

Figure 4.2b: Epithelial tissues.

(b) Simple cuboidal epithelium

Description: Single layer of cuboidal cells with large, spherical central nuclei.

Function: Secretion and absorption.

Location: Kidney tubules; ducts and secretory portions of small glands; ovary surface.

Photomicrograph: Simple cuboidal epithelium in kidney tubules (400x).

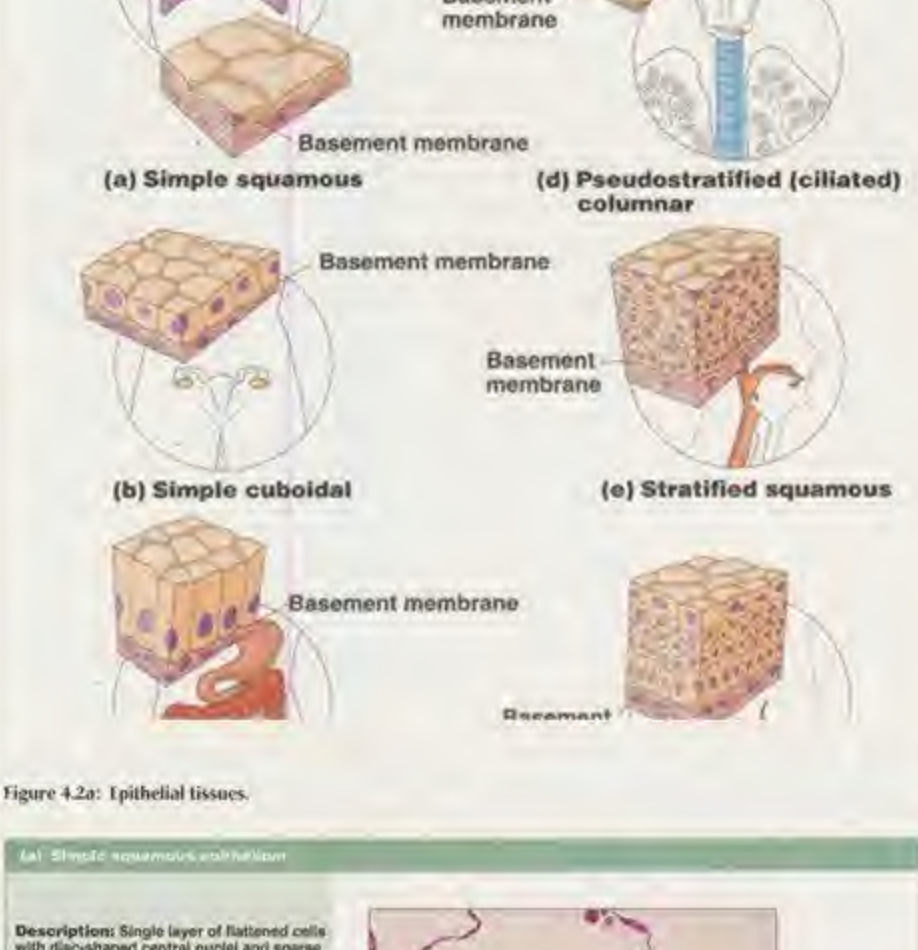


Figure 4.2a: Epithelial tissues.

(a) Simple squamous epithelium

Description: Single layer of flattened cells with disc-shaped central nuclei and sparse cytoplasm; the simplest of the epithelia.

Function: Allows passage of materials by diffusion and filtration in sites where secretion is not important; secretes lubricating substances in serosae.

Location: Kidney glomeruli; air sacs of lungs; lining of heart, blood vessels, and lymphatic vessels; lining of ventral body cavity (serosae).

Photomicrograph: Simple squamous epithelium forming part of the alveolar (air sac) walls (400x).

Figure 4.2c: Epithelial tissues.

(c) Simple columnar epithelium

Description: Single layer of tall cells with rounded or oval nuclei; some cells bear cilia; layer may contain mucin-secreting unicellular glands (goblet cells).

Function: Absorption; secretion of mucus, enzymes, and other substances; ciliated type propels mucus (for reproductive cells) by ciliary action.

Location: Nonciliated type lines most of the digestive tract (stomach to anal canal), gallbladder, and excretory ducts of some glands; ciliated variety lines small bronchi, uterine tubes, and some regions of the uterus.

Photomicrograph: Simple columnar epithelium of the stomach mucosa (1300x).

Figure 4.2e: Epithelial tissues.

(e) Stratified squamous epithelium

Description: Thick membrane composed of several cell layers; basal cells are cuboidal or columnar and metabolically active; surface cells are flattened (squamous); in the keratinized type, the surface cells are full of keratin and dead; basal cells are active in mitosis and produce the cells of the more superficial layers.

Function: Protects underlying tissues in areas subject to abrasion.

Location: Nonkeratinized type forms the moist linings of the esophagus, mouth, and vagina; keratinized variety forms the epidermis of the skin, a dry membrane.

Photomicrograph: Stratified squamous epithelium lining of the esophagus (300x).

Figure 4.2d: Epithelial tissues.

(d) Pseudostratified ciliated columnar epithelium

Description: Single layer of cells of differing heights, some not reaching the free surface; nuclei seen at different levels; may contain goblet cells and bear cilia.

Function: Secretion, particularly of mucus; propulsion of mucus by ciliary action.

Location: Nonciliated type in male's sperm-carrying ducts and ducts of large glands; ciliated variety lines the trachea, most of the upper respiratory tract.

Photomicrograph: Pseudostratified ciliated columnar epithelium lining the human trachea (400x).

Figure 4.2f: Epithelial tissues.

(f) Transitional epithelium

Description: Resembles both stratified squamous and stratified cuboidal; basal cells cuboidal or columnar; surface cells dome shaped or squamuloslike, depending on degree of organ stretch.

Function: Stretches readily and permits distension of urinary organ by contained urine.

Location: Lines the ureters, bladder, and part of the urethra.

Photomicrograph: Transitional epithelium lining of the bladder, relaxed state (200x); note the bulbous, or rounded, appearance of the cells at the surface; these cells flatten and become elongated when the bladder is filled with urine.

Figure 4.3a: Connective tissues.

(a) Embryonic mesenchyme

Description: Embryonic connective tissue; gel-like ground substance containing fibers, star-shaped mesenchymal cells.

Function: Gives rise to all other connective tissue types.

Location: Primarily in embryo.

Photomicrograph: Mesenchymal tissue, an embryonic connective tissue (600x); the clear-appearing background is the fluid ground substance of the matrix; notice the fine, sparse fibers.

Figure 4.3b: Connective tissues.

(b) Dense regular connective tissue

Description: Gel-like matrix with all three fiber types; cells: fibroblasts, macrophages, mast cells, and some white blood cells.

Function: Wraps and cushions organs; its macrophages phagocytose bacteria; plays important role in inflammation; holds and conveys tissue fluid.

Location: Widely distributed under epithelia of body, e.g., forms lamina propria of mucosae; packages organs; surrounds capsules.

Photomicrograph: Dense regular connective tissue, a soft packaging tissue of the body (600x).

Figure 4.3c: Connective tissues.

(c) Adipose tissue

Description: Matrix as in areolar, but very sparse; closely packed adipocytes, or fat cells, have nucleus pushed to the side by large fat droplet.

Function: Provides reserve food fuel; insulates against heat loss; supports and protects organs.

Location: Under skin; around kidneys and viscera; within abdomen; in breasts.

Photomicrograph: Adipose tissue from the subcutaneous layer under the skin (600x).

Figure 4.3d: Connective tissues.

(d) Reticular connective tissue

Description: Network of reticular fibers in a typical loose ground substance; reticular cells lie on the network.

Function: Fibers form a soft internal skeleton (stroma) that supports other cell types including white blood cells, mast cells, and macrophages.

Location: Lymphatic organs (lymph nodes, spleen, marrow, and spleen).

Photomicrograph: Dark-staining network of reticular connective tissue fibers forming the internal skeleton of the spleen (300x).

Figure 4.3e: Connective tissues.

(e) Dense regular connective tissue

Description: Primarily parallel collagen fibers; a few elastic fibers; major cell type is the fibroblast.

Function: Attaches muscles to bones or to muscle; attaches bones to bones; withstands great tensile stress when pulling force is applied in one direction.

Location: Tendons, most ligaments, aponeuroses.

Photomicrograph: Dense regular connective tissue from a tendon (1000x).

Figure 4.3f: Connective tissues.

(f) Dense irregular connective tissue

Description: Primarily irregularly arranged collagen fibers; some elastic fibers; major cell type is the fibroblast.

Function: Able to withstand tension exerted in many directions; provides structural strength.

Location: Dermis of the skin; submucosa of digestive tract; fibrous capsules of organs and of joints.

Photomicrograph: Dense irregular connective tissue from the dermis of the skin (600x).

Figure 4.3g: Connective tissues.

(g) Hyaline cartilage

Description: Amorphous but firm matrix; collagen fibers form an imperceptible network; chondroblasts produce the matrix and when mature (chondrocytes) lie in lacunae.

Function: Supports and reinforces; has resilient cushioning properties; resists compressive stress.

Location: Forms most of the embryonic skeleton; covers the ends of long bones in joint cavities; forms costal cartilages of the ribs; cartilages of the nose, trachea, and larynx.

Photomicrograph: Hyaline cartilage from the trachea (200x).

Figure 4.3h: Connective tissues.

(h) Elastic cartilage

Description: Similar to hyaline cartilage, but more elastic fibers in matrix.

Function: Maintains the shape of a structure while allowing great flexibility.

Location: Supports the external ear (pinna); epiglottis.

Photomicrograph: Elastic cartilage from the human ear pinna; forms the flexible skeleton of the ear (400x).

Figure 4.3i: Connective tissues.

(i) Fibrocartilage

Description: Matrix similar to but less firm than that in hyaline cartilage; thick collagen fibers predominate.

Function: Tensile strength with the ability to absorb compressive stress.

Location: Intervertebral discs; pubic symphysis; discs of knee joint.

Photomicrograph: Fibrocartilage of an intervertebral disc (200x).

Figure 4.3j: Connective tissues.

(j) Osseous tissue (compact bone)

Description: Hard, calcified matrix containing many collagen fibers; osteocytes lie in lacunae. Very well vascularized.

Function: Bone supports and protects (by enclosing); provides levers for the muscles to act on; stores calcium and other minerals and fat; mineral salts (hydroxyapatite).

Location: Bones.

Photomicrograph: Cross-sectional view of bone (70x).

Figure 4.3k: Connective tissues.

(k) Blood

Description: Red and white blood cells in a fluid matrix (plasma).

Function: Transport of respiratory gases, nutrients, wastes and other substances.

Location: Contained within blood vessels.

Photomicrograph: Smear of human blood (1500x); two white blood cells (neutrophil in upper left and lymphocyte in lower right) are seen surrounded by red blood cells.

Figure 4.5: Major classes of connective tissue

Common embryonic origin	Mesenchyme			
Cellular descendants	Fibroblast	Chondroblast	Osteoblast	Hematopoietic stem cell
	Fibrocyte	Chondrocyte	Osteocyte	Blood cells (and macrophages)
Class of connective tissue resulting	Connective tissue proper	Cartilage	Osteons (bone)	Blood
Subclasses	1. Loose connective tissue Types: Areolar, Reticular 2. Dense connective tissue Types: Regular, Elastic	1. Hyaline cartilage 2. Fibrocartilage 3. Elastic cartilage	1. Compact bone 2. Spongy (cancellous) bone	* Blood cell formation and differentiation are major topics. Details are provided in Chapter 17.

Figure 4.1a: Muscle tissues.

(a) Smooth muscle

Description: Long, cylindrical, multinucleated cells; obvious striations.

Function: Voluntary movement; locomotion; manipulation of the environment; facial expression; voluntary control.

Location: In skeletal muscle attached to bones or occasionally to skin.

Photomicrograph: Skeletal muscle (approx. 300x). Notice the obvious banding pattern and the fact that these large cells are multinucleated.

Figure 4.1b: Muscle tissues.

(b) Cardiac muscle

Description: Branching striated, generally uninucleate cells that interdigitate at specialized junctions (intercalated discs).

Function: As it contracts, it pumps blood into the circulation; involuntary control.

Location: The walls of the heart.

Photomicrograph: Cardiac muscle (800x); notice the striations, branching of cells, and the intercalated discs.

Figure 4.1c: Muscle tissues.

(c) Smooth muscle

Description: Spindle-shaped cells with central nuclei; no striations; cells arranged closely to form sheets.

Function: Propels substances or objects (foodstuffs, urine, a baby) along internal passageways; involuntary control.

Location: Mostly in the walls of hollow organs.

Photomicrograph: Sheet of smooth muscle (approx. 600x).

Figure 4.1d: Muscle tissues.

(d) Skeletal muscle

Description: Long, cylindrical, multinucleated cells; obvious striations.

Function: Voluntary movement; locomotion; manipulation of the environment; facial expression; voluntary control.

Location: In skeletal muscle attached to bones or occasionally to skin.

Photomicrograph: Skeletal muscle (approx. 300x). Notice the obvious banding pattern and the fact that these large cells are multinucleated.

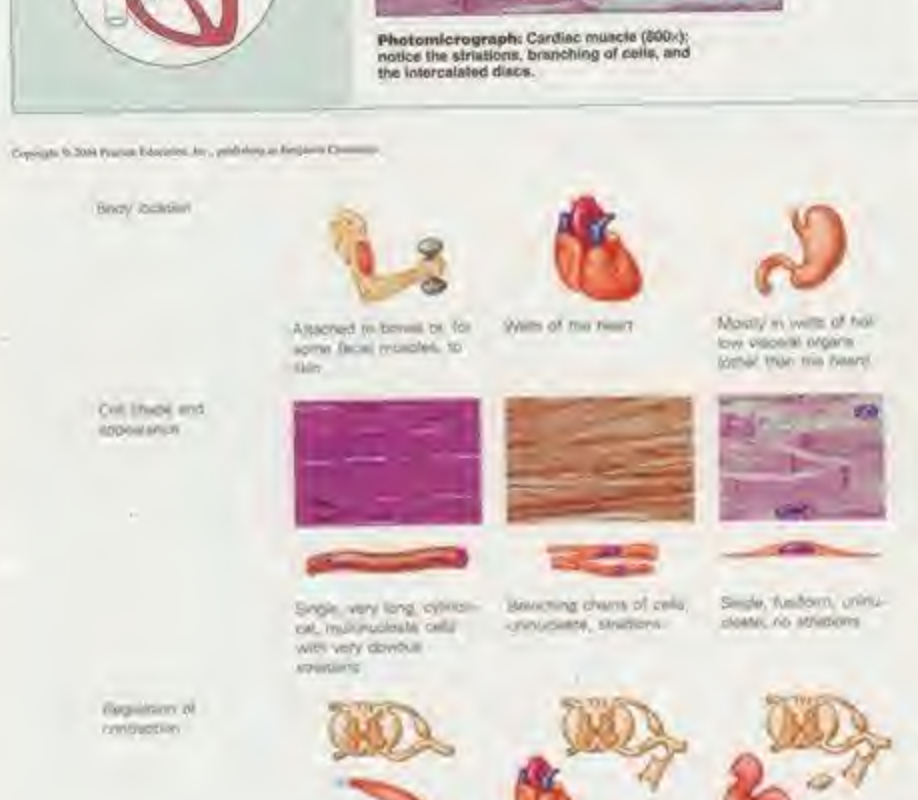


Figure 4.3: Types of multicellular exocrine glands.

Common embryonic origin	Mesenchyme			
Cellular descendants	Fibroblast	Chondroblast	Osteoblast	Hematopoietic stem cell
	Fibrocyte	Chondrocyte	Osteocyte	Blood cells (and macrophages)
Class of connective tissue resulting	Connective tissue proper	Cartilage	Osteons (bone)	Blood
Subclasses	1. Loose connective tissue Types: Areolar, Reticular 2. Dense connective tissue Types: Regular, Elastic	1. Hyaline cartilage 2. Fibrocartilage 3. Elastic cartilage	1. Compact bone 2. Spongy (cancellous) bone	* Blood cell formation and differentiation are major topics. Details are provided in Chapter 17.