Doctor 022

Histology

Sheet no. 4

Writer: ROAA ALSHARAIAH

Corrector: SHATHA BARDAWEEL

Doctor: GHADA ABU EL GHANAM

Note: Dr.Ghada's speech is in black colour , slides is in blue colour.

We talked about the epithelium tissue in the last lectures, and now we will talk about

Connective tissue

Connective tissues we have seen it before, It located under the epithelium and make a part of lamina propria, it gives the epithelial tissue the support and the nutrients it's needed .In addition it glues the epithelial tissue to the inner tissues too.

For example:

- liver mainly composed of one cell called hepatocytes but they can't on the own create an organ, they need a support and they need a glue to connect the cells together surrounded and protected; so I have the hepatocytes and I have additional connective tissues that surround the liver from the outside and from inside it sends tiny partitions (fibers)to support the anterior structure of these tissues.

In many organ you will hear two important terms: parenchyma (are usually composed of epithelium) and Stroma (usually composed of connective tissue).

In almost every organ this two(Stroma & parenchyma) come to meet and they have a special arrangement (well supported and isolated organ).

- Skeleton composed of number of bones, and each two bones form a joint.

How this bones tighten together ? By connective tissue (ligaments) which connects the bones where we have joints and immovable joints.

- Synovial joint that have another connective tissue called capsule (it's also connective tissues)which wrap two bones.

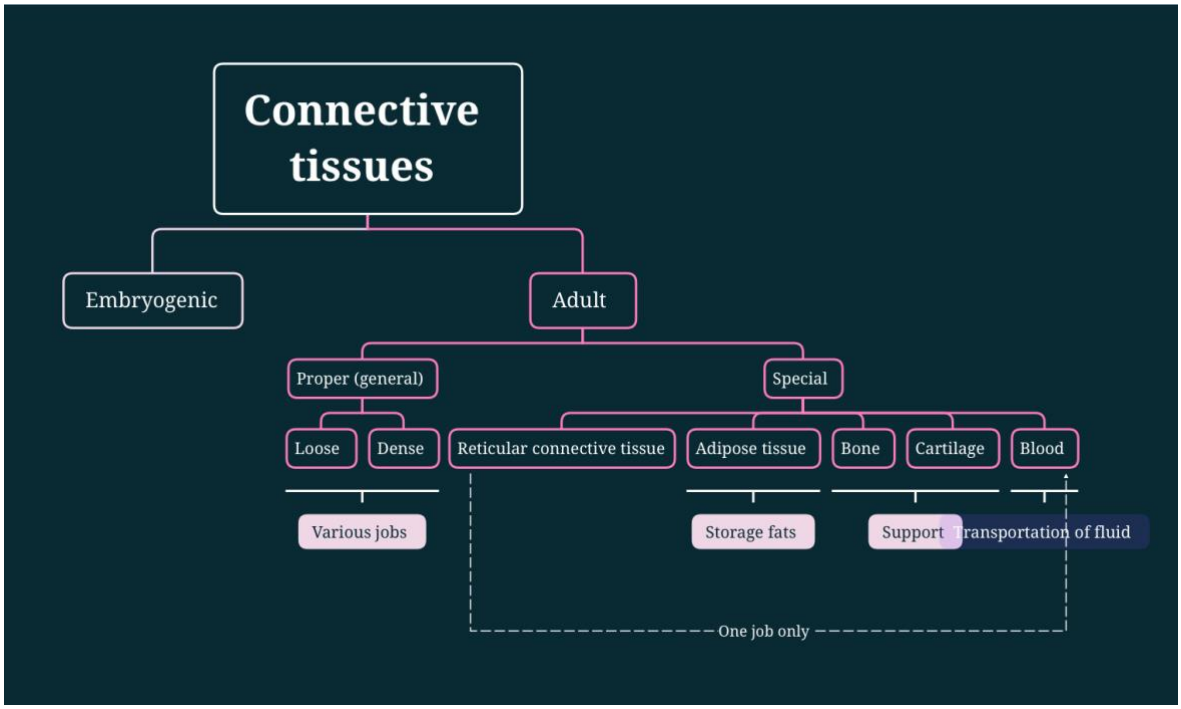
So whenever we need support, whenever we need connection between different part ,whenever we need partition within the cavities we have connective tissue , the connective tissue general do these job(Found in any part of body with varies job)

Bones , cartilage ,blood (these is a special type of connective tissue)

• Connective tissue provides a matrix that supports and physically connects other tissues and cells together to form organs of the body.

• The interstitial fluid of connective tissue gives metabolic support to cells as the medium for diffusion of nutrients and waste products.

 # Connective tissue is a huge family can be divided into:



Note:

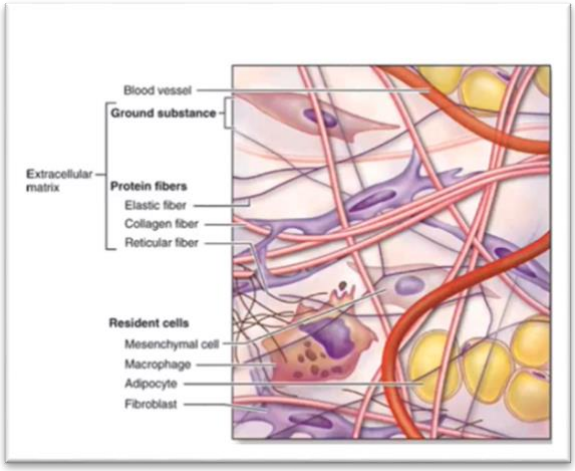
- ❖ proper: A. Loose= less fibers & more cells& more ground substance
  B. Dense= more fibers & less cells& less ground substance

- In the previous lectures we talk about epithelium which is composed from one type of cell whether it's simple or stratified, and they resemble to each other without spaces. (There's no second elements)
- Muscle tissue :similar with slight differences
- Nervous tissue: similar cells , however we might find other types of cells but neurones are the mainly one.

These three families different from the fourth family (connective tissue) ;it has many cell types and composed of three elements , unlike the other tissues.

Connective tissue differ from other basic tissue and no order in its structure and compose of three elements : many family members,cells ,fibers and in between (ground substance — الحشوة it means number of hydrophilic proteins)

Connective tissue composed of 3 components;



- ✓ **Cells**
- ✓ **Fibers** : (elastic ,cartilage ,reticular fibers)
- ✓ **Ground substance:** (in between) it's not water or sponge, it's different type of protein; which is a complex of anionic, hydrophilic (because its fluid), proteoglycans, glycosaminoglycans (GAGs) and multi adhesive glycoproteins (laminin , fibronectin , and others).

*The amount and the type of ground substance depend on the type of connective tissue.

❖General features :

1. connective tissue originates from the mesoderm which is a layer of an embryo after fertilisation of an ovum, this 46 fertilized ovum is doubling (but we have to control it) and differentiation, and specialising in certain types of tissue This stage is called Trilaminar; producing 3 layers (tri); mesoderm, endoderm, and ectoderm (this is a layers of embryo). Each layer will give all type of our tissue. For example:

👉 Epithelium arise from three layers depend on location such as epidermis arise from ectoderm, lining of GI tract arise from endoderm.

👉 some of the tissue only arise from one layer such as

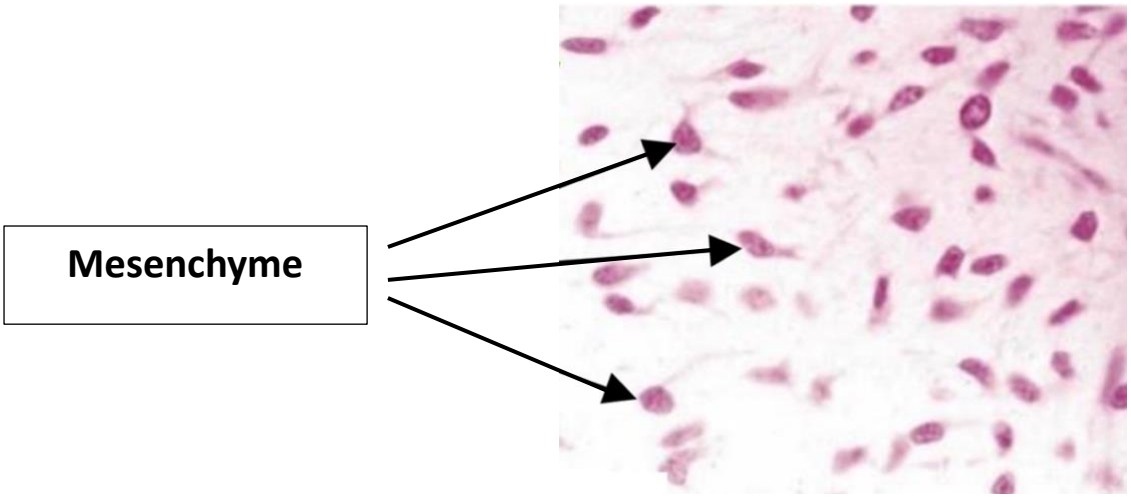
- Nervous tissue arise from ectoderm to give neural crest cell that form a nervous tissue
- Bones arise from mesoderm.
- Mesoderm gives a connective tissue (special and general) to form the organs except some parts of head and neck , they don't originate from the mesoderm ; Further differentiation of mesoderm gives Mesenchyme (cells

with euchromatic nuclei, small amount of cytoplasm ,has many processes called Mesenchyme stem cells).

These Mesenchyme stem cells later on give a fully differentiated connective tissue cells (the reach ultimate specialization).

ما حيطلع منهم نوع جديد بالمستقبل.

So these cells after embryogenesis, start to differentiate to fibroblast, Osteoblasts work in teams to build bone, chondroplastes work to build cartilages, etc. of connective tissue cells.



2. composed of cells (fixed and wandering in Type and number), fibres and ground substance.
3. variable vascularity: (variable because we have many types of connective tissues some of them they have high vascularity other they have the low)

👉Bone :is highly vascular (the amount of blood that reach bone is quit high.

👉 cartilage:vascular doesn't exist ,consider avascular ;blood vessels stop at perichondrium, they don't penetrate into the inner tissue of the cartilage , so the blood reach them by diffusion like epithelium.

4. variable regeneration power. (Make new tissues in case of damage).

*Usually tissues that have high vascularity or receive high supply of blood they tend to have high regeneration power, for example :

👉The bones (special type),is richly supplied ,have high regeneration power, any fracture could be healed and fixed by the position of new bone.

👉 cartilage (we have three types) two of them have limited regeneration power ,and third type don't have regeneration power.

If the loss of cartilage tissue is very huge ,it will not be replaced by cartilage tissue , in this case cell called fibroblasts come to make fibrosis.

- Fibrocartilage:regeneration and healing done by another tissue type (scar tissue not the original tissue that we had before the injury).

❖ **Functions**: all types

1.Structural framework (skeleton) for body. (by bones and cartilage , and both are special types), in addition fibrous bands (ligaments).

2.Transportation of fluids and dissolved substances. (by blood special)

3.Protection of delicate organs. (by connective tissue layers that surround the organs)

if you remember the capsule around an organ is strong sheet of connective tissue that covers and protects the anterior and sending septa inside .So, Protection is another major function of connective tissue, in the form of fibrous capsules (1st) and bones (2nd) that protect delicate organs and, of course, the skeletal system.

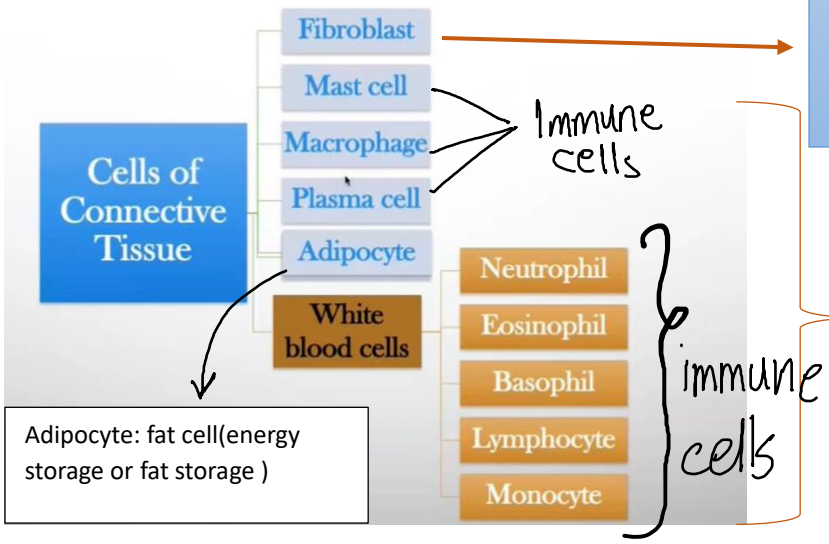
4.Supports, surrounds, and connects other tissues. (we talked about it , connective tissue is under the epithelium so supports it, surrounds it, and provides it with nutrients by its vessels (because we know that epithelium is avascular) like the connection with epithelium and muscular skeleton , usually by tendons and is a strong connective tissue at the end of muscles to fix it to do its functions)

5.Storage of energy in the form of lipids. (by adipose tissue (connective tissue has fat cells that store the energy as fats or lipids)

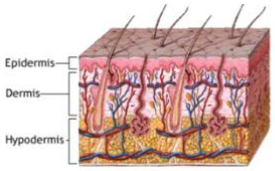
6.Defend the body against microorganisms. (by WBCs in blood)

#fibroblast is Most important and most present.

"The mother of the connective tissue proper", in special has another cells but you will see fibroblast as well. And it is responsible to build the ground substance and the fibers (Components of connective tissue)



The rest of the cells are variable depending on the health state; if there is an infection you will see more plasma cells and macrophages; a strong immune reaction you will see a lot of mast cells



⁉ Why do we have all these immune cells?

Skin is the largest organ in the body and covers the body's entire external surface. It is made up of three layers, the **epidermis** (is the outermost that composed of epithelium), **dermis** (composed of two layer ;loose and dense connective tissues), and the **hypodermis**.

we have WBC in the loose connective tissue.

Because if injuries will occur ,it may cross the epithelium and reach the connective tissue(which contains vascular blood tissue,interstitial fluid,capillarities and venules).

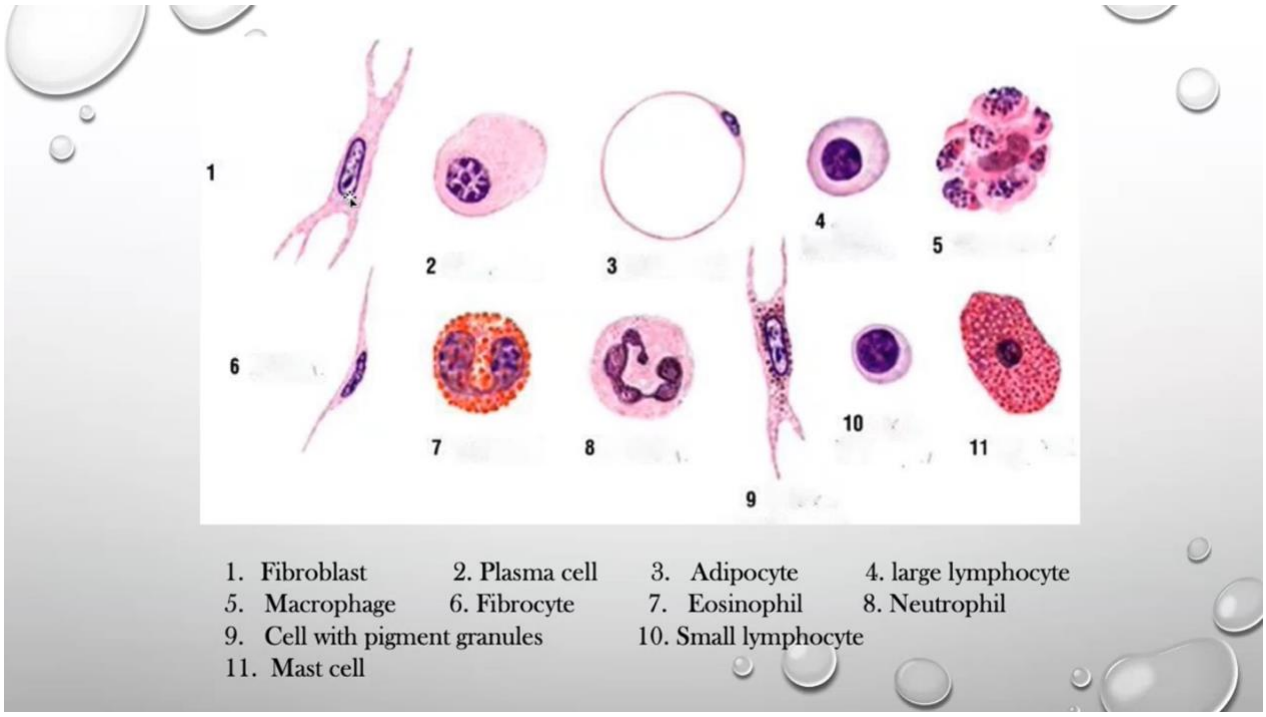
so if microorganism have ability to access connective tissue it can gain access to blood,there is no one to stop it ,reach to circulation and microorganism quickly multiply especially bacteria (just need water and glucose for keep alive, unlike viruses)

That's why we have WBC to capture anything that can get access into connective tissues by the first line fighter then they initiate the immune reaction and they get more from the blood.

This process also applying on any system especially system that has connection with external environment like respiratory tract and GI tract!these systems have many WBC.

#This image shows all the previous types

👉 (3) adipocyte : this flat cell resembles ring (segment rings), the empty space in the middle was simply occupied by fat , and fat during tissue preparation will dissolve by solvents.



👉(1) fibroblast ; blast refer to some thing that is active

👉(6) fibrocyte; cyte refer to something that is quiescent ,retired or resting.

Connective tissue cells

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

White blood cells

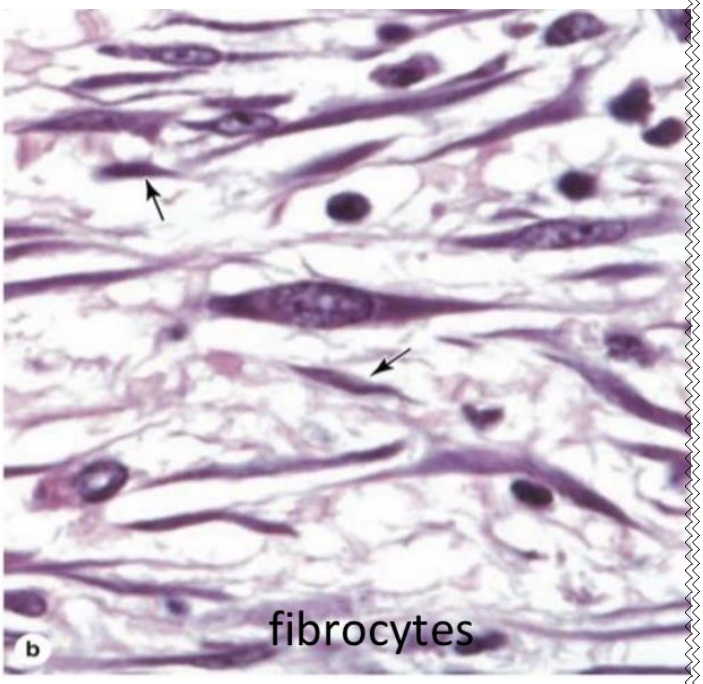
Lymphocyte is huge family simply classified into B and T lymphocytes , plasma cell develop from B cells

So when we have parasite, we usually have Eosinophil in connective tissue

Work side by side with macrophage when first entry of microorganisms, these are more general WBC have been found at the first line defense.

1.Fibroblasts

The most common cells in connective tissue proper, produce and maintain most of the tissue's extracellular components. Fibroblasts synthesize and secrete collagen which is the only fiber can be observed with H&E stain!(the most abundant protein of the body) and elastin, which both form large fibers, as well as the GAGs, proteoglycans, and multiadhesive glycoproteins that comprise the ground substance. As described later, most of the secreted ECM components undergo further modification outside the cell before assembling as a matrix.



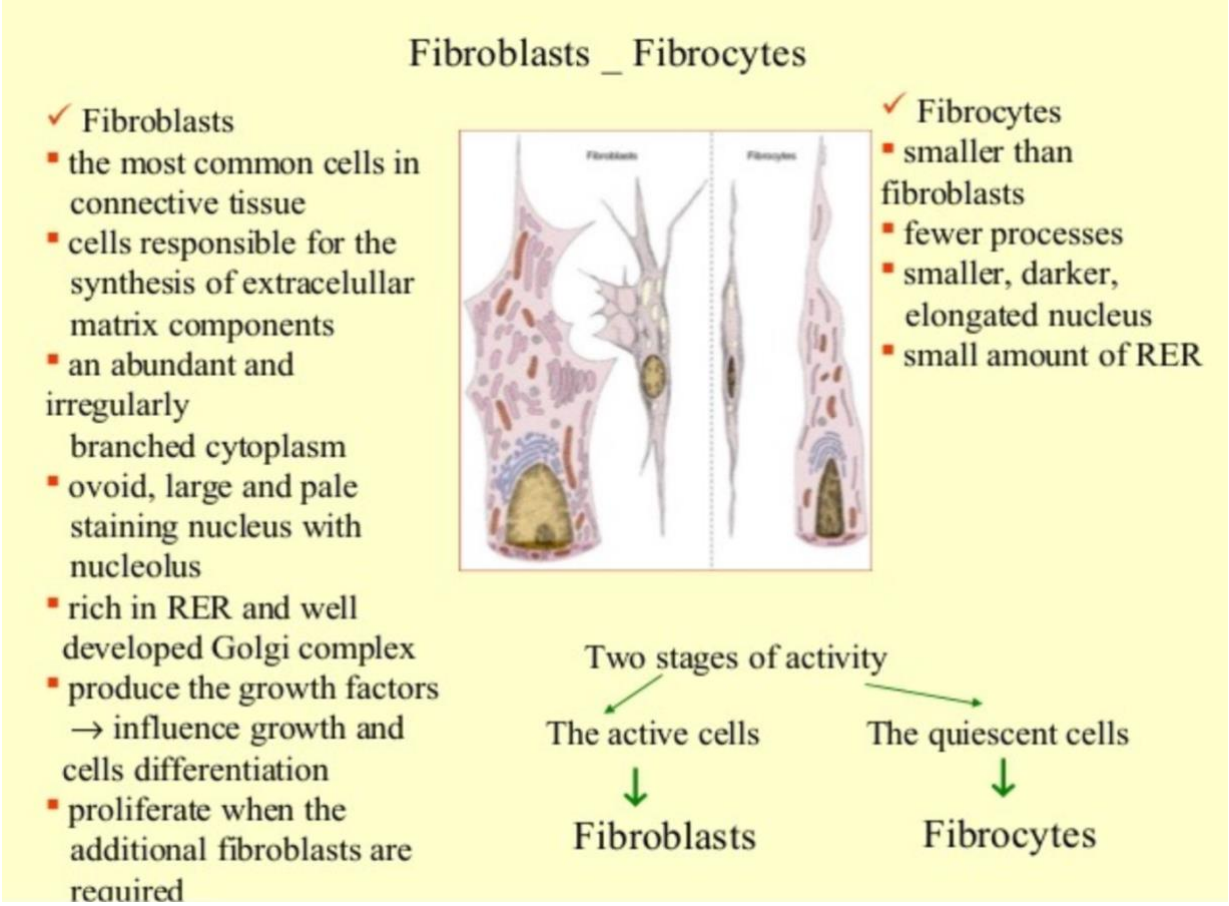
How can I differentiate between them?

- **Fibroblast:** (active) because it has a large nucleus (Euchromatic chromosomes ;DNA disperse ready to be copied and sending mRNA to produce more product particularly fibers and ground substance) , large amount of cytoplasm, more process,more organelles,more golgi and RER.

- **Fibrocyte**: (inactive) is smaller spindle shape, fewer processes, darker smaller nucleus, and tiny amount of cytoplasm ;because this cell is quiescent inactive ,so it's not gonna perform that many functions, it's not gonna make us proteins, it doesn't need much RER or Golgi.

  It's retired but not dead, it can be reactive when you need it

- we usually use the term fibroblast and it refer to both fibroblast and fibrocytes .
- **Both make the extracellular fibers and ground substance.**



#we cannot actually detect cytoplasm of plasma membrane by H&E ;because it dissolved during preparation.

2.Macrophages الخلايا الأكوله الكبيرة

Its major function: defense by antigen presenting (اشهار مولدات الضد على سطحها)

after these cells phagocytose the pathogen, they represent their antigens by Major histocompatibility complex (MHC) molecules function is to determine which something is strange or not.

- Macrophages represent the most functionally versatile cells in the animal body; involving inflammation,phagocytosis (means engulfing ,eating or cleaning) and after presentation.

In addition to recognizing and destroying pathogens, macrophages remove senescent.

That you would imagine it as the vacuum of the connective tissue, it can wander and clean up all the debris that are present.

*for example: if we have an immune reaction ,we have a lot a lot of dead cells, a lot of destroyed connective tissue , this is one that would clean up as debris and engulf them and further process them.

• Macrophages have highly developed phagocytic ability and specialize in turnover of protein fibers and removal of dead cells, tissue debris, or other particulate material.

• being especially abundant at sites of inflammation.

• Size and shape vary considerably, corresponding to their state of functional activity.

•A typical macrophage measures between 10 and 30 µm in diameter and has an eccentrically *away from the center* located, oval or kidney-shaped nucleus. (it has one nucleus, however some of them might have more than one depending on which location that we actually talk about).

• They generally have well-developed Golgi complexes and many lysosomes with their content of proteases enzyme that they digest a protein.

It has a lot of lysosomes which important for the destruction of the any microorganisms that might get access in the connective tissue. And you will see many of them if you have any immune reaction or an inflammation in that site.

Macrophages usually side by side with fibroblast.

you have to identify macrophages when you see section of connective tissue.

it's usually in contact with the microorganism when the first gain access to connective tissue.

it has rough boundary to be ready to go around,to clean up to do it's functions.

- Macrophages are members of the mononuclear phagocyte system
- Originates from a precursor: **monocytes** that circulate in the blood.

"والحَولُ والقُوَّةُ كُلُّها لِله، وإنَّا دُونَ مَعونَتِه عَدَمٌ."!

Best wishes ★

V2

Page (4+5) : I rearranged the paragraph that appears in red colour.