

Connective Tissue

4 Types of Tissue

- Epithelial
- **Connective**
- Muscle
- Neural



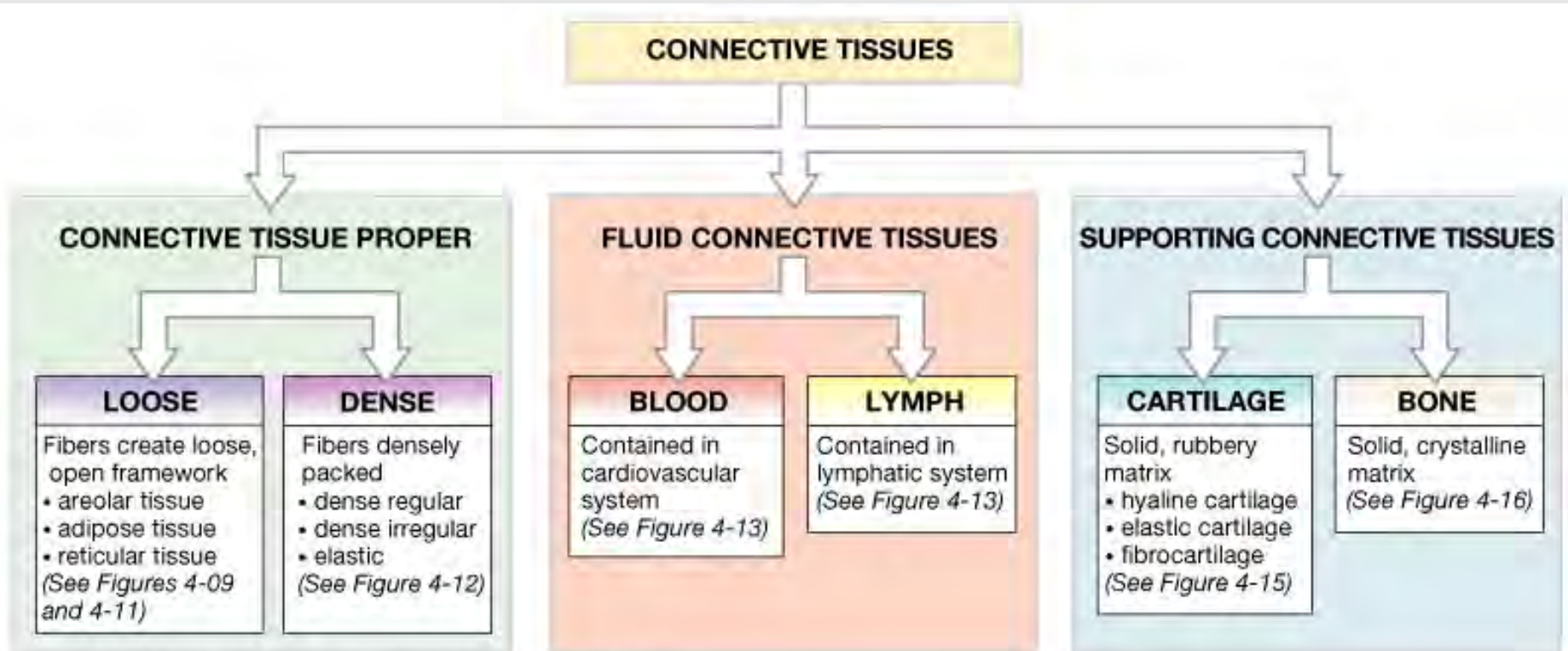
Connective Tissue

- Fills internal spaces
- Supports & binds other tissues
- Transports materials
- Stores energy

Classification of Connective Tissues

- Connective tissue **proper**:
 - connect and protect (adipose, tendon)
- **Fluid** connective tissues:
 - Transport (blood, lymph)
- **Supportive** connective tissues:
 - structural strength (cartilage, bone)

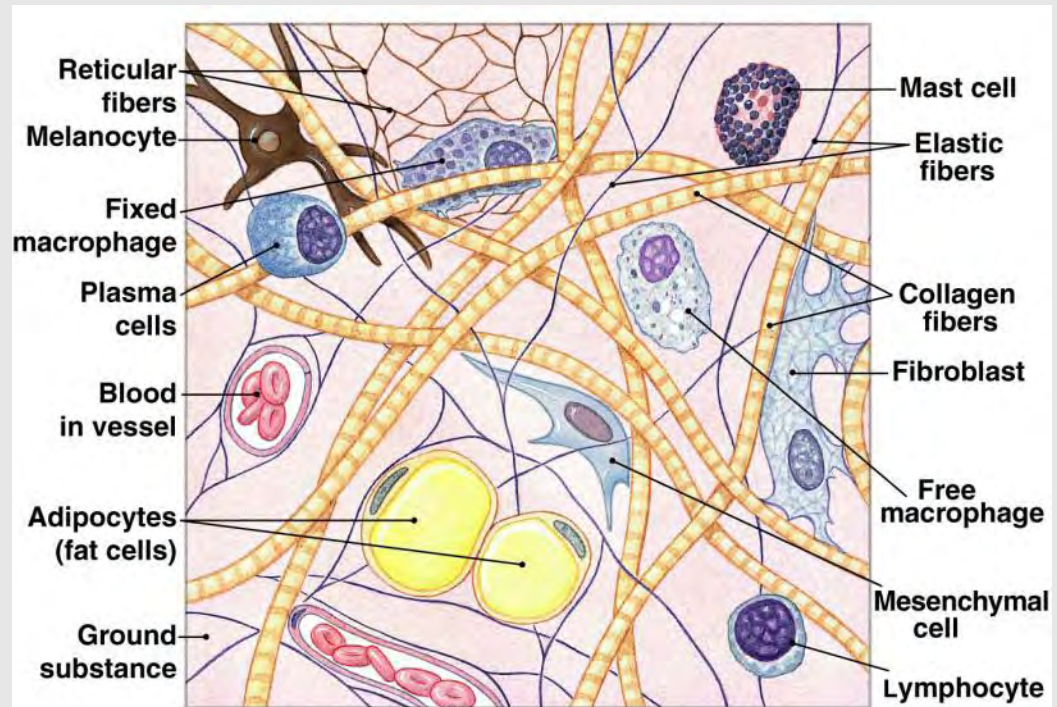
Classification of Connective Tissues



All types have:

1. Specialized **cells**
2. Extracellular **protein fibers**
3. Fluid (**ground substance**)

Last two = **Matrix**
(most volume of
CT is matrix)



Connective Tissue (CT) Functions

- **Connect** epithelia to the rest of the body (**basal lamina**)
- Provide **structure** (bone)
- **Store energy** (fat)
- **Transport materials** (blood)
- Has no contact with environment



CT Proper: Cell types

- **Fixed & Wandering cells**
- **Fixed cells**
 - **Fibroblasts** = undifferentiated cells, **make CT**; most abundant & **ALWAYS** present
 - Become chondroblasts, osteoblasts, hematopoietic cells
 - **Macrophages** = 'Big eaters'; attack pathogens & damaged cells. Initiate immune response.
 - **Adipocytes** = Energy storage
 - **Melanocytes** = Determine skin & eye color



CT Proper: Cell types

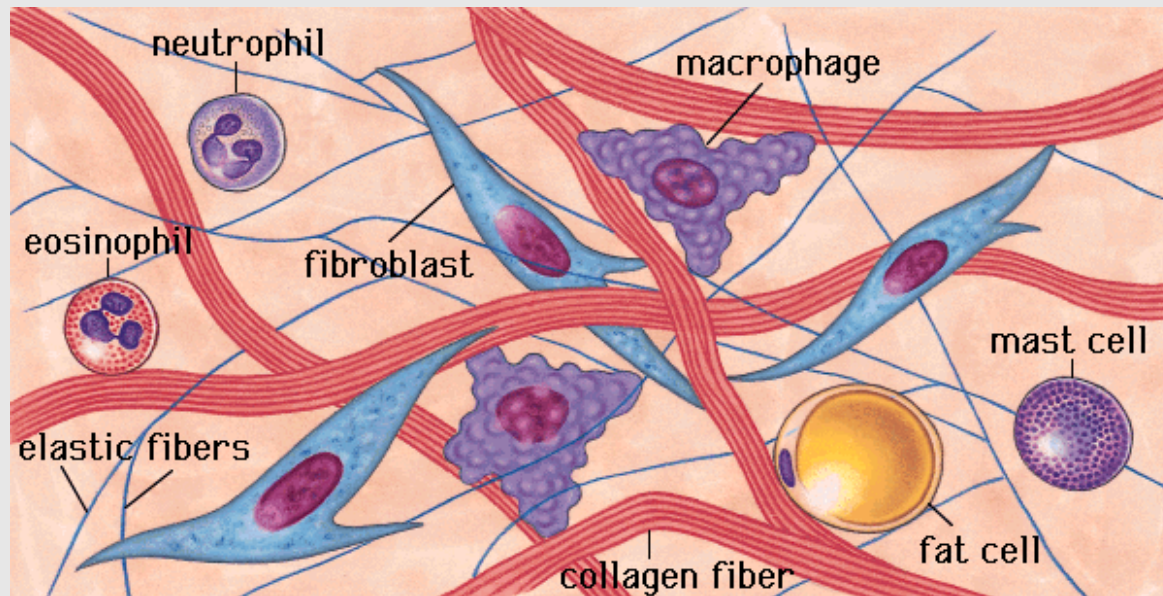
- **Wandering cells**
 - **Macrophages:** "big eaters"
 - **Mast cells:** secrete histamine and heparin
 - **Lymphocytes:** T cells and B cells - immunity! More later


CT Proper: Fiber types

- **Collagen (white)** - Resists tensile forces; tendons
 - Long, straight, unbranched, strong, flexible
 - Three protein strands wound together in a rope
- **Reticular** - stabilize major structures of organs
 - Same protein subunit as collagen
 - Branching and interwoven
 - Tough but flexible
- **Elastic** - from elastin (yellow) stretch; elastic ligaments
 - Branched and wavy fibers
 - Coil and uncoil

CT Proper: Ground substance

- Ground Substance - the sieve part
 - Fills space between cells & surrounds fibers
 - Clear, colorless
 - Made of Hyaluronic acid, proteoglycans and glycoproteins





CT Proper - 3 types

- **Loose:** "Packing material"; cushion, stabilize, fill space; **mostly ground substance**
- **Dense:** transmit & resist forces; **mostly fibers**
- **Elastic:** stabilize positions of bones



CT Proper: Loose

1. **Areolar** - Padding; absorbs shock & distorts easily
2. **Adipose** - AKA Fat; padding, insulation, energy storage, heat generator
3. **Reticular** - Suspend specialized cells of filtering organs (liver, spleen)

CT Proper: Dense

- **Dense Regular:** fibers parallel, tightly packed, aligned with applied forces
 - with **collagen:** tendons (bone to muscle), aponeuroses (tendonous sheets)
 - with **elastin:** ligaments (bone to bone)
- **Dense Irregular:** interwoven mesh, no pattern, applied forces from many directions
 - encapsulates kidneys, spleen, joints, beneath dermis
 - Encircles bone (*periosteum*) & cartilage (*perichondrium*)



CT Proper: Elastic

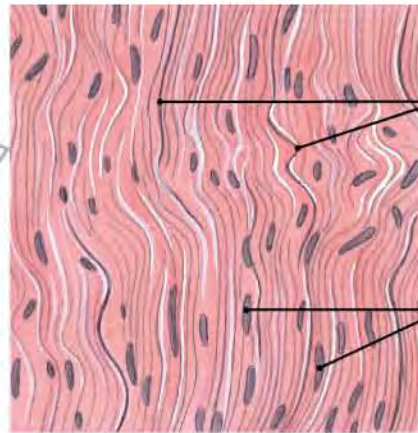
- **Elastic**
 - Dense Regular
 - Vocal cords & between vertebral bodies

Dense Regular

DENSE REGULAR CONNECTIVE TISSUE

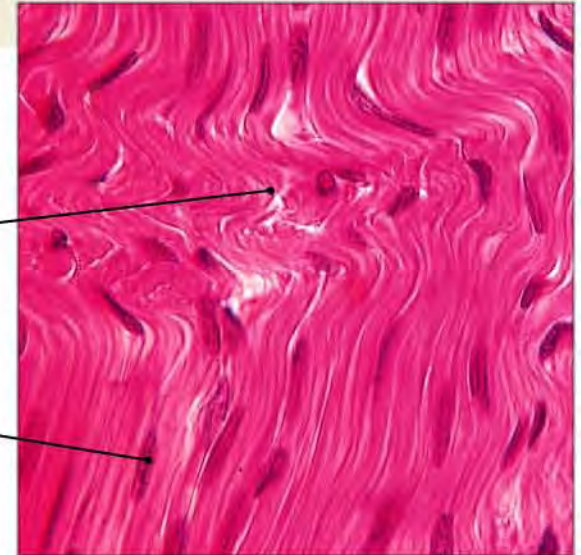
LOCATIONS: Between skeletal muscles and skeleton (tendons and aponeuroses); between bones or stabilizing positions of internal organs (ligaments); covering skeletal muscles; deep fasciae

FUNCTIONS: Provides firm attachment; conducts pull of muscles; reduces friction between muscles; stabilizes relative positions of bones



Collagen fibers

Fibroblast nuclei



LM × 440

(a) Tendon

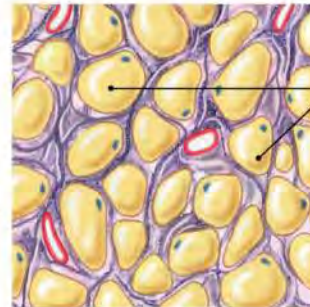
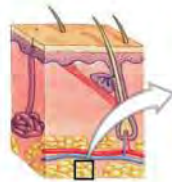
Firm attachment; parallel collagen fibers

Loose Connective Tissues

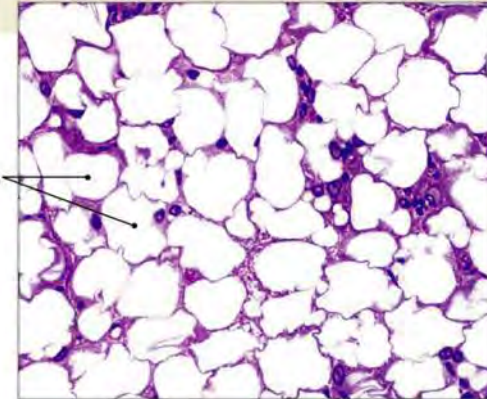
ADIPOSE TISSUE

LOCATIONS: Deep to the skin, especially at sides, buttocks, breasts; padding around eyeballs and kidneys

FUNCTIONS: Provides padding and cushions shocks; insulates (reduces heat loss); stores energy reserves



Adipocytes



LM × 133

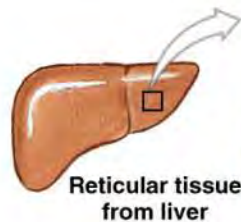
(a) Adipose tissue

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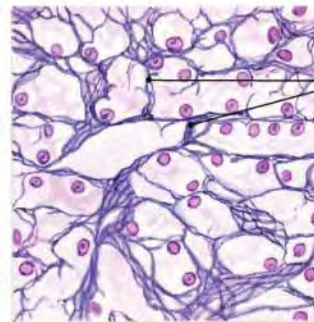
RETICULAR TISSUE

LOCATIONS: Liver, kidney, spleen, lymph nodes, and bone marrow

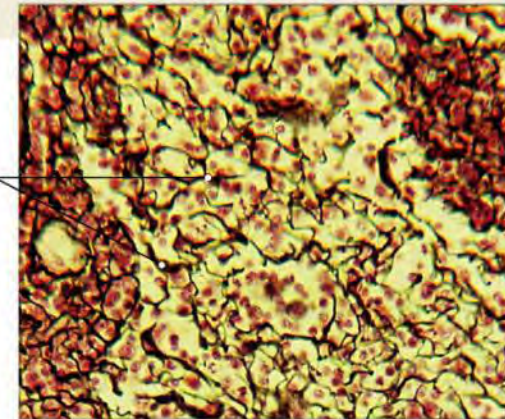
FUNCTIONS: Provides supporting framework



Reticular tissue from liver



Reticular fibers



LM × 375

(b) Reticular tissue

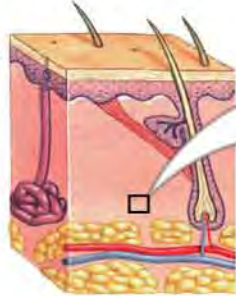
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Dense Irregular

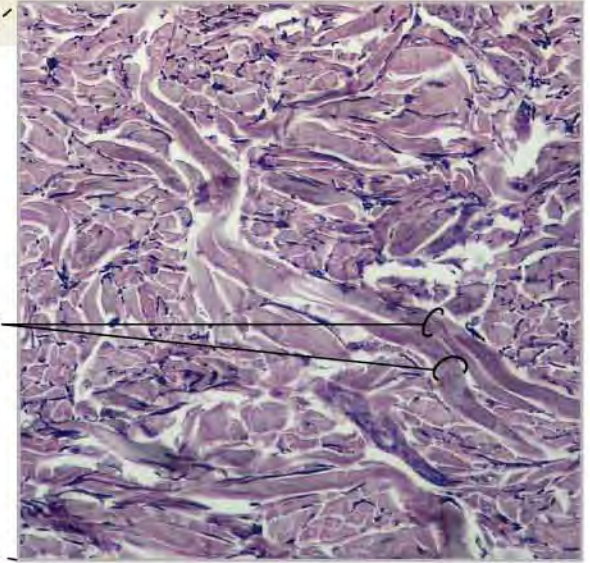
DENSE IRREGULAR CONNECTIVE TISSUE

LOCATIONS: Capsules of visceral organs; periosteum and perichondria; nerve and muscle sheaths; dermis

FUNCTIONS: Provides strength to resist forces applied from many directions; helps prevent overexpansion of organs such as the urinary bladder



Collagen
fiber
bundles



LM × 111

(b) Deep dermis

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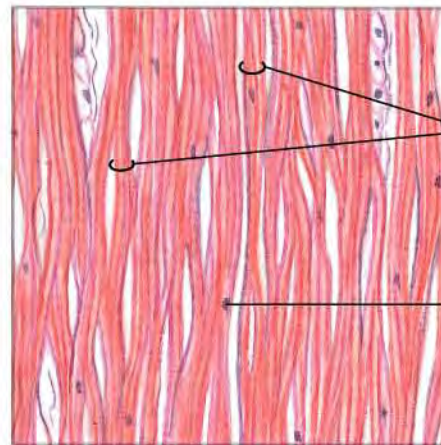
Resist forces from many directions

Elastic

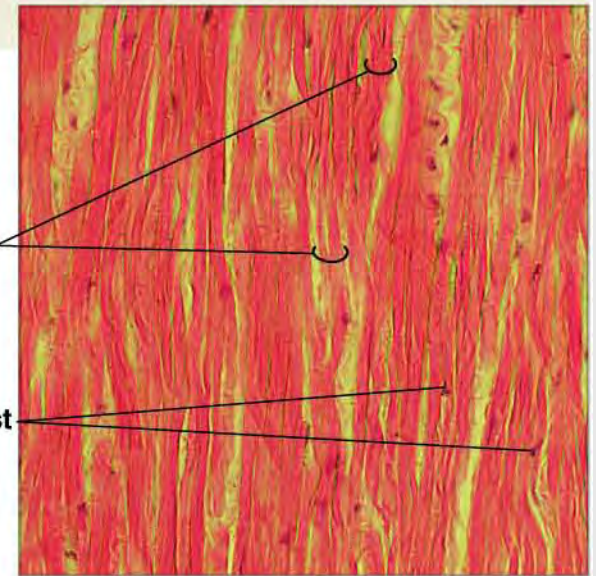
ELASTIC TISSUE

LOCATIONS: Between vertebrae of the spinal column (ligamentum flavum and ligamentum nuchae); ligaments supporting penis; ligaments supporting transitional epithelia; in blood vessel walls

FUNCTIONS: Stabilizes positions of vertebrae and penis; cushions shocks; permits expansion and contraction of organs



(c) Elastic ligament

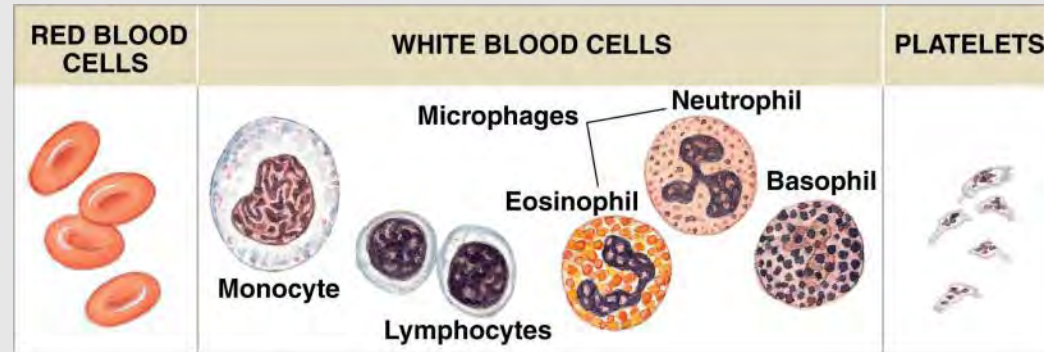


LM × 887

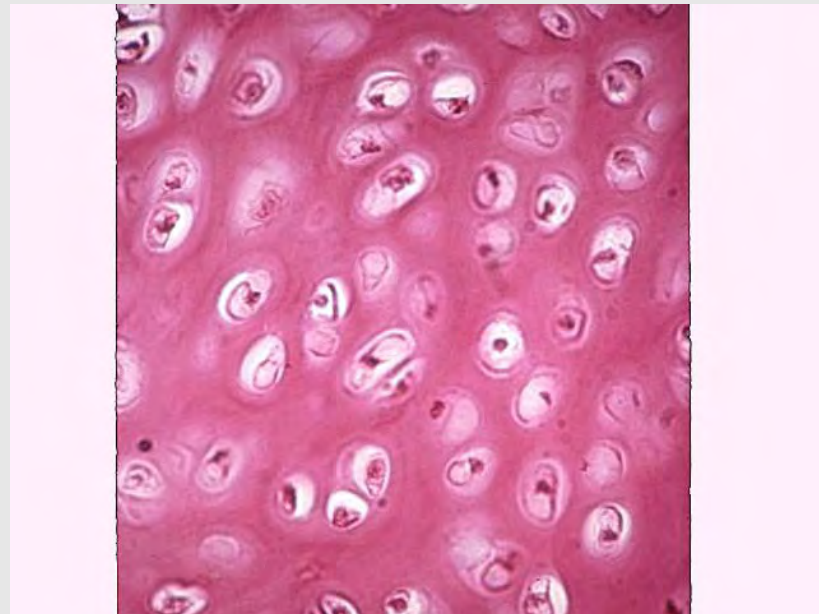
Permit some expansion without damage & regain shape

More types of CT

- Fluid CT - why is this called CT?
- Supporting CT: Bone and Cartilage
 - Cartilage:
chondrocytes & chondroitin sulfates
 - Hyaline
 - Elastic
 - Fibro



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Supporting CT: Cartilage

- **Hyaline cartilage**

- Most common; support, friction reduction

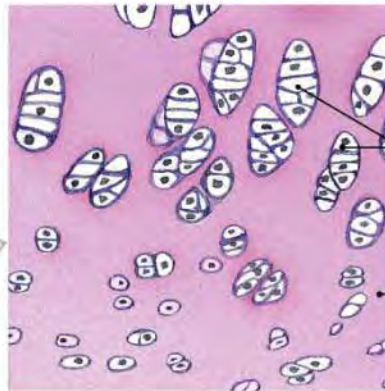
- closely packed collagen fiber

- Ends of bones, larynx, trachea, nasal septum, epiphyseal plate

HYALINE CARTILAGE

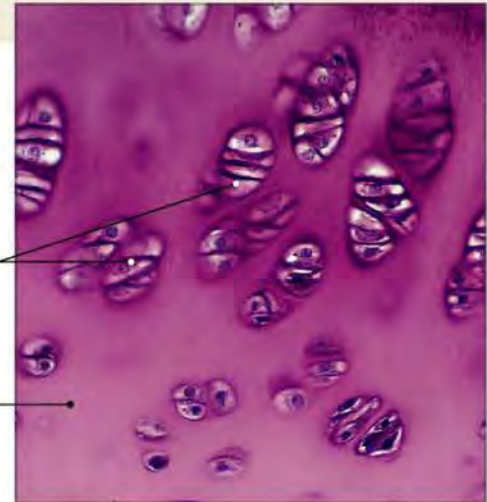
LOCATIONS: Between tips of ribs and bones of sternum; covering bone surfaces at synovial joints; supporting larynx (voice box), trachea, and bronchi; forming part of nasal septum

FUNCTIONS: Provides stiff but somewhat flexible support; reduces friction between bony surfaces



Chondrocytes
in lacunae

Matrix



LM × 500

(a) Hyaline cartilage

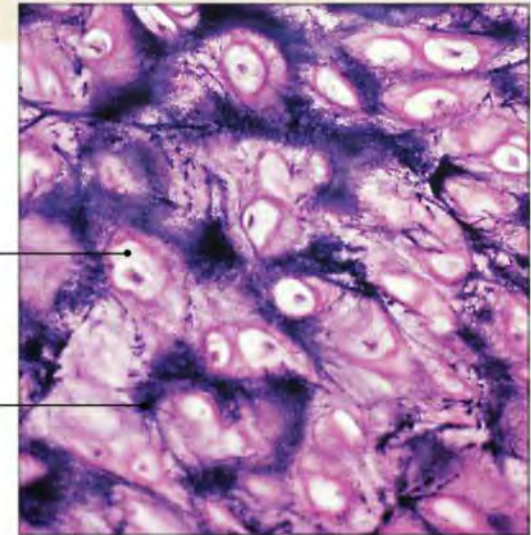
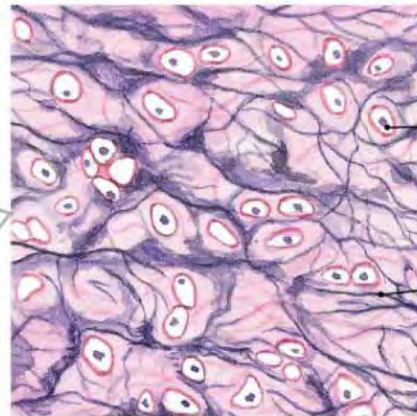
Supporting CT: Cartilage

- **Elastic Cartilage**
 - mostly elastic fibers; many cells
 - Pinna, tip of nose, epiglottis

ELASTIC CARTILAGE

LOCATIONS: Auricle of external ear; epiglottis; auditory canal; cuneiform cartilages of larynx

FUNCTIONS: Provides support, but tolerates distortion without damage and returns to original shape



(b) Elastic cartilage

LM × 358

Supporting CT: Cartilage

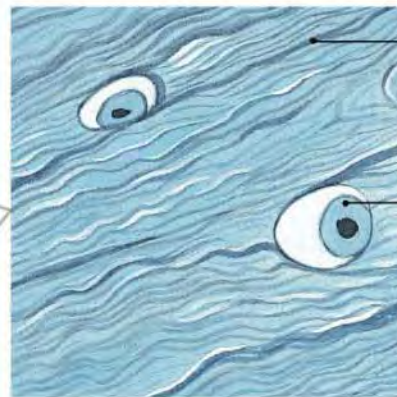
- **Fibrocartilage**

- Little ground substance; fewer cells; densely interwoven collagen fibers
- Resist compression, absorb shock

FIBROCARTILAGE

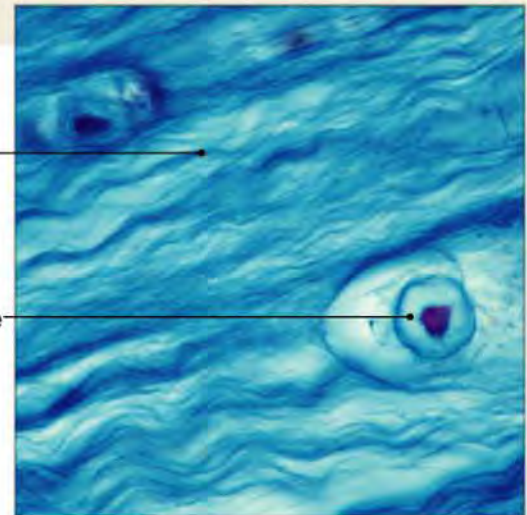
LOCATIONS: Pads within knee joint; between pubic bones of pelvis; intervertebral discs

FUNCTIONS: Resists compression; prevents bone-to-bone contact; limits relative movement



Collagen fibers in matrix

Chondrocyte in lacuna

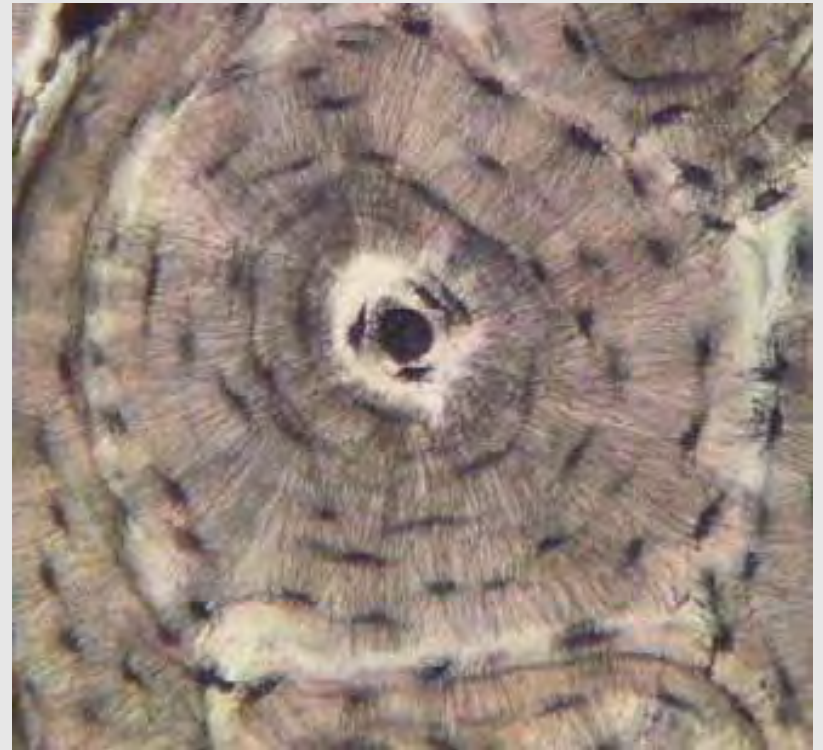


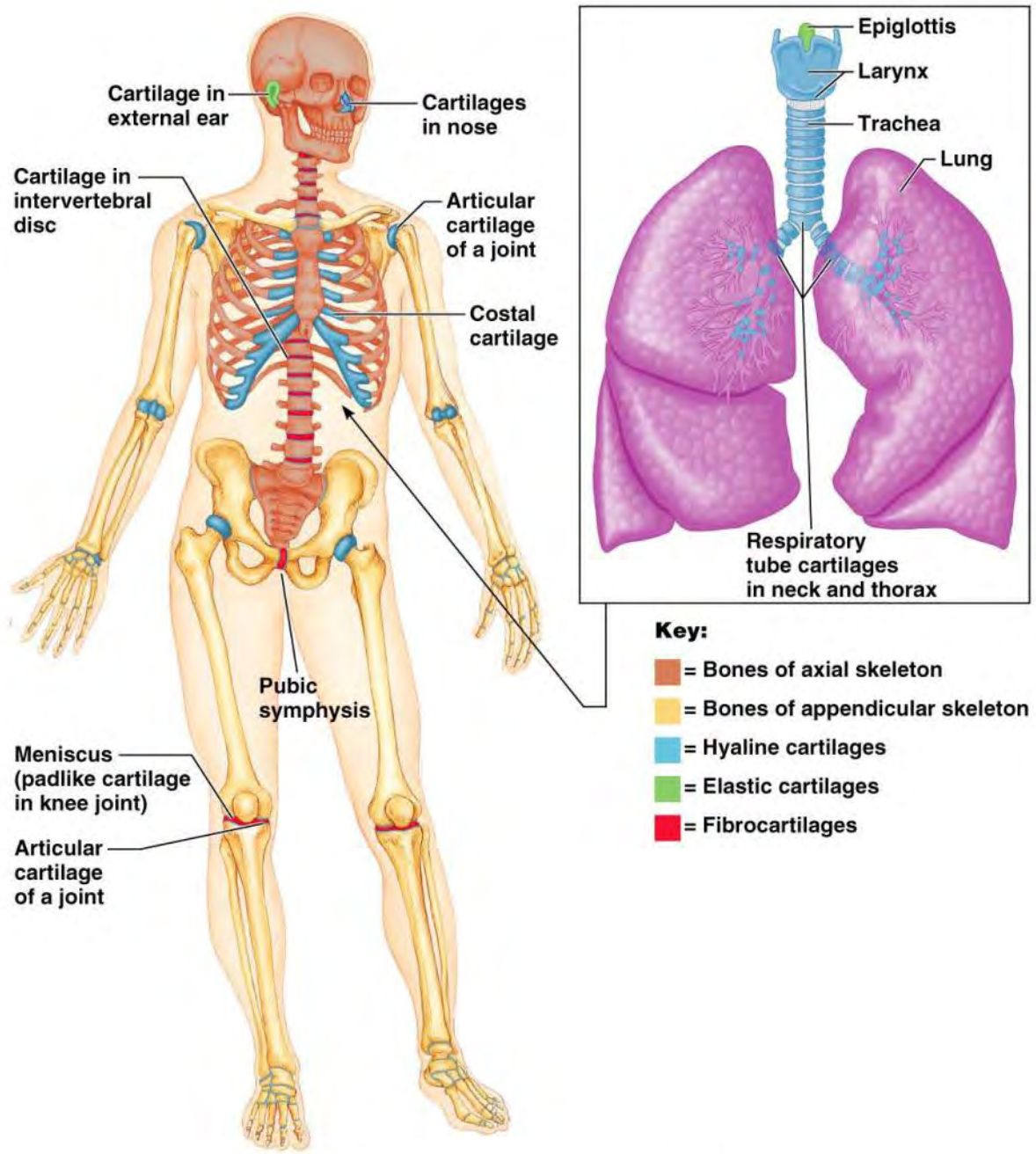
LM × 750

(c) Fibrocartilage

Supporting CT: Bone

- Bone = osseous CT
 - Cells
 - Osteocytes
 - Osteoblasts
 - Osteoclasts
 - Matrix
 - Very little ground substance
 - Hydroxyapatite (2/3)
 - Collagen fibers (1/3)
 - More later





Fascia: CT framework

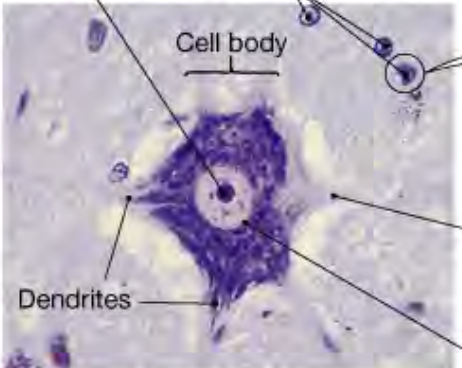

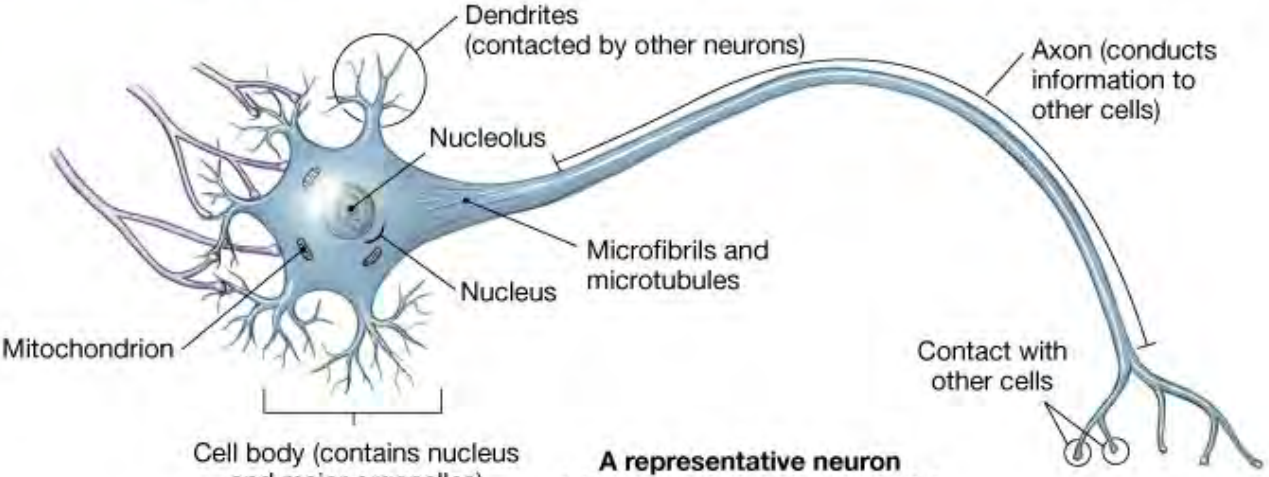
- **Superficial**
 - areolar & adipose CT
 - separates skin from organs
- **Deep**
 - Dense irregular CT
 - Surrounds organs; connects to bones & muscles
- **Subserous**
 - Areolar CT
 - Separates serous membrane from deep fascia



Neural Tissue

- Specialized tissue for the conduction of information; consists of brain, spinal cord, and nerves
- Cells that are found in neural tissue
 - Neurons
 - Neuroglia cells (supporting)
 - The glue that holds neurons together

Neurons and neuroglia cells

NEURONS	NEUROGLIA (supporting cells)
 <p>Nucleolus Nuclei of neuroglia</p> <p>Cell body</p> <p>Axon</p> <p>Dendrites</p> <p>Nucleus of neuron</p> <p>LM × 600</p>	<ul style="list-style-type: none"> • Maintain physical structure of tissues • Repair tissue framework after injury • Perform phagocytosis • Provide nutrients to neurons • Regulate the composition of the interstitial fluid surrounding neurons 
 <p>Dendrites (contacted by other neurons)</p> <p>Axon (conducts information to other cells)</p> <p>Nucleolus</p> <p>Nucleus</p> <p>Microfibrils and microtubules</p> <p>Mitochondrion</p> <p>Cell body (contains nucleus and major organelles)</p> <p>Contact with other cells</p> <p>A representative neuron (sizes and shapes vary widely)</p>	