Tissues

- Groups of cells similar in structure and function
- The four types of tissues
  - Epithelial
  - Connective
  - Muscle
  - Nerve

Epithelial Tissue

- **Cellularity** – composed almost entirely of cells
- **Special contacts** – form continuous sheets held together by tight junctions and desmosomes
- **Polarity** – apical and basal surfaces
- **Supported by connective tissue** – reticular and basal laminae
- **Avascular but innervated** – contains no blood vessels but supplied by nerve fibers
- **Regenerative** – rapidly replaces lost cells by cell division

Classification of Epithelia

- Simple or stratified

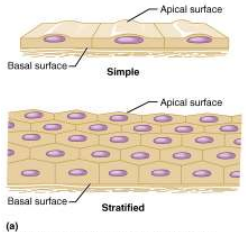

Figure 4.1a

Classification of Epithelia

- Squamous, cuboidal, or columnar

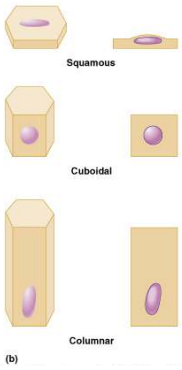

Figure 4.1b

Epithelia: Simple Squamous

- Single layer of flattened cells with disc-shaped nuclei and sparse cytoplasm
- Functions
  - Diffusion and filtration
  - Provide a slick, friction-reducing lining in lymphatic and cardiovascular systems
- Present in the kidney glomeruli, lining of heart, blood vessels, lymphatic vessels, and serosae

Epithelia: Simple Squamous

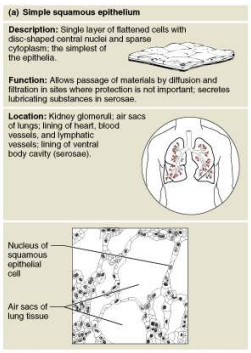

Figure 4.2a

Epithelia: Simple Cuboidal

- Single layer of cubelike cells with large, spherical central nuclei
- Function in secretion and absorption
- Present in kidney tubules, ducts and secretory portions of small glands, and ovary surface

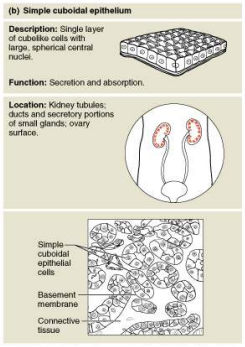

Figure 4.2b

Epithelia: Simple Columnar

- Single layer of tall cells with oval nuclei; many contain cilia
- Goblet cells are often found in this layer
- Function in absorption and secretion
- Nonciliated type line digestive tract and gallbladder
- Ciliated type line small bronchi, uterine tubes, and some regions of the uterus

Epithelia: Simple Columnar

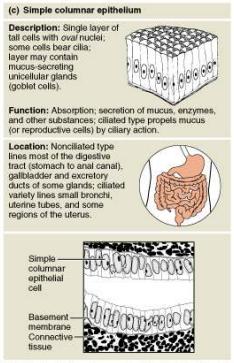

Figure 4.2c

Epithelia: Pseudostratified Columnar

- Single layer of cells with different heights; some do not reach the free surface
- Nuclei are seen at different layers
- Function in secretion and propulsion of mucus
- Present in the male sperm-carrying ducts (nonciliated) and trachea (ciliated)

Epithelia: Pseudostratified Columnar

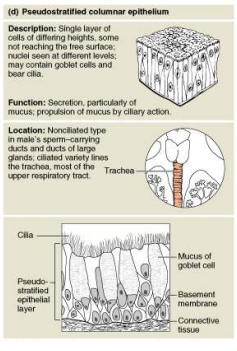

Figure 4.2d

Epithelia: Stratified Squamous

- Thick membrane composed of several layers of cells
- Function in protection of underlying areas subjected to abrasion
- Forms the external part of the skin's epidermis (keratinized cells), and linings of the esophagus, mouth, and vagina (nonkeratinized cells).

Epithelia: Stratified Squamous

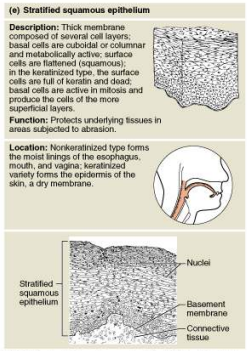

Figure 4.2e

Epithelia: Stratified Columnar

- Several cell layers with cuboidal basal cells and columnar superficial cells
- Functions in protection and secretion
- Present in large ducts of some glands, and in portions of the male urethra

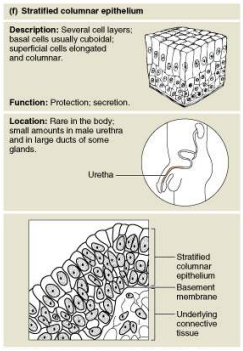

Figure 4.2f

Epithelia: Transitional

- Several cell layers, basal cells are cuboidal, surface cells are dome shaped
- Stretches to permit the distension of the urinary bladder
- Lines the urinary bladder, ureters, and part of the urethra

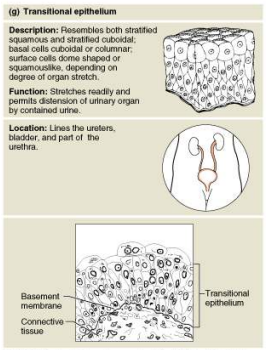

Figure 4.2g

Glandular Epithelia

- A gland is one or more cells that makes and secretes an aqueous fluid
- Classified by:
  - Site of product release – endocrine or exocrine
  - Relative number of cells forming the gland – unicellular or multicellular

Endocrine Glands

- Ductless glands that produce hormones
- Secretions include amino acids, proteins, glycoproteins, and steroids

Exocrine Glands

- More numerous than endocrine glands
- Secrete their products onto body surfaces (skin) or into body cavities
- Examples include mucous, sweat, oil, and salivary glands
- The only important unicellular gland is the goblet cell
- Multicellular exocrine glands are composed of a duct and secretory unit

Multicellular Exocrine Glands

- Classified according to:
  - Simple or compound duct type
  - Structure of their secretory units

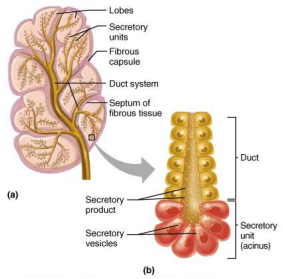

Figure 4.3

Structural Classification of Multicellular Exocrine Glands

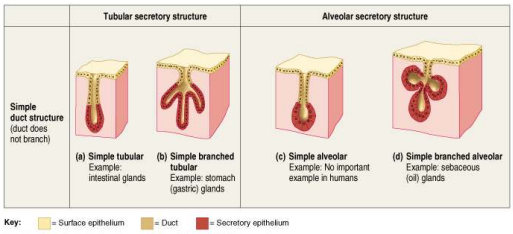

Figure 4.4a-d

Structural Classification of Multicellular Exocrine Glands

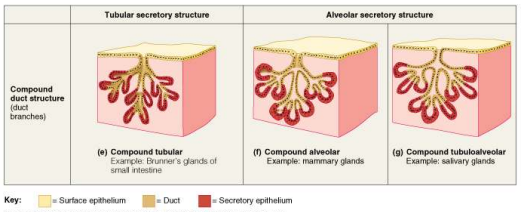

Figure 4.4e-g

Modes of Secretion

- Merocrine – products are secreted by exocytosis (e.g., pancreas, sweat, and salivary glands)
- Holocrine – products are secreted by the rupture of gland cells (e.g., sebaceous glands)

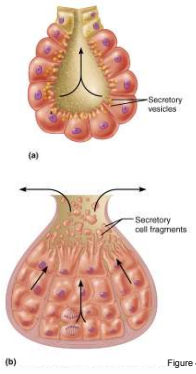

Figure 4.5

Connective Tissue

- Found throughout the body; most abundant and widely distributed in primary tissues
- Connective tissue proper
- Cartilage
- Bone
- Blood

Connective Tissue

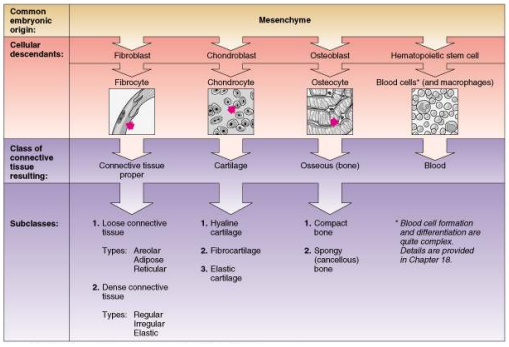

Figure 4.6

Functions of Connective Tissue

- Binding and support
- Protection
- Insulation
- Transportation

Characteristics of Connective Tissue

- Connective tissues have:
  - Mesenchyme as their common tissue of origin
  - Varying degrees of vascularity
  - Nonliving extracellular matrix, consisting of ground substance and fibers

Structural Elements of Connective Tissue

- Ground substance – unstructured material that fills the space between cells
- Fibers – collagen, elastic, or reticular
- Cells – fibroblasts, chondroblasts, osteoblasts, and hematopoietic stem cells

Ground Substance

- Interstitial (tissue) fluid
- Adhesion proteins – fibronectin and laminin
- Proteoglycans – glycosaminoglycans (GAGs)
- Functions as a molecular sieve through which nutrients diffuse between blood capillaries and cells

Fibers

- Collagen – tough; provides high tensile strength
- Elastic – long, thin fibers that allow for stretch
- Reticular – branched collagenous fibers that form delicate networks

Chapter 4

Tissue: The Living Fabric

Part C

Connective Tissue: Fundamental Cell Type

- Fibroblasts – connective tissue proper
- Chondroblasts – cartilage
- Osteoblasts – bone
- Hematopoietic stem cells – blood
- White blood cells (WBCs), plasma cells, macrophages, and mast cells

Connective Tissue (CT): Embryonic

- Mesenchyme – embryonic CT
  - Gel-like ground substance with fibers and star-shaped mesenchymal cells
  - Gives rise to all other connective tissues
  - Found in the embryo

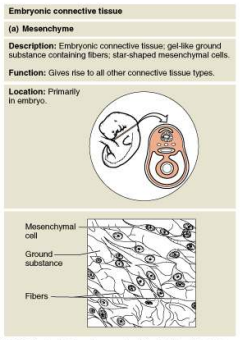

Figure 4.8a

Connective Tissue Proper: Loose

- Areolar CT
  - Gel-like matrix with all three CT fibers
  - Fibroblasts, macrophages, mast cells, and some WBCs
  - Wraps and cushions organs
  - Widely distributed throughout the body

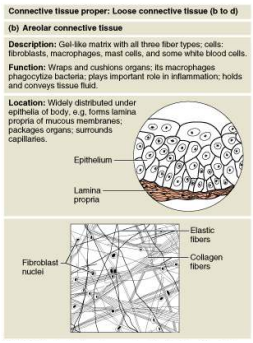

Figure 4.8b

Connective Tissue Proper: Loose

- Adipose CT
  - Matrix similar to areolar CT with closely packed adipocytes
  - Reserve food stores, insulates against heat loss, and supports and protects
  - Found under skin, around kidneys, within abdomen, and in breasts

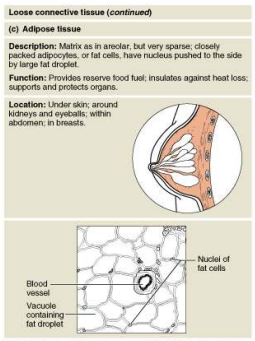

Figure 4.8c

Connective Tissue Proper: Loose

- Reticular CT
  - Loose ground substance with reticular fibers
  - Reticular cells lie in a fiber network
  - Forms a soft internal skeleton, or stroma, that supports other cell types
  - Found in lymph nodes, bone marrow, and the spleen

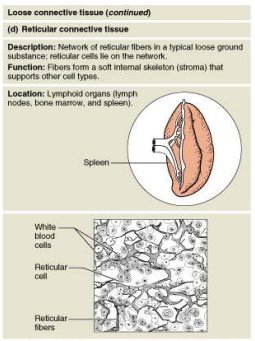

Figure 4.8d

Connective Tissue Proper: Dense Regular

- Parallel collagen fibers with a few elastic fibers
- Major cell type is fibroblasts
- Attaches muscles to bone or to other muscles, and bone to bone
- Found in tendons, ligaments, and aponeuroses

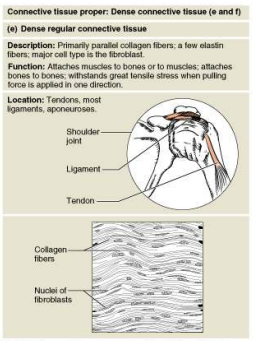

Figure 4.8e

Connective Tissue Proper: Dense Irregular

- Irregularly arranged collagen fibers with some elastic fibers
- Major cell type is fibroblasts

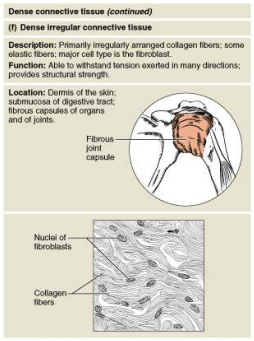

Figure 4.8f

Connective Tissue Proper: Dense Irregular

- Withstands tension in many directions providing structural strength
- Found in the dermis, submucosa of the digestive tract, and fibrous organ capsules

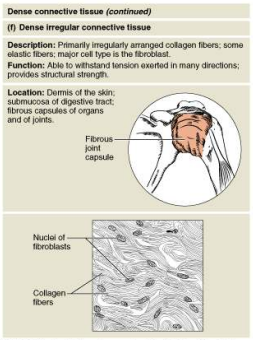

Figure 4.8f

Chapter 4

Tissue: The Living Fabric

Part D

Connective Tissue: Cartilage

- Hyaline cartilage
  - Amorphous, firm matrix with imperceptible network of collagen fibers
  - Chondrocytes lie in lacunae
  - Supports, reinforces, cushions, and resists compression

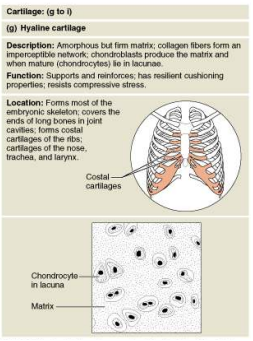

Figure 4.8g

Connective Tissue: Cartilage

- Forms the costal cartilage
- Found in: embryonic skeleton, the end of long bones, nose, trachea, and larynx

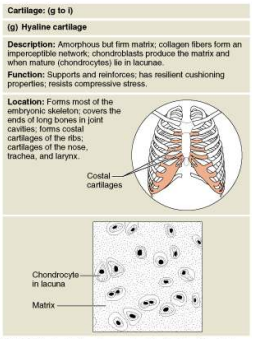

Figure 4.8g

Connective Tissue: Cartilage

- Elastic cartilage
  - Similar to hyaline cartilage but with more elastic fibers
  - Maintains shape and structure while allowing flexibility
  - Supports external ear (pinna) and the epiglottis

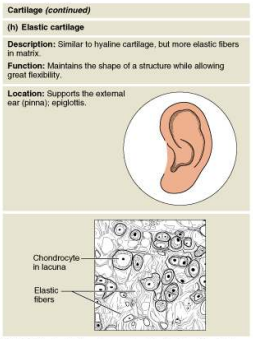

Figure 4.8h

Connective Tissue: Cartilage

- Fibrocartilage
  - Matrix similar to hyaline cartilage but less firm with thick collagen fibers
  - Provides tensile strength and absorbs compression shock
  - Found in intervertebral discs, the pubic symphysis, and in discs of the knee joint

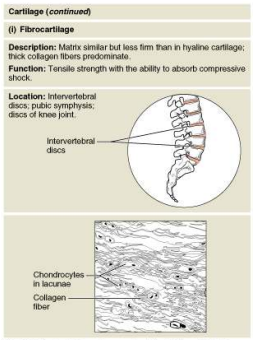

Figure 4.8i

Connective Tissue: Bone (Osseous Tissue)

- Osseous tissue
  - Hard, calcified matrix with collagen fibers found in bone
  - Osteocytes are found in lacunae and are well vascularized

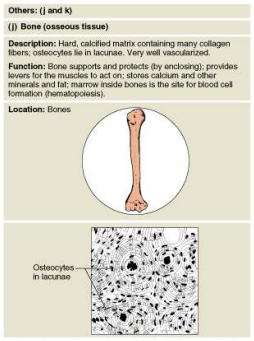

Figure 4.8j

Connective Tissue: Bone (Osseous Tissue)

- Supports, protects, and provides levers for muscular action
- Stores calcium, minerals, and fat
- Marrow inside bones is the site of hematopoiesis

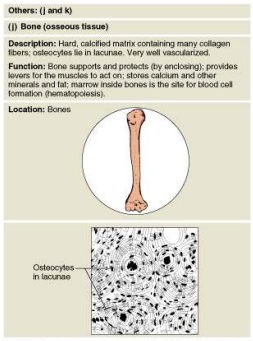

Figure 4.8j

Connective Tissue: Blood

- Blood
  - Red and white cells in a fluid matrix (plasma)
  - Contained within blood vessels
  - Functions in the transport of respiratory gases, nutrients, and wastes

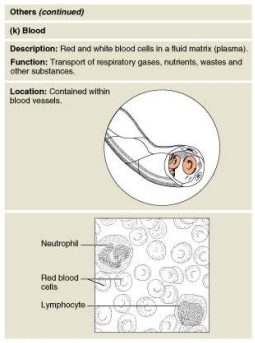

Figure 4.8k

Epithelial Membranes

- Cutaneous – skin

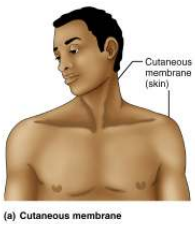

Figure 4.9a

Epithelial Membranes

- Mucous – lines body cavities open to the exterior (e.g., digestive and respiratory tracts)
- Serous – moist membranes found in closed ventral body cavity

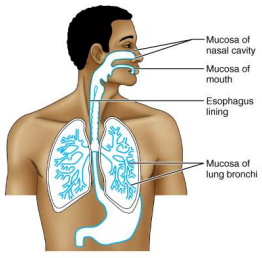

Figure 4.9b

Epithelial Membranes

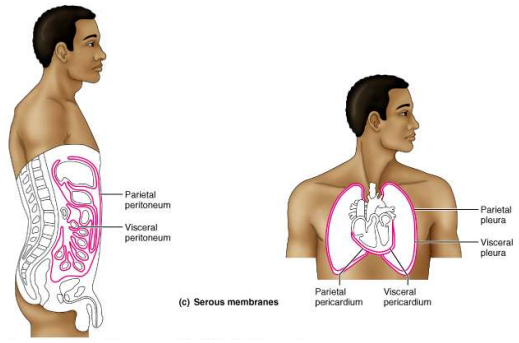

Figure 4.9c

Chapter 4

Tissue: The Living Fabric

Part E

Nervous Tissue

- Branched neurons with long cellular processes and support cells
- Transmits electrical signals from sensory receptors to effectors
- Found in the brain, spinal cord, and peripheral nerves

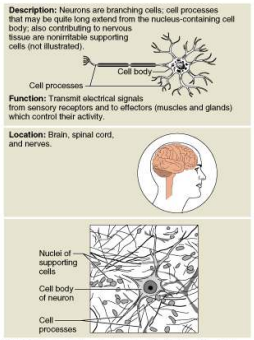

Figure 4.10

Muscle Tissue: Skeletal

- Long, cylindrical, multinucleate cells with obvious striations
- Initiates and controls voluntary movement
- Found in skeletal muscles that attach to bones or skin

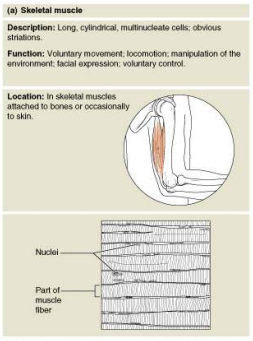

Figure 4.11a

Muscle Tissue: Cardiac

- Branching, striated, uninucleate cells interdigitating at intercalated discs
- Propels blood into the circulation
- Found in the walls of the heart

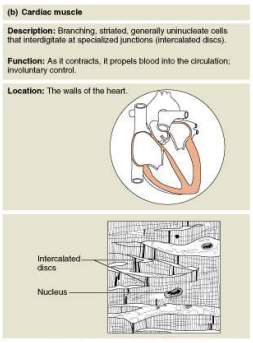

Figure 4.11b

Muscle Tissue: Smooth

- Sheets of spindle-shaped cells with central nuclei that have no striations
- Propels substances along internal passageways (i.e., peristalsis)
- Found in the walls of hollow organs

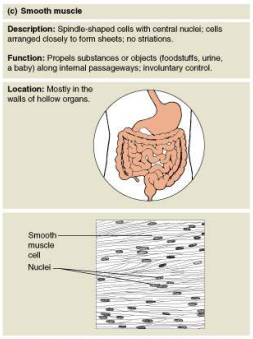

Figure 4.11c

Tissue Trauma

- Causes inflammation, characterized by:
  - Dilation of blood vessels
  - Increase in vessel permeability
  - Redness, heat, swelling, and pain

Tissue Repair

- Organization and restored blood supply
  - The blood clot is replaced with granulation tissue
- Regeneration and fibrosis
  - Surface epithelium regenerates and the scab detaches

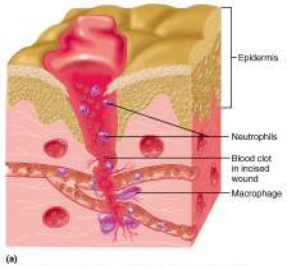

Figure 4.12a

Tissue Repair

- Fibrous tissue matures and begins to resemble the adjacent tissue

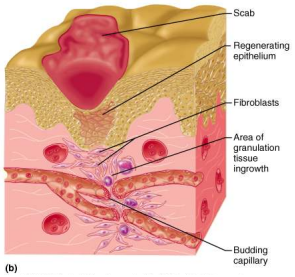

Figure 4.12b

Tissue Repair

- Results in a fully regenerated epithelium with underlying scar tissue

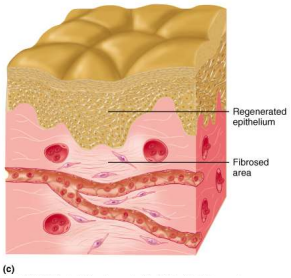

Figure 4.12c