Body Tissues

- Tissues
  - Groups of cells with similar structure and function
  - Four primary types:
    1. Epithelial tissue (epithelium).
    2. Connective tissue.
    3. Muscle tissue.
    4. Nervous tissue.

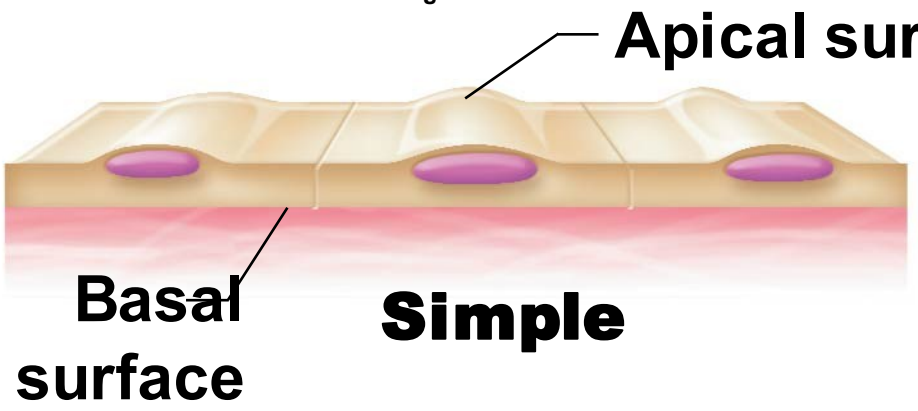
Epithelial Tissues

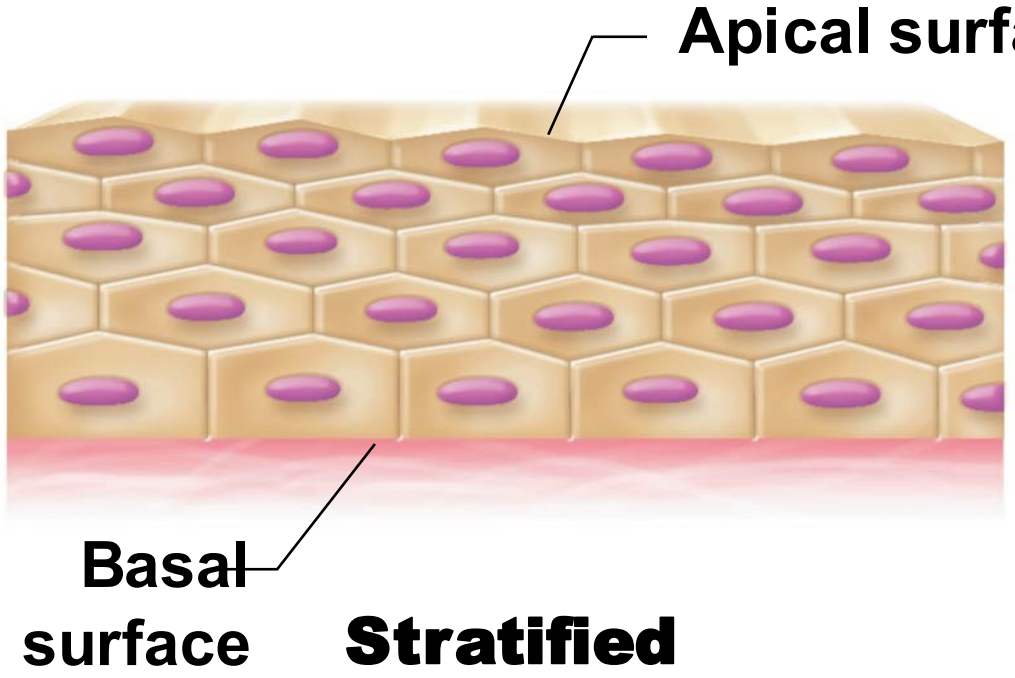
- Locations:
  - Body coverings–
  - Body linings–
  - Glandular tissue–
- Functions:
  - Protection–
  - Absorption–
  - Filtration–
  - Secretion–

Epithelium Characteristics

- Cells fit closely together and often form sheets
- The apical surface is the free surface of the tissue
- The lower surface of the epithelium rests on a basement membrane
- Avascular (no blood supply)
- Regenerate easily if well nourished

Figure 3.17a Classification and functions of epithelia.



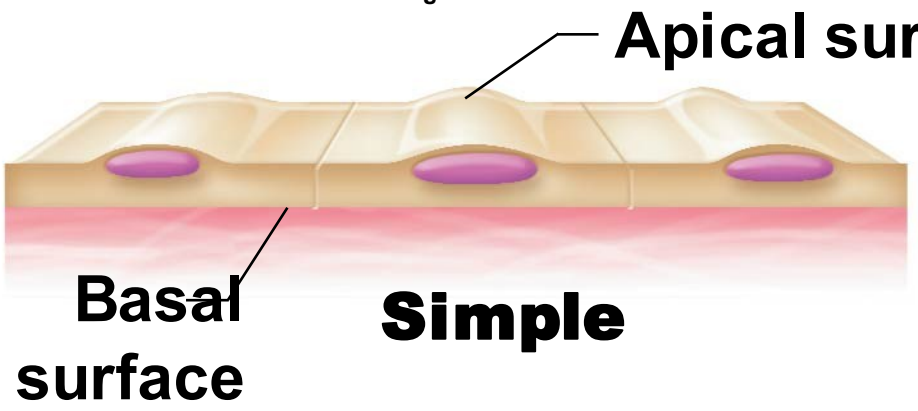


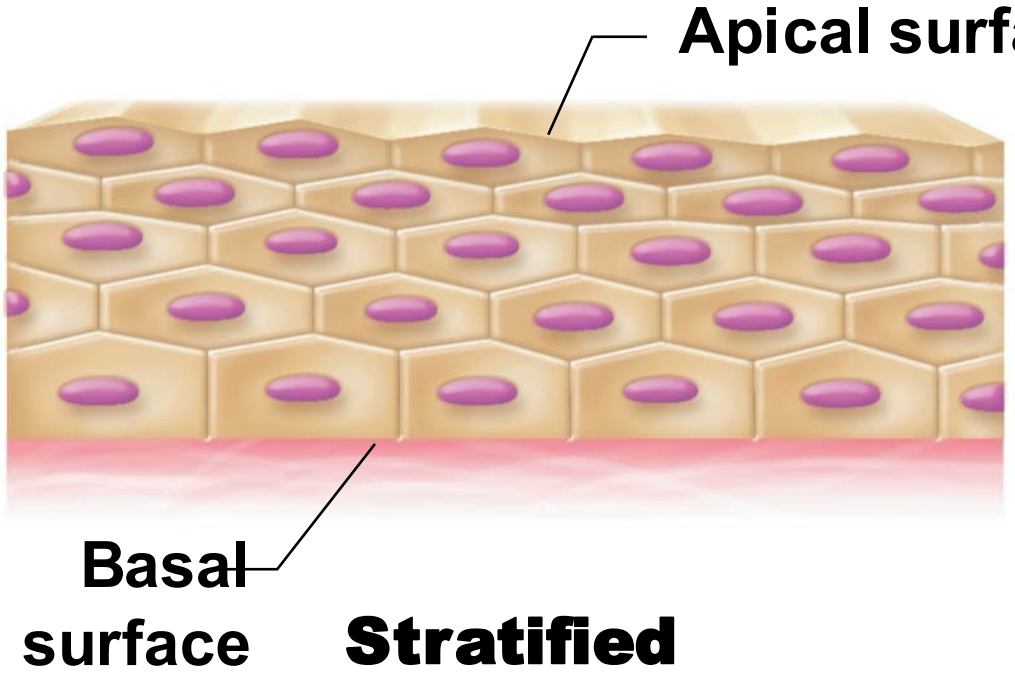
(a) Classification based on number of cell layers

Classification of Epithelia

- Number of cell layers
  - Simple—one layer
  - Stratified—more than one layer

Figure 3.17a Classification and functions of epithelia.



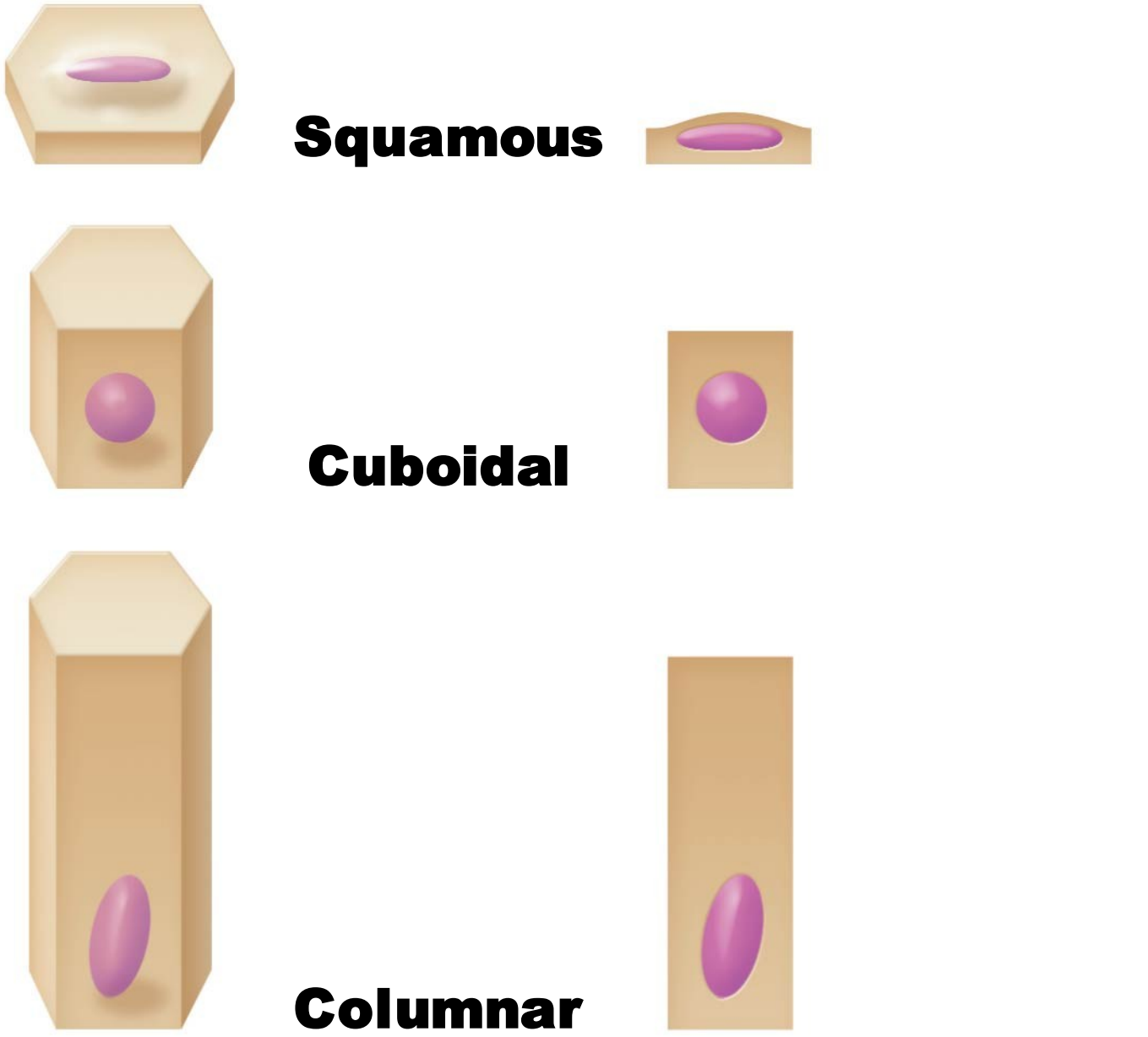


(a) Classification based on number of cell layers

Classification of Epithelia

- Shape of cells
  - Squamous—Flattened, like fish scales
  - Cuboidal—Cube-shaped, like dice
  - Columnar—Column-like

Figure 3.17b Classification and functions of epithelia.



(b) Classification based on cell shape

Figure 3.17c Classification and functions of epithelia.

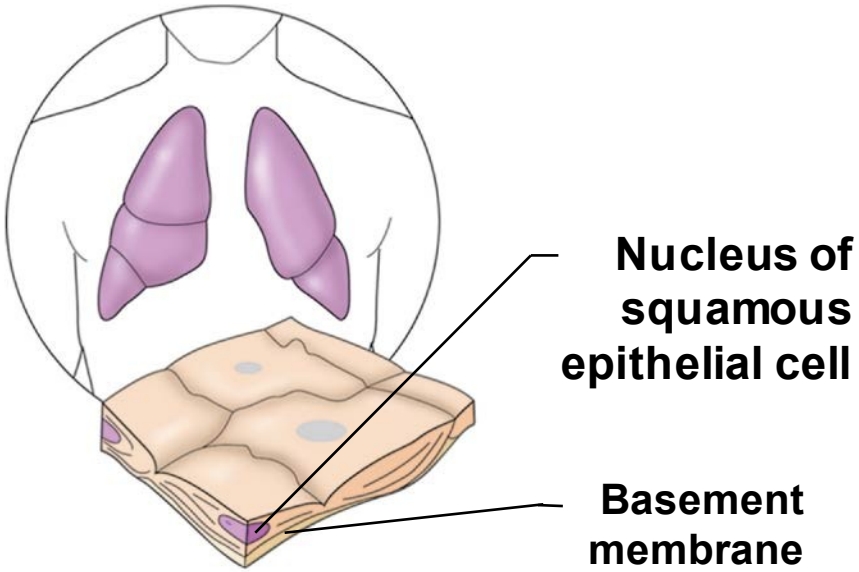
Cell shape	Number of layers	
	One layer: simple epithelial tissues	More than one layer: stratified epithelial tissues
Squamous	Diffusion and filtration Secretion in serous membranes	Protection
Cuboidal	Secretion and absorption; ciliated types propel mucus or reproductive cells	Protection; these tissue types are rare in humans
Columnar	Secretion and absorption; ciliated types propel mucus or reproductive cells	
Transitional		Protection; stretching to accommodate distension of urinary structures

(c) Function of epithelial tissue related to tissue type

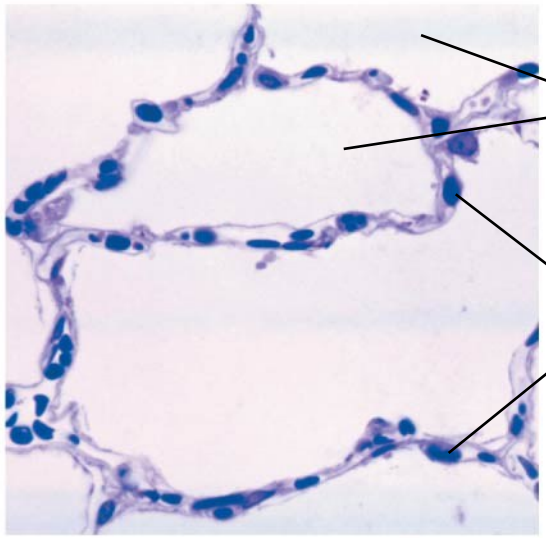
Simple Epithelia

- Simple squamous
  - Single layer of flat cells
  - Location—usually forms membranes
    - Lines air sacs of the lungs
    - Forms walls of capillaries
    - Forms serous membranes (serosae) that line and cover organs in ventral cavity
  - Functions in diffusion, filtration, or secretion in membranes

Figure 3.18a Types of epithelia and their common locations in the body.



(a) Diagram: Simple squamous

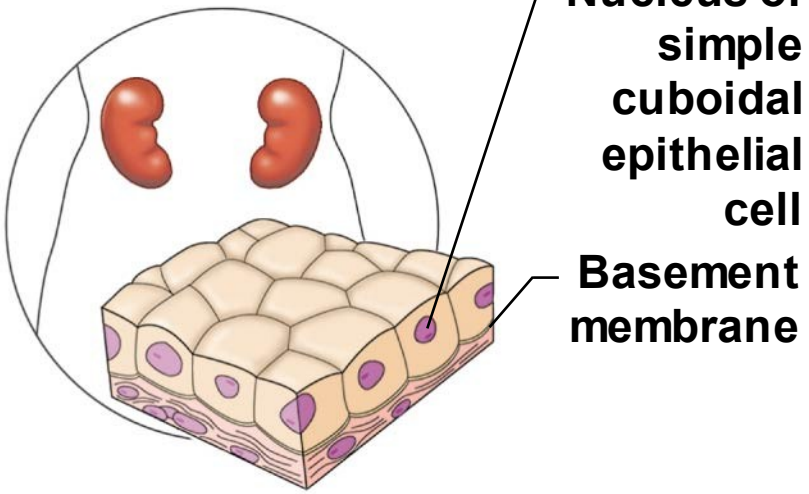


Photomicrograph: Simple squamous epithelium forming part of the alveolar (air sac) walls (275×).

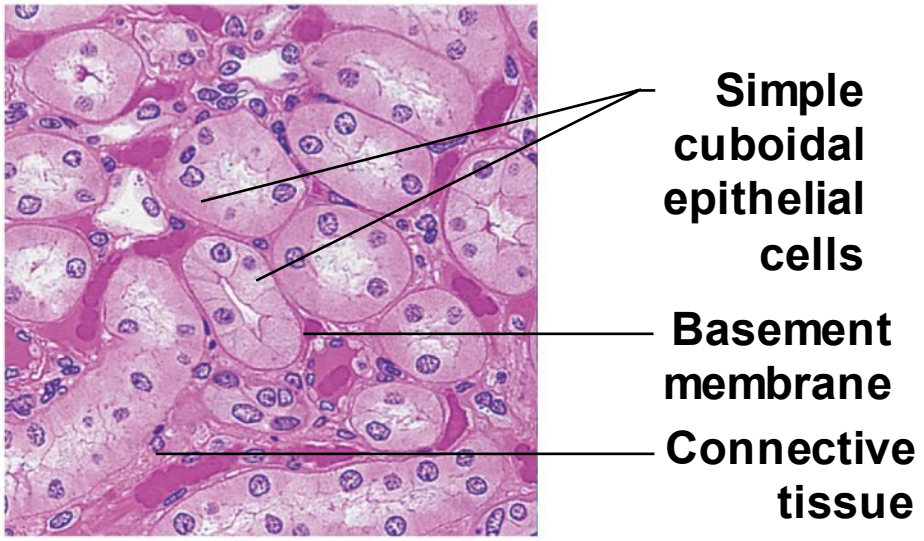
Simple Epithelia

- Simple cuboidal
  - Single layer of cube-like cells
  - Locations:
    - Common in glands and their ducts
    - Forms walls of kidney tubules
    - Covers the surface of ovaries
  - Functions in secretion and absorption; ciliated types propel mucus or reproductive cells

Figure 3.18b Types of epithelia and their common locations in the body.



(b) Diagram: Simple cuboidal

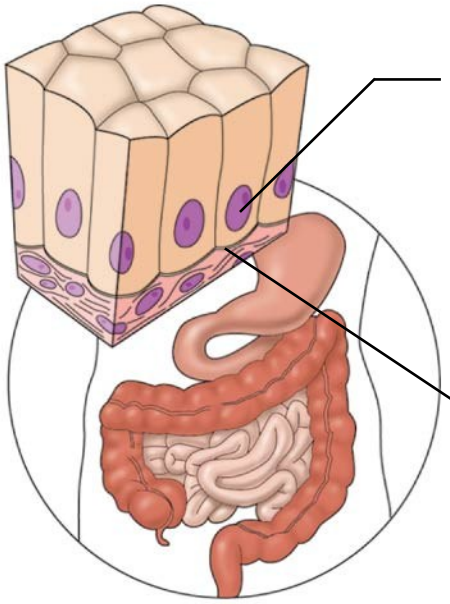


Photomicrograph: Simple cuboidal epithelium in kidney tubules (250 ×).

Simple Epithelia

- Simple columnar
  - Single layer of tall cells
  - Goblet cells secrete mucus
  - Location:
    - Lines digestive tract from stomach to anus
    - Mucous membranes (mucosae) line body cavities opening to the exterior
  - Functions in secretion and absorption; ciliated types propel mucus or reproductive cells

Figure 3.18c Types of epithelia and their common locations in the body.



(c) Diagram: Simple columnar

Photomicrograph: Simple columnar epithelium of the small intestine (575 ×).

Simple Epithelia

- Pseudostratified columnar
  - All cells rest on a basement membrane
  - Single layer, but some cells are shorter than others – giving a false (pseudo) impression of stratification
  - Location:
    - Respiratory tract, where it is ciliated and known as pseudostratified ciliated columnar epithelium
  - Functions in absorption or secretion

Connective Tissue

- Found everywhere in the body
- Includes the most abundant and widely distributed tissues
- Functions:
  - Provides protection
  - Binds body tissues together
  - Supports the body

Connective Tissue Characteristics

- Variations in blood supply
  - Some tissue types are well vascularized
  - Some have a poor blood supply or are avascular
- Extracellular matrix
  - Nonliving material that surrounds living cells

Extracellular Matrix

- Two main elements
  1. Ground substance—mostly water along with adhesion proteins and polysaccharide molecules
  2. Fibers.
- Produced by the cells
- Three types:
  1. Collagen (white) fibers.
  2. Elastic (yellow) fibers.
  3. Reticular fibers (a type of collagen).

Connective Tissue Types

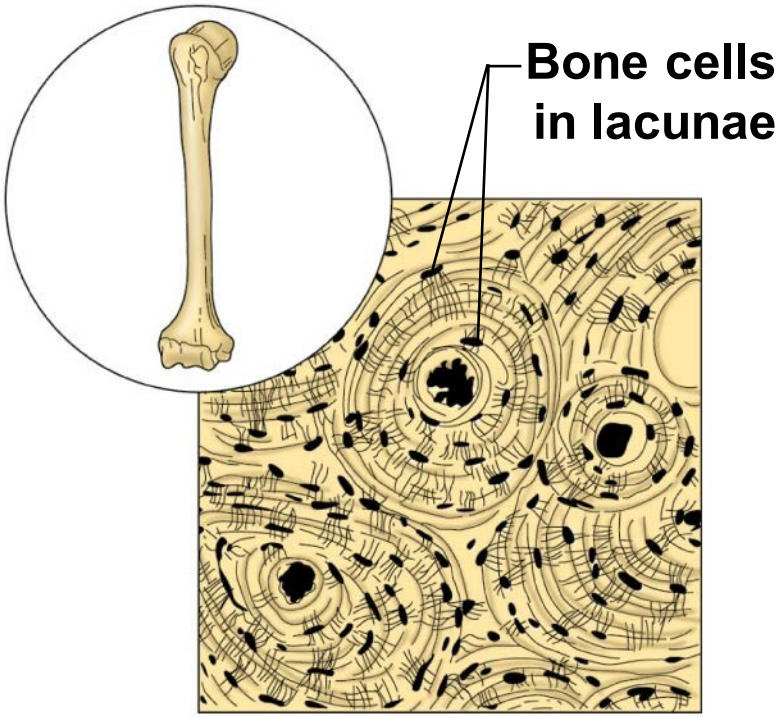
From most rigid to softest, or most fluid:

- Bone–
- Cartilage–
- Dense connective tissue–
- Loose connective tissue–
- Blood–

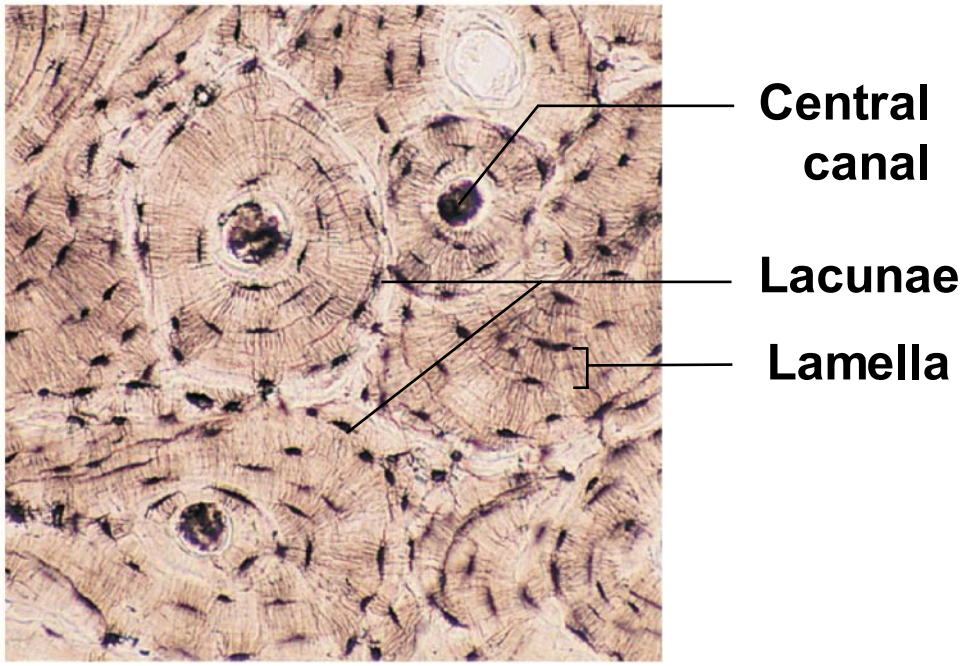
Connective Tissue Types

- Bone (osseous tissue)
  - Composed of:
    - Osteocytes (bone cells) sitting in lacunae (cavities)
    - Hard matrix of calcium salts
    - Large numbers of collagen fibers
  - Functions to protect and support the body

Figure 3.19a Connective tissues and their common body locations.



(a) Diagram: Bone



Photomicrograph: Cross-sectional view of ground bone (165×)

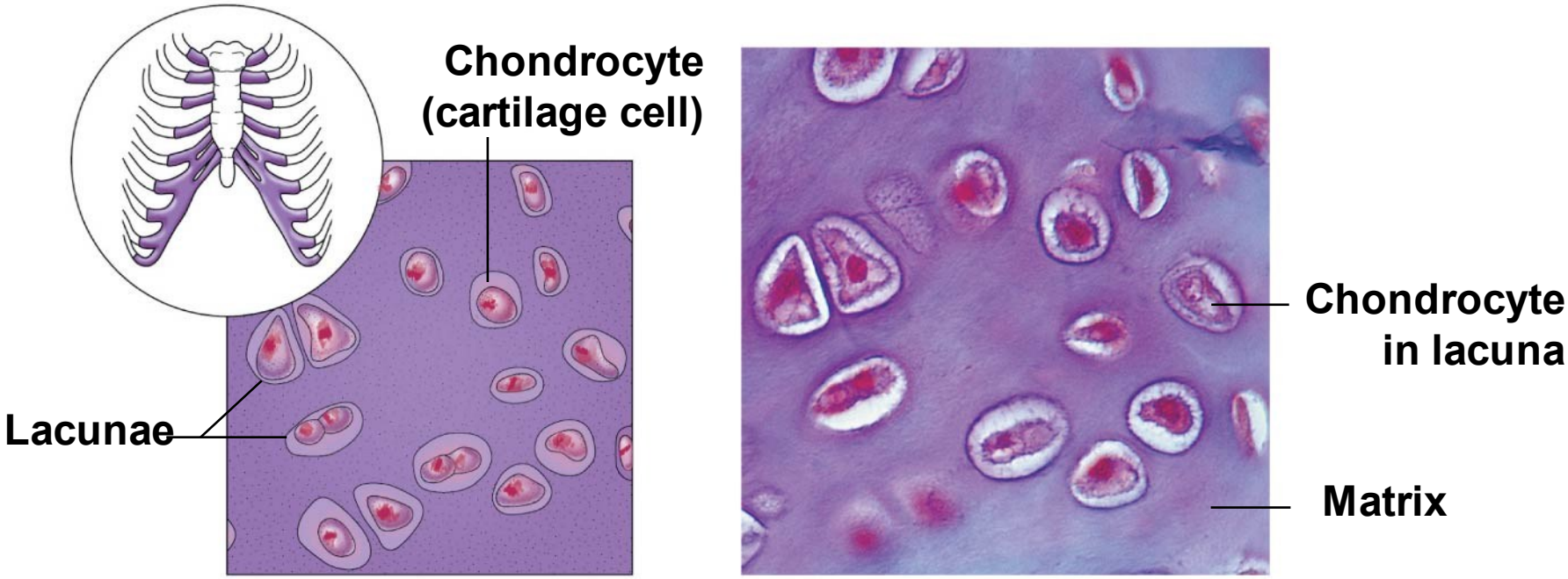
Connective Tissue Types

- Cartilage
  - Less hard and more flexible than bone
  - Found in only a few places in the body
  - Chondrocyte (cartilage cell) is the major cell type

Connective Tissue Types

- Hyaline cartilage
  - Hyaline cartilage is the most widespread type of cartilage
  - Composed of abundant collagen fibers and a rubbery matrix
  - Locations:
    - Larynx
    - Entire fetal skeleton prior to birth
    - Epiphyseal plates
  - Functions as a more flexible skeletal element than bone

Figure 3.19b Connective tissues and their common body locations.



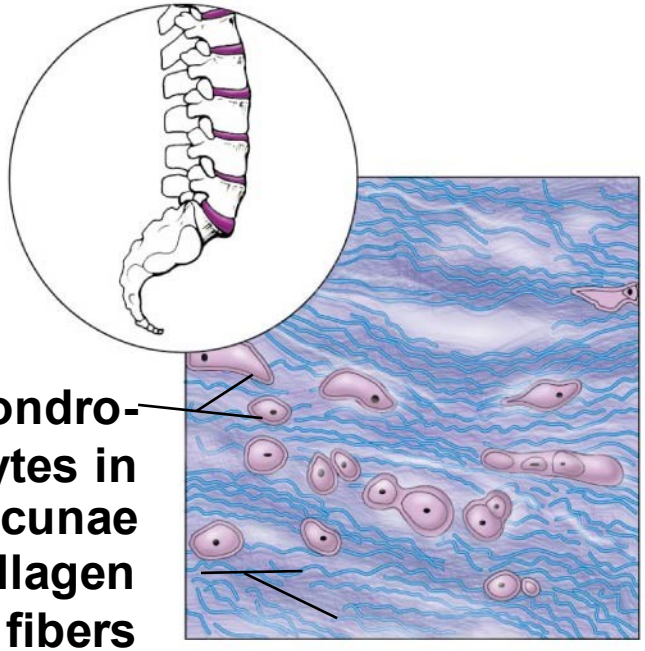
(b) Diagram: Hyaline cartilage

Photomicrograph: Hyaline cartilage from the trachea (400×)

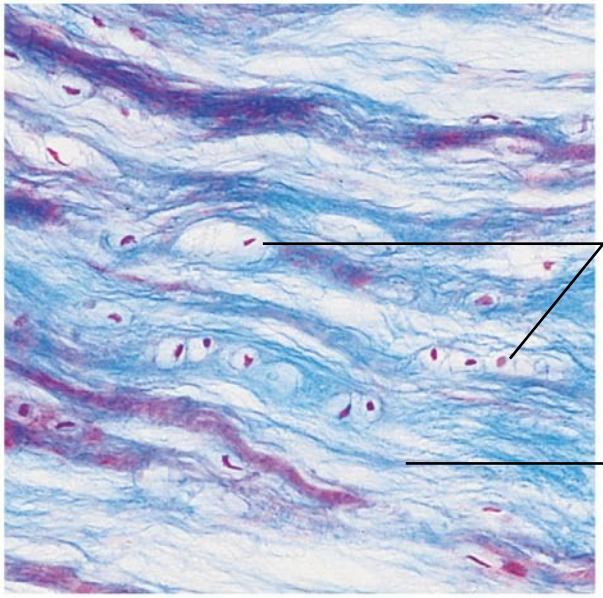
Connective Tissue Types

- Elastic cartilage (not pictured)
  - Provides elasticity
  - Location:
    - Supports the external ear
- Fibrocartilage
  - Highly compressible
  - Location:
    - Forms cushionlike discs between vertebrae of the spinal column

Figure 3.19c Connective tissues and their common body locations.



(c) Diagram: Fibrocartilage

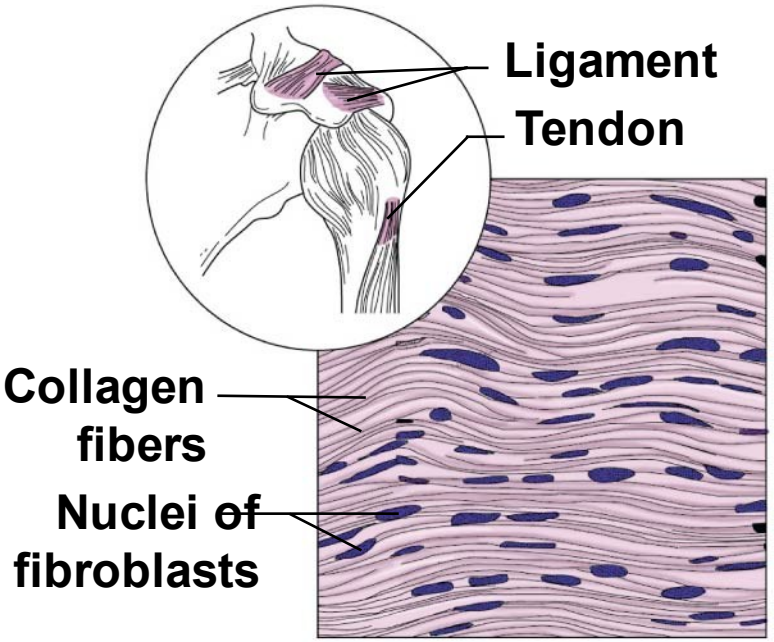


Photomicrograph: Fibrocartilage of an intervertebral disc (150×)

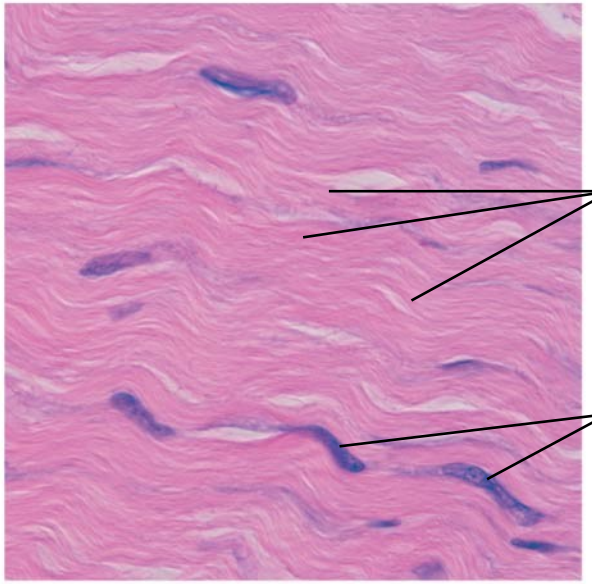
Connective Tissue Types

- Dense connective tissue (dense fibrous tissue)
  - Main matrix element is collagen fiber
  - Fibroblasts are cells that make fibers
  - Locations:
    - Tendons—attach skeletal muscle to bone
    - Ligaments—attach bone to bone at joints and are more elastic than tendons
    - Dermis—lower layers of the skin

Figure 3.19d Connective tissues and their common body locations.



(d) Diagram: Dense fibrous

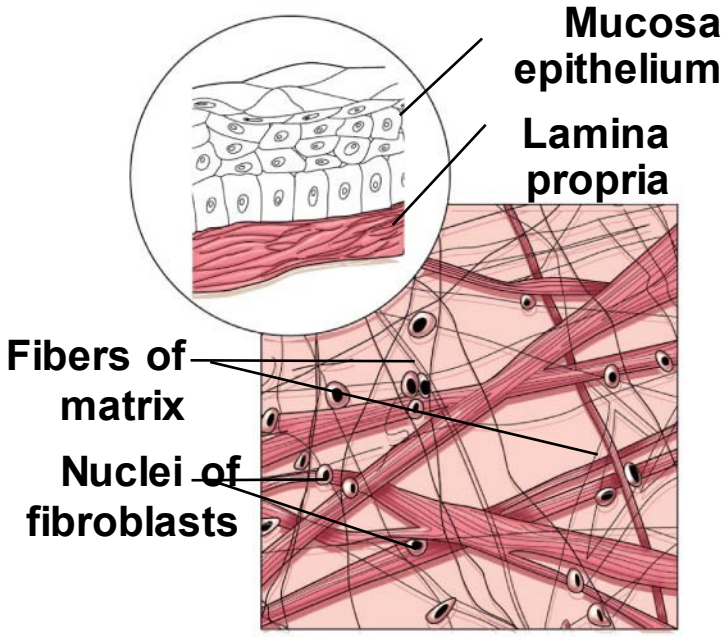


Photomicrograph: Dense fibrous connective tissue from a tendon (475×)

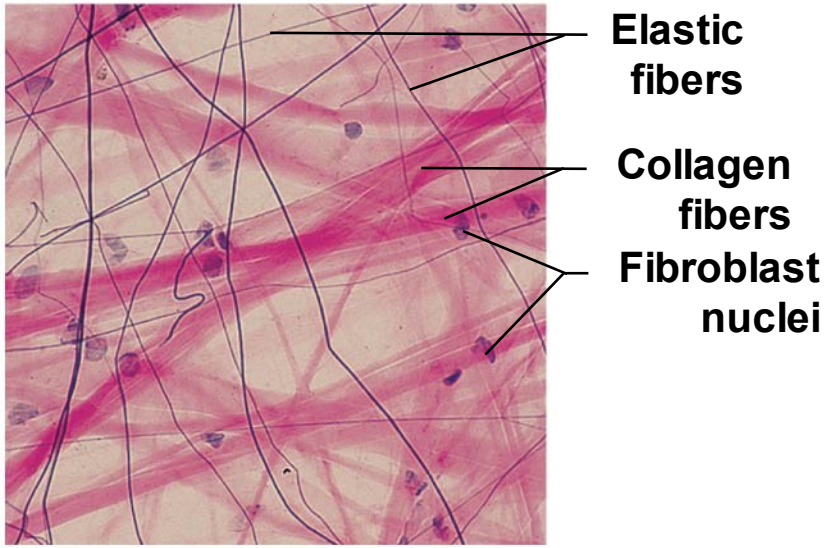
Connective Tissue Types

- Loose connective tissue types
  - Areolar tissue–
    - Most widely distributed connective tissue
    - Soft, pliable tissue like “cobwebs”
    - Functions as a universal packing tissue and “glue” to hold organs in place
    - Layer of areolar tissue called *lamina propria* underlies all membranes
    - All fiber types form a loose network
    - Can soak up excess fluid (causes edema)

Figure 3.19e Connective tissues and their common body locations.



(e) Diagram: Areolar

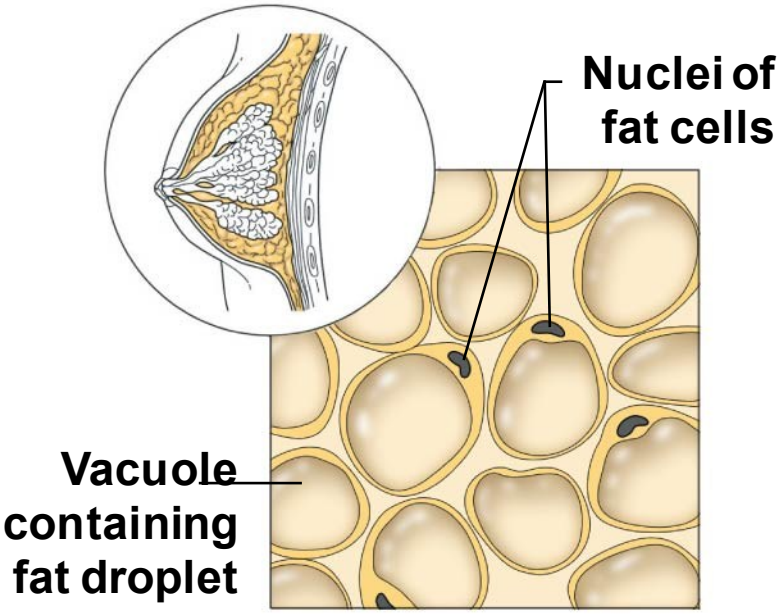


Photomicrograph: Areolar connective tissue, a soft packaging tissue of the body (270×)

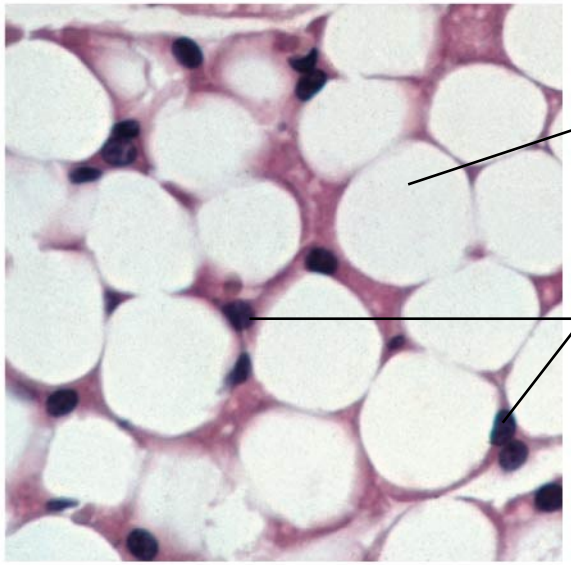
Connective Tissue Types

- Loose connective tissue types
  - Adipose tissue
    - Matrix is an areolar tissue in which fat globules predominate
    - Many cells contain large lipid deposits with nucleus to one side (signet ring cells)
  - Functions
    - Insulates the body
    - Protects some organs
    - Serves as a site of fuel storage

Figure 3.19f Connective tissues and their common body locations.



(f) Diagram: Adipose

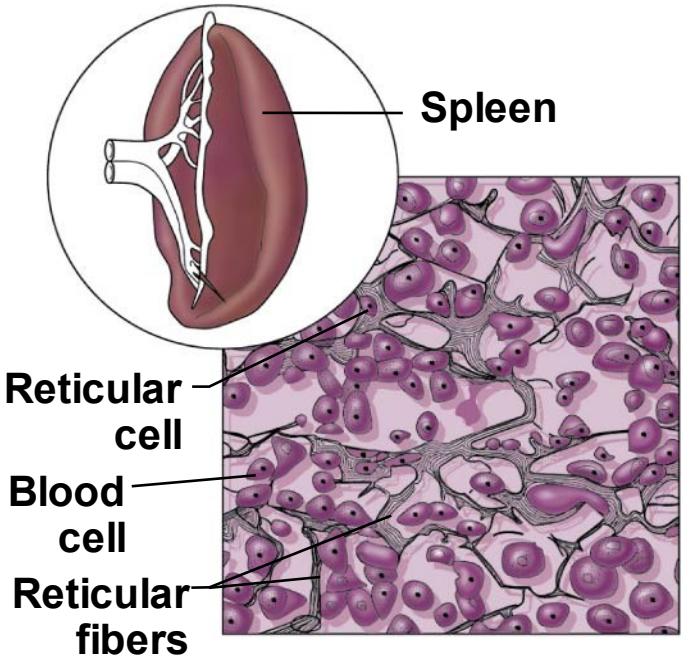


Photomicrograph: Adipose tissue from the subcutaneous layer beneath the skin (570 ×)

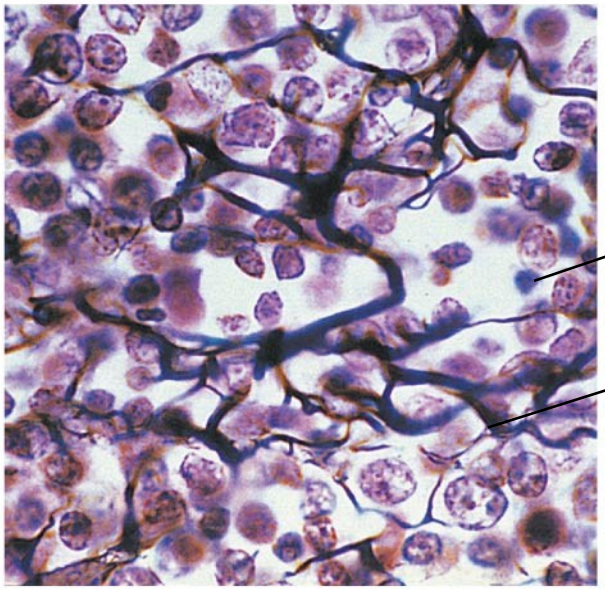
Connective Tissue Types

- Loose connective tissue types
  - Reticular connective tissue–
    - Delicate network of interwoven fibers with reticular cells (like fibroblasts)
    - Locations:
      - Forms stroma (internal framework) of organs, such as these – lymphoid organs:
        - Lymph nodes
        - Spleen
        - Bone marrow

Figure 3.19g Connective tissues and their common body locations.



(g) Diagram: Reticular

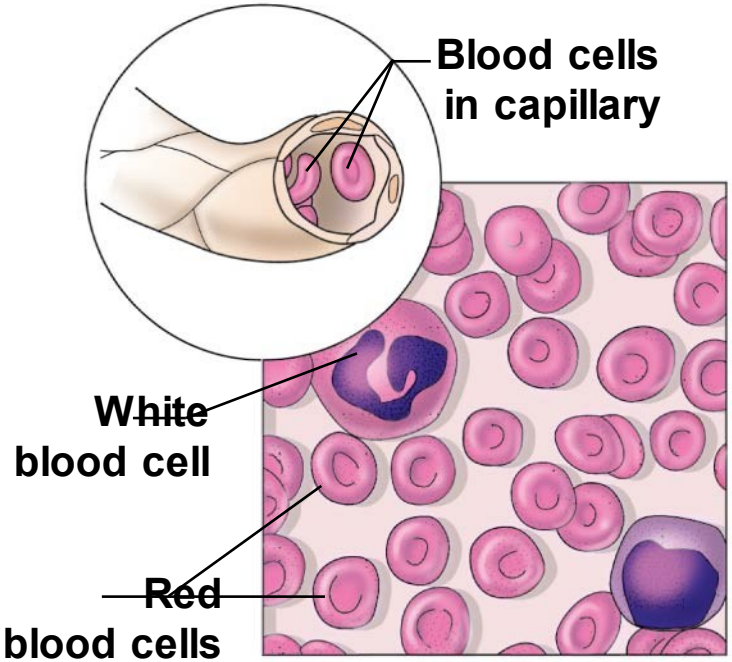


Photomicrograph: Dark-staining network of reticular connective tissue (400×)

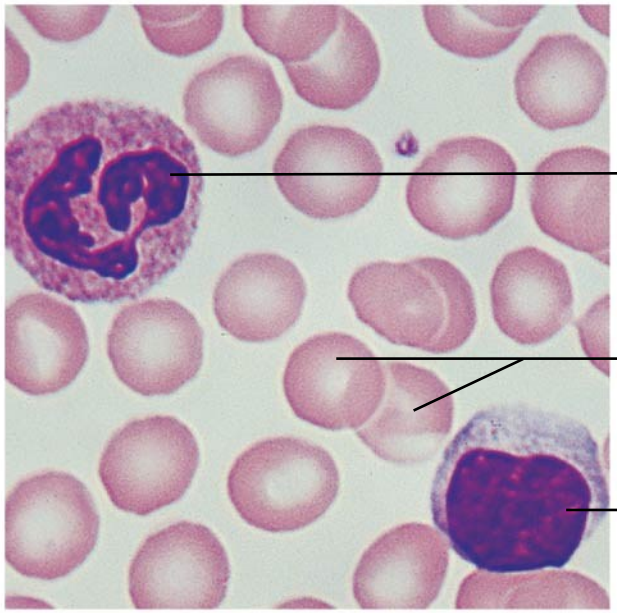
Connective Tissue Types

- Blood (vascular tissue)
  - Blood cells surrounded by fluid matrix known as *blood plasma*
  - Soluble fibers are visible only during clotting
  - Functions as the transport vehicle for the cardiovascular system, carrying:
    - Nutrients
    - Wastes
    - Respiratory gases

Figure 3.19h Connective tissues and their common body locations.



(h) Diagram: Blood



Photomicrograph: Smear of human blood (1290 ×)

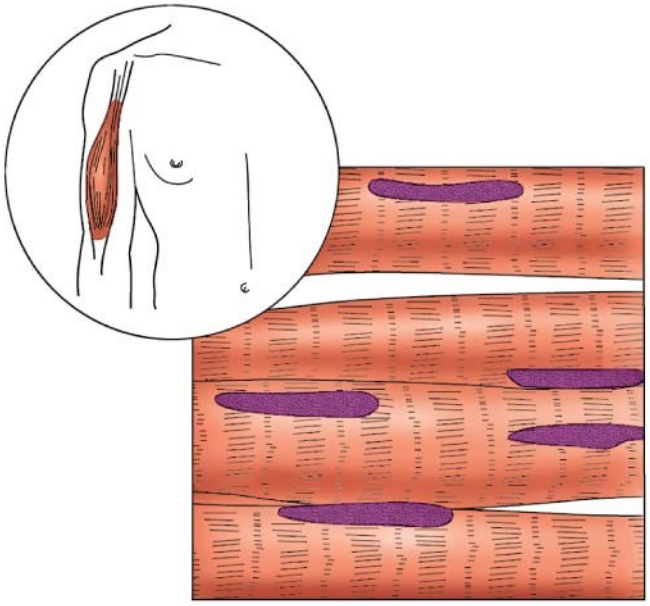
Muscle Tissue

- Function is to contract, or shorten, to produce movement
- Three types:
  ١. Skeletal muscle.
  ٢. Cardiac muscle.
  ٣. Smooth muscle.

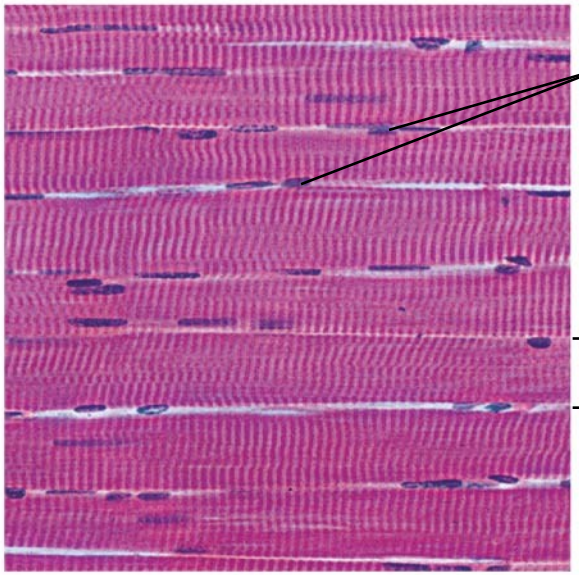
Muscle Tissue Types

- Skeletal muscle
  - Voluntarily (consciously) controlled
  - Attached to the skeleton and pull on bones or skin
  - Produces gross body movements or facial expressions
  - Characteristics of skeletal muscle cells
    - Striations (stripes)
    - Multinucleate (more than one nucleus)
    - Long, cylindrical shape

Figure 3.20a Type of muscle tissue and their common locations in the body.



(a) Diagram: Skeletal muscle

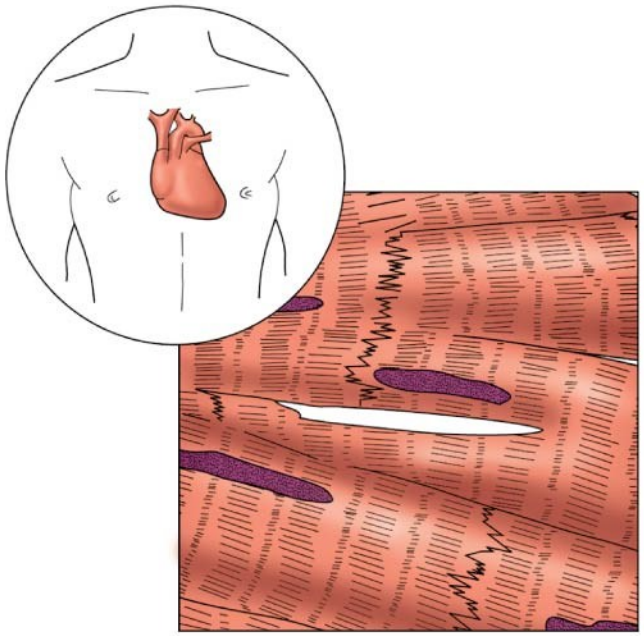


Photomicrograph: Skeletal muscle (195×)

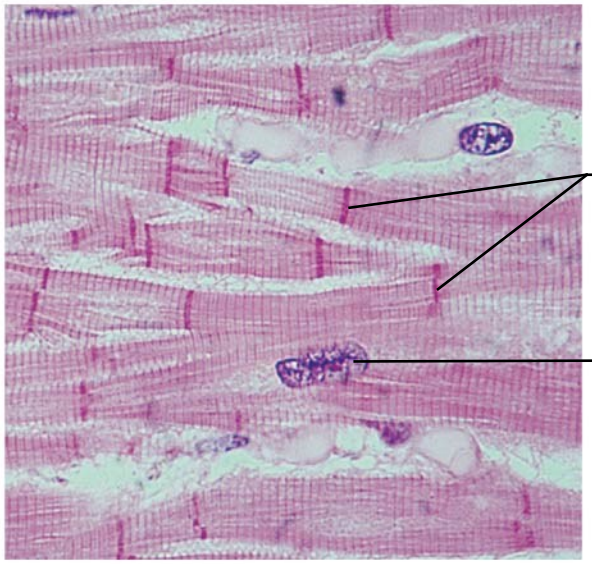
Muscle Tissue Types

- Cardiac muscle
  - Involuntarily controlled
  - Found only in the heart
  - Pumps blood through blood vessels
  - Characteristics of cardiac muscle cells
    - Striations
    - Uninucleate, short, branching cells
    - Intercalated discs contain gap junctions to connect cells together

Figure 3.20b Type of muscle tissue and their common locations in the body.



(b) Diagram: Cardiac muscle

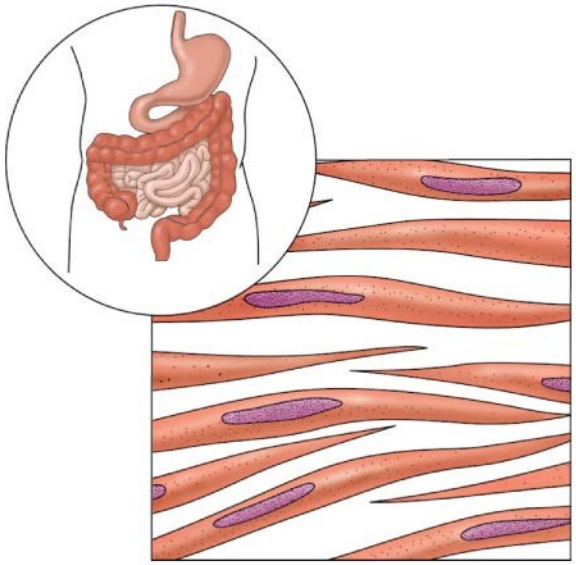


Photomicrograph: Cardiac muscle (475×)

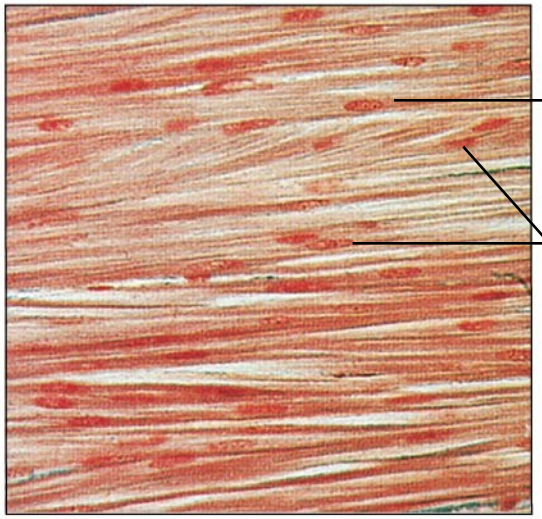
Muscle Tissue Types

- Smooth (visceral) muscle
  - Involuntarily controlled
  - Found in walls of hollow organs such as stomach, uterus, and blood vessels
  - Peristalsis, a wavelike activity, is a typical activity
  - Characteristics of smooth muscle cells
    - No visible striations
    - Uninucleate
    - Spindle-shaped cells

Figure 3.20c Type of muscle tissue and their common locations in the body.



(c) Diagram: Smooth muscle



Photomicrograph: Sheet of smooth muscle (285×)

Nervous Tissue

- Composed of neurons and nerve support cells
- Function is to receive and conduct electrochemical impulses to and from body parts
  - Irritability–
  - Conductivity–
- Support cells called *neuroglia* insulate, protect, and support neurons

Figure 3.21 Nervous tissue.

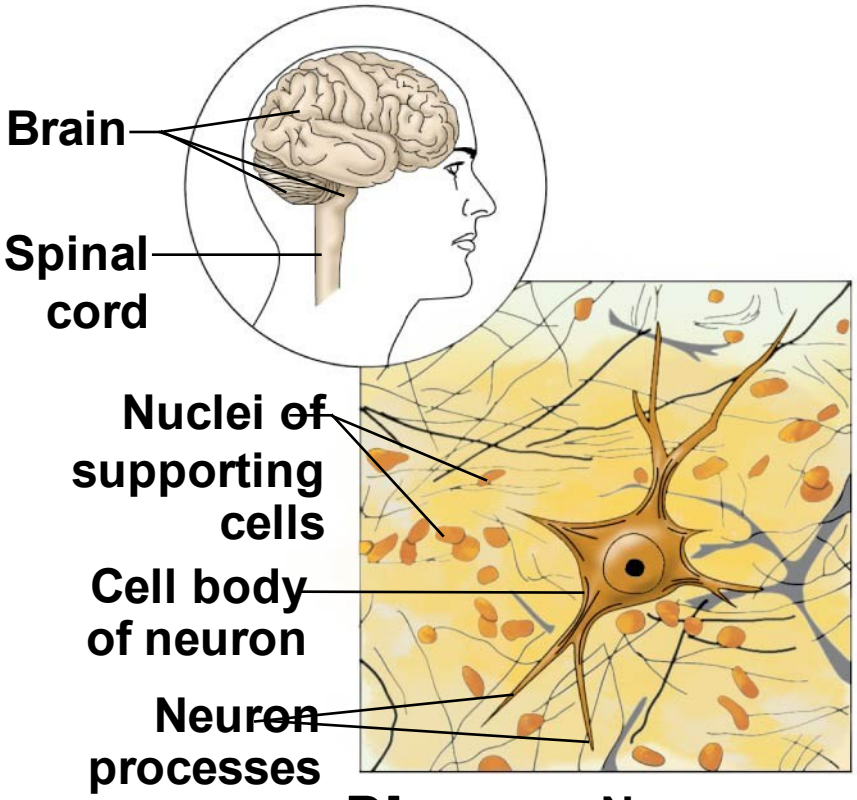
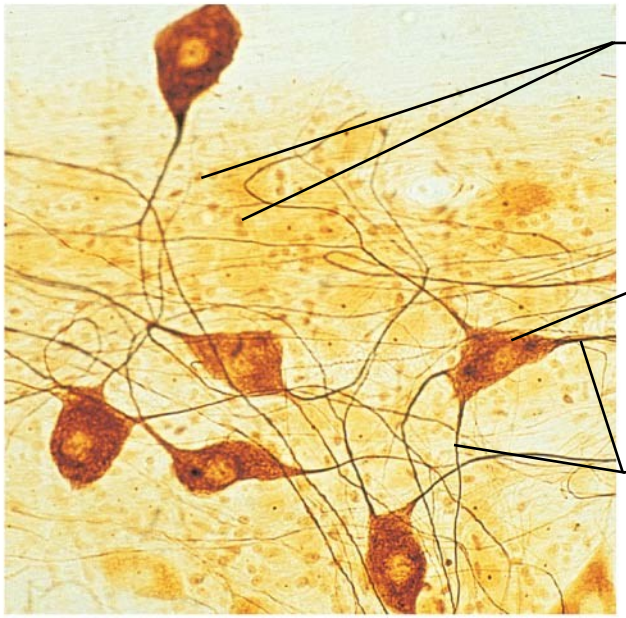


Diagram: Nervous tissue



Photomicrograph: Neurons (320×)