

CONNECTIVE TISSUE

Junquiera's Basic Histology
Chapter 5, 6, 7, and 8
pp. 96–159

OBJECTIVES:

- 1. Classify the different types of connective tissues.**
- 2. Describe the components and functions of connective tissues.**
- 3. Analyze how the connective tissues structures enable to provide support, protection, and integration in the human body**

Connective Tissue

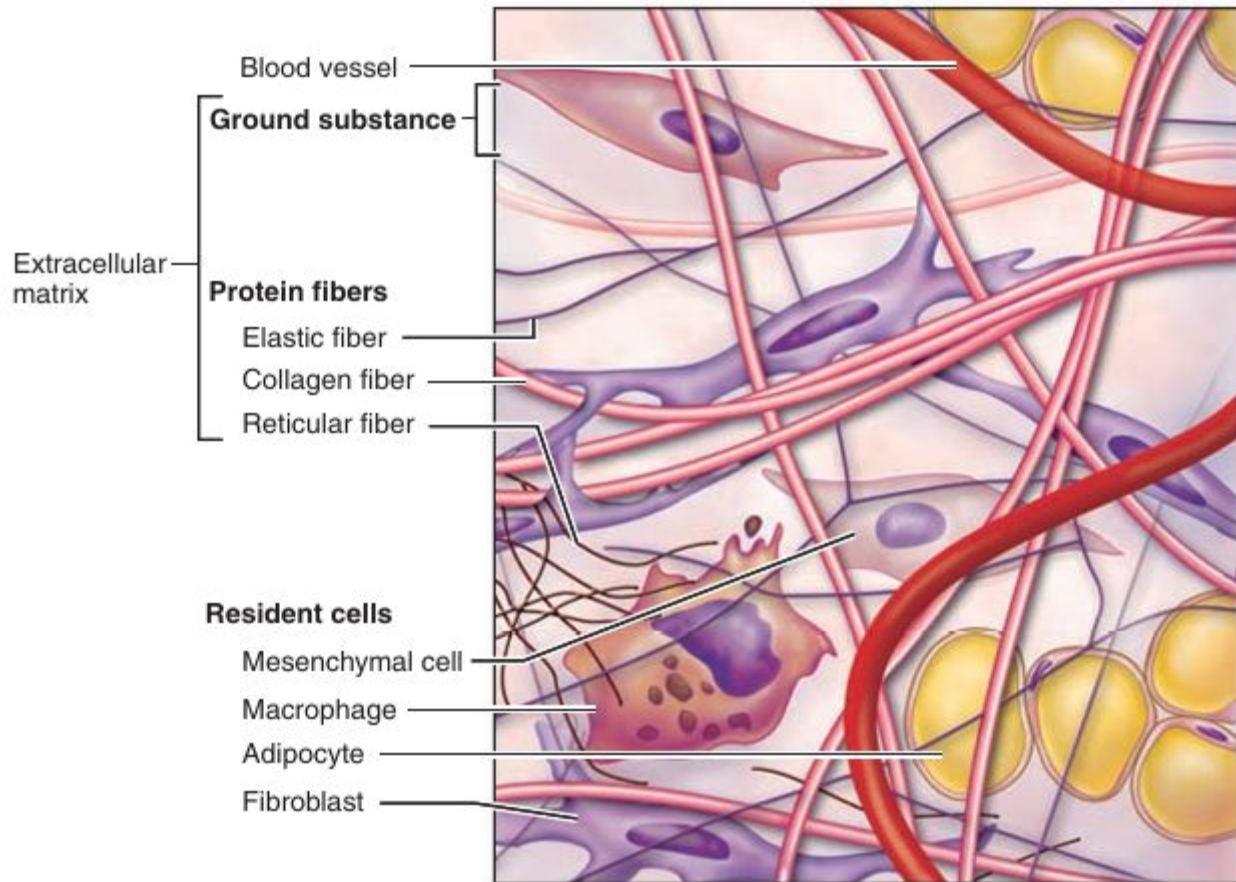
- **Diverse group of tissues that provide structural and functional support**
- **Functions: Binding, support, protection, insulation and transportation**
- **Major components:**
 - **Cells**
 - **extracellular matrix (protein fibers + ground substance)**

Connective Tissue

- Abundant extracellular matrix
- Varying degrees of vascularity
- Originates from mesenchyme (embryonic tissue)

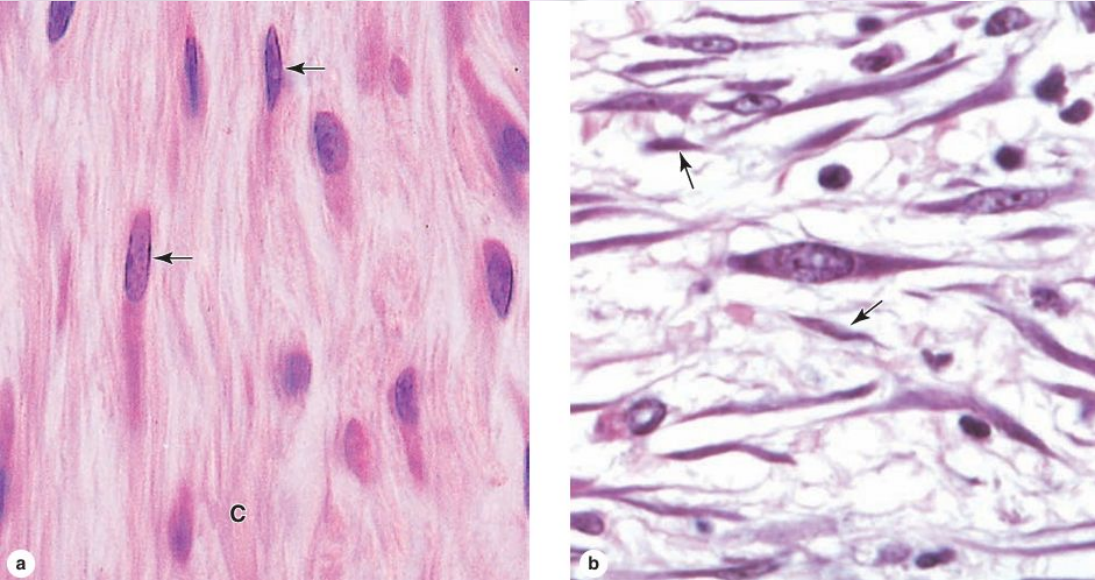
Components of Connective Tissue

- **Cells**
 - Fibroblast, macrophages, mast cells, adipocytes, etc
- **Fibers**
 - Collagen, elastic, and reticular
- **Ground substance**
 - Gel-like material filling spaces between cells and fiber



Cells

Cells of Connective Tissue



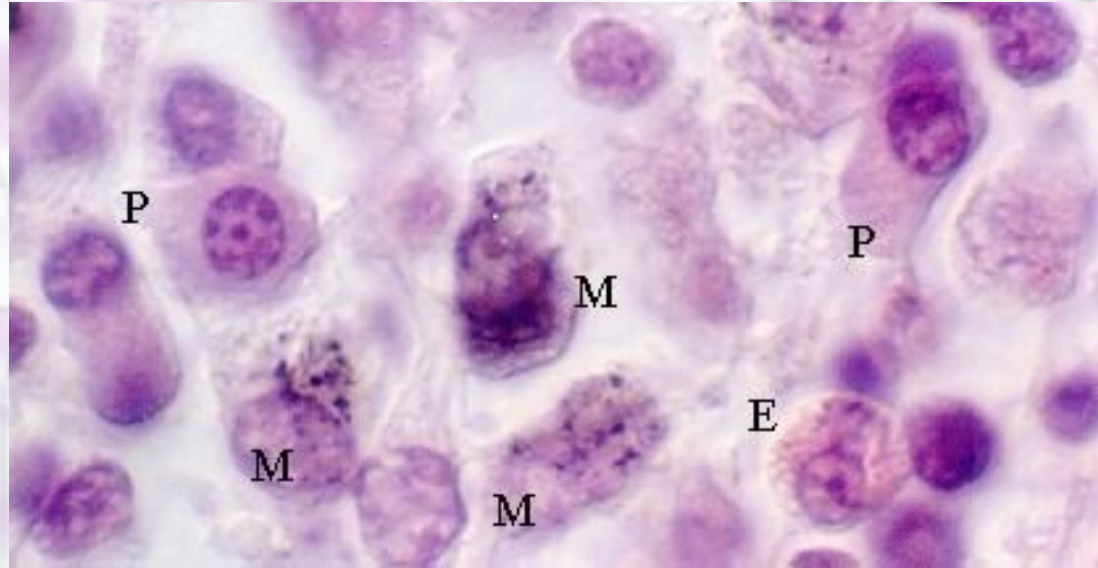
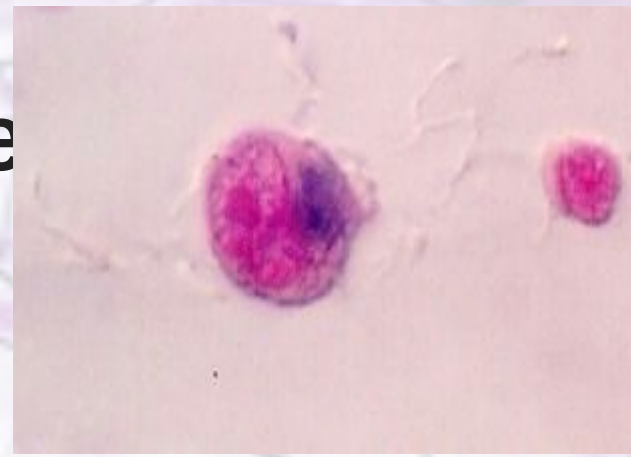
FIBROBLAST

- the most common cells in connective tissue
- They produce and maintain the extracellular matrix (ECM), including collagen, elastin and ground substance.
- typically have large active nuclei and eosinophilic cytoplasm that tapers off in both directions (spindle-shape)

Cells of Connective Tissue

MACROPHAGE

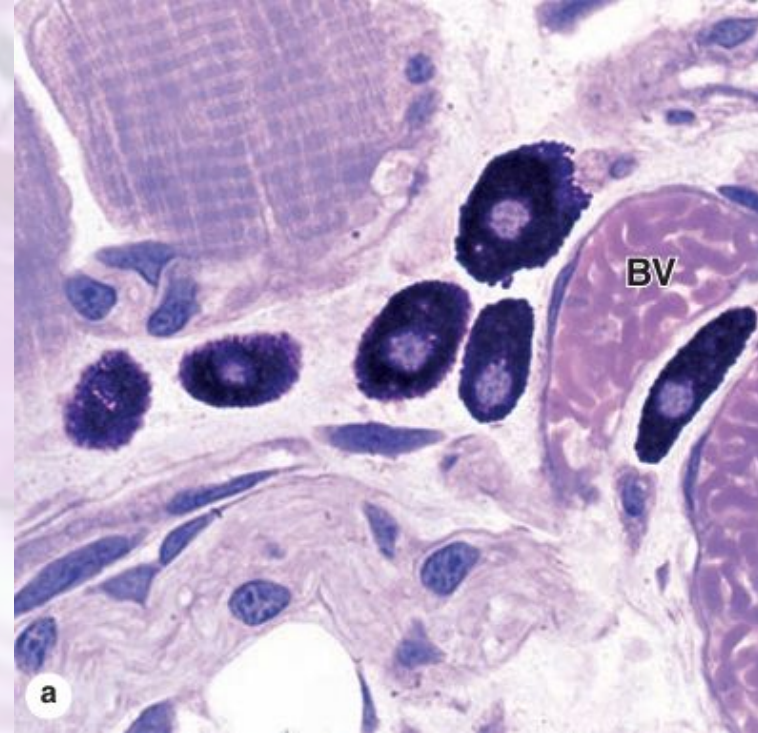
- Large, phagocytic cells derived from monocytes.
- A typical macrophage measures between **10 and 30 m in diameter** and has an **eccentrically located, oval or kidney shaped nucleus**.
- help with immune defense by engulfing pathogens, dead cells and debris.
- Aka Histiocytes



Cells of Connective Tissue

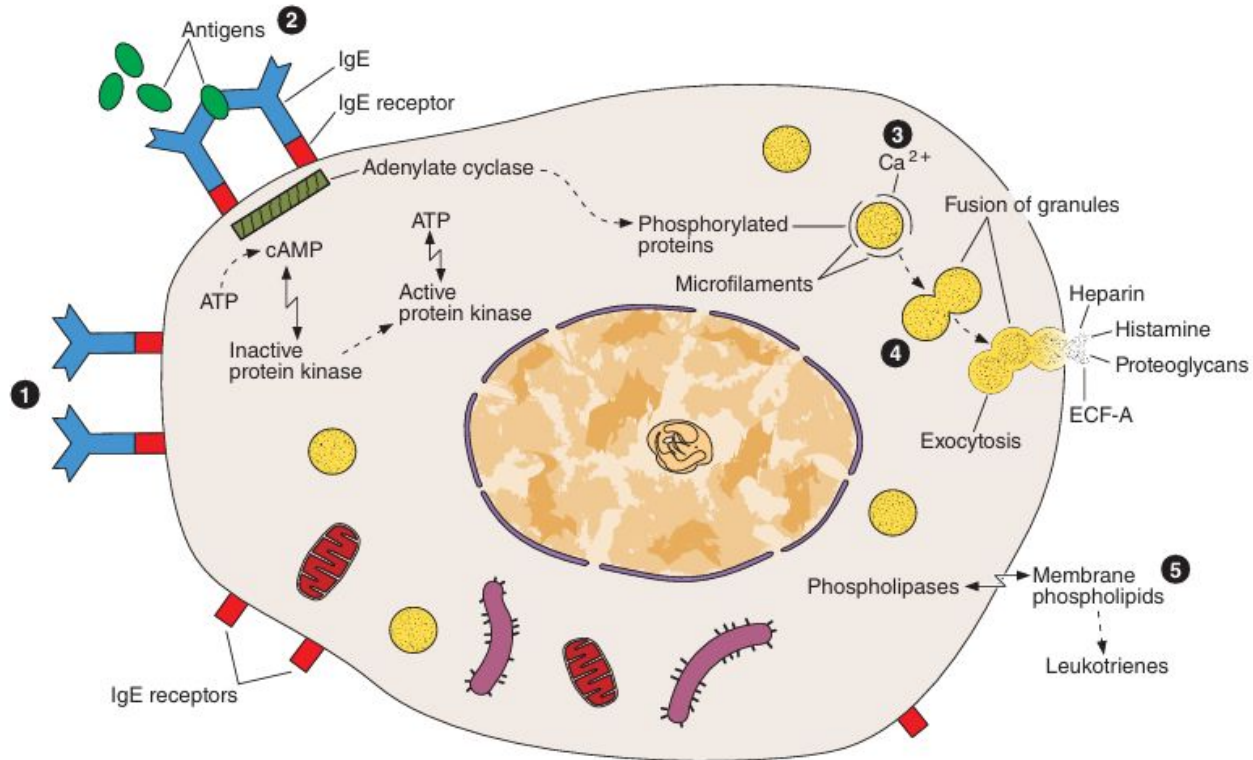
MAST CELLS

- play a role In allergic reactions, inflammation, tissue repair and immune response.
- They are typically oval shaped, with cytoplasm filled with strongly basophilic granules.
- Contains granules rich in histamine and heparin.
- **Heparin:** a sulfated GAG that acts locally as an anticoagulant
- **Histamine:** promotes increased vascular permeability and smooth muscle contraction



Cells of Connective Tissue

FIGURE 5-6 Mast cell secretion.

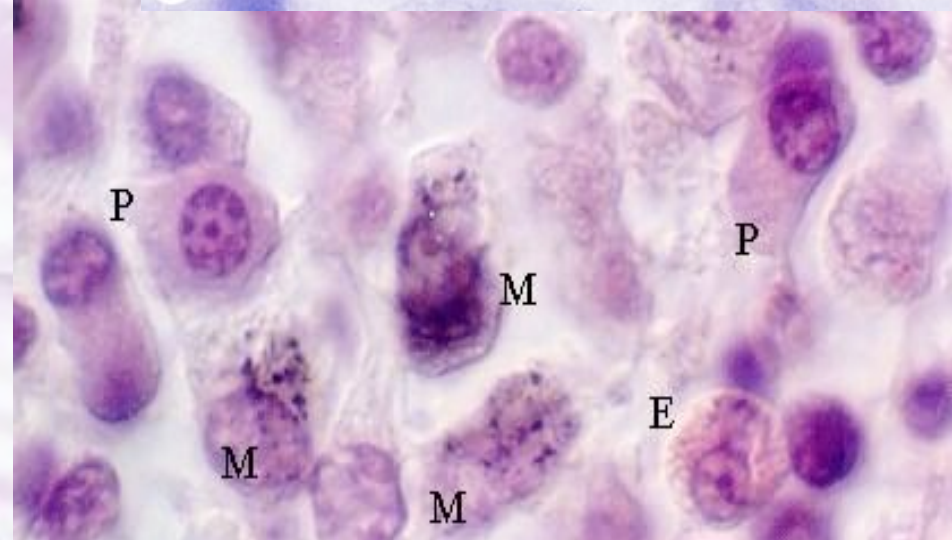
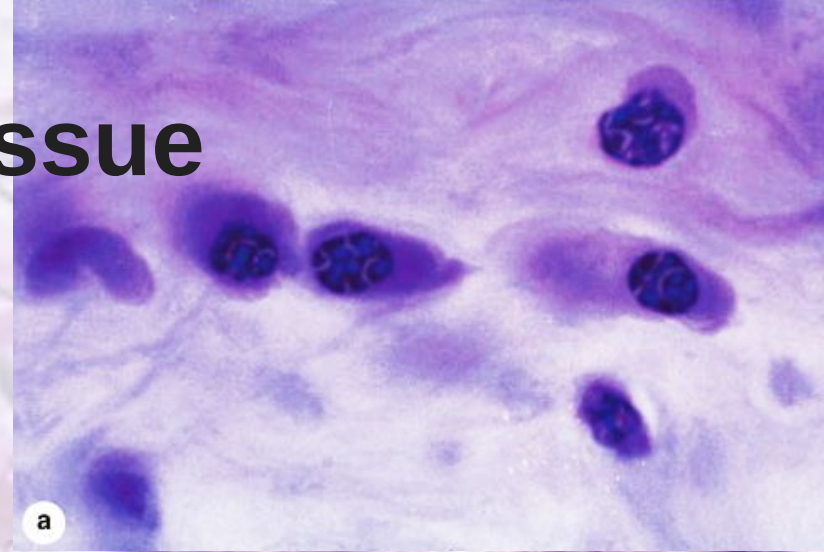


Cells of Connective Tissue

PLASMA CELLS

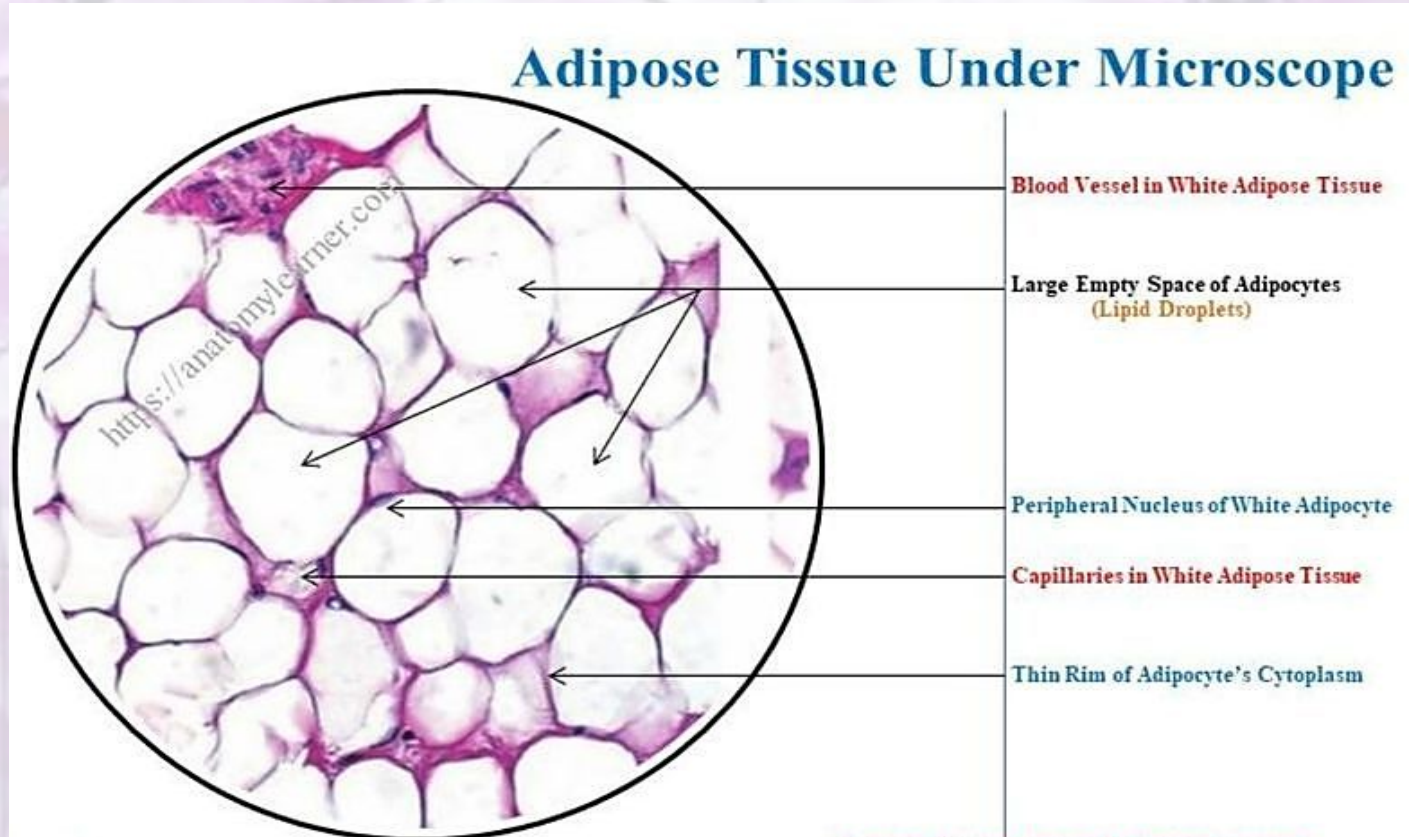
Clock-face appearance

- Derived from B lymphocytes
- They produce antibodies to help fight infections
- large, ovoid cells have basophilic cytoplasm rich in RER and a large Golgi apparatus near the nucleus that may appear pale in routine histologic preparations

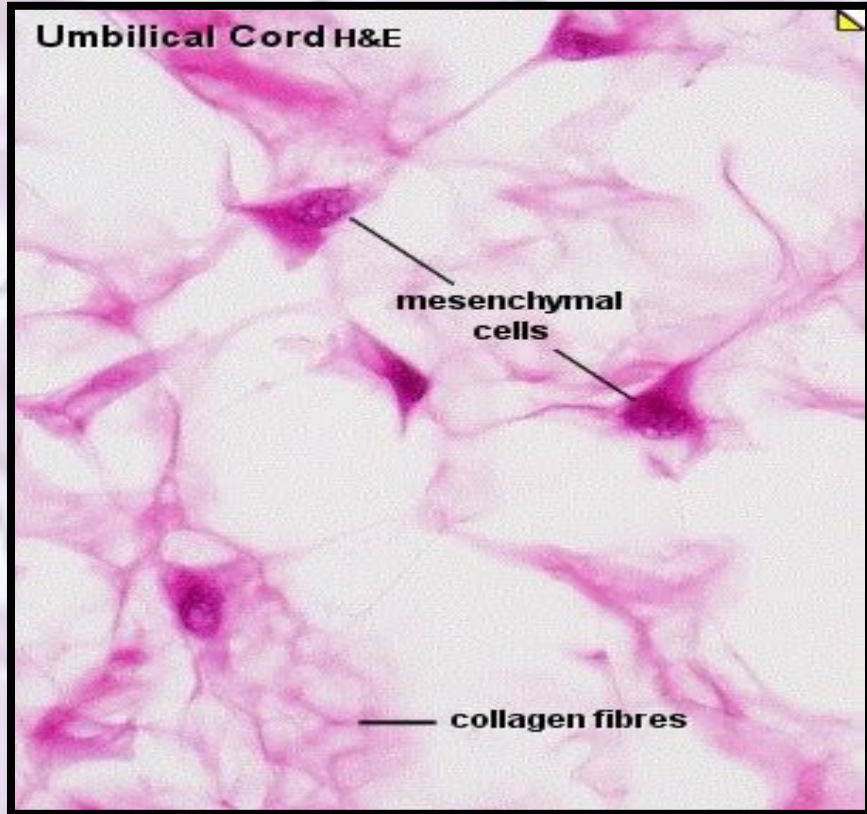


Cells of Connective Tissue

- store energy in the form of lipids and provide insulation and cushioning
- Tissue with a large population of adipocytes, is called **adipose connective tissue**



Cells of Connective Tissue



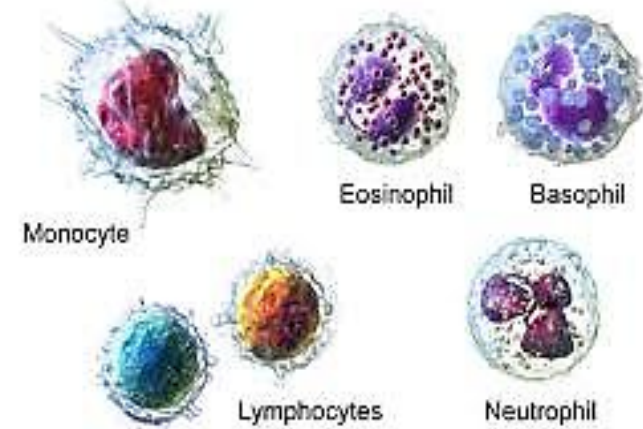
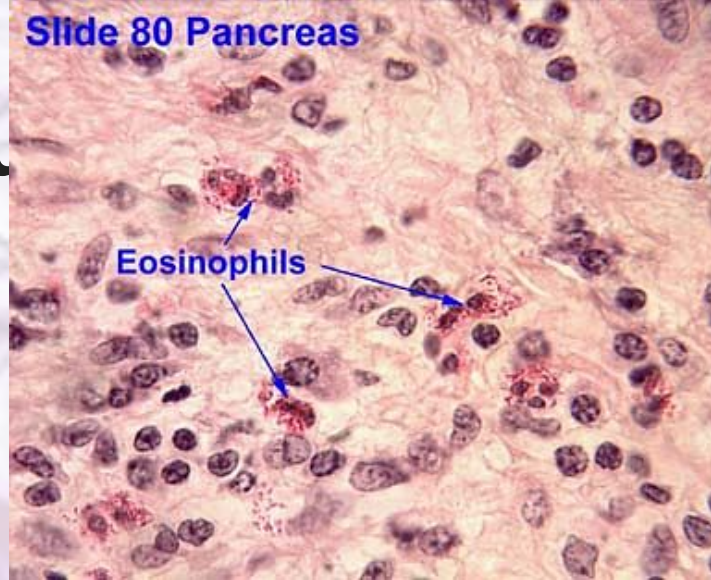
MESENCHYMAL CELLS

- Undifferentiated stem cells that can differentiate into various connective tissue cells for repair and regeneration.
- small spindle-shaped cells with large nuclei, prominent nucleoli and fine chromatin.

Cells of Connective Tissue

LEUKOCYTES

- Derived from circulating blood cells, they leave blood by migrating between the endothelial cells of venules to enter connective tissue
- increases greatly during **inflammation**, which is a vascular and cellular defensive response to injury or foreign substances
- Includes: neutrophils, lymphocytes and other immune cells



White Blood Cells

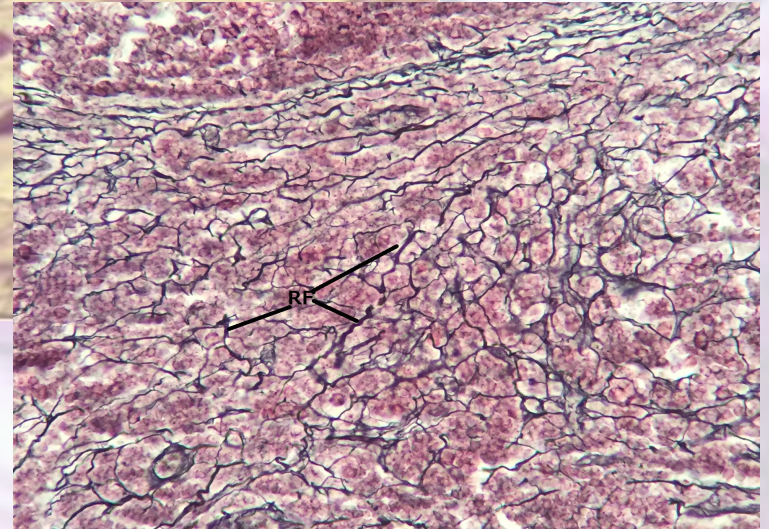
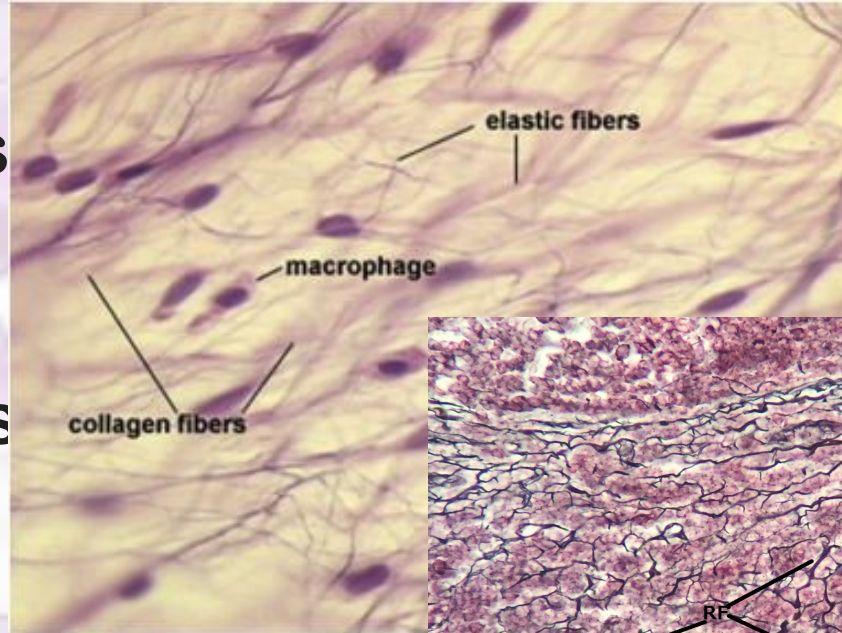
TABLE 5-1**Functions of cells in connective tissue proper.**

Cell Type	Major Product or Activity
Fibroblasts (fibrocytes)	Extracellular fibers and ground substance
Plasma cells	Antibodies
Lymphocytes (several types)	Various immune/defense functions
Eosinophilic leukocytes	Modulate allergic/vasoactive reactions and defense against parasites
Neutrophilic leukocytes	Phagocytosis of bacteria
Macrophages	Phagocytosis of ECM components and debris; antigen processing and presentation to immune cells; secretion of growth factors, cytokines, and other agents
Mast cells and basophilic leukocytes	Pharmacologically active molecules (eg, histamine)
Adipocytes	Storage of neutral fats

Fibers

Fibers of Connective Tissue

- Collagen fibers
- Elastic Fibers
- Reticular fibers



Fibers of Connective Tissue

Collagen fibers

- Thick, strong, and rope-like fibers made primarily of collagen protein.
- Appear wavy and stain pink in H&E staining
- Fx: Provide tensile **strength** and **resistance stretching**

Type I Collagen – provides high tensile strength

- tendons, ligaments, bone and dermis

Type II Collagen – offers resistance to compressive forces

- cartilage

Type III Collagen - forms reticular fibers

- Lymphoid organs and basement membrane

Type IV Collagen– provides support and filtration

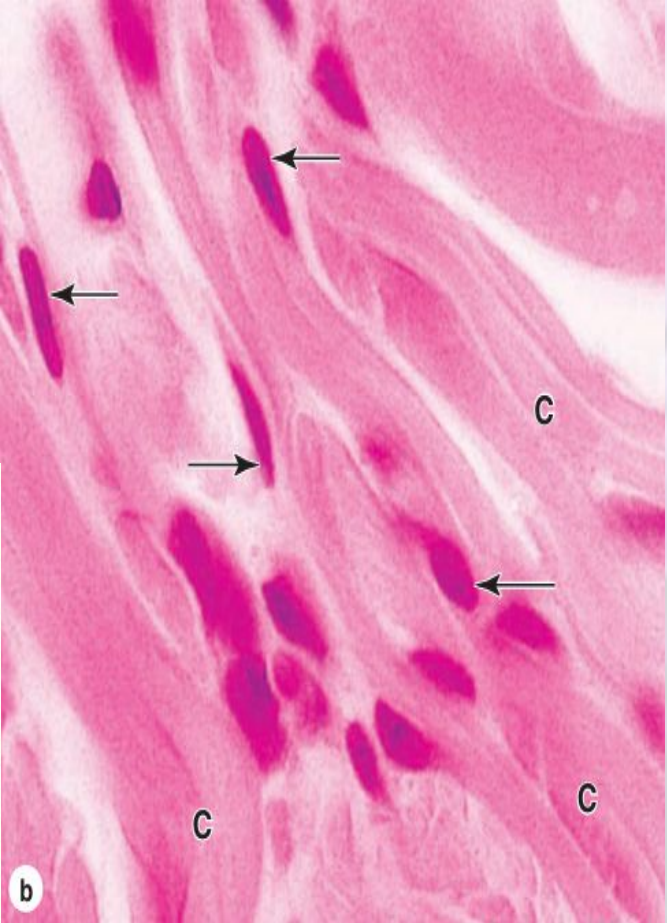
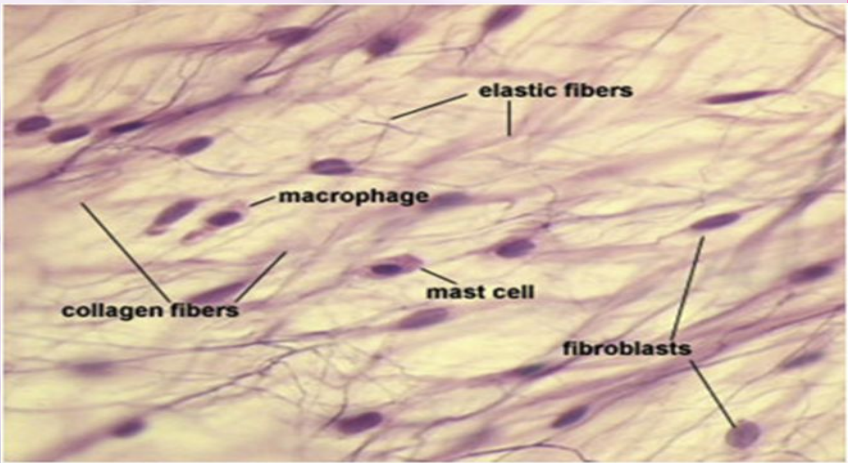
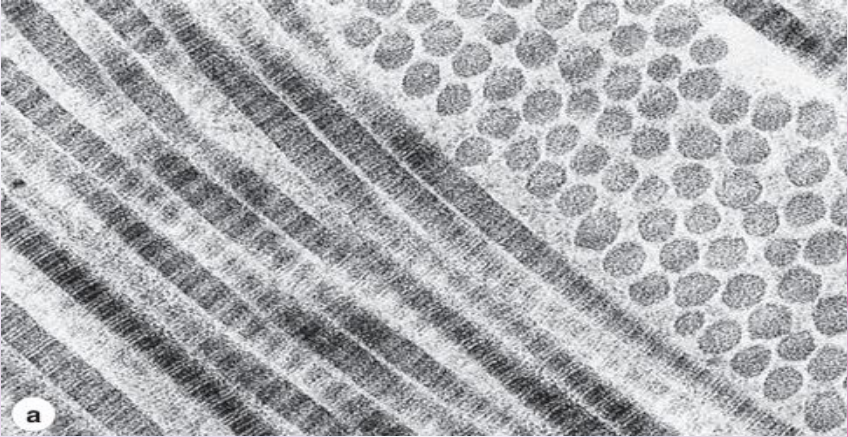
- Basement membrane

TABLE 5-3

Collagen types.

Type	α -Chain Composition	Structure	Optical Microscopy	Major Location	Main Function
Fibril-Forming Collagens					
I	$[\alpha 1 (I)]_2[\alpha 2 (I)]$	300-nm molecule, 67-nm-banded fibrils	Thick, highly picosirius birefringent, fibers	Skin, tendon, bone, dentin	Resistance to tension
II	$[\alpha 1 (II)]_3$	300-nm molecule, 67-nm-banded fibrils	Loose aggregates of fibrils, birefringent	Cartilage, vitreous body	Resistance to pressure
III	$[\alpha 1 (III)]_3$	67-nm-banded fibrils	Thin, weakly birefringent, argyrophilic (silver-binding) fibers	Skin, muscle, blood vessels, frequently together with type I	Structural maintenance in expansible organs
V	$[\alpha 1 (V)]_3$	390-nm molecule, N-terminal globular domain	Frequently forms fiber together with type I	Fetal tissues, skin, bone, placenta, most interstitial tissues	Participates in type I collagen function
XI	$[\alpha 1 (XI)] [\alpha 2 (XI)] [\alpha 3 (XI)]$	300-nm molecule	Small fibers	Cartilage	Participates in type II collagen function
Network-Forming Collagens					
IV	$[\alpha 1 (IV)]_2 [\alpha 2 (IV)]$	Two-dimensional cross-linked network	Detected by immunocytochemistry	All basal and external laminae	Support of epithelial cells; filtration
X	$[\alpha 1 (X)]_3$	Hexagonal lattices	Detected by immunocytochemistry	Hypertrophic cartilage involved in endochondral bone formation	Increases density of the matrix
Linking/Anchoring Collagens					
VII	$[\alpha 1 (VII)]_3$	450 nm, globular domain at each end	Detected by immunocytochemistry	Epithelial basement membranes	Anchors basal laminae to underlying reticular lamina
IX	$[\alpha 1 (IX)] [\alpha 2 (IX)] [\alpha 3 (IX)]$	200-nm molecule	Detected by immunocytochemistry	Cartilage, vitreous body	Binds various proteoglycans; associated with type II collagen
XII	$[\alpha 1 (XII)]_3$	Large N-terminal domain	Detected by immunocytochemistry	Placenta, skin, tendons	Interacts with type I collagen
XIV	$[\alpha 1 (XIV)]_3$	Large N-terminal domain; cross-shaped molecule	Detected by immunocytochemistry	Placenta, bone	Binds type I collagen fibrils, with types V and XII, strengthening fiber formation

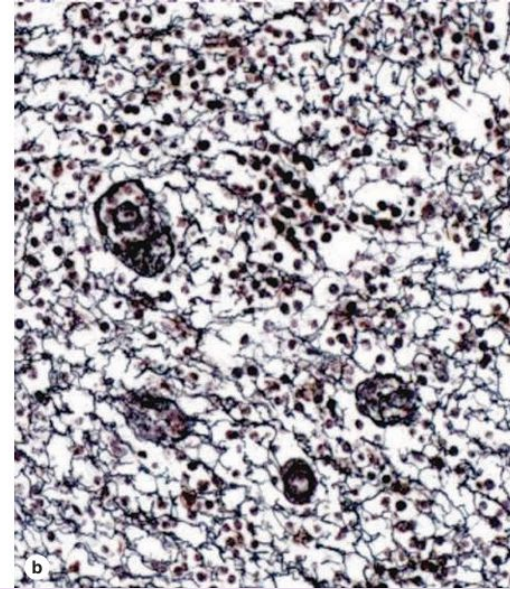
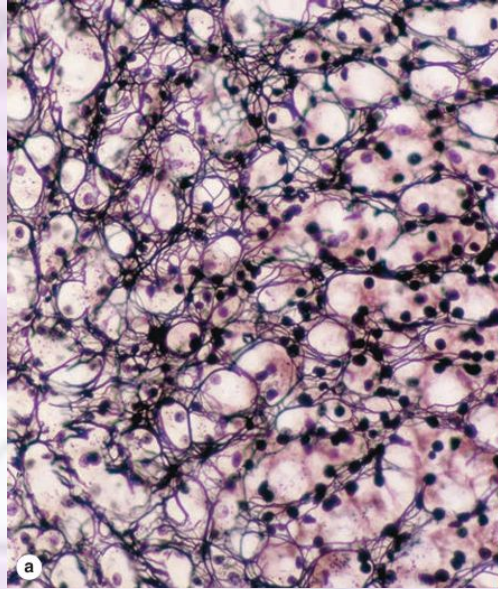
COLLAGEN FIBERS



Fibers of Connective Tissue

Reticular fibers

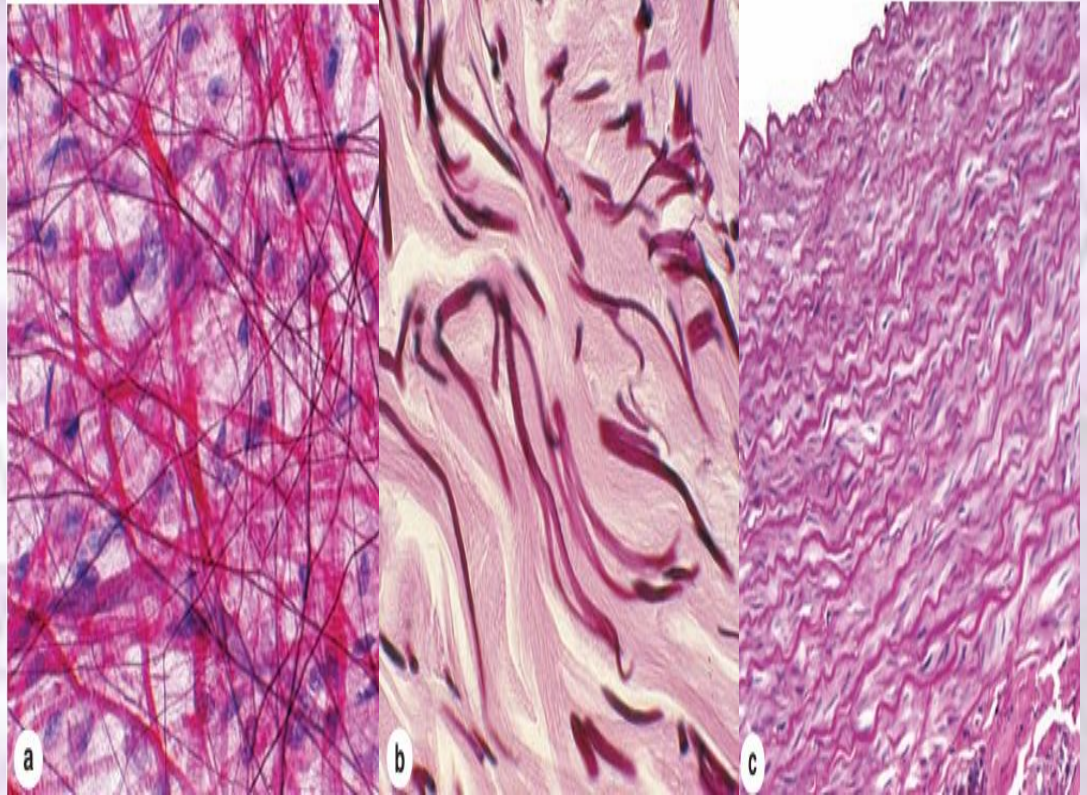
- Thin, delicate fibers made of **type III collagen**, forming mesh-like network
- Found in lymphoid organs, bone marrow, and basement membrane
- Fx: Provide structural support, esp in soft tissues and organs

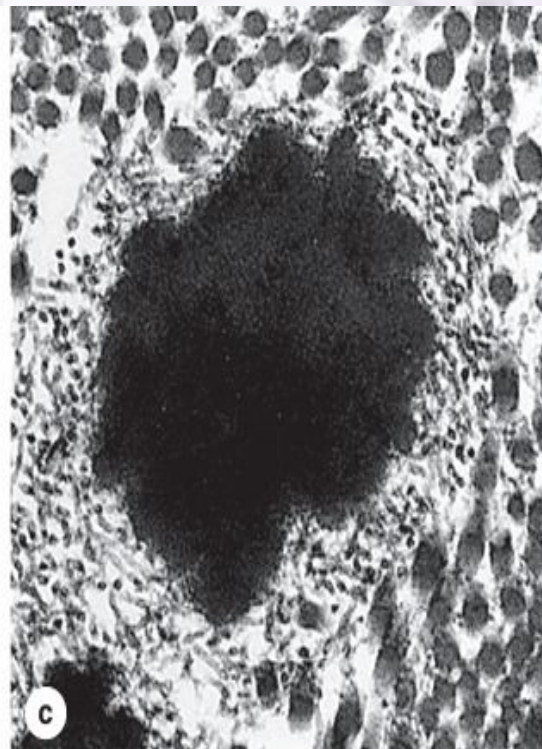
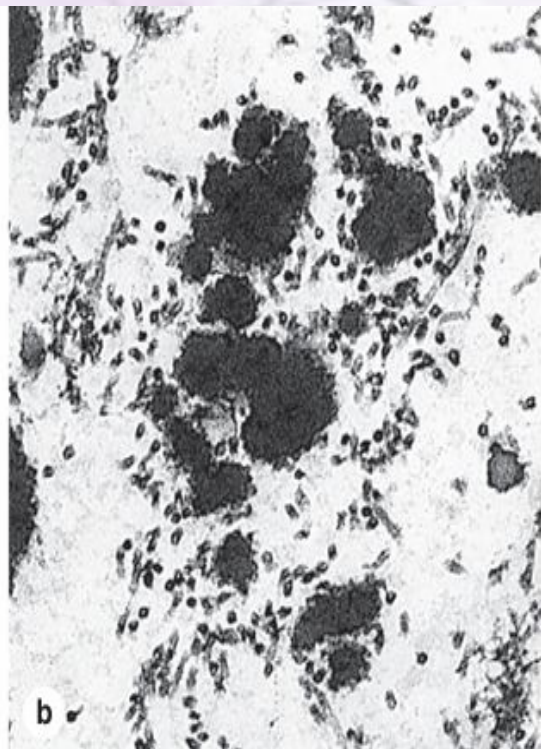
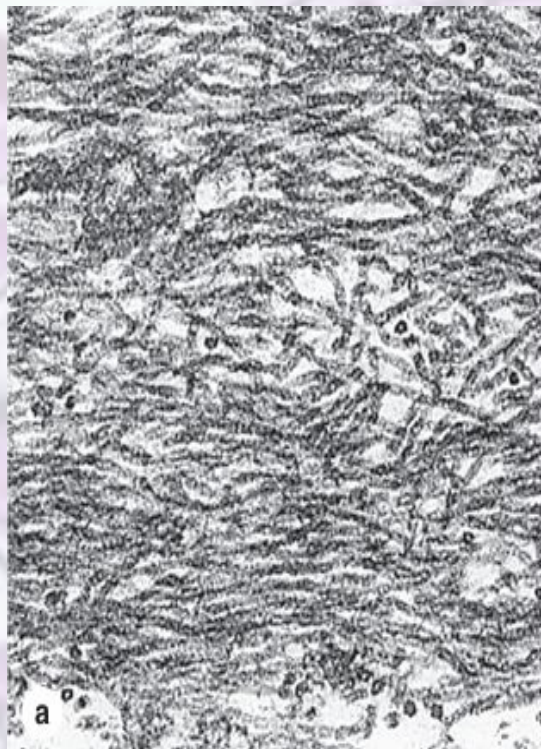


Fibers of Connective Tissue

Elastic fibers

- Thin, branching fibers
- Elastin and fibrillin
- Dark purple or black with special stains like Verhoeff-Van Gieson
- Skin, lungs and blood vessels
- Fx: Provide elasticity and flexibility, allowing tissues to stretch and recoil





Ground Substance

Ground Substance

- amorphous, gel-like material that fills the space between cells and fibers in connective tissue
- Composition:
 - **Glycosaminoglycans (GAGs)** – long, unbranched polysaccharides that attract water and contribute to the gel-like consistency
 - **Hyaluronic acid** (lubrication), **Chondroitin sulfate** (resilience), **Heparin sulfate** (cell signaling and filtration)
 - **Proteoglycans** – large molecules consisting of **GAGs** attached to a core **protein**; helps retain water, resist compression and regulate molecule movement
 - **Adhesive Glycoproteins** – proteins that facilitate cell adhesion and communication with the extracellular matrix
 - **Fibronectin** (connect cells to collagen) and **Laminin** (support and attachment for E.C)

Ground Substance

- **Functions:**
 - **Supports and bind cells**
 - **Hydration**
 - **Acts as a medium for nutrient and waste exchange**
 - **Barrier against pathogens**

FIGURE 5-16 Ground substance of the ECM.

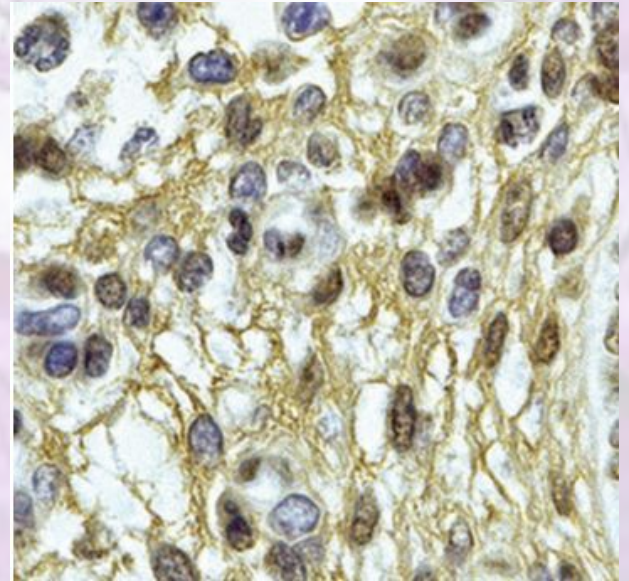
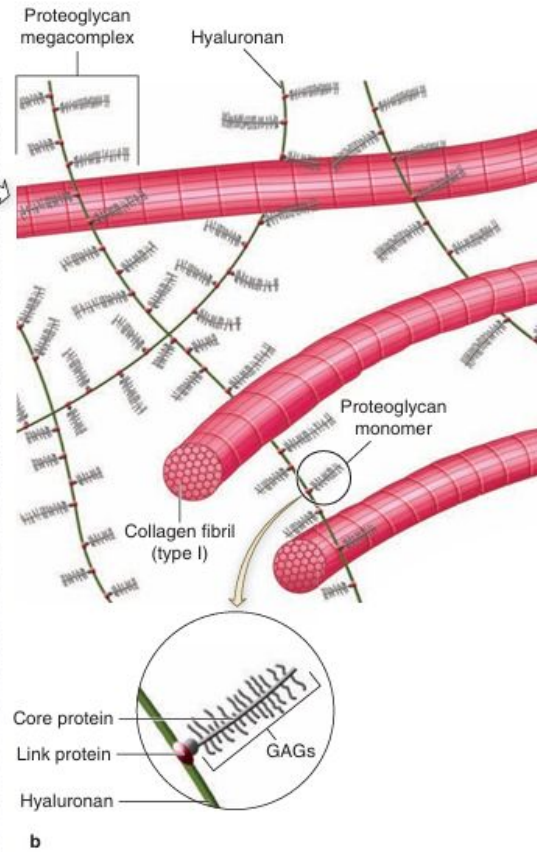
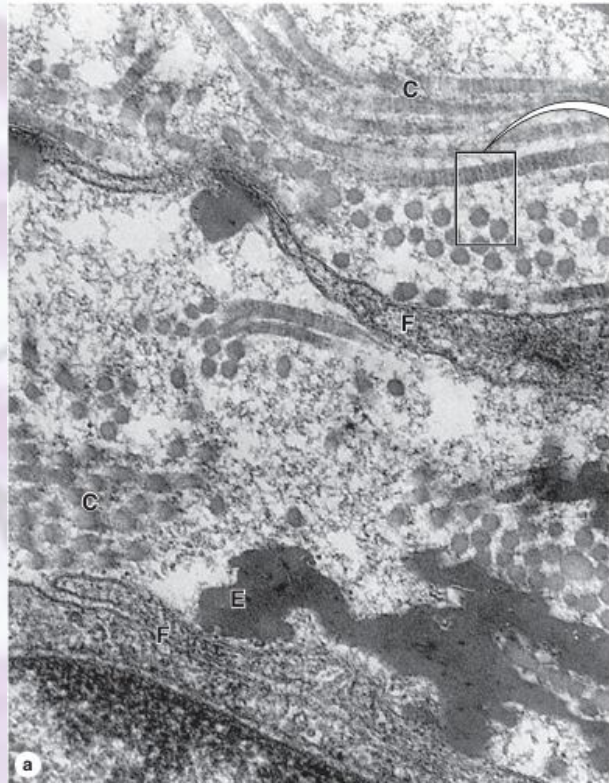
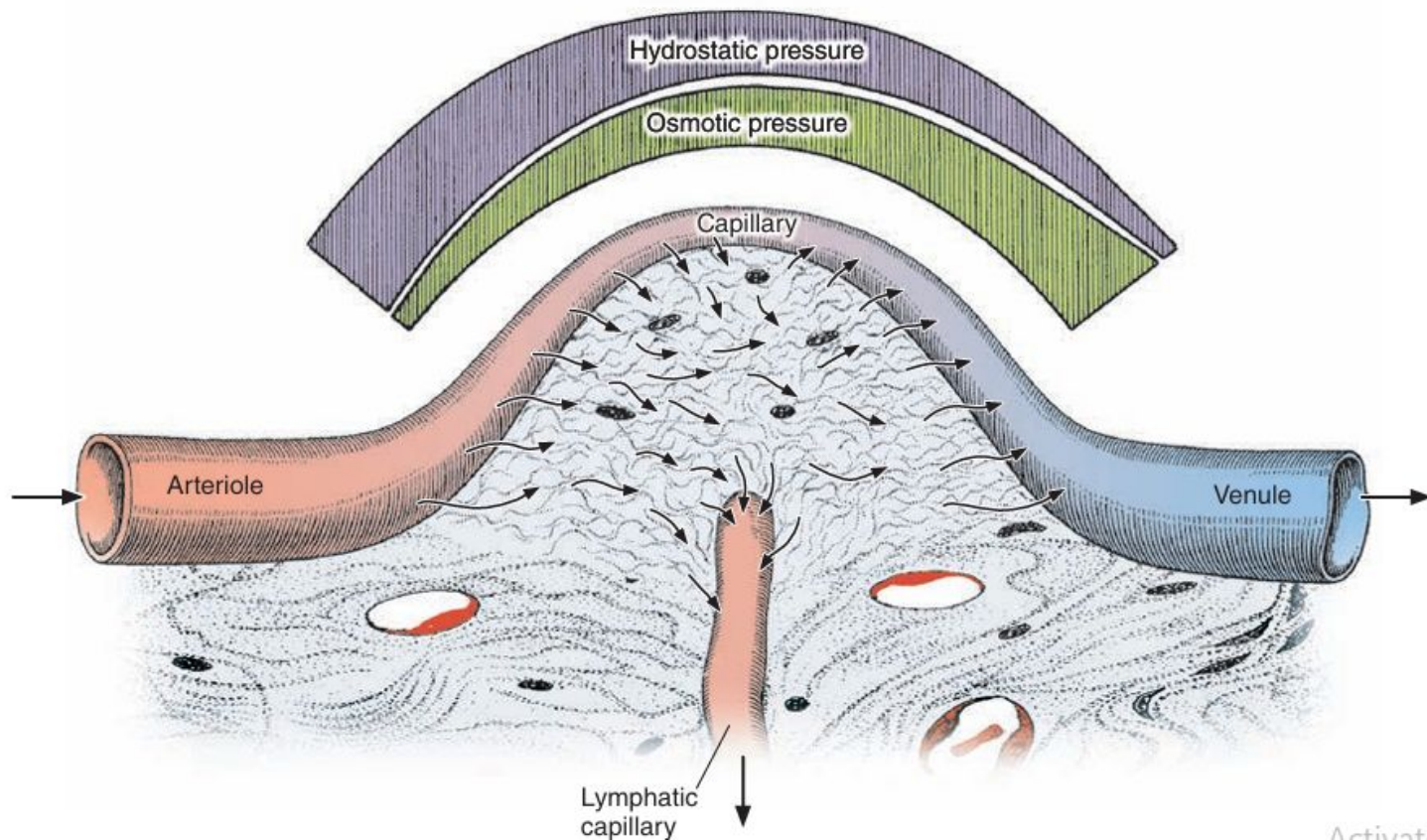


FIGURE 5-18 Movement of fluid in connective tissue.



Types of Connective Tissue

Types of connective Tissue

- **CONNECTIVE TISSUE PROPER**

- Loose – Areolar
- Dense – Regular, Irregular, Elastic

- **EMBRYONIC CONNECTIVE TISSUE**

- Muroid connective tissue
- Mesenchyme

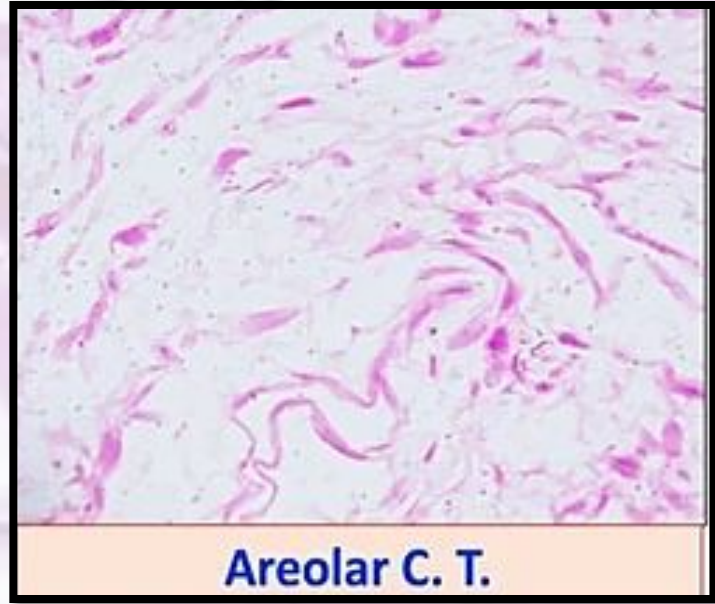
- **SPECIALIZED CONNECTIVE TISSUE**

- Cartilage – Hyaline, Elastic, Fibrocartilage
- Bone
- Blood
- Adipose
- Reticular

Connective Tissue Proper

Loose connective tissue

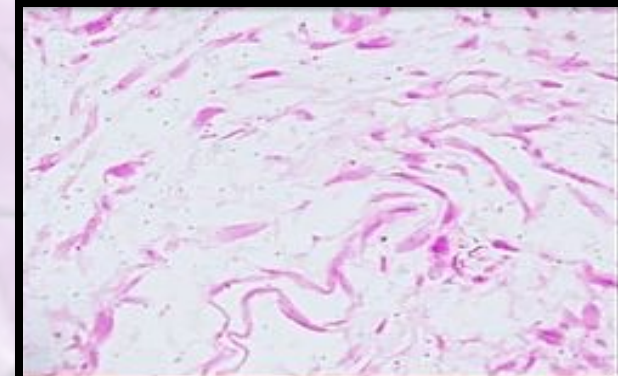
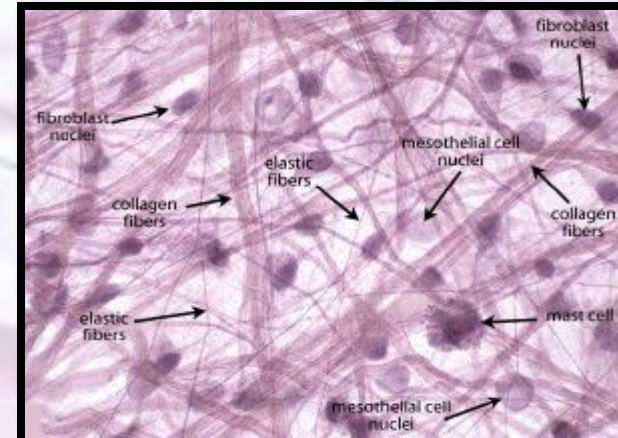
- Loosely arranged fibers and abundant ground substance
- Provides support, cushioning and flexibility
- Areolar Tissue



Loose Connective Tissue

Areolar Tissue

- Contains fibroblasts, macrophages, mast cells and other immune cells
- Gel-like substance with collagen, elastic and reticular fibers loosely arranged
- Fx: supports and cushions organs, surrounds blood vessels and nerves, and plays a role in immune defense
- Location: under epithelial tissue (dermis of the skin, around blood vessels and between muscles)

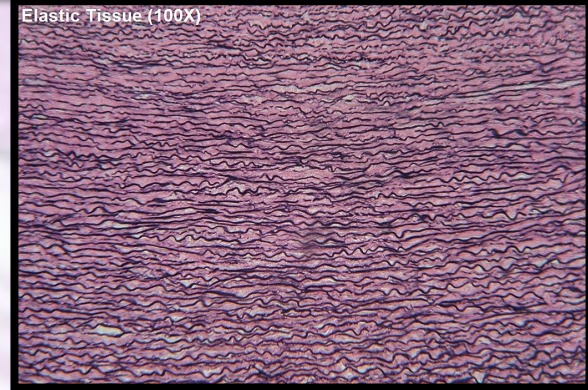
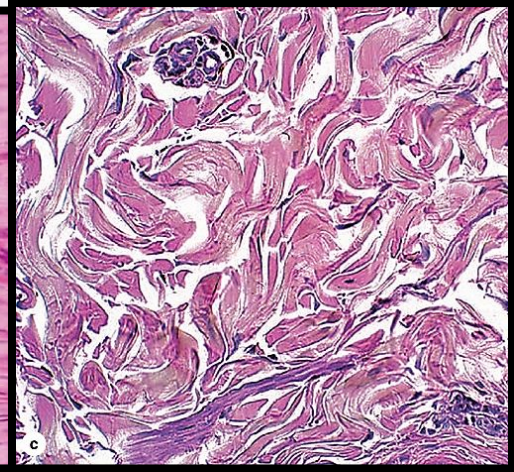
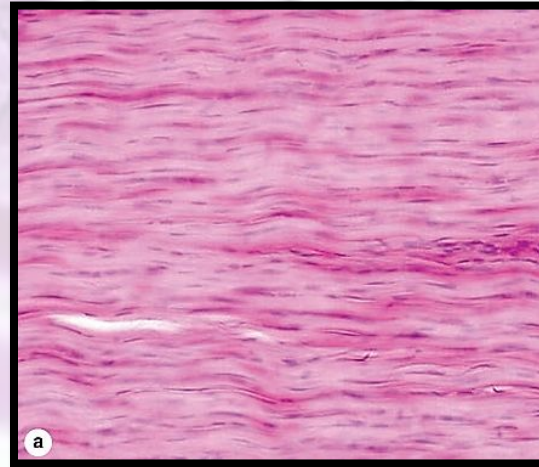


Areolar C. T.

Connective Tissue Proper

Dense connective tissue

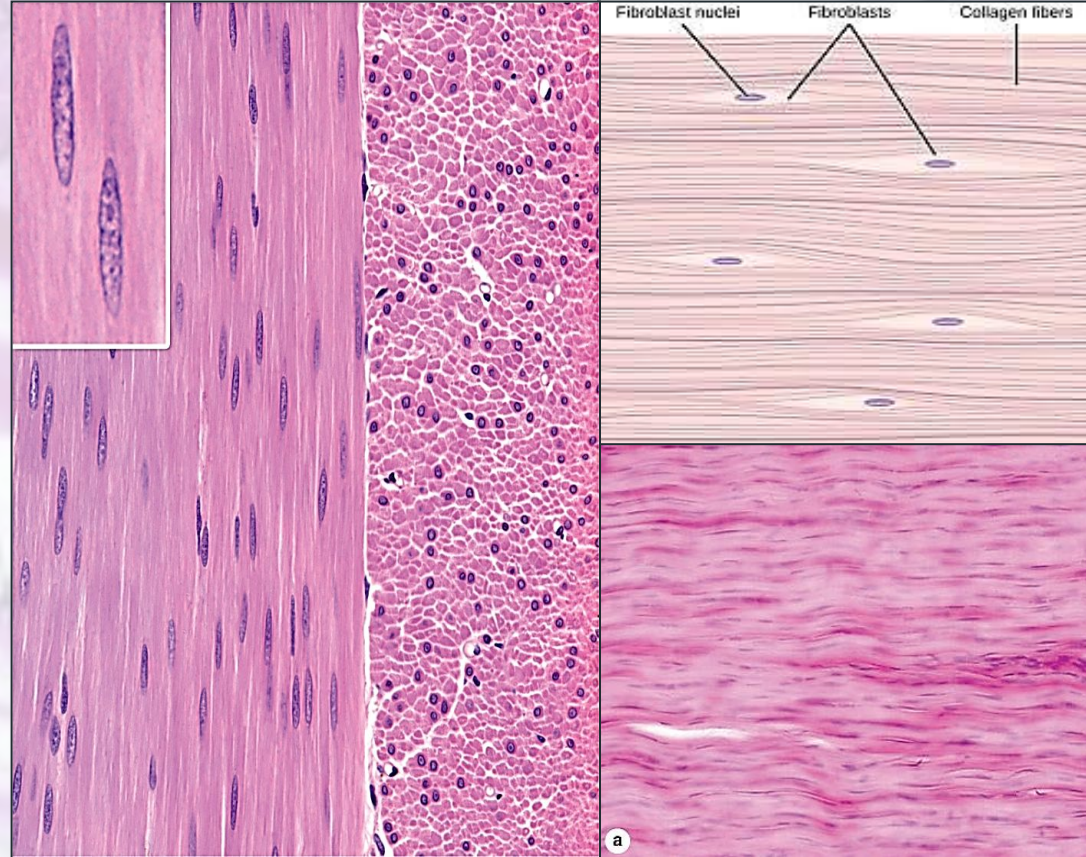
- high concentration of collagen fibers
- provides structural support and protection for the body
 - Dense regular – parallel fibers
 - Dense irregular – multidirectional fibers
 - Elastic – as elastin



Connective Tissue Proper

Dense regular CT

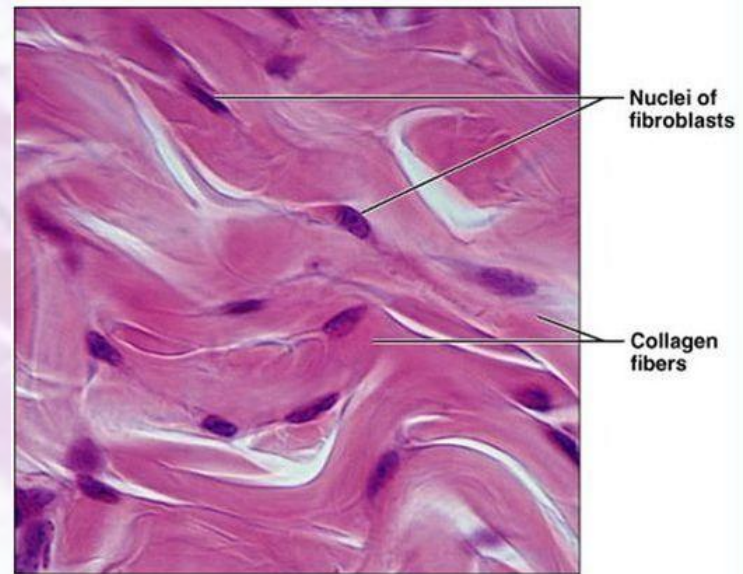
- Collagen fibers are tightly packed and arranged in parallel bundles
- fibroblast
- Poorly vascularized
- Fx: provides strong tensile strength in one direction
- Location: tendons, ligaments, aponeuroses



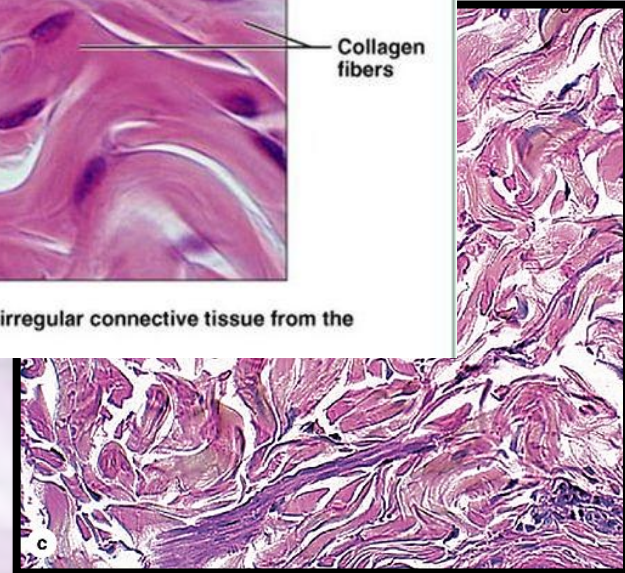
Connective Tissue Proper

Dense irregular CT

- Collagen fibers are arranged in an irregular, interwoven pattern
- FUNCTION:
 - Provides strength and resistance to stretching in multiple directions
 - Protects organs and structures from mechanical stress
- LOCATION:
 - Dermis of the skin, joint capsules, periosteum, fibrous capsules of organs



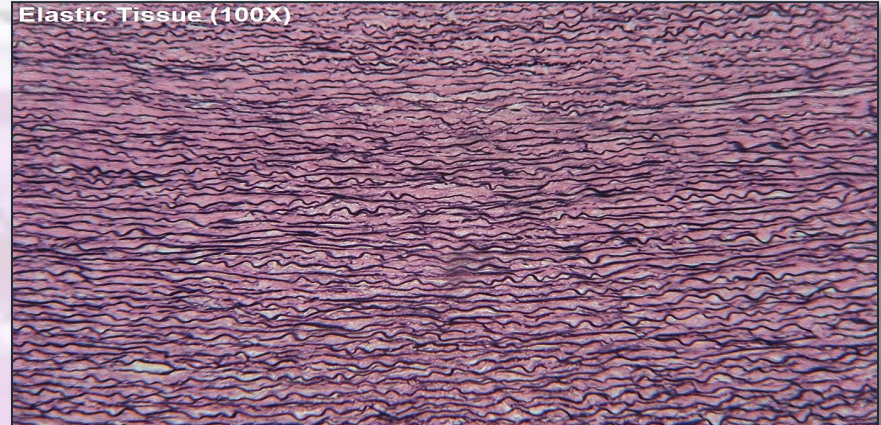
Photomicrograph: Dense irregular connective tissue from the dermis of the skin (400 \times).



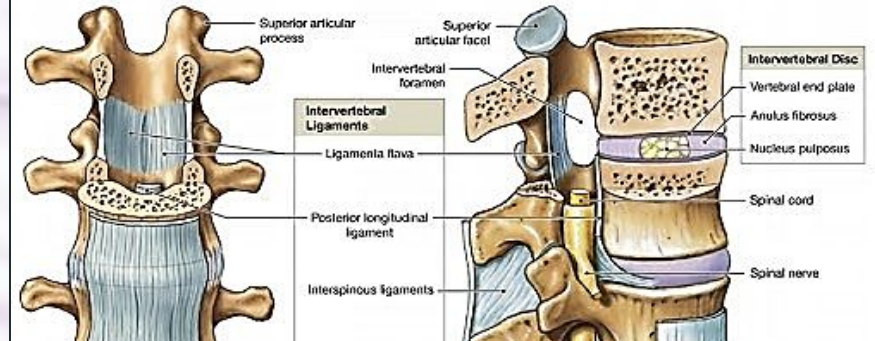
Connective Tissue Proper

Elastic connective tissue

- Contains abundant elastic fibers
- Allows tissue to stretch and recoil
- FUNCTION:
 - Provides elasticity and allows structures to expand and contract
 - Helps maintain blood pressure and airflow
- LOCATION:
 - Walls of large arteries, lungs and bronchi, ligamenta flava



Vertebral Ligaments | Stabilizing the Spine

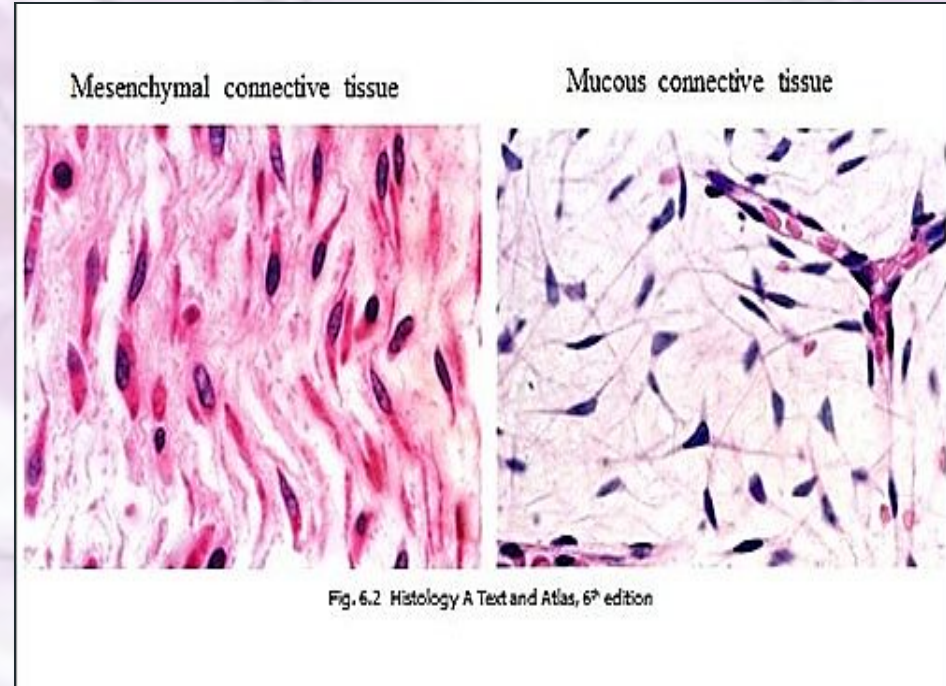


Dense Connective Tissue

TYPE	STRUCTURE	FUNCTION	LOCATION
DENSE REGULAR	Parallel collagen fibers	Strong tensile strength in one direction	Tendons, ligaments, aponeuroses
DENSE IRREGULAR	Irregularly arranged collagen fiber	Withstands stress in multiple directions	Dermis, joint capsules, periosteum, organ capsules
ELASTIC	Elastic fibers with some collagen	Stretching and recoil	Large arteries, lungs, elastic ligaments

Embryonic Connective Tissue

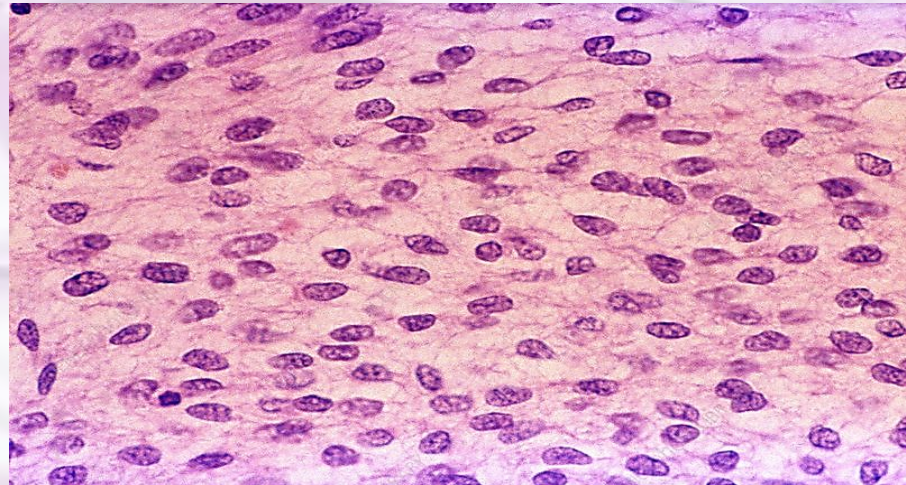
- Earliest form of connective tissue
- Present during fetal development
- Gives rise to all adult connective tissue
- Types:
 - Mesenchymal CT
 - Muroid (Mucous) CT



Embryonic Connective Tissue

Mesenchymal CT (Mesenchyme)

- Undifferentiated tissue composed of mesenchymal cells (spindle-shaped, with large nuclei)
- Cells are loosely arranged in a gel-like ground substance
- Few fibers
- Function:
 - Origin of all connective tissues
 - wound healing and tissue regeneration
- Location

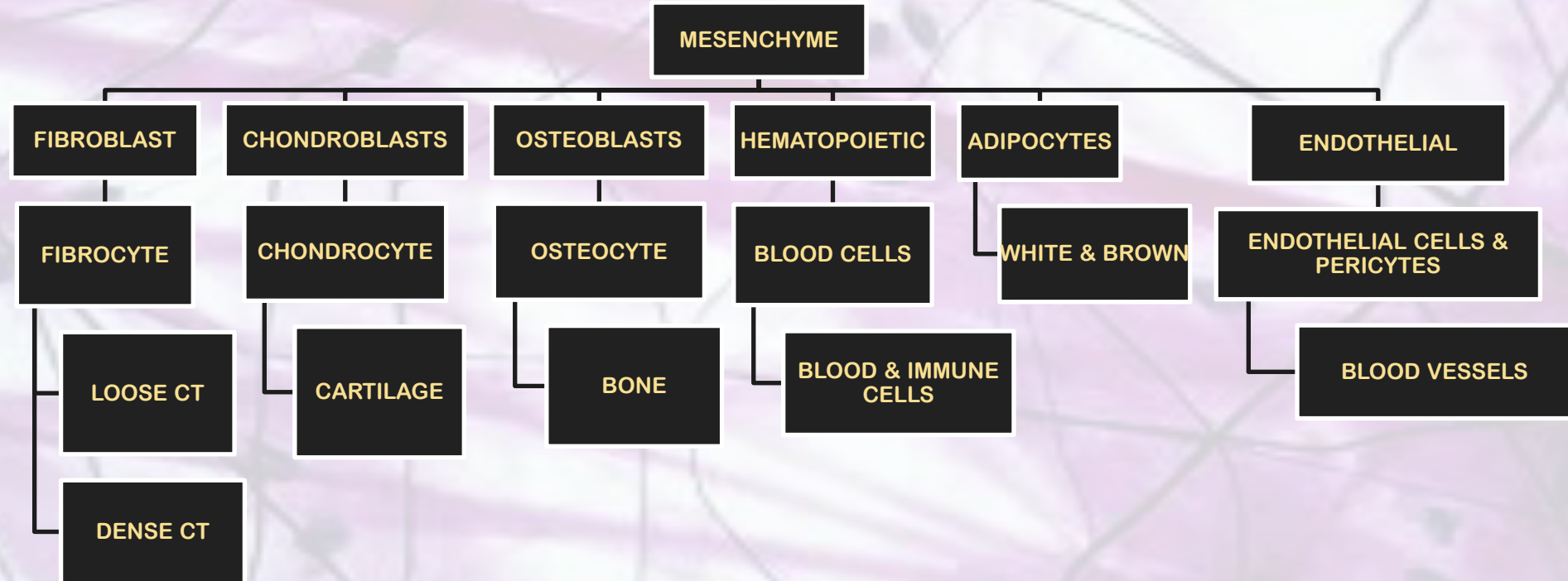


Embryo, niches of bone marrow

Embryonic Connective Tissue

Mesenchymal CT (Mesenchyme)

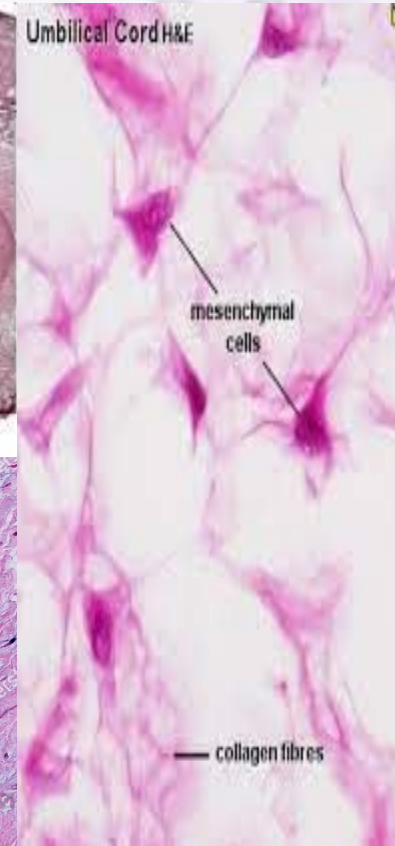
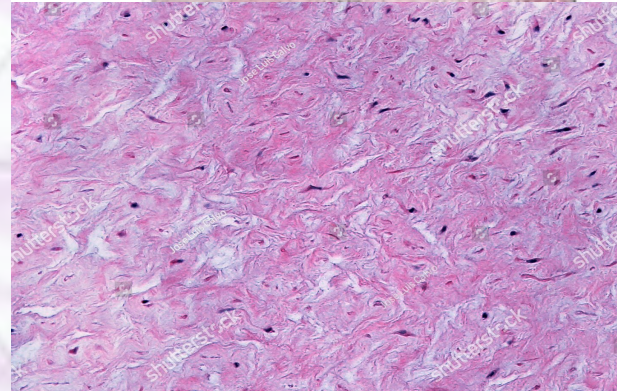
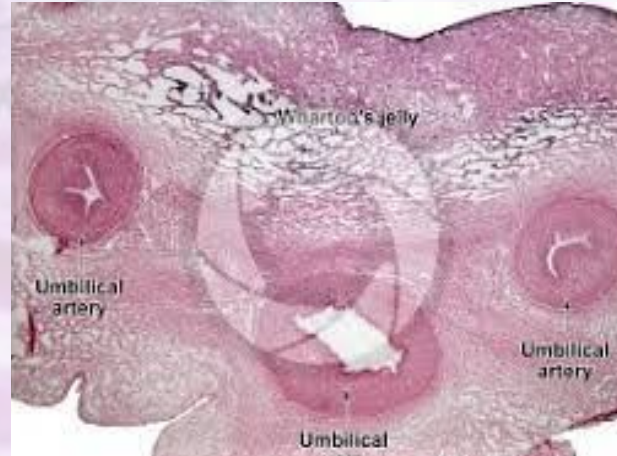
- Origin of all connective tissues



Embryonic Connective Tissue

MUCOID (Mucous) CT

- Wharton's jelly
- Stellate (star-shaped) fibroblast-like cells embedded in a jelly-like ground substance
- ground substance rich in hyaluronic acid
- Scattered collagen fibers
- Function:
 - mechanical protection and prevents compression of the umbilical cord
 - Temporary connective tissue
- Location
 - Umbilical cord



Embryonic Connective Tissue

FEATURE	MESENCHYMAL CT	MUCUOS CT
Cells	Mesenchymal cells (spindle-shaped)	Stellate fibroblast-like cells
Fibers	Few reticular fibers	Sparse collagen fibers
Ground Substance	Gel-like, rich in hyaluronic acid	Jelly-like, very rich in hyaluronic acid
Function	Gives rise to all connective tissues	Protects umbilical cord from compression
Location	Embryo, some adult stem cell niches	Umbilical cord (Wharton's jelly)

CONNECTIVE TISSUE (Part 2)

Junquiera's Basic Histology
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Specialized Connective Tissue

- Composed of specialized cells and an extracellular matrix tailored to their function
- May have a solid (cartilage, bone), liquid (blood), or semi-solid (adipose) matrix
- FX: support, transport, energy storage, and immunity
- Types:
 - Cartilage
 - Bone
 - Blood
 - Adipose
 - Reticular

Specialized Connective Tissue

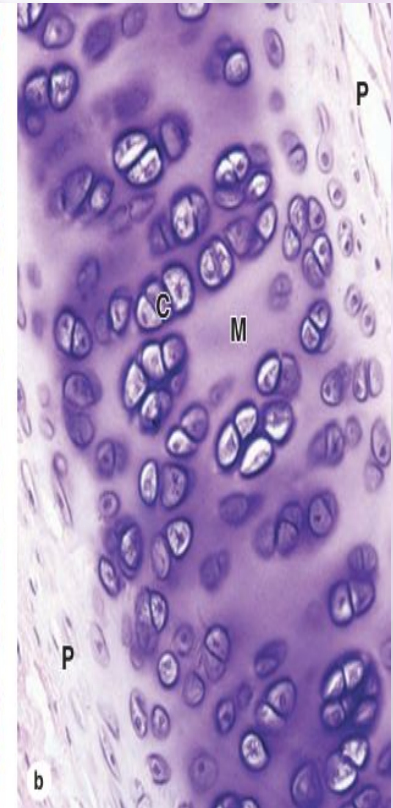
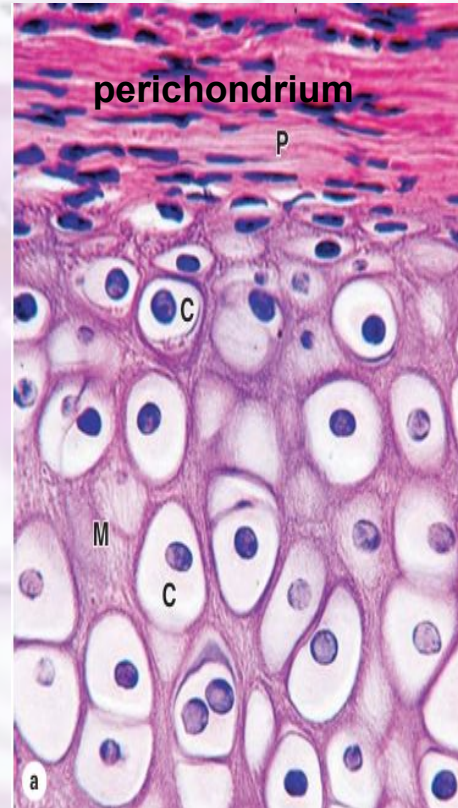
Cartilage

- **Avascular, firm and flexible**
- **Chondrocytes**
- **Fx: Provides support, reduces friction in joints and serves as a model for bone formation**
- **Location: joints, rib cage, ear, nose, trachea, intervertebral discs**
- **Types: hyaline, elastic and fibrocartilage**

Specialized Connective Tissue

Hyaline Cartilage

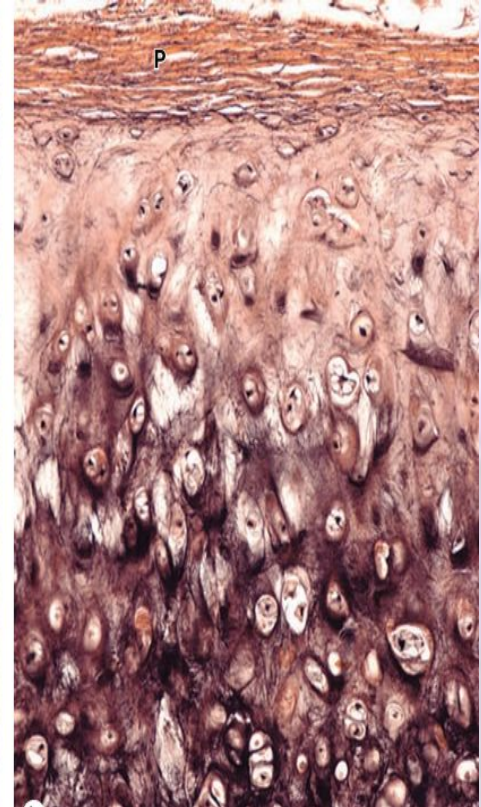
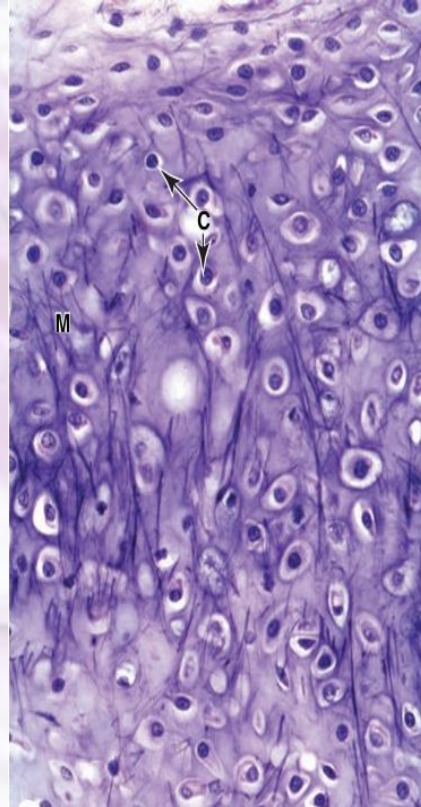
- Most abundant type
- Appears glassy and smooth
- type II collagen fibers embedded in a gel-like ground substance
- Chondrocytes are located in lacunae
- Lacks visible fibers in the matrix
- Function
 - Provides smooth surfaces for joint movement
 - template for bone formation
 - Support and maintains the shape of structures
- Location
 - Ends of long bones
 - Nose, trachea, larynx
 - Costal cartilage
 - Fetal skeleton



Specialized Connective Tissue

Elastic Cartilage

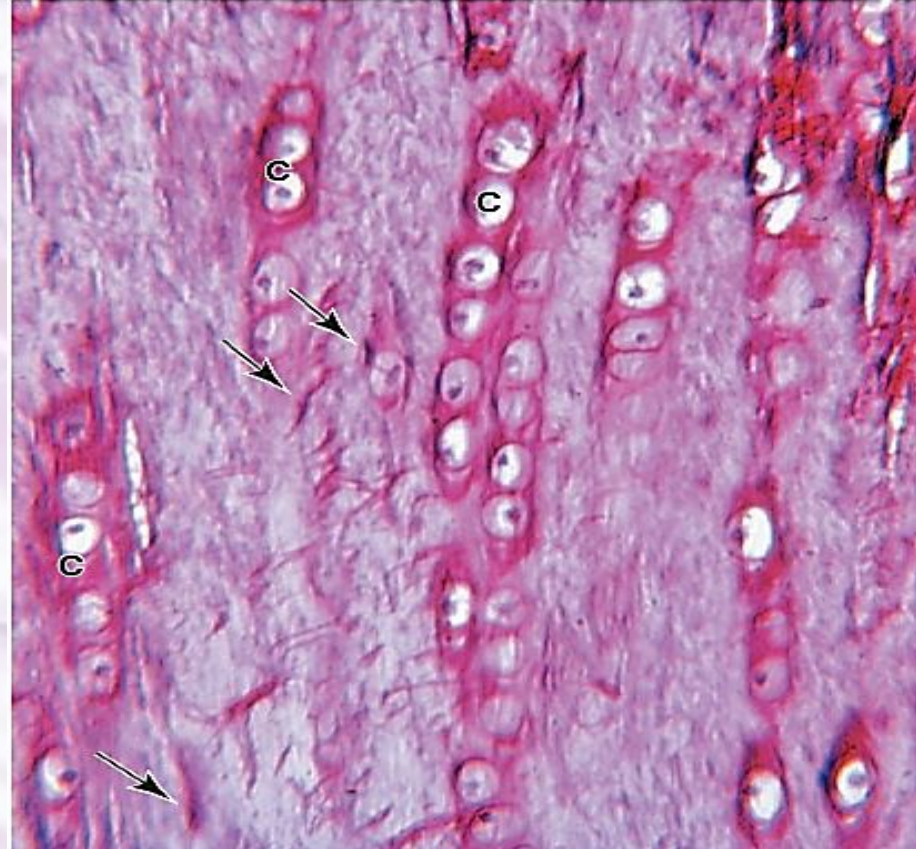
- Numerous fibers
- More flexible than hyaline c.
- Yellowish color
- Chondrocytes are more numerous and closely packed
- Function
 - Provides flexibility and resilience
 - Maintains shape of structures
- Location
 - External ear
 - Epiglottis
 - Eustacian tube



Specialized Connective Tissue

Fibrocartilage

- Dense fibers of type I collagen fibers
- Lacks perichondrium
- Yellowish color
- Chondrocytes are arranged in rows between collagen fibers
- Fibrous, tough appearance
- Function
 - Provides high tensile strength
 - Shock absorber
- Location
 - Intervertebral discs
 - Pubic symphysis
 - Menisci of the knee joint
 - Temporomandibular joint



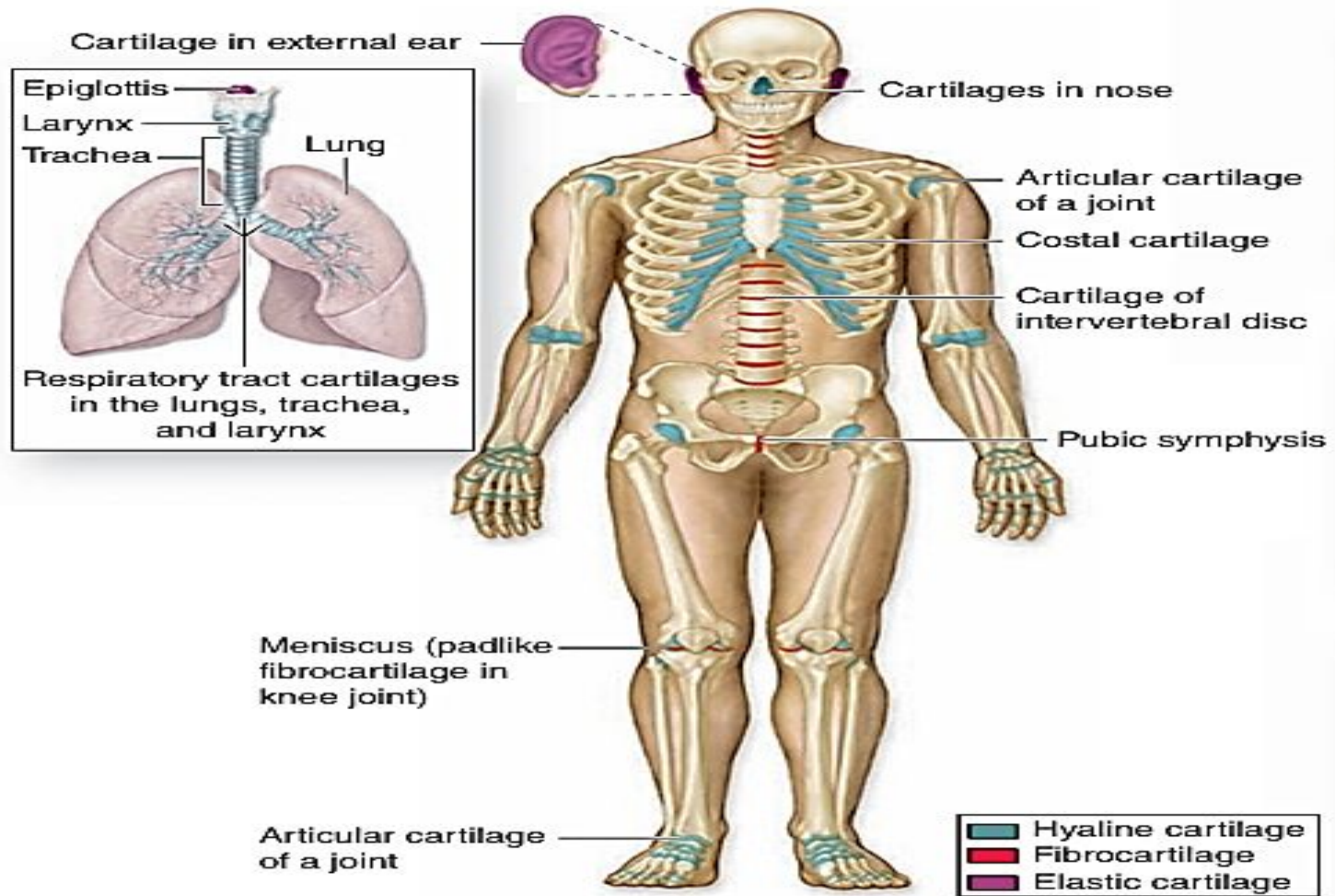
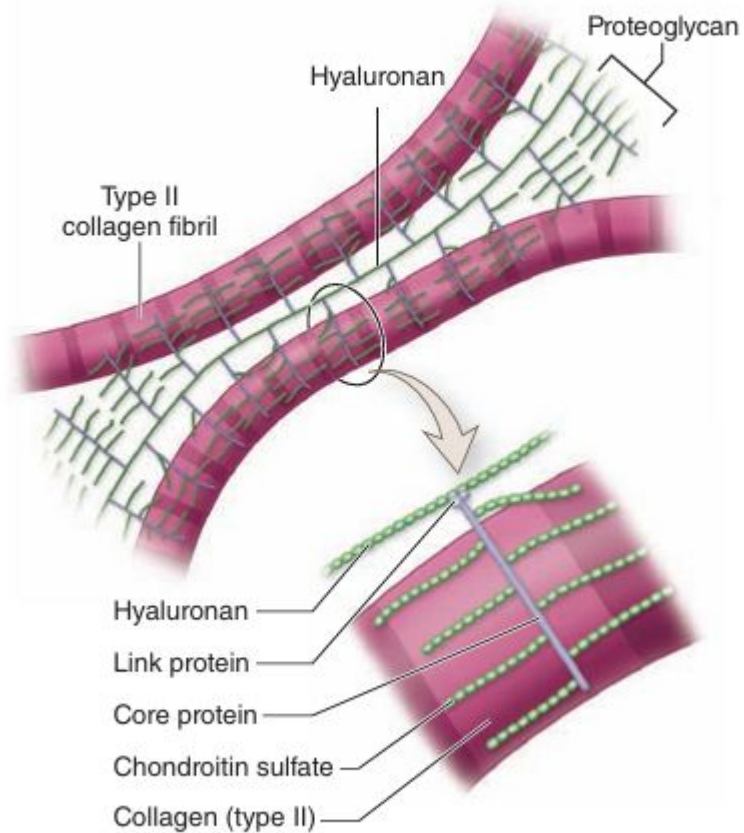
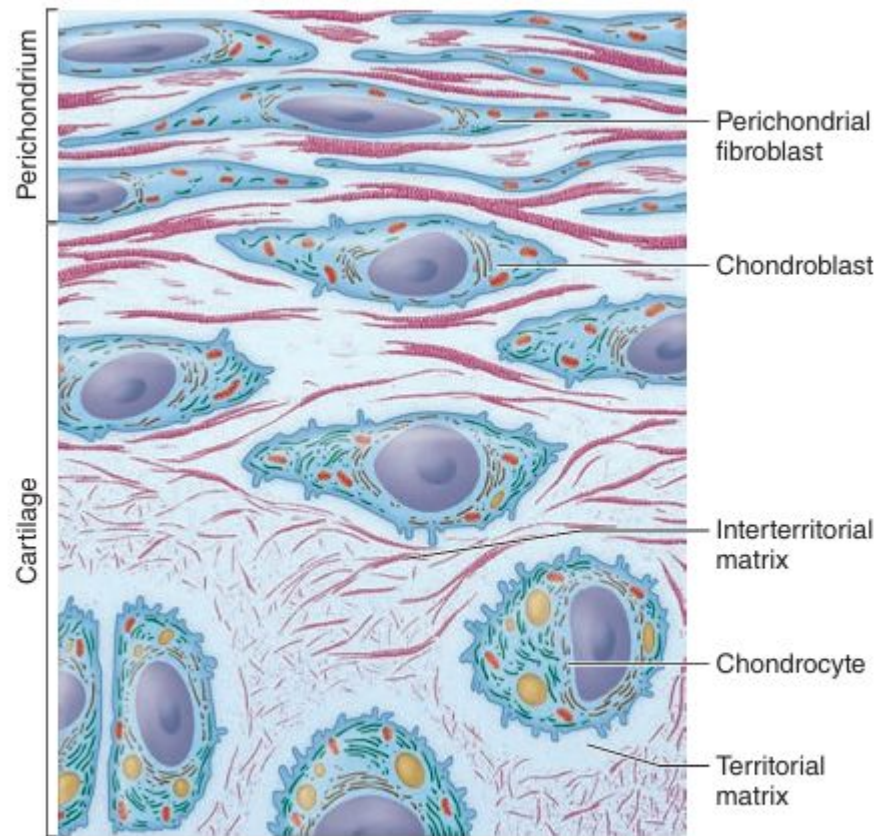


FIGURE 7-2 The structure of cartilage matrix and cells.



a



b

FIGURE 7-7 Chondrocytes in growing cartilage.

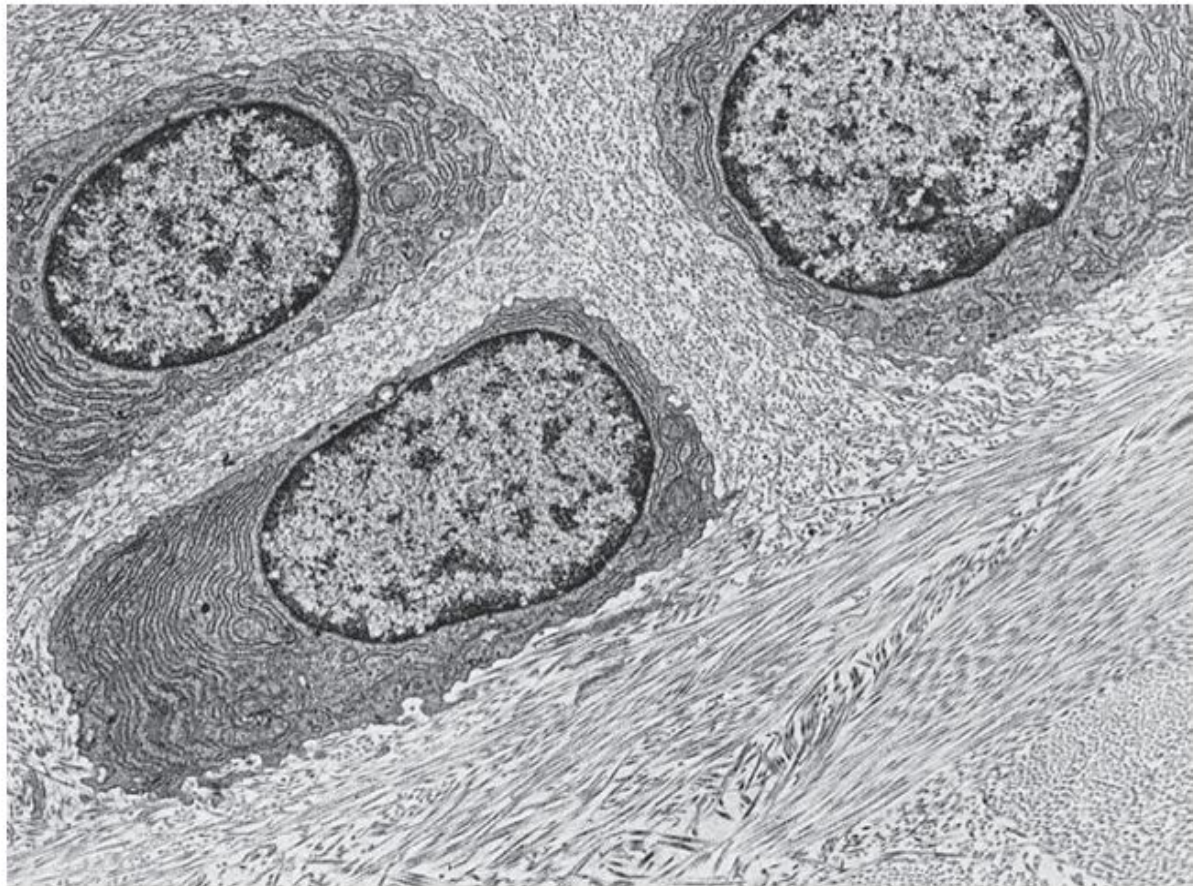


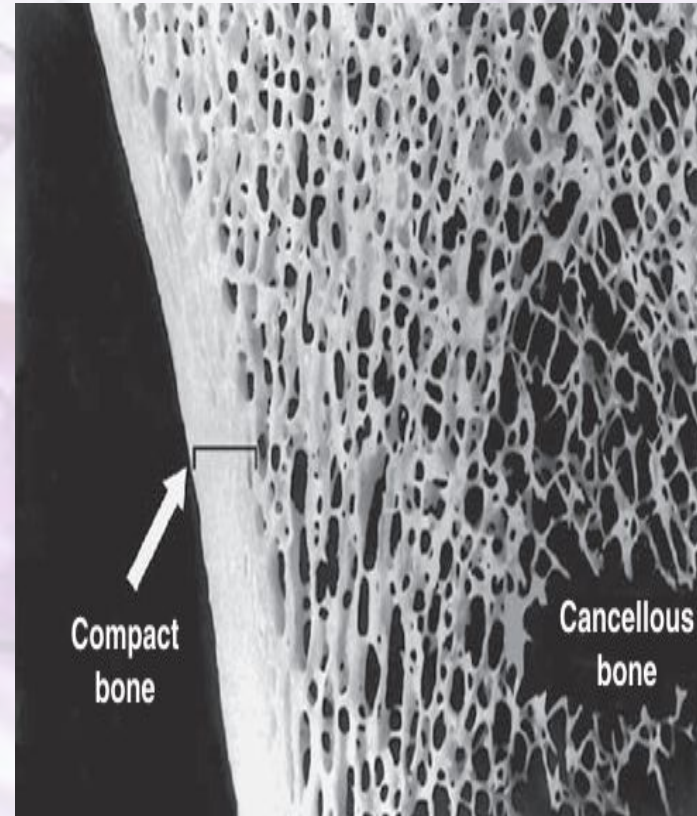
TABLE 7-1**Important features of the major cartilage types.**

	Hyaline Cartilage	Elastic Cartilage	Fibrocartilage
Main features of the extracellular matrix	Homogeneous, with type II collagen and aggrecan	Type II collagen, aggrecan, and darker elastic fibers	Type II collagen and large areas of dense connective tissue with type I collagen
Major cells	Chondrocytes, chondroblasts	Chondrocytes, chondroblasts	Chondrocytes, fibroblasts
Typical arrangement of chondrocytes	Isolated or in small isogenous groups	Usually in small isogenous groups	Isolated or in isogenous groups arranged axially
Presence of perichondrium	Yes (except at epiphyses and articular cartilage)	Yes	No
Main locations or examples	Many components of upper respiratory tract; articular ends and epiphyseal plates of long bones; fetal skeleton	External ear, external acoustic meatus, auditory tube; epiglottis and certain other laryngeal cartilages	Intervertebral discs, pubic symphysis, meniscus, and certain other joints; insertions of tendons
Main functions	Provides smooth, low-friction surfaces in joints; structural support for respiratory tract	Provides flexible shape and support of soft tissues	Provides cushioning, tensile strength, and resistance to tearing and compression

Specialized Connective Tissue

Bone Tissue

- Highly vascular
- Mineralized ECM
- Osteoblasts, osteoclasts, and osteocytes
- Fx: structural support, protection, movement, mineral storage, blood cell production
- Location: all bones in the body
- Types: Compact (Cortical), Spongy (Cancellous)

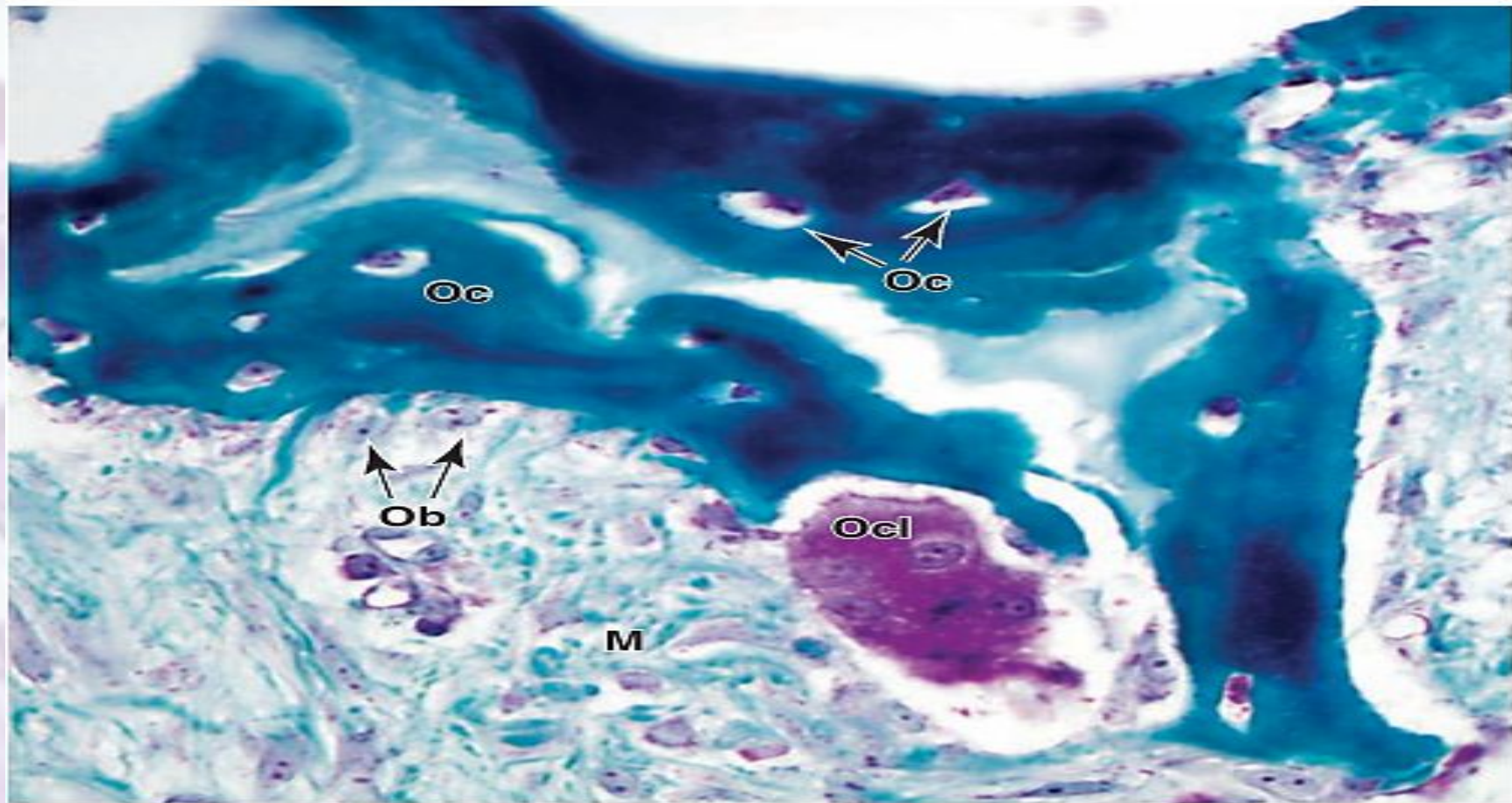


Bone Tissue

Bone Cells

CELL TYPE	CHARACTERISTICS	FUNCTION
OSTEOBLASTS	Actively secrete osteoid (unmineralized bone matrix) and promote calcium deposition. Found on the bone surface.	Build new bone tissue by producing collagen and minerals.
OSTEOCYTES	Mature bone cells, located inside lacunae, with long cytoplasmic extensions in canaliculi for communication.	Maintain bone matrix and sense mechanical stress.
OSTEOCLASTS	Large, multinucleated cells derived from monocytes. Found in Howship's lacunae.	Break down bone tissue for remodeling and calcium release (bone resorption).

FIGURE 8-2 Bone tissue.



Bone matrix

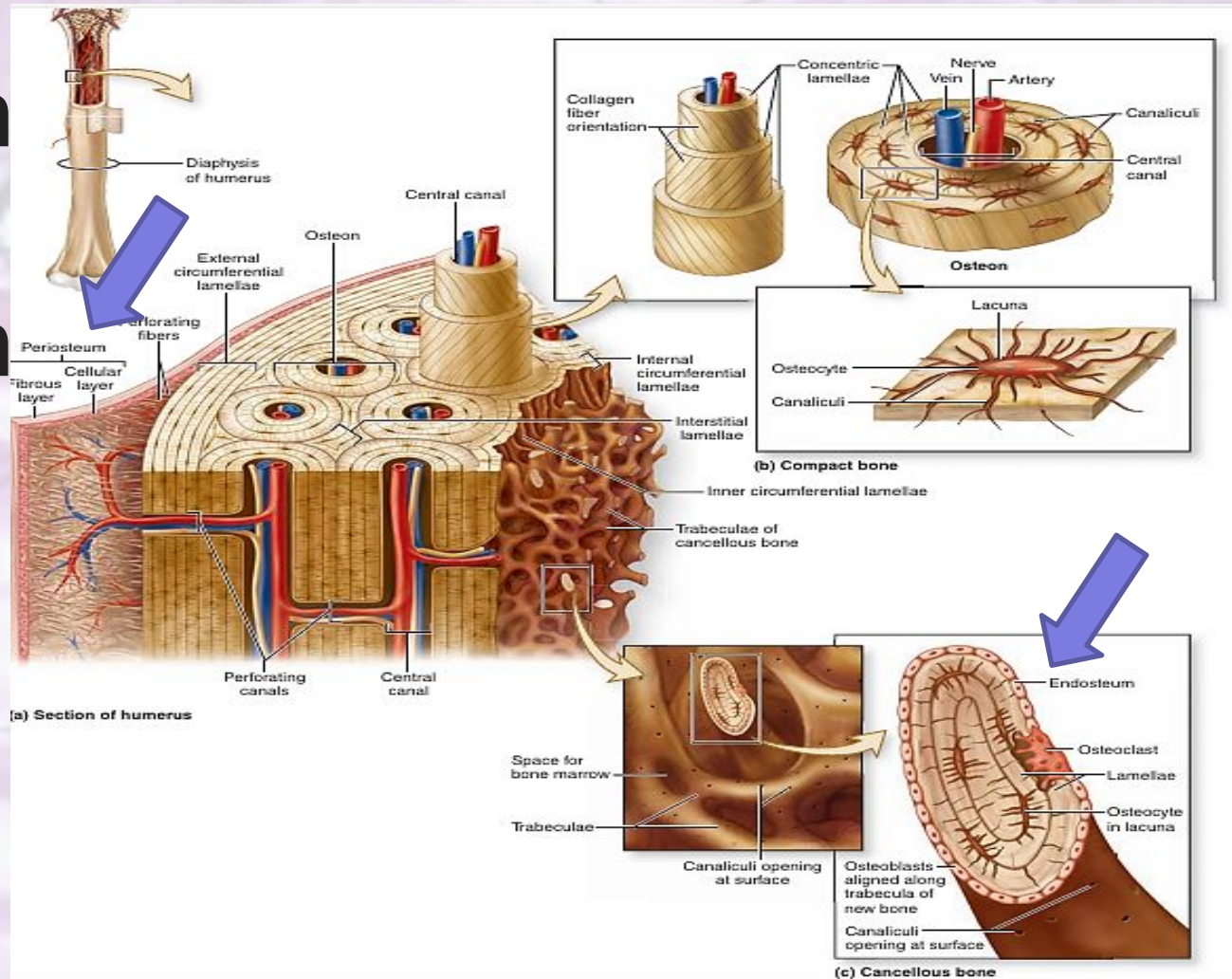
Organic component (35%)

- FX: provides flexibility and elasticity
- Collagen type I (90%)
 - Provides tensile strength and resistance to stretching
- Ground substance (10%)
 - Osteocalcin, Osteonectin, Osteopontin

Inorganic component (65%)

- FX: provides hardenss and weight-bearing strength
- Calcium hydroxyapatite
 - Gives bone rigidity and strength
 - Deposited along collagen fibers
- Other minerals
 - Calcium carbonate, Mg, Fluoride, Na

Periosteum & Endosteum



Periosteum & Endosteum

FEATURE	PERIOSTEUM	ENDOSTEUM
LOCATION	Covers external bone surface (except joints)	Lines internal bone surfaces (medullary cavity, trabeculae)
STRUCTURE	Two layers: Fibrous (outer) & Osteogenic (inner)	Thin, single layer of cells (osteoprogenitors, osteoblasts, osteoclasts)
FUNCTION	Bone growth, repair, nourishment, tendon attachment	Bone remodeling, growth, repair
CELLS PRESENT	Fibroblasts, osteoprogenitor cells, osteoblasts	Osteoprogenitor cells, osteoblasts, osteoclasts
BLOOD SUPPLY	Rich blood vessels and nerves	Less vascular, but important for bone remodeling

Types of Bone

Compact (Cortical)

- Dense, hard outer shell
- 80% of the total bone tissue
- Osteons, lamellae, lacunae, Volkmann's canals
- Have Haversian system
- FX: provides strength, protects internal structures, resists mechanical stress, stores calcium
- Location: outer layer of all bones, Diaphysis of long bones, covers flat and irregular bones

Spongy (Cancellous / Trabecular)

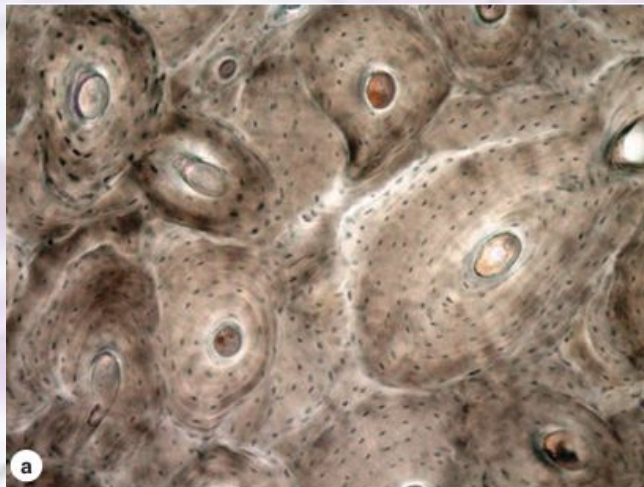
- Lighter, porous
- 20% of the total bone tissue
- Lacks osteons
- Arranged in trabeculae
 - Contain red marrow
- No Haversian system
- FX: reduces bone weight, provides support and flexibility, houses red marrow, absorbs shock and distribute stress
- Location: Epiphysis, interior of flat bones, vertebrae and pelvis

Types of Bone

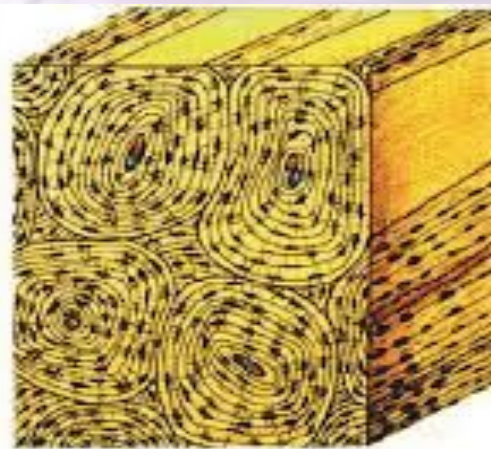
TABLE 8-1

Summary of bone types and their organization.

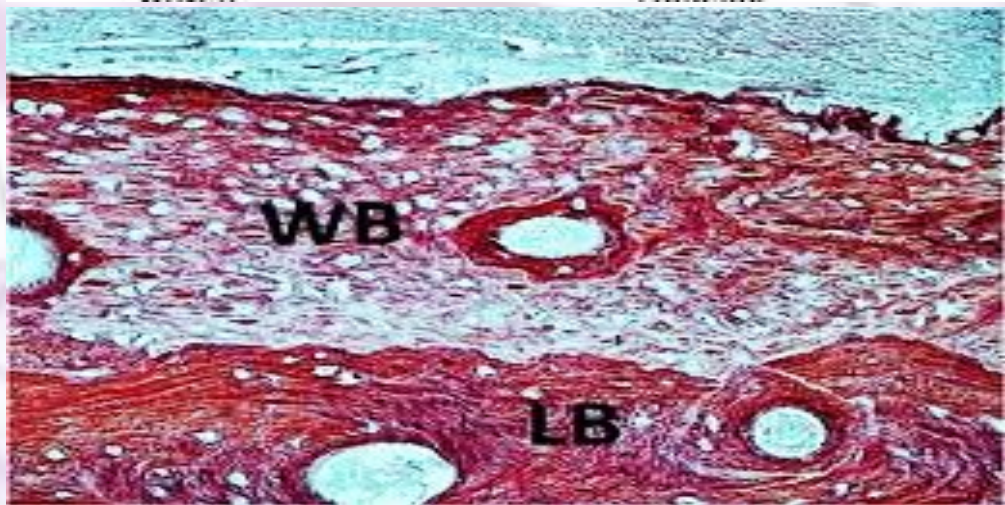
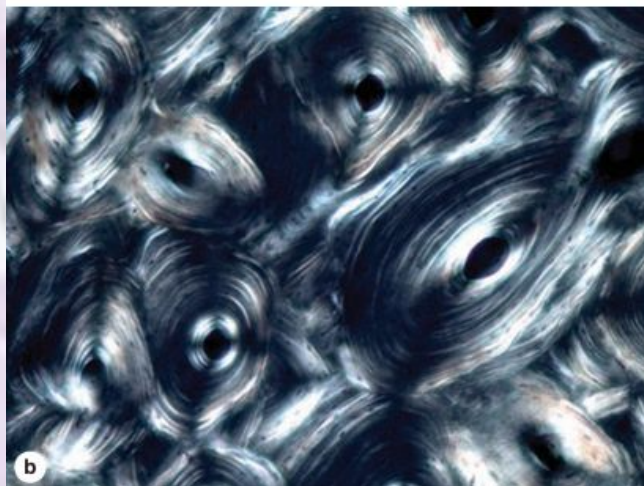
Type of Bone	Histological Features	Major Locations	Synonyms
Woven bone , newly calcified	Irregular and random arrangement of cells and collagen; lightly calcified	Developing and growing bones; hard callus of bone fractures	Immature bone; primary bone; bundle bone
Lamellar bone , remodeled from woven bone	Parallel bundles of collagen in thin layers (lamellae), with regularly spaced cells between; heavily calcified	All normal regions of adult bone	Mature bone; secondary bone
Compact bone , ~80% of all lamellar bone	Parallel lamellae or densely packed osteons, with interstitial lamellae	Thick, outer region (beneath periosteum) of bones	Cortical bone
Cancellous bone , ~20% of all lamellar bone	Interconnected thin spicules or trabeculae covered by endosteum	Inner region of bones, adjacent to marrow cavities	Spongy bone; trabecular bone; medullary bone

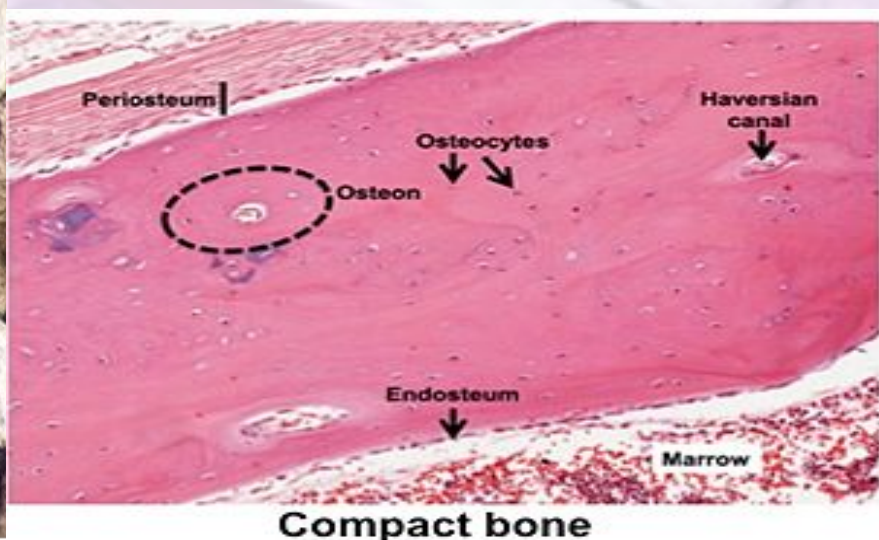
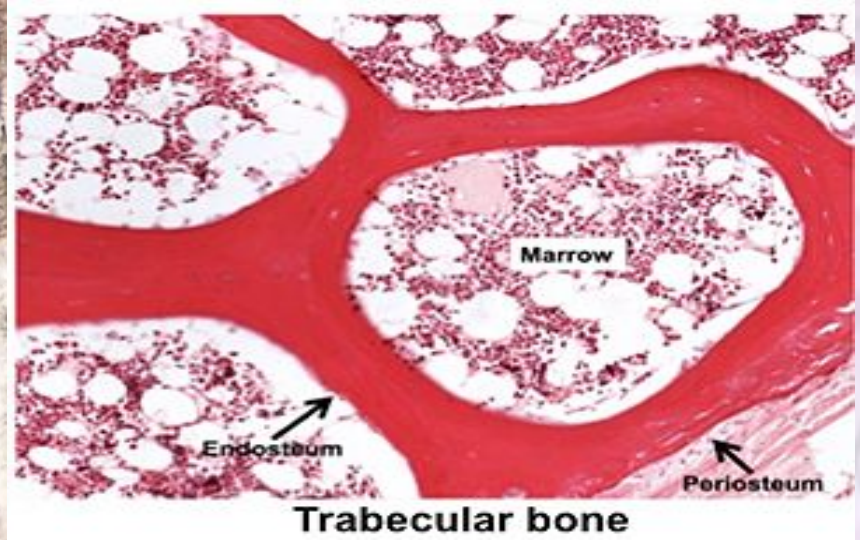


Woven



Lamellar





Specialized Connective Tissue

Osteogenesis

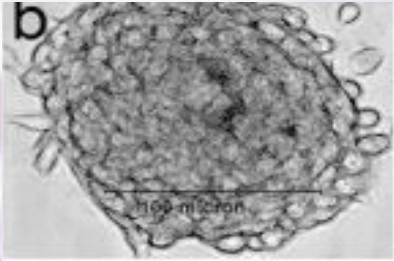
- process of bone formation that occurs during fetal development, growth, and bone repair
- differentiation of mesenchymal cells into bone-forming cells (osteoblasts) and the production of bone matrix.
- Intramembranous Ossification
- Endochondral Ossification

Bone

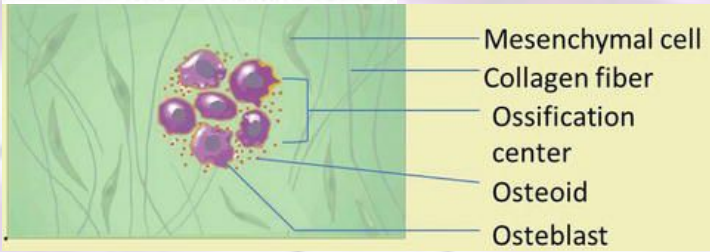
Intramembranous Ossification

- Bone forms directly from mesenchymal tissue
- Occurs in flat bones, clavicle, mandible
- Fx: forms flat bones; bone healing after fractures

Intramembranous Ossification steps



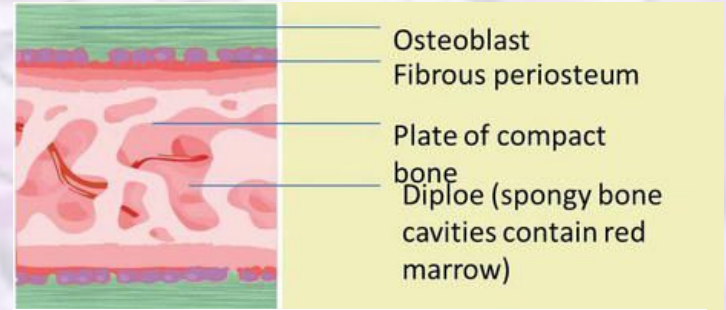
1. Mesenchymal cells cluster



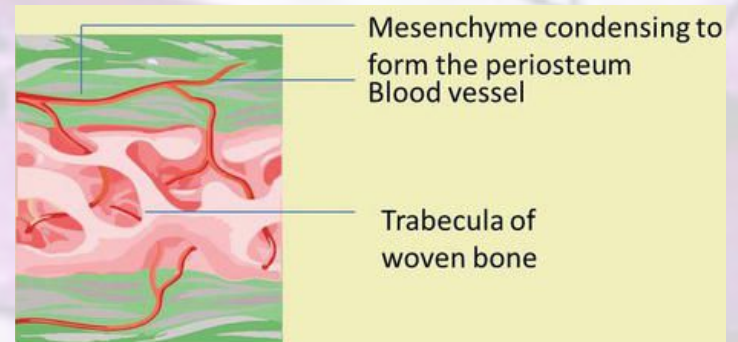
2. Osteoblasts secrete osteoid



3. Osteoid calcifies



4. Trabeculae (spongy bone) form



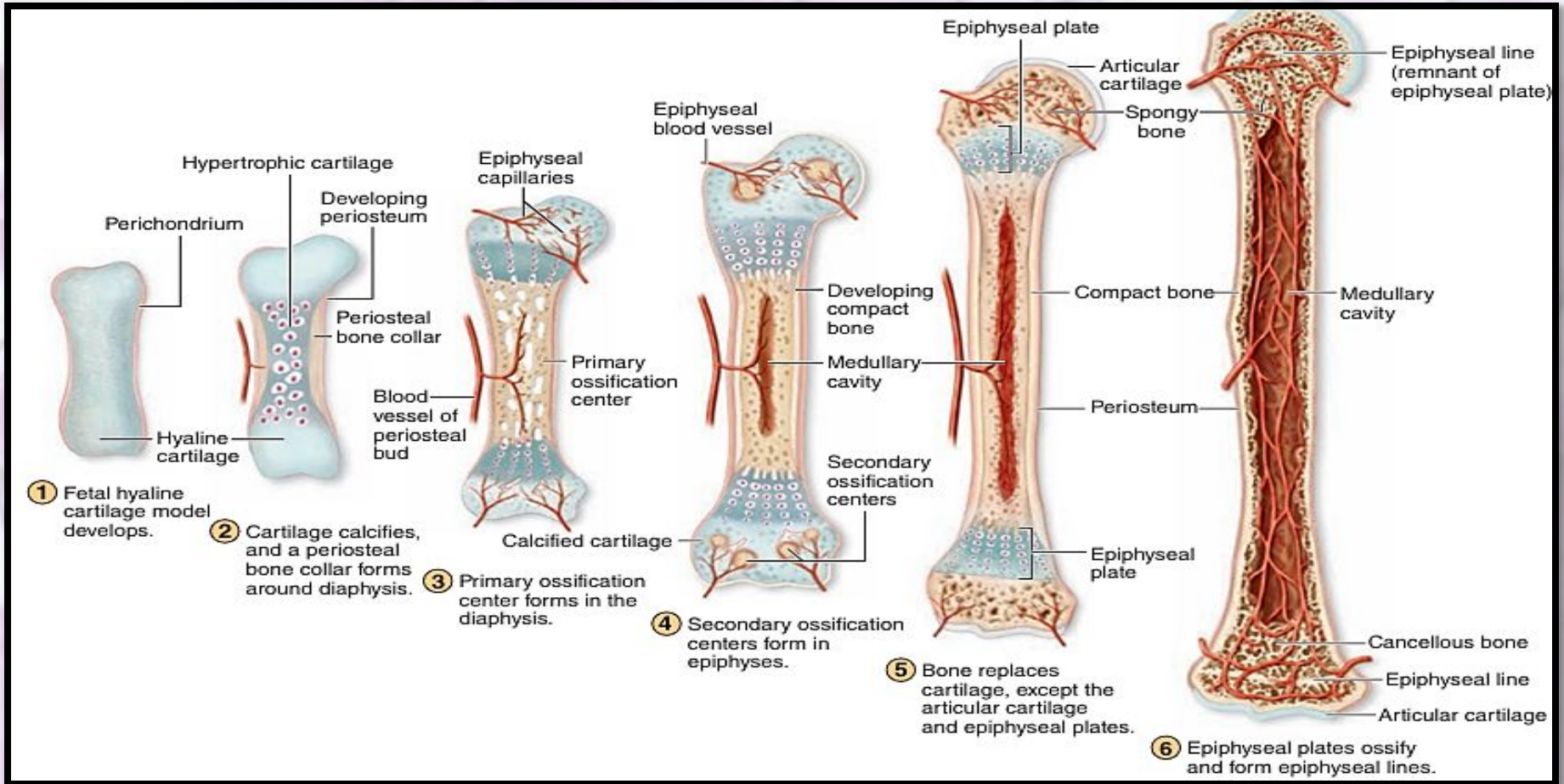
5. Outer mesenchyme forms the periosteum & compact bone develops on the surface

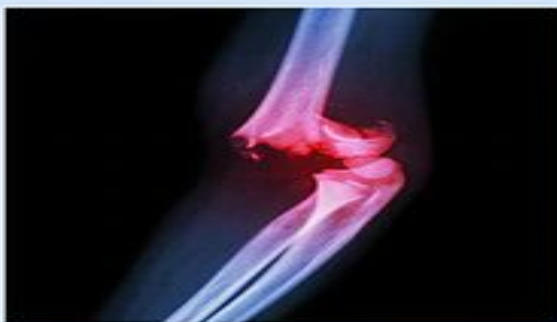
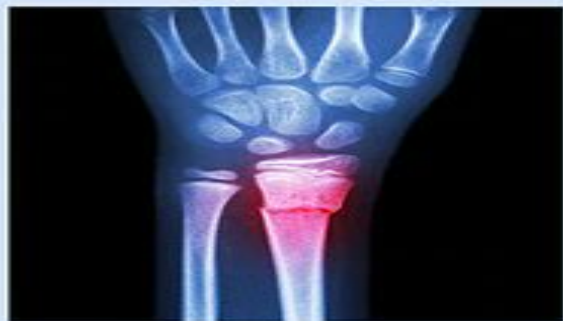
Bone

Endochondral Ossification

- Bone forms from a pre-existing hyaline cartilage
- Occurs in long bones, vertebrae, ribs and pelvis
- Fx: forms most bones; responsible for growth in length

Endochondral Ossification Process





Bone Remodeling and Repair

- Bone growth involves resorption of old tissue and deposition of new bone.
- Osteogenesis: sum of osteoblast and osteoclast activities.
- High turnover rate in children; continuous remodeling in adults.
- Bone adapts to stress (e.g., orthodontic treatment).
- Bone repair process:
 - Initial fibrocartilage formation.
 - Replacement with woven bone.

Bone remodeling

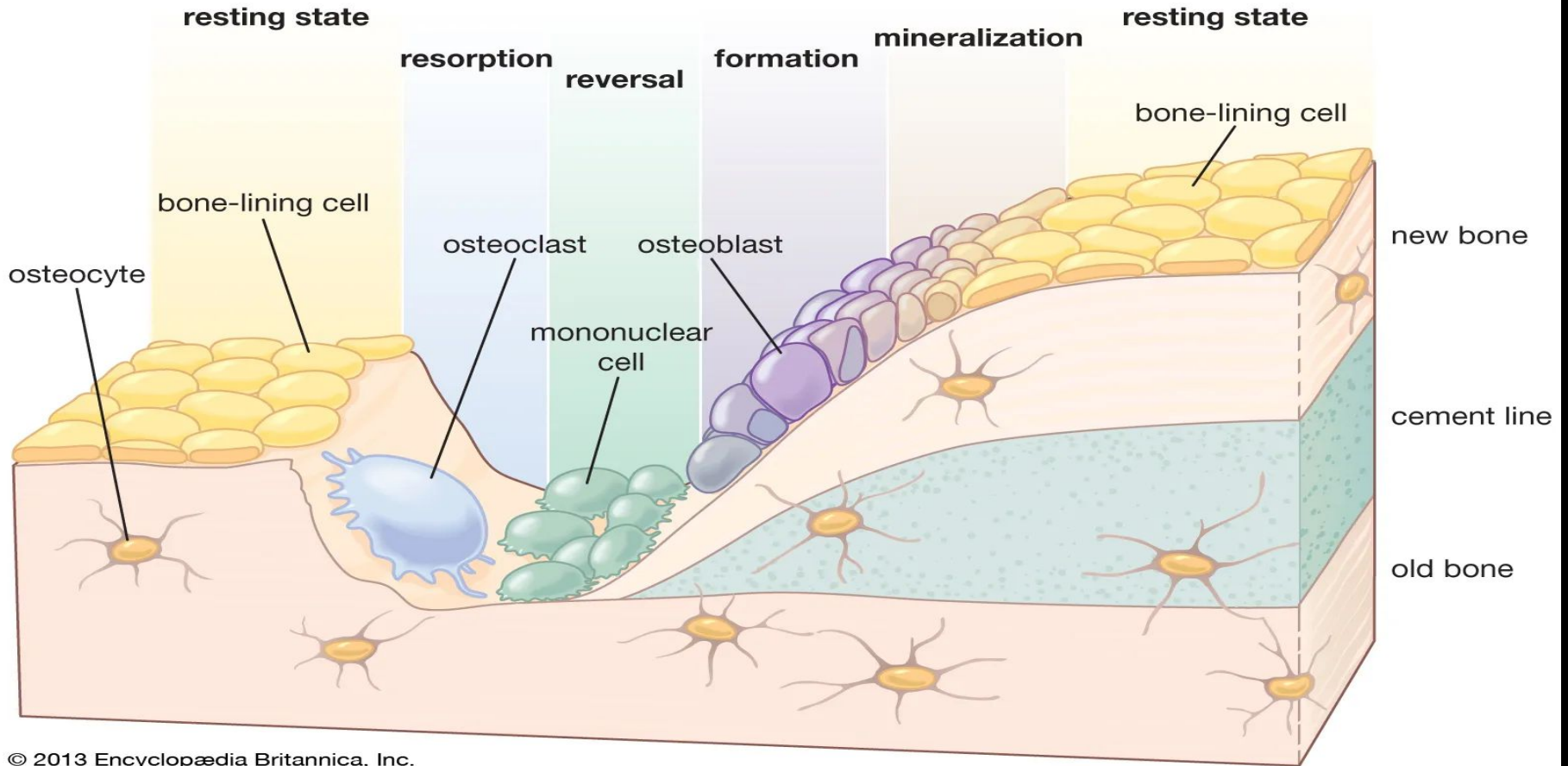
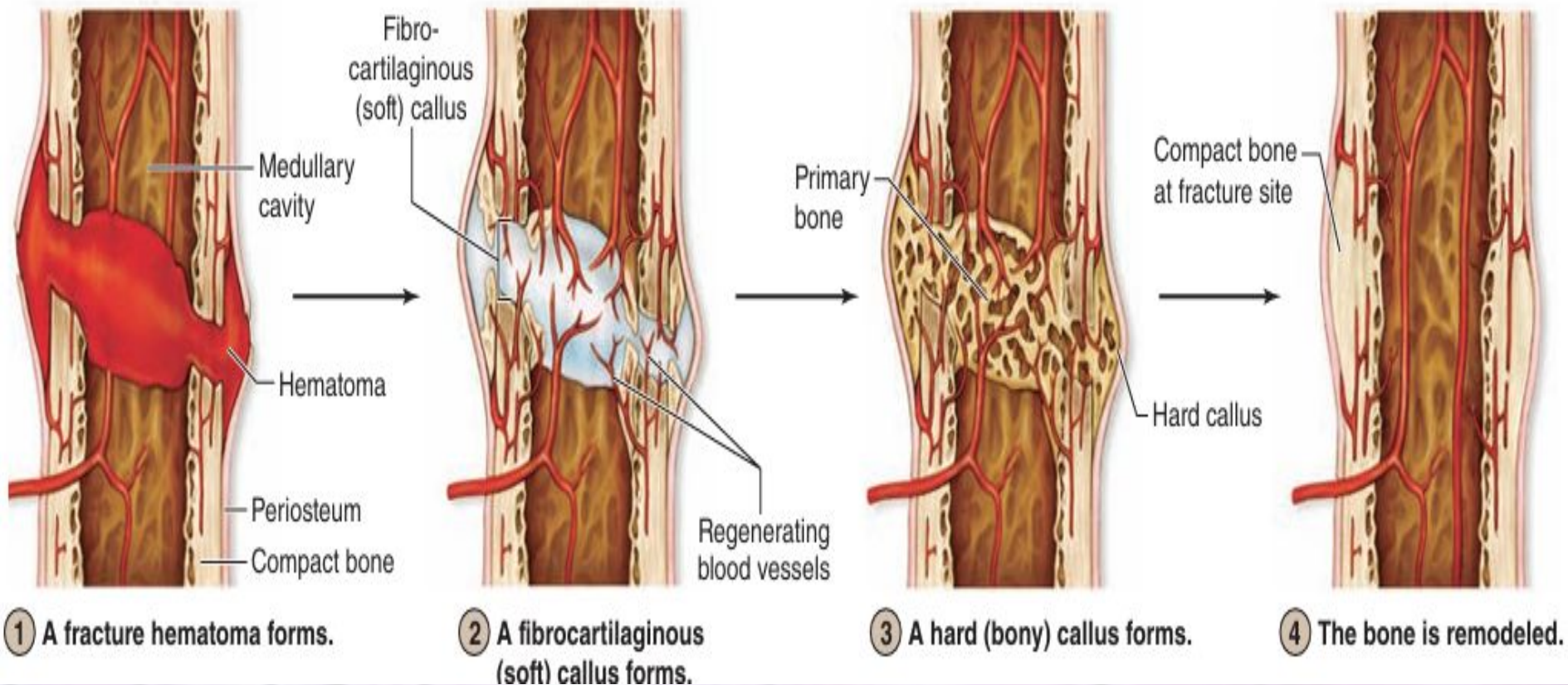
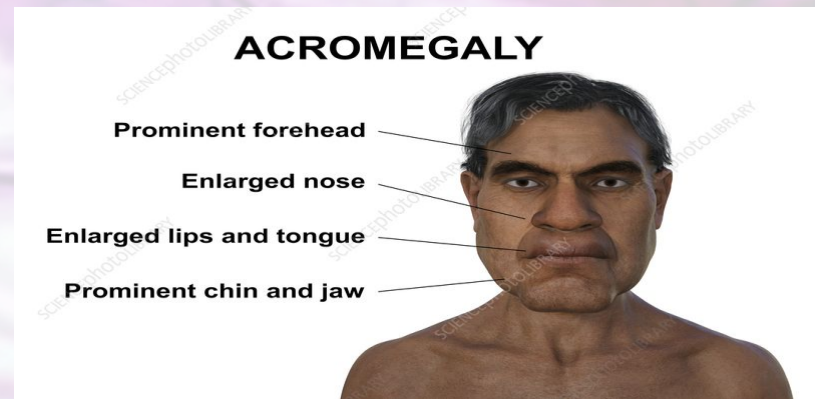
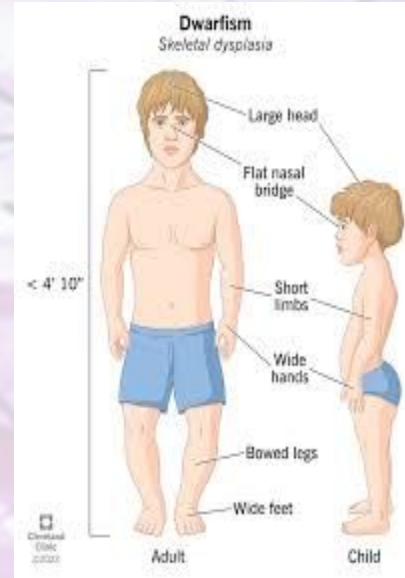
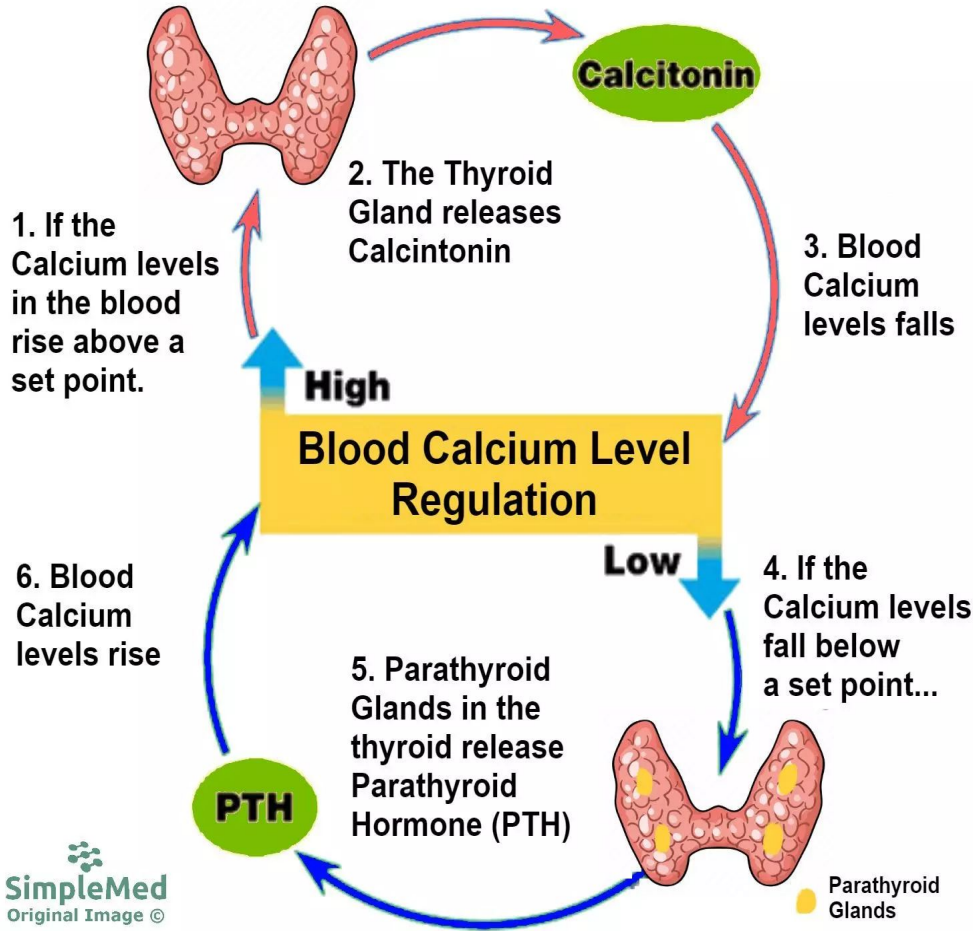


FIGURE 8-19 Main features of bone fracture repair.



Metabolic role of Bone

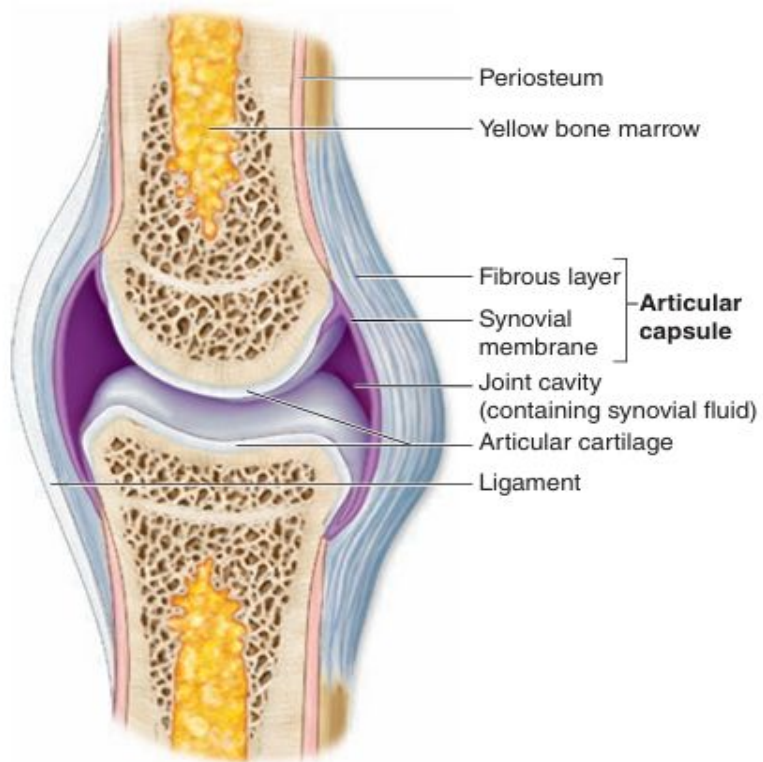
- Bone serves as the body's calcium reservoir (99% of calcium in hydroxyapatite).
- Continuous calcium exchange maintains stable blood levels (9-10 mg/dL).
- Hormonal regulation:
 - Parathyroid hormone (PTH): Increases blood calcium by stimulating bone resorption.
 - Calcitonin: Lowers blood calcium by inhibiting osteoclast activity.



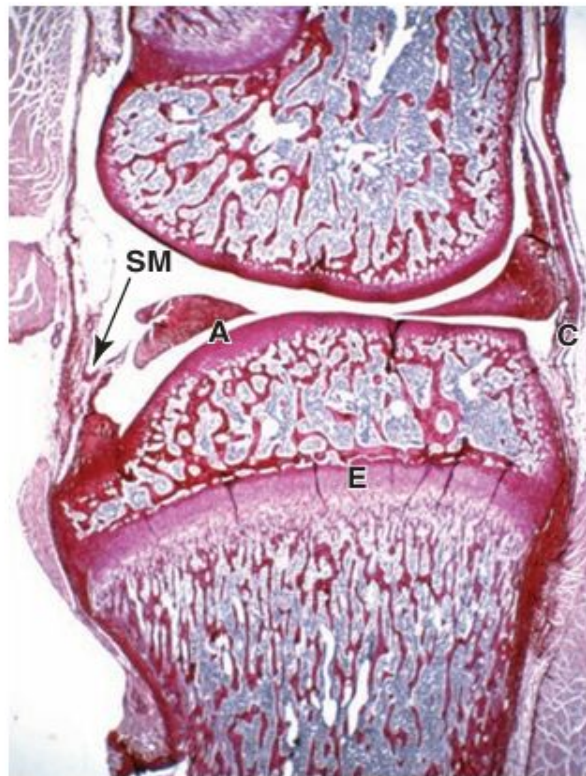
Joint

- the places where two or more bones meet
- allow bones to move
- **Synarthroses (Little/No Movement)**
 - Synostoses: Skull bones in adults.
 - Syndesmoses: Dense CT joins bones (e.g., tibiofibular joint).
 - Symphyses: Fibrocartilage pads (e.g., intervertebral discs).
- **Diarthroses (Freely Movable Joints):**
 - Have a synovial membrane that produces synovial fluid.
 - Type A cells: Remove debris.
 - Type B cells: Produce hyaluronan for lubrication.
- **Clinical Relevance**
 - Osteoarthritis (OA): Breakdown of articular cartilage in synovial joints leads to pain and stiffness.
 - Rheumatoid Arthritis (RA): An autoimmune disease where synovial membrane inflammation damages joints.
 - Synovial Fluid Analysis: Can help diagnose joint diseases by checking for inflammation, infection, or crystal deposits (gout).

FIGURE 8–21 Diarthroses or synovial joints.

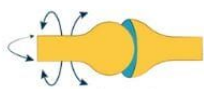


a Typical synovial joint



b

JOINT MOTION



Ball and socket joint



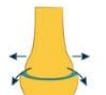
Saddle joint



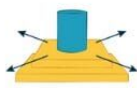
Hinge joint



Pivot joint

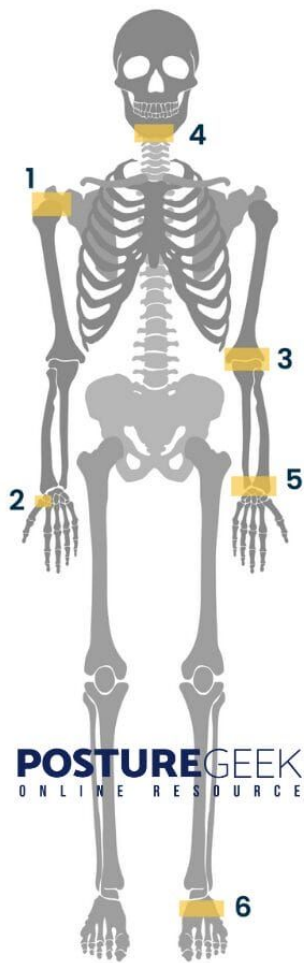


Ellipsoid/Condyloid joint



Plane/Gliding joint

TYPES OF JOINTS



POSTUREGEEK
ONLINE RESOURCE

SYNOVIAL JOINTS



Shoulder



Thumb Finger



Elbow



Spinal



Wrist



Feet

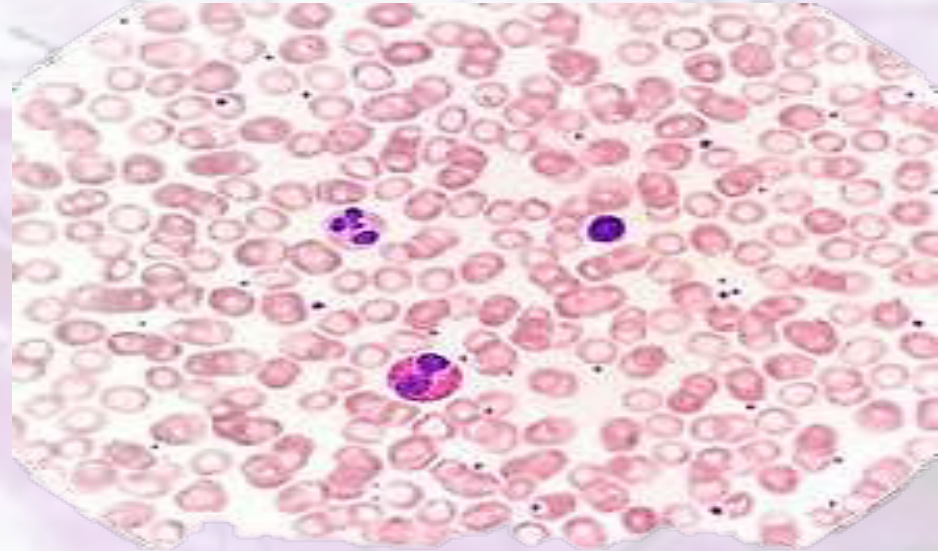
OSTEOARTHRITIS



Specialized Connective Tissue

Blood

- **Fluid connective tissue**
 - Fluid nature
 - Lack of structural fibers
 - Produced in bone marrow
- **Cells: RBCs, WBCs and platelets**
- **ECM: plasma**
- **Location: within blood vessels, arteries and capillaries, heart, bone marrow, lymphatic system**
- **Fx: Immune defense, clotting, pH & electrolyte balance, temperature regulation**



Specialized Connective Tissue

Adipose Tissue

- dominated by adipocytes, with very little extracellular
- Adipocytes store lipids in large fat droplets, which push the nucleus to the periphery of the cell.
- Contains few fibers, mainly reticular and collagen fibers
- Highly vascularized
- Fx: Stores energy, insulation, cushioning, and secretes hormones
- Location: Subcutaneous layer, around visceral organs, Bone marrow, between muscles and behind the eyeballs.
- Types
 - White



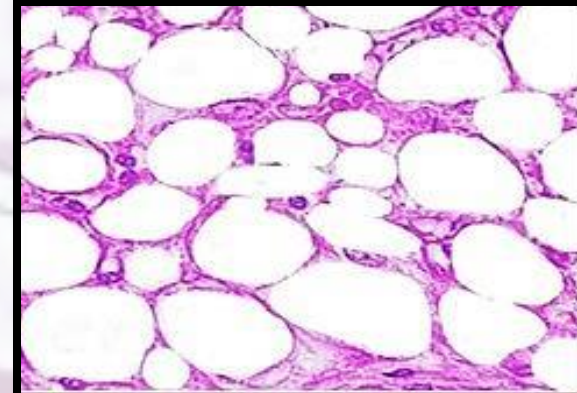
Loose Connective Tissue Proper

White Adipose Tissue

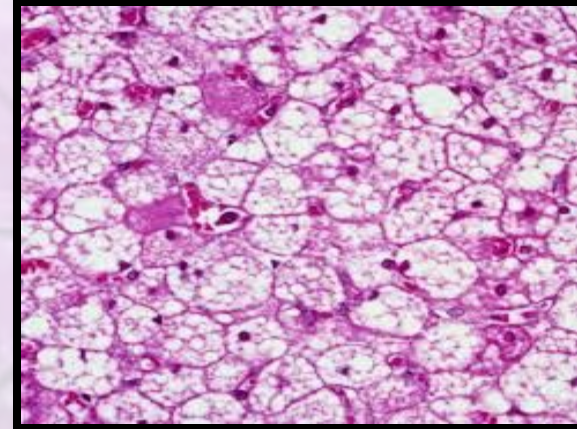
- Unilocular (one large fat droplet per cell)
- Stores energy, insulates, and cushions
- Subcutaneous tissue, around organs, and bone marrow.

Brown Adipose Tissue

- Multilocular (many small fat droplets per cell)
- Generates heat (non-shivering thermogenesis)
- More abundant in newborns and decreases with age.



Adipose C. T.

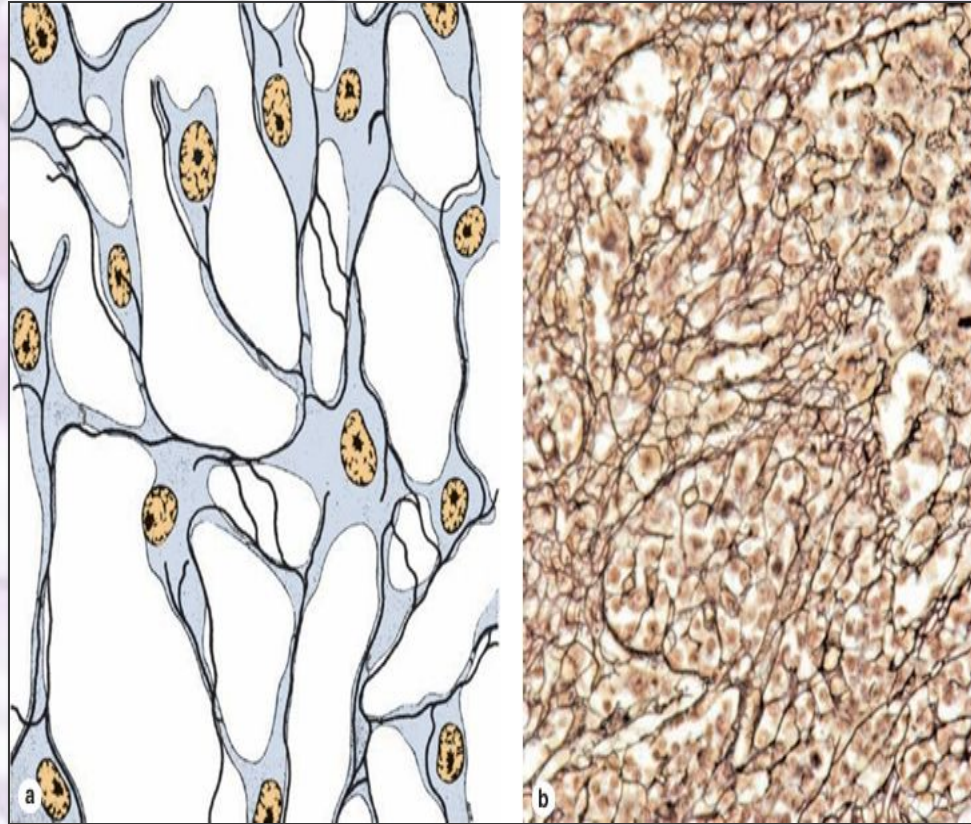


Feature	White Adipose Tissue (WAT)	Brown Adipose Tissue (BAT)
Primary Function	Energy storage and insulation	Heat production (thermogenesis)
Energy Role	Stores excess calories as triglycerides for long-term energy use	Burns stored fat to generate heat, especially in infants
Thermoregulation	Insulates the body by reducing heat loss	Produces heat via non-shivering thermogenesis
Metabolism	Releases energy slowly through lipid metabolism	Burns fatty acids rapidly to generate heat
Endocrine Function	Secretes hormones like leptin (appetite regulation) and adiponectin (glucose metabolism)	Influences metabolism by producing uncoupling protein 1 (UCP1), which stimulates heat generation
Response to Cold	Acts as an insulating layer to prevent heat loss	Activates rapidly in response to cold to produce heat
Role in Obesity	Excess WAT contributes to obesity and metabolic disorders	More BAT is associated with higher metabolism and less obesity

Specialized Connective Tissue

Reticular Tissue

- Made of reticular fibers (type III collagen) forming a mesh-like network.
- Contains reticular cells, fibroblasts, and immune cells.
- Supports organs without rigidity, allowing flexibility.
- Highly cellular and involved in immune and blood filtration.



Specialized Connective Tissue

Reticular Tissue

- function

FUNCTION	DETAILS
Structural support	Forms the stroma (framework) for soft organs like the spleen, lymph nodes, and bone marrow.
Immune function	Houses immune cells, aiding in pathogen filtration and immune responses.
Filtration & phagocytosis	Traps old or damaged blood cells (e.g., in the spleen) and foreign particles.
Blood cell formation	Provides a supportive microenvironment for hematopoiesis (blood cell production) in bone marrow.

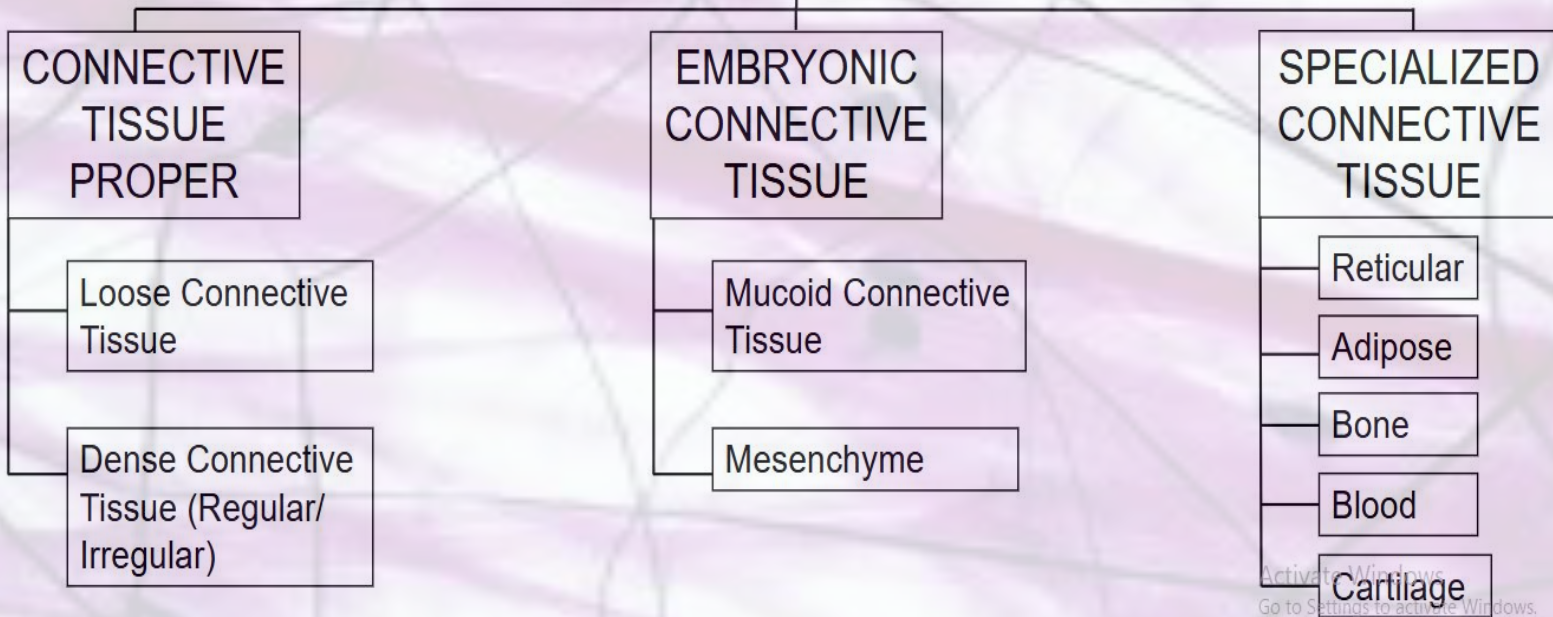
Specialized Connective Tissue

Reticular Tissue

- LOCATION

LOCATION	FUNCTION IN ORGAN
Lymph Nodes	Forms the framework where lymphocytes and macrophages reside for immune response.
Spleen	Supports splenic red and white pulp, filtering blood and recycling old RBCs.
Bone marrow	Provides a supportive stroma for hematopoiesis (blood cell production).
Liver	Helps form the structural framework around hepatocytes.
Kidney	Supports the internal architecture of the organ.

CONNECTIVE TISSUE



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Go to Settings to activate Windows.

Thank you!

- **Junquera's Basic Histology 16th edition**
 - **Chapter 5, 6, 7 and 8**
 - **pp. 96-159**