separate functions. It is as if the nervous system is composed of many organs that all look similar and can only be differentiated using tools such as the microscope or electrophysiology.

Watch this Video:



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Media 5.1 [The Nervous System, Part 1: Crash Course A&P #8](#) [Online video]. Copyright 2015 by [CrashCourse](#).

ANATOMY OF THE NERVOUS SYSTEM

The Central and Peripheral Nervous Systems

The nervous system can be divided into two major regions: the central and peripheral nervous systems. The central nervous system (CNS) is the brain and spinal cord, and the peripheral nervous system (PNS) is everything else (see [Figure 5.1](#)). The brain is contained within the cranial cavity of the skull, and the spinal cord is contained within the vertebral cavity of the vertebral column. The peripheral nervous system is so named because it is on the periphery—meaning beyond the brain and spinal cord.

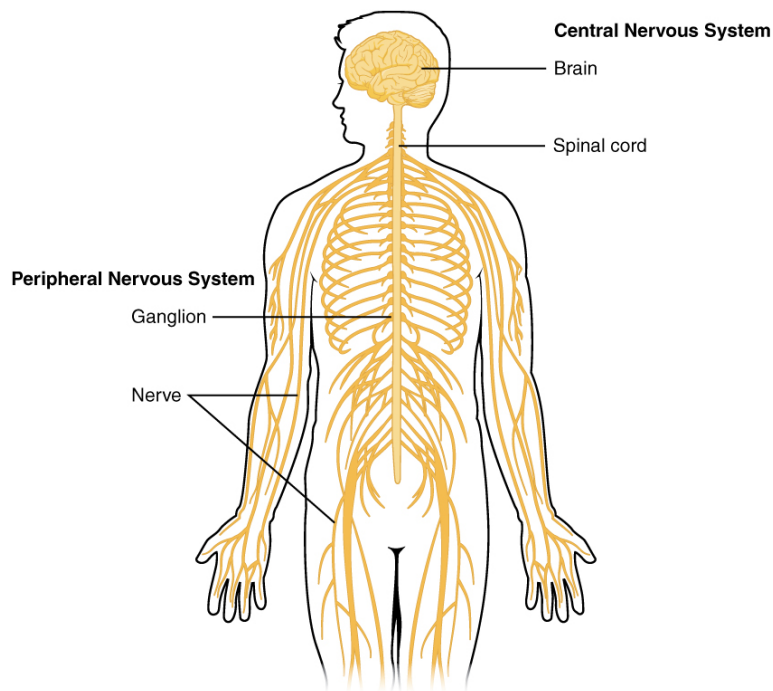


Figure 5.1 Central and Peripheral Nervous System. The structures of the PNS are referred to as ganglia and nerves, which can be seen as distinct structures. The equivalent structures in the CNS are not obvious from this overall perspective and are best examined in prepared tissue under the microscope. From Betts, et al., 2013. Licensed under [CC BY 4.0](#). [\[Image description.\]](#)

Nervous tissue, present in both the CNS and PNS, contains two basic types of cells: neurons and glial cells. Neurons are the primary type of cell that most anyone associates with the nervous system. They are electrically

active and release chemical signals to target cells. A glial cell is one of a variety of cells that provide a framework of tissue that supports the neurons and their activities.

Neurons are cells and therefore have a soma, or cell body, but they also have extensions of the cell; each extension is generally referred to as a process. There is one important process that every neuron has called an axon, which is the fiber that connects a neuron with its target. Another type of process that branches off from the soma is the dendrite. Dendrites are responsible for receiving most of the input from other neurons.

Looking at nervous tissue, there are regions that predominantly contain cell bodies and regions that are largely composed of just axons. These two regions within nervous system structures are often referred to as gray matter (the regions with many cell bodies and dendrites) or white matter (the regions with many axons). [Figure 5.2](#) demonstrates the appearance of these regions in the brain and spinal cord.

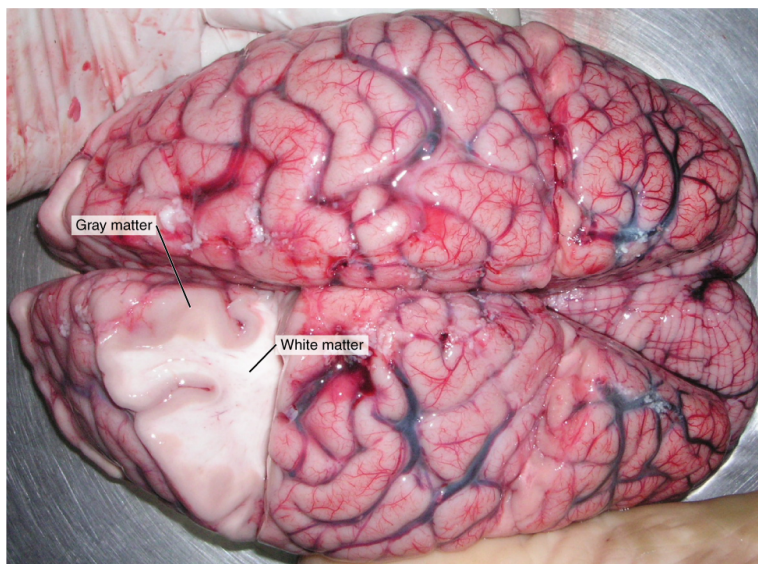


Figure 5.2 Gray Matter and White Matter. A brain removed during an autopsy, with a partial section removed, shows white matter surrounded by gray matter. Gray matter makes up the outer cortex of the brain. (Credit: modification of work by “Suseno”/Wikimedia Commons.) From Betts, et al., 2013. Licensed under [CC BY 4.0](#). [\[Image description.\]](#)

The Adult Brain

The adult brain is separated into four major regions: the cerebrum, the diencephalon, the brain stem, and the cerebellum.

The Cerebrum

The iconic gray mantle of the human brain, which appears to make up most of the mass of the brain, is the cerebrum (see [Figure 5.3](#)). The wrinkled portion is the cerebral cortex, and the rest of the structure is beneath that outer covering. There is a large separation between the two sides of the cerebrum called the longitudinal fissure. It separates the cerebrum into two distinct halves, a right and left cerebral hemisphere. Deep within the cerebrum, the white matter of the corpus callosum provides the major pathway for communication between the two hemispheres of the cerebral cortex.

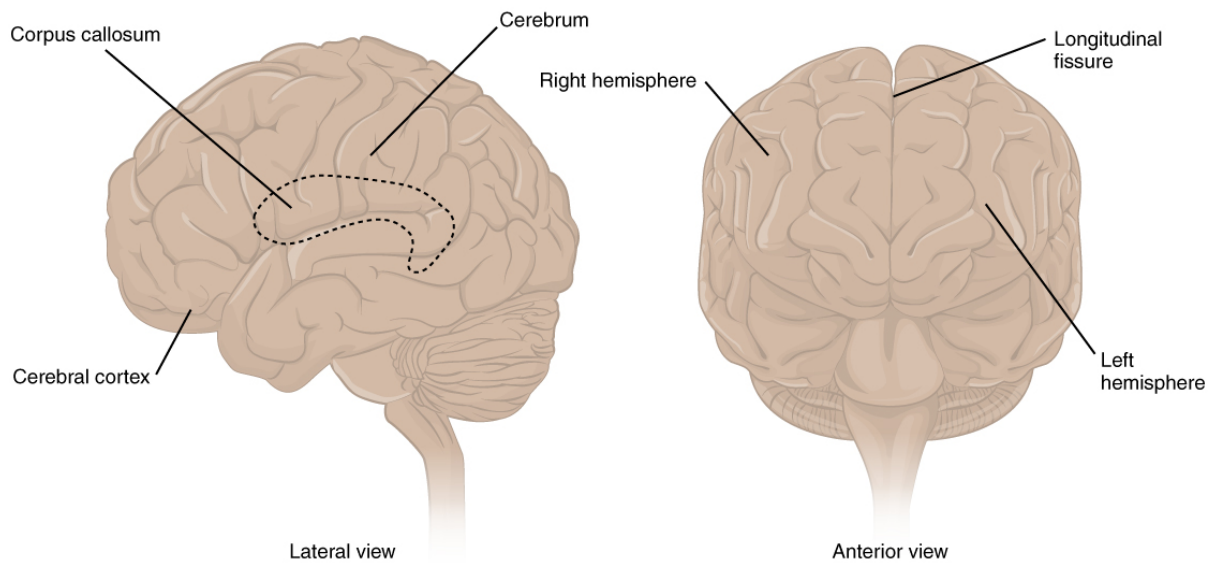


Figure 5.3 The Cerebrum. The cerebrum is a large component of the CNS in humans, and the most obvious aspect of it is the folded surface called the cerebral cortex. From Betts, et al., 2013. Licensed under [CC BY 4.0](#). [[Image description](#).]

Many of the higher neurological functions, such as memory, emotion, and consciousness, are the result of cerebral function. In mammals, the cerebrum comprises the outer gray matter that is the cortex (from the Latin word meaning “bark of a tree”).

Cerebral Cortex

The cerebrum is covered by a continuous layer of gray matter that wraps around either side of the forebrain—the cerebral cortex. This thin, extensive region of wrinkled gray matter is responsible for the higher functions of the nervous system. A gyrus (plural = gyri) is the ridge of one of those wrinkles, and a sulcus (plural = sulci) is the groove between two gyri. The pattern of these folds of tissue indicates specific regions of the cerebral cortex.

Extensive folding in the cerebral cortex enables more gray matter to fit into this limited space. If the gray matter of the cortex were peeled off of the cerebrum and laid out flat, its surface area would be roughly equal to one square meter.

Using these landmarks (the largest gyri and sulci), the cortex can be separated into four major regions, or lobes (see [Figure 5.4](#)).

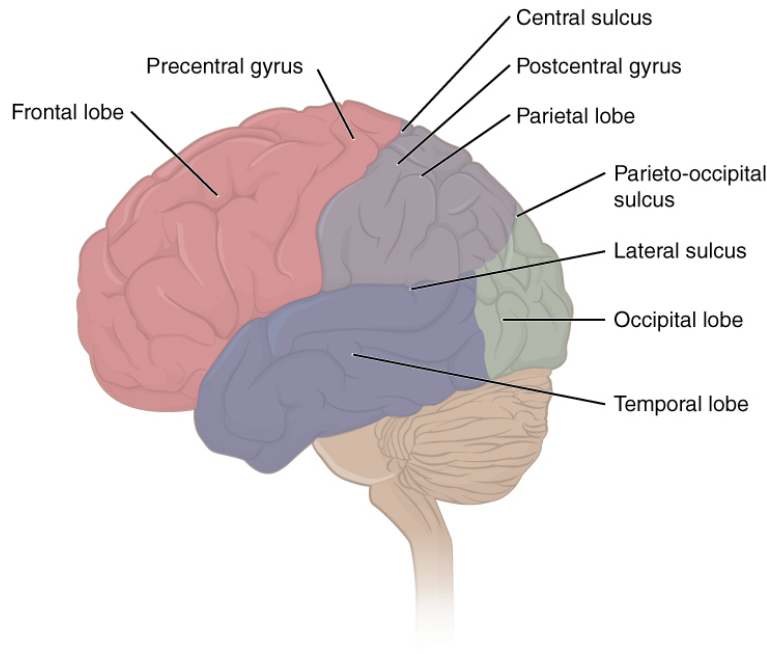


Figure 5.4 Lobes of the Cerebral Cortex. The cerebral cortex is divided into four lobes. Extensive folding increases the surface area available for cerebral functions. From Betts, et al., 2013. Licensed under [CC BY 4.0](#). [\[Image description.\]](#)

The Diencephalon

The diencephalon is deep beneath the cerebrum and constitutes the walls of the third ventricle. The two major regions of the diencephalon are the thalamus itself and the hypothalamus (see [Figure 5.5](#)).

Thalamus

The thalamus is a collection of nuclei that relay information between the cerebral cortex and the periphery, spinal cord, or brain stem. All sensory information, except for the sense of smell, passes through the thalamus before being processed by the cortex.

Hypothalamus

Inferior and slightly anterior to the thalamus is the hypothalamus, the other major region of the diencephalon. The hypothalamus is a collection of nuclei that are largely involved in regulating homeostasis. The hypothalamus is the executive region in charge of the autonomic nervous system and the endocrine system through its regulation of the anterior pituitary gland. Other parts of the hypothalamus are involved in memory and emotion as part of the limbic system.

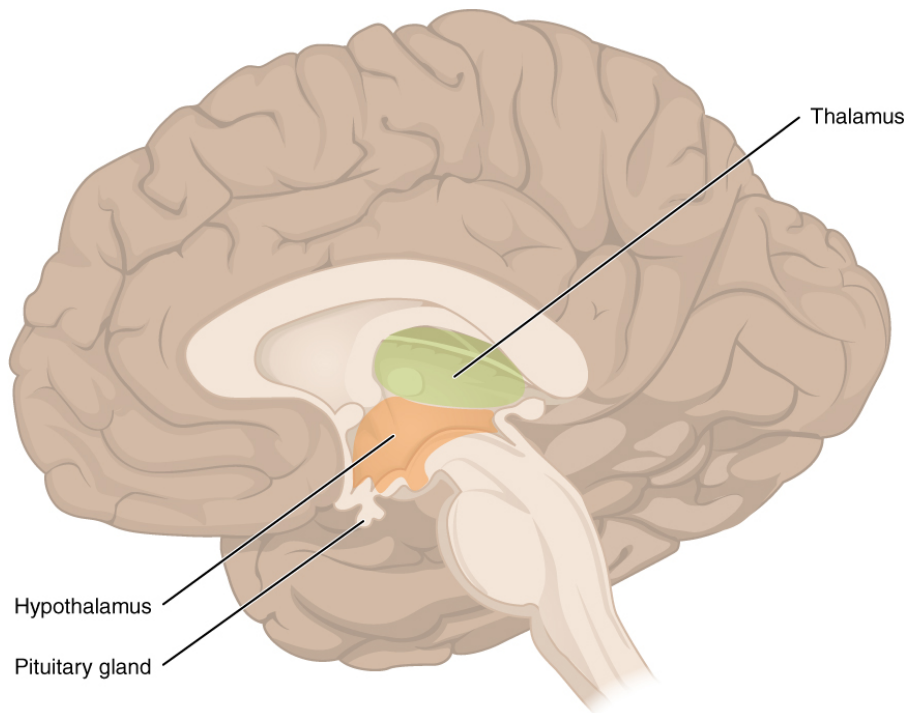


Figure 5.5 The Diencephalon. The diencephalon is composed primarily of the thalamus and hypothalamus, which together define the walls of the third ventricle. The thalami are two elongated, ovoid structures on either side of the midline that make contact in the middle. The hypothalamus is inferior and anterior to the thalamus, culminating in a sharp angle to which the pituitary gland is attached. From Betts, et al., 2013. Licensed under [CC BY 4.0](#). [\[Image description.\]](#)

The midbrain and hindbrain (composed of the pons and the medulla) are collectively referred to as the brain stem (see [Figure 5.6](#)). The structure emerges from the ventral surface of the forebrain as a tapering cone that connects the brain to the spinal cord. The midbrain coordinates sensory representations of the visual, auditory, and somatosensory perceptual spaces. The pons is the main connection with the cerebellum. The pons and the medulla regulate several crucial functions, including the cardiovascular and respiratory systems and rates. The major ascending and descending pathways between the spinal cord and brain, specifically the cerebrum, pass through the brain stem.

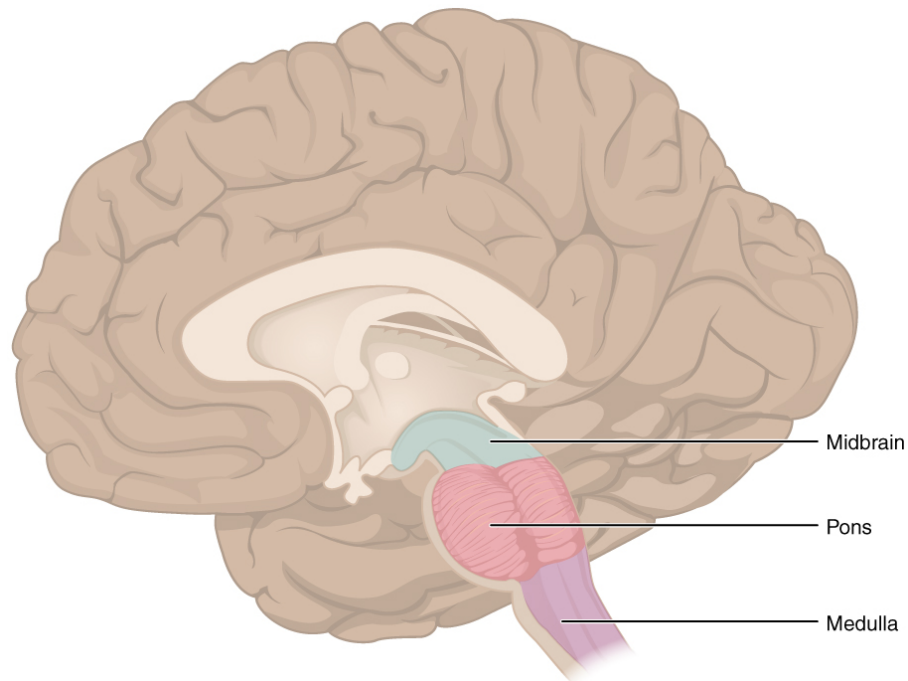


Figure 5.6 The Brain Stem. The brain stem comprises three regions: the midbrain, the pons, and the medulla. From Betts, et al., 2013. Licensed under [CC BY 4.0](#). [\[Image description.\]](#)

The Cerebellum

The cerebellum, as the name suggests, is the “little brain.” It is covered in gyri and sulci like the cerebrum and looks like a miniature version of that part of the brain (see [Figure 5.7](#)). The cerebellum is largely responsible for comparing information from the cerebrum with sensory feedback from the periphery through the spinal cord. It accounts for approximately 10 percent of the mass of the brain.

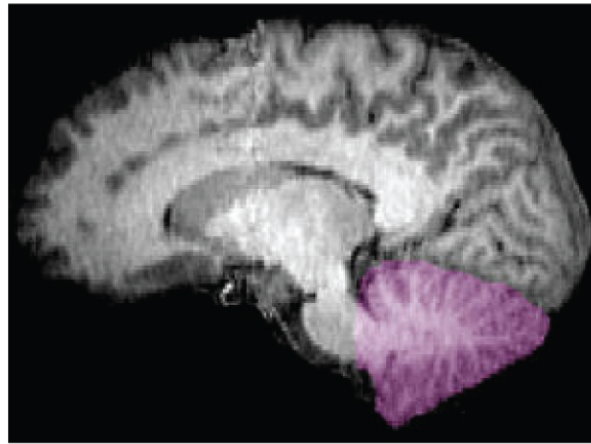
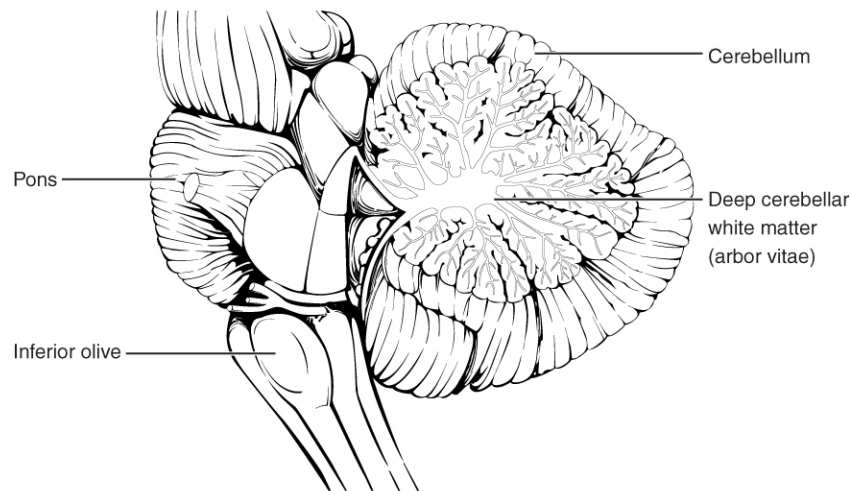


Figure 5.7 The Cerebellum. The cerebellum is situated on the posterior surface of the brain stem. Descending input from the cerebellum enters through the large white matter structure of the pons. Ascending input from the periphery and spinal cord enters through the fibers of the inferior olive. Output goes to the midbrain, which sends a descending signal to the spinal cord. From Betts, et al., 2013. Licensed under [CC BY 4.0](#). [\[Image description.\]](#)

The Spinal Cord

The description of the CNS is concentrated on the structures of the brain, but the spinal cord is another major organ of the system.

The length of the spinal cord is divided into regions that correspond to the regions of the vertebral column.

The name of a spinal cord region corresponds to the level at which spinal nerves pass through the intervertebral foramina. Immediately adjacent to the brain stem are the following divisions of the spinal cord:

- cervical region
- thoracic region
- lumbar region
- sacral region

The spinal cord is not the full length of the vertebral column because the spinal cord does not grow significantly longer after the first or second year, but the skeleton continues to grow. The nerves that emerge from the spinal cord pass through the intervertebral foramina at the respective levels. As the vertebral column grows, these nerves grow with it and result in a long bundle of nerves that resembles a horse's tail and is named the cauda equina. The sacral spinal cord is at the level of the upper lumbar vertebral bones. The spinal nerves extend from their various levels to the proper level of the vertebral column.

Neurons

Neurons are the cells considered to be the basis of nervous tissue. They are responsible for the electrical signals that communicate information about sensations and that produce movements in response to those stimuli, along with inducing thought processes within the brain.

Parts of a Neuron

As you learned in the first section, the main part of a neuron is the cell body, which is also known as the soma (soma = “body”). The cell body contains the nucleus and most of the major organelles. But what makes neurons special is that they have many extensions of their cell membranes, which are generally referred to as processes. Neurons are usually described as having one, and only one, axon—a fiber that emerges from the cell body and projects to target cells. That single axon can branch repeatedly to communicate with many target cells. It is the axon that propagates the nerve impulse, which is communicated to one or more cells. The other processes of the neuron are dendrites, which receive information from other neurons at specialized areas of contact called synapses. The dendrites are usually highly branched processes, providing locations for other neurons to communicate with the cell body. Information flows through a neuron from the dendrites, across the cell body, and down the axon.

[Figure 5.8](#) shows the relationship of these parts to one another.

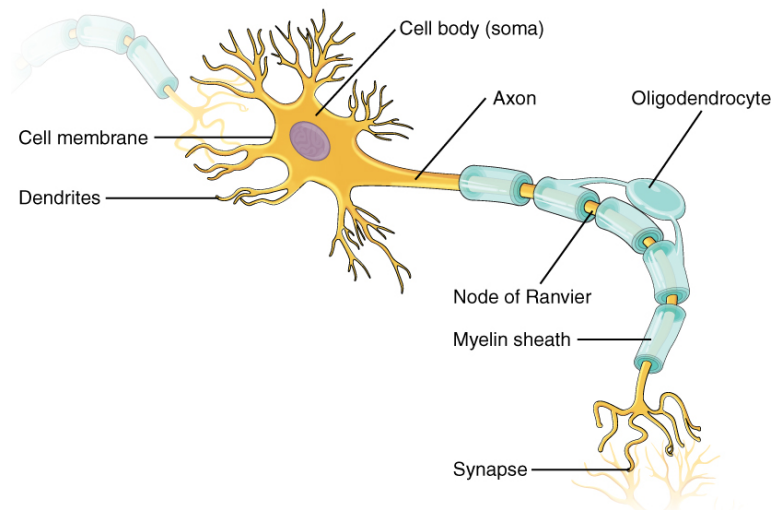


Figure 5.8 Parts of a Neuron. The major parts of the neuron are labeled on a multipolar neuron from the CNS. From Betts, et al., 2013. Licensed under [CC BY 4.0](#). [\[Image description.\]](#)

Many axons are wrapped by an insulating substance called myelin, which is actually made from glial cells. Myelin acts as insulation, much like the plastic or rubber that is used to insulate electrical wires. A key difference between myelin and the insulation on a wire is that there are gaps in the myelin covering of an axon. Each gap is called a node of Ranvier and is important to the way that electrical signals travel down the axon. At the end of the axon is the axon terminal, where there are usually several branches extending toward the target cell, each of which ends in an enlargement called a synaptic end bulb. These bulbs are what make the connection with the target cell at the synapse.

Glial Cells

Glial cells, or neuroglia or simply glia, are the other type of cell found in nervous tissue. They are considered to be supporting cells, and many functions are directed at helping neurons complete their function for communication. The name glia comes from the Greek word that means “glue.”

There are six types of glial cells. Four of them are found in the CNS, and two are found in the PNS. [Table 5.1](#) outlines some common characteristics and functions.

Table 5.1: Glial Cell Types by Location and Basic Function

CNS GLIA	PNS GLIA	BASIC FUNCTION
Astrocyte	Satellite cell	Support
Oligodendrocyte	Schwann cell	Insulation, myelination
Microglia	–	Immune surveillance and phagocytosis
Ependymal cell	–	Creating CSF

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Image Descriptions

Figure 5.1 image description: This diagram shows a silhouette of a human highlighting the nervous system. The central nervous system is composed of the brain and spinal cord. The brain is a large mass of ridged and striated tissue within the head. The spinal cord extends down from the brain and travels through the torso, ending in the pelvis. Pairs of enlarged nervous tissue, labeled ganglia, flank the spinal cord as it travels through the rib area. The ganglia are part of the peripheral nervous system, along with the many thread-like nerves that radiate from the spinal cord and ganglia through the arms, abdomen, and legs. [\[Return to Figure 5.1\].](#)

Figure 5.2 image description: This photo shows an enlarged view of the dorsal side of a human brain. The right side of the occipital lobe has been shaved to reveal the white and gray matter beneath the surface blood vessels. The white matter branches through the shaved section like the limbs of a tree. The gray matter branches and curves on the outside of the white matter, creating a buffer between the outer edges of the occipital lobe and the internal white matter. [\[Return to Figure 5.2\].](#)

Figure 5.3 image description: This figure shows the lateral view on the left panel and anterior view on the right panel of the brain. The major parts including the cerebrum are labeled. Lateral view labels (clockwise from top) read: cerebrum, cerebral cortex, corpus callosum (located on the interior of the brain). Anterior view labels indicate the right and left hemispheres and the longitudinal fissure between them. [\[Return to Figure 5.3\].](#)

Figure 5.4 image description: This figure shows the lateral view of the brain and the major lobes are labeled. From the front of the brain (left) labels read: frontal lobe, precentral gyrus, central sulcus, postcentral gyrus, parietal lobe, lateral sulcus, occipital lobe, temporal lobe. [\[Return to Figure 5.4\].](#)

Figure 5.5 image description: This figure shows the location of the thalamus, hypothalamus, and pituitary gland in the brain. Each part is labeled respectively. The thalamus is located in the midsection of the

brain. The hypothalamus is located below the thalamus and the pituitary gland below that. [\[Return to Figure 5.5\].](#)

Figure 5.6 image description: This figure shows the location of the midbrain, pons, and the medulla in the brain that make up the brain stem. The midbrain is located at the top, the pons is located beneath that, and the medulla is the lowest most point of the brain stem. [\[Return to Figure 5.6\].](#)

Figure 5.7 image description: This figure shows the location of the cerebellum in the brain which is located on the posterior surface of the brain stem. Labels read (top, left): pons, inferior olive, (top, right) cerebellum, deep cerebellar white matter (arbor vitae). In the top panel, a lateral view labels the location of the cerebellum and the deep cerebellar white matter. In the bottom panel, a photograph of a brain, with the cerebellum in pink is shown. [\[Return to Figure 5.7\].](#)

Figure 5.8 image description: This illustration shows the anatomy of a neuron. The neuron has a very irregular cell body (soma) containing a purple nucleus. There are six projections protruding from the top, bottom, and left side of the cell body. Each of the projections branches many times, forming small, tree-shaped structures protruding from the cell body. The right side of the cell body tapers into a long cord called the axon. The axon is insulated by segments of myelin sheath, which resemble a semitransparent toilet paper roll wound around the axon. The myelin sheath is not continuous but is separated into equally spaced segments. The bare axon segments between the sheath segments are called nodes of Ranvier. An oligodendrocyte is reaching its two arm-like projections onto two myelin sheath segments. The axon branches many times at its end, where it connects to the dendrites of another neuron. Each connection between an axon branch and a dendrite is called a synapse. The cell membrane completely surrounds the cell body, dendrites, and its axon. The axon of another nerve is seen in the upper left of the diagram connecting with the dendrites of the central neuron. [\[Return to Figure 5.8\].](#)

WORD PARTS AND STRUCTURAL TERMS

Combining Forms

arachn/o: spider

astr/o: star

cephal/o: head

cerebell/o: cerebellum

cerebr/o: cerebrum

cortic/o: outer layer or covering

crani/o: cranium, head

dur/o: dura mater, hard

encephal/o: brain

esthesi/o: sensation, sensitivity, feeling

gangli/o: ganglion

ganglion/o: ganglion

gli/o: glia, gluey substance

heme/o: blood

hydr/o: water

mening/o: meninges

meningi/o: meninges

ment/o: mind

mon/o: one, single

myel/o: spinal cord

neur/o: nerve

pariet/o: wall

phas/o: speech

poli/o: gray matter

psych/o: mind

quadr/i: four

radic/o: nerve root

radicul/o: nerve root

rhiz/o: nerve root

somat/o: body

thromb/o: clot

Prefixes

a-: absence of, without, no, not

an-: absence of, without, no, not

dys-: painful, abnormal, difficult, labored

hemi-: half

hyper-: above, excessive

hypo-: below, deficient

inter-: between

intra-: within

pan-: all, total

para-: beside, beyond, around, abnormal

poly-: many, much

post-: after

pre-: before

sub-: below, under

syn-: together

Suffixes

-al: pertaining to (adjective)

-algia: pain (noun)

-cele: hernia, protrusion (noun)

-cyte: cell (noun)

-ectomy: excision, surgical removal, cutting out (noun)

-genic: producing, originating, causing (adjective)

-gram: the record, radiographic image (noun)

-graph: instrument used to record (noun)

-graphy: process of recording, radiographic imaging (noun)

-ia: condition of, diseased state or abnormal state (adjective)

-ic: pertaining to (adjective)

-iatrist: specialist, physician (noun)

-atry: specialty, treatment (noun)

-ictal: seizure, attack

- itis**: inflammation
- logist**: specialist, physician
- logy**: study of
- lysis**: loosening, dissolution, separating
- malacia**: softening
- oid**: resembling
- oma**: tumor
- osis**: abnormal condition
- paresis**: slight paralysis
- pathy**: disease
- peri**: around or about
- phasia**: speech
- plasty**: surgical repair
- plegia**: paralysis
- rrhaphy**: suture
- sclerosis**: hardening
- rrhaphy**: suturing, repairing
- tomy**: incision, cut into

Structural Terms Built from Word Parts

- arachnoid**: resembling a spider
- astrocyte**: star-shaped cell; a type of glial cell
- cephalgia**: pain in the head
- cephalic**: pertaining to the head
- cerebellar**: pertaining to the cerebellum
- cerebral**: pertaining to the cerebrum
- cortical**: pertaining to the gray matter of the cerebrum
- cranial**: pertaining to the cranium or skull cap
- craniocerebral**: pertaining to the cranium and cerebrum
- dendrite**: tree-like structure; receptive process of the neuron
- diencephalon**: thalamus and hypothalamus
- ganglial**: pertaining to a localized collection of neuron cell bodies
- glial**: pertaining to neuroglia
- gliocyte**: glial cell
- hypothalamic**: pertaining to the hypothalamus

hypothalamus: structure below the thalamus; part of the diencephalon

intracerebral: pertaining to within the cerebrum

medulla oblongata: innermost, oblong-shaped part of the brain stem

meningeal: pertaining to the membranes protecting the brain

mental: pertaining to the brain

microglia: small neuroglial cell

myelin: a fatty sheath around an axon of some neurons

neuroglia: “nerve glue”; supportive cells of nerve tissue

neuroid: resembling a nerve

parietal: pertaining to the wall

parietal lobe: one of the cerebral lobes; named for the cranial bone it is situated beneath

peripheral: pertaining to around the center

peripheral nervous system: the division of the nervous system outside of the central nervous system

psychogenic: originating in the mind

somatic: pertaining to the body

somatic nervous system: pertaining to peripheral nervous system sections that carry impulses to the skeletal muscles

subarachnoid space: space under the middle layer of the meninges where cerebrospinal fluid flows

DISEASES AND DISORDERS

Disease and Disorder Terms Built from Word Parts

amnesia: without memory; a sudden loss of memory

amyotrophic lateral sclerosis: hardening and breakdown of neurons supplying skeletal muscles causing muscle wasting

aphasia: condition of without speaking; inability to speak

astrocytoma: tumor of the star-shaped glial cells; can be in the brain or spinal cord

cephalgia: pain in the head

cerebellitis: inflammation of the cerebellum

cerebral thrombosis: abnormal condition of blood clotting in the brain

cerebrovascular accident: a clot or bleeding in the vessels of the brain; a stroke

dementia: impairment in thinking; can affect memory, personality, reasoning, and processing

duritis: inflammation of the dura mater

dysphasia: difficult speech; impaired ability to speak

encephalitis: inflammation of the brain

encephalomalacia: softening of the brain

encephalomyeloradiculitis: inflammation of the brain, spinal cord, and nerve roots

encephalosclerosis: hardening of the brain tissue

epidural hematoma: collection of blood between the skull and the dura mater

gangliitis: inflammation of the ganglion

glioblastoma: tumor of developing glial tissue

glioma: tumor of the glial tissue

hemiparesis: partial paralysis of one side of the body

hemiplegia: paralysis of one side of the body

hydrocephalus: “water on the brain”; excessive cerebrospinal fluid in and around the brain

hyperesthesia: excessive sensitivity to stimuli

ictal: pertaining to between seizures

interictal: pertaining to during a seizure

meningioma: noncancerous tumor of the meninges

meningitis: inflammation of the meninges

meningomyelocele: protrusion of the meninges and spinal cord

microcephaly: small head; congenital condition where the brain and skull are too small

monoparesis: mild paralysis of one (limb)

mononeuropathy: disease affecting a single nerve

multiple sclerosis: disease of plaques (hardened areas) in the brain and demyelination

myelitis: inflammation of the spinal cord

myelomalacia: softening of the spinal cord

myelomeningocele: protrusion (herniation) of the membranes of the brain or spinal cord through a hole in the skull or vertebrae

neuralgia: pain in a nerve

neuritis: inflammation of the nerves

neuroarthropathy: disease of the nerves and joints

neuroma: tumor of nerve tissue

neuropathy: disease of nerve fibers

panplegia: total paralysis

paralysis: destruction of nerves in the spinal cord; loss of muscle functions

paraplegia: paralysis of the lower extremities and often the lower body trunk

paresthesia: loss of sensation, numbness

plegia: paralysis

polyneuritis: inflammation of many nerves

polyneuropathy: disease of many nerves

poliomyelitis: inflammation of the gray matter in the spinal cord and brain

preictal: occurs before a seizure or attack

psychopathy: disease of the mind

psychosis: abnormal condition of the mind

psychosomatic: pertaining to the mind and body

psychotic disorder: a disorder pertaining to the mind

quadriplegia: paralysis of four limbs; can also include the trunk

radicotomy: incision into a nerve root

radiculitis: inflammation of the nerve roots

radiculopathy: disease of the nerve roots

rhizomeningomyelitis: inflammation of the nerve root, meninges, and spinal cord

subarachnoid hemorrhage: bleeding into the area between the arachnoid mater and the pia mater

subdural hematoma: blood-filled tumor pertaining to below the dura mater

Disease and Disorder Terms Not Built from Word Parts

Alzheimer's disease: a dementia disorder caused by plaques and degeneration of the myelin in the central nervous system

Guillain-Barre syndrome: disease causing demyelination of the peripheral nerves

Parkinson's disease: central nervous system disease causing dopamine deficiency

MEDICAL, SURGICAL, & VIEWING TERMS AND ABBREVIATIONS

Medical Careers & Professional Terminology

neurologist: specialist in the prevention, diagnosis, and treatment of disorders of the nervous system

neurology: study of nerves

neurosurgeon: surgeon who specializes in operations on the nervous system

psychiatrist: medical doctor who specializes in the diagnosis and treatment of mental disorders

psychiatry: specialty of the mind

psychologist: nonmedical doctor who specializes in the diagnosis and treatment of mental disorders

Imaging Techniques/Diagnostic Procedures/Procedures for the Organ System

cerebral angiography: process of recording vessels in the cerebrum

CT myelography: process of recording the spinal cord with computed tomography

electroencephalogram: the record of electrical activity of the brain

electromyography: test that measures the electrical activity between the brain and spinal cord and the peripheral nerves innervating the skeletal muscles

lumbar puncture: procedure used to test cerebrospinal fluid

myelography: radiography of the spinal cord and nerve roots

tensilon test: test used to diagnose myasthenia gravis

Surgical Techniques/Procedures Used in the Organ System

craniotomy: removal of part of the skull to relieve pressure in the brain tissue

ganglionectomy: excision of a ganglion

lobotomy: incision into a lobe of the brain

neurectomy: excision of the nerves

neurotomy: incision into a nerve

neurolysis: dissolution of nerve (for pain management)

neuroplasty: surgery to repair a nerve

neurorrhaphy: suturing of a nerve

rhizotomy: incision into a nerve root

Abbreviations Commonly Used with the Organ System

AD: Alzheimer's disease

ADHD: attention deficit hyperactivity disorder

ALS: amyotrophic lateral sclerosis

CNS: central nervous system

CP: cerebral palsy

CSF: cerebrospinal fluid

CTE: chronic traumatic encephalopathy

CVA: cerebrovascular accident

EEG: electroencephalogram

EMG: electromyography

EP studies: evoked potential studies

LP: lumbar puncture

MRI: magnetic resonance imaging

MS: multiple sclerosis

OCD: obsessive-compulsive disorder

PD: Parkinson's disease

PET: positron emission tomography

PNS: peripheral nervous system

PTSD: post-traumatic stress disorder

SAH: subarachnoid hemorrhage

TIA: transient ischemic attack

Medical Terms Practice

For each card, click the speaker icon to hear the correct pronunciation of the listed term. Practice saying the

term to yourself, then attempt to define the term from memory. Click “Turn” to flip the card and see the definition. Use the right and left arrows to toggle through the cards in each set.



An interactive H5P element has been excluded from this version of the text. You can view it online here:

<https://louis.pressbooks.pub/medicalterminology/?p=1258#h5p-109>

PRACTICE

The following activities will allow you to practice what you've learned in this chapter.

Anatomy Labeling Activity

Click and drag each term to the box corresponding with the anatomic structure, body part, body plane, or body region for that term.



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History and Physical Examination

Click and drag each term from the word bank to its correct place in this exercise.



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Consultation Report

Click and drag each term from the word bank to its correct place in this exercise.



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Follow-Up Report

Click and drag each term from the word bank to its correct place in this exercise.



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Vocabulary Reinforcement Activity

Click the term that correctly answers each question or completes each sentence.



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PART VI

ENDOCRINE SYSTEM

Learning Objectives

When completing this chapter, the learner will be able to do the following:

- Identify the anatomy of the endocrine system
- Describe the main functions of the endocrine system
- Spell the medical terms of the endocrine system and use correct abbreviations
- Pronounce the medical terms of the endocrine system and use correct abbreviations
- Identify the medical specialties associated with the endocrine system
- Explore common diseases, disorders, and procedures related to the endocrine system

Introduction

You may never have thought of it this way, but when you send a text message to two friends to meet you at the dining hall at six, you're sending digital signals that (you hope) will affect their behavior—even though they are some distance away. Similarly, certain cells send chemical signals to other cells in the body that influence their behavior. This long-distance intercellular communication, coordination, and control is critical to maintain equilibrium (homeostasis). This intercellular activity is the fundamental function of the endocrine system.

Watch This Video:



One or more interactive elements has been excluded from this version of the text. You can view them online here: <https://louis.pressbooks.pub/medicalterminology/?p=1403#oembed-1>

Media 6.1. [Endocrine System, Part 1—Glands & Hormones: Crash Course A&P #23](#) [Online video].
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BASIC ANATOMY & PHYSIOLOGY OF THE ENDOCRINE SYSTEM

The endocrine system is composed of endocrine glands distributed throughout the body. These glands are pituitary, thyroid, parathyroid, adrenal, pineal, pancreas, gonads (ovaries and testes), and thymus ([Figure 6.1](#)).

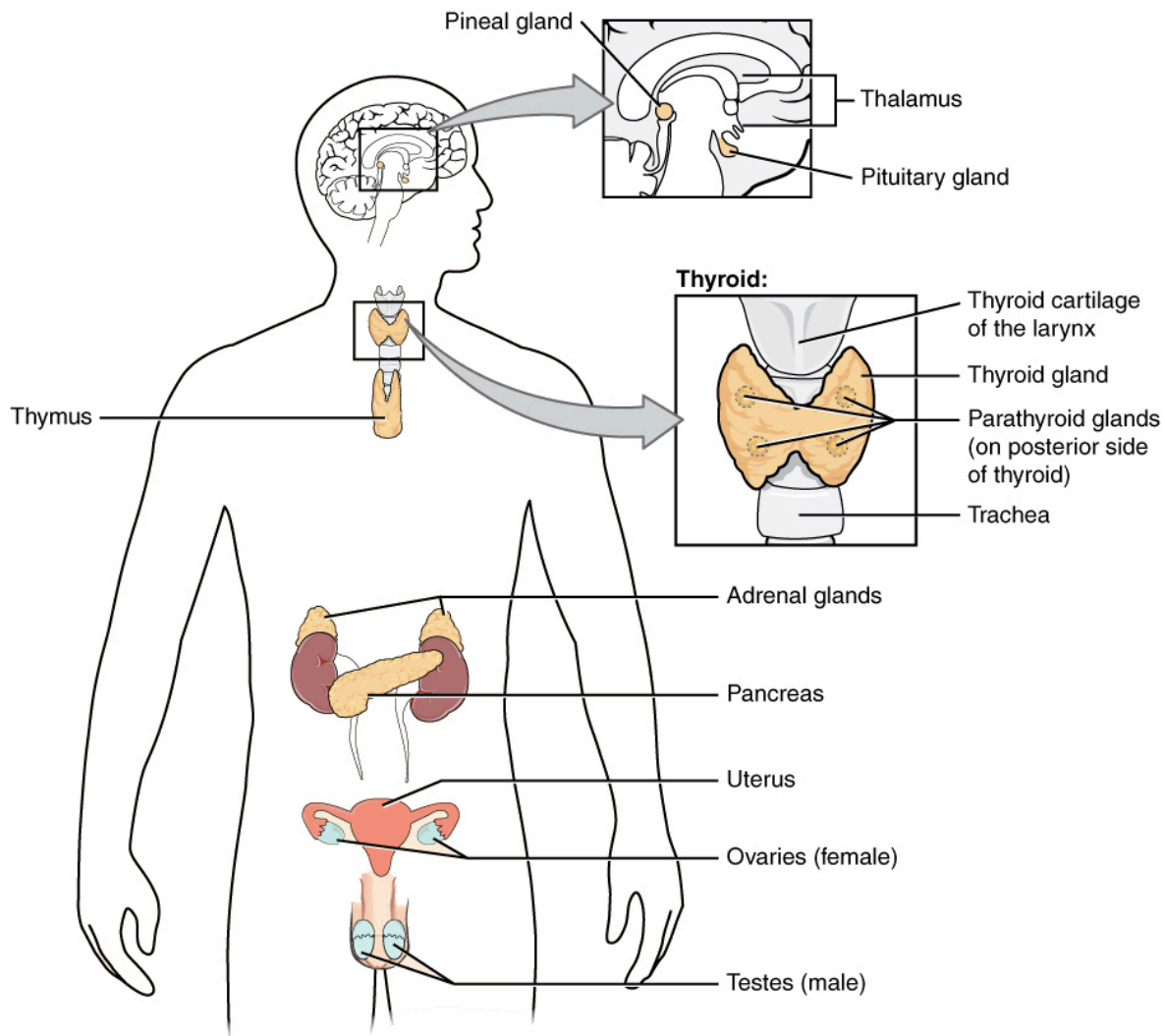


Figure 6.1 Endocrine System. Endocrine glands and cells are located throughout the body and play an important role in maintaining equilibrium (homeostasis). From Betts, et al., 2013. Licensed under CC BY 4.0. [\[Image description.\]](#)

The endocrine system consists of cells, tissues, and organs that secrete hormones as a primary or secondary

function. The primary function of the **endocrine glands** is to secrete **hormones** into the bloodstream. Hormones are chemical messengers that will influence metabolic activities, growth, and development. Some glands have both endocrine and nonendocrine functions. For example, the pancreas contains cells that function in digestion as well as cells that secrete the endocrine hormones like insulin and glucagon, which regulate blood glucose levels. The hypothalamus, thymus, heart, kidneys, stomach, small intestine, liver, skin, female ovaries, and male testes are other organs that contain cells with endocrine function. Moreover, fat (adipose) tissue has long been known to produce hormones, and recent research has revealed that even bone tissue has endocrine functions. The ductless endocrine glands are not to be confused with the body's **exocrine system**, whose glands release their secretions through ducts. Examples of exocrine glands include the sebaceous and sweat glands of the skin. As just noted, the pancreas also has an exocrine function: most of its cells secrete pancreatic juice through the pancreatic and accessory ducts to the lumen of the small intestine.

Endocrine Signaling

The **endocrine system** uses one method of communication called chemical signaling. These chemical signals are sent by the endocrine organs. The endocrine organs secrete chemicals—called hormones—into the fluid outside of the tissue cells (extracellular fluid). Hormones are then transported primarily via the bloodstream throughout the body, where they bind to receptors on target cells, creating a particular response. For example, the hormones released when you are presented with a dangerous or a frightening situation, called the fight-or-flight response, occur through the release of hormones from the adrenal gland—epinephrine and norepinephrine—within seconds. In contrast, it may take up to 48 hours for target cells to respond to certain reproductive hormones.

In addition, endocrine signaling is typically less specific than neural (nerve) signaling. The same hormone may also play a role in a variety of different physiological processes depending on the target cells involved. For example, the hormone oxytocin generates uterine contractions in women who are in labor. This hormone is also important in generating the milk-release reflex during breastfeeding and may be involved in the sexual response and in feelings of emotional attachment in both males and females.

Generally, the nervous system involves quick responses to rapid changes in the external environment, and the endocrine system is usually slower acting—taking care of the internal environment of the body, maintaining equilibrium (homeostasis), and controlling reproduction (see [Table 6.1](#)). So how does the fight-or-flight response, mentioned earlier, happen so quickly if hormones are usually slower acting? It is because the two systems are connected. It is the fast action of the nervous system in response to the danger in the environment that stimulates the adrenal glands to secrete their hormones, epinephrine and norepinephrine. As a result, the nervous system can cause rapid endocrine responses to keep up with sudden changes in both the external and internal environments when necessary.

Table 6.1: Endocrine and Nervous Systems

Characteristic	Endocrine System	Nervous System
Signaling mechanism(s)	Chemical	Chemical/electrical
Primary chemical signal	Hormones	Neurotransmitters
Distance traveled	Long or short	Always short
Response time	Fast or slow	Always fast
Environment targeted	Internal	Internal and external

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Table 6.2: Endocrine Glands and Their Major Hormones

Endocrine Gland	Associated Hormones	Chemical Class	Effect
Pituitary (anterior)	Growth hormone (GH)	Protein	Promotes growth of body tissues
Pituitary (anterior)	Prolactin (PRL)	Peptide	Promotes milk production
Pituitary (anterior)	Thyroid-stimulating hormone (TSH)	Glycoprotein	Stimulates thyroid hormone release
Pituitary (anterior)	Adrenocorticotropic hormone (ACTH)	Peptide	Stimulates hormone release by adrenal cortex
Pituitary (anterior)	Follicle-stimulating hormone (FSH)	Glycoprotein	Stimulates gamete production
Pituitary (anterior)	Luteinizing hormone (LH)	Glycoprotein	Stimulates androgen production by gonads
Pituitary (posterior)	Antidiuretic hormone (ADH)	Peptide	Stimulates water reabsorption by kidneys
Pituitary (posterior)	Oxytocin	Peptide	Stimulates uterine contractions during childbirth
Thyroid	Thyroxine (T ₄), triiodothyronine (T ₃)	Amine	Stimulate basal metabolic rate
Thyroid	Calcitonin	Peptide	Reduces blood Ca ²⁺ levels
Parathyroid	Parathyroid hormone (PTH)	Peptide	Increases blood Ca ²⁺ levels
Adrenal (cortex)	Aldosterone	Steroid	Increases blood Na ⁺ levels
Adrenal (cortex)	Cortisol, corticosterone, cortisone	Steroid	Increases blood glucose levels
Adrenal (medulla)	Epinephrine, norepinephrine	Amine	Stimulates fight-or-flight response
Pineal	Melatonin	Amine	Regulates sleep cycles
Pancreas	Insulin	Protein	Reduces blood glucose levels
Pancreas	Glucagon	Protein	Increases blood glucose levels
Testes	Testosterone	Steroid	Stimulates development of male secondary sex characteristics and sperm production
Ovaries	Estrogens and progesterone	Steroid	Stimulates development of female secondary sex characteristics and prepares the body for childbirth

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Hormone Receptors

The message a hormone sends is received by a hormone **receptor**, a protein located either inside the cell or within the cell membrane. The receptor will process the message by initiating other signaling events or cellular mechanisms that result in the target cell's response. Hormone receptors recognize molecules with specific shapes and side groups and respond only to those hormones that are recognized. The same type of receptor may be located on cells in different body tissues and trigger somewhat different responses. Thus, the response triggered by a hormone depends not only on the hormone but also on the target cell.

Image Descriptions

Figure 6.1 image description: This diagram shows the endocrine glands and cells that are located throughout the body. The endocrine system organs include the pineal gland and pituitary gland in the brain. The pituitary is located on the anterior side of the thalamus, while the pineal gland is located on the posterior side of the thalamus. The thyroid gland is a butterfly-shaped gland that wraps around the trachea within the neck. Four small, disc-shaped parathyroid glands are embedded into the posterior side of the thyroid. The adrenal glands are located on top of the kidneys. The pancreas is located at the center of the abdomen. In females, the two ovaries are connected to the uterus by two long, curved tubes in the pelvic region. In males, the two testes are located in the scrotum below the penis. [\[Return to Figure 6.1\]](#).

WORD PARTS AND STRUCTURAL TERMS

Combining Forms

acr/o: extremities, height

aden/o: gland

adren/o: adrenal glands

adrenal/o: adrenal glands

calc/i: calcium

cortic/o: cortex, outer layer of a body organ

dips/o: thirst

glyc/o: sugar

endocrin/o: endocrine

kal/i: potassium

natr/o: sodium

parathyroid/o: parathyroid gland

pituitar/o: pituitary gland

thyr/o: thyroid gland

thyroid/o: thyroid gland

Prefixes

eu-: normal, good

hypo-: below, under, deficient

hyper-: above, excessive

para-: around, beside, beyond, abnormal

poly-: many, much

syn-: joined, together

pan-: all, total

Suffixes

- al**: pertaining to
- drome**: run, running together
- ectomy**: excision, cut out
- emia**: in the blood
- ia**: condition of, abnormal state, diseased state
- ism**: state of
- itis**: inflammation
- logist**: specialist or physician who studies and treats
- logy**: study of
- megaly**: enlarged, enlargement
- oid**: resembling
- oma**: tumor
- pathy**: disease
- plasia**: condition of, formation, development, growth
- tomy**: incision, cut into

Structural Terms Built from Word Parts

pituitary gland: approximately the size of a pea and located at the base of the brain. The pituitary is divided into two lobes. It is often referred to as the master gland because it produces hormones that stimulate the function of other endocrine glands.

hypothalamus: located superior to the pituitary gland in the brain. The hypothalamus secretes “releasing” hormones that function to stimulate or inhibit the release of pituitary gland hormones.

thyroid gland: largest endocrine gland. It is located anteriorly in the neck below the larynx and comprises bilateral lobes connected by an isthmus. The thyroid gland secretes the hormones triiodothyronine (T₃) and thyroxine (T₄), which require iodine for their production. Thyroxine is necessary for body cell metabolism.

parathyroid glands: four small bodies embedded in the posterior aspect of the lobes of the thyroid gland. Parathyroid hormone (PTH), the hormone produced by the glands, helps maintain the level of calcium in the blood by its effects on bone and kidneys.

islets of Langerhans: clusters of endocrine tissue found throughout the pancreas, made up of different cell types that secrete various hormones, including insulin and glucagon. Nonendocrine cells found throughout the pancreas produce enzymes that facilitate digestion.

adrenal glands: paired glands, one of which is located superior to each kidney. The outer portion is called the adrenal cortex, and the inner portion is called the adrenal medulla.

DISEASES AND DISORDERS

Disease and Disorder Terms Built from Word Parts

acromegaly: enlargement of the extremities (and face due to increased soft tissue, bone, and cartilage; caused by excessive production of the growth hormone by the pituitary gland after puberty)

adrenalitis: inflammation of the adrenal glands

adrenomegaly: enlargement (of one or both) of the adrenal glands

endocrinopathy: any disease of the endocrine system

hypercalcemia: excessive calcium in the blood

hyperglycemia: excessive sugar in the blood

hyperkalemia: excessive potassium in the blood

hyperparathyroidism: state of excessive parathyroid gland activity (resulting in hypercalcemia and leading to osteoporosis, as well as symptoms of muscle weakness, abdominal pain, nausea, vomiting, and drowsiness)

hyperpituitarism: state of excessive pituitary gland activity (characterized by excessive secretion of pituitary hormones)

hyperthyroidism: state of excessive thyroid gland activity (characterized by excessive secretion of thyroid hormones; signs and symptoms include tachycardia, weight loss, irritability, and heat intolerance)

hypocalcemia: deficient calcium in the blood

hypoglycemia: deficient sugar in the blood

hypokalemia: deficient potassium in the blood

hyponatremia: deficient sodium in the blood

hypopituitarism: state of deficient pituitary gland activity (characterized by decreased secretion of one or more of the pituitary hormones, which can affect the function of the target endocrine gland; for example, hypothyroidism can result from decreased secretion of thyroid-stimulating hormone by the pituitary gland)

hypothyroidism: state of deficient thyroid gland activity (characterized by decreased secretion of thyroid hormones; signs and symptoms include fatigue, weight gain, and cold intolerance)

HYPOTHYROIDISM results in decreased production of the thyroid hormone called thyroxine. A severe form of hypothyroidism in adults is called myxedema and in infants is called congenital hypothyroidism.

panhypopituitarism: state of total deficient pituitary gland activity (characterized by decreased secretion of all the anterior pituitary hormones; a more serious condition than hypopituitarism in that it affects the function of all the other endocrine glands)

PANHYPOPITUITARISM contains two prefixes: pan-meaning total and hypo-meaning deficient.

parathyroidoma: tumor of a parathyroid gland

thyroiditis: inflammation of the thyroid gland

Disease and Disorder Terms Not Built from Word Parts

Addison disease: chronic syndrome resulting from a deficiency in the hormonal secretion of the adrenal cortex. Signs and symptoms may include weakness, weight loss, hypotension, darkening of skin, and loss of appetite.

ADDISON DISEASE was named in 1855 for Thomas Addison, an English physician and pathologist. He described the disease as a “morbid state with feeble heart action, anemia, irritability of the stomach, and a peculiar change in the color of the skin.”

congenital hypothyroidism: condition caused by congenital absence or atrophy (wasting away) of the thyroid gland, resulting in hypothyroidism. The disease is characterized by puffy features, mental deficiency, large tongue, and short stature.

Cushing syndrome: group of signs and symptoms attributed to the excessive production of cortisol by the adrenal cortices (pl. of cortex). This syndrome may be the result of a pituitary tumor that produces ACTH or a primary adrenal cortex hypersecretion. Signs include abnormally pigmented skin, “moon face,” pads of fat on the chest and abdomen, “buffalo hump” (fat on the upper back), wasting away of muscle, and hypertension.

CUSHING SYNDROME was named for an American neurosurgeon, Harvey Williams Cushing (1869–1939), after he described adrenocortical hyperfunction.

diabetes insipidus (DI): result of decreased secretion of antidiuretic hormone by the posterior lobe of the pituitary gland. Symptoms include excessive thirst (polydipsia), large amounts of urine (polyuria), and water being excreted from the body.

diabetes mellitus (DM): chronic disease involving a disorder of carbohydrate metabolism caused by underactivity of the insulin-producing islets of Langerhans and characterized by elevated blood sugar (hyperglycemia). DM can cause chronic renal disease, retinopathy, and neuropathy. In extreme cases the patient may develop ketosis, acidosis, and finally coma.

gigantism: condition brought about by hypersecretion of growth hormone by the pituitary gland before puberty

GIGANTISM AND ACROMEGALY are both caused by overproduction of growth hormone. Gigantism occurs before puberty and before the growing ends of the bones have closed. If untreated, an individual may reach 8 feet tall in adulthood. Acromegaly occurs after puberty. The body parts most affected are those in the hands, feet, and jaw.

graves disease: autoimmune disorder of the thyroid gland characterized by the production of more thyroid hormone than the body needs (hyperthyroidism), goiter, and exophthalmos (abnormal protrusion of the eyeballs)

Hashimoto thyroiditis: disease in which thyroid gland cells are destroyed by autoimmune processes. Characterized by hypothyroidism and goiter; more common in females.

ketoacidosis: serious condition resulting from uncontrolled diabetes mellitus in which acid ketones accumulate from fat metabolism in the absence of adequate insulin. If not promptly controlled by adequate insulin and hydration, can progress to coma and death.

metabolic syndrome: group of signs and symptoms including insulin resistance, obesity characterized by excessive fat around the area of the waist and abdomen, hypertension, hyperglycemia, elevated triglycerides, and low levels of the “good” cholesterol HDL. Risks include development of type 2 diabetes mellitus, coronary heart disease, or stroke (also called syndrome X and insulin resistance syndrome).

myxedema: condition resulting from an extreme deficiency of the thyroid hormone thyroxine; a severe form of hypothyroidism in an adult. Signs include puffiness of the face and hands, coarse and thickened skin, enlarged tongue, slow speech, and anemia.

neuroblastoma: malignant cancer that often starts in the adrenal medulla, composed of immature nerve cells. Primarily affects children.

pheochromocytoma: tumor of the adrenal medulla, which is usually nonmalignant and characterized by hypertension, headaches, palpitations, diaphoresis, chest pain, and abdominal pain. Surgical removal of the tumor is the most common treatment. Though usually curable with early detection, it can be fatal if untreated.

thyrotoxicosis: condition caused by excessive thyroid hormones

Watch this video:



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Media 6.2 [Endocrine System, part 2—Hormone Cascades](#) [Online video]. Copyright 2015 by [CrashCourse](#).

MEDICAL, SURGICAL, & VIEWING TERMS AND ABBREVIATIONS

Medical Careers & Professional Terminology

endocrinology: a specialization in the field of medicine that focuses on the treatment of endocrine system disorders.

endocrinologist: medical doctors who specialize in this field are experts in treating diseases associated with hormonal systems, ranging from thyroid disease to diabetes.

endocrine surgeons: treat endocrine disease through the removal of the affected endocrine gland or tissue.

Some patients experience health problems as a result of the normal decline in hormones that can accompany aging. These patients can consult with an endocrinologist to weigh the risks and benefits of hormone replacement therapy intended to boost their natural levels of reproductive hormones. In addition to treating patients, endocrinologists may be involved in research to improve the understanding of endocrine system disorders and develop new treatments for these diseases (Betts, et al., 2013).

thyroid specialist: an endocrinologist whose subspecialty is focused on the treatment and disorders of the thyroid gland such as hypothyroidism (too low secretion) and hyperthyroidism (too high secretion).

diabetes specialist: an endocrinologist whose subspecialty is focused on the treatment of diabetic conditions.

Imaging Techniques/Procedures for the Organ System

thyroid scan: This procedure is designed to check the status of the thyroid. In a thyroid scan, a radioactive compound is given and localized in the thyroid gland (Giorgi & Cherney, 2018).

radioactive iodine uptake: Thyroid function evaluated by injecting radioactive iodine and then measuring how much is removed from the blood by the thyroid (MedlinePlus, 2020).

blood serum testing: Blood testing to determine the concentration and the presence of various endocrine hormones in the blood. These tests include the following levels: calcium, cortisol, electrolytes, FSH, GH, glucose, insulin, parathyroid hormones, T3, T4, testosterone, and TSH. All of these can be evaluated with blood serum tests (Betts, et al., 2013).

Surgical Techniques/Procedures Used in the Organ System

Most of the surgeries and procedures performed on the endocrine system involve removal of a gland or an incision into the gland. Once an endocrine gland is surgically removed, due to a tumor or enlargement, hormone replacement treatment is required. Medication is required to artificially or synthetically replace the hormone produced by the gland and the function it regulates (Betts, et al., 2013).

Abbreviations Commonly Used with the Organ System

ACTH: adrenocorticotrophic hormone

ADH: antidiuretic hormone

DI: diabetes insipidus

DKA: diabetic ketoacidosis

DM: diabetes mellitus

FBS: fasting blood sugar

FNA: fine needle aspiration

FSH: follicle-stimulating hormone

GH: growth hormone

HbA1C: glycosylated hemoglobin

LH: luteinizing hormone

PRL: prolactin

RAIU: radioactive iodine uptake

TSH: thyroid-stimulating hormone

Thyroid profile: T4, T3, and TSH

T4: thyroxine level

T3: triiodothyronine level

TSH: thyroid-stimulating hormone

Medical Terms Practice

For each card, click the speaker icon to hear the correct pronunciation of the listed term. Practice saying the

term to yourself, then attempt to define the term from memory. Click “Turn” to flip the card and see the definition. Use the right and left arrows to toggle through the cards in each set.



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PRACTICE

The following activities will allow you to practice what you've learned in this chapter.

Endocrine System Labeling Activity

Click and drag each term from the word bank to its correct place in this exercise.



An interactive H5P element has been excluded from this version of the text. You can view it online here:

<https://louis.pressbooks.pub/medicalterminology/?p=2041#h5p-118>

Vocabulary Reinforcement Activity

Click the term that correctly answers each question or completes each sentence.



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<https://louis.pressbooks.pub/medicalterminology/?p=2041#h5p-122>

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PART VII

INTEGUMENTARY SYSTEM

Learning Objectives

When completing this chapter, the learner will be able to do the following:

- Identify the basic anatomy of the integumentary system
- Describe the main functions of the integumentary system
- Spell the integumentary system medical terms and use correct abbreviations
- Identify the medical specialties associated with the integumentary system
- Explore common diseases, disorders, and procedures related to the integumentary system

Introduction

The integumentary system refers to the skin and its accessory structures. In the adult human body, the skin makes up about 16 percent of body weight and covers an area of 1.5 to 2 m². In fact, the skin and accessory structures are the largest organ systems in the human body. The skin protects your inner organs and it is in need of daily care and protection to maintain its health.

Watch this video:



One or more interactive elements has been excluded from this version of the text. You can view them online here: <https://louis.pressbooks.pub/medicalterminology/?p=1303#oembed-1>

Media 5.1 [The Integumentary System, Part 1—Skin Deep: Crash Course A&P #6](#) [Online video].
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ANATOMY OF THE INTEGUMENTARY SYSTEM

Basic Anatomy of the System

The skin and its accessory structures make up the **integumentary system**, which provides the body with overall protection. The skin is made of multiple layers of cells and tissues, which are held to underlying structures by connective tissue ([Figure 7.1](#)). The deeper layer of skin is well **vascularized**. It also has numerous sensory and **autonomic** nerve fibers ensuring communication to and from the brain.

The skin is composed of two main layers:

1. The **epidermis**
2. The **dermis**
 - Beneath the dermis lies the **hypodermis** (subcutaneous).

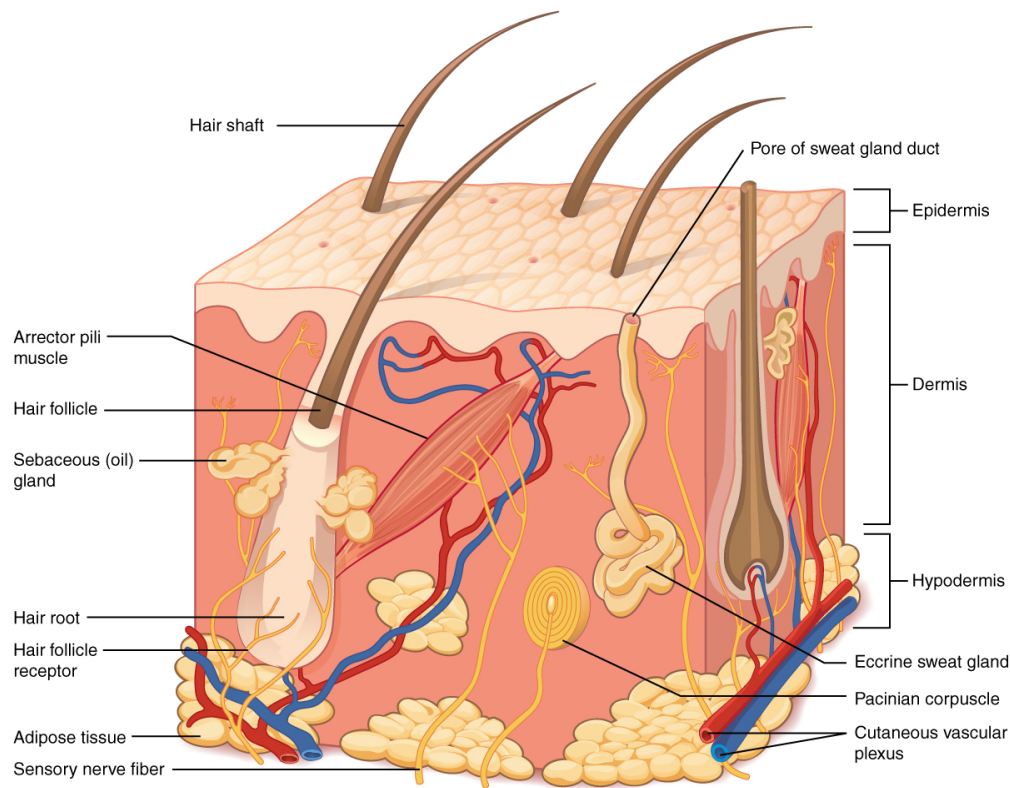


Figure 7.1 Layers of Skin. From Betts, et al., 2013. Licensed under [CC BY 4.0](#).
[\[Image description.\]](#)

Epidermis

The outer layer, the epidermis, is composed of **keratinized**, stratified squamous epithelium. It is made of four or five layers of epithelial cells, depending on its location in the body. It is avascular.

Dermis

The dermis contains blood and lymph vessels, nerves, and other structures, such as **hair follicles** and **sweat glands**. The dermis is made of two layers (papillary layer and reticular layer) of connective tissue that compose an interconnected mesh of elastin and collagenous fibers, produced by fibroblasts.

Hypodermis

The **hypodermis** serves to connect the skin to the underlying **fascia** of the bones and muscles. It is not strictly a part of the skin, although the border between the **hypodermis** and **dermis** can be difficult to

distinguish. The hypodermis consists of well-vascularized, loose, areolar connective tissue and adipose tissue, which functions as a mode of fat storage and provides insulation and cushioning for the integument.

Image Descriptions

Figure 7.1 image description: This illustration shows a cross section of skin tissue. The outermost layer is called the epidermis and occupies one-fifth of the cross section. Several hairs are emerging from the surface. The epidermis dives around one of the hairs, forming a follicle. The middle layer is called the dermis, which occupies four-fifths of the cross section. The dermis contains an erector pili muscle connected to one of the follicles. The dermis also contains an eccrine sweat gland, composed of a bunch of tubules. One tubule travels up from the bunch, through the epidermis, opening onto the surface a pore. There are two string-like nerves traveling vertically through the dermis. The right nerve is attached to a Pacinian corpuscle, a yellow structure consisting of concentric ovals similar to an onion. The lowest level of the skin, the hypodermis, contains fatty tissue, arteries, and veins. Blood vessels travel from the hypodermis and connect to hair follicles and erector pili muscle in the dermis. [\[Return to Figure 7.1\]](#).

PHYSIOLOGY OF THE INTEGUMENTARY SYSTEM

Basic Physiology of the System

Protection

The skin protects the body from wind, water, and UV sunlight. It acts as a protective barrier against water loss, and it also is the first line of defense against abrasive activity such as grit, microbes, or harmful chemicals. Sweat excreted from sweat glands deters microbes from over-colonizing the skin surface by generating dermcidin, which has antibiotic properties.

Sensory Function

The skin acts as a sense organ because the epidermis, dermis, and the hypodermis contain specialized sensory nerve structures that detect touch, surface temperature, and pain. These receptors are more concentrated on the tips of the fingers, which are most sensitive to touch, especially the **Meissner corpuscle** (tactile corpuscle), which responds to light touch, and the **Pacinian corpuscle** (lamellar corpuscle), which responds to vibration.

Thermoregulation

The integumentary system helps regulate body temperature through its tight association with the **sympathetic nervous system**. The sympathetic nervous system is continuously monitoring body temperature and initiating appropriate responses.

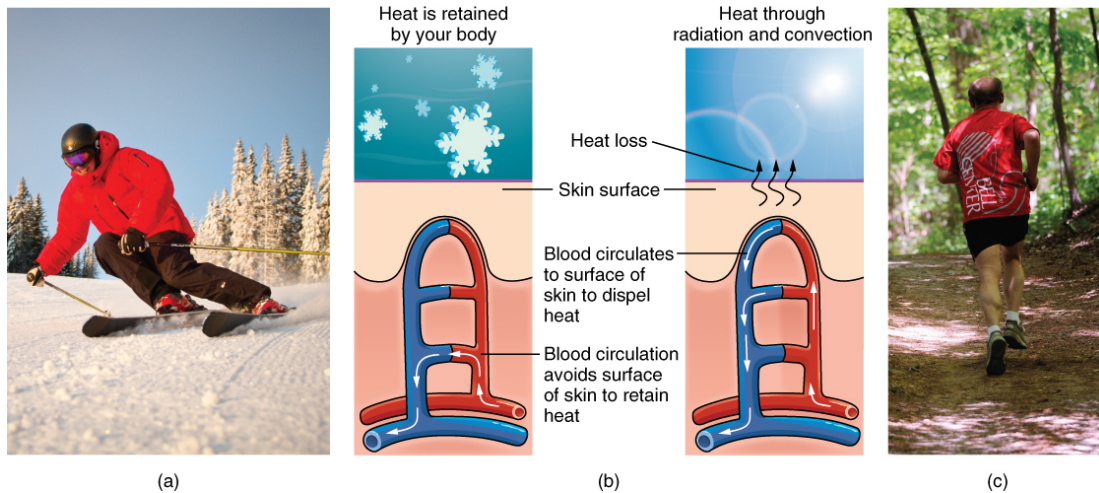


Figure 7.2 Thermoregulation. During strenuous physical activities, such as skiing (a) or running (c), the dermal blood vessels dilate and sweat secretion increases (b). These mechanisms prevent the body from overheating. In contrast, the dermal blood vessels constrict to minimize heat loss in response to low temperatures (b). (Credit a: “Trysil”/flickr; credit c: Ralph Daily.) From Betts, et al., 2013. Licensed under [CC BY 4.0](#). [\[Image description.\]](#)

Vitamin D Synthesis

The epidermal layer of human skin synthesizes vitamin D when exposed to UV radiation. In the presence of sunlight, a form of vitamin D₃ called cholecalciferol is synthesized from a derivative of the steroid cholesterol in the skin.

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Media 5.2 [The Integumentary System, Part 2—Skin Deeper: Crash Course A&P #7](#) [Online Video]
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Accessory Structures

Accessory structures of the skin include hair, nails, sweat glands, and sebaceous glands. These structures embryologically originate from the epidermis and can extend down through the dermis into the **hypodermis**.

Hair

Hair is a keratinous filament growing out of the **epidermis**. It is primarily made of dead, keratinized cells. Strands of hair originate in the **hair follicle**. The **hair shaft** is the part of the hair not anchored to the follicle, and much of this is exposed at the skin's surface. The rest of the hair lies below the surface of the skin and is referred to as the hair root. The **hair root** ends deep in the dermis at the hair bulb. The **hair bulb** surrounds the **hair papilla**, which is made of connective tissue and contains blood capillaries and nerve endings from the dermis (see [Figure 7.3](#)).

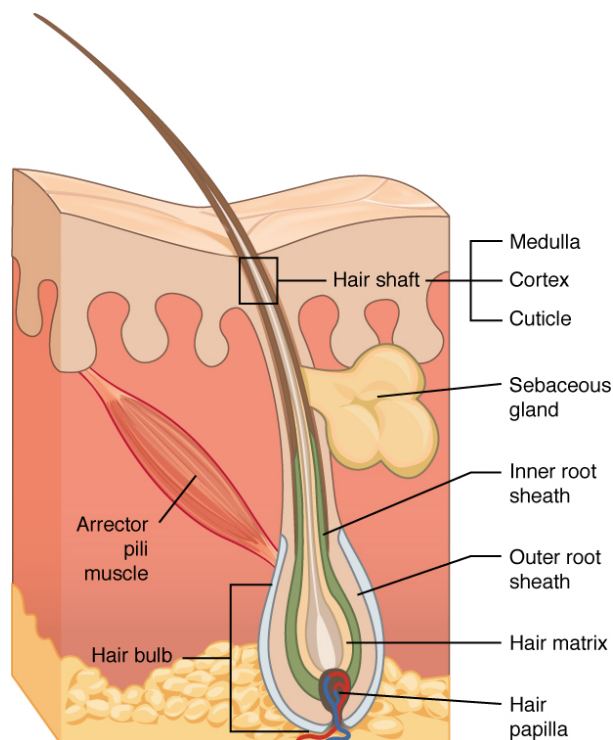


Figure 7.3 Hair. Hair follicles originate in the epidermis and have many different parts. From Betts, et al., 2013. Licensed under [CC BY 4.0](#). [\[Image description.\]](#)

Nails

The **nail bed** is a specialized structure of the epidermis that is found at the tips of our fingers and toes. The **nail body** is composed of densely packed dead **keratinocytes**, forms on the nail bed, and protects the tips of our fingers and toes. The nail body forms at the **nail root**, which enables the nail to grow continuously. The **nail cuticle** is also called the **eponychium** (see [Figure 7.4](#)).

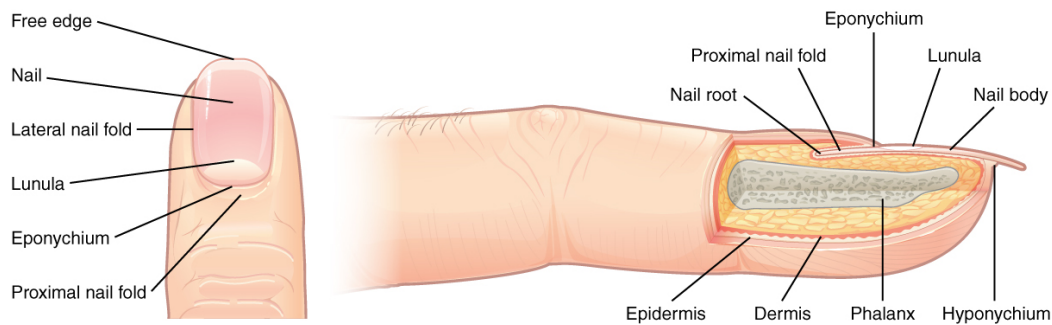


Figure 7.4 Nails. The nail is an accessory structure of the integumentary system. From Betts, et al., 2013. Licensed under [CC BY 4.0](#). [\[Image description.\]](#)

Sudoriferous (Sweat) Glands

When the body becomes warm, sudoriferous glands produce sweat to cool the body. There are two types of sweat glands, each secreting slightly different products.

An **eccrine** sweat gland is a type of gland that produces a watery sweat for cooling the body. These glands have pores that are found all over the skin's surface ([Figure 7.5](#)). Eccrine glands are a primary component of thermoregulation in humans and thus help to maintain **homeostasis** (the internal balance of the body).

An **apocrine** sweat gland is usually associated with hair follicles in densely hairy areas, such as armpits and genital regions. Apocrine sweat glands are larger than eccrine sweat glands, with the duct normally emptying into the hair follicle. In addition to water and salts, apocrine sweat includes organic compounds that make the sweat thicker and subject to bacterial decomposition and subsequent smell.

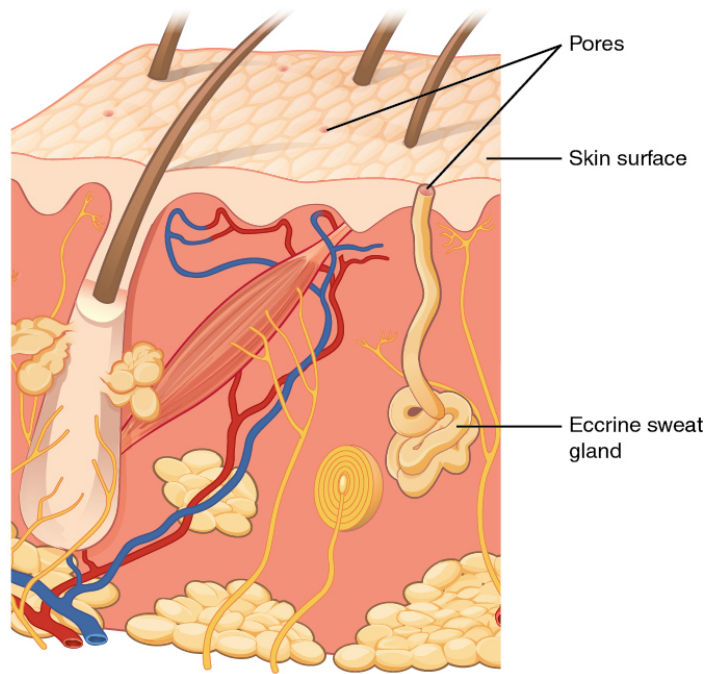


Figure 7.5 Eccrine Gland. Eccrine glands are coiled glands in the dermis that release sweat that is mostly water. From Betts, et al., 2013. Licensed under [CC BY 4.0](#). [\[Image description.\]](#)

A **sebaceous** gland is a type of oil gland that is found all over the body and helps to lubricate and waterproof the skin and hair. Most sebaceous glands are associated with hair follicles. They generate and excrete **sebum**, a mixture of lipids (fats), onto the skin surface, thereby naturally lubricating the dry and dead layer of keratinized cells of the stratum corneum, keeping it pliable.

Image Descriptions

Figure 7.2 image description: Part A is a photo of a man skiing with several snow-covered trees in the background. Part B is a diagram with a right and left half. The left half is titled “Heat is retained by the body,” while the right half is titled “Heat loss through radiation and convection.” Both show blood flowing from an artery through three capillary beds within the skin. The beds are arranged vertically, with the topmost bed located along the boundary of the dermis and epidermis. The bottommost bed is located deep in the hypodermis. The middle bed is evenly spaced between the topmost and bottommost beds. In each bed, oxygenated blood (red) enters the bed on the left and deoxygenated blood (blue) leaves the bed on the right. The left diagram shows a picture of snowflakes above the capillary beds, indicating that the weather is cold. Blood is only flowing through the deepest of the three capillary beds, as the upper beds are closed off to reduce heat loss from the outer layers of the skin. The right diagram shows a picture of the sun above the capillary

beds, indicating that the weather is hot. Blood is flowing through all three capillary beds, allowing heat to radiate out of the blood, increasing heat loss. Part C is a photo of a man running through a forested trail on a summer day. [\[Return to Figure 7.2\].](#)

Figure 7.3 image description: A cross section of the skin containing a hair follicle. The follicle is teardrop shaped. Its enlarged base, labeled the hair bulb, is embedded in the hypodermis. The outermost layer of the follicle is the epidermis, which invaginates from the skin surface to envelop the follicle. Within the epidermis is the outer root sheath, which is only present on the hair bulb. It does not extend up the shaft of the hair. Within the outer root sheath is the inner root sheath. The inner root sheath extends about half of the way up the hair shaft, ending midway through the dermis. The hair matrix is the innermost layer. The hair matrix surrounds the bottom of the hair shaft where it is embedded within the hair bulb. The hair shaft, in itself, contains three layers: the outermost cuticle, a middle layer called the cortex, and an innermost layer called the medulla. [\[Return to Figure 7.3\].](#)

Figure 7.4 image description: The anatomy of the fingernail region. The top image shows a dorsal view of a finger. The proximal nail fold is the part underneath where the skin of the finger connects with the edge of the nail. The eponychium is a thin, pink layer between the white proximal edge of the nail (the lunula), and the edge of the finger skin. The lunula appears as a crescent-shaped white area at the proximal edge of the pink-shaded nail. The lateral nail folds are where the sides of the nail contact the finger skin. The distal edge of the nail is white and is called the free edge. An arrow indicates that the nail grows distally out from the proximal nail fold. The lower image shows a lateral view of the nail bed anatomy. In this view, one can see how the edge of the nail is located just proximal to the nail fold. This end of the nail, from which the nail grows, is called the nail root. [\[Return to Figure 7.4\].](#)

Figure 7.5 image description: An illustration of an eccrine sweat gland embedded in a cross section of skin tissue. The eccrine sweat gland is a bundle of white tubes embedded in the dermis. A single white tube travels up from the bundle and opens onto the surface of the epidermis. The opening is called a pore. There are several pores on the small block of skin portrayed in this diagram. [\[Return to Figure 7.5\].](#)

WORD PARTS AND STRUCTURAL TERMS

Combining Forms

adip/o: fat

albin/o: white

aut/o: self

bi/o: life

carcin/o: cancer, malignant

coni/o: dust

crypt/o: hidden

cutane/o: skin

cyan/o: blue

cyst/o: fluid-filled sac

cyt/o: cell

derm/o: skin

dermat/o: skin

erythr/o: red

heter/o: other

hidr/o: sweat

ichthy/o: fishlike, dry, scaly

kerat/o: hard, horny tissue, keratin

melan/o: black

myc/o: fungus

necr/o: death

onych/o: nail

pachy/o: thick

pil: hair

pruri/o: itch

reticul/o: net

rhytid/o: wrinkles

scler/o: hard

seb/o: oil/sebum

staphyl/o: grapelike clusters

strept/o: twisted chains

vascul/o: blood vessel

xanth/o, cirrh/o, jaund/o: yellow

xer/o: dryness, dry

Prefixes

a-: absence of

bi-: two or both

cryo-: cold

dia-: through, complete

dys-: difficult, painful, abnormal, labored

epi-: upon, on, over

hyper-: above, excessive

hypo-: deficient, below, under, incomplete

intra-: within, in

meta-: change, beyond, after

neo-: new

para-: beside, around, beyond, abnormal

per-: through

pro-: before

sub-: under, below

trans-: through, across, beyond

uni-: one

Suffixes

-a: no meaning, noun ending

-al: pertaining to

-ad: toward

-coccus: berry-shaped

-cyte: cell

-ectomy: excision

-gen: substance that produces/causes, agent that produces/causes

-genic: producing, originating, causing

-ia: condition of, diseased state, abnormal state

- ic**: pertaining to
- itis**: inflammation
- ior**: pertaining to
- logy**: study of
- logist**: specialist who studies and treats
- malacia**: softening
- megaly**: enlarged, enlargement
- oid**: resembling
- oma**: tumor, swelling
- opsy**: view of, process of viewing, viewing
- osis**: abnormal condition, increased numbers relating to blood
- ous**: pertaining to
- pathy**: disease
- phagia**: eating, swallowing
- plasia**: development, growth, condition of formation
- plasm**: growth, substance, formation
- plasty**: surgical repair
- rrhea**: flow, discharge
- sis**: state of
- stasis**: stop, controlling, standing
- tome**: instrument used to cut

Structural Terms Built from Word Parts

adipocytes: fat cells

avascular: pertaining to no blood vessels

cutaneous: pertaining to the skin

dermal: pertaining to the skin

dermat: skin

dermatome: area of skin supplied by a single spinal nerve

epidermal: pertaining to on top of the skin

hypodermic: pertaining to below the skin (interchangeable with subcutaneous)

intra dermal: pertaining to within the skin

keratinocytes: cell producing a hard protein

melanocyte: melanin-producing cell

percutaneous: pertaining to through the skin

phagocyte: cell that eats

reticular: pertaining to being net-like

sebaceous: pertaining to sebum (oil) / oil producing

subcutaneous: pertaining to below the skin (interchangeable with hypodermic)

subungual: pertaining to under the nail

transcutaneous: pertaining to through or across the skin

transdermal: pertaining to through or across the skin

ungual: pertaining to the nail

vascular: pertaining to / having blood vessels

MEDICAL, SURGICAL, & VIEWING TERMS AND ABBREVIATIONS

Medical Careers & Professional Terminology

aesthetician: a medical specialist who performs only clinical skincare

dermatologist: physician who specializes in diagnosing and treating disorders of the skin

dermatology: the study of the skin and diseases affecting the skin

dermatopathology: the study of skin diseases

esthetician: a professional who performs manicures, pedicures, waxing, and other body/skin treatments

Imaging Techniques/Treatments for the Organ System

antibiotics: medicines that kill bacteria

antifungals: medicines that kill fungi

anti-inflammatories: medicines that reduce swelling/edema

antipruritics: medicines that reduce itching

antipyretics: medicines that reduce fever

antiseptic: agents/chemicals that inhibit (prevent) bacterial growth

keratogenic: agent causing growth of horny tissue

scabicides: medicine that kills mites

Surgical Techniques/Procedures Used for the Organ System

biopsy: view of life (process of removing tissue for study)

cryosurgery: cold surgery, used to freeze tissue for removal

cryotherapy: treatment of diseases using extreme cold

debridement: removal of dead tissue from a wound

dermatoautoplasty: surgical repair using one's own skin

dermatoheteroplasty: surgical repair using skin from others

dermoplasty: surgical repair of the skin

onychectomy: surgical removal of a fingernail or toenail

onychotomy: incision into a fingernail or toenail

rhytidectomy: excision (surgical removal) of wrinkles

rhytidoplasty: surgical repair of wrinkles

Abbreviations Commonly Used with the Organ System

BCC: basal cell carcinoma

bx: biopsy

derm: dermatology

ID: intradermal

MRSA: methicillin-resistant *Staphylococcus aureus*

SCC: squamous cell carcinoma

SLE: systemic lupus erythematosus

staph: staphylococcus

strep: streptococcus

subcut: subcutaneous

TD: transdermal

Medical Terms Practice

For each card, click the speaker icon to hear the correct pronunciation of the listed term. Practice saying the term to yourself, then attempt to define the term from memory. Click “Turn” to flip the card and see the definition. Use the right and left arrows to toggle through the cards in each set.



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DISEASES AND DISORDERS

Disease and Disorder Terms Built from Word Parts

albinism: “condition of white”; a partial or complete lack of melanin-producing cells

basal cell carcinoma: a cancerous tumor of the regenerative cells in the epidermis of the skin

carcinoma: cancerous tumor

cyanosis: abnormal condition of blue skin; usually caused by low oxygen

cyst: a fluid-filled growth in skin

dermatitis: inflammation of the skin

dermatosis: abnormal condition of the skin caused by dust

dermatofibroma: fibrous tumor of the skin

dermatomycosis: fungal infection of the skin

epidermitis: inflammation of the outer layer of the skin

erythematosis: an inflammatory disease causing scaly red patches on the skin; also called systemic lupus erythematosis

erythroderma: red skin (abnormal redness of the skin)

hemangioma: benign tumor of the blood vessels; a type of birthmark

hidradenitis: inflammation of the sweat gland

hyperhidrosis: abnormal condition of excessive sweat

ichthyosis: abnormal condition of scaly/fishlike skin

keratosis: abnormal condition of horny tissue growth

leukoderma: white skin (patches of white skin caused by lack of pigment)

leioderma: condition of smooth skin

melanoma: cancerous tumor of the melanin-producing cells; also called malignant melanoma

metastasize: produce cells that can mobilize and produce tumors in other organs

necrosis: condition of death (death of tissue)

onychocryptosis: abnormal condition of a hidden nail

onychomalacia: softening of the nails

onychomycosis: abnormal condition of a fungus in the nail

onychopathy: any disease of the nails

onychophagia: eating of the nails (nail biting)

pachyderma: thick

paronychia: infection around the nail

pruritus: condition causing itching

seborrhea: excessive discharge of sebum

scleroderma: hardness of the skin, chronic disease causing hardening of the skin

staphylococcus: berry-shaped bacterium in grapelike clusters

streptococcus (strep): berry-shaped bacterium in twisted chains

xeroderma: extremely dry skin

xerosis: abnormal condition of dryness

Disease and Disorder Terms Not Built from Word Parts

abscess: localized collection of pus

acne: inflammatory papular and pustular eruption of the skin

alopecia: partial or complete loss or lack of hair (baldness)

benign: noncancerous/nonmalignant tumor

bullae: fluid-filled raised lesion >1cm (blister)

comedo: black head

decubitus ulcer: chronic ulcer caused by pressure over bony areas (seen in immobilized people)

ecchymosis: purple discoloration of skin >3mm in size, caused by blood pooling under the skin

eczema: inflammatory disorder causing redness, blisters, and scaling of skin

excoriation: linear break in skin (scratch)

fissure: deep, elongated break in the skin (crack)

impetigo: inflammatory disease with pustules that rupture

keloid: a raised scar

lesion: any wound, injury, or pathologic change in body tissue

macule: flat, discolored, flush area of the skin (freckle)

nevus: raised, discolored area, usually benign, but can be cancerous (mole)

nodule: small, round swelling under the skin

petechiae: tiny red/purple spots caused by capillary rupture

plaque: flat or raised lesions that may itch

polyp: an overgrowth of tissue on a mucous membrane

pustule: small, round, elevated lesion filled with pus

scabies: an infection of the skin caused by mites, highly contagious

shingles: a viral infection causing painful inflammation and pustular eruption of the nerve endings (also called herpes zoster)

ulcer: open sore of the skin or mucous membranes

urticaria: hives

verruca: wart caused by a virus

vesicle: small, fluid-filled, raised lesion (blister)

vitiligo: a loss of skin pigmentation in specific areas

wheal: smooth, rounded, slightly elevated area of skin that often itches

PRACTICE

The following activities will allow you to practice what you've learned in this chapter.

Label the Layers of the Skin

Click and drag each term to the box corresponding with the anatomic structure, body part, body plane, or body region for that term.



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Medical Terms in Context—1

Click and drag each term from the word bank to its correct place in this exercise.



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Medical Terms in Context—2

Click and drag each term from the word bank to its correct place in this exercise.



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Vocabulary Reinforcement Activity

Click the term that correctly answers each question or completes each sentence.



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<https://louis.pressbooks.pub/medicalterminology/?p=2094#h5p-14>

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PART VIII

CARDIOVASCULAR SYSTEM—PART I: THE HEART

Learning Objectives

When completing this chapter, the learner will be able to do the following:

- Identify the anatomy of the heart
- Describe the main functions of the heart
- Spell terms relating to the heart and use correct abbreviations
- Pronounce terms relating to the heart and use correct abbreviations
- Identify the medical specialties associated with the heart
- Explore common diseases, disorders, and procedures related to the heart

Introduction to the Heart

The heart is a fist-sized vital organ that has one job: to pump blood. If one assumes an average **heart rate** of 75 beats per minute, a human heart would beat approximately 108,000 times in one day, more than 39 million times in one year, and nearly 3 billion times during a 75-year lifespan. At rest, each of the major pumping chambers of the heart ejects approximately 70 mL of blood per contraction in an adult. This would be equal to 5.25 liters of blood per minute and approximately 14,000 liters per day. Over one year, that would equal 10,000,000 liters of blood sent through roughly 100,000 km of blood vessels. In order to understand how that happens, it is necessary to understand the anatomy and physiology of the heart.

Watch this video:



One or more interactive elements has been excluded from this version of the text. You can view them online here: <https://louis.pressbooks.pub/medicalterminology/?p=1407#oembed-1>

Media 8.1. [The Heart, Part 1—Under Pressure: Crash Course A&P #25](#) [Online video]. Copyright 2015 by [CrashCourse](#).

ANATOMY OF THE HEART

Location

The human heart is located within the thoracic cavity, between the lungs in the space known as the **mediastinum**. [Figure 8.1](#) shows the position of the heart within the thoracic cavity. Within the mediastinum, the heart is separated from the other mediastinal structures by a tough membrane known as the **pericardium**, or **pericardial sac**, and sits in its own space called the **pericardial cavity**. The **great vessels**, which carry blood to and from the heart, are attached to the superior surface of the heart, which is called the base. The inferior tip of the heart is called the apex.

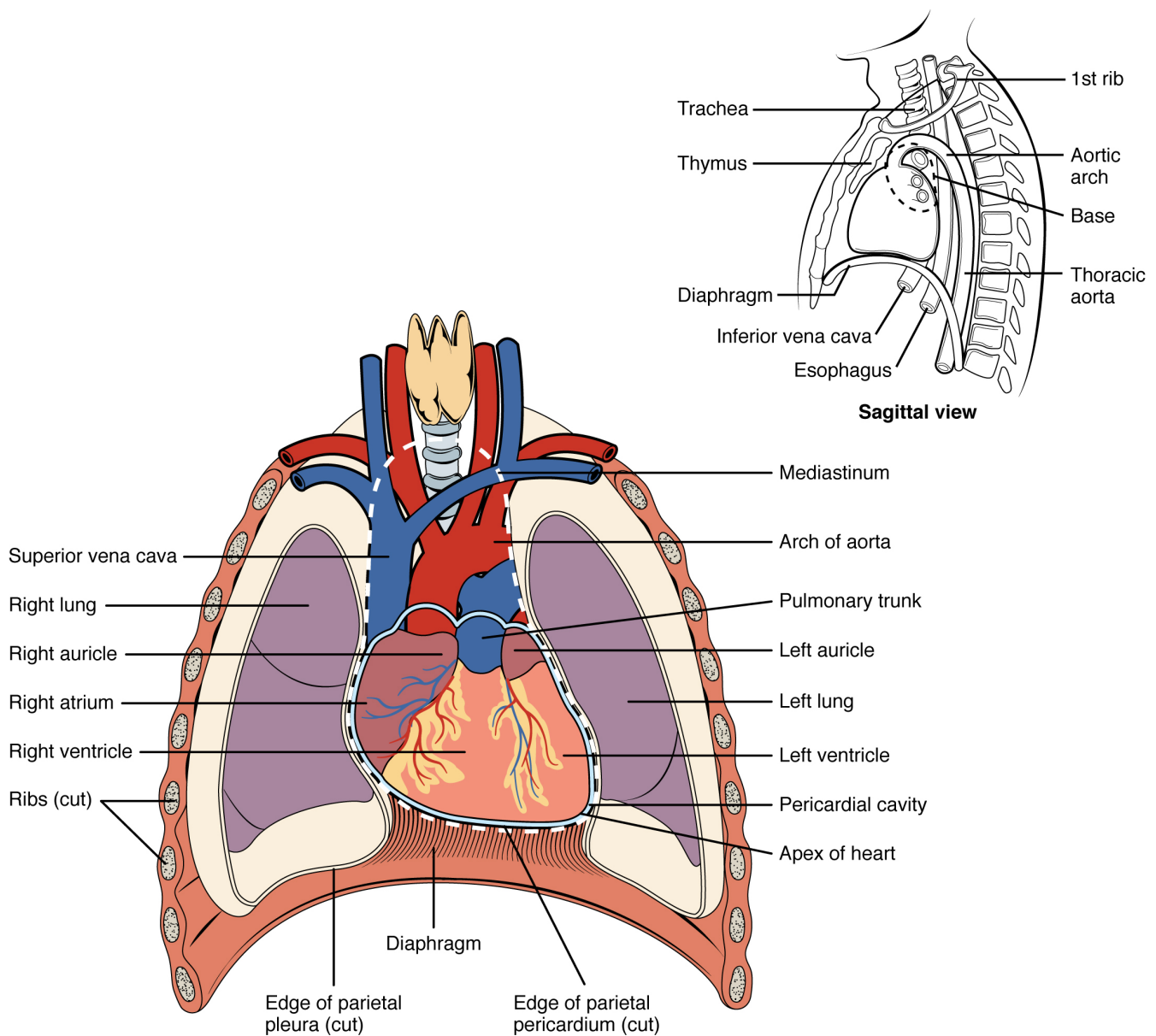


Figure 8.1 Position of the Heart in the Thorax. The heart is located within the thoracic cavity, medially between the lungs in the mediastinum. It is about the size of a fist, is broad at the top, and tapers toward the base. From Betts, et al., 2013. Licensed under [CC BY 4.0](#). [\[Image description.\]](#)

Membranes and Layers of the Heart Walls

The heart and the roots of the great vessels are surrounded by a membrane known as the pericardium or pericardial sac ([Figure 8.2](#)). The pericardium consists of two distinct sublayers:

- the outer **parietal pericardium**, which is fused to the **fibrous pericardium**
- the inner **visceral pericardium**, or **epicardium**, which is fused to the heart and forms the outer layer of the heart wall

The walls of the heart consist of three layers:

- the outer epicardium, which is another name for the visceral pericardium mentioned above
- the thick, middle **myocardium**, which is made of muscle tissue and gives the heart its ability to contract
- the inner **endocardium**, which lines the heart chambers and is the main component of the heart valves

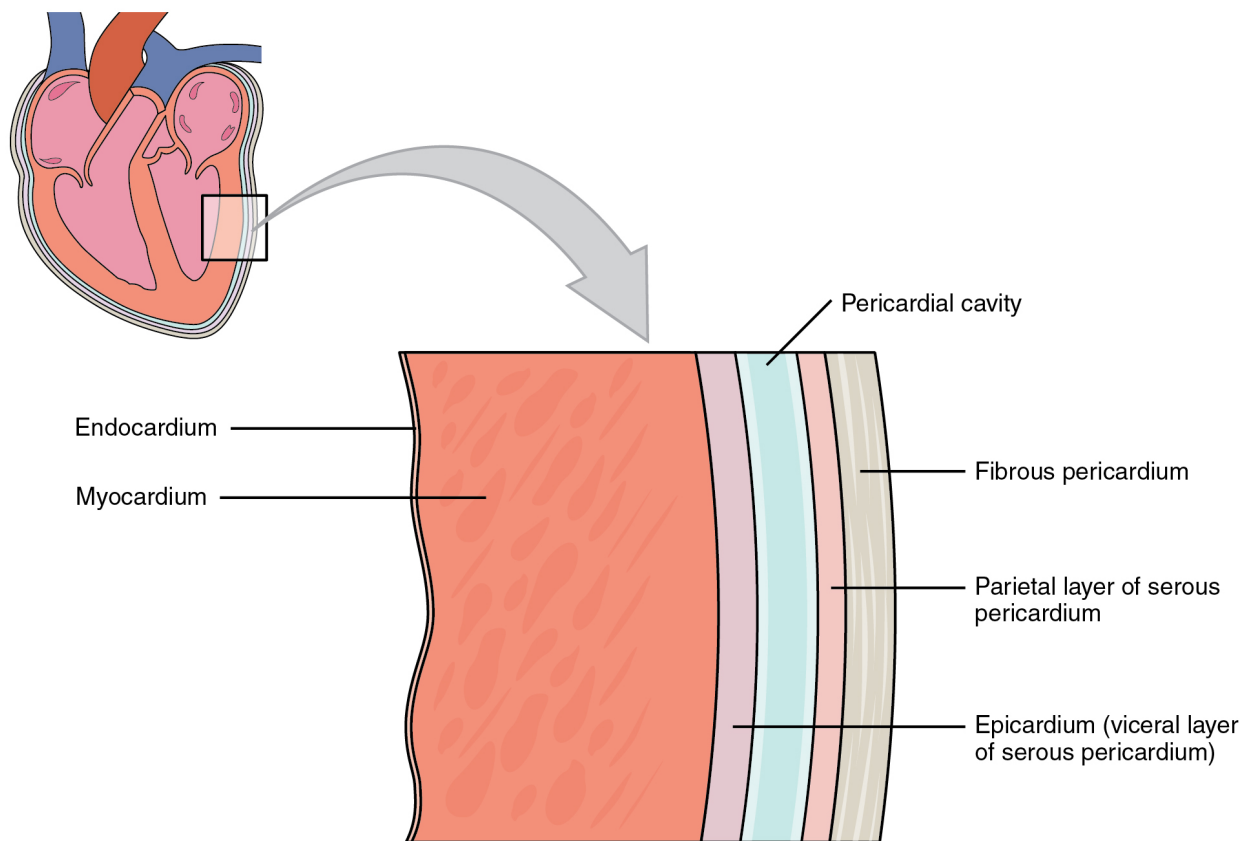


Figure 8.2 Pericardial Membranes and Layers of the Heart Wall. The pericardial membrane that surrounds the heart consists of three layers and the pericardial cavity. The heart wall also consists of three layers. The pericardial membrane and the heart wall share the epicardium. From Betts, et al., 2013. Licensed under [CC BY 4.0](#). [\[Image description.\]](#)

Internal Structures of the Heart

The heart consists of four chambers:

- The upper chambers are the **right and left atria** (singular: atrium).
- The lower chambers are the **right and left ventricles**.

The **interventricular septum** is a muscular wall that separates the right and left ventricles. The **interatrial septum** separates the right and left atria. The atrium and ventricle on each side of the heart are separated by an **atrioventricular (AV) valve**:

- The right AV valve, or **tricuspid valve**, separates the right atrium and right ventricle.
- The left AV valve, or **bicuspid valve**, separates the left ventricle and the left atrium. This valve is also called the mitral valve.

There are also two semilunar valves:

- The **pulmonary valve** separates the right ventricle from the pulmonary trunk.
- The **aortic valve** separates the left ventricle from the aorta.

Image Descriptions

Figure 8.1 image description: This diagram shows the location of the heart in the thorax (sagittal and anterior views). The sagittal view labels read (from top, clockwise): first rib, aortic arch, thoracic arch, esophagus, inferior vena cava, diaphragm, thymus, trachea. The anterior view labels read (from top, clockwise): mediastinum, arch of aorta, pulmonary trunk, left auricle, left lung, left ventricle, pericardial cavity, apex of heart, edge of parietal pericardium, diaphragm, edge of parietal pleura, ribs, right ventricle, right atrium, right auricle, right lung, superior vena cava. [\[Return to Figure 8.1\]](#).

Figure 8.2 image description: This image shows a magnified view of the structure of the heart wall. Labels read (from top, clockwise): pericardial cavity, fibrous pericardium, parietal layer of serous pericardium, epicardium (visceral layer of serous pericardium), myocardium, endocardium. [\[Return to Figure 8.2\]](#).

PHYSIOLOGY OF THE HEART

In order for the heart to do its job of pumping blood to the lungs and to the body, nutrients and oxygen must be supplied to the cells of the heart. The heart also needs to coordinate its contractions so that all parts are working together to pump blood effectively. To understand how all of this works together to give the heart its ability to pump blood, we will examine three interdependent aspects of heart function:

1. Circulation through the heart: Blood is pumped by the heart in order to provide oxygen and nutrients to every cell in the body.
2. The heart as an organ (coronary blood supply): The heart is an organ made of cells and tissues that require their own blood supply.
3. The heart's electrical conduction system: The heart is able to independently generate and transmit electrical signals to the myocardium in order to make it contract and pump the blood.

1. Circulation through the Heart: The Heart as a Pump

The heart pumps blood to two distinct but linked circulatory systems called the **pulmonary** and **systemic circuits**. The pulmonary circuit transports blood to and from the lungs, where it picks up oxygen and drops off carbon dioxide. The systemic circuit transports freshly oxygenated blood to virtually all of the tissues of the body and returns relatively deoxygenated blood and carbon dioxide to the heart to be sent back to the pulmonary circulation.

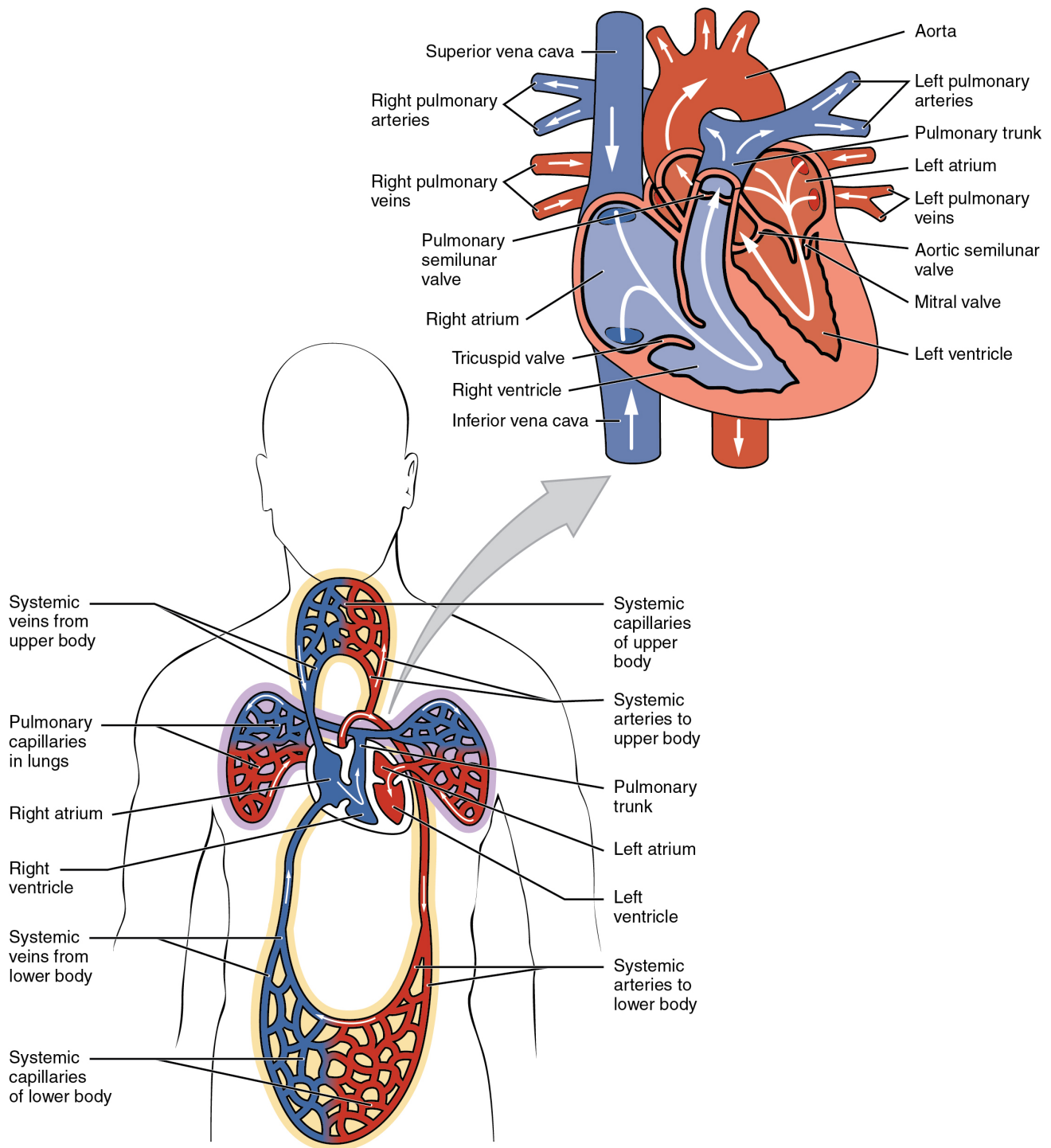


Figure 8.4 Dual System of Human Blood Circulation. Blood flows from the right atrium to the right ventricle, where it is pumped into the pulmonary circuit. The blood in the pulmonary artery branches is low in oxygen but relatively high in carbon dioxide. Gas exchange occurs in the pulmonary capillaries (oxygen into the blood, carbon dioxide out), and blood high in oxygen and low in carbon dioxide is returned to the left atrium. From here, blood enters the left ventricle, which pumps it into the systemic circuit. Following exchange in the systemic capillaries (oxygen and nutrients out of the capillaries and carbon dioxide and wastes in), blood returns to the right atrium, and the cycle is repeated. From Betts, et al., 2013. Licensed under [CC BY 4.0](#). [Image description.]

Cardiac Cycle

The process of pumping and circulating blood is active, coordinated, and rhythmic. Each heartbeat represents one cycle of the heart receiving blood and ejecting blood.

- **Diastole** is the portion of the cycle in which the heart is relaxed and the atria and ventricles are filling with blood. The AV valves are open so that blood can move from the atria to the ventricles.
- **Systole** is the portion of the cycle in which the heart contracts, the AV valves slam shut, and the ventricles eject blood to the lungs and to the body through the open semilunar valves. Once this phase ends, the semilunar valves close in preparation for another filling phase.

2. The Heart as an Organ: The Coronary Blood Supply

Myocardial cells require their own blood supply to carry out their function of contracting and relaxing the heart in order to pump blood. This blood supply, provided by the **coronary arteries** and **coronary veins**, supplies nutrients and oxygen and carries away carbon dioxide and waste.

3. The Heart's Electrical Conduction System

In order for all parts of the heart to work together to beat regularly and effectively, the heart has its own electrical system, which initiates and conducts each heartbeat through the entire myocardium. Specialized groups of heart cells perform this function all on their own, without requiring messages from the central nervous system.

Image Descriptions

Figure 8.4 image description: The top panel shows the human heart with the arteries and veins labeled (from top, clockwise): aorta, left pulmonary arteries, pulmonary trunk, left atrium, left pulmonary veins, aortic semilunar valve, mitral valve, left ventricle, inferior vena cava, right ventricle, tricuspid valve, right atrium, pulmonary semilunar valve, right pulmonary veins, right pulmonary arteries, superior vena cava. The bottom panel shows a rough map of the human circulatory system. Labels read (from top, clockwise): systemic capillaries of upper body, systemic arteries to upper body, pulmonary trunk, left atrium, left ventricle, systemic

arteries to lower body, systemic capillaries of lower body, systemic veins from lower body, right ventricle, right atrium, pulmonary capillaries in lungs, systemic veins from upper body. [\[Return to Figure 8.4\].](#)

WORD PARTS AND STRUCTURAL TERMS

Combining Forms

atri/o: atrium

cardi/o: heart

cuspid/i: point

ech/o: sound

electr/o: electricity

symptomato/o: symptom

valv/o: valve

valvul/o: valve

vascul/o: vessel

ventricul/o: ventricle

Prefixes

a-: absence of, without

bi-: two

brady-: slow

endo-: within, in

epi-: on, upon, over

hyper-: above, excessive

hypo-: below, deficient

inter-: between

pan-: all, total

peri-: surrounding, around

tachy-: fast, rapid

tri-: three

Suffixes

- ac**: pertaining to (adjective)
- apheresis**: removal (noun)
- ar**: pertaining to (adjective)
- centesis**: surgical puncture to aspirate fluid (noun)
- ectomy**: excision, surgical removal (noun)
- genic**: producing, originating, causing (adjective)
- gram**: record, radiographic image (noun)
- graph**: instrument used to record (noun)
- graphy**: process of recording, radiographic imaging (noun)
- ia**: condition of, diseased state, abnormal state (noun)
- ic**: pertaining to (adjective)
- itis**: inflammation (noun)
- lysis**: loosening, dissolution, separating (noun)
- megaly**: enlarged, enlargement (noun)
- logist**: specialist, physician who studies and treats (noun)
- oma**: tumor (noun)
- osis**: abnormal condition (noun)
- tomy**: cut into, incision (noun)
- ous**: pertaining to (adjective)
- pathy**: disease (noun)
- penia**: abnormal reduction in number (noun)
- pexy**: surgical fixation, suspension (noun)
- plasty**: surgical repair (noun)
- poiesis**: formation (noun)
- sclerosis**: hardening (noun)
- scope**: instrument used to view (noun)
- scopy**: process of viewing (noun)
- stasis**: stop, stopping, controlling (noun)
- stenosis**: narrowing, constriction (noun)

Structural Terms Built from Word Parts

atrial: pertaining to one or both atria

atrioventricular: pertaining to the atrium and ventricle

- bicuspid:** having two pointed folds/flaps
cardiac: pertaining to the heart
cardiogenic: originating in the heart
cardiovascular: pertaining to the heart and vessels
endocardial: pertaining to the endocardium
interatrial: pertaining to between the atria
interventricular: pertaining to between the ventricles
myocardial: pertaining to the myocardium
pericardial: pertaining to the pericardium
tricuspid: having three pointed folds/flaps
ventricular: pertaining to one or both ventricles

DISEASES AND DISORDERS

Disease and Disorder Terms Built from Word Parts

- bradycardia:** an abnormally slow heart rate
- cardiodynia:** pain in the heart
- cardiomegaly:** enlargement of the heart
- cardiomyopathy:** disease of the myocardium
- cardiovalvulitis:** inflammation of the heart valves
- endocarditis:** inflammation of the endocardium
- myocarditis:** inflammation of the myocardium
- pericarditis:** inflammation of the pericardium
- tachycardia:** an abnormally fast heart rate

Disease and Disorder Terms Not Built from Word Parts

- acute coronary syndrome:** sudden symptoms of insufficient blood supply to the heart, caused by angina or a myocardial infarction
- angina pectoris:** chest pain
- arrhythmia:** absence of a regular heart rhythm
- atrial fibrillation:** arrhythmia originating in the conductive cells of the atrium
- bruit:** abnormal blowing, swishing heart sound heard on auscultation
- cardiac arrest:** sudden cessation of cardiac output
- cardiac tamponade:** the pericardial sac surrounding the heart has filled with blood or other fluid and the resulting pressure is preventing the heart from beating effectively
- congenital heart disease:** an inborn heart disease
- cor pulmonale:** a condition that causes right-sided heart failure, caused by long-term high blood pressure in the pulmonary arteries and right ventricle
- heart block:** an obstruction in the electrical conduction system of the heart, which leads to arrhythmia
- heart failure:** inability of the heart to pump enough blood through the body
- heart murmur:** an abnormal heart sound
- hypertensive heart disease:** heart disorder caused by chronic hypertension

mitral valve stenosis: abnormal narrowing of the mitral valve

myocardial infarction: death of myocardial tissue due to ischemia of a coronary artery (“heart attack”)

rheumatic heart disease: autoimmune damage to the endocardium and heart valves caused by a streptococcal infection

Tetralogy of Fallot: a congenital heart disease with four distinct areas of heart malformation

MEDICAL, SURGICAL, & VIEWING TERMS AND ABBREVIATIONS

Medical Careers & Professional Terminology

cardiology: the study of the heart and its disorders

cardiology technologists: perform diagnostic tests such as electrocardiography, stress testing, Holter monitor testing, and ambulatory blood pressure testing, as well as pacemaker monitoring and programming

cardiologist: a physician specializing in cardiology

cardiovascular perfusionists: responsible for operation of the heart-lung bypass machine during open heart surgery; also monitor the patient's vitals, administering IV fluids and other drugs

Imaging Techniques/Procedures for the Organ System

coronary angiogram: a visual record of coronary angiography

coronary angiography: a procedure that uses contrast dye, usually containing iodine, and x-ray pictures to detect blockages in the coronary arteries that are caused by plaque buildup

Surgical Techniques/Medical Procedures/ Diagnostic Procedures/Medications Used with the Organ System

artificial cardiac pacemaker: a small, battery-operated medical device that generates electrical impulses delivered by electrodes to cause the heart muscle chambers to contract and pump blood

auscultation: listening to a patient's heart sounds

automatic implantable cardiac defibrillator: an electronic implant that provides an automatic shock to convert a dangerous heart rhythm to a normal heart rhythm

cardiac catheterization: a procedure in which a thin, flexible tube is guided through a blood vessel to the heart to diagnose or treat certain heart conditions

catheter ablation: Using extreme heat or extreme cold to destroy cells in parts of the heart that were causing abnormal rhythms

coronary artery bypass graft: a nonvital superficial vessel from another part of the body (often the great saphenous vein) or a synthetic vessel is inserted to create a path around the blocked area of a coronary artery

coronary stent: a tiny coil of wire mesh that supports the walls of a coronary artery and helps prevent it from re-narrowing after angioplasty

echocardiogram: a visual record using sound to record the heart

echocardiography: Process of using sound to record the heart.

electrocardiogram: a visual record of the electrical impulses in the heart

electrocardiograph: a device used to create an electrocardiogram

electrocardiography: the process of recording the electrical impulses of the heart

exercise stress test: a test that shows how the heart works during physical activity

pericardiocentesis: removal of pericardial fluid for treatment or testing

valvuloplasty: surgical repair of a heart valve

Abbreviations Commonly Used with the Organ System

ACS: acute coronary syndrome

Afib: atrial fibrillation

AICD: automatic implantable cardiac defibrillator

AV: atrioventricular

CAD: coronary artery disease

CPR: cardiopulmonary resuscitation

ECG/EKG: electrocardiogram

ECHO: echocardiogram

HF: heart failure

HHD: hypertensive heart disease

MI: myocardial infarction

Medical Terms Practice

For each card, click the speaker icon to hear the correct pronunciation of the listed term. Practice saying the term to yourself, then attempt to define the term from memory. Click “Turn” to flip the card and see the definition. Use the right and left arrows to toggle through the cards in each set.



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PRACTICE

The following activities will allow you to practice what you've learned in this chapter.

Anatomy Labeling Activity

Click and drag each term to the box corresponding with the anatomic structure, body part, body plane, or body region for that term.



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Medical Terms in Context

Click and drag each term from the word bank to its correct place in this exercise.



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Vocabulary Reinforcement Activity

Click the term that correctly answers each question or completes each sentence.



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PART IX

CARDIOVASCULAR SYSTEM—PART II: BLOOD AND BLOOD VESSELS

Learning Objectives

- Identify the anatomy of the blood vessels and blood
- Describe the main functions of the blood vessels and blood
- Spell terms relating to the blood vessels and blood and use correct abbreviations
- Pronounce terms relating to the blood vessels and blood and use correct abbreviations
- Identify the medical specialties associated with the blood vessels and blood
- Explore common diseases, disorders, and procedures related to the blood vessels and blood

Introduction

Our large, complex bodies need blood to deliver nutrients to and remove wastes from our trillions of cells. The heart, as discussed in the previous chapter, pumps blood throughout the body in a network of blood vessels. Together, these three components—blood, heart, and vessels—make up the cardiovascular system.

Virtually every cell, tissue, organ, and system in the body is impacted by the circulatory system. This includes the generalized and more specialized functions of transport of materials, capillary exchange, maintaining health by transporting white blood cells and various immunoglobulins (antibodies), hemostasis, regulation of body temperature, and helping to maintain acid-base balance.

Watch this video:



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Media 9.1 [Blood Vessels, Part 1—Form and Function: Crash Course A&P #27](#) [Online video].

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ANATOMY OF THE BLOOD VESSELS

Anatomy of the Blood Vessels

Blood pumped by the heart flows through a series of vessels known as arteries, arterioles, capillaries, venules, and veins before returning to the heart.

- **Arteries** transport blood away from the heart and branch into smaller vessels, forming arterioles.
- **Arterioles** distribute blood to capillary beds, the sites of exchange with the body tissues.
- A **capillary** is a microscopic channel that supplies blood to the tissues themselves, a process called **perfusion**.
 - Exchange of gases and other substances occurs in the capillaries between the blood and the surrounding cells and their tissue fluid (interstitial fluid).
 - For capillaries to function, their walls must be leaky, allowing substances to pass through.
 - Capillaries lead back to small vessels known as **venules**.
- Venules are small veins that converge into larger **veins**.
- A vein is a blood vessel that conducts blood toward the heart.
 - Compared to arteries, veins are thin-walled vessels with large and irregular lumens.
 - Larger veins are commonly equipped with valves that promote the unidirectional flow of blood toward the heart and prevent backflow toward the capillaries caused by the inherent low blood pressure in veins as well as the pull of gravity.
 - Other ways in which the body assists the transport of venous blood back to the heart involve contractions of skeletal muscles in the extremities (see figure below) as well as pressure variations caused by the breathing motion of the chest.

Both arteries and veins have the same three distinct tissue layers, called tunics (after the garments first worn by ancient Romans). From the most interior layer to the outer, these tunics are the **tunica intima**, the **tunica media**, and the **tunica externa** (see [Figure 9.1](#)). The smooth muscle in the middle layer, the tunica media, provides the vessel with the ability to **vasoconstrict** and **vasodilate** as needed to ensure sufficient blood flow.

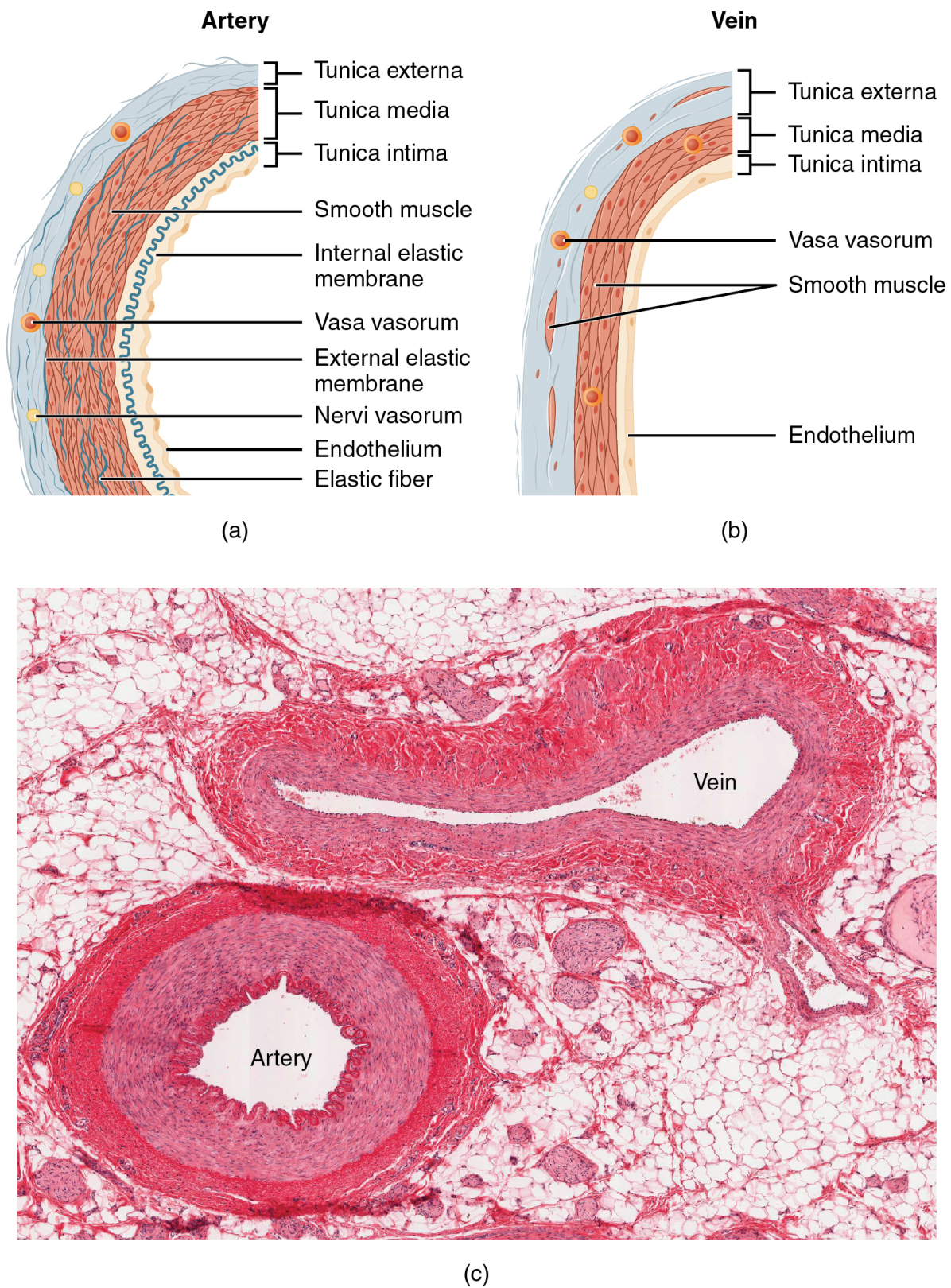


Figure 9.1 Structure of Blood Vessels. (a) Arteries and (b) veins share the same general features, but the walls of arteries are much thicker because of the higher pressure of the blood that flows through them. (c) A micrograph shows the relative differences in thickness. LM $\times 160$. (Micrograph

provided by the Regents of the University of Michigan Medical School © 2012.) From Betts, et al., 2013. Licensed under [CC BY 4.0](#). [\[Image description.\]](#)

Image Descriptions

Figure 9.1 image description: The top left panel of this figure shows the ultrastructure of an artery (labels read from top: tunica externa, tunica media, tunica intima, smooth muscle, internal elastic membrane, vasa vasorum, external elastic membrane, nervi vasorum, endothelium, elastic fiber), and the top right panel shows the ultrastructure of a vein (labels read from top: tunica externa, tunica media, tunica intima, vasa vasorum, smooth muscle, endothelium). The bottom panel shows a micrograph with the cross sections of an artery and a vein. [\[Return to Figure 9.1\]](#).

PHYSIOLOGY OF THE BLOOD VESSELS AND BLOOD

Physiology of the Blood Vessels

Arteries and veins transport blood in two distinct circuits: the **systemic circuit** and the **pulmonary circuit**. Systemic arteries provide blood rich in oxygen to the body's tissues. The blood returned to the heart through systemic veins has less oxygen, since much of the oxygen carried by the arteries has been delivered to the cells. In contrast, in the pulmonary circuit, arteries carry blood low in oxygen exclusively to the lungs for gas exchange. Pulmonary veins then return freshly oxygenated blood from the lungs to the heart to be pumped back out into systemic circulation.

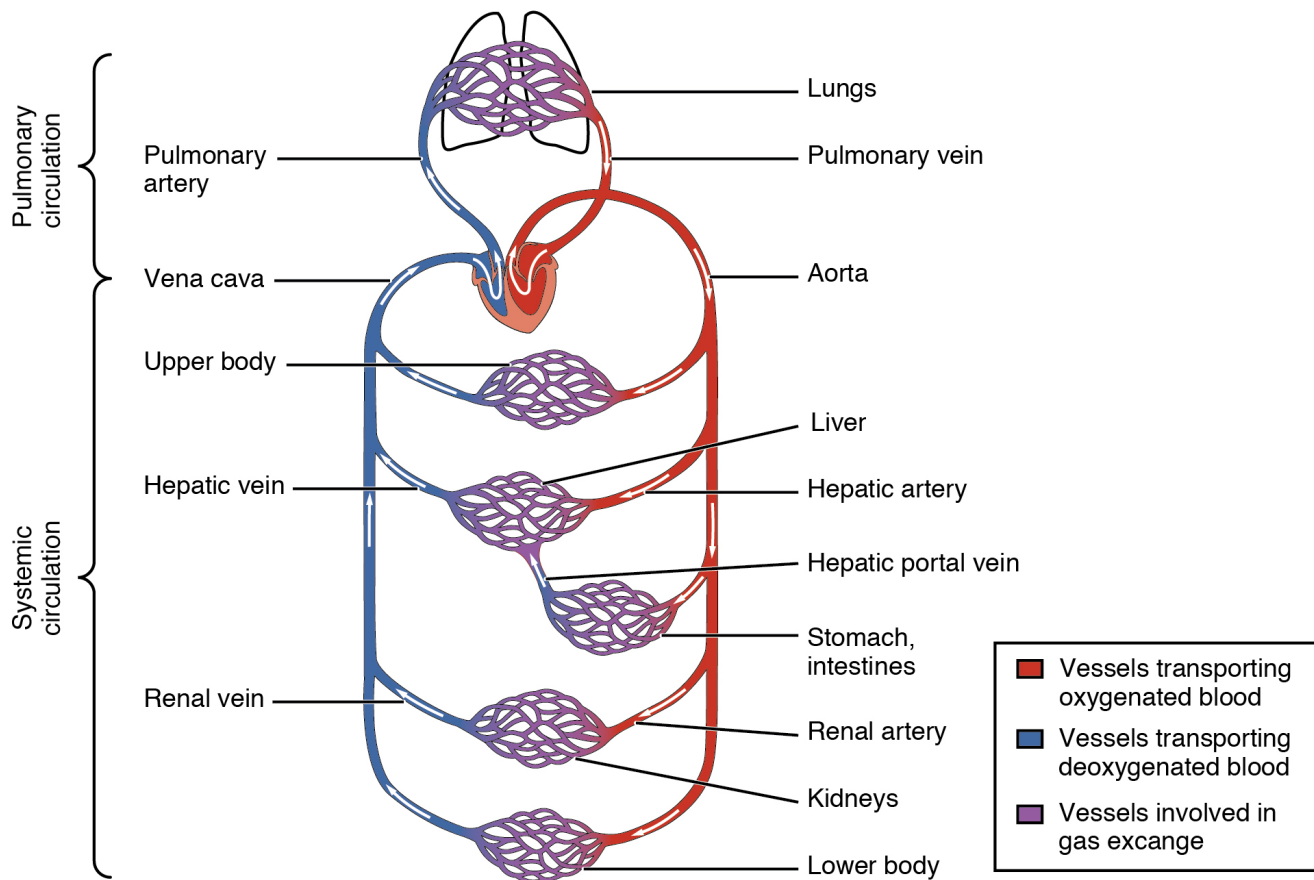


Figure 9.2 Cardiovascular Circulation. The pulmonary circuit moves blood from the right side of the heart to the lungs and back to the heart. The systemic circuit moves blood from the left side of the heart to the head and body and returns it to the right side of the heart to repeat the cycle. The arrows indicate the direction of blood flow, and the colors show the relative levels of oxygen concentration. From Betts, et al., 2013. Licensed under [CC BY 4.0](https://creativecommons.org/licenses/by/4.0/). [Image description.]

Blood Pressure

Blood pressure is the force exerted by blood upon the walls of the blood vessels or the chambers of the heart. Blood pressure may be measured in capillaries and veins, as well as the vessels of the pulmonary circulation; however, the general term “blood pressure” refers to the pressure of blood flowing in the arteries of the systemic circulation. Blood pressure is one of the critical parameters measured on virtually every patient in every health care setting. The technique used today was developed more than 100 years ago by a pioneering Russian physician, Dr. Nikolai Korotkoff. Turbulent blood flow through the vessels can be heard as a soft ticking while measuring blood pressure; these sounds are known as **Korotkoff sounds**. Blood pressure is measured in mm Hg and is usually obtained from the brachial artery using a **sphygmomanometer** and a **stethoscope**. Blood pressure is recorded as **systolic pressure** over **diastolic pressure**.

The Composition (Anatomy) of Blood and the Functions of the Components

Blood is a connective tissue made up of **cellular elements** and an **extracellular matrix**. The cellular elements are referred to as the **formed elements** and include red blood cells (RBCs), white blood cells (WBCs), and platelets. The extracellular matrix, called **plasma**, makes blood unique among connective tissues because it is fluid. This fluid, which is mostly water, perpetually suspends the formed elements and enables them to circulate throughout the body within the cardiovascular system.

In the laboratory, blood samples are often centrifuged in order to separate the components of blood from one another (see the figure below). **Erythrocytes** are the heaviest elements in blood and settle at the very bottom of the tube. Above the erythrocyte layer, we see the **buffy coat**, a pale, thin layer of **leukocytes** and **thrombocytes**, which together make up less than 1% of the sample of whole blood. Above the buffy coat is the blood plasma, normally a pale, straw-colored fluid, which constitutes the remainder of the sample.

In normal blood, about 45 percent of a sample is erythrocytes, referred to as the **hematocrit**. The hematocrit of any one sample can vary significantly, however, by about 36–50 percent. One of the factors that determines hematocrit is testosterone levels, and so cisgender men tend to have higher hematocrits than cisgender women. Taking synthetic testosterone can elevate it as well. Not counting the buffy coat, which makes up less than 1% of the blood, we can estimate the mean plasma percentage to be the percentage of blood that is not erythrocytes: approximately 55%.

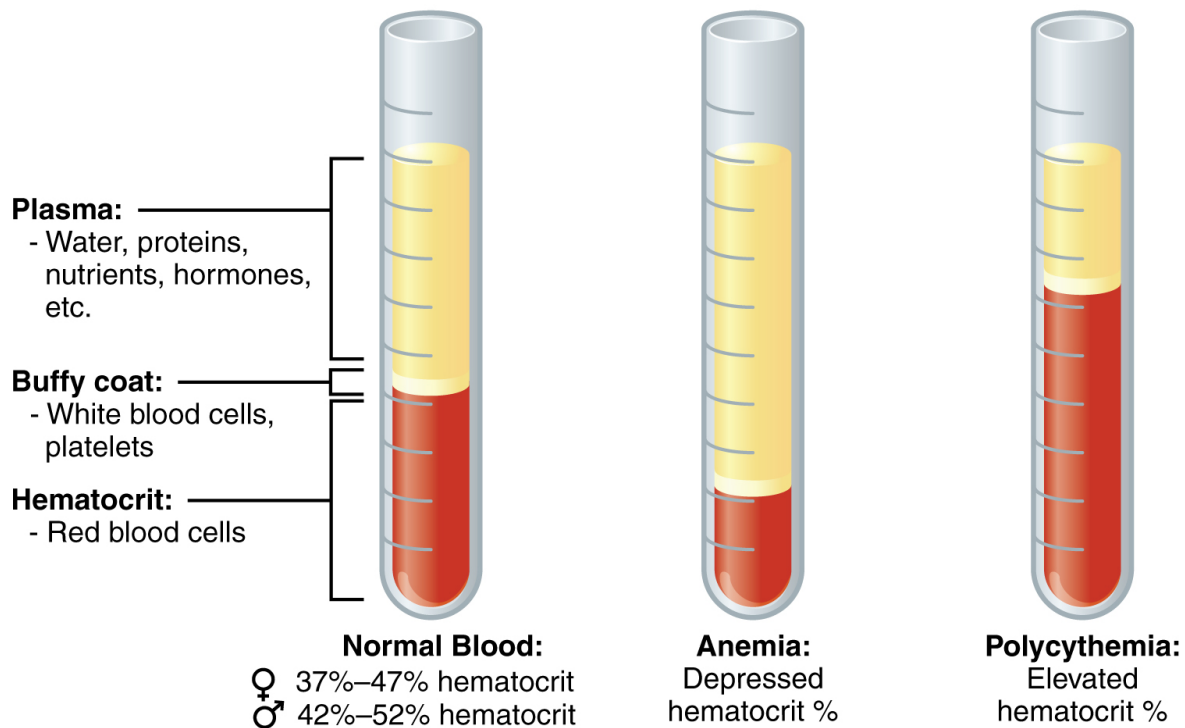


Figure 9.3 Composition of Blood. The cellular elements of blood include a vast number of erythrocytes and comparatively fewer leukocytes and platelets. Plasma is the fluid in which the formed elements are suspended. A sample of blood spun in a centrifuge reveals that plasma is the lightest component. It floats at the top of the tube separated from the heaviest elements, the erythrocytes, by a buffy coat of leukocytes and platelets. Hematocrit is the percentage of the total sample that is composed of erythrocytes. Depressed and elevated hematocrit levels are shown for comparison. From Betts, et al., 2013. Licensed under [CC BY 4.0](#). [\[Image description.\]](#)

Blood Plasma

Like other fluids in the body, plasma is composed primarily of water. In fact, it is about 92% water. Dissolved or suspended within this water is a mixture of substances, most of which are proteins.

Erythrocytes

The most abundant formed elements in blood, erythrocytes are basically sacs packed with an oxygen-carrying compound called hemoglobin. Production of erythrocytes in the red bone marrow occurs at the staggering rate of more than 2 million cells per second. For this production to occur, raw materials including iron, copper, zinc, B vitamins, glucose, lipids, and amino acids must be present in adequate amounts. Erythrocytes live only 120 days on average and thus must be continually replaced. Worn-out erythrocytes are phagocytized by macrophages, and their hemoglobin is broken down. The breakdown products are recycled or removed as wastes.

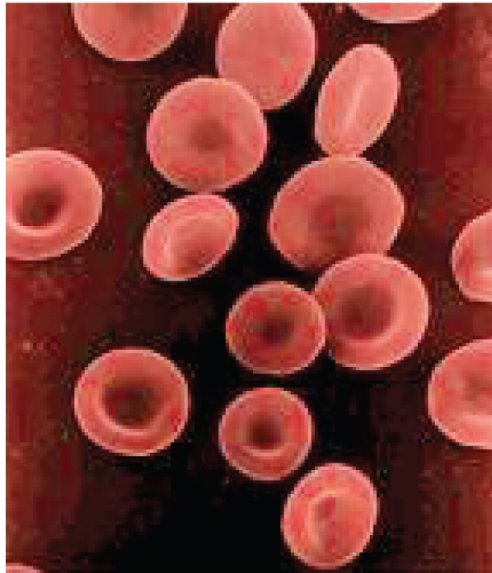


Figure 9.4 Shape of Red Blood Cells. Erythrocytes are biconcave discs with very shallow centers. This shape optimizes the ratio of surface area to volume, facilitating gas exchange. It also enables them to fold up as they move through narrow blood vessels. From Betts, et al., 2013. Licensed under [CC BY 4.0](#).

Leukocytes

Leukocytes protect the body against invading microorganisms and body cells with mutated DNA, and they clean up debris; thus they are a major component of the body's defenses against disease.

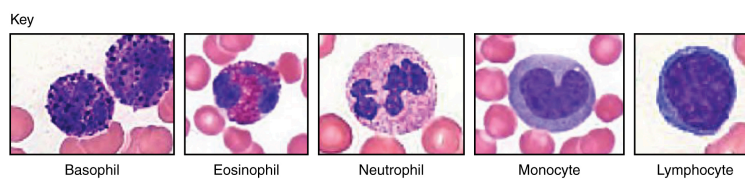


Figure 9.5 Leukocytes. (Micrographs provided by the Regents of University of Michigan Medical School © 2012.) From Betts, et al., 2013. Licensed under [CC BY 4.0](#).

Platelets

After entering the circulation, approximately one-third of the newly formed platelets migrate to the spleen for storage for later release in response to any rupture in a blood vessel. They then become activated to perform their primary function, which is to limit blood loss. Platelets remain only about 10 days, then are phagocytized by macrophages.

Platelets are key players in hemostasis, the process by which the body seals a ruptured blood vessel and prevents further loss of blood. Although rupture of larger vessels usually requires medical intervention, hemostasis is quite effective in dealing with small, simple wounds. There are three steps to the process: vascular spasm, the formation of a platelet plug, and coagulation (blood clotting). Failure of any of these steps will result in **hemorrhage**.

Physiology of Blood

Although carrying oxygen and nutrients to cells and removing wastes from cells is the main function of blood, it is important to realize that blood also serves in defense, distribution of heat, and maintenance of homeostasis.

Transportation

- Nutrients from the foods you eat are absorbed in the digestive tract. Most of these travel in the bloodstream directly to the liver, where they are processed and released back into the bloodstream for delivery to body cells.
- Oxygen from the air you breathe diffuses into the blood, which moves from the lungs to the heart, which then pumps it out to the rest of the body.
- Endocrine glands scattered throughout the body release their products, called hormones, into the bloodstream, which carries them to distant target cells.
- Blood also picks up cellular wastes and byproducts and transports them to various organs for removal. For instance, blood moves carbon dioxide to the lungs for exhalation from the body, and various waste products are transported to the kidneys and liver for excretion from the body in the form of urine or bile.

Defense

- Leukocytes protect the organism from disease-causing bacteria, cells with mutated DNA that could multiply to become cancerous, or body cells infected with viruses.
- When damage to the vessels results in bleeding, blood platelets and certain proteins dissolved in the

plasma interact to block the ruptured areas of the blood vessels involved. This protects the body from further blood loss.

Homeostasis

- If you were exercising on a warm day, your rising core body temperature would trigger several homeostatic mechanisms, including increased transport of blood from your core to your body periphery, which is typically cooler. As blood passes through the vessels of the skin, heat would be dissipated to the environment, and the blood returning to your body core would be cooler. In contrast, on a cold day, blood is diverted away from the skin to maintain a warmer body core. In extreme cases, this may result in frostbite.
- Blood helps to regulate the water content of body cells.
- Blood also helps to maintain the chemical balance of the body. Proteins and other compounds in the blood act as buffers, which thereby help to regulate the pH of body tissues. The pH of blood ranges from 7.35 to 7.45.

Image Descriptions

Figure 9.2 image description: This diagram shows how oxygenated and deoxygenated blood flows through the major organs in the body. Pulmonary circulation involves the lungs, pulmonary artery and vein, vena cava, and aorta. Systemic circulation involves the upper body, hepatic vein, renal vein, aorta, liver, hepatic artery, hepatic portal vein, stomach, intestines, renal artery, kidneys, and lower body. [\[Return to Figure 9.2\].](#)

Figure 9.3 image description: This figure shows three test tubes with a red and yellow liquid in them. The left panel shows normal blood, the center panel shows anemic blood and the right panel shows polycythemic blood. Labels indicate plasma (water, proteins, nutrients, hormones, etc.), buffy coat (white blood cells, platelets), and hematocrit (red blood cells). [\[Return to Figure 9.3\].](#)

WORD PARTS AND STRUCTURAL TERMS

Combining Forms

angi/o: vessel, blood vessel

aort/o: aorta

arteri/o: artery

ather/o: fatty plaque

cyt/o: cell

hemat/o: blood

hem/o: blood

isch/o: deficiency, blockage

lymph/o: lymph, lymph tissue

lymphaden/o: lymph node, lymph tissue

myel/o: bone marrow, spinal cord

phleb/o: vein

plasm/o: plasma

therm/o: heat

thromb/o: clot

thym/o: thymus gland

splen/o: spleen

ven/o: vein

Prefixes

a-: absence of, without

endo-: within, in

epi-: on, upon, over

hypo-: below, deficient

hyper-: above, excessive

inter-: between

pan-: all, total

peri-: surrounding, around

poly-: many, much

Suffixes

- ac**: pertaining to (adjective)
- apheresis**: removal (noun)
- ar**: pertaining to (adjective)
- centesis**: surgical puncture to aspirate fluid (noun)
- ectomy**: excision, surgical removal (noun)
- emia**: in the blood (noun)
- genic**: producing, originating, causing (adjective)
- gram**: record, radiographic image (noun)
- graph**: instrument used to record (noun)
- graphy**: process of recording, radiographic imaging (noun)
- ia**: condition of, diseased state, abnormal state (noun)
- ic**: pertaining to (adjective)
- itis**: inflammation (noun)
- logist**: specialist, physician who studies and treats (noun)
- logy**: specialty (noun)
- lysis**: loosening, dissolution, separating (noun)
- megaly**: enlarged, enlargement (noun)
- oma**: tumor (noun)
- osis**: abnormal condition (noun)
- otomy**: cut into, incision (noun)
- ous**: pertaining to (adjective)
- pathy**: disease (noun)
- penia**: abnormal reduction in number (noun)
- pexy**: surgical fixation, suspension (noun)
- plasty**: surgical repair (noun)
- poiesis**: formation (noun)
- sclerosis**: hardening (noun)
- stenosis**: narrowing, constriction (noun)
- scope**: instrument used to view (noun)
- scopy**: process of viewing (noun)
- stasis**: stop, stopping, controlling (noun)
- stenosis**: narrowing, constriction (noun)

Structural Terms Built from Word Parts

arterial: pertaining to the arteries

intravenous: pertaining to within the veins

venous: pertaining to the veins

DISEASES AND DISORDERS

Disease and Disorder Terms Built from Word Parts

anemia: when the number of RBCs or hemoglobin is deficient

angioma: tumor composed of blood vessels

angiostenosis: abnormal narrowing of a blood vessel

aortic stenosis: abnormal narrowing of the aorta

arteriosclerosis: hardening of the arteries

atherosclerosis: hardening of the arteries that involves the accumulation of plaque

cyanosis: abnormal condition of blue (bluish-color lips and nail beds), typically caused by low oxygenation

hematoma: a collection of blood outside of blood vessels, usually due to trauma, disease, or surgery

hypercholesterolemia: higher than normal levels of cholesterol in the blood

hyperlipidemia: excessive fat in the blood

hypertension: chronic and persistent blood pressure measurements of 140/90 mm Hg or above

hypertriglyceridemia: excessive triglycerides in the blood

hypotension: low blood pressure

hypothermia: low body temperature

hypoxemia: low blood oxygen levels

hypoxia: lower-than-normal amount of oxygen to tissues

ischemia: a condition in which cells receive insufficient amounts of blood and oxygen

leukemia: a cancer involving an abundance of leukocytes

leukocytopenia: lower-than-normal amounts of one or more types of white blood cells

leukocytosis: excessive leukocyte proliferation

myeloma: a tumor of the bone marrow affecting plasma cells (specialized B cells that produce antibodies)

myocarditis: inflammation of the myocardium

pancytopenia: lower-than-normal amounts of all blood cells

pericarditis: inflammation of the pericardium

phlebitis: inflammation of one or more veins

polyarteritis: inflammation of many arteries

polycythemia: an elevated RBC count

thrombocytopenia: lower-than-normal platelet count

thrombophlebitis: inflammation of a vein caused by a blood clot

thrombosis: formation of unwanted blood clots

thrombus: a blood clot; an aggregation of platelets, erythrocytes, and even WBCs typically trapped within a mass of fibrin strands

valvulitis: inflammation of a valve

Disease and Disorder Terms Not Built from Word Parts

aneurysm: weakening of the wall of a blood vessel, causing it to thin and balloon out and possibly eventually burst, resulting in internal bleeding

blood dyscrasia: a pathologic condition of the blood, usually referring to a disorder of the cellular elements of the blood

circulatory shock: a life-threatening condition in which the circulatory system is unable to maintain blood flow to adequately supply sufficient oxygen and other nutrients to the tissues to maintain cellular metabolism

coarctation of the aorta: a congenital condition in which a part of the aorta is narrower than usual

coronary artery disease: the blood vessels that supply blood to the myocardium become hardened and narrowed, impairing the delivery of oxygen to the heart muscle

deep vein thrombosis: a type of venous thrombosis involving the formation of a blood clot in a deep vein, most commonly in the legs

edema: swelling of tissues due to excess interstitial fluid

embolus: a freely moving piece of a substance (plaque or blood clot) that travels through the circulation until it blocks a smaller blood vessel, cutting off the supply of oxygen to the tissue

embolism: when an embolus becomes trapped

extravasation: leakage of blood into surrounding tissues

hemophilia: a group of related genetic disorders in which certain plasma clotting factors are lacking, inadequate, or nonfunctional

hemorrhage: excessive or uncontrolled bleeding from the blood vessels

intermittent claudication: pain in the legs caused by insufficient oxygen delivery in muscle tissue while exercising

peripheral artery disease: when atherosclerosis affects arteries in the legs

sepsis: a potentially life-threatening condition that occurs when the body's response to an infection damages its own tissues; may lead to septic shock

varicose veins: when defective valves allow blood to accumulate within the veins, causing them to distend, twist, and become visible on the surface of the skin

MEDICAL, SURGICAL, & VIEWING TERMS AND ABBREVIATIONS

Medical Careers & Professional Terminology

diagnostic vascular technologist: technologist that images the vascular system

hematologist: specialist physician that diagnoses and treats blood disorders

medical laboratory technologist: performs complex analyses of tissue, blood, and other body fluids

phlebotomist: professional trained to draw blood

vascular surgeon: surgeon that treats diseases of the blood and lymphatic vessels

Imaging Techniques/Procedures for the Organ System

angiogram: the placement of a catheter in a blood vessel and injection of contrast material while taking x-rays of the vessel

angiography: the process of obtaining an angiogram

angioscope: a miniature fiber-optic endoscope that is threaded into the heart through a catheter; it can be used to view thrombi, plaque, arterial dissections, and other vascular abnormalities

angiосcopy: the process of using an angioscope

aortogram: the placement of a catheter in the aorta and injection of contrast material while taking x-rays of the aorta

arteriogram: the placement of a catheter in an artery and injection of contrast material while taking x-rays of the artery

Doppler ultrasound: a noninvasive test that can be used to estimate the blood flow through the blood vessels by bouncing sound waves off circulating red blood cells

venogram: the placement of a catheter in a vein and injection of contrast material while taking x-rays of the vein

Surgical Techniques / Medical Procedures / Diagnostic Procedures / Medications Used with the

Organ System

aneurysmectomy: surgical removal of an aneurysm from a blood vessel

angioplasty: a balloon-tip catheter is fed through a blood vessel up to the site of the narrowing; the balloon is inflated to re-open the artery

anticoagulant: a medication that slows or inhibits blood clotting

arterial blood gas: measures blood pH, oxygen, and CO₂ levels in a sample of arterial blood, usually taken from the wrist

atherectomy: surgical excision of fatty plaque from a blood vessel

bone marrow aspiration: removal of bone marrow via needle

bone marrow biopsy: a diagnostic test of a sample of red bone marrow

bone marrow transplant: a treatment in which a donor's healthy bone marrow and its stem cells replace the faulty bone marrow of a patient

coagulation time: the time required by a blood specimen to clot

complete blood count and differential: a collection of blood tests that count the different blood cells (RBCs, WBCs, platelets) and the different types of WBCs (neutrophils, lymphocytes, monocytes, eosinophils, basophils)

embolectomy: surgical removal of an embolus, usually with a balloon catheter

endarterectomy: surgical removal of plaque from a blood vessel

femoropopliteal bypass: surgery that creates a new route for blood between the femoral and popliteal arteries of the leg

hematocrit: a lab test that measures the percentage of red blood cells in a sample of whole blood; it represents how much of the person's blood is made up of red blood cells by volume

hemoglobin: a protein found in red blood cells that carries oxygen; abnormal amounts indicate a blood disorder

percutaneous transluminal coronary angioplasty: a procedure that opens blocked or stenosed coronary arteries using a balloon catheter

phlebectomy: surgical excision of a vein

phlebotomy: incision or puncture of a vein with a needle

thrombolytic therapy: the use of drugs to break up or dissolve blood clots

vasoconstrictor: a substance that constricts blood vessel walls

vasodilator: a substance that dilates blood vessel walls

venipuncture: puncture of a vein to withdraw blood or administer medication or fluids

Abbreviations Commonly Used with the Organ System

ABG: arterial blood gas

BP: blood pressure

CBC/diff: complete blood count/differential

DVT: deep vein thrombosis

Hct: hematocrit

Hgb: hemoglobin

HTN: hypertension

IV: intravenous

PAD: peripheral artery disease

PTCA: percutaneous transluminal coronary angioplasty

RBC: red blood cell

WBC: white blood cell

Medical Terms Practice

For each card, click the speaker icon to hear the correct pronunciation of the listed term. Practice saying the term to yourself, then attempt to define the term from memory. Click “Turn” to flip the card and see the definition. Use the right and left arrows to toggle through the cards in each set.



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PRACTICE

The following activity will allow you to practice what you've learned in this chapter.

Consultation Report

Click and drag each term from the word bank to its correct place in this exercise.



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PART X

CARDIOVASCULAR SYSTEM—PART III: THE LYMPHATIC AND IMMUNE SYSTEMS

Learning Objectives

When completing this chapter, the learner will be able to do the following:

- Identify the anatomy of the immune and lymphatic systems
- Describe the main functions of the immune and lymphatic systems
- Spell terms relating to the immune and lymphatic systems and use correct abbreviations
- Pronounce terms relating to the immune and lymphatic systems and use correct abbreviations
- Identify the medical specialties associated with the immune and lymphatic systems
- Explore common diseases, disorders, and procedures related to the immune and lymphatic systems

Introduction to the Lymphatic and Immune Systems

The **lymphatic system** is a series of vessels, ducts, and trunks that remove interstitial fluid from the tissues and return it to the blood. The lymphatic vessels are also used to transport dietary lipids and cells of the **immune system**. Cells of the immune system, lymphocytes, all come from the hematopoietic system of the bone marrow. **Primary lymphoid organs**, the bone marrow and thymus gland, are the locations where lymphocytes proliferate and mature. **Secondary lymphoid organs** are the site in which mature lymphocytes

congregate to mount immune responses. Many immune system cells use the lymphatic and circulatory systems for transport throughout the body to search for and then protect against pathogens.

Watch this video:



One or more interactive elements has been excluded from this version of the text. You can view them online here: <https://louis.pressbooks.pub/medicalterminology/?p=1411#oembed-1>

Media 10.1 [Lymphatic System: Crash Course A&P #44](#) [Online video]. Copyright 2015 by [CrashCourse](#).

ANATOMY AND PHYSIOLOGY OF THE LYMPHATIC SYSTEM

The **lymphatic vessels** begin as close-ended **lymphatic capillaries**, which feed into larger and larger lymphatic vessels, and eventually empty into the bloodstream. Along the way, the lymph travels through the **lymph nodes**, which are commonly found near the groin, armpits, neck, chest, and abdomen. Humans have about 500–600 lymph nodes throughout the body (see [Figure 10.1](#)). Several organs and tissues that participate in immunity are also part of the lymphatic system.

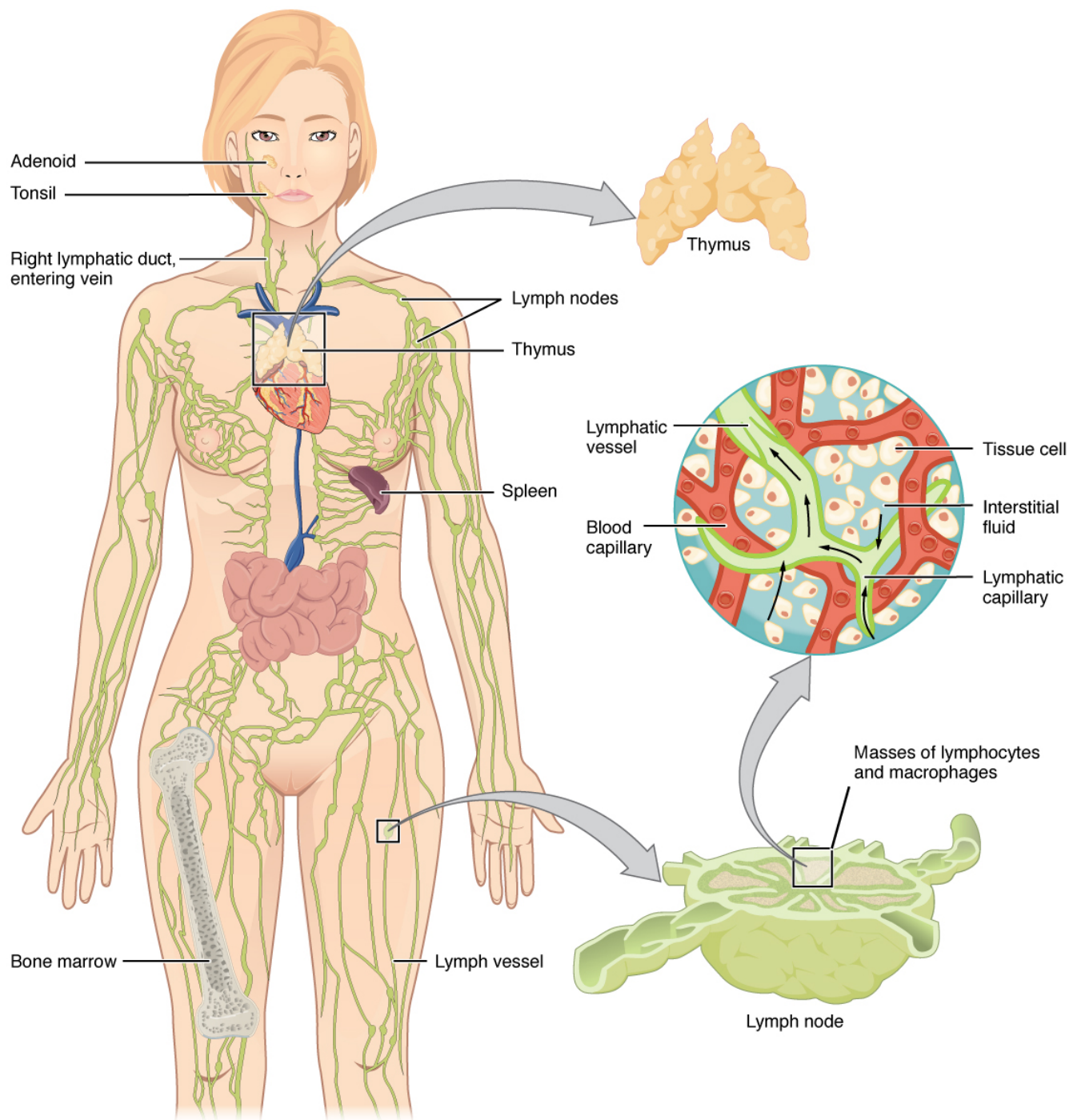


Figure 10.1 Anatomy of the Lymphatic System. Lymphatic vessels in the arms and legs convey lymph to the larger lymphatic vessels in the torso. From Betts, et al., 2013. Licensed under [CC BY 4.0](#). [\[Image description.\]](#)

Lymphatic Capillaries

An important function of the lymphatic system is to return the fluid (lymph) to the blood. **Lymph** may be thought of as recycled blood plasma. Blood pressure causes leakage of fluid from the blood capillaries, resulting in the accumulation of fluid in the **interstitial space**. In humans, 20 liters of plasma are released into the interstitial space of the tissues each day due to capillary leakage. The blood vessels reabsorb 17 liters of this **interstitial fluid**, leaving 3 liters in the tissues for the lymphatic system to transport back into the body's circulation. If the lymphatic system is damaged in some way, such as by being blocked by cancer cells or destroyed by injury, interstitial fluid accumulates in the tissue spaces, causing a condition called lymphedema.

Lymphatic capillaries, also called terminal lymphatics, are vessels where interstitial fluid enters the lymphatic system to become lymph. Located in almost every tissue in the body, these vessels are interlaced among the arterioles and venules of the circulatory system in the soft connective tissues of the body. See [Figure 10.2](#). Exceptions are the central nervous system, bone marrow, bones, teeth, and the cornea of the eye, which do not contain lymph vessels.

Lymph capillaries in the tissue spaces

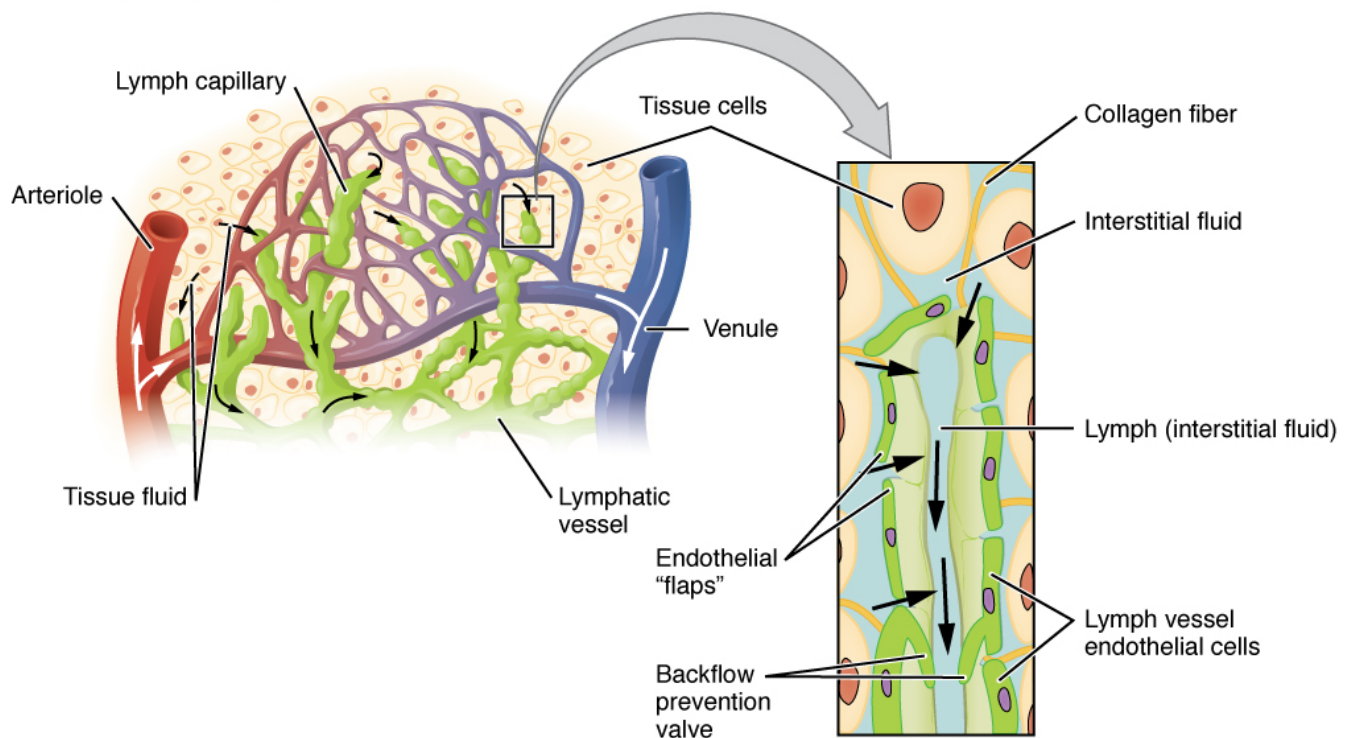


Figure 10.2 Lymphatic Capillaries. Lymphatic capillaries are interlaced with the arterioles and venules of the cardiovascular system. Collagen fibers anchor a lymphatic capillary in the tissue (inset). Interstitial fluid slips through spaces between the overlapping endothelial cells that compose the lymphatic capillary. From Betts, et al., 2013. Licensed under [CC BY 4.0](#). [\[Image description.\]](#)

Larger Lymphatic Vessels, Trunks, and Ducts

The lymphatic capillaries empty into larger lymphatic vessels, which are similar to veins in terms of their three-tunic structure and the presence of valves. These one-way valves are located fairly close to one another, and each one causes a bulge in the lymphatic vessel (see [Figure 10.2](#)).

In general, **superficial lymphatics** follow the same routes as veins, whereas **deep lymphatic vessels** of the viscera generally follow the paths of arteries. The superficial and deep lymphatics eventually merge to form larger lymphatic structures known as **lymphatic trunks**. On the right side of the body, the right sides of the head, thorax, and right upper limb trunks drain lymph fluid into the right subclavian vein via the right lymphatic duct (see [Figure 10.3](#)). On the left side of the body, the trunks from the remaining portions of the body drain into the larger thoracic duct, which drains into the left subclavian vein. The thoracic duct itself begins just beneath the diaphragm in the **cisterna chyli**.

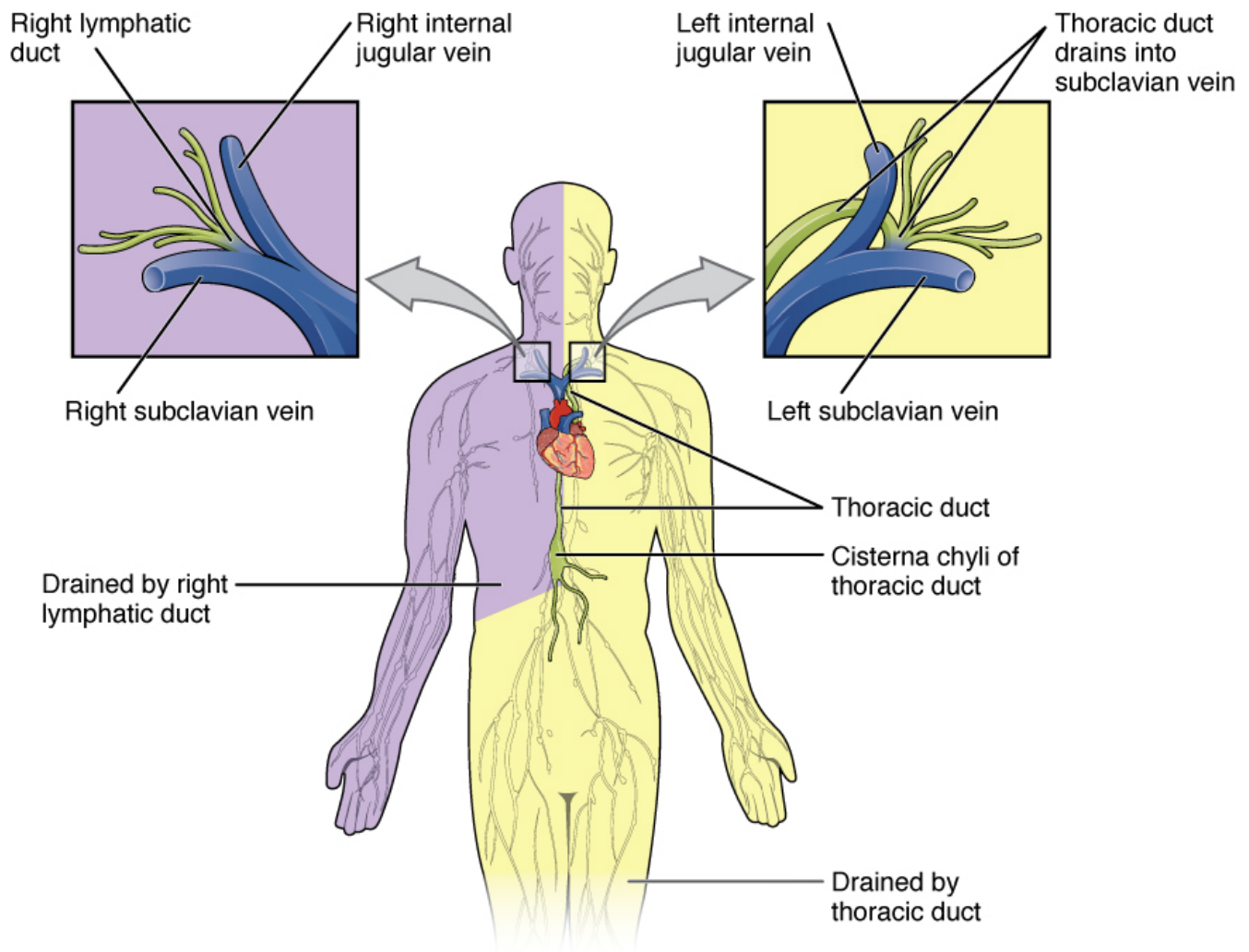


Figure 10.3 Major Trunks and Ducts of the Lymphatic System. The thoracic duct drains a much larger portion of the body than does the right lymphatic duct. From Betts, et al., 2013. Licensed under [CC BY 4.0](#). [\[Image description.\]](#)

Primary Lymphoid Organs

The primary lymphoid organs are the **bone marrow** and **thymus gland**. The lymphoid organs are where lymphocytes mature, proliferate, and are selected, which enables them to attack pathogens without harming the cells of the body.

Bone Marrow

Recall that all blood cells, including lymphocytes, are formed in the red bone marrow. The B cell undergoes

nearly all of its development in the red bone marrow, whereas the immature T cell, called a thymocyte, leaves the bone marrow and matures largely in the thymus gland.

Thymus

The thymus gland, where T cells mature, is a bilobed organ found in the space between the sternum and the aorta of the heart. Connective tissue holds the lobes closely together but also separates them and forms a capsule.

Secondary Lymphoid Organs

Lymphocytes develop and mature in the primary lymphoid organs, but they mount immune responses from the **secondary lymphoid organs**, which include the **lymph nodes**, **spleen**, and **lymphoid nodules**. A naïve lymphocyte is one that has left the primary organ, where it learned to function immunologically, and entered a secondary lymphoid organ, where it waits to encounter an antigen against which it will mount a response.

Lymph Nodes

Lymph nodes function to remove debris and pathogens from the lymph, and are thus sometimes referred to as the “filters of the lymph.” Any bacteria that infect the interstitial fluid are taken up by the lymphatic capillaries and transported to a regional lymph node. Dendritic cells and macrophages within this organ internalize and kill many of the pathogens that pass through, thereby removing them from the body. The lymph node is also the site of **adaptive immune responses** mediated by T cells, B cells, and accessory cells of the adaptive immune system.

Spleen

The spleen is a vascular organ that is somewhat fragile due to the absence of a capsule. It is about 12 cm long and is attached to the lateral border of the stomach. The spleen is sometimes called the “filter of the blood” because of its extensive vascularization and the presence of macrophages and dendritic cells that remove microbes and other materials from the blood, including dying red blood cells. The spleen also functions as the location of immune responses to blood-borne pathogens.

Lymphoid Nodules

The other lymphoid tissues, the lymphoid nodules, consist of a dense cluster of lymphocytes without a surrounding fibrous capsule. These nodules are located in the respiratory and digestive tracts, areas routinely exposed to environmental pathogens. These include **tonsils**, **bronchus-associated lymphoid tissue (BALT)**, and **mucosa-associated lymphoid tissue (MALT)**.

Image Descriptions

Figure 10.1 image description: The left panel shows a female human body, and the entire lymphatic system is shown. Labels read (clockwise from top): thymus, lymph nodes, thymus, spleen, lymph vessel, bone marrow, right lymphatic duct, entering vein, tonsil, adenoid. The right panel shows magnified images of the thymus and the lymph node. Labels read (clockwise from top): tissue cell, interstitial fluid, lymphatic capillary, blood capillary, lymphatic vessel. Label of lymph node reads masses of lymphocytes and macrophages. [\[Return to Figure 10.1\].](#)

Figure 10.2 image description: This image shows the lymph capillaries in the tissue spaces. Labels read (clockwise, from top): lymph capillary, tissue cells, venule, lymphatic vessel, tissue fluid, arteriole. It also shows a magnified image of the interstitial fluid and the lymph vessels. Labels read (clockwise, from top): collagen fiber, interstitial fluid, lymph, lymph vessel endothelial cells, backflow prevention valve, endothelial flaps. [\[Return to Figure 10.2\].](#)

Figure 10.3 image description: This figure shows the lymphatic trunks and the duct system in the human body. Labels read (clockwise from top) thoracic duct, cisterna chyli of thoracic duct, drained by thoracic duct, drained by right lymphatic duct. Callouts to the left and right show the magnified views of the left and right jugular veins, respectively. Labels read (right lymphatic duct): right internal jugular vein, right subclavian vein, right lymphatic duct; (left jugular vein): left internal jugular vein, thoracic duct drains into subclavian vein, left subclavian vein. [\[Return to Figure 10.3\].](#)

WORD PARTS AND STRUCTURAL TERMS

Combining Forms

immun/o: immune, immunity

lymph/o: lymph, lymph tissue

lymphaden/o: lymph gland, lymph node

myel/o: bone marrow, spinal cord

splen/o: spleen

thym/o: thymus gland

Prefixes

a-: no, not, negates meaning

an-: no, not, negates meaning

Suffixes

-cyte: cell

-ectomy: excision, cut out

-itis: inflammation

-logist: specialist, physician who studies and treats

-logy: study of

-megaly: enlarged, enlargement

-oid: resembling

-oma: tumor, swelling

-osis: abnormal condition

-pathy: disease

-rrhaphy: suturing

Structural/Complementary Terms Built from Word

Parts

lymphoid: relating to the lymphatic tissue

lymphocyte: immune cell commonly found in the lymphatic system; responsible for adaptive and long-term immunity

Structural/Complementary Terms Not Built from Word Parts

antibody: proteins produced by B lymphocytes in response to a non-self antigen; also called immunoglobulins

antigen: a substance that provokes an immune response

immune: possessing immunity to a pathogen

immunity: after an infection, memory cells remain in the body for a long time and can very quickly mount an immune response against the same pathogen if it tries to re-infect

immunization: the process of inducing immunity artificially with weakened or killed pathogens, antigens from the pathogen, or mRNA coding for a protein from a pathogen

vaccine: an agent administered by injection, orally, or by nasal spray that provides active acquired immunity to a particular infectious disease

DISEASES AND DISORDERS

Disease and Disorder Terms Built from Word Parts

lymphadenitis: inflammation of lymph nodes

lymphadenopathy: disease of lymph nodes

lymphoma: a form of cancer in which masses of malignant T and/or B lymphocytes collect in lymph nodes, the spleen, the liver, and other tissues

splenomegaly: enlargement of spleen

thymoma: tumor of the thymus

Disease and Disorder Terms Not Built from Word Parts

acquired immunodeficiency syndrome: a drop in T-cell numbers due to infection with the HIV virus

allergy: inflammatory response due to a hypersensitivity to a substance

anaphylactic shock: an inhaled, ingested, or injected allergen causes a significant drop in blood pressure along with contractions of smooth muscles of the airways; can be fatal within minutes

autoimmune disease: disease in which the immune system begins to attack cells of the patient's own body, causing chronic inflammation and significant damage

Hodgkin disease: a type of lymphoma in which cancer originates from lymphocytes

infectious mononucleosis: a disease caused by the Epstein-Barr virus, characterized by swollen lymph glands, fever, sore throat, and extreme fatigue

severe combined immunodeficiency disease: genetic disease that leads to decreases in both T-cell and B-cell numbers

systemic lupus erythematosus: an autoimmune disease in which the immune system recognizes its own cell antigens as being “non-self” and mounts an immune response against them; as a result, many body tissues and vital organs become chronically inflamed and damaged

MEDICAL, SURGICAL, & VIEWING TERMS AND ABBREVIATIONS

Medical Careers & Professional Terminology

allergist: a physician who specializes in hypersensitivity reactions of the immune system

immunologist: a physician or scientist who specializes in immunology

immunology: the study of the immune system and immunity

Surgical Techniques/Medical Procedures/ Diagnostic Procedures/Medications Used with the Organ System

splenectomy: surgical removal of all or part of the spleen

splenorrhaphy: surgical suturing of the spleen

thymectomy: surgical removal of all or part of the thymus

Abbreviations Commonly Used with the Organ System

AIDS: acquired immune deficiency syndrome

HIV: human immunodeficiency virus

SCID: severe combined immunodeficiency

Medical Terms Practice

For each card, click the speaker icon to hear the correct pronunciation of the listed term. Practice saying the term to yourself, then attempt to define the term from memory. Click “Turn” to flip the card and see the definition. Use the right and left arrows to toggle through the cards in each set.



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<https://louis.pressbooks.pub/medicalterminology/?p=1510#h5p-69>

PRACTICE

The following activity will allow you to practice what you've learned in this chapter.

Anatomy Labeling Activity

Click and drag each term to the box corresponding with the anatomic structure, body part, body plane, or body region for that term.



An interactive H5P element has been excluded from this version of the text. You can view it online here:

<https://louis.pressbooks.pub/medicalterminology/?p=2116#h5p-70>

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[CrashCourse]. (2015, November 30). [Lymphatic system: Crash course A&P #44](https://youtu.be/I7orwMgTQ5I) [Video]. YouTube. <https://youtu.be/I7orwMgTQ5I>

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PART XI

RESPIRATORY SYSTEM

Learning Objectives

When completing this chapter, the learner will be able to do the following:

- Identify the anatomy of the respiratory system
- Describe the main functions of the respiratory system
- Spell the respiratory system medical terms and use correct abbreviations
- Identify the medical specialties associated with the respiratory system
- Explore common diseases, disorders, and procedures related to the respiratory system

Introduction

Can you hold your breath as you continue reading...? How long can you do it? Chances are you are feeling uncomfortable already. A typical human cannot survive without breathing for more than three minutes, and even if you wanted to hold your breath longer, your **autonomic** nervous system would take control. Although oxygen is critical for cells, it is the accumulation of carbon dioxide that primarily drives your need to breathe.

The major structures of the respiratory system function primarily to provide oxygen to body tissues for cellular respiration, remove the waste product carbon dioxide, and help to maintain acid-base balance. Portions of the respiratory system are also used for nonvital functions, such as sensing odors, speech production, and straining, such as coughing.

Watch these videos:



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Media 11.1. [Respiratory System, Part 1: Crash Course A&P #31](#) [Online video]. Copyright 2015 by [CrashCourse](#).



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Media 11.2. [Respiratory System, Part 2: Crash Course A&P #32](#) [Online video]. Copyright 2015 by [CrashCourse](#).



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Media 11.3. [Spirometry](#) [Online video]. Copyright 2009 by [freshwaterl](#).

ANATOMY AND PHYSIOLOGY OF THE RESPIRATORY SYSTEM

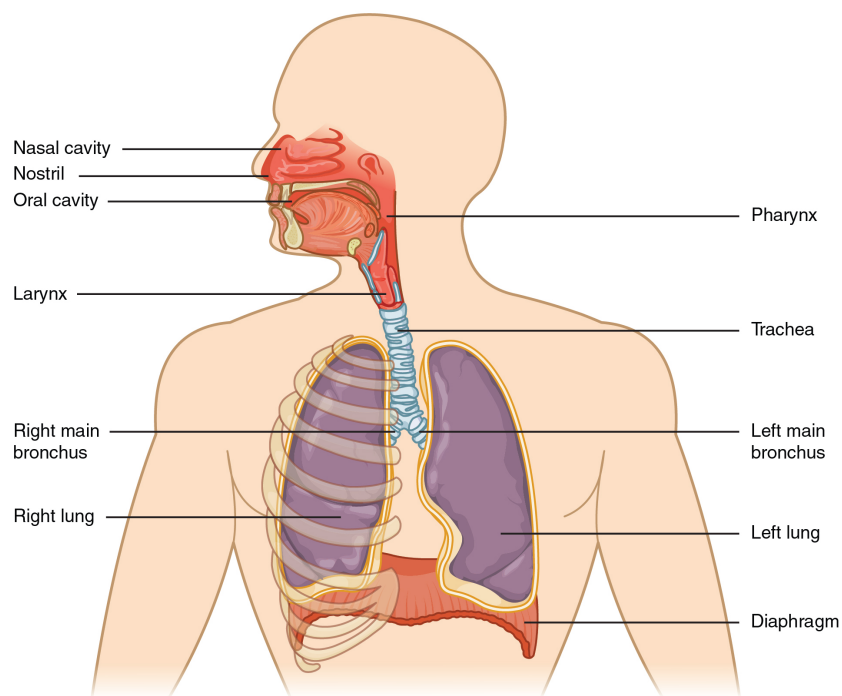


Figure 11.1 Major Respiratory Structures. The major respiratory structures span the nasal cavity to the diaphragm. From Betts, et al., 2013. Licensed under [CC BY 4.0](#). [\[Image description.\]](#)

The Nose and Its Adjacent Structures

The major entrance and exit for the respiratory system is through the nose. When discussing the nose, it is helpful to divide it into two major sections: **external nose** and **internal nose**.

The **nares** open into the **nasal cavity**, which is separated into left and right sections by the **nasal septum** ([Figure 11.2](#)). The nasal septum is formed anteriorly by a portion of the **septal cartilage** and posteriorly by the perpendicular plate of the ethmoid bone and the thin vomer bones.

Each lateral wall of the nasal cavity has three bony projections: the **inferior conchae** are separate bones, and the **superior** and **middle conchae** are portions of the ethmoid bone. Conchae increase the surface area of the nasal cavity, disrupting the flow of air as it enters the nose, which causes air to bounce along

the epithelium, where it is cleaned and warmed. The conchae and meatuses trap water during exhalation, preventing dehydration.

The floor of the nasal cavity is composed of the **hard palate** and the **soft palate**. Air exits the nasal cavities via the **internal nares** and moves into the **pharynx**.

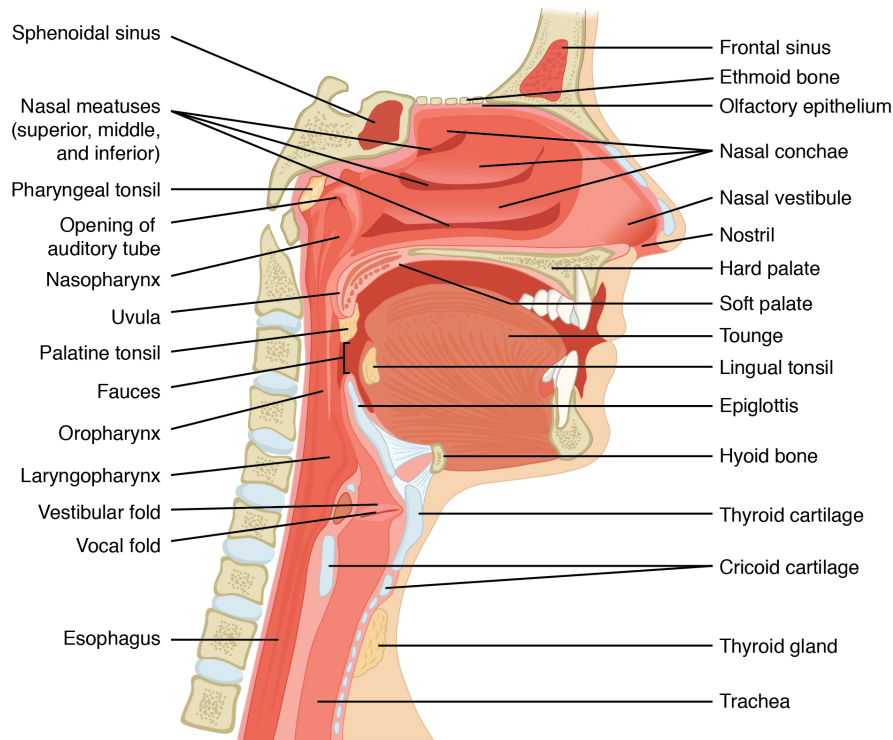


Figure 11.2 Upper Airway. From Betts, et al., 2013. Licensed under [CC BY 4.0](#). [\[Image description.\]](#)

Paranasal sinuses serve to warm and humidify incoming air and are lined with a mucosa that produces mucus. Paranasal sinuses are named for their associated bone:

- frontal sinus
- maxillary sinus
- sphenoidal sinus
- ethmoidal sinus

The nares and anterior portion of the nasal cavities are lined with mucous membranes containing sebaceous glands and hair follicles that serve to prevent the passage of large debris, such as dirt, through the nasal cavity. An olfactory epithelium used to detect odors is found deeper in the nasal cavity.

The conchae, meatuses, and paranasal sinuses are lined by respiratory epithelium composed of pseudostratified ciliated columnar epithelium ([Figure 11.3](#)). The epithelium contains specialized epithelial cells

that produce mucus to trap debris. The cilia of the respiratory epithelium help to remove mucus and debris with a constant beating motion, sweeping materials toward the throat to be swallowed.

This moist epithelium functions to warm and humidify incoming air. Capillaries located just beneath the nasal epithelium warm the air by convection.

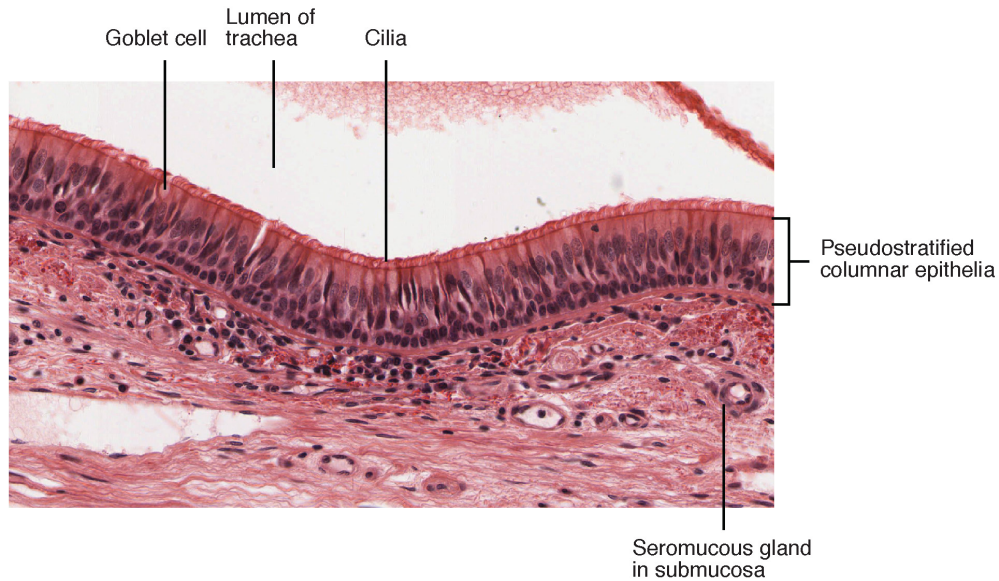


Figure 11.3 Pseudostratified Ciliated Columnar Epithelium. Respiratory epithelium is pseudostratified ciliated columnar epithelium. Seromucous glands provide lubricating mucus. LM \times 680. (Micrograph provided by the Regents of University of Michigan Medical School \copyright 2012.) From Betts, et al., 2013. Licensed under [CC BY 4.0](#). [\[Image description.\]](#)

Pharynx

The **pharynx** is divided into three major regions: the **nasopharynx**, the **oropharynx**, and the **laryngopharynx** (see [Figure 11.4](#)).

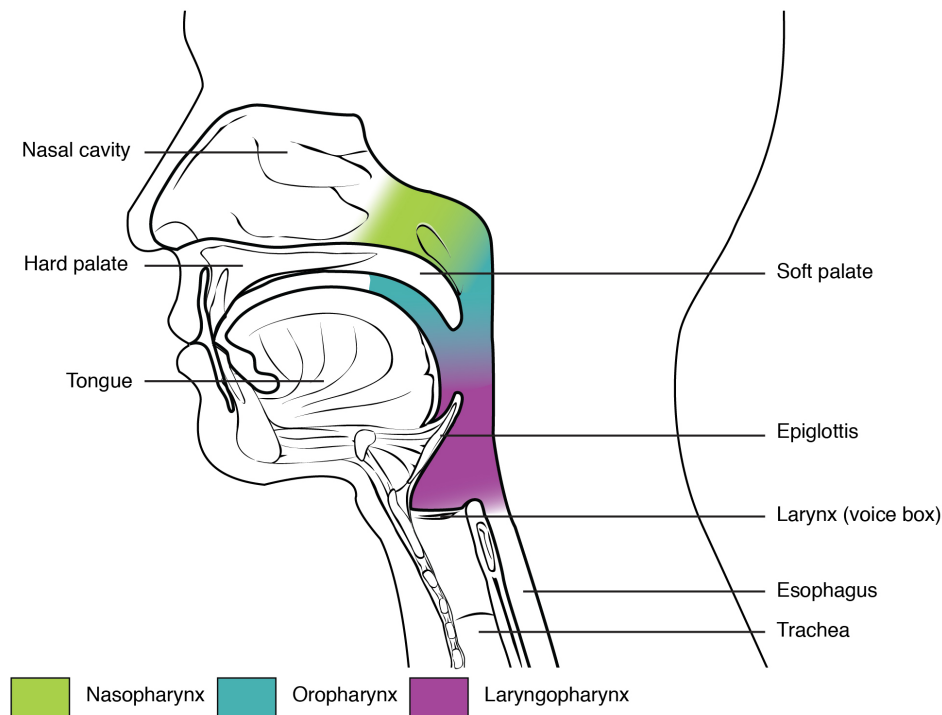


Figure 11.4 Divisions of the Pharynx. The pharynx is divided into three regions: the nasopharynx, the oropharynx, and the laryngopharynx. From Betts, et al., 2013. Licensed under CC BY 4.0. [\[Image description.\]](#)

At the top of the **nasopharynx** are the **pharyngeal tonsils**. The function of the tonsil is not well understood, but it contains a rich supply of **lymphocytes** and is covered with ciliated epithelium that traps and destroys invading pathogens that enter during inhalation. The pharyngeal tonsils are large in children but tend to regress with age and may even disappear. The **uvula** and **soft palate** move like a pendulum during swallowing, swinging upward to close off the nasopharynx to prevent ingested materials from entering the nasal cavity. **Auditory (Eustachian) tubes** that connect to each middle ear cavity open into the nasopharynx. This connection is why colds often lead to ear infections.

The **oropharynx** is bordered superiorly by the **nasopharynx** and anteriorly by the oral cavity. The oropharynx contains two distinct sets of tonsils: the **palatine tonsils** and the **lingual tonsils**.

Similar to the pharyngeal tonsil, the **palatine** and **lingual** tonsils are composed of lymphoid tissue and trap and destroy pathogens entering the body through the oral or nasal cavities.

The **laryngopharynx** is **inferior** to the oropharynx and **posterior** to the larynx. It continues the route for ingested material and air until its inferior end, where the digestive and respiratory systems diverge. The stratified squamous epithelium of the oropharynx is continuous with the laryngopharynx. **Anteriorly**, the laryngopharynx opens into the **larynx**, whereas **posteriorly**, it enters the esophagus.

Larynx

The structure of the larynx is formed by several pieces of cartilage. Three large cartilage pieces form the major structure of the larynx:

- **Thyroid cartilage** (anterior):
 - The thyroid cartilage is the largest piece of cartilage that makes up the larynx. The thyroid cartilage consists of the prominence, or “Adam’s apple,” which tends to be more prominent in males.
 - Three smaller, paired cartilages—the arytenoid, corniculate, and cuneiform cartilages—attach to the thyroid cartilage and the vocal cords and muscles that help move the vocal cords to produce speech.
- **Epiglottis** (superior)
- **Cricoid cartilage** (inferior):
 - The thick cricoid cartilage forms a ring with a wide posterior region and a thinner anterior region.

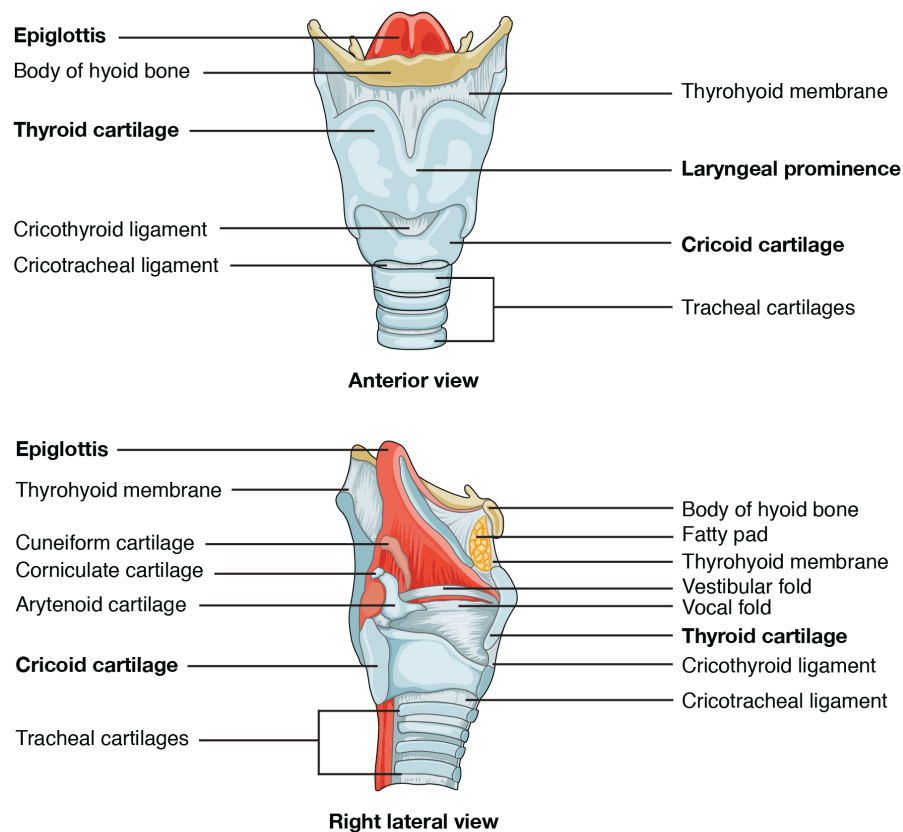


Figure 11.5 Larynx. The larynx extends from the laryngopharynx and the hyoid bone to the trachea. From Betts, et al., 2013. Licensed under [CC BY 4.0](#). [\[Image description.\]](#)

When the **epiglottis** is in the “closed” position, the unattached end of the epiglottis rests on the **glottis**. A **vestibular fold**, or **false vocal cord**, is one of a pair of folded sections of mucous membrane. A **true vocal cord** is one of the white, membranous folds attached by muscle to the thyroid and arytenoid cartilages of the larynx on their outer edges. The inner edges of the true vocal cords are free, allowing oscillation to produce sound.

The act of swallowing causes the pharynx and larynx to lift upward, allowing the pharynx to expand and the epiglottis of the larynx to swing downward, closing the opening to the trachea. These movements produce a larger area for food to pass through while preventing food and beverages from entering the trachea.

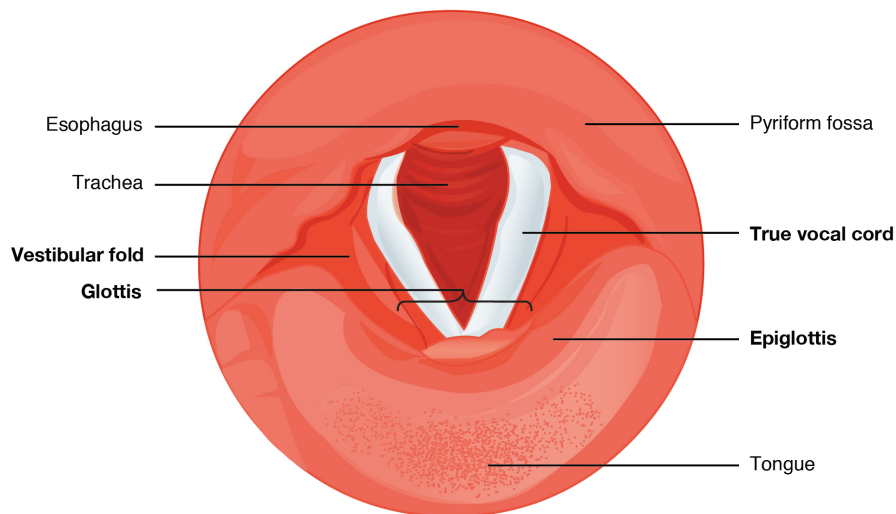


Figure 11.6 Vocal Cords. The true vocal cords and vestibular folds of the larynx are viewed inferiorly from the laryngopharynx. From Betts, et al., 2013. Licensed under [CC BY 4.0](#). [\[Image description.\]](#)

Similar to the nasal cavity and nasopharynx, this specialized epithelium produces mucus to trap debris and pathogens as they enter the trachea. The cilia beat the mucus upward toward the laryngopharynx, where it can be swallowed down the esophagus.

Trachea

The **trachea** is formed by 16 to 20 stacked, C-shaped pieces of hyaline cartilage that are connected by dense connective tissue. The trachealis muscle and elastic connective tissue together form the **fibroelastic membrane**. The fibroelastic membrane allows the trachea to stretch and expand slightly during inhalation and exhalation, whereas the rings of cartilage provide structural support and prevent the trachea from collapsing. The trachealis muscle can be contracted to force air through the trachea during exhalation. The trachea is

lined with pseudostratified ciliated columnar epithelium, which is continuous with the larynx. The esophagus borders the trachea **posteriorly**.

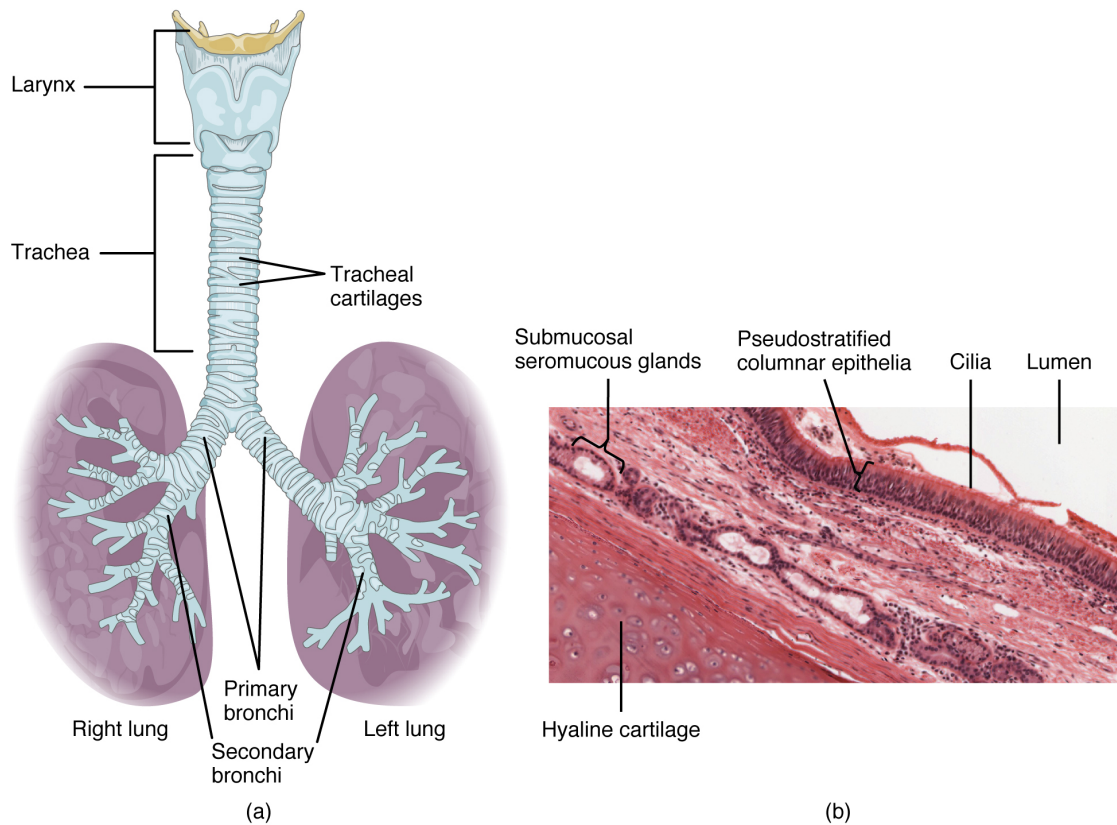


Figure 11.7 Trachea. (a) The tracheal tube is formed by stacked, C-shaped pieces of hyaline cartilage. (b) The layer visible in this cross section of tracheal wall tissue between the hyaline cartilage and the lumen of the trachea is the mucosa, which is composed of pseudostratified ciliated columnar epithelium that contains goblet cells. LM $\times 1220$. (Micrograph provided by the Regents of University of Michigan Medical School \copyright 2012.) From Betts, et al., 2013. Licensed under [CC BY 4.0](#). [\[Image description.\]](#)

Bronchial Tree

The trachea branches into the **right** and **left primary bronchi** at the **carina**. These bronchi are also lined by pseudostratified ciliated columnar epithelium containing mucus-producing goblet cells. The carina is a raised structure that contains specialized nervous tissue that induces violent coughing if a foreign body, such as food, is present. Rings of cartilage, similar to those of the trachea, support the structure of the bronchi and prevent their collapse. The primary bronchi enter the lungs at the **hilum**. The bronchi continue to branch into the **bronchial tree**. Bronchial tree (or respiratory tree) is the collective term used for these multiple-branched bronchi. The main function of the bronchi, like other conducting zone structures, is to provide a passageway for air to move into and out of each lung. The mucous membrane traps debris and pathogens.

A **bronchiole** branches from the tertiary bronchi. Bronchioles, which are about 1 mm in diameter, further branch until they become the tiny **terminal bronchioles**, which lead to the structures of gas exchange. There are more than 1,000 terminal bronchioles in each lung. The muscular walls of the bronchioles do not contain cartilage like those of the bronchi. This muscular wall can change the size of the tubing to increase or decrease airflow through the tube.

Respiratory Zone

In contrast to the conducting zone, the respiratory zone includes structures that are directly involved in gas exchange. The respiratory zone begins where the terminal bronchioles join a **respiratory bronchiole**, the smallest type of bronchiole (see [Figure 11.8](#)), which then leads to an **alveolar duct**, opening into a cluster of alveoli.

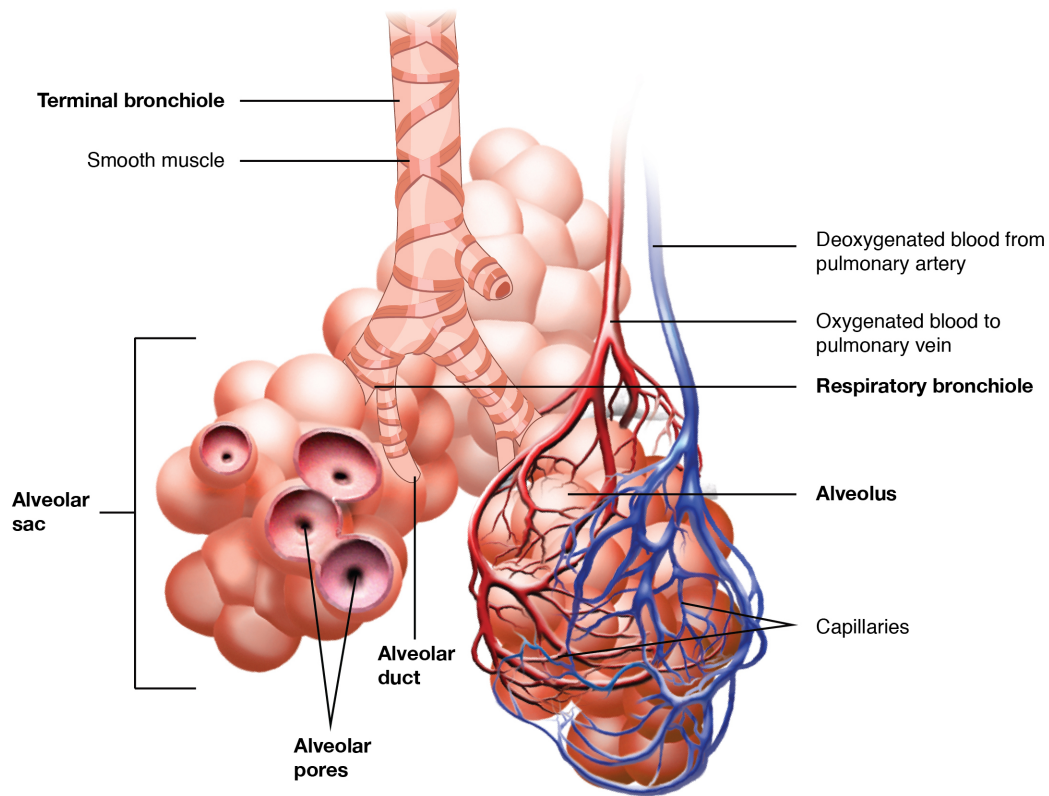


Figure 11.8 Respiratory Zone. Bronchioles lead to alveolar sacs in the respiratory zone, where gas exchange occurs. From Betts, et al., 2013. Licensed under [CC BY 4.0](#). [\[Image description.\]](#)

Alveoli

An **alveolar duct** opens into a cluster of alveoli. An **alveolus** is one of the many small, grapelike sacs that are attached to the alveolar ducts. An alveolar sac is a cluster of many individual alveoli that are responsible for gas exchange. An alveolus is approximately 200 μm in diameter with elastic walls that allow the alveolus to stretch during air intake, which greatly increases the surface area available for gas exchange. Alveoli are connected to their neighbors by alveolar pores, which help maintain equal air pressure throughout the alveoli and lung (see [Figure 11.9](#)).

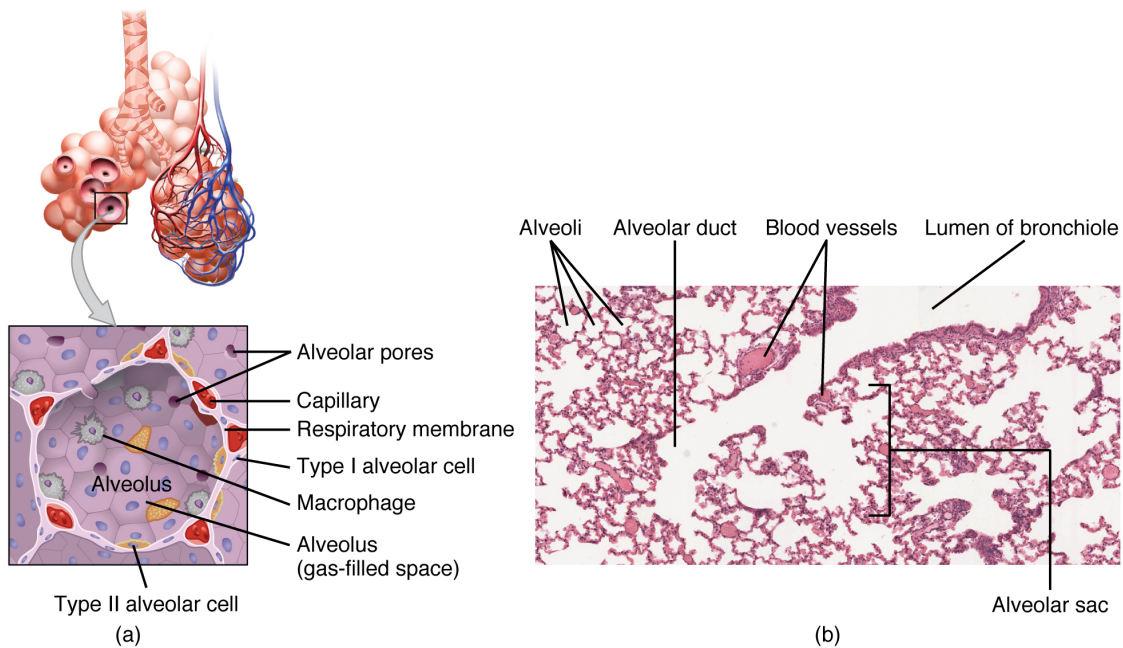


Figure 11.9 Structures of the Respiratory Zone. (a) The alveolus is responsible for gas exchange. (b) A micrograph shows the alveolar structures within lung tissue. LM \times 178. (Micrograph provided by the Regents of University of Michigan Medical School \copyright 2012.) From Betts, et al., 2013. Licensed under [CC BY 4.0](#). [\[Image description.\]](#)

Gross Anatomy of the Lungs

The lungs are pyramid-shaped, paired organs that are connected to the trachea by the right and left bronchi; on the inferior surface, the lungs are bordered by the **diaphragm**. The lungs are enclosed by the **pleurae**, which are attached to the **mediastinum**. The right lung is shorter and wider than the left lung, and the left lung occupies a smaller volume than the right. The **cardiac notch** allows space for the heart (see [Figure 11.10](#)). The apex of the lung is the superior region, whereas the base is the opposite region near the diaphragm. The costal surface of the lung borders the ribs. The mediastinal surface faces the midline.

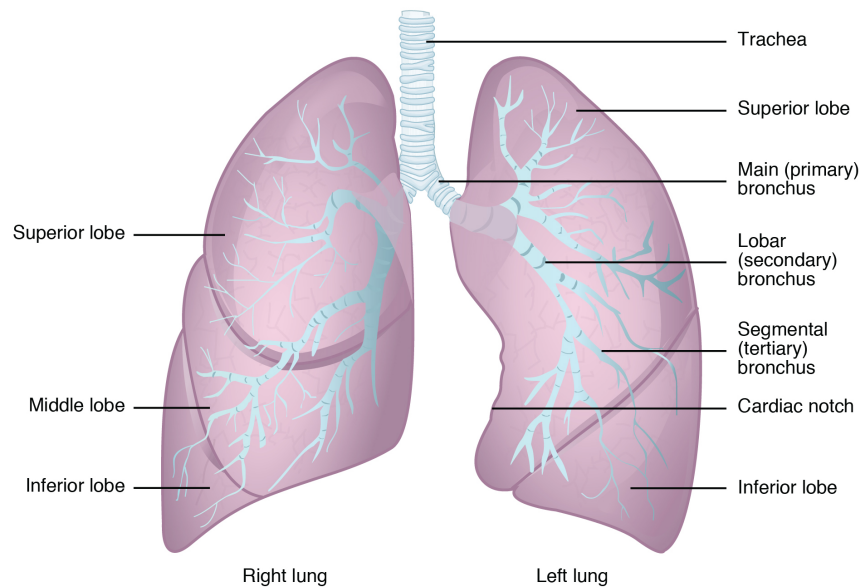


Figure 11.10 Gross Anatomy of the Lungs. From Betts, et al., 2013.
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Each lung is composed of smaller units called **lobes**. **Fissures** separate these lobes from each other. The right lung consists of three lobes: the superior, middle, and inferior lobes. The left lung consists of two lobes: the superior and inferior lobes. A pulmonary lobule is a subdivision formed as the bronchi branch into bronchioles. Each lobule receives its own large bronchiole that has multiple branches. An interlobular septum is a wall, composed of connective tissue, which separates lobules from one another.

Pleura of the Lungs

Each lung is enclosed within a cavity that is surrounded by the pleura. The pleura (plural = pleurae) is a serous membrane that surrounds the lung. The right and left pleurae, which enclose the right and left lungs, respectively, are separated by the mediastinum.

The pleurae consist of two layers:

1. The **visceral pleura** is the layer that is superficial to the lungs and extends into and lines the lung fissures (see [Figure 11.11](#)).
2. The **parietal pleura** is the outer layer that connects to the thoracic wall, the mediastinum, and the diaphragm.

The **visceral** and **parietal pleurae** connect to each other at the **hilum**. The **pleural cavity** is the space between the visceral and parietal layers.

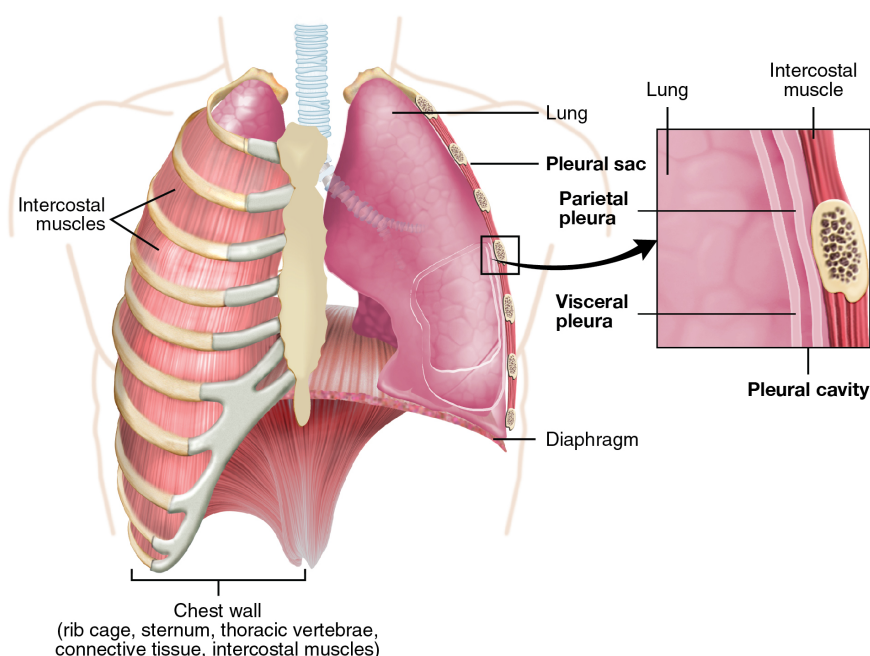


Figure 11.11 Parietal and Visceral Pleurae of the Lungs. From Betts, et al., 2013. Licensed under [CC BY 4.0](#). [\[Image description.\]](#)

The pleurae perform two major functions:

1. The pleurae produce pleural fluid that lubricates surfaces, reduces friction to prevent trauma during breathing, and creates surface tension that helps maintain the position of the lungs against the thoracic wall. This adhesive characteristic of the pleural fluid causes the lungs to enlarge when the thoracic wall expands during ventilation, allowing the lungs to fill with air.
2. The pleurae also create a division between major organs that prevents interference due to the movement of the organs while preventing the spread of infection.

Image Descriptions

Figure 11.1 image description: This figure shows the upper half of the human body. The major organs in the respiratory system are labeled. [\[Return to Figure 11.1\]](#)

Figure 11.2 image description: This figure shows a cross section view of the nose and throat. The major parts are labeled. [\[Return to Figure 11.2\]](#)

Figure 11.3 image description: This figure shows a micrograph of pseudostratified epithelium. [\[Return to Figure 11.3\]](#).

Figure 11.4 image description: This figure shows the side view of the face. The different parts of the pharynx are color-coded and labeled (from the top): nasal cavity, hard palate, soft palate, tongue, epiglottis, larynx, esophagus, trachea. [\[Return to Figure 11.4\]](#).

Figure 11.5 image description: The top panel of this figure shows the anterior view of the larynx, and the bottom panel shows the right lateral view of the larynx. [\[Return to Figure 11.5\]](#).

Figure 11.6 image description: This diagram shows the cross section of the larynx. The different types of cartilages are labeled (clockwise from top): pyriiform fossa, true vocal cord, epiglottis, tongue, glottis, vestibular fold, trachea, esophagus. [\[Return to Figure 11.6\]](#).

Figure 11.7 image description: The top panel of this figure shows the trachea and its organs. The major parts including the larynx, trachea, bronchi, and lungs are labeled. [\[Return to Figure 11.7\]](#).

Figure 11.8 image description: This image shows the bronchioles and alveolar sacs in the lungs and depicts the exchange of oxygenated and deoxygenated blood in the pulmonary blood vessels. [\[Return to Figure 11.8\]](#).

Figure 11.9 image description: This figure shows the detailed structure of the alveolus. The top panel shows the alveolar sacs and the bronchioles. The middle panel shows a magnified view of the alveolus, and the bottom panel shows a micrograph of the cross section of a bronchiole. [\[Return to Figure 11.9\]](#).

Figure 11.10 image description: Diagram of the lungs with the major parts labeled (from top, clockwise): trachea, superior lobe, main bronchus, lobar bronchus, segmental bronchus, inferior lobe, inferior lobe, middle lobe, superior lobe of the left lung. [\[Return to Figure 11.10\]](#).

Figure 11.11 image description: This figure shows the lungs and the chest wall, which protects the lungs, in the left panel. In the right panel, a magnified image shows the pleural cavity and a pleural sac. [\[Return to Figure 11.11\]](#).

WORD PARTS AND STRUCTURAL TERMS

Combining Forms

adenoid/o: adenoid/pharyngeal tonsil

alveol/o: alveolus

atel/o: incomplete

bronchi/o: bronchus

bronch/o: bronchus

capn/o: carbon dioxide

diaphragmat/o: diaphragm

epiglott/o: epiglottis

hem/o: blood

laryng/o: larynx

lob/o: lobe of lung

muc/o: mucus

nas/o: nose

orth/o: straight

ox/i, ox/o: oxygen

pharyng/o: pharynx

phon/o: sound, voice

phren/o: diaphragm

pleur/o: pleura

pneum/o: lung, air

pneumat/o: lung, air

pneumon/o: lung, air

pulmon/o: lung

py/o: pus

rhin/o: nose

sept/o: septum/dividing wall

sinus/o: sinus

spir/o: breathing

thorac/o: thorax, chest

tonsill/o: tonsil

trache/o: trachea

Prefixes

a-/an-: absence of

dys-: painful, abnormal, difficult, labored

endo-: within, inside

eu-: normal, healthy

hemi-: half

pan-: all

poly-: many

sub-: under, below

tachy-: rapid

Suffixes

-al: pertaining to (adjective)

-algia: pain (noun)

-ar, -ary: pertaining to (adjective)

-cele: hernia (noun)

-centesis: surgical puncture to aspirate fluid (noun)

-ectasis: expansion (noun)

-ectomy: excision (noun)

-gram: the record, radiographic image (noun)

-graph: instrument used to record (noun)

-graphy: process of recording (noun)

-ia: condition of, diseased state, abnormal state (noun)

-iasis: condition (noun)

-itis: inflammation (noun)

-logist: specialist or physician who studies and treats (noun)

-logy: study of (noun)

-meter: instrument for measuring (noun)

-metry: process of measuring (noun)

-oma: tumor (noun)

-osis: abnormal condition (noun)

-pathy: disease (noun)

- pexy**: surgical fixation (noun)
- plasty**: surgical repair (noun)
- pnea**: breathing (noun)
- rrhea**: flow, discharge (noun)
- scope**: instrument used for visualization (noun)
- scopy**: process of viewing, visualization (noun)
- spasm**: involuntary muscular contraction (noun)
- stomy**: creation of an artificial opening (noun)

Structural Terms Built from Word Parts

- adenoidal**: pertaining to the adenoid/pharyngeal tonsil
- alveolar**: pertaining to one or more alveoli
- bronchial**: pertaining to one or more bronchi
- bronchoalveolar**: pertaining to the bronchi and alveoli
- cardiopulmonary**: pertaining to the heart and lungs
- diaphragmatic**: pertaining to the diaphragm
- endotracheal**: pertaining to within the trachea:
- interpleural**: pertaining to between the pleura (space between the pleural membranes)
- laryngeal**: pertaining to the larynx
- lobar**: pertaining to a lobe of a lung
- mediastinal**: pertaining to the mediastinum
- mucous**: pertaining to mucus
- pharyngeal**: pertaining to the pharynx
- phrenic**: pertaining to the diaphragm
- pleural**: pertaining to the pleura
- pulmonary**: pertaining to one or both lungs
- respiratory**: pertaining to the act of breathing
- thoracic**: pertaining to the chest
- tonsillar**: pertaining to one or more tonsils
- tracheal**: pertaining to the trachea

DISEASES AND DISORDERS

Disease and Disorder Terms Built from Word Parts

acapnia: lack of carbon dioxide

adenoiditis: inflammation of the adenoid/pharyngeal tonsil

anoxia: lack of oxygen

aphonia: lack of voice

apnea: lack of breathing

atelectasis: incomplete expansion (for example, of an airway)

bronchiectasis: dilation of bronchi

bronchitis: inflammation of bronchi

bronchiolitis: inflammation of bronchioles

bronchogenic carcinoma: cancerous tumor originating in a bronchus (lung cancer)

bronchopneumonia: disease of bronchi and lungs

bronchospasm: spasmodic contraction of the bronchi

diaphragmatocele: herniation of diaphragm

dysphonia: condition of difficult speaking

dyspnea: painful or labored breathing

epiglottitis: inflammation of epiglottis

eupnea: normal breathing

hemothorax: blood in the pleural space / thoracic cavity

hypercapnia: excessive carbon dioxide in the body

hyperpnea: forced breathing or breathing that is excessive

hypopnea: deficient breathing

hypoxemia: deficient oxygen in the blood

hypoxia: condition of deficient oxygen in the tissues

laryngitis: inflammation of the larynx

laryngospasm: spasmodic contraction of the larynx

lobar pneumonia: disease of one lobe of a lung

nasopharyngitis: inflammation of the nose and pharynx

orthopnea: being able to breathe more easily while sitting up straight

pharyngitis: inflammation of the pharynx

phrenalgia: pain in the diaphragm

phrenospasm: spasmodic contraction of the diaphragm

pleuritis: inflammation of pleura (formerly known as **pleurisy**)

pneumoconiosis: abnormal condition of dust in the lungs

pneumonia: disease involving the lung (typically used to indicate a lower respiratory tract infection)

pneumonitis: inflammation of the lung

pneumothorax: air in the thoracic cavity; can lead to lung collapse

pyothorax: pus in the thoracic cavity

rhinitis: inflammation of the nose

rhinomycosis: abnormal condition of fungus in the nose

rhinorrhagia: rapid flow of blood from the nose

rhinorrhea: discharge from the nose

sinusitis: inflammation of one or more sinuses

tachypnea: rapid breathing

thoracalgia: pain in the thoracic cavity

tonsillitis: inflammation of one or more tonsils

tracheitis: inflammation of the trachea

tracheostenosis: narrowing of the trachea

Disease and Disorder Terms Not Built from Word Parts

acute respiratory distress syndrome: a type of respiratory failure characterized by rapid onset of widespread inflammation in the lungs; symptoms include shortness of breath, rapid breathing, and cyanosis

asphyxia: inability to breathe

asthma: a chronic inflammatory disease of the airways of the lungs characterized by reversible airflow obstruction and easily triggered bronchospasms

chronic obstructive pulmonary disease: a chronic lung condition, a combination of emphysema and chronic bronchitis

coccidioidomycosis: an infection caused by *Coccidioides* fungus, which lives in the soil of dry, low-rainfall areas

crackles: clicking, rattling, or crackling noises that may be made by lungs of a human with a respiratory disease during inhalation

croup: an infection of the upper airway that obstructs breathing and causes a characteristic barking cough

cystic fibrosis: genetic disorder that affects mostly the lungs but also the pancreas, liver, kidneys, and intestine; can lead to difficulty breathing and coughing up mucus as a result of frequent lung infections

deviated septum: a displacement of the nasal septum

emphysema: a lung condition that causes shortness of breath due to damaged alveoli

epistaxis: nosebleed

hyperventilation: breathing too quickly or too much

hypoventilation: breathing too slowly or not enough

influenza: an upper respiratory tract infection with influenza virus

lower respiratory infection: an infection of the trachea, bronchi, bronchioles, and/or alveoli

lung cancer: malignant cancer originating within lung tissue

obstructive sleep apnea: a sleep disorder in which pauses in breathing or periods of shallow breathing during sleep occur more often than normal

pertussis: an upper respiratory tract infection with *Bordetella pertussis* bacteria

pleural effusion: accumulation of excessive fluid in the pleural space

pulmonary embolism: an embolism (a free-moving blood clot, air bubble, atherosclerotic plaque, etc.) within a blood vessel of a lung

pulmonary edema: edema (fluid accumulation) within one or both lungs

sputum: mucus originating in the lower respiratory tract

tuberculosis: a lower respiratory tract infection with *Mycobacterium tuberculosis* bacteria

upper respiratory infection: an infection of the nose, pharynx, and/or larynx

MEDICAL, SURGICAL, & VIEWING TERMS AND ABBREVIATIONS

Medical Specialties Related to the Respiratory System

pulmonologist: physician who specializes in pulmonology

pulmonology: medical specialty that deals with diseases involving the respiratory tract

respiratory therapist: a medical specialist who cares for patients who have breathing disorders

thoracic surgeon: a surgeon who has specialized in either thoracic surgery or cardiothoracic surgery

Imaging Techniques / Diagnostic Procedures for the Organ System

acid-fast bacilli smear: a microscope slide containing a sputum sample, stained to detect *Mycobacterium tuberculosis* bacteria

arterial blood gas analysis: a blood test that measures the pH and the levels of oxygen and carbon dioxide within an artery

bronchoscope: device used to view inside of the bronchi

bronchoscopy: procedure used to view inside of the bronchi

capnometer: instrument used to measure

laryngoscope: device used to view inside of the larynx

laryngoscopy: procedure used to view inside of the larynx

oximeter: instrument used to measure oxygen

pulmonary function tests: noninvasive tests that measure lung volume, capacity, rates of flow, and gas exchange within the lungs

spirometer: instrument used to measure lung capacity

spirometry: procedure to determine lung capacity

thoracoscope: device used to view inside of the thoracic cavity

thoracoscopy: procedure used to view inside of the thoracic cavity

Medical and Surgical Techniques/Procedures Used for the Organ System

- adenoidectomy:** surgical excision of the adenoid/pharyngeal tonsil
- aspirate:** to suction out a substance, such as from the airways
- bronchoconstrictor:** substance that constricts the bronchi and bronchioles
- bronchodilator:** substance that dilates the bronchi and bronchioles
- bronchoplasty:** surgical repair of a bronchus
- laryngectomy:** surgical excision of all or part of the larynx
- laryngoplasty:** surgical repair of the larynx
- laryngostomy:** artificial opening into the larynx
- laryngotracheotomy:** incision into the larynx and trachea
- lobectomy:** surgical removal of a lobe of a lung
- nebulizer:** device used to administer medication in the form of a mist inhaled into the lungs
- pneumonectomy:** surgical removal of a lung
- rhinoplasty:** surgical repair of the nose
- septoplasty:** surgical repair of the (nasal) septum
- septotomy:** incision into the (nasal) septum
- thoracocentesis:** aspiration of fluid from the thoracic cavity
- thoracotomy:** incision into the chest cavity
- tracheoplasty:** surgical repair of the trachea
- tracheostomy:** artificial opening into the trachea
- tracheotomy:** incision into the trachea
- ventilator:** machine that provides mechanical ventilation by moving air into and out of the lungs of a patient who is unable to breathe unassisted

Abbreviations Commonly Used with the Respiratory System

- ABGs:** arterial blood gases
- AFB:** acid-fast bacilli
- ARDS:** acute respiratory distress syndrome
- BiPAP:** bilevel positive airway pressure
- C&S:** culture and sensitivity
- CAP:** community-acquired pneumonia

CF: cystic fibrosis
CO₂: carbon dioxide
COPD: chronic obstructive pulmonary disease
CPAP: continuous positive airway pressure
CPT: chest physiotherapy
CT: computed tomography, computerized tomography
CXR: chest x-ray
DPI: dry powder inhaler
flu: influenza
IPPB: intermittent positive-pressure breathing
IPF: idiopathic pulmonary fibrosis
LLL: left lower lobe
LTB: laryngotracheobronchitis
LUL: left upper lobe
MDI: metered-dose inhaler
NIPPV: noninvasive positive-pressure ventilator
O₂: oxygen
OSA: obstructive sleep apnea
PE: pulmonary embolism
PEP: positive expiratory pressure
PFM: peak flow meter
PFTs: pulmonary function tests
RLL: right lower lobe
RML: right middle lobe
RUL: right upper lobe
SOB: shortness of breath
SVN: small-volume nebulizer
TB: tuberculosis
URI: upper respiratory infection
VAP: ventilator-associated pneumonia

Medical Terms Practice

For each card, click the speaker icon to hear the correct pronunciation of the listed term. Practice saying the term to yourself, then attempt to define the term from memory. Click “Turn” to flip the card and see the definition. Use the right and left arrows to toggle through the cards in each set.



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<https://louis.pressbooks.pub/medicalterminology/?p=1716#h5p-16>

PRACTICE

The following activities will help you practice what you learned in this chapter.

Respiratory System Anatomy Labeling Activity

Click and drag each term to the box corresponding with the anatomic structure, body part, body plane, or body region for that term.



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Vocabulary Reinforcement Activity

Click the term that correctly answers each question or completes each sentence.



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PART XII

DIGESTIVE SYSTEM

Learning Objectives

When completing this chapter, the learner will be able to do the following:

- Identify the anatomy of the digestive system
- Describe the main functions of the digestive system
- Spell the medical terms of the digestive system and use correct abbreviations
- Pronounce the medical terms of the digestive system and use correct abbreviations
- Identify the medical specialties associated with the digestive system
- Explore common diseases, disorders, and procedures related to the digestive system

Introduction

The digestive system is continually at work, yet people seldom appreciate the complex tasks it performs in a choreographed biologic symphony. Consider what happens when you eat an apple. Of course, you enjoy the apple's taste as you chew it, but in the hours that follow, unless something goes amiss and you get a stomachache, you don't notice that your digestive system is working. You may be taking a walk or studying or sleeping, having forgotten all about the apple, but your stomach and intestines are busy digesting it and absorbing its vitamins and other nutrients. By the time any waste material is excreted, the body has appropriated all it can use from the apple. In short, whether you pay attention or not, the organs of the digestive system perform their specific functions, allowing you to use the food you eat to keep you going.

This chapter examines the structure and functions of these organs and explores the mechanics and chemistry of the digestive processes. The function of the digestive system is to break down the foods you eat, release their nutrients, and absorb those nutrients into the body. Although the small intestine is the workhorse

of the system, where the majority of digestion occurs and where most of the released nutrients are absorbed into the blood or lymph, each of the digestive system organs makes a vital contribution to this process.

Watch this video:



One or more interactive elements has been excluded from this version of the text. You can view them online here: <https://louis.pressbooks.pub/medicalterminology/?p=1418#oembed-1>

Media 12.1 [Digestive System, Part 1: Crash Course A&P #33](#). Copyright 2015 by [CrashCourse](#).

ANATOMY OF THE DIGESTIVE SYSTEM

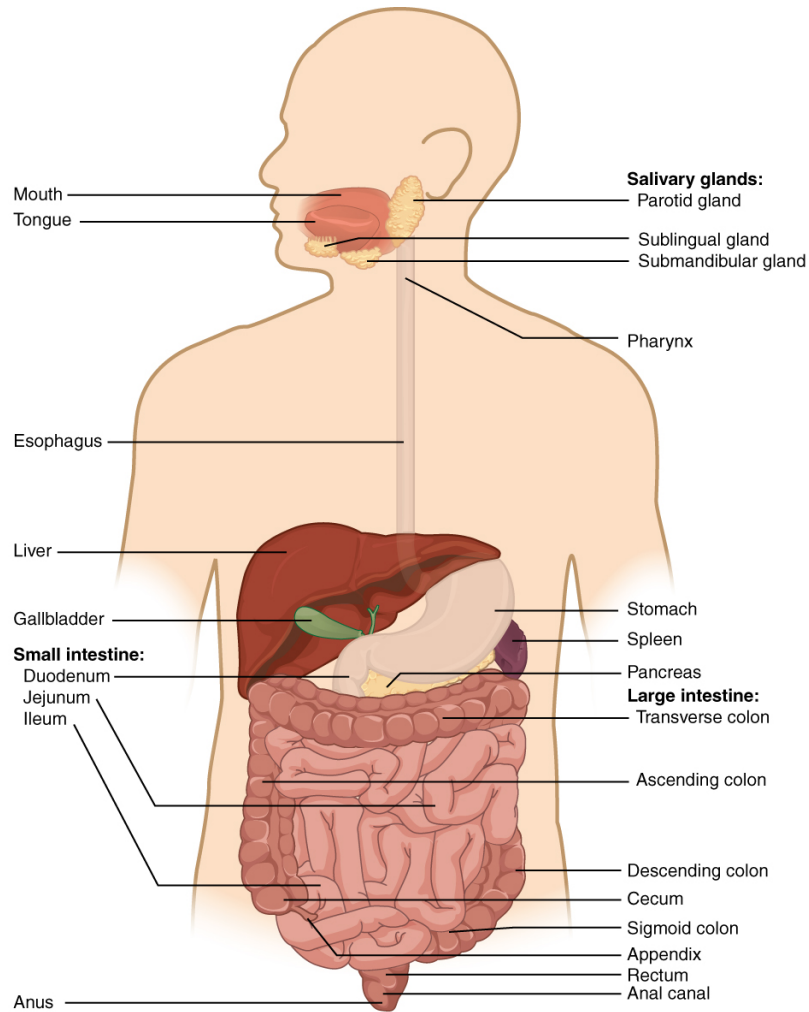


Figure 12.1 Components of the Digestive System. All digestive organs play integral roles in the life-sustaining process of digestion. From Betts, et al., 2013. Licensed under [CC BY 4.0](#). [\[Image description.\]](#)

The Mouth

The cheeks, tongue, and palate frame the mouth, which is also called the **oral cavity** (or buccal cavity). The structures of the mouth are illustrated in [Figure 12.2](#).

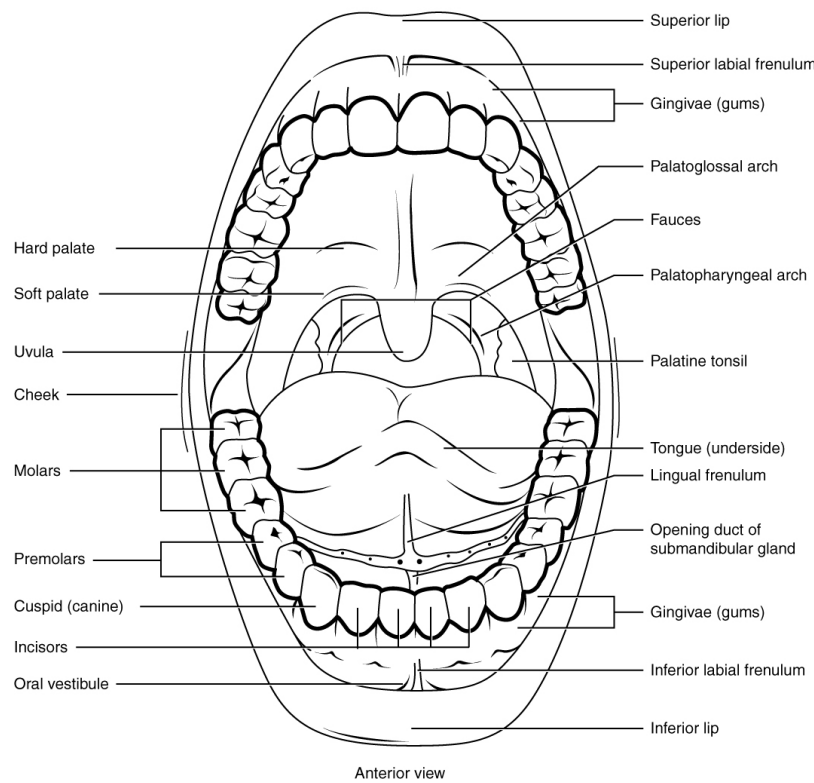


Figure 12.2 Mouth. The mouth includes the lips, tongue, palate, gums, and teeth. From Betts, et al., 2013. Licensed under [CC BY 4.0](#). [Image description.]

When you are chewing, you do not find it difficult to breathe simultaneously. The next time you have food in your mouth, notice how the arched shape of the roof of your mouth allows you to handle both digestion and respiration at the same time. This arch is called the **palate**. The anterior region of the palate serves as a wall (or septum) between the oral and nasal cavities as well as a rigid shelf against which the tongue can push food. It is created by the maxillary and palatine bones of the skull and, given its bony structure, is known as the **hard palate**. If you run your tongue along the roof of your mouth, you'll notice that the hard palate ends in the posterior oral cavity, and the tissue becomes fleshier. This part of the palate, known as the **soft palate**, is composed mainly of skeletal muscle. You can therefore manipulate, subconsciously, the soft palate—for instance, to yawn, swallow, or sing (see [Figure 12.2](#)).

A fleshy bead of tissue called the **uvula** drops down from the center of the posterior edge of the soft palate. Although some have suggested that the uvula is a vestigial organ, it serves an important purpose. When you swallow, the soft palate and uvula move upward, helping to keep foods and liquid from entering the **nasal cavity**. Unfortunately, it can also contribute to the sound produced by snoring.

Tongue

Perhaps you have heard it said that the tongue is the strongest muscle in the body. Although it is difficult to quantify the relative strength of different muscles, it remains indisputable that the tongue is a workhorse, facilitating ingestion, mechanical digestion, chemical digestion (lingual lipase), sensation (of taste, texture, and temperature of food), swallowing, and vocalization.

Salivary Glands

Many small **salivary glands** are housed within the mucous membranes of the mouth and tongue. These minor **exocrine** glands are constantly secreting saliva, either directly into the oral cavity or indirectly through ducts, even while you sleep. In fact, an average of 1 to 1.5 liters of saliva is secreted each day. Usually just enough saliva is present to moisten the mouth and teeth. Secretion increases when you eat, because saliva is essential to moisten food and initiate the chemical breakdown of **carbohydrates**.

Pharynx

The **pharynx** (throat) is involved in both digestion and respiration. It receives food and air from the mouth and air from the nasal cavities. When food enters the pharynx, involuntary muscle contractions close off the air passageways. A short tube of skeletal muscle lined with a mucous membrane, the pharynx runs from the posterior oral and nasal cavities to the opening of the esophagus and larynx. It has three subdivisions. The most superior, the **nasopharynx**, is involved only in breathing and speech. The other two subdivisions, the **oropharynx** and the **laryngopharynx**, are used for both breathing and digestion. The oropharynx begins inferior to the nasopharynx and is continuous below with the laryngopharynx. The inferior border of the laryngopharynx connects to the esophagus, whereas the anterior portion connects to the larynx, allowing air to flow into the bronchial tree.

Esophagus

The **esophagus** is a muscular tube that connects the pharynx to the stomach. It is approximately 25.4 cm (10 in) in length, located posterior to the trachea, and remains in a collapsed form when not engaged in swallowing. As you can see in [Figure 12.3](#), the esophagus runs a mainly straight route through the mediastinum of the thorax. To enter the abdomen, the esophagus penetrates the diaphragm through an opening called the esophageal hiatus.

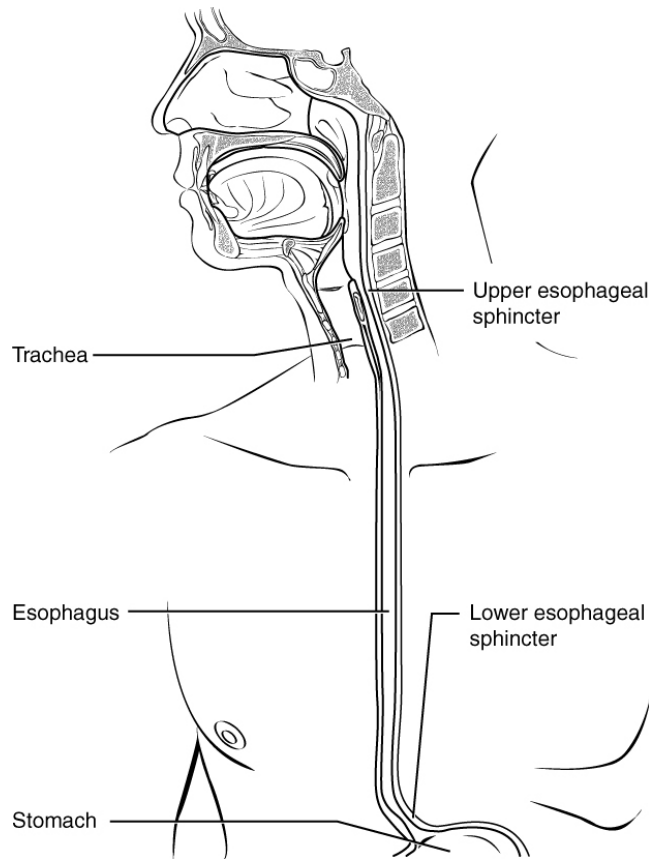


Figure 12.3 Esophagus. The upper esophageal sphincter controls the movement of food from the pharynx to the esophagus. The lower esophageal sphincter controls the movement of food from the esophagus to the stomach. From Betts, et al., 2013. Licensed under [CC BY 4.0](#). [\[Image description.\]](#)

Stomach

There are four main regions in the **stomach**: the **cardia**, **fundus**, **body**, and **pylorus** (see [Figure 12.4](#)). The cardia (or cardiac region) is the point where the esophagus connects to the stomach and through which food passes into the stomach. Located inferior to the diaphragm, above and to the left of the cardia, is the dome-shaped fundus. Below the fundus is the body, the main part of the stomach. The funnel-shaped pylorus connects the stomach to the duodenum. The wider end of the funnel, the **pyloric antrum**, connects to the body of the stomach. The narrower end is called the **pyloric canal**, which connects to the duodenum. The smooth muscle **pyloric sphincter** is located at this latter point of connection and controls stomach emptying.

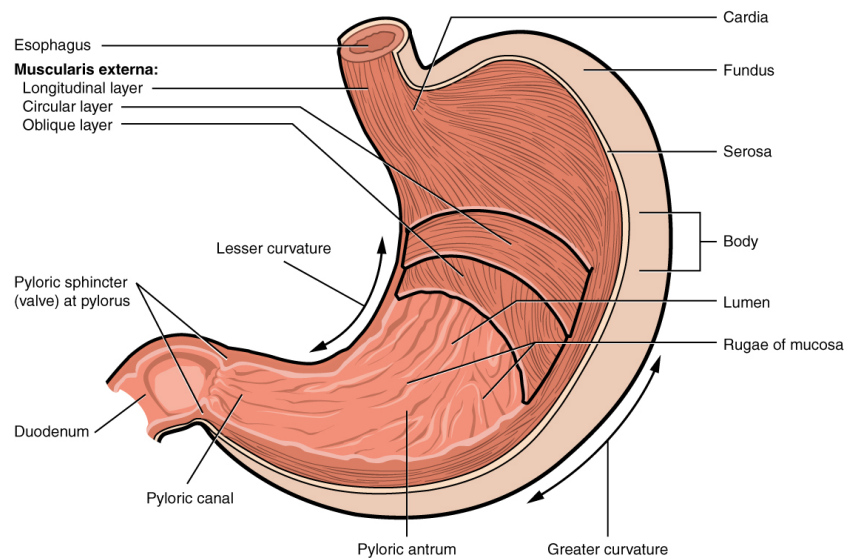


Figure 12.4 Stomach. The stomach has four major regions: the cardia, fundus, body, and pylorus. The addition of an inner oblique smooth muscle layer gives the muscularis the ability to vigorously churn and mix food. From Betts, et al., 2013. Licensed under [CC BY 4.0](#). [\[Image description.\]](#)

Small Intestine

Chyme released from the stomach enters the **small intestine**, which is the primary digestive organ in the body. Not only is this where most digestion occurs, but it is also where practically all absorption occurs. The longest part of the alimentary canal, the small intestine is about 3.05 meters (10 feet) long in a living person (but about twice as long in a cadaver due to the loss of muscle tone). Since this makes it about five times longer than the large intestine, you might wonder why it is called “small.” In fact, its name derives from its relatively smaller diameter of only about 2.54 cm (1 in), compared with 7.62 cm (3 in) for the large intestine. As we’ll see shortly, in addition to its length, the folds and projections of the lining of the small intestine work to give it an enormous surface area, which is approximately 200 m^2 , more than 100 times the surface area of your skin. This large surface area is necessary for complex processes of digestion and absorption that occur within it.

The coiled tube of the small intestine is subdivided into three regions. From proximal (at the stomach) to distal, these are the **duodenum**, **jejunum**, and **ileum** (see [Figure 12.5](#)).

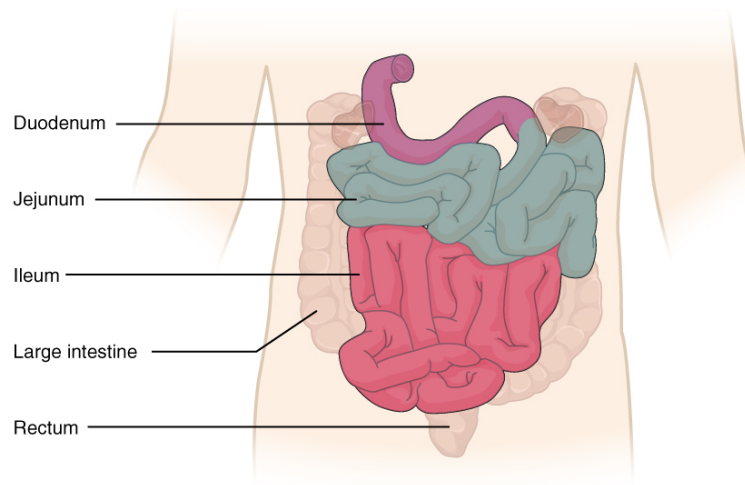


Figure 12.5 Small Intestine. The three regions of the small intestine are the duodenum, jejunum, and ileum. From Betts, et al., 2013. Licensed under [CC BY 4.0](#). [\[Image description.\]](#)

Large Intestine

The **large intestine** is the terminal part of the alimentary canal. The primary function of this organ is to finish absorption of nutrients and water, synthesize certain vitamins, form feces, and eliminate feces from the body.

The large intestine runs from the appendix to the anus. It frames the small intestine on three sides. Despite its being about one-half as long as the small intestine, it is called large because it is more than twice the diameter of the small intestine, about 3 inches.

The large intestine is subdivided into four main regions: the **cecum**, the **colon**, the **rectum**, and the **anus**. The **ileocecal valve**, located at the opening between the ileum and the large intestine, controls the flow of chyme from the small intestine to the large intestine (see [Figure 12.6](#)).

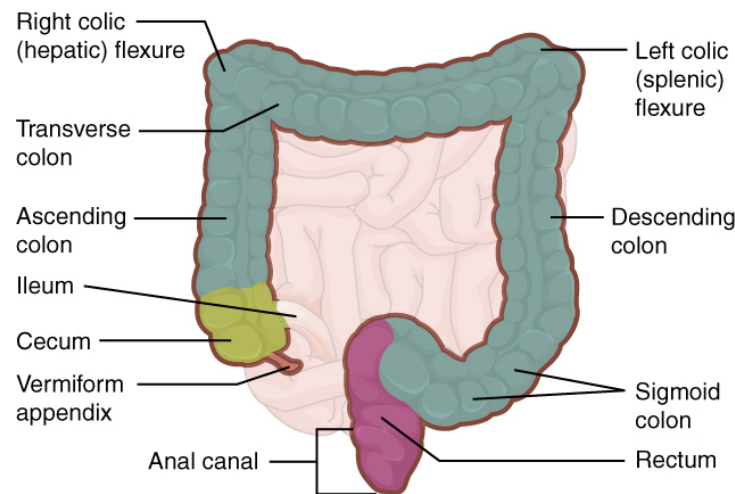


Figure 12.6 Large Intestine. The large intestine includes the cecum, colon, and rectum. From Betts, et al., 2013. Licensed under [CC BY 4.0](#). [\[Image description.\]](#)

Accessory Organs of Digestion

Chemical digestion in the small intestine relies on the activities of three accessory digestive organs: the **liver**, **pancreas**, and **gallbladder**. The digestive role of the liver is to produce bile and export it to the duodenum. The gallbladder primarily stores, concentrates, and releases bile. The pancreas produces pancreatic juice, which contains digestive enzymes and bicarbonate ions, and delivers it to the duodenum.

Liver

The liver is the largest gland in the body, weighing about three pounds in an adult. It is also one of the most important organs. In addition to being an accessory digestive organ, it plays a number of roles in metabolism and regulation. The liver lies inferior to the diaphragm in the right upper quadrant of the abdominal cavity and receives protection from the surrounding ribs. The liver is divided into two primary lobes: a large right lobe and a much smaller left lobe.

The porta hepatis (“gate to the liver”) is where the hepatic artery and hepatic portal vein enter the liver. These two vessels, along with the common hepatic duct, run behind the lateral border of the lesser omentum on the way to their destinations. The hepatic portal vein delivers partially deoxygenated blood containing nutrients absorbed from the small intestine and actually supplies more oxygen to the liver than do the much smaller hepatic arteries. In addition to nutrients, drugs and toxins are also absorbed. After processing the blood-borne nutrients and toxins, the liver releases nutrients needed by other cells back into the blood, which drains into the central vein and then through the hepatic vein to the inferior vena cava. With this hepatic portal

circulation, all blood from the alimentary canal passes through the liver. This largely explains why the liver is the most common site for the metastasis of cancers that originate in the alimentary canal.

Bile produced by the liver is a mixture secreted by the liver to accomplish the **emulsification** of lipids in the small intestine.

Between meals, bile is produced but conserved. The valve-like hepatopancreatic ampulla closes, allowing bile to divert to the gallbladder, where it is concentrated and stored until the next meal.

Gallbladder

The gallbladder is 8–10 cm (~3–4 in) long and is nested in a shallow area on the posterior aspect of the right lobe of the liver. This muscular sac stores, concentrates, and, when stimulated, propels the bile into the duodenum via the **common bile duct**. The **cystic duct** is 1–2 cm (less than 1 in) long and turns inferiorly as it bridges the neck and **hepatic duct**.

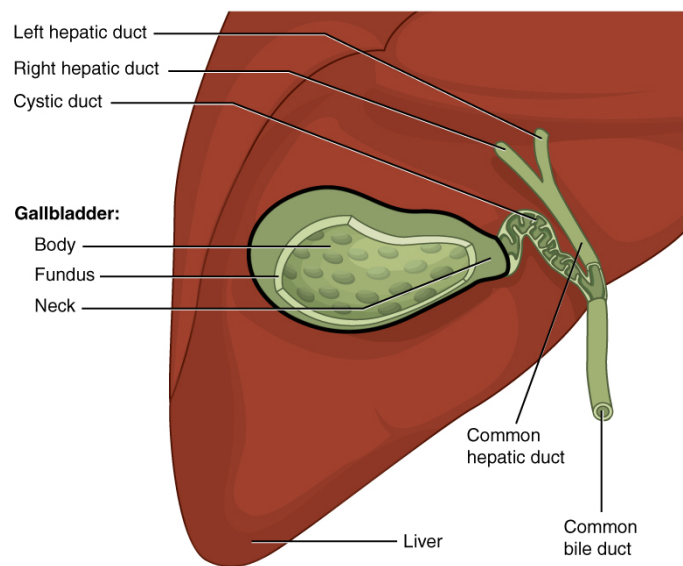


Figure 12.7 Gallbladder. The gallbladder stores and concentrates bile and releases it into the two-way cystic duct when it is needed by the small intestine. From Betts, et al., 2013. Licensed under [CC BY 4.0](#). [\[Image description.\]](#)

Pancreas

The soft, oblong, glandular pancreas lies transversely in the retroperitoneum behind the stomach. It has a mix of **exocrine** (secreting digestive enzymes) and **endocrine** (releasing hormones into the blood) functions ([Figure 12.8](#)).

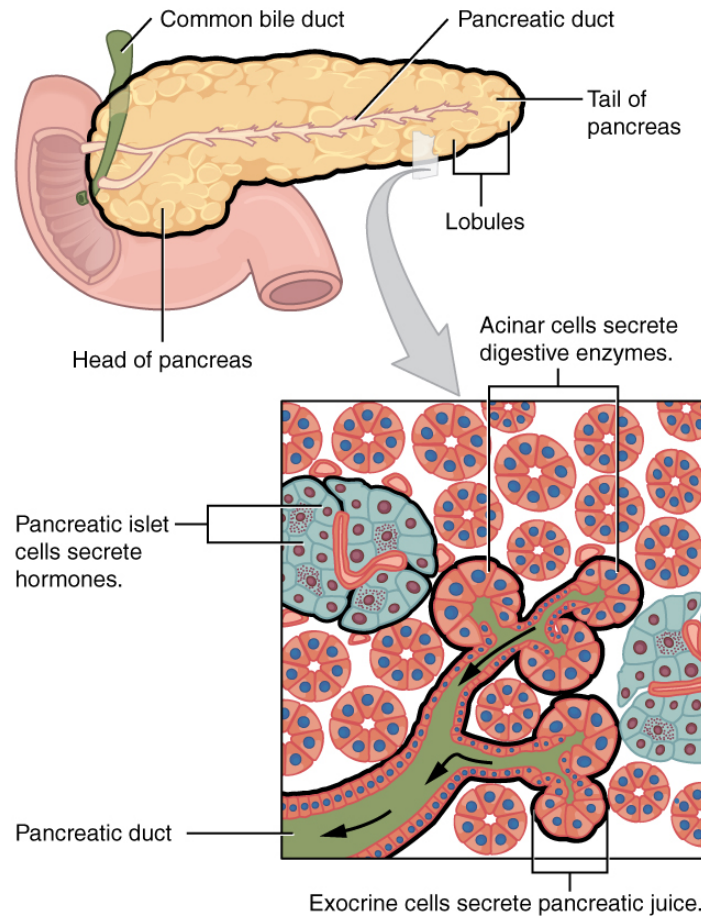


Figure 12.8 Exocrine and Endocrine Pancreas. The pancreas has a head, a body, and a tail. It delivers pancreatic juice to the duodenum through the pancreatic duct. From Betts, et al., 2013. Licensed under [CC BY 4.0](#). [\[Image description.\]](#)

The exocrine part of the pancreas arises as little grapelike cell clusters, each called an acinus (plural = acini), located at the terminal ends of pancreatic ducts. These acinar cells secrete enzyme-rich pancreatic juice into tiny merging ducts that form two dominant ducts. The larger duct fuses with the **common bile duct** (carrying bile from the liver and gallbladder) just before entering the duodenum via a common opening (the **hepatopancreatic ampulla**). The smooth muscle sphincter of the hepatopancreatic ampulla controls the release of pancreatic juice and bile into the small intestine. The second and smaller pancreatic duct, the **accessory duct (duct of Santorini)**, runs from the pancreas directly into the duodenum, approximately 1 inch above the hepatopancreatic ampulla.

Scattered through the sea of exocrine acini are small islands of endocrine cells, the **islets of Langerhans**. These vital cells produce the hormones pancreatic polypeptide, insulin, glucagon, and somatostatin.

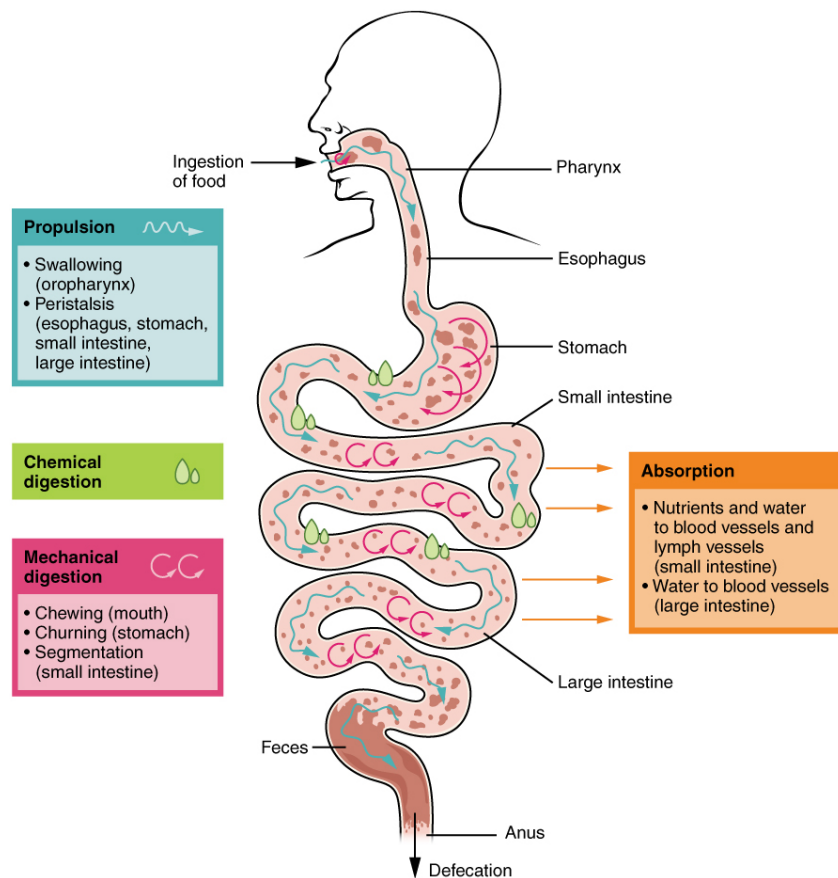


Figure 12.9 Digestive Processes. The digestive processes are ingestion, propulsion, mechanical digestion, chemical digestion, absorption, and defecation. From Betts, et al., 2013. Licensed under CC BY 4.0. [\[Image description.\]](#)

Image Descriptions

Figure 12.1 image description: This diagram shows the digestive system of a human being, with the major organs labeled. Labels read (clockwise, from top): salivary glands: parotid gland, sublingual gland, submandibular gland; pharynx, stomach, spleen, pancreas, large intestine: transverse colon, ascending colon, descending colon, cecum, sigmoid colon, appendix, rectum, anal canal, anus; small intestine: duodenum, jejunum, ileum, gallbladder, liver, esophagus, tongue, mouth. [\[Return to Figure 12.1\].](#)

Figure 12.2 image description: This diagram shows an anterior view of the structure of the mouth. The teeth, lips, tongue, gums, and many other parts are labeled. Labels read (clockwise from top): superior lip, superior labial frenulum, gingivae, palatoglossal arch, fauces, palatopharyngeal arch, palatine tonsil, tongue, lingual frenulum, opening duct of submandibular gland, gingivae, inferior labial frenulum, inferior lip, oral vestibule, incisors, cuspid, premolars, molars, cheek, uvula, soft palate, hard palate. [\[Return to Figure 12.2\].](#)

Figure 12.3 image description: This diagram shows the esophagus, going from the mouth to the stomach.

The upper and the lower esophageal sphincter are labeled. Labels read (from top): upper esophageal sphincter, trachea, esophagus, lower esophageal sphincter, stomach. [\[Return to Figure 12.3\].](#)

Figure 12.4 image description: This image shows a cross section of the stomach, and the major parts: the cardia, fundus, body, and pylorus are labeled. Labels read (from top of stomach): esophagus, muscular externa (longitudinal layer, circular layer, oblique layer), cardia, fundus, serosa, lesser and greater curvatures, lumen, rugae of mucosa, pyloric antrum, pyloric canal, pyloric sphincter valve at pylorus, duodenum. [\[Return to Figure 12.4\].](#)

Figure 12.5 image description: This diagram shows the small intestine. The different parts of the small intestine are labeled. Labels read (from top of small intestine): duodenum, jejunum, ileum, large intestine, rectum. [\[Return to Figure 12.5\].](#)

Figure 12.6 image description: This image shows the large intestine; the major parts of the large intestine are labeled. Labels read (from start of large intestinal tract): vermiform complex, cecum, ileum, ascending colon, transverse colon, right colic hepatic flexure, left colic splenic flexure, descending colon, sigmoid colon, rectum, anal canal. [\[Return to Figure 12.6\].](#)

Figure 12.7 image description: This diagram shows the accessory organs of the digestive system. The liver, spleen, pancreas, gallbladder, and their major parts are shown. Labels read: liver (right lobe, quadrate lobe, left lobe, caudate lobe), spleen, pancreas, pancreatic duct, gallbladder right hepatic duct, cystic duct, common hepatic duct, common bile duct, left hepatic duct. [\[Return to Figure 12.7\].](#)

Figure 12.8 image description: This figure shows the gallbladder and its major parts are labeled. Labels read (starting in gallbladder): body, fundus, neck, cystic duct, common hepatic duct, common bile duct, left and right hepatic ducts, liver. [\[Return to Figure 12.8\].](#)

Figure 12.9 image description: This image shows the different processes involved in digestion. The image shows how food travels from the mouth through the major organs. Associated textboxes list the various digestive processes: Absorption (nutrients and water to blood vessels and lymph vessels (small intestine), water to blood vessels (large intestine)), propulsion (swallowing (oropharynx), peristalsis (esophagus, stomach, small intestine, large intestine)), chemical digestion, mechanical digestion (chewing (mouth), churning (stomach), segmentation (small intestine)). Parts of the digestive tract are labeled: ingestion of food, pharynx, esophagus, stomach, small intestine, large intestine, feces, anus, defecation. [\[Return to Figure 12.9\].](#)

PHYSIOLOGY OF THE DIGESTIVE SYSTEM

Physiology (Function) of the Digestive System

The main functions of the digestive system are:

- Ingesting food
- Digesting food
- Absorbing nutrients
- Elimination of waste products

Digestive Processes

The processes of digestion include six activities: ingestion, propulsion, mechanical or physical digestion, chemical digestion, absorption, and defecation.

The first of these processes, ingestion, refers to the entry of food into the alimentary canal through the mouth. There, the food is chewed and mixed with saliva, which contains enzymes that begin breaking down the carbohydrates in the food plus some lipid digestion via lingual lipase. Chewing increases the surface area of the food and allows an appropriately sized **bolus** to be produced.

Food leaves the mouth when the tongue and pharyngeal muscles propel it into the esophagus. This act of swallowing, the last voluntary act until defecation, is an example of propulsion, which refers to the movement of food through the digestive tract. It includes both the voluntary process of swallowing and the involuntary process of peristalsis. Peristalsis consists of sequential, alternating waves of contraction and relaxation of alimentary wall smooth muscles, which act to propel food along. These waves also play a role in mixing food with digestive juices. Peristalsis is so powerful that foods and liquids you swallow enter your stomach even if you are standing on your head.

Digestion includes both mechanical and chemical processes. **Mechanical digestion** is a purely physical process that does not change the chemical nature of the food. Instead, it makes the food smaller to increase both surface area and mobility. It includes mastication, or chewing, as well as tongue movements that help break food into smaller bits and mix food with saliva. The mechanical churning of food in the stomach serves to further break it apart and expose more of its surface area to digestive juices, creating an acidic “soup” called **chyme**. Segmentation, which occurs mainly in the small intestine, consists of localized contractions of circular muscle of the muscularis layer of the alimentary canal. These contractions isolate small sections of the intestine,

moving their contents back and forth while continuously subdividing, breaking up, and mixing the contents. By moving food back and forth in the intestinal lumen, segmentation mixes food with digestive juices and facilitates absorption.

In **chemical digestion**, starting in the mouth, digestive secretions break down complex food molecules into their chemical building blocks (for example, proteins into separate amino acids). These secretions vary in composition but typically contain water, various enzymes, acids, and salts. The process is completed in the small intestine.

Food that has been broken down is of no value to the body unless it enters the bloodstream and its nutrients are put to work. This occurs through the process of **absorption**, which takes place primarily within the small intestine. There, most nutrients are absorbed from the lumen of the alimentary canal into the bloodstream through the epithelial cells that make up the mucosa. Lipids are absorbed into **lacteals** and are transported via the lymphatic vessels to the bloodstream.

In **defecation**, the final step in digestion, undigested materials are removed from the body as feces.

WORD PARTS AND STRUCTURAL TERMS

Combining Forms

abdomin/o: abdomen, abdominal

an/o: anus

antr/o: antrum

append/o, appendic/o: appendix

cec/o: cecum

celi/o: abdomen, abdominal cavity

cheil/o: lip

cholangi/o: bile duct

chol/e: gall, bile

choledoch/o: common bile duct

col/o: colon

colon/o: colon

diverticul/o: diverticulum

duoden/o: duodenum

enter/o: intestine

esophag/o: esophagus

gastr/o: stomach

gingiv/o: gum

gloss/o: tongue

hepat/o: liver

herni/o: hernia, protrusion of an organ through a membrane or cavity wall

ile/o: ileum

jejun/o: jejunum

lapar/o: abdomen, abdominal cavity

lingu/o: tongue

lith/o: stone

or/o: mouth

palat/o: palate

pancreat/o: pancreas

peritone/o: peritoneum

polyp/o: polyp, small growth

proct/o: rectum

pylor/o: pylorus

rect/o: rectum

sial/o: saliva, salivary gland

sigmoid/o: sigmoid colon

steat/o: fat

stomat/o: mouth

uvul/o: uvula

Prefixes

hemi-: half

endo-: within, in

sub-: under, below

dys-: painful, abnormal, difficult, labored

Suffixes

-ac: pertaining to (adjective)

-al: pertaining to (adjective)

-cele: hernia, protrusion (noun)

-centesis: surgical puncture to aspirate fluid (noun)

-ectomy: excision (noun)

-gram: the record, radiographic image (noun)

-graph: instrument used to record (noun)

-graphy: process of recording (noun)

-ia: condition of, diseased state, abnormal state (noun)

-iasis: condition (noun)

-itis: inflammation (noun)

-logist: specialist or physician who studies and treats (noun)

-logy: study of (noun)

-malacia: softening (noun)

-osis: abnormal condition (noun)

-pathy: disease (noun)

-pepsia: digestion (noun)

- phagia**: eating or swallowing (noun)
- plasty**: surgical repair (noun)
- ptosis**: prolapse, drooping (noun)
- rrhaphy**: suturing, repairing (noun)
- rrhea**: flow, discharge (noun)
- scope**: instrument used for visualization (noun)
- scopy**: process of viewing, visualization (noun)
- stomy**: creation of an artificial opening (noun)
- tomy**: incision, cut into (noun)

Structural Terms Built from Word Parts

abdominal: pertaining to the abdomen

anal: pertaining to the anus

celiac: pertaining to the abdomen

colorectal: pertaining to the colon and rectum

duodenal: pertaining to the duodenum

esophageal: pertaining to the esophagus

gastric: pertaining to the stomach

ileocecal: pertaining to the ileum and cecum

lingual: pertaining to the tongue

nasogastric: pertaining to the nose and stomach

oral: pertaining to the mouth

pancreatic: pertaining to the pancreas

peritoneal: pertaining to the peritoneum

rectal: pertaining to the rectum

stomatogastric: pertaining to the mouth and stomach

sublingual: pertaining to under the tongue

DISEASES AND DISORDERS

Disease and Disorder Terms Built from Known Word Parts

aphagia: lack of ability to swallow

appendicitis: inflammation of the appendix

cholangioma: tumor of a bile duct

cholecystitis: inflammation of the gallbladder

choledocholithiasis: condition of having gallstones in the common bile duct

cholelithiasis: condition of having gallstones

colitis: inflammation of the colon

diverticulitis: inflammation of one or more diverticula

diverticulosis: the condition of having diverticulitis

dyspepsia: difficult or painful digestion

dysphagia: difficulty swallowing

enteropathy: disease of the intestines

esophagitis: inflammation of the esophagus

gastritis: inflammation of the stomach

gastroenteritis: inflammation of the stomach and intestines

gastroenterocolitis: inflammation of the stomach and intestines, including the colon

gastromalacia: softening of the stomach

gingivitis: inflammation of the gums

glossitis: inflammation of the tongue

hepatitis: inflammation of the liver

hepatoma: benign tumor of the liver

hepatocarcinoma: malignant tumor of the liver

hepatomegaly: enlargement of the liver

palatitis: inflammation of the palate

pancreatitis: inflammation of the pancreas

peritonitis: inflammation of the peritoneum

polyposis: condition of having polyps

proctoptosis: drooping/falling of the rectum

rectocele: herniation of the rectum

sialolith: stone in a salivary gland or duct

steatohepatitis: inflammation of the liver with fatty tissue present

steatorrhea: discharge of undigested/partially digested fats

steatosis: abnormal condition of fat retention within a cell or organ

uvulitis: inflammation of the uvula

Disease and Disorder Terms Not Built from Known Word Parts

adhesion: fibrous bands of scar tissue that form between internal organs and tissues, joining them together abnormally

ascites: abnormal fluid collection within the abdominal cavity

celiac sprue (celiac disease): disease that occurs due to an immune reaction to gluten in the intestines; can lead to malabsorption and damage to the intestinal lining

cirrhosis: chronic liver disease that leads to destruction of hepatocytes and formation of scar tissue

cleft lip: congenital cleft in lip

cleft palate: congenital cleft in either the hard palate, soft palate, or both

Crohn disease: chronic disease of the GI tract that leads to cobblestone ulcerations and formation of scar tissue

colon cancer: malignant tumor of the colon

diarrhea: liquid or semisolid feces

dysentery: large amount of diarrhea containing blood or mucus due to damage to the intestinal lining

emesis: vomit

emetic: substance that induces vomiting

esophageal cancer: malignant tumor of the esophagus

feces: solid/semisolid waste from digestive system

flatus: intestinal gas

gastroesophageal reflux disease (acid reflux/heartburn): disease featuring pain/discomfort caused by acid being ejected from the stomach into the esophagus

hematemesis: blood in vomit

hematochezia: visible blood in stool

hemochromatosis: genetic disease that leads to increased absorption of iron in the GI tract, overproduction of red blood cells, and deposition of iron within various body tissues

hemorrhoid: varicose vein in the rectum and/or anal canal

ileus: lack of effective peristalsis in the intestines, which can lead to obstruction

intussusception: telescoping of the intestines, which can lead to obstruction

irritable bowel syndrome: disturbances in bowel function not due to another diagnosable bowel disease; can lead to periods of constipation, diarrhea, or both

melena: black, tarry stool that contains digested blood from the upper GI tract

nausea: feeling of the urge to vomit

obesity: excess body fat and increase in body weight in which BMI is over 30

peptic ulcer: erosion of the mucous membrane of the stomach, leading to pain/discomfort

polyp: tumorlike outgrowth of a mucous membrane; usually benign, but may become cancerous if not removed

reflux: GI fluids being ejected backward

stoma: surgical opening between an organ and the outside of the body, between body structures, or between intestinal portions

ulcerative colitis: chronic disease of the large intestine with inflammation of the colon and the formation of ulcers, which can cause bloody diarrhea

volvulus: twisting or kinking of an intestine, which can lead to an obstruction

MEDICAL, SURGICAL, & VIEWING TERMS AND ABBREVIATIONS

Medical Careers & Professional Terminology

gastroenterologist: a physician specializing in diseases of the digestive system, including esophagus, stomach, and intestines

hepatologist: a physician specializing in diseases of the liver

proctologist: a physician specializing in diseases of the rectum and anus

Imaging and Diagnostic Techniques/Procedures for the Organ System

abdominal sonography: using sound waves to visualize the abdominal cavity

barium enema/lower gastrointestinal series: procedure in which barium is introduced rectally and x-rays are taken to visually examine the lower GI tract

cholangiogram: visual record of the bile ducts

cholangiography: process of obtaining visual record of the bile ducts

CT colonography: visual record of the colon obtained through computed tomography

colonoscope: instrument used to visually examine the colon

colonoscopy: process of visually examining the colon

endoscope: instrument used to visually examine a hollow body organ/structure

endoscopic retrograde cholangiopancreatography: procedure in which contrast media is introduced into the biliary and pancreatic ducts to detect liver, gallbladder, or pancreatic disease

endoscopic ultrasound: using sound waves to probe the GI tract for tumors or cystic growths

endoscopy: process of visually examining a hollow body organ/structure

esophagogastrroduodenoscopy: process of visually examining the esophagus, stomach, and duodenum

esophagogram: visual record of the esophagus

esophagoscopy: process of visually examining the esophagus

fecal occult blood test: test that detects hidden or invisible blood in the feces

gastroscope: instrument used to visually examine the stomach

gastroscopy: process of visually examining the stomach

***Helicobacter pylori* antibodies test:** detects the presence of *H. pylori* bacteria in the stomach, which may cause ulcers

laparoscope: instrument used to visually examine the abdomen

laparoscopy: process of visually examining the abdomen

proctoscope: instrument used to visually examine the rectum

proctoscopy: process of visually examining the rectum

sigmoidoscope: instrument used to visually examine the sigmoid colon

sigmoidoscopy: process of visually examining the sigmoid colon

stool culture: microscopic examination and laboratory tests performed on feces

upper gastrointestinal series: procedure in which barium is introduced orally and X-rays are taken to visually examine the upper GI tract

Medical and Surgical Techniques/Procedures Used for the Organ System

abdominocentesis: removing fluid from the abdominal cavity for testing

abdominoplasty: surgical repair of the abdomen

anastomosis: joining together of two

anoplasty: surgical repair of the anus

antrectomy: surgical removal of all or part of the pyloric antrum of the stomach

appendectomy: surgical removal of the vermiform appendix

bariatric surgery: surgery that temporarily or permanently reduces the size of the stomach to reduce appetite and cause weight loss

celiotomy: surgical incision into the abdomen

cheiloplasty: surgical repair of a lip

cheilorrhaphy: surgical suturing/repair of a lip

cholecystectomy: surgical removal of the gallbladder

choledocholithotomy: incision to remove gallstones from the common bile duct

cholelithotripsy: removal of gallstones through sound waves

colectomy: surgical removal of all or part of the colon

colostomy: creation of a stoma between the colon and the outside of the body

diverticulectomy: surgical removal of one or more diverticula

enterorrhaphy: surgical suturing/repair of an intestine

gastrectomy: surgical removal of all or part of the stomach

gastric lavage: washing of the stomach to remove contents

gastroplasty: surgical repair of the stomach

gastrostomy: creation of a stoma between the stomach and the outside of the body

gastrojejunostomy: creation of a stoma between the stomach and the jejunum

gavage: feeding by means of a tube leading to the stomach

gingivectomy: surgical removal of all or part of a gum

glossorrhaphy: surgical suturing/repair of the tongue

hemicolectomy: surgical removal of part of the colon

hemorrhoidectomy: surgical removal of one or more hemorrhoids

herniorrhaphy: surgical suturing/repair of a hernia

ileostomy: creation of a stoma between the ileum and the outside of the body

laparotomy: surgical incision into the abdomen

palatoplasty: surgical repair of the palate

percutaneous endoscopic gastrostomy: creation of a stoma between the stomach and the outside of the body in which a tube is inserted for feeding purposes

polypectomy: surgical removal of one or more polyps

pyloromyotomy: surgical incision into the muscle of the pylorus of the stomach

pyloroplasty: surgical repair of the pylorus of the stomach

uvulectomy: surgical removal of all or part of the uvula

uvulopalatopharyngoplasty: surgical repair of the uvula, palate, and pharynx, usually done to correct snoring / sleep apnea

vagotomy: surgical incision of the vagus nerve, done to reduce acid production in the stomach

Abbreviations Commonly Used with the Organ System

APR: abdominoperineal resection

BE: barium enema

EGD: esophagogastroduodenoscopy

ERCP: endoscopic retrograde cholangiopancreatography

EUS: endoscopic ultrasound

FOBT: fecal occult blood test

GERD: gastroesophageal reflux disease

GI: gastrointestinal

H. pylori: *Helicobacter pylori*

IBS: irritable bowel syndrome

N&V: nausea and vomiting

PEG: percutaneous endoscopic gastrostomy

UC: ulcerative colitis

UGI: upper gastrointestinal

UPPP: uvulopalatopharyngoplasty

Medical Terms Practice

For each card, click the speaker icon to hear the correct pronunciation of the listed term. Practice saying the term to yourself, then attempt to define the term from memory. Click “Turn” to flip the card and see the definition. Use the right and left arrows to toggle through the cards in each set.



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<https://louis.pressbooks.pub/medicalterminology/?p=1529#h5p-78>

PRACTICE

The following activities will help you practice what you learned in this chapter.

Medical Terms Practice

Click and drag each term from the word bank to its correct place in this exercise.



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<https://louis.pressbooks.pub/medicalterminology/?p=2126#h5p-79>

Digestive System Anatomy

Click and drag each term to the box corresponding with the anatomic structure, body part, body plane, or body region for that term.



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Consultation Report

Click and drag each term from the word bank to its correct place in this exercise.



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Operative Report

Click and drag each term from the word bank to its correct place in this exercise.



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Vocabulary Reinforcement Activity

Click the term that correctly answers each question or completes each sentence.



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<https://louis.pressbooks.pub/medicalterminology/?p=2126#h5p-85>

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PART XIII

URINARY SYSTEM

Learning Objectives

When completing this chapter, the learner will be able to do the following:

- Identify the anatomy of the urinary system
- Describe the main functions of the urinary system
- Spell and pronounce the urinary system medical terms and use correct abbreviations
- Identify the medical specialties associated with the urinary system
- Explore common diseases, disorders, and procedures related to the urinary system

Introduction

The urinary system has roles you may be well aware of. Cleansing the blood and ridding the body of wastes probably come to mind. However, there are additional, equally important functions played by the system. Take, for example, the regulation of pH, a function shared with the lungs and the buffers in the blood. Additionally, the regulation of blood pressure is a role shared with the heart and blood vessels. What about regulating the concentration of solutes in the blood? Did you know that the kidney is important in determining the concentration of red blood cells? Eighty-five percent of the erythropoietin (EPO) produced to stimulate red blood cell production is produced in the kidneys. The kidneys also perform the final synthesis step of vitamin D production, converting calcidiol to calcitriol, the active form of vitamin D. If the kidneys fail, these functions are compromised or lost altogether, with devastating effects on homeostasis.

Watch this video:



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Media 13.1. [Urinary System, Part 1: Crash Course A&P #38](#) [Online video]. Copyright 2015 by [CrashCourse](#).

ANATOMY AND PHYSIOLOGY OF THE URINARY SYSTEM

Kidney(s)

The **kidneys** lie on either side of the spine in the retroperitoneal space between the parietal peritoneum and the posterior abdominal wall, well protected by muscle, fat, and ribs. They are roughly the size of your fist. The male kidney is typically a bit larger than the female kidney. The kidneys are well vascularized, receiving about 25 percent of the cardiac output at rest. [Figure 13.1](#) displays the location of the kidneys.

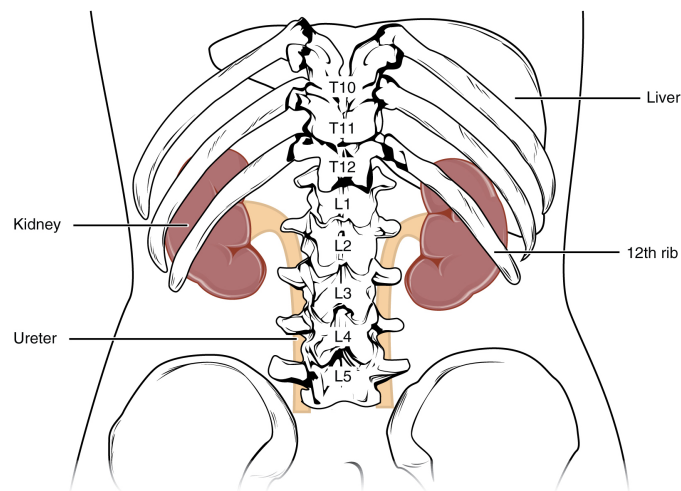


Figure 13.1 Kidneys. The kidneys are slightly protected by the ribs and are surrounded by fat for protection (not shown). From Betts, et al., 2013. Licensed under [CC BY 4.0](#).

Kidneys' Internal Structure

A frontal section through the kidney reveals an outer region called the **renal cortex** and an inner region called the **medulla** (see [Figure 13.2](#)). The **renal columns** are connective tissue extensions that radiate downward from the cortex through the medulla to separate the most characteristic features of the medulla, the **renal pyramids** and **renal papillae**. The papillae are bundles of collecting ducts that transport urine made by nephrons to the **calyces** of the kidney for excretion. The renal columns also serve to divide the kidney into 6–8

lobes and provide a supportive framework for vessels that enter and exit the cortex. The pyramids and renal columns taken together constitute the kidney **lobes**.

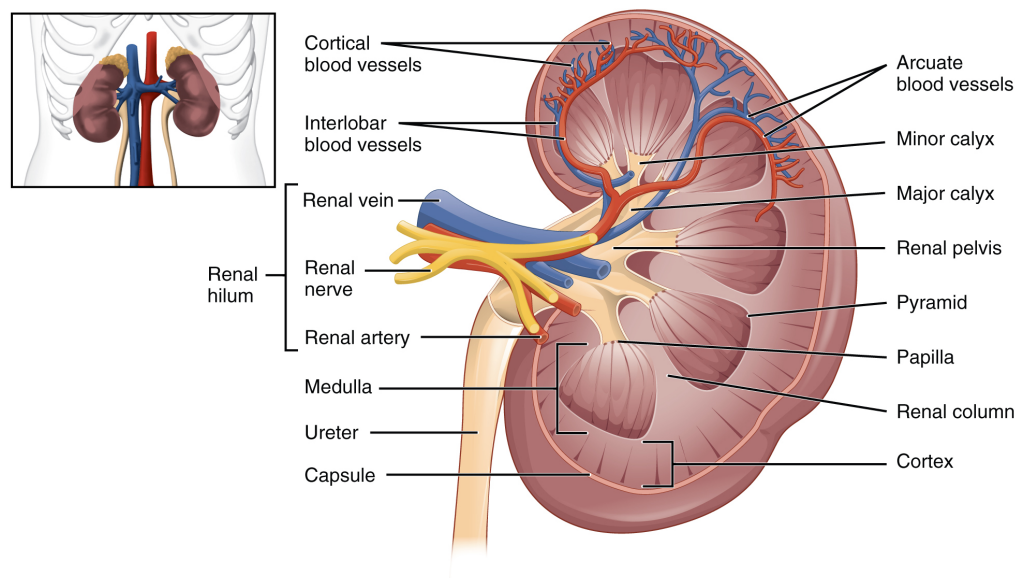


Figure 13.2 Left Kidney. From Betts, et al., 2013. Licensed under [CC BY 4.0](#). [\[Image description.\]](#)

Renal Hilum

The **renal hilum** is the entry and exit site for structures servicing the kidneys: vessels, nerves, lymphatics, and ureters. The medial-facing hila are tucked into the sweeping convex outline of the cortex. Emerging from the hilum is the **renal pelvis**, which is formed from the major and minor calyces in the kidney. The smooth muscle in the renal pelvis funnels urine via peristalsis into the **ureter**. The **renal arteries** form directly from the descending aorta, whereas the **renal veins** return cleansed blood directly to the inferior vena cava. The artery, vein, and renal pelvis are arranged in an anterior-to-posterior order.

Nephrons and Vessels

The renal artery first divides into segmental arteries, followed by further branching to form interlobar arteries that pass through the renal columns to reach the cortex (see [Figure 13.3](#)). The interlobar arteries, in turn, branch into arcuate arteries, cortical radiate arteries, and then afferent arterioles. The afferent arterioles service about 1.3 million nephrons in each kidney.

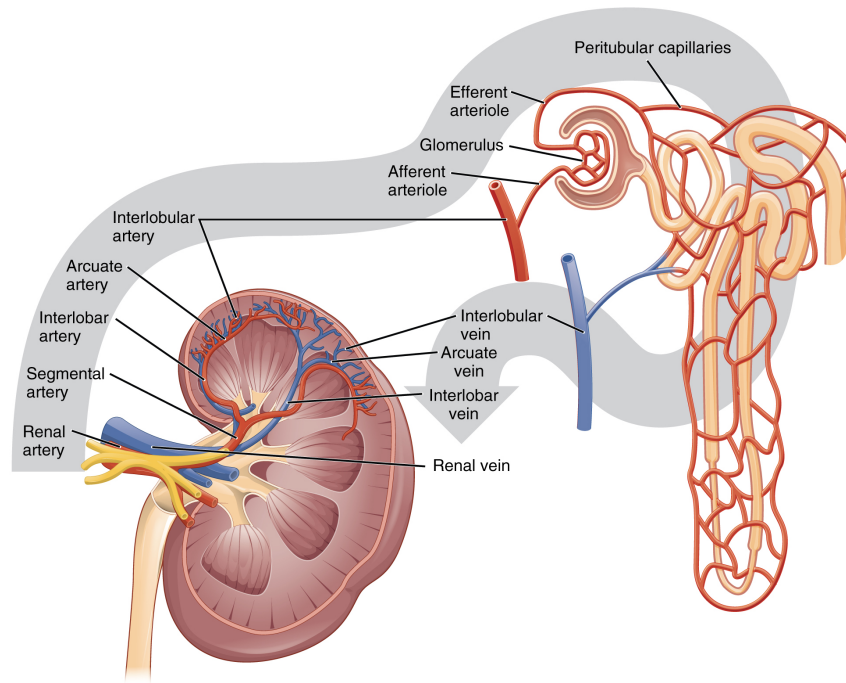


Figure 13.3 Blood Flow in the Kidney. From Betts, et al., 2013. Licensed under [CC BY 4.0](#).

Nephrons are the “functional units” of the kidney; they cleanse the blood and balance the constituents of the circulation. The afferent arterioles form a tuft of high-pressure capillaries about 200 μm in diameter, the **glomerulus**. The rest of the nephron consists of a continuous sophisticated tubule whose proximal end surrounds the glomerulus in an intimate embrace—this is **Bowman’s (glomerular) capsule**. The glomerulus and Bowman’s capsule together form the renal corpuscle. As mentioned earlier, these glomerular capillaries filter the blood based on particle size. After passing through the **renal corpuscle**, the capillaries form a second arteriole, the **efferent arteriole** (see [Figure 13.4](#)). These will next form a capillary network around the more distal portions of the nephron tubule, the **peritubular capillaries** and **vasa recta**, before returning to the venous system. As the glomerular filtrate progresses through the nephron, these capillary networks recover most of the solutes and water and return them to the circulation.

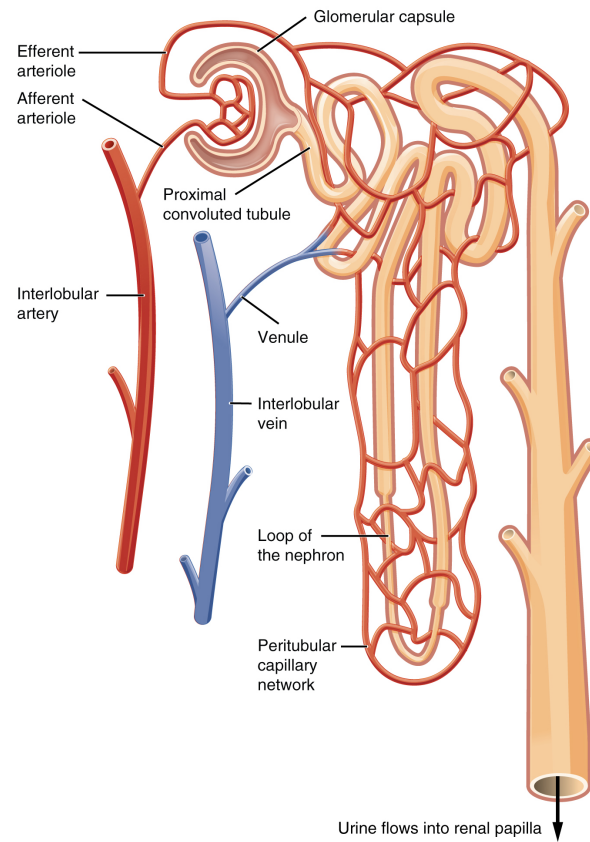


Figure 13.4 Blood Flow in the Nephron. The two capillary beds are clearly shown in this figure. The efferent arteriole is the connecting vessel between the glomerulus and the peritubular capillaries and vasa recta. From Betts, et al., 2013. Licensed under [CC BY 4.0](#).

Ureter(s)

As urine is formed, it drains into the calyces of the kidney, which merge to form the funnel-shaped renal pelvis in the hilum of each kidney. The hilum narrows to become the **ureter** of each kidney. As urine passes through the ureter, it does not passively drain into the bladder but rather is propelled by waves of peristalsis. The ureters are approximately 30 cm long.

Bladder

The **urinary bladder** collects urine from both ureters (see [Figure 13.5](#)). The bladder lies anterior to the uterus in females, posterior to the pubic bone and anterior to the rectum. In males, the anatomy is similar, minus the uterus, and with the addition of the prostate inferior to the bladder. The bladder is partially retroperitoneal

(outside the peritoneal cavity) with its peritoneal-covered “dome” projecting into the abdomen when the bladder is distended with urine.

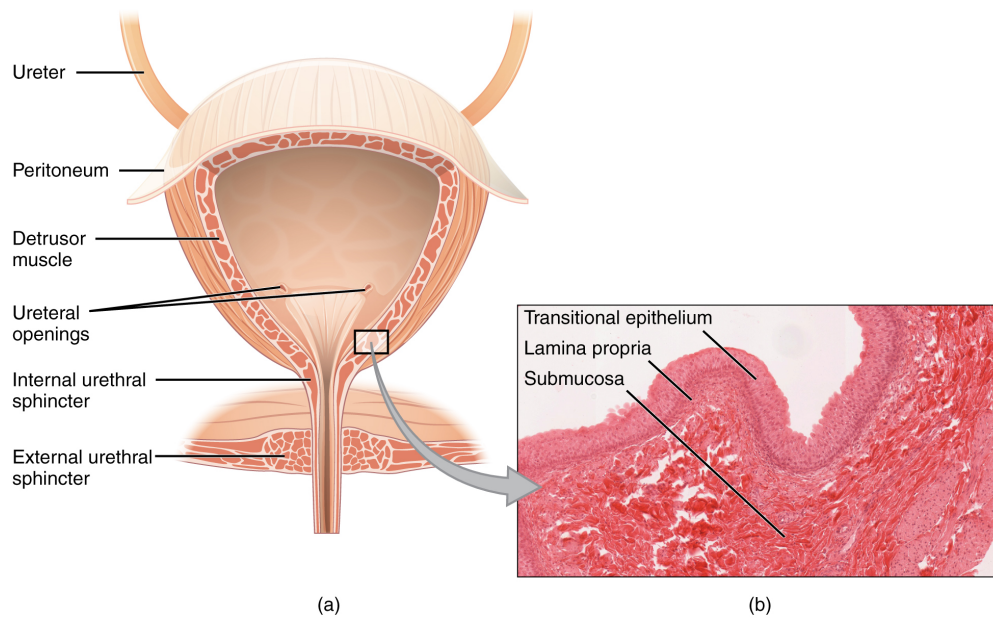


Figure 13.5 Bladder. (a) Anterior cross section of the bladder. (b) The detrusor muscle of the bladder (source: monkey tissue) LM $\times 448$. (Micrograph provided by the Regents of the University of Michigan Medical School \copyright 2012.) From Betts, et al., 2013. Licensed under [CC BY 4.0](#). [\[Image description.\]](#)

Urethra

The **urethra** transports urine from the bladder to the outside of the body for disposal. The urethra is the only urologic organ that shows any significant anatomic difference between males and females; all other urine transport structures are identical (see [Figure 13.6](#)).

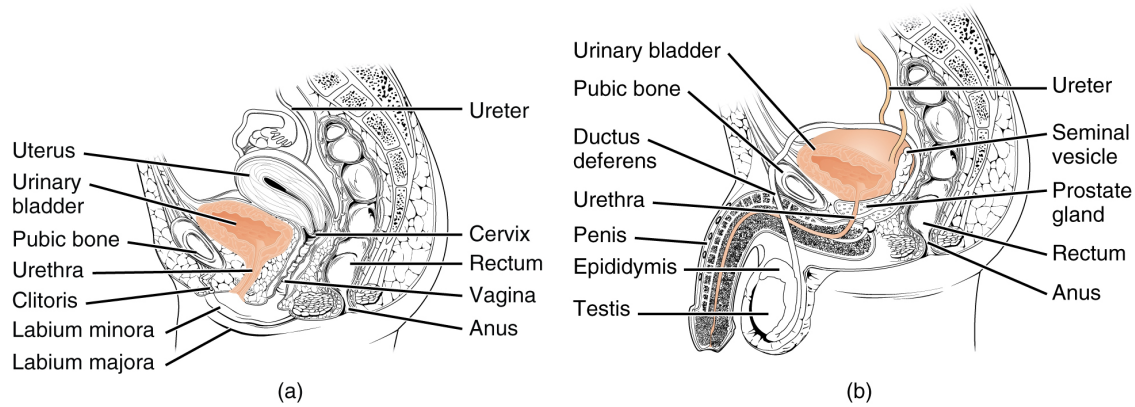


Figure 13.6 Female and Male Urethras. The urethra transports urine from the bladder to the outside of the body. This image shows (a) a female urethra and (b) a male urethra. From Betts, et al., 2013. Licensed under [CC BY 4.0](#). [\[Image description.\]](#)

The urethra in both males and females begins inferior and central to the two ureteral openings forming the three points of a triangular-shaped area at the base of the bladder called the trigone (Greek tri- = “triangle” and the root of the word “trigonometry”). The urethra tracks posterior and inferior to the pubic symphysis. **Voiding** is regulated by an involuntary autonomic nervous system-controlled internal urinary sphincter consisting of smooth muscle and voluntary skeletal muscle that forms the external urinary sphincter below it.

Image Descriptions

Figure 13.2 image description: The left panel of this figure shows the location of the kidneys in the abdomen. The right panel shows the cross section of the kidney. [\[Return to Figure 13.2\].](#)

Figure 13.5 image description: The left panel of this figure shows the cross section of the bladder and the major parts are labeled. The right panel shows a micrograph of the bladder. [\[Return to Figure 13.5\].](#)

Figure 13.6 image description: Diagrams of the (a) female and (b) male genitalia highlighting the respective urethras. [\[Return to Figure 13.6\].](#)

WORD PARTS AND STRUCTURAL TERMS

Combining Forms

albumin/o: albumin

azot/o: nitrogen or urea

cyst/o: bladder

glomerul/o: glomerulus

glyc/o, glycos/o: glucose, sugar

hydr/o: water, urine

lith/o: stone

meat/o: meatus

nephr/o: kidney

noct/i: night

olig/o: scanty, very small amount

pyel/o: pelvis

ren/o: kidney

ureter/o: ureter

urethr/o: urethra

ur/o, urin/o: urine

vesic/o: bladder

Suffixes

-esis: condition (noun)

-iasis: condition (noun)

-lysis: breakdown, dissolution (noun)

-ptosis: drooping, sagging (noun)

-rrhaphy: suturing, surgically repairing (noun)

-tripsy: crushing (noun)

-trophy: growth (noun)

-uria: urine (noun)

Structural Terms Built from Word Parts

meatal: pertaining to the meatus

renal: pertaining to the kidney

urinary: pertaining to the urine

DISEASES AND DISORDERS

Disease and Disorder Terms Built from Word Parts

albuminuria: condition of albumin in the urine

anuria: condition of producing no urine

azotemia: condition of urea in the blood

cystitis: inflammation of the bladder

cystocele: a dropped or prolapsed bladder that bulges into the vaginal space

cystolith: stone in the bladder

diabetic nephropathy: kidney disease caused by complications of diabetes mellitus

diuresis: excessive urination

dysuria: condition of painful urination

glomerulonephritis: inflammation of the glomeruli of the kidney

glycosuria: condition of glucose in the urine

hematuria: condition of blood in the urine

hydronephrosis: dilation of the renal pelvis and calyces due to buildup of urine; caused by an obstruction to urine flow downstream

nephritis: inflammation of a kidney

nephrohypertrophy: excessive growth of a kidney

nephrolithiasis: condition of stone formation in the kidney

nephroma: tumor of the kidney

nephromegaly: enlarged kidney

nephroptosis: dropping or sagging kidney

nocturia: condition of nighttime urination; feeling the urge to wake during the night in order to urinate

oliguria: condition of scanty or deficient urine production

polyuria: condition of excessive urine production

pyelitis: inflammation of the renal pelvis

pyelonephritis: inflammation of the renal pelvis and the rest of the kidney

pyuria: condition of pus in the urine

ureteritis: inflammation of a ureter

ureterocele: a birth defect that causes a ballooning of the end of the ureter inside the bladder

ureterolithiasis: condition of stones in a ureter

ureterostenosis: narrowing of a ureter

urethrocystitis: inflammation of the urethra and bladder

uremia: condition of urea in the blood

Disease and Disorder Terms Not Built from Word Parts

acute kidney injury: a sudden decrease in kidney function that develops within a week

chronic kidney disease: a loss of kidney function over a long period of time

distension: swelling of an organ

end-stage renal disease: a complete loss of kidney function as a result of chronic kidney disease; patient subsequently requires hemodialysis

enuresis: bed-wetting

epispadias: a condition in which the urethral opening is located on the upper side of the penis

hypospadias: a condition in which the urethral opening is located on the underside of the penis

incontinence: inability to control urination

micturate: to urinate

overactive bladder: a group of symptoms that can include the urge to urinate more frequently, greater urgency to urinate, urinary incontinence, and nocturia

polycystic kidney disease: a genetic disorder that causes fluid-filled cysts to develop within the kidneys, leading to a gradual loss of kidney function and hypertension

renal calculus: an individual stone in the urinary tract

renal cell carcinoma: malignant tumor of the kidney

renal hypertension: hypertension caused by a narrowing in the arteries that deliver blood to the kidney

stricture: a narrowing of a tube or opening, such as the urethra

urinary retention: inability to void urine

urinary suppression: inability to produce urine

urinary tract infection: an infection anywhere in the urinary tract

MEDICAL, SURGICAL, & VIEWING TERMS AND ABBREVIATIONS

Medical Careers & Professional Terminology

nephrology: study of the kidneys

nephrologist: physician specializing in kidney disorders and treatment

urology: study of the urinary system

urologist: physician specializing in urinary system disorders and treatment

Imaging Techniques / Diagnostic Procedures for the Organ System

blood urea nitrogen: a laboratory test that measures the amount of urea nitrogen in the blood; indicates kidney function

cystogram: an x-ray image obtained after contrast media injected into the bladder

cystography: the process of obtaining a cystogram

cystoscope: a thin tube with a camera or lens, used to visualize the bladder

cystoscopy: visual examination of the bladder using a cystoscope

intravenous urogram: an x-ray image obtained after injecting contrast media to visually evaluate the entire urinary tract

nephrography: the process of obtaining a radiographic image of the kidney

nephroscopy: visual examination of the kidney

nephrosonography: obtaining a visual recording of the kidney via ultrasound waves

nephrotomogram: an image obtained via intravenous contrast media and x-ray tomography

renogram: an x-ray image obtained after injecting contrast media to evaluate blood flow in the kidney

specific gravity: a measurement of the density of a fluid (such as urine) compared to water

ureteroscopy: visual examination of the ureter

urethroscopy: visual examination of the urethra

urinalysis: analyzing the composition of urine via laboratory tests

urodynamics: any procedure that measures how well the bladder and urethra store and release urine

voiding cystourethrogram: a procedure that uses x-rays and a contrasting agent to evaluate the size, shape, and capacity of the bladder and urethra

Medical/Surgical Techniques & Procedures

cystectomy: surgical removal of the bladder

cystolithotomy: surgical incision to remove a bladder stone

cystorrhaphy: surgical suturing of the bladder

cystostomy: surgical creation of an opening in the bladder to void urine outside the body

cystotomy: surgical incision of the bladder

extracorporeal shock wave lithotripsy: administering a series of shock waves to break apart a kidney stone

fulguration: using a laser to destroy living tissue, such as bladder lesions

hemodialysis: purifying the blood of a patient whose kidneys no longer function properly; can utilize a dialysis machine or the patient's peritoneum

meatotomy: surgical incision of the urinary meatus

nephrectomy: surgical removal of a kidney

nephrolithotripsy: surgical crushing and removal of a kidney stone

nephropexy: surgical suspension of a kidney

nephrostomy: surgical creation of an opening in the kidney to void urine outside the body

pyelolithotomy: surgical incision to remove stone from the renal pelvis

pyeloplasty: surgical repair of the renal pelvis

renal transplant: transplanting a donor kidney into a recipient when their own kidneys no longer function

ureterectomy: surgical removal of a ureter

urethroplasty: surgical repair of a ureter

urinal: a device for collecting urine

urinary catheterization: placing a catheter inside the urethra for collecting urine

vesicourethral suspension: surgical suspension of the bladder and urethra; often performed to treat stress incontinence

void: to empty urine from the body

Abbreviations

ARF: acute renal failure

BUN: blood urea nitrogen

cath: catheter, catheterization

CKD: chronic kidney disease

ESRD: end-stage renal disease

ESWL: extracorporeal shock wave lithotripsy

HD: hemodialysis

KUB: kidney, ureter, and bladder radiographic image

OAB: overactive bladder

SG: specific gravity

UA: urinalysis

UTI: urinary tract infection

VCUG: voiding cystourethrogram

Medical Terms Practice

For each card, click the speaker icon to hear the correct pronunciation of the listed term. Practice saying the term to yourself, then attempt to define the term from memory. Click “Turn” to flip the card and see the definition. Use the right and left arrows to toggle through the cards in each set.



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PRACTICE

The following activities will allow you to practice what you've learned in this chapter.

Urinary System Activity

Click and drag each term to the box corresponding with the anatomic structure, body part, body plane, or body region for that term.



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<https://louis.pressbooks.pub/medicalterminology/?p=2140#h5p-26>

Operative Report

Click and drag each term from the word bank to its correct place in this exercise.



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Consultation Report

Click and drag each term from the word bank to its correct place in this exercise.



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PART XIV

MALE REPRODUCTIVE SYSTEM

Learning Objectives

When completing this chapter, the learner will be able to do the following:

- Identify the anatomy of the male reproductive system
- Describe the main functions of the male reproductive system
- Spell the male reproductive system medical terms and use correct abbreviations
- Identify the medical specialties associated with the male reproductive system
- Explore common diseases, disorders, and procedures related to the male reproductive system

Introduction to Male Reproductive System

The male reproductive system produces **gametes**. Gametes are the reproductive cells that combine to form a zygote and, later, an embryo and fetus. Organs called **gonads** produce the gametes along with the hormones that regulate human reproduction. The male gametes are called **spermatozoa** (sperm) and are produced by the **testes**. **Spermatogenesis** occurs within the **seminiferous tubules** that make up most of a testis. The scrotum is a sac that holds the testes outside of the body cavity.

Watch this video:



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Media 14.1. [Reproductive System, Part 2—Male Reproductive System: Crash Course A&P 41](#)
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ANATOMY AND PHYSIOLOGY OF THE MALE REPRODUCTIVE SYSTEM

Anatomy of the Male Reproductive System

The anatomy of the male reproductive system consists of structures that include the testes, the epididymis, the penis, and the ducts and glands that produce and carry **semen**. Sperm exit the scrotum through the **vas deferens**. The **spermatic cord** is an enclosed sheath that includes the vas deferens, arteries, veins, and nerves. The **seminal vesicles** and **prostate gland** add fluids to the sperm to create semen.

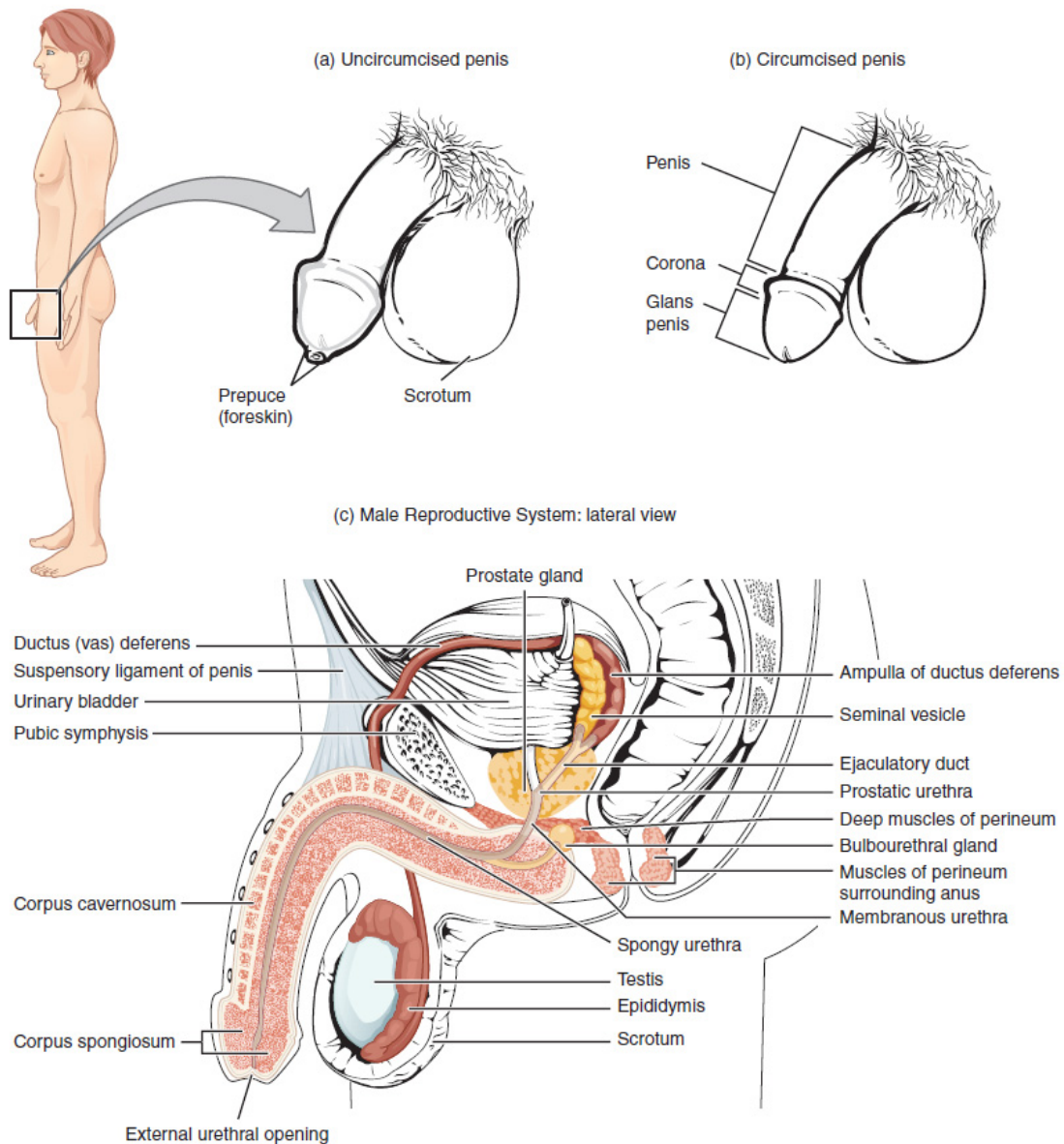


Figure 14.1 Male Reproductive System. From Betts, et al., 2013. Licensed under [CC BY 4.0](#). [\[Image description.\]](#)

Physiology of the Male Reproductive System

The anatomy of the male reproductive system consists of structures that include spermatogenesis, sperm, sperm transport, epididymis, ducts, prostate gland, and bulbourethral glands.

Spermatogenesis

Spermatogenesis occurs in the seminiferous tubules that form the bulk of each testis. The process begins at

puberty, after which time sperm are produced constantly throughout a man's life. One production cycle takes approximately 64 days. One production cycle is considered from spermatogonia through to formed sperm. A new cycle starts approximately every 16 days, although this timing is not synchronous across the seminiferous tubules.

Sperm

Sperm are smaller than most cells in the body; in fact, the volume of a sperm cell is 85,000 times less than that of the female gamete. Approximately 100 to 300 million sperm are produced each day, whereas women typically ovulate only one oocyte per month. As is true for most cells in the body, the structure of sperm cells speaks to their function. Sperm have a distinctive head, mid-piece, and tail region (see [Figure 14.2](#)).

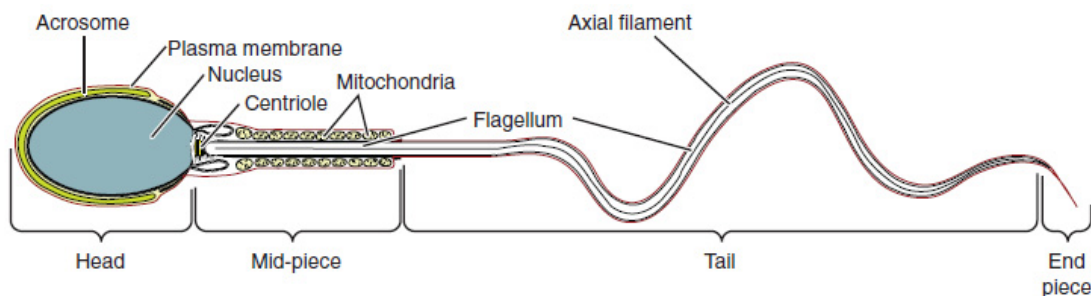


Figure 14.2 Structure of Sperm. Sperm cells are divided into a head, containing DNA; a mid-piece, containing mitochondria; and a tail, providing motility. The acrosome is oval and somewhat flattened. From Betts, et al., 2013. Licensed under [CC BY 4.0](#). [\[Image description.\]](#)

Sperm Transport

To fertilize an egg, sperm must be moved from the seminiferous tubules in the testes, through the epididymis, and—later during **ejaculation**—along the length of the penis and out into the female reproductive tract. It takes an average of 12 days for sperm to move through the coils of the epididymis, with the shortest recorded transit time in humans being one day.

Epididymis

Sperm enter the head of the epididymis and are moved by the contraction of smooth muscles lining the epididymal tubes. As the sperm mature, they acquire the ability to move under their own power. Once inside

the female reproductive tract, they will use this ability to move independently toward the unfertilized egg. The more mature sperm are then stored in the tail of the epididymis until ejaculation occurs.

Ducts

During ejaculation, sperm exit the tail of the epididymis and are pushed by smooth muscle contraction to the vas deferens (also called the ductus deferens). The vas deferens is a thick, muscular tube that is bundled together inside the scrotum with connective tissue, blood vessels, and nerves into a structure called the spermatic cord. From each epididymis, each vas deferens extends through the inguinal canal in the abdominal wall and continues to a region called the ampulla. The sperm is mixed with fluid from the paired seminal vesicles and moves into its associated **ejaculatory duct**. The ejaculatory ducts transport the seminal fluid to the prostate gland.

Prostate Gland

The prostate gland secretes an alkaline, milky fluid to the passing seminal fluid (referred to as semen) to first coagulate and then decoagulate the semen following ejaculation. The temporary thickening of semen helps retain it within the female reproductive tract. Once decoagulated, the sperm can pass farther into the female reproductive tract.

Bulbourethral Glands

Bulbourethral glands release a thick, salty fluid that lubricates the end of the urethra and vagina and helps to clean urine residues from the penile urethra.

Image Descriptions

Figure 14.1 image description: This figure shows the different organs in the male reproductive system. The top panel shows the side view of a man and an uncircumcised and a circumcised penis. The bottom panel shows the lateral view of the male reproductive system and the major parts are labeled. [\[Return to Figure 14.1\]](#).

Figure 14.2 image description: This diagram shows the structure of sperm; the major parts are labeled (from left to right): head section (acrosome, plasma membrane, nucleus), mid-piece (centriole, mitochondria, flagellum), tail (flagellum, axial filament), end piece (end piece). [\[Return to Figure 14.2\]](#).

WORD PARTS AND STRUCTURAL TERMS

Combining Forms

andr/o: male

balan/o: glans penis

epididym/o: epididymis

gonad/o: gonad

orch/o: testis, testicle

orchi/o: testis, testicle

orchid/o: testis, testicle

pen/i: penis

pen/o: penis

phall/o: penis

preputi/o: prepuce, foreskin

posth/o: prepuce, foreskin

prostat/o: prostate gland

scrot/o: scrotum

semin/i: semen

sperm/o: sperm, spermatozoon

spermat/o: sperm, spermatozoon

test/o: testis, testicle

testicular/o: testis, testicle

urethr/o: urethra

vas/o: vas deferens, vessel, duct

vesicul/o: seminal vesicle

Prefixes

a-: absence of, without

an-: absence of, without

crypt-: hidden

dys-: painful, difficult

en-: in

epi-: above

hydro-: water

hyper-: above, excessive

hypo-: below

par-: near

poly-: much or many

trans-: through, across, beyond

Suffixes

-al: pertaining to

-algia: pain

-ar: pertaining to

-atic: pertaining to

-cision: processing of cutting

-ectomy: excision or surgical removal

-ferous: pertaining to

-genesis: production

-gram: record

-graphy: process of recording

-ia: diseased state, abnormal state, condition of, condition

-ic: pertaining to

-ile: pertaining to

-ism: state of, condition

-itis: inflammation

-logy: study of

-lysis: loosening, dissolution, separating

-oma: tumor, mass

-ous: pertaining to

-pathy: disease

-pexy: surgical fixation, suspension

-plasia: development, growth

-plasty: surgical repair

-rrhea: flow, discharge

-sis: condition

- stomy**: creation of new opening, process of new opening
- tion**: process of
- tomy**: cut into, incision

Structural Terms Built from Word Parts

- epididymal**: pertaining to the epididymis
- penile**: pertaining to the penis
- prostatic**: pertaining to the prostate
- scrotal**: pertaining to the scrotum
- seminiferous**: pertaining to semen
- testicular**: pertaining to the testicle or testicles
- urethral**: pertaining to the urethra

Medical Terms Not Built from Word Parts

- coitus**: sexual intercourse between male and female
- condom**: sheath or cover for the penis worn during coitus to prevent conception and spread of sexually transmitted infection
- gamete**: haploid reproductive cell that contributes genetic material to form an offspring
- gonads**: reproductive organs (testes in men and ovaries in women) that produce gametes and reproductive hormones
- infertility**: inability to achieve pregnancy
- semen**: ejaculatory fluid composed of sperm and secretions from the seminal vesicles, prostate, and bulbourethral glands
- sperm (spermatozoon)**: male gamete
- spermatogenesis**: formation of new sperm; occurs in the seminiferous tubules of the testes
- spermatogonia**: diploid precursor cells that become sperm (singular = spermatogonium)
- sterility**: a condition of being unable to conceive or reproduce

DISEASES AND DISORDERS

Disease and Disorder Terms Built from Word Parts

andropathy: disease specific to males

anorchism: lack of a testis or testes

aspermia: condition of no spermatozoa or inability to produce spermatozoa

balanitis: inflammation of the glans penis

balanorrhea: discharge from the glans penis

benign prostatic hyperplasia: overgrowth of the prostate; common in older men

cryptorchidism: “state of hidden testis”; condition where one or both testes have not descended into the scrotum

dysuria: painful urination

epididymitis: inflammation of the back of the testicle that carries sperm

oligospermia: condition of having few or scanty spermatozoa

orchiditis: inflammation of a testis

orchiepididymitis: inflammation of a testis and epididymis

orchitis: inflammation of a testis

prostatitis: inflammation of the prostate gland

prostatocystitis: inflammation of the prostate gland and bladder

prostatolith: small stone or crystal that forms within the prostate gland

prostatorrhea: discharge from the prostate gland

prostatovesiculitis: inflammation of the prostate gland and one or both seminal vesicles

Disease and Disorder Terms Not Built from Word Parts

chlamydia: one of the most common sexually transmitted infections (STIs) caused by bacteria that infect the cervix, urethra, and other reproductive organs

erectile dysfunction disorder: a condition in which a male has difficulty either initiating or maintaining an erection

gonorrhea (gonococcus): a sexually transmitted infection caused by bacteria that infects the cervix, urethra, and other reproductive organs; infections can also infect the throat and anus

herpes simplex virus: a sexually transmitted infection that causes genital herpes

human papillomavirus: a common sexually transmitted infection that can cause visible genital warts and can sometimes lead to the development of some genital cancers

hydrocele: fluid-filled sac around the testicle

male infertility: inability to produce children after at least one year of unprotected intercourse or artificial insemination

penile cancer: a cancer in which tumors usually appear on the end of the penis or on the foreskin

Peyronie's disease: causes scar tissue or hard lump inside of the penis

phimosis: occurs when the foreskin remains unusually tight and cannot be drawn back

priapism: persistent erection that lasts at least 4 hours; may not be related to sexual stimulation but can be painful; if left untreated, it can cause lasting damage

prostate cancer: a cancer that is caused in the prostate; it is the second most common cancer occurring in men

spermatocele: distension of the epididymis, containing fluid and spermatozoa

testicular cancer: a cancer that begins in the testicle or testis; it is most often found in men aged 15 to 44 years, although it can be diagnosed at any age

testicular torsion: twisting of a testis and spermatic cord within the scrotum; this is a medical emergency and must be reversed immediately

varicocele: varicose veins within the spermatic cord; can lead to decreased sperm production

MEDICAL, SURGICAL, & VIEWING TERMS AND ABBREVIATIONS

Medical Careers & Professional Terminology

andrologist: a physician specializing in andrology

andrology: a medical specialty that is responsible for treating genitourinary conditions that are faced by males

reproductive endocrinologist: a physician who has special training in the diagnosis and treatment of infertility

urologist: a physician specializing in urology

urology: a medical specialty that is responsible for treating conditions that affect the urinary tract in males

Diagnostic and Imaging Techniques/Procedures for the Organ System

computerized tomography: series of x-ray images taken to detect bone and joint problems

digital rectal examination: palpation of the prostate with a gloved finger through the wall of the rectum

magnetic resonance imaging: uses strong magnetic field and radio waves to detect problems with the tissue and the nervous system

positron emission tomography: an imaging test that can detect cancer and how far it has spread

prostate-specific antigen: a protein produced by the prostate that can be detected via a blood test; a sudden rise may indicate prostate cancer

transrectal ultrasound: an imaging test that uses sound waves to view the prostate gland

Medical and Surgical Techniques/Procedures Used for the Organ System

ablation: destruction of abnormal or excessive tissue by eroding, vaporization, or melting

artificial insemination: introduction of spermatozoa into the vagina or cervix by artificial means

balanoplasty: surgical repair of the glans penis

circumcision: surgical removal of the prepuce (foreskin)

enucleation: excision of a whole organ or mass without cutting into it

epididymectomy: excision of part or all of an epididymis

HPV vaccine: a vaccine called Gardasil® 9, available for 9 HPV strains; this vaccine assists the immune system in protecting the body against infections and diseases caused by HPV

hydrocelectomy: surgical removal of a fluid-filled sac around the testicle causing scrotal swelling (hydrocele)

no-scalpel vasectomy (NSV): a minimally invasive vasectomy procedure with a shorter recovery time

orchiectomy: removal of part or all of a testis; the most common procedure for diagnosing and treating testicular cancer

orchiotomy: incision into a testis

prostatectomy: excision of all or part of the prostate gland

transurethral incision of the prostate gland: a surgical procedure that widens the urethra where it meets the bladder and prostate

vasectomy: a sterilization procedure in which a small section of the ductus (vas) deferens is removed from the scrotum; this cuts off the path taken by sperm through the ductus deferens

vasovasostomy: vasectomy reversal; creation of an opening within a vas deferens

vesiculectomy: excision of one or both seminal vesicles

Abbreviations Commonly Used with the Male Reproductive System

AIDS: acquired immunodeficiency syndrome

BPH: benign prostatic hyperplasia, benign prostatic hypertrophy

Bx: biopsy

CT: chlamydia

DRE: digital rectal examination

ED: erectile dysfunction

FTA-ABS: fluorescent treponemal antibody absorption test

GC: gonococcus

GU: genitourinary

HIV: human immunodeficiency virus

HoLEP: holmium laser enucleation of the prostate gland

HPV: human papillomavirus

HSV: herpes simplex virus

LUTS: lower urinary tract symptoms

NGU: nongonococcal urethritis

NSV: no-scalpel vasectomy

PSA: prostate-specific antigen

PVP: photoselective vaporization of the prostate gland

RP: radical prostatectomy

STD: sexually transmitted disease

STI: sexually transmitted infection

TRUS: transrectal ultrasound

TSE: testicular self-examination

TUIP: transurethral incision of the prostate gland

TUMT: transurethral microwave thermotherapy

TURP: transurethral resection of the prostate gland

VD: venereal disease

Medical Terms Practice

For each card, click the speaker icon to hear the correct pronunciation of the listed term. Practice saying the term to yourself, then attempt to define the term from memory. Click “Turn” to flip the card and see the definition. Use the right and left arrows to toggle through the cards in each set.



An interactive H5P element has been excluded from this version of the text. You can view it online here:

<https://louis.pressbooks.pub/medicalterminology/?p=1640#h5p-33>

PRACTICE

The following activities will allow you to practice what you've learned in this chapter.

Male Reproductive System Anatomy

Click and drag each term to the box corresponding with the anatomic structure, body part, body plane, or body region for that term.



An interactive H5P element has been excluded from this version of the text. You can view it online here:

<https://louis.pressbooks.pub/medicalterminology/?p=2143#h5p-34>

Medical Report

Click and drag each term from the word bank to its correct place in this exercise.



An interactive H5P element has been excluded from this version of the text. You can view it online here:

<https://louis.pressbooks.pub/medicalterminology/?p=2143#h5p-38>

Vocabulary Reinforcement Activity

Click the term that correctly answers each question or completes each sentence.



An interactive H5P element has been excluded from this version of the text. You can view it online here:

<https://louis.pressbooks.pub/medicalterminology/?p=2143#h5p-39>

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PART XV

FEMALE REPRODUCTIVE SYSTEM

Learning Objectives

When completing this chapter, the learner will be able to do the following:

- Identify the anatomy of the female reproductive system
- Describe the main functions of the female reproductive system
- Spell the medical terms of the female reproductive system and use correct abbreviations
- Identify the medical specialties associated with the female reproductive system
- Explore common diseases, disorders, and procedures related to the female reproductive system

Introduction to Female Reproductive System

This chapter examines the structure and function of how the female reproductive system operates. The female reproductive system functions to produce gametes and reproductive hormones. In addition, the female reproductive system supports the developing **fetus** and delivers it to the outside world. The female reproductive system is located primarily inside the pelvic cavity. The female gonads are called **ovaries**, and the gamete they produce is called an **oocyte**.

Watch this video:



One or more interactive elements has been excluded from this version of the text. You can view them online here: <https://louis.pressbooks.pub/medicalterminology/?p=1424#oembed-1>

Media 51.1 [The Female Reproductive System, Part 1: Crash Course A&P #40](#) [Online video].

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ANATOMY AND PHYSIOLOGY OF THE FEMALE REPRODUCTIVE SYSTEM

Anatomy of the Female Reproductive System

The anatomy of the female reproductive system consists of structures that include the external female genitals and internal female reproductive organs. They are described below.

External Female Genitals

The external female reproductive structures are referred to collectively as the **vulva** and include the **mons pubis**, the **labia majora**, and the **labia minora**.

The **mons pubis** is a pad of fat that is located at the anterior, over the pubic bone. After puberty, it becomes covered in pubic hair.

The **labia majora** (labia = “lips”; majora = “larger”) are folds of hair-covered skin that begin just posterior to the mons pubis.

The **labia minora** (labia = “lips”; minora = “smaller”) is thinner and more pigmented and extends medially to the labia majora. Although they naturally vary in shape and size from woman to woman, the labia minora serve to protect the female urethra and the entrance to the female reproductive tract.

The superior, anterior portions of the labia minora come together to encircle the **clitoris** (or glans clitoris), an organ that originates from the same cells as the glans penis and has abundant nerves that make it important in sexual sensation and orgasm. The **hymen** is a thin membrane that sometimes partially covers the entrance to the vagina.

The **vaginal opening** is located between the opening of the urethra and the anus. It is flanked by outlets to the **Bartholin’s glands**.

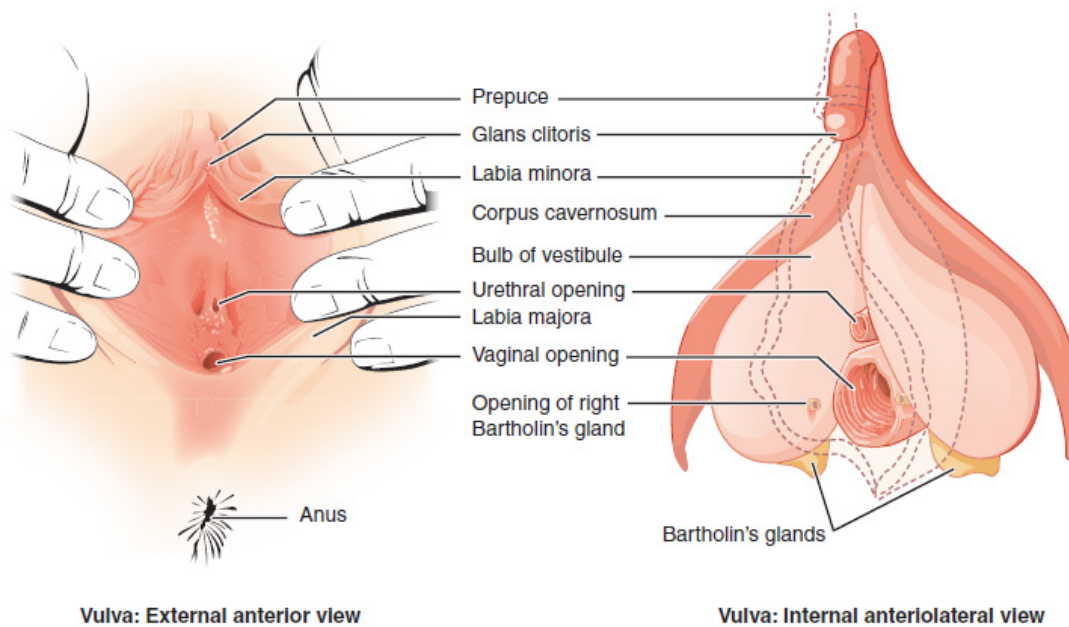


Figure 15.1 The Vulva. The external female genitalia are referred to collectively as the vulva. From Betts, et al., 2013. Licensed under [CC BY 4.0](#). [\[Image description.\]](#)

Internal Female Reproductive Organs

Vagina

The **vagina** is a muscular canal (approximately 10 cm long) that is the entrance to the reproductive tract. It also serves as the exit from the uterus during menses and childbirth. The outer walls of the anterior and posterior vagina are columns with ridges. The superior fornix meets the uterine cervix. The cervix is the opening to the uterus.

The walls of the vagina are lined with:

- An outer, fibrous adventitia
- A middle layer of smooth muscle
- An inner mucous membrane with transverse folds (called rugae)

Together, the middle and inner layers allow the expansion of the vagina to accommodate intercourse and childbirth. The thin, perforated hymen can partially surround the opening to the vaginal orifice. The **Bartholin's glands** and the **lesser vestibular glands** (located near the clitoris) secrete mucus, which keeps the vestibular area moist.

The vagina has a normal population of microorganisms that help to protect against infection. There are both pathogenic bacteria and yeast in the vagina. In a healthy woman, the most predominant type of

vaginal bacteria is from the genus *Lactobacillus*, which secretes lactic acid. Lactic acid protects the vagina by maintaining an acidic pH (below 4.5).

Lactic acid, in combination with other vaginal secretions, makes the vagina a self-cleansing organ. However, douching can disrupt the normal balance of healthy microorganisms and increase a woman's risk for infections and irritation. It is recommended that women do not douche and that they allow the vagina to maintain its normal healthy population of protective microbial flora.

Ovaries

The **ovaries** are the female gonads. There are two, one at each entrance to the fallopian tube. They are each about 2 to 3 cm in length, about the size of an almond. The ovaries are located within the pelvic cavity. The ovary itself is attached to the uterus via the ovarian ligament. The ovarian stroma forms the bulk of the adult ovary. **Oocytes** develop within the outer layer of this stroma, each surrounded by supporting cells. This grouping of an oocyte and its supporting cells is called a **follicle**.

The Fallopian Tubes

The **fallopian tubes** are the conduit of the oocyte from the ovary to the uterus. Each of the two fallopian tubes is close to, but not directly connected to, the ovary.

- The isthmus is the narrow medial end of each uterine tube that is connected to the uterus.
- The wide distal infundibulum flares out with slender, finger-like projections called fimbriae.
- The middle region of the tube, called the **ampulla**, is where fertilization often occurs.

The fallopian tubes have three layers:

- An outer serosa
- A middle smooth muscle layer
- An inner mucosal layer

In addition to its mucus-secreting cells, the inner mucosa contains ciliated cells that beat in the direction of the uterus, producing a current that will be critical to moving the oocyte.

The Uterus and Cervix

The **uterus** is the muscular organ that nourishes and supports the growing embryo. Its average size is approximately 5 cm wide by 7 cm long, and it has three sections:

- The portion of the uterus superior to the opening of the uterine tubes is called the fundus.
- The middle section of the uterus is called the body of the uterus (or corpus).
- The cervix is the narrow inferior portion of the uterus that projects into the vagina.

The **cervix** produces mucus secretions that become thin and stringy under the influence of high systemic plasma estrogen concentrations, and these secretions can facilitate sperm movement through the reproductive tract.

The wall of the uterus is made up of three layers:

- **Perimetrium:** the most superficial layer and serous membrane.
- **Myometrium:** a thick layer of smooth muscle responsible for uterine contractions.
- **Endometrium:** the innermost layer containing a connective tissue lining covered by epithelial tissue that lines the lumen. It provides the site of implantation for a fertilized egg and sheds during menstruation if no egg is fertilized.

Physiology of the Female Reproductive System

Following ovulation, the fallopian tube receives the oocyte. Oocytes lack flagella and therefore cannot move on their own.

High concentrations of estrogen that occur around the time of ovulation induce contractions of the smooth muscle along the length of the fallopian tube. These contractions occur every 4 to 8 seconds, causing the oocyte to flow toward the uterus through the coordinated beating of the cilia that line the outside and lumen of the length of the fallopian tube which pulls the oocyte into the interior of the tube. Once inside, the muscular contractions and beating cilia move the oocyte slowly toward the uterus. When fertilization does occur, sperm typically meet the egg while it is still moving through the ampulla.

Watch this [video on ovulation from MedlinePlus](#) to observe ovulation and its initiation in response to the release of FSH and LH from the pituitary gland.

Media 10.2. Ovulation. From Betts, et al., 2013. Licensed under [CC BY 4.0](#).

The Menstrual Cycle

The three phases of the menstrual cycle are:

- The **menses phase** of the menstrual cycle is the phase during which reproductive hormone levels are low, the woman menstruates, and the lining is shed. The menses phase lasts between 2–7 days with an average of 5 days.
- The **proliferative phase** is when menstrual flow ceases and the endometrium begins to proliferate (regrow). During this phase, reproductive hormones are working in homeostasis to trigger ovulation on approximately day 14 of a typical 28-day menstrual cycle. Ovulation marks the end of the proliferative phase.
- The **secretory phase** is when the endometrial lining prepares for the implantation of a fertilized egg. If no pregnancy occurs within approximately 10–12 days, the endometrium will grow thinner and shed starting the first day of the next cycle.

Image Descriptions

Figure 15.1 image description: This figure shows the parts of the vulva. The right panel shows the external anterior view and the left panel shows the internal anterolateral view. The major parts are labeled (from top): prepuce, glans clitoris, labia minora, corpus cavernosum, bulb of vestibule, urethral opening, labia majora, vaginal opening, opening of right Bartholin's gland, Bartholin's glands, anus. [\[Return to Figure 15.1\]](#).

WORD PARTS AND STRUCTURAL TERMS

Combining Forms

arche/o: first, beginning

cervic/o: cervix

colp/o: vagina

endometri/o: endometrium

episi/o: vulva

gyn/o: woman

gynec/o: woman

hymen/o: hymen

hyster/o: uterus

mamm/o: breast

mast/o: breast

men/o: menstruation

metr/o: uterus

metr/i: uterus

oophor/o: ovary

pelv/i: pelvis, pelvic bones, pelvic cavity

perine/o: perineum

salping/o: uterine tube, fallopian tube

trachel/o: cervix

vagin/o: vagina

vulv/o: vulva

Prefixes

a-: absence of, without

an-: absence of, without

anti-: opposed to, against

dys-: painful, difficult, abnormal, labored

endo-: within

peri-: surrounding

poly-: much or many

Suffixes

-al: pertaining to

-atresia: occlusion, closure

-clesis: surgical closure

-ectomy: excision, surgical removal

-gram: record, image

-graphy: process of recording or imaging

-itis: inflammation

-logist: specialist or physician who studies and treats

-logy: study of

-osis: abnormal condition

-pexy: surgical fixation, suspension

-plasty: surgical repair

-rrhaphy: suturing, repairing

-rrhea: flow, discharge

-salpinx: uterine tube

-scope: instrument used for visual examination

-scopy: visually examining

-tomy: cut into, incision

Structural Terms Built from Word Parts

cervical: pertaining to the cervix

ovarian: pertaining to one or both ovaries

tubal: pertaining to one or both fallopian tubes

uterine: pertaining to the uterus

vaginal: pertaining to the vagina

vulval: pertaining to the vulva

Female Reproductive System Medical Terms

androgens: male hormones.

antiandrogens: a group of medications that counteract the effects of male hormones

contraception: intentional prevention of conception (pregnancy)

menarche: first menstrual period

oocyte: female gamete

ovulation: release of ovum from a mature Graafian follicle

DISEASES AND DISORDERS

Disease and Disorder Terms Built from Word Parts

amenorrhea: absence of periods

Bartholin adenitis: inflammation of a Bartholin gland

cervicitis: irritation or infection of the cervix

colpitis: inflammation of the vagina

dysmenorrhea: painful periods

dyspareunia: painful intercourse

endocervicitis: inflammation of the cervical lining

endometriosis: a condition resulting from the appearance of endometrial tissue outside the uterus and causing pelvic pain

endometritis: inflammation of the uterine lining

hematosalpinx: blood in a fallopian tube

hydrosalpinx: fluid trapped within a swollen fallopian tube

hysteratresia: closure of the uterus

mastitis: inflammation of a breast or breast tissue

menometrorrhagia: heavy flow of blood, both during menstruation and between menstrual periods

menorrhagia: heavy flow of blood during menstruation

metrorrhagia: heavy flow of blood between menstrual periods

myometritis: inflammation of the myometrium

oligomenorrhea: infrequent or irregular periods

oophoritis: inflammation of one or both ovaries

perimetritis: inflammation of the perimetrium

polymenorrhea: excessive bleeding during one's period

pyosalpinx: pus in a fallopian tube

salpingitis: inflammation of one or both fallopian tubes

vaginitis: inflammation of the vagina

vulvovaginitis: inflammation of the vulva and vagina

Disease and Disorder Terms Not Built from Word Parts

acanthosis nigricans: a disorder that causes darkening and thickening of the skin on the neck, groin, underarms, or skin folds

adenomyosis: growth of endometrial tissue into the myometrium

breast cancer: a disease in which cells in the breast grow out of control

cervical cancer: a disease in which cells in the cervix grow out of control

ectopic pregnancy: a pregnancy in which the fetus develops outside of the uterus

fibrocystic breast disease: benign cysts that grow within breast tissue; can grow and shrink with different phases of the menstrual cycle

fibroid tumor: benign tumor of uterine muscle

fistula: abnormal passageway between two organs or an internal organ and the body surface

ovarian cancer: a disease in which cells in the ovary grow out of control

pelvic inflammatory disease: inflammation of the female reproductive tract usually caused by untreated gonorrhea or chlamydia; major cause of infertility and ectopic pregnancy

polycystic ovarian syndrome (PCOS): a hormonal disorder in which the ovaries produce an abnormal amount of androgens

prolapsed uterus: displacement of the uterus from its normal position

toxic shock syndrome: infection by certain *Staphylococcus aureus* strains in the vagina; can lead to sepsis and septic shock

MEDICAL, SURGICAL, & VIEWING TERMS AND ABBREVIATIONS

Medical Careers & Professional Terminology

gynecologist: a physician who deals with the function and diseases specific to women's and girls' reproductive systems

gynecology: the study of the female reproductive system

obstetrician: a physician qualified to deliver children

obstetrics: the medical specialty concerned with childbirth

reproductive endocrinologist: a physician who has special training in the diagnosis and treatment of infertility

Imaging Techniques/Procedures for the Organ System

colposcope: device for viewing the vagina

endoscopy: process of viewing internally

hysterosalpingography: an x-ray exam of the uterus and fallopian tubes

laparoscopy: a surgical procedure in which a fiber-optic instrument is inserted through the abdominal wall to view the organs in the abdomen or to permit a surgical procedure

mammogram: an image obtained through mammography

mammography: a technique using x-rays to diagnose and locate tumors of the breasts

pelvic sonography: using ultrasound to visualize the pelvic organs, such as during pregnancy

transvaginal sonography: using an ultrasound wand inserted into the vagina to visualize the pelvic organs

Medical and Surgical Techniques/Procedures Used for the Organ System

cervicectomy: excision of all or part of the cervix

colpoplasty: surgical repair of the vagina

colporrhaphy: surgical suturing of the vagina

douching: washing the vagina with fluid

endometrial ablation: removal of endometrial tissue through use of a laser

episiotomy: surgical incision of the vulva

episiorrhaphy: surgical repair of the vulva

hysterectomy: surgical removal of the uterus

hysteropexy: surgical fixation of the uterus

hysterosalpingo-oophorectomy: excision of the uterus, uterine tubes, and ovaries

mammoplasty: surgical repair of the breast, particularly after a mastectomy

mastectomy: excision of breast(s) and or breast tissue

myomectomy: surgical removal of a fibroid tumor

oophorectomy: surgical removal of one or both ovaries

Papanicolaou smear (Pap smear): a smear method for examining cells that is used to detect cancers of the cervix

perineorrhaphy: surgical repair of the perineum

salpingectomy: surgical removal of one or both uterine tubes

salpingo-oophorectomy: surgical removal of one or both uterine tubes and ovaries

salpingostomy: creation of an opening within a fallopian tube

speculum: instrument for opening a body cavity to allow visual inspection

tubal ligation: surgical closure of the fallopian tubes for sterilization

Abbreviations Commonly Used with the Organ System

BC: birth control

Cx: cervix

D&C: dilation and curettage

FBD: fibrocystic breast disease

GYN: gynecology

HPV: human papillomavirus

HRT: hormone replacement therapy

HSG: hysterosalpingogram

IUD: intrauterine device

LAVH: laparoscopically assisted vaginal hysterectomy

PCOS: polycystic ovarian syndrome

PID: pelvic inflammatory disease

PMS: premenstrual syndrome

SGH: sonohysterography

TAH/BSO: total abdominal hysterectomy/bilateral salpingo-oophorectomy

TLH: total laparoscopic hysterectomy

TSS: toxic shock syndrome

TVH: total vaginal hysterectomy

TVS: transvaginal sonography

UAE: uterine artery embolization

Medical Terms Practice

For each card, click the speaker icon to hear the correct pronunciation of the listed term. Practice saying the term to yourself, then attempt to define the term from memory. Click “Turn” to flip the card and see the definition. Use the right and left arrows to toggle through the cards in each set.



An interactive H5P element has been excluded from this version of the text. You can view it online here:

<https://louis.pressbooks.pub/medicalterminology/?p=1657#h5p-41>

PRACTICE

The following activities will allow you to practice what you've learned in this chapter.

Female Reproductive Anatomy

Click and drag each term to the box corresponding with the anatomic structure, body part, body plane, or body region for that term.



An interactive H5P element has been excluded from this version of the text. You can view it online here:

<https://louis.pressbooks.pub/medicalterminology/?p=2147#h5p-42>

Medical Report—1

Click and drag each term from the word bank to its correct place in this exercise.



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<https://louis.pressbooks.pub/medicalterminology/?p=2147#h5p-45>

Medical Report—2

Click and drag each term from the word bank to its correct place in this exercise.



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<https://louis.pressbooks.pub/medicalterminology/?p=2147#h5p-46>

Consultation Report

Click and drag each term from the word bank to its correct place in this exercise.



An interactive H5P element has been excluded from this version of the text. You can view it online here:

<https://louis.pressbooks.pub/medicalterminology/?p=2147#h5p-47>

Vocabulary Reinforcement Activity

Click the term that correctly answers each question or completes each sentence.



An interactive H5P element has been excluded from this version of the text. You can view it online here:

<https://louis.pressbooks.pub/medicalterminology/?p=2147#h5p-48>

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PART XVI

EMBRYOLOGY, PREGNANCY, AND NEONATOLOGY

Learning Objectives

When completing this chapter, the learner will be able to do the following:

- Identify the common processes in obstetrics
- Describe the specialty of obstetrics
- Spell and pronounce the medical terms used in obstetrics and use correct abbreviations
- Identify the medical specialties associated with obstetrics and neonatology
- Explore common complications and procedures related to obstetrics and neonatology

Introduction

Obstetrics is a specialty that is concerned with the mother and fetus during pregnancy, childbirth, and the immediate postpartum period. Obstetricians study obstetrics and gynecology and are referred to as OB/GYNs (obstetrics and gynecology).

Watch this video:



One or more interactive elements has been excluded from this version of the text. You can view them online here: <https://louis.pressbooks.pub/medicalterminology/?p=1426#oembed-1>

Media 16.1. [Reproductive System, Part 4—Pregnancy & Development: Crash Course A&P #43](#)
[Online video]. Copyright 2015 by [CrashCourse](#).

FERTILIZATION AND CHILDBIRTH

Fertilization

Fertilization occurs when a sperm and an oocyte (egg) combine. Because each of these reproductive cells is a **haploid** cell containing half of the genetic material needed to form a human being, their combination forms a **diploid** cell. This new single cell is called a **zygote**. Most of the time, a woman releases a single egg during an ovulation cycle. In approximately 1 percent of ovulation cycles, two eggs are released and both are fertilized. Two zygotes form, implant, and develop, resulting in the birth of **dizygotic** (or fraternal) twins. Because dizygotic twins develop from two eggs fertilized by two sperm, they are no more identical than siblings born at different times. Less common, one zygote can divide into two separate offspring during early development. This results in the birth of **monozygotic** (or identical) twins.

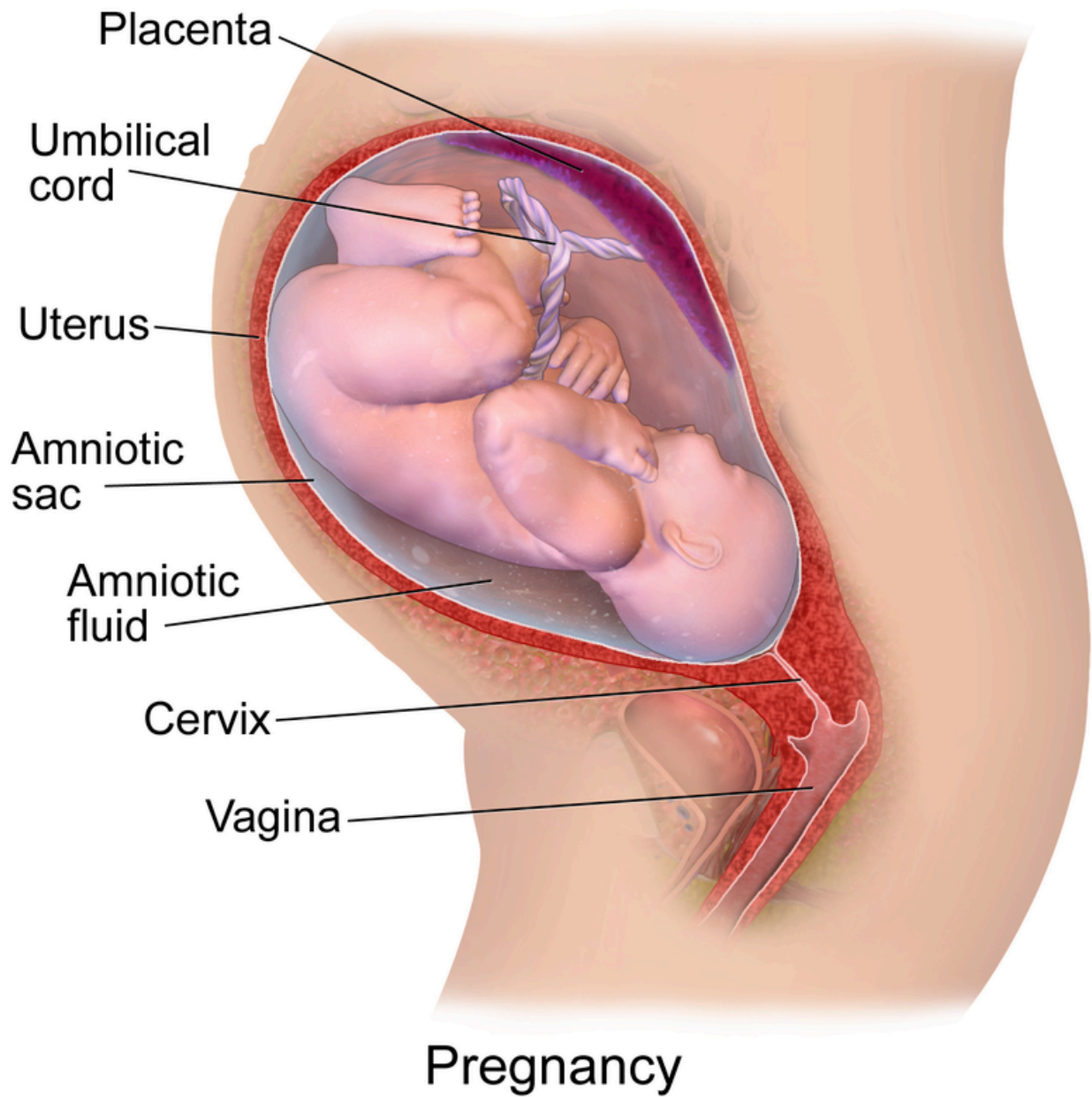


Figure 16.1 A gravid uterus and fetus during the last trimester of pregnancy. From Blausen.com staff, 2014. Licensed under [CC BY 3.0](#). [\[Image description.\]](#)

Stages of Childbirth

The process of childbirth can be divided into three stages (see [Figure 16.2](#)):

1. Cervical dilation
2. Expulsion of the newborn
3. After birth

For vaginal birth to occur, the cervix must dilate fully to 10 cm in diameter, wide enough to deliver the newborn's head. The dilation stage is the longest stage of labor and typically takes 6–12 hours. However, it varies widely and may take minutes, hours, or days, depending in part on whether the mother has given birth before. In each subsequent labor, this stage tends to be shorter.

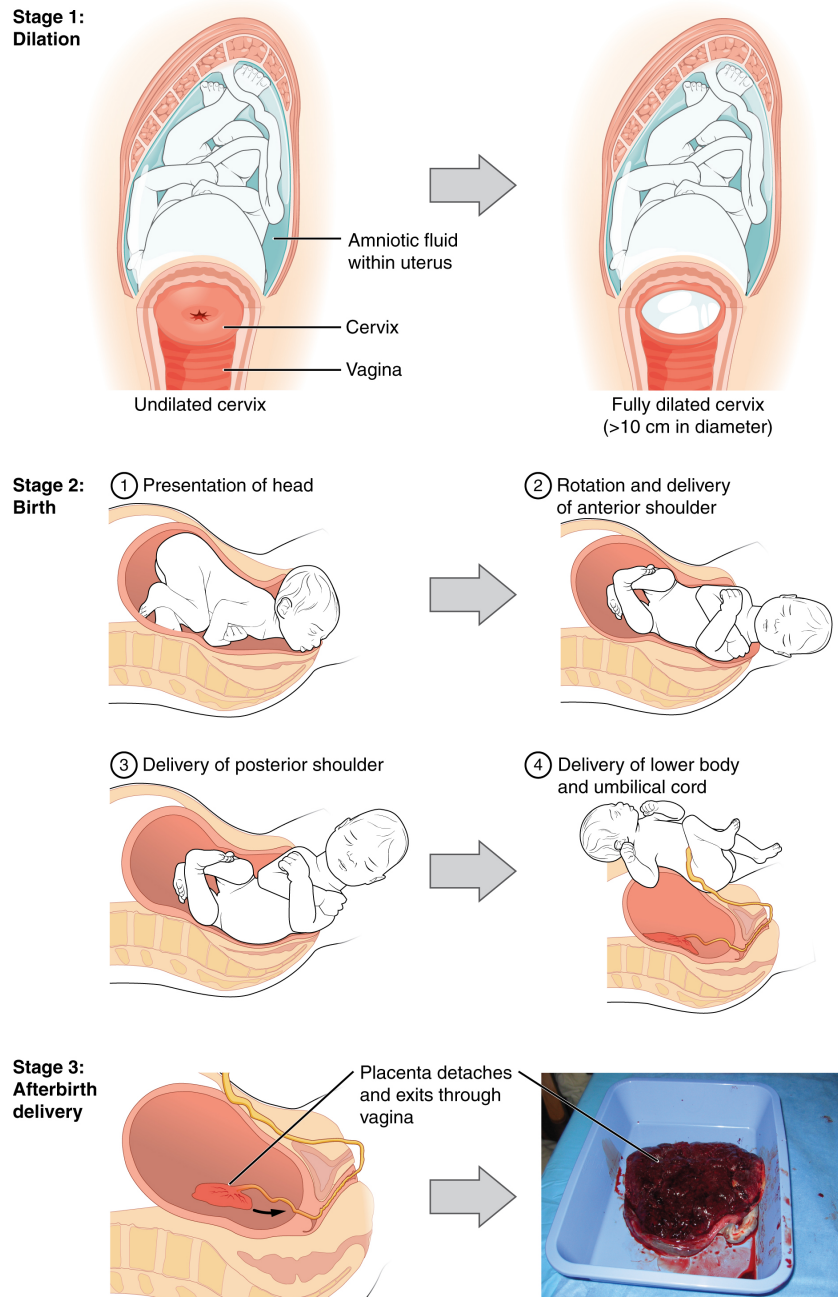


Figure 16.2 Stages of Childbirth. The stages of childbirth include Stage 1, early cervical dilation; Stage 2, full dilation and expulsion of the newborn; and Stage 3, delivery of the placenta and associated fetal membranes. (The position of the newborn's shoulder is described relative to the mother.) From Betts, et al., 2013. Licensed under [CC BY 4.0](#). [Image description.]

Homeostasis in the Newborn: Apgar Score

In the minutes following birth, a newborn must undergo dramatic systemic changes to be able to survive

outside the womb. An obstetrician, midwife, or nurse can estimate how well a newborn is doing by obtaining an Apgar score. The Apgar score was introduced in 1952 by the anesthesiologist Dr. Virginia Apgar as a method to assess the effects on the newborn of anesthesia given to the laboring mother. Health care providers now use it to assess the general well-being of the newborn, whether or not analgesics or anesthetics were used.

The five criteria—skin color, heart rate, reflex, muscle tone, and respiration—are assessed, and each criterion is assigned a score of 0, 1, or 2. Scores are taken at 1 minute after birth and again at 5 minutes after birth. Each time scores are taken, the five scores are added together. High scores (out of a possible 10) indicate the baby has made the transition from the womb well, whereas lower scores indicate that the baby may be in distress.

The technique for determining an Apgar score is quick and easy, is painless for the newborn, and does not require any instruments except for a stethoscope. A convenient way to remember the five scoring criteria is to apply the mnemonic APGAR:

1. Appearance (skin color)
2. Pulse (heart rate)
3. Grimace (reflex)
4. Activity (muscle tone)
5. Respiration

Of the five Apgar criteria, heart rate and respiration are the most critical. Poor scores for either of these measurements may indicate the need for immediate medical attention to resuscitate or stabilize the newborn. In general, any score lower than 7 at the 5-minute mark indicates that medical assistance may be needed. A total score below 5 indicates an emergency situation. Normally, a newborn will get an intermediate score of 1 for some of the Apgar criteria and will progress to a 2 by the 5-minute assessment. Scores of 8 or above are normal.

Image Descriptions

Figure 16.1 image description: This figure shows a gravid uterus and fetus during the last trimester of pregnancy. It shows the placenta, umbilical cord, uterus, amniotic sac, amniotic fluid, cervix, and vagina. [\[Return to Figure 16.1\].](#)

Figure 16.2 image description: This multi-part figure shows the different stages of childbirth. The top panel shows dilation of the cervix (undilated vs. fully dilated), the middle panel shows birth (presentation of the head, rotation and delivery of anterior shoulder, delivery of posterior shoulder, delivery of lower body and umbilical cord), and the bottom panel shows afterbirth delivery. [\[Return to Figure 16.2\].](#)

WORD PARTS AND OBSTETRIC & NEONATOLOGY TERMS

Combining Forms

amni/o: amnion, amniotic fluid

cephal/o: head

chori/o: chorion

embry/o: embryo

esophag/o: esophagus

fet/i: fetus, unborn offspring

fet/o: fetus, unborn offspring

gravid/o: pregnancy

lact/o: milk

nat/o: birth

omphal/o: umbilicus, navel

par/o, part/o: to bear, labor, childbirth, give birth to

prim/i: first

pseud/o: false

puerper/o: childbirth

pylor/o: pylorus, pyloric sphincter

terat/o: malformation

Prefixes

ante-: before

dys-: painful, labored, difficult

micro-: small

multi-: many

neo-: new

nulli-: none

post-: after

pre-: before

Suffixes

- a:** no meaning, noun ending
- al:** pertaining to (adjective)
- amnios:** amnion, amniotic fluid (noun)
- cyesis:** pregnancy (noun)
- e:** noun ending, no meaning
- gen:** substance that produced, agent that produced (noun)
- genic:** producing, originating, causing (adjective)
- graphy:** process of recording (noun)
- ic:** pertaining to (adjective)
- is:** noun suffix, no meaning
- itis:** inflammation (noun)
- logist:** specialist who studies and treats, physician who studies and treats (noun)
- logy:** study of (noun)
- oid:** resembling (adjective)
- oma:** tumor (noun)
- rrhea:** discharge, flow (noun)
- rrhexis:** rupture (noun)
- stenosis:** constriction, narrowing (noun)
- tocia:** birth, labor (noun)
- tomy:** incision, cut into (noun)
- um:** noun ending, no meaning
- us:** noun ending, no meaning

Obstetric and Neonatology Terms Built from Word Parts

- amniochorial:** pertaining to the amnion and chorion
- amniorrhea:** flow of amniotic fluid
- amniotic:** pertaining to the amnion
- amniorrhexis:** rupture of the amnion
- antepartum:** before childbirth (referring to the gestational parent)

embryogenic: pertaining to producing an embryo

embryoid: resembling an embryo

embryonic: pertaining to the embryo

fetal: pertaining to the fetus

gravida: pregnant gestational parent

gravidopuerperal: pertaining to the time period around pregnancy and childbirth

intrapartum: occurring during labor or delivery

lactic: pertaining to milk

lactogenic: pertaining to milk production

lactorrhea: flow of milk

multigravida: a gestational parent who has had two or more pregnancies

multipara: a gestational parent who has given birth two or more times

natal: pertaining to birth

neonate: a newborn infant

neonatal: pertaining to a newborn infant

nulligravida: a gestational parent who has never been pregnant

nullipara: a gestational parent who has never given birth

para: a gestational parent who has given birth to an offspring after the point of viability, whether alive or stillborn

postpartum: pertaining to after childbirth (referring to the gestational parent)

prenatal: pertaining to before childbirth

primigravida: a gestational parent who is pregnant for the first time

primipara: a gestational parent who has given birth to their first offspring after the point of viability, whether alive or stillborn

puerpera: a gestational parent who has just given birth

puerperal: pertaining to a puerpera

puerperium: the time period between childbirth and when the reproductive organs return to normal (about six weeks)

teratogen: a substance capable of causing malformations in a developing embryo or fetus

teratogenic: pertaining to a teratogen

Obstetric and Neonatology Terms Not Built from Word Parts

breech presentation: when the full-term fetus is positioned with its feet or buttocks pointing down in the uterus

cephalic presentation: when the full-term fetus is positioned with its head pointing down in the uterus

embryo: the unborn child during weeks 5–10 of pregnancy

fetus: the unborn child beginning at week 11 of pregnancy

gestation: pregnancy

lactation: production of breastmilk

lochia: vaginal discharge consisting of blood, mucus, and uterine tissue that is shed for 4–6 weeks after childbirth

meconium: the first stool of a neonate

parturition: childbirth

premature infant: an infant born before 36 weeks' gestation

quickening: movement of the fetus in the uterus that can be felt by the gestational parent

zygote: the cell that forms when the genetic material of a sperm and an ovum combine during conception

DISEASES AND DISORDERS

Disease and Disorder Terms Built from Word Parts

amenorrhea: lack of menstrual flow

amnionitis: inflammation of the amnion

chorioamnionitis: inflammation of the chorion and amnion

choriocarcinoma: a malignant cancer of the chorion

dystocia: excessive pain or discomfort during labor

hysterorrhexis: rupture of the uterus

microcephalus: an infant born with a smaller head circumference than normal

oligohydramnios: a smaller amount of amniotic fluid than normal

omphalitis: inflammation of the umbilical cord stump of the newborn

omphalocele: a congenital anomaly; herniation of the area around the umbilicus of the newborn

polyhydramnios: a greater amount of amniotic fluid than normal

pseudocyesis: false pregnancy

pyloric stenosis: a pyloric sphincter that is smaller than normal in the newborn; can cause projectile vomiting

tracheoesophageal fistula: a condition where the trachea and esophagus are joined together in the newborn

Disease and Disorder Terms Not Built from Word Parts

abruptio placentae: occurs when the placenta prematurely becomes detached from the uterine wall; this is a medical emergency and requires an immediate C-section

cephalopelvic disproportion: a condition where the infant's head is larger than the pelvic outlet and therefore will require a C-section

cleft lip / cleft palate: a congenital anomaly; an opening or fissure in the lip, hard palate, and/or soft palate

congenital anomaly: a defect present at birth

eclampsia: a very serious condition in pregnancy with hypertension; patients are at high risk of coma, convulsions, and even death

ectopic pregnancy: the embryo implants and starts developing in any other place but the inner uterine lining

erythroblastosis fetalis / hemolytic disease of the newborn: a condition where an Rh- gestational parent makes antibodies against an Rh+ fetus, leading to the destruction of the fetus's red blood cells and possible miscarriage, stillbirth, or severe anemia

fetal alcohol syndrome: a condition caused by the gestational parent drinking too much alcohol during pregnancy; leads to characteristic facial features and often developmental disabilities and personality changes as well

gastroschisis: a congenital anomaly in which the infant's intestines extend outside of the abdomen through a hole next to the umbilicus

gestational diabetes: the condition of developing diabetes during pregnancy; the newborn tends to be large at delivery, and the gestational parent is monitored closely for weight gain and glucose testing

gestational hypertension: a condition where there is an increase in blood pressure during pregnancy; blood pressure is monitored closely during pregnancy for the safety of the gestational parent and infant

hyperemesis gravidarum: excessive vomiting during pregnancy

meconium aspiration: when the fetus inhales meconium during delivery

placenta previa: when the placenta partially or completely covers the cervical os (opening)

preeclampsia: an abnormal condition in pregnancy where the patient experiences hypertension, edema, and proteinuria

respiratory distress syndrome: a common breathing disorder in premature infants where they are unable to produce enough surfactant in their lungs

spina bifida: a congenital anomaly in which there is incomplete closing of the spine and the membranes around the spinal cord during early development in pregnancy

stillbirth: when an infant is born dead

MEDICAL, SURGICAL, & VIEWING TERMS AND ABBREVIATIONS

Medical Careers & Professional Terminology

doula: a trained non–health care professional who provides physical, emotional, and informational support to parents before, during, and after childbirth

lactation consultant: a health professional who helps new parents and infants with lactation and breastfeeding

midwife: a health professional who cares for mothers and newborns around childbirth

midwifery: the practice of being a midwife

neonatologist: a physician who specializes in newborn infant care

neonatology: the study or medical specialization of newborn care

obstetrician: a physician who specializes in delivering infants

obstetrics: the study or medical specialization of delivering infants

teratologist: a scientist or physician who specializes in abnormal fetal development

teratology: the study or medical specialization of abnormal fetal development

Imaging Techniques/Procedures for the Organ System

amnioscope: the device used to visually examine the amnion

amniocopy: the process of using an amnioscope to visually examine the amnion

pelvic sonography: visual examination of the pregnancy using ultrasound

Medical, Diagnostic, and Surgical Techniques/Procedures Used for the Organ System

abortion: a miscarriage or elective ending of a pregnancy

alpha-fetoprotein test: a test to measure the amount of alpha-fetoprotein, produced in the liver of the developing fetus, in the gestational parent's blood

amniocentesis: a procedure that uses a needle to aspirate amniotic fluid for prenatal testing

artificial insemination: introducing semen into the vagina by mechanical/artificial means

cesarean section: delivery of a baby via abdominopelvic surgery

cephalic version: a procedure performed to turn a fetus from a breech or transverse presentation to a cephalic presentation prior to birth

cerclage: stitching the cervix to maintain a pregnancy

chorionic villus sampling: a biopsy taken of a chorionic villus for prenatal testing

dilation & curettage: dilating the cervix and scraping the uterine wall; used after a miscarriage or for obtaining tissue samples for testing purposes

episiotomy: a cut made in the vulva to facilitate a vaginal delivery

gamete intrafallopian transfer: injection of sperm cells and oocytes into a fallopian tube to aid in conception

induction: a medical process that causes labor to begin

in vitro fertilization: fertilization of oocytes with sperm that takes place in a Petri dish (see Figure 16.3)

intrauterine insemination: injecting washed semen directly into the uterus to aid in conception

non-stress test: test to measure fetal heart rate and movement in the latter stages of pregnancy

vaginal birth after cesarean section: delivering a baby vaginally after having a previous cesarean section

zygote intrafallopian transfer: injection of a zygote into a fallopian tube, after which implantation in the uterus may occur (see [Figure 16.3](#))

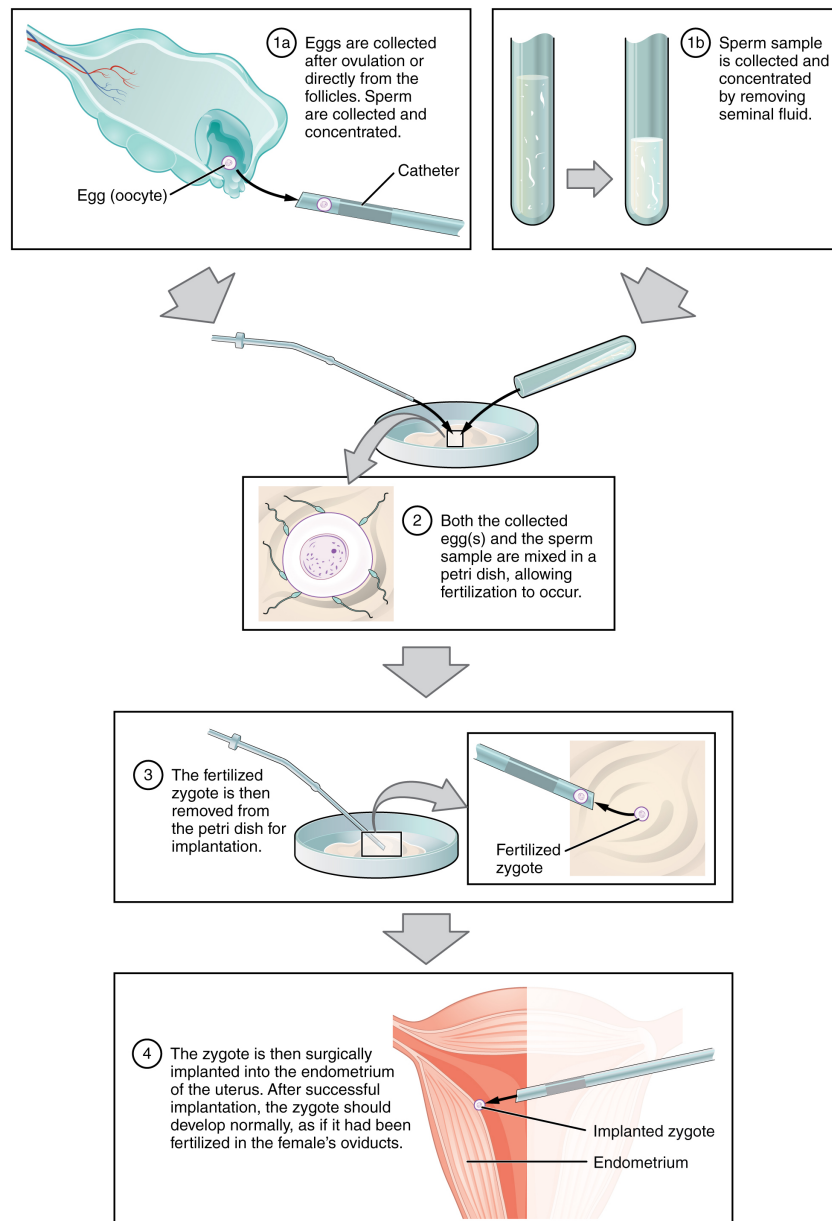


Figure 16.3 IVF. In vitro fertilization involves egg collection from the ovaries, fertilization in a petri dish, and the transfer of embryos into the uterus. From Betts, et al., 2013. Licensed under [CC BY 4.0](https://creativecommons.org/licenses/by/4.0/). [\[Image description.\]](#)

Abbreviations Commonly Used with the Organ System

AB: abortion

AFP: alpha-fetoprotein test

AI: artificial insemination

CS, C-section: cesarean section
CVS: chorionic villus sampling
D&C: dilation and curettage
DOB: date of birth
EDD: expected or estimated date of delivery
FAS: fetal alcohol syndrome
GIFT: gamete intrafallopian transfer
HDN: hemolytic disease of the newborn
HG: hyperemesis gravidarum
IUI: intrauterine insemination
IVF: in vitro fertilization
LMP: last menstrual period
multip: multipara
NB: newborn
OB: obstetrics
primip: primipara
RDS: respiratory distress syndrome
VBAC: vaginal birth after cesarean section
ZIFT: zygote intrafallopian transfer

Medical Terms Practice

For each card, click the speaker icon to hear the correct pronunciation of the listed term. Practice saying the term to yourself, then attempt to define the term from memory. Click “Turn” to flip the card and see the definition. Use the right and left arrows to toggle through the cards in each set.



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<https://louis.pressbooks.pub/medicalterminology/?p=1451#h5p-50>

Image Descriptions

Figure 16.3 image description: This multi-part figure shows the different steps in in vitro fertilization. The

top panel shows how the oocytes and the sperm are collected and prepared. (text label reads: 1a) Eggs are collected after ovulation or directly from the follicles. Sperm are collected and concentrated. (text label reads: 1b) Sperm sample is collected and concentrated by removing seminal fluid. The next panel shows the sperm and oocytes being mixed in a petri dish. (text label reads: 2) Both the collected eggs and the sperm sample are mixed in a petri dish, allowing fertilization to occur. The panel below that shows the fertilized zygote being prepared for implantation. (text label reads: 3a) The fertilized zygote is then removed from the petri dish for implantation. (text label reads: 3b) Fertilized zygote. The last panel shows the fertilized zygote being implanted into the uterus. (text label reads: 4) The zygote is then surgically implanted into the endometrium of the uterus. After successful implantation, the zygote should develop normally, as if it had been fertilized in the female's oviducts. [\[Return to Figure 16.3\]](#)

PRACTICE

The following activities will allow you to practice what you've learned in this chapter.

Pathology Report

Click and drag each term from the word bank to its correct place in this exercise.



An interactive H5P element has been excluded from this version of the text. You can view it online here:

<https://louis.pressbooks.pub/medicalterminology/?p=2151#h5p-53>

Vocabulary Reinforcement Activity

Click the term that correctly answers each question or completes each sentence.



An interactive H5P element has been excluded from this version of the text. You can view it online here:

<https://louis.pressbooks.pub/medicalterminology/?p=2151#h5p-54>

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PART XVII

EYE AND EAR

Learning Objectives

When completing this chapter, the learner will be able to do the following:

- Identify the anatomy of the eye and ear system
- Describe the main functions of the eye and ear
- Spell the eye and ear medical terms and use correct abbreviations
- Identify the medical specialties associated with the eye and ear (sight and sound)
- Explore common diseases, disorders, and procedures related to the eye and ear

Introduction

Two of the major senses are **hearing** and **sight**. However, these are not all of the senses. Within the realm of physiology, senses can be classified as either general or special. A general sense is one that is distributed throughout the body and has **receptor cells** within the structures of other organs. **Mechanoreceptors** in the skin, the muscles, or the walls of blood vessels are examples of this type. General senses often contribute to the sense of touch, which is most important to autonomic functions. A special sense is one that has a specific organ devoted to it—namely, the **eye** and **inner ear**.

VISION

Anatomy and Physiology of the Eye

Watch this video:



One or more interactive elements has been excluded from this version of the text. You can view them online here: <https://louis.pressbooks.pub/medicalterminology/?p=1438#oembed-1>

Media 17.1 [Vision: Crash Course A&P #18](#) [Online video]. Copyright 2015 by [CrashCourse](#).

Vision is the special sense of sight that is based on the transduction of light stimuli received through the eyes. The eyes are located within either orbit in the skull. The bony orbits surround the eyeballs, protecting them and anchoring the soft tissues of the eye (see [Figure 17.1](#)). The eyelids, with lashes at their leading edges, help to protect the eye from abrasions by blocking particles that may land on the surface of the eye.

The inner surface of each lid is a thin membrane known as the palpebral **conjunctiva**. The conjunctiva extends over the **sclera**, connecting the **eyelids** to the **eyeball**. Tears are produced by the lacrimal gland, located beneath the lateral edges of the nose. Tears produced by this gland flow through the lacrimal duct to the medial corner of the eye, where the tears flow over the conjunctiva, washing away foreign particles.

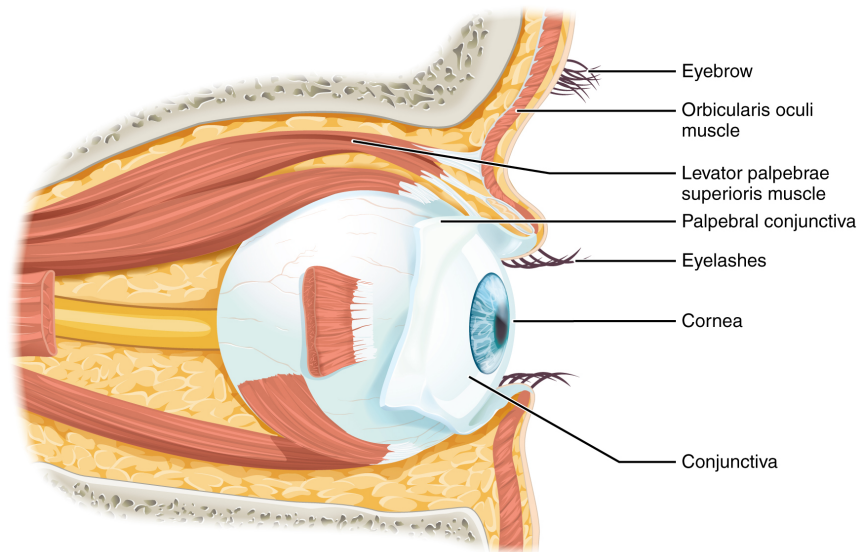


Figure 17.1 The Eye in the Orbit. The eye is located within the orbit and surrounded by soft tissues that protect and support its function. The orbit is surrounded by cranial bones of the skull. From Betts, et al., 2013. Licensed under [CC BY 4.0](#). [\[Image description.\]](#)

Movement of the eye within the orbit is accomplished by the contraction of six extraocular muscles that originate from the bones of the orbit and insert into the surface of the eyeball. Four of the muscles are arranged at the cardinal points around the eye and are named for those locations:

- superior rectus
- medial rectus
- inferior rectus
- lateral rectus

When each of these muscles contract, the eye moves toward the contracting muscle. For example, when the superior rectus contracts, the eye rotates to look up.

Tissue Layers

The eye itself is a hollow sphere composed of three layers of tissue.

The **outermost layer** is the fibrous tunic, which includes the white sclera and clear **cornea**. The sclera accounts for five-sixths of the surface of the eye, most of which is not visible, though humans are unique compared with many other species in having so much of the “white of the eye” visible (see [Figure 17.2](#)). The transparent cornea covers the anterior tip of the eye and allows light to enter the eye.

The **middle layer** of the eye is the vascular tunic, which is mostly composed of the **choroid**, **ciliary body**,

and **iris**. The choroid is a layer of highly vascularized connective tissue that provides a blood supply to the eyeball. The choroid is posterior to the ciliary body, a muscular structure that is attached to the lens by zonule fibers. These two structures bend the lens, allowing it to focus light on the back of the eye. Overlaying the ciliary body, and visible in the anterior eye, is the iris—the colored part of the eye. The iris is a smooth muscle that opens or closes the **pupil**, which is the hole at the center of the eye that allows light to enter. The iris constricts the pupil in response to bright light and dilates the pupil in response to dim light.

The **innermost layer** of the eye is the neural tunic, or **retina**, which contains the nervous tissue responsible for photoreception.

Cavities

The eye is also divided into two cavities: the **anterior cavity** and the **posterior cavity**.

The anterior cavity is the space between the cornea and lens, including the iris and ciliary body. It is filled with a watery fluid called the **aqueous humor**.

The posterior cavity is the space behind the lens that extends to the posterior side of the interior eyeball, where the retina is located. The posterior cavity is filled with a more viscous fluid called the **vitreous humor**.

Retina

The retina is composed of several layers and contains specialized cells for the initial processing of visual stimuli. The **photoreceptors** (**rods** and **cones**) change their membrane potential when stimulated by light energy. There are no photoreceptors at the very back of the eye, where the optic nerve begins. This creates a “blind spot” in the retina and a corresponding blind spot in our visual field.

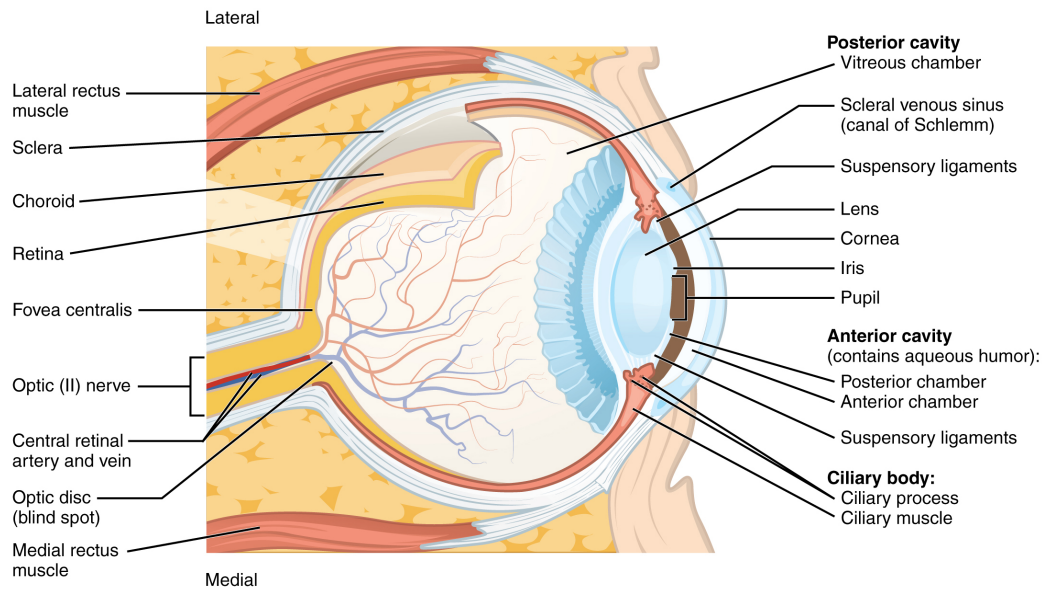


Figure 17.2 Structure of the Eye. The sphere of the eye can be divided into anterior and posterior chambers. The wall of the eye is composed of three layers: the fibrous tunic, vascular tunic, and neural tunic. Within the neural tunic is the retina, with three layers of cells and two synaptic layers in between. The center of the retina has a small indentation known as the fovea. From Betts, et al., 2013. Licensed under [CC BY 4.0](#). [\[Image description.\]](#)

Photoreceptors in the retina (rods and cones) are located behind the axons, RGCs (retinal ganglion cell), bipolar cells, and retinal blood vessels. A significant amount of light is absorbed by these structures before the light reaches the photoreceptor cells. At the exact center of the retina is a small area known as the **fovea**. At the fovea, the retina lacks the supporting cells and blood vessels and only contains photoreceptors. Therefore, **visual acuity** is greatest at the fovea. This is because the fovea is where the least amount of incoming light is absorbed by other retinal structures. As one moves in either direction from this central point of the retina, visual acuity drops significantly.

Image Descriptions

Figure 17.1 image description: This diagram shows the lateral view of the eye. The major parts are labeled. Labels read (from top): eyebrow, orbicularis oculi muscle, levator palpebrae superioris muscle, palpebral conjunctiva, eyelashes, cornea, conjunctiva. [\[Return to Figure 17.1\].](#)

Figure 17.2 image description: This diagram shows a lateral and medial view of the eyeball. The major parts are labeled. Labels read (from top, clockwise): posterior cavity (vitreous chamber, scleral venous sinus (canal of Schlemm), suspensory ligaments, lens, cornea, iris, pupil); anterior cavity (contains aqueous humor, posterior chamber, anterior chamber, suspensory ligaments); Ciliary body (ciliary process and muscle), medial

rectus muscle, optic disc (blind spot), central retinal artery and vein, fovea centralis, retina, choroid, sclera, lateral rectus muscle. [\[Return to Figure 17.2\].](#)

AUDITION

Anatomy and Physiology of the Ear

Watch this video:



One or more interactive elements has been excluded from this version of the text. You can view them online here: <https://louis.pressbooks.pub/medicalterminology/?p=1570#oembed-1>

Media 17.2 [Hearing & Balance: Crash Course A&P #17](#) [Online video]. Copyright 2015 by [CrashCourse](#).

Hearing, or **audition**, is the transduction of sound waves into a neural signal that is made possible by the structures of the ear (see [Figure 17.3](#)).

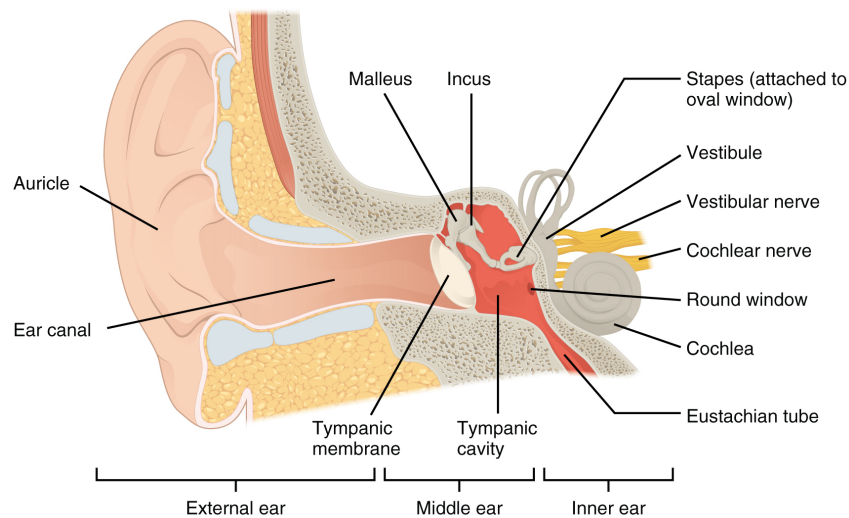


Figure 17.3 Structures of the Ear. The external ear contains the auricle, ear canal, and tympanic membrane. The middle ear contains the ossicles and is connected to the pharynx by the Eustachian tube. The inner ear contains the cochlea and vestibule, which are responsible for audition and equilibrium, respectively. From Betts, et al., 2013. Licensed under [CC BY 4.0](#). [\[Image description.\]](#)

Structure of the Ear

The structure of the ear can be divided into three parts:

The **external ear** consists of the **auricle**, sometimes referred to as the **pinna**, and the **ear canal**. The C-shaped curves of the auricle direct sound waves toward the auditory canal. This canal enters the skull through the external auditory meatus of the temporal bone. At the end of the auditory canal is the **tympanic membrane**, a structure that vibrates when struck by sound waves and separates the ear canal from the middle ear space.

The **middle ear** consists of the **ossicles**, the **oval window**, and the **Eustachian tube**. The three ossicles are the **malleus**, **incus**, and **stapes**, which are Latin names that roughly translate to hammer, anvil, and stirrup. The malleus is attached to the tympanic membrane on one end and articulates with the incus on the other. The incus, in turn, articulates with the stapes. The stapes is then attached to the inner ear, where the sound waves are transduced into a neural signal. Vibrations of the ossicles travel through the **oval window**, moving fluid in a wave-like motion. The frequencies of the fluid waves match the frequencies of the sound waves. The middle ear is connected to the pharynx through the **Eustachian tube**, which helps equilibrate air pressure across the tympanic membrane. The tube is normally closed but will pop open when the muscles of the pharynx contract during swallowing or yawning.

The **inner ear** is often described as a **bony labyrinth**, as it is composed of a series of canals embedded within the temporal bone. It consists of the **cochlea**, which is responsible for hearing, and the **vestibule**, which is responsible for balance. The neural signals from these two regions are relayed to the **brain stem** through

separate fiber bundles. However, these two distinct bundles travel together from the **inner ear** to the brain stem as the **vestibulocochlear nerve**. Sound is transduced into neural signals within the **cochlear** region of the inner ear, which contains the sensory neurons of the spiral ganglia. These ganglia are located within the spiral-shaped cochlea of the inner ear.

Image Descriptions

Figure 17.3 image description: This image shows the structure of the ear with the major parts labeled. The ear is divided up into 3 parts from left to right: external ear, middle ear, and inner ear. Labels for each part read: external ear (auricle, ear canal), middle ear (tympanic membrane, malleus, incus, tympanic cavity), inner ear (stapes, vestibule, vestibular nerve, cochlear nerve, cochlea, round window, eustachian tube). [\[Return to Figure 17.3\]](#).

WORD PARTS AND STRUCTURAL TERMS

Combining Forms

Eye

blephar/o: eyelid

conjunctiv/o: conjunctiva

cor/o: pupil

core/o: pupil

corne/o: cornea

dacry/o: tear, tear duct

dipl/o: two, double

ir/o: iris

irid/o: iris

is/o: equal

kerat/o: cornea

lacrim/o: tear, tear duct

leuk/o: white

myc/o: fungus

ocul/o: eye

ophthalm/o: eye

opt/o: vision

phac/o, phak/o: lens

phot/o: light

presby/o: old age

pupill/o: pupil

retin/o: retina

scler/o: sclera

ton/o: pressure, tension

xer/o: dry

Ear

audi/o: hearing

aur/o, aur/i: ear

cochle/o: cochlea

labyrinth/o: labyrinth, inner ear

mastoid/o: mastoid bone

myring/o: tympanic membrane, eardrum

ot/o: ear

staped/o: stapes, middle ear

tympan/o: can mean tympanic membrane, but usually means middle ear

vestibul/o: vestibular system—responsible for the sense of balance

Prefixes

a-, an-: absence of, without, no, not; negates meaning

bi-, bin-: two

endo-: within, in

pseudo-: false

Suffixes

-al: pertaining to (adjective)

-algia: pain (noun)

-ar: pertaining to (adjective)

-ary: pertaining to (adjective)

-ectomy: excision or surgical removal (noun)

-eal: pertaining to (adjective)

-gram: record, radiographic image (noun)

-graphy: process of recording (noun)

-ia: condition of, diseased or abnormal state (noun)

-ic: pertaining to (adjective)

-itis: inflammation (noun)

-logist: specialist or physician who studies and treats (noun)

-logy: study of (noun)

- malacia**: softening (noun)
- meter**: instrument used to measure (noun)
- metry**: process of measuring (noun)
- oma**: tumor, swelling (noun)
- opia**: vision, as it relates to a condition (noun)
- osis**: abnormal condition (noun)
- ptosis**: prolapse, drooping, sagging (noun)
- pathy**: disease (noun)
- pexy**: surgical fixation (noun)
- phobia**: abnormal fear, aversion to specific things, intense fear or dislike (noun)
- plasty**: surgical repair (noun)
- plegia**: paralysis (noun)
- rrhea**: flow, discharge (noun)
- sclerosis**: hardening (noun)
- scope**: instrument used to view (noun)
- scopy**: process of viewing (noun)
- stenosis**: abnormal narrowing (noun)
- stomy**: creation of artificial opening (noun)
- tomy**: incision, cut into (noun)

Structural/Functional Terms Built from Word Parts

Eye Terms

- binocular**: pertaining to both eyes
- corneal**: pertaining to the cornea
- emmetropia**: normal refractive condition of the eye
- intraocular**: pertaining to within the eye
- lacrimal**: pertaining to the tear duct
- nasolacrimal**: pertaining to the nose and tear ducts
- ocular**: pertaining to the eye
- ophthalmic**: pertaining to the eye
- optical**: pertaining to the sense of vision
- pupillary**: pertaining to the pupil
- retinal**: pertaining to the retina
- visual acuity**: sharpness of vision

Ear Terms

aural: pertaining to the ear

auricular: pertaining to the ear

cochlear: pertaining to the cochlea

vestibular: pertaining to the vestibule or the sense of balance

vestibulocochlear: pertaining to the vestibule and cochlea

DISEASES AND DISORDERS

Disease and Disorder Terms Built from Word Parts

Eye Terms

anisocoria: condition of absence of equal pupil size

aphakia: condition of the absence of a lens

blepharitis: inflammation of eyelid

blepharoptosis: drooping of the eyelid

conjunctivitis: inflammation of the conjunctiva; pinkeye

dacryocystitis: inflammation of the tear (lacrimal) sac

dacryostenosis: abnormal narrowing of a tear duct; blocked tear duct

diplopia: double vision

endophthalmitis: inflammation inside of the eye

iridoplegia: paralysis of the iris

iritis: inflammation of the iris

keratitis: inflammation of the cornea

keratomalacia: softening of the cornea

leukocoria: condition of having a white pupil

oculomycosis: fungal disease of the eye

ophthalmalgia: pain in the eye

ophthalmopathy: disease of the eye

ophthalmoplegia: paralysis of the eye

phacomalacia: softening of the lens

photophobia: sensitivity to light

pseudophakia: the condition of having a false lens (after cataract surgery)

retinoblastoma: malignant tumor of retina

retinopathy: disease of the retina

sclerokeratitis: inflammation of the sclera and cornea

scleromalacia: softening of the sclera

xerophthalmia: dry eye

Ear Terms

- labyrinthitis:** inflammation of the inner ear
- mastoiditis:** inflammation of the mastoid process
- myringitis:** inflammation of the tympanic membrane
- otalgia:** pain in the ear
- otomastoiditis:** inflammation of the ear and mastoid bone
- otomycosis:** fungus in the ear
- otopyorrhea:** pus discharge from the ear
- otorrhea:** any discharge from the ear
- otosclerosis:** hardening of the stapes bone
- tympanitis:** inflammation of the middle ear

Disease and Disorder Terms Not Built from Word Parts

Eye Terms

- amblyopia:** “lazy eye”; an eye that is not facing the same direction as the other eye
- astigmatism:** irregular curvature of a cornea or lens
- blindness:** lack of vision
- cataract:** cloudiness of a lens
- chalazion:** obstruction of an oil gland in an eyelid
- diabetic retinopathy:** disease of the retina due to diabetes complications
- glaucoma:** increased pressure within the eye
- hyperopia:** farsightedness; near objects look blurred but distant objects are more clearly visible
- macular degeneration:** loss or blurring of central vision due to deterioration of the central portion of the retina
- myopia:** nearsightedness; near objects are clear but far objects are not
- nyctalopia:** night blindness
- nystagmus:** involuntary jerking movement of the eyes
- ophthalmia neonatorum:** conjunctivitis in newborns
- pinguecula:** yellow mass on the conjunctiva
- presbyopia:** age-related loss of near vision
- pterygium:** thin tissue growing into the conjunctiva from the cornea; “eyeweb”

retinal detachment: when a retina separates partially or totally from the underlying chorion

strabismus: crossed eyes or eyes looking in different directions

sty: acute infection of eyelash hair follicle

Ear Terms

acoustic neuroma: a benign tumor in the internal auditory canal

ceruminoma: tumor of the ceruminous (earwax) gland

cholesteatoma: abnormal growth of skin in the middle ear

conductive hearing loss: occurs when there is a problem transferring sound waves anywhere along the pathway through the outer ear, tympanic membrane, or middle ear

Meniere disease: inflammation of the vestibulocochlear nerve; leads to vertigo and hearing loss

otitis externa: inflammation of the outer ear

otitis media: inflammation of the middle ear

presbycusis: hearing loss that takes place in old age

sensorineural hearing loss: hearing loss in which the root cause lies in the inner ear or the vestibulocochlear nerve

tinnitus: ringing or buzzing sound in the ears

vertigo: severe dizziness

MEDICAL, SURGICAL, & VIEWING TERMS AND ABBREVIATIONS

Medical Careers & Professional Terminology

Eye Terms

ophthalmologist: physician who can diagnose, treat, and manage eye diseases

ophthalmology: study of the eye

optician: medical specialist who fills prescriptions for lenses

optometrist: health professional who prescribes corrective lenses

optometry: the measurement of visual acuity

Ear Terms

audiologist: a medical specialist who studies hearing and hearing disorders

audiology: study of hearing

otologist: physician who diagnoses and treats ear diseases

otology: study of ear diseases

otorhinolaryngologist: physician who diagnoses and treats diseases and disorders of the ears, nose, and throat

Imaging/Audiology Techniques/Procedures for the Organ System

Eye Techniques/Procedures

keratometer: instrument used to measure the curvature of the eye

miotic: an agent that causes the pupil to constrict

mydriatic: an agent that causes the pupil to dilate

ophthalmoscope: instrument used to view the eye

ophthalmoscopy: visual exam of the eye

optometry: measuring vision

pupillometer: instrument that measures pupil diameter

pupilloscope: instrument used for visual examination of the pupil

retinoscopy: process of viewing the retina

tonometer: instrument that measures intraocular pressure

tonometry: the measurement of intraocular pressure

Ear Techniques/Procedures

audiogram: graphic record of hearing

audiometry: the process of measuring hearing

electrocochleography: process of recording the electrical activity in the cochlea

otoscope: instrument used to visually examine the ear

otoscopy: the process of visual examination of the ear

tympanometer: instrument used to measure the middle ear

tympanometry: measurement of the tympanic membrane

Medical and Surgical Techniques/Procedures Used for the Organ System

Eye Techniques/Procedures

blepharoplasty: surgical repair of eyelid

cryoretinopexy: surgical fixation of the retina using extreme cold

dacryocystorhinostomy: creation of an artificial opening between the lacrimal sac and the nose (to restore drainage)

enucleation: surgical removal of an eyeball

intraocular lens: an artificial lens implanted in the eye during cataract surgery

iridectomy: excision of part of an iris

iridotomy: incision into the iris

keratoplasty: surgical repair of the cornea

LASIK (laser-assisted in situ keratomileusis): reshaping the cornea with a laser to correct vision problems

phacoemulsification: removal of a cataract with an ultrasonic needle probe

photorefractive keratectomy: using a laser to flatten the cornea to correct nearsightedness

scleral buckling: surgical procedure to repair a detached retina

sclerotomy: incision into the sclera

trabeculectomy: surgical creation of a drain to reduce intraocular pressure in glaucoma

vitrectomy: surgical removal of all or part of the vitreous humor

Ear Techniques/Procedures

cochlear implant: surgically implanted device that partially restores hearing

labyrinthectomy: excision of the inner ear (labyrinth)

mastoidectomy: excision of the air cells of the mastoid process

mastoidotomy: incision into the mastoid process

myringoplasty: surgical repair of the tympanic membrane

myringotomy: incision in the tympanic membrane

stapedectomy: excision of the stapes bone (to be replaced with a prosthetic bone)

tympanoplasty: surgical repair of the eardrum and ossicles

Abbreviations Commonly Used with the Organ System

Eye Abbreviations

ARMD: age-related macular degeneration

Ast: astigmatism

Em: emmetropia

IOL: intraocular lens

IOP: intraocular pressure

LASIK: laser-assisted in situ keratomileusis

Ophth: ophthalmology

PHACO: phacoemulsification

PRK: photorefractive keratectomy

VA: visual acuity

Ear Abbreviations

AOM: acute otitis media

ENT: ears, nose, throat

EENT: eyes, ears, nose, and throat

OM: otitis media

Medical Terms Practice

For each card, click the speaker icon to hear the correct pronunciation of the listed term. Practice saying the term to yourself, then attempt to define the term from memory. Click “Turn” to flip the card and see the definition. Use the right and left arrows to toggle through the cards in each set.



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<https://louis.pressbooks.pub/medicalterminology/?p=1577#h5p-99>

PRACTICE

The following activities will allow you to practice what you've learned in this chapter.

Ear Anatomy Labeling Activity

Click and drag each term to the box corresponding with the anatomic structure, body part, body plane, or body region for that term.



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Eye Anatomy Labeling Activity—1

Click and drag each term to the box corresponding with the anatomic structure, body part, body plane, or body region for that term.



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Eye Anatomy Labeling Activity—2

Click and drag each term to the box corresponding with the anatomic structure, body part, body plane, or body region for that term.



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APPENDIX A: CHECKLIST FOR ACCESSIBILITY

Organizing Content

- Content is organized under headings and subheadings.
- Headings and subheadings are used sequentially (e.g., Heading 1, Heading 2).

Images

- Images that convey information include alternative text (alt text) descriptions of the image's content or function.
- Graphs, charts, and maps also include contextual or supporting details in the text surrounding the image.
- Images do not rely on color to convey information.
- Images that are purely decorative do not have alt text descriptions. (Descriptive text is unnecessary if the image doesn't convey contextual content information.)

Links

- The link text describes the destination of the link and does not use generic text such as “click here” or “read more.”
- If a link will open or download a file (like a PDF or Excel file), a textual reference is included in the link information (e.g., [PDF]).
- Links do not open in new windows or tabs.
- If a link must open in a new window or tab, a textual reference is included in the link information (e.g., [NewTab]).
- For citations and references, the title of the resource is hyperlinked, and the full URL is not hyperlinked.

Tables

- Tables are used to structure information and not for layout.

- Tables include row and column headers.
- Row and column headers have the correct scope assigned.
- Tables include a caption.
- Tables avoid merged or split cells.
- Tables have adequate cell padding.

Multimedia

- All audio content includes a transcript. The transcript includes all speech content and relevant descriptions of non-speech audio and speaker names/headings where necessary.
- Videos have captions of all speech content and relevant non-speech content that has been edited by a human for accuracy.
- All videos with contextual visuals (graphs, charts, etc.) are described audibly in the video.

Formulas

- Equations written in plain text use proper symbols (i.e., $-$, \times , \div).¹
- For complex equations, one of the following is true:
 - They were written using LaTeX and are rendered with MathJax (Pressbooks).
 - They were written using Microsoft Word's equation editor.
 - They are presented as images with alternative text descriptions.
- Written equations are properly interpreted by text-to-speech tools.²

Font Size

- Font size is 12 point or higher for body text in Word and PDF documents.
- Font size is 9 point for footnotes or endnotes in Word and PDF documents.
- Font size can be enlarged by 200 percent in webbook or ebook formats without needing to scroll side to side.

Learn more about [Pressbooks' commitment to Accessibility](#).

1. For example, a hyphen (-) may look like a minus sign ($-$), but it will not be read out correctly by text-to-speech tools.

2. Written equations should prioritize semantic markup over visual markup so text-to-speech tools will read out an equation in a way that makes sense to auditory learners. This applies to both equations written in LaTeX and equations written in Microsoft Word's equation editor.

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