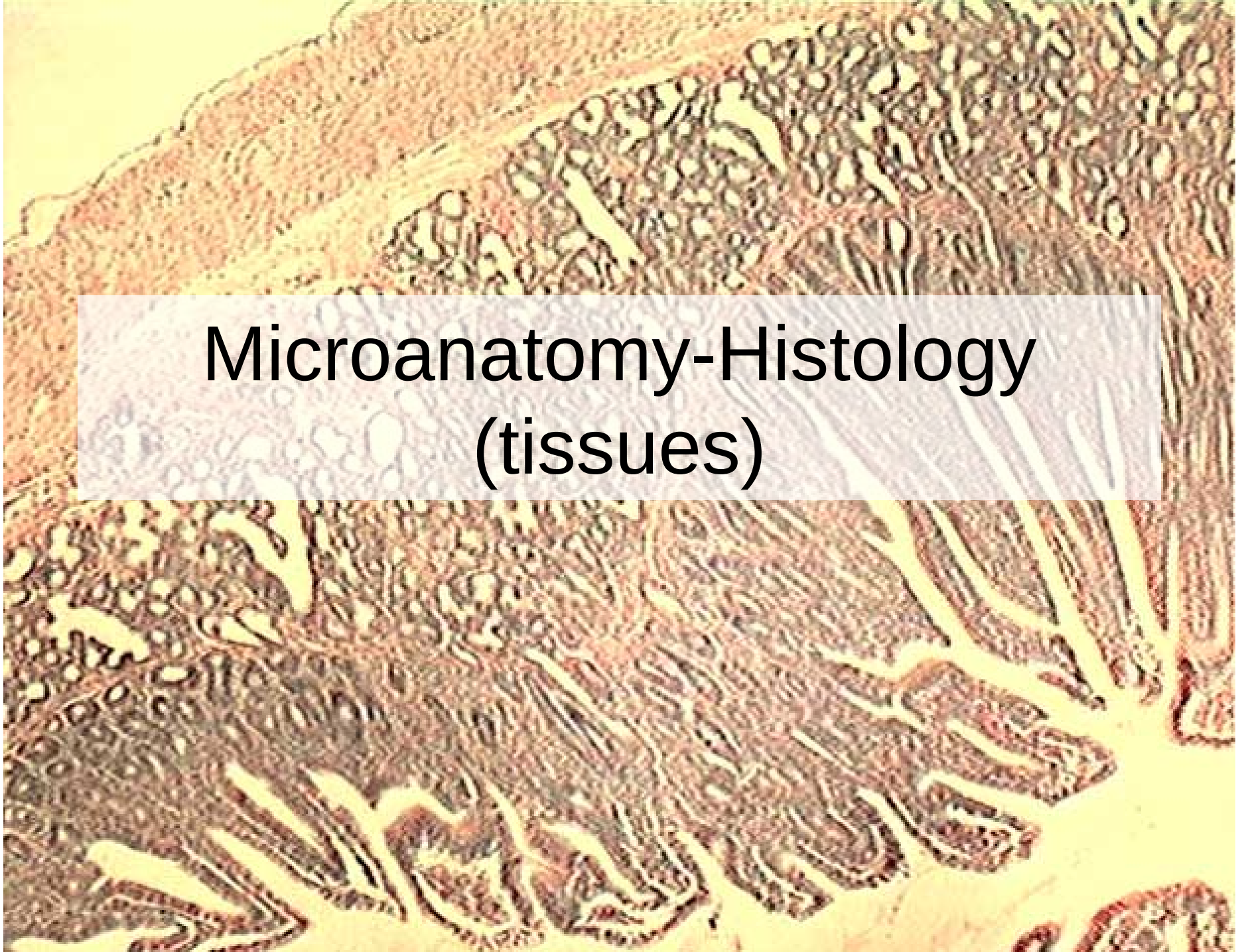


# Microanatomy-Histology (tissues)

# Levels of Organization

least complex most complex

Chemical level>cellular level>**Tissue level**>Organ level>Organ system level>Organism level

# Four types of tissues

- Epithelial tissue
- Connective tissue
- Muscular tissue
- Nervous tissue

# Epithelial tissue

- Sheets of cells that cover exposed surfaces, line body cavities, ducts, and vessels
- Properties of epithelial tissue:
  - Cellularity
  - Attachment to the basement membrane
  - Polarity
  - Avascularity
  - Regeneration

# Properties of epithelial tissue

**Cellularity**-the cells are closely bound to each other by cell junctions (tight junction, desmosome) making a wide sheet

**Attachment**-the deepest (basal) layer is attached to the basement membrane

**Polarity**-opposite ends (superficial/deep ) of the cells have distinct features.

The basal end of a cell is closesr to the basement membrane.

The apical end of the cell is closer to the superficial border.

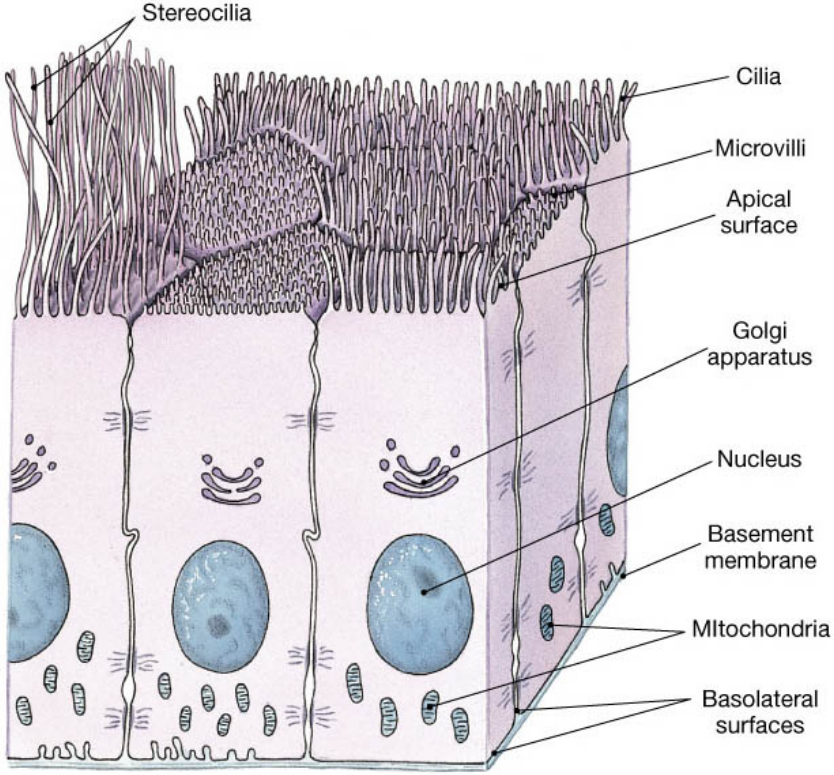
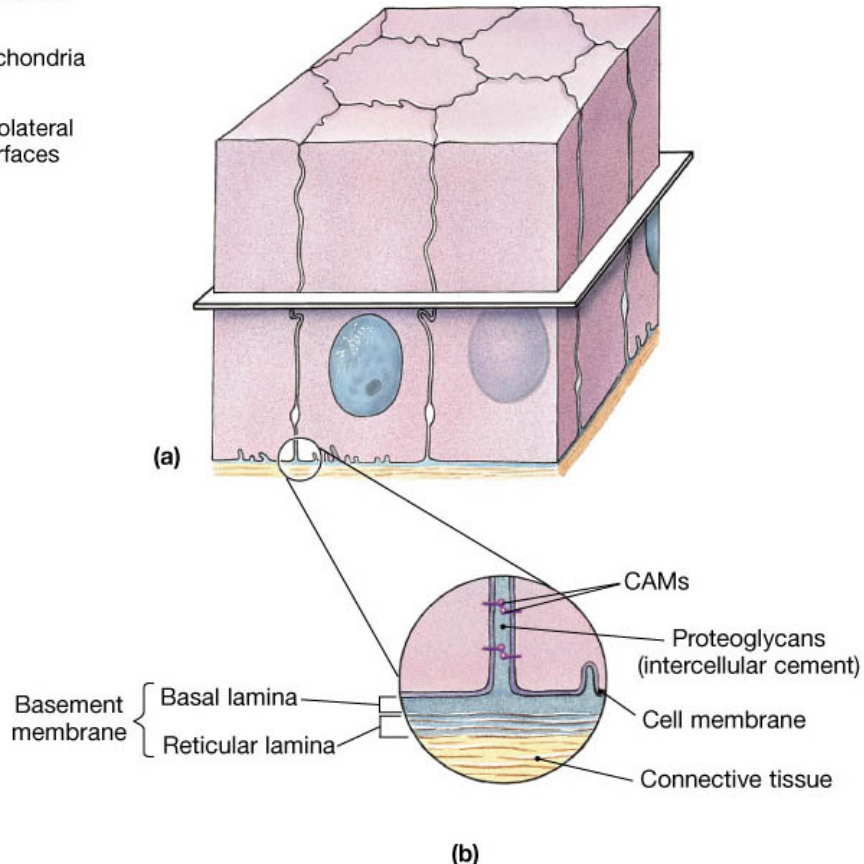

Stereocilia
Cilia
Microvilli
Apical surface
Golgi apparatus
Nucleus
Basement membrane
MItochondria
Basolateral surfaces
(a)

Fig 3.2

Fig 3.3


(a)
CAMs
Proteoglycans (intercellular cement)
Basement membrane
Basal lamina
Reticular lamina
Cell membrane
Connective tissue
(b)

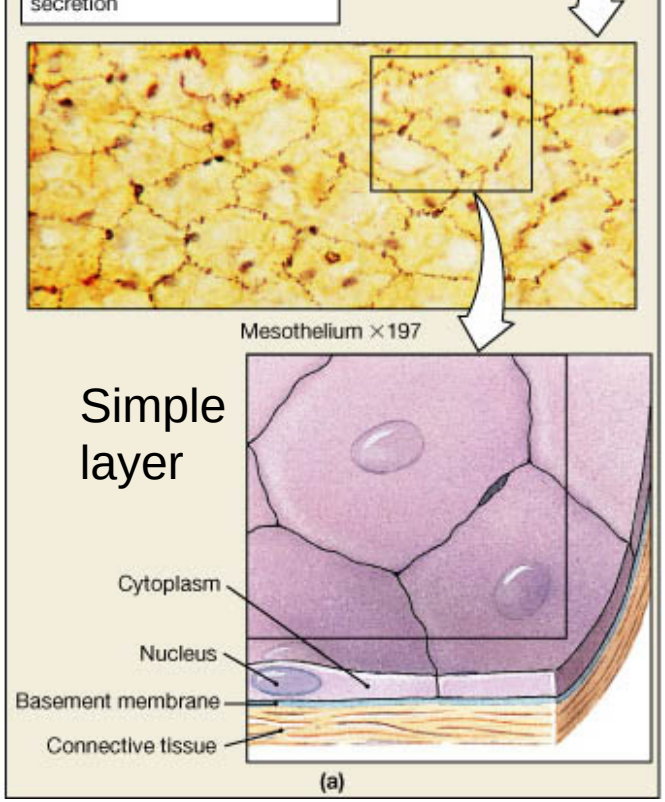
**Avascularity**-lacking blood vessels. Epithelia must be in close contact with other vascular tissue (usually connective tissue)

**Regeneration**-damaged tissue is re-grown

Stem cell research is trying to discover how to regenerate cardiac and neural cells

# Layering of epithelial cells

- **Simple layer**-1 layer of cells (all cells contact the basement membrane = BM)
- **Stratified layer**-2 or more cell layers deep, only the deepest touches the BM
- **Pseudostratified-**1 cell layer (layering appears to be stratified dur to irregular shape)



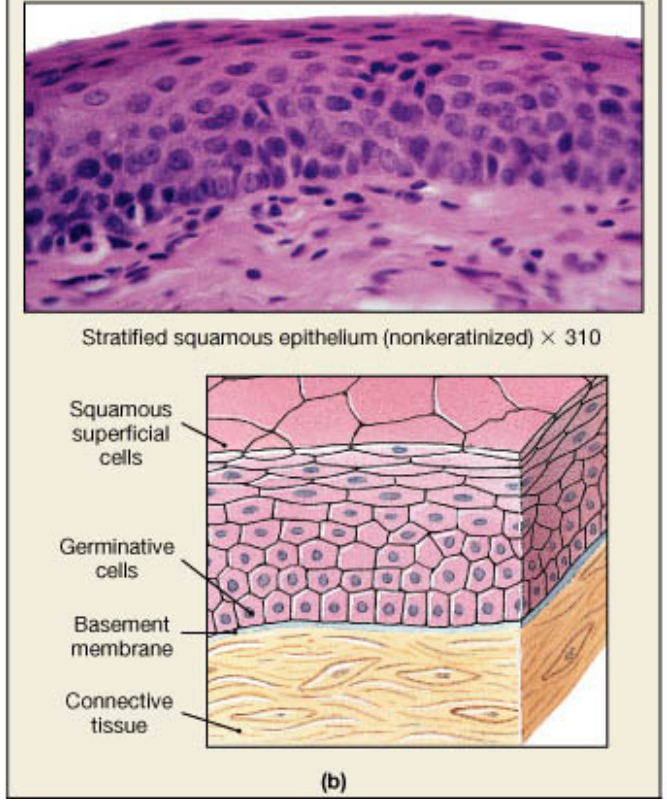
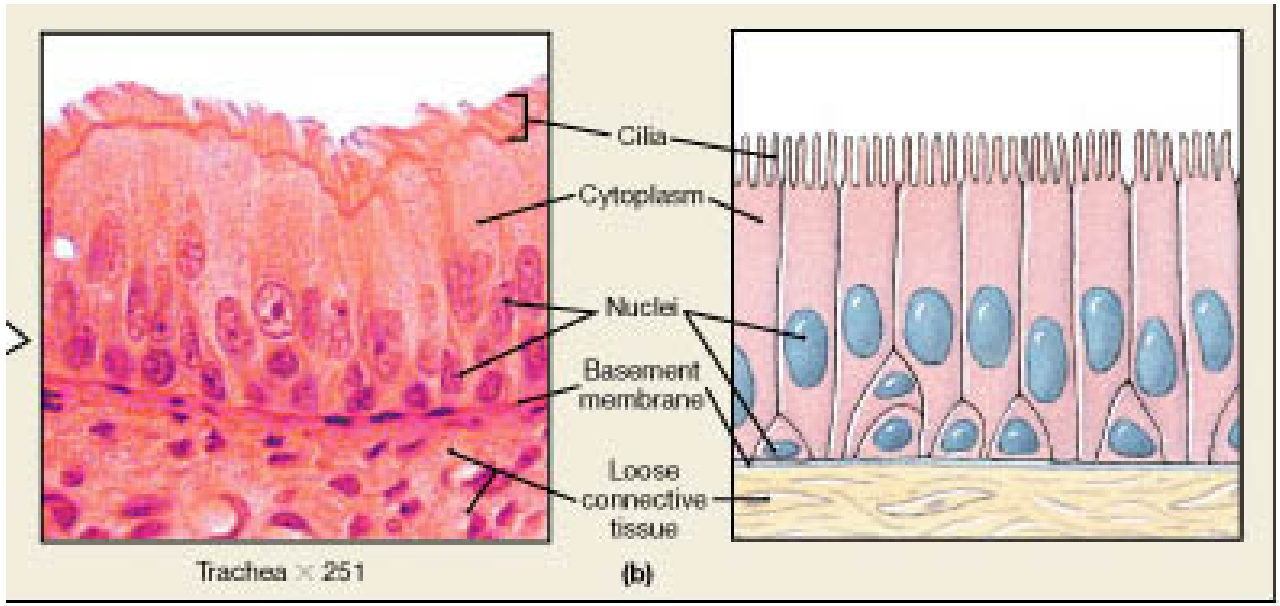




Fig 3.4

Stratified layer

Pseudostratified layer

Fig 3.6



# Cell shape

- Three general shapes of epithelial cells:
- Squamous
- Cuboidal
- Columnar

# Squamous

- flat, irregular-shaped cells ( eggs sunny side up)

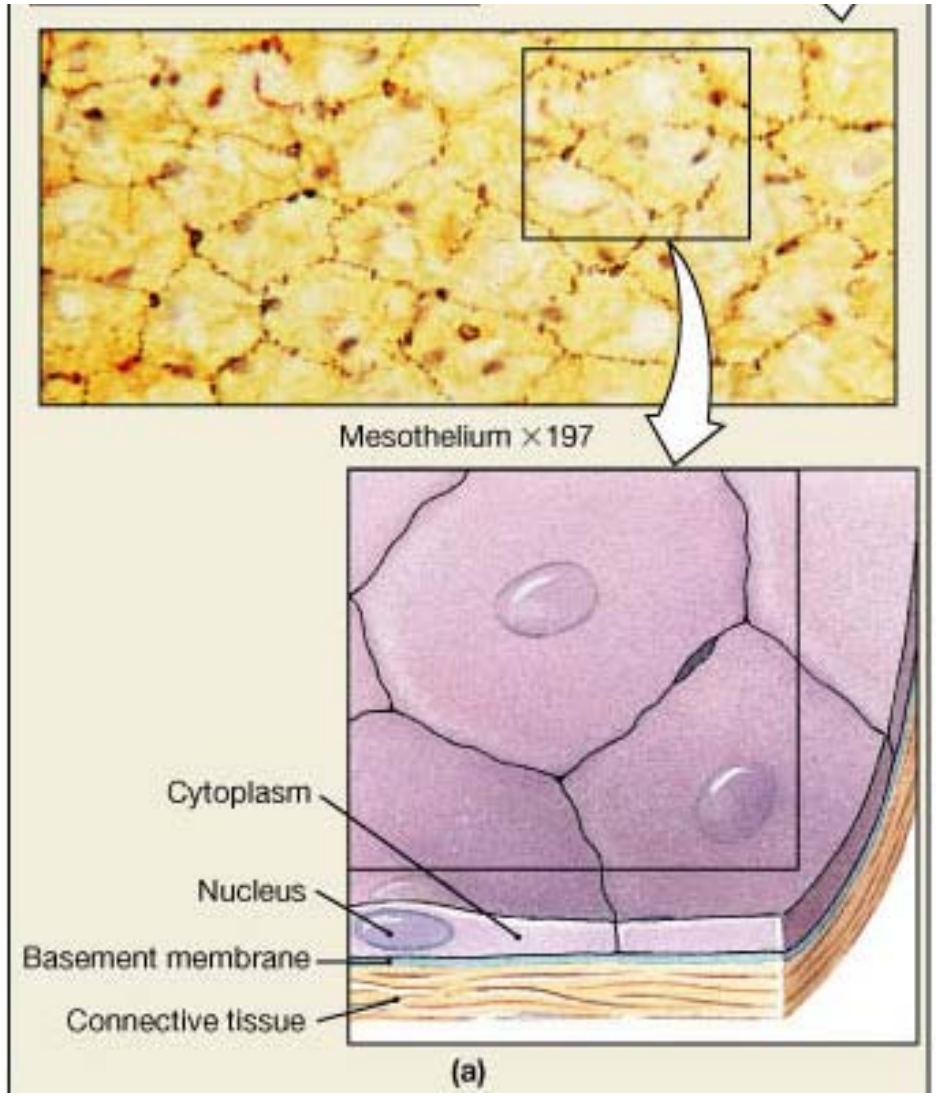



Fig 3.4

# Cuboidal

- Cube-shaped cells

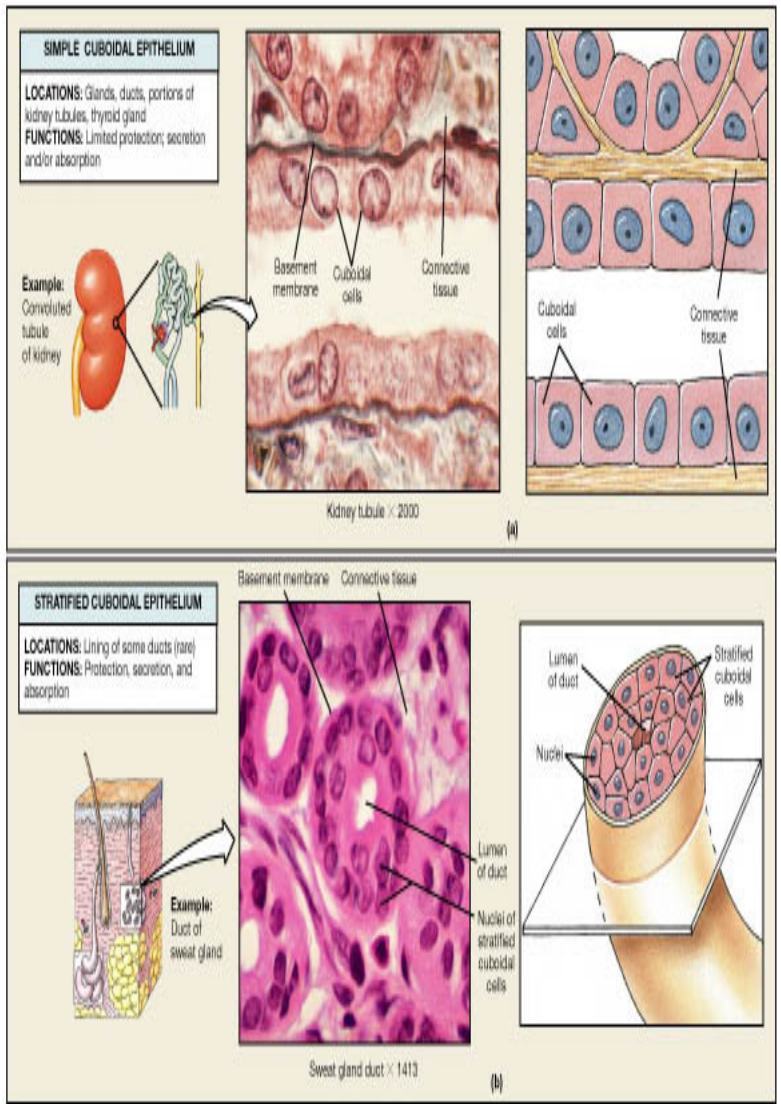



Fig 3.5

# Columnar

- Tall, thin cells (column-like)

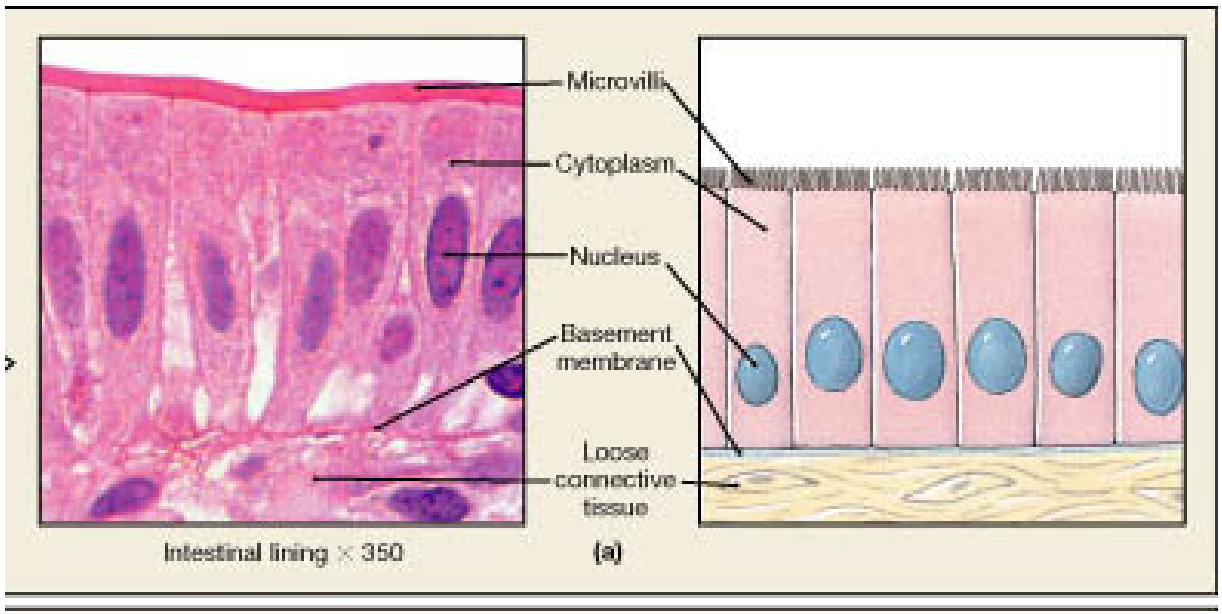



Fig 3.6

# Epithelial tissue types

Layering and shape are combined to name specific types of epithelial tissue example:

Simple squamous

Simple cuboidal

Stratified cuboidal

# Glandular epithelia

- Exocrine glands-release secretions onto the surface of epithelia
- Glands are composed of epithelia cells

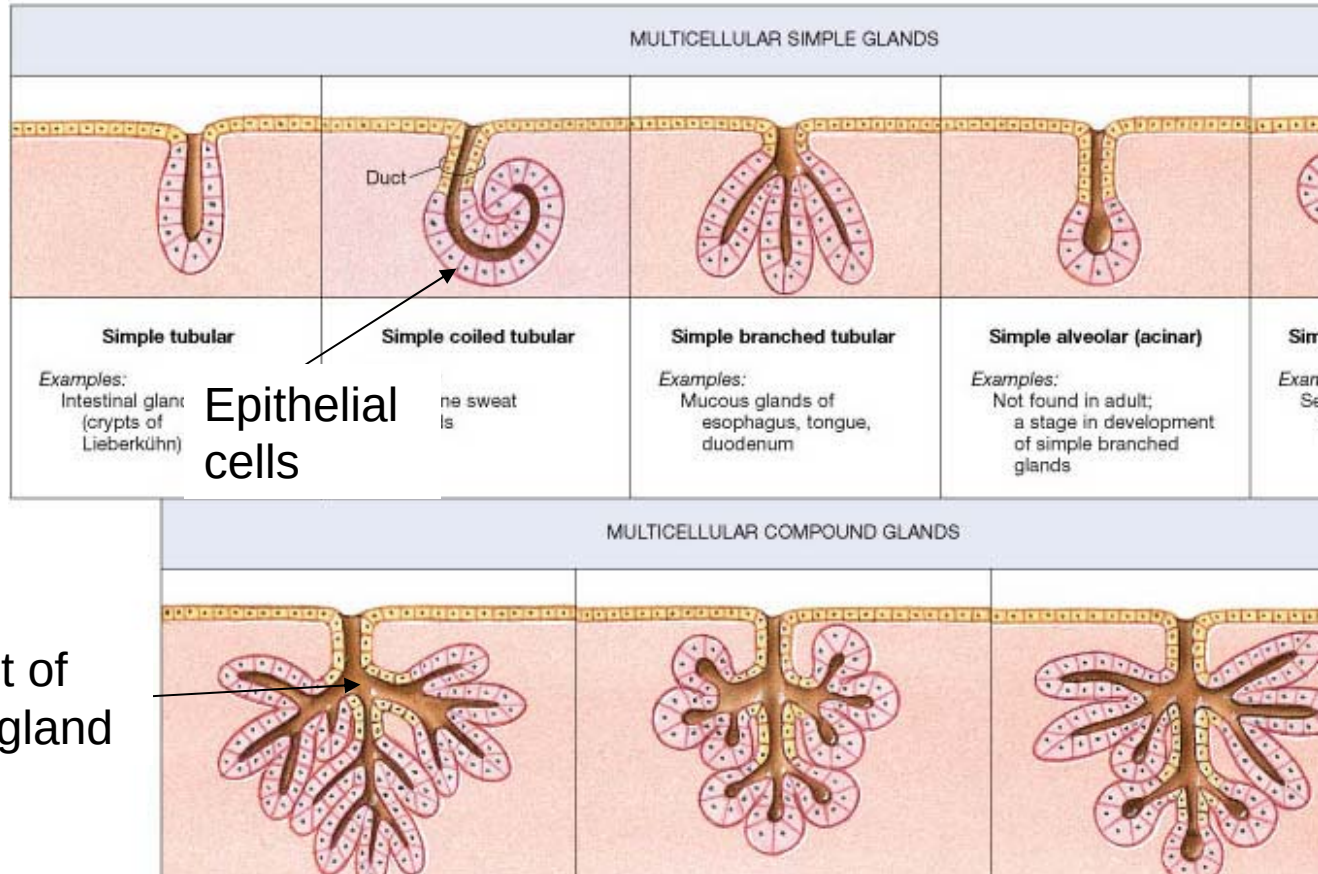
- Types of glands:
- Serous glands
- Mucous glands
- Mixed exocrine glands

# Types of glands

- Serous glands-Secrete a serous solution-watery
- Mucous glands-Secrete a mucous secretion-mucus
- Mixed exocrine glands-Secrete both serous and mucous

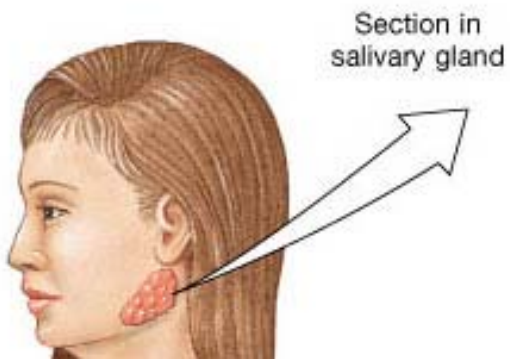
# Mechanisms of exocrine release

- Three mechanisms (the method by which secretions are released from cells):
  - Merocrine
  - Apocrine
  - Holocrine



# Merocrine

- Secretions are released by exocytosis
  - ie. Salivary glands, eccrine sweat glands



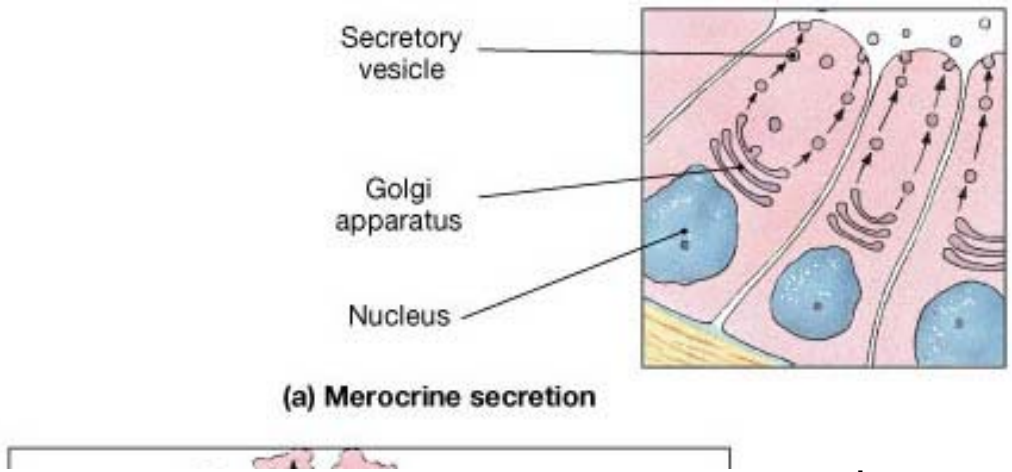
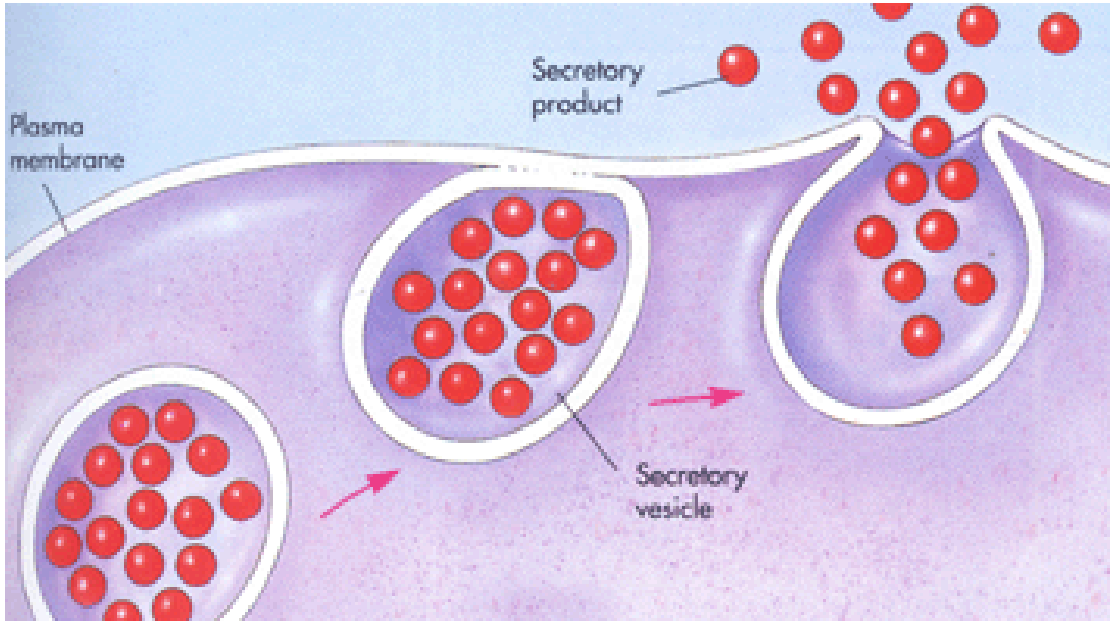




Fig 3.9

# Exocytosis

- Moving molecules out of the cell
- A vesicle fuses to the inside of the membrane releasing contents to the extracellular fluid



# Apocrine

- Secretions are released when the apical end of the cell is shed.
  - ie. Lactiferous glands

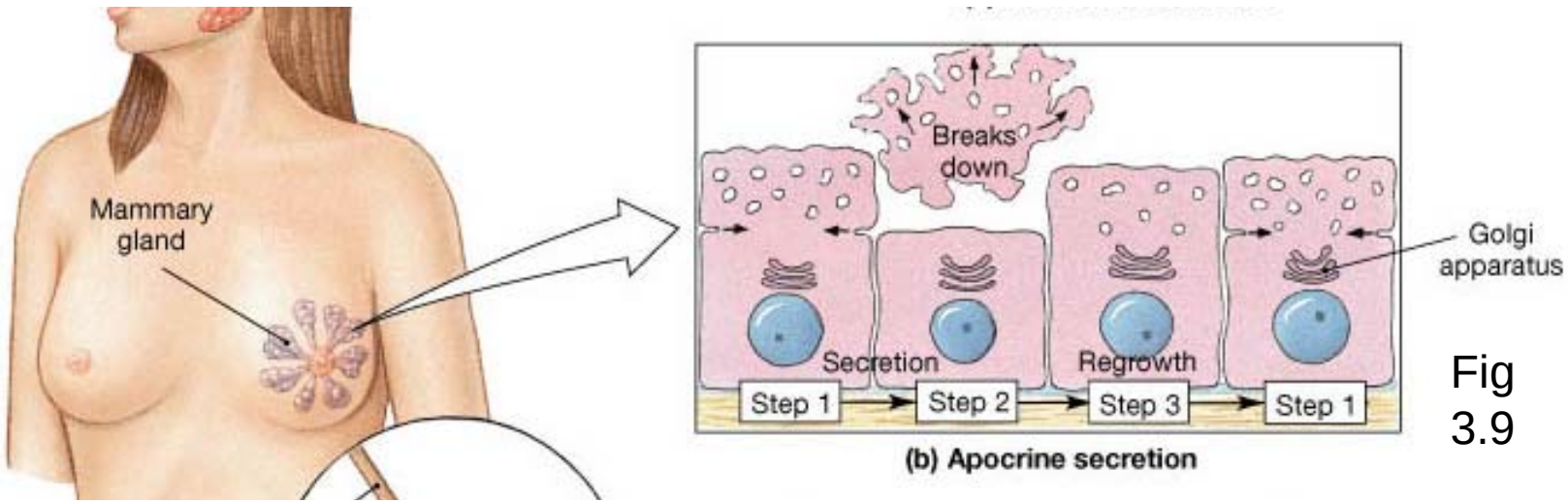
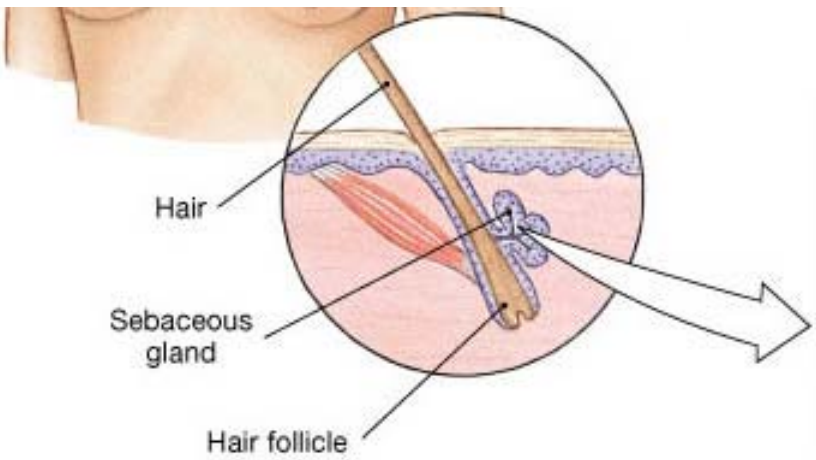



Fig 3.9

# Holocrine

- Secretions are released when the cell membrane ruptures
  - ie. Sebaceous glands



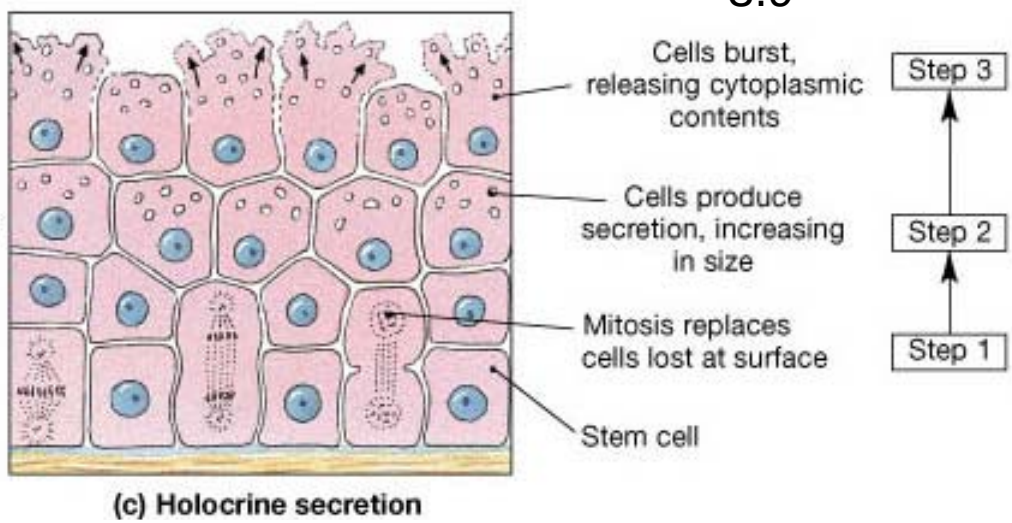




Fig 3.9

# ?’s About epithelial tissue

- Chapter 3 in the text

# Supports, surrounds & interconnects other tissue types

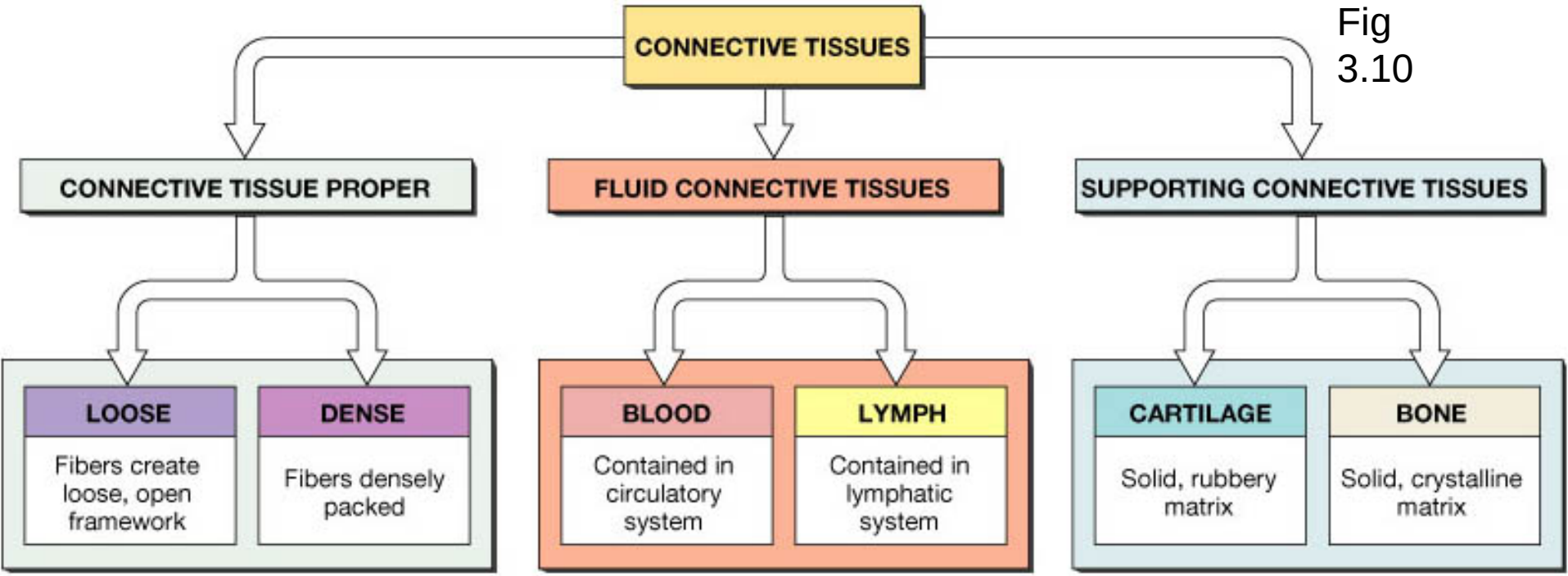



Fig 3.10

Areolar

Adipose

Reticular

Dense irregular

Dense regular

Hyaline

Fibrocartilage

Elastic

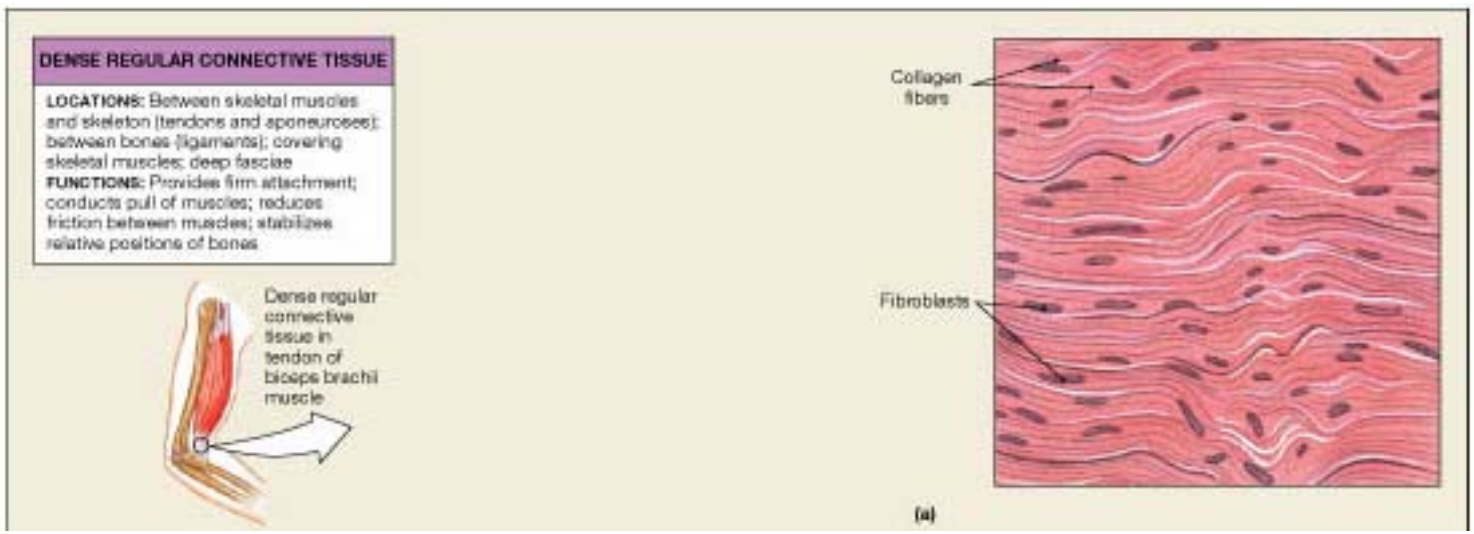
# Connective tissues fibers

- Three types produced by fibroblasts:
  - Collagen fibers
  - Reticular fibers
  - Elastic fibers

# Collagen fibers

- Long thick fibers act like a tough rope to provide tensile strength
  - tendons

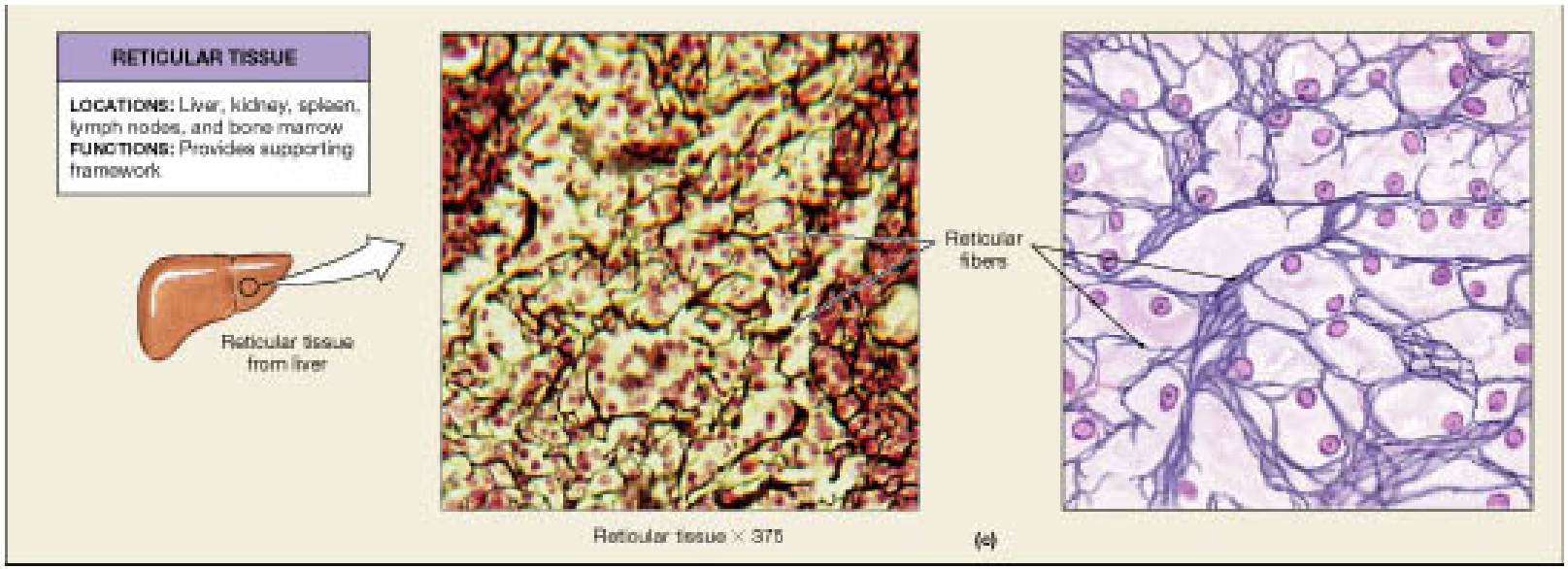
Fig 3.14



# Reticular fibers

- Thin branching fibers that form a framework of an organ
  - ie. liver

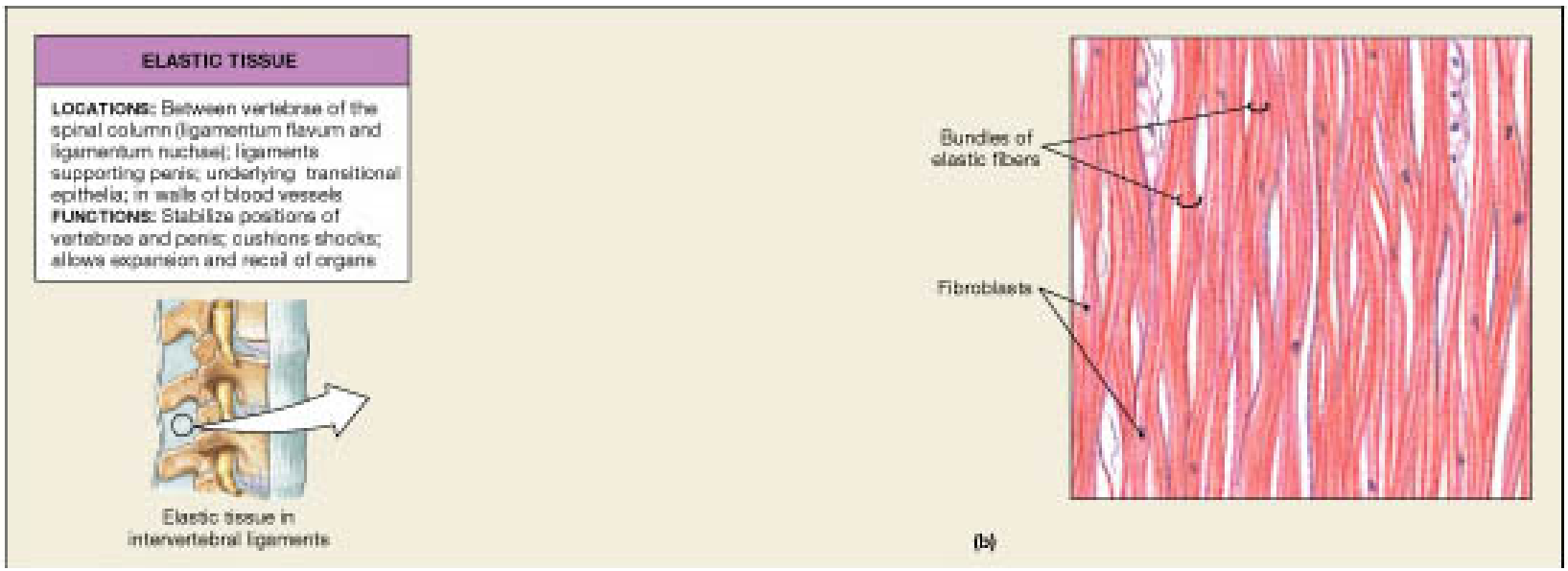
Fig 3.13



# Elastic fibers

- Act like rubber bands found in areas of stretching
  - Elastic ligaments

Fig 3.14



# Cells of connective tissue proper

- Fixed cells-stationary
  - Fibroblasts-produce CT fibers
  - Fixed macrophages-destroy pathogen
  - Adipocytes-store lipid
  - Mesenchymal-stem cells
  - Melanocytes-produce pigment

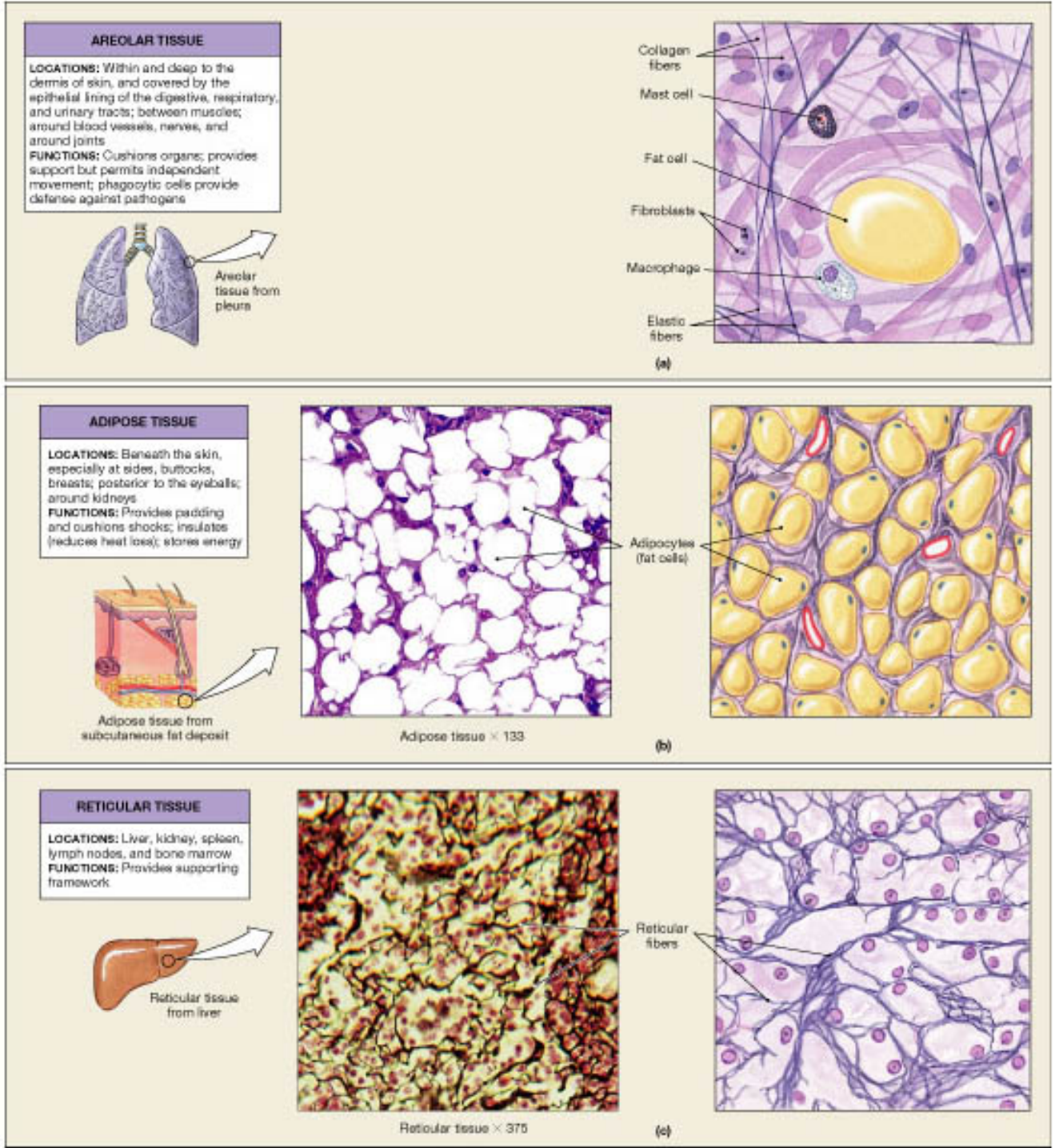
# Cells of connective tissue proper

- Wandering cells-move though circulation
  - Free macrophages-destroy pathogens
  - Mast cells-stimulation inflammation
  - Lymphocytes-immune function
  - Microphages-immune function during injury/infection

# Loose CT-provides cushioning

- Areolar CT-superficial region of the dermis, around blood vessels, nerves, & joints
- Adipose CT-hypodermis, posterior to the eyes, surrounding the kidneys
- Reticular-liver, kidney, spleen

Fig 3.13

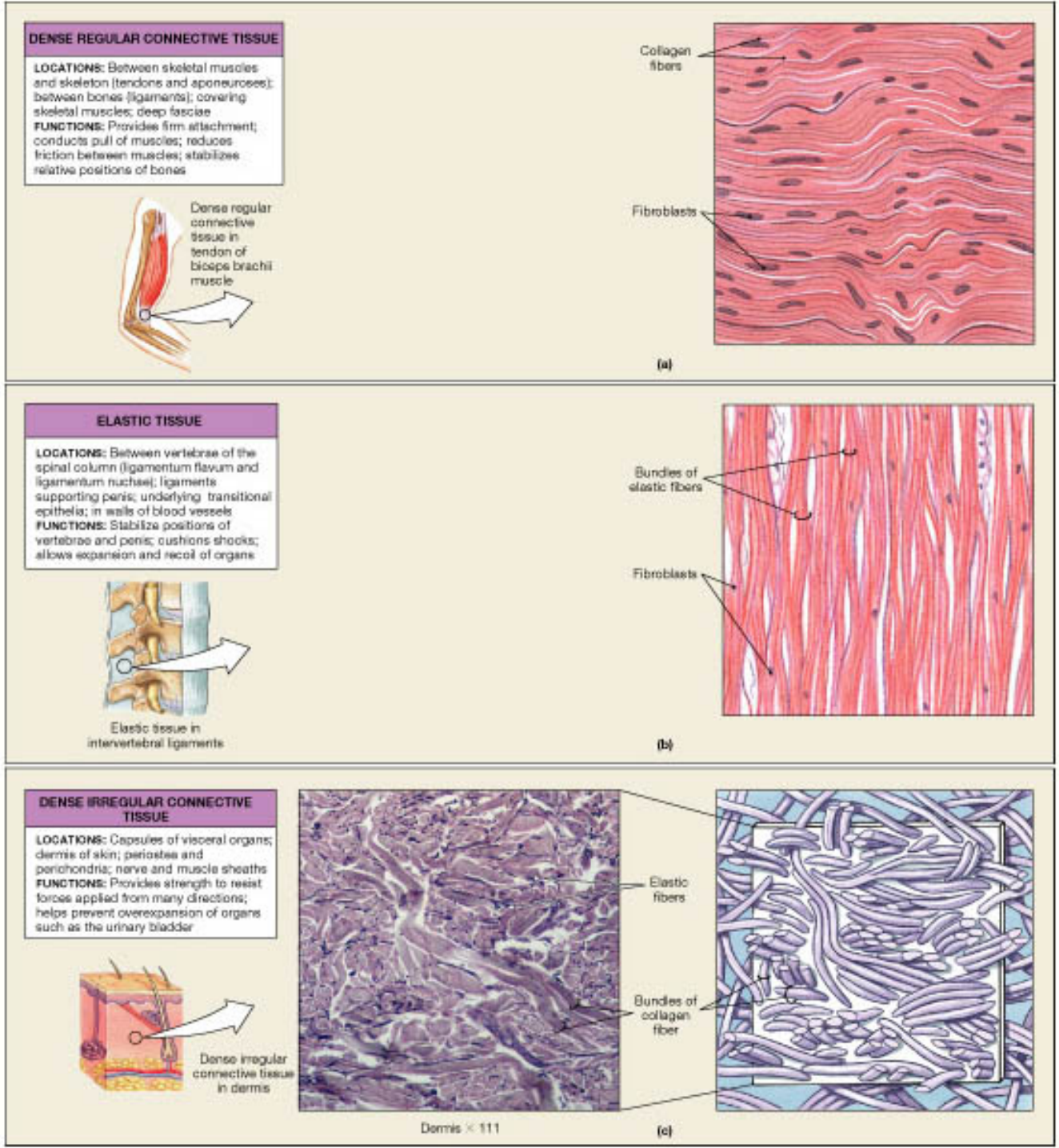

AREOLAR TISSUE
LOCATIONS: Within and deep to the dermis of skin, and covered by the epithelial lining of the digestive, respiratory, and urinary tracts; between muscles; around blood vessels, nerves, and around joints
FUNCTIONS: Cushions organs; provides support but permits independent movement; phagocytic cells provide defense against pathogens
Areolar tissue from pleura
Collagen fibers
Mast cell
Fat cell
Fibroblasts
Macrophage
Elastic fibers
(a)
ADIPOSE TISSUE
LOCATIONS: Beneath the skin, especially at sides, buttocks, breasts; posterior to the eyeballs; around kidneys
FUNCTIONS: Provides padding and cushions shocks; insulates (reduces heat loss); stores energy
Adipose tissue from subcutaneous fat deposit
Adipocytes (fat cells)
Adipose tissue × 133
(b)
RETICULAR TISSUE
LOCATIONS: Liver, kidney, spleen, lymph nodes, and bone marrow
FUNCTIONS: Provides supporting framework
Reticular tissue from liver
Reticular fibers
Reticular tissue × 375
(c)

# Dense CT

- Dense irregular CT-dermis & joint capsules (collagen fibers in a interwoven network)

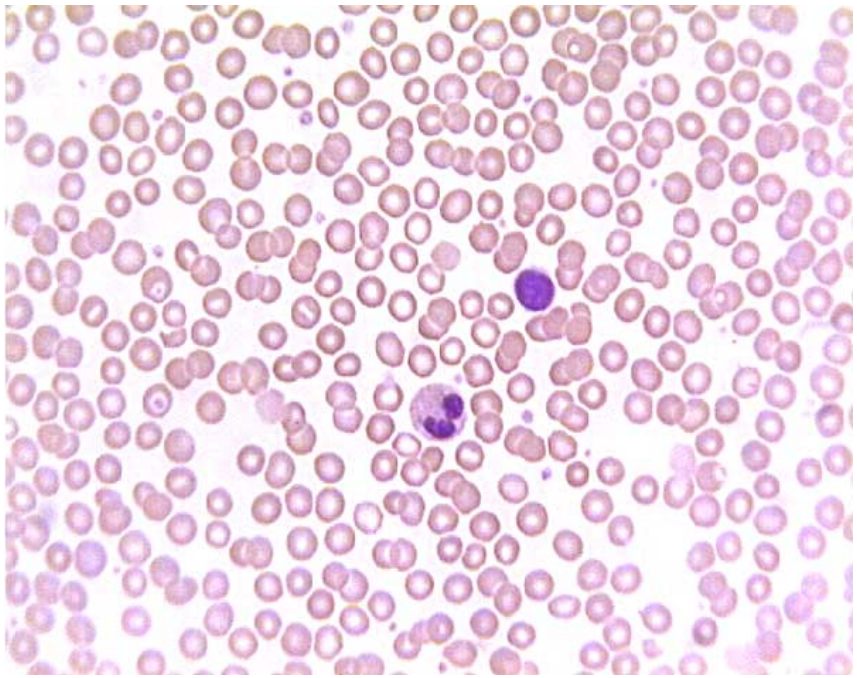
- Dense regular CT-tendons, aponeuroses, elastic tissue, & ligaments (collagen fibers arranged parallel to each other)

Fig 3.14


DENSE REGULAR CONNECTIVE TISSUE
LOCATIONS: Between skeletal muscles and skeleton (tendons and aponeuroses); between bones (ligaments); covering skeletal muscles; deep fasciae
FUNCTIONS: Provides firm attachment; conducts pull of muscles; reduces friction between muscles; stabilizes relative positions of bones
Dense regular connective tissue in tendon of biceps brachii muscle
Collagen fibers
Fibroblasts
(a)
ELASTIC TISSUE
LOCATIONS: Between vertebrae of the spinal column (ligamentum flavum and ligamentum nuchae); ligaments supporting penis; underlying transitional epithelia; in walls of blood vessels
FUNCTIONS: Stabilize positions of vertebrae and penis; cushions shocks; allows expansion and recoil of organs
Elastic tissue in intervertebral ligaments
Bundles of elastic fibers
Fibroblasts
(b)
DENSE IRREGULAR CONNECTIVE TISSUE
LOCATIONS: Capsules of visceral organs; dermis of skin; periosteo and perichondria; nerve and muscle sheaths
FUNCTIONS: Provides strength to resist forces applied from many directions; helps prevent overexpansion of organs such as the urinary bladder
Dense irregular connective tissue in dermis
Elastic fibers
Bundles of collagen fiber
Dermis × 111
(c)

# Fluid CT-fluid with many cells within

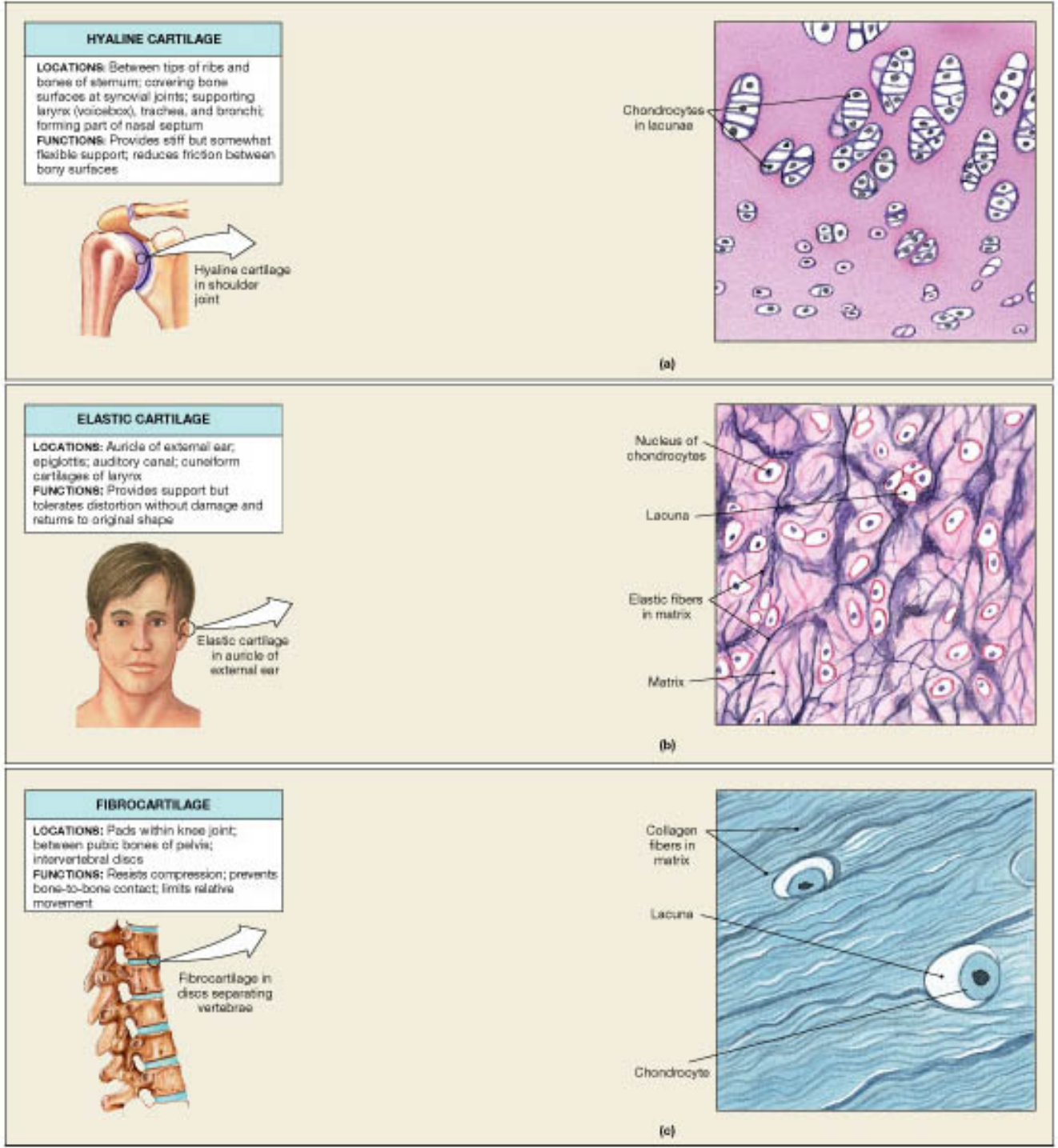
- Blood-fluid in the cardiovascular system
- Lymph-fluid in the lymphatic system



# Supporting CT

- Cartilage-firm avascular gel
  - Hyaline cartilage- between ribs and sternum, trachea, cartilage covering bones at joints (drumsticks)
  - Fibrocartilage-symphysis pubis, interverterbral discs
  - Elastic cartilage-otic region, nose
- Bone-mix of collagen and calcium salts

Fig 3.17


HYALINE CARTILAGE
LOCATIONS: Between tips of ribs and bones of sternum; covering bone surfaces at synovial joints; supporting larynx (voicebox), trachea, and bronchi; forming part of nasal septum
FUNCTIONS: Provides stiff but somewhat flexible support; reduces friction between bony surfaces
Hyaline cartilage in shoulder joint
Chondrocytes in lacunae
(a)
ELASTIC CARTILAGE
LOCATIONS: Auricle of external ear; epiglottis; auditory canal; cuneiform cartilages of larynx
FUNCTIONS: Provides support but tolerates distortion without damage and returns to original shape
Elastic cartilage in auricle of external ear
Nucleus of chondrocytes
Lacuna
Elastic fibers in matrix
Matrix
(b)
FIBROCARTILAGE
LOCATIONS: Pads within knee joint; between pubic bones of pelvis; intervertebral discs
FUNCTIONS: Resists compression; prevents bone-to-bone contact; limits relative movement
Fibrocartilage in discs separating vertebrae
Collagen fibers in matrix
Lacuna
Chondrocyte
(c)

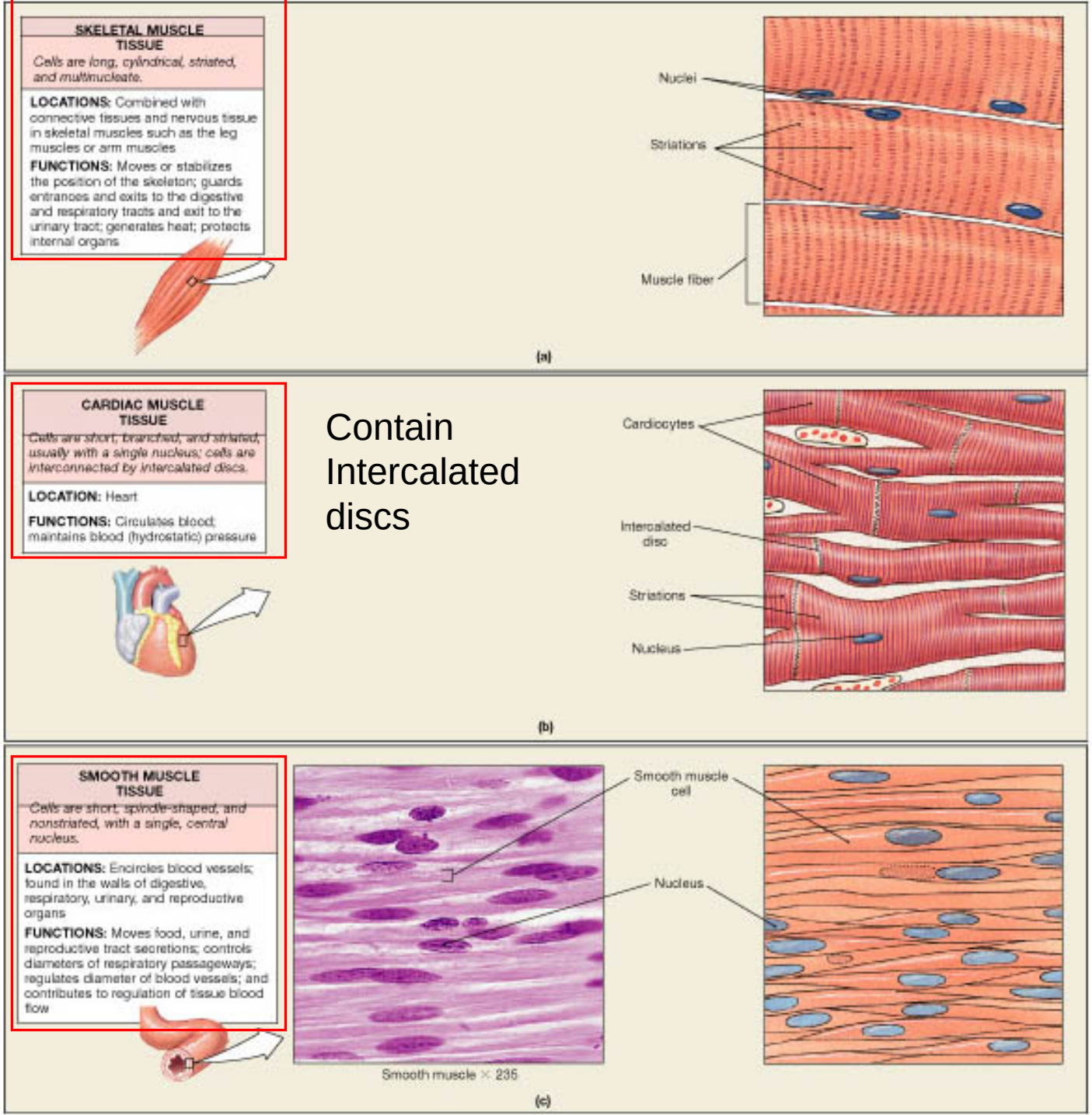
# ?’s About connective tissue

- Chapter 3 in the text

# Muscular tissue

- Muscle tissue is contractile and produce force
- Three types:
  - **Skeletal muscle**-muscles attached to the skeleton, voluntary controlled by nervous sys.
  - **Cardiac muscle**-heart, involuntary control
  - **Smooth muscle**-blood vessels, hollow organs (urinary bladder, uterus), iris, involuntary control

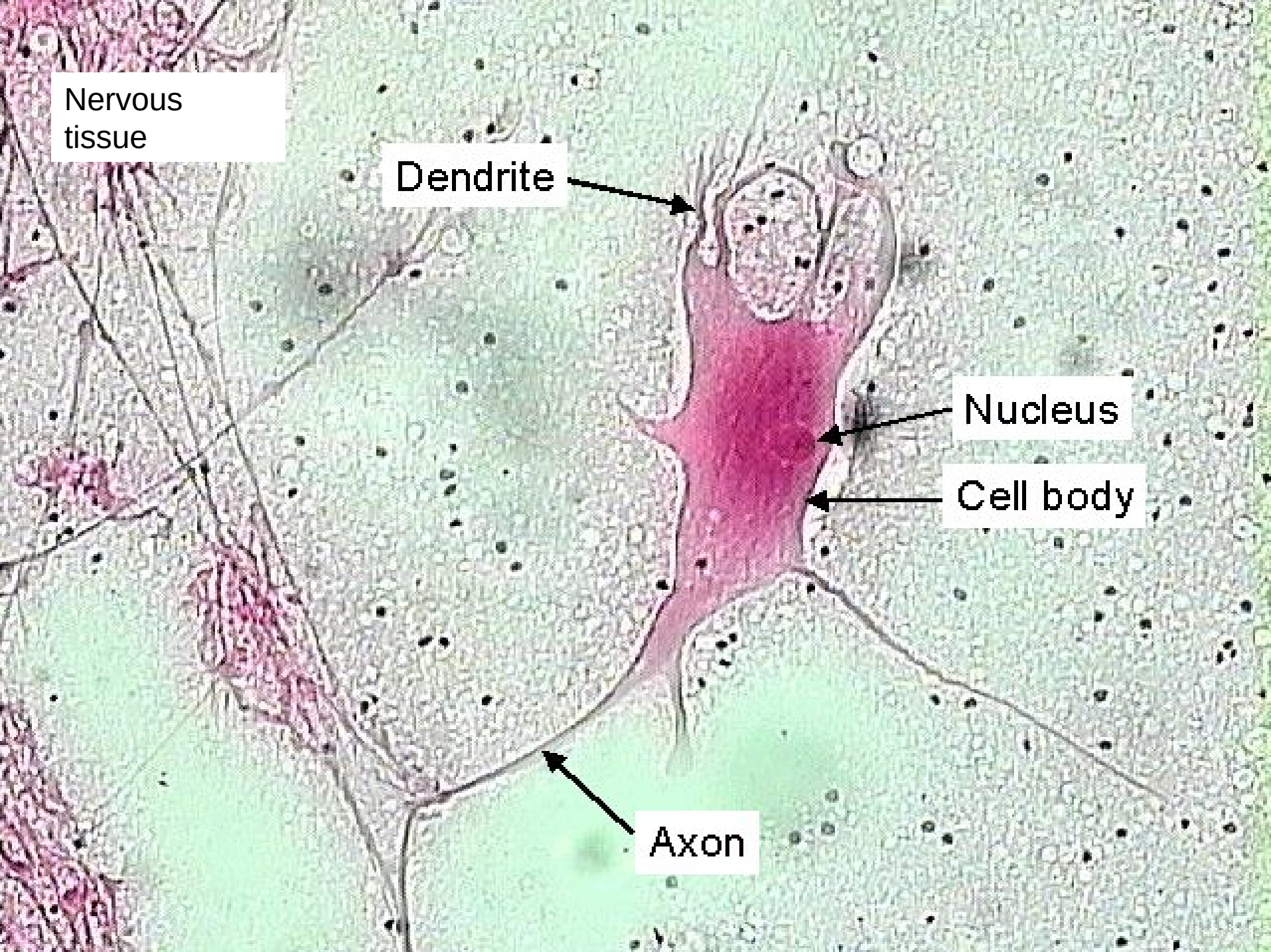
Fig 3.21




Contain Intercalated discs

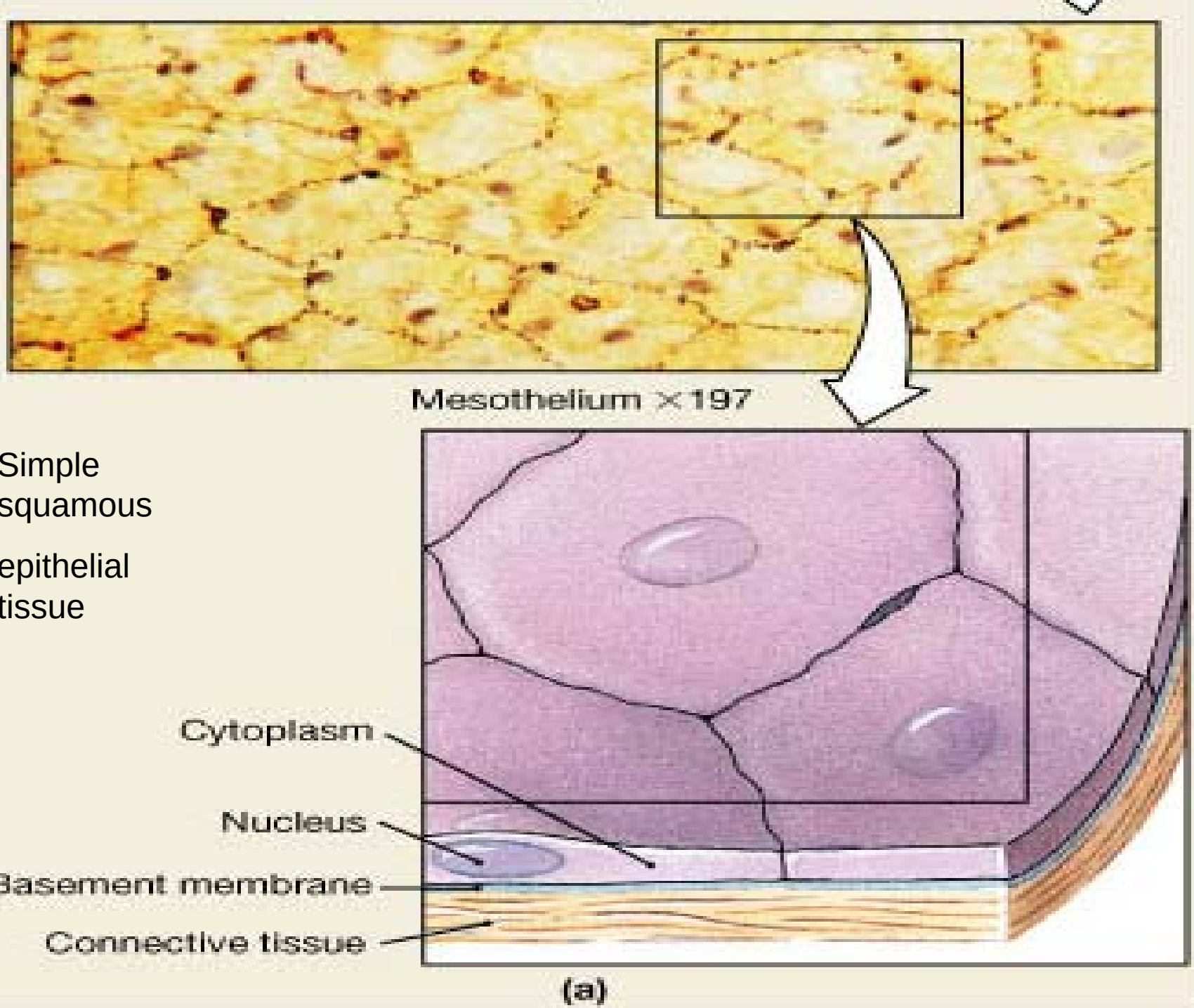
# Nervous tissue

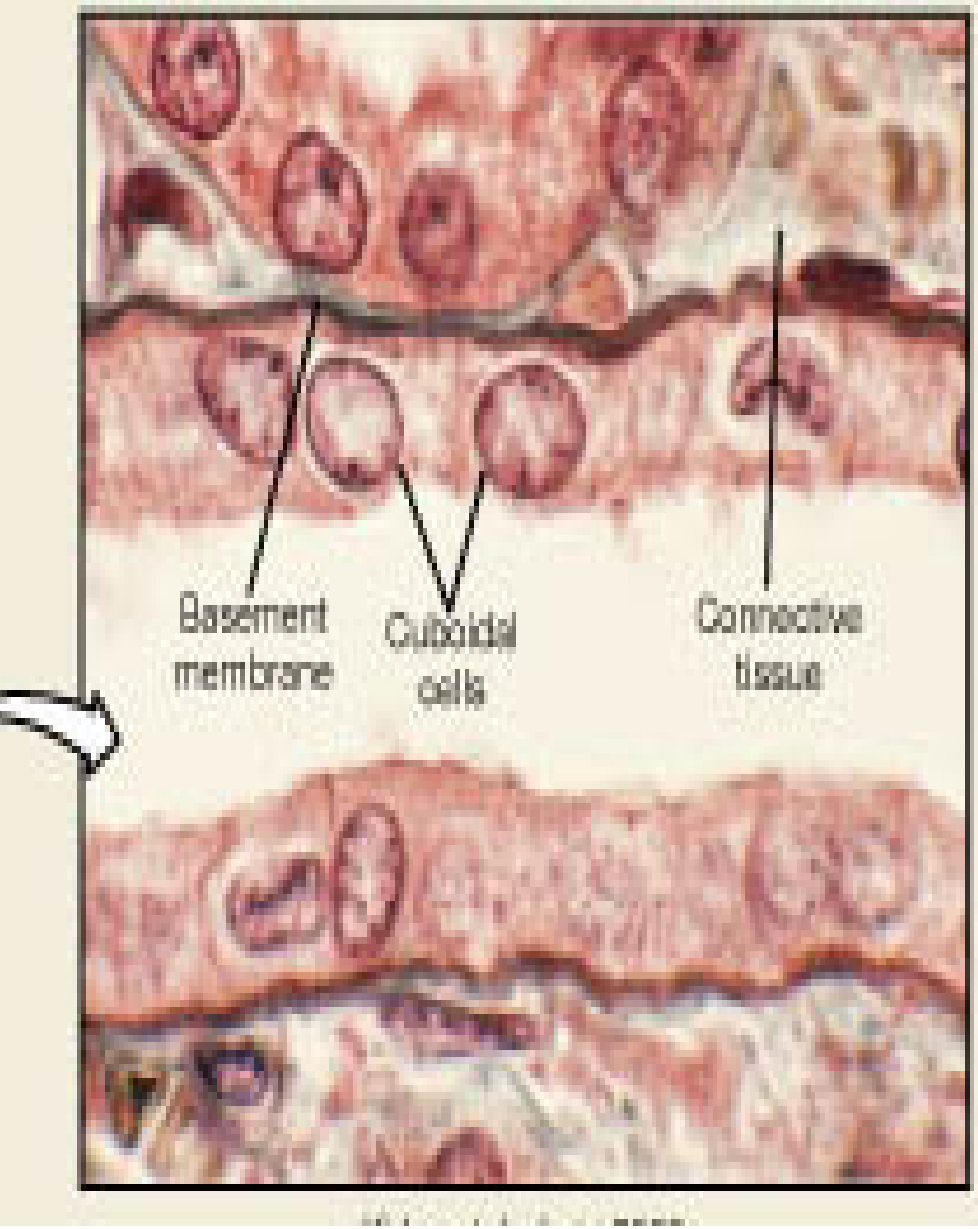
- Nervous tissue is capable of transmitting electrical impulses.
- Located in the brain (96%), spinal cord, nerves
- Two types of cells:
- Neurons-transfer and process information Neuroglia-supporting cells
- 5 neuroglia cells to 1 neuron

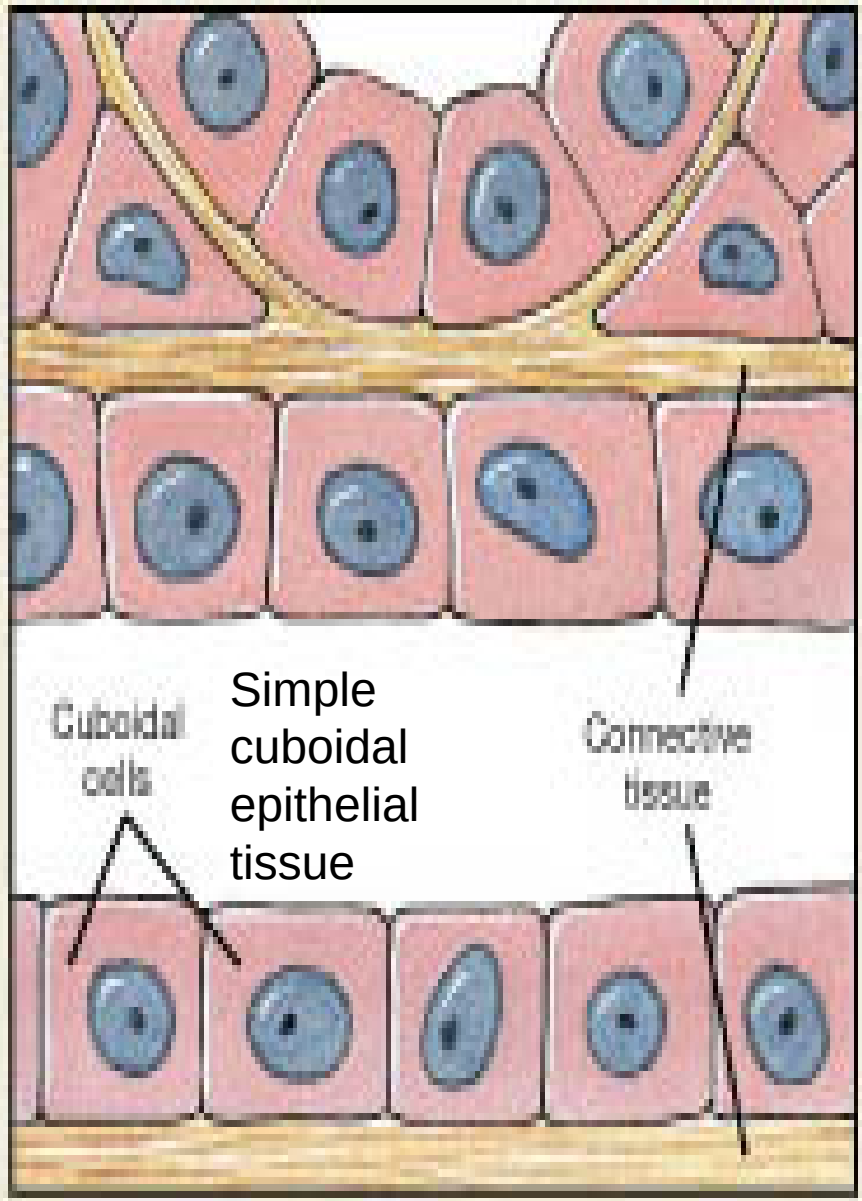

Nervous tissue
Dendrite
Nucleus
Cell body
Axon

# Lab 4

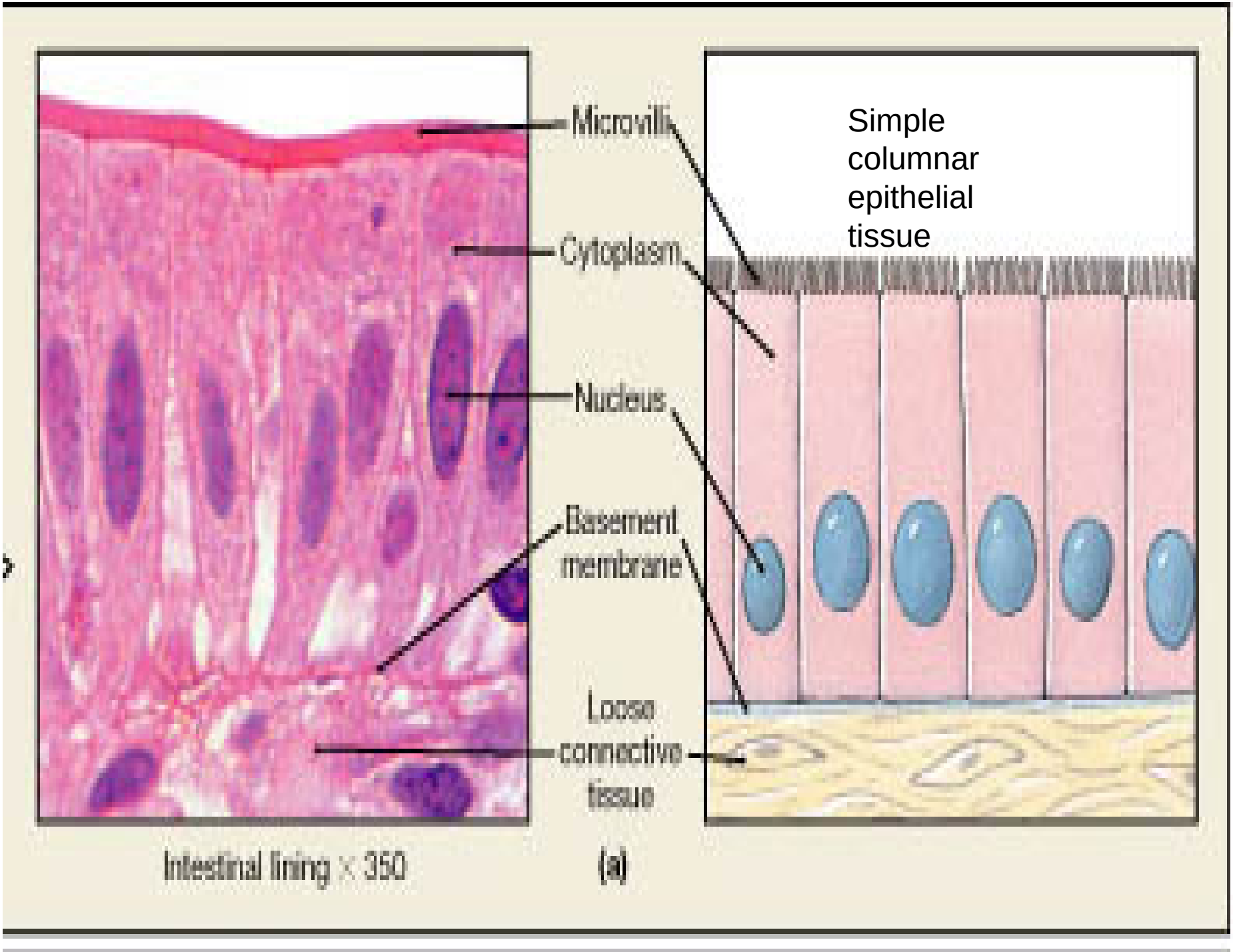
Simple squamous epithelial tissue

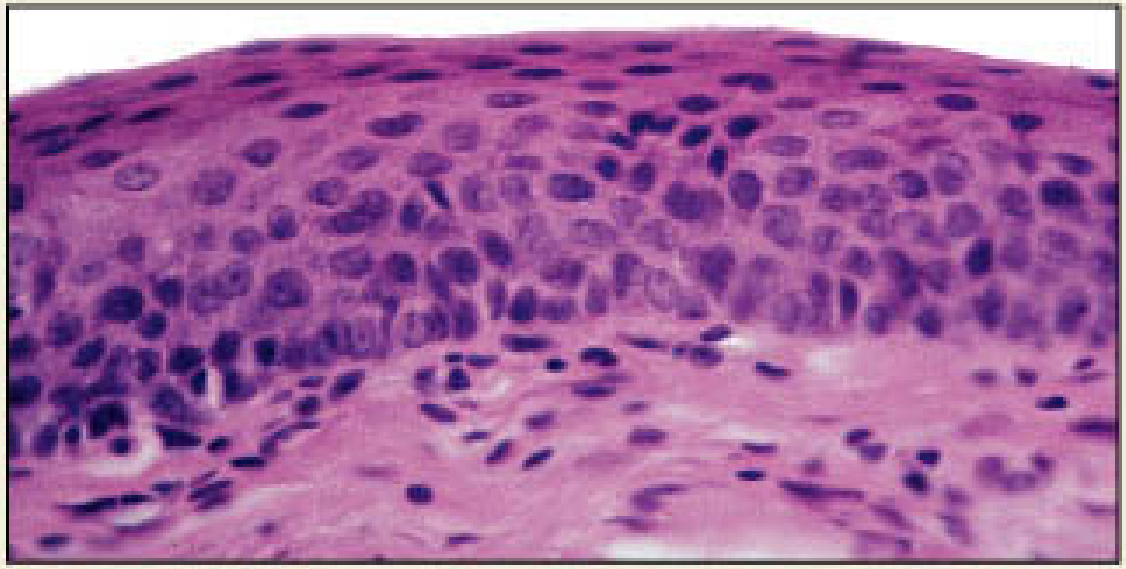




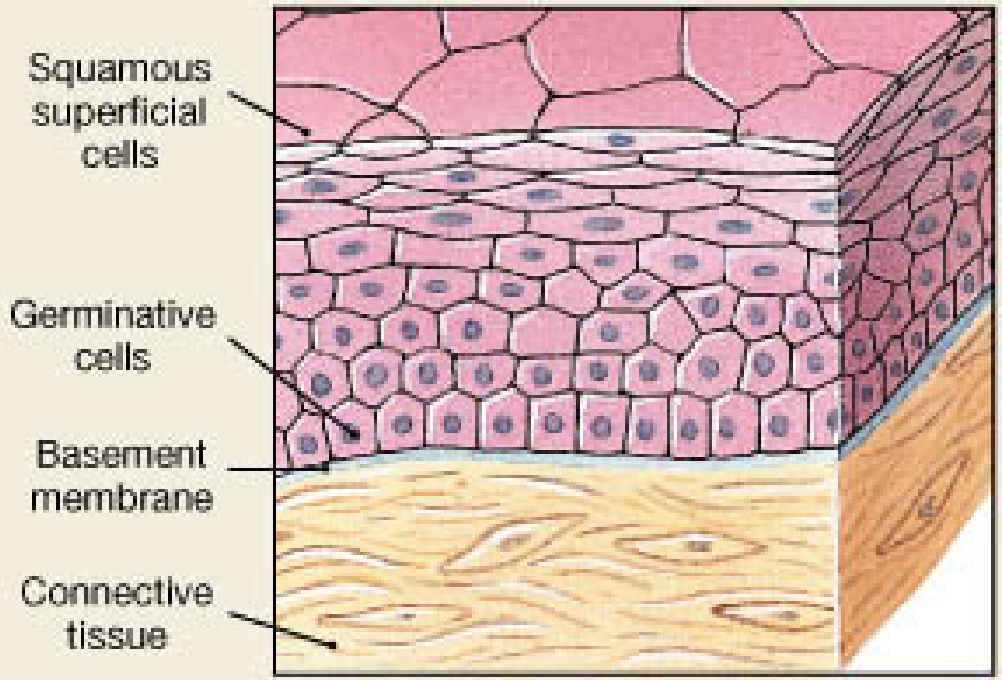




Simple cuboidal epithelial tissue

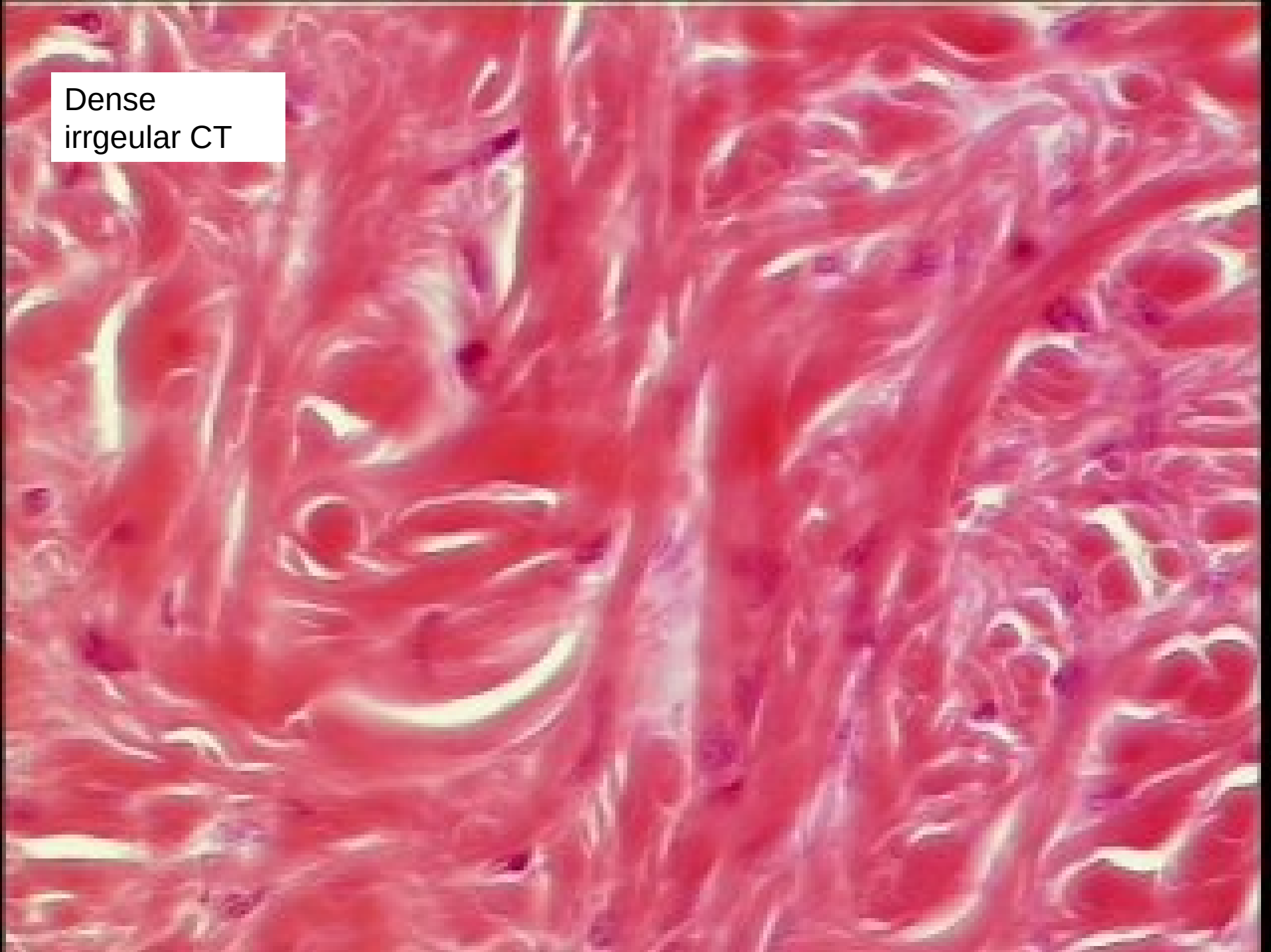

Microvilli
Cytoplasm
Nucleus
Basement membrane
Loose connective tissue
Simple columnar epithelial tissue
Intestinal lining × 350
(a)

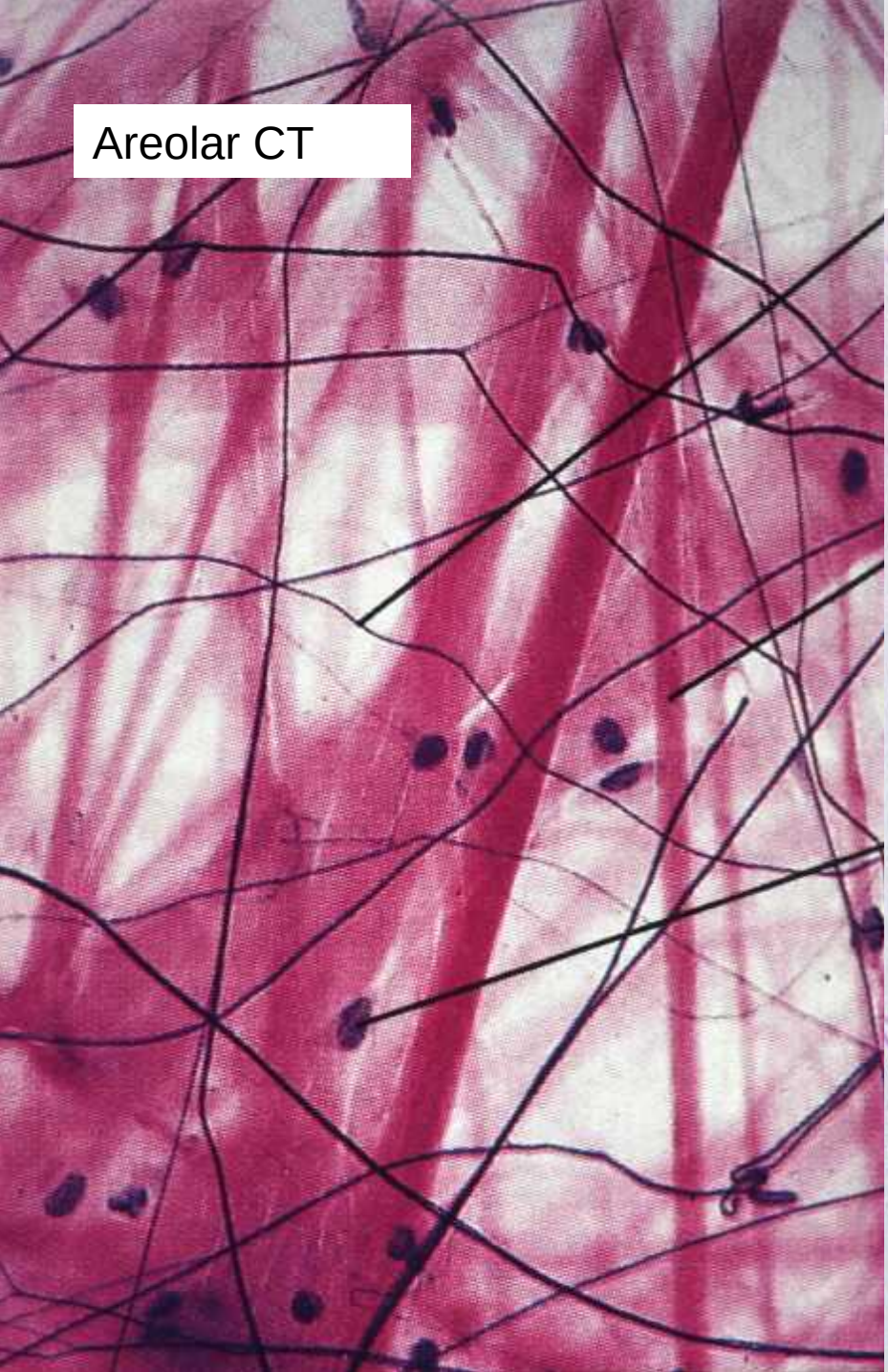


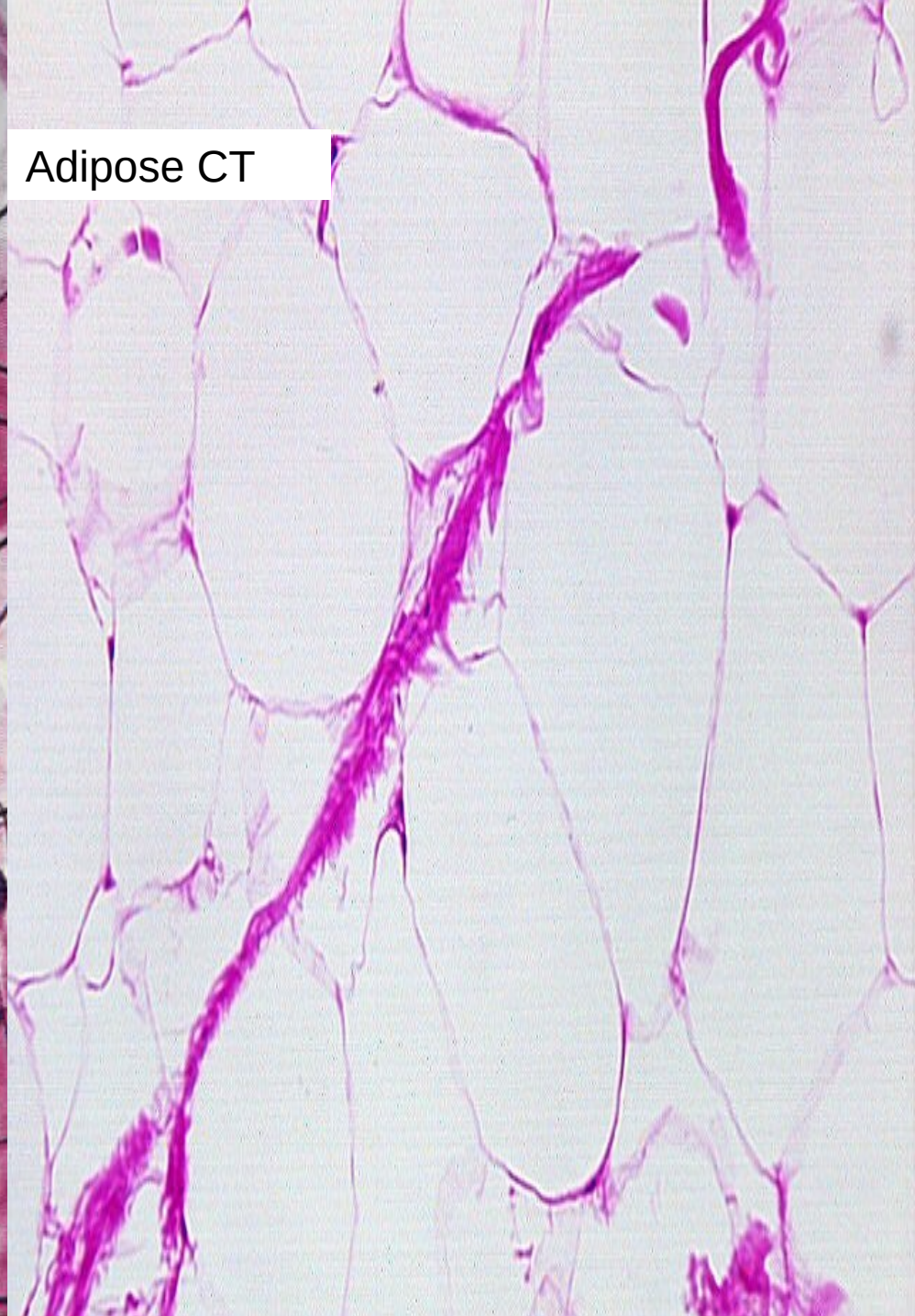
Stratified squamous epithelium (nonkeratinized) × 310



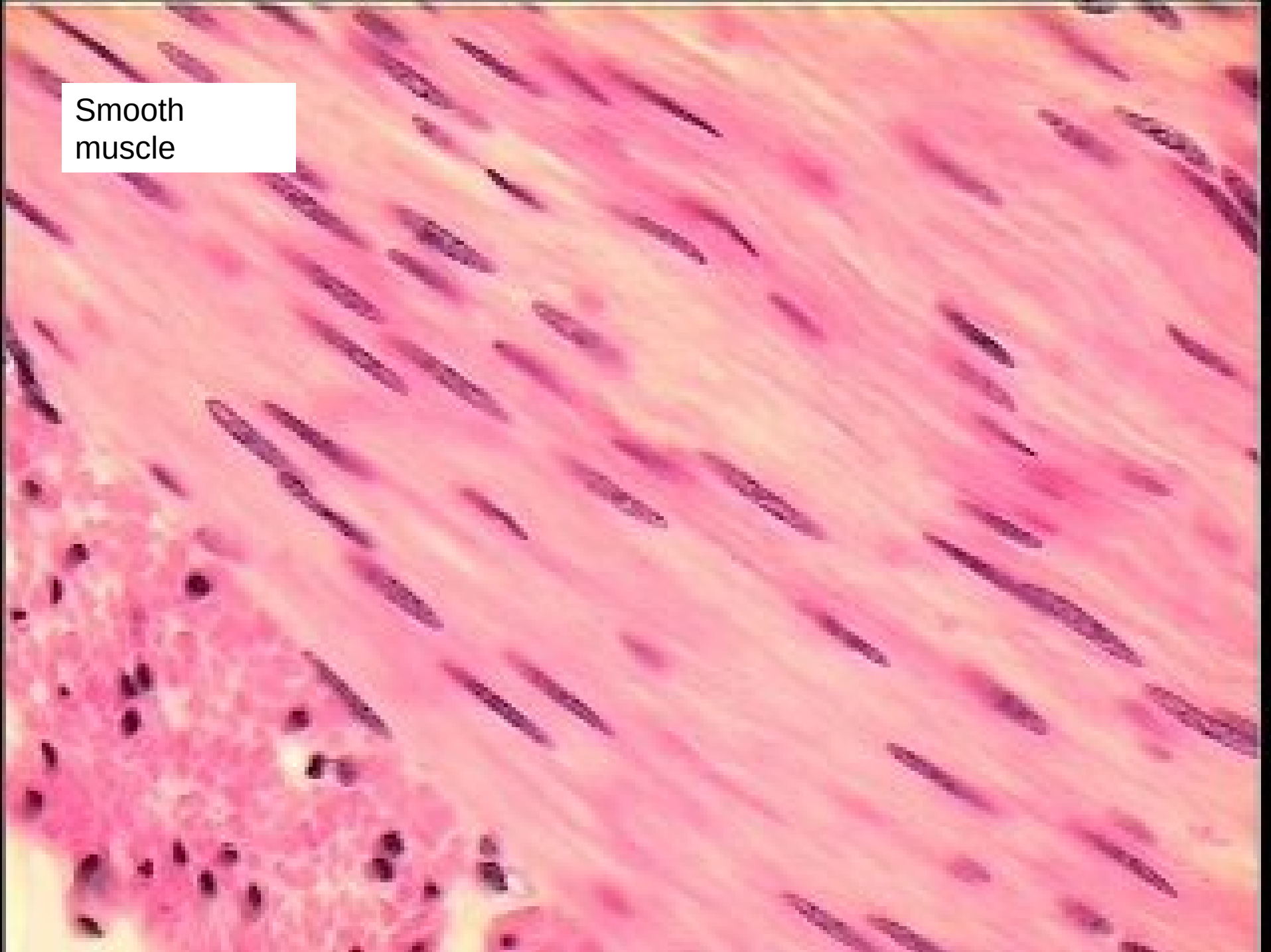

(b)

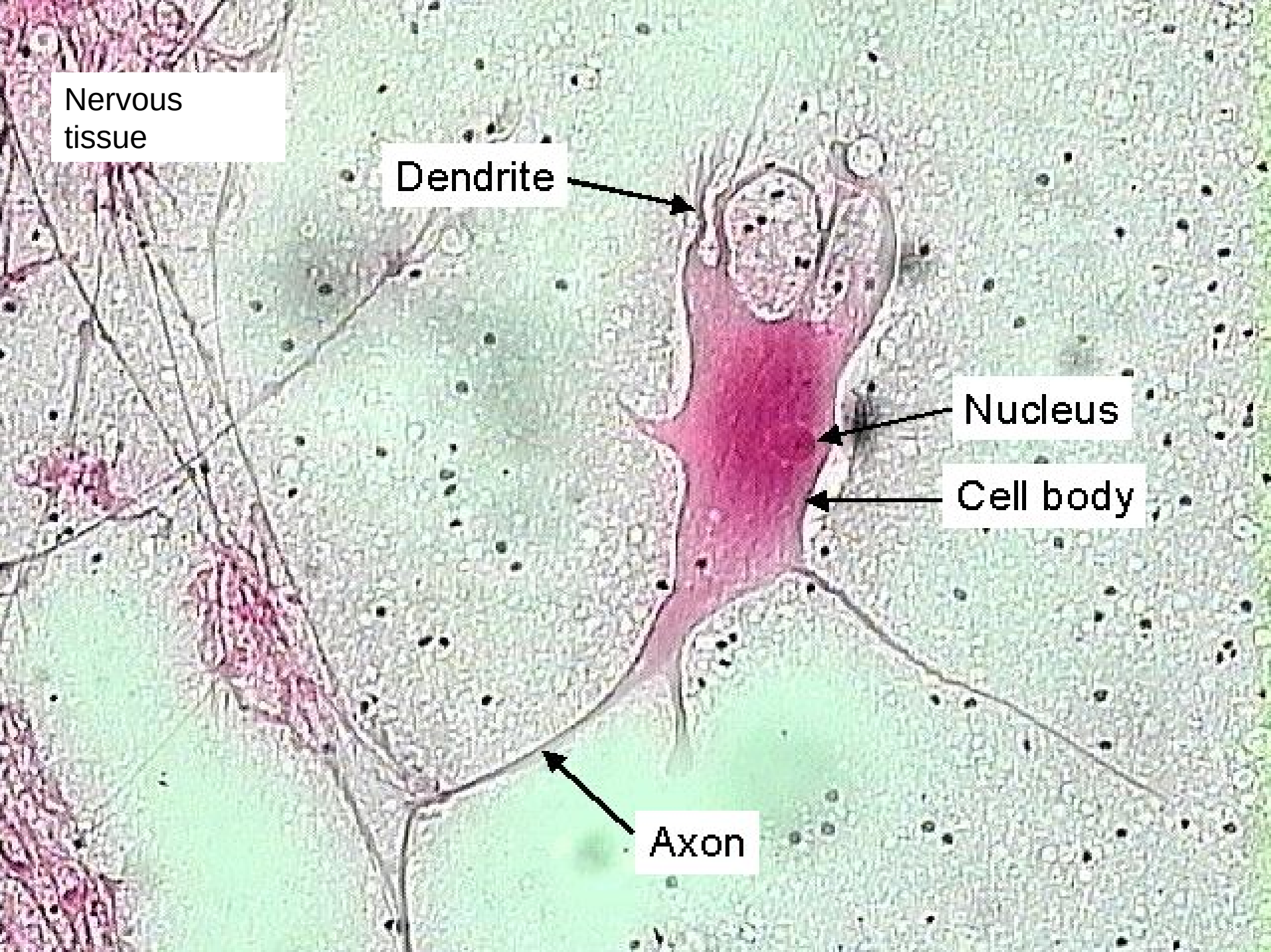

Dense
irrgeular CT


Areolar CT


Adipose CT


Hyaline
cartilage


Smooth
muscle


Nervous tissue
Dendrite
Nucleus
Cell body
Axon