

# CHAPTER 6

# General Anatomy and Physiology

## Chapter Outline

- Why Study Anatomy and Physiology?
- Cells
- Tissues
- Organs and Body Systems
- The Skeletal System
- The Muscular System
- The Nervous System
- The Circulatory System
- The Lymphatic/Immune System
- The Endocrine System
- The Digestive System
- The Excretory System
- The Respiratory System
- The Integumentary System
- The Reproductive System



# Learning Objectives

After completing this chapter, you will be able to:

- L01** Define and explain why the study of anatomy, physiology, and histology is important to the esthetician.
- L02** Describe cells, their structure, and their reproduction.
- L03** Define tissue and identify the types of tissues found in the body.
- L04** Name the 9 major body organs and the 11 main body systems and explain their basic functions.

# Key Terms

Page number indicates where in the chapter the term is used.

<b>abductors</b> pg. 131	<b>auricularis posterior</b> pg. 128	<b>capillaries</b> pg. 140	<b>common carotid arteries</b> pg. 141
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<b>aorta</b> pg. 140	<b>body systems (systems)</b> pg. 121	<b>cervical cutaneous nerve</b> pg. 137	<b>depressor anguli oris (triangularis muscle)</b> pg. 129
<b>arteries</b> pg. 140	<b>brachial artery</b> pg. 143	<b>cervical nerves</b> pg. 137	<b>depressor labii inferioris (quadratus labii inferioris muscle)</b> pg. 129
<b>arterioles</b> pg. 140	<b>brain</b> pg. 133	<b>cervical vertebrae</b> pg. 124	<b>diaphragm</b> pg. 146
<b>atrioventricular valves (ATV)</b> pg. 140	<b>brain stem</b> pg. 134	<b>circulatory system (cardiovascular system, vascular system)</b> pg. 138	<b>diencephalon</b> pg. 133
<b>atrium</b> pg. 138	<b>buccal nerve</b> pg. 137	<b>clavicle (collarbone)</b> pg. 125	
<b>auricularis anterior</b> pg. 128	<b>buccinator</b> pg. 129		

# Key Terms

Page number indicates where in the chapter the term is used.

<b>digestion</b> pg. 145	<b>frontal bone</b> pg. 124	<b>kidneys</b> pg. 128	<b>metacarpus (palm)</b> pg. 126
<b>digestive enzymes</b> pg. 145	<b>frontalis</b> pg. 128	<b>lacrimal bones</b> pg. 124	<b>middle temporal artery</b> pg. 142
<b>digestive system (gastrointestinal system)</b> pg. 145	<b>glands</b> pg. 144	<b>lateral pterygoid</b> pg. 128	<b>mitosis</b> pg. 119
<b>digital nerve</b> pg. 137	<b>greater auricular nerve</b> pg. 137	<b>latissimus dorsi</b> pg. 130	<b>mitral valve (bicuspid valve)</b> pg. 139
<b>eleventh cranial nerve (accessory nerve)</b> pg. 137	<b>greater occipital nerve</b> pg. 137	<b>levator anguli oris (caninus)</b> pg. 129	<b>motor nerves (efferent nerves)</b> pg. 134
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	<b>interstitial fluid</b> pg. 143	<b>mentalis</b> pg. 130	<b>occipitalis</b> pg. 128
	<b>joint</b> pg. 123	<b>metabolism</b> pg. 120	

# Key Terms

Page number indicates where in the chapter the term is used.

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**W**hether applying product, giving a treatment, or doing a skin care analysis, as licensed estheticians, we are permitted to touch people as part of our profession. This is true of very few other occupations, and it is an honor to be able to aid others in a greater sense of well-being.

**Anatomy** (ah-NAT-ah-mee) is the study of the structures of the human body that can be seen with the naked eye, and of what substances they are made. It is the science of the structure of organisms, or of their parts.

**Physiology** (fiz-ih-OL-oh-jee) is the study of the functions and activities performed by the body structures.

**Histology** (his-TAHL-uh-jee), also known as **microscopic anatomy**, is the study of the tiny structures found in living tissue.

Estheticians focus primarily on the muscles, bones, nerves, and circulation of the head, face, neck, arms, and hands. Understanding this anatomy and physiology will help you develop your skills and perform your work safely.

## Why Study Anatomy and Physiology?

As an esthetic professional, an overview of human anatomy and physiology will enable you to perform your services knowledgeably and effectively on a consistent basis.

- Estheticians need to understand how the human body functions as an integrated whole.
- As a service provider, you must be able to recognize changes from the norm.
- A scientific basis is needed for the proper application of services and products such as facials and hand and arm massages.
- Estheticians must understand the effect that services will have on tissues, organs, and body systems.
- Decisions on which treatment plans and protocols to provide for a client are based on the foundation and structures within the body.  L01

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## Cells

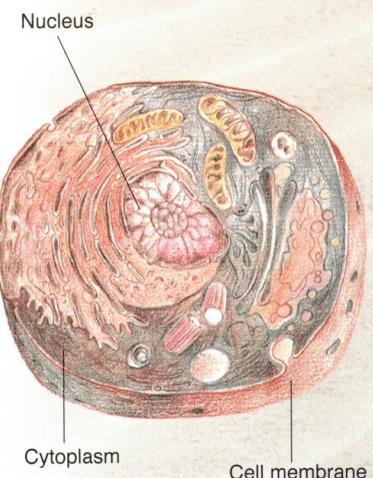
**Cells** are the basic unit of all living things, from bacteria to plants to animals to human beings. Without cells, life does not exist. As a basic functional unit, the cell is responsible for carrying on all life processes. There are trillions of cells in the human body, and they vary widely in size, shape, and purpose.

## Basic Structure of the Cell

The cells of all living things are composed of a substance called **protoplasm** (PROH-toh-plaz-um), a colorless, jellylike substance in which food elements such as proteins, fats, carbohydrates, mineral salts, and water are present. You can visualize the protoplasm of a cell as being similar to the clear gel of a raw egg.

In addition to protoplasm, most cells also include a nucleus, an **organelle** (small organ), cytoplasm, and the cell membrane (Figure 6–1).

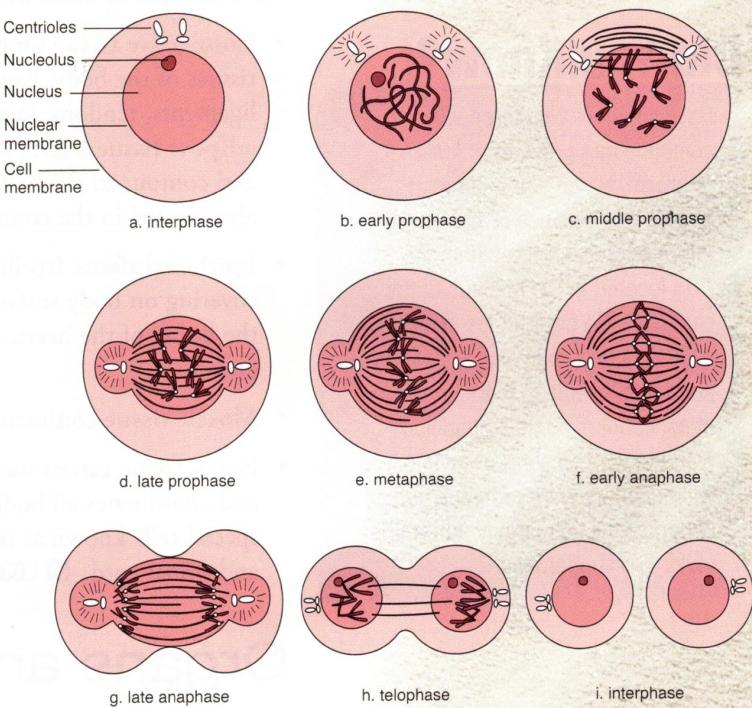
- The **nucleus** (NOO-klee-us) is the dense, active protoplasm found in the center of the cell. It plays an important part in cell reproduction and metabolism. You can visualize the nucleus as the yolk of a raw egg. Within the nucleus of the cell is the **nucleoplasm**, which is a fluid that contains proteins, and a very important acid known as **deoxyribonucleic acid (DNA)** (DEE-ok-see-RYE-boh-noo-KLEE-ik ASS-id). DNA is what determines our genetic makeup, including the color of our eyes, skin, and hair.
- The **cytoplasm** (sy-toh-PLAZ-um) is all the protoplasm of a cell except that found in the nucleus. This watery fluid contains the food material necessary for cell growth, reproduction, and self-repair.
- The **cell membrane** is the part of the cell that encloses the protoplasm and permits soluble substances to enter and leave.



▲ Figure 6–1  
Anatomy of the cell.

## Cell Reproduction and Division

Cells have the ability to reproduce, thus providing new cells for the growth and replacement of worn or injured ones. **Mitosis** (my-TOH-sis) is the usual process of cell reproduction in human tissues that occurs when the cell divides into two identical cells called daughter cells. Two small structures near the nucleus called centrioles (SEN-tree-olz) move to each side during mitosis to help divide the cell. As long as conditions are favorable, the cell will grow and reproduce. Favorable conditions include an adequate supply of food, oxygen, and water; suitable temperatures; and the ability to eliminate waste products. If conditions become unfavorable, the cell will become impaired or may be destroyed. Unfavorable conditions include toxins (poisons), disease, and injury (Figure 6–2).  LO2



▲ Figure 6–2  
Phases of mitosis.

## Did You Know?

According to Jeffrey Utz, M.D., from the department of Neuroscience at Allegheny University, an average adult body is 50 to 65 percent water—which equals roughly 45 qt (42.5 l). Men's bodies contain more water than women's bodies do. A man's body is 60 to 65 percent water, compared to 50 to 60 percent for a woman. In infants, the figure is amazingly more at 70 percent. Water content differs throughout various tissues in the body; for instance, blood is made up of 83 percent water, and muscle is 75 percent water.

## Did You Know?

Have you ever wondered why someone has green eyes instead of brown, or red hair instead of blond? It is because of the genetic information enclosed within the DNA located in the nucleus of the cell. The DNA determines all of the cell's functions and characteristics, and the information is transferred at conception. As an esthetician working with all sorts of people, you will become aware of how a person's genetic code will largely determine his or her appearance.

## Cell Metabolism

**Metabolism** (muh-TAB-uh-liz-um) is a chemical process that takes place in living organisms. Through metabolism, cells are nourished and carry out their activities. Metabolism has two phases, anabolism and catabolism, that are carried out simultaneously and continually within the cells.

- **Anabolism** (uh-NAB-uh-liz-um) is constructive metabolism, the process of *building up* larger molecules from smaller ones. During this process, the body stores water, food, and oxygen for the time when these substances will be needed for cell growth and repair.
- **Catabolism** (kuh-TAB-uh-liz-um) is the phase of metabolism in which complex compounds within the cells are broken down into smaller ones. This process releases energy that is stored by special molecules to be used in muscle contractions, body secretions, or heat production.

## Tissues

**Tissue** (TISH-oo) is a collection of similar cells that perform a particular function. Each tissue has a specific function and can be recognized by its characteristic appearance. Body tissues are composed of large amounts of water, along with various other substances. There are four types of tissue in the body.

- **Connective tissue** supports, protects, and binds together other tissues of the body. Examples of connective tissue are bone, cartilage, ligaments, tendons, fascia (which separates muscles), and fat or **adipose tissue** (ADD-ih-pohz TISH-oo), which gives smoothness and contour to the body. Collagen and elastin are protein fibers also located in the connective tissue.
- **Epithelial tissue** (ep-ih-THEE-lee-ul TISH-oo) is a protective covering on body surfaces. Examples are skin, mucous membranes, the lining of the heart, digestive and respiratory organs, and the glands.
- **Muscle tissue** contracts and moves the various parts of the body.
- **Nerve tissue** carries messages to and from the brain and controls and coordinates all bodily functions. Nerve tissue is composed of special cells known as neurons, which make up the nerves, brain, and spinal cord.  L03

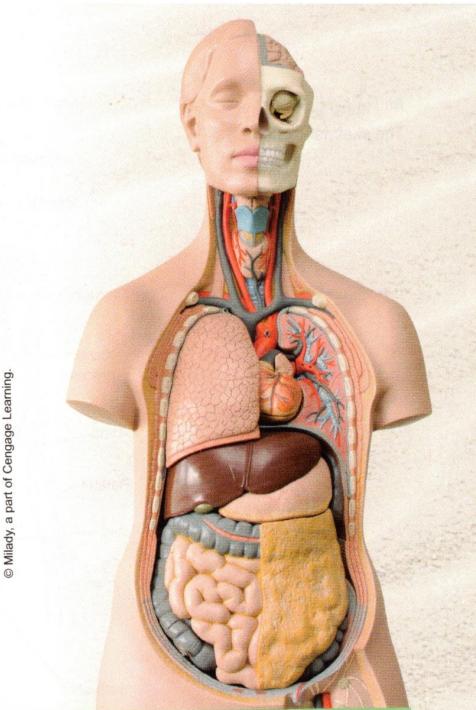
## Organs and Body Systems

**Organs** are structures composed of specialized tissues designed to perform a specific functions in plants and animals. **Table 6-1** lists some of the most important organs of the body.

## NINE MAJOR BODY ORGANS AND THEIR FUNCTIONS

ORGAN	FUNCTION
Brain	Controls the body.
Eyes	Control the body's vision.
Heart	Circulates the blood.
Kidneys	Excrete water and waste products.
Lungs	Supply oxygen to the blood.
Liver	Removes waste created by digestion.
Skin	External protective coating that covers the body.
Stomach	Digests food, along with the intestines.
Intestines	Digests food, along with the stomach.

▲ Table 6–1 Nine Major Body Organs and Their Functions.



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## ELEVEN MAIN BODY SYSTEMS AND THEIR FUNCTIONS

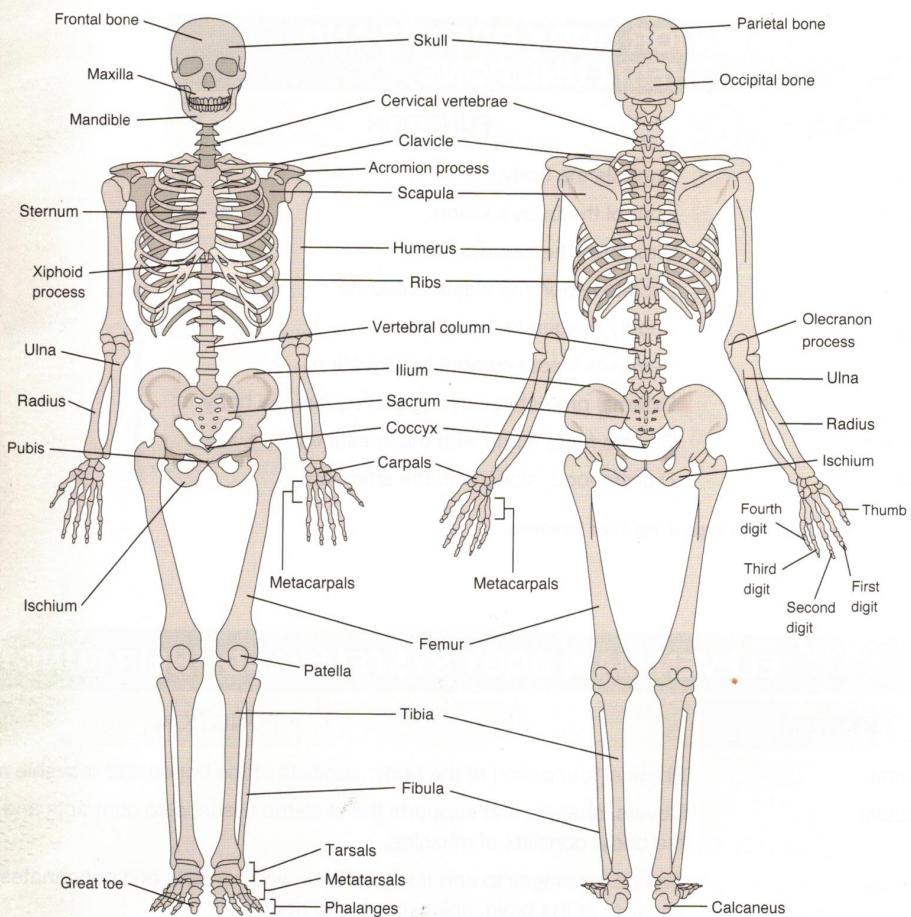
SYSTEM	FUNCTION
Skeletal	Physical foundation of the body; consists of the bones and movable and immovable joints.
Muscular	Covers, shapes, and supports the skeleton tissue; also contracts and moves various parts of the body; consists of muscles.
Nervous	Carries messages to and from the brain and controls and coordinates all bodily functions; consists of the brain, spinal cord, and nerves.
Circulatory	Controls the steady circulation of the blood through the body by means of the heart and blood vessels.
Lymphatic/Immune	Protects the body from disease by developing immunities and destroying disease-causing toxins and bacteria.
Endocrine	Affects growth, development, sexual activities, and health of the body; consists of specialized glands.
Digestive	Changes food into nutrients and wastes; consists of mouth, stomach, intestines, salivary and gastric glands.
Excretory	Purifies the body by elimination of waste matter; consists of kidneys, liver, skin, intestines, and lungs.
Respiratory	Enables breathing, supplies the body with oxygen, and eliminates carbon dioxide as a waste product; consists of lungs and air passages.
Integumentary	Serves as a protective covering for the body and helps in temperature regulation; consists of skin, accessory organs such as oil and sweat glands, sensory receptors, hair, and nails.
Reproductive	The reproductive system performs the function of reproducing and perpetuating the human race.

▲ Table 6–2 Eleven Main Body Systems and Their Functions.

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**Body systems**, also known as **systems**, are groups of bodily organs acting together to perform one or more functions. The human body is composed of 11 major systems (Table 6–2). L04

► **Figure 6–3**  
The skeletal system.



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## The Skeletal System

The **skeletal system** forms the physical foundation of the body (**Figure 6–3**). The skeletal system serves many important functions; it provides the shape and form for our bodies in addition to supporting, protecting, allowing bodily movement, producing blood for the body, and storing minerals such as calcium carbonate and calcium phosphate.

**Osteology** (ahs-tee-AHL-oh-jee) is the study of the anatomy, structure, and function of the bones. **Os** (AHS) means *bone* and is used as a prefix in many medical terms, such as osteoarthritis, a joint disease.

The skeleton has 206 bones that form a rigid framework to which the softer tissues and organs of the body are attached. Muscles are connected to bones by tendons. Bones are connected to each other by ligaments. The place where bones meet one another is typically called a joint.

The bone tissue is composed of several types of bone cells embedded in a web of inorganic salts (mostly calcium and phosphorus) and collagenous and ground fibers. The web gives the bone strength, and the fibers give the bone flexibility.

### Did You Know?

People often complain of joint pain; however, the pain is usually caused by inflammation of the tissue surrounding the joint and not by the joint itself.

You have over 230 moveable and semi-moveable joints in your body.

The primary functions of the skeletal system are to:

- Give shape and support to the body.
- Protect various internal structures and organs.
- Serve as attachments for muscles and act as levers to produce body movement.
- Help produce both white and red blood cells (one of the functions of bone marrow).
- Store most of the body's calcium supply as well as phosphorus, magnesium, and sodium.

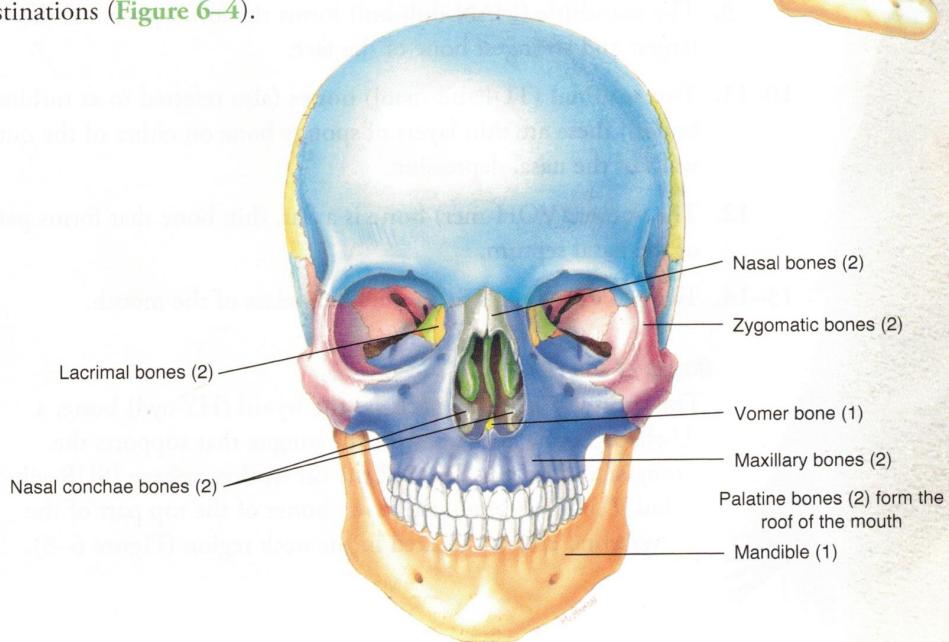
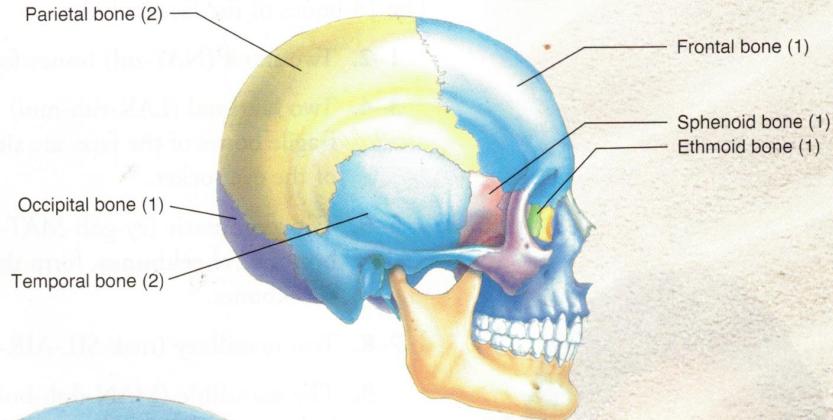
A **joint** is the connection between two or more bones of the skeleton.

There are two types of joints: movable, such as elbows, knees, and hips; and immovable, such as the pelvis or skull, which allow little or no movement.

## Bones of the Skull

The human head contains 22 bones divided into two groups: the cranium and the facial bones. The **cranium** (KRAY-nee-um) is an oval, bony case that protects the brain, formed by 8 bones; and the face consists of 14 bones including the maxilla (upper jaw) and mandible (lower jaw). The skull has many small openings in its base that allow the cranial nerves to travel to their destinations (**Figure 6-4**).

▼ Figure 6-4  
The cranial and facial bones.



## Did You Know?

Painful inflammation involving the carpus area can be caused by repetitive motions, such as flexing your wrist excessively or locking it in a bent position. Keeping the wrist straight can help prevent these injuries.

### Bones of the Cranium

The cranium is made up of eight bones:

- The **occipital** (ahk-SIP-ih-tul) **bone** is the hindmost bone of the skull; it forms the back of the skull above the nape.
- The two **parietal** (puh-RY-uh-tul) **bones** form the sides and crown (top) of the cranium.
- The **frontal** (FRUNT-ul) **bone** forms the forehead.
- The two **temporal** (TEM-puh-rul) **bones** form the sides of the head in the ear region.
- The **ethmoid** (ETH-moyd) **bone** is the light, spongy bone between the eye sockets that forms part of the nasal cavities.
- The **sphenoid** (SFEEN-oyd) **bone** joins all the bones of the cranium together.

### Bones of the Face

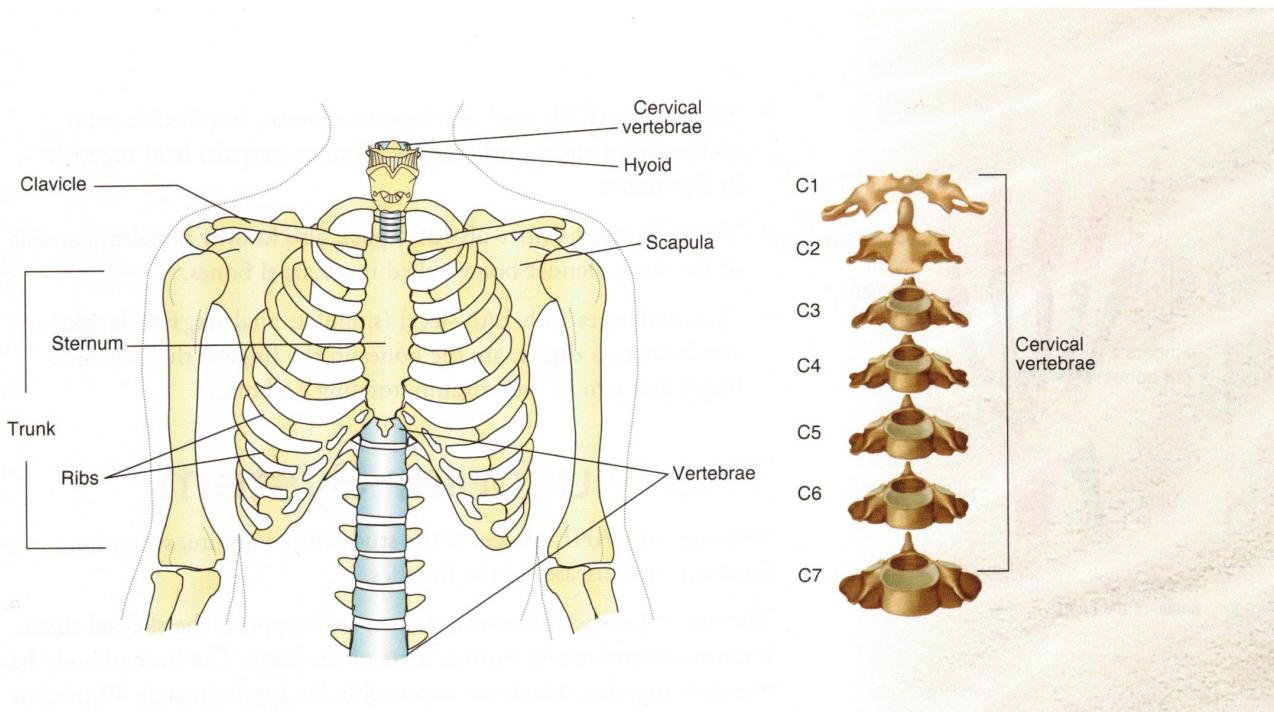
The 14 bones of the face include:

- 1–2. Two **nasal** (NAY-zul) **bones** form the bridge of the nose.
- 3–4. Two **lacrimal** (LAK-ruh-mul) **bones**, the smallest and most fragile bones of the face, are situated at the front inside part of the eye socket.
- 5–6. Two **zygomatic** (zy-goh-MAT-ik) **bones**, also known as **malar bones** or **cheekbones**, form the prominence of the cheeks, or cheekbones.
- 7–8. Two **maxillary** (mak-SIL-AIR-EE) **bones** form the upper jaw.
9. The **mandible** (MAN-duh-bul) forms the lower jawbone, the largest and strongest bone of the face.
- 10–11. Two **turbinal** (TUR-bih-nahl) **bones** (also referred to as turbinate bones); these are thin layers of spongy bone on either of the outer walls of the nasal depression.
12. The **vomer** (VOH-mer) **bone** is a flat, thin bone that forms part of the nasal septum.
- 13–14. Two **palatine bones** form the hard palate of the mouth.

### Bones of the Neck

The main bones of the neck are the **hyoid** (HY-oyd) **bone**, a U-shaped bone at the base of the tongue that supports the tongue and its muscles, and the **cervical vertebrae** (SUR-vih-kul VURT-uh-bray), the seven bones of the top part of the vertebral column located in the neck region (**Figure 6–5**).

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## Bones of the Chest

The bones of the trunk or torso are comprised of:

- **Thorax** (THOR-aks). The chest or pulmonary trunk consisting of the sternum, ribs, and thoracic vertebrae. It is an elastic, bony cage that serves as a protective framework for the heart, lungs, and other internal organs.
- **Ribs.** Twelve pairs of bones forming the wall of the thorax.
- **Scapula** (SKAP-yuh-luh) also known as **shoulder blade**. The large, flat, triangular bone of the shoulder. There are two scapulas.
- **Sternum** (STUR-num), also known as **breastbone**. The flat bone that forms the ventral (front) support of the ribs.
- **Clavicle** (KLAV-ih-kul), also known as **collarbone**. The bone that joins the sternum and scapula.

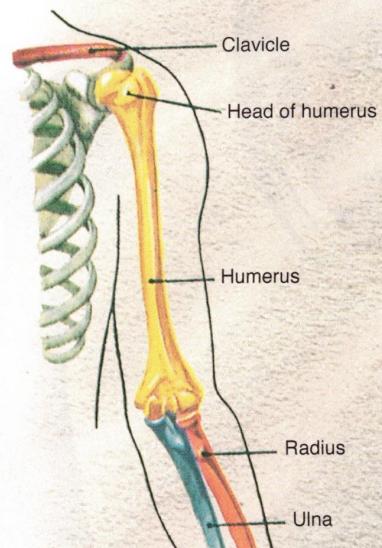
## Bones of the Arms and Hands

The important bones of the arms and hands are as follows

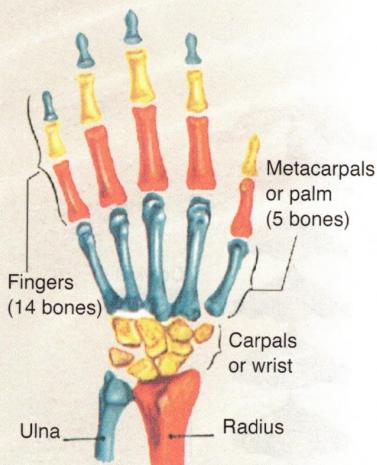
(**Figures 6–6 and 6–7**):

- The **humerus** (HYOO-muh-rus) is the uppermost and largest bone of the arm, extending from the elbow to the shoulder.
- The **ulna** (UL-nuh) is the inner and larger bone of the forearm (lower arm), attached to the wrist and located on the side of the little finger.
- The **radius** (RAY-dee-us) is the smaller bone in the forearm on the same side as the thumb.

▲ Figure 6–5  
Bones of the neck, shoulder, and back.



▲ Figure 6–6  
Bones of the arm.



▲ Figure 6–7  
Bones of the hand.

## Did You Know?

About 40 to 50 percent of body weight is in muscles. And there are over 630 muscles that make your body move.

- The **carpus** (KAR-pus) also known as **wrist**, is a flexible joint composed of eight small, irregular bones (carpals) held together by ligaments.
- The **metacarpus** (met-uh-KAR-pus), also known as **palm**, consists of five long, slender bones called metacarpal bones.
- The **phalanges** (fuh-LAN-jeez) (singular: phalanx, FAY-langks), also known as **digits**, are the bones in the fingers, three in each finger and two in each thumb, totaling 14 bones.

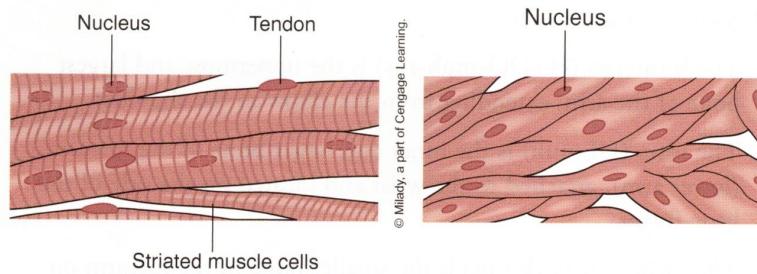
## The Muscular System

**Myology** (my-AHL-uh-jee) is the study of the nature, structure, function, and diseases of the muscles.

The **muscular system** covers, shapes, and supports the skeletal tissue. It contracts and moves various parts of the body. The human body has over 630 muscles, which are responsible for approximately 40 percent of the body's weight. Out of the over 630 muscles, 30 of them are facial muscles. Muscles are fibrous tissues with the ability to stretch and contract according to the demands of the body's movements.

There are three types of muscular tissue.

- Striated** (STRY-ayt-ed) **muscles**, also known as **skeletal** or **voluntary**, are attached to the bones and make up a large percentage of body mass and are controlled by the will (Figure 6–8). Nerve impulses trigger a reaction from the muscle which contracts, moving its associated bone or joint.
- Nonstriated muscles**, also known as **involuntary**, **visceral**, or **smooth**, function automatically, without conscious will (Figure 6–9). These muscles are found in the digestive and circulatory systems as well as some internal organs of the body.
- Cardiac muscle** is the involuntary muscle that makes up the heart (Figure 6–10). This type of muscle is unique and not found in any other part of the body. It is striated and has a crossing, banding



▲ Figure 6–8  
Striated muscle cells.

▲ Figure 6–9  
Nonstriated muscle cells.

pattern that allows contraction and thus the beating of the heart. It is under the control of the autonomic nervous system.

A muscle has three parts:

- The **origin** is the more fixed part of the muscle closest to the skeleton, which flexes, but remains stationary.
- The **belly** is the middle part of the muscle.
- The **insertion** is the part of the muscle which is the movable attachment and farthest from the skeleton. Pressure in massage is usually directed from the insertion to the origin.

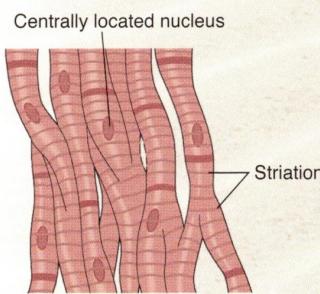
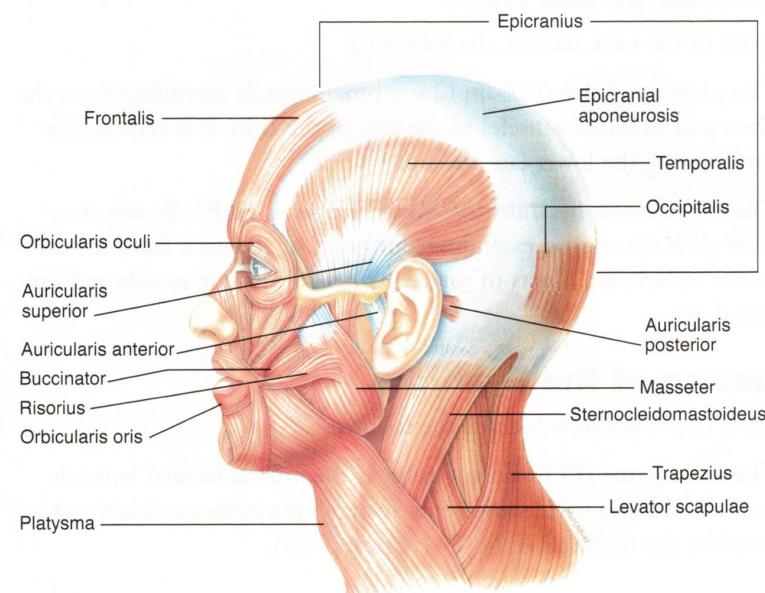
Muscular tissue can be stimulated by:

- Massage (hand or electric vibrator)
- Electrical therapy current (See Chapter 8, Basics of Electricity, for additional information on high-frequency, galvanic, or microcurrent.)
- Light rays (infrared light, light-emitting diode [LED] or ultraviolet radiation)
- Heat rays (heating lamps or heating caps)
- Moist heat (steamers or moderately warm steam towels)
- Nerve impulses (through the nervous system)
- Chemicals (certain acids and salts)

## Muscles of the Scalp

There are four muscles of the scalp:

- The **epicranius** (ep-ih-KRAY-nee-us), also known as **occipitofrontalis** (ahk-SIP-ihtoh-frun-TAY-lus), is a broad muscle that covers the top of the skull. It consists of two parts, occipitalis and frontalis (**Figure 6–11**).



▲ **Figure 6–10**  
Cardiac muscle cells.

- 
- The **occipitalis** (ahk-SIP-i-tahl-is), the back of the epicranium, is the muscle that draws the scalp backward.
  - The **frontalis** (frun-TAY-lus) is the anterior (front) portion of the epicranium. It is the scalp muscle that raises the eyebrows, draws the scalp forward, and causes wrinkles across the forehead.
  - The **epicranial aponeurosis** (ep-ih-KRAY-nee-al ap-uh-noo-ROH-sus) is a tendon connecting the occipitalis and the frontalis.

## Muscles of the Ear

These muscles are attached to the ear.

- The **auricularis** (aw-rik-yuh-LAIR-is) **superior** is the muscle above the ear that draws the ear upward.
- The **auricularis anterior** is the muscle in front of the ear that draws the ear forward.
- The **auricularis posterior** is the muscle behind the ear that draws the ear backward.

## Muscles of Mastication (Chewing)

The main muscles of mastication coordinate to open and close the mouth and bring the jaw forward or backward. These muscles, listed below, are sometimes referred to as the *chewing muscles*.

- **Masseter** (muh-SEE-tur)
- **Temporalis** (tem-poh-RAY-lis)
- **Medial pterygoid** (MEE-dee-ul TEHR-ih-goyd)
- **Lateral pterygoid** (LAT-ur-ul TEHR-ih-goyd)

## Muscles of the Neck

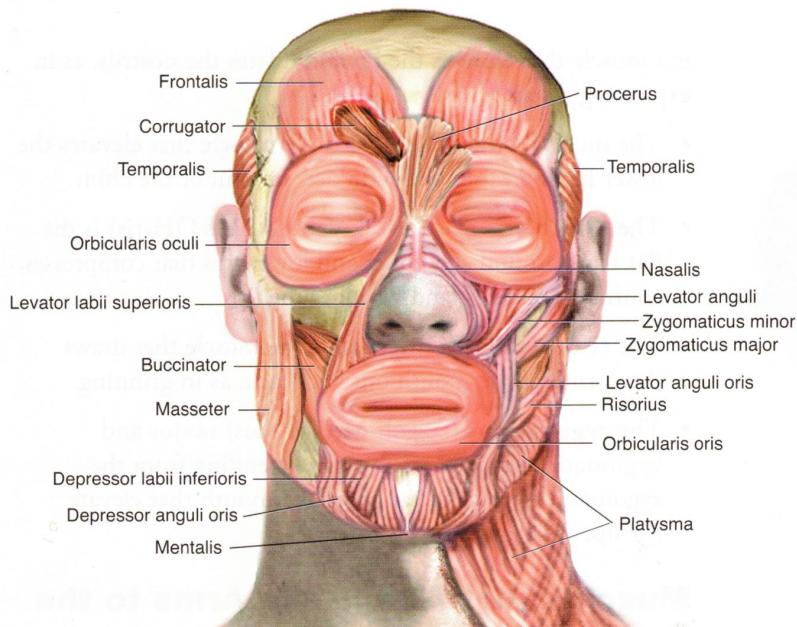
Muscles of the neck include the following.

- The **platysma** (plah-TIZ-muh) is a broad muscle extending from the chest and shoulder muscles to the side of the chin. It is responsible for lowering the lower jaw and lip.
- The **sternocleidomastoid (SCM)** (STUR-noh-KLEE-ih-doh-mas-TOY-d) is the muscle extending along side of the neck from the ear to the collarbone. It acts to rotate the head from side to side and up and down.

## Muscles of the Eyebrow

Muscles of the eyebrow include the following.

- The **corrugator** (KOR-oo-gay-tohr) is the muscle located beneath the frontalis and orbicularis oculi. It draws the eyebrow down and wrinkles the forehead vertically (**Figure 6–12**).



◀ Figure 6–12  
Muscles of the face.

- The **orbicularis oculi** (or-bik-yuh-LAIR-is AHK-yuh-lye) is the ring muscle of the eye socket; it closes the eyes.

### Muscles of the Nose

The two primary muscles of the nose are:

- The **procerus** ( prah-sir-us or pro-SAARH-us) lowers the eyebrows and causes wrinkles across the bridge of the nose.
- The **nasalis** is a two part muscle which covers the nose that includes the *transverse part* and the *alar part*, which flair the nostrils.

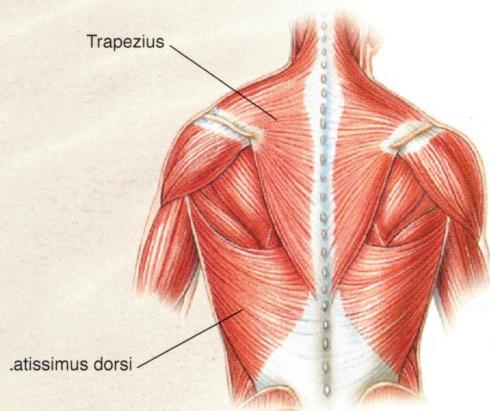
### Muscles of the Mouth

The following are important muscles of the mouth (see **Figure 6–12**).

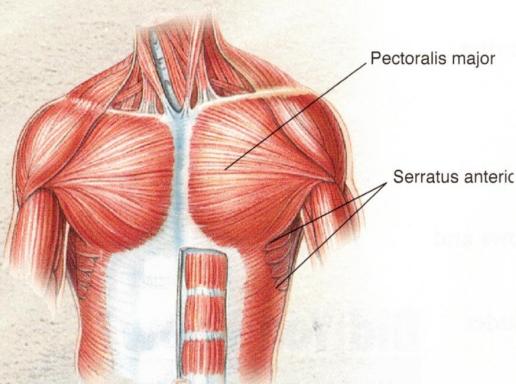
- The **buccinator** (BUK-sih-nay-tur) is the thin, flat muscle of the cheek between the upper and lower jaw that compresses the cheeks and expels air between the lips, as in when blowing a whistle.
- The **depressor anguli oris**, also known as **triangularis** (try-ang-gyuh-LAY-rus) **muscle**, is the muscle extending alongside the chin that pulls down the corners of the mouth.
- The **depressor labii inferioris** (dee-PRES-ur LAY-bee-eye in-FEER-ee-or-us), also known as **quadratus labii inferioris**, is a muscle surrounding the lower lip that depresses the it and draws the lower lip to one side.
- The **levator anguli oris** (lih-VAYT-ur ANG-yoo-ly OH-ris), also known as **caninus** (kay-NY-nus), is a muscle that raises the angle of the mouth and draws it inward.
- The **levator labii superioris** (lih-VAYT-ur LAY-bee-eye soo-peer-ee-OR-is), also known as **quadratus** (kwah-DRA-tus) **labii superioris**,

### Did You Know?

You have over 30 muscles in your face that control your expressions.



**▲ Figure 6–13**  
Muscles of the back and neck that attach the arms to the body.



**▲ Figure 6–14**  
Muscles of the chest that attach the arms to the body.

is a muscle that elevates the lip and dilates the nostrils, as in expressing distaste.

- The **mentalis** (men-TAY-lis) is the muscle that elevates the lower lip and raises and wrinkles the skin of the chin.
- The **orbicularis oris** (or-bik-yuh-LAIR-is OH-ris) is the flat band around the upper and lower lips that compresses, contracts, puckers, and wrinkles the lips.
- The **risorius** (rih-ZOR-ee-us) is the muscle that draws the corner of the mouth out and back, as in grinning.
- The **zygomaticus major** and **zygomaticus minor** are muscles extending from the zygomatic bone to the angle of the mouth that elevate the lip, as in laughing.

## Muscles that Attach the Arms to the Body

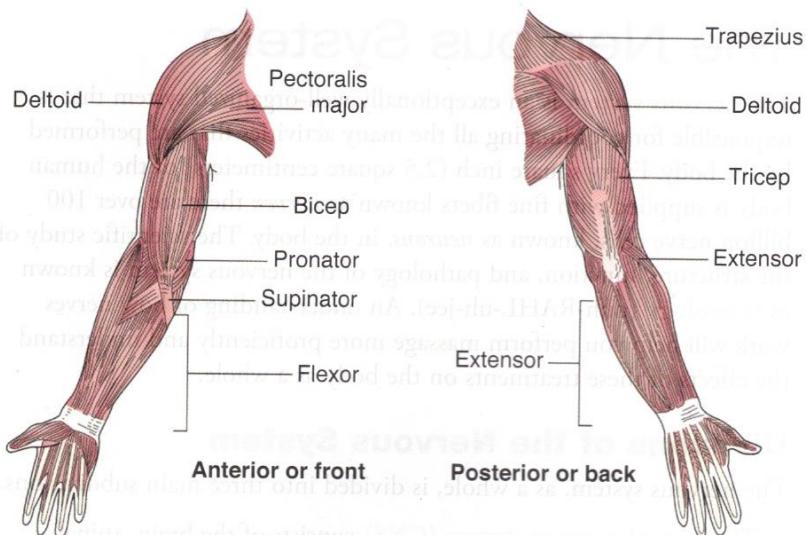
Muscles attaching the arms to the body include the following.

- The **latissimus dorsi** (lah-TIS-ih-mus DOR-see) is a large, flat, triangular muscle that covers the lower back. It comes up from the lower half of the vertebral column and iliac crest (hip bone) and narrows to a rounded tendon attached to the front of the upper part of the humerus (**Figure 6–13**).
- The **pectoralis major** (pek-tor-AL-is) and **pectoralis minor** are muscles of the chest that assist the swinging movements of the arm.
- The **serratus anterior** (ser-RAT-us an-TEER-ee-or) is a muscle of the chest that assists in breathing and in raising the arm (**Figure 6–14**).

## Muscles of the Shoulder and Arm

Here are the principal muscles of the shoulders and upper arms (**Figure 6–15**).

- The **trapezius** (trah-PEE-zee-us) muscle covers the back of the neck, shoulders, and upper and middle region of the back; shrugs shoulders and stabilizes the scapula.
- The **biceps** (BY-seps) muscles produce the contour of the front and inner side of the upper arm; they lift the forearm, flex the elbow, and turn the palms outward.
- The **deltoid** (DEL-toyd) is a large, triangular muscle covering the shoulder joint that allows the arm to extend outward and to the side of the body.



**Figure 6–15**  
Muscles of the anterior and posterior shoulder and arm.

- The **triceps** (TRY-seps) is a large muscle that covers the entire back of the upper arm and extends the forearm.

The forearm is made up of a series of muscles and strong tendons. As an esthetician, you will be concerned with the following muscles.

- The **extensors** (ik-STEN-surs) are muscles that straighten the wrist, hand, and fingers to form a straight line.
- The **flexors** (FLEK-surs), extensor muscles of the wrist, are involved in flexing the wrist.
- The **pronators** (proh-NAY-tohrs) are muscles that turn the hand inward so that the palm faces downward.
- The **supinators** (SOO-puh-nayt-ur) muscle rotates the radius outward and the palm upward.

## Muscles of the Hand

The hand is one of the most complex parts of the body, with many small muscles that overlap from joint to joint, providing flexibility and strength to open and close the hand and fingers. During the aging process, these muscles lose mobility, causing stiffness in the joints. Massage can help relax and maintain the pliability of these muscles.

Important muscles to know include the:

- Abductors** (ab-DUK-turz). Muscles that draw a body part, such as a finger, arm, or toe, away from the midline of the body or of an extremity. In the hand, abductors separate the fingers.
- Adductors** (ah-DUK-turz). Muscles that draw a body part, such as a finger, arm, or toe, inward toward the median axis of the body or of an extremity. In the hand, adductors draw the fingers together (Figure 6–16).



**Figure 6–16**  
Muscles of the hand.

## Did You Know?

If you did not have a central nervous system, you could not taste, smell, see, hear, think, breathe, move, run, sleep, remember, sing, laugh, or write, to name just a few things.

# The Nervous System

The **nervous system** is an exceptionally well-organized system that is responsible for coordinating all the many activities that are performed by the body. Every square inch (2.5 square centimeters) of the human body is supplied with fine fibers known as *nerves*; there are over 100 billion nerve cells, known as *neurons*, in the body. The scientific study of the structure, function, and pathology of the nervous system is known as **neurology** (nuh-RAHL-uh-jee). An understanding of how nerves work will help you perform massage more proficiently and understand the effects of these treatments on the body as a whole.

## Divisions of the Nervous System

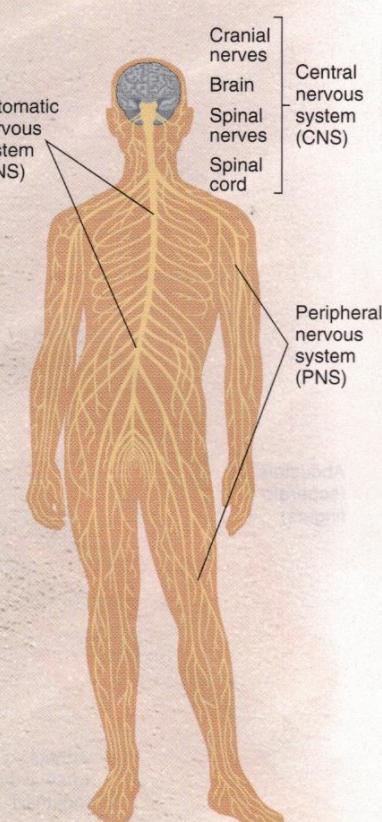
The nervous system, as a whole, is divided into three main subdivisions.

- The **central nervous system (CNS)** consists of the brain, spinal cord, spinal nerves, and cranial nerves. It controls consciousness and many mental activities, voluntary functions of the five senses (seeing, hearing, feeling, smelling, and tasting), and voluntary muscle actions including all body movements and facial expressions.
- The **peripheral nervous system (PNS)** (puh-RIF-uh-rul NURV-vus SIS-tum) is a system of nerves that connects the peripheral (outer) parts of the body to the central nervous system; it has both sensory and motor nerves. Its function is to carry impulses, or messages, to and from the central nervous system.
- The **autonomic nervous system (ANS)** (aw-toh-NAHM-ik NURV-us SIS-tum) is the part of the nervous system that controls the involuntary muscles; it regulates the action of the smooth muscles, glands, blood vessels, heart, and breathing (**Figure 6–17**).

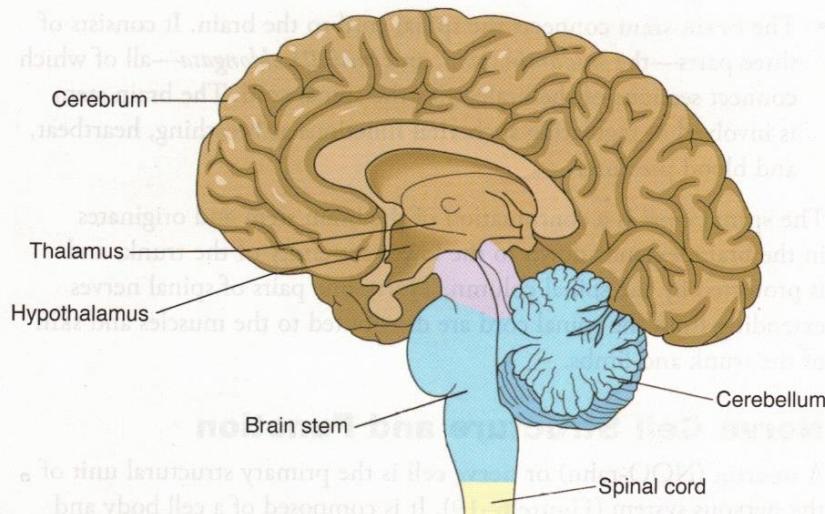
The peripheral nervous system (PNS) is further divided into two sections, the afferent peripheral system and the efferent peripheral system. From the efferent peripheral system, there are two subcategories, the somatic nervous system, which causes us to react to our external environment; and the autonomic nervous system (ANS), which is responsible for the internal regulation of impulses from the central nervous system to smooth muscles, such as the heart, and blood vessels and glands. The autonomic nervous system is considered involuntary.

The organs affected by the autonomic system receive nerve cells or fibers from its two divisions, the sympathetic and the parasympathetic. The **sympathetic division** stimulates or speeds up activity and prepares the body for stressful situations, whereas the **parasympathetic division** operates under normal, nonstressful conditions and helps restore and slow down activity, thus keeping the body in balance.

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▲ **Figure 6–17**  
Principal parts of the nervous system.



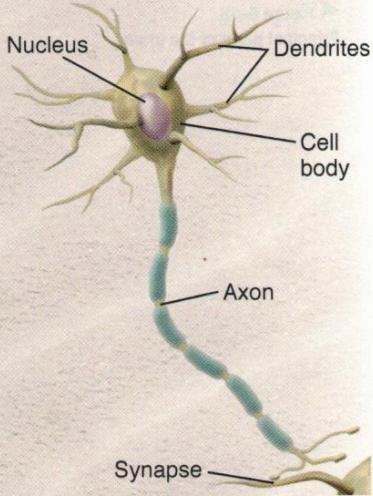
◀ Figure 6-18  
Principal parts of the brain.

## The Brain and Spinal Cord

The **brain** is the largest and most complex mass of nerve tissue in the body. The brain is contained in the cranium, weighs an average of 44 to 48 ounces (1.25 to 1.35 kilograms), and has four main parts. They are the cerebrum, the cerebellum, the diencephalon, and the brain stem. The brain controls sensation, muscles, glandular activity, and the power to think and feel. It sends and receives telegraphic messages through 12 pairs of cranial nerves that originate in the brain and reach various parts of the head, face, and neck (Figure 6-18).

The brain is divided into four parts.

- The **cerebrum** makes up the bulk of the brain. It is located in the front, upper part of the cranium. It has an inner core of white matter, composed of bundles of axons each coated with a sheath of myelin, and an outer core of gray matter, composed of masses of cell bodies and dendrites. Within the cerebrum is the *cerebral cortex*, located in the part of the cerebrum from which most messages from the brain are sent—such as those conveying thought, hearing, and sight.
- The term **cerebellum** is Latin for *little brain*. It lies at the base of the cerebrum and is attached to the brain stem. It acts to control movement, coordinate voluntary muscular activity, and maintain balance and equilibrium.
- The **diencephalon** (Dy-en-sef-ah-lon) is located in the uppermost part of the midbrain and has two main parts, called the *thalamus* and the *hypothalamus*. The thalamus, located in the upper part of the diencephalon, acts as a relay station for sensory impulses and plays a role in the recognition of pain and temperature in the body. The hypothalamus, located in the lower part of the diencephalon, controls many bodily functions such as body temperature. The hypothalamus also controls the pituitary gland.



**▲ Figure 6-19**  
A neuron or nerve cell.

- The **brain stem** connects the spinal cord to the brain. It consists of three parts—the *midbrain*, *pons*, and *medulla oblongata*—all of which connect sections of the brain with the spinal cord. The brain stem is involved in regulating such vital functions as breathing, heartbeat, and blood pressure.

The **spinal cord** is a continuation of the brain stem and originates in the brain, extends down to the lower extremity of the trunk, and is protected by the spinal column. Thirty-one pairs of spinal nerves extending from the spinal cord are distributed to the muscles and skin of the trunk and limbs.

## Nerve Cell Structure and Function

A **neuron** (NOO-rahn) or **nerve cell** is the primary structural unit of the nervous system (Figure 6-19). It is composed of a cell body and nucleus; **dendrites** (DEN-dryts), nerve fibers extending from the nerve cell that receive impulses from other neurons; and an **axon** (AK-sahn), which sends impulses away from the cell body to other neurons, glands, or muscles.

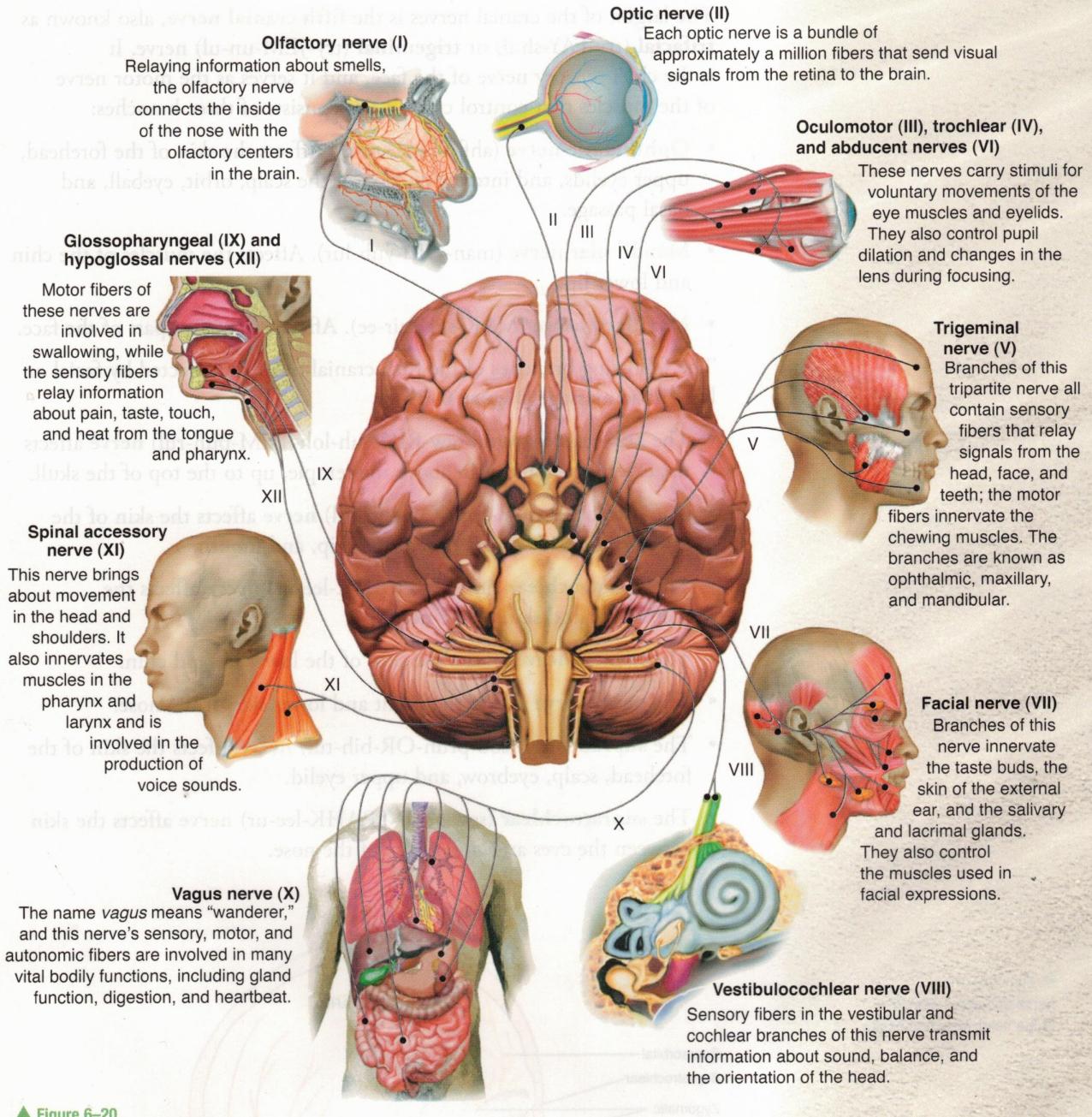
**Nerves** are whitish cords, made up of bundles of nerve fibers held together by connective tissue, through which impulses are transmitted. Nerves have their origin in the brain and spinal cord and send their branches to all parts of the body.

## Types of Nerves

There are two types of nerves:

- Sensory nerves**, also known as **afferent nerves** (AAF-eer-ent NURVS), carry impulses or messages from the sense organs to the brain, where sensations such as touch, cold, heat, sight, hearing, taste, smell, pain, and pressure are experienced. Sensory nerve endings called receptors are located close to the surface of the skin. As impulses pass from the sensory nerves to the brain and back through the motor nerves to the muscles, a complete circuit is established, resulting in movement of the muscles.
- Motor nerves**, also known as **efferent nerves** (EF-uh-rent NURVS), carry impulses from the brain to the muscles or glands. These transmitted impulses produce movement.

A **reflex** (REE-fleks) is an automatic nerve reaction to a stimulus that involves the movement of an impulse from a sensory receptor along the afferent nerve to the spinal cord and a responsive impulse back along an efferent neuron to a muscle, causing a reaction (for example, the quick removal of the hand from a hot object). Reflexes do not have to be learned, they are automatic.



**▲ Figure 6–20**  
The cranial nerves and their functions.

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## Nerves of the Head, Face, and Neck

There are 12 pairs of cranial nerves arising at the base of the brain and the brain stem. The cranial nerves activate the muscles and sensory structure of the head and neck including skin, membranes, eyes, and ears (Figure 6–20).

Estheticians are primarily concerned with nerves V, VII, and XI, and each one has several branches.

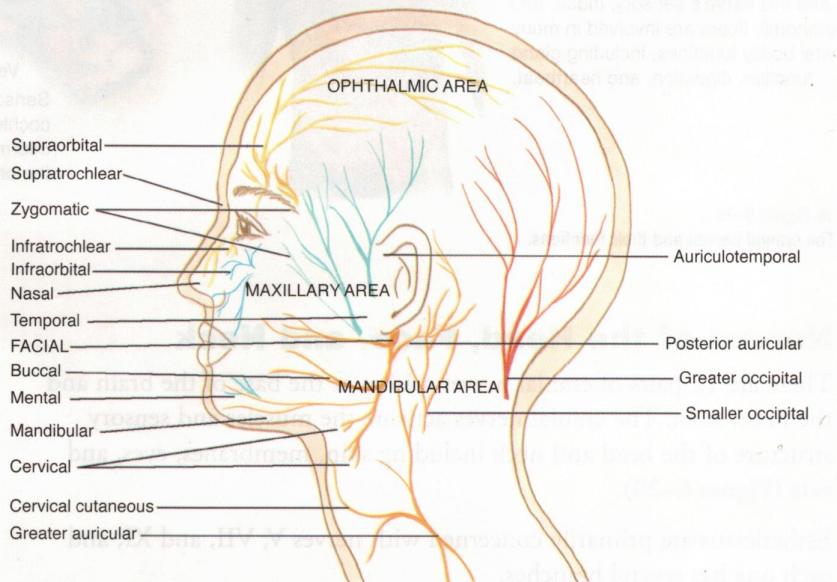
The largest of the cranial nerves is the **fifth cranial nerve**, also known as **trifacial** (try-FAY-shul) or **trigeminal** (try-JEM-un-ul) nerve. It is the chief sensory nerve of the face, and it serves as the motor nerve of the muscles that control chewing. It consists of three branches:

- **Ophthalmic nerve** (ahf-THAL-mik). Affects the skin of the forehead, upper eyelids, and interior portion of the scalp, orbit, eyeball, and nasal passage.
- **Mandibular nerve** (man-DIB-yuh-lur). Affects the muscles of the chin and lower lip.
- **Maxillary nerve** (MAK-suh-lair-ee). Affects the upper part of the face.

The following branches of the fifth cranial nerve are affected by facial or lymphatic massage (**Figure 6-21**).

- The **auriculotemporal** (aw-RIK-yuh-loh-TEM-puh-rul) **nerve** affects the external ear and skin above the temple, up to the top of the skull.
- The **infraorbital** (in-fruh-OR-bih-tul) **nerve** affects the skin of the lower eyelid, side of the nose, upper lip, and mouth.
- The **infratrochlear** (in-frah-TRAHK-lee-ur) **nerve** affects the membrane and skin of the nose.
- The **mental nerve** affects the skin of the lower lip and chin.
- The **nasal nerve** affects the point and lower side of the nose.
- The **supraorbital** (soo-pruh-OR-bih-tul) **nerve** affects the skin of the forehead, scalp, eyebrow, and upper eyelid.
- The **supratrochlear** (soo-pruh-TRAHK-lee-ur) **nerve** affects the skin between the eyes and upper side of the nose.

► **Figure 6-21**  
Nerve and nerve branches  
of the head, face, and neck.



- The **zygomatic** (zy-goh-MAT-ik) **nerve** affects the muscles of the upper part of the cheek.

The **seventh cranial nerve**, also known as **facial nerve**, is the chief motor nerve of the face. It emerges near the lower part of the ear and extends to the muscles of the neck. Its divisions and their branches supply and control all the muscles of facial expression and the secretions of saliva. The following are the most important branches of the facial nerve.

- The **buccal** (BUK-ul) **nerve** affects the muscles of the mouth.
- The **cervical** (SUR-vih-kul) **nerves** (branches of the facial nerve) affect the side of the neck and the platysma muscle.
- The **mandibular** nerve affects the muscles of the chin and lower lip.
- The **posterior auricular nerve** affects the muscles behind the ear at the base of the skull.
- The **temporal nerve** affects the muscles of the temple, side of the forehead, eyebrow, eyelid, and upper part of the cheek.
- The **zygomatic nerve** (upper and lower) affects the muscles of the upper part of the cheek.

The **eleventh cranial nerve**, also known as **accessory nerve**, is a type of motor nerve that controls the motion of the neck and shoulder muscles. This nerve is important to estheticians because it is affected during facials, primarily with massage.

Cervical nerves originate at the spinal cord, and their branches supply the muscles and scalp at the back of the head and neck as follows.

The **cervical cutaneous** (kyoo-TAY-nee-us) **nerve**, located at the side of the neck, affects the front and sides of the neck as far down as the breastbone.

- The **greater auricular nerve**, located at the side of the neck, affects the face, ears, neck, and parotid gland.
- The **greater occipital nerve**, located in the back of the head, affects the scalp as far up as the top of the head.
- The **smaller occipital nerve**, also known as **lesser occipital nerve**, located at the base of the skull, affects the scalp and muscles behind the ear.

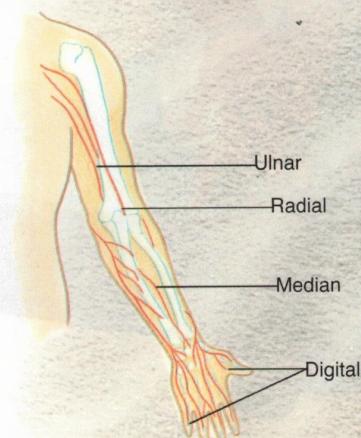
## Nerves of the Arm and Hand

The principal nerves supplying the superficial parts of the arm and hand are as follows (Figure 6-22).

- The **digital nerve** (DIJ-ut-tul) is a sensory-motor nerve that, with its branches, supplies the fingers.

## Did You Know?

The ulnar nerve runs along the bottom of the elbow. This explains why leaning on the elbows for long periods can cause the little fingers to go numb. This is due to localized inflammation (irritation and swelling) around the nerve.



▲ Figure 6-22  
Nerves of the arm and hand.

- The **radial** (RAY-dee-ul) **nerve** is a sensory-motor nerve that, with its branches, supplies the thumb side of the arm and back of the hand.
- The **median** (MEE-dee-un) **nerve** is a smaller sensory-motor nerve than the ulnar and radial nerves; with its branches, it supplies the arm and hand.
- The **ulnar** (UL-nur) **nerve** is a sensory-motor nerve that, with its branches, affects the little-finger side of the arm and palm of the hand.

## The Circulatory System

The **circulatory system**, also known as **cardiovascular system** or **vascular system**, controls the steady circulation of the blood through the body by means of the heart and blood vessels (veins and arteries). The **vascular system** consists of the heart, arteries, veins, and capillaries for the distribution of blood throughout the body.

### The Heart

The **heart** is often referred to as the body's pump (Figure 6–23 on page 30); it is a muscular, cone-shaped organ that keeps the blood moving within the circulatory system. It is enclosed by a membrane known as the **pericardium** (payr-ih-KAR-dee-um). The heart is about the size of a closed fist, weighs approximately 9 ounces (255 grams), and is located in the chest cavity. The heartbeat is regulated by the vagus (tenth cranial) nerve and other nerves in the autonomic nervous system. In a normal resting state, the heart beats 72 to 80 times per minute.

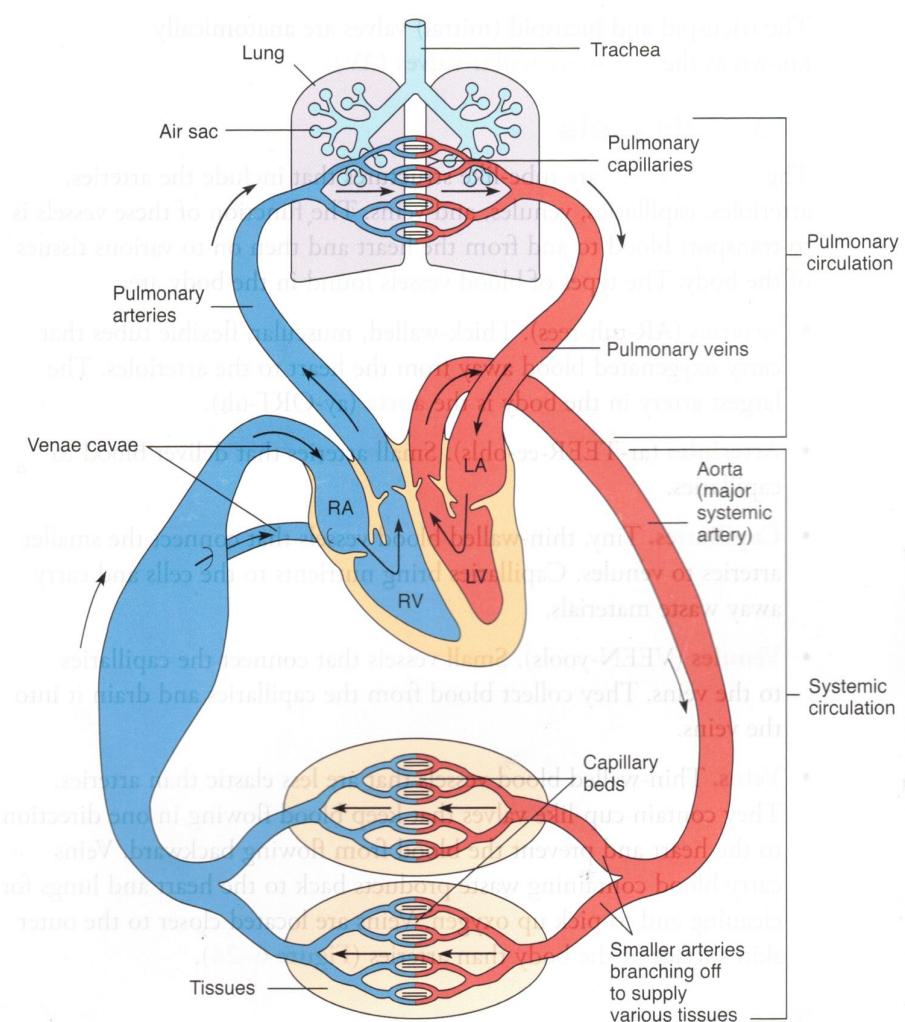
The interior of the heart contains four chambers and four valves. The upper, thin-walled chambers are the right **atrium** (AY-tree-um) and left atrium. The lower, thick-walled chambers are the right **ventricle** (VEN-truh-kul) and left ventricle. **Valves** between the chambers allow the blood to flow in only one direction. With each contraction and relaxation of the heart, the blood flows in, travels from the atria (plural of *atrium*) to the ventricles, and is then driven out, to be distributed throughout the body.

The blood is in constant and continuous circulation from the time it leaves the heart until it returns to the heart. Two systems attend to this circulation:

- **Pulmonary circulation** sends the blood from the heart to the lungs to be oxygenated.
- **Systemic or general circulation** carries the oxygenated blood from the heart throughout the body and back to the heart again.

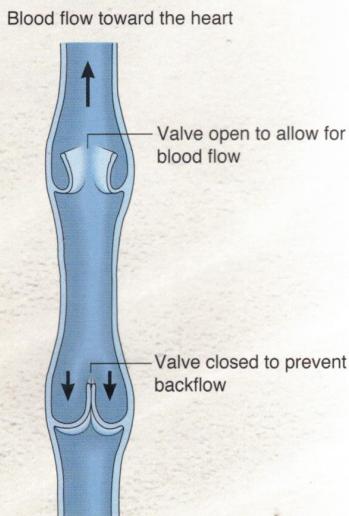
The following is a brief explanation of how the pulmonary circulation system and the systemic circulation system work.

1. Deoxygenated (oxygen-poor) blood flows from the body into the right atrium.



**Figure 6–23**  
Drawing of blood flow through the heart.

2. From the right atrium, it flows through the **tricuspid valve** (try-KUS-pid VALV) into the right ventricle.
3. The right ventricle pumps the blood to the pulmonary arteries, which move the deoxygenated blood to the lungs. When the blood reaches the lungs, it releases waste gases (carbon dioxide) and receives oxygen. The blood is then considered to be oxygen-rich.
4. The oxygen-rich blood returns to the heart through the pulmonary veins and enters the left atrium.
5. From the left atrium, the blood flows through the **mitral valve**, also known as **bicuspid valve** (by-KUS-pid VALV), into the left ventricle.
6. The blood then leaves the left ventricle and travels to all parts of the body.



**▲ Figure 6-24**  
Valves in the veins.

The tricuspid and bicuspid (mitral) valves are anatomically known as the **atrioventricular valves (AV)**.

## Blood Vessels

The **blood vessels** are tube-like structures that include the arteries, arterioles, capillaries, venules, and veins. The function of these vessels is to transport blood to and from the heart and then on to various tissues of the body. The types of blood vessels found in the body are:

- **Arteries** (AR-tuh-rees). Thick-walled, muscular, flexible tubes that carry oxygenated blood away from the heart to the arterioles. The largest artery in the body is the **aorta** (ay-ORT-uh).
- **Arterioles** (ar-TEER-ee-ohls). Small arteries that deliver blood to capillaries.
- **Capillaries**. Tiny, thin-walled blood vessels that connect the smaller arteries to venules. Capillaries bring nutrients to the cells and carry away waste materials.
- **Venules** (VEEN-yools). Small vessels that connect the capillaries to the veins. They collect blood from the capillaries and drain it into the veins.
- **Veins**. Thin-walled blood vessels that are less elastic than arteries. They contain cup-like valves that keep blood flowing in one direction to the heart and prevent the blood from flowing backward. Veins carry blood containing waste products back to the heart and lungs for cleaning and to pick up oxygen. Veins are located closer to the outer skin surface of the body than arteries (**Figure 6-24**).

## The Blood

**Blood** is a nutritive fluid circulating through the circulatory system and is considered connective tissue. There are 8 to 10 pints (3.8 to 4.7 liters) of blood in the human body, accounting for about one-twentieth of the body's weight. Blood is approximately 83 percent water. It is sticky and salty, with a normal temperature of 98.6 degrees Fahrenheit (36 degrees Celsius). It is bright red in the arteries—except for the pulmonary artery—and dark red in the veins. The color change occurs during the exchange of carbon dioxide for oxygen as the blood passes through the lungs, and the exchange of oxygen for carbon dioxide as the blood circulates throughout the body.

Blood performs the following critical functions.

- It carries water, oxygen, food, and secretions to all cells of the body.
- It carries away carbon dioxide and waste products to be eliminated through the lungs, skin, kidneys, and large intestines.
- It helps to equalize the body's temperature, thus protecting the body from extreme heat and cold.

- It aids in protecting the body from harmful bacteria and infections through the action of the white blood cells.
- It closes injured minute blood vessels by forming clots, thus preventing blood loss.

## Did You Know?

An adult heart beats about 30 million times a year and pumps nearly 4,000 gal (15,142 l) of blood every day.

### Composition of the Blood

Blood is composed of red blood cells, white blood cells, plasma, and platelets.

**Red blood cells**, also known as **red corpuscles** (KOR-pus-uls) or **erythrocytes** (ih-RITH-ruh-syts), are produced in the red bone marrow. They contain **hemoglobin** (HEE-muh-glooh-bun), a complex iron protein that gives the blood its bright red color. The function of red blood cells is to carry oxygen to the body cells. **White blood cells**, also known as **white corpuscles** or **leukocytes** (LOO-koh-syts), perform the function of destroying disease causing germs. **Platelets**, also known as **thrombocytes** (THRAHM-buh-syts), are much smaller than red blood cells. They contribute to the blood-clotting process, which stops bleeding.

**Plasma** (PLAZ-muh) is the fluid part of the blood in which the red and white blood cells and platelets flow. It is about 90 percent water and contains proteins, sugars, and oxygen. The main function of plasma is to carry food and secretions to the cells and to take carbon dioxide away from the cells.

### Arteries of the Head, Face, and Neck

The **common carotid** (kuh-RAHT-ud) **arteries** are the main source of blood supply to the head, face, and neck. They are located on either side of the neck, and each one is divided into an internal and external branch.

The **internal carotid artery** supplies blood to the brain, eyes, eyelids, forehead, nose, and internal ear. The **external carotid artery** supplies blood to the anterior (front) parts of the scalp, ear, face, neck, and side of the head (**Figure 6-25**). The external carotid artery subdivides into several branches. Of particular interest to the esthetician are the following arteries:

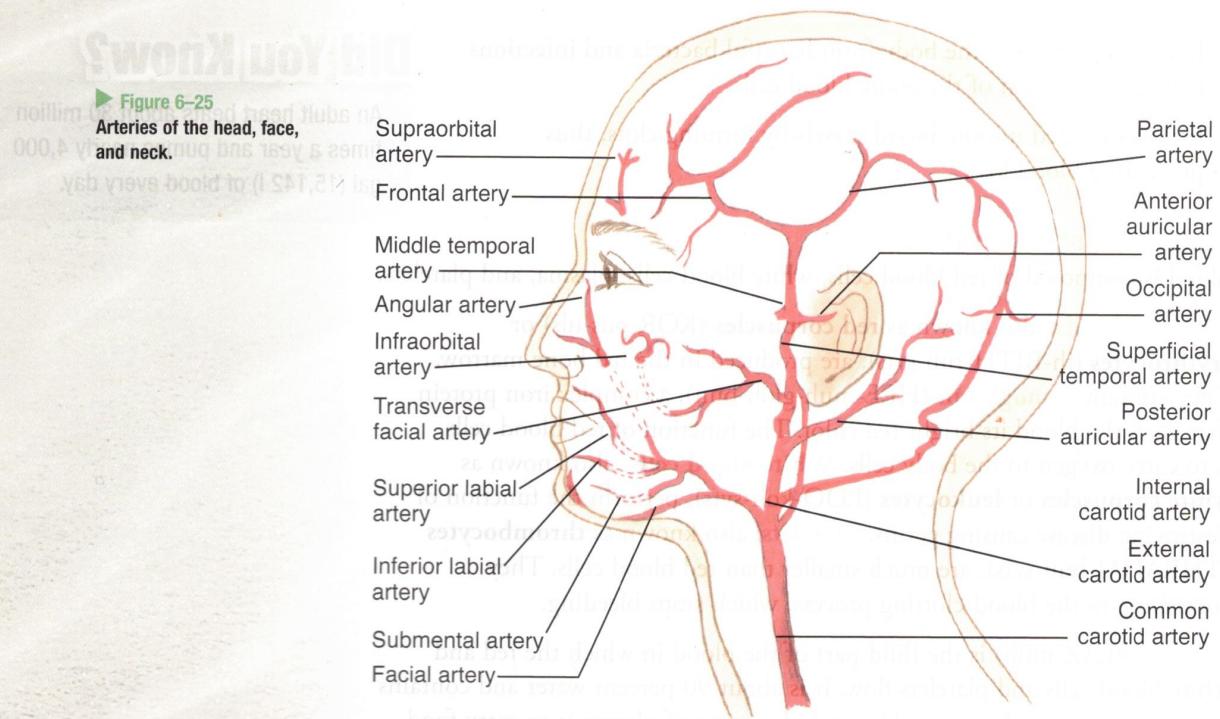
The **facial artery**, also known as **external maxillary artery**, supplies blood to the lower region of the face, mouth, and nose. Here are some of its branches.

- The **submental** (sub-MEN-tul) **artery** supplies blood to the chin and lower lip.
- The **inferior labial** (LAY-bee-ul) **artery** supplies blood to the lower lip.
- The **angular artery** supplies blood to the side of the nose.
- The **superior labial artery** supplies blood to the upper lip and region of the nose.

The **superficial temporal artery** is a continuation of the external carotid artery and supplies blood to the muscles of the front, side, and top of the head. Some of its important branches are as follows.

## Did You Know?

An adult has over 60,000 miles (96,561 km) of blood vessels in their body. If you tied all of your blood vessels together, they would go around the Earth about two and one-half times!



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**► Figure 6–25**  
Arteries of the head, face,  
and neck.

- The **frontal artery** supplies blood to the forehead and upper eyelids.
- The **parietal artery** supplies blood to the side and crown of the head.
- The **transverse facial** (tranz-VURS) **artery** supplies blood to the skin and masseter.
- The **middle temporal artery** supplies blood to the temples.
- The **anterior auricular artery** supplies blood to the front part of the ear.

Two other arteries that branch from the external carotid artery are as follows.

- The **occipital artery** supplies blood to the skin and muscles of the scalp and back of the head up to the crown.
- The **posterior auricular artery** supplies the scalp, the area behind and above the ear, and the skin behind the ear.

Here are two branches of the internal carotid artery that are important to know.

- The **supraorbital** (soo-pruh-OR-bih-tul) **artery** supplies blood to the upper eyelids and forehead.
- The **infraorbital** (in-frah-OR-bih-tul) **artery** supplies blood to the muscles of the eye.

## Veins of the Head, Face, and Neck

The blood returning to the heart from the head, face, and neck flows on each side of the neck in two principal veins: the **internal jugular** (JUG-yuh-lur) **vein** and **external jugular vein**. The most important veins of the

face and neck are parallel to the arteries and take the same names as the arteries, however, there are no jugular arteries; rather, they are known as the carotid arteries.

### Blood Supply to the Arm and Hand

The ulnar and radial arteries are the main blood supply of the arms and hands and are branches of the **brachial artery** (Figure 6–26). The **ulnar artery** and its numerous branches supply the little-finger side of the arm and palm of the hand. The **radial artery** and its branches supplies blood to the thumb side of the arm and the back of the hand, as well as the muscles of the skin, hands, fingers, wrist, elbow, and forearm.

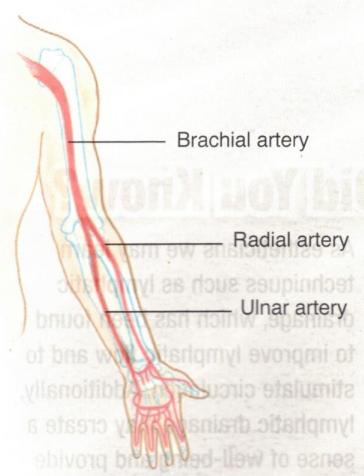
The important veins are located almost parallel with the arteries and take the same names as the arteries. While the arteries are found deep in the tissues, the veins lie nearer to the surface of the arms and hands.

## The Lymphatic/Immune System

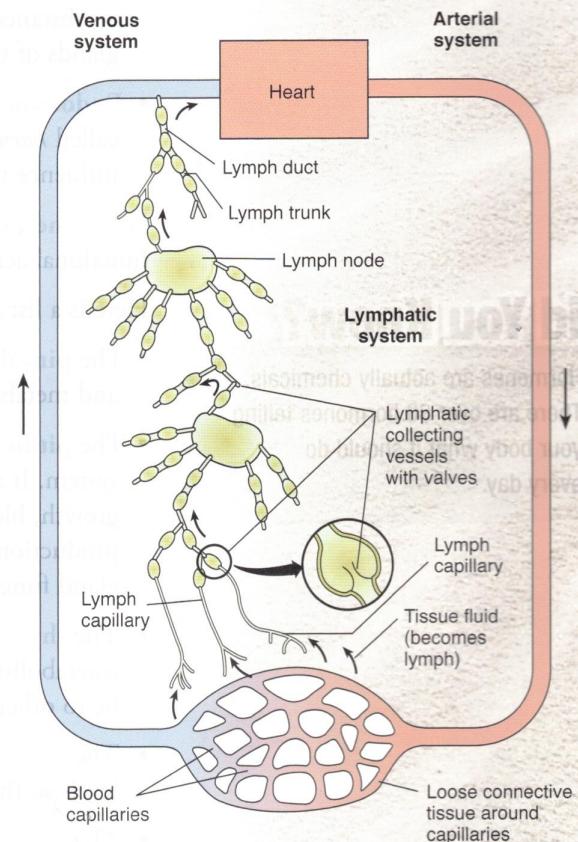
The **lymphatic/immune system** is a vital factor to the circulatory and immune systems and is made up of lymph, lymph nodes, the thymus gland, the spleen, and lymph vessels that act as an aid to the blood system; the lymphatic and immune systems are closely connected in that they protect the body from disease by developing immunities and destroying disease-causing microorganisms. **Lymph** is a colorless, watery fluid derived from blood plasma as a result of filtration through the capillary walls into the tissue spaces. The function of the lymphatic system is to protect the body from disease by developing immunities, to destroy disease-causing microorganisms, and to drain tissue spaces of excess **interstitial fluid** (blood plasma found in the spaces between tissue cells) in the blood. It then carries waste and impurities away from the cells.

The lymphatic system is closely connected to the blood and the cardiovascular system for the transportation of fluids. The difference is that the lymphatic system transports lymph fluid.

The lymphatic vessels start as tubes that are closed at one end (Figure 6–27). They can occur individually or in clusters that are called **lymph capillaries**. The lymph capillaries are distributed throughout most of the body, except the nervous system.



**▲ Figure 6–26**  
Arteries of the arm and hand.



**▲ Figure 6–27**  
The lymphatic system.

## Did You Know?

As estheticians we may learn techniques such as lymphatic drainage, which has been found to improve lymphatic flow and to stimulate circulation. Additionally, lymphatic drainage may create a sense of well-being and provide relaxation for the client.

## Did You Know?

Hormones are actually chemicals. There are over 30 hormones telling your body what it should do every day.

The lymphatic vessels are filtered by the **lymph nodes**, which are gland-like structures found inside the vessels. This filtering process helps to detoxify and fight infection before the lymph is reintroduced into the bloodstream.

The primary functions of the lymphatic system are:

- To act as a defense against invading bacteria and toxins.
- To remove waste material from the body cells to the blood.
- To aid in reducing swelling, inflammation, and accumulations in the blood vessels.

## The Endocrine System

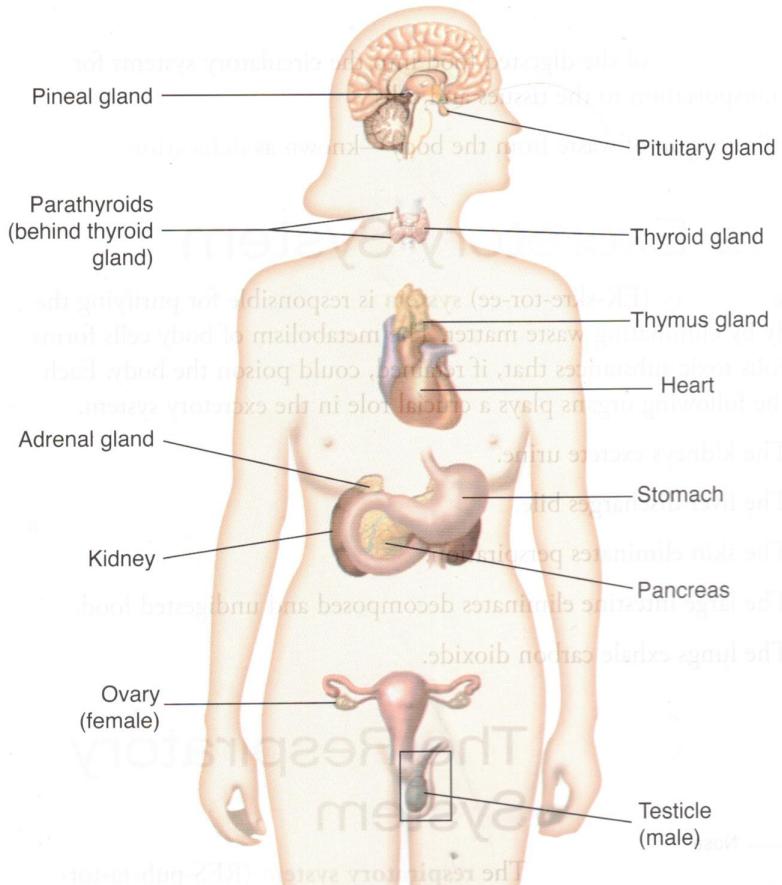
The **endocrine** (EN-duh-krin) **system** is a group of specialized glands that affect the growth, development, sexual activities, and health of the entire body. **Glands** are specialized organs that remove certain elements from the blood to convert them into new compounds. There are two main types of glands.

- **Exocrine** (EK-suh-krin) **glands**, also known as **duct glands**, produce a substance that travels through small, tube-like ducts. Sweat and oil glands of the skin belong to this group.
- **Endocrine glands**, also known as **ductless glands**, release secretions called *hormones* directly into the bloodstream, which in turn influence the welfare of the entire body (Figure 6–28).

**Hormones**, such as insulin, adrenaline, and estrogen, stimulate functional activity or secretion in other parts of the body.

Here is a list of the endocrine glands and their functions.

- The **pineal gland** plays a major role in sexual development, sleep, and metabolism.
- The **pituitary gland** is the most complex organ of the endocrine system. It affects almost every physiologic process of the body: growth, blood pressure, contractions during childbirth, breast-milk production, sexual organ functions in both women and men, thyroid gland function, the conversion of food into energy (metabolism).
- The **thyroid gland** controls how quickly the body burns energy (metabolism), makes proteins, and how sensitive the body should be to other hormones.
- The **parathyroid glands** regulate blood calcium and phosphorus levels so that the nervous and muscular systems can function properly.
- The **pancreas** secretes enzyme-producing cells that are responsible for digesting carbohydrates, proteins, and fats. The islet of Langerhans cells within the pancreas control insulin and glucagon production.



**Figure 6–28**  
The endocrine glands and other body organs.

- The **adrenal glands** secrete about 30 steroid hormones and control metabolic processes of the body, including the fight-or-flight response.
- The **ovaries** and **testes** function in sexual reproduction as well as determining male and female sexual characteristics.

## Did You Know?

The average adult has about 25 ft (7.6 m) of intestines. In your lifetime, your digestive system handles about 50 tons (45 metric tons) of food.

## The Digestive System

The **digestive system**, also called the **gastrointestinal** (gas-troh-in-tes-tun-ul) **system**, is responsible for changing food into nutrients and waste. **Digestive enzymes** (EN-zymz) are chemicals that change certain kinds of food into a form that can be used by the body. The food, now in soluble form, is transported by the bloodstream and used by the body's cells and tissues.

The digestive system prepares food for use by the cells through five basic activities.

- Eating or **ingestion**—taking food into the body
- Moving food along the digestive tract—known as **peristalsis**
- Breakdown of food by mechanical and chemical means—known as **digestion**

## Web Resources

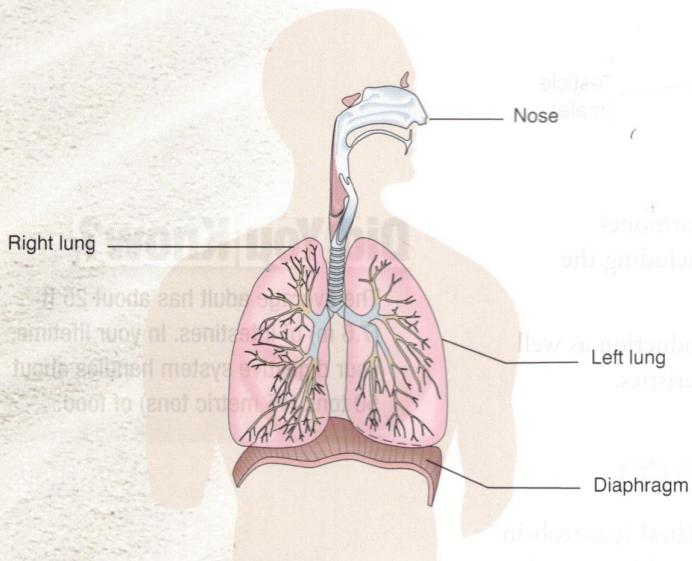
[www.innerbody.com](http://www.innerbody.com)  
[www.getbodysmart.com](http://www.getbodysmart.com)

- **Absorption** of the digested food into the circulatory systems for transportation to the tissues and cells
- Elimination of waste from the body—known as **defecation**

## The Excretory System

The **excretory** (EK-skre-tor-ee) **system** is responsible for purifying the body by eliminating waste matter. The metabolism of body cells forms various toxic substances that, if retained, could poison the body. Each of the following organs plays a crucial role in the excretory system.

- The kidneys excrete urine.
- The liver discharges bile.
- The skin eliminates perspiration.
- The large intestine eliminates decomposed and undigested food.
- The lungs exhale carbon dioxide.



**▲ Figure 6–29**  
The respiratory system.

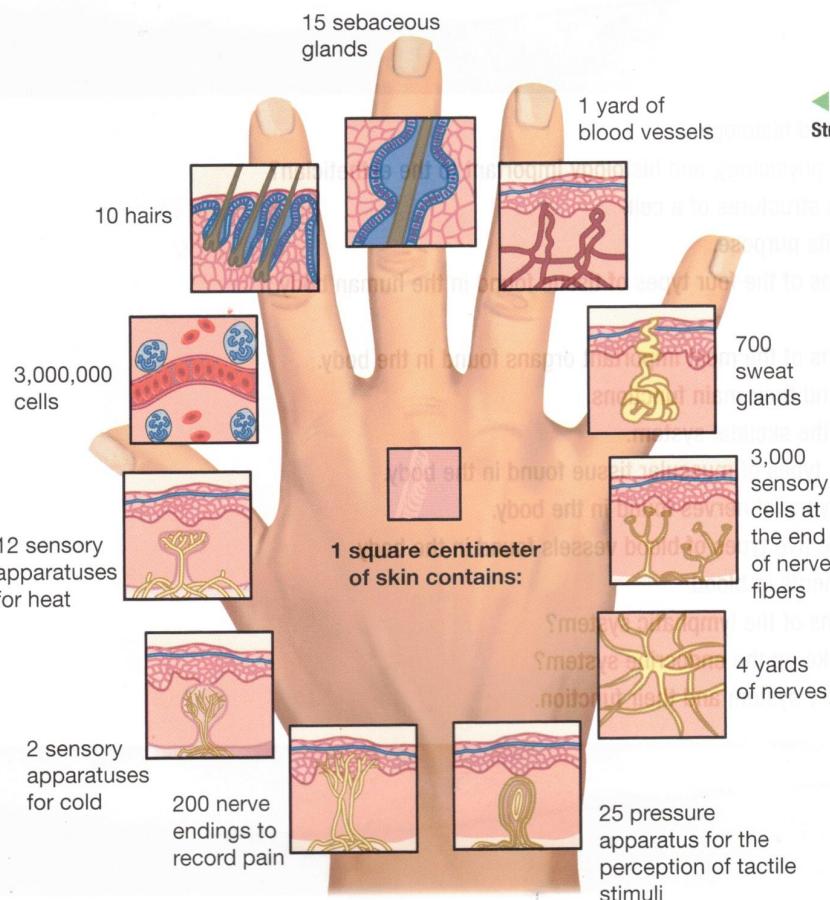
## The Respiratory System

The **respiratory system** (RES-puh-ra-tor-ee SIS-tuhm) enables breathing (**respiration**) and consists of the lungs and air passages. The **lungs** are spongy tissues composed of microscopic cells in which inhaled air is exchanged for carbon dioxide during one breathing cycle. The respiratory system is located within the chest cavity and is protected on both sides by the ribs. The **diaphragm** is a muscular wall that separates the thorax from the abdominal region and helps control breathing (Figure 6–29).

With each breathing cycle, an exchange of gases takes place. During **inhalation** (in-huh-LAY-shun), or breathing in, oxygen is absorbed into the blood. During **exhalation** (eks-huh-LAY-shun), or breathing outward, carbon dioxide is expelled from the lungs.

## The Integumentary System

The **integumentary system** is made up of the skin and its various accessory organs, such as the oil and sweat glands, sensory receptors, hair, and nails (Figure 6–30). (Skin anatomy and physiology are discussed in detail in Chapter 10, Physiology and Histology of the Skin.)



◀ Figure 6-30

Structures of the skin.

The word integument means a natural covering. So, you can think of the skin as a protective overcoat for your body against the outside elements that you encounter every day such as germs, chemicals, and sun exposure.

## The Reproductive System

The **reproductive system** (ree-proh-DUK-tiv SIS-tum) includes the ovaries, uterine tubes, uterus, and vagina in the female and the testes, prostate gland, penis, and the urethra in the male. It performs the function of producing children and passing on our genetics from one generation to another.

The reproductive system produces hormones—estrogen in females and testosterone in males. These hormones, or lack thereof, affect and change the skin in several ways as we age. Acne, loss of collagen and elastin, loss of scalp hair, facial hair growth and color, and changes in skin pigmentation such as **melasma** (pregnancy mask) are some of the results of changing or fluctuating hormones. Estheticians today have many resources—including products, treatments, and lifestyle modification recommendations—for helping clients.

### Did You Know?

Your lungs contain almost 1,500 miles (2,414 km) of airways so you can breathe. Every minute you breathe in about 13 pt (6 l) of air.

### Did You Know?

Every minute you shed about 30,000 to 40,000 dead skin cells from your body. That can total up to about 40 lb (18 kg) of skin in your lifetime.

# Review Questions

1. Define anatomy, physiology, and histology.
2. Why is the study of anatomy, physiology, and histology important to the esthetician?
3. Name and describe the basic structures of a cell.
4. Explain cell metabolism and its purpose.
5. List and describe the functions of the four types of tissue found in the human body.
6. What are organs?
7. List and describe the functions of the most important organs found in the body.
8. Name the 11 body systems and their main functions.
9. List the primary functions of the skeletal system.
10. Name and describe the three types of muscular tissue found in the body.
11. Name and describe the two types of nerves found in the body.
12. Name and briefly describe the five types of blood vessels found in the body.
13. List and describe the components of blood.
14. What are the primary functions of the lymphatic system?
15. What two types of glands make up the endocrine system?
16. List the organs of the excretory system and their function.

## Glossary

<b>abductors</b>	Muscles that draw a body part, such as a finger, arm, or toe, away from the midline of the body or of an extremity. In the hand, abductors separate the fingers.
<b>absorption</b>	The transport of fully digested food into the circulatory system to feed the tissues and cells.
<b>adductors</b>	Muscles that draw a body part, such as a finger, arm, or toe, inward toward the median axis of the body or of an extremity. In the hand, adductors draw the fingers together.
<b>adipose tissue</b>	A specialized connective tissue considered fat, which gives smoothness and contour to the body and cushions and insulates the body.
<b>adrenal glands</b>	Glands that secrete about 30 steroid hormones and control metabolic processes of the body, including the fight-or-flight response.
<b>anabolism</b>	Constructive metabolism; the process of building up larger molecules from smaller ones.
<b>anatomy</b>	The study of human body structure that can be seen with the naked eye and how the body parts are organized and the science of the structure of organisms or of their parts.
<b>angular artery</b>	Artery that supplies blood to the side of the nose.
<b>anterior auricular artery</b>	Artery that supplies blood to the front part of the ear.
<b>aorta</b>	The body's largest artery. The arterial trunk that carries blood from the heart to be distributed by branch arteries through the body.
<b>arteries</b>	Thick-walled muscular and flexible tubes that carry oxygenated blood from the heart to the capillaries throughout the body.

# Glossary

<b>arterioles</b>	Small arteries that deliver blood to capillaries.
<b>atrioventricular valves</b>	Abbreviated ATVs; valves which are designed to prevent the blood from flowing back into the pumping chamber.
<b>atrium</b>	Thin-walled, upper chamber of the heart through which blood is pumped to the ventricles. There is a right atrium and a left atrium.
<b>auricularis anterior</b>	Muscle in front of the ear that draws the ear forward.
<b>auricularis posterior</b>	Muscle behind the ear that draws the ear backward.
<b>auricularis superior</b>	Muscle above the ear that draws the ear upward.
<b>auriculotemporal nerve</b>	Nerve that affects the external ear and skin above the temple, up to the top of the skull.
<b>autonomic nervous system</b>	Abbreviated ANS; the part of the nervous system that controls the involuntary muscles; regulates the action of the smooth muscles, glands, blood vessels, and heart.
<b>axon</b>	The extension of a neuron through which impulses are sent away from the cell body to other neurons, glands, or muscles.
<b>belly</b>	Middle part of a muscle.
<b>biceps</b>	Muscle producing the contour of the front and inner side of the upper arm.
<b>blood</b>	Nutritive fluid circulating through the circulatory system (heart, veins, arteries, and capillaries) to supply oxygen and nutrients to cells and tissues and to remove carbon dioxide and waste from them.
<b>blood vessels</b>	Tube-like structures that transport blood to and from the heart, and to various tissues of the body; include arteries, arterioles, capillaries, venules, and veins.
<b>body systems</b>	Also known as <i>systems</i> ; groups of bodily organs acting together to perform one or more functions. The human body is composed of 11 major systems.
<b>brachial artery</b>	Located in the upper arm, the brachial artery is a major blood vessel which runs down the arm and ends by dividing into the radial and ulnar arteries, which run down through the forearm.
<b>brain</b>	Part of the central nervous system contained in the cranium; largest and most complex nerve tissue; controls sensation, muscles, glandular activity, and the power to think and feel.
<b>brain stem</b>	Structure that connects the spinal cord to the brain.
<b>buccal nerve</b>	Nerve that affects the muscles of the mouth.
<b>buccinator</b>	Thin, flat muscle of the cheek between the upper and lower jaw that compresses the cheeks and expels air between the lips.
<b>capillaries</b>	Tiny, thin-walled blood vessels that connect the smaller arteries to the veins. Capillaries bring nutrients to the cells and carry away waste materials.
<b>cardiac muscle</b>	The involuntary muscle that is the heart. This type of muscle is not found in any other part of the body.
<b>carpus</b>	Also known as wrist; a flexible joint composed of eight small, irregular bones (carpals) held together by ligaments.

# Glossary

<b>catabolism</b>	The phase of metabolism that involves the breaking down of complex compounds within the cells into smaller ones, often resulting in the release of energy to perform functions such as muscular efforts, secretions, or digestion.
<b>cell membrane</b>	Part of the cell that encloses the protoplasm and permits soluble substances to enter and leave the cell.
<b>cells</b>	Basic unit of all living things; minute mass of protoplasm capable of performing all the fundamental functions of life.
<b>central nervous system</b>	Abbreviated CNS; cerebrospinal nervous system; consists of the brain, spinal cord, spinal nerves, and cranial nerves.
<b>cerebellum</b>	Lies at the base of the cerebrum and is attached to the brain stem; this term is Latin for "little brain."
<b>cerebrum</b>	Makes up the bulk of the brain and is located in the front, upper part of the cranium.
<b>cervical cutaneous nerve</b>	Nerve located at the side of the neck that affects the front and sides of the neck as far down as the breastbone.
<b>cervical nerves</b>	Nerves that originate at the spinal cord, whose branches supply the muscles and scalp at the back of the head and neck; affect the side of the neck and the platysma muscle.
<b>cervical vertebrae</b>	The seven bones of the top part of the vertebral column, located in the neck region.
<b>circulatory system</b>	Also known as <i>cardiovascular system</i> or <i>vascular system</i> ; system that controls the steady circulation of the blood through the body by means of the heart and blood vessels.
<b>clavicle</b>	Also known as <i>collarbone</i> ; bone joining the sternum and scapula.
<b>common carotid arteries</b>	Arteries that supply blood to the face, head, and neck.
<b>connective tissue</b>	Fibrous tissue that binds together, protects, and supports the various parts of the body such as bone, cartilage, and tendons. Examples of connective tissue are bone, cartilage, ligaments, tendons, blood, lymph, and fat.
<b>corrugator muscle</b>	Facial muscle that draws eyebrows down and wrinkles the forehead vertically.
<b>cranium</b>	Oval, bony case that protects the brain.
<b>cytoplasm</b>	All the protoplasm of a cell except that which is in the nucleus; the watery fluid containing food material necessary for cell growth, reproduction, and self-repair.
<b>defecation</b>	Elimination of feces from the body.
<b>deltoid</b>	Large, triangular muscle covering the shoulder joint that allows the arm to extend outward and to the side of the body.
<b>dendrites</b>	Tree-like branching of nerve fibers extending from a nerve cell; short nerve fibers that carry impulses toward the cell and receive impulses from other neurons.
<b>deoxyribonucleic acid</b>	Abbreviated DNA; the blueprint material of genetic information; contains all the information that controls the function of every living cell.
<b>depressor anguli oris</b>	Also known as <i>triangularis muscle</i> ; muscle extending alongside the chin that pulls down the corner of the mouth.

# Glossary

<b>depressor labii inferioris</b>	Also known as <i>quadratus labii inferioris</i> ; muscle surrounding the lower lip that depresses the lower lip and draws it to one side.
<b>diaphragm</b>	Muscular wall that separates the thorax from the abdominal region and helps control breathing.
<b>diencephalon</b>	Located in the uppermost part of the midbrain; consists of two main parts the thalamus and the hypothalamus.
<b>digestion</b>	Breakdown of food by mechanical and chemical means.
<b>digestive enzymes</b>	Chemicals that change certain kinds of food into a form that can be used by the body.
<b>digestive system</b>	Also called the <i>gastrointestinal system</i> ; responsible for changing food into nutrients and wastes; consists of the mouth, stomach, intestines, salivary and gastric glands and other organs.
<b>digital nerve</b>	Sensory-motor nerve that, with its branches, supplies impulses to the fingers.
<b>eleventh cranial nerve</b>	Also known as <i>accessory nerve</i> ; a motor nerve that controls the motion of the neck and shoulder muscles.
<b>endocrine glands</b>	Also known as <i>ductless glands</i> ; release secretions called hormones directly into the bloodstream which in turn influence the welfare of the entire body.
<b>endocrine system</b>	Group of specialized glands that affect the growth development, sexual activities, and health of the entire body.
<b>epicranial aponeurosis</b>	Tendon connecting the occipitalis and the frontalis.
<b>epicranius</b>	Also known as <i>occipitofrontalis</i> ; the broad muscle that covers the top of the skull and consists of the occipitalis and frontalis.
<b>epithelial tissue</b>	Protective covering on body surfaces, such as the skin, mucous membranes, and lining of the heart; digestive and respiratory organs; and glands.
<b>ethmoid bone</b>	Light, spongy bone between the eye sockets that forms part of the nasal cavities.
<b>excretory system</b>	Group of organs—including the kidneys, liver, skin, large intestine, and lungs—that purify the body by elimination of waste matter.
<b>exhalation</b>	Breathing outward; expelling carbon dioxide from the lungs.
<b>exocrine glands</b>	Also known as <i>duct glands</i> ; produce a substance that travels through small, tube-like ducts. Sweat and oil glands of the skin belong to this group.
<b>extensors</b>	Muscles that straighten the wrist, hand, and fingers to form a straight line.
<b>external carotid artery</b>	Artery that supplies blood to the anterior parts of the scalp, ear, face, neck, and side of the head.
<b>external jugular vein</b>	Vein located on the side of the neck that carries blood returning to the heart from the head, face, and neck.
<b>facial artery</b>	Also known as <i>external maxillary artery</i> ; supplies blood to the lower region of the face, mouth, and nose.
<b>fifth cranial nerve</b>	Also known as <i>trifacial or trigeminal nerve</i> ; it is the chief sensory nerve of the face, and it serves as the motor nerve of the muscles that control chewing. It consists of three branches.

# Glossary

<b>flexors</b>	Extensor muscles of the wrist, involved in flexing the wrist.
<b>frontal artery</b>	Artery that supplies blood to the forehead and upper eyelids.
<b>frontal bone</b>	Bone forming the forehead.
<b>frontalis</b>	Front (anterior) portion of the epicranium; muscle of the scalp that raises the eyebrows, draws the scalp forward, and causes wrinkles across the forehead.
<b>glands</b>	Specialized organs that remove certain elements from the blood to convert them into new compounds.
<b>greater auricular nerve</b>	Nerve at the sides of the neck affecting the face, ears, neck, and parotid gland.
<b>greater occipital nerve</b>	Nerve located in the back of the head, affects the scalp as far up as the top of the head.
<b>heart</b>	Muscular cone-shaped organ that keeps the blood moving within the circulatory system.
<b>hemoglobin</b>	Iron-containing protein in red blood cells that binds to oxygen.
<b>histology</b>	Also known as <i>microscopic anatomy</i> ; the study of the structure and composition of tissue.
<b>hormones</b>	Secretions produced by one of the endocrine glands and carried by the bloodstream or body fluid to another part of the body, or a body organ, to stimulate functional activity or secretion, such as insulin, adrenaline, and estrogen.
<b>humerus</b>	Uppermost and largest bone in the arm, extending from the elbow to the shoulder.
<b>hyoid bone</b>	U-shaped bone at the base of the tongue that supports the tongue and its muscle.
<b>inferior labial artery</b>	Supplies blood to the lower lip.
<b>infraorbital artery</b>	Artery that originates from the internal maxillary artery and supplies blood to the eye muscles.
<b>infraorbital nerve</b>	Nerve that affects the skin of the lower eyelid, side of the nose, upper lip, and mouth.
<b>infratrochlear nerve</b>	Nerve that affects the membrane and skin of the nose.
<b>ingestion</b>	Eating or taking food into the body.
<b>inhala<sup>n</sup>tion</b>	Breathing in through the nose or mouth, and thus oxygen is absorbed by the blood.
<b>insertion</b>	Point where the skeletal muscle is attached to a bone or other more movable body part.
<b>integumentary system</b>	The skin and its accessory organs, such as the oil and sweat glands, sensory receptors, hair, and nails.
<b>internal carotid artery</b>	Artery that supplies blood to the brain, eyes, eyelids, forehead, nose, and internal ear.
<b>internal jugular vein</b>	Vein located at the side of the neck to collect blood from the brain and parts of the face and neck.
<b>interstitial fluid</b>	Blood plasma found in the spaces between tissues.
<b>joint</b>	Connection between two or more bones of the skeleton.
<b>kidneys</b>	One of the organs which supports the excretory system by eliminating water and waste products.
<b>lacrimal bones</b>	Small, thin bones located in the anterior medial wall of the orbits (eye sockets).
<b>lateral pterygoid</b>	Muscles that coordinate with the masseter, temporalis, and medial pterygoid muscles to open and close the mouth and bring the jaw forward; sometimes referred to as chewing muscles.

# Glossary

<b>latissimus dorsi</b>	Large, flat, triangular muscle covering the lower back.
<b>levator anguli oris</b>	Also known as <i>caninus</i> ; is a muscle that raises the angle of the mouth and draws it inward.
<b>levator labii superioris</b>	Also known as <i>quadratus labii superioris</i> ; muscle surrounding the upper lip that elevates the upper lip and dilates the nostrils, as in expressing distaste.
<b>liver</b>	One of the organs which supports the excretory system by removing toxic waste products of digestion.
<b>lungs</b>	Spongy tissues composed of microscopic cells in which inhaled air is exchanged for carbon dioxide during one respiratory cycle.
<b>lymph</b>	Clear, yellowish fluid that circulates in the lymph spaces (lymphatic) of the body; carries waste and impurities away from the cells.
<b>lymph capillaries</b>	Lymphatic vessels that occur in clusters and are distributed throughout most of the body.
<b>lymph nodes</b>	Gland-like structures found inside lymphatic vessels; filter the lymphatic vessels and help fight infection.
<b>lymphatic/immune system</b>	Vital to the circulatory and to the immune system made up of lymph, lymph nodes, the thymus gland, the spleen, and lymph vessels that act as an aid to the blood system; the lymphatic and immune system are closely connected in that they protect the body from disease by developing immunities and destroying disease-causing microorganisms.
<b>mandible</b>	Lower jawbone; largest and strongest bone of the face.
<b>mandibular nerve</b>	Branch of the fifth cranial nerve that supplies the muscles and skin of the lower part of the face; also, nerve that affects the muscles of the chin and lower lip.
<b>masseter</b>	One of the muscles that coordinate with the temporalis, medial pterygoid, and lateral pterygoid muscles to open and close the mouth and bring the jaw forward; sometimes referred to as chewing muscles.
<b>maxillary bones</b>	Form the upper jaw.
<b>maxillary nerve</b>	Branch of the fifth cranial nerve that supplies the upper part of the face.
<b>medial pterygoid</b>	One of the muscles that coordinate with the masseter, temporalis, and lateral pterygoid muscles to open and close the mouth and bring the jaw forward; sometimes referred to as chewing muscles.
<b>median nerve</b>	Nerve, smaller than the ulnar and radial nerves, that supplies the arm and hand.
<b>melasma</b>	Also referred to as <i>pregnancy mask</i> ; skin condition that is triggered by hormones that causes darker pigmentation in areas such as on the upper lip and around the eyes and cheeks.
<b>mental nerve</b>	Nerve that affects the skin of the lower lip and chin.
<b>mentalis</b>	Muscle that elevates the lower lip and raises and wrinkles the skin of the chin.
<b>metabolism</b>	(1) Chemical process taking place in living organisms whereby the cells are nourished and carry out their activities. (2) The process of changing food into forms the body can use as energy. Metabolism consists of two parts: anabolism and catabolism.
<b>metacarpus</b>	Also known as <i>palm</i> ; consists of five long, slender bones called metacarpal bones.
<b>middle temporal artery</b>	Artery that supplies blood to the temples.

# Glossary

<b>mitosis</b>	Cells dividing into two new cells (daughter cells); the usual process of cell reproduction of human tissues.
<b>mitral valve</b>	Also known as <i>bicuspid valve</i> ; a valve in which, from the left atrium, the blood flows through into the left ventricle.
<b>motor nerves</b>	Also known as <i>efferent nerves</i> ; carry impulses from the brain to the muscles or glands. These transmitted impulses produce movement.
<b>muscle tissue</b>	Tissue that contracts and moves various parts of the body.
<b>muscular system</b>	Body system that covers, shapes, and supports the skeleton tissue; contracts and moves various parts of the body.
<b>myology</b>	Study of the nature, structure, function, and diseases of the muscles.
<b>nasal bones</b>	Bones that form the bridge of the nose.
<b>nasal nerve</b>	Nerve that affects the point and lower sides of the nose.
<b>nasalis muscle</b>	Two-part muscle which covers the nose.
<b>nerve tissue</b>	Tissue that controls and coordinates all body functions.
<b>nerves</b>	Whitish cords made up of bundles of nerve fibers held together by connective tissue, through which impulses are transmitted.
<b>nervous system</b>	Body system composed of the brain, spinal cord, and nerves; controls and coordinates all other systems and makes them work harmoniously and efficiently.
<b>neurology</b>	The scientific study of the structure, function, and pathology of the nervous system.
<b>neuron or nerve cell</b>	The basic unit of the nervous system, consisting of a cell body, nucleus, dendrites, and axon.
<b>nonstriated muscles</b>	Also known as <i>involuntary, visceral, or smooth muscles</i> ; function automatically, without conscious will.
<b>nucleoplasm</b>	Fluid within the nucleus of the cell that contains proteins and DNA; determines our genetic makeup.
<b>nucleus</b>	The central part, core. 1) In histology the dense, active protoplasm found in the center of a eukaryotic cell that acts as the genetic control center; it plays an important role in cell reproduction and metabolism. 2) In chemistry, the center of the atom, where protons and neutrons are located.
<b>occipital artery</b>	Artery that supplies blood to the skin and muscles of the scalp and back of the head up to the crown.
<b>occipital bone</b>	Hindmost bone of the skull, below the parietal bones; forms the back of the skull above the nape.
<b>occipitalis</b>	Back of the epicranium; muscle that draws the scalp backward.
<b>ophthalmic nerve</b>	Branch of the fifth cranial nerve that supplies the skin of the forehead, upper eyelids, and interior portion of the scalp, orbit, eyeball, and nasal passage.
<b>orbicularis oculi</b>	Ring muscle of the eye socket; closes the eyelid.
<b>orbicularis oris</b>	Flat band around the upper and lower lips that compresses, contracts, puckers, and wrinkles the lips.

# Glossary

<b>organelle</b>	Small structures or miniature organs within a cell that have their own function.
<b>organs</b>	Structures composed of specialized tissues and performing specific functions in plants and animals.
<b>origin</b>	Part of the muscle that does not move; it is attached to the skeleton and is usually part of a skeletal muscle.
<b>os</b>	Means <i>bone</i> and is used as a prefix in many medical terms, such as <i>osteoarthritis</i> , a joint disease
<b>osteology</b>	Study of anatomy, structure, and function of the bones.
<b>ovaries</b>	Function in sexual reproduction as well as determining male and female sexual characteristics.
<b>palatine bones</b>	Two bones that form the hard palate of the mouth.
<b>pancreas</b>	Secretes enzyme-producing cells that are responsible for digesting carbohydrates, proteins, and fats. The islet of Langerhans cells within the pancreas control insulin and glucagon production.
<b>parasympathetic division</b>	Part of the autonomic nervous system, it operates under normal nonstressful situations, such as resting. It also helps to restore calm and balance to the body after a stressful event.
<b>parathyroid glands</b>	Regulate blood calcium and phosphorus levels so that the nervous and muscular systems can function properly.
<b>parietal artery</b>	Artery that supplies blood to the side and crown of the head.
<b>parietal bones</b>	Bones that form the sides and top of the cranium.
<b>pectoralis major and minor</b>	Muscles of the chest that assist the swinging movements of the arm.
<b>pericardium</b>	Double-layered membranous sac enclosing the heart; made of epithelial tissue.
<b>peripheral nervous system</b>	Abbreviated PNS; system of nerves and ganglia that connects the peripheral parts of the body to the central nervous system; has both sensory and motor nerves.
<b>peristalsis</b>	Moving food along the digestive tract.
<b>phalanges (singular: phalanx)</b>	Also known as <i>digits</i> ; are the bones in the fingers, three in each finger and two in each thumb, totaling 14 bones.
<b>physiology</b>	Study of the functions or activities performed by the body's structures.
<b>pineal gland</b>	A gland located in the brain. Plays a major role in sexual development, sleep, and metabolism.
<b>pituitary gland</b>	A gland found in the center of the head. The most complex organ of the endocrine system. It affects almost every physiologic process of the body: growth, blood pressure, contractions during childbirth, breast-milk production, sexual organ functions in both women and men, thyroid gland function, and the conversion of food into energy (metabolism).
<b>plasma</b>	Fluid part of the blood and lymph that carries food and secretions to the cells and carbon dioxide from the cells.
<b>platelets</b>	Also known as <i>thrombocytes</i> ; much smaller than red blood cells; contribute to the blood-clotting process, which stops bleeding.

# Glossary

<b>platysma</b>	Broad muscle extending from the chest and shoulder muscles to the side of the chin; responsible for depressing the lower jaw and lip.
<b>posterior auricular artery</b>	Artery that supplies blood to the scalp, behind and above the ear.
<b>posterior auricular nerve</b>	Nerve that affects the muscles behind the ear at the base of the skull.
<b>procerus</b>	Muscle that covers the bridge of the nose, depresses the eyebrows, and causes wrinkles across the bridge of the nose.
<b>pronators</b>	Muscles that turn the hand inward so that the palm faces downward.
<b>protoplasm</b>	Colorless, jellylike substance in cells; contains food elements such as protein, fats, carbohydrates, mineral salts, and water.
<b>pulmonary circulation</b>	Sends the blood from the heart to the lungs to be purified, then back to the heart again.
<b>radial artery</b>	Artery, along with numerous branches, that supplies blood to the thumb side of the arm and the back of the hand; supplies the muscles of the skin, hands, fingers, wrist, elbow, and forearm.
<b>radial nerve</b>	Nerve that, with its branches, supplies the thumb side of the arm and back of the hand.
<b>radius</b>	Smaller bone in the forearm on the same side as the thumb.
<b>red blood cells</b>	Also known as <i>red corpuscles</i> or <i>erythrocytes</i> ; produced in the red bone marrow; blood cells that carry oxygen from the lungs to the body cells and transport carbon dioxide from the cells back to the lungs.
<b>reflex</b>	Automatic reaction to a stimulus that involves the movement of an impulse from a sensory receptor along the sensory nerve to the spinal cord. A responsive impulse is sent along a motor neuron to a muscle, causing a reaction (for example, the quick removal of the hand from a hot object). Reflexes do not have to be learned; they are automatic.
<b>reproductive system</b>	Body system that includes the ovaries, uterine tubes, uterus and vagina in the female and the testes, prostate gland, penis and urethra in the male. This system performs the function of producing offspring and passing on the genetic code from one generation to another.
<b>respiration</b>	Process of inhaling and exhaling; the act of breathing; the exchange of carbon dioxide and oxygen in the lungs and within each cell.
<b>respiratory system</b>	Body system consisting of the lungs and air passages; enables breathing, which supplies the body with oxygen and eliminates carbon dioxide as a waste product.
<b>ribs</b>	Twelve pairs of bones forming the wall of the thorax.
<b>risorius</b>	Muscle of the mouth that draws the corner of the mouth out and back, as in grinning.
<b>scapula</b>	Also known as <i>shoulder blade</i> ; one of a pair of large, flat triangular bone of the shoulder.
<b>sensory nerves</b>	Also known as <i>afferent nerves</i> ; carry impulses or messages from the sense organs to the brain, where sensations such as touch, cold, heat, sight, hearing, taste, smell, pain, and pressure are experienced. Sensory nerve endings called receptors are located close to the surface of the skin.

# Glossary

<b>serratus anterior</b>	Muscle of the chest that assists in breathing and in raising the arm.
<b>seventh cranial nerve</b>	Also known as <i>facial nerve</i> ; it is the chief motor nerve of the face. It emerges near the lower part of the ear and extends to the muscles of the neck.
<b>skeletal system</b>	Physical foundation of the body, composed of the bones and movable and immovable joints.
<b>skin</b>	External protective coating that covers the body. The body's largest organ; acts as a barrier to protect body systems from the outside elements.
<b>smaller occipital nerve</b>	Also known as <i>lesser occipital nerve</i> ; located at the base of the skull, affects the scalp and muscles behind the ear.
<b>sphenoid bone</b>	Bone that joins all the bones of the cranium together.
<b>spinal cord</b>	Portion of the central nervous system that originates in the brain, extends down to the lower extremity of the trunk, and is protected by the spinal column.
<b>sternocleidomastoid</b>	Abbreviated SCM; muscle of the neck that depresses and rotates the head.
<b>sternum</b>	Also known as <i>breastbone</i> ; the flat bone that forms the ventral support of the ribs.
<b>striated muscles</b>	Also known as <i>skeletal</i> or <i>voluntary</i> muscles; attached to the bones and make up a large percentage of body mass; controlled by the will.
<b>submental artery</b>	Artery that supplies blood to the chin and lower lip.
<b>superficial temporal artery</b>	A continuation of the external carotid nerve artery; artery that supplies blood to the muscles of the front, side, and top of the head.
<b>superior labial artery</b>	Artery that supplies blood to the upper lip and region of the nose.
<b>supinator</b>	Muscle of the forearm that rotates the radius outward and the palm upward.
<b>supraorbital artery</b>	Artery that supplies blood to the upper eyelid and forehead.
<b>supraorbital nerve</b>	Nerve that affects the skin of the forehead, scalp, eyebrow, and upper eyelid.
<b>supratrochlear nerve</b>	Nerve that affects the skin between the eyes and upper side of the nose.
<b>sympathetic division</b>	Part of the autonomic nervous system that stimulates or speeds up activity and prepares the body for stressful situations, such as in running from a dangerous situation, or competing in a sports event.
<b>systemic or general circulation</b>	Circulation of blood from the heart throughout the body and back again to the heart.
<b>temporal bones</b>	Bones forming the sides of the head in the ear region.
<b>temporal nerve</b>	Nerve affecting the muscles of the temple, side of the forehead, eyebrow, eyelid, and upper part of the cheek.
<b>temporalis muscle</b>	Temporal muscle; one of the muscles involved in mastication (chewing).
<b>testes</b>	Male organs which produce the male hormone testosterone.
<b>thorax</b>	Also known as <i>chest</i> or <i>pulmonary trunk</i> ; consists of the sternum, ribs, and thoracic vertebrae; elastic, bony cage that serves as a protective framework for the heart, lungs, and other internal organs.

# Glossary

<b>thyroid gland</b>	A gland located in the neck; controls how quickly the body burns energy (metabolism), makes proteins, and how sensitive the body should be to other hormones.
<b>tibial nerve</b>	Division of the sciatic nerve, passes behind the knee; subdivides and supplies impulses to the knee, the muscles of the calf, the skin of the leg, and the sole, heel, and underside of the toes.
<b>tissue</b>	Collection of similar cells that perform a particular function.
<b>transverse facial artery</b>	Artery that supplies blood to the skin and the masseter.
<b>trapezius</b>	Muscle that covers the back of the neck and upper and middle region of the back; stabilizes the scapula and shrugs the shoulders.
<b>triceps</b>	Large muscle that covers the entire back of the upper arm and extends the forearm.
<b>tricuspid valve</b>	The heart valve that prevents backflow between the right atrium and the right ventricle.
<b>turbinal bones</b>	Thin layers of spongy bone on either of the outer walls of the nasal depression.
<b>ulna</b>	Inner and larger bone of the forearm, attached to the wrist on the side of the little finger.
<b>ulnar artery</b>	Artery that supplies blood to the muscle of the little-finger side of the  and palm of the hand.
<b>ulnar nerve</b>	Sensory-motor nerve that, with its branches, affects the little-finger side of the arm and palm of the hand.
<b>valves</b>	Structures that temporarily close a passage or permit flow in one direction only.
<b>vascular system</b>	Body system consisting of the heart, arteries, veins, and capillaries for the distribution of blood throughout the body.
<b>veins</b>	Thin-walled blood vessels that are less elastic than arteries; they contain cuplike valves to prevent backflow and carry impure blood from the various capillaries back to the heart and lungs.
<b>ventricle</b>	A thick-walled, lower chamber of the heart that receives blood pumped from the atrium. There is a right ventricle and a left ventricle.
<b>venules</b>	Small vessels that connect the capillaries to the veins. They collect blood from the capillaries and drain it into veins.
<b>vomer bone</b>	Flat, thin bone that forms part of the nasal septum.
<b>white blood cells</b>	Also known as <i>white corpuscles</i> or <i>leukocytes</i> ; perform the function of destroying disease causing germs.
<b>zygomatic bones</b>	Also known as <i>malar bones</i> or <i>cheekbones</i> ; bones that form the prominence of the cheeks; the cheekbones.
<b>zygomatic nerve</b>	Nerve that affects the skin of the temple, side of the forehead, and upper part of the cheek.
<b>zygomaticus major and minor</b>	Muscles on both sides of the face that extend from the zygomatic bone to the angle of the mouth. These muscles elevate the lip, pull the mouth upward and backward, as when you are laughing or smiling.