

Chapter 4 - Tissue: The Living Fabric

Objectives

Epithelial Tissue

1. Describe the special characteristics of epithelial tissue.
2. Discuss how epithelial tissue is named and classified.
3. List the types of epithelial tissues and give an example of each.
4. Define gland, and explain the difference between exocrine and endocrine glands.
5. Describe the three modes of exocrine secretions.

Connective Tissue

6. Describe the functions of connective tissue.
7. Discuss the similarities and differences between connective tissue types.
8. Explain the types of connective tissue found in the body and their characteristic functions.

Covering and Lining Membranes

9. Describe the structure and the function of cutaneous, mucous, and serous membranes.

Nervous Tissue

10. List the structure and function of nervous tissue.

Muscle Tissue

11. Compare and contrast the structure, location, and function of the three types of muscular tissue.

Tissue Repair

12. Discuss the process involved in normal tissue repair.

Developmental Aspects of Tissues

13. Discuss the embryonic origin of the different tissue types.
14. Explain the changes that occur in the tissues with age.

Lecture Outline

I. Introduction to Tissue (p. 118)

- A. Tissues are groups of cells that are similar in structure and function.
- B. There are four primary tissue types: epithelial (covering), connective (support), nervous (control), and muscular (movement).

II. Preparing Human Tissue for Microscopy (p. 118)

- A. Tissue specimens must be fixed (preserved) and sectioned (sliced) thinly enough to allow light transmission.
- 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.

III. Epithelial Tissue (pp. 118–126)

A. Features of Epithelia (p. 118)

1. An epithelium is a sheet of cells that covers a body surface or lines a cavity.
2. Epithelium occurs in the body as covering or lining epithelium, and as glandular epithelium.

B. Special Characteristics of Epithelium (pp. 118–119)

1. Composed of closely packed cells with little extracellular material between.
2. Adjacent epithelial cells are bound together by specialized contacts such as desmosomes and tight junctions.
3. Exhibits polarity by having an apical surface (free) and a basal surface (attached).
4. Supported by the underlying connective tissue.
5. Innervated but avascular.
6. Has a high regeneration capacity.

C. Classification of Epithelia (pp. 119–124; Figs. 4.1–4.2)

1. Each epithelial tissue is given two names.
 - a. The first name indicates the number of layers present, either simple (one) or stratified (more than one).
 - b. The second name describes the shape of the cells.
2. Simple epithelia are mostly concerned with absorption, secretion, and filtration.
 - a. Simple squamous epithelium is a single layer of fish scale-shaped cells.
 - b. Simple cuboidal epithelium is a single layer of cube-shaped cells forming the smallest ducts of glands and many kidney tubules.
 - c. Simple columnar epithelium is a single layer of column-shaped cells that line the digestive tract.
 - d. Pseudostratified columnar epithelium contains cells of varying heights giving the false impression of the presence of many layers.
3. Stratified epithelia's main function is protection.
 - a. Stratified squamous epithelium is composed of several layers with the cells on the free surface being squamous-shaped and the underlying cells being cuboidal or columnar in shape.
 - b. Stratified cuboidal epithelium is rare, found mostly in the ducts of some of the larger glands.
 - c. Stratified columnar epithelium is found in limited distribution with small amounts in the pharynx, male urethra, and lining some glandular ducts.
 - d. Transitional epithelium forms the lining of the hollow organs of the urinary system that stretch as they fill.

D. Glandular Epithelia (pp. 124–126; Figs. 4.3–4.5)

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. Exocrine glands may be unicellular or multicellular.
 - b. Exocrine secretions in humans may be merocrine, which are products released through exocytosis, or holocrine, which are synthesized products released when the cell ruptures.

IV. Connective Tissue (pp. 126–138)

A. Functions of Connective Tissue (pp. 126–127)

1. The major functions of connective tissue are binding and support, protection, insulation, and transportation.
- B. 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.
- C. Structural Elements of Connective Tissue (pp. 127–130; Fig. 4.3)
1. Ground substance is the unstructured material that fills the space between the cells and contains the 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.
 3. Each major class of connective tissue has a fundamental cell type that exists in immature and mature forms.
- D. Types of Connective Tissue (pp. 131–139; Figs. 4.6, 4.9)
1. Mesenchyme forms during the early weeks of embryonic development from the mesoderm layer and eventually differentiates into all other connective tissues.
 2. Loose connective tissue is one of the two subclasses of connective tissue proper.
 - a. Areolar connective tissue serves to bind body parts together while allowing them to move freely over one another, wraps small blood vessels and nerves, surrounds glands, and forms the subcutaneous tissue.
 - 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.
 3. Dense connective tissue is one of the two subclasses of connective tissue proper.
 - a. Dense regular connective tissue contains closely packed bundles of collagen fibers running in the same direction and makes up tendons and ligaments.
 - b. Dense irregular connective tissue contains thick bundles of collagen fibers arranged in an irregular fashion, and is found in the dermis.
 4. Cartilage 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 stretchability are needed, such as the external ear.
 - c. Fibrocartilage is found where strong support and the ability to withstand heavy pressure are required, such as the intervertebral disks.
 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 developed from mesenchyme, and consists of blood cells and plasma proteins surrounded by blood plasma.

V. Nervous Tissue (p. 139; Fig. 4.10)

- A. Nervous tissue is the main component of the nervous system, which regulates and controls body functions.
- B. Nervous tissue is composed of two types of cells.
 - 1. Neurons are specialized cells that generate and conduct electrical impulses.
 - 2. Supporting cells are nonconductive cells that support, insulate, and protect the neurons.

VI. Muscle Tissue (pp. 139–141; Fig. 4.11)

- A. Muscle tissues are highly cellular, well-vascularized tissues responsible for movement.
- B. There are three types of muscular tissue:
 - 1. Skeletal muscle attaches to the skeleton and produces voluntary body movement.
 - 2. Cardiac muscle is responsible for the involuntary movement of the heart.
 - 3. Smooth muscle is found in the walls of the hollow organs.

VII. Covering and Lining Membranes (pp. 141–143; Fig. 4.12)

- A. Cutaneous membrane, or skin, is an organ system consisting of a keratinized squamous epithelium firmly attached to a thick layer of dense irregular connective tissue (p. 138).
- B. Mucous membranes line body cavities that open to the exterior and contain either stratified squamous or simple columnar epithelia (pp. 141–142).
- C. Serous membranes consist of simple squamous epithelium resting on a thin layer of loose connective (areolar) tissue. (pp. 142–143)

VIII. Tissue Repair (pp. 143–145; Fig. 4.13)

- A. Tissue repair occurs in two ways: regeneration and fibrosis.
- B. Three steps are involved in the tissue repair process.
 - 1. Inflammation prepares the area for the repair process.
 - 2. Organization restores the blood supply.
 - 3. Regeneration and fibrosis effect permanent repair.
- C. The generative capacity of tissues varies widely among the tissue types.

IX. Developmental Aspects of Tissues (pp. 145–148)

- A. Embryonic and Fetal Development of Tissues (Fig. 4.14)
 - 1. Primary germ layer formation is one of the first events of embryonic development.
 - a. Ectoderm is the most superficial of the layers.
 - b. Mesoderm is the middle layer.
 - c. Endoderm is the deepest layer.
 - 2. The primary germ layers specialize to form the four primary tissues.
- B. With increasing age, epithelia become thin, the amount of collagen fibers in the body decreases, and bone, muscle, and nervous tissue atrophy.

Cross References

Additional information on topics covered in Chapter 4 can be found in the chapters listed below.

- 1. Chapter 1: The hierarchy of structural organization; divisions of the ventral body cavity

2. Chapter 5: The function of keratin in keratinized stratified squamous epithelium; cutaneous membrane (skin); function of the basement membrane in skin; role of connective tissues in the integument; exocrine glands found in the skin
3. Chapter 6: Osseous tissue and the structure and growth of bone; formation of osseous tissue; chondrocytes and cartilage in bone formation
4. Chapter 8: Connective tissues in ligaments and tendons; cartilage in joint formation
5. Chapter 9: Skeletal and smooth muscle; connective tissue coverings of muscles
6. Chapter 11: Nervous tissue
7. Chapter 13: Function of nervous tissue
8. Chapter 16: Ductless (endocrine) glands
9. Chapter 17: Blood
10. Chapter 18: Cardiac muscle; serous coverings of the heart, epithelium of the heart, and connective tissue in cardiac valves; function of nervous tissue
11. Chapter 19: Epithelial and connective tissue components of the blood vessels
12. Chapter 20: Interstitial fluid (generation and removal); reticular connective tissue support of lymphatic tissue
13. Chapter 21: Inflammatory and immune responses
14. Chapter 22: Cartilaginous support of respiratory structures; pseudostratified epithelium in the lining of the trachea
15. Chapter 23: Epithelial and secretory cells of the digestive tract
16. Chapter 25: Epithelial cell characteristics of filtration, secretion, and absorption

Laboratory Correlations

1. Marieb, E. N. *Human Anatomy & Physiology Laboratory Manual: Cat and Fetal Pig Versions*. Eighth Edition Updates. Benjamin Cummings, 2006.
Exercise 6A: Classification of Tissues
2. Marieb, E. N. *Human Anatomy & Physiology Laboratory Manual: Main Version*. Seventh Edition Update. Benjamin Cummings, 2006.
Exercise 6A: Classification of Tissues