

Essentials of Zoology

(Cytology and Histology)

1st year General Biology/Ecology students

2019-2020

Lec. 7

Intended learning outcomes (ILO's):

By the end of this lecture, students should be able to:

- 1- State the general functions of connective tissues.
- 2- List the types of CT.
- 3- Differentiate between the different types of CT.
- 4- Relate the structure to the function of the different types of CT.
- 5- Recognize the inter-relatedness of all CT cells.

Connective tissues (CT)

- CT are widely distributed all over the body.
- Every organ is composed of or enclosed by some CT.
- CT consists of cells and extracellular matrix that includes fibers and specialized types of proteins forming the ground substances*.
- All CT contain isolated cells surrounded by extracellular matrix.
- CT cells create their own matrix that hold organs together.

Functions of CT

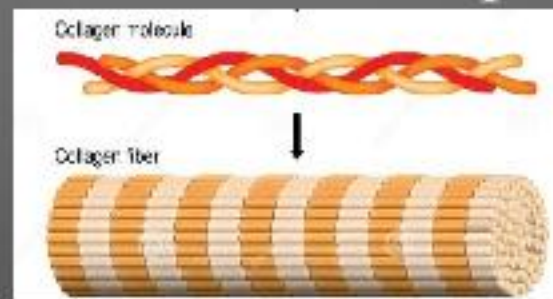
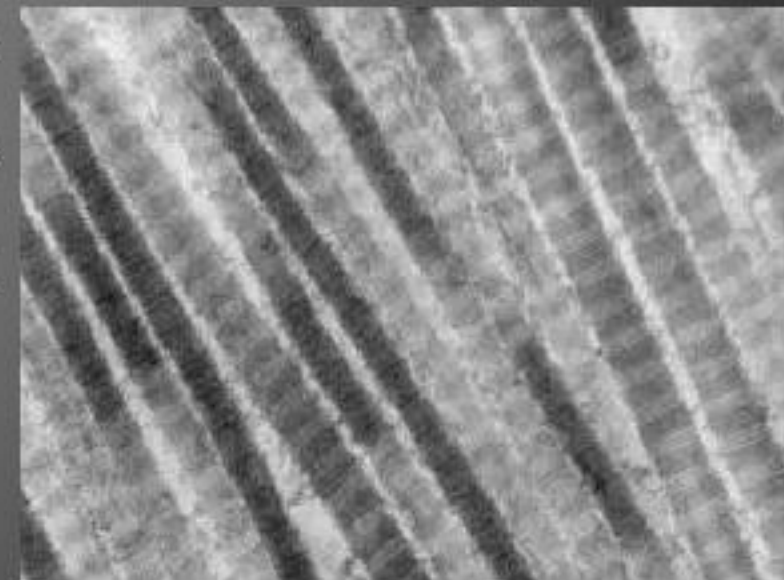
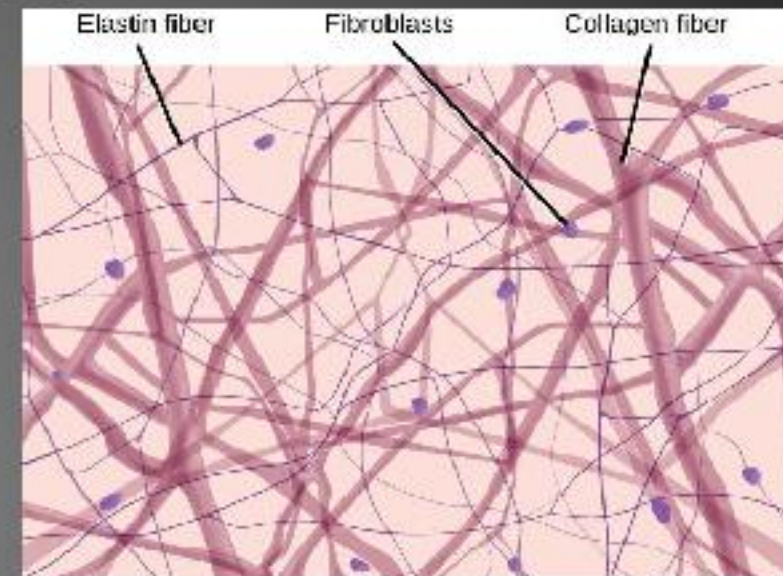
- Main function is to connect organs together.
- Functions of the various types of CT are generally depending on the types of cells, fibers, and the characters of the ground substances in the matrix.

1- CT Fibers

- Fibers are produced by fibroblasts and smooth muscle cells*.

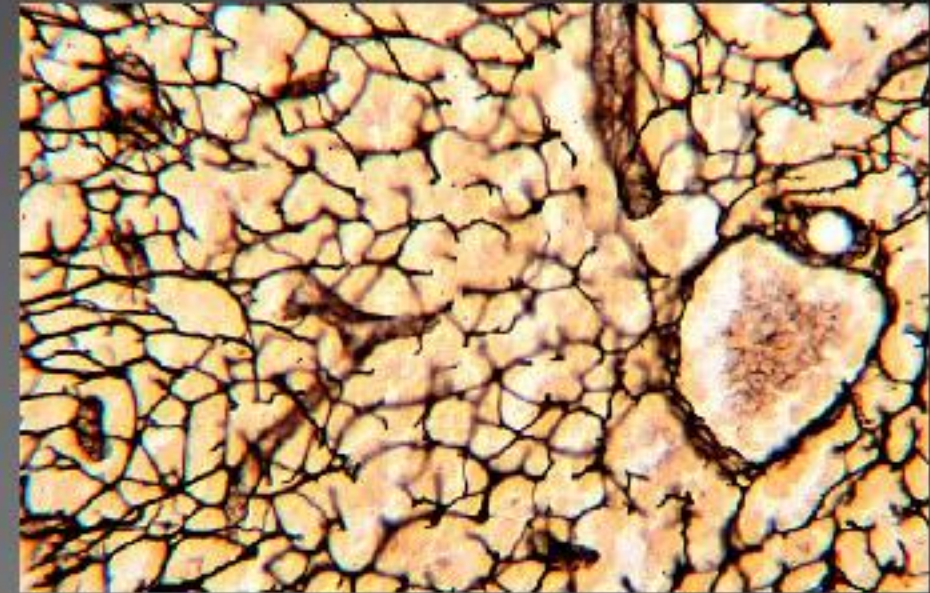
1- Collagen Fibers

- Most abundant structural components of the CT.
- Flexible and have high tensile strength.
- With light microscope, the fibers are wavy with variable width and length.
- With electron microscope, appears as bundles of fine fibrils, uniform in diameter, the surface show transverse bands at equal distances.



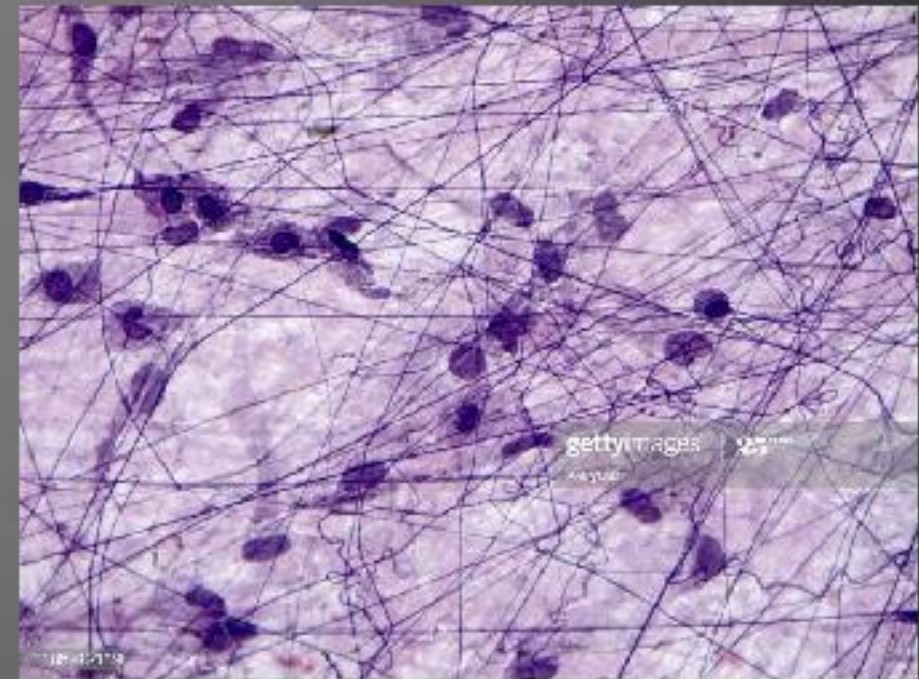
2- Reticular Fibers

- Composed also of collagen.
- Fibrils are branched, with a narrow diameter, and do not bundle to form thick fibers.
- Provide a supporting framework for cellular constituents of various organs.



3- Elastic Fibers

- Thin and branched fibers.
- Allow tissue to respond to stretch and distension.
- Interwoven with collagen fibers to limit the distensibility of tissue and prevent excessive stretching.
- Composed of a central elastin core and a surrounding network of fibrillin.



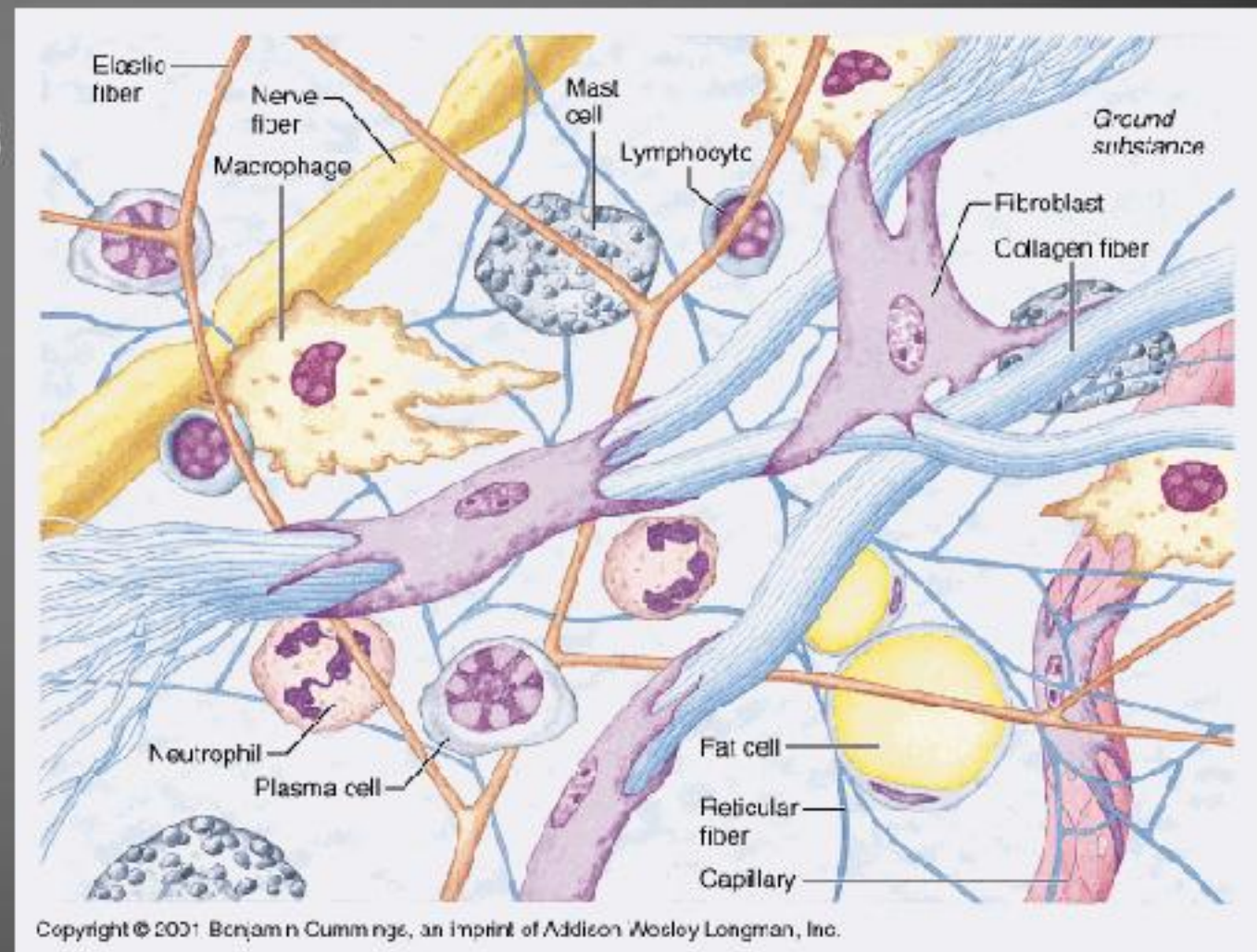
2- CT Cells

A- Resident Cells

- Fibroblasts
- Myofibroblasts
- Macrophage
- Mast cells
- Pericytes
- Mesenchymal stem cells
- Adipose cells

B- Transient (Migrating) Cells

- Lymphocytes
- Monocytes
- Plasma cells
- Neutrophils
- Eosinophils
- Basophils



Classification of CT

1- Embryonic CT

A- Mucous CT: Umbilical cord

B- Mesenchyme (Embryonic loose CT)

2- CT proper

A- Loose CT (Areolar, Adipose, Reticular)

B- Dense CT (Dense regular & irregular)

3- Specialized types of C.T.

A- Blood

B- Lymphatic tissue

C- Hemopoietic tissue (Bone Marrow)

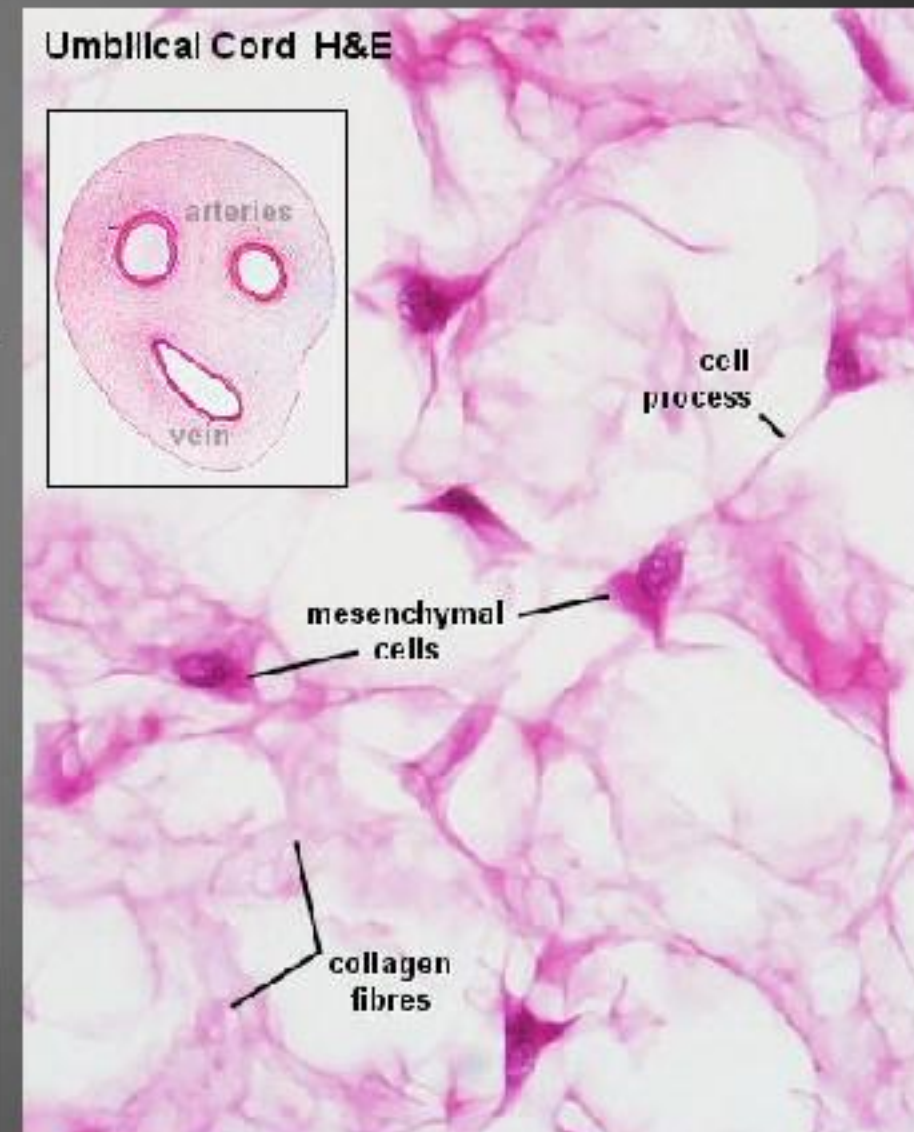
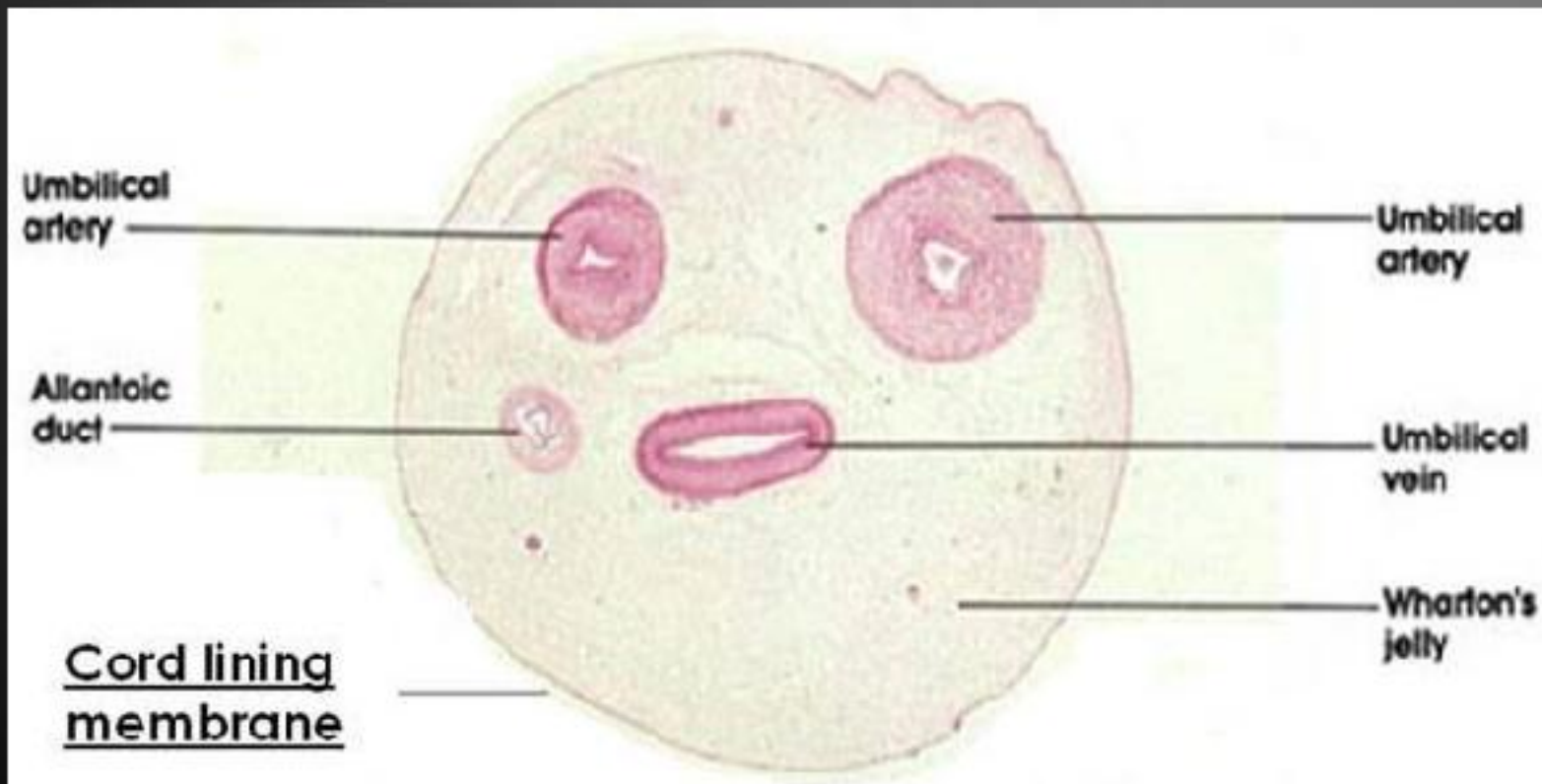
D- Cartilage

E- Bone

1- Embryonic C.T

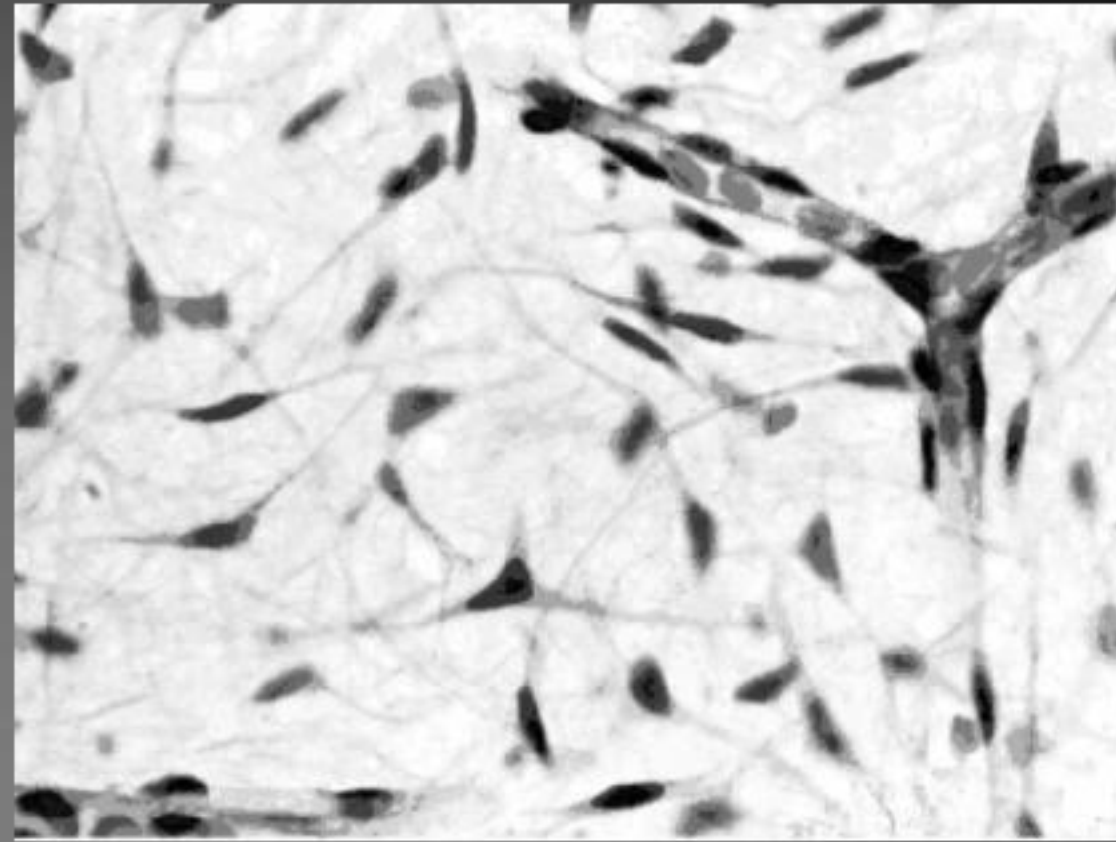
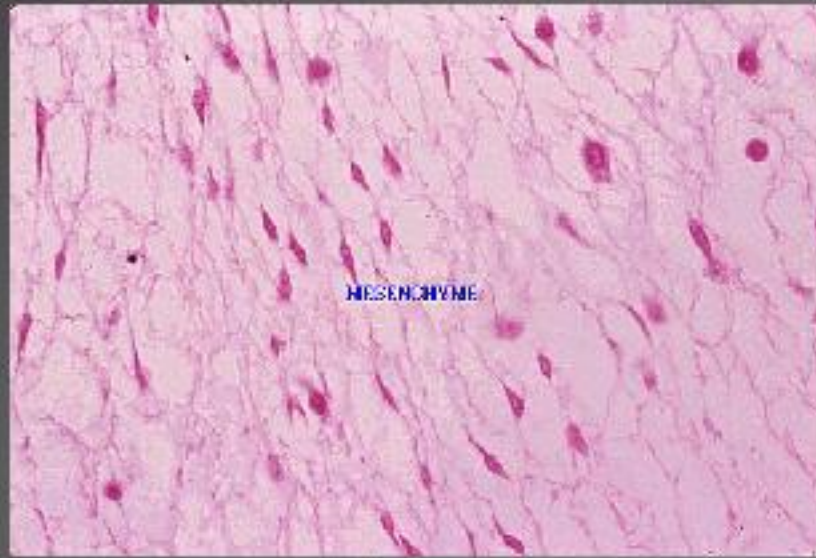
A- Mucous CT: (Wharton's jelly of umbilical cord).

With mucous matrix and clear fibres



B- Mesenchyme (embryonic loose CT)

- Cells are irregular, stellate (star) or spindle shaped.
- Ground substance lacks fibers.



2- CT proper

- CT proper are classified according to:

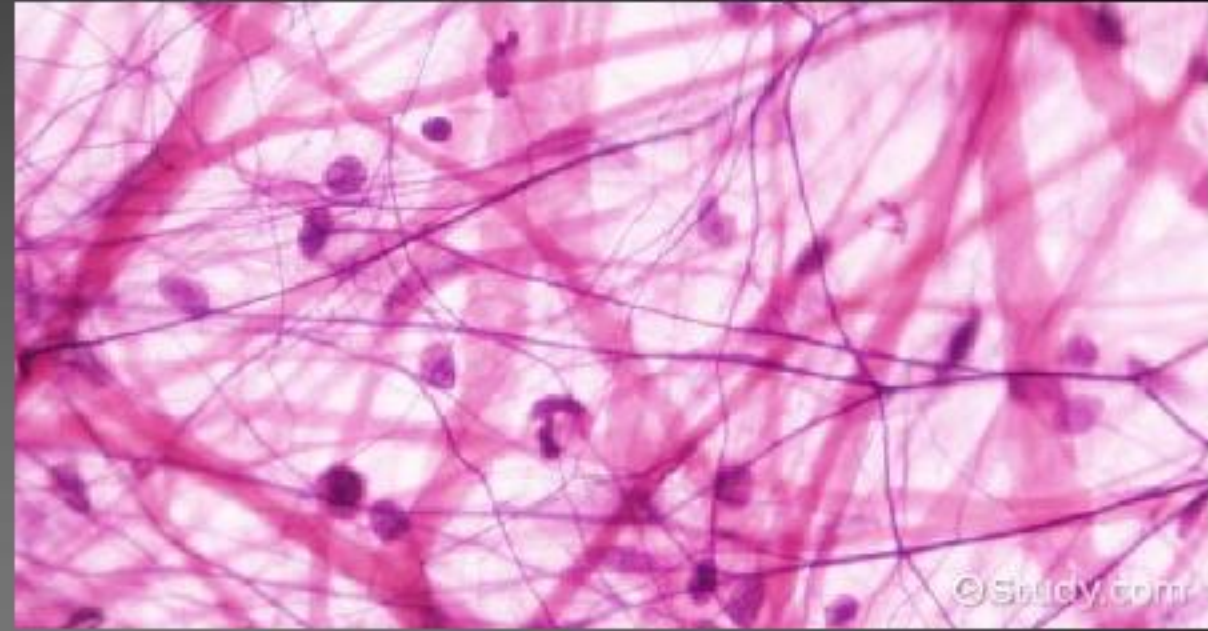
1- Proportion of fibers: (low — Loose; high — Dense).

2- Arrangement of fibers: (Regular (in parallel bundles) or Irregular (in a coarse feltwork شعر خشن)).

A- Loose CT

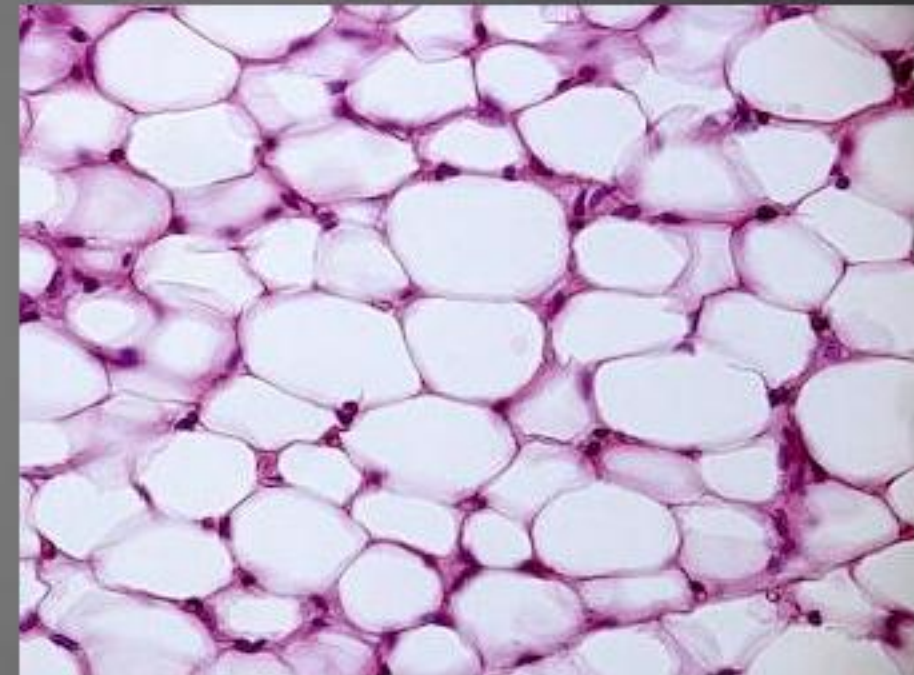
1- Areolar CT:

- It occurs as packing يحزم and support of most structures.
- Has all types of fibers with collagen the most conspicuous.
- Well-supplied with nerves and blood vessels.



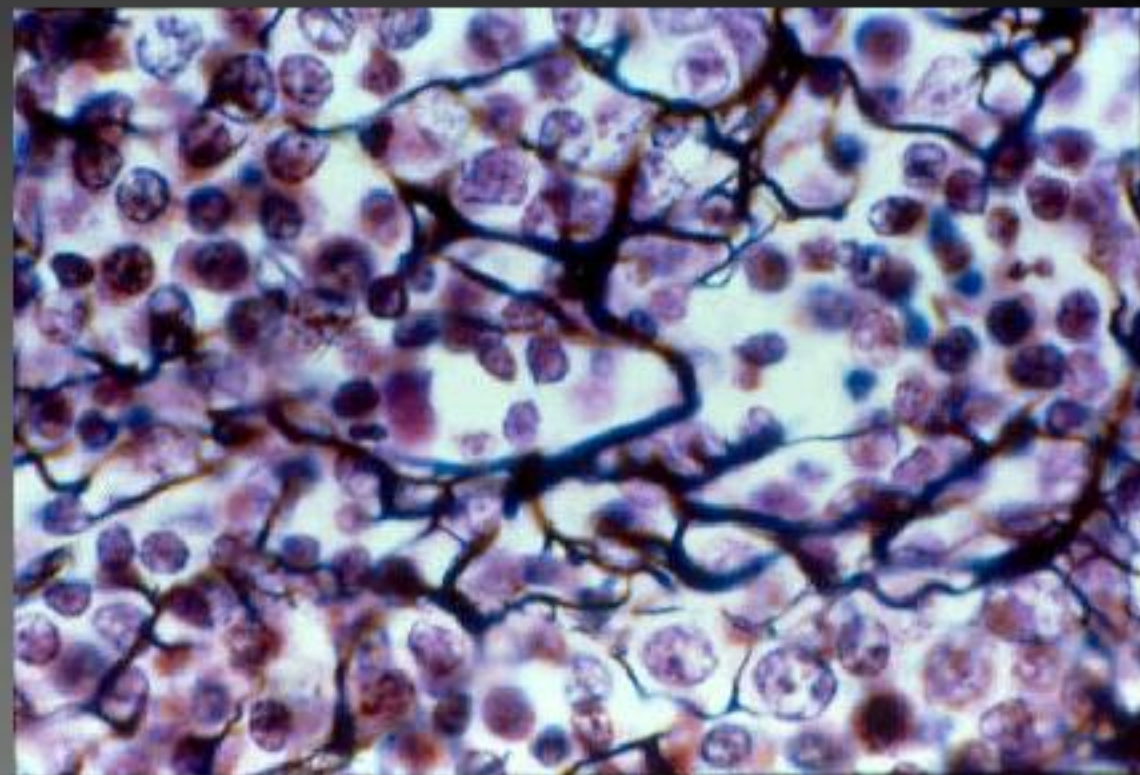
2- Adipose Tissue:

- Fat cells are the main cell type
- Surrounded by reticular fibres.
- Highly vascular reflecting the dynamic state of rapid metabolism and turnover of lipid.
- Brown Adipose Tissue (BAT) has many small lipid droplets, in contrast to the single droplet in White Adipose Tissue.



3- Reticular tissue:

- Composed of probably pluripotent cells and reticular fibres.
- Found in lymphoid tissues.

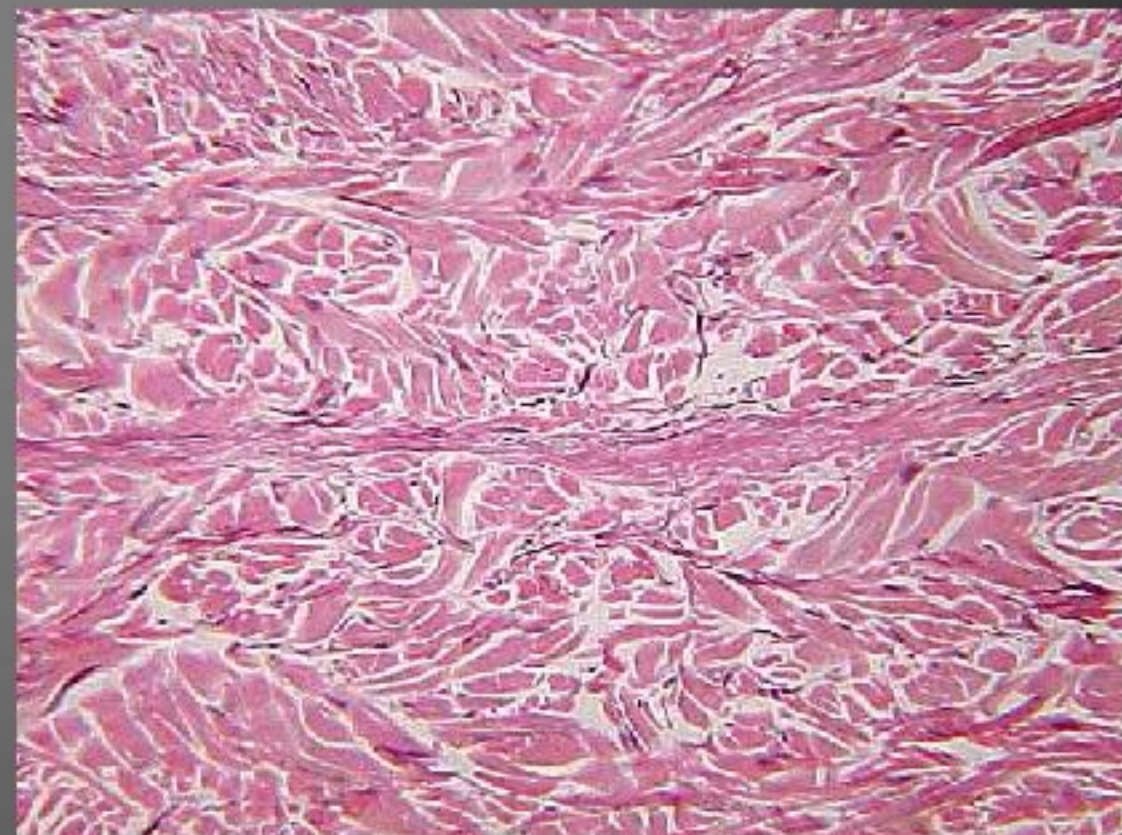


B - Dense CT

- Characterised by having a relatively high proportion of fibers.

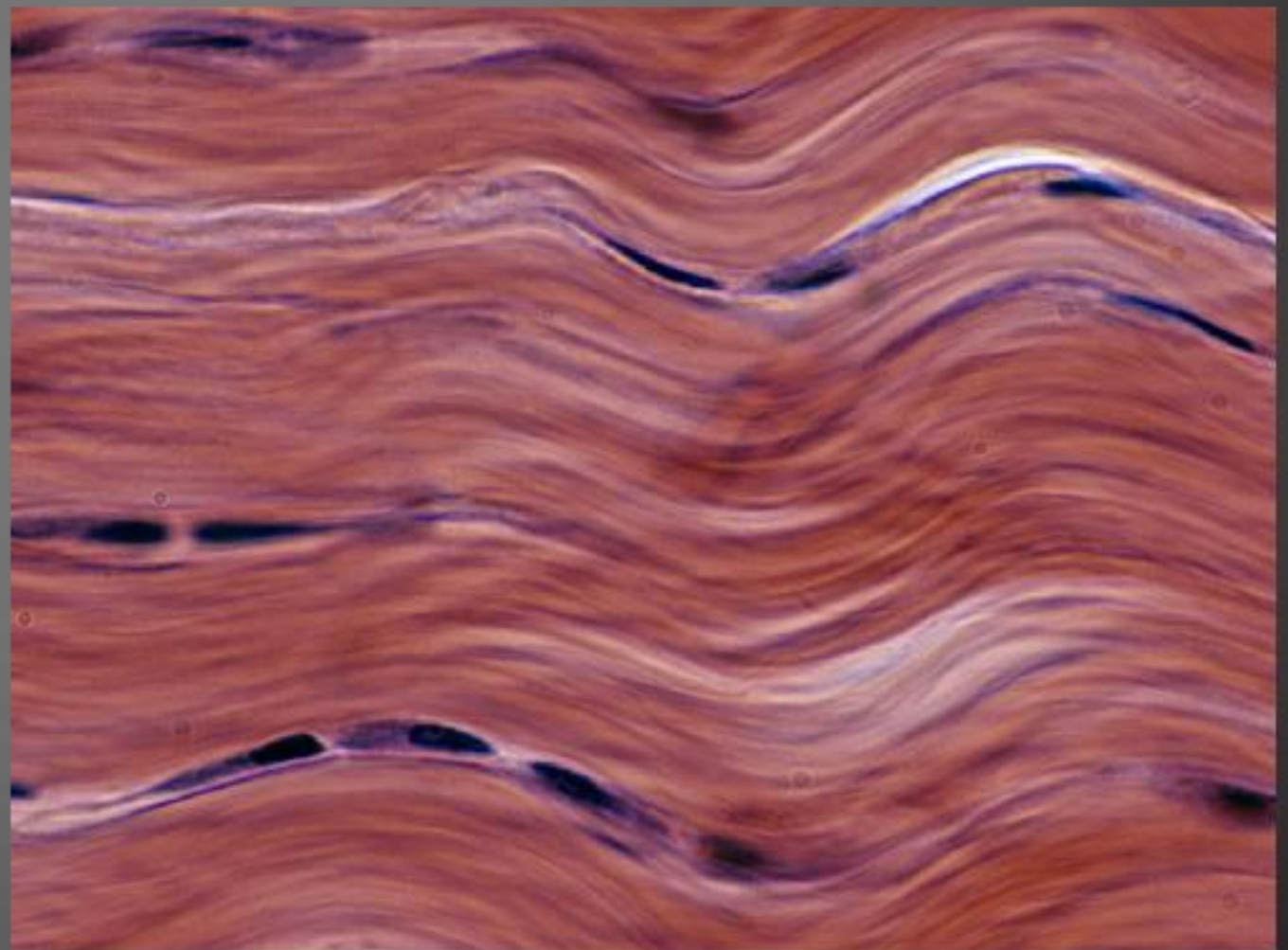
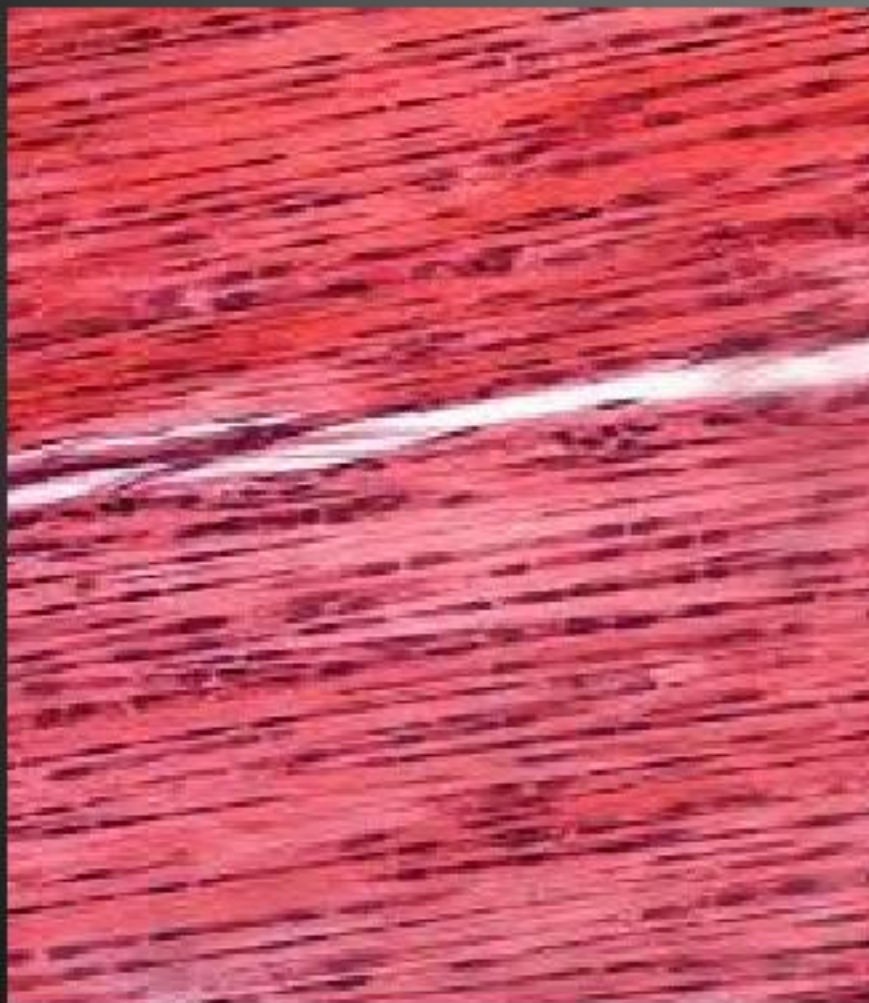
1- Dense Irregular CT:

- A coarse feltwork of mainly collagenous fibres forming sheets.
- Designed to withstand multidirectional stress.



2- Dense Regular CT:

- Parallel fibers to withstand unidirectional stress.
- Fibroblasts are the main cell type.
- The main fiber type is collagen, except in special elastic ligaments. Examples. Tendons and ligaments, where the collagen fibres are arranged into bundles or fascicles.



3- Connective tissues of specialized functions

A- Blood

- Blood is a viscous fluid formed of cellular element suspended in plasma.
- A fluid CT of a low ratio of cells to liquid matrix (blood plasma). In human adults about 5 liters of blood contributes 7-8 % to the body weight.
- The cellular element is composed of erythrocytes (red blood corpuscles), leucocytes (white blood cells), and platelets.
- Plasma is a viscous, translucent, and yellowish fluid composed of water (90%), proteins (7%), salts (1%), and organic compound (2%) such as amino acids, lipids, and vitamins.
- The ratio of cellular to the total blood volume is about 43% and known as hematocrit value.
- Plasma proteins: Albumins, Globulins, Lipoproteins and coagulation proteins e.g. prothrombin and fibrinogen which gives rise to fibrin.

The cellular elements of blood

- Erythrocytes (RBCs)

- No nucleus in adult mammals (nucleated in embryonic and fetal mammals and in other vertebrates).

- With hemoglobin, which fills almost the entire cytoplasm.



- Typically biconcave disks, and do not contain organelles.

- Lifespan in the bloodstream is ~120 days.

- Function in the transport of O_2 and CO_2 .

- RBCs number is about 4.5 -5.5 million /mm³, the number is more in males than in females.



- Abnormalities of RBCs e.g. anemia mostly due to changes in shape, number, or hemoglobin content.

- White blood cells (WBC) or leucocytes

- Leukocytes can be subdivided into:

Granular leukocytes (neutrophils, basophils and eosinophils)

Non-granular leukocytes (monocytes and lymphocytes).

- In healthy individuals the total number of circulating leukocyte is about 4000-10000/mm³.

- The differential leukocyte count is the percentage of each type of WBCs in blood:

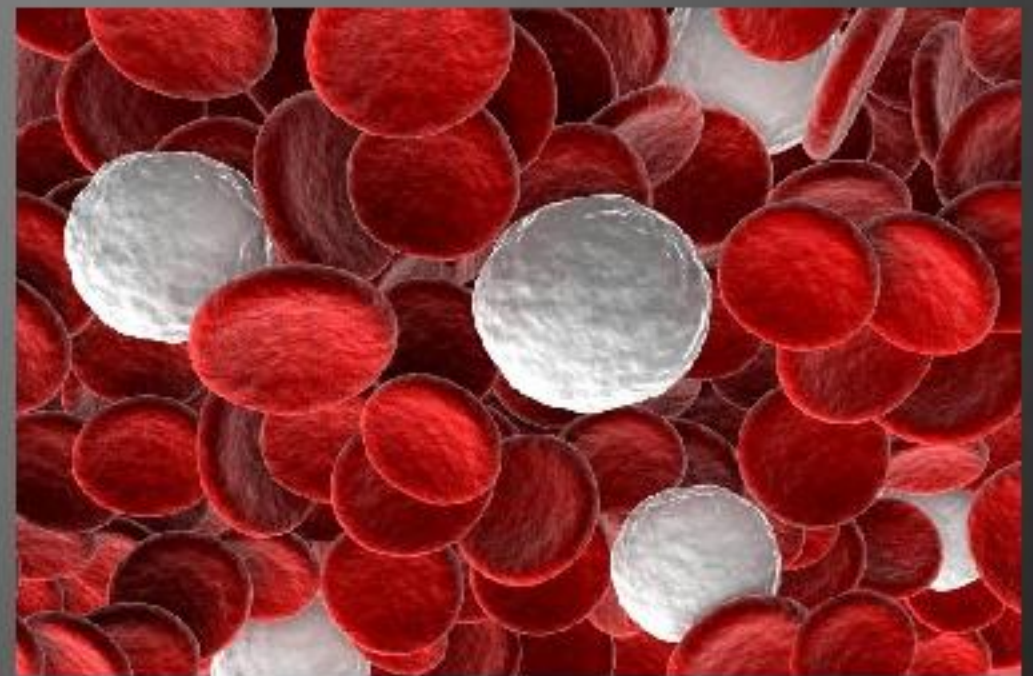
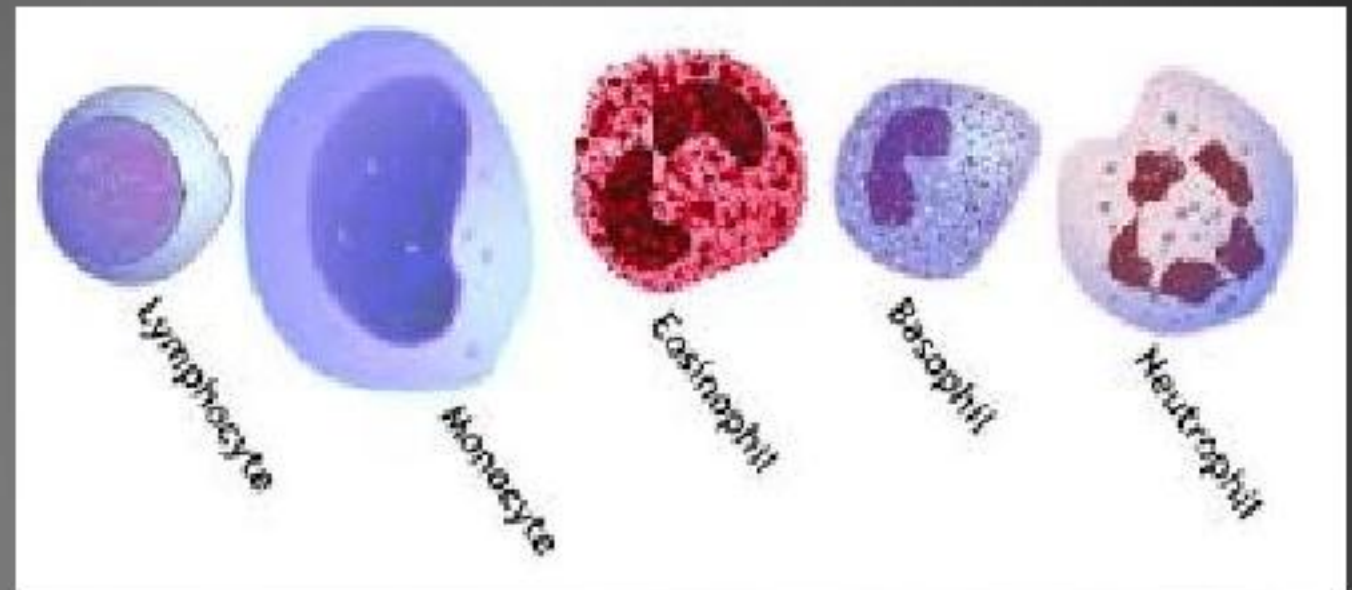
~ 60% neutrophils (50% - 70%)

~ 4% eosinophils (>0% - 5%)

~ 0.5-1% basophils (>0% - 2%)

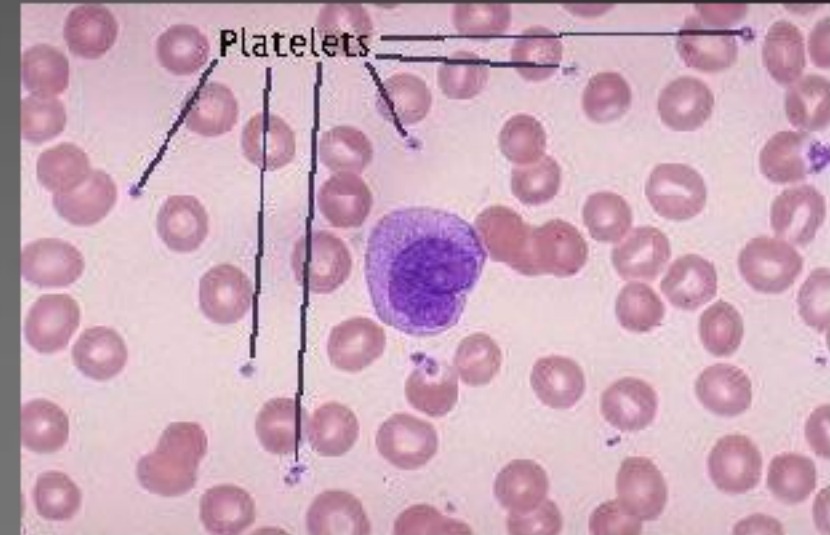
~ 5% monocytes (1% - 9%)

~ 30% lymphocytes (20% - 40%)



- Blood platelets (thrombocytes)

- Blood platelets do not contain nucleus, they are cytoplasmic fragments of very large thrombocytes that are found in the bone marrow.
- Their number is 150,000 - 400,000/mm³.
- Platelets assist in the arrest of bleeding.



B- Cartilage

- Cartilage is a special type of CT has a firm pliable صلبة و مرنة matrix that can:
 - resist mechanical stress,
 - act as a shock absorber.
- Cartilage together with long bone form the skeleton and support the body (main function); it forms the whole fetal skeleton.
- Cartilage is non-vascular structure and not supplied with nervous or lymphatic tissues.

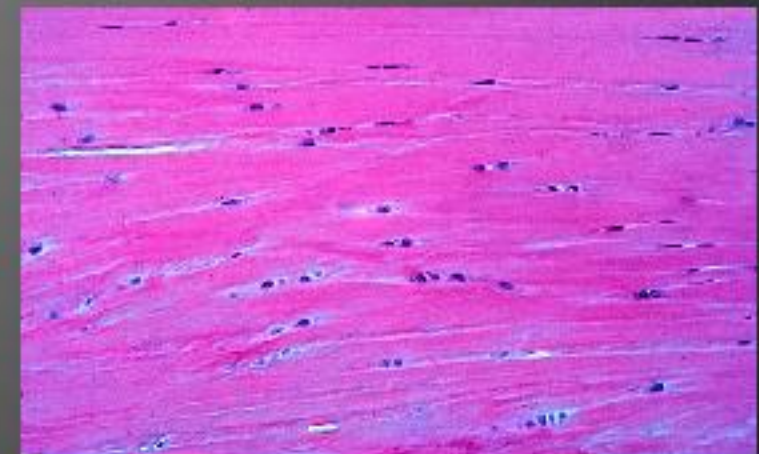
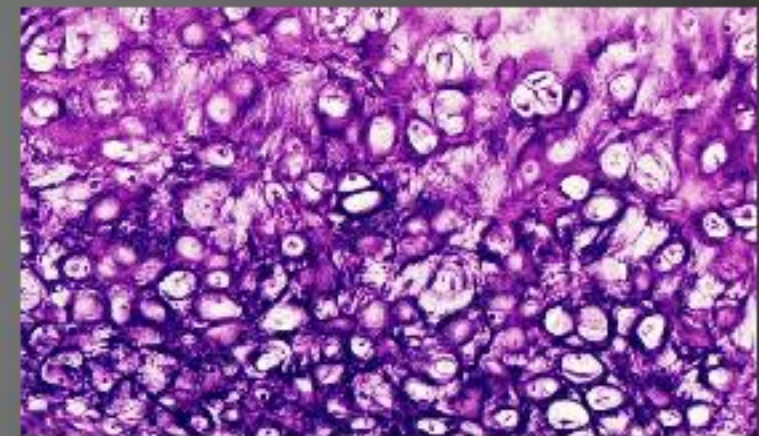
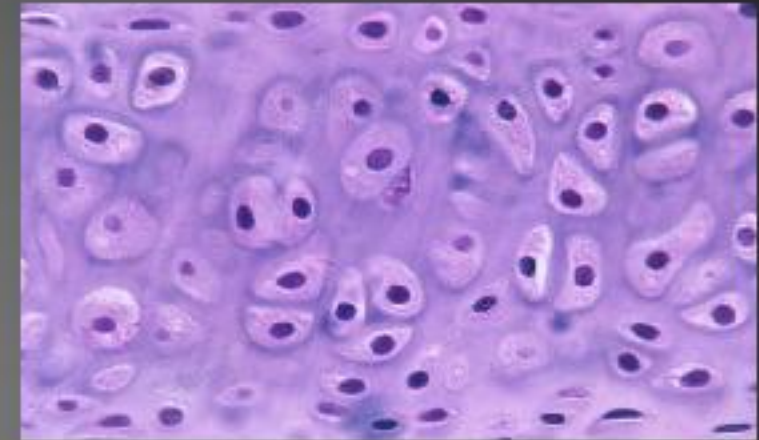
- Cartilage is formed of:
 - Cells: Chondroblasts, Chondrocytes
 - Fibers: Collagen fibers, Elastic fibers
 - Matrix: Proteoglycans, Glycosaminoglycans

- Types of Cartilage:

- Hyaline cartilage: With fine collagen fibers. Commonest type, present in the nose, larynx, trachea, bronchi, articulated surfaces of joints, on the ventral ends of ribs.

- Elastic cartilage: With fine collagen fibers and abundant elastic fibers. Located in the ear pinna, external and internal auditory tube.

- Fibrocartilage: With dense, coarse collagen fibers. Located in the inter-vertebral disks, tendons at insertion to bone.



C- Bone

- Structure of bone
- Like other CTs, bone is formed of:
 - Cells: Osteoblasts, Osteocytes. Osteocytes are the main type; are branched and lie in lacunae which interconnect via narrow tunnels (canaliculi).
 - Matrix: Organic and non-organic components. Matrix is largely composed of calcium salts (60% by weight).
 - Fibers: fine collagen fibers.
- Types of bone:
 - Compact bone (Dense bone).
 - Spongy bone.

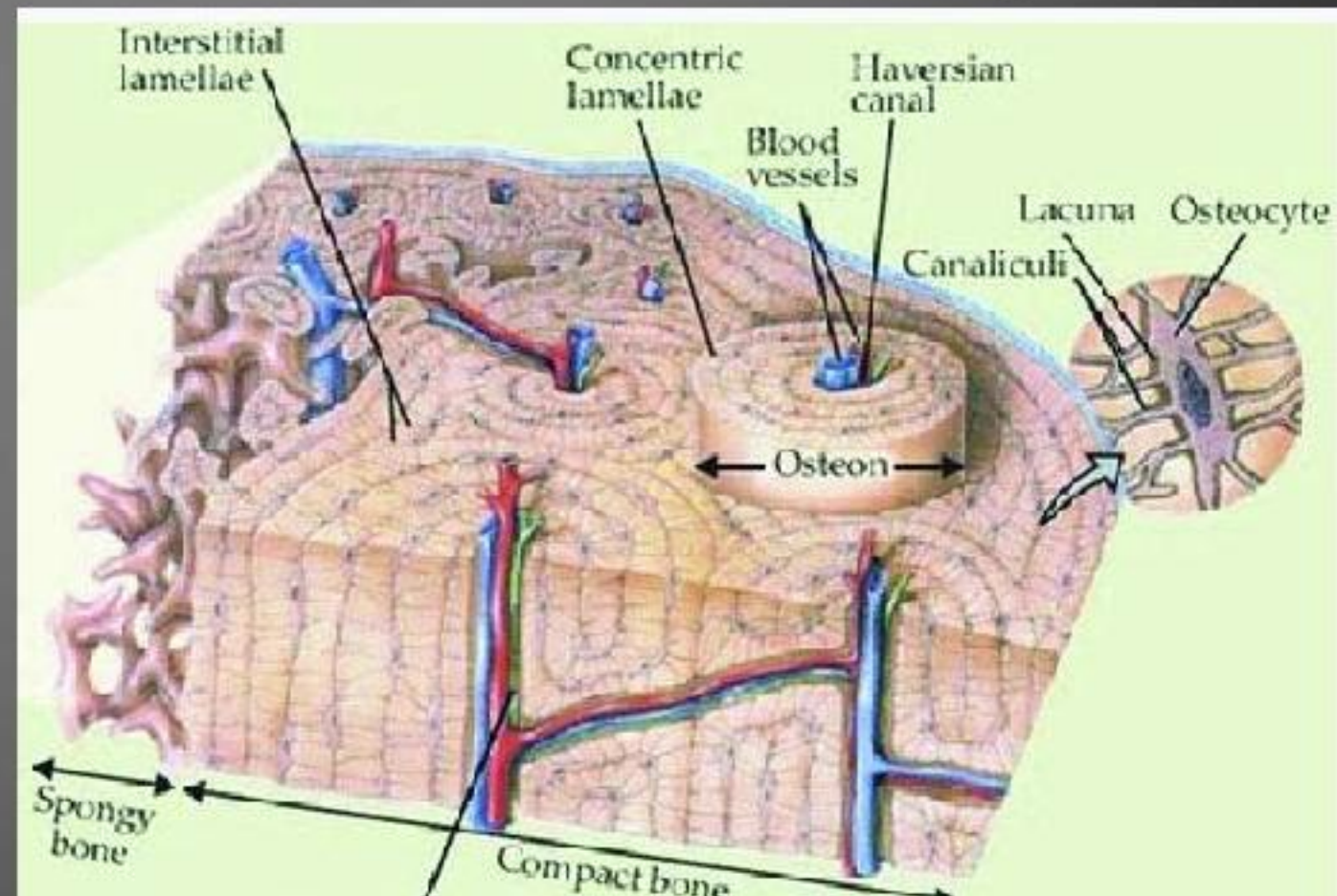
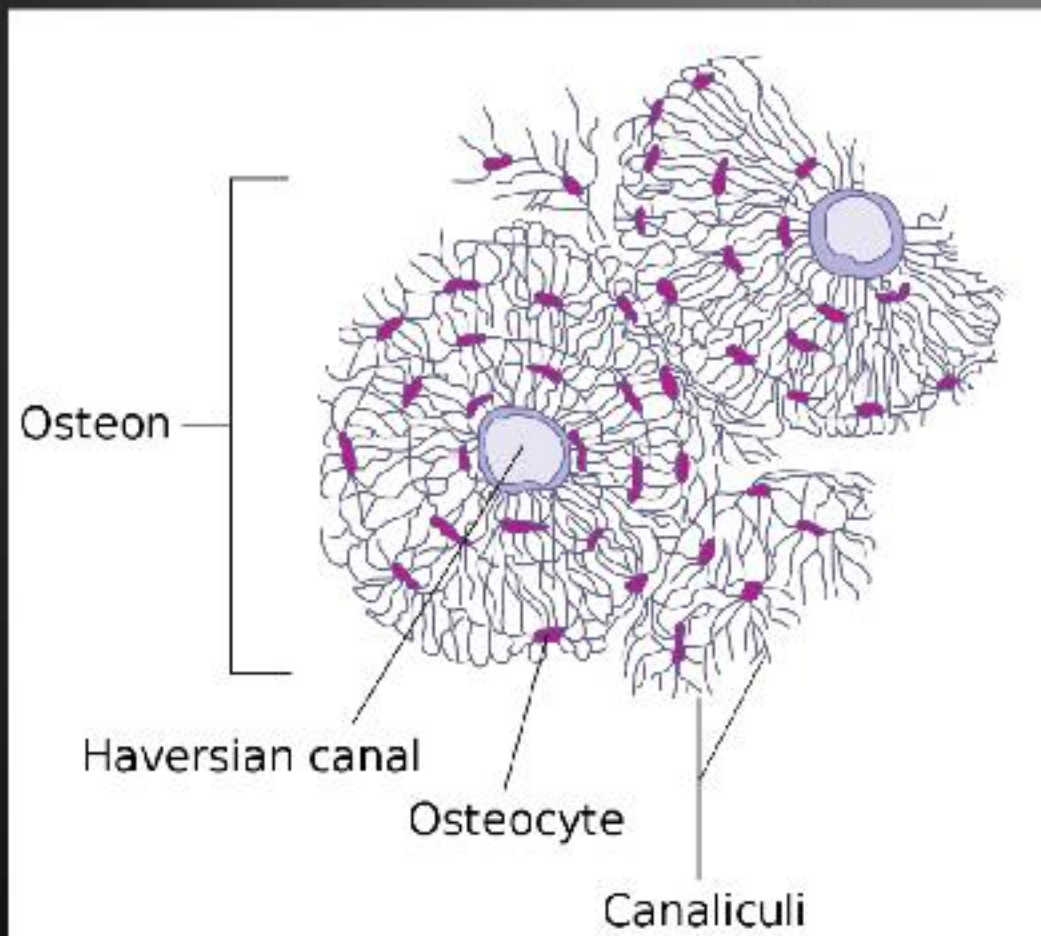
- Compact (Dense) bone

- Formed of Haversian and non-Haversian systems.

- Haversian system: Bone lamellae are arranged around the blood vessels (Haversian canals).

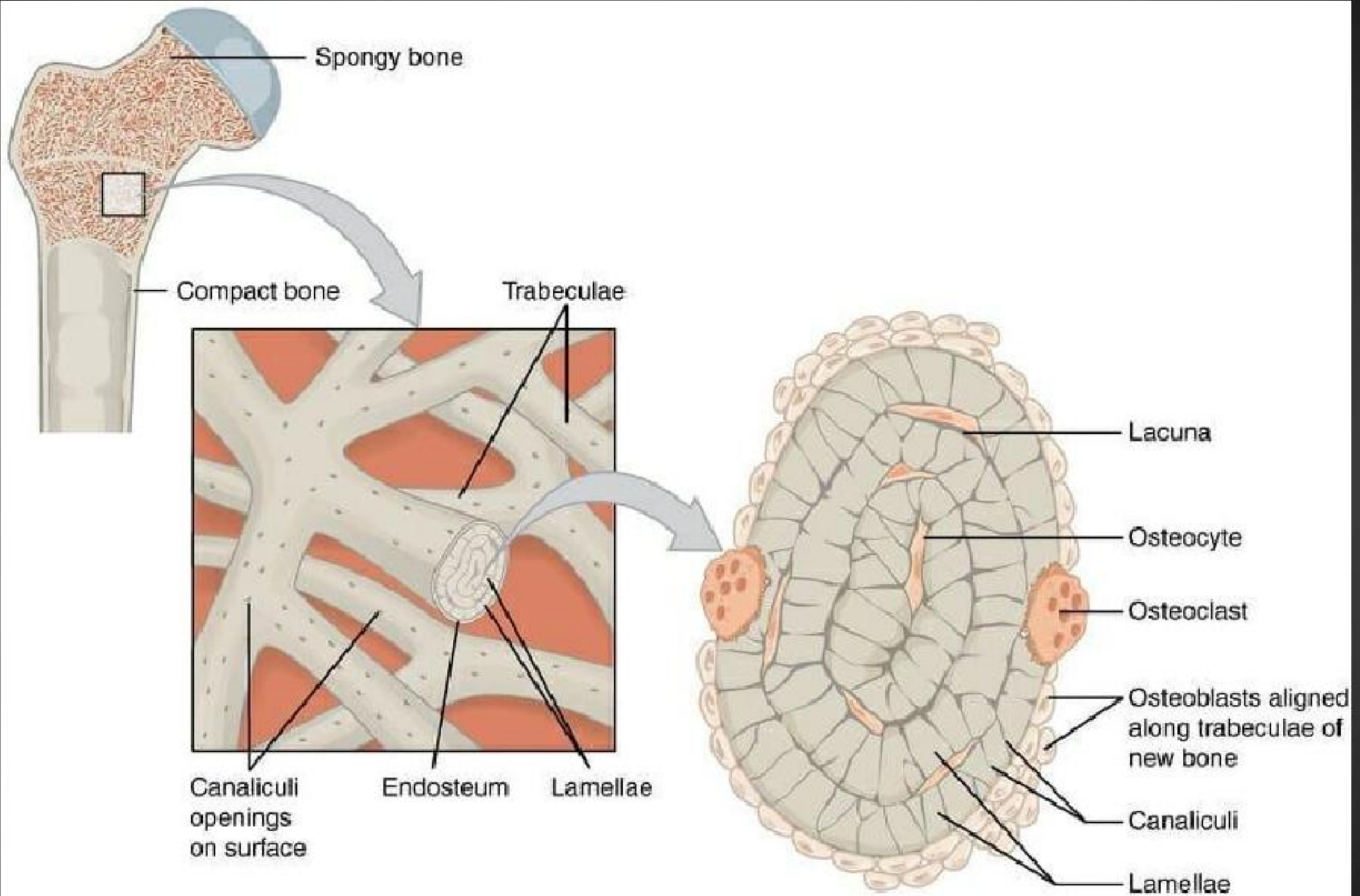
- The bone lamellae are formed of osteocytes inside lacunae and canaliculi embedded in calcified matrix.

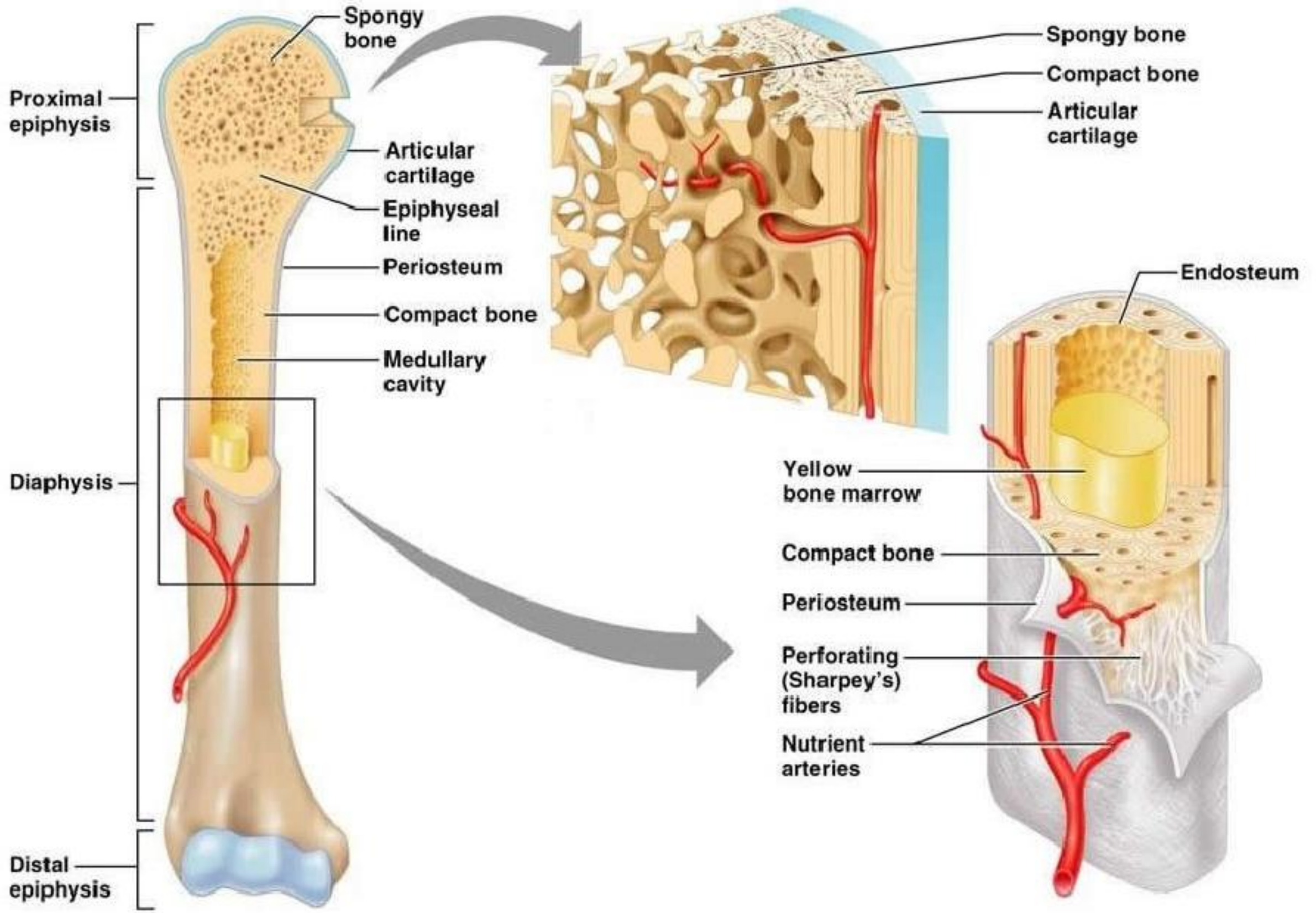
- Non-Haversian system: similar without the circular arrangement



- Spongy (Cancellous) bone

- Has cavities containing osteocytes inside the solid matrix.





Thank you

