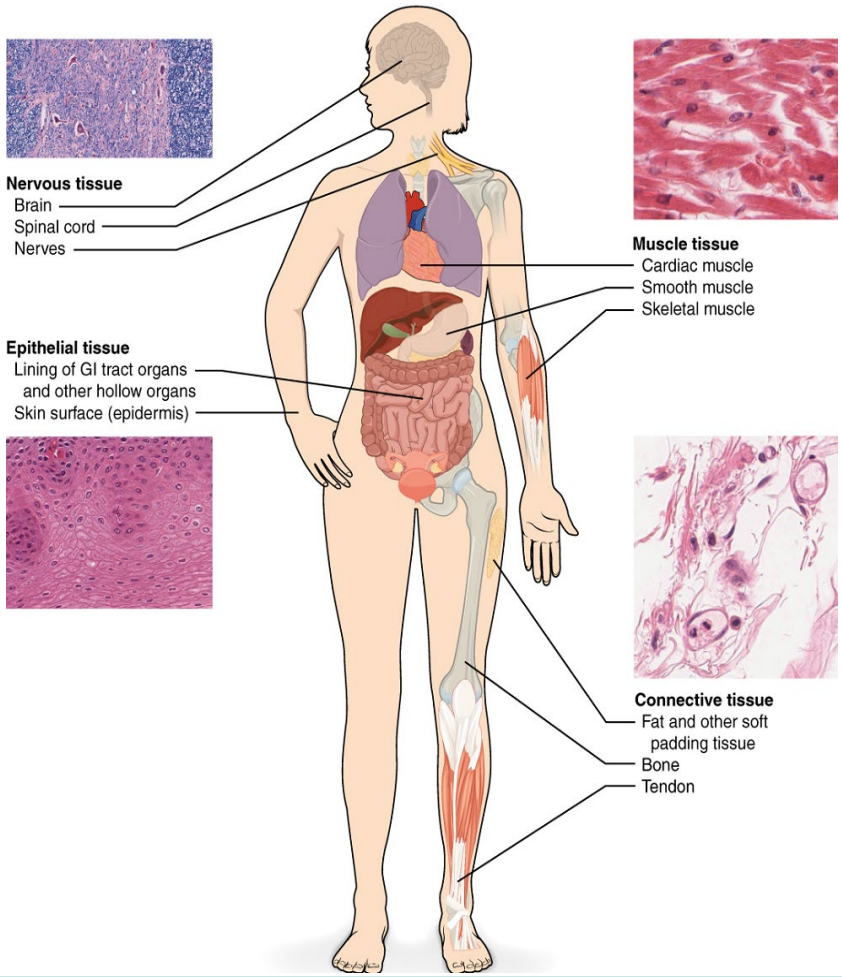
BIOLOGY 1103/1109
Human Anatomy and Physiology I



Unit 6

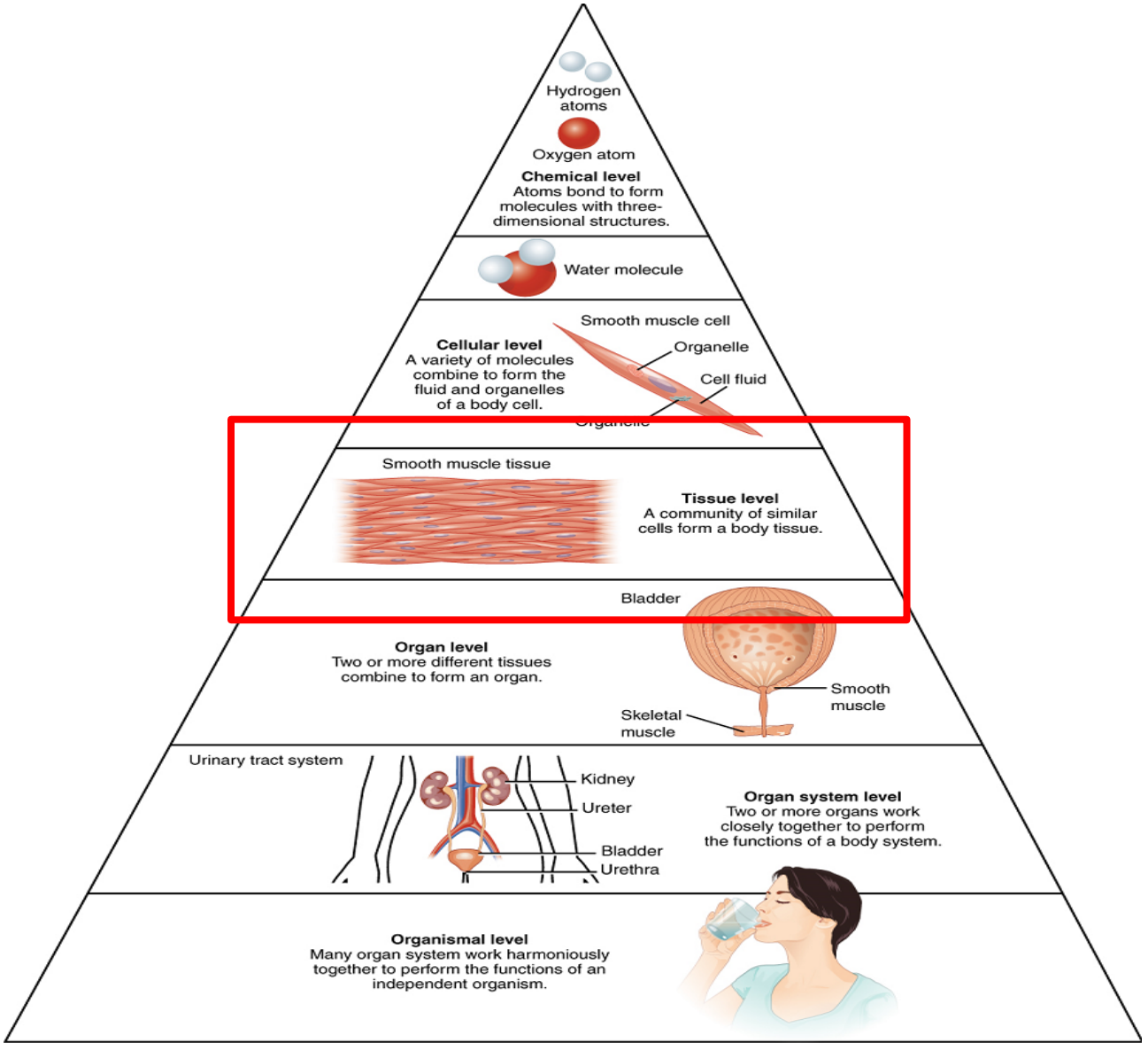
Tissue structure

Tissue structure

Objectives

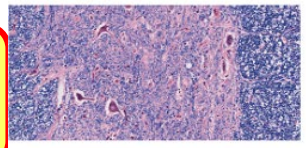
1. Define tissue and describe the importance of tissue level organization to an organism.
2. Describe the structure and function of epithelial tissue.
3. Describe the structure and function of connective tissue.
4. Describe the structure and function of muscle tissue.
5. Describe the structure and function of nervous tissue.
6. Explain the relationships between structure and function of tissues.

Levels of structural organization of the body

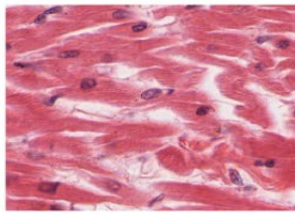


The four types of tissues

Information flow and control



Nervous tissue
Brain
Spinal cord
Nerves

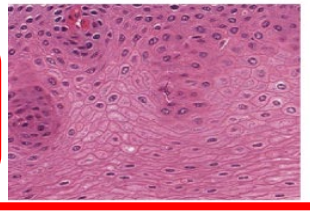


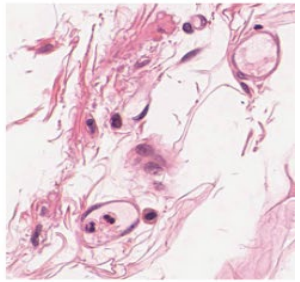
Muscle tissue
Cardiac muscle
Smooth muscle
Skeletal muscle

Movement and heat

Covers, linings and secretions

Epithelial tissue
Lining of GI tract organs and other hollow organs
Skin surface (epidermis)



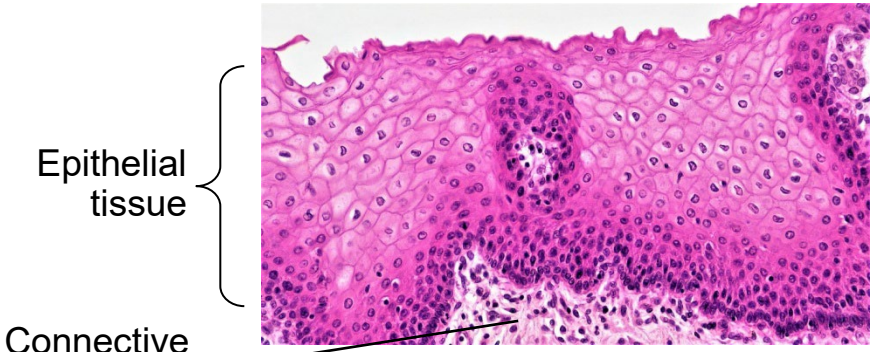


Connective tissue
Fat and other soft padding tissue
Bone
Tendon

Protection and support

Epithelial tissue

Main characteristics
- Lines & covers other tissues - Cells are tightly packed together - Little extracellular matrix (ECM) - Avascular (no blood vessels) but sometimes innervated (nerve fibers) - Typically adjoining connective tissue



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Function	Examples
Selective barrier for exchanges of substances	- Lining of small intestine that absorbs digested food - Lining of alveoli in lungs that exchanges gases
Physical protection	Protect underlying tissues from UV light, abrasion, corrosion, water loss, pathogens
Secretion of cellular substances	Mucus produced by goblet cells in epithelial lining of airways, digestive tract and skin

Epithelial tissue

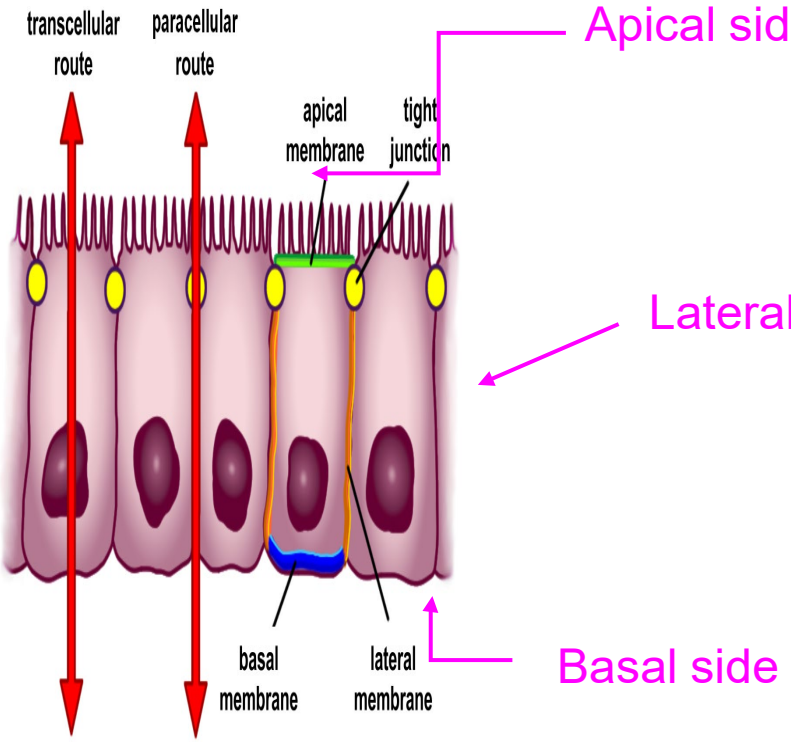
three surfaces: apical, lateral and basal

Outside or Lumen of organ/tube/vessel

Epithelium

Basement membrane

Connective tisue



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Apical = outside or free surface

Lateral = between cells

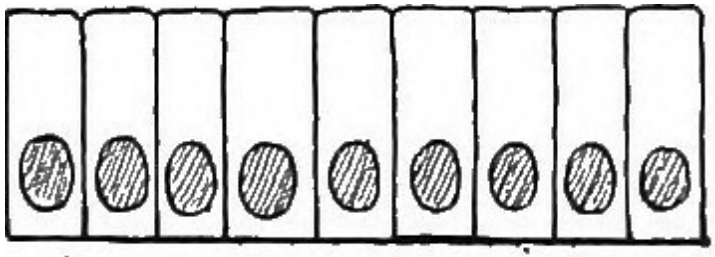
Basement = two layers that act as anchors

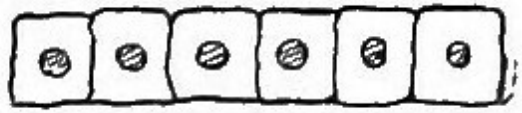
Epithelial tissue has nerves but is avascular (no blood)

Epithelial tissue
(act as barrier and secretory surfaces)

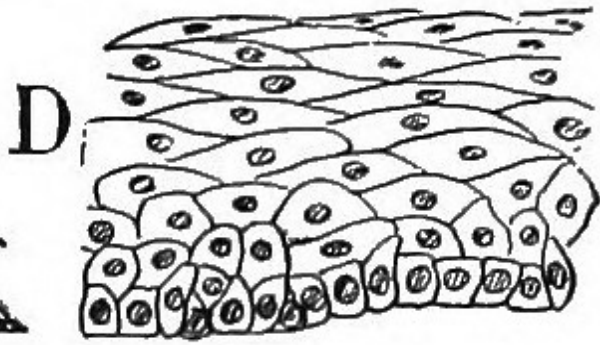
classification

Columnar





Cuboidal



Squamous

Simple

Stratified

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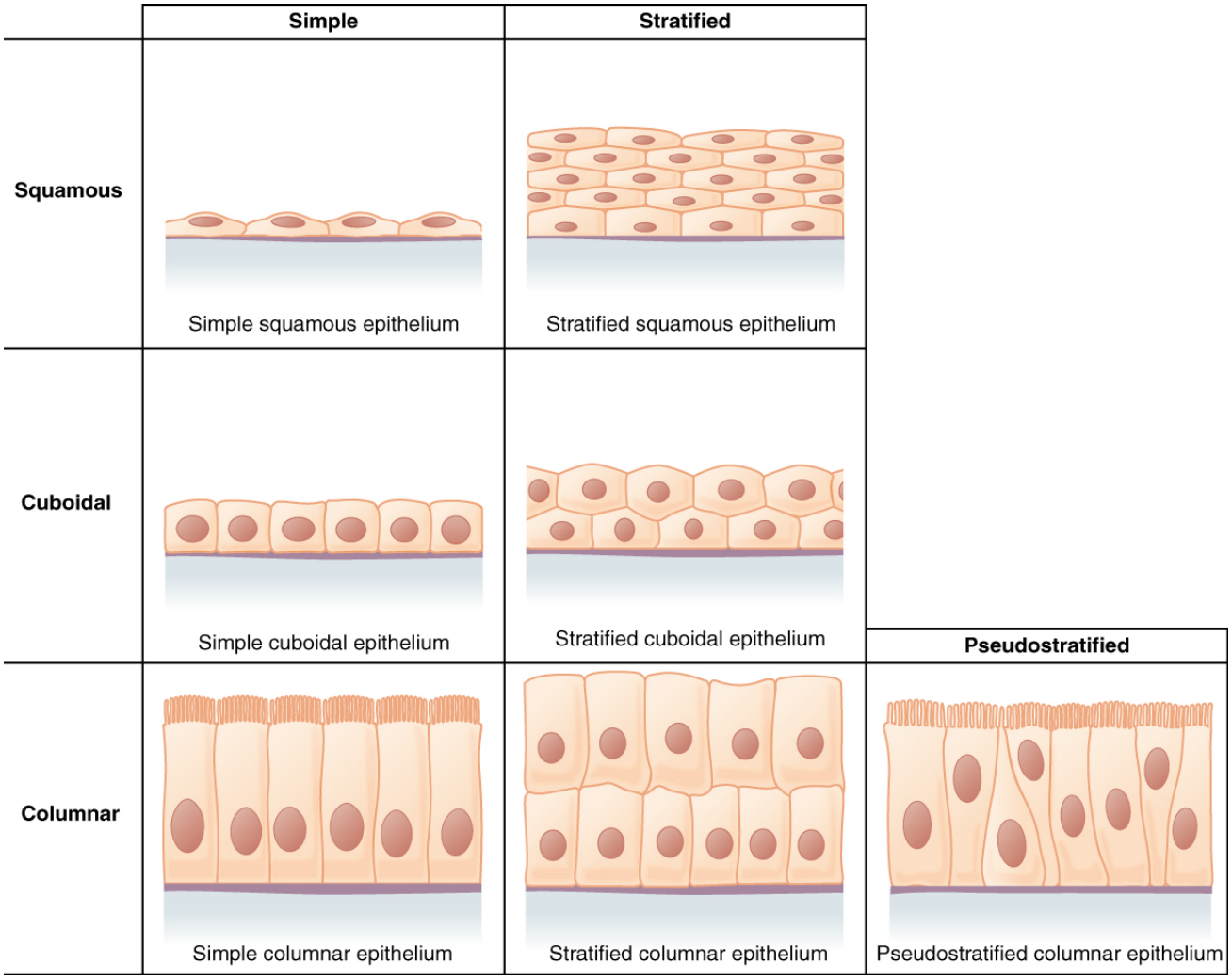
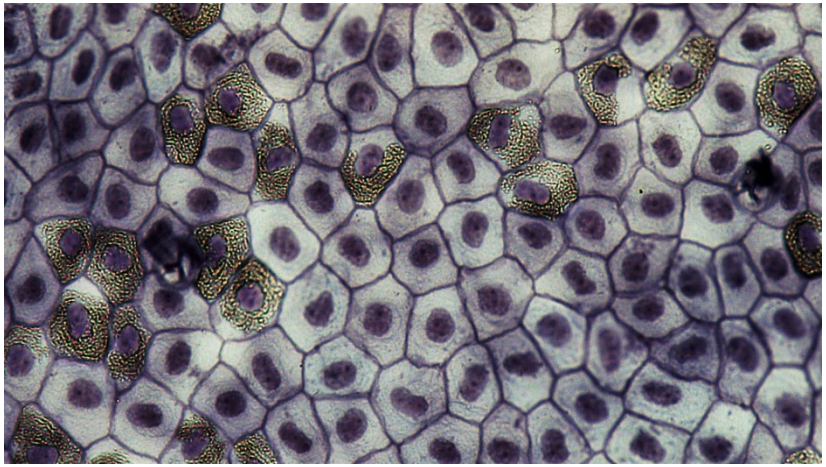
Epithelial tissue classification



Epithelial tissue

simple squamous epithelium



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- **Simple squamous epithelium**
- The thin scale-like cells allows for rapid _____exchange_____
- The alveoli of lungs where gases diffuse, segments of kidney tubules, and the lining of capillaries are made of simple squamous epithelial tissue.

Epithelial tissue

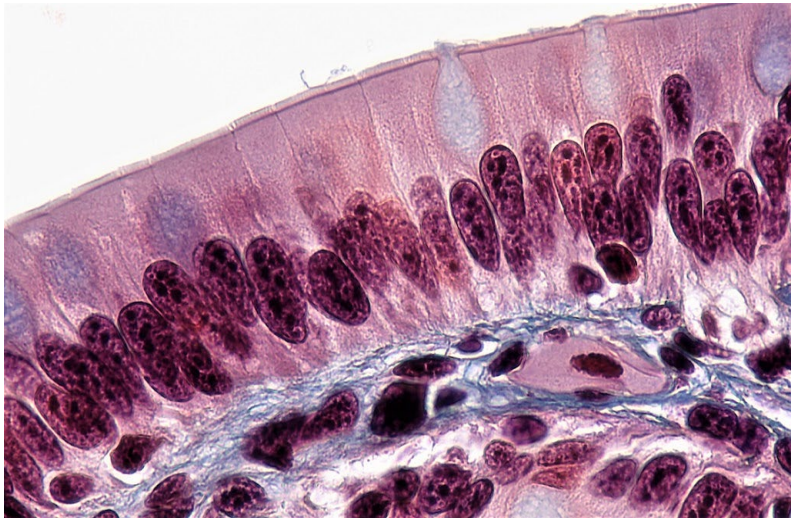
simple cuboidal epithelium

Flickr.com

- In **simple cuboidal epithelium**, the nucleus of the Box-like cells appears round and is generally located near the center of the cell.
- Function in the secretion and absorptions of molecules.
- Simple cuboidal epithelia are observed in the lining of the kidney tubules and in the ducts of glands

Epithelial tissue

simple columnar epithelium



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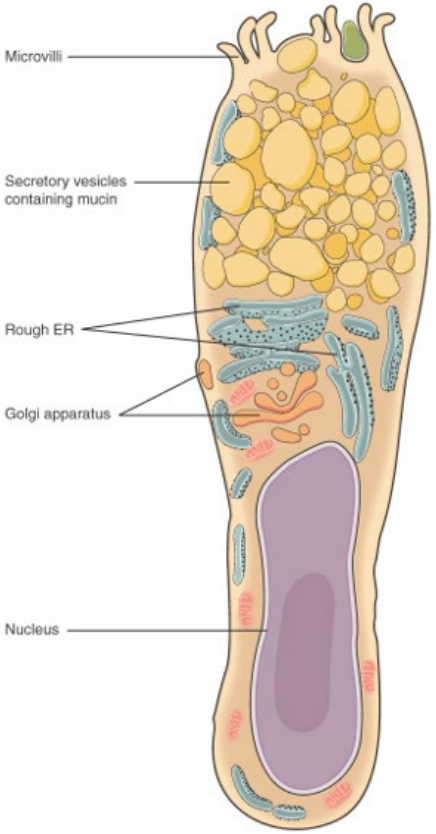
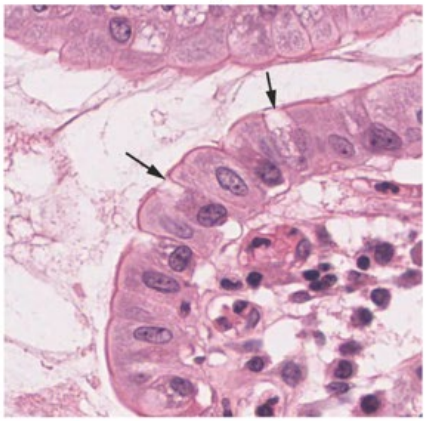
- In **simple columnar epithelium**, the nucleus of the tall column -like cells is elongated and located in the basal end of the cells.
- Active in the absorption and secretion of molecules.
- Forms the lining of some parts of the digestive system and the female reproductive tract.
- Some have cilia and are found lining the fallopian tubes and parts of the respiratory system

Epithelial tissue

pseudostratified columnar epithelium



(a)

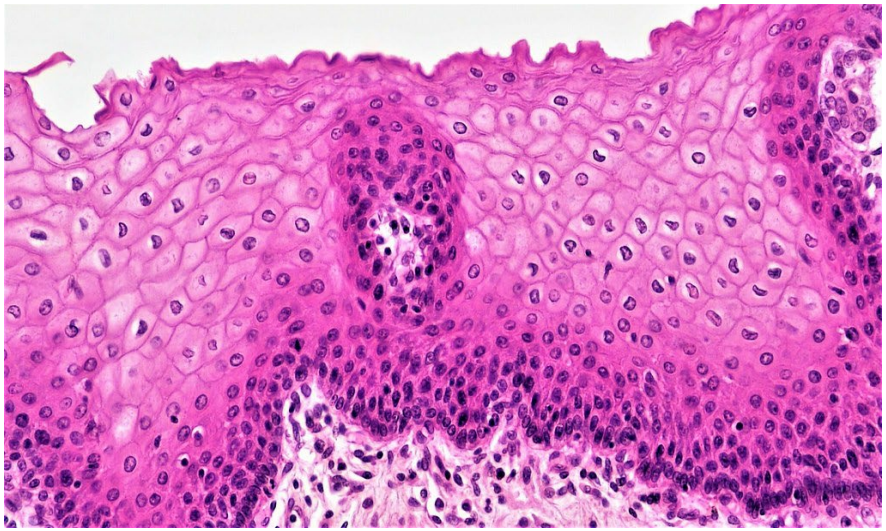


(b)

- Nuclei of neighboring cells appear at different levels which gives the appearance of stratification.
- Found in the respiratory tract, where some of these cells have cilia.
- Some have goblet cell = is a mucous-secreting unicellular “gland” interspersed between the columnar

Epithelial tissue

stratified squamous epithelium



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- The stratified epithelium is named by the shape of the most _____ layer of cells, closest to the free space

  apical

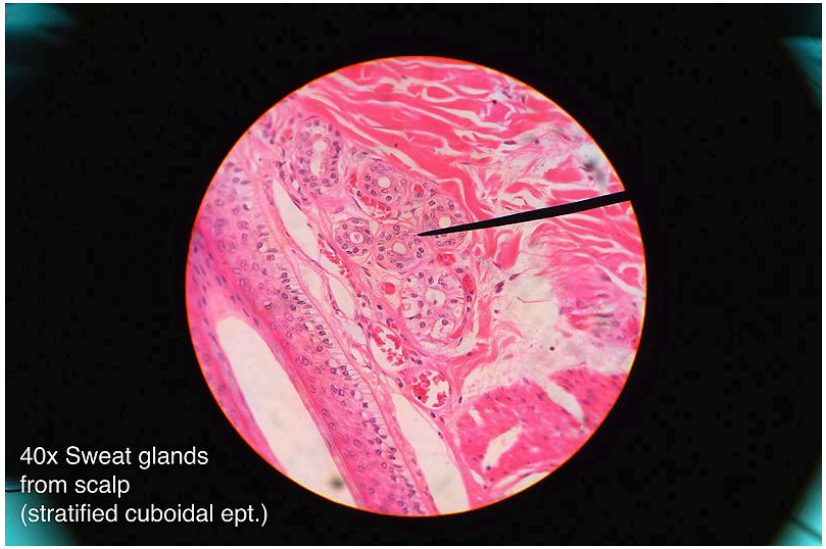
- **Stratified squamous epithelium** is the most common type in the human body

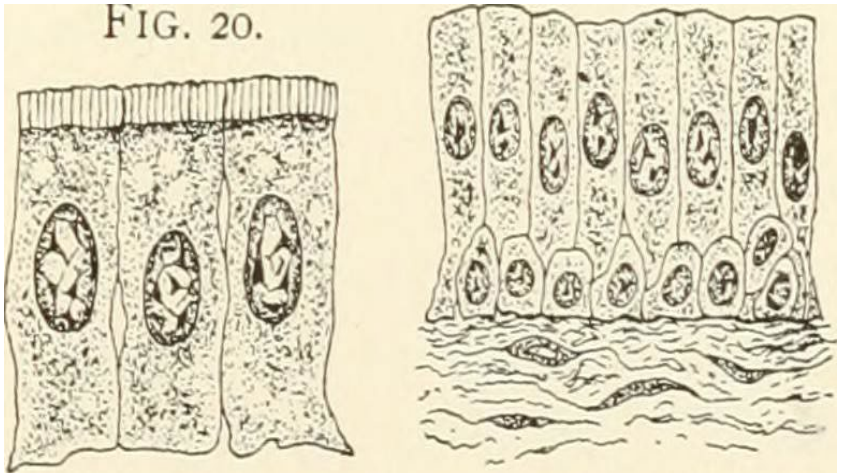
- Found lining the mouth cavity

  AND Skin

Epithelial tissue

stratified cuboidal and columnar epithelium





- **Stratified cuboidal epithelium** and **stratified columnar epithelium** are found in certain glands and ducts but are uncommon in the human body.

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Epithelium summary

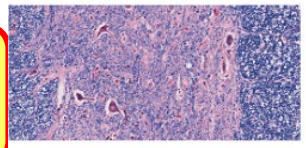
Type	Examples of locations	Main functions
simple squamous epithelium	Serous membranes, lungs, kidneys, blood capillaries	Reduce friction, exchange of materials (via filtration, secretion, diffusion)
simple cuboidal epithelium	Various glands & ducts, retina, kidney tubules	Secretion & absorption of materials
simple columnar epithelium	Digestive tract, respiratory airways, uterus	Secretion & absorption of materials, ciliated cells move substances, limited protection
stratified squamous epithelium	Tongue, mouth, throat, esophagus, skin, rectum	Protect underlying tissues
stratified cuboidal epithelium	Ducts of sweat, mammary & esophageal glands	Physical protection, secretion & absorption of materials
stratified columnar epithelium	Ducts of esophageal glands, urethra, nasal cavity, pharynx	Physical protection, secretion of materials

Uncommon

study for their pictures as well for the quiz

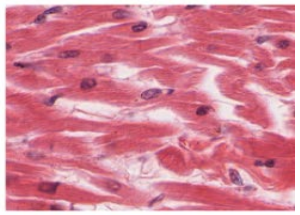
The four types of tissues

Information flow and control



Nervous tissue
Brain
Spinal cord
Nerves

Movement and heat



Muscle tissue
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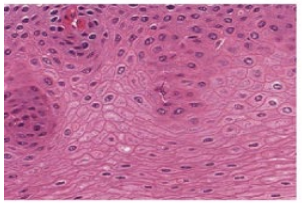
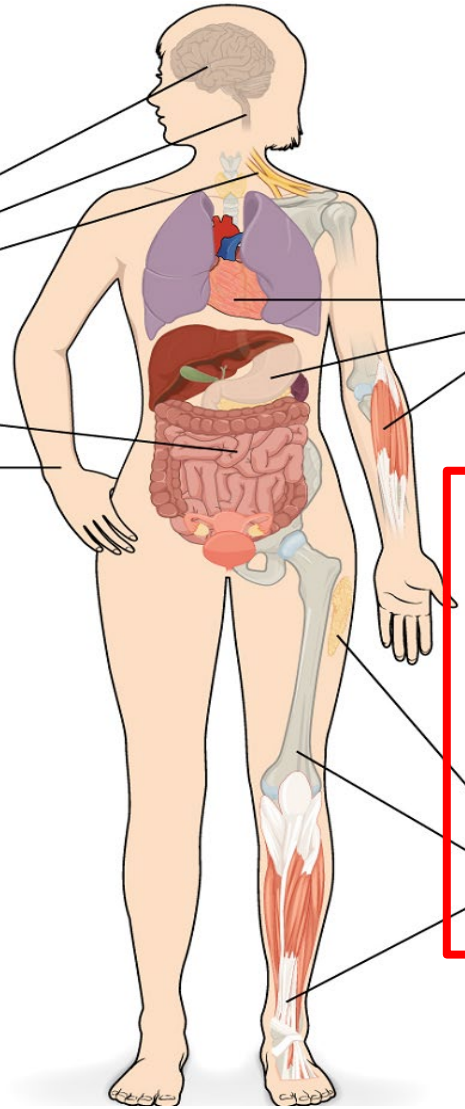
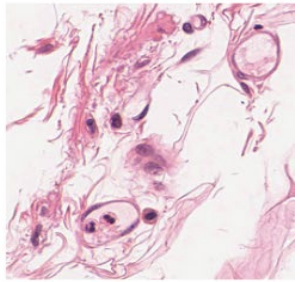
Skin surface (epidermis)

Covers, linings and secretions







Connective tissue
Fat and other soft padding tissue
Bone
Tendon

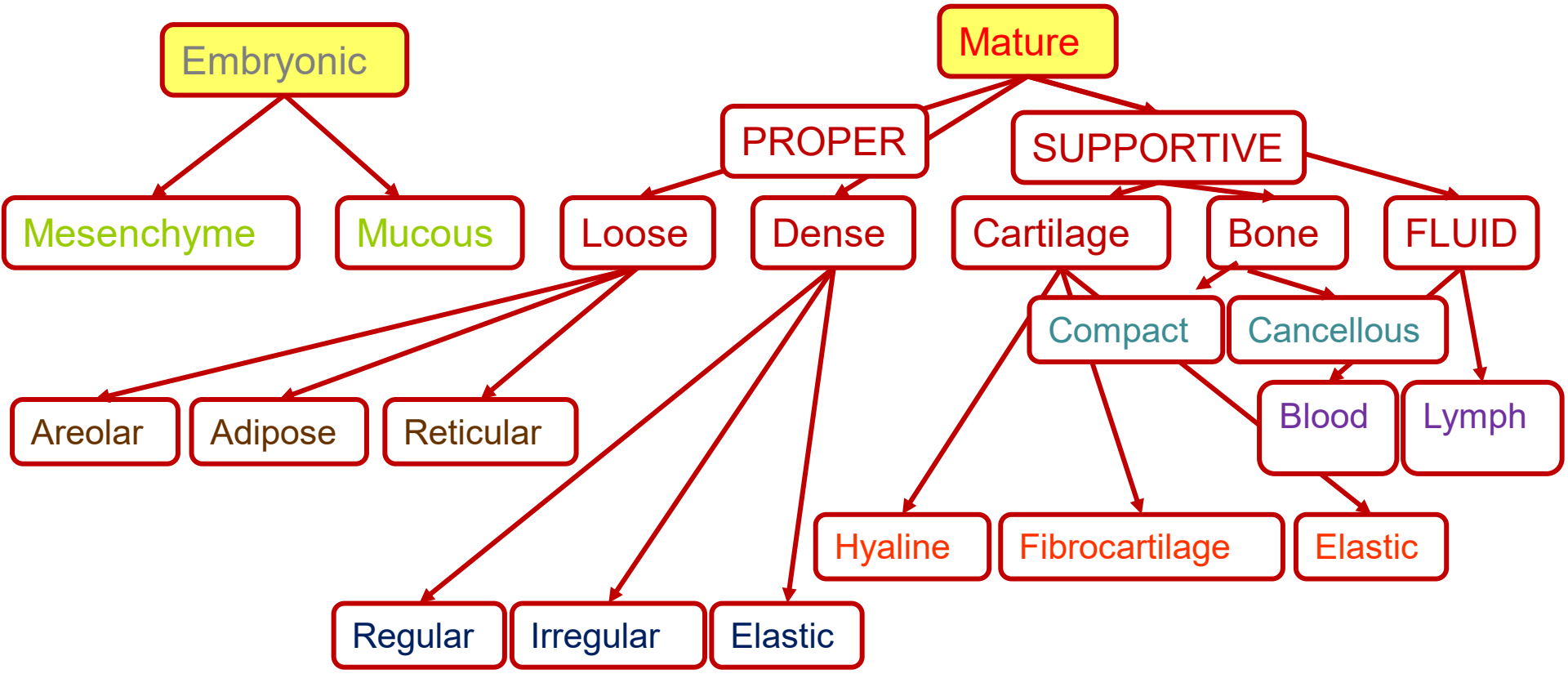
Protection and support

Connective tissue

General structure	- Abundant & widely distributed - Loosely arranged cells (various cell types) - Rich & extensive ECM with fibers - Usually vascular (blood vessels) & innervated (nerve fibers)
Major functions	- Structural support - Connect other tissue types - Transport of substances - Insulation - Storage of energy reserves

Connective tissue

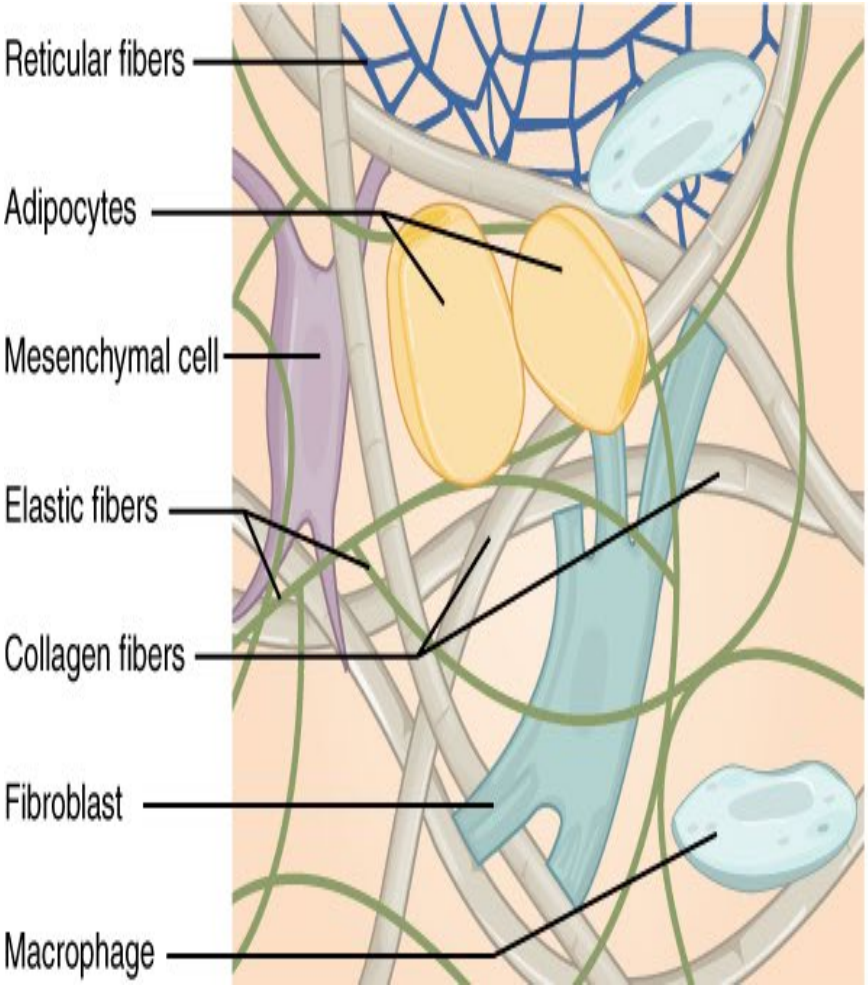
classification



- Diverse in structure and appearance but all similar in that all have a small number of cells and a large amount of extracellular material called matrix

Connective tissue

typical components



Connective tissue

cell types and extracellular matrix

Cell types include: -blasts (immature cell, still growing)

Fibroblasts : secrete polysaccharides and proteins

Adipocytes: stores lipids -cytes (mature cell)

Mesenchymal cells: adult stem cells

Macrophage, lymphocytes and plasma cells: cells of the immune system

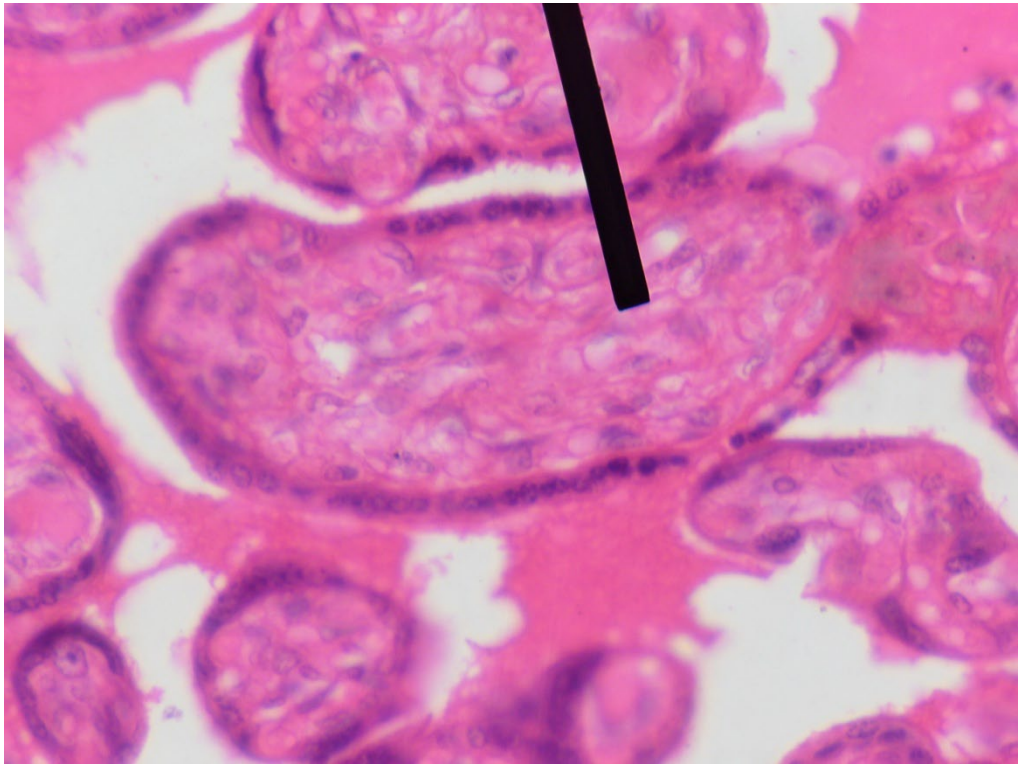
Mast cells: contain histamine and heparin

Extracellular matrix included protein fibers (collagen, elastic and reticular) and ground substance.

The nature of ground substance changes between the different types of connective tissue; can range from fluid to calcified structures.

Embryonic connective tissue

Mesenchyme



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- Immature precursor type in embryo
- These tissues give rise to all the other types of connective tissues

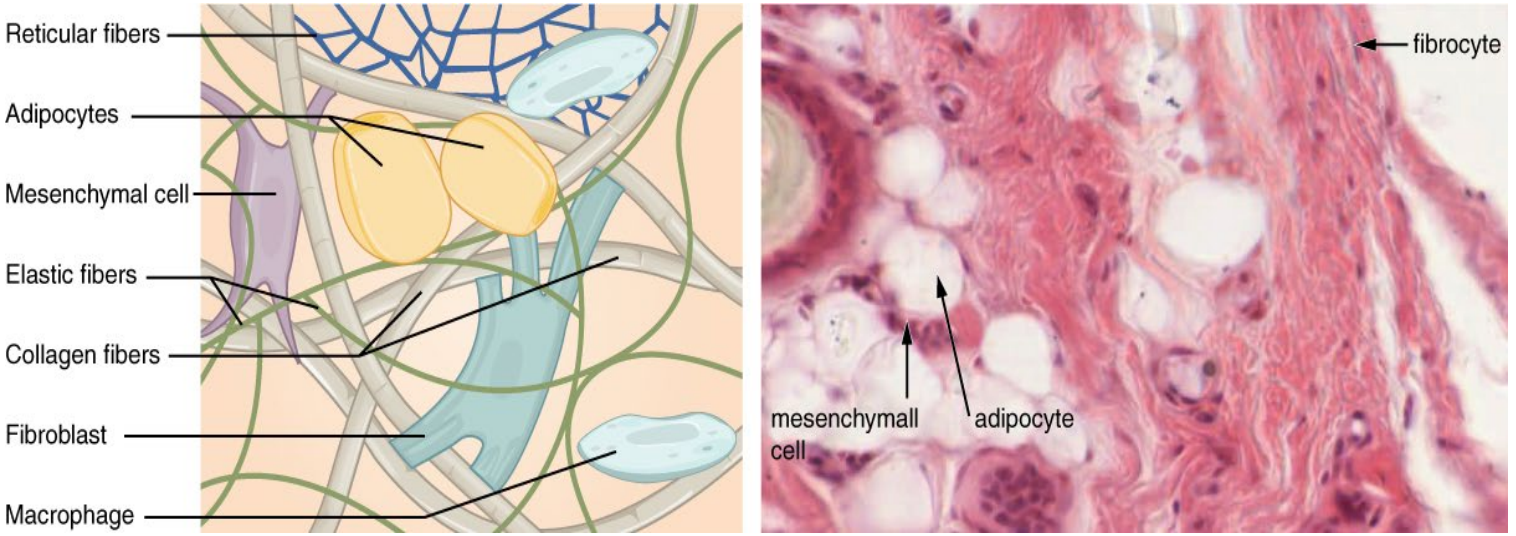
Connective tissue classification

Categories	Types
Loose	- Areolar - Adipose - Reticular
Dense	- Regular - Irregular
Other	- Cartilage (hyaline, fibro, elastic) - Bone (compact, spongy) - Blood

- Loose **connective tissue** is found between many organs where it acts both to absorb shock and bind tissues together.
- It allows water, salts, and various nutrients to diffuse through to adjacent or imbedded cells and tissues.

Connective tissue

areolar



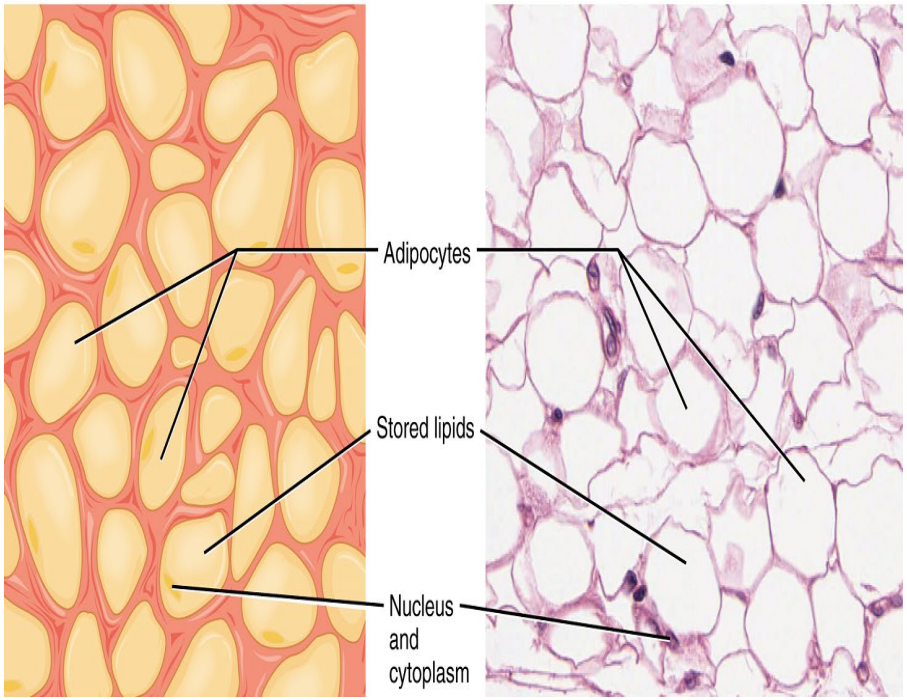
- **Areolar tissue** contains all the cell types and fibers distributed in a random, web-like fashion.

- It fills the spaces between muscle fibers, surrounds blood and lymph vessels, and supports organs in the abdominal cavity.

Connective tissue

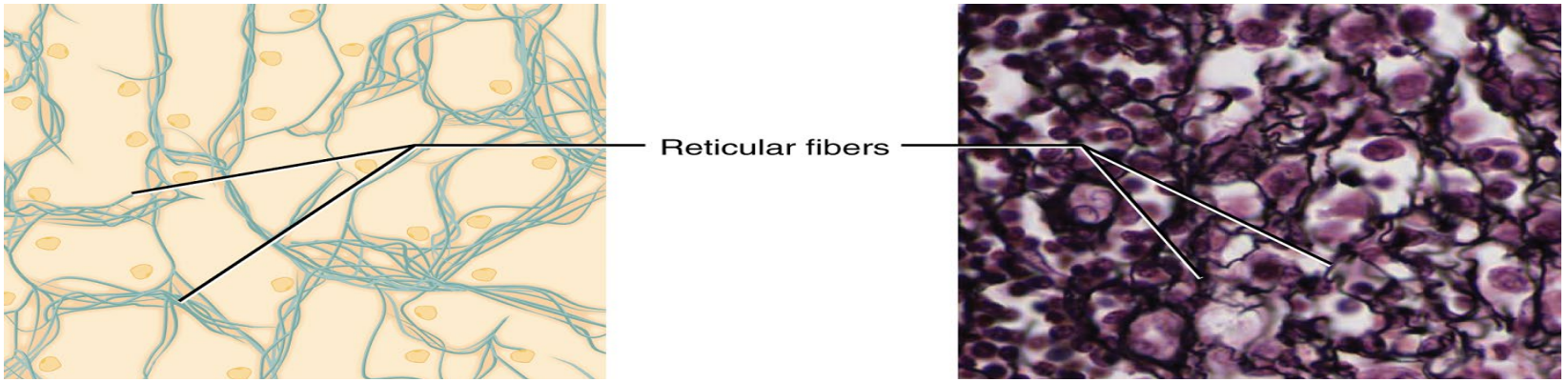
adipose

- **Adipose tissue** consists mostly of fat storage cells, with little extracellular matrix
- A large number of capillaries allow rapid storage and mobilization of lipid molecules
- Lipid storage and can serve as insulation from cold temperatures and mechanical injuries



Connective tissue

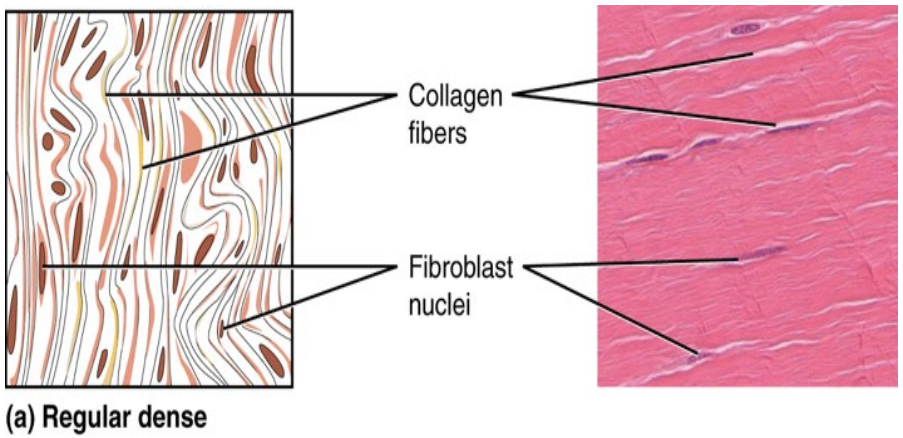
reticular



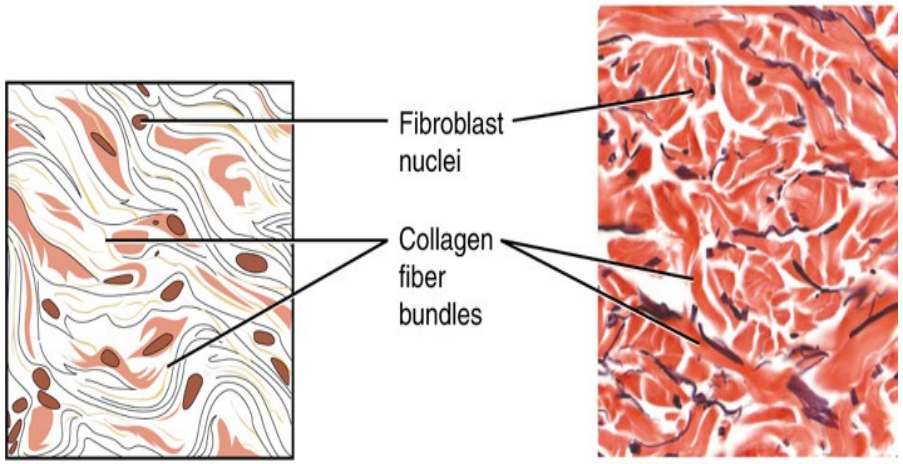
- Reticular **tissue** is a mesh-like, supportive framework for soft organs such as lymphatic tissue, the spleen, and the liver

Connective tissue

dense regular and irregular



(a) Regular dense



(b) Irregular dense

- **Dense connective tissue** contains lots of collagen fibers
  - **Dense regular connective** tissue fibers are parallel to each other, enhancing tensile strength and resistance to stretching.
  - Found in ligaments and tendons
  - In **dense irregular connective** tissue, the direction of fibers is random which gives strength in all directions.
  - Found in the dermis of skin

Connective tissue

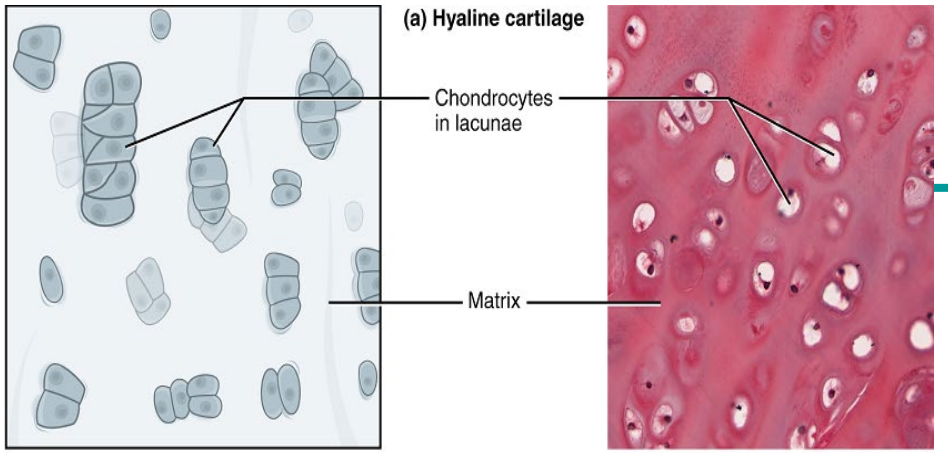
cartilage

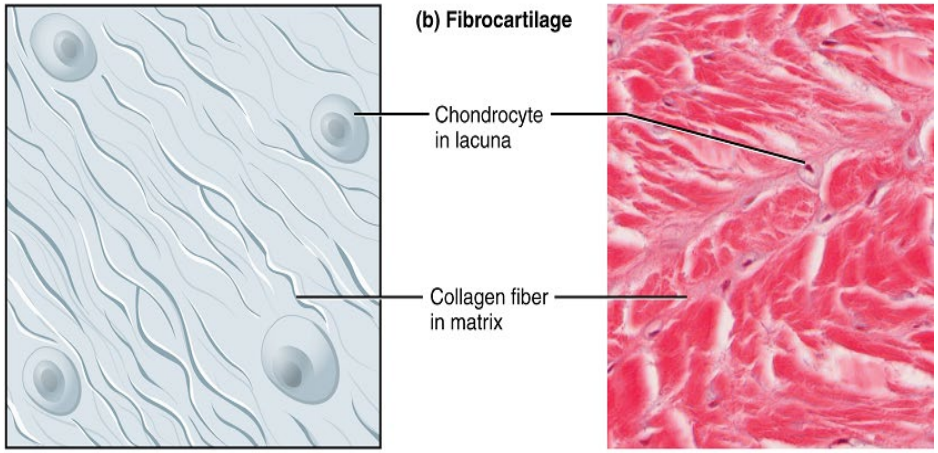
- The distinctive appearance of cartilage is due to polysaccharides called chondroitin sulfates, which bind with ground substance proteins.

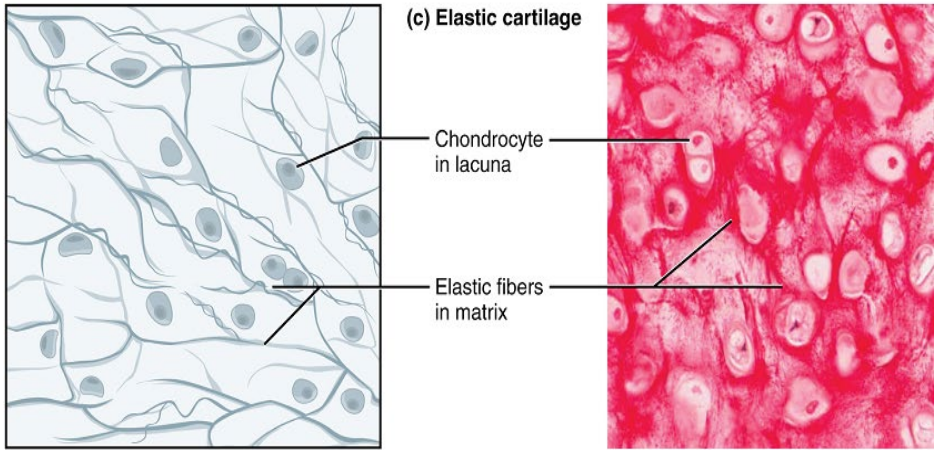
- Embedded within the cartilage matrix are chondrocytes, or cartilage cells, and the space they occupy are called **lacunae.**

- Cartilaginous tissue is avascular, thus all nutrients need to diffuse through the matrix to reach the chondrocytes.

- Three main types of cartilage:



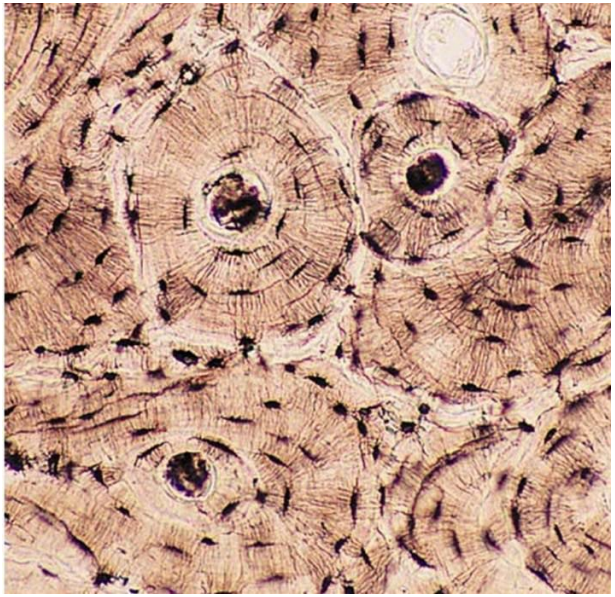




- Hyaline **cartilage** is smooth, strong and flexible
- Found: rib cage and nose and covers bones where they meet to form moveable joints
- Fibro **cartilage** has thick bundles of collagen fibers in the matrix
- Found: rhe knee and jaw joints and the intervertebral discs
- Elastic **cartilage** contains elastic fibers and collagen, which gives rigid support as well as elasticity
- Found: ear lobes

Connective tissue

bone



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- **Bone**, as the hardest connective tissue, provides protection and support
- It has a rigid extracellular matrix contains mostly collagen fibers embedded in a mineralized ground substance containing calcium phosphate

- Bone cells (Osteocytes) are located within lacunae.
- Osteocytes are arranged in concentric circles around a central canal.
- Bone is a highly vascularized tissue
- Spongy bone verse compact bone

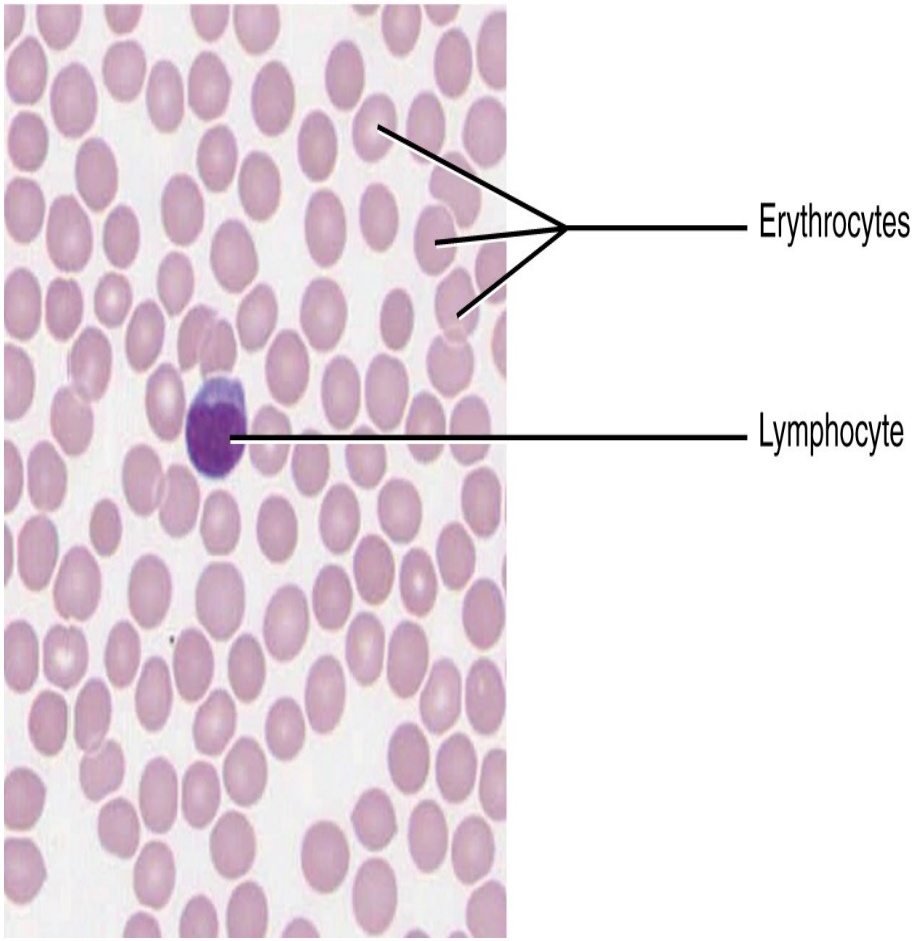
Connective tissue

blood

- **Blood** is _____ connective tissues

fluid

- Erythrocytes, red blood cells, transport oxygen and some carbon dioxide.
- Leukocytes, white blood cells, are responsible for defending against potentially harmful pathogens or molecules.
- Platelets are cell fragments involved in blood clotting.

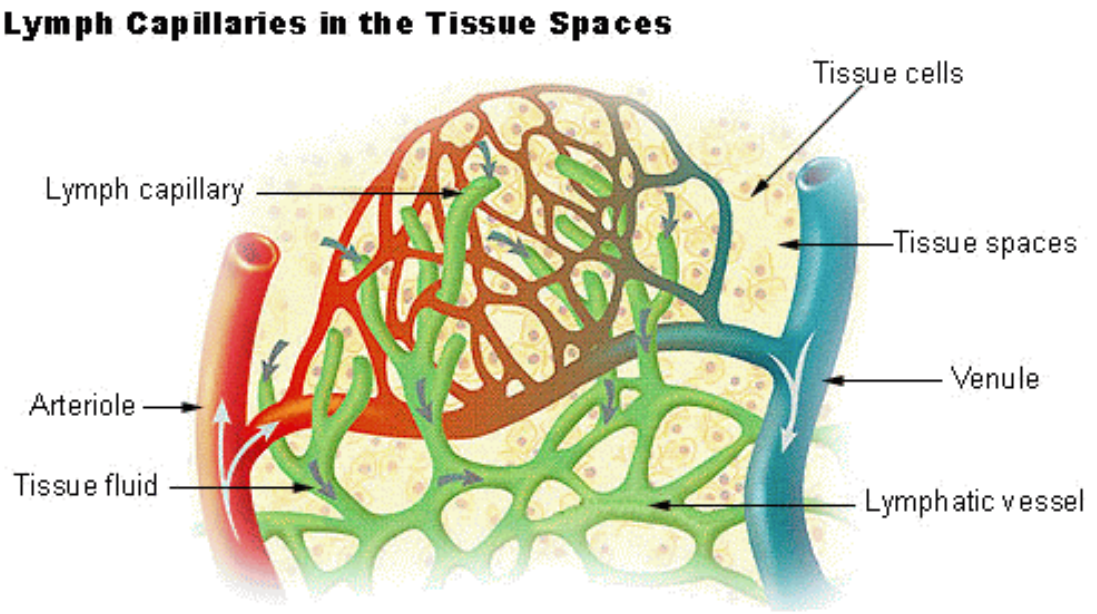


Connective tissue

Lymph

- **Lymph** is fluid connective tissues

- In lymphatic capillaries
- Contains liquid matrix and white blood cells
- Lymph drains into blood vessels



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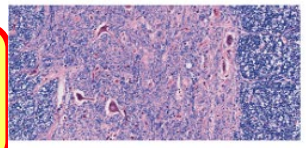
The four types of tissues

Information flow and control



Nervous tissue
Brain
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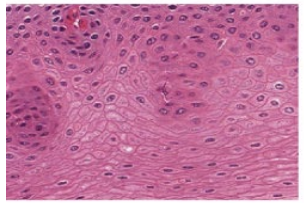
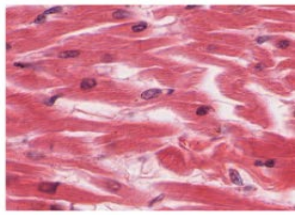
Epithelial tissue
Lining of GI tract organs and other hollow organs
Skin surface (epidermis)

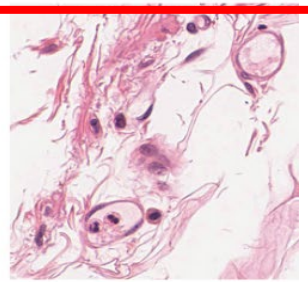


Covers, linings and secretions



Muscle tissue
Cardiac muscle
Smooth muscle
Skeletal muscle

Movement and heat



Connective tissue
Fat and other soft padding tissue
Bone
Tendon

Protection and support

Muscle tissue

Main characteristics
- Very cell-rich tissue - Cells named “Muscle fibers” - Vascularized tissue - Striations present in some types - Movement of body parts involves alternating contraction & relaxation of muscle fibers

Muscle tissue

Types of Muscle Tissue

I. Smooth

In organs; involuntary

II. Striated (Skeletal)

Linked to bones; voluntary

III. Cardiac

In the heart; involuntary

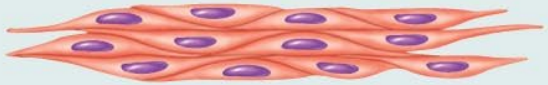
Muscle cells are elongated cells that use ATP to generate force

Muscle tissue

smooth muscle (involuntary; found around organs)

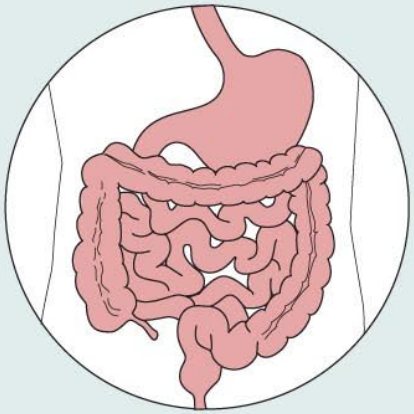
(c) Smooth muscle

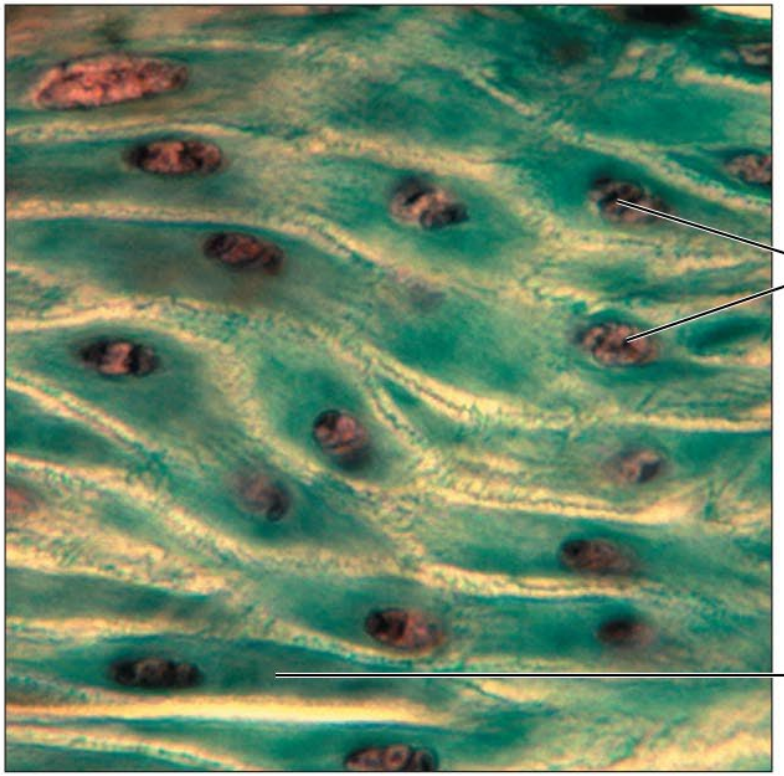
Description: Spindle-shaped cells with central nuclei; no striations; cells arranged closely to form sheets.



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 (720x).

Marieb, Figure 4.12c

Muscle tissue

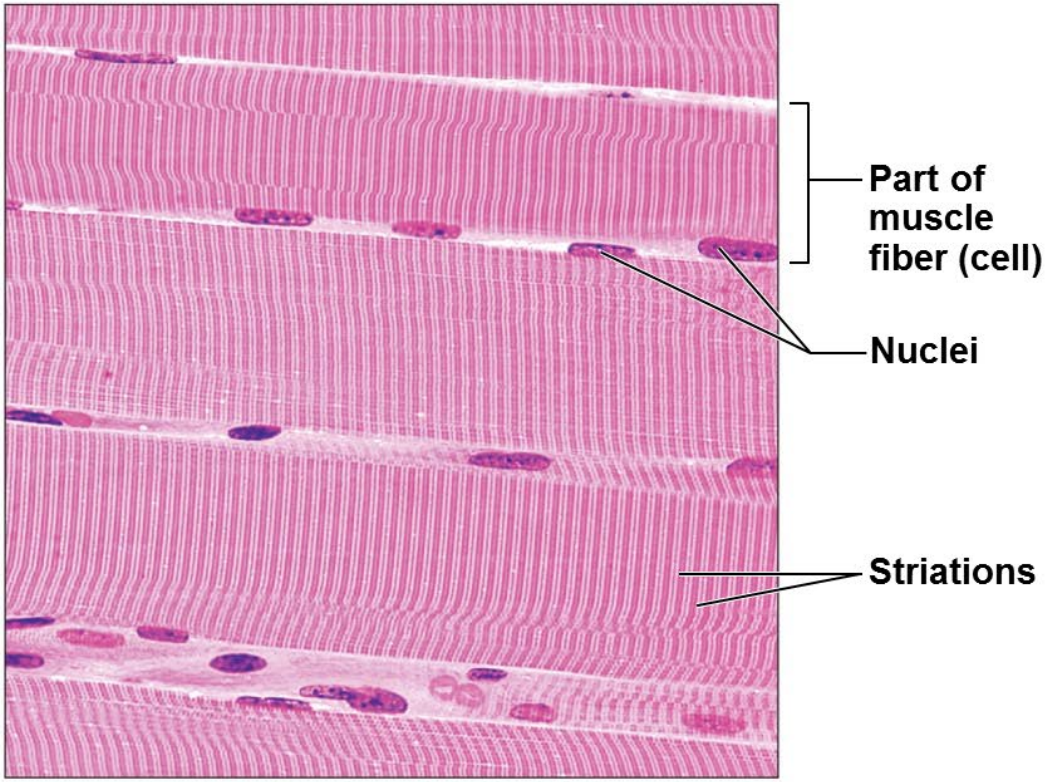
striated (skeletal) muscle (voluntary; associated with bone)

(a) Skeletal muscle

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

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

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



Photomicrograph: Skeletal muscle (approx. 440x). Notice the obvious banding pattern and the fact that these large cells are multinucleate.

Open textbook 4.4

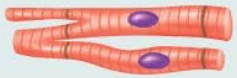
Marieb ,Figure 4.12a

Muscle tissue

cardiac muscle (involuntary; make up the heart)

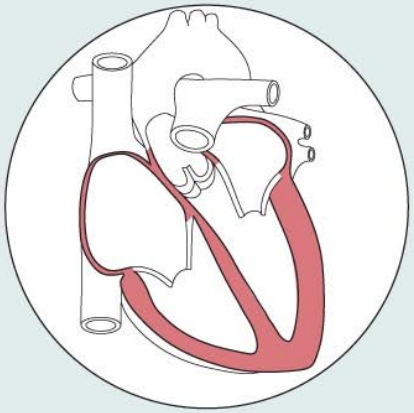
(b) Cardiac muscle

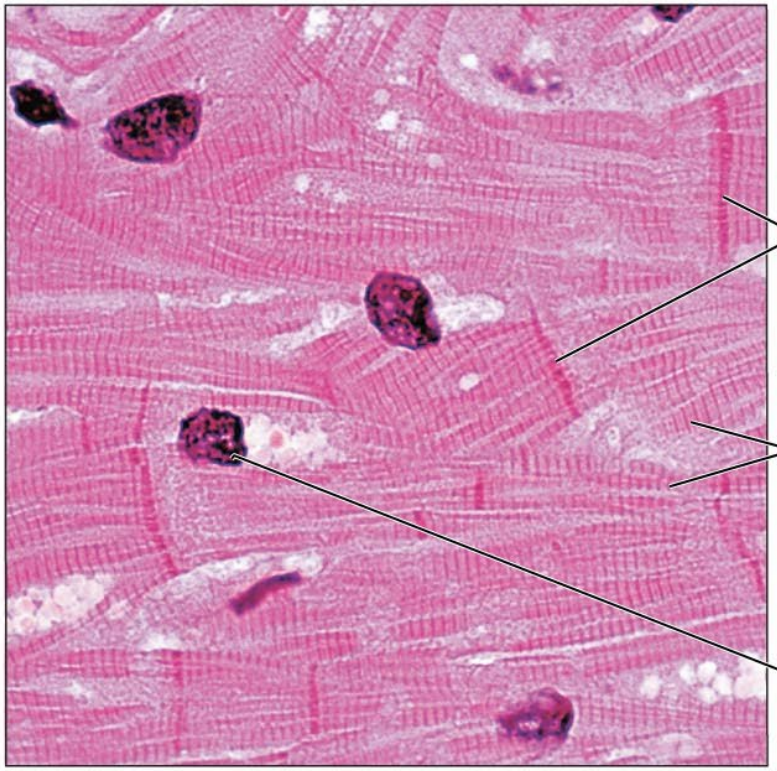
Description: Branching, striated, generally uninucleate cells that interdigitate at specialized junctions (intercalated discs).



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

Location: The walls of the heart.





Photomicrograph: Cardiac muscle (900x); notice the striations, branching of cells, and the intercalated discs.

Marieb, Figure 4.12b

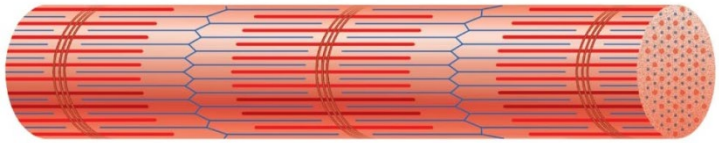
Open textbook 4.4

Muscle tissue

Summary

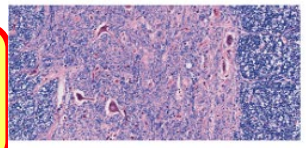
Type	Cell Shape	Striated?	Nuclei	Control	Location
Skeletal	cylinder	yes	many	voluntary	attached to bones
Smooth	spindle-shaped	no	1	involuntary	Organs
Cardiac	branched	yes	1	involuntary	heart

Myofibrils contain various myofilaments responsible for striations (banding patterns) in skeletal & cardiac muscles.

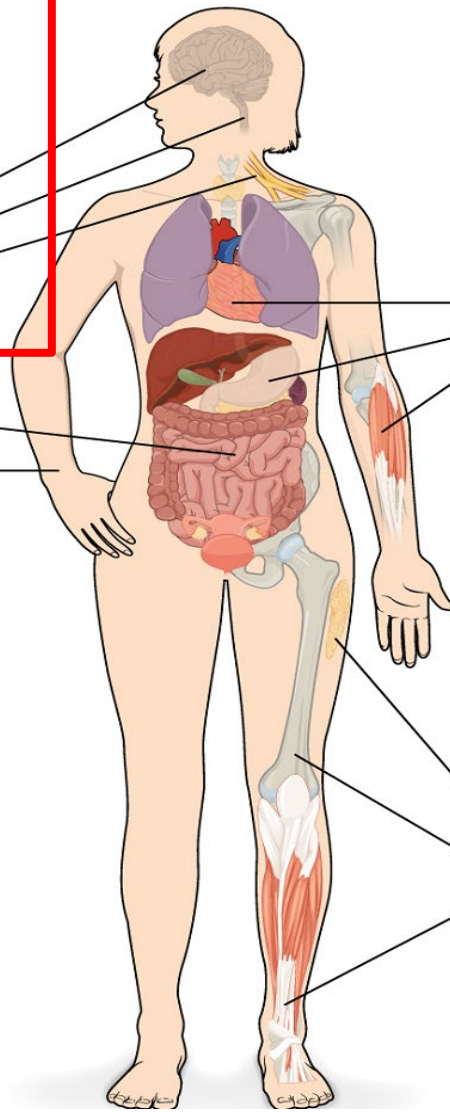


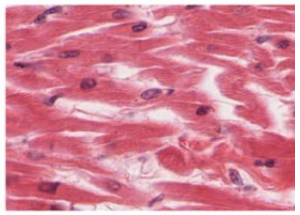
The four types of tissues

Information flow and control



Nervous tissue
Brain
Spinal cord
Nerves

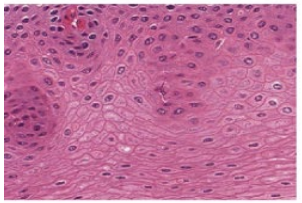




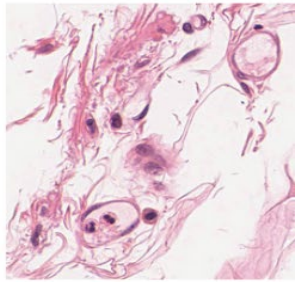
Muscle tissue
Cardiac muscle
Smooth muscle
Skeletal muscle

Movement and heat

Epithelial tissue
Lining of GI tract organs and other hollow organs
Skin surface (epidermis)



Covers, linings and secretions

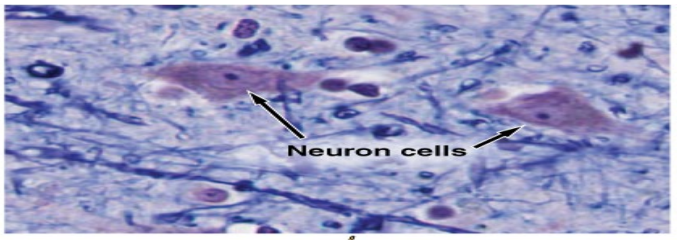


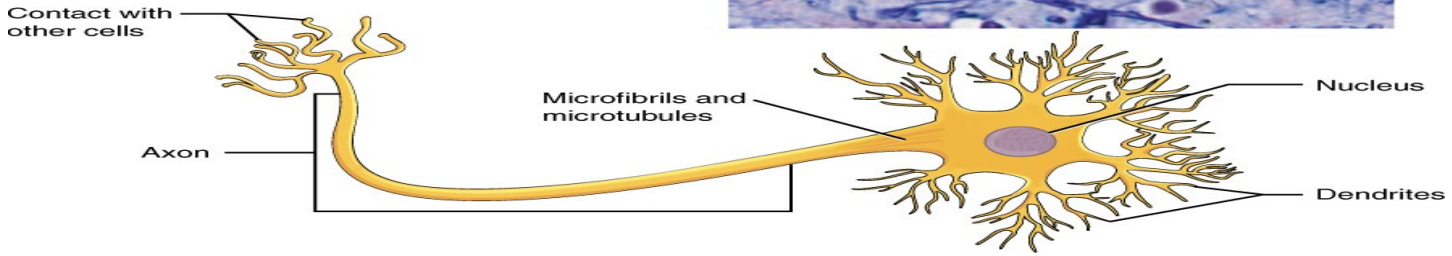
Connective tissue
Fat and other soft padding tissue
Bone
Tendon

Protection and support

Nervous tissue

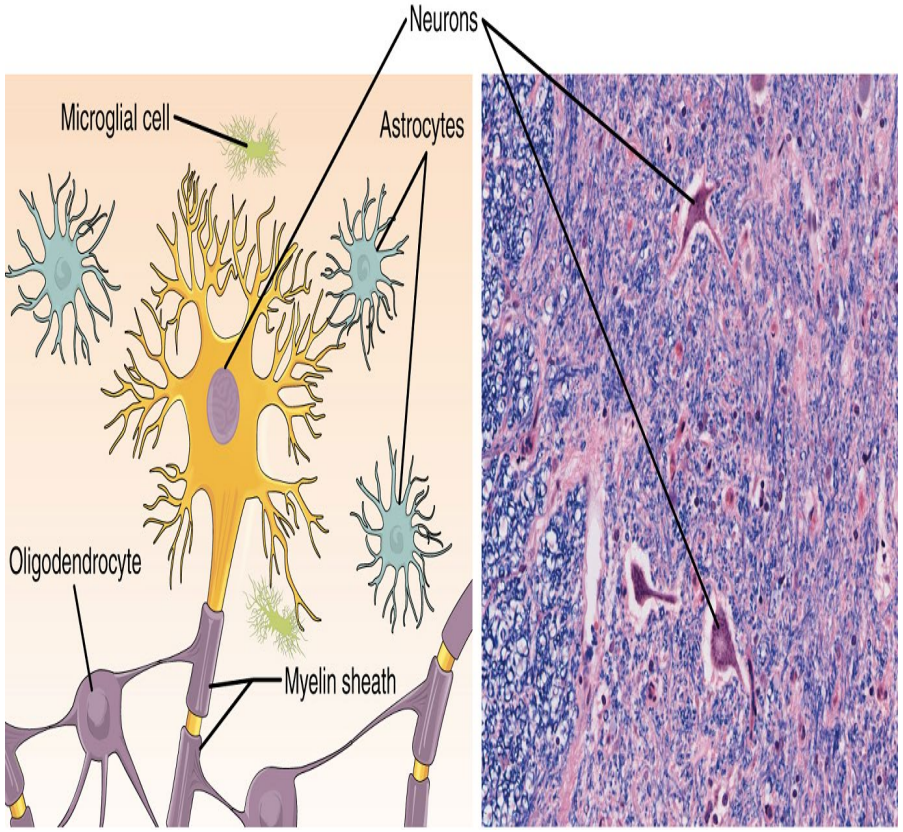
Cell types	- Neurons - Neuroglia
Main functions of neurons	- Convert stimuli into electrical signals - Propagate nerve impulses to muscles & glands - Direct activity of muscles & glands
Main functions of neuroglia	- Support, protect & help nourish neurons - Regulate internal environment in nervous systems - Repair tissue after injury





Nervous tissue

neurons and neuroglia



- The cell body includes most of the cytoplasm, the organelles, and the nucleus.
- Dendrites branch off the cell body and appear as thin extensions.
- A long "tail," the axon, extends from the neuron body and can be wrapped in an insulating layer known as **myelin.**
- Neuroglia are support cells.

Tissue structure

Objectives

1. Define tissue and describe the importance of tissue level organization to an organism.
2. Describe the structure and function of epithelial tissue.
3. Describe the structure and function of connective tissue.
4. Describe the structure and function of muscle tissue.
5. Describe the structure and function of nervous tissue.
6. Explain the relationships between structure and function of tissues.