ISHIK UNIVERSITY

FACULTY OF PHARMACY

Lecture series in Histology for undergraduate medical students

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Dear students it is absolutely necessary to read these notes and do what it says if you would like to be a successful one while you are a student or in your profession after graduation.

1- Students must arrive in the lecture hall before few minutes of start

2-Students must read the lecture before attending it .

3-Students must try to answer all the question marks inside the slides with other fellow students or alone.
4-Students must participate in the discussions during the lecture

Good Luck

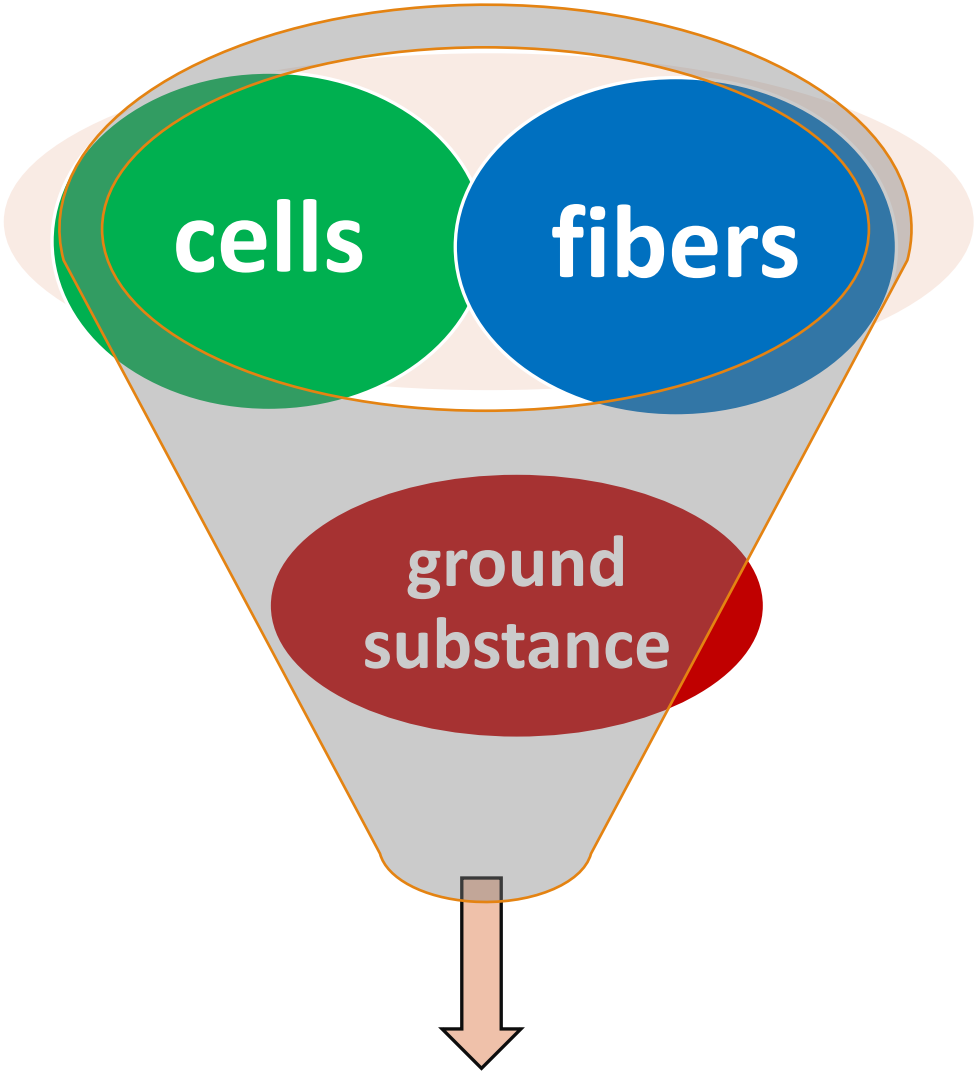
B- Connective Tissue (C.T)

INTRODUCTION

1-Connective tissue is a tissue which lie beneath the epithelial cells and protects ,connects, supports, binds, or separates other tissues and organs, typically having relatively **few cells embedded in an abundance of intercellular matrix ?.**

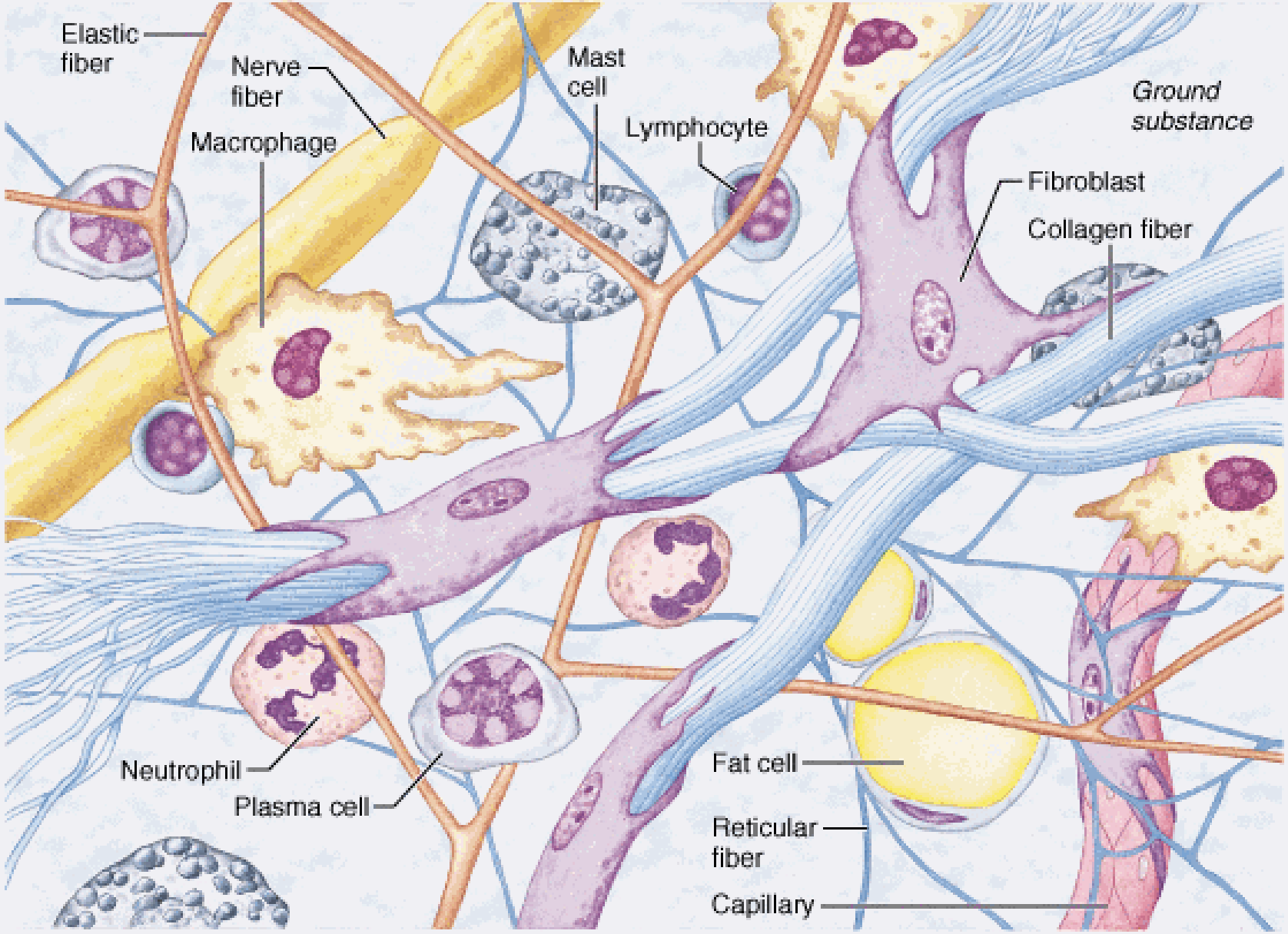
2- Connective tissue is the most **frequent and widely distributed** of the primary tissues, it also has the widest variety of functions.

3-Connective tissue has **three** main components: **cells, fibers** and **ground substance**.
Together the ground substance and fibers make up the extracellular matrix which varies according to the type of C.T and its classification is based on?.



Components of Connective Tissue

Schematic Drawing of Loose Connective Tissue



“Primary basic tissues of the body”

B: Connective Tissue (C . T)

Objectives:

1. List the structural features of connective tissue that distinguish it from other basic tissue
2. Describe the components of the extracellular matrix
3. Know the structure and function of the cell types found in different types of connective tissue
4. Compare connective tissue types in terms of types, amounts and arrangement of their components
5. Relate the composition of each type of connective tissue its specific functions
6. **Name the body sites where each connective tissue type occurs, and relate the location of each type to its function .**

Major functions of connective tissue include:

1) Supporting and moving ?
2) Protection against disease, ? how
3) Insulation, example such as ?
4) Storing reserve fuel, such as ?
5) Transporting substances within the body. Example ?
6) Filling spaces, body and organs ?
7) Giving shape and support to the body ,example?
8) Binding one tissue to another Like?
9) Help repair tissue damage. How? ?
10) Cushion and protect body.

Classification of Connective Tissue(C.T) :

1- Fibrous connective tissue (proper or soft c.t)are of two types:

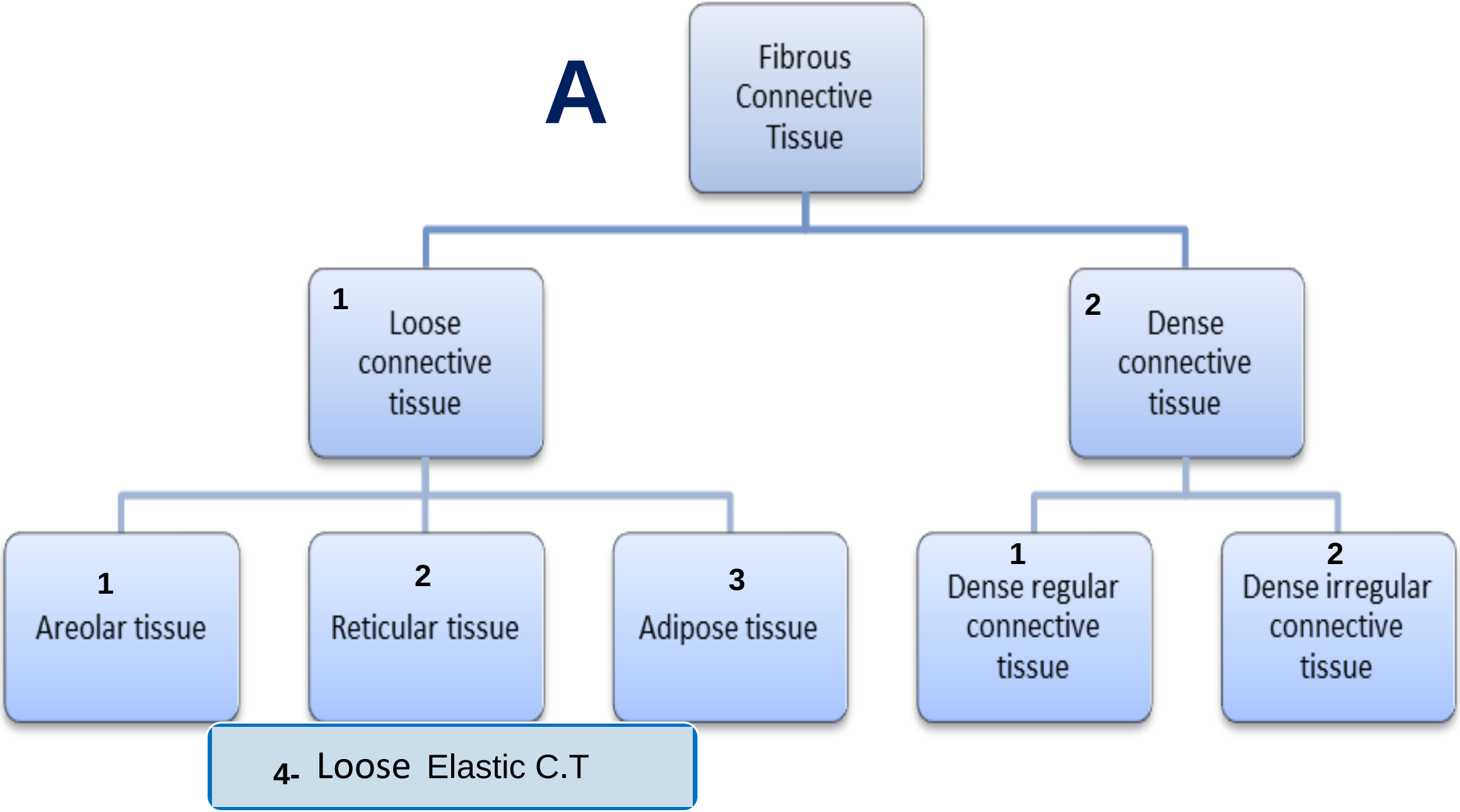
a- Loose connective tissue (areolar, reticular, elastic and adipose) .

b- Dens connective tissue of two types:

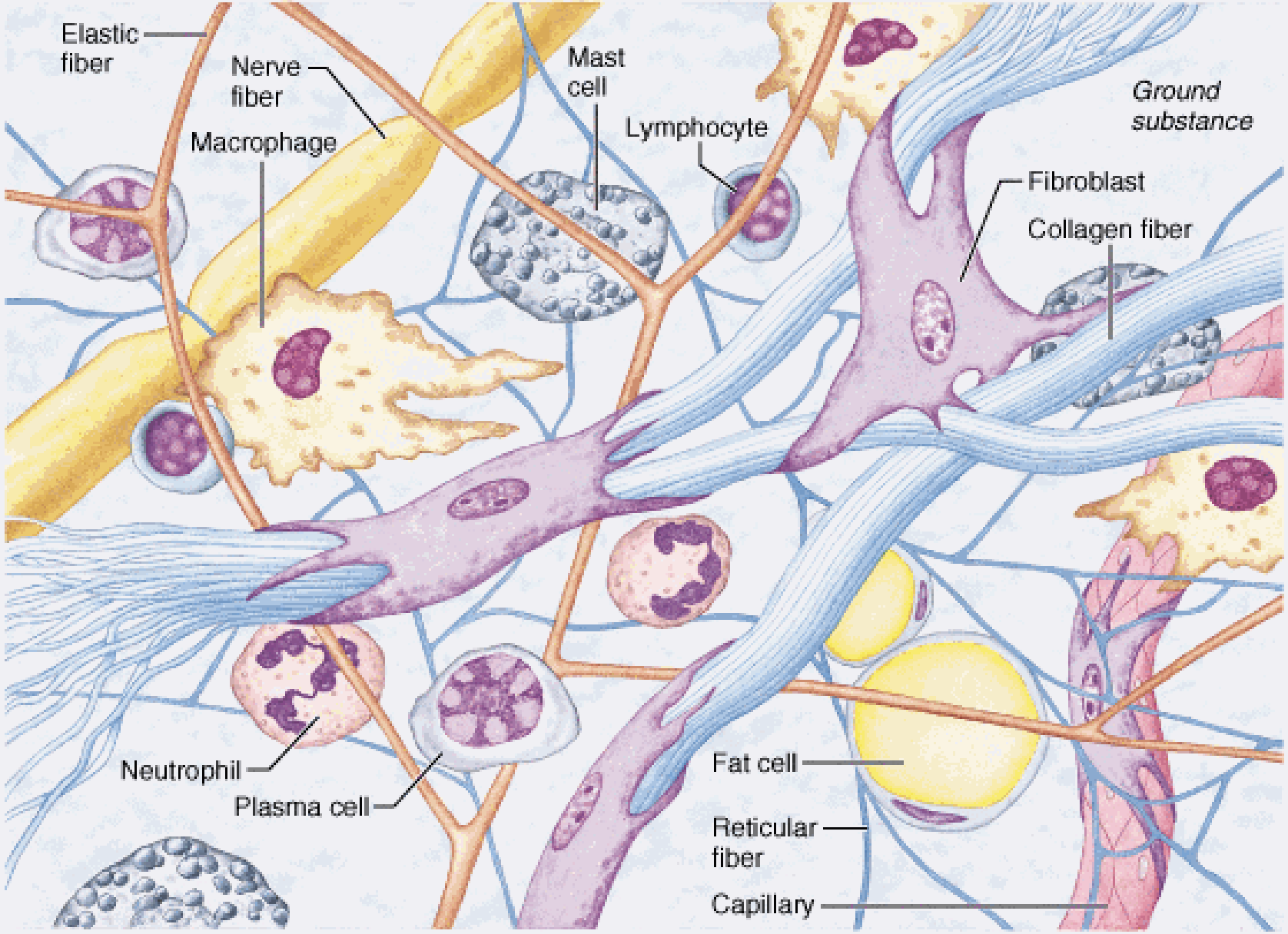
dens regular connective tissue and dens irregular connective tissue

2-supporting and specialized connective tissue(cartilage, bone , adipose c.t , blood and lymph) .

A



4- Loose Elastic C.T



Schematic Drawing of Loose Connective Tissue

General Structure of Connective Tissue

Connective tissue has three main components:

1-Cells, (mainly fibroblast + many other types).

2-Ground substance,

3-Fibers , (collagen, reticular and elastic).

The wide variety of c.t types is because of the variations in the composition and amount of these 3 components. This is the reason for the remarkable **structural& functional diversities** of connective tissue.

Ground substance and fibers make up **EXTRACELLULAR MATRIX .**

Explain?

1-connective tissue proper(soft);

a-Types of cells:

Cells of connective tissue are suspended in a non-cellular matrix that provides structural and biochemical support to the surrounding cells.**?**

1-Fibroblasts – large flat cells with tapering ends. Migrate throughout connective tissue secreting both fibers and ground substance

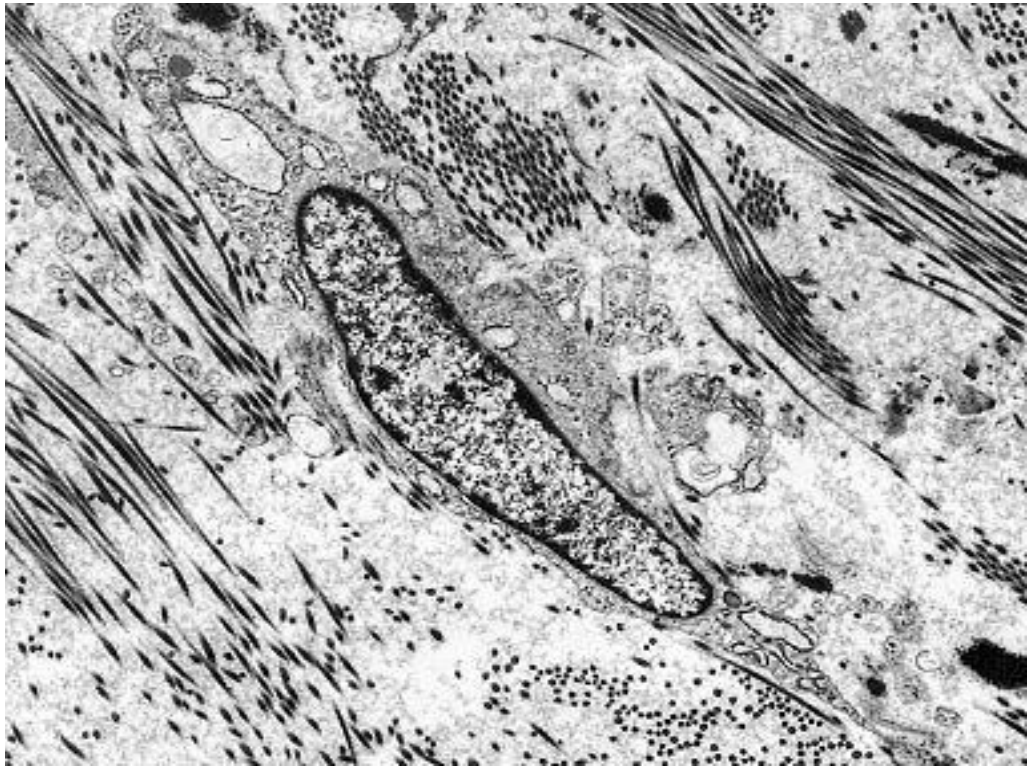
2-Macrophages–wandering phagocytic cells which arise from monocytes that destroy bacteria ,foreign particles and dead cells.

3-Plasma cells: synthesize antibodies(Immunity) **.**

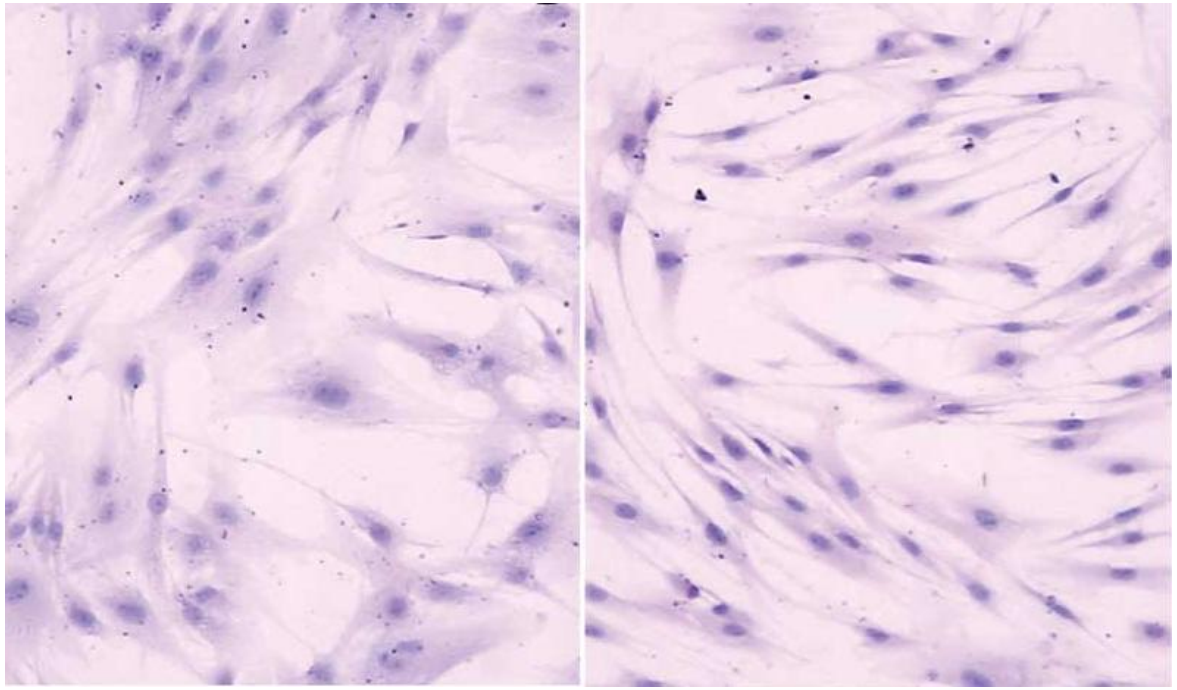
4-Mast Cells – alongside blood vessels that supply connective tissue. Produce histamine – a chemical that dilates blood vessels.**?**

5-Adipocytes – “fat cells” store triglycerides.

6-Extravssated? leukocytes :white blood cells…also seen.



Fibroblast with bundles of collagen fibers E M section.

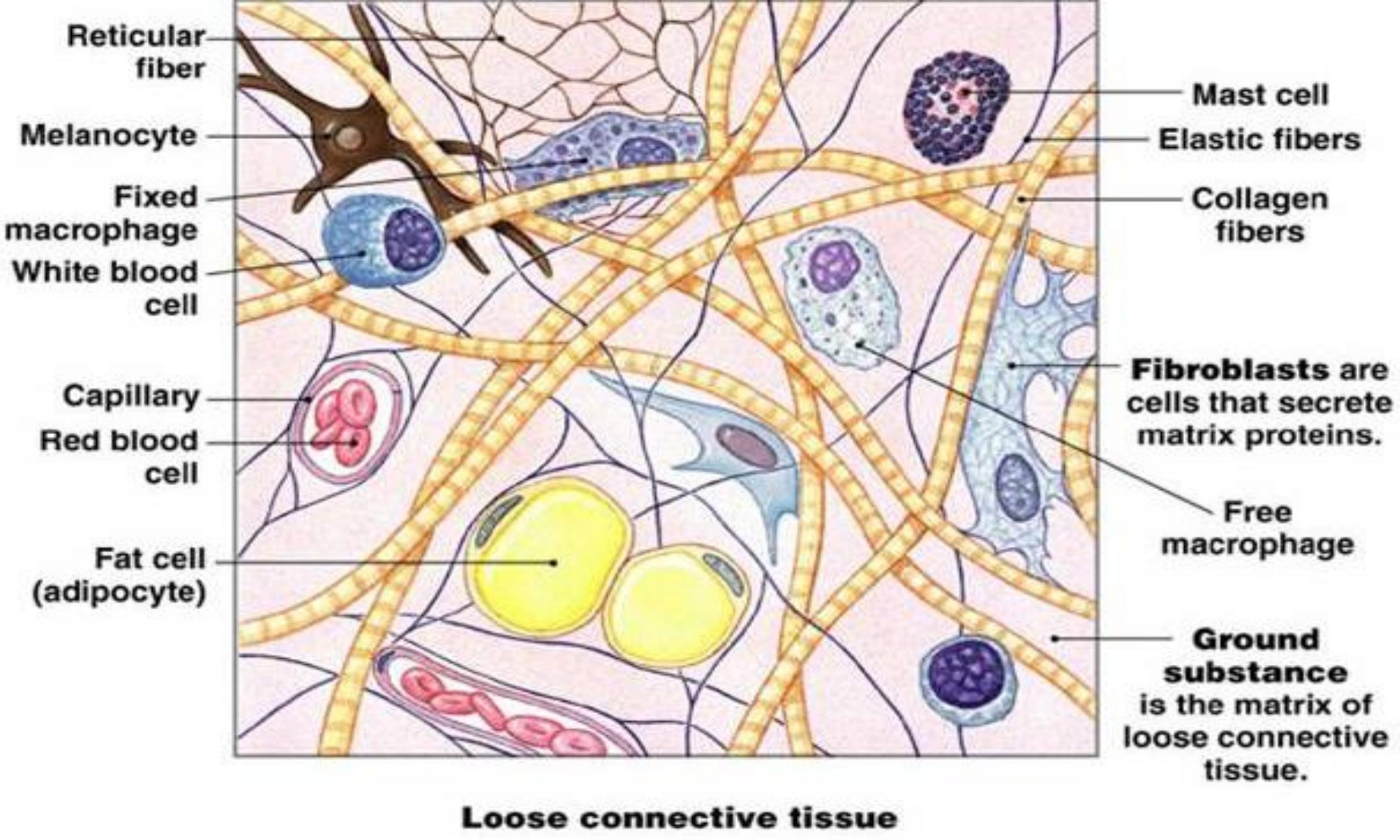


Fibroblasts-light microscope section

b- Ground Substance(C.T proper) – :

A component of connective tissue (secreted by fibroblasts) between the cells and fibers, supports cells, binds them together, and provides a medium through which **substances are exchanged.** **How?**

c-Fibers . Collagen and Elastic (which are produced by fibroblasts) and Reticular fibers (which are produced by reticular cells in the lymphoid tissues).



Loose connective tissue

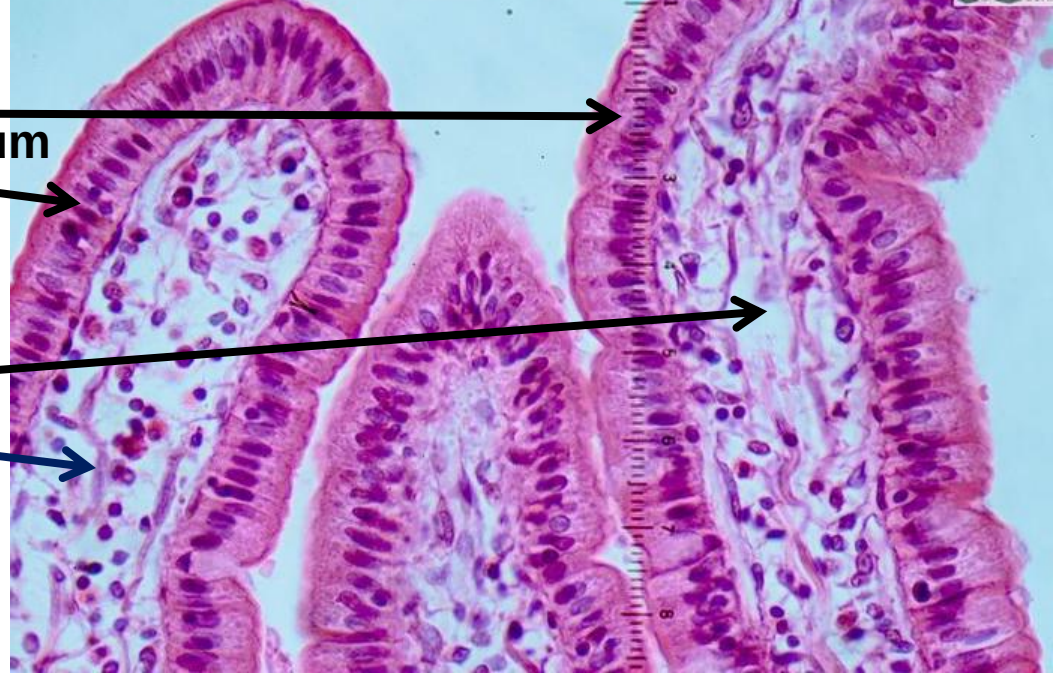
Structure and distribution of Connective Tissue Proper:

1-Loose areolar connective Tissue(LACT):

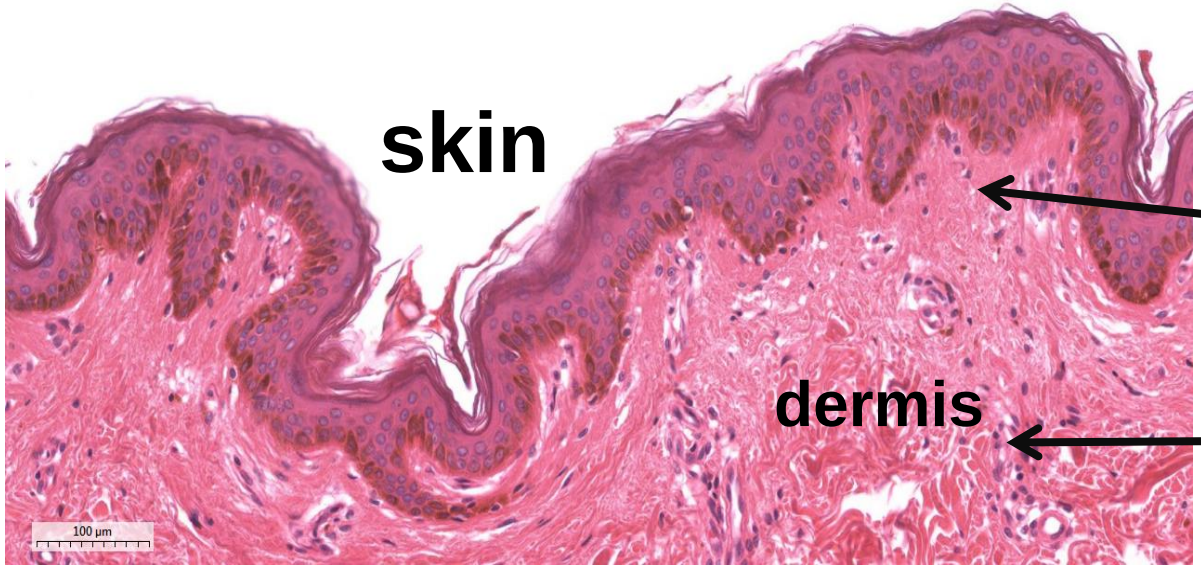
- It wraps around and cushions other tissues and organs.
- It is widely distributed throughout the body especially beneath epithelium?
- Contains fibroblasts, macrophages, plasma cells, mast cells, adipocytes and a few white blood cells as well as all 3 types of fibers: collagen, reticular & elastic.
- Helps to form the subcutaneous layer beneath skin (dermis)
- It is **found** surrounding blood vessels, nerve bundles, muscles, and organs. It also fills the spaces between organs and connects the skin to underlying structures .

Lining simple columnar epithelium

Loose areolar connective tissue



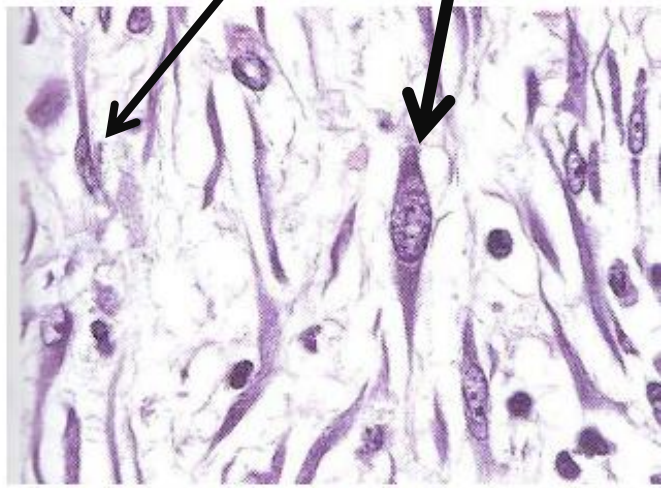
intestine



Loose areolar connective tissue

Dens irregular c.t

Fibroblast cells



Loose areolar connective tissue

2-Dense connective tissue-DCT.

Contains more thicker and denser fibers but fewer cells than loose connective tissue. 2types:

Dense regular connective tissue and **Dense Irregular c.t**

a-Dense regular connective tissue-DRCT.

Bundles of collagen fibers are arranged regularly in parallel patterns that give it strength, tough and pliable .Found in **tendons (attaching muscle to bone) and Ligaments (attaching bone to bone ;vertibrae, joints).**

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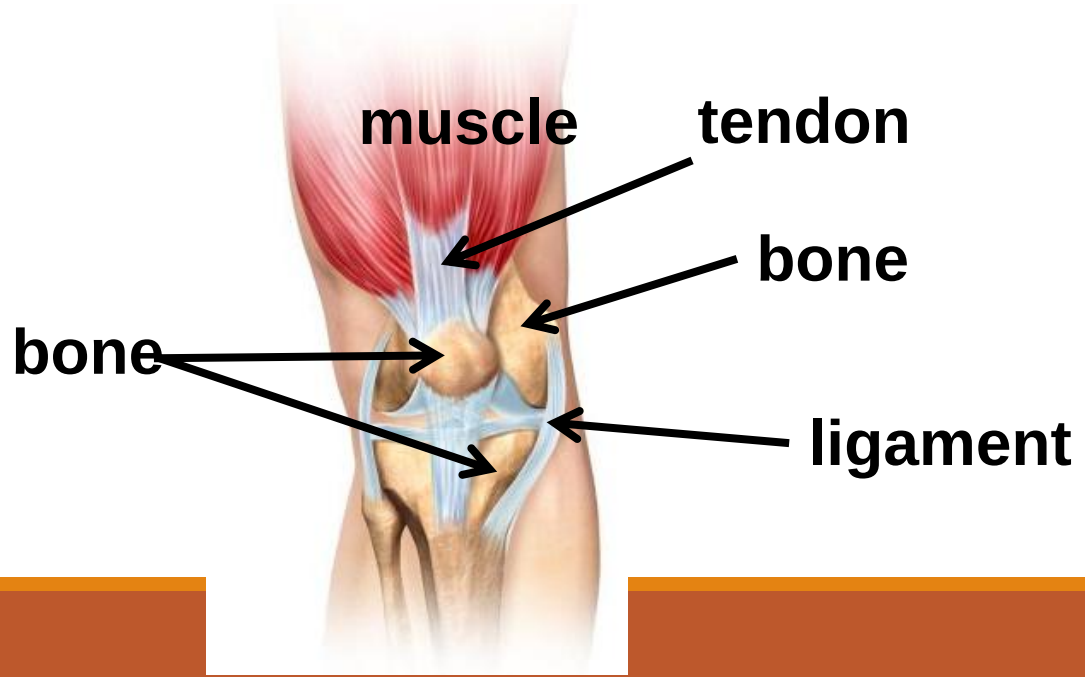
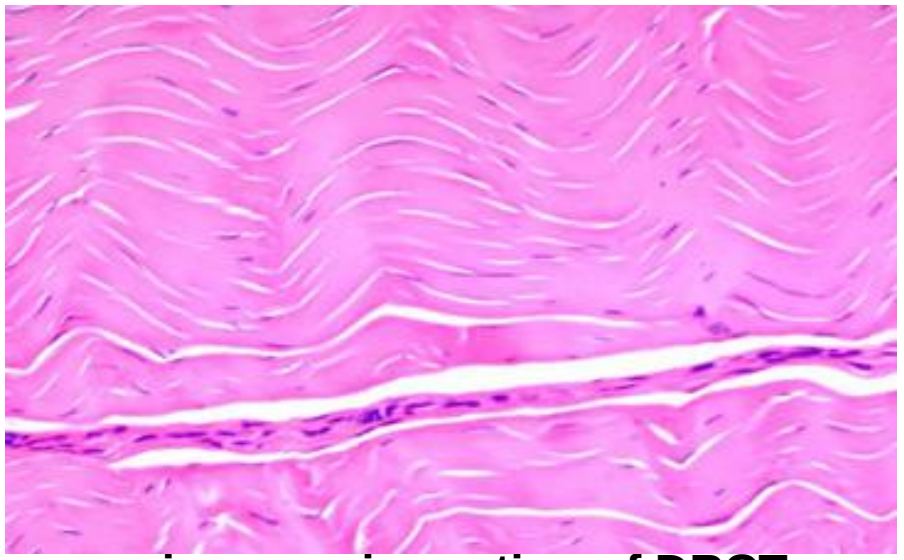
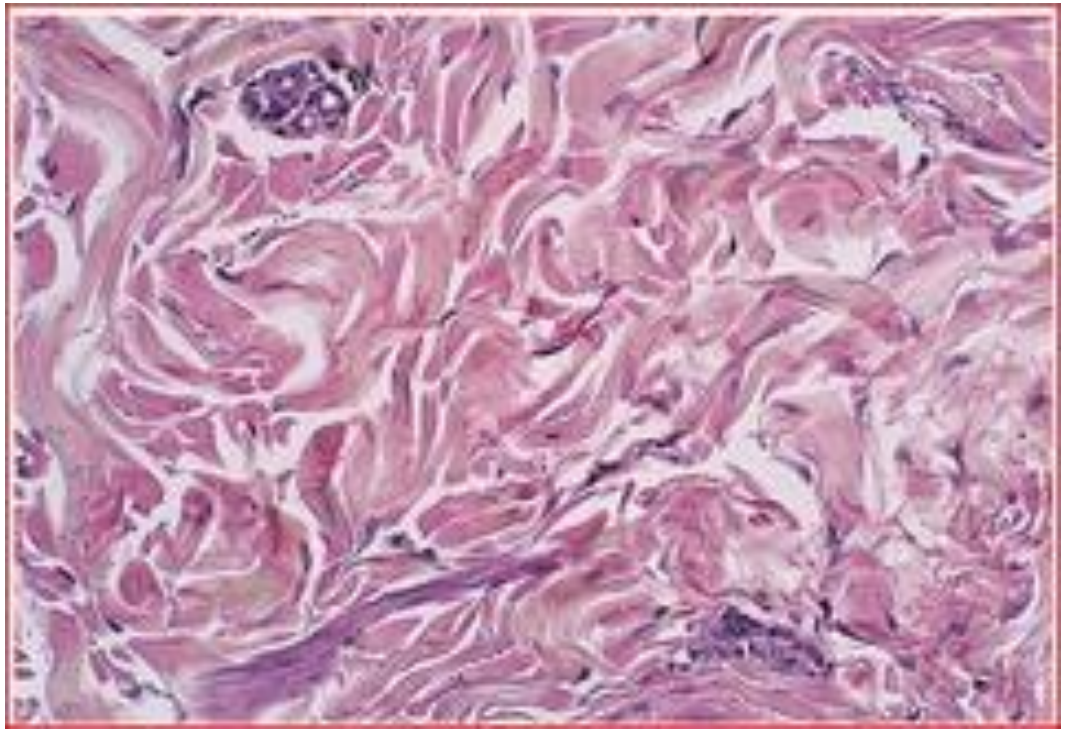
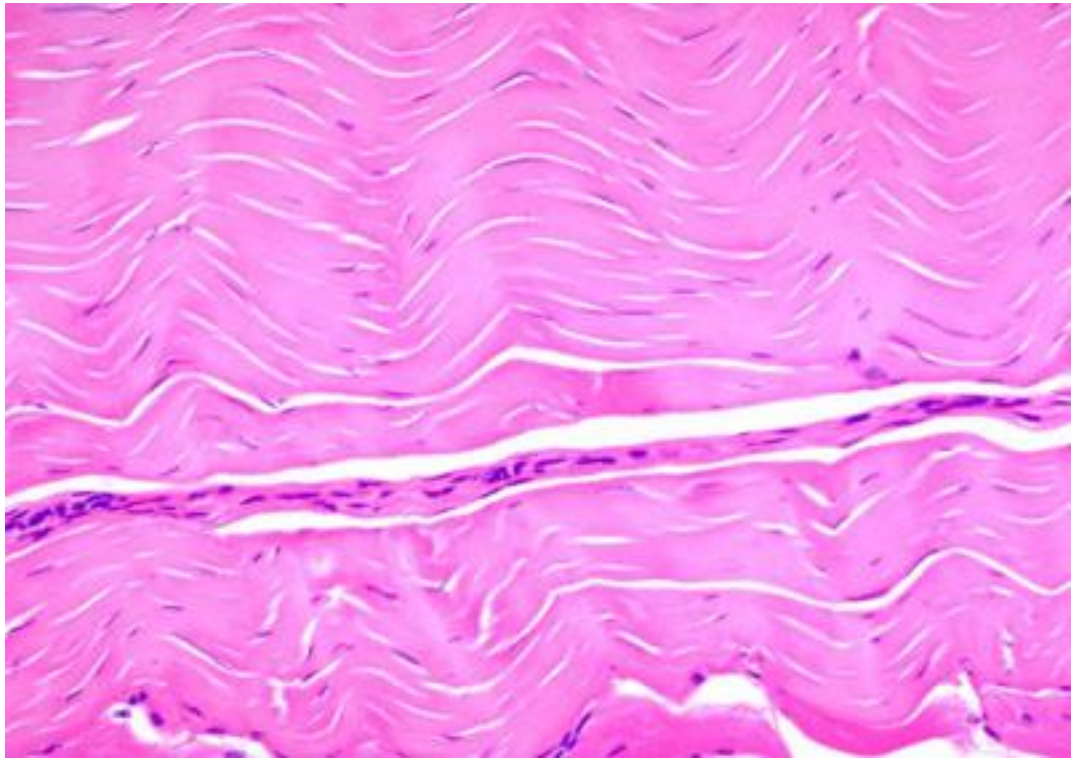




microscopic section of DRCT



Dens irregular connective Tissue

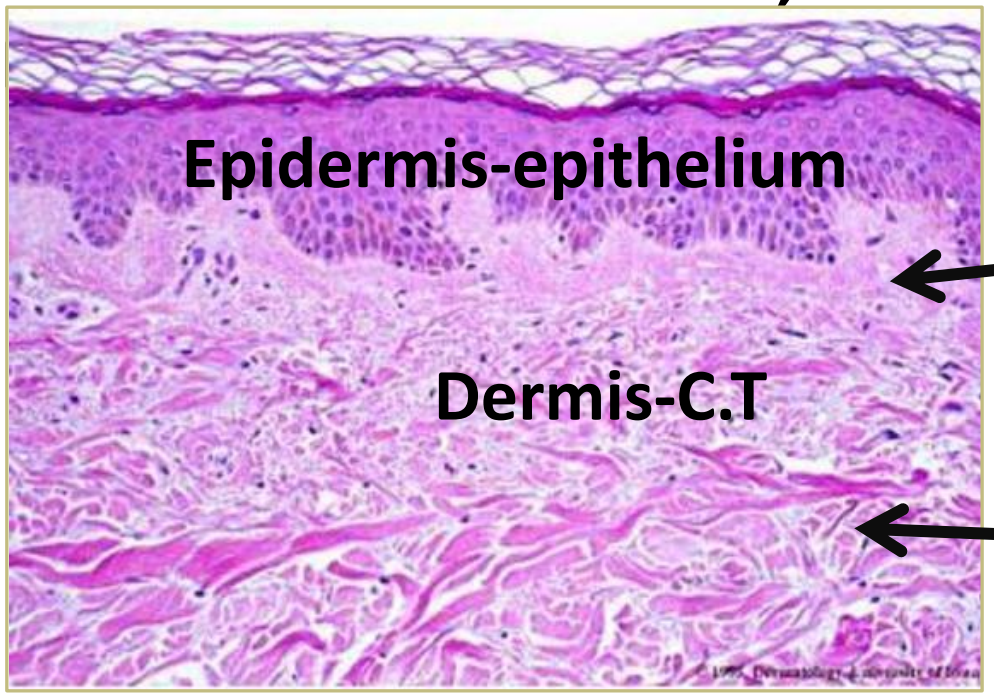


Dense regular connective tissue

b-Dens irregular connective Tissue(DICT) can withstand tension in many directions.

Collagen fibers are packed closely together in an irregular, random pattern

Found :Dermis of the skin, heart valves…



Loose areolar connective tissue

Dense Irregular connective tissue

Microscopic section of SKIN

Other types of loose fibrous connective tissues:

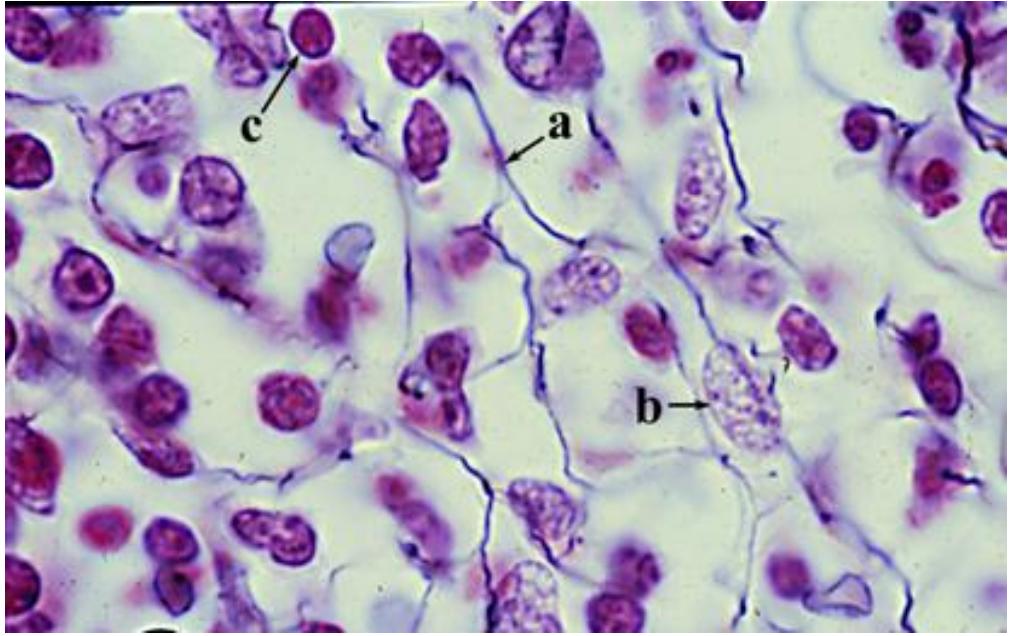
1-Loose reticular c.t; forms soft internal skeleton supporting other tissues; Found in lymph nodes, bone marrow , spleen & liver

2-Loose adipose c.t; Fat storage for insulation and heat loss and energy storage, also protection and support.

Found under skin, kidneys, within abdomen and breasts. Why?

3-Elastic connective tissue: Contains branching elastic fibers and fibroblasts. Yellowish in color strong, can regain shape after stretching

Found in lungs and arteries.

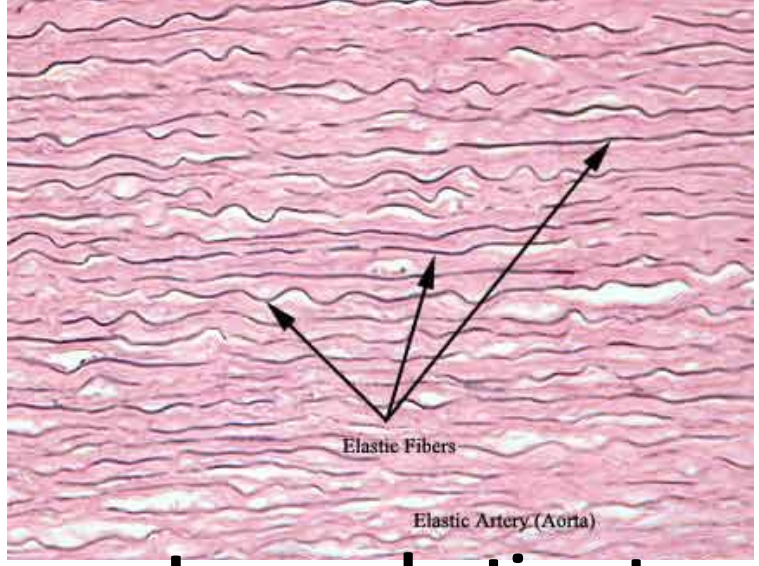


Loose reticular c.t

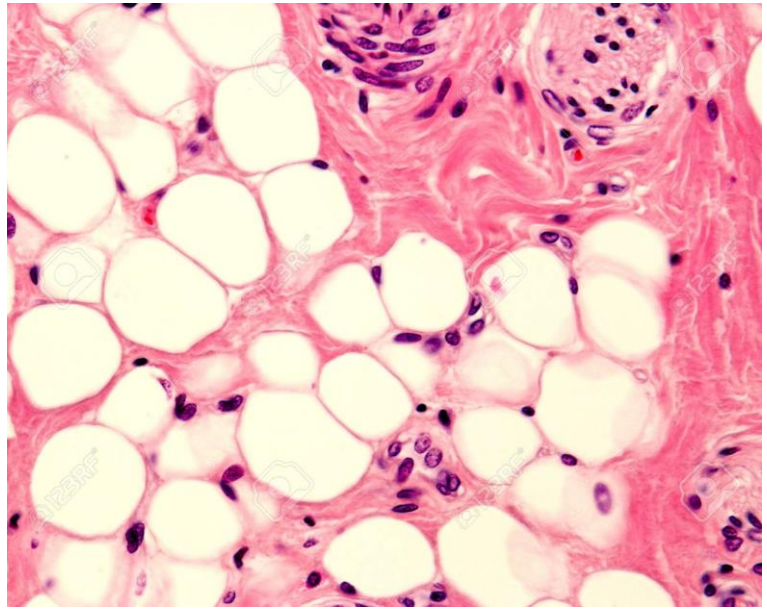
a- reticular fibers

b-fibroblast cell nucleus

c-lymphocyte nucleus

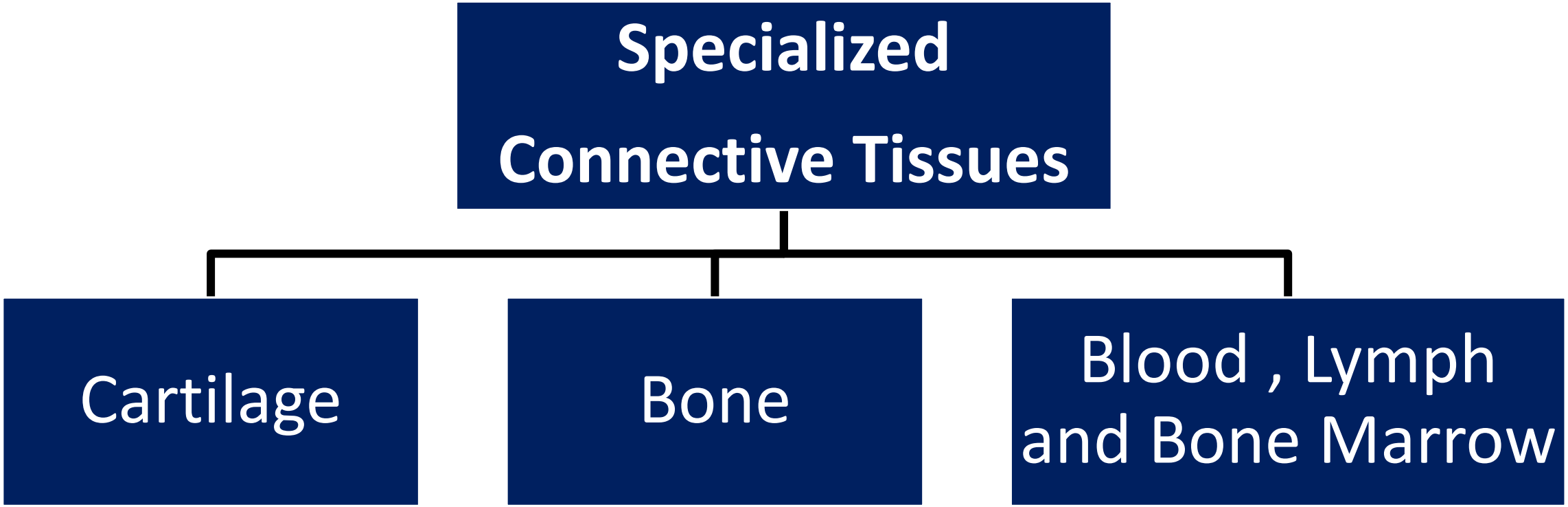


Loose elastic c.t



Loose adipose c.t

B


Specialized Connective Tissues
Cartilage
Bone
Blood , Lymph and Bone Marrow

B- Specialized C.T:

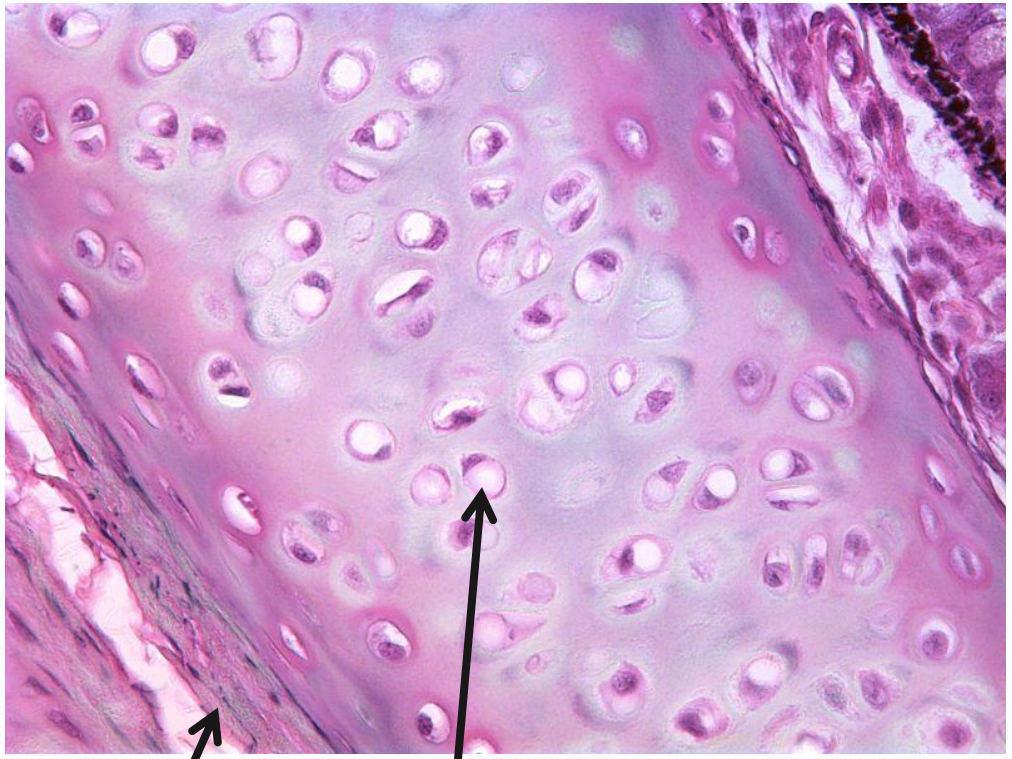
i-Cartilage is a specialized form of connective tissue composed of cells called **chondrocytes** and their surrounding matrix containing

network of collagen fibers and elastic fibers,covered externally by a layer of connective tissue called Perichondrium .

Perichondrium – dense irregular connective tissue that surrounds cartilage. Cartilage is AVASCULAR and NO NERVE supply

but the Perichondrium does has both blood and nerve supply?

There are three types of cartilage that are distinguished based on their matrix characteristics. **Hyaline, Elastic and Fibrous.**



Hyaline cartilage

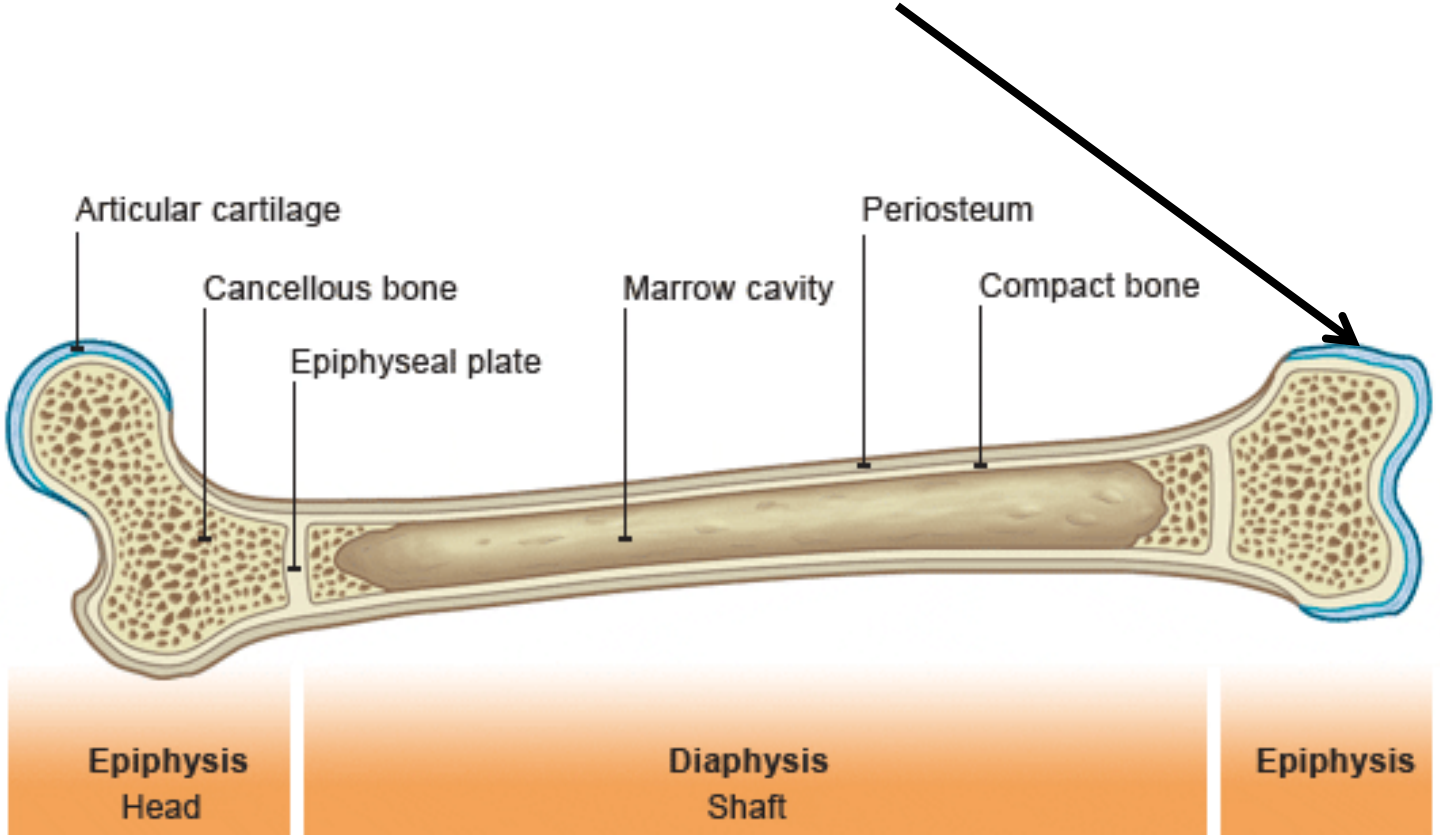
Perichondrium

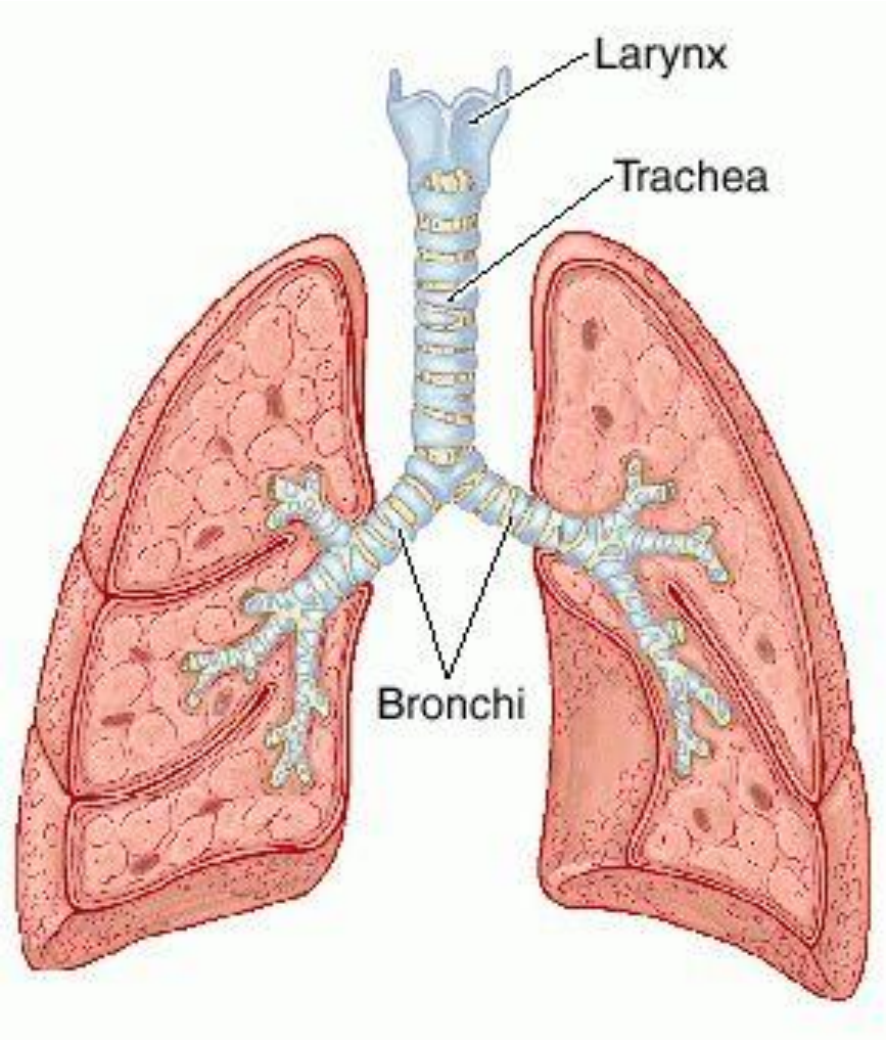
chondrocytes inside lacuna spaces

Types of Cartilage

1-Hyaline cartilage the most abundant,

Found in the wall of **respiratory passages** and at the end of long **bones(articular- cartilage).**



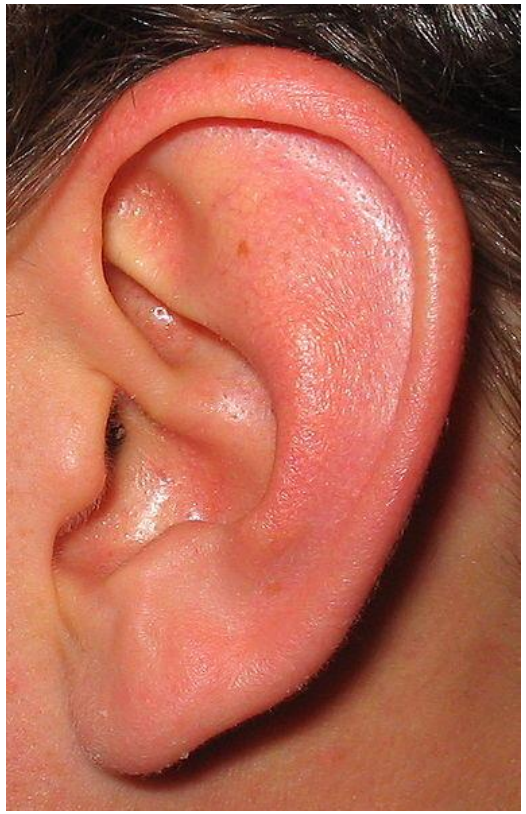


Types of Cartilage……

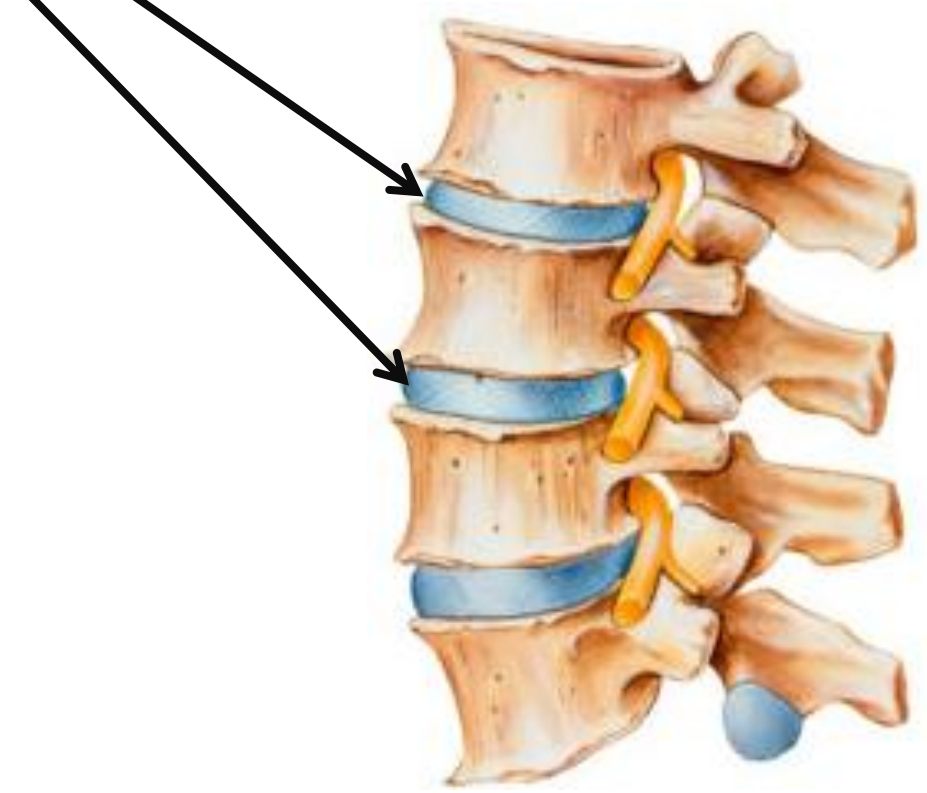
2-Elastic cartilage Provides strength, elasticity present in **external ear.**

3-Fibrocartilage :Strongest of the 3 types of cartilage **no perichondrium**.

Found in the **intervertebral discs**



elastic cartilage external ear

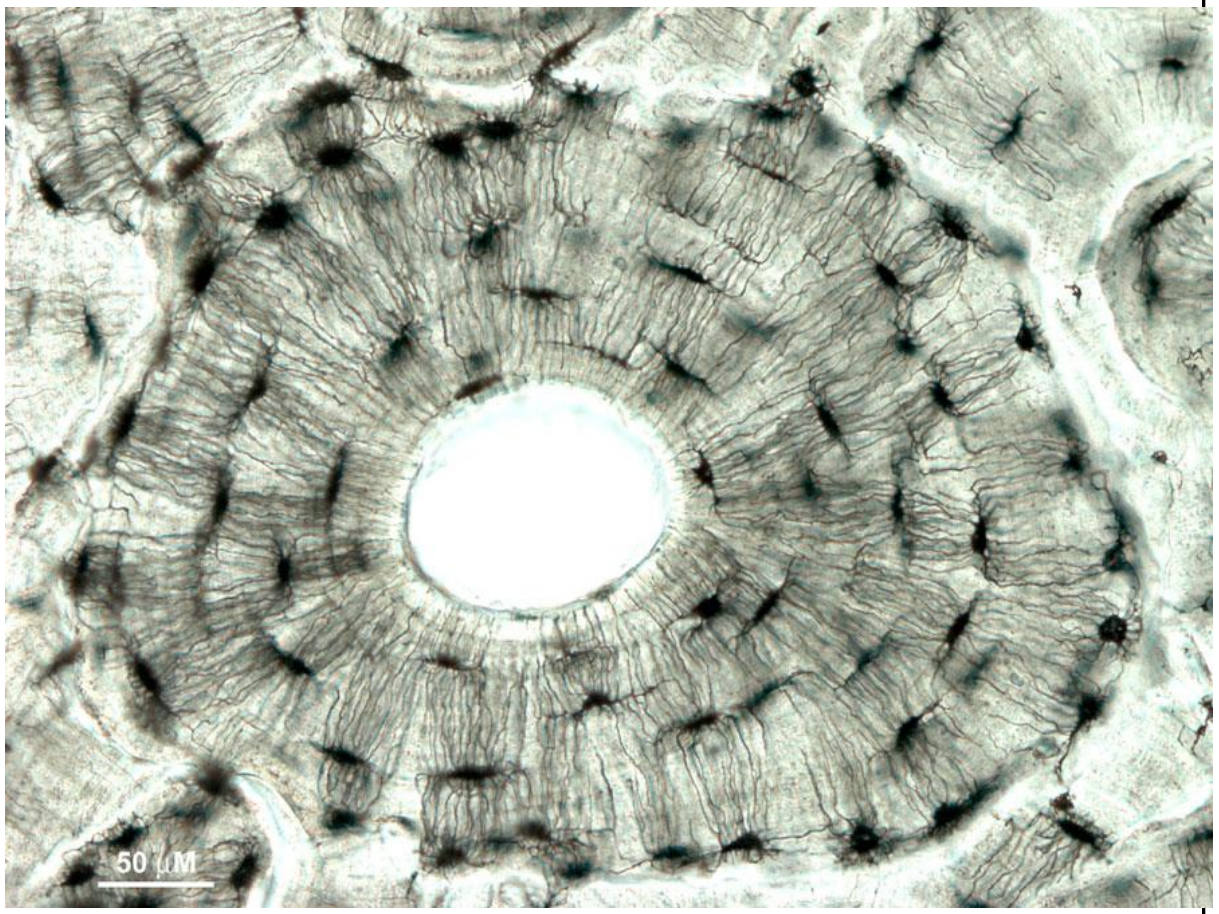


ii-Bone Tissue (osseous tissue)

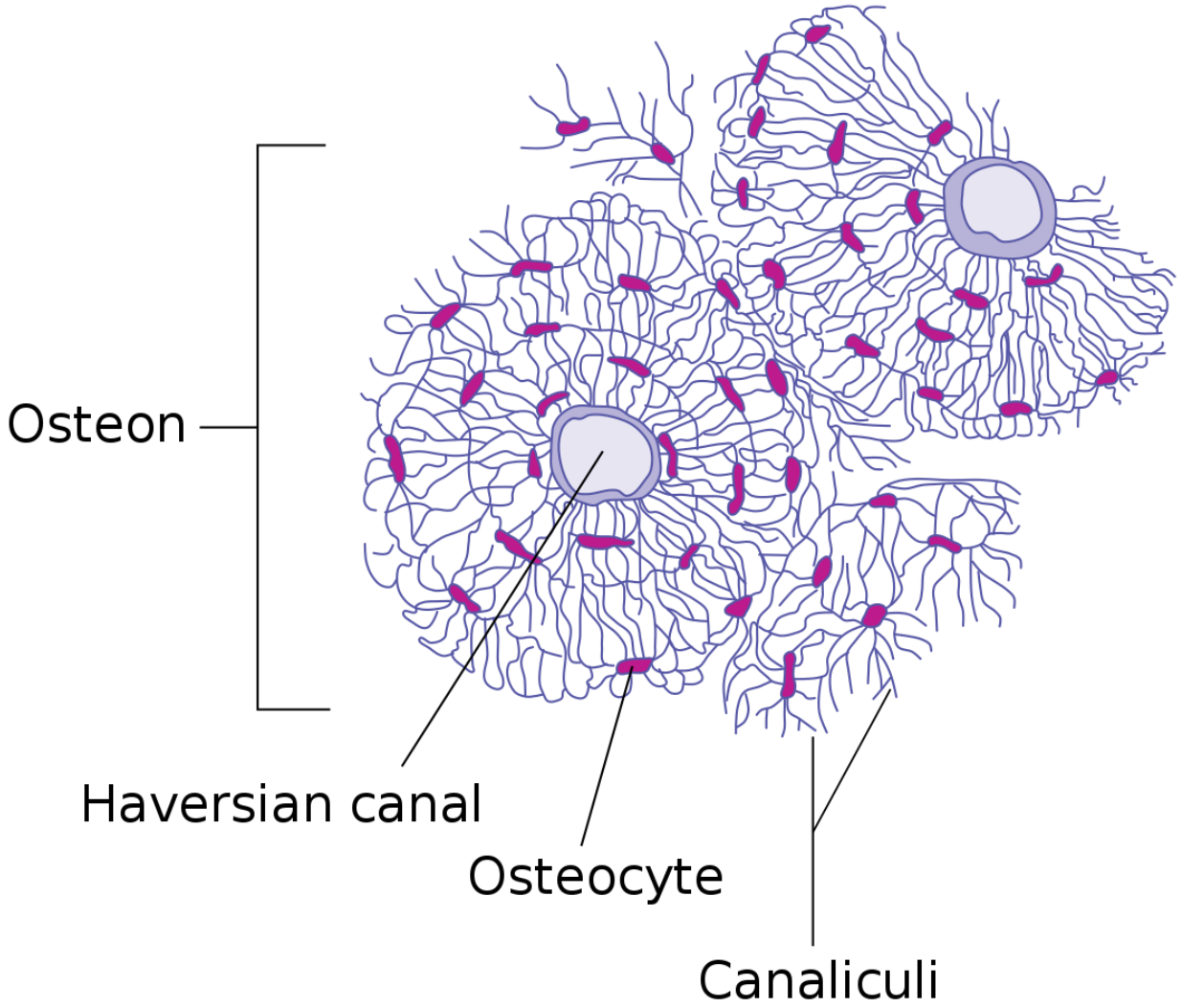
Bone tissue (osseous tissue) differs greatly from other tissues in the body. Bone is hard and many of its functions depend on that **characteristic hardness**. The structure of a **long bone** allows for the best visualization of all of the parts of a bone .

The basic unit is osteon(Haversian system)

Haversian canals typically run parallel to the surface and along the long axis of the bone. The canals and the surrounding lamellae (8–15) are called a Haversian system or an osteon. A Haversian canal generally contains **capillaries and nerve fibers.**



osteon(Haversian system)



Bone Tissue (osseous tissue)

Two types – compact and spongy

A-Compact bone

1-Osteon – basic unit of compact bone

2-Lamellae – concentric circles of matrix

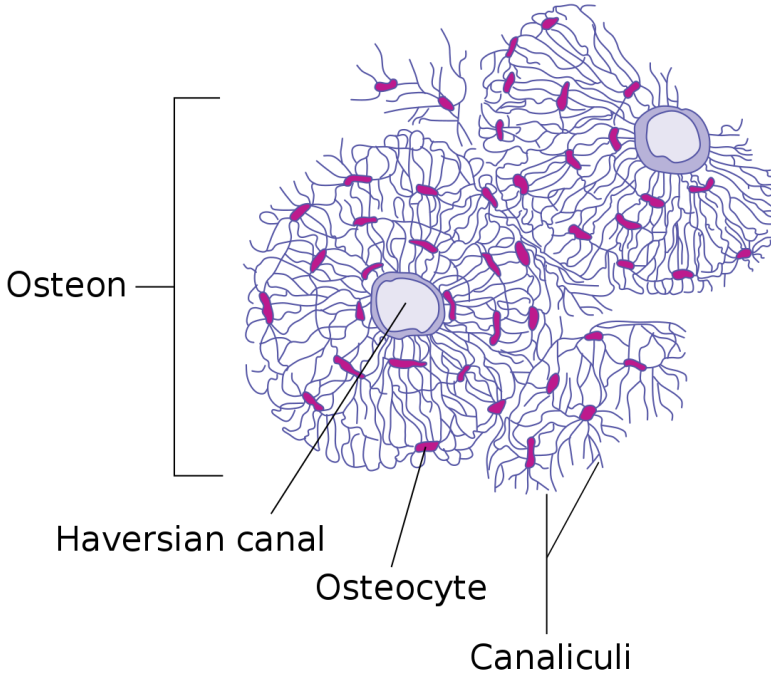
3-Lacunae – spaces in the matrix that house cells

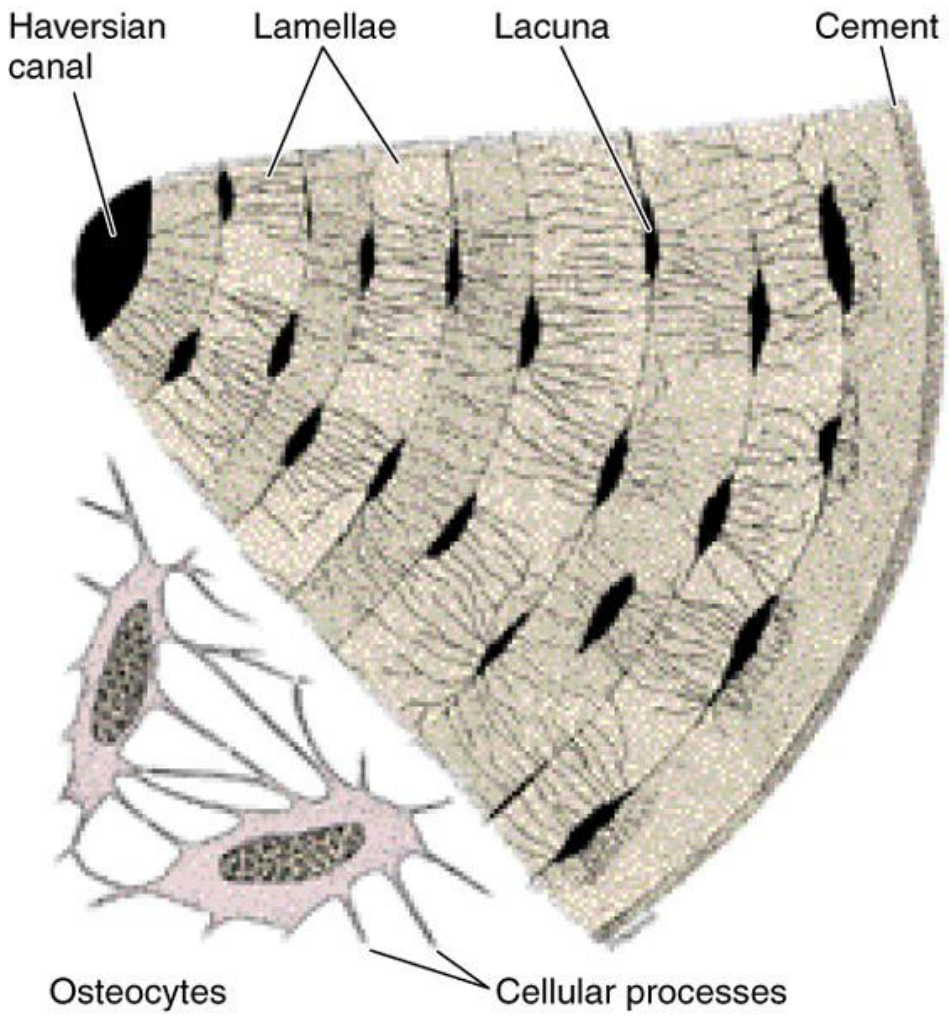
4-Osteocytes – mature bone cells

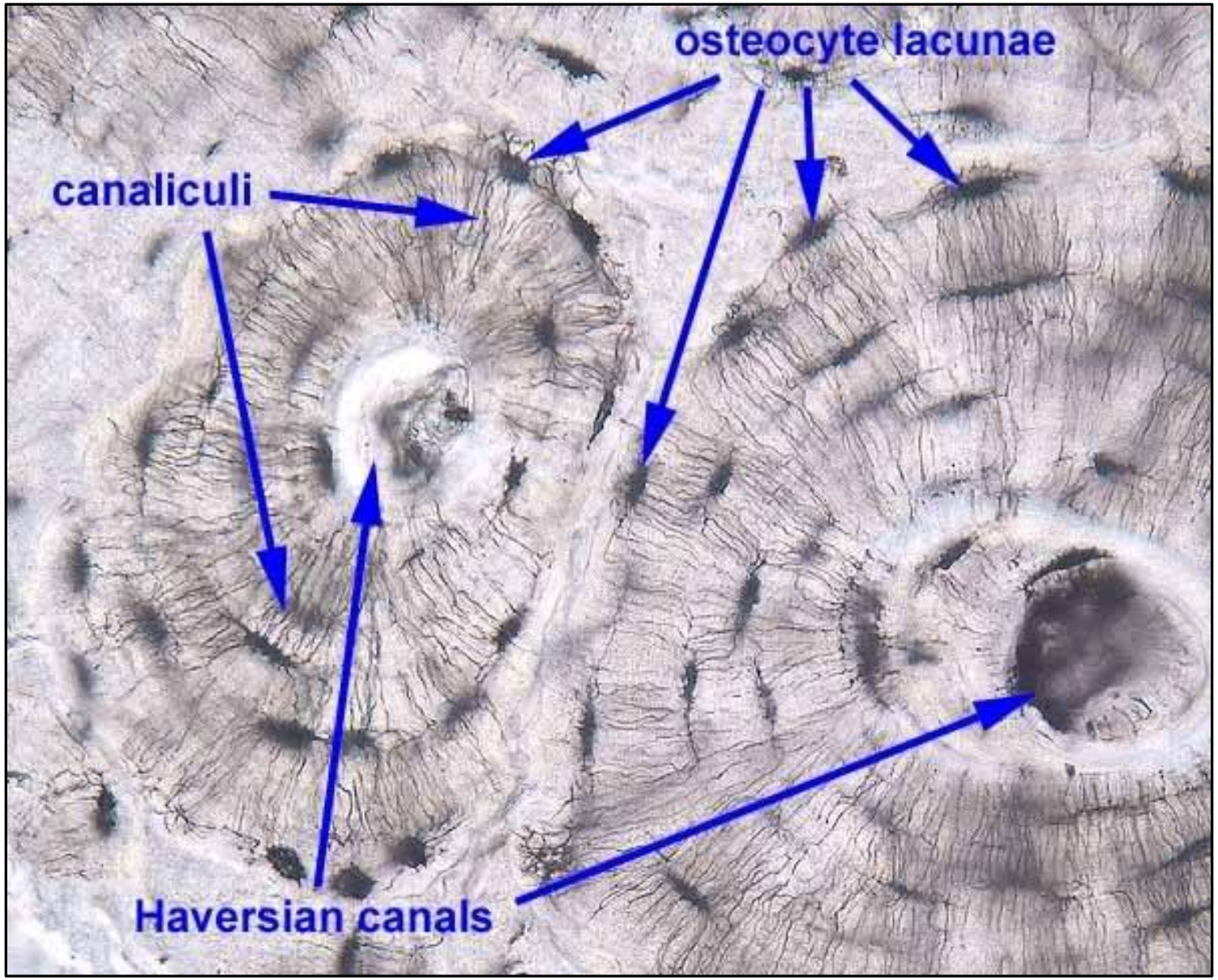
5- Osteoblasts- immature bone cells

6- Osteoclasts- bone resorption cells ?

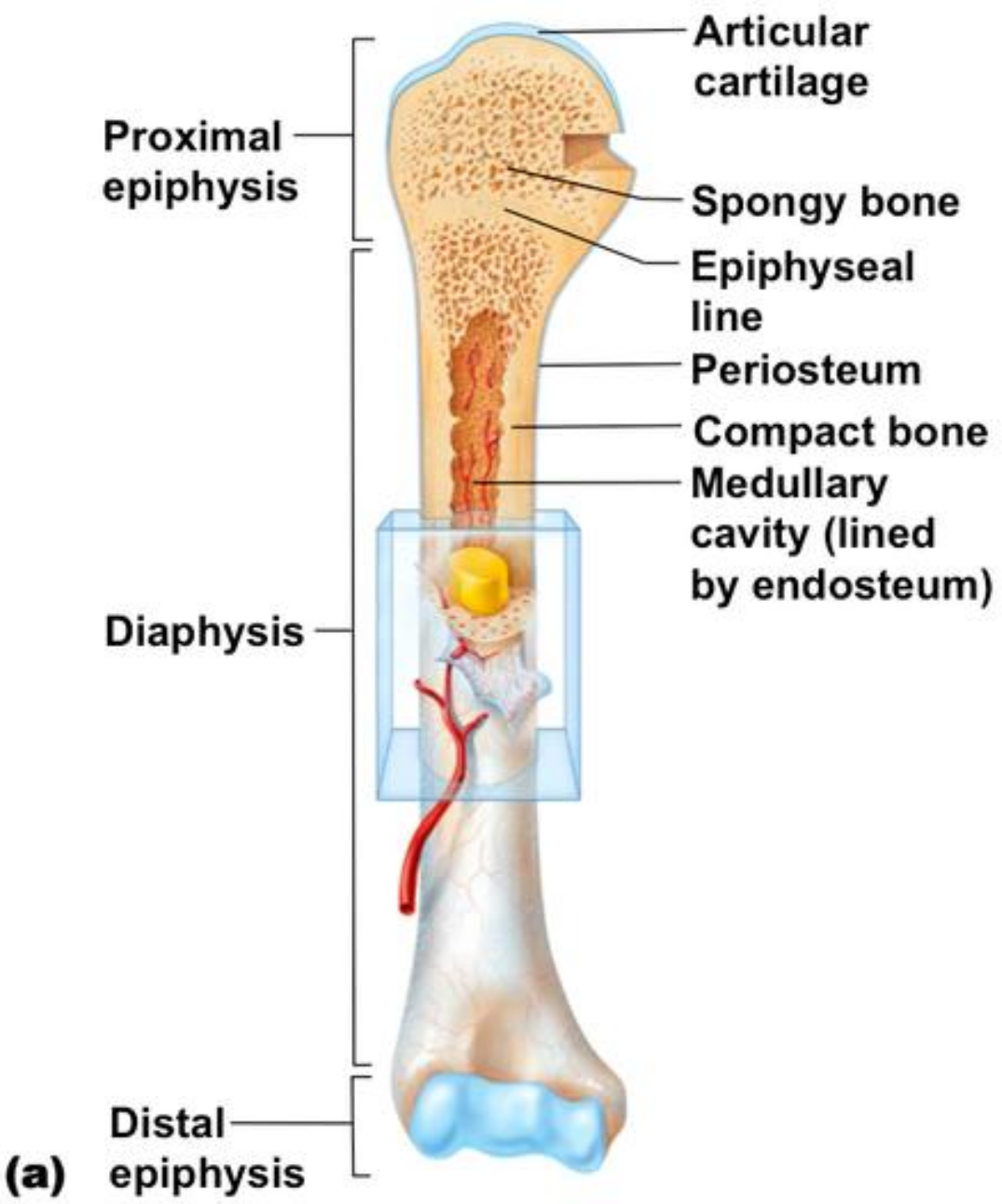
7--Endosteum(inner c.t covering)& Periosteum (outer c.t. covering)

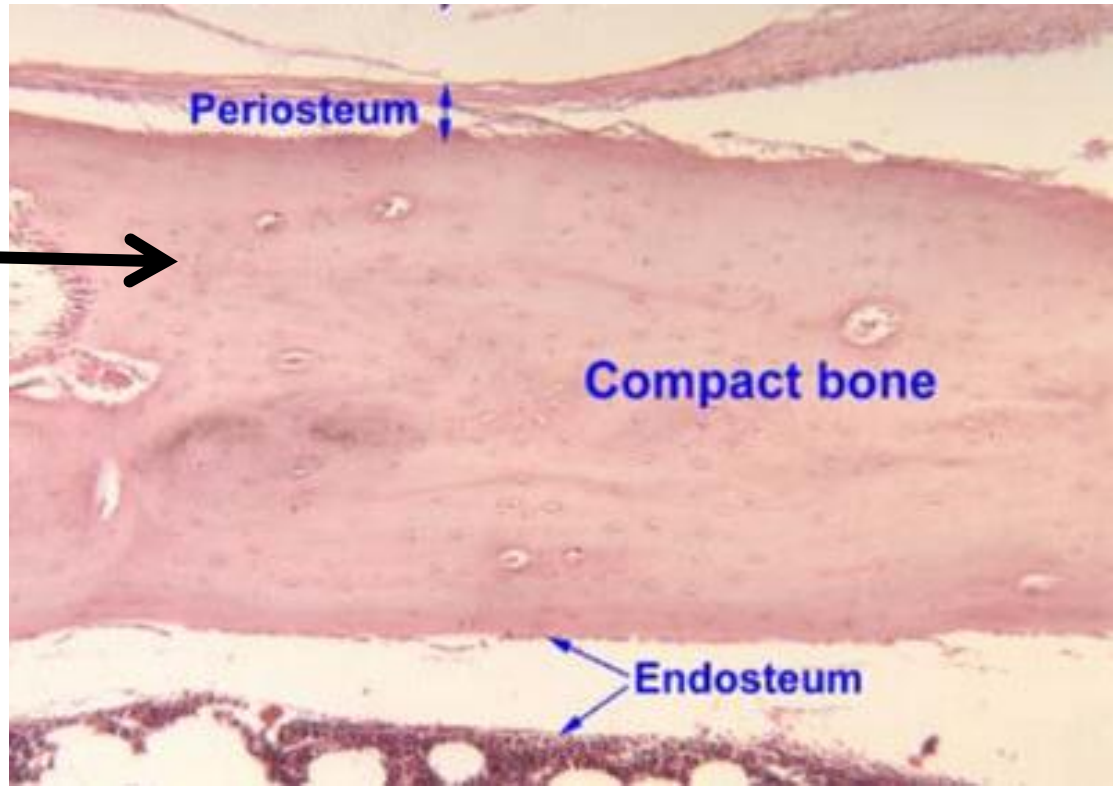






Labeled Bone Sections


Articular cartilage
Proximal epiphysis
Spongy bone
Epiphyseal line
Periosteum
Compact bone
Medullary cavity (lined by endosteum)
Diaphysis
Distal epiphysis
(a)


Periosteum
Compact bone
Endosteum

Bone Tissue (osseous tissue)……..

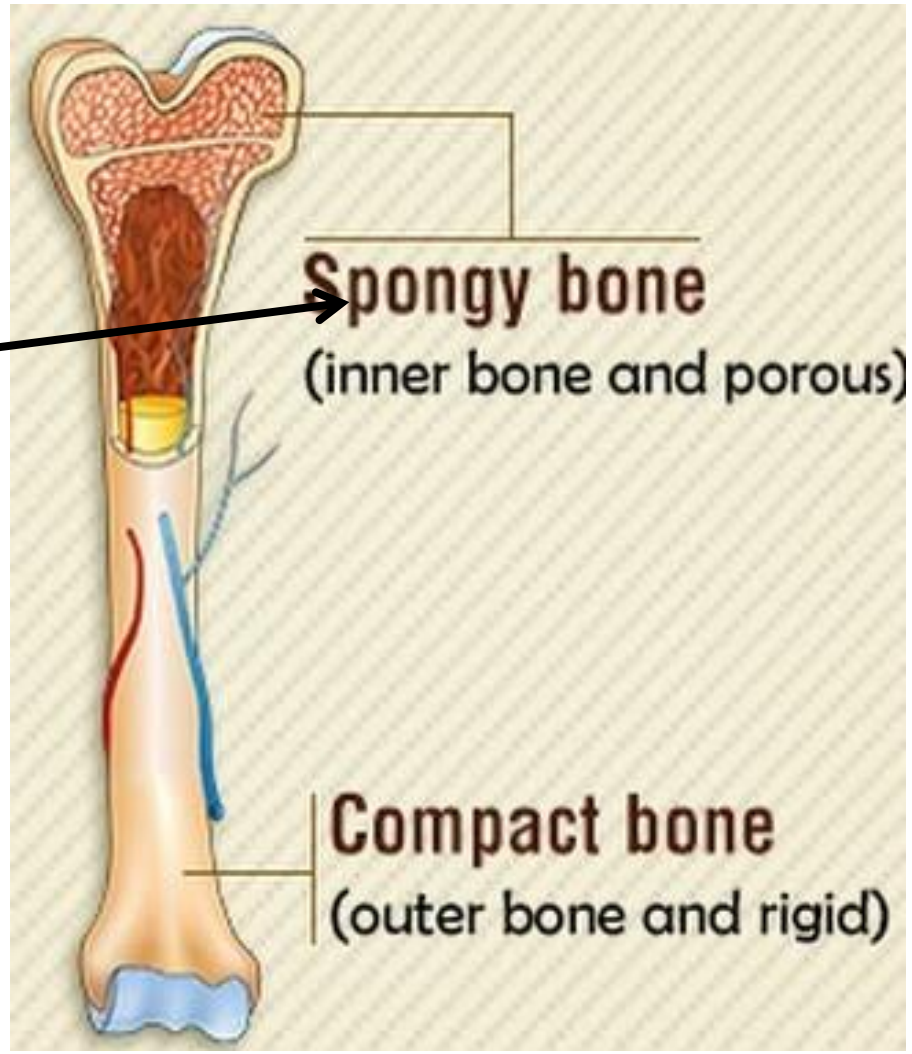
Types of bone– compact and spongy

A-Compact bone , in adults contain yellow inactive bone marrow?

B –Spongy bone:

Trabeculae – columns of bone with spaces filled with …

red active bone marrow???



Blood supply and regeneration of connective tissues

Connective tissues can have various levels of vascularity.

1. Cartilage is **avascular**, while dense connective tissue is poorly vascularized .
2. Others, such as bone and loose areolar connective tissue, are richly supplied with blood vessels and nerves.
3. Connective tissue cells are able to reproduce but not as rapidly as epithelial cells.

iii-Blood , Bone Marrow &Lymph

A- Blood :

A Connective Tissue with a liquid matrix called plasma and cells such as:

1-Red Blood Cells (erythrocytes) – transport oxygen

2-White Blood Cells(leukocytes) – function in immunity

Neutrophils, Eosinophils, Basophils, and lymphocytes,

3-Platelets – participate in blood clotting.

4- Plasma is the liquid part of blood containing clotting factors (fibrinogen)

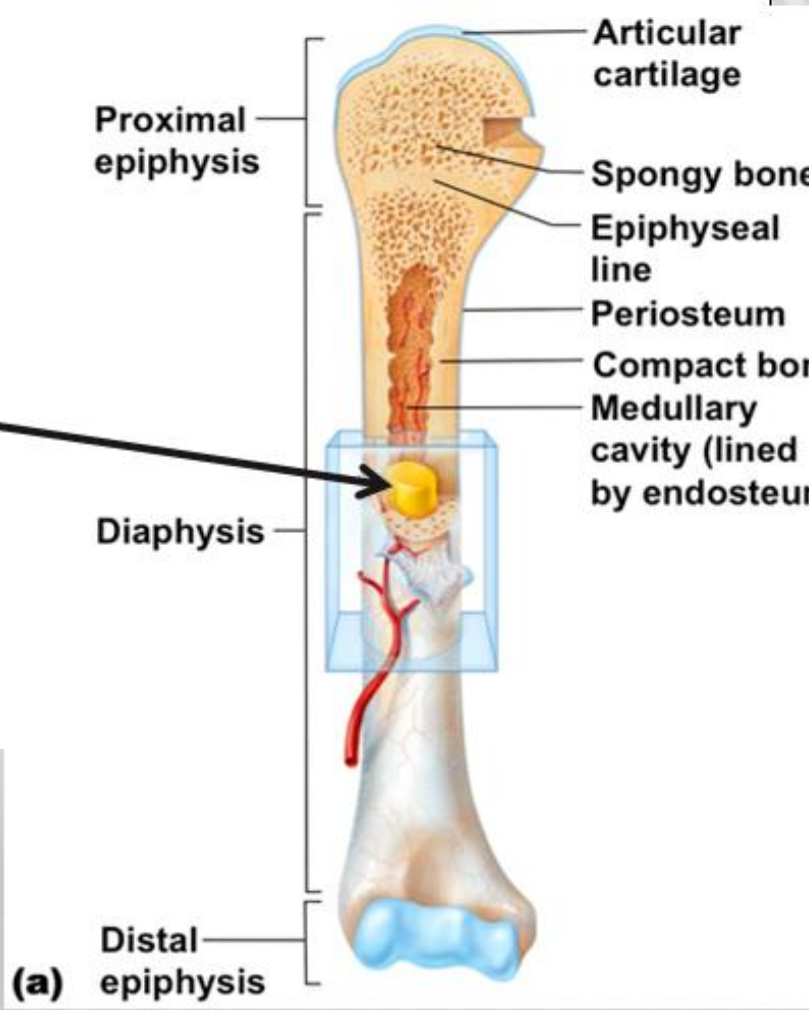
5- Serum is the liquid part of blood after clotting(coagulation).

B- Bone Marrow

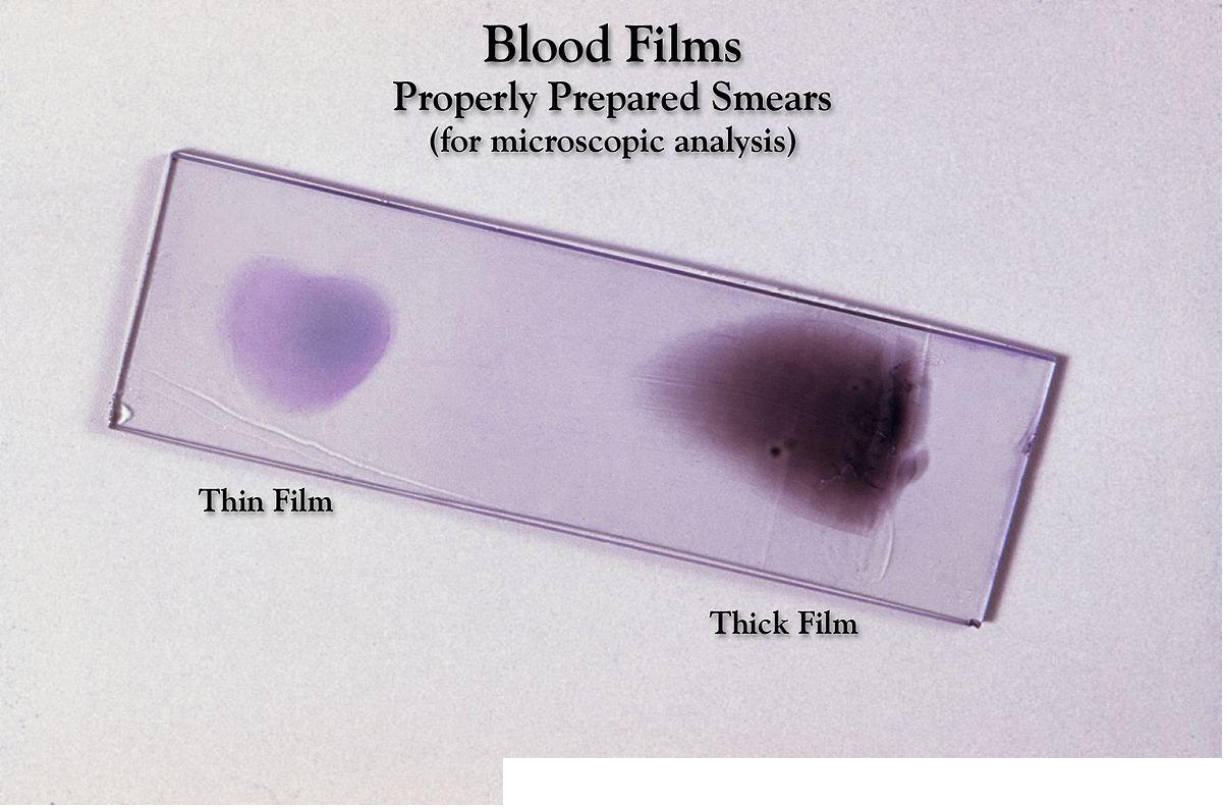
1-Active red bone marrow found in flat bones and epiphyseal ends of long bones, where the bone is or spongy.

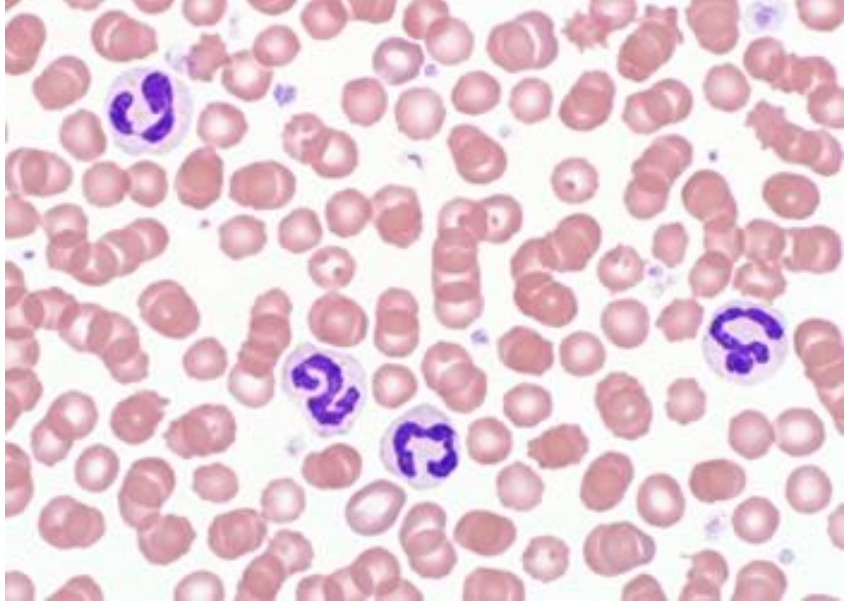
Function: produce blood cells from stem cells.

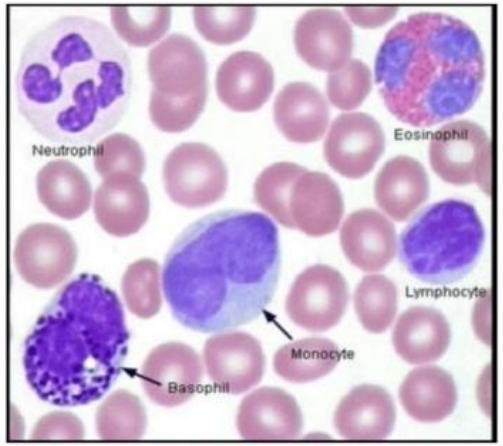
2- Yellow B.M: Mainly fat ,found in medullary cavities of long bones



C-Lymph is a fluid **connective tissue** that consists of a clear fluid and various cells, some of which include lymphocytes, a **type** of white blood cell.

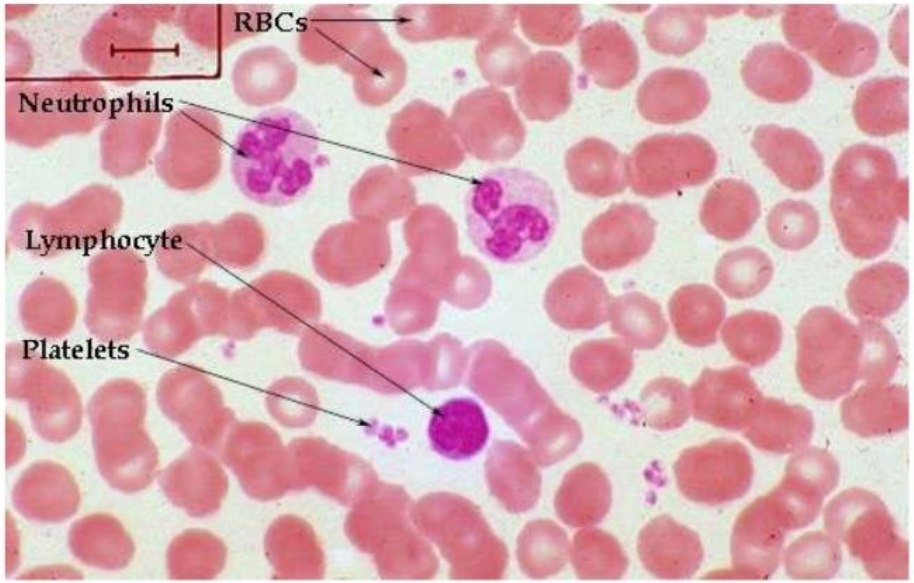






Normal blood smear
WBC

Peripheral-blood-smear



Blood , Bone Marrow &Lymph summary:

1-Why blood and lymph are considered to be types of connective tissue?
2-What are the functions of Bone Marrow ?
3- What is the most widely distributed type of C.T
4- What are the two main fiber types of C.T.

C- Connective tissue coverings(membranes) of major tissues:

a- epithelia : not covered by C.T but rests on C.T called basement membrane and supported by loose C.T underneath ..??

b-The **Perichondrium** is a connective tissue membrane covering the surfaces of cartilage. It contains blood vessels, which supply cartilage through diffusion.

c-The **Periosteum** is a connective tissue membrane that covers the surfaces of bones. It contains blood vessels that enter and supply the bone.

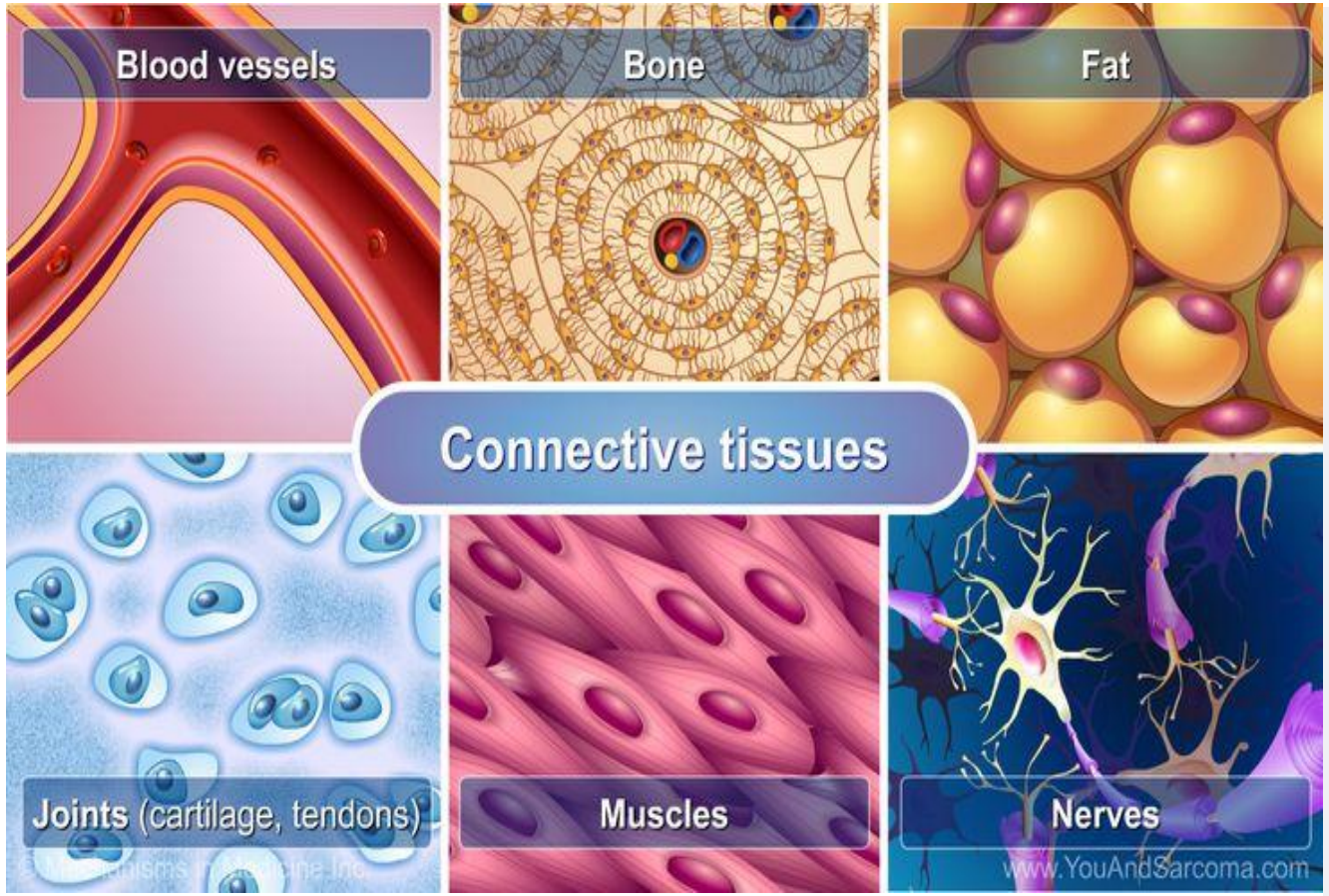
d-The **Meninges** are three connective tissue membranes that envelop the brain and spinal cord **.**

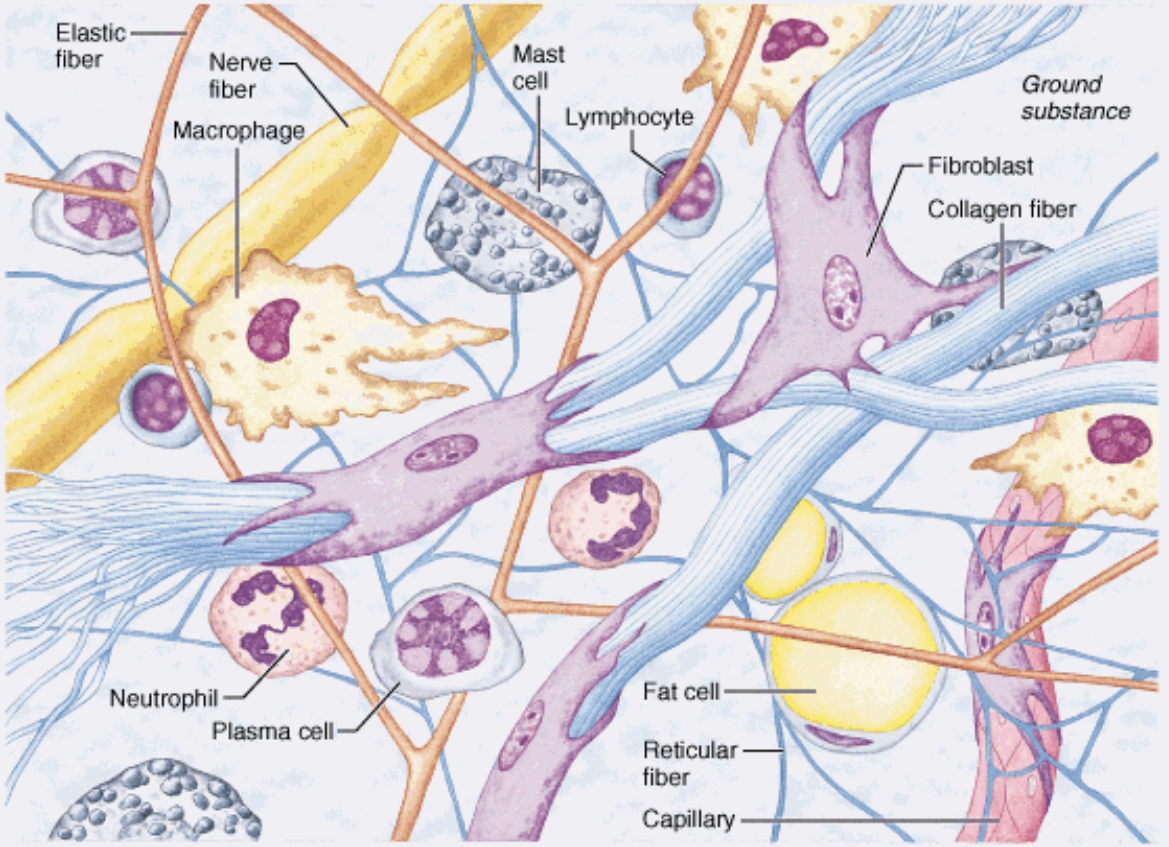
e-**Synovial membranes** line the cavities of freely movable joints, such as the **knee joint.** They secrete watery synovial fluid, which reduces friction in the joint.

Summary of Major Points:

1- Structure and components of C.T
2- Main Types and distribution in the body
3- Functions
4- C.T is all tissues in the body Except 1….2……and 3…..?

Why is connective tissue important?





Schematic Drawing of Connective Tissue, muscles and nerves

THE END

Next Lecture will be about Muscle tissue

References:

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