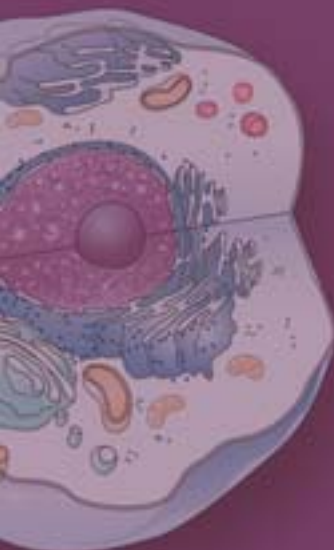


SELECTED KEY TERMS


The following terms and other boldface terms in the chapter are defined in the Glossary



adipose
areolar
benign
cartilage
chemotherapy
collagen
endocrine
epithelium
exocrine
fascia
histology
malignant
matrix
membrane
metastasis
mucosa
myelin
neoplasm
neuroglia
neuron
parietal
serosa
staging
visceral

LEARNING OUTCOMES

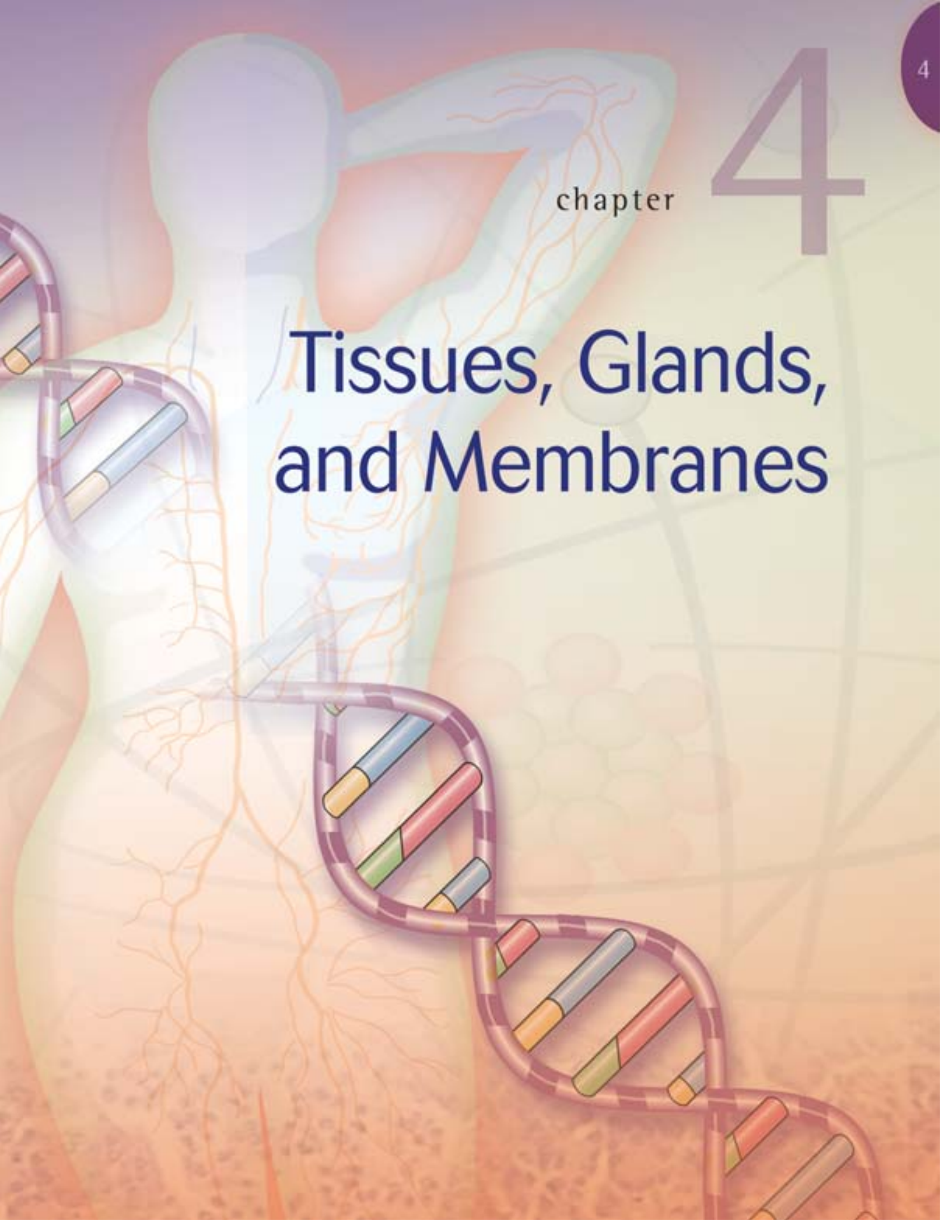
After careful study of this chapter, you should be able to:

- 
1. Name the four main groups of tissues and give the location and general characteristics of each
 2. Describe the difference between exocrine and endocrine glands and give examples of each
 3. Give examples of liquid, soft, fibrous, and hard connective tissues
 4. Describe three types of epithelial membranes
 5. List several types of connective tissue membranes
 6. Explain the difference between benign and malignant tumors and give several examples of each type
 7. List some signs of cancer
 8. List six methods of diagnosing cancer
 9. Describe three traditional methods of treating cancer
 10. Show how word parts are used to build words related to tissues, glands, and membranes (see Word Anatomy at the end of the chapter)

chapter

4

Tissues, Glands, and Membranes



Tissues are groups of cells similar in structure, arranged in a characteristic pattern, and specialized for the performance of specific tasks. The study of tissues is known as **histology** (his-TOL-o-je). This study shows that the form, arrangement, and composition of cells in different tissues account for their properties.

The tissues in our bodies might be compared with the different materials used to construct a building. Think for a moment of the great variety of building materials used according to need—wood, stone, steel, plaster, insulation, and others. Each of these has different properties, but together they contribute to the building as a whole. The same may be said of tissues. To read about the origin of the different tissues, see Box 4-1, Stem Cells: So Much Potential.

► Tissue Classification

The four main groups of tissue are the following:

- **Epithelial** (ep-ih-THE-le-al) tissue covers surfaces, lines cavities, and forms glands.
- **Connective tissue** supports and forms the framework of all parts of the body.
- **Muscle tissue** contracts and produces movement.
- **Nervous tissue** conducts nerve impulses.

This chapter concentrates mainly on epithelial and connective tissues; muscle and nervous tissues receive more attention in later chapters.

► Epithelial Tissue

Epithelial tissue, or **epithelium** (ep-ih-THE-le-um), forms a protective covering for the body. It is the main tissue of the skin's outer layer. It also forms membranes,

ducts, and the lining of body cavities and hollow organs, such as the organs of the digestive, respiratory, and urinary tracts.

Structure of Epithelial Tissue

Epithelial cells are tightly packed to better protect underlying tissue or form barriers between systems. The cells vary in shape and arrangement according to their function. Epithelial tissue is classified on the basis of these characteristics. In shape, the cells may be described as follows:

- **Squamous** (SKWA-mus)—flat and irregular
- **Cuboidal**—square
- **Columnar**—long and narrow

The cells may be arranged in a single layer, in which case it is described as **simple** (Fig. 4-1). Simple epithelium functions as a thin barrier through which materials can pass fairly easily. For example, simple epithelium allows for absorption of materials from the lining of the digestive tract into the blood and allows for passage of oxygen from the blood to body tissues. Areas subject to wear-and-tear that require protection are covered with epithelial cells in multiple layers, an arrangement described as **stratified** (Fig. 4-2). If the cells are staggered so that they appear to be in multiple layers but really are not, they are termed *pseudostratified*. Terms for both shape and arrangement are used to describe epithelial tissue. Thus, a single layer of flat, irregular cells would be described as *simple squamous epithelium*, whereas tissue with many layers of these same cells would be described as *stratified squamous epithelium*.

Some organs, such as the urinary bladder, must vary a great deal in size as they work. These organs are lined with **transitional epithelium**, which is capable of great expansion but returns to its original form once tension is relaxed—as when, in this case, the bladder is emptied.

Box 4-1 Hot Topics

Stem Cells: So Much Potential

At least 200 different types of cells are found in the human body, each with its own unique structure and function. All originate from unspecialized precursors called **stem cells**, which exhibit two important characteristics: they can divide repeatedly and have the potential to become specialized cells.

Stem cells come in two types. **Embryonic stem cells**, found in early embryos, are the source of all body cells and potentially can differentiate into any type of cell. **Adult stem cells**, found in babies and children as well as adults, are stem cells that remain in the body after birth and can differentiate into only a few cell types. They assist with tissue growth and repair. For example, in red bone marrow, these cells differentiate into blood cells, whereas in the skin, they differentiate into new skin cells after a cut or scrape.

The potential healthcare applications of stem cell research are numerous. In the near future, stem cell trans-

plants may be used to repair damaged tissues in treating illnesses such as diabetes, cancer, heart disease, Parkinson disease, and spinal cord injury. This research may also help explain how cells develop and why some cells develop abnormally, causing birth defects and cancer. Stem cells may also be used to test drugs before trying them on animals and humans.

But stem cell research is controversial. Some argue that it is unethical to use embryonic stem cells because they are obtained from aborted fetuses or fertilized eggs left over from in vitro fertilization. Others argue that these cells would be discarded anyway and have the potential to improve lives. A possible solution is the use of adult stem cells. However, adult stem cells are less abundant and lack embryonic stem cells' potential to differentiate, so more research is needed to make this a viable option.

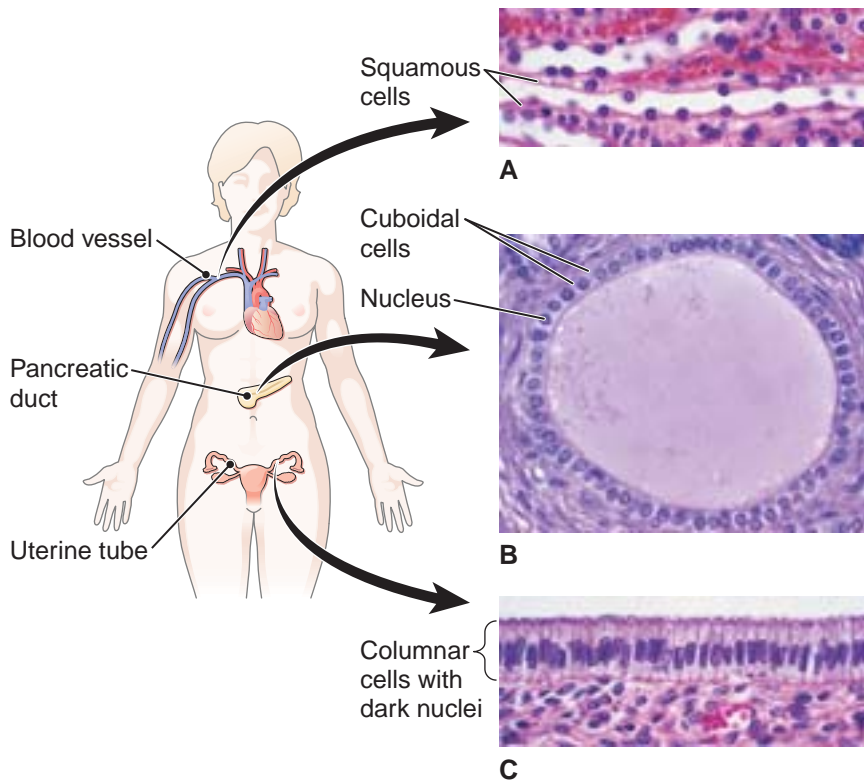


Figure 4-1 Simple epithelial tissues. (A) Simple squamous has flat, irregular cells. (B) Cuboidal cells are square in shape with darkly staining round nuclei. (C) Columnar cells are long and narrow with darkly staining nuclei. (A and C, Reprinted with permission from Cormack DH. *Essential Histology*. 2nd ed. Philadelphia: Lippincott Williams & Wilkins, 2001; B, reprinted with permission from Ross MH, Kaye GI, Pawlina W. *Histology*. 4th ed. Philadelphia: Lippincott Williams & Wilkins, 2003.)
ZOOMING IN ♦ In how many layers are these epithelial cells?

Special Functions of Epithelial Tissue

The cells of some epithelium produce secretions, including **mucus** (MU-kus) (a clear, sticky fluid), digestive juices, sweat, and other substances. The air that we breathe passes over epithelium that lines the passageways of the respiratory (breathing) system. Mucus-secreting **goblet cells**, named for their shape, are scattered among the pseudostratified epithelial cells (Fig. 4-3 A). The epithelial cells also have tiny hairlike projections called **cilia**. Together, the mucus and the cilia help trap bits of dust and other foreign particles that could otherwise reach the lungs and damage them. The digestive tract is lined with simple columnar epithelium that also contains goblet cells. They secrete mucus that protects the lining of the digestive organs (Fig. 4-3 B).

Epithelium repairs itself quickly after it is injured. In areas of the body subject to normal wear and tear, such as the skin, the inside of the mouth, and the lining of the intestinal tract, epithelial cells reproduce frequently, replacing damaged tissue. Certain areas of the epithelium that form the outer layer of the skin are capable of modifying themselves for greater strength whenever they are subjected to unusual wear and tear; the growth of calluses is a good example of this response.

Checkpoint 4-1 Epithelium is classified according to cell shape. What are the three basic shapes?

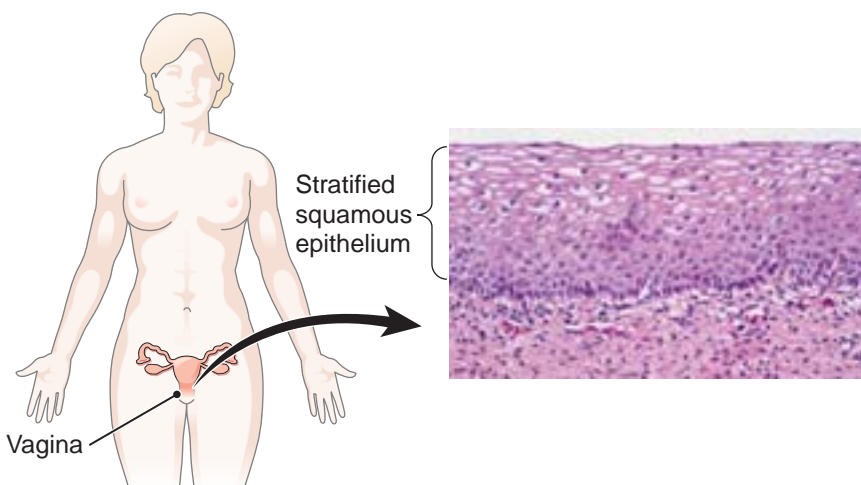


Figure 4-2 Stratified squamous epithelium. Cells are arranged in multiple layers. (Reprinted with permission from Cormack DH. *Essential Histology*. 2nd ed. Philadelphia: Lippincott Williams & Wilkins, 2001.)

Glands

The active cells of many glands are epithelial cells. A gland is an organ specialized to produce a substance that is sent out to other parts of the body. The gland manufactures these secretions from materials removed from the blood. Glands are divided into two categories based on how they release their secretions:

- ♦ **Exocrine** (EK-so-krin) glands have ducts or tubes to carry secretions away from the gland. The secretions may be

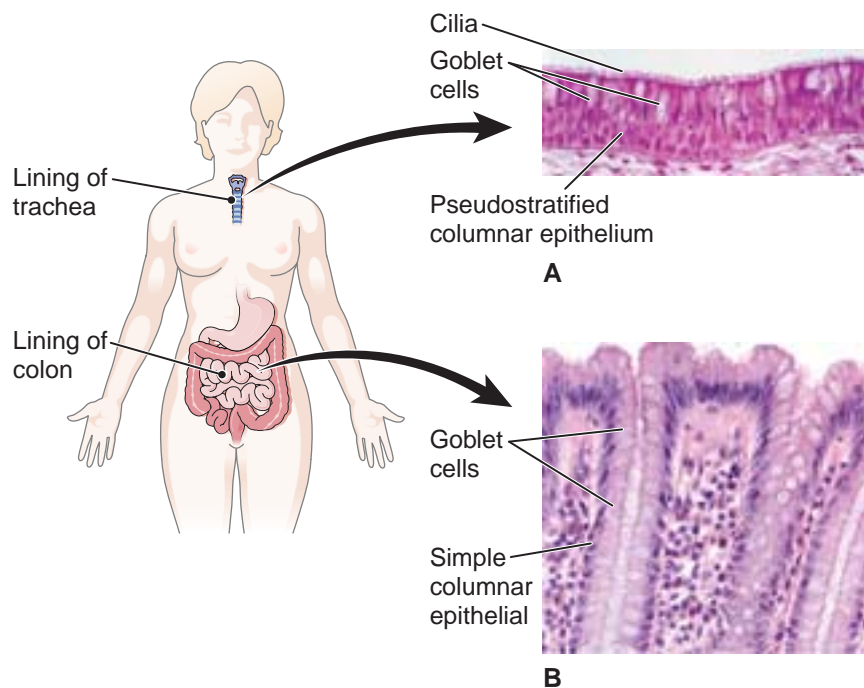


Figure 4-3 Special features of epithelial tissues. (A) The lining of the trachea showing cilia and goblet cells that secrete mucus. (B) The lining of the intestine showing goblet cells. (A, Reprinted with permission from Ross MH, Kaye GI, Pawlina W. *Histology*. 4th ed. Philadelphia: Lippincott Williams & Wilkins, 2003; B, reprinted with permission from Cormack DH. *Essential Histology*. 2nd ed. Philadelphia: Lippincott Williams & Wilkins, 2001.)

carried to another organ, to a body cavity, or to the body surface. They are effective in a limited area near their source. Examples of exocrine glands include the glands in the gastrointestinal tract that secrete digestive juices, the sebaceous (oil) glands of the skin, and the lacrimal glands that produce tears. These and other exocrine glands are discussed in the chapters on specific systems.

In structure, an exocrine gland may consist of a single cell, such as the cells that secrete mucus into the digestive tract. Most, however, are composed of multiple cells in various arrangements (Fig. 4-4). They may be tubular, in a simple straight form or in a branched formation, as are found in the digestive tract. They may also be coiled, as are the sweat glands of the skin. They may be saclike, as are the sebaceous (oil) glands of the skin, or compound formations of tubes and sacs, as are the salivary glands in the mouth.

- ▶ **Endocrine (EN-do-krin) glands** secrete directly into the blood, which then carries their secretions to another area of the body. These secretions, called **hormones**, have effects on specific tissues known as the *target tissues*. Endocrine glands have an extensive network of blood vessels. These so-called *ductless glands* include the pituitary, thyroid, adrenal glands, and others described in greater detail in Chapter 12.

Checkpoint 4-2 Glands are classified according to whether they secrete through ducts or secrete directly into the bloodstream. What are these two categories of glands?

Connective Tissue

The supporting fabric of all parts of the body is connective tissue. This is so extensive and widely distributed that if we were able to dissolve all the tissues except connective tissue, we would still be able to recognize the contours of the entire body. Connective tissue has large amounts of nonliving material between the cells. This intercellular background material or **matrix** (MA-trix) contains varying amounts of water, fibers, and hard minerals.

There are several ways of classifying connective tissue. Some is considered more generalized because it occurs throughout the body wherever structure and protection are needed. Others, such as bone and blood, have a more specialized function. Based on the composition of the matrix, the various connective tissues also differ in their degree of hardness. For simplicity, we will categorize them according to these physical properties:

- ▶ **Liquid connective tissue**—blood and lymph (the fluid that circulates in the lymphatic system) are examples of liquid connective tissues (Fig. 4-5). The cells in liquid connective tissue are suspended in a fluid environment. Chapters 13 and 16 have more information on the liquid connective tissues.
- ▶ **Soft connective tissue**—loosely held together with semi-liquid material between the cells; includes adipose (fat) tissue and areolar (loose) connective tissue
- ▶ **Fibrous connective tissue**—most connective tissue contains some fibers, but this type is densely packed with them. Cells called *fibroblasts* produce the fibers in connective tissue. (The word ending *-blast* refers to a young and active cell). Examples of structures composed of fibrous connective tissue are ligaments, tendons, and the capsules (coverings) around certain organs.
- ▶ **Hard connective tissue**—has a very firm consistency, as in cartilage, or is hardened by minerals in the matrix, as in bone.

Checkpoint 4-3 Connective tissue varies according to the composition of the material that is between the cells. What is the general name for this intercellular material?

Soft Connective Tissue

The **areolar** (ah-RE-o-lar), or loose, form of connective tissue (see Fig. 4-5) is found in membranes around vessels and organs, between muscles, and under the skin. It is the most common type of connective tissue in the body.

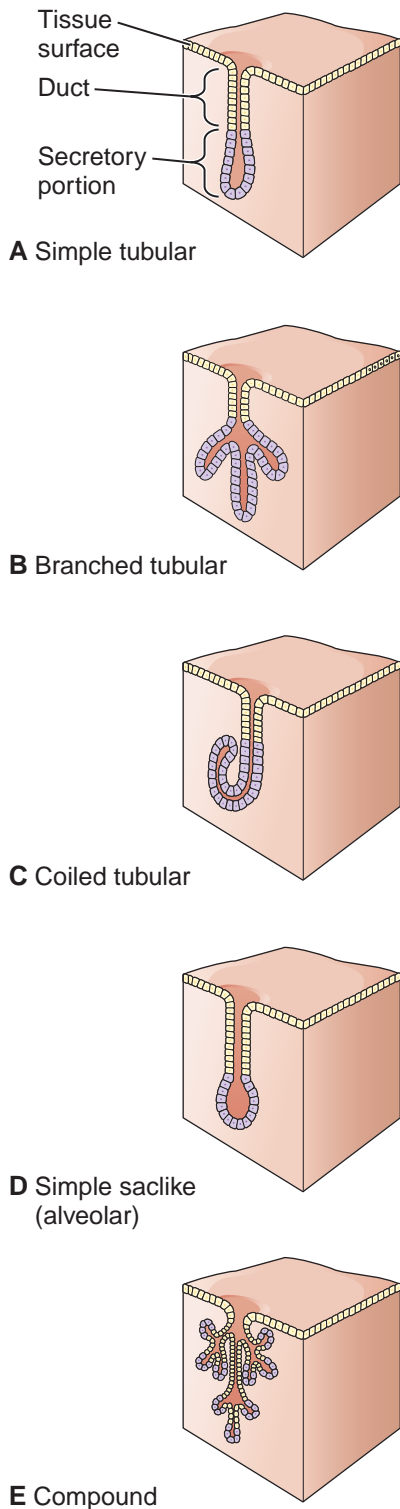


Figure 4-4 Some structural types of exocrine glands. (A) Simple tubular, as found in the intestine. (B) Branched tubular, as found in the stomach. (C) Coiled tubular, such as the sweat glands of the skin. (D) Simple saclike (alveolar), such as the oil glands of the skin. (E) Compound, with tubes and sacs, such as the salivary glands.

It contains cells and fibers in a very loose, jellylike background material.

Adipose (AD-ih-pose) **tissue** (see Fig. 4-5) contains cells that are able to store large amounts of fat. The fat in this tissue is used as a reserve energy supply for the body. Adipose tissue also serves as a heat insulator and as protective padding for organs and joints.

Fibrous Connective Tissue

Fibrous connective tissue (Fig. 4-6 A) is very dense and has large numbers of fibers that give it strength and flexibility. The main type of fiber in this and other connective tissues is **collagen** (KOL-ah-jen), a flexible white protein. (see Box 4-2, Collagen: The Body's Scaffolding).

Some fibrous connective tissue contains large amounts of elastic fibers that allow the tissue to stretch and then return to its original length. This type of elastic connective tissue appears in the vocal cords, the passageways of the respiratory tract, and the walls of the large arteries (blood vessels).

Fibrous connective tissue makes up the fibrous membranes that cover various organs, as described later in this chapter. Particularly strong forms make up the tough **capsules** around certain organs, such as the kidneys, the liver, and some glands. If the fibers in the connective tissue are all arranged in the same direction, like the strands of a cable, the tissue can pull in one direction. Examples are the cordlike **tendons**, which connect muscles to bones, and the **ligaments**, which connect bones to other bones.

Hard Connective Tissue

The hard connective tissues, cartilage and bone, are more solid than the other groups.

Cartilage Because of its strength and flexibility, cartilage is used as a structural material and as reinforcement. It is also used as a shock absorber and as a bearing surface that reduces friction between moving parts, as at joints. A common form of cartilage known as **hyaline** (HI-ah-lin) **cartilage** forms the tough, translucent material, popularly called *gristle*, seen over the ends of the long bones (see Fig. 4-6 B). Hyaline cartilage is also found at the tip of the nose and in parts of the larynx (“voicebox”) and the trachea (“windpipe”).

Another form of cartilage, **fibrocartilage** (fi-bro-KAR-tih-laj), is found between segments of the spine, at the anterior joint between the pubic bones of the hip, and in the knee joint. **Elastic cartilage** can spring back into shape after it is bent. An easy place to observe the properties of elastic cartilage is in the outer portion of the ear. It is also located in the larynx.

The cells that produce cartilage are **chondrocytes** (KON-dro-sites), a name derived from the word root *chondro*, meaning “cartilage” and the root *cyto*, meaning “cell.”

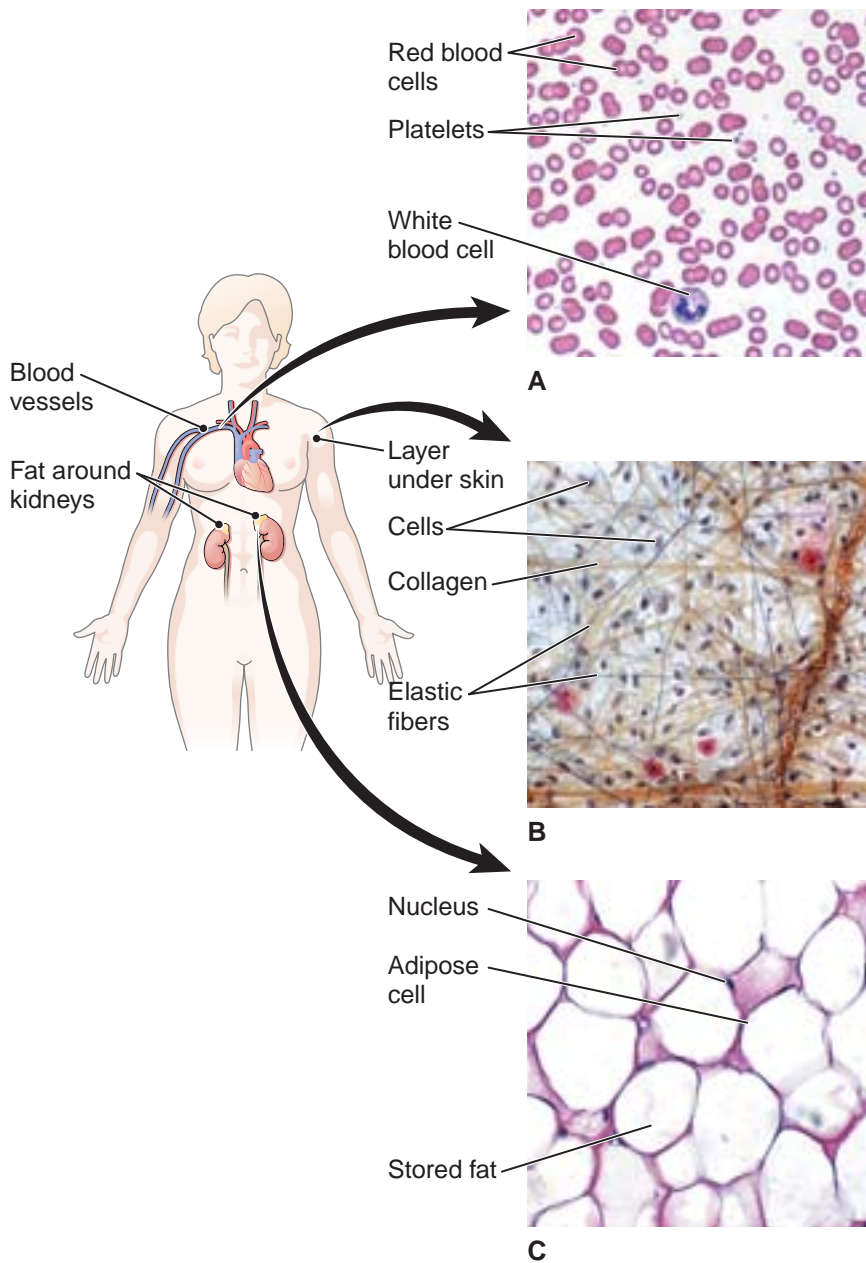


Figure 4-5 Liquid and soft connective tissue. (A) Blood smear showing various blood cells in a liquid matrix. (B) Areolar (loose) connective tissue, a mixture of cells and fibers in a jellylike matrix. (C) Adipose tissue showing stored fat. The nuclei are at the edges of the cells. (Reprinted with permission from Ross MH, Kaye GI, Pawlina W. *Histology*. 4th ed. Philadelphia: Lippincott Williams & Wilkins, 2003.) **ZOOMING IN** ◆ Which of these tissues has the most fibers? Which of these tissues is modified for storage?

Bone The tissue of which bones are made, called **osseous** (OS-e-us) **tissue**, is much like cartilage in its cellular structure (see Fig. 4-6 C). In fact, the skeleton of the fetus in the early stages of development is made almost entirely of cartilage. This tissue gradually becomes impregnated with salts of calcium and phosphorus that make bone characteristically solid and hard. The cells that form bone are called **osteoblasts** (OS-te-o-blasts), a name that combines the root for bone (*oste*) with a root

(*blast*) that means an immature cell. As these cells mature, they are referred to as **osteocytes** (OS-te-o-sites). Within the osseous tissue are nerves and blood vessels. Enclosed within bones is a specialized type of tissue, the bone marrow. The red bone marrow contained in certain bone regions produces blood cells. Chapter 7 has more information on bones.

Checkpoint 4-4 Connective tissue is the supportive and protective material found throughout the body. What are some examples of liquid, soft, fibrous, and hard connective tissue?

► Muscle Tissue

Muscle tissue is designed to produce movement by contraction of its cells, which are called **muscle fibers** because most of them are long and threadlike. If a piece of well-cooked meat is pulled apart, small groups of these muscle fibers may be seen. Muscle tissue is usually classified as follows:

- **Skeletal muscle**, which works with tendons and bones to move the body (Fig. 4-7 A). This type of tissue is described as **voluntary muscle** because it can be made to contract by conscious thought. The cells in skeletal muscle are very large and are remarkable in having multiple nuclei and a pattern of dark and light banding described as **striations**. This type of muscle is also called **striated muscle**. Chapter 8 has more details on skeletal muscles.
- **Cardiac muscle**, which forms the bulk of the heart wall and is known also as **myocardium** (mi-o-KAR-de-um) (see Fig. 4-7 B). This is the muscle that produces the regular

contractions known as *heartbeats*. Cardiac muscle is described as **involuntary muscle** because it typically contracts independently of thought. Most of the time we are not aware of its actions at all. Cardiac muscle has branching cells and specialized membranes between the cells that appear as dark lines under the microscope. Their technical name is *intercalated* (in-TER-cal-a-ted) *disks*. The heart and cardiac muscle are discussed in Chapter 14.

Box 4-2 A Closer Look

Collagen: The Body's Scaffolding

The most abundant protein in the body, making up about 25% of total protein, is collagen. Its name, derived from a Greek word meaning “glue,” reveals its role as the main structural protein in connective tissue.

Fibroblasts secrete collagen molecules into the surrounding matrix, where the molecules are then assembled into fibers. These fibers give the matrix its strength and its flexibility. Collagen fibers' high tensile strength makes them stronger than steel fibers of the same size, and their flexibility confers resilience on the tissues that contain them. For example, collagen in skin, bone, tendons, and ligaments resists pulling forces, whereas collagen found in joint cartilage and between vertebrae resists compression. Based on amino acid structure, there are at least 19 types of collagen, each of which imparts a different property to the connective tissue containing it.

The arrangement of collagen fibers in the matrix reveals much about the tissue's function. In the skin and membranes covering muscles and organs, collagen fibers are arranged irregularly, with fibers running in all directions. The result is a tissue that can resist stretching forces in many different directions. In tendons and ligaments, collagen fibers have a parallel arrangement, forming strong ropelike cords that can resist longitudinal pulling forces. In bone tissue, collagen fibers' meshlike arrangement promotes deposition of calcium salts into the tissue, which gives bone strength while also providing flexibility.

Collagen's varied properties are also evident in the preparation of a gelatin dessert. Gelatin is a collagen extract made by boiling animal bones and other connective tissue. It is a viscous liquid in hot water but forms a semisolid gel on cooling.

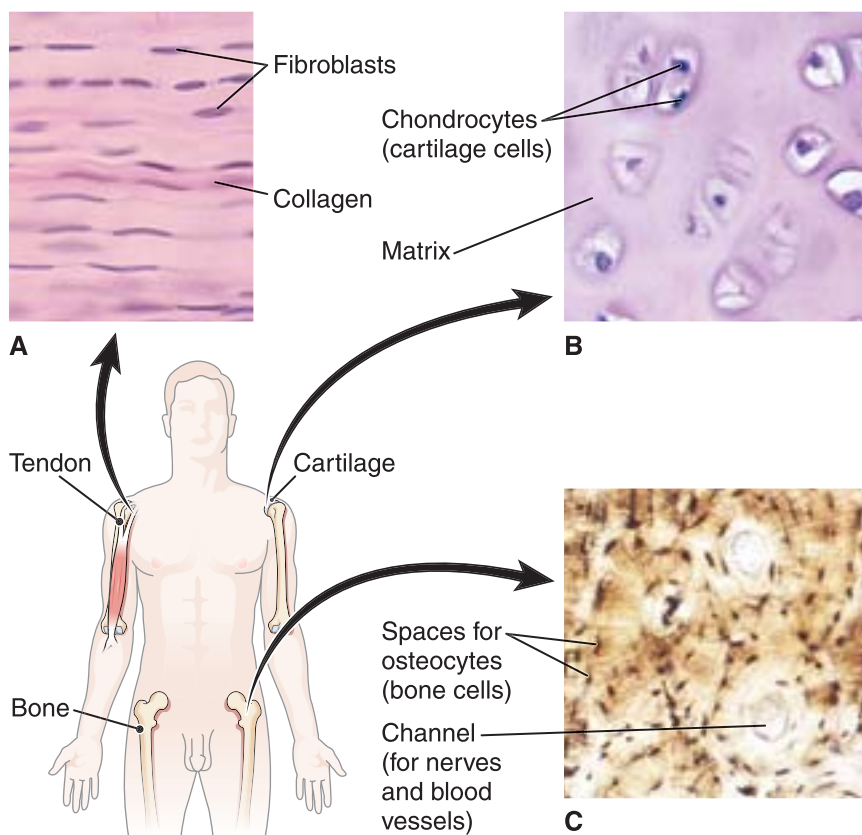


Figure 4-6 Fibrous and hard connective tissue. (A) Fibrous connective tissue. In tendons and ligaments, the fibers are arranged in the same direction. (B) In cartilage, the cells (chondrocytes) are enclosed in a firm matrix. (C) Bone is the hardest connective tissue. The cells (osteocytes) are within the hard matrix. (Reprinted with permission from Ross MH, Kaye GI, Pawlina W.. Histology. 4th ed. Philadelphia: Lippincott Williams & Wilkins, 2003.)

Smooth muscle is also involuntary muscle (see Fig. 4-7 C). It forms the walls of the hollow organs in the ventral body cavities, including the stomach, intestines, gallbladder, and urinary bladder. Together these organs are known as viscera (VIS-eh-rah), so smooth muscle is sometimes referred to as *visceral muscle*. Smooth muscle is also found in the walls of many tubular structures, such as the blood vessels and the tubes that carry urine from the kidneys. A smooth muscle is attached to the base of each body hair. Contraction of these muscles causes the condition of the skin that we call *gooseflesh*. Smooth muscle cells are of a typical size and taper at each end. They are not striated and have only one nucleus per cell. Structures containing smooth muscle are discussed in the chapters on the various body systems.

Muscle tissue, like nervous tissue, repairs itself only with difficulty or not at all once an injury has been sustained. When injured, muscle tissue is frequently replaced with connective tissue.

Checkpoint 4-5 What are the three types of muscle tissue?

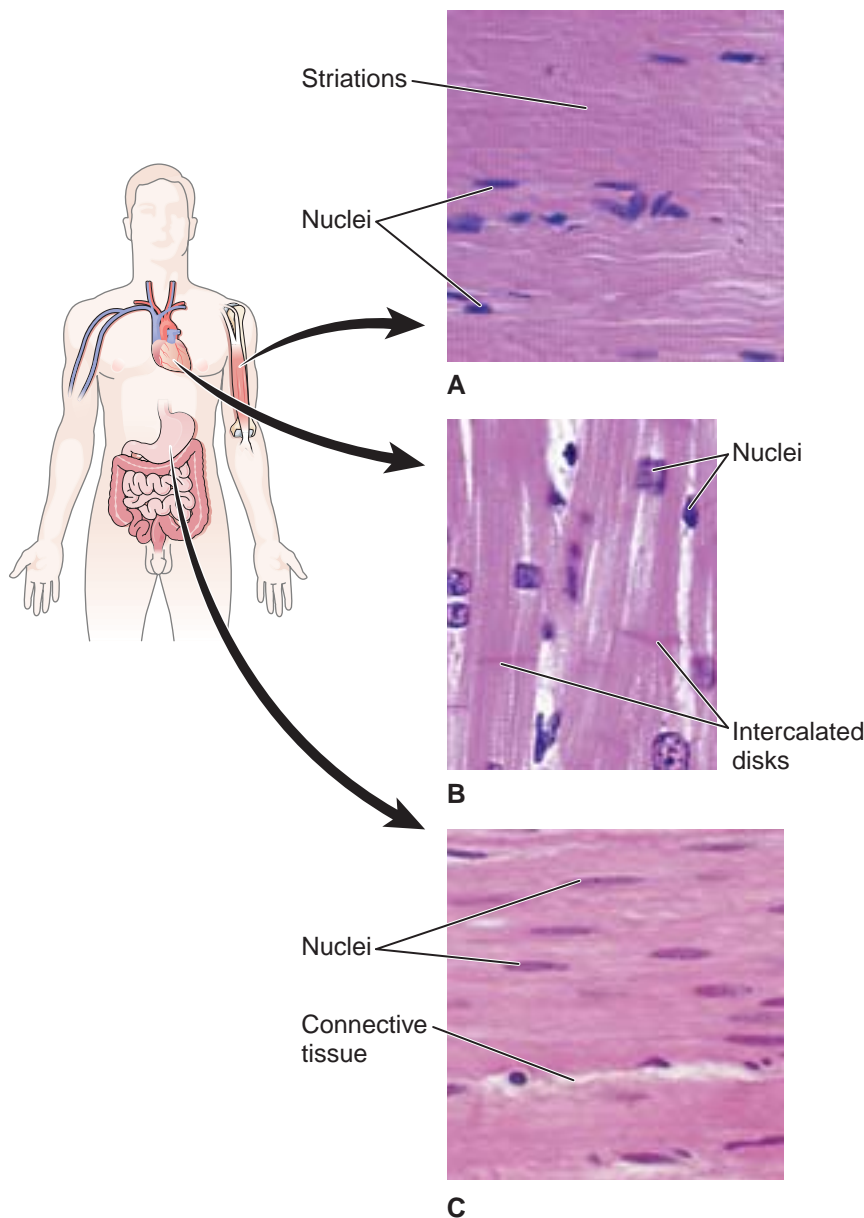


Figure 4-7 Muscle tissue. (A) Skeletal muscle cells have bands (striations) and multiple nuclei. (B) Cardiac muscle makes up the wall of the heart. (C) Smooth muscle is found in soft body organs and in vessels. (A and B, Reprinted with permission from Ross MH, Kaye GI, Pawlina W. *Histology*. 4th ed. Philadelphia: Lippincott Williams & Wilkins, 2003; C, reprinted with permission from Cormack DH. *Essential Histology*. 2nd ed. Philadelphia: Lippincott Williams & Wilkins, 2001.)

Nervous Tissue

The human body is made up of countless structures, both large and small, each of which contributes something to the action of the whole organism. This aggregation of structures might be compared to a large corporation. For all the workers in the corporation to coordinate their efforts, there must be some central control, such as the president or CEO. In the body, this central agent is the **brain**. Each structure of the body is in direct communica-

tion with the brain by means of its own set of “wires,” called **nerves**. Nerves from even the most remote parts of the body come together and form a great trunk cable called the **spinal cord**, which in turn leads into the central switchboard of the brain. Here, messages come in and orders go out 24 hours a day. Some nerves, the cranial nerves, connect directly with the brain and do not form part of the spinal cord. This entire communication system, including the brain, is made of nervous tissue.

The Neuron

The basic unit of nervous tissue is the **neuron** (NU-ran), or nerve cell (Fig. 4-8 A). A neuron consists of a nerve cell body plus small branches from the cell called *fibers*. One type of fiber, the **dendrite** (DEN-drite), is generally short and forms tree-like branches. This type of fiber carries messages in the form of nerve impulses to the nerve cell body. A single fiber, the **axon** (AK-son), carries impulses away from the nerve cell body. Neurons may be quite long; their fibers can extend for several feet. A **nerve** is a bundle of such nerve cell fibers held together with connective tissue (see Fig. 4-8 B).

Just as wires are insulated to keep them from being short-circuited, some axons are insulated and protected by a coating of material called **myelin** (MI-eh-lin). Groups of myelinated fibers form “white matter,” so called because of the color of the myelin, which is much like fat in appearance and consistency.

Not all neurons have myelin, however; some axons are unmyelinated, as are all dendrites and all cell bodies. These areas appear gray in color. Because the outer layer of the brain has

large collections of cell bodies and unmyelinated fibers, the brain is popularly termed *gray matter*, even though its interior is composed of white matter (see Fig. 4-8 C).

Neuroglia

Nervous tissue is supported by specialized cells known as **neuroglia** (nu-ROG-le-ah) or *glial* (GLI-al) *cells*, which are named from the Greek word *glia* meaning “glue.” Some of these cells protect the brain from harmful sub-

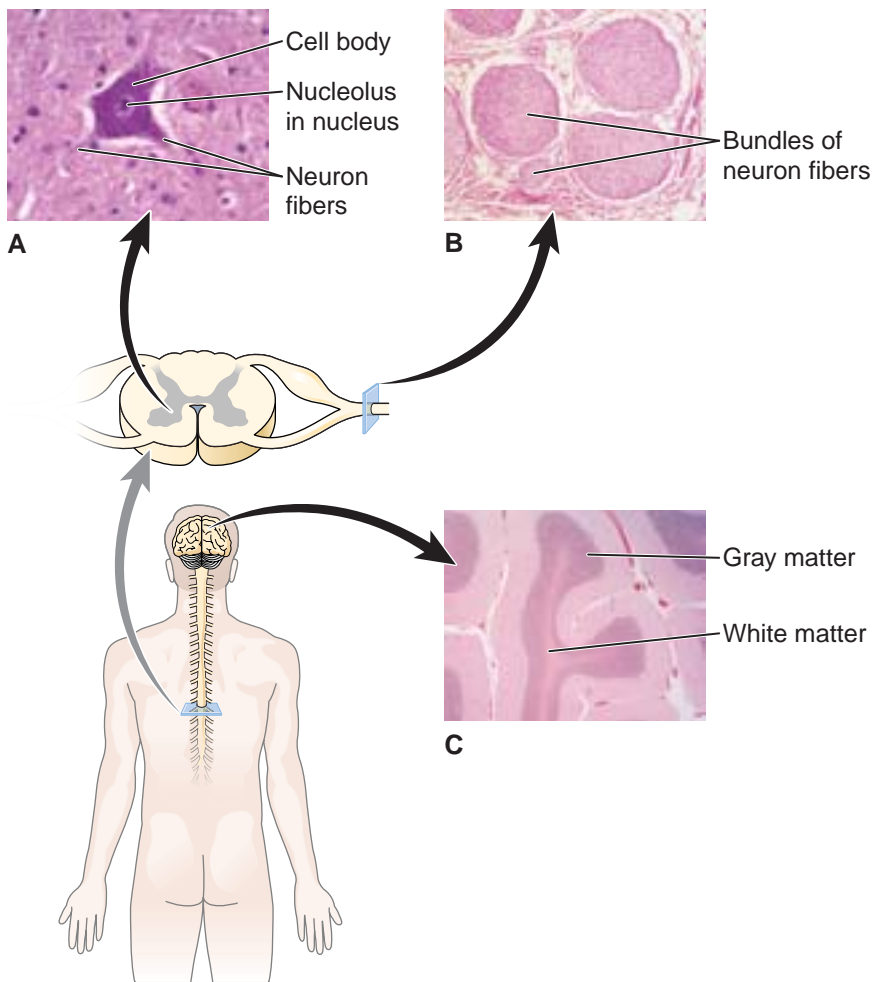


Figure 4-8 Nervous tissue. (A) A neuron, or nerve cell. (B) Cross-section of a nerve. (C) Brain tissue. (Reprinted with permission from Cormack DH. *Essential Histology*. 2nd ed. Philadelphia: Lippincott Williams & Wilkins, 2001.)

stances; others get rid of foreign organisms and cellular debris; still others form the myelin sheath around axons. They do not, however, transmit nerve impulses. A more detailed discussion of nervous tissue and the nervous system can be found in Chapters 9 and 10.

Checkpoint 4-6 What is the basic cellular unit of the nervous system and what is its function?

Checkpoint 4-7 What are the nonconducting support cells of the nervous system called?

Membranes

Membranes are thin sheets of tissue. Their properties vary: some are fragile, others tough; some are transparent, others opaque (*i.e.*, they cannot be seen through). Membranes may cover a surface, may serve as a dividing partition, may line a hollow organ or body cavity, or may anchor an organ. They may contain cells that secrete lubricants to ease the movement of organs, such as the heart and lung,

and the movement of joints. Epithelial membranes and connective tissue membranes are described below.

Epithelial Membranes

An **epithelial membrane** is so named because its outer surface is made of epithelium. Underneath, however, there is a layer of connective tissue that strengthens the membrane, and in some cases, there is a thin layer of smooth muscle under that. Epithelial membranes are made of closely packed active cells that manufacture lubricants and protect the deeper tissues from invasion by microorganisms. Epithelial membranes are of several types:

- ▶ **Serous (SE-rus), membranes** line the walls of body cavities and are folded back onto the surface of internal organs, forming their outermost layer.
- ▶ **Mucous (MU-kus) membranes** line tubes and other spaces that open to the outside of the body.
- ▶ The **cutaneous (ku-TA-ne-us) membrane**, commonly known as the *skin*, has an outer layer of epithelium. This membrane is complex and is discussed in detail in Chapter 6 on the integumentary system.

Serous Membranes Serous membranes line the closed ventral body cavities and do not connect with the outside of the body. They secrete a thin, watery lubricant, known as serous fluid, that allows organs to move with a minimum of friction. The thin epithelium of serous membranes is a smooth, glistening kind of tissue called **mesothelium** (mes-o-THE-le-um). The membrane itself may be referred to as the **serosa** (se-RO-sah).

There are three serous membranes:

- ▶ The **pleurae (PLU-re)**, or **pleuras (PLU-rahs)**, line the thoracic cavity and cover each lung.
- ▶ The **serous pericardium (per-ih-KAR-de-um)** forms part of a sac that encloses the heart, which is located in the chest between the lungs.
- ▶ The **peritoneum (per-ih-to-NE-um)** is the largest serous membrane. It lines the walls of the abdominal cavity, covers the organs of the abdomen, and forms supporting and protective structures within the abdomen (see Fig. 19-3 in Chapter 19).

Serous membranes are arranged so that one portion forms the lining of a closed cavity, while another part folds back to cover the surface of the organ contained in

that cavity. The relationship between an organ and the serous membrane around it can be visualized by imagining your fist punching into a large, soft balloon (Fig. 4-9). Your fist is the organ and the serous membrane around it is in two layers, one against your fist and one folded back to form an outer layer. Although in two layers, each serous membrane is continuous.

The portion of the serous membrane attached to the wall of a cavity or sac is known as the **parietal** (pah-RI-eh-tal) layer; the word *parietal* refers to a wall. In the example above, the parietal layer is represented by the outermost layer of the balloon. Parietal pleura lines the thoracic (chest) cavity, and parietal pericardium lines the

fibrous sac (the fibrous pericardium) that encloses the heart (see Fig. 4-9).

Because internal organs are called *viscera*, the portion of the serous membrane attached to an organ is the **visceral layer**. Visceral pericardium is on the surface of the heart, and each lung surface is covered by visceral pleura. Portions of the peritoneum that cover organs in the abdomen are named according to the particular organ involved. The visceral layer in our balloon example is in direct contact with your fist.

The visceral and parietal layers of a serous membrane normally are in direct contact with a minimal amount of lubricant between them. The area between the two layers of the membrane forms a **potential space**. That is, it is *possible* for a space to exist there, although normally one does not. Only if substances accumulate between the layers, as when inflammation causes the production of excessive amounts of fluid, is there an actual space.

Mucous Membranes Mucous membranes are so named because they produce a thick and sticky substance called **mucus** (MU-kus). (Note that the adjective *mucous* contains an “o,” whereas the noun *mucus* does not.) These membranes form extensive continuous linings in the digestive, respiratory, urinary, and reproductive systems, all of which are connected with the outside of the body. These membranes vary somewhat in both structure and function. The cells that line the nasal cavities and the passageways of the respiratory tract are supplied with tiny, hairlike extensions called *cilia*, described in Chapter 3. The microscopic cilia move in waves that force secretions outward. In this way, foreign particles, such as bacteria, dust, and other impurities trapped in the sticky mucus, are prevented from entering the lungs and causing harm. Ciliated epithelium is also found in certain tubes of both the male and the female reproductive systems.

The mucous membranes that line the digestive tract have special functions. For example, the mucous membrane of the stomach serves to protect the deeper tissues from the action of powerful digestive juices. If for some reason a portion of this membrane is injured, these juices begin to digest a part of the stomach itself—as happens in

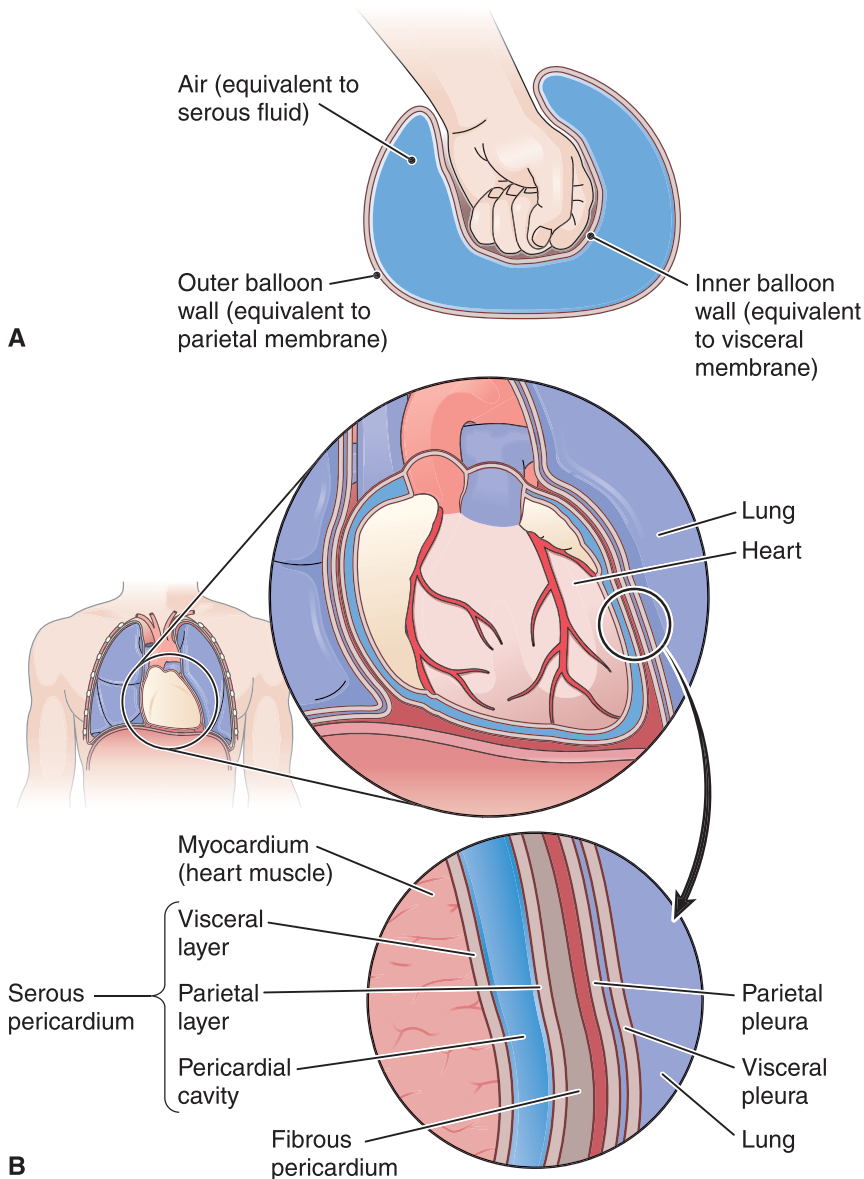


Figure 4-9 Organization of serous membranes. (A) An organ fits into a serous membrane like a fist punching into a soft balloon. (B) The outer layer of a serous membrane is the parietal layer. The inner layer is the visceral layer. The fibrous pericardium reinforces the parietal pericardium.

cases of peptic ulcers. Mucous membranes located farther along in the digestive system are designed to absorb nutrients, which the blood then transports to all body cells.

The noun **mucosa** (mu-KO-sah) is used in referring to the mucous membrane of an organ.

Checkpoint 4-8 Epithelial membranes have an outer layer of epithelium. Which are the three types of epithelial membranes?

Connective Tissue Membranes

The following list is an overview of membranes that consist of connective tissue with no epithelium. These membranes are described in greater detail in later chapters.

- ▶ **Synovial** (sin-O-ve-al) **membranes** are thin connective tissue membranes that line the joint cavities. They secrete a lubricating fluid that reduces friction between the ends of bones, thus permitting free movement of the joints. Synovial membranes also line small cushioning sacs near the joints called **bursae** (BUR-se).
- ▶ The **meninges** (men-IN-jeze) are several layers of membranes covering the brain and the spinal cord.

Fascia (FASH-e-ah) refers to fibrous bands or sheets that support organs and hold them in place. Fascia is found in two regions:

- ▶ **Superficial fascia** is the continuous sheet of tissue that underlies the skin and contains adipose (fat) tissue that insulates the body and protects the skin. This tissue is also called *subcutaneous fascia*, because it is located beneath the skin.
- ▶ **Deep fascia** covers, separates, and protects skeletal muscles.

Finally, there are membranes whose names all start with the prefix *peri-* because they are around organs:

- ▶ The **fibrous pericardium** (per-e-KAR-de-um) forms the cavity that encloses the heart, the pericardial cavity. This fibrous sac and the serous pericardial membranes described above are often referred to together as the pericardium (see Fig. 4-9 B).
- ▶ The **periosteum** (per-e-OS-te-um) is the membrane around a bone.
- ▶ The **perichondrium** (per-e-KON-dre-um) is the membrane around cartilage.

Membranes and Disease

We are all familiar with a number of diseases that directly affect membranes. These range from the common cold, which is an inflammation of the mucosa of the nasal passages, to the sometimes fatal condition known as **peritonitis**, an infection of the peritoneum, which can follow rupture of the appendix and other mishaps in the abdominal region.

Although membranes usually help to prevent the spread of infection from one area of the body to another,

they may sometimes act as pathways along which disease may spread. In general, epithelial membranes appear to have more resistance to infections than do layers made of connective tissue. Lowered resistance, however, may allow the transmission of infection along any membrane. For example, throat infections may travel along mucous membranes into other parts of the upper respiratory tract and even into the sinuses and the ears. In females, an infection may travel up the tubes and spaces of the reproductive system into the peritoneal cavity (see Fig. 23-15 in Chapter 23).

The connective tissue, or collagen, diseases, such as **systemic lupus erythematosus** (LU-pus er-ih-them-ah-TO-sus) (SLE) and **rheumatoid** (RU-mah-toyd) **arthritis**, may affect many parts of the body because collagen is the major intercellular protein in solid connective tissue. In SLE, serous membranes, such as the pleura, pericardium, and peritoneum, are often involved. In rheumatoid arthritis, the synovial membrane becomes inflamed and swollen, and the cartilage in the joints is gradually replaced with fibrous connective tissue.

Benign and Malignant Tumors

For a variety of reasons, the normal pattern of cell and tissue growth may be broken by an upstart formation of cells having no purpose whatsoever in the body. Any abnormal growth of cells is called a **tumor**, or **neoplasm**. If the tumor is confined to a local area and does not spread, it is called a **benign** (be-NINE) tumor. If the tumor spreads to neighboring tissues or to distant parts of the body, it is called a **malignant** (mah-LIG-nant) tumor. The general term for any type of malignant tumor is **cancer**. The process of tumor cell spread is called **metastasis** (meh-TAS-tah-sis).

Tumors are found in all kinds of tissue, but they occur most frequently in those tissues that repair themselves most quickly, specifically epithelium and connective tissue, in that order.

Benign Tumors

Benign tumors, theoretically at least, are not dangerous in themselves; they do not spread. Their cells stick together, and often they are encapsulated, that is, surrounded by a containing membrane. The cells in a benign tumor are very similar in appearance to the normal cells from which they are derived (Fig. 4-10 A and B). Benign tumors grow as a single mass within a tissue, lending them neatly to complete surgical removal. Medically, they are described as growing *in situ*, meaning that they are confined to their place of origin and do not invade other tissues or spread to other sites. Of course, some benign tumors can be quite harmful; they may grow within an organ, increase in size, and cause considerable mechanical damage. A benign tumor of the brain, for example, can kill a person just as a malignant one can because it grows in an enclosed area and compresses vital brain tissue. Some ex-

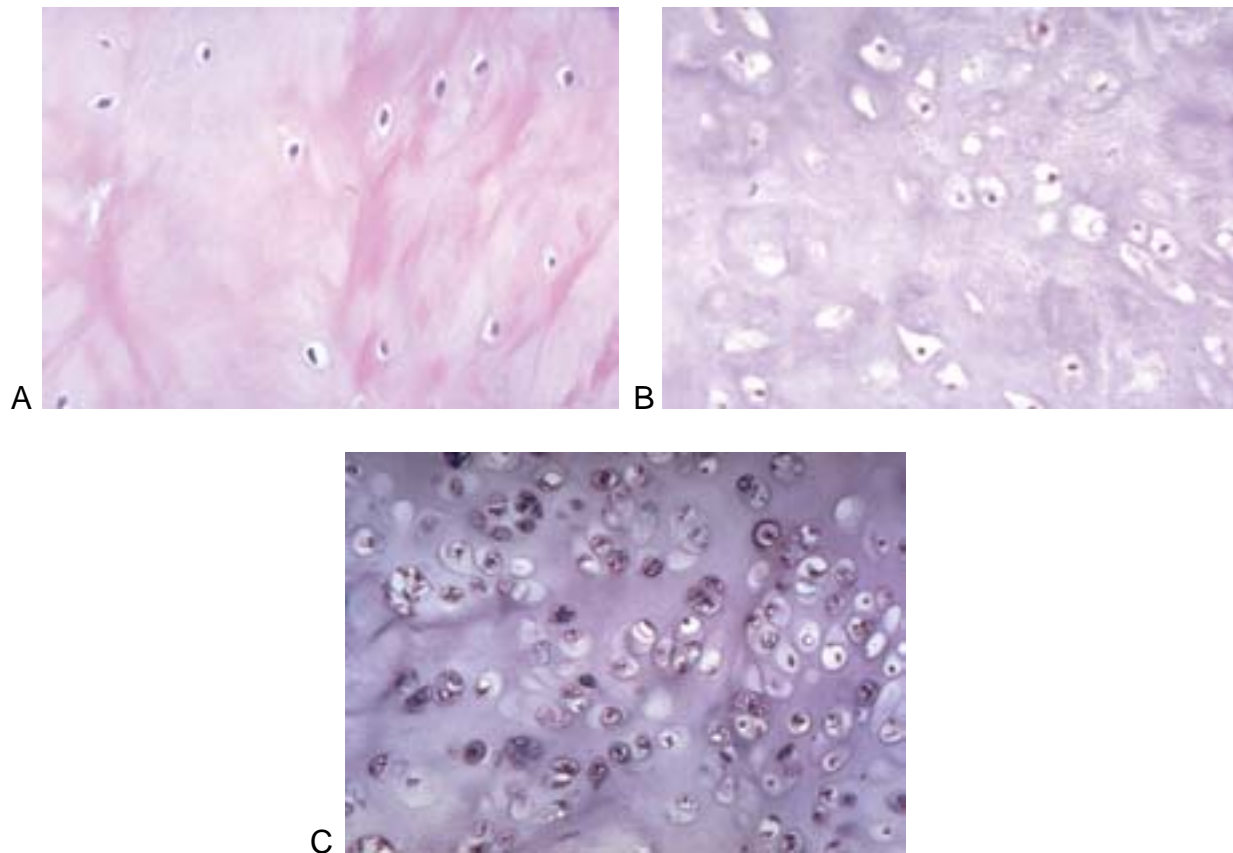


Figure 4-10 Benign and malignant tumors. (A) Normal cartilage. (B) A benign chondroma closely resembles normal cartilage. (C) Chondrosarcoma of bone. The tumor is composed of malignant chondrocytes, which have bizarre shapes and abnormal nuclei. (A and B, Reprinted with permission from Rubin E, Farber JL. *Pathology*. 3rd ed. Philadelphia: Lippincott Williams & Wilkins, 1999. C, Reprinted from Bullough PG, Vigorita VJ. *Atlas of orthopaedic pathology*. New York: Gower Medical Publishing, 1984. With permission from Elsevier.)

amples of benign tumors are given below (note that most of the names end in *-oma*, which means “tumor”).

- ▶ **Papilloma** (pap-ih-LO-mah)—a tumor that grows in epithelium as a projecting mass. One example is a wart.
- ▶ **Adenoma** (ad-eh-NO-mah)—an epithelial tumor that grows in and about the glands (*adeno-* means “gland”).
- ▶ **Lipoma** (lip-O-mah)—a connective tissue tumor originating in fatty (adipose) tissue.
- ▶ **Osteoma** (os-te-O-mah)—a connective tissue tumor that originates in the bones.
- ▶ **Myoma** (mi-O-mah)—a tumor of muscle tissue. Rare in voluntary muscle, it is common in some types of involuntary muscle, particularly in the uterus (womb). When found in the uterus, however, it is ordinarily called a *fibroid*.
- ▶ **Angioma** (an-je-O-mah)—a tumor that usually is composed of small blood or lymphatic vessels; an example is a birthmark.
- ▶ **Nevus** (NE-vus)—a small skin tumor of one of a variety of tissues. Some nevi are better known as moles; some are angiomas. Ordinarily, these tumors are harmless, but they can become malignant.
- ▶ **Chondroma** (kon-DRO-mah)—a tumor of cartilage cells that may remain within the cartilage or develop on the surface, as in the joints (see Fig. 4-10 B).

Malignant Tumors

Malignant tumors, unlike benign tumors, can cause death no matter where they occur. Malignant cells are very different in appearance from their parent cells and are unable to function normally (see Fig. 4-10 C). Malignant tumors, moreover, grow much more rapidly than benign tumors. The word *cancer* means “crab,” and this is descriptive: a cancer sends out clawlike extensions into neighboring tissue. Cancer cells also spread to other parts of the body by either the blood or the lymph (another circulating fluid). When the cancer cells reach their destination, they immediately form new (secondary) growths, or **metastases** (meh-TAS-tah-seze).

Malignant tumors are classified into two main categories according to whether they originate in epithelial or connective tissue:

- ▶ **Carcinoma** (kar-sih-NO-mah). This type of cancer originates in epithelium and is by far the most common form of cancer. Usual sites of carcinoma are the skin, mouth, lung, breast, stomach, colon, prostate, and uterus. Carcinomas are usually spread by the lymphatic system (see Chapter 16).
- ▶ **Sarcoma** (sar-KO-mah). These are cancers of connective tissue of all kinds and hence may be found anywhere in

the body. Their cells are usually spread by the blood stream, and they often form secondary growths in the lungs. The cells of a chondrosarcoma, a tumor that arises from cartilage cells, is shown in [Figure 4-10 C](#).

Cancers of the nervous system, lymphatic system, and blood are classified differently according to the cells in which they originate as well as other clinical features. A **neuroma** (nu-RO-mah) is a tumor that arises from a nerve. Because nervous tissue does not multiply throughout life, however, it is rarely involved in cancer. Usually, a tumor of the nervous system originates in the support (neuroglial) tissue of the brain or spinal cord and is called a **glioma** (gli-O-mah). A malignant neoplasm of lymphatic tissue is called a **lymphoma** (lim-FO-mah), and cancer of white blood cells is **leukemia** (lu-KE-me-ah).

Checkpoint 4-9 What is the difference between a benign and a malignant tumor?

Symptoms of Cancer

Everyone should be familiar with certain signs that may indicate early cancer and should report these signs for further investigation by their healthcare provider. Early symptoms may include unusual bleeding or discharge, persistent indigestion, chronic hoarseness or cough, changes in the color or size of moles, a sore that does not heal in a reasonable time, the presence of an unusual lump, and the presence of white patches inside the mouth or white spots on the tongue. Late symptoms of cancer include weight loss and pain. Many cases of cancer are now diagnosed by routine screening tests that are part of the standard physical examination.

Diagnosis of Cancer

Improved methods of cancer detection lead to earlier and more successful treatment. These methods include the following:

- **Microscopic study** of tissue or cells removed from the body. **Biopsy** (BI-op-se) is the removal of living tissue

for the purpose of microscopic examination. Specimens can be obtained by needle withdrawal (aspiration) of fluid; by a small punch, as of the skin; by an endoscope (lighted tube) introduced into a body cavity; or by surgical removal (excision). In some cases, fluids can be examined for signs of cancerous cells, as these cells often slough off into surrounding fluids. The most common example of this type of cytologic study is the Pap (Papanicolaou) test for cancer of the uterine cervix. Pleural or peritoneal fluids also may be studied for signs of cancerous cells (see [Box 4-3, Histotechnologist](#)).

- **Radiography** is the use of x-rays to obtain images of internal structures. This method is most commonly applied to study of the breasts in the process of mammography. Other structures such as the lungs, nervous system, and digestive system also may be examined by this method, although a contrast medium is often needed to show changes in soft tissues.
- **Ultrasound** (ultrasonography) is the use of reflected high-frequency sound waves to differentiate various kinds of tissue.
- **Computed tomography** (CT) is the use of x-rays to produce a cross-sectional picture of body parts, such as the brain (see [Fig. 10-12 A](#) in Chapter 10).
- **Magnetic resonance imaging** (MRI) is the use of magnetic fields and radio waves to show changes in soft tissues.
- **Positron emission tomography** (PET) shows activity within an organ by computerized interpretation of the radiation emitted following administration of a radioactive substance, such as glucose. This method has been used to diagnose tumors of the lung and brain.

New Methods of Diagnosis Tests for tumor markers are newer approaches to cancer diagnosis. Tumor markers are substances, such as hormones, enzymes, or other proteins, produced in greater than normal quantity by cancerous cells. These markers can be detected in the laboratory in cells or in body fluids, such as blood. The most widely used of these screenings is for PSA (prostate-specific anti-

Box 4-3 • Health Professions

Histotechnologist

In the clinical laboratory, the histotechnologist is the healthcare professional who prepares tissue samples for microscopic examination. When a tissue sample arrives at the laboratory, the histotechnologist cuts it into very thin slices, called sections, mounts the sections on glass slides, and treats them with various chemicals to preserve and prepare them for staining. The histotechnologist then stains the preserved sections with specific dyes to emphasize cellular details that a pathologist might look for. To perform these tasks, histotechnolo-

gists require a strong clinical background and a thorough understanding of chemistry, anatomy, and physiology.

Most histotechnologists work in hospital and medical clinic laboratories, although some find employment in research laboratories, pharmaceutical companies, and government agencies. Job prospects are promising because of the growing need for healthcare and the development of new laboratory tests and technologies. For more information about careers in histotechnology, contact the American Society for Clinical Laboratory Science.

gen), a protein produced in large quantity by prostate tumors. Some others are CA 125 in ovarian cancer, AFP (alpha-fetoprotein) in liver cancer, CEA (carcinoembryonic antigen) in digestive system and breast cancers, and CD antigens (proteins) in cancer of the blood and lymphatic system. Although tumor markers are often produced in amounts too small to be detected early in the disease process, they still can be used to monitor treatment.

In a small number of cases, cancer has been linked to changes in a person's genetic makeup. In these cases, a certain type of cancer would "run in families," and people could be genetically tested for a predisposition to that form of the disease. The clearest correlation between genetics and cancer has been established in a small percentage of breast cancers.

Staging Diagnostic studies are used for a process called **staging**, which is a procedure for establishing the extent of tumor spread, both at the original site and in other parts of the body (metastases). Staging is important for selecting and evaluating therapy and for predicting the outcome of the disease. The TMN system is commonly used for staging. These letters stand for primary tumor (T), regional lymph nodes (N), and distant metastases (M). Based on TMN results, a stage ranging in Roman numerals from I to IV in severity is assigned. Cancers of the blood, lymphatic system, and nervous system are evaluated by different methods.

Treatment of Cancer

Some standard forms of treatment are described, followed by some newer approaches to cancer treatment. Note that various methods of treatment may be combined. For example, chemotherapy alone or with radiation therapy may precede surgery, or surgery may be performed before other treatment is given.

Surgery Benign tumors usually can be removed completely by surgery. Malignant tumors cannot be treated so easily, for a number of reasons. If cancerous tissue is removed surgically, there is always the possibility that a few hidden cells will be left behind to resume growth of the tumor. If the cells have spread to distant parts of the body, predicted outcome is usually much less favorable.

The **laser** (LA-zer) is a device that produces a highly concentrated and intense beam of light. It is used to destroy tumors or as a cutting device for removing a tumorous growth. Important advantages of the laser are its ability to coagulate blood, so that bleeding is largely prevented, and the capacity to direct a narrow beam of light accurately to attack harmful cells and avoid normal cells.

Other methods for destroying cancerous tissue include electrosurgery, which uses high-frequency current; cryosurgery, which uses extreme cold generated by liquid nitrogen; and chemosurgery, which employs chemicals.

Radiation Sometimes, surgery is preceded or followed by radiation. Radiation therapy is administered by x-ray machines or by the placement of small amounts of radioactive material within the involved organ. These materials can be in the form of needles, beads, seeds, or other devices. Some radioactive chemicals can be injected or taken orally. Radiation destroys the more rapidly dividing cancer cells while causing less damage to the more slowly dividing normal cells. A goal in radiation therapy is accurate focus of the radiation beam to reduce damage to normal body structures.

Chemotherapy Chemotherapy is a general term for treatment with drugs, but often the term is understood to mean the treatment of cancer with **antineoplastic** (an-ti-ne-o-PLAS-tik) **agents**. These agents are drugs that act selectively on actively growing cells, and they are most effective when used in combination. Certain types of leukemia, various cancers of the lymphatic system, and other forms of cancer often are treated effectively by this means. Research continues to develop new drugs and more effective drug combinations. Although antineoplastic agents are more toxic to tumor cells than to normal cells, they do also damage normal cells and must be administered under careful control by health professionals who understand the complications they may cause. Patients who receive these drugs, because of their weakened state, are subject to the development of opportunistic infections; that is, infections that develop in a person who has been weakened by disease.

Newer Approaches to Cancer Treatment The immune system constantly works to protect the body against abnormal and unwanted cells, a category that includes tumor cells. **Immunotherapy** involves the use of substances that stimulate the immune system as a whole or vaccines prepared specifically against a tumor to control growth. In certain types of breast cancer, antibodies have been used to block receptor sites for a factor that stimulates tumor growth.

Some cancers, such as those of the breast, testis, and prostate, are stimulated to grow more rapidly by hormones. Counteracting hormones or other chemicals that block receptors for the stimulants can be used to restrict tumor growth in these tissues.

For a tumor to establish itself, new blood vessels must develop and supply the rapidly growing cells with nutri-

ents and oxygen. Some attempts have been made to block tumor growth by preventing this process of angiogenesis (growth of blood vessels).

Checkpoint 4-10 What are the three standard approaches to the treatment of cancer?

Tissues and Aging

With aging, tissues lose elasticity and collagen becomes less flexible. These changes affect the skin most noticeably, but internal changes occur as well. The blood vessels, for example, have a reduced capacity to expand. Less blood supply and lower metabolism slow the healing process. Tendons and ligaments stretch, causing a stooped posture and joint instability. Bones may lose calcium salts, becoming brittle and prone to fracture. With age, muscles and other tissues waste from loss of cells, a process termed *atrophy* (AT-ro-fe) (Fig. 4-11). Changes that apply to specific organs and systems are described in later chapters.

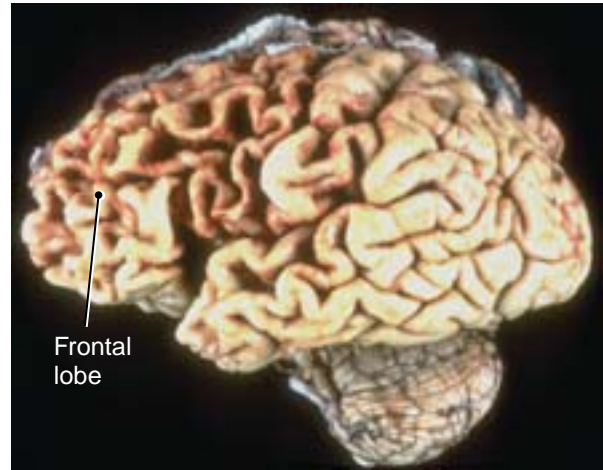


Figure 4-11 Atrophy of the brain. Brain tissue has thinned and larger spaces appear between sections of tissue, especially in the frontal lobe. (Reprinted with permission from Okazaki H, Scheithauer BW. Atlas of neuropathology. New York: Gower Medical Publishing, 1988. By permission of the author.)

Word Anatomy

Medical terms are built from standardized word parts (prefixes, roots, and suffixes). Learning the meanings of these parts can help you remember words and interpret unfamiliar terms.

WORD PART	MEANING	EXAMPLE
hist/o	tissue	<i>Histology</i> is the study of tissues.
Epithelial Tissue		
epi-	on, upon	<i>Epithelial</i> tissue covers body surfaces.
pseud/o-	false	<i>Pseudostratified</i> epithelium appears to be in multiple layers, but is not.
Connective Tissue		
-blast	immature cell, early stage of cell	A <i>fibroblast</i> is a cell that produces fibers.
chondr/o	cartilage	A <i>chondrocyte</i> is a cartilage cell.
oss, osse/o	bone, bone tissue	<i>Osseous</i> tissue is bone tissue.
oste/o	bone, bone tissue	An <i>osteocyte</i> is a mature bone cell.
Muscle Tissue		
my/o	muscle	The <i>myocardium</i> is the heart muscle.
cardi/o	heart	
Nervous Tissue		
neur/o	nerve, nervous system	A <i>neuron</i> is a nerve cell.
Membranes		
pleur/o	side, rib	The <i>pleurae</i> are membranes that line the chest cavity.
peri-	around	The <i>peritoneum</i> wraps around the abdominal organs.
-itis	inflammation	<i>Peritonitis</i> is inflammation of the peritoneum.
arthr/o	joint	<i>Arthritis</i> is inflammation of a joint.
Benign and Malignant Tumors		
neo-	new	A <i>neoplasm</i> is an abnormal growth of new cells, a tumor.
mal-	bad, disordered, diseased, abnormal	A <i>malignant</i> tumor spreads to other parts of the body.

WORD PART**Benign and Malignant Tumor**

-oma
papill/o
aden/o
angi/o
leuk/o-
graph/o

ultra-
ant/i-

MEANING

tumor, swelling
nipple
gland
vessel
white, colorless
writing, record

beyond
against

EXAMPLE

A *papilloma* is a projecting (nipple-like) tumor, such as a wart. See preceding example.

An *adenoma* is a tumor of a gland.

An *angioma* is a tumor composed of small vessels.

Leukemia is a cancer of white blood cells.

Mammography is x-ray imaging (radiography) of the breast (mamm/o).

Ultrasound is high-frequency sound waves.

An *antineoplastic* agent is a drug active against cancer.

Summary

I. Tissue classification—epithelial tissue, connective tissue, muscle tissue, nervous tissue

- A. Epithelial tissue—covers surfaces; lines cavities, organs, and ducts
1. Cells—squamous, cuboidal, columnar
 2. Arrangement—simple or stratified
 3. Special functions
 - a. Produces secretions, *e.g.*, mucus, digestive juices, sweat
 - b. Filters impurities using cilia
- B. Glands—active cells are epithelial cells
1. Exocrine
 - a. Secrete through ducts
 - b. Examples: digestive glands, tear glands, sweat and oil glands of skin
 2. Endocrine
 - a. Secrete into bloodstream
 - b. Produce hormones

II. Connective tissue—supports, binds, forms framework of body

- A. Liquid
1. Blood
 2. Lymph
- B. Soft—jellylike intercellular material (matrix)
1. Areolar (loose)
 2. Adipose—stores fat
- C. Fibrous—dense tissue with collagenous or elastic fibers between cells
1. Examples
 - a. Tendons—attach muscle to bone
 - b. Ligaments—connect bones
 - c. Capsules—around organs
 - d. Fascia—bands or sheets that support organs
- D. Hard—firm and solid
1. Cartilage—found at joints and ends of bones, nose, outer ear, trachea, etc.
 - a. Types—hyaline, elastic, fibrocartilage
 - b. Cells—chondrocytes
 2. Bone
 - a. Contains mineral salts

- b. Cells
 - (1) Osteoblasts—produce bone
 - (2) Osteocytes—mature cells

III. Muscle tissue—contracts to produce movement

- A. Types
1. Skeletal muscle—voluntary; moves skeleton
 2. Cardiac muscle—forms main part of the heart
 3. Smooth muscle—involuntary; forms visceral organs

IV. Nervous tissue

- A. Neuron—nerve cell
1. Cell body—contains nucleus
 2. Dendrite—fiber carrying impulses toward cell body
 3. Axon—fiber carrying impulses away from cell body
 - a. Myelin—fatty material that insulates some axons
 - (1) Myelinated fibers—make up white matter
 - (2) Unmyelinated cells and fibers—make up gray matter
- B. Neuroglia—support and protect nervous tissue

V. Membranes—thin sheets of tissue

- A. Epithelial membranes—outer layer epithelium
1. Serous membrane—secretes watery fluid
 - a. Parietal layer—lines body cavity
 - b. Visceral layer—covers internal organs
 - c. Examples—pleurae, pericardium, peritoneum
 2. Mucous membrane
 - a. Secretes mucus
 - b. Lines tube or space that opens to the outside (*e.g.*, respiratory, digestive, reproductive tracts)
 3. Cutaneous membrane—skin
- B. Connective tissue membranes
1. Synovial membrane—lines joint cavity
 2. Meninges—around brain and spinal cord
 3. Fascia—under skin and around muscles
 4. Pericardium—around heart; periosteum—around bone; perichondrium—around cartilage
- C. Membranes and disease—may confine infection, but may be route for spread

VI. Benign and malignant tumors—tumor (neoplasm) results from uncontrolled growth of cells

- A.** Benign tumor—localized
- B.** Malignant tumor—invades tissue and spreads to other parts of the body (metastasizes)
1. Carcinoma—originates in epithelium
 2. Sarcoma—cancer of connective tissue
 3. Others—cancers of nervous system, lymphatic system, blood
- C.** Symptoms of cancer—bleeding, persistent indigestion, hoarseness or cough, change in mole, lump, nonhealing sore, pain, weight loss
- D.** Diagnosis of cancer
1. Microscopic study (biopsy to obtain specimen), ultrasound, CT, MRI, PET
 - a. Also blood tests for markers, genetic tests
 2. Staging—classification based on size of tumor and extent of invasion
- E.** Treatment of cancer
1. Surgical removal
 2. Radiation
 3. Chemotherapy—drugs
 4. Others—immunotherapy, hormones, inhibitors of blood vessel formation

Questions for Study and Review

Building Understanding

Fill in the blanks

1. A group of similar cells arranged in a characteristic pattern is called a(n) _____.
2. Glands that secrete their products directly into the blood are called _____ glands.
3. Tissue that supports and forms the framework of the body is called _____ tissue.
4. A tumor that is confined to a local area and does not spread is a(n) _____ tumor.
5. The removal of living tissue for the purpose of microscopic examination is called _____.

Matching

Match each numbered item with the most closely related lettered item.

- | | |
|---|------------------|
| ___6. Membrane around the heart | a. perichondrium |
| ___7. Membrane around each lung | b. pericardium |
| ___8. Membrane around bone | c. peritoneum |
| ___9. Membrane around cartilage | d. periosteum |
| ___10. Membrane around abdominal organs | e. pleura |

Multiple choice

- ___11. Epithelium composed of a single layer of long and narrow cells is called
 - a. simple cuboidal epithelium
 - b. simple columnar epithelium
 - c. stratified cuboidal epithelium
 - d. stratified columnar epithelium
- ___12. Tendons and ligaments are examples of
 - a. liquid connective tissue
 - b. soft connective tissue
 - c. fibrous connective tissue
 - d. hard connective tissue
- ___13. A tissue composed of long striated cells with multiple nuclei is
 - a. smooth muscle tissue
 - b. cardiac muscle tissue
 - c. skeletal muscle tissue
 - d. nervous tissue
- ___14. A bundle of nerve cell fibers held together with connective tissue is called a(n)
 - a. dendrite
 - b. axon
 - c. nerve
 - d. myelin
- ___15. All of the following are types of epithelial membranes except
 - a. cutaneous membrane
 - b. mucous membrane
 - c. serous membrane
 - d. synovial membrane

Understanding Concepts

16. Explain how epithelium is classified and discuss at least three functions of this tissue type.
17. Compare the structure and function of exocrine and endocrine glands and give two examples of each type.
18. Describe the functions of connective tissue. Name two kinds of fibers found in connective tissue and discuss how their presence affects tissue function.
19. Compare and contrast the three different types of muscle tissue.
20. Compare serous and mucous membranes.
21. Describe the difference between a benign tumor and a malignant tumor.
22. Define the term *cancer* and name some of its early symptoms. How is cancer diagnosed? How is it treated?

Conceptual Thinking

23. Prolonged exposure to cigarette smoke causes damage to ciliated epithelium that lines portions of the respiratory tract. Discuss the implications of this damage.
24. The middle ear is connected to the throat by a tube called the eustachian (auditory) tube. All are lined by a continuous mucous membrane. Using this information,

describe why a throat infection (pharyngitis) may lead to an ear infection (otitis media).

25. Osteogenesis imperfecta is a connective tissue disease characterized by abnormal collagen fiber synthesis. Based on the fact that collagen is the predominant fiber type in connective tissue, list some possible symptoms of this disease.