

Tissue: The Living Fabric

Outline

- 4.1 Tissue samples are fixed, sliced, and stained for microscopy (pp. 115-117)
 - A. Tissue specimens must be fixed (preserved) and sectioned (sliced) thinly enough to allow light transmission. (p. 116)
 - B. Tissue sections must be stained with dyes that bind to different parts of the cell in slightly different ways so that anatomical structures are distinguished from one another. (p. 116)
- 4.2 Epithelial tissue covers body surfaces, lines cavities, and forms glands (pp. 117-126; Figs. 4.1-4.6)
 - A. Features of Epithelia (p. 117)
 1. Epithelium occurs in the body as covering or lining epithelium, or as glandular epithelium.
 2. Epithelial tissues perform several functions in the body: protection, absorption, filtration, excretion, secretion, and sensory reception.
 - B. Special Characteristics of Epithelium (pp. 117-118)
 1. Exhibits polarity by having an upper free apical surface, and a lower attached basal surface.
 2. Epithelial tissues are continuous sheets that have little space between cells.
 3. Adjacent epithelial cells are bound together by specialized contacts such as desmosomes and tight junctions.
 4. Supported by a basement membrane, derived partly from underlying connective tissue.
 5. Epithelial tissues are innervated, but avascular.
 6. Epithelial tissue has a high regeneration capacity.
 - C. Classification of Epithelia (pp. 118-123; Figs. 4.2-4.3)
 1. Each epithelial tissue has a two-part name: the first part indicates the number of layers present, and the second part describes the shape of the cells.
 - a. Layers may be simple (one), or stratified (more than one).
 - b. Cell shapes may be squamous (flat), cuboidal (box-like), or columnar (column shaped).
 2. A simple epithelium consists of a single layer of cells that functions in absorption, secretion, and filtration.
 - a. Simple squamous epithelium is located where filtration or exchange of substances occurs.
 - b. Simple cuboidal epithelium forms the smallest ducts of glands or kidney tubules.
 - c. Simple columnar epithelium lines the digestive tract.
 - d. Pseudostratified columnar epithelium contains cells of varying heights that all sit on the basement membrane, giving the appearance of many layers.
 3. A stratified epithelium is made up of several layers of cells that mostly provide protection.

- a. Stratified squamous epithelium makes up the external part of the skin, and extends into every body opening.
 - b. Stratified cuboidal epithelium is found mostly in the ducts of some of the larger glands.
 - c. Stratified columnar epithelium is found in the pharynx, in the male urethra, and lining some glandular ducts.
 - d. Transitional epithelium forms the lining of the hollow organs of the urinary system and is specialized to allow cells to change shape and stretch as the organ distends.
- D. Glandular Epithelia (pp. 123–126; Figs. 4.4–4.6)
- 1. Endocrine glands are ductless glands that secrete hormones by exocytosis directly into the blood or lymph.
 - 2. Exocrine glands have ducts and secrete their product onto a surface or into body cavities.
 - a. Unicellular exocrine glands secrete mucus to epithelial linings of the intestinal or respiratory tract.
 - b. Multicellular exocrine glands consist of a duct, and a group of secretory cells, and may be classified by duct structure, or mechanism of secretion.
 - i. Simple glands have an unbranched duct, while compound glands have a branched duct.
 - ii. Secretions in humans may be merocrine, which are products released through exocytosis, or holocrine, which are synthesized products released when the cell ruptures.

4.3 **Connective tissue is the most abundant and widely distributed tissue in the body (pp. 126–137; Figs. 4.7–4.8; Table 4.1)**

A. Common Characteristics of Connective Tissue (p. 127)

- 1. All connective tissue arises from an embryonic tissue called mesenchyme.
- 2. Connective tissue ranges from avascular to highly vascularized.
- 3. Connective tissue is composed mainly of nonliving extracellular matrix that separates the cells of the tissue.

B. Structural Elements of Connective Tissue (pp. 127–128; Fig. 4.7)

- 1. Ground substance fills the space between the cells and consists of interstitial fluid, cell adhesion proteins, proteoglycans, and protein fibers.
- 2. Fibers of the connective tissue provide support.
 - a. Collagen fibers are extremely strong and provide high tensile strength to the connective tissue.
 - b. Elastic fibers contain elastin, which allows them to be stretched and to recoil.
 - c. Reticular fibers are fine, collagenous fibers that form networks where connective tissue contacts other types of tissues.
- 3. Each major class of connective tissue has a fundamental cell type that exists in immature and mature forms.

C. Types of Connective Tissue (pp. 128–137; Fig. 4.8; Table 4.1)

- 1. There are two types of connective tissue proper: loose connective tissue, including areolar, adipose, and reticular tissue; and dense connective tissues, consisting of dense regular, dense irregular, and reticular connective tissues.

- a. Areolar connective tissue serves to support and bind body parts, contain body fluids, defend against infection, and store nutrients.
 - b. Adipose (fat) tissue is a richly vascularized tissue that functions in nutrient storage, protection, and insulation.
 - c. Reticular connective tissue forms the internal framework of the lymph nodes, the spleen, and the bone marrow.
 - d. Dense regular connective tissue contains closely packed bundles of collagen fibers running in the same direction and makes up tendons and ligaments.
 - e. Dense irregular connective tissue contains thick bundles of collagen fibers arranged in an irregular fashion and is found in the dermis.
 - f. Elastic connective tissue is found in select locations and is stretchier than dense regular connective tissue.
4. Cartilage grows from chondrocytes, lacks nerve fibers, and is avascular.
 - a. Hyaline cartilage is the most abundant cartilage, providing firm support with some pliability.
 - b. Elastic cartilage is found where strength and exceptional stretch are needed, such as the external ear and epiglottis.
 - c. Fibrocartilage is found where strong support and the ability to withstand heavy pressure are required, such as the intervertebral discs.
 5. Bone (osseous tissue) has an exceptional ability to support and protect body structures due to its hardness, which is determined by the additional collagen fibers and calcium salts found in the extracellular matrix.
 6. Blood is classified as a connective tissue because it develops from mesenchyme and consists of blood cells and plasma proteins surrounded by blood plasma.
- 4.4 Muscle tissue is responsible for body movement (pp. 137–139; Fig. 4.9)
- A. Muscle tissues are highly cellular, well-vascularized tissues responsible for movement. (pp. 136–137; Fig. 4.9)
 - B. There are three types of muscular tissue (pp. 137–139; Fig. 4.9):
 1. Skeletal muscle attaches to the skeleton, and is composed of long, cylindrical, multinucleate cells.
 2. Cardiac muscle cells are striated, uninucleate, and branched, and are located only in the heart.
 3. Smooth muscle cells are unstriated, small, and spindle-shaped, and found in the walls of the hollow organs.
- 4.5 Nervous tissue is a specialized tissue of the nervous system (pp. 139–140; Fig. 4.10)
- A. Nervous tissue is the main component of the nervous system, which regulates and controls body functions, and is composed of two types of cells: (pp. 139–140; Fig. 4.10)
 1. Neurons are specialized cells that generate and conduct electrical impulses.
 2. Supporting cells are nonconducting cells that support, insulate, and protect the neurons.

- 4.6 The cutaneous membrane is dry; mucous and serous membranes are wet (pp. 141–143; Fig. 4.11)
- A. The cutaneous membrane, or skin, is a dry membrane consisting of keratinized stratified squamous epithelium attached to a thick layer of dense irregular connective tissue. (p. 142; Fig. 4.11)
 - B. Mucous membranes are wet membranes that line body cavities that open to the exterior, and contain either stratified squamous or simple columnar epithelia over a connective tissue lamina propria. (p. 143; Fig. 4.11)
 - C. Serous membranes are moist membranes within closed body cavities, and consist of simple squamous epithelium resting on a thin layer of loose connective (areolar) tissue. (p. 143; Fig. 4.11)
- 4.7 Tissue repair involves inflammation, organization, and regeneration (pp. 143–145; Fig. 4.12)
- A. Tissue repair occurs in two ways: regeneration, in which damaged cells are replaced with the same type of cell; and fibrosis, which replaces damaged cells with fibrous connective tissue. (p. 143)
 - B. Three steps are involved in the tissue repair process. (pp. 144–145; Fig. 4.12)
 - 1. Cellular damage promotes inflammation, which prepares the area for the repair process.
 - 2. Organization replaces the blood clot with granulation tissue, restoring blood supply.
 - 3. Regeneration and fibrosis restore tissue.
 - C. The regenerative capacity of tissues varies widely among the tissue types: In tissues that do not regenerate, damaged cells are replaced with fibrotic tissue. (p. 145)
- Developmental Aspects of Tissues (pp. 145–146; Fig. 4.13)
- A. Primary germ layer formation is one of the first events of embryonic development, giving rise to three layers of tissue, ectoderm, mesoderm, and endoderm, which further specialize to form the four primary tissue types. (pp. 145–146; Fig. 4.13)
 - B. In adults, only epithelia and blood-forming tissues remain highly mitotic. (p. 146)
 - C. Some tissues that regenerate throughout life do so by division of mature cells, while others have populations of stem cells that can divide as necessary. (p. 146)