CHAPTER 1

Introduction

KEY TERMS

Atom
Calcium
Cardiac muscle
Cell
Connective tissue
DNA
Electrolyte
Epithelial tissue
Hydrogen
Macromolecule
Molecules
Muscle tissue
Nervous tissue
Organ system
Organelles
Organ
Potassium
Protein
RNA
Skeletal muscle
Smooth muscle
Sodium
Tissue

Introduction to Medical Terminology

The language of medicine is based on medical terms, which are constructed in a way that communicates specific details of anatomy, physiology, procedures, injury, or disease. Many medical terms appear highly technical at first glance, and some of them are quite long, but there are patterns in their complexity and a logic to the way they are constructed. Once you have cracked the code of medical terminology, the study of medical terms, you will find that most terms are not difficult to interpret or understand. Indeed, they are helpful for thinking, and talking, about medicine. Cracking the code will take guidance and practice, the purpose of this text is to help provide you with both.

FIGURE 1.1 A student of medical terminology

It is important to have a solid grasp of medical terminology in an allied health profession, because it will ensure that you can communicate with other healthcare professionals using a shared vocabulary. The vocabulary in this text is medical English, it is used consistently across medical fields and medical English is the language of choice for most international medical journals and conferences. The English terms tend to derive from ancient Greek or Latin. Effective use of medical terms fosters consistency in documenting, diagnosing, and treating patients'

illnesses. Having this common language increases patient safety and decreases medical errors.

There are thousands of medical terms; *Taber's Cyclopedic Medical Dictionary* has more than 30,000 of them. Memorizing the meaning of each would be impossible, and pulling the dictionary out to look up each term in the middle of a conversation would be cumbersome and awkward. Fortunately, most medical terms are created by combining frequently used word parts, and if you learn the parts and how to combine them, you will have the ability to build terms, and dissect them to ascertain their meanings. It is like having an array of articles of clothing that you can mix and match into many different outfits. Let us take a closer look at the component parts and how they can be mixed and matched to construct the words of the language of medicine

The foundation of most medical terms is the root. Roots are often derived from Greek or Latin and may apply to a particular cell, tissue, or organ. For example, the root *nephr* means kidney and it is derived from *nephros*, which is Greek for kidney. There are numerous medical terms using this one root, and if you know its meaning, you know what tissue or organ the term is referring to. Roots have other word parts added to them to enhance their meaning. These word parts may be additional roots, suffixes, or prefixes. All medical terms have suffixes, which are added at the end of roots, and often denote a condition or procedure. In this text, suffixes will be denoted with a hyphen preceding them, as in *-ectomy* and *-osis*. The suffix *-ectomy* means surgical removal and *-osis* means abnormal condition. A *nephrectomy* would be the surgical removal of a kidney and *nephrosis* is an abnormal condition of the kidney.

The suffixes *-ectomy* and *-osis* begin with vowels, so when they are added to the root *nephr*, they form terms that are easy to pronounce. Many suffixes, however, do not begin with vowels, which presents a problem with pronunciation. Consider, for example, the suffix *-megaly*, which means enlarged. Adding it to nephr would produce, *nephrmegaly*, which would be difficult to pronounce. To facilitate pronunciation, a combining vowel is used with a root to make a combining form. The combining vowel is nearly always the vowel *o*. Thus, the combining form for kidney would be *nephr/o*. Roots are typically written as their combining form to make pronunciation easier. Using this combining form, the correct term for an enlarged kidney would be *nephromegaly* (nephr/o + -megaly). Combining forms are used whenever a suffix begins with a consonant.

Some common roots, as combining forms, that refer to body organs are in the table below. Note that some medical terms have multiple meanings, *cervic/o* can mean cervix or neck. Some terms have multiple meanings that are similar, *orchid/o* means testicle and testis, which refer to the same structure, but both names are commonly used. Multiple terms may also have the same meaning, for example, the combining forms *pneum/o* and *pulmon/o* both refer to the lung.

TABLE 1.1

Common Roots as Combining Forms
arthr/o: joint
cardi/o: heart
ceric/o: cervix; neck
col/o: colon
cyst/o: urinary bladder; sac
dent/o: tooth
derm/o: skin
encephal/o: brain
enter/o: small intestine
gastr/o: stomach
gloss/o: tongue
hemat/o: blood
hem/o: blood
hepat/o: liver
hyster/o: uterus
muscul/o: muscle
nephr/o: kidney
neur/o: nerve; neuron
onych/o: nail
orchid/o: testicle, testis

Common Roots as Combining Forms
oophor/o: ovary
oste/o: bone
pneum/o: lung; air
phleb/o: vein
proct/o: anus; rectum
pulmon/o: lung
ren/o: kidney
rhin/o: nose
ureter/o: ureter

Combining forms are also used when two roots are used together in a term, as in the combination of *nephr/o*, *py/o*, which means pus, and *-osis* to form *nephropyosis*, or an abnormal condition of pus in the kidney. If the second root begins with a vowel, the combining form of the first root is still used. For example, *nephr/o*, *ureter/o* (means ureter), and *-ectomy* are combined to make the term *nephroureterectomy*, which means the surgical removal of a kidney and ureter.

Prefixes are added to the front of medical terms and often provide information about location, number, or time. In this text, prefixes will be denoted with a hyphen following them, as in *hemi-*, which means half. A *heminephrectomy* can be broken down into the following word parts; hemi-, nephr/o, and -ectomy, and means the surgical removal of half a kidney. Notice how multiple terms were made using the root *nephr* by combining it with prefixes and suffixes to add to its meaning, and describe medical procedures and conditions. Thus, many seemingly long and unintelligible medical terms can be broken apart and then defined by learning a list of commonly used combining forms, prefixes and suffixes.

Body Organization

The size and location of a body structure can be embedded in a medical term. For the purposes of medical terminology, the size of structures that are discussed range from the level of an atom or molecule up to the organ or organ system. The way a location is described can be based on body region, body cavity, or relative position.

Levels of Organization

Atoms are the smallest stable units of matter; all of the materials that compose the human body are made of atoms. **Atoms** are composed of three types of subatomic particles: neutrons, protons, and electrons. Protons have a charge, it is positive; electrons have a negative charge; and neutrons have no charge, they are neutral. Hydrogen, carbon, nitrogen, oxygen, sodium, calcium, and potassium are all examples of types of atoms. Some atoms carry a charge when they gain, or lose, electrons; these atoms are called ions. The concentrations of specific ions in body fluids are tightly regulated because they have an enormous influence on critical body processes, like neuron communication and muscle contraction. **Hydrogen** (H^+), **sodium** ions (Na^+), **potassium** ions (K^+), and **calcium** ions (Ca^{2+}), are among the most impactful in this regard. **Electrolytes** are chemicals that break apart into ions when dissolved in water. Groups of atoms that share a strong bond, called a covalent bond, are called **molecules**. Pure water is made of molecules that contain an atom of oxygen covalently bound to two atoms of hydrogen. Large molecules, like **proteins**, **RNA**, and **DNA**, are classified as **macromolecules**. **Cells** are the building blocks of all life, similar to the way atoms are the building blocks of all matter. All living things are composed of one, or more, cells. In a human adult, there are tens of trillions of cells, each containing proteins that provide support and motility and drive metabolic reactions. Cells contain **organelles**, which typically include a nucleus, endoplasmic reticulum, and Golgi apparatus, among many other organelles, that provide compartments within the cell to perform particular tasks. Groups of cells that share a similar function are called **tissues**, the study of tissues is histology. Tissues are categorized as epithelial, connective, muscular, or nervous. **Epithelial tissues** are sheets of cells that cover and line organs. **Connective tissues** include bone, tendon, cartilage, fat, and blood. Connective tissues support and connect organs. **Muscle tissue** allows organs to move because it is composed of cells that contract, or shorten. It is classified as cardiac, smooth, or skeletal muscle. **Cardiac muscle** is found only in the heart, its contractions drive the heartbeat. **Smooth muscle** is found in the walls of hollow organs, like

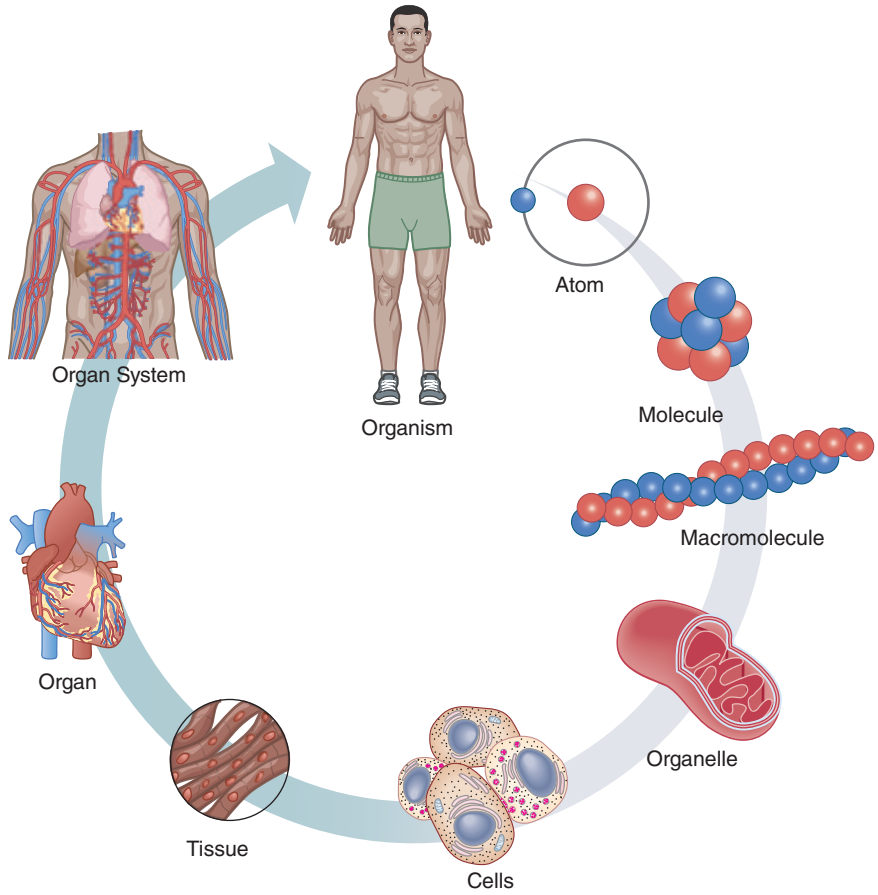

FIGURE 1.2 Scale of anatomical structures

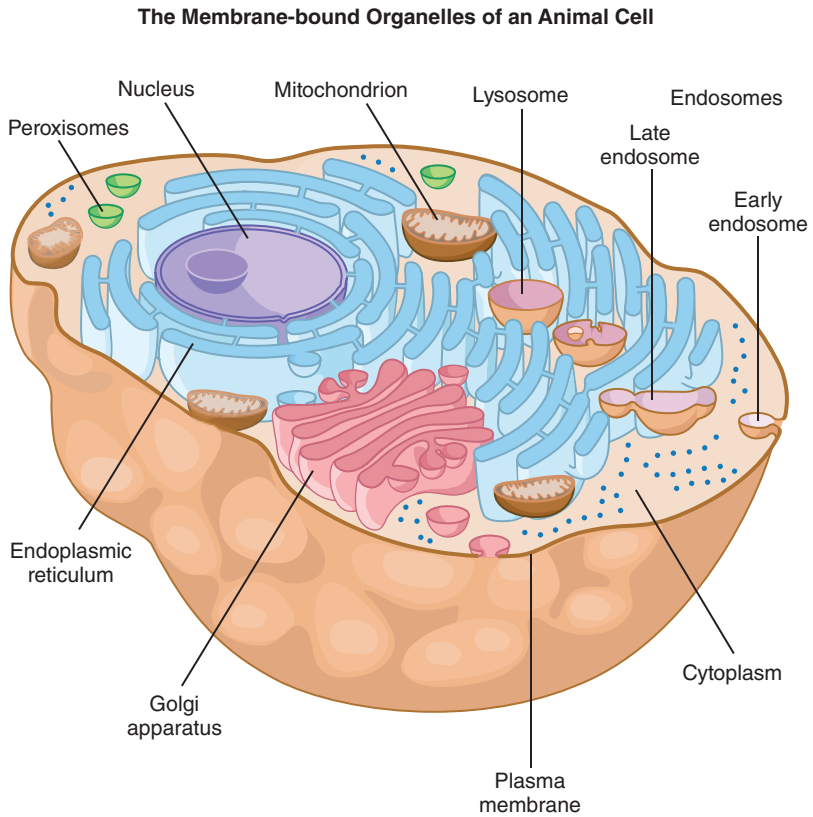

FIGURE 1.3 Cell organelles

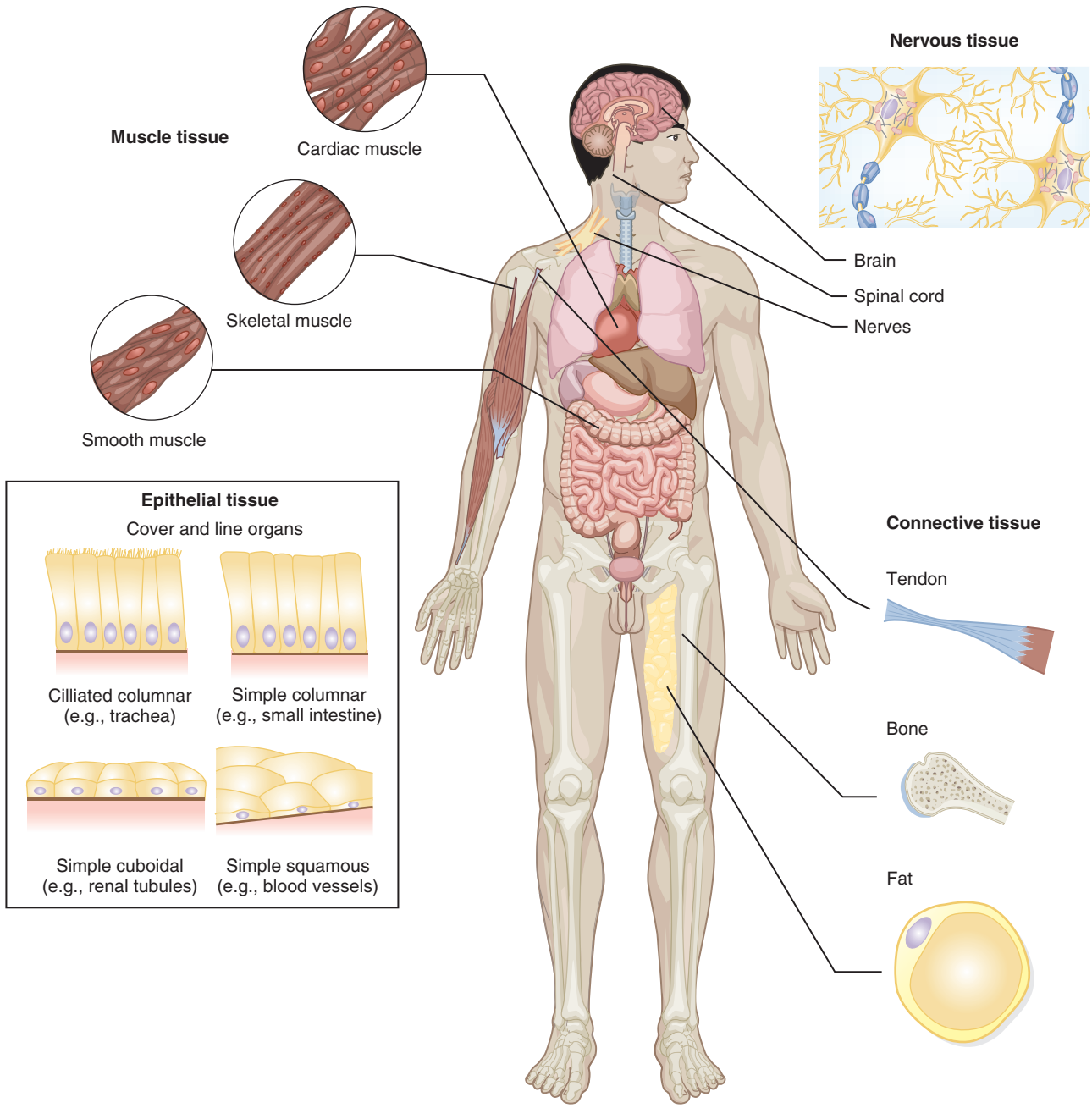

FIGURE 1.4 Some examples of types of tissues found in the body

blood vessels, the intestine, and the airways of the respiratory tract. Smooth muscle contraction tends to influence the movement of contents through the hollow tube. **Skeletal muscle** is the only muscle type that can be controlled voluntarily; it attaches to bone through tendons and allows movement of body parts. **Nervous tissue** is found in the brain, spinal cord, and nerves throughout the body. The primary functional cells of nervous tissue are neurons, which can transmit electrical impulse signals to other cells. **Organs** are composed of one, or more, tissue and perform special functions; the heart, brain, and stomach are examples of organs of the cardiovascular, nervous, and digestive systems, respectively. **Organ systems**, like the cardiovascular system, work together to perform very complex functions. The heart pumps blood through the blood vessels of the cardiovascular system. The cardiovascular system provides all body cells, directly or indirectly, with nutrients and oxygen, while removing wastes and carbon dioxide. There are 12 body, or organ, systems; integumentary, muscular, skeletal, cardiovascular, lymphatic, respiratory, digestive, urinary, female reproductive, male reproductive, endocrine, and nervous. The systems are covered in more detail in the subsequent chapters of this text.

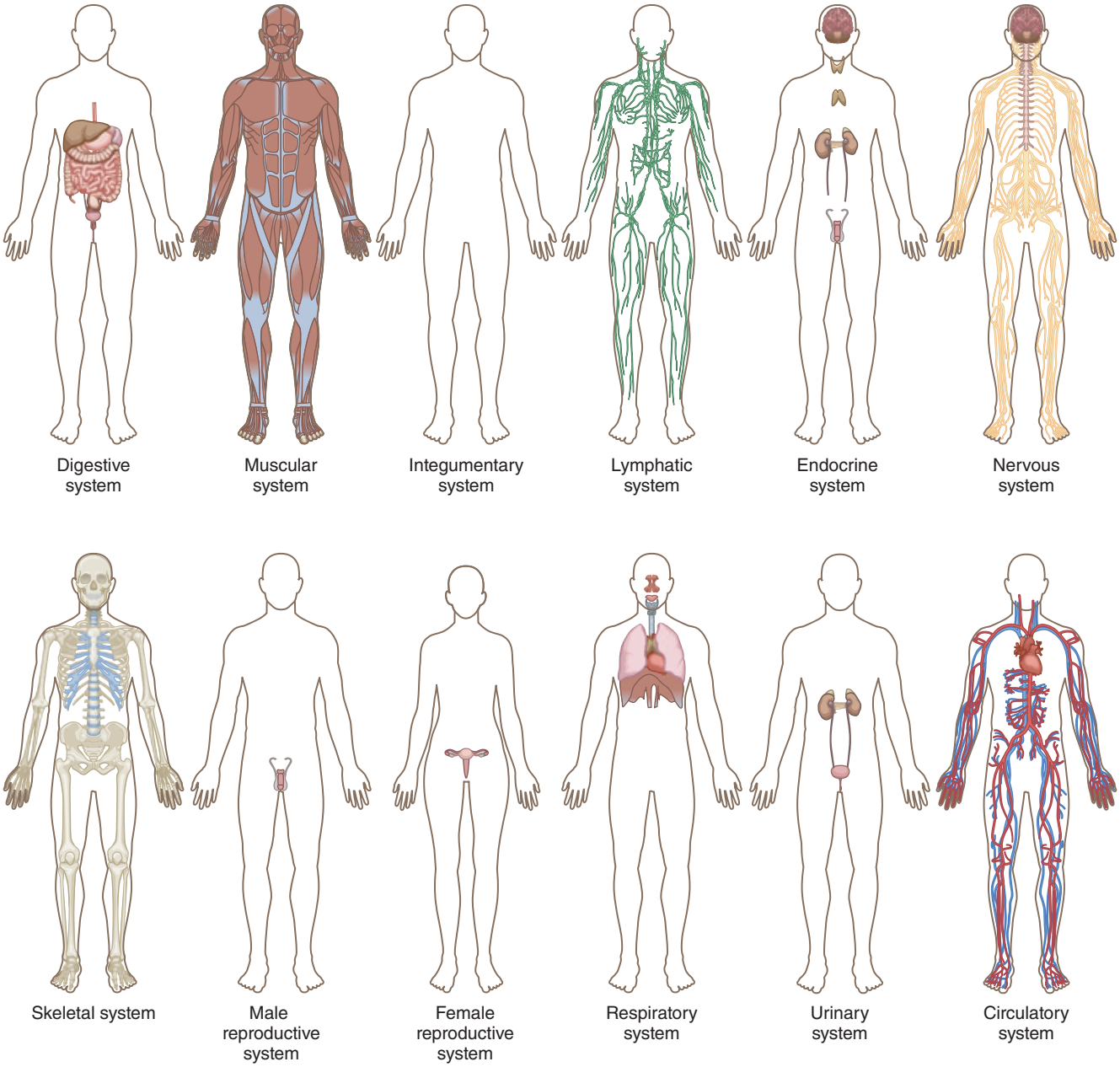

FIGURE 1.5 The organ systems

Body Regions

The body can be broken down into regions, or landmarks, that can be used to describe external locations, when referring to internal or external anatomy. Spending time to learn these landmarks and their names early in your study of medical terminology will be an invaluable asset as you progress through the body systems. The landmarks are frequently encountered when discussing anatomy, physiology, procedures, and diseases.

Body Cavities

The human body has four major cavities, which house specific organs. Two cavities are along the dorsal, or posterior, surface of the body. Two are ventral, located more anteriorly. The dorsal cavities include the cranial and spinal cavities, which enclose the brain and spinal cord. The ventral cavities are the thoracic and abdominopelvic cavities. The thoracic cavity contains the lungs, heart, esophagus, and thymus gland. The abdominopelvic cavity contains a wide range of

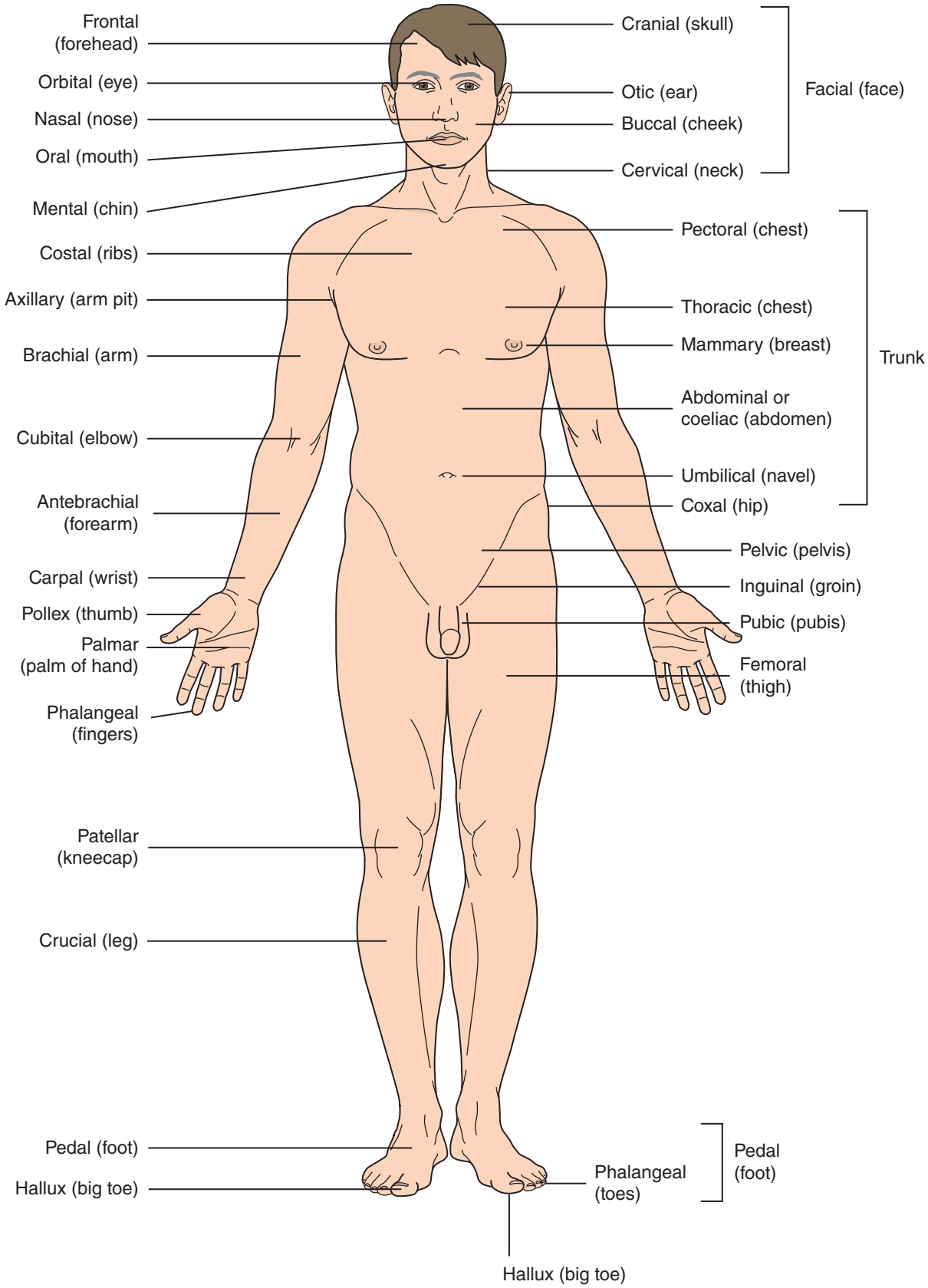

FIGURE 1.6 Anterior view of the body regions

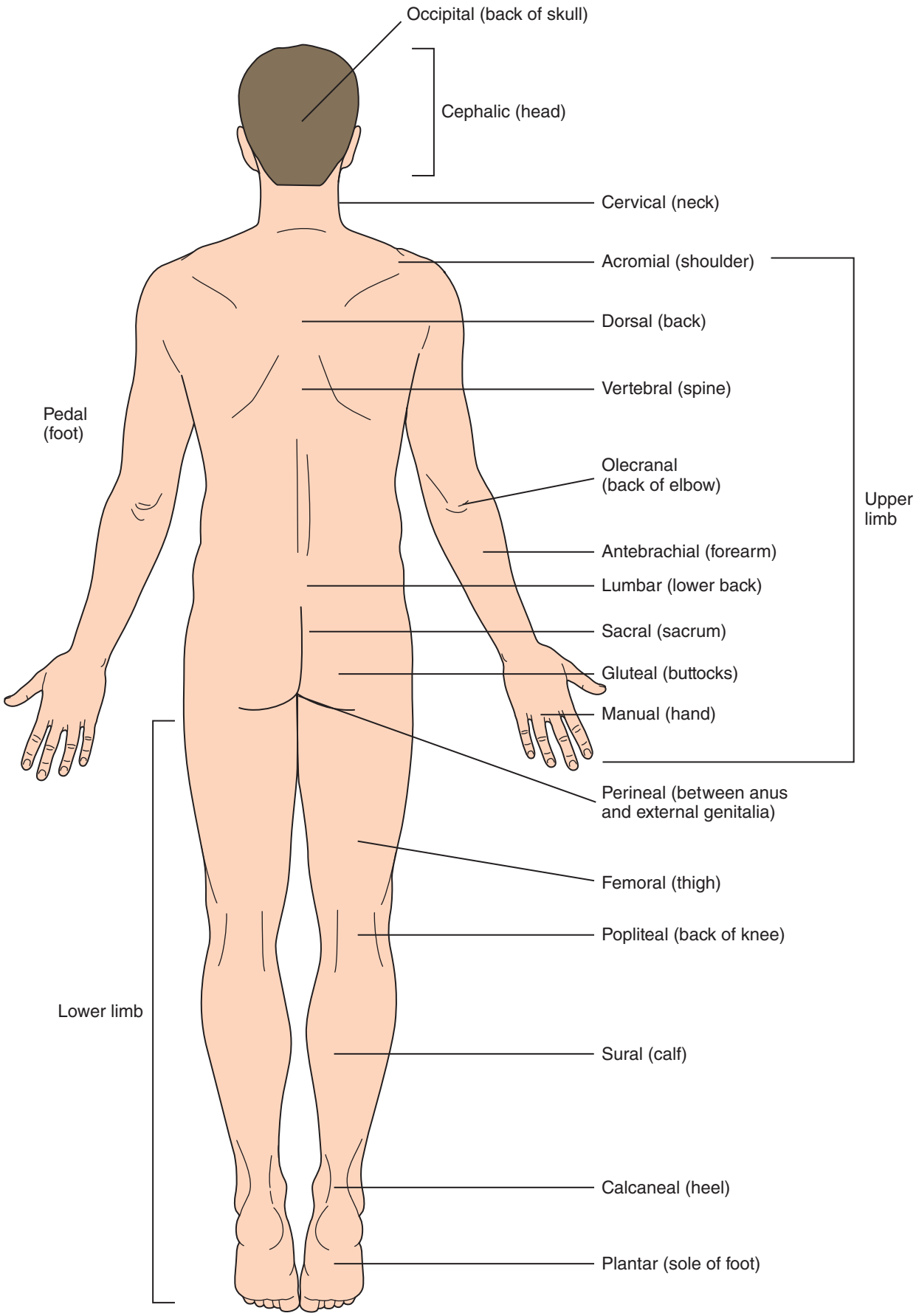

FIGURE 1.7 Posterior view of the body regions

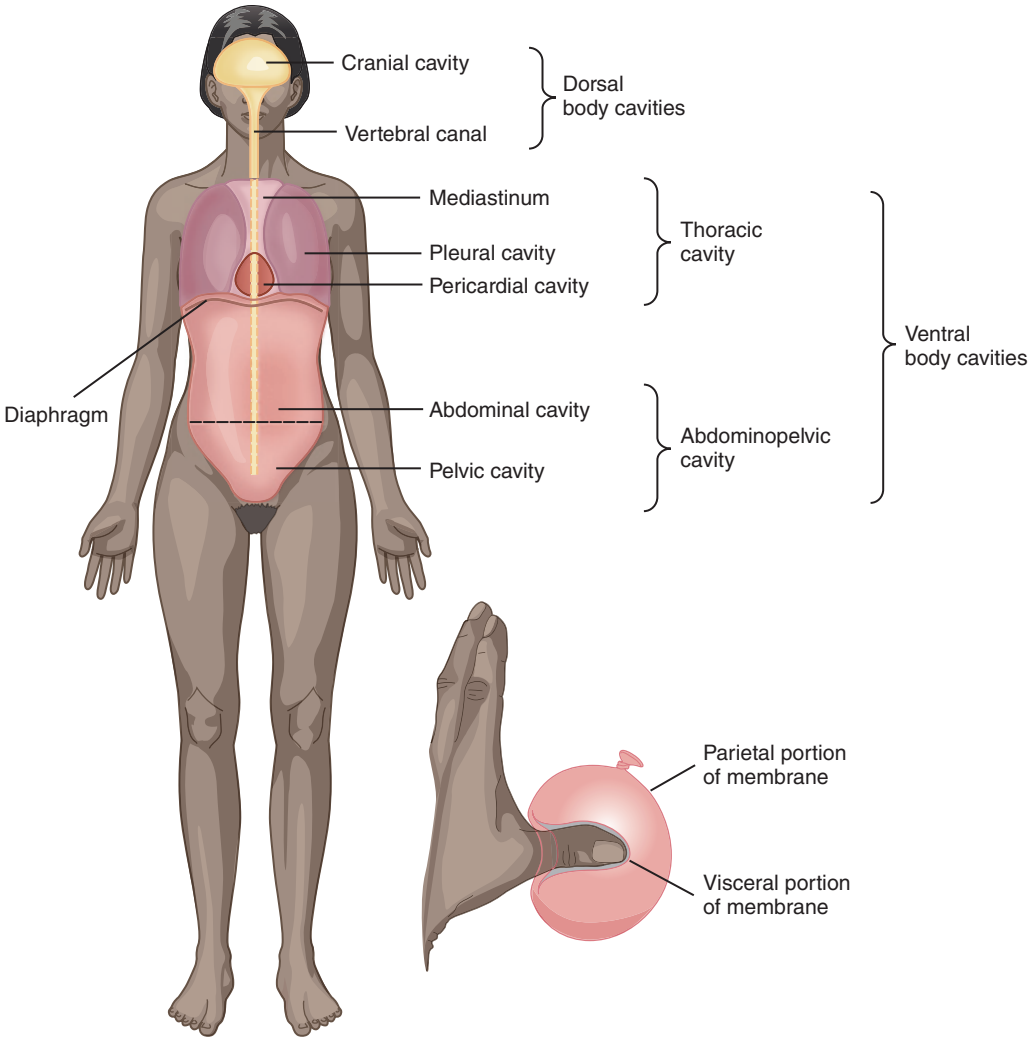

FIGURE 1.8 Body cavities

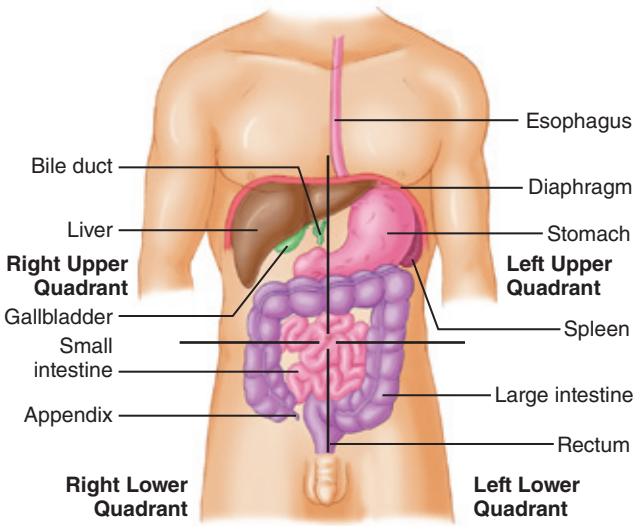

FIGURE 1.9 The four abdominal quadrants

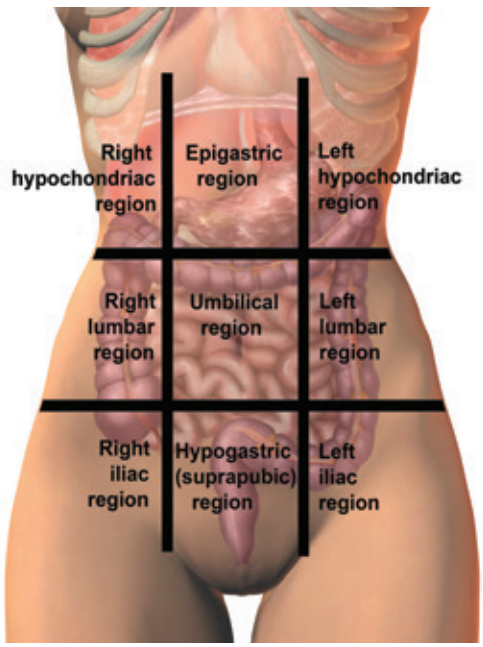

FIGURE 1.10 The nine abdominal regions

organs of the digestive, urinary, and reproductive systems. This cavity can be divided, from an anterior perspective, into four quadrants or nine regions. This facilitates describing, in greater detail, the location of an organ or symptom relating to an organ.

Body Planes

Planes through the body, organs, or other structures separate them into two parts. This is useful when explaining the position of one structure relative to another, or when describing a medical illustration that represents internal anatomy. To understand the planes, imagine cuts through the body or structure at a particular angle. The planes can be sagittal (or medial), frontal (or coronal), or transverse (or horizontal). A diagonal section is called oblique. A sagittal section produces left and right parts. It is important to recognize that when referring to anatomical left and right, it is always from the perspective of the patient or the medical illustration. Although the left and right side of the body appear to be fairly similar, albeit opposite, reflections of each other, there are some profound anatomical differences between the two. A frontal section produces anterior and posterior parts, and a transverse section produces superior (top) and inferior (bottom) parts.

Directional Terms

Directional terms are used to describe anatomical structures relative to one another. A sagittal plane directly down the midline of the body is called a midsagittal section. Medial structures are closer to the midline whereas lateral structures are farther away from it. The left eye is medial to the left ear because it is closer to the midline; the left eye is also lateral to the left nostril because, in this pairing, it is farther from the midline. Proximal structures are closer to the attachment to the body; distal structures are farther away. Anterior structures are more toward

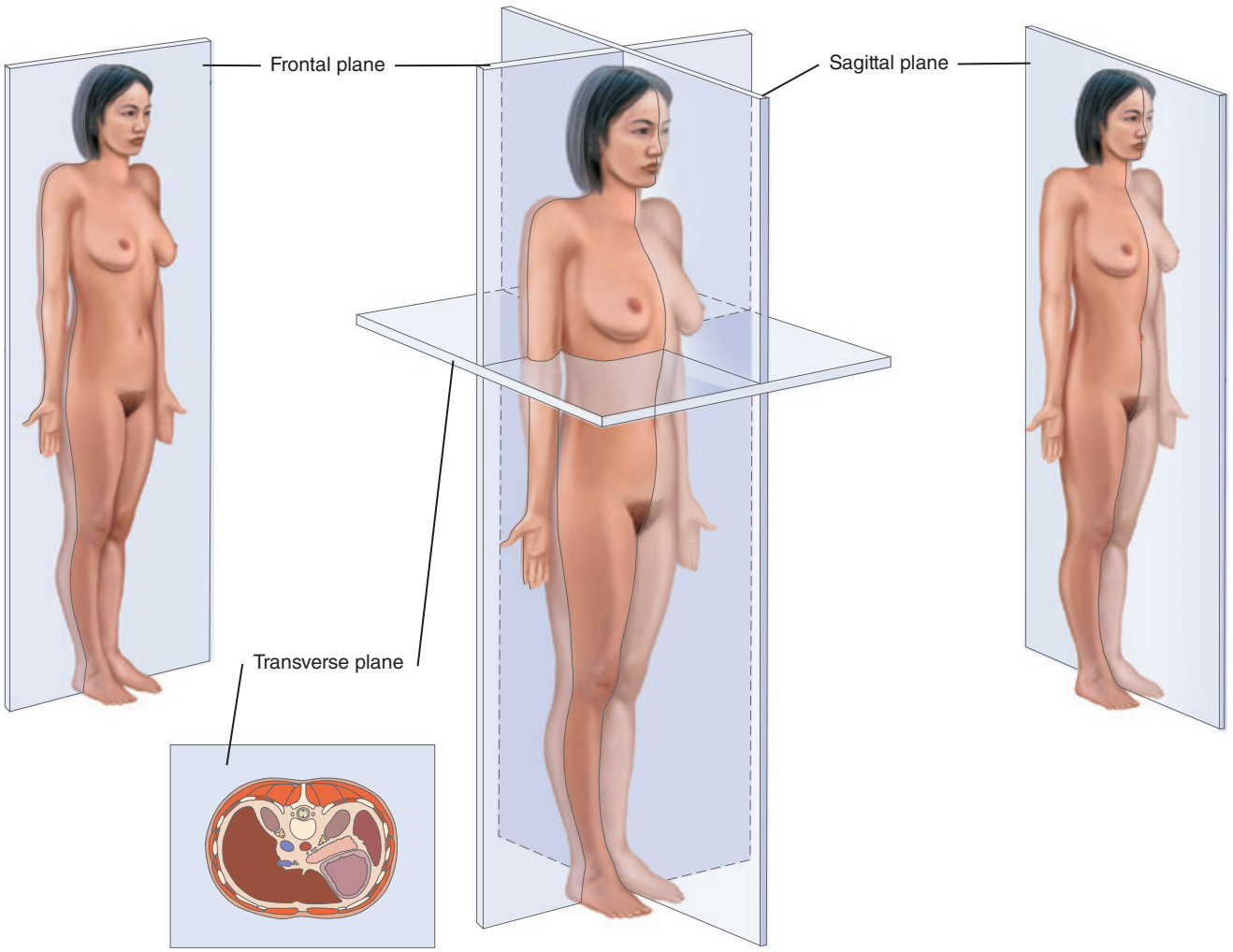

FIGURE 1.11 Body planes

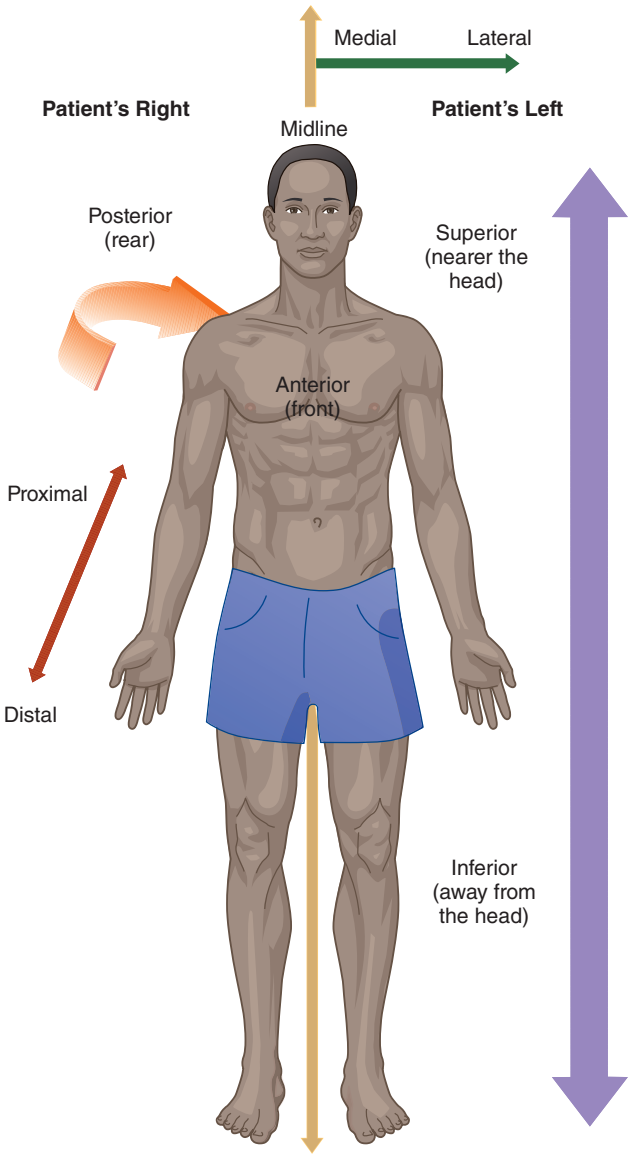

FIGURE 1.12 Directional terms

the front, or belly, whereas posterior structures are more toward the back. Superior is closer to the head, or above another structure. Inferior is closer to the feet, or below another structure. Superficial structures are near the surface of the body or an organ, whereas underlying structures are described as deep.

A Deeper Look at Medical Terminology

Now that you have been introduced to the basics of medical terminology and have considered the way the human body is organized, a more extensive list of word parts (i.e., prefixes, combining forms, and suffixes), many of which are used in multiple organ systems, will be presented. This will allow you to build a richer

TABLE 1.2 Word Parts That Describe Location or Position

Word parts in this category tend to be prefixes or combining forms

Prefixes	Combining Forms
anti-: against	anter/o: front
co-: together, with	cortic/o: outer layer
contra-: against, opposite	dist/o: away from
ecto-: out, outside	dors/o: back
endo-: within	infer/o: below
epi-: above	later/o: side
exo-: outward	medi/o: middle
extra-: outside of	medull/o: inner region
in-: inward; not	peripher/o: away from center
infra-: below, beneath	poster/o: back
inter-: between	proxim/o: near to
intra-: within	super/o: above
ipsi-: same	ventr/o: belly
meso-: middle	
peri-: around	
post-: after	
pre-: before	
re-: back; again	
retro-: behind	
sub-: under	
supra-: above, upper	
sym-: together, with	
trans-: across, through	

TABLE 1.3 Word Parts That Describe Amount, Quantity, or Speed

Word parts in this category tend to be prefixes, but a few are combining forms.

Prefixes	Combining Forms
a-: without, not	dipl/o: double
bi-: two	is/o: same, equal
brady-: slow	
de-: without	
di-: two, aside	
hemi-: half	
hyper-: above, excessive	
hypo-: below, deficient, insufficient	
macro-: large	
micro-: small	
mono-: one	
multi-: many	
non-: not	
pan-: all	
poly-: many, much	
quadri-: four	
tachy-: fast	
tetra-: four	
tri-: three	
un-: not	
uni-: one	

TABLE 1.4 Word Parts That Describe Color

The parts in this category are combining forms.

Combining Forms
albin/o: white
chlor/o: green
chrom/o: color
chromat/o: color
cirrh/o: yellow-orange
cyan/o: blue
eosin/o: rosy
erythr/o: red
glauc/o: gray
leuk/o: white
melan/o: black
xanth/o: yellow

TABLE 1.5 Word Parts That Describe Procedures

The word parts in this category are suffixes.

Suffixes
-centesis: puncture to withdraw fluid
-clast: to break
-desis: surgical fusion
-ectomy: surgical removal
-gram: record or picture
-graphy: recording
-lysis: to break down, destroy

Suffixes
-lytic: destruction
-manometer: instrument to measure pressure
-meter: instrument to measure
-metric: pertaining to measuring
-metry: measuring
-opsy: view of
-ostomy: surgically create an opening
-otomy: cutting into
-pexy: surgical fixation
-plasty: surgical repair
-rrhaphy: surgical suturing
-scope: instrument for viewing
-scopic: pertaining to visually examining
-scopy: visually examining
-therapy: treatment
-tripsy: surgical crushing

catalog of terms and dissect more complex ones. The tables below contain word parts organized by category, and each list within a table is separated by prefix, combining form, and suffix and are ordered alphabetically.

With the concepts and word parts covered thus far in this chapter, you can start breaking down terms to understand their meaning, even if you are unfamiliar with them. Use the medical term hemicolectomy as an example and two steps to reveal the meaning. Step 1 is to divide the term into its component parts: *hemi-*; *col/o*; *-ectomy*. Step 2 is to define each of the component parts. *Hemi-* you already learned means half. *Col/o* is the combining form for colon and *-ectomy* you already learned means surgical removal. The conventional way to put these together into a complete definition is to start with the suffix, move to the prefix, and end with the root. A patient who is scheduled for a *hemicolectomy* will undergo the surgical removal of half of the colon.

Think about the following two terms, *polyarthritis* and *onychopathology.* Try the two steps to see if you can determine their meaning and then continue. For *polyarthritis*, in Step 1, we will divide the term into its component parts: *poly-*; *arthr/o*; *-itis*. *Poly-* is a common prefix meaning many, *arthr/o* means joint, and *-itis* is a common suffix indicating inflammation. A patient with *polyarthritis* has an inflammation of many joints. *Onychopathology* is a term that is a combination of two roots with a suffix, and no prefix. *Onych/o* means nail (as in fingernail or toenail), *path/o* means disease, and *-logy* indicates the study of. The term refers to the study of nail diseases. Not every medical term

TABLE 1.6 Word Parts That Describe Conditions

The parts in this category tend to be suffixes, but a few are prefixes or combining forms.

Prefixes	Combining Forms	Suffixes
auto-: self	alges/o: sense of pain	-algesia: sensitivity to pain
dys-: painful; abnormal; difficult	dips/o: thirst	-algia: pain
eu-: normal	esthesi/o: sensation, feeling	-asthenia: weakness
hetero-: different	isch/o: to hold back	-chezia: defecation, elimination of waste
homeo-: same, unchanging	odyn/o: pain	-constriction: narrowing
homo-: same	path/o: disease	-dynia: pain

(continues)

TABLE 1.6 Word Parts That Describe Conditions *(continued)*

Prefixes	Combining Forms	Suffixes
mal-: bad		-edema: swelling
pseudo-: false		-emesis: vomiting
		-esthesia: nervous condition
		-eurysm: widening
		-iasis: abnormal condition
		-itis: inflammation
		-malacia: softening
		-megaly: enlarged
		-osis: abnormal condition
		-pathy: disease
		-penia: abnormal decrease
		-phil: attracted to
		-phobia: irrational fear
		-phoria: feeling
		-ptosis: drooping, drooping eyelid
		-ptysis: spitting
		-rrhage: abnormal flow
		-rrhagia: abnormal flow condition
		-rrhea: discharge
		-rrhexis: rupture
		-sclerosis: hardening
		-spasm: sudden contraction
		-static: pertaining to stopping, standing still
		-stasis: standing still
		-uria: urine condition

TABLE 1.7 Word Parts That Refer to Practitioners or Specialists

The parts in this category tend to be suffixes.

Combining Forms	Suffixes
iatr/o: physician, medicine, treatment	-iatric: pertaining to medical treatment
	-iatrist: physician
	-iatry: medical treatment
	-ician: specialist
	-ist: specialist
	-istry: specialty of; pertaining to
	-logic: pertaining to study of
	-logist: one who studies
	-logy: study of'
	-metrist: specialist in measuring
	-or: one that is; condition of

TABLE 1.8 Word Parts That Refer to Proteins, Cells, or Tissues

Word parts in this category tend to be suffixes or combining forms.

Combining Forms	Suffixes
adip/o: fat	-blast: immature
blast/o: immature	-cyte: cell
carcin/o: cancer	-cytic: pertaining to cells
crin/o: secreting	-cytosis: more than the normal number of cells
cyt/o: cell	-gen: that which produces
histi/o: tissue	-genesis: producing, forming
hist/o: tissue	-genic: produced by or in
lip/o: fat	-genous: producing

(continues)

TABLE 1.8 Word Parts That Refer to Proteins, Cells, or Tissues *(continued)*

Word parts in this category tend to be suffixes or combining forms.

Combining Forms	Suffixes
myomat/o: muscular tumor	-globin: protein
necr/o: death	-nuclear: nucleus
onc/o: tumor	-oid: resembling
troph/o: nourishment	-oma: tumor, mass
	-plasia: development; formation of cells
	-plasm: growth, formation
	-poiesis: formation
	-trophic: pertaining to development; stimulation
	-tropin: to stimulate
	-trophy: development

can be broken down in this way and some will require looking them up in a medical dictionary or other reliable resource, but the vast majority of terms can be dissected and translated once you have memorized a list of common prefixes and suffixes and learned the combining forms presented in each chapter.

TABLE 1.9 Other Commonly Used Suffixes

General Suffixes	General Suffixes to Form Adjectives
-arity: relating to	-a: pertaining to
-ated: process, condition	-ac: pertaining to
-ation: process, condition	-al: pertaining to
-esis: condition, state of	-an: pertaining to
-ia: condition	-ar: pertaining to
-ice: condition	-ary: pertaining to
-ification: process of becoming	-atic: pertaining to
-ion: process	-atory: pertaining to
-ism: condition of	-eal: pertaining to

General Suffixes	General Suffixes to Form Adjectives
-ity: condition	-iac: pertaining to
-ive: tendency	-ic: pertaining to
-ization: process of making	-ical: pertaining to
-nymous: name	-id: pertaining to
-or: condition of	-ile: pertaining to
-um: structure	-ine: pertaining to
-us: structure, thing	-ior: pertaining to
-y: condition, process	-istry: pertaining to
	-nic: pertaining to
	-ory: pertaining to
	-ose: pertaining to
	-ous: pertaining to
	-tic: pertaining to
	-tory: pertaining to
	-tous: pertaining to

Exceptions to the Rules

As you continue to learn about medical terminology, you will find that, like most complex systems that are built on rules, there are exceptions to the rules. A few examples include prefixes embedded in a term and imperfect combinations. An example of a prefix embedded in a term is neuroendocrinologist, which can be broken down into *neur/o*; *endo-*; *crin/o*; and *-logist*. *Neur/o* means neuron or nerve, *endo-* means within, *crin/o* means secreting, and *-logist* means one who studies. A neuroendocrinologist is one who studies secretions, in this case hormones, within the brain. Note that *endo-* is a prefix, but it is found embedded in the term. An example of an imperfect combination is the term monozygotic, which can be broken down into mono-; zygote; and -tic. The prefix *mono-* means one, a zygote is an egg that has been fertilized by a sperm cell, and *-tic* means pertaining to. Monozygotic describes twins that have arisen from a single fertilized egg, or identical twins. Combining the word parts without modification produces monozygotetic, which is an invented word without meaning that is difficult to pronounce. Moreover, there is no accepted combining form for zygote. As a result, this is a case where the term does not directly follow the rules as described earlier in this chapter but is an imperfect combination of word parts.

Plural Endings

There is no straightforward rule for making a singular noun plural in medical terminology. In some cases, the English rule of adding a "s" or "es" to a noun, or

dropping a "y" and adding "ies," is used. For example, the plural of the noun nerve is nerves, vsinus is sinuses, and therapy is therapies. In other cases, Greek and Latin rules apply when changing the ending of a noun to make it plural.

For example:

a is changed to *ae*, as in vertebra to vertebrae

ax is changed to *aces*, as in pneumothorax to pneumothoraces

en is changed to *ina*, as in foramen to foramina

is is changed to *es*, as in metastasis to metastases

ix is changed to *ices*, as in cervix to cervices

ma is changed to *mata*, as in fibroma to fibromata

on is changed to *a*, as in ganglion to ganglia

um is changed to *a*, as in atrium to atria

us is changed to *i*, as in alveolus to alveoli

x is changed to *ges*, as in meninx to meninges

y is changed to *ies*, as in therapy to therapies

Abbreviations

Many medical terms have generally accepted abbreviations, although the abbreviations should only be used if they are approved in a particular facility or setting. Some examples of common abbreviations are CBC for Complete Blood Count, BUN for Blood Urea Nitrogen, and BMI for Body Mass Index. An extensive list of abbreviations is provided as an appendix.

Practice Exercises

To practice what you have learned in this chapter, define the word parts and meaning for the terms below. You may remember the word part definitions; if not, look for them in the tables. Once entered, use them to think about what the meaning of the term is. If you need assistance, refer to a medical dictionary or other online resource (see preface). This exercise will help prepare you for the active learning and deeper thought required in subsequent chapters, as you are guided through the body systems and use your knowledge and creativity to interpret case studies and medical terms.

1. Hypertrophic: Hyper- _____, -trophic _____,
   means _____.
2. Anesthesia: An- _____,
   esthesi/o _____, -ia _____,
   means _____.
3. Bilateral: Bi- _____,
   later/o _____, -al _____,
   means _____.
4. Arthralgia: Arthr/o _____, -algia _____,
   means _____.
5. Tachycardia: Tachy- _____,
   cardi/o _____, -ia _____,
   means _____.
6. Dizygotic: Di- _____, zygote _*zygote*_, -ic _____,
   means _____.

7. Ischemia: Isch/o _____,
   hem/o _____, -ia _____,
   means _____.
8. Hematochezia: Hemat/o _____, -chezia _____,
   means _____.
9. Anuria: An- _____, -uria _____,
   means _____.
10. Pancytopenia: Pan- _____,
    cyt/o _____, -penia _____,
    means _____.
11. Polydipsia: Poly- _____,
    dips/o _____, -ia _____,
    means _____.
12. Gastroenterostomy: Gastr/o _____,
    enter/o _____, -ostomy _____,
    means _____.