

Histology 2 – Connective Tissue

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Connective Tissue

- They are the most abundant and widely distributed tissue type in the body.
- Connective tissues run the gamut for vascularity. Some tissues are avascular (Cartilage), some are poorly vascularized (dense connective tissue), and some have rich blood supplies (bone).

Connective Tissue

- Connective tissues can be rigid (bone), flexible (adipose), or fluid (blood).
- Unlike the tightly packed Epithelial tissues, living cells in connective tissues are separated by a non-living **extracellular matrix** (Ground Substance and Fibers).
- Due to the matrix, connective tissues are able to bear weight, withstand tension, and endure abuses that no other tissues could tolerate.

Connective Tissue

- Connective Tissues have many specific functions. Its major functions include
 - 1.Binding and support
 - 2.Protection
 - 3.Insulation
 - 4.Transportation of substances

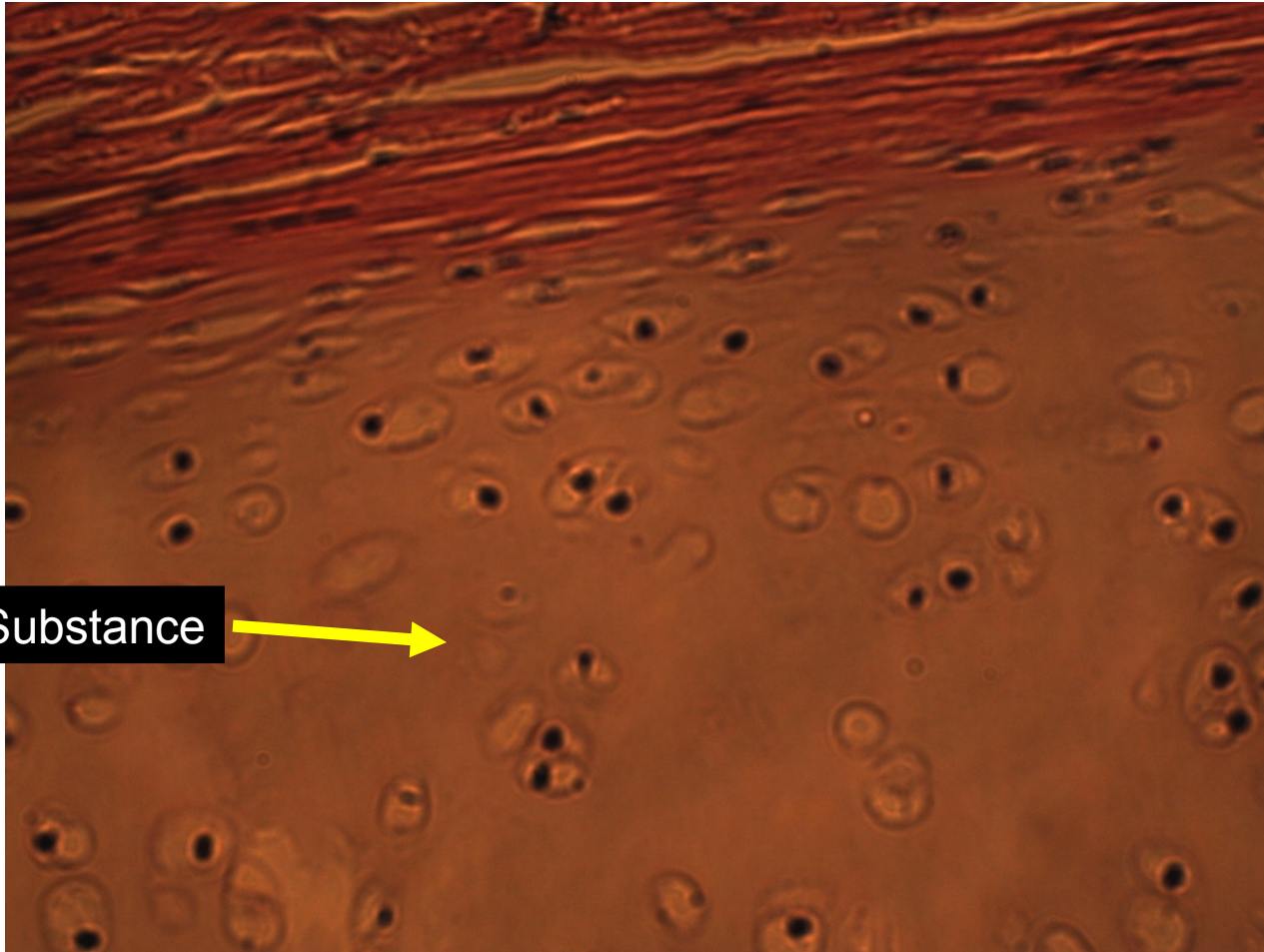
Connective Tissue

- Connective Tissues are made of three main components:
 1. Ground Substance
 2. Fibers
 3. Cells

Connective Tissue- Ground Substance

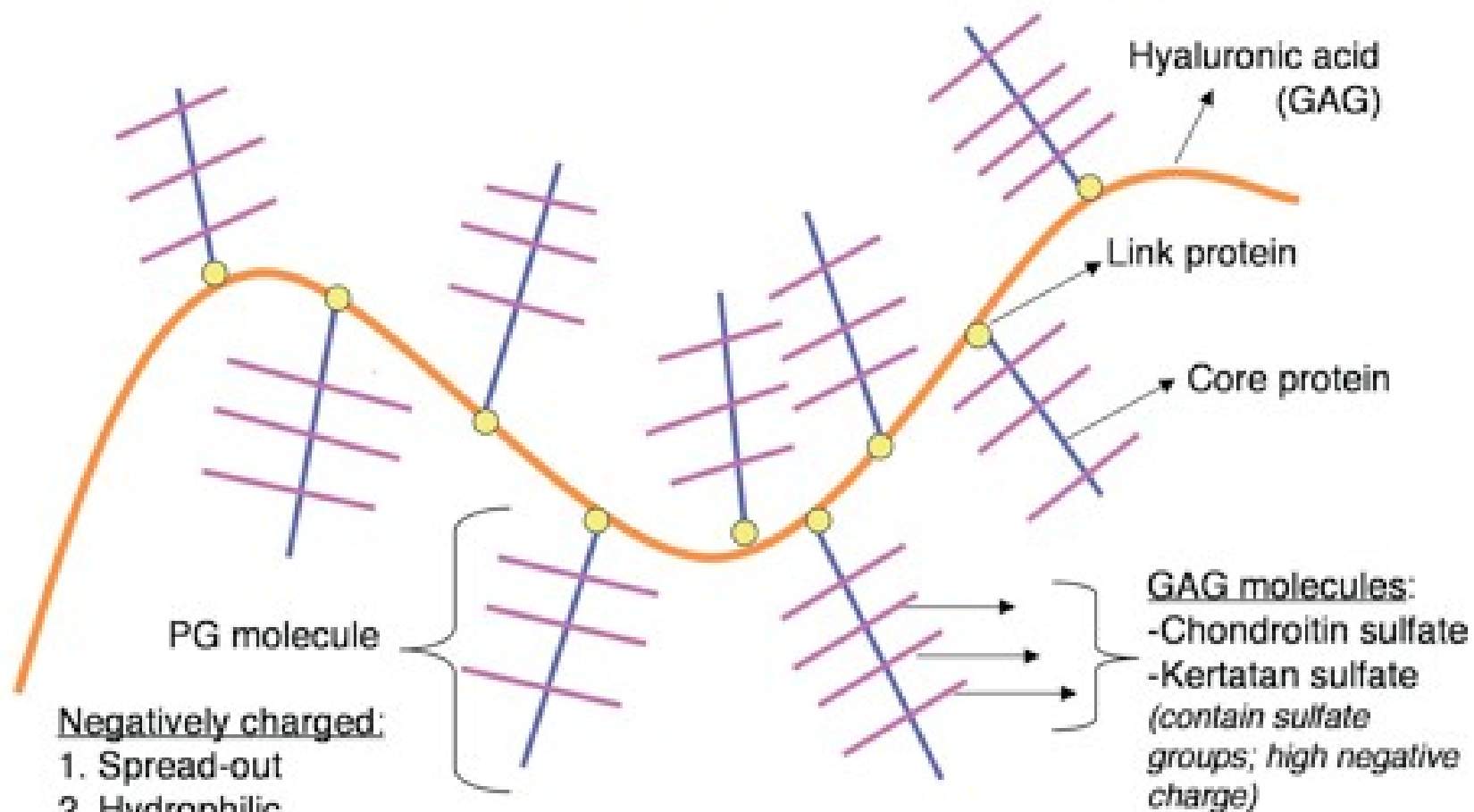
- The **ground substance** is the unstructured material between cells that contains the fibers.
- The ground substance holds large amounts of fluid and serves as a medium through which nutrients and other substances can diffuse between blood vessels and the cells.

Ground Substance



Ground Substance



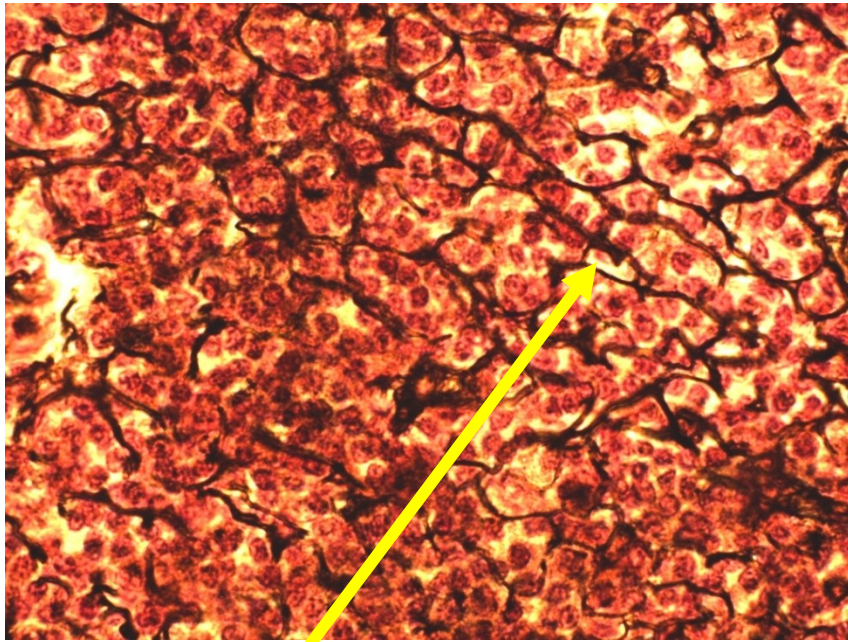


- Negatively charged:
1. Spread-out
 2. Hydrophilic
 3. Basophilic
 4. Metachromatic

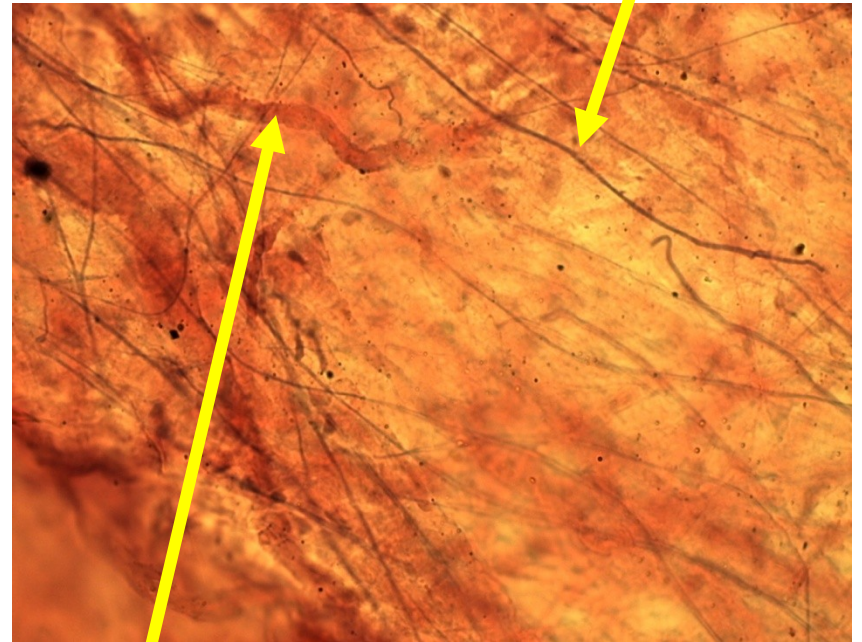
Connective Tissue - Fibers

- There are three types of fibers prevalent in Connective tissues
 - A.) **collagen fibers** – are wide and wavy in appearance and generally stain pink. 79% of the protein in the body is collagen.
 - B.) **elastic fibers** – are thin flexible fibers made from the protein elastin, that generally stain black.
 - C.) **reticular fibers** – are actually thin collagen fibers. They have a spider web appearance and appear black under stain.

Fiber Types



Reticular Fibers



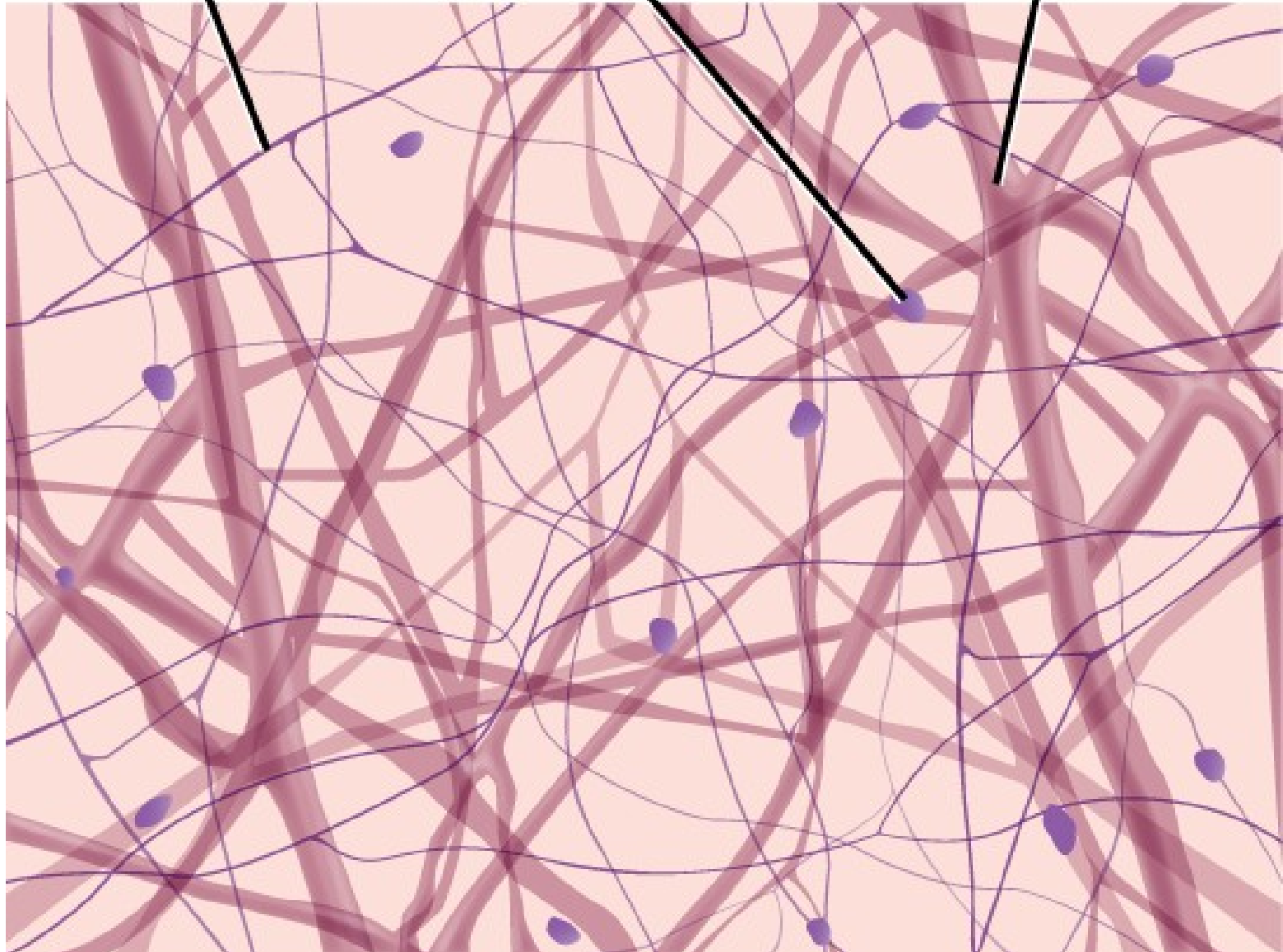
Collagen Fiber

Elastic Fiber

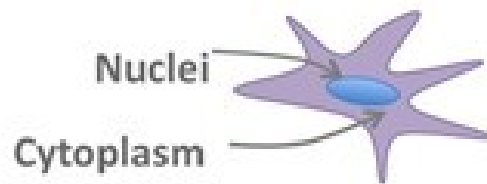
Elastin fiber

Fibroblasts

Collagen fiber



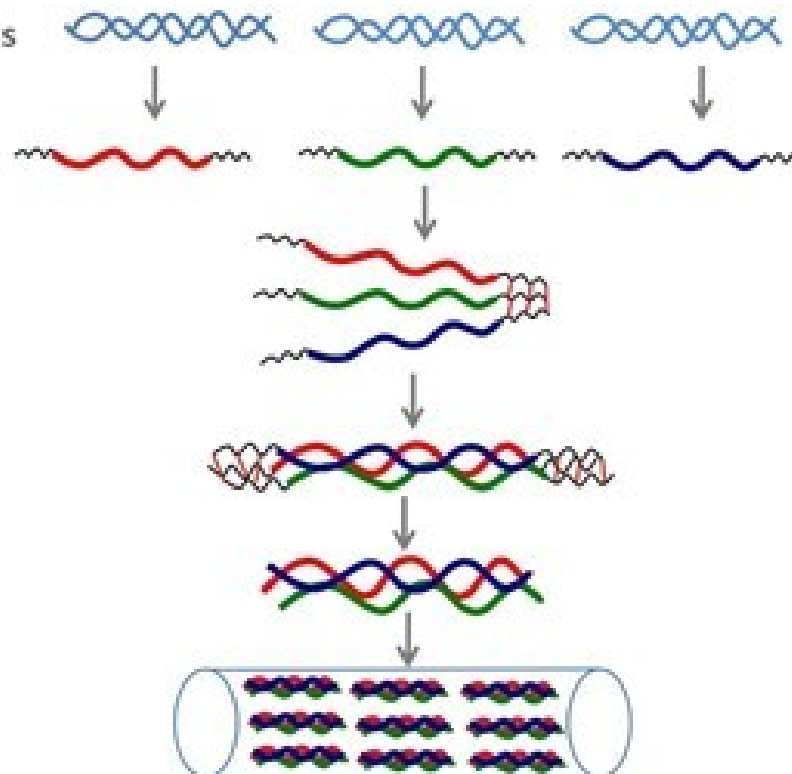
MECHANISM OF COLLAGEN FORMATION



Activated Fibroblast

BIOSYNTHESIS STEPS

- 1 DNA genes coding for α chains
- 2 Transcription and translation of DNA
- 3 Assembly of α chains through a trimerization domain
- 4 Formation of Pro-Collagen
- 5 Formation of Collagen
- 6 Formation of Collagen Fibrils



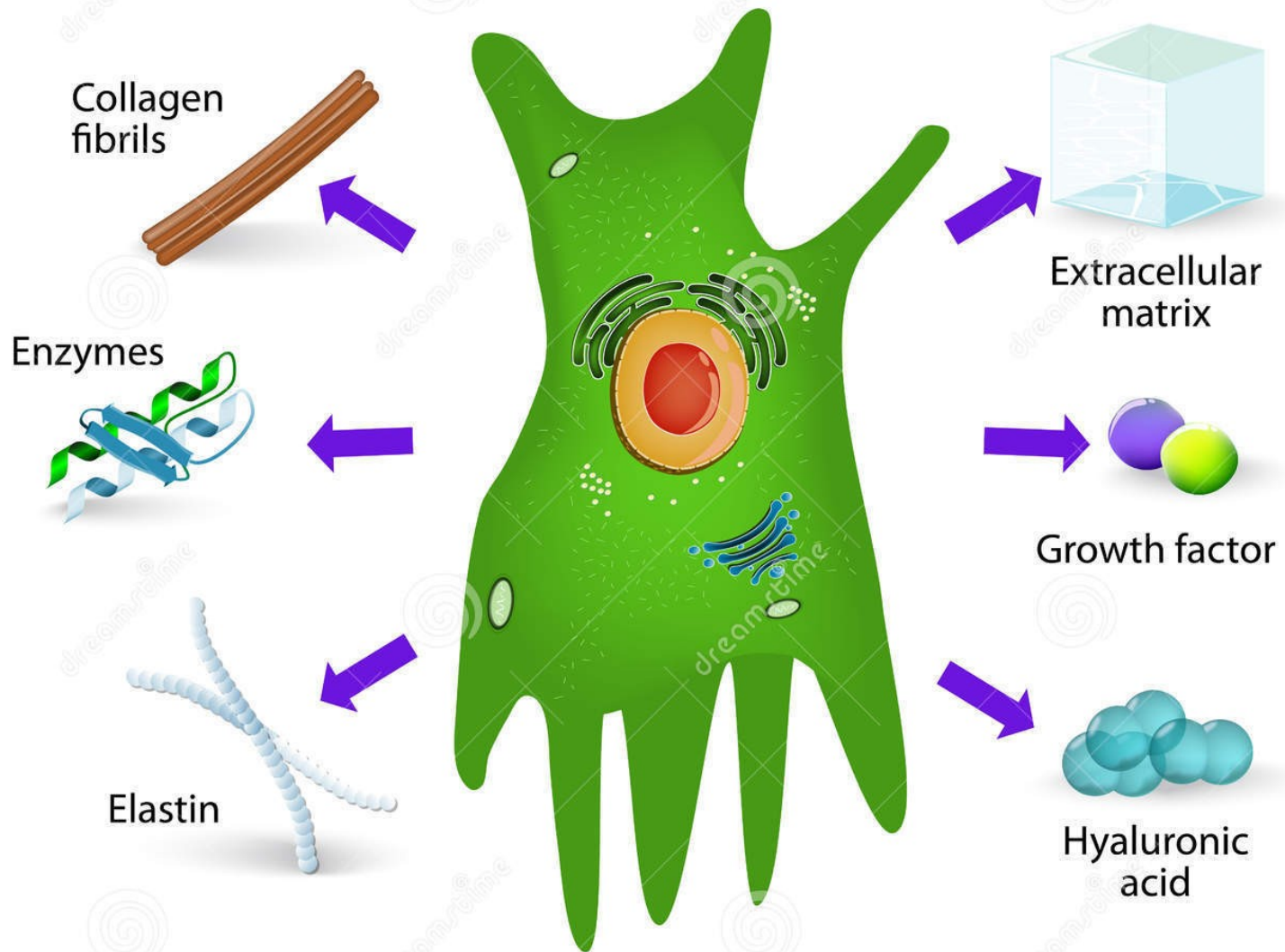
Types of Collagen

- Collagen I – skin, bone, tendon, cornea
- Collagen II – cartilage, embryonic cornea
- Collagen III – reticular fibers, loose CT, Blood vessels, dermis
- Collagen IV – basal lamina of epithelium

Connective Tissue - The Cells

- Each major type of connective tissue has its own fundamental cell type in both immature and mature forms

FIBROBLAST



Cell Types

Type of Connective Tissue → Immature Cell → Mature Cell

Connective Tissue Proper → Fibroblast → Fibrocyte

Cartilage → Chondroblast → Chondrocyte

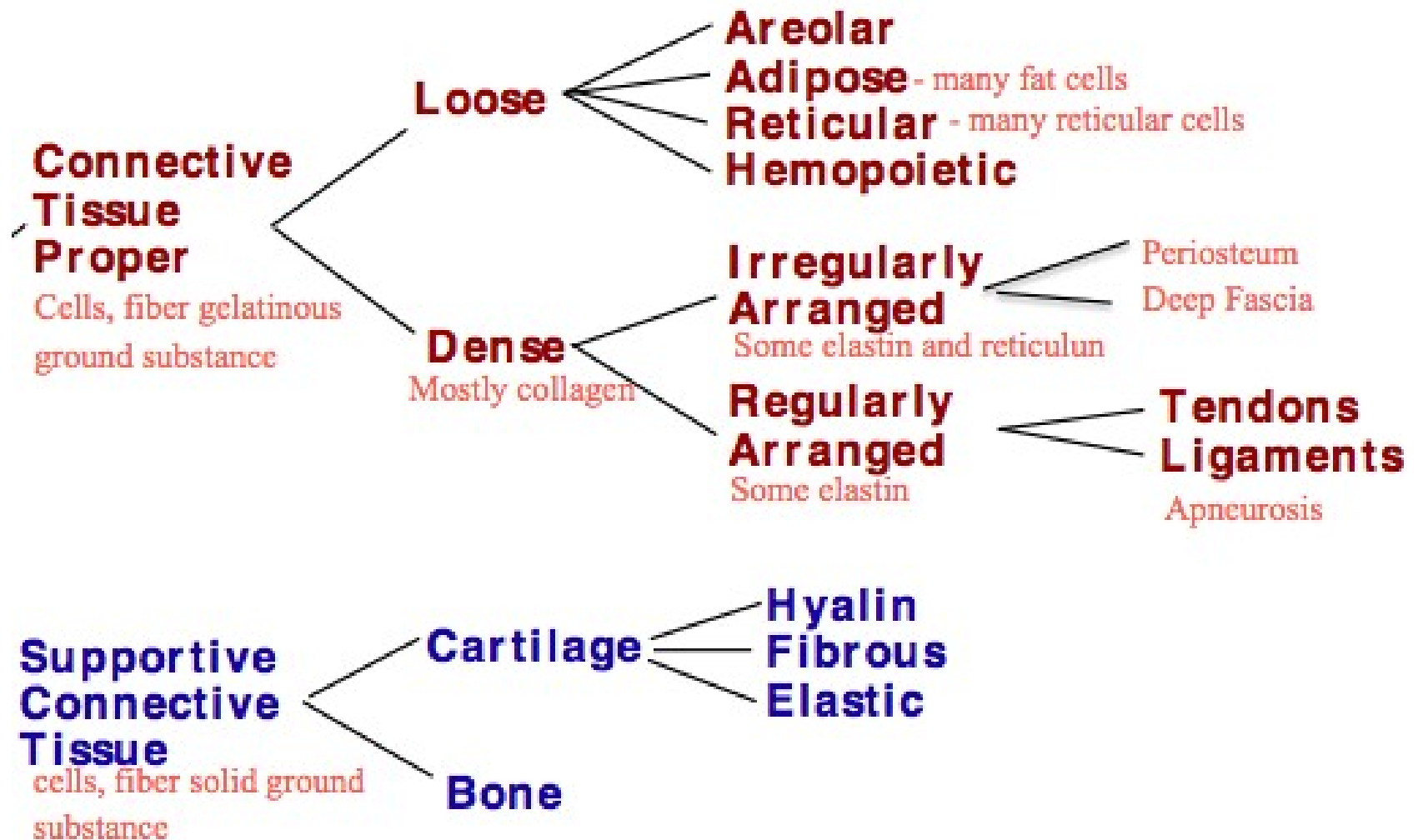
Bone → Osteoblast → Osteocyte

Blood → Hematopoietic Stem Cell → Blood cell (macrophages)

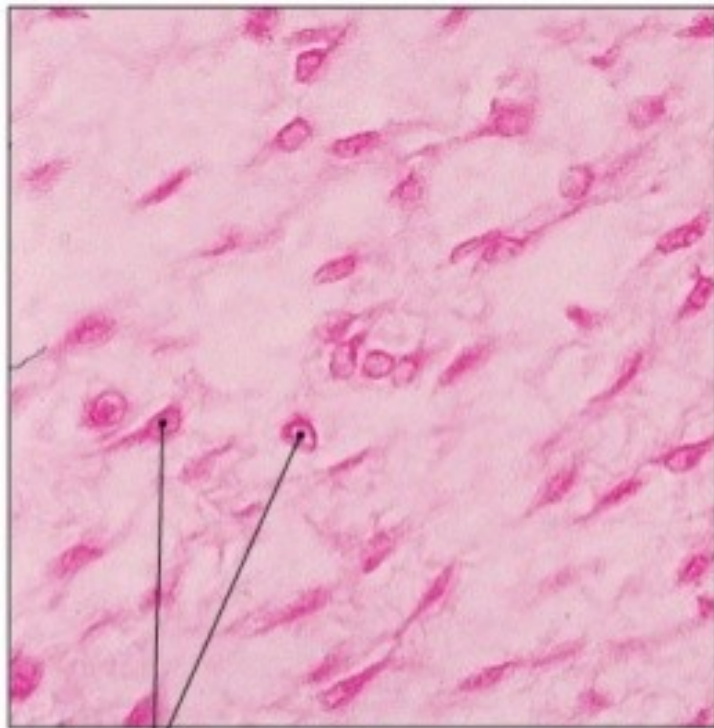
Other Cells Present

- Connective tissue is also home to many other cell types including Fat Cells, and mobile cells that migrate into the connective tissue from the blood stream, ie. mast cells and macrophages.

Connective Tissue Types

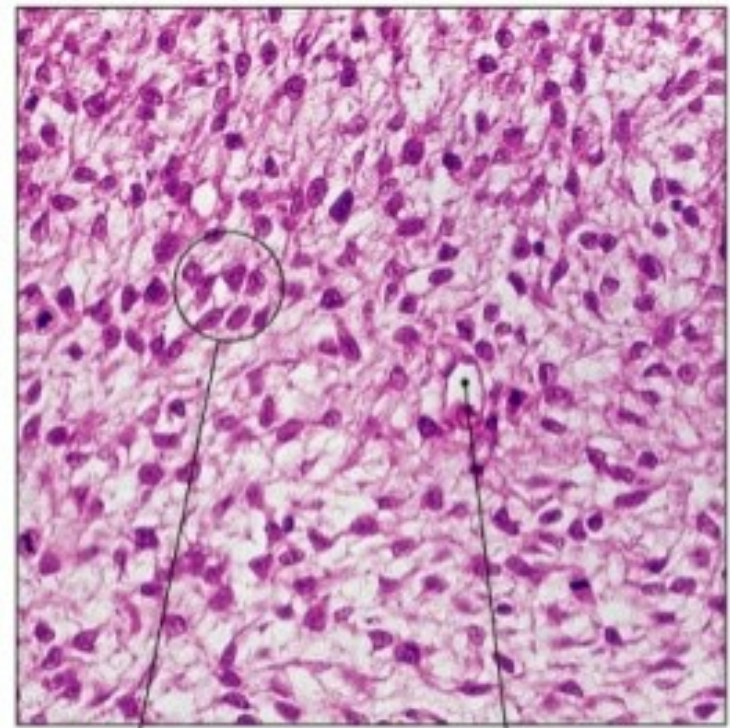


Embryonic Connective Tissue



Mesenchymal cells

(a) Mesenchyme (LM × 136)



Mesenchymal cells

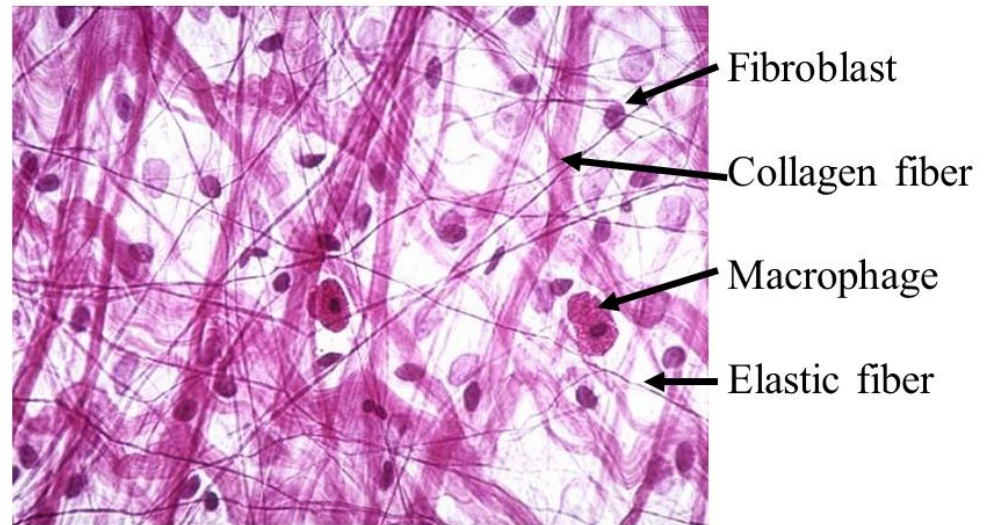
Blood vessel

(b) Mucous connective tissue (LM × 136)

Connective Tissue Proper - Areolar Connective Tissue

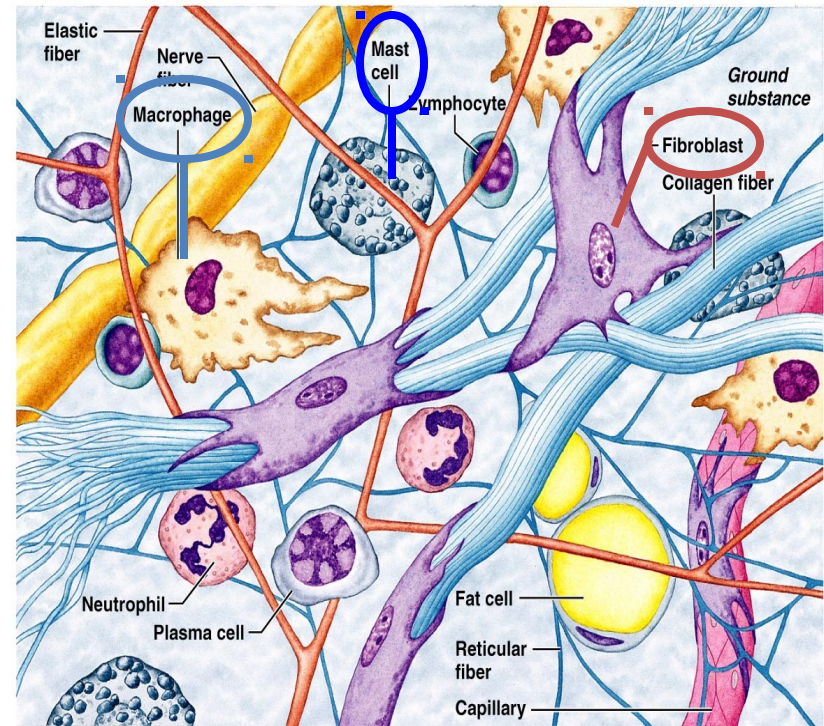
Structure-

- gel like matrix with all three fiber types present.
- Three cell types present
 1. Mast cells
 2. Macrophages
 3. fibroblasts



Connective Tissue Proper - Areolar Connective Tissue

1. **Mast Cells** – produce heparin and histamine.
2. **Macrophages** - are “big eaters”. They eat bacteria and dead or dying cells.
3. **Fibroblasts** – fiber builders.

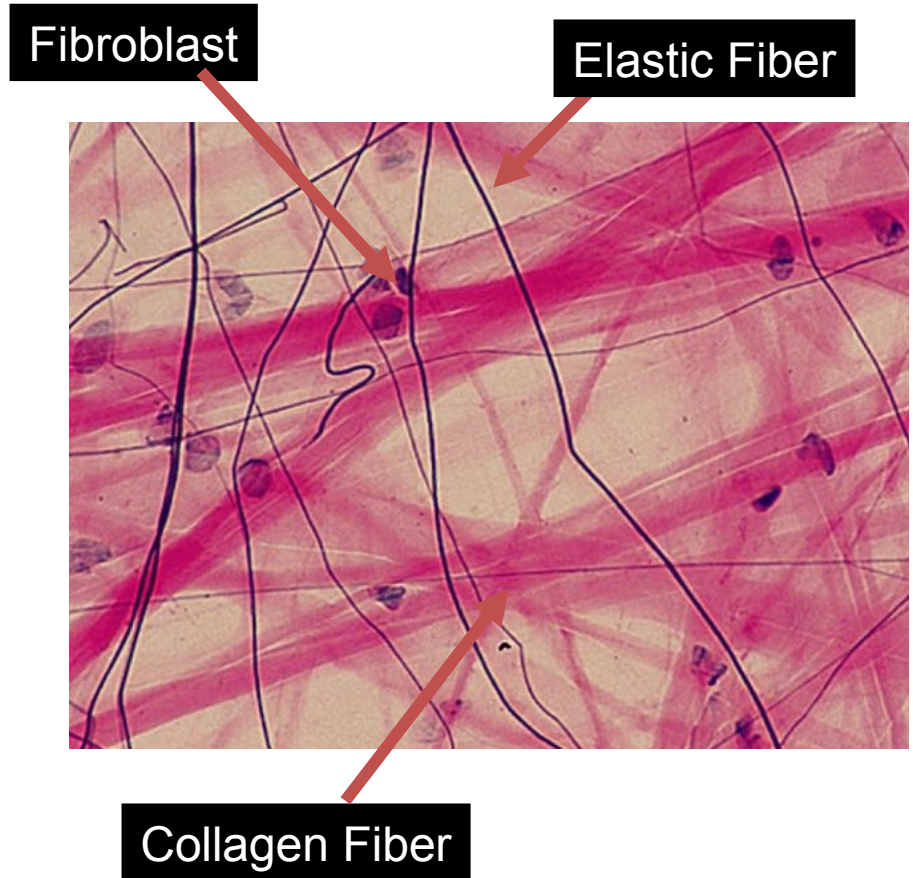


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Connective Tissue Proper - Areolar Connective Tissue

Location –

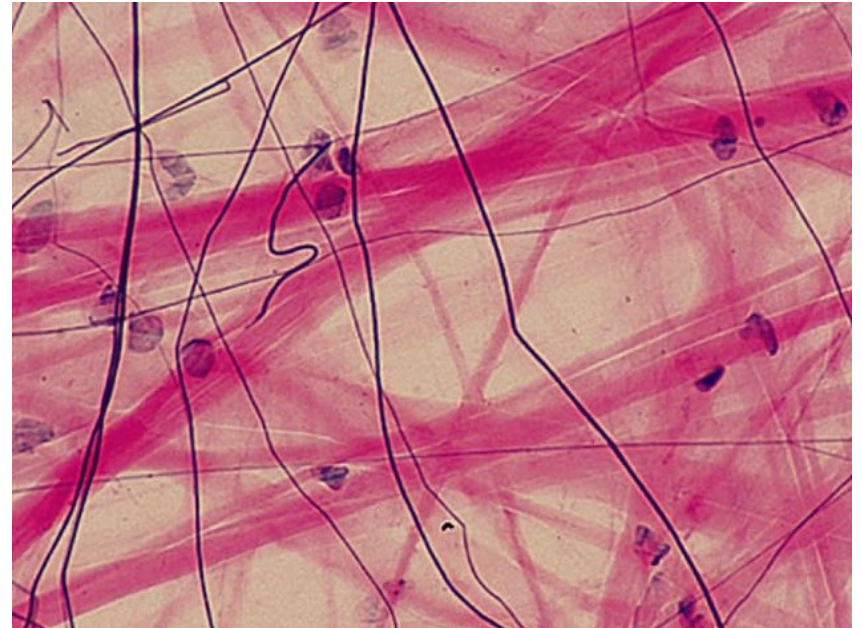
- Found between the skin and muscle.
- Also found between muscles
- Packages organs
- Surrounds Capillaries



Connective Tissue Proper - **Areolar Connective Tissue**

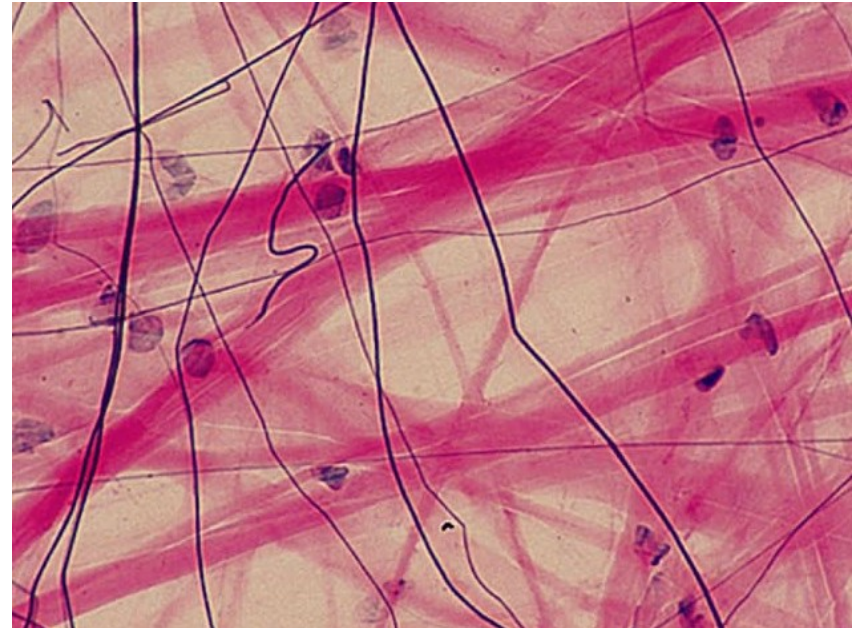
Function –

1. Wraps and cushions organs.
2. Macrophages phagocytize bacteria
3. Holds and conveys tissue fluid.



Connective Tissue Proper - Areolar Connective Tissue

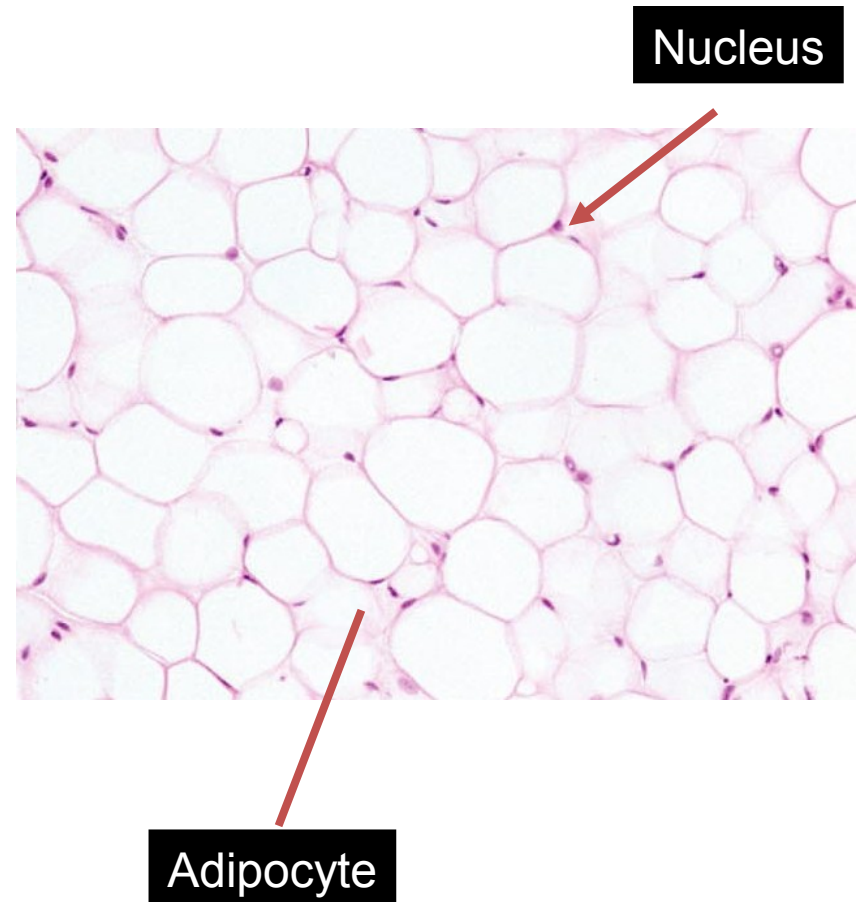
- Areolar Connective Tissue is the **most widely distributed** connective tissue in the body. It serves as a kind of **packaging** material between other tissues.



Connective Tissue Proper - Adipose Tissue

Structure –

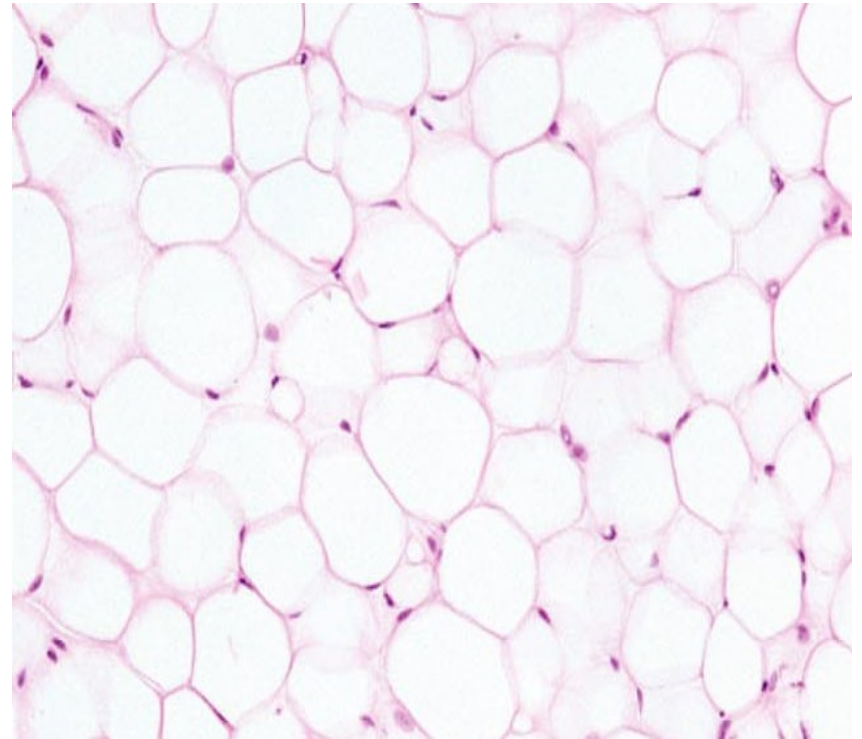
- **Adipocytes** (fat filled cells) are ring shaped cells filled with **tryglycerides**.



Connective Tissue Proper - **Adipose Tissue**

Location –

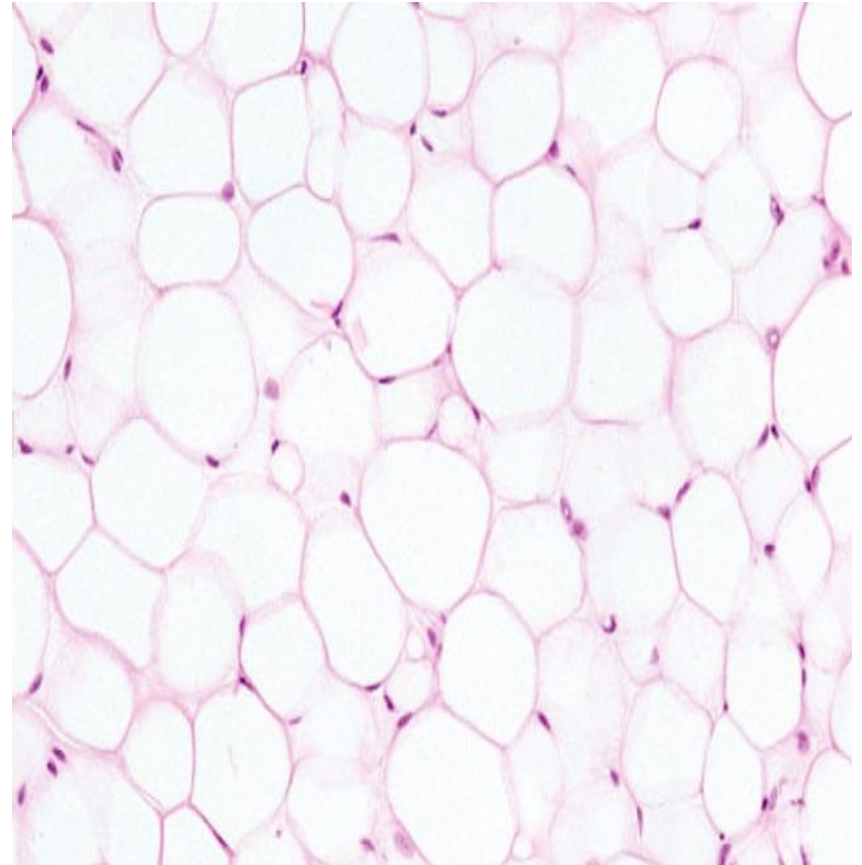
- Found around organs, joints, surrounding the eyeball, within the abdomen.



Connective Tissue Proper - **Adipose Tissue**

Function –

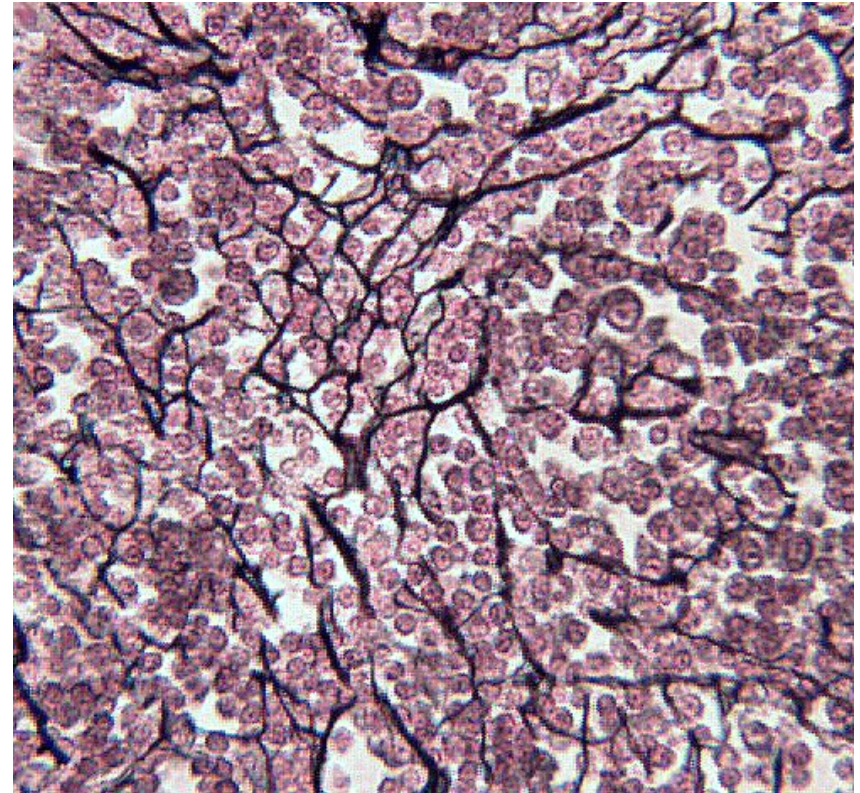
- Shock absorption
- Energy Storage
- Protection
- Insulation



Connective Tissue Proper - **Reticular Tissue**

Structure –

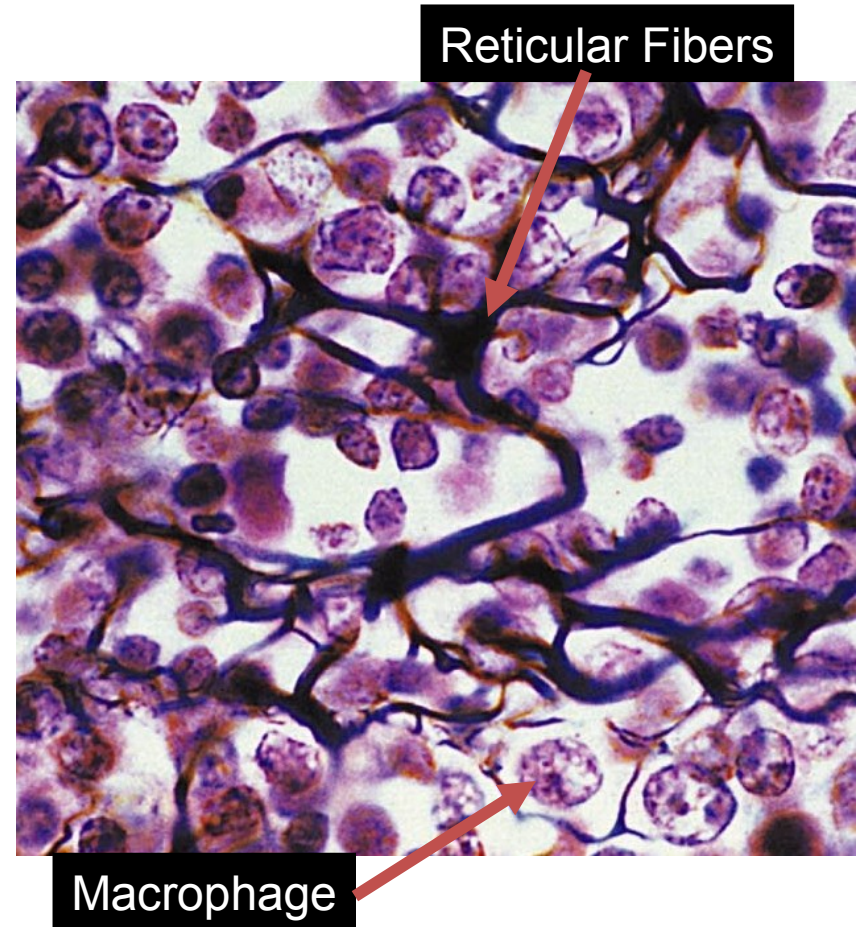
- A network of reticular fibers with macrophages interspersed.



Connective Tissue Proper - Reticular Tissue

Location –

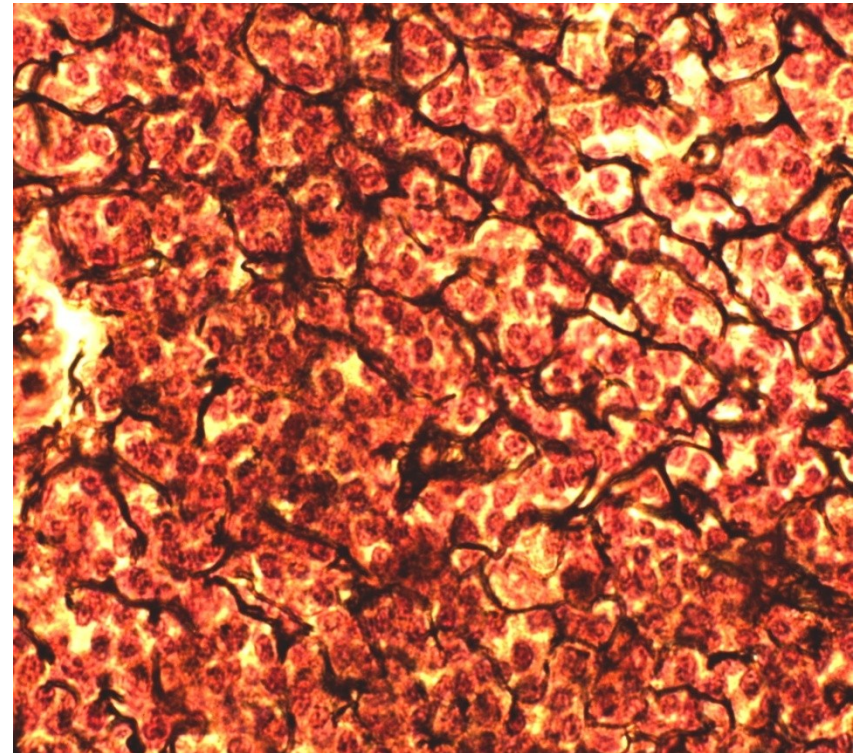
- Spleen
- Lymph nodes
- liver



Connective Tissue Proper - Reticular Tissue

Function

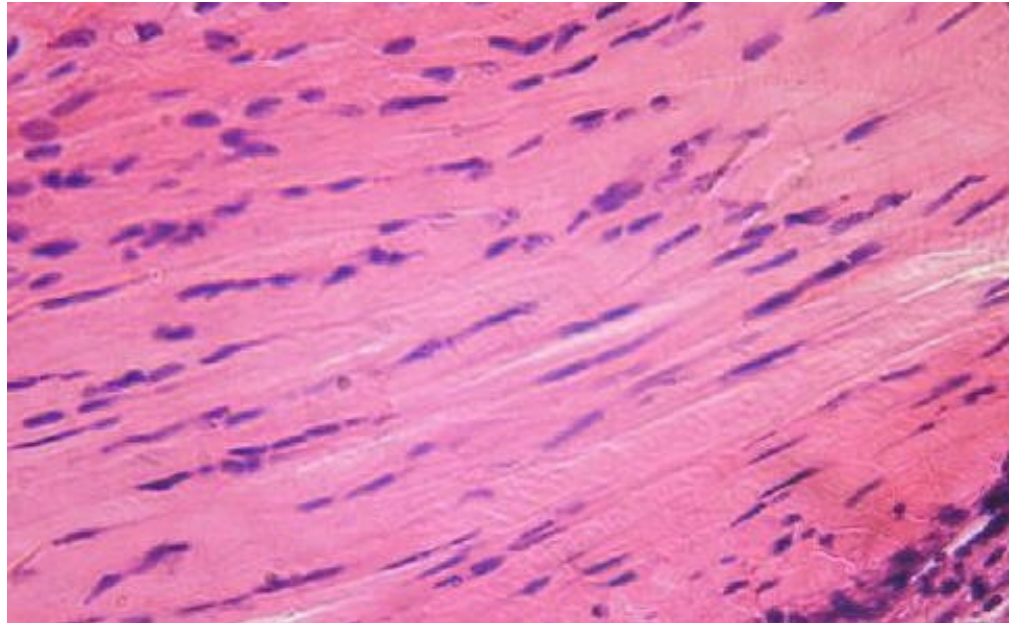
- In Lymph Nodes – macrophages devour bacteria, viruses and cancer cells.
- In Spleen – macrophages break down dying RBC's.
- In Liver – macrophages (Kupffer cells) devour bacteria.
- *This tissue forms a soft internal skeleton that supports other cell types.*



Connective Tissue Proper - Dense Regular Connective Tissue

Structure –

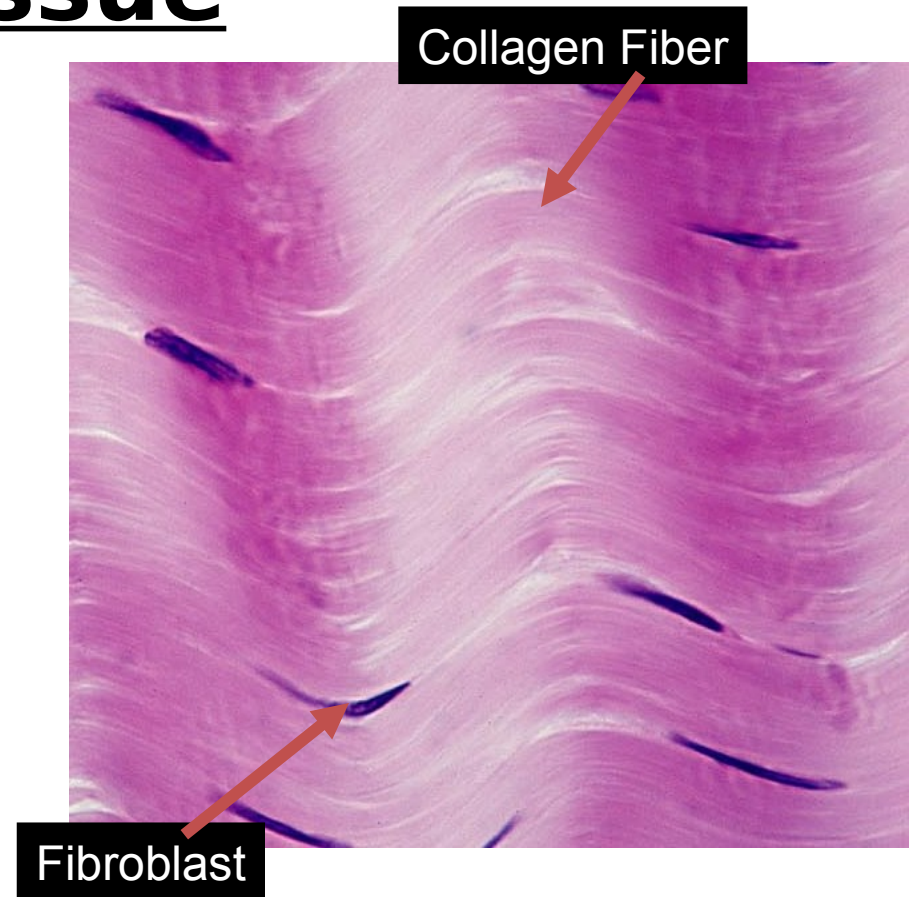
- Parallel collagen fibers.
- Dark colored fibroblasts interspersed.



Connective Tissue Proper - Dense Regular Connective Tissue

Location –

- In tendons and ligaments.
- In scar tissue
- Aponeuroses



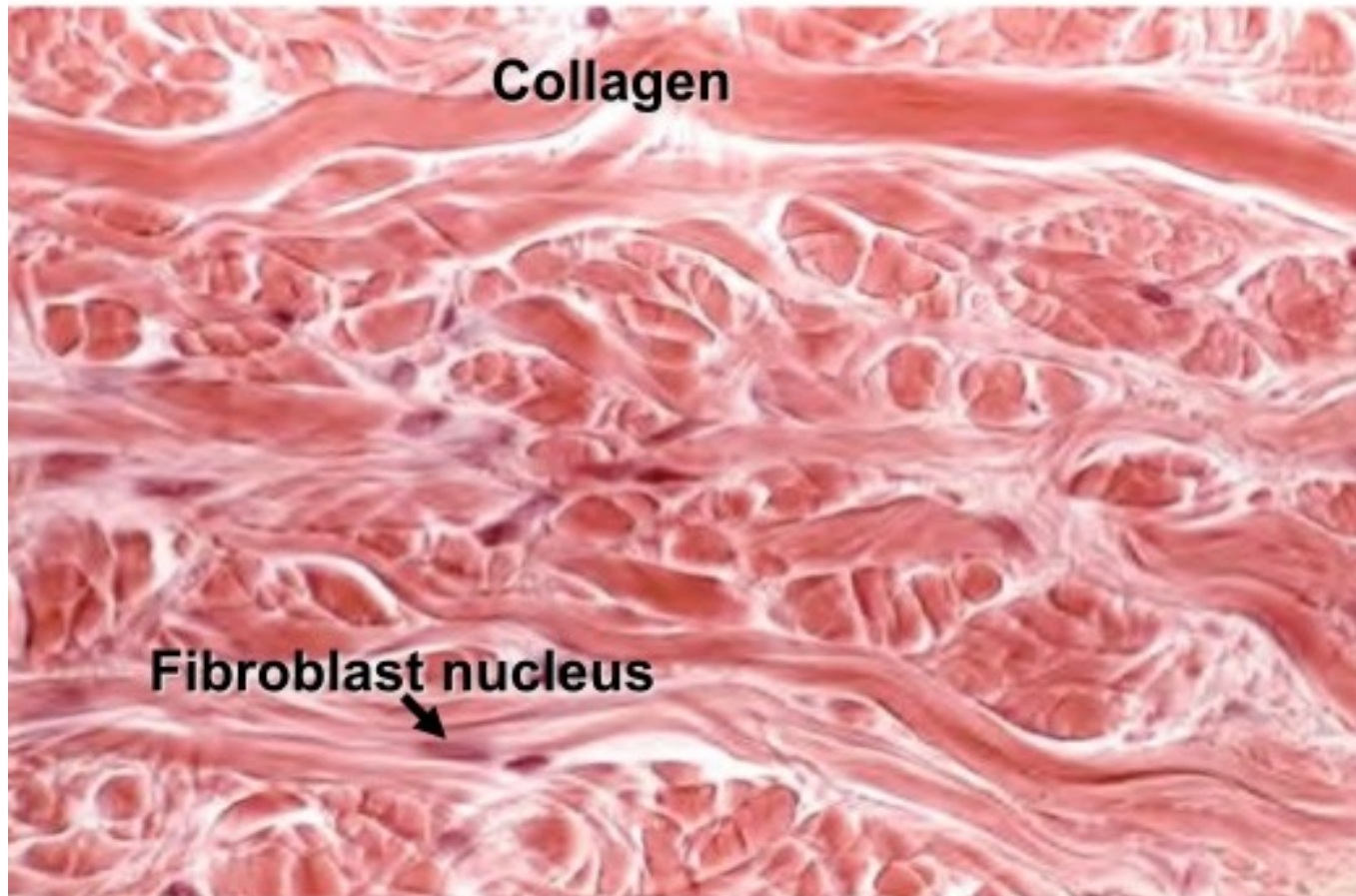
Connective Tissue Proper - Dense Regular Connective Tissue

Function –

- Provide high tensile strength in one direction.
- Attached muscles to bone, bone to bone



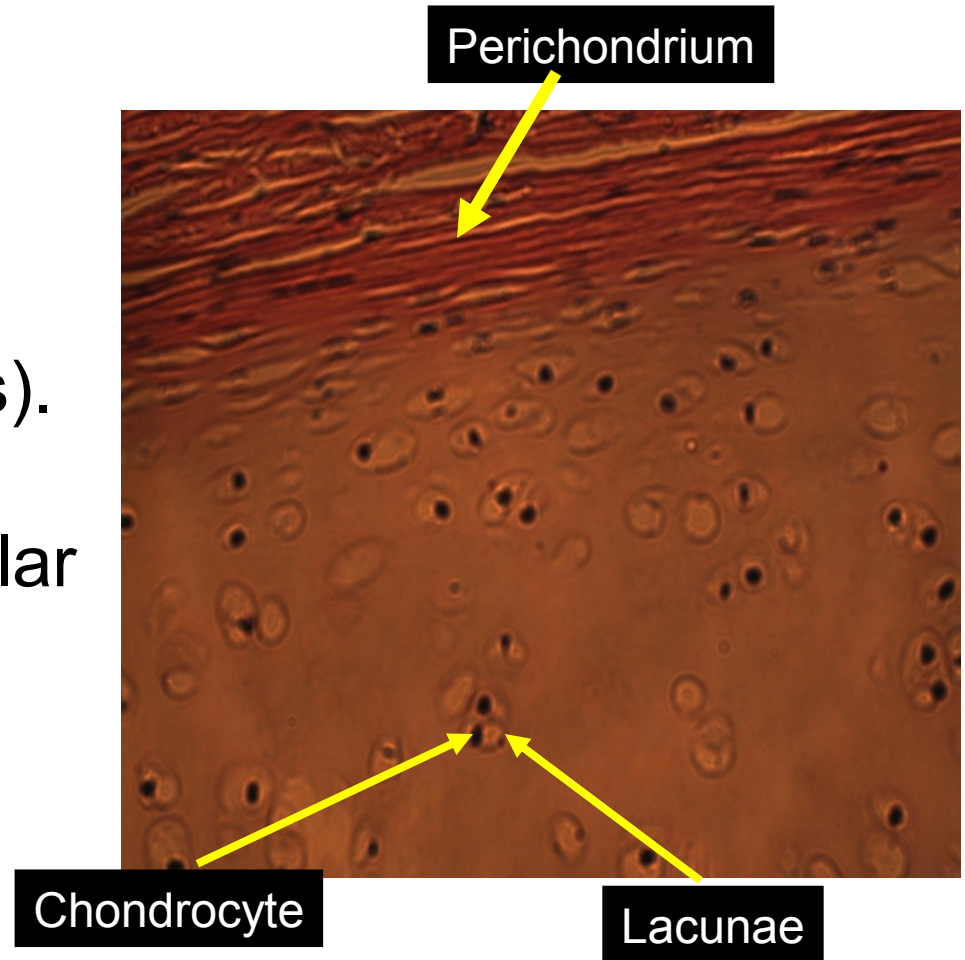
Connective Tissue Proper - Dense Irregular Connective Tissue



Hyaline Cartilage

Structure –

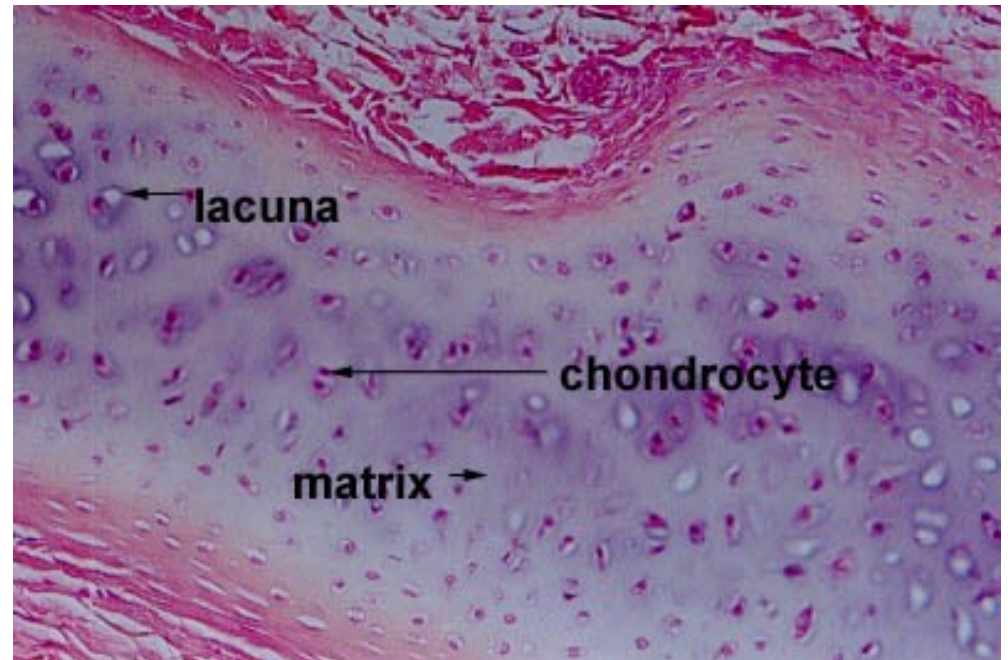
- The chondrocytes (cells) lie in lacunae (spaces around cells).
- There is a large amount of extracellular matrix which is bordered on either side by the perichondrium.



Hyaline Cartilage

Location -

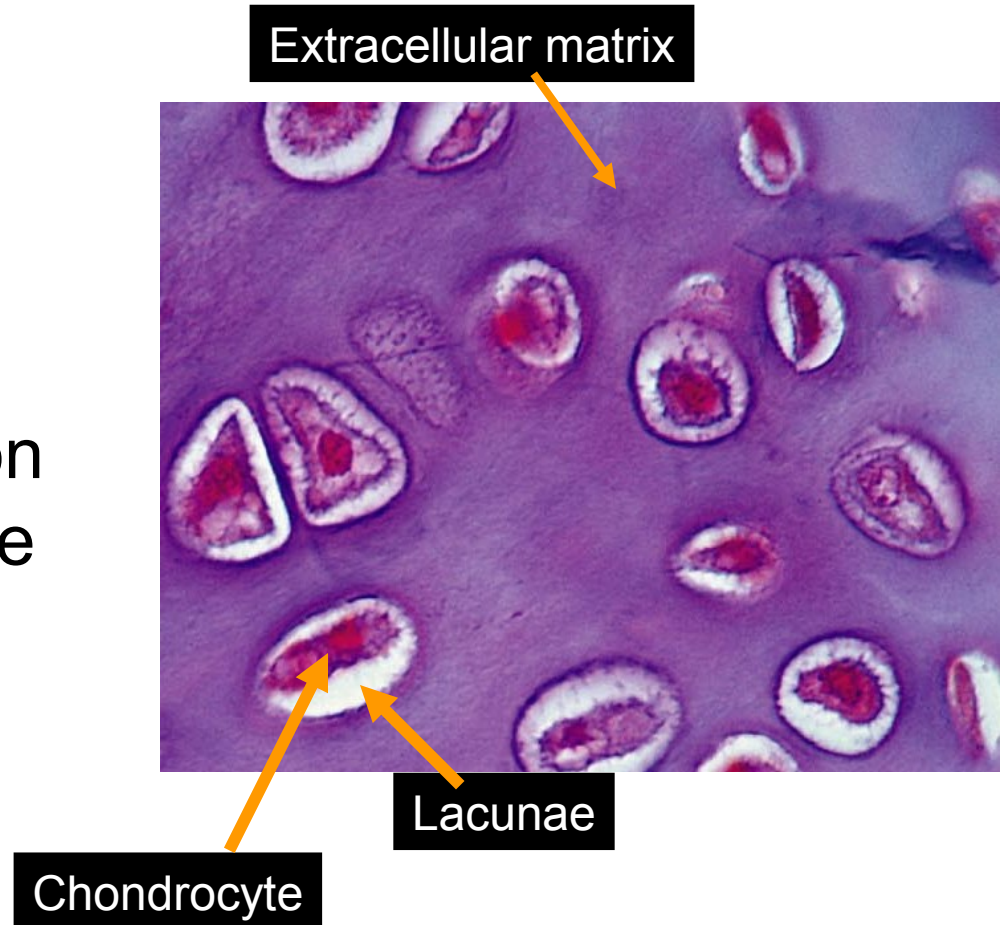
- Forms most of the embryonic skeleton.
- Covers the ends of long bones.
- Costal cartilage
- Nose
- Trachea
- Larynx



Hyaline Cartilage

Function –

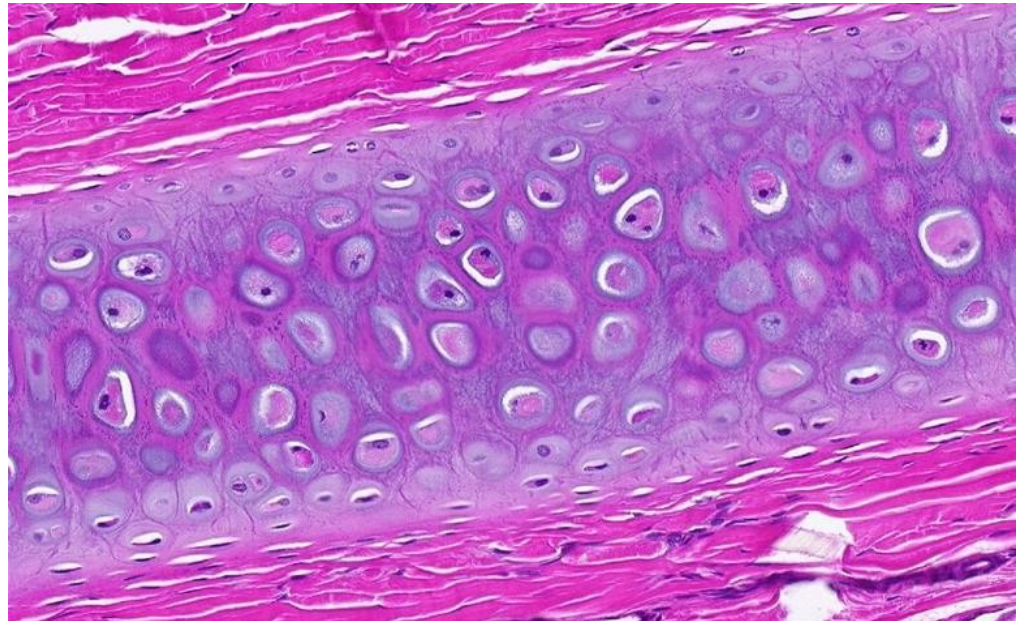
- Provides a smooth surface for joints to move over.
- Resists compression and provides flexible support.



Elastic Cartilage

Structure-

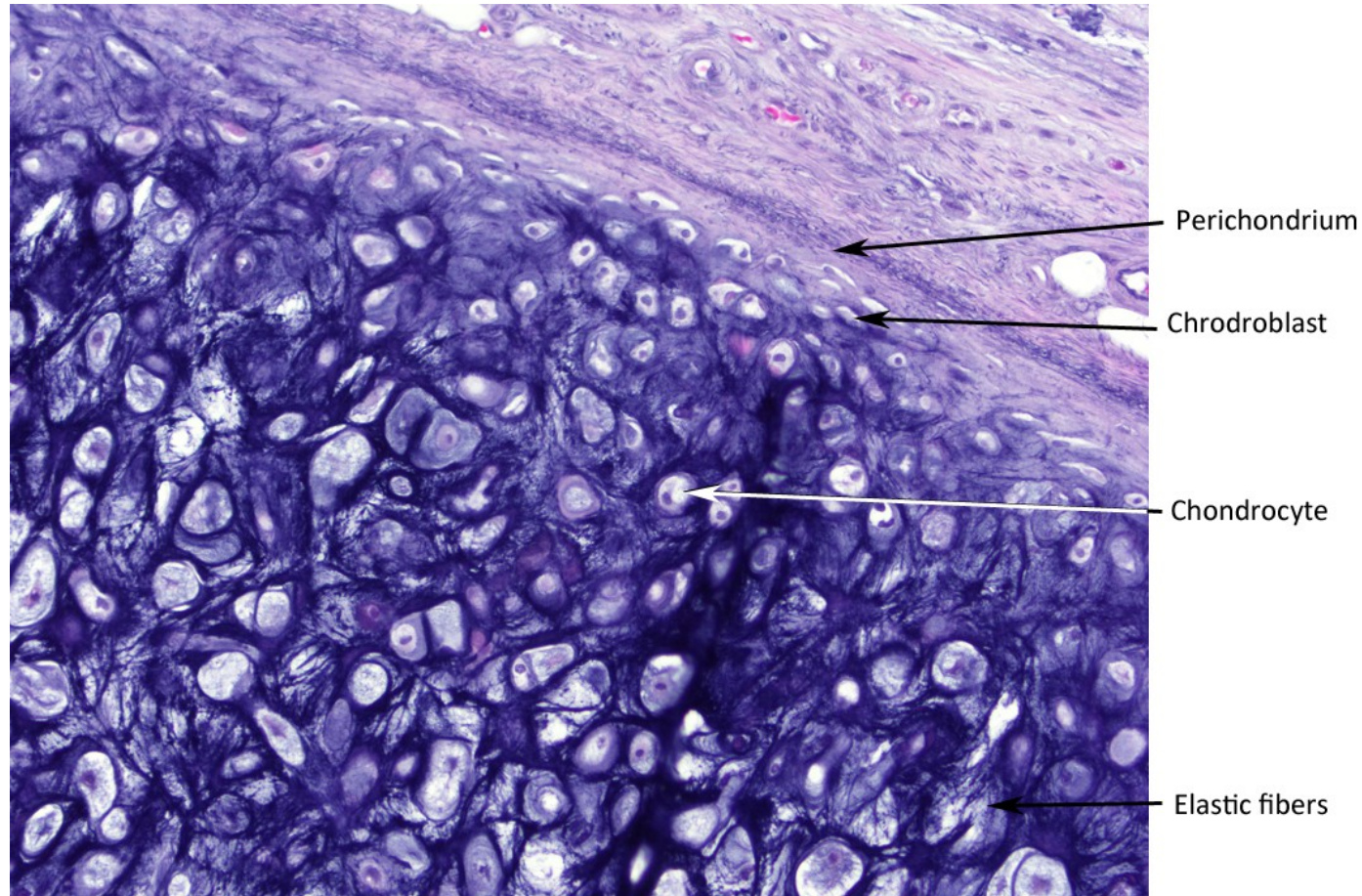
- Similar to Hyaline cartilage with the exception of the elastic fibers in the matrix.



Elastic Cartilage

Location –

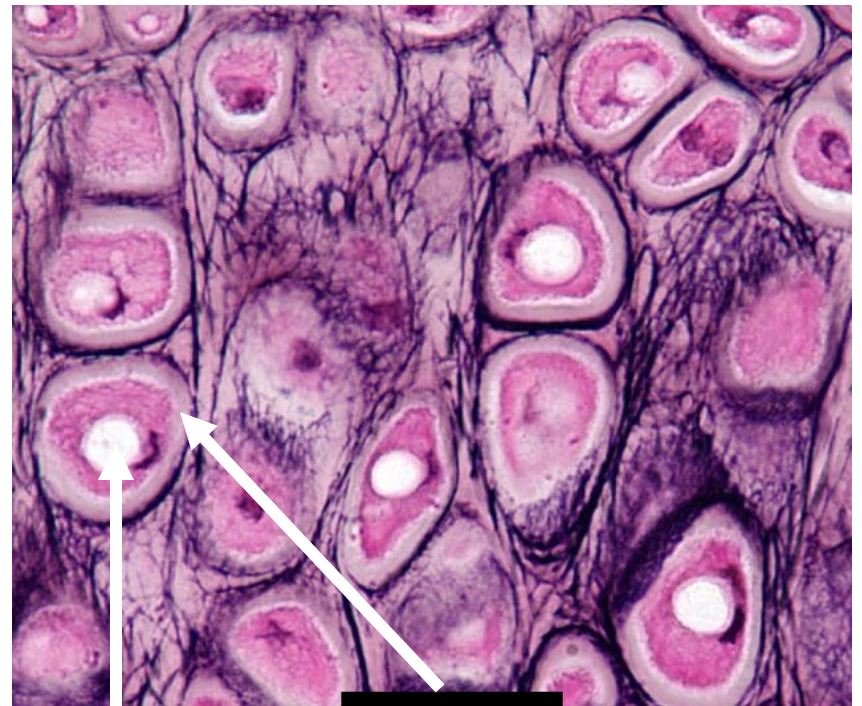
- Ears
- Epiglottis



Elastic Cartilage

Function –

- Maintains shape of a structure but is also extremely flexible.



Chondrocyte

Lacunae

Fibrocartilage

Structure –

- Thick collagen fibers predominate the matrix.
- Chondrocytes are interspersed among the fibers.

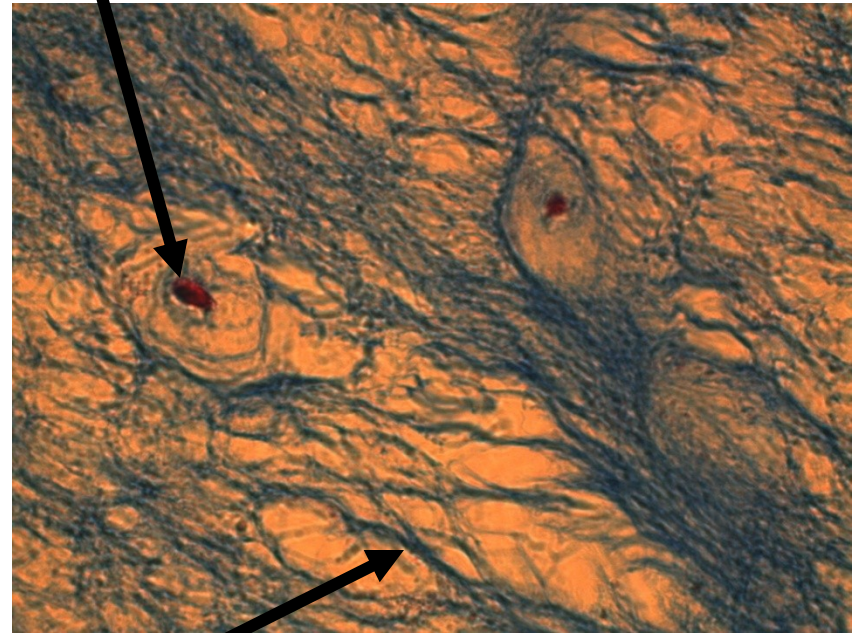


Fibrocartilage

Location –

- Intervertebral Discs
- Pubic Symphysis
- Menisci of the knee

Chondrocyte

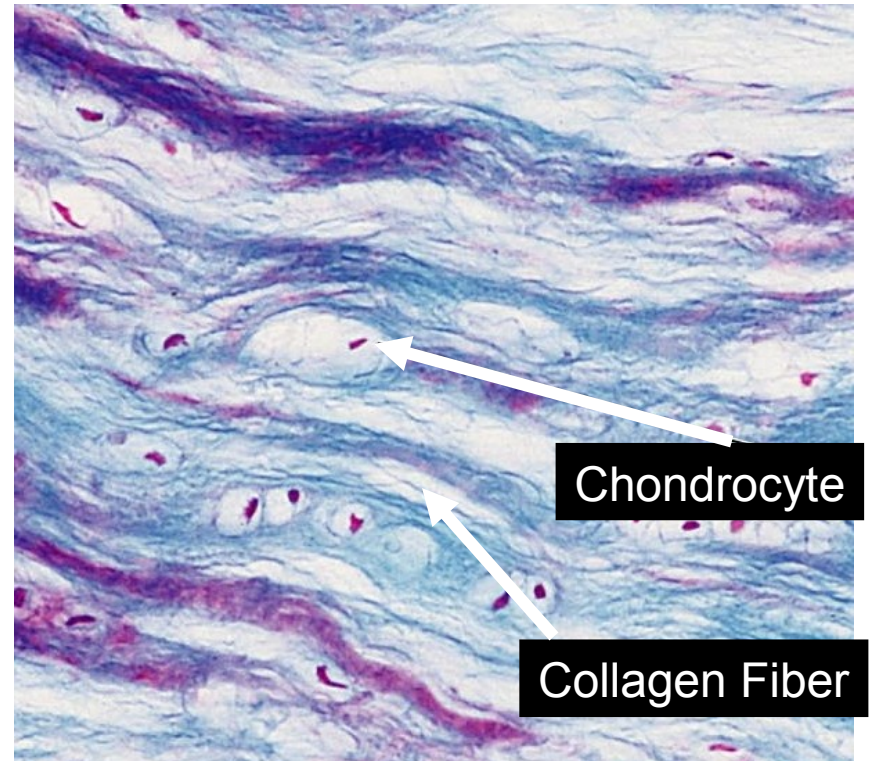


Collagen Fiber

Fibrocartilage

Function –

- Shock absorption
- Smooth tough support



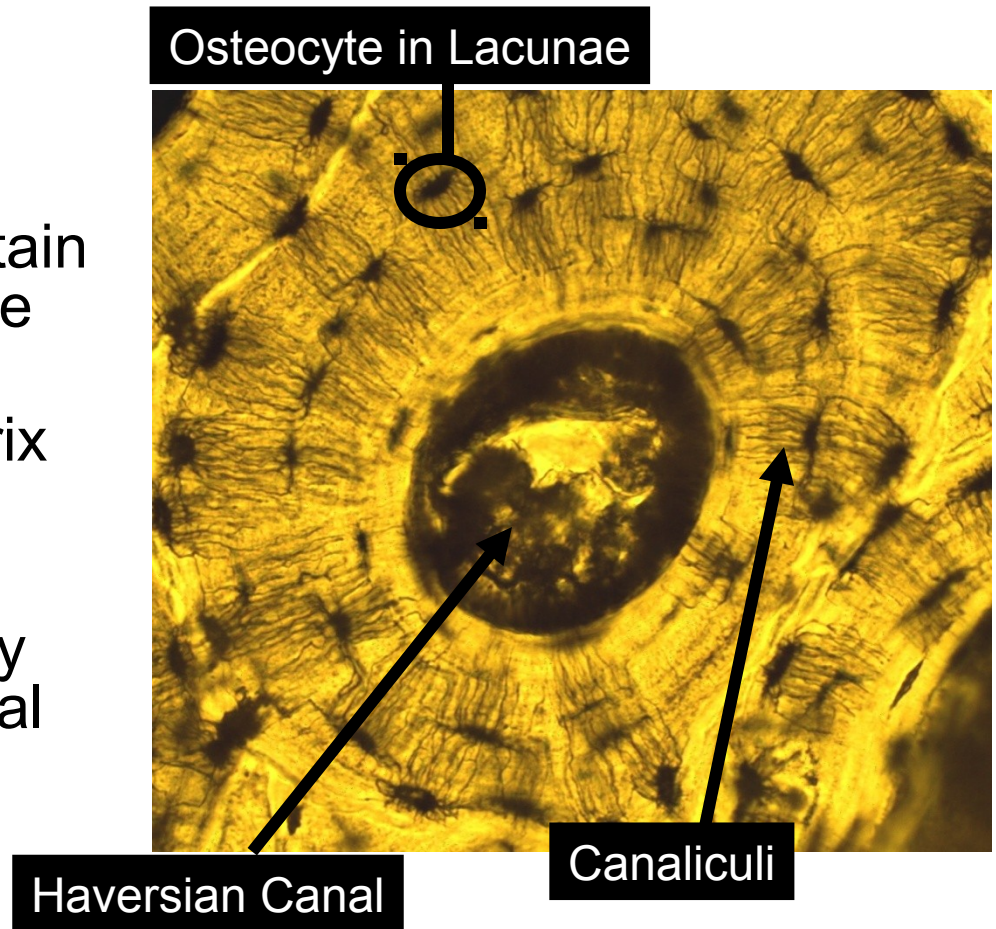
FEATURES OF IDENTIFICATION

HYALINE CARTILAGE	ELASTIC CARTILAGE	FIBRO CARTILAGE
1. PERICHONDRIUM PRESENT	1. PERICHONDRIUM PRESENT	1. PERICHONDRIUM ABSENT
2. GROUND SUBSTANCE HIGHLY BASOPHILIC AND HOMOGENEOUS	2. NUMEROUS ELASTIC FIBRES	2. BUNDLES OF COLLAGEN FIBRES
3. CHONDROCYTES IN LACUNAE AND IN GROUPS	3. SINGLE CHONDROCYTES IN LACUNA	FEW CHONDROCYTES SEEN

Compact Bone

Structure –

- Bone is highly vascular
- **Haversian canals** contain an artery vein and nerve
- **Osteocytes** reside in lacunae within the matrix
- Consists of a hard calcified matrix
- **Canaliculi** branch away from the haversian canal to take nutrients to the osteocytes



Compact Bone

Location –

- in compact bone
- The Haversian system is only found in compact bone
- Spongy bone has osteoblasts and osteocytes but no Haversian systems

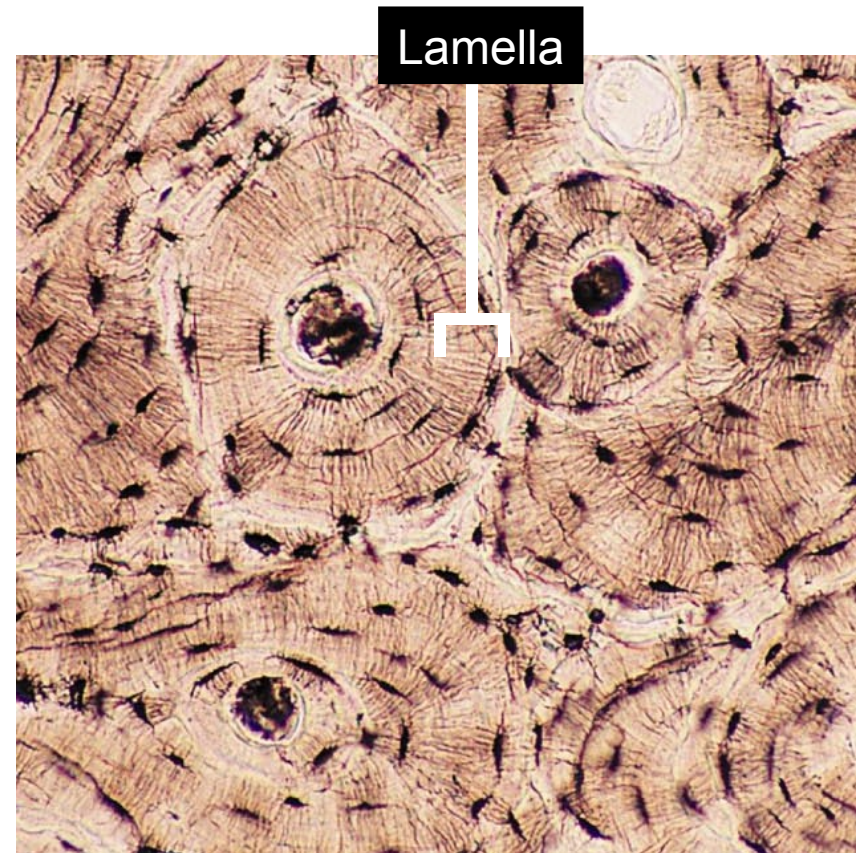


Compact Bone (100x)

Compact Bone

Function –

- Provides stability to the body and allows for movement with attachment of muscles.



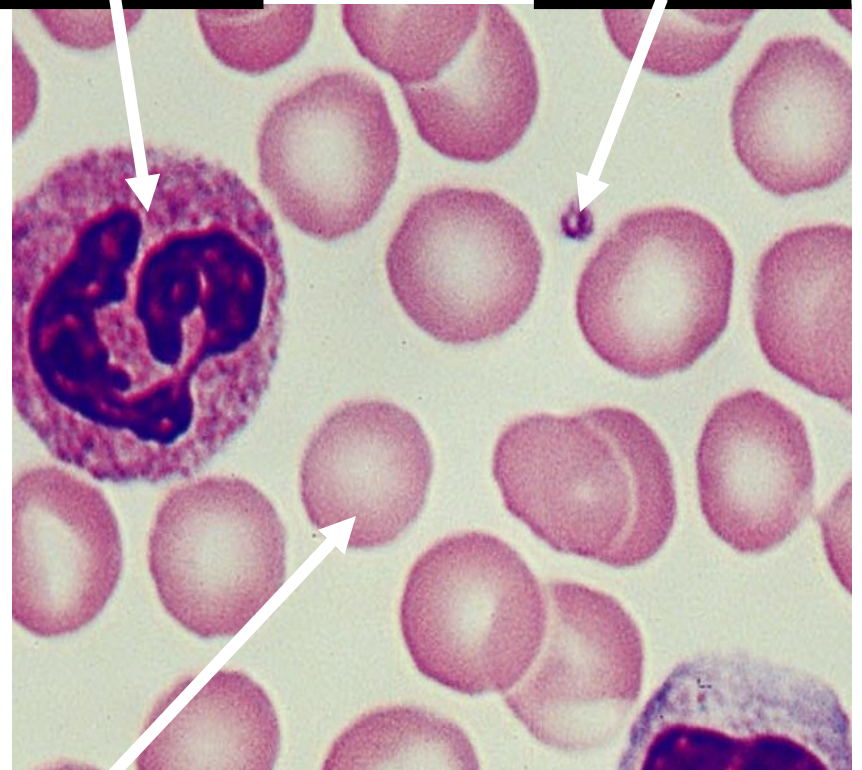
Blood

Structure –

- Red (Erythrocytes) and White (Leukocytes) blood cells.
- There are also platelets (Thrombocytes)
- Cells are immersed in a fluid matrix (plasma)

Leukocyte (Neutrophil)

Thrombocyte

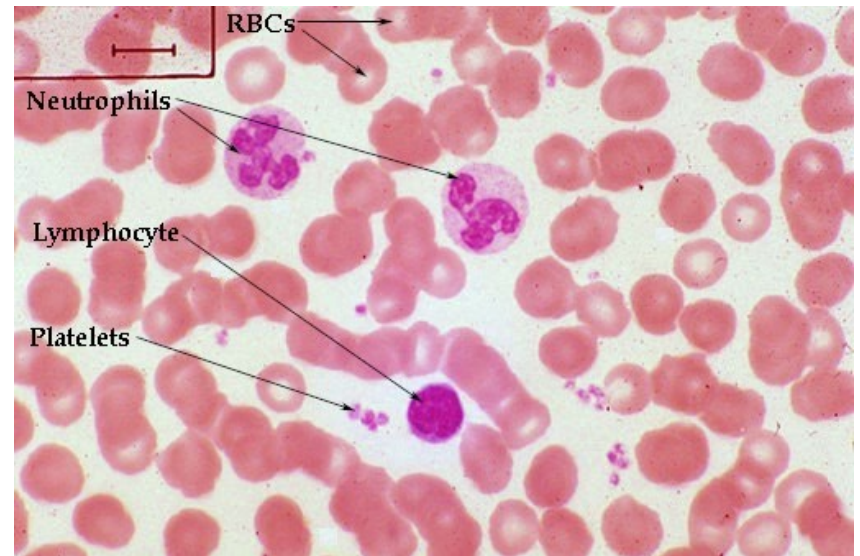


Erythrocyte

Blood

Location –

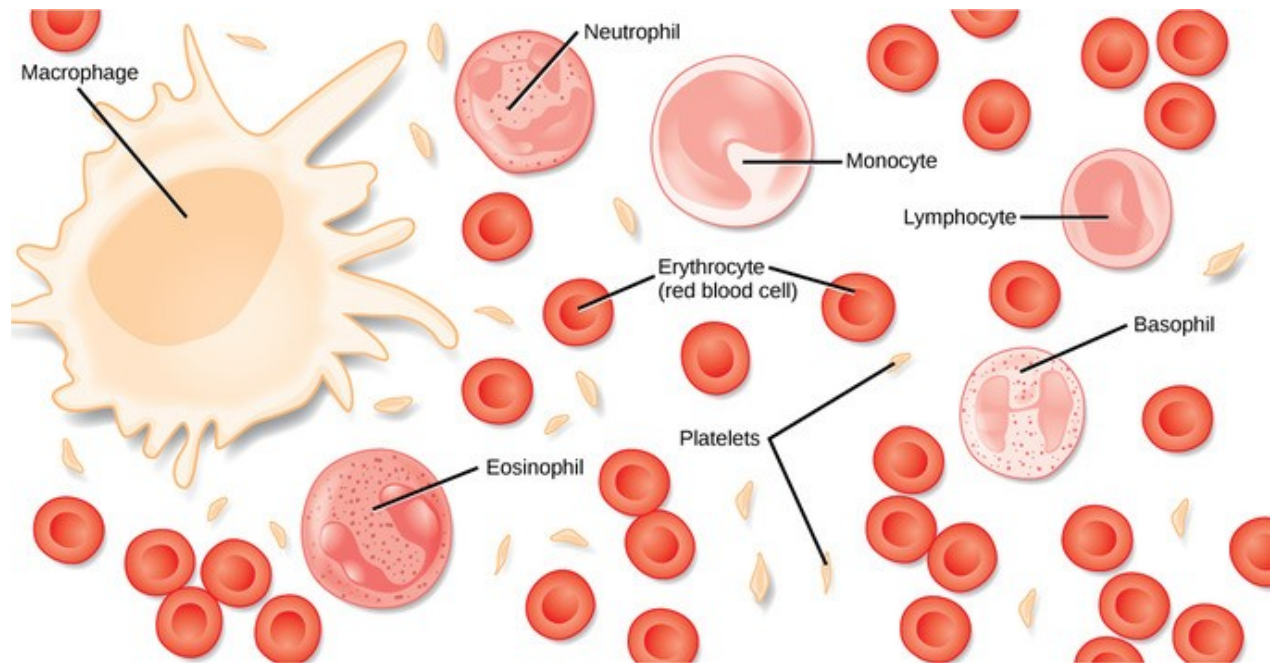
- Contained within blood vessels and heart.



Blood

Function –

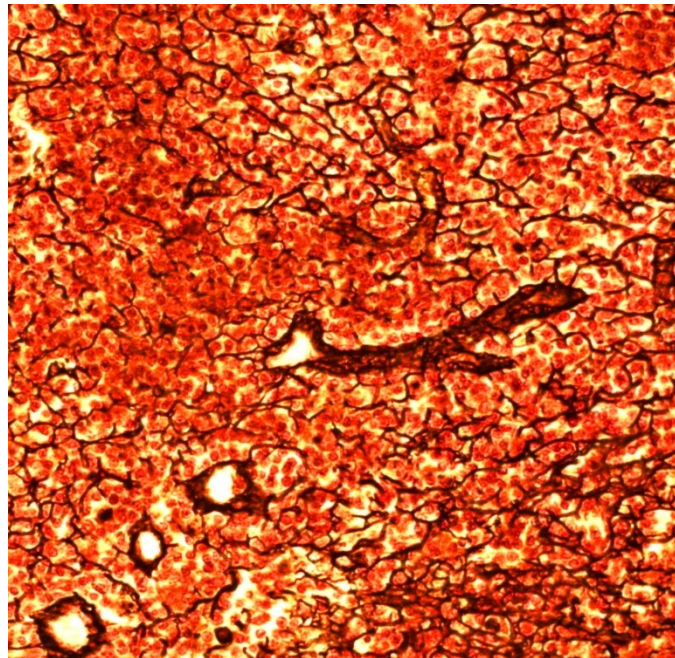
- Transport of gases
- Transport of nutrients
- Transport of waste



Practice Quiz

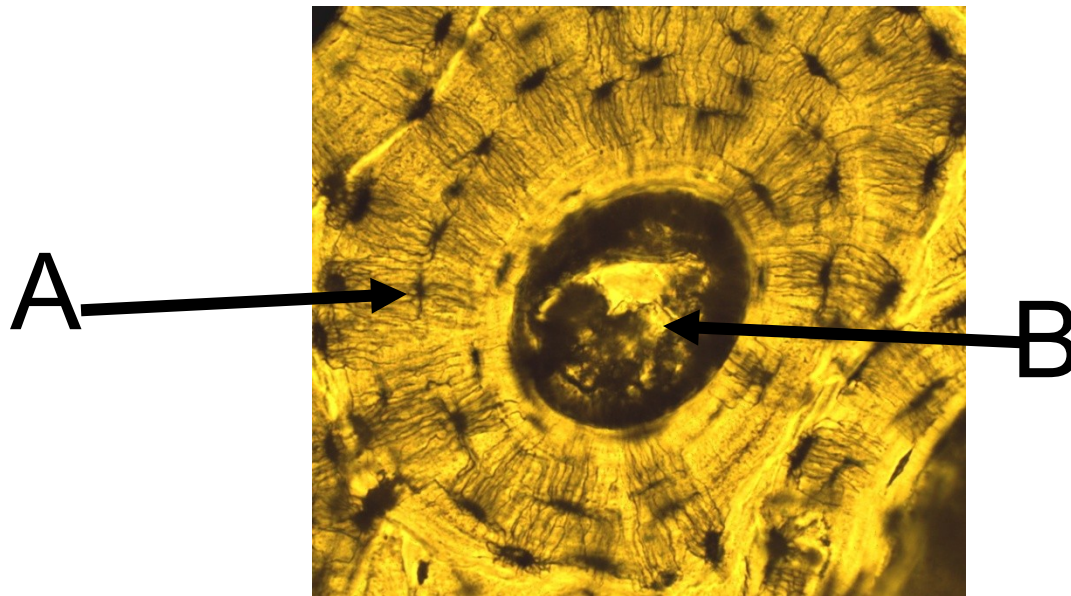
Practice Quiz

- 1.) Name this type of Connective Tissue.



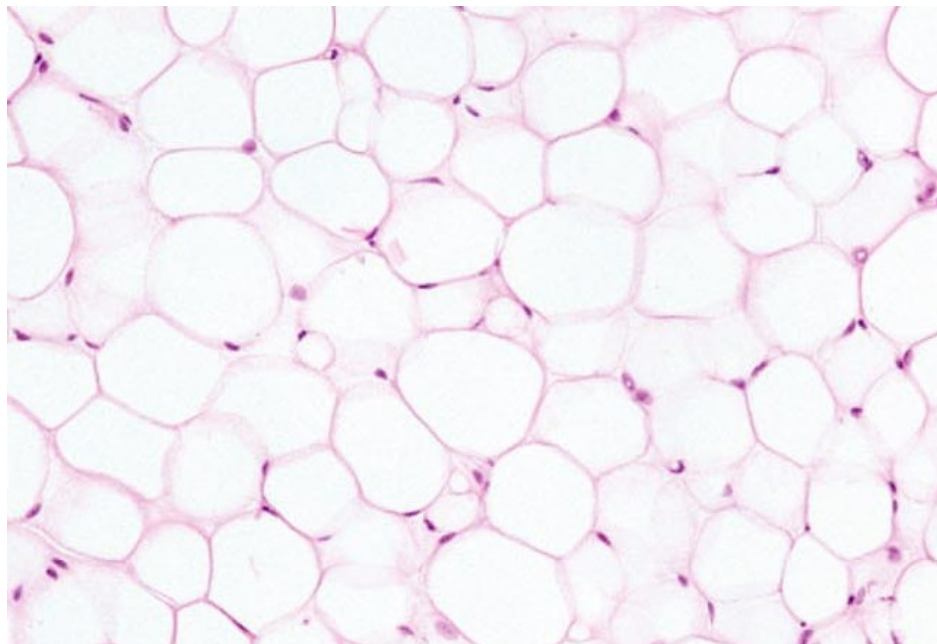
Practice Quiz

- 2.) a.) Name the structure labeled A.
b.) Name the structure labeled B.



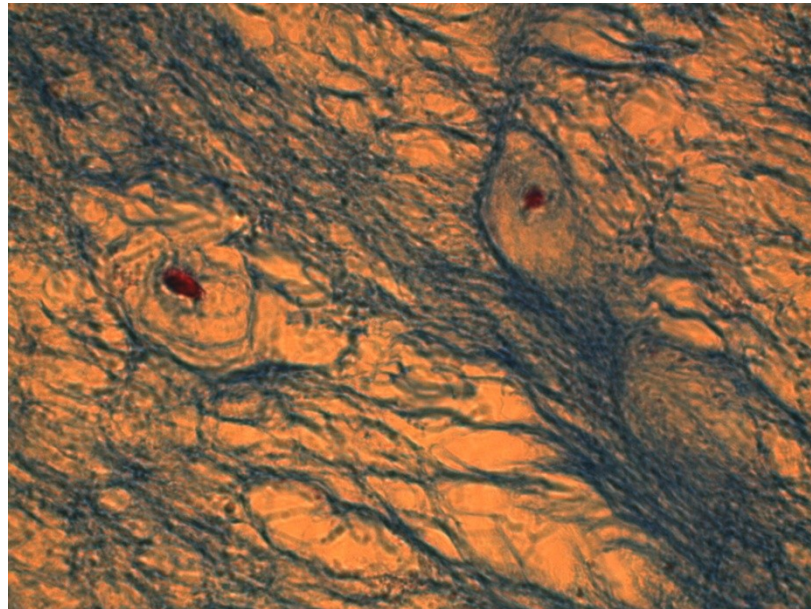
Practice Quiz

3.) Name one function of this tissue?



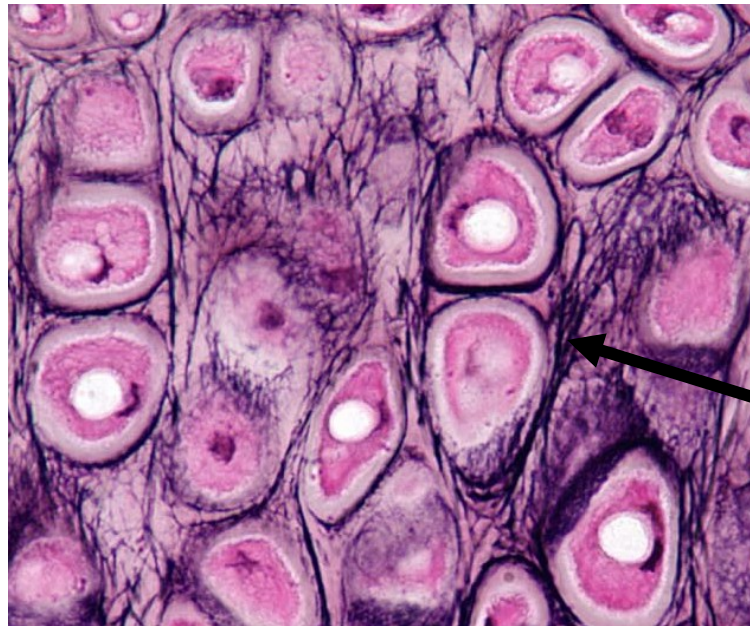
Practice Quiz

4.) Where in the body would you find this tissue?



Practice Quiz

5.) Name the fiber type labeled A.



A

Fill in the blanks. (10 mins)

- Connective tissue is made up of 1 and 2 . There are 2 types of (1) namely 3 and 4 while (2) has 2 components called 5 , and 6 . Classification of the CT is based on the presence and abundance of the 3 types of (6) which may be 7 , 8 and 9 . All of (7, 8 and 9) is synthesized by 10 .

Answers

- 1.) Reticular Tissue
- 2.) a.) osteocyte b.) Haversian Canal
- 3.) Shock absorption, Insulation,
Protection, Energy Storage
- 4.) Intervertebral Discs, Pubic
symphysis, menisci of the knee
- 5.) Elastic Fiber