Tissues

SAP 1

- SAP 1. Obtain, evaluate, and communicate information to analyze anatomical structures of the human body
- b. Construct an explanation about the relationship between a body structure (i.e., cells, tissues, organs, and organ systems) and its function within the human body.

Key Terms

- Histology:
  - The study of tissues.
- Pathology:
  - The study of the cause and effect of diseases or injuries.
- Tissues:
  - Groups of cells which are similar in structure and which perform common or related functions.

Four Basic Kinds of Tissues

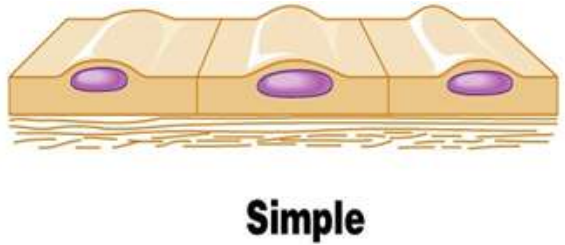
- Epithelial Tissue
- Connective Tissue
- Muscle Tissue
- Nervous Tissue

Epithelial Tissue

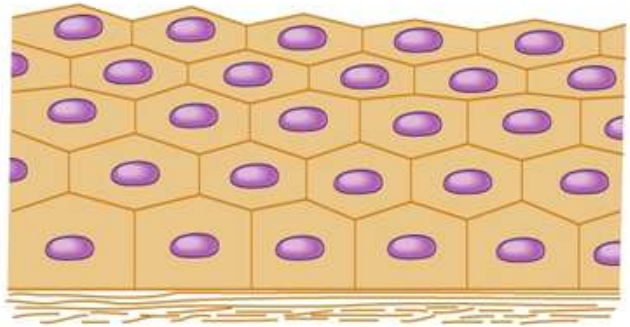
- Epithelial Tissue Locations:
  - Covers all free body surfaces and lines organs
  - Forms the outer layer of skin
  - Anchored to connective tissue by basement membrane
  - Lacks blood vessels, obtains nutrients through diffusion from capillaries
  - Can regenerate easily
- Epithelial Tissue Functions:
  - Protection from physical & chemical injury
  - Protection against microbial invasion
  - Contains receptors which respond to stimuli
  - Filters, secretes & reabsorbs materials
  - Secretes serous fluids to lubricate structures

Classification

- Simple-consists of one layer of cells
- Stratified-two or more layers of cells
- Pseudostratified-appears to be layered but it is not



Simple

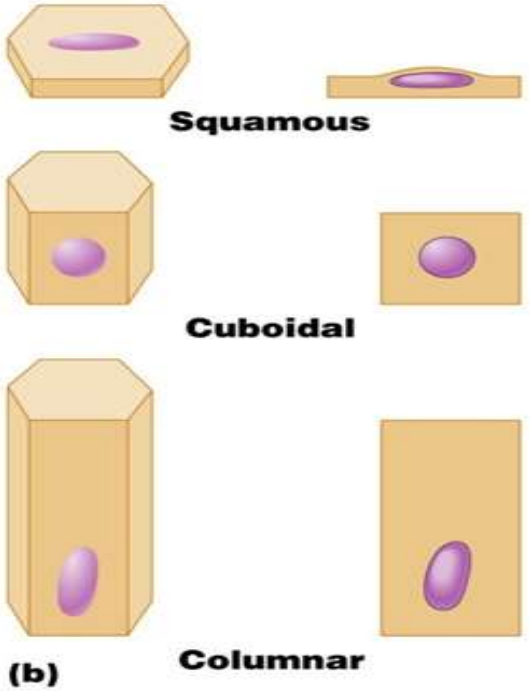


Stratified

(a)

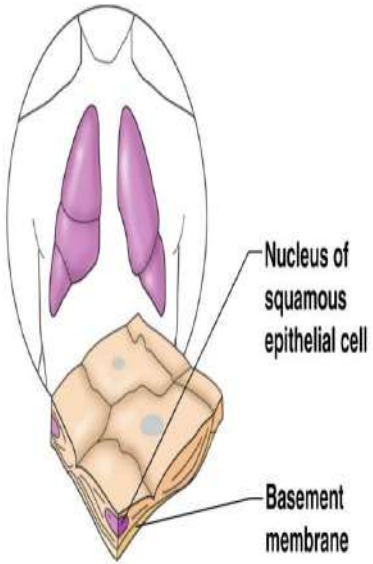
Classification (Cell Shape)

- Squamous- flat or irregularly shaped cells
- Cuboidal-looks like small boxes
- Columnar- taller than they are wide; rectangular
- Transitional- changes shape from squamous to cuboidal

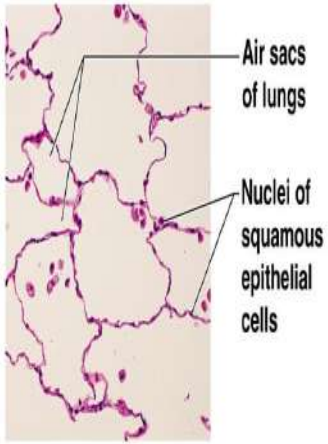


Simple Squamous Epithelial Tissue

- Single layer of flattened cells
- Functions in filtration (kidneys) and the exchange of gases in the lungs (diffusion)
- Lines the heart, blood vessels, and lymphatic vessels
  - Endothelium
- Forms serous membranes that lines the ventral body cavity and covers the organs.



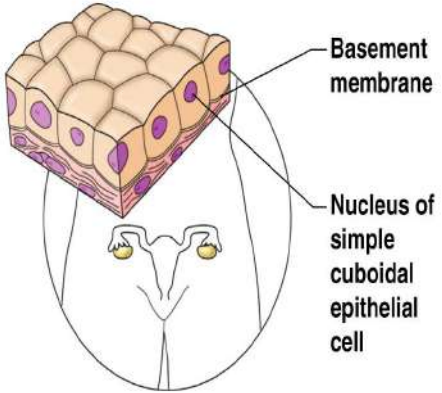
(a) Diagram: Simple squamous



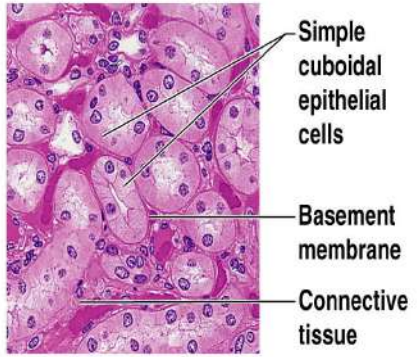
Photomicrograph: Simple squamous epithelium forming part of the alveolar (air sac) walls (100x).

Simple Cuboidal Epithelial Tissue

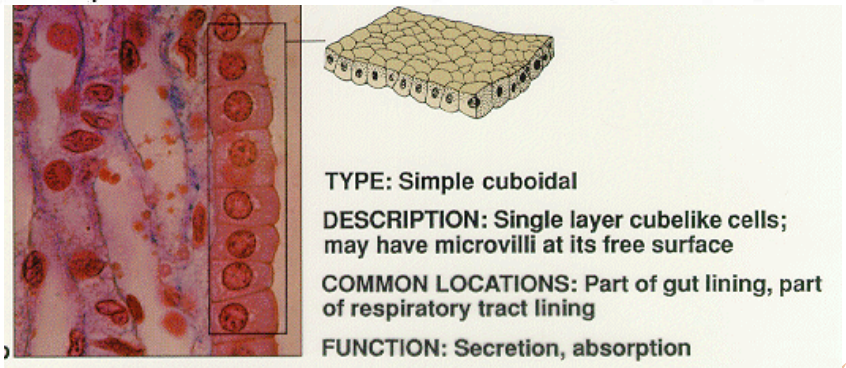
- Single layer of cube-shaped cells
- Common in glands and ducts (respiratory and gut)
  - Carries on secretion and absorption in the kidneys, salivary gland, ovaries and thyroid



(b) Diagram: Simple cuboidal

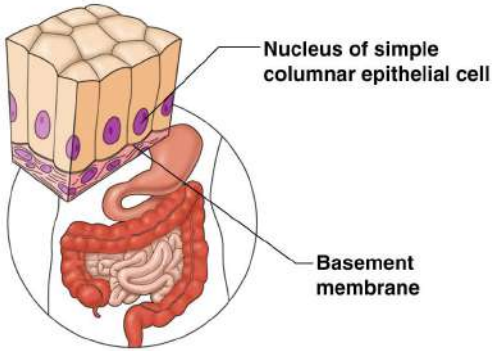


Photomicrograph: Simple cuboidal epithelium in kidney tubules (400x).

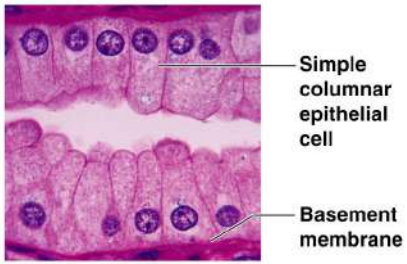


Simple Columnar Epithelial Tissue

- Single layer of rectangular cells whose nuclei are located near the basement membrane
- Lines the uterus and digestive tract
- Contains “goblet cells” that secrete mucus
  - Also functions in secretion
- Ciliated type propels mucus or reproductive cells in the uterus



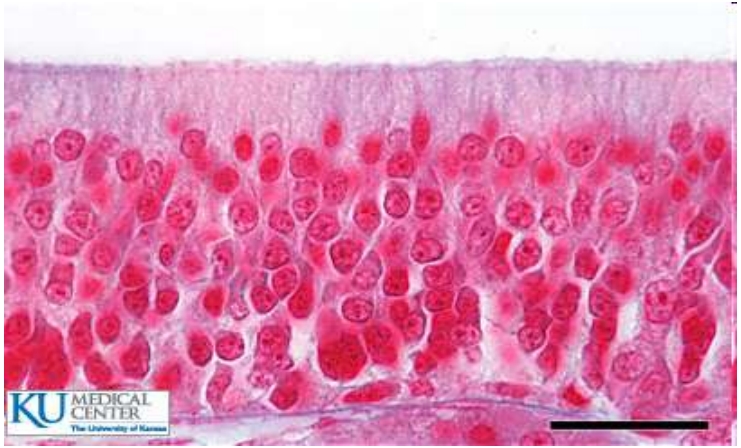
(c) Diagram: Simple columnar

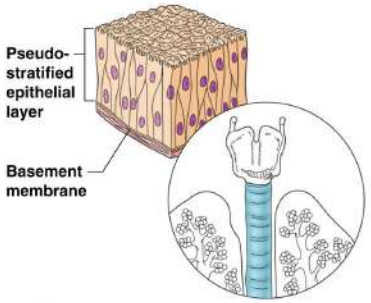


Photomicrograph: Simple columnar epithelium of the stomach lining (900x).

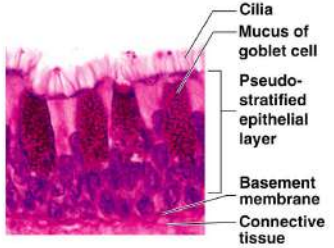
Pseudostratified Columnar Epithelial Tissue

- Appears layered but is not because the nuclei are located in 2 or more levels
- Contains both goblet cells and cilia
  - Functions in secretion
- Lines the respiratory and reproductive systems





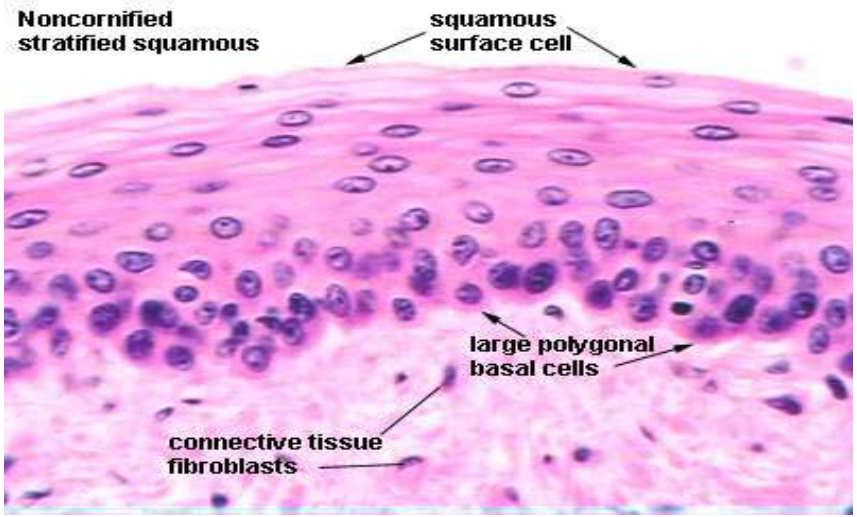
(d) **Diagram:** Pseudostratified (ciliated) columnar

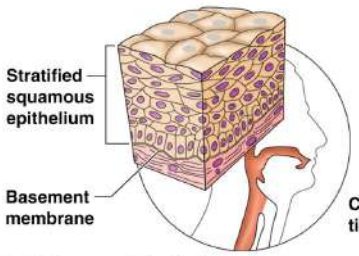


Photomicrograph: Pseudostratified ciliated columnar epithelium lining the human trachea (700x).

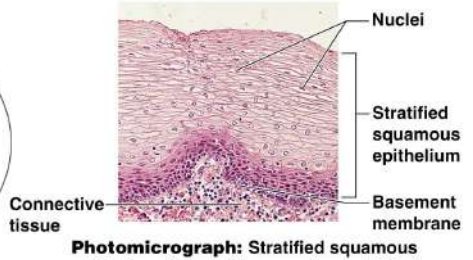
Stratified Squamous Epithelial Tissue

- Most common type of tissue
- Composed of many layers of flat cells
- Covers the skin and lines the mouth, throat, vagina, and anal canal (areas that subjected to abuse or friction)
  - Functions in protection





(e) **Diagram:** Stratified squamous



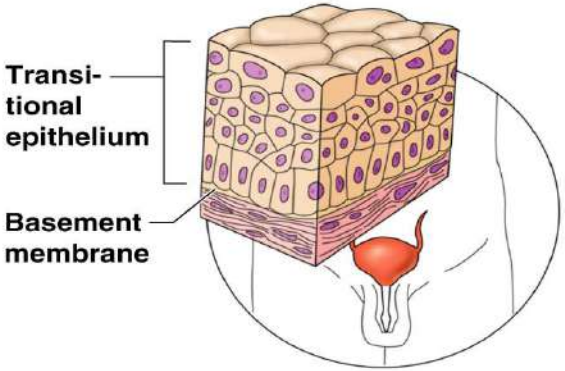
Photomicrograph: Stratified squamous epithelium lining of the esophagus (200x).

THINK CRITICALLY

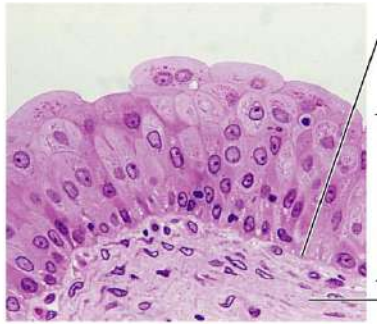
Why is stratified squamous epithelium better suited for surfaces exposed to wear and tear, while simple squamous epithelium is better suited for filtration?

Transitional Epithelial Tissues

- A specialized form of stratified tissue that appears to change shape depending on whether the bladder is empty or full
- Functions in extension



(f) Diagram: Transitional



Photomicrograph: Transitional epithelium lining of the bladder, relaxed state (300x); note the rounded appearance of the cells at the surface; these cells flatten and elongate when the bladder fills with urine.

Glandular Epithelial

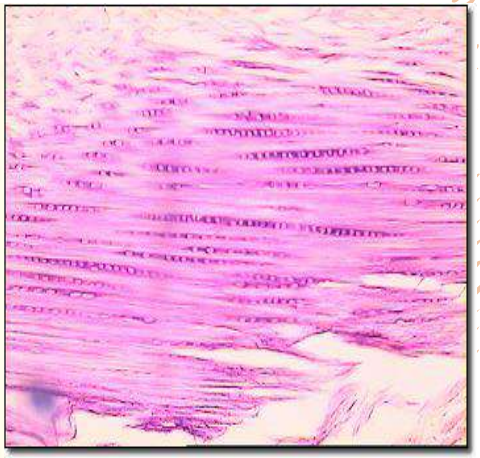
- Gland- one or more cells which make and secretes substances into ducts, onto a surface, or into the blood.
- Endocrine glands- do not have ducts but secrete their products into the blood (hormones)
  - Pituitary, thyroid, and adrenal glands
- Exocrine glands- secrete their products into one or more ducts that open into the skin or mucous membrane.
  - Sweat, salivary and mammary glands
  - Pancreas, ovaries, and testes have both

Connective Tissue

- Most abundant & widely distributed tissue
- Connective Tissue Functions:
  - Connects, binds and supports structures
    - Tendons, ligaments, etc.
  - Protects & cushions organs and tissues
  - Insulates (fat) and
  - Transports substances (blood)
  - Able to reproduce

Tendon

Ligament



Connective Tissue Cell Types

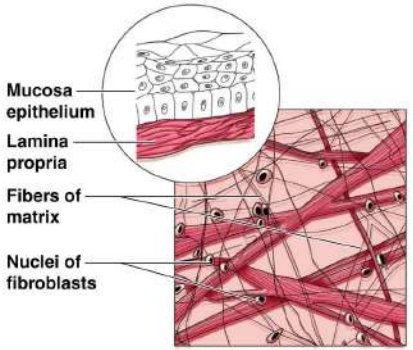
- Fibroblasts- produces collagen, elastic, and reticular fibers
- Macrophages- active phagocytes that move through connective tissue engulfing foreign matter and dead or dying cells
- Plasma cells- secretes antibodies, important for the immune response
- Mast cells- produce histamines as part of the anti-inflammatory response; can also kill bacteria
- Adipocytes- store triglycerides, found below skin and around organs

Extracellular Matrix

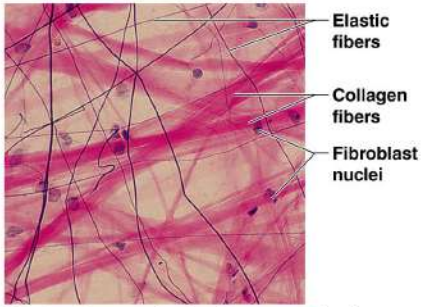
- Nonliving matrix that separates the living cells of the tissue; consists of ground substances and fibers
- 3 types of fibers:
  - Collagen- most abundant type, appears in bands, have high tensile strength; aka white fibers
  - Elastic- composed of elastin; pliable and elastic, able to stretch and recoil; aka yellow fibers
  - Reticular- highly branched, short, thin, and delicate; supports blood vessels and organs

Loose Connective Tissue

- Areolar
  - The most widely distributed
  - Consists of soft pliable tissue like “cobwebs”
  - Functions as a packing tissue and contains all fiber types
  - Holds body fluids (reason for edema)
  - Defends against infection
  - Provides strength, elasticity, and support
  - Found in skin, around blood vessels, nerves and body organs.



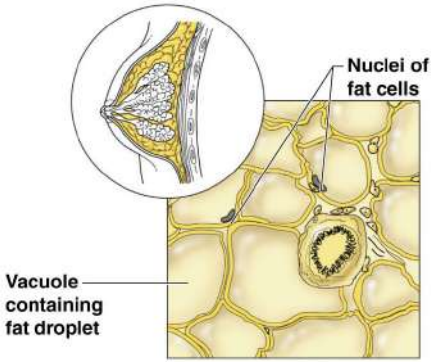
(e) Diagram: Areolar



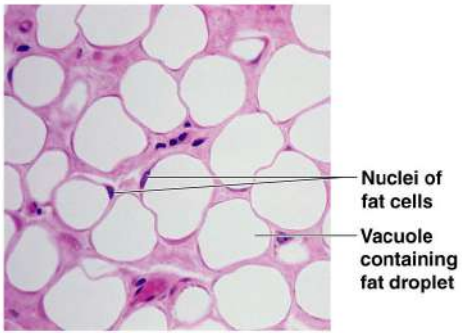
Photomicrograph: Areolar connective tissue, a soft packaging tissue of the body (330x).

Loose Connective Tissue

- Adipose
  - Stores fat
  - Insulates the body
  - Shock absorber (protects body from bumps)
  - Protects some organs
  - Serves as a site of fuel storage
  - Rich vascular system
  - Found around heart, kidneys, yellow bone marrow, and joints



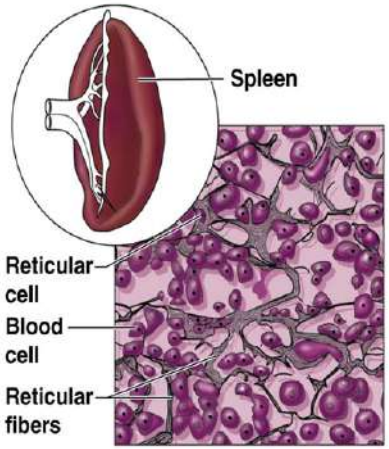
(f) Diagram: Adipose



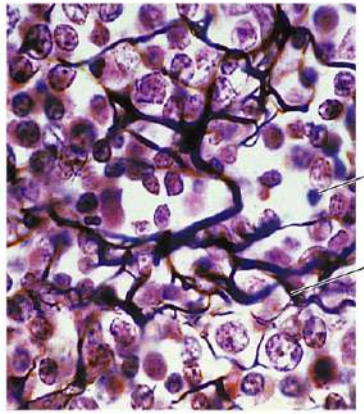
Photomicrograph: Adipose tissue from the subcutaneous layer beneath the skin (330x).

Loose Connective Tissue

- Reticular
  - Consists of a delicate network of interwoven fibers
  - Forms the stroma (internal supporting network) of lymphoid organs
  - Composed of many phagocytic cells
  - Protects body against invasion
  - Found in lymph nodes, spleen, and bone marrow



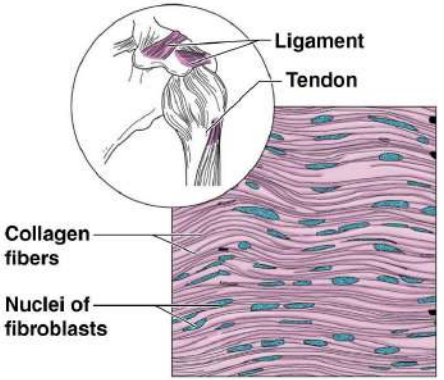
(g) Diagram: Reticular



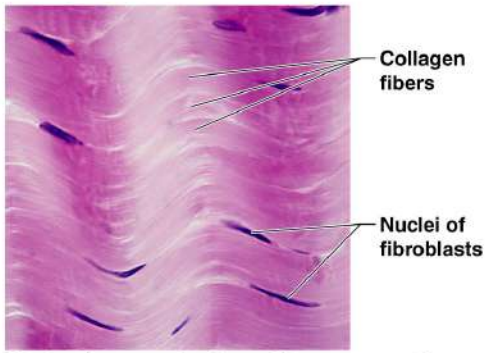
Photomicrograph: Dark-staining network of reticular connective tissue (400x).

Dense Connective Tissue

- Fibrous Connective Tissue
  - Composed of strong, collagenous fibers
  - Found in tendons and ligaments which is made up of fibroblasts
    - Fibroblast are fiber forming cells
    - Tendons attach skeletal muscle to bones
    - Ligaments connect bone to bone
  - Used for tensile strength
  - Makes up dermis



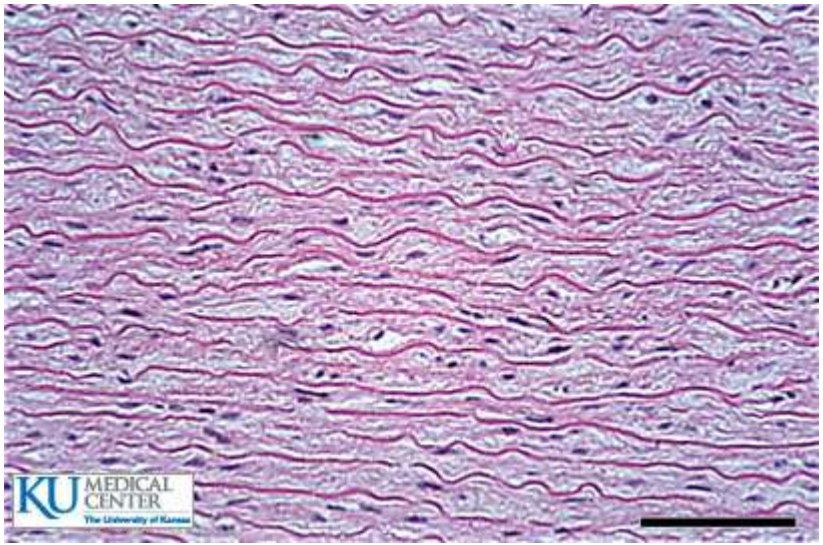
(d) Diagram: Dense fibrous



Photomicrograph: Dense fibrous connective tissue from a tendon (500x).

Dense Connective Tissue

- Elastic Connective Tissue
  - Composed of elastic fibers with fibroblasts
  - Found in the walls of the arteries, bronchial tubes, and vocal cords
  - Strong, can recoil to original shape



Cartilage

- Provides support and framework
- Chondrocytes are cartilage cells
- Lacunae are small chambers which house the chondrocytes
- Lacks a direct blood supply
- 3 types:
  - Hyaline-most common, occurs on the ends of bones, nose, attaches ribs to sternum, and forms respiratory passages. Found in fetal skeletons
  - Elastic-flexible, found in the ear and part of the larynx
  - Fibrocartilage-tough, found between the bony parts of the backbone and the knee

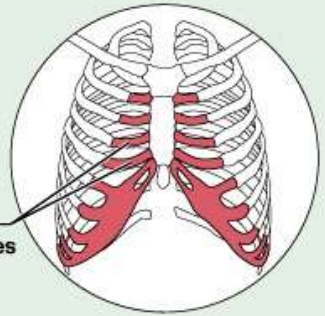
Hyaline Cartilage

(g) Cartilage: hyaline

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 (300×).

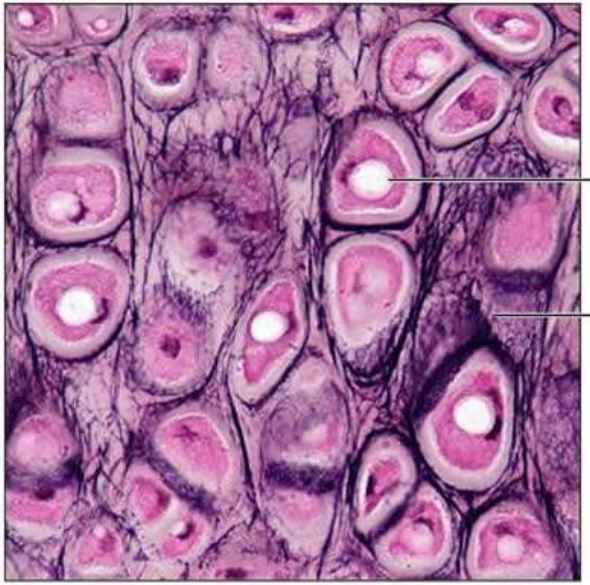
Elastic Cartilage

(g) Cartilage: elastic

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 (640×).

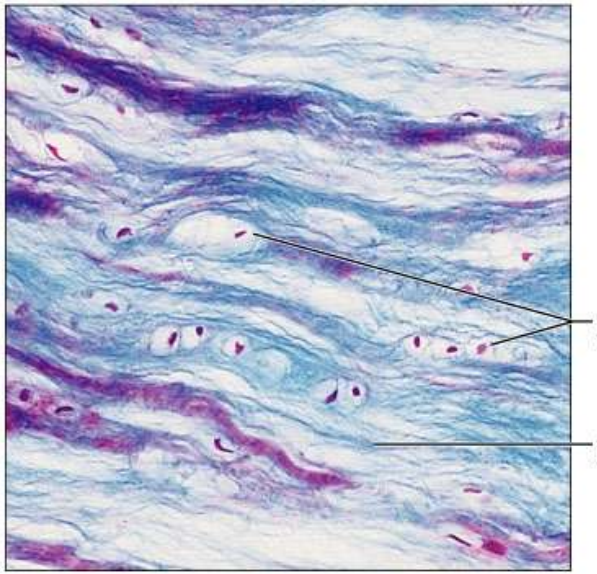
Fibrocartilage

(i) Cartilage: 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 shock.

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



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

THINK CRITICALLY

Since cartilage is avascular, how is it supplied with the essentials of life?

Bone

- Most rigid
- Functions to support the body, protect vital organs, serves as a point of attachment for muscles, forms blood cells (hematopoesis), and stores various minerals
- Osteocytes are bones cells
  - Osteoblast-build new bone
  - Osteoclast- break down bone
- Red and yellow marrow occupy the space within the bone
- Periosteum is the outer covering of the bone

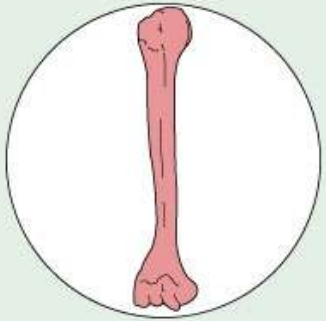
Bone

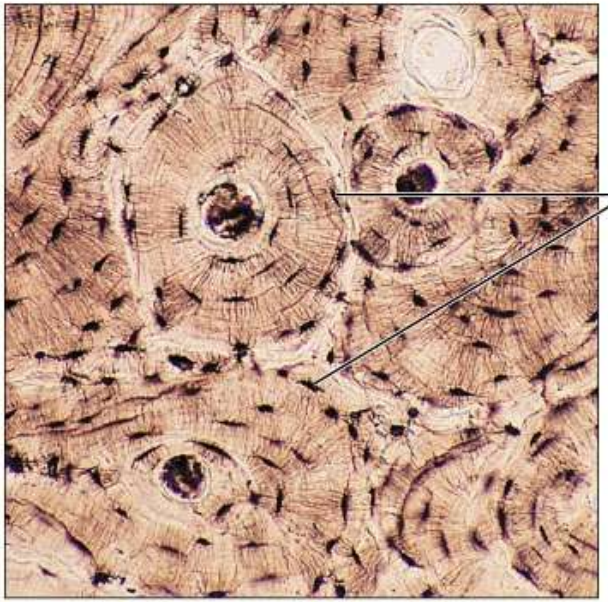
(j) Others: bone (osseous tissue)

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; marrow inside bones is the site for blood cell formation (hematopoiesis).

Location: Bones





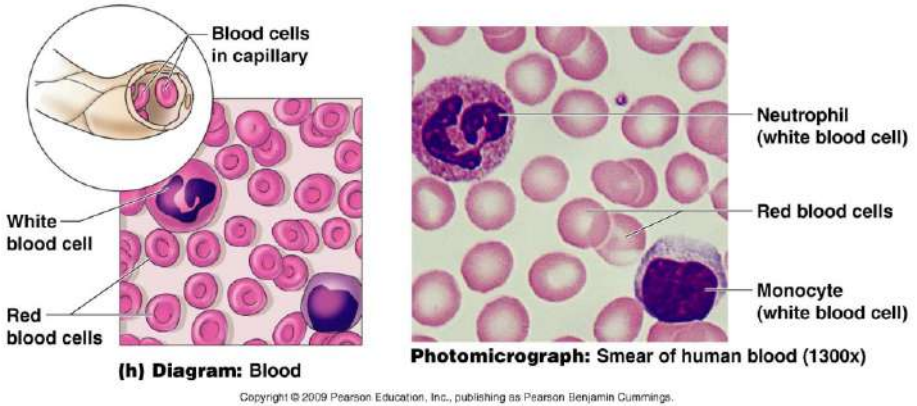
Photomicrograph: Cross-sectional view of bone (70×).

THINK CRITICALLY

Why is bone considered to be living?

Blood

- Composed of cells (red and white blood cells, and platelets) suspended in a fluid (plasma)
- Formed in the bone marrow
- Fibers of blood only visible during blood clotting
- Transports respiratory gases, nutrients, wastes and other substances



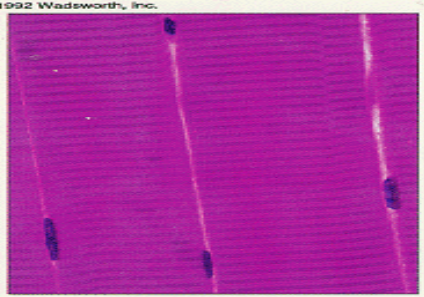
Muscle Tissue

- Muscle Tissue:
  - Associated with the bones of the skeleton, the heart and in the walls of the hollow organs of the body.
- Muscle Tissue Functions:
  - Movement
  - Locomotion
  - Maintains posture
  - Produces heat
  - Facial expressions
  - Pumps blood
  - Peristalsis

Muscle Types

- Skeletal
  - Attached to bones, have striations, voluntary, and multinucleated
- Smooth
  - Found in the walls of internal organs, no striations, involuntary, and mononucleic
- Cardiac
  - Found in the heart, striated, involuntary, have a single nuclei, have intercalated discs that connect between cells

Muscle Types



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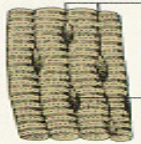
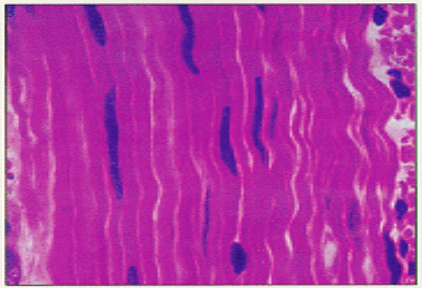


TYPE: Skeletal muscle
DESCRIPTION: Long, striated cells with multiple nuclei
COMMON LOCATIONS: In skeletal muscles
FUNCTION: Contraction for voluntary movements



b

TYPE: Smooth muscle
DESCRIPTION: Long, spindle-shaped cells, each with a single nucleus
COMMON LOCATIONS: In hollow organs (e.g., stomach)
FUNCTION: Propulsion of substances along internal passageways

c

TYPE: Cardiac muscle
DESCRIPTION: Branching, striated cells fused at plasma membranes
COMMON LOCATIONS: Wall of heart
FUNCTION: Pumping of blood in the circulatory system

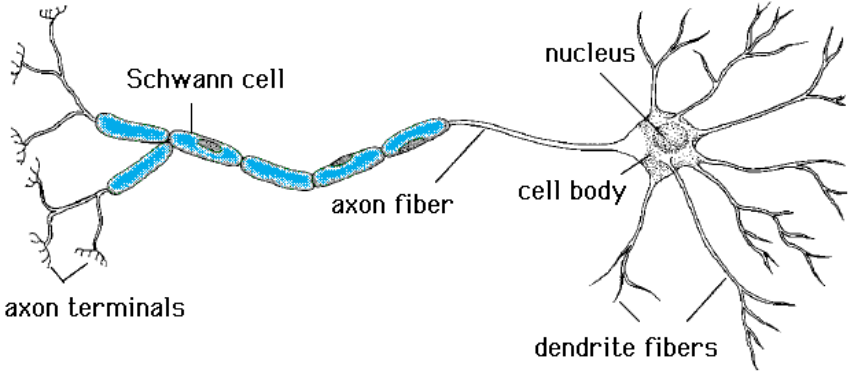
THINK CRITICALLY

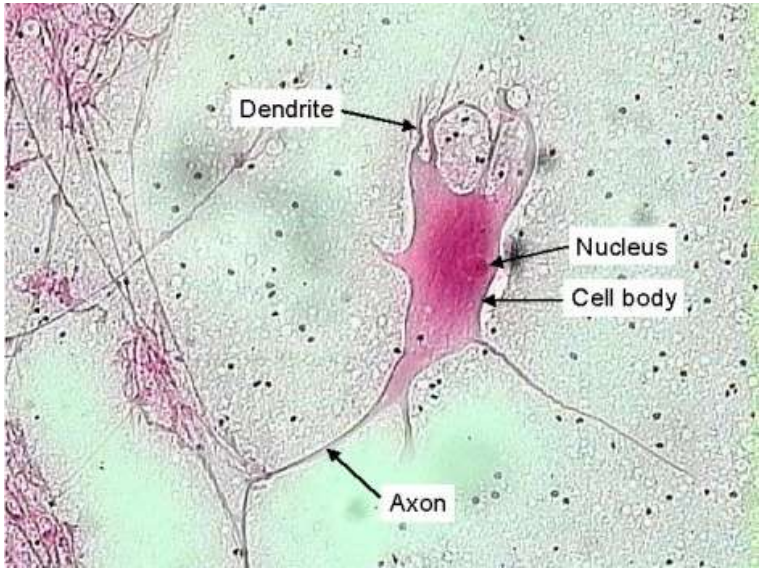
- Explain the statement that your face is merely the expression of dead cells. Think about what the function of Botox is and how it paralyzes the muscles. People who are opposed to Botox injections argue that facial exercises that tone facial muscles will improve sagging features and will avoid injections of a poison. What is the relationship between the skin and the underlying muscle structure? What are the positive aspects to this idea?

Nervous Tissue

- Nervous Tissue:
  - Main component of the nervous system,
    - Brain, spinal cord & nerves.
- Nervous Tissue Functions:
  - Regulates & controls body functions
  - Generates & transmits nerve impulses
  - Supports, insulates and protects impulse generating neurons.
  - Neurons are nerve cells that send electrical messages through the body
  - Neuroglial cells bind and support nerve tissue, carry out phagocytosis, connect neurons to blood vessels

Nerve Cells


Schwann cell
nucleus
axon fiber
cell body
axon terminals
dendrite fibers

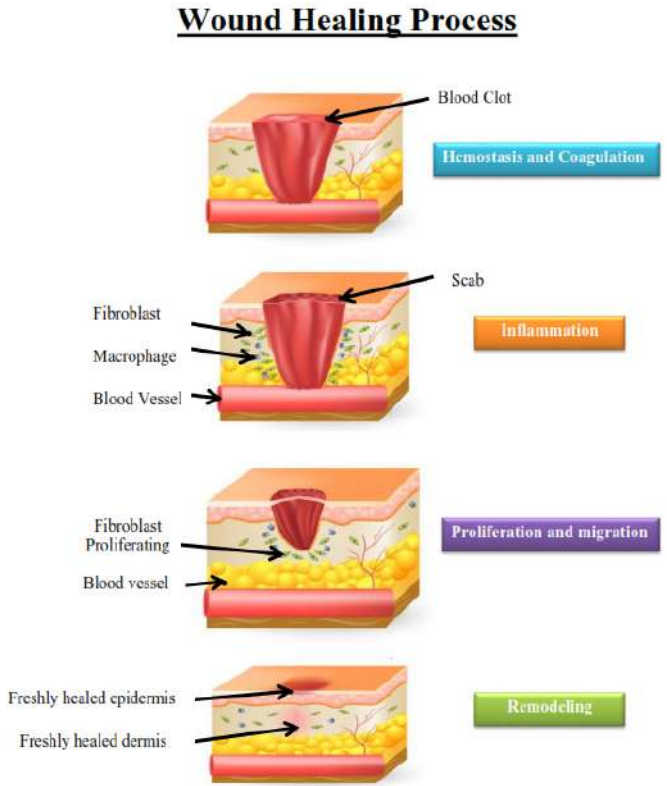

Dendrite
Nucleus
Cell body
Axon

Tissue Repair (Wound Healing)

- Regeneration
  - Replacement of destroyed tissue by the same kind of cells
- Fibrosis
  - Repair by dense (fibrous) connective tissue (scar tissue)
- Determination of method
  - Type of tissue damaged
  - Severity of the injury

Events in Tissue Repair

- Capillaries become very permeable
  - Introduce clotting proteins
  - A clot walls off the injured area
- Formation of granulation tissue
  - Growth of new capillaries
  - Rebuild collagen fibers
- Regeneration of surface epithelium
  - Scab detaches



Regeneration of Tissues

- Tissues that regenerate easily
  - Epithelial tissue (skin and mucous membranes)
  - Fibrous connective tissues and bone
- Tissues that regenerate poorly
  - Skeletal muscle
- Tissues that are replaced largely with scar tissue
  - Cardiac muscle
  - Nervous tissue within the brain and spinal cord

THINK CRITICALLY

How does tissue repair differ from tissue regeneration?

Describe the different types of tissues that can be harvested from one area of a patient to be used to augment or restructure other parts of the body during plastic surgery, and describe how these tissues are used.