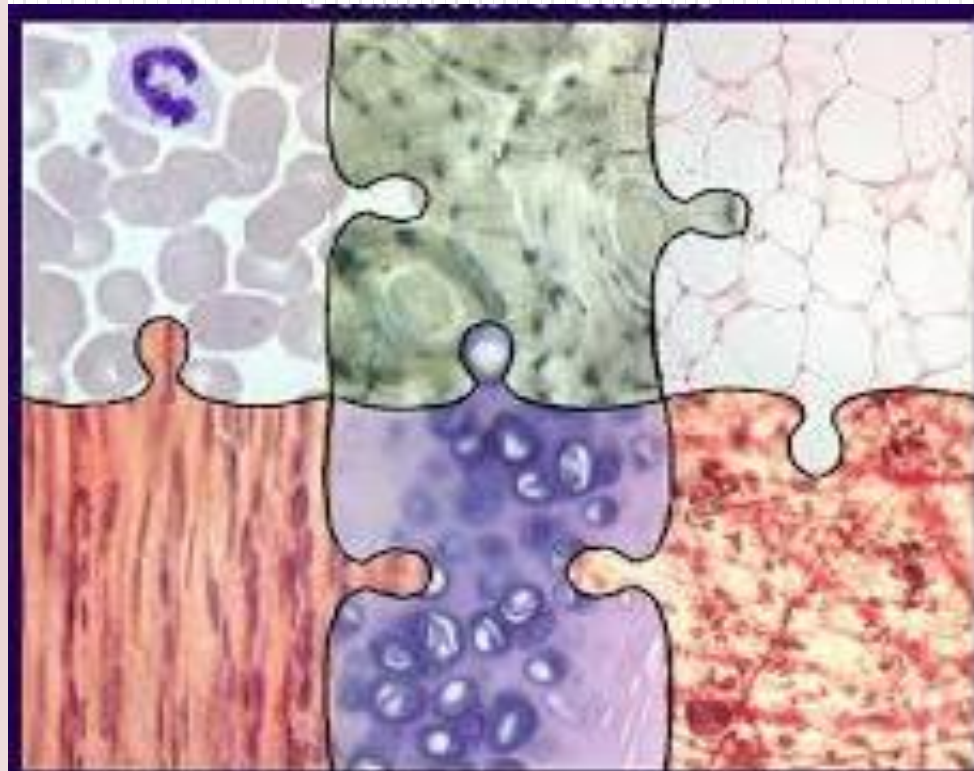


# CONNECTIVE TISSUE

By

Heba Hassan Abd Elgawad

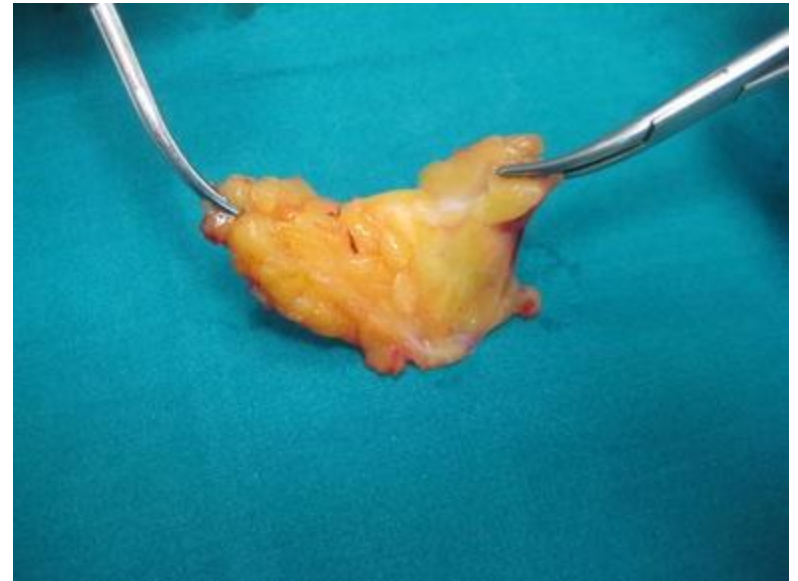
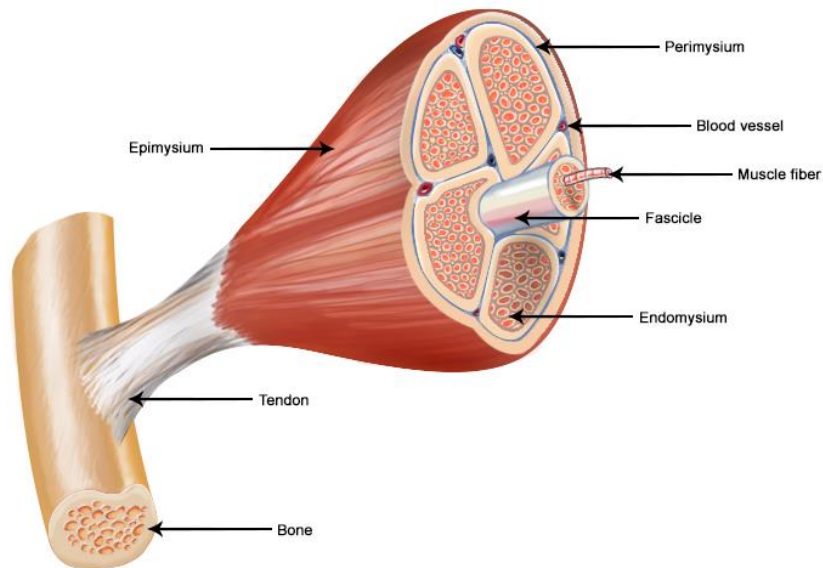
**Ass. Prof of  
Histology**



# CONNECTIVE TISSUE (C.T.)

It is one of the four basic tissues. The name “connective” is related to the function of connection and binding cells and organs together.

Structure of a Skeletal Muscle



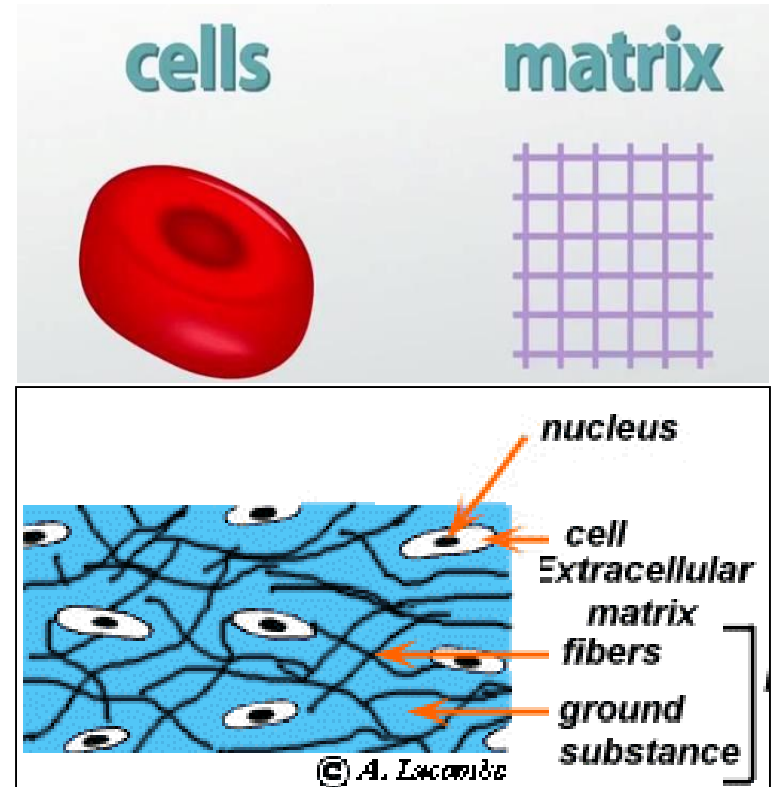
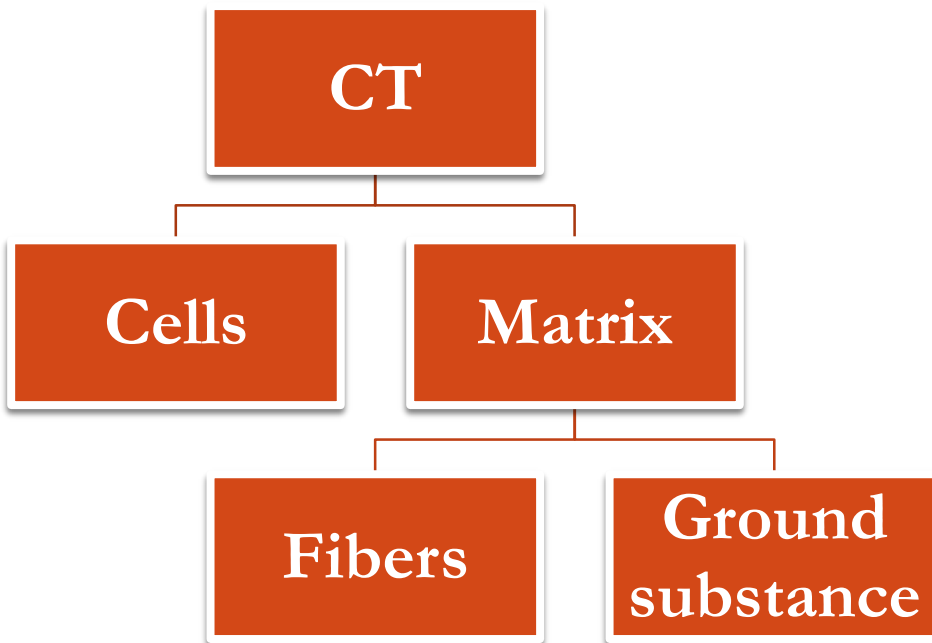
## Characters of connective tissue:

- 1- The cells of connective tissue are widely separated with large amount of intercellular substance between them.
- 2- It is derived from mesoderm.
- 3- It contains blood vessels, nerves and lymphatics supplying the organs.
- 4- The functions of connective tissue include structural support, defense, nutrition, storage (lipids), and repair of wounds.

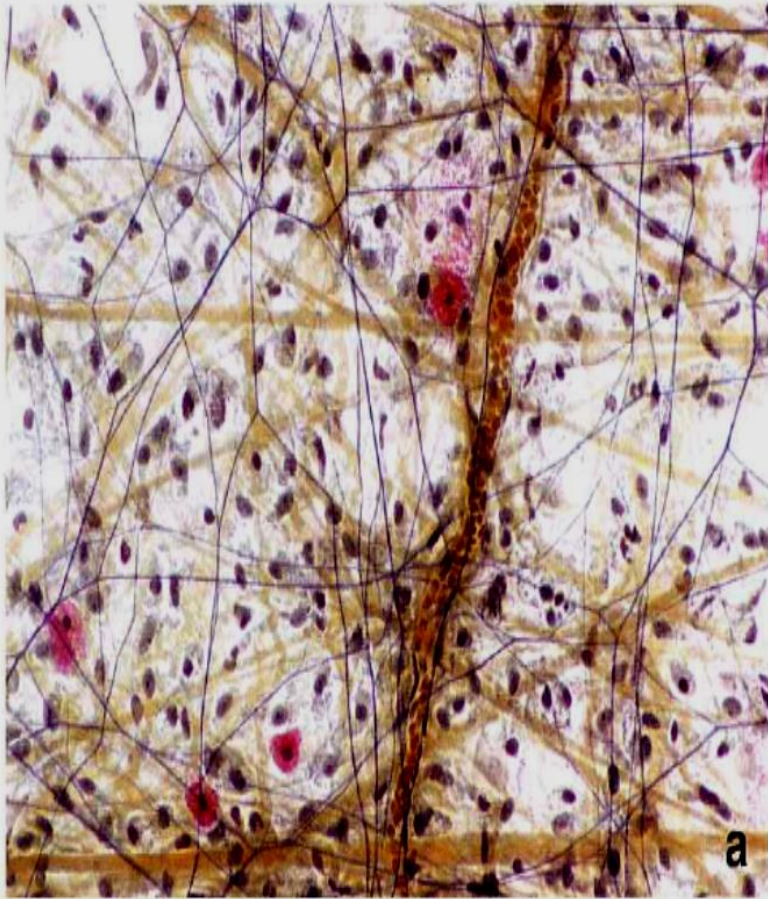
# Structure of C.T.

a - Connective tissue cells (less.)

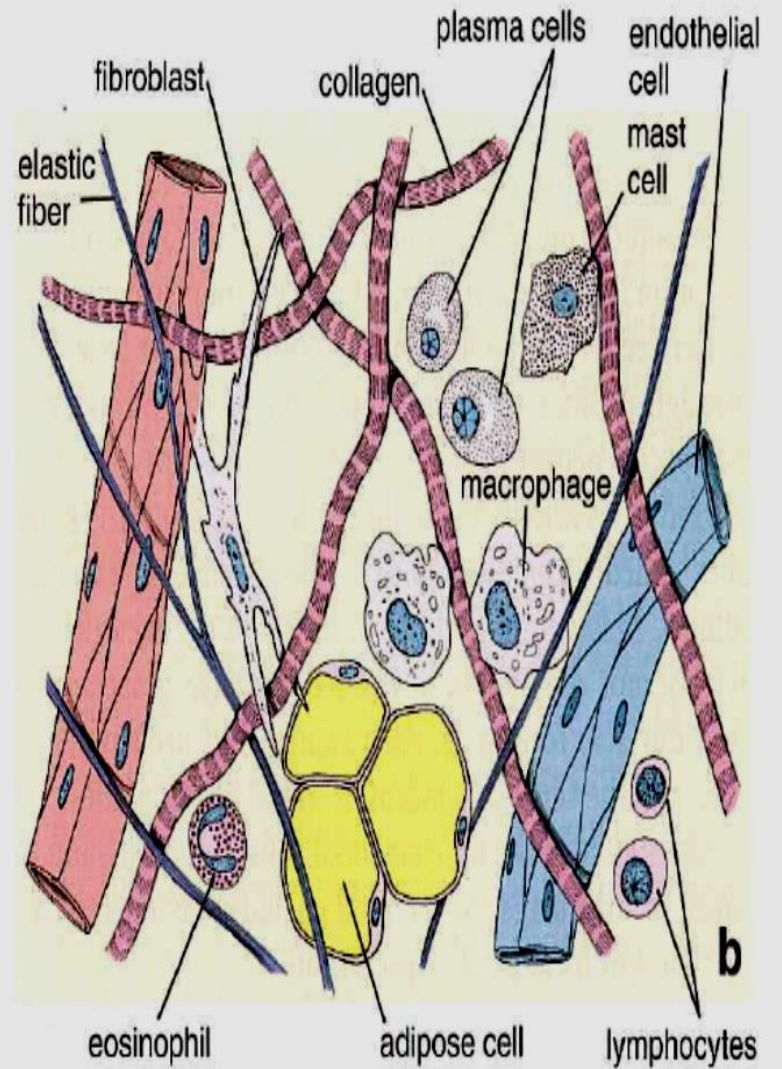
b - Intercellular substance (Matrix) (More).







**a**



**b**

# Connective tissue cells

## A- Fixed cells

Developed & remain in CT.  
They *originate locally* from undifferentiated mesenchymal cells and spend their life in C.T.  
They are long-lived cells.

Fibroblasts

Adipocytes

UMC

## B- Transient cells (Free or Wandering)

- Cells coming *from outside*
- Come from hematopoietic stem cells in bone marrow
- Circulate in blood and then move into C.T (wondering)

Plasma cells

Macrophage

Mast cells

Leukocytes

## Cell types

Macrophage

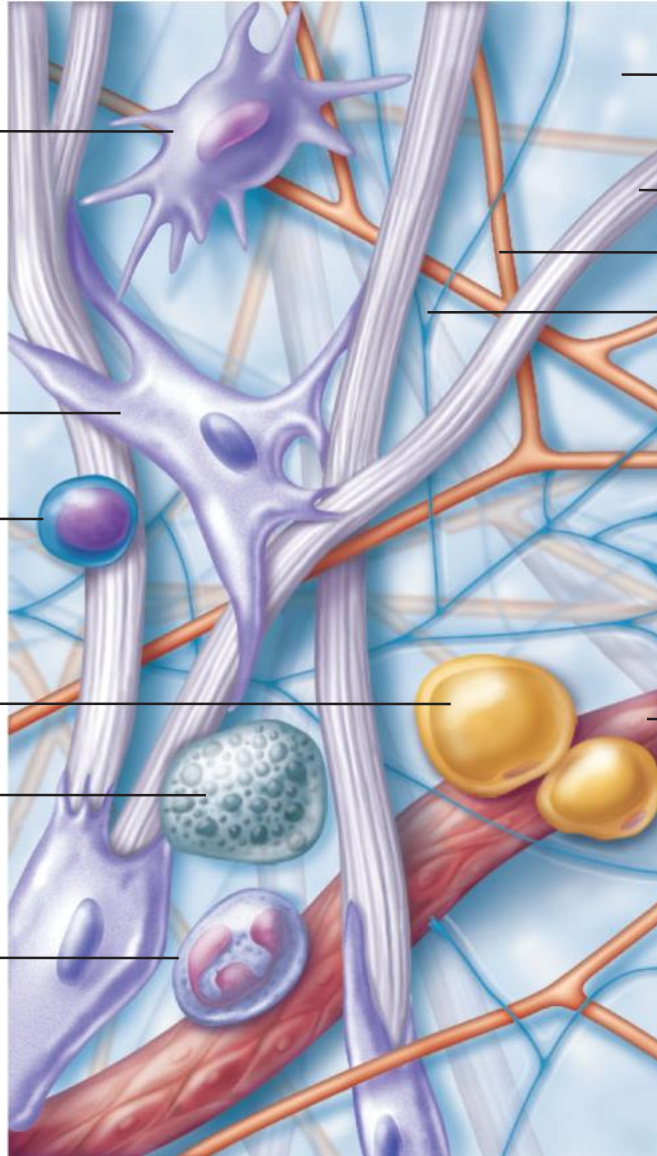
Fibroblast

Lymphocyte

Fat cell

Mast cell

Neutrophil



## Extracellular matrix

Ground substance

### Fibers

- Collagen fiber
- Elastic fiber
- Reticular fiber

Capillary

# Connective tissue cells

Shape

Size

Nucleus

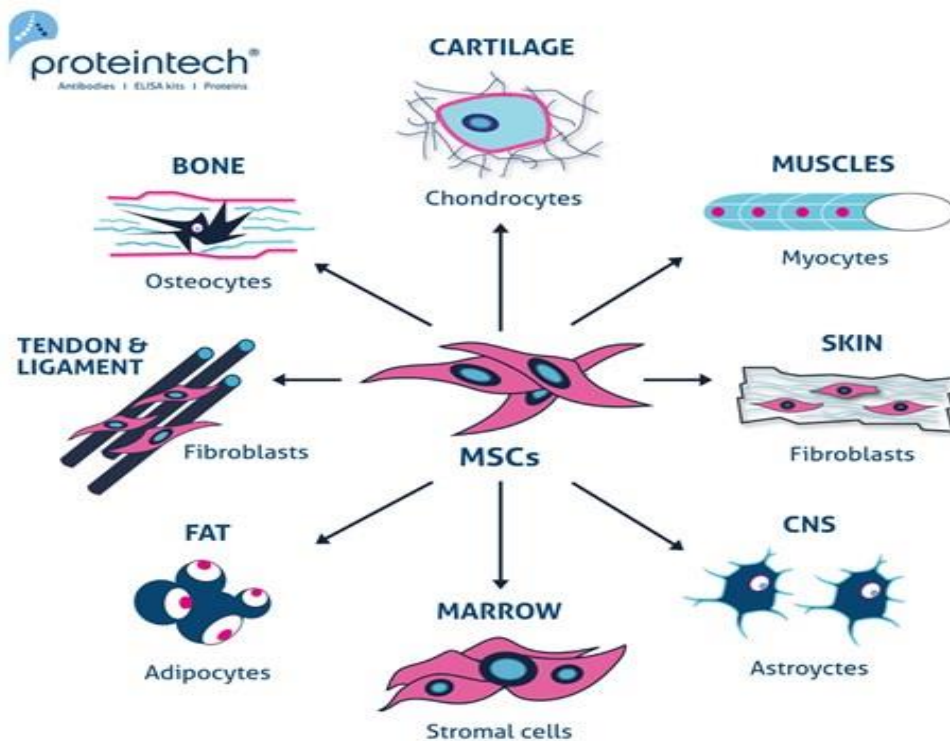
Cytoplasm

Function



# Undifferentiated mesenchymal cell

- - It is flat, spindle shaped cell having many processes with oval pale nucleus and basophilic cytoplasm
- -Function: It is the stem cell of most connective tissue cells.



## Undifferentiated mesenchymal cell



# Fibroblast

Most  
common  
cell in  
C.T.

Shape

large fusiform **branching** cells

Size

**larger** than fibrocyte

Nucleus

- Large ovoid
- Pale staining with fine chromatin
- Prominent nucleolus

**Active cell**

Cytoplasm

L.M.: **Basophilic**

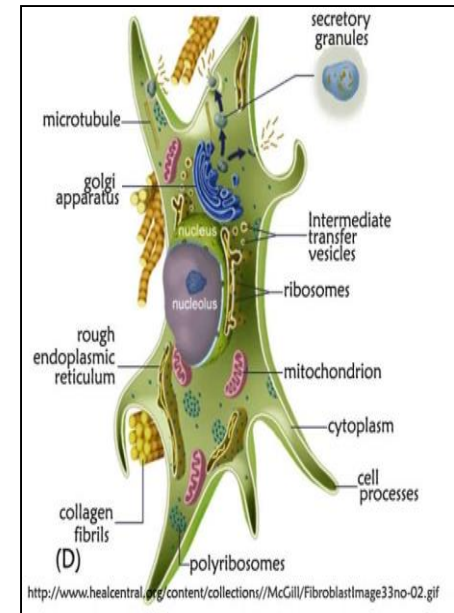
E/M:

- **Rich in RER**
- Well developed Golgi

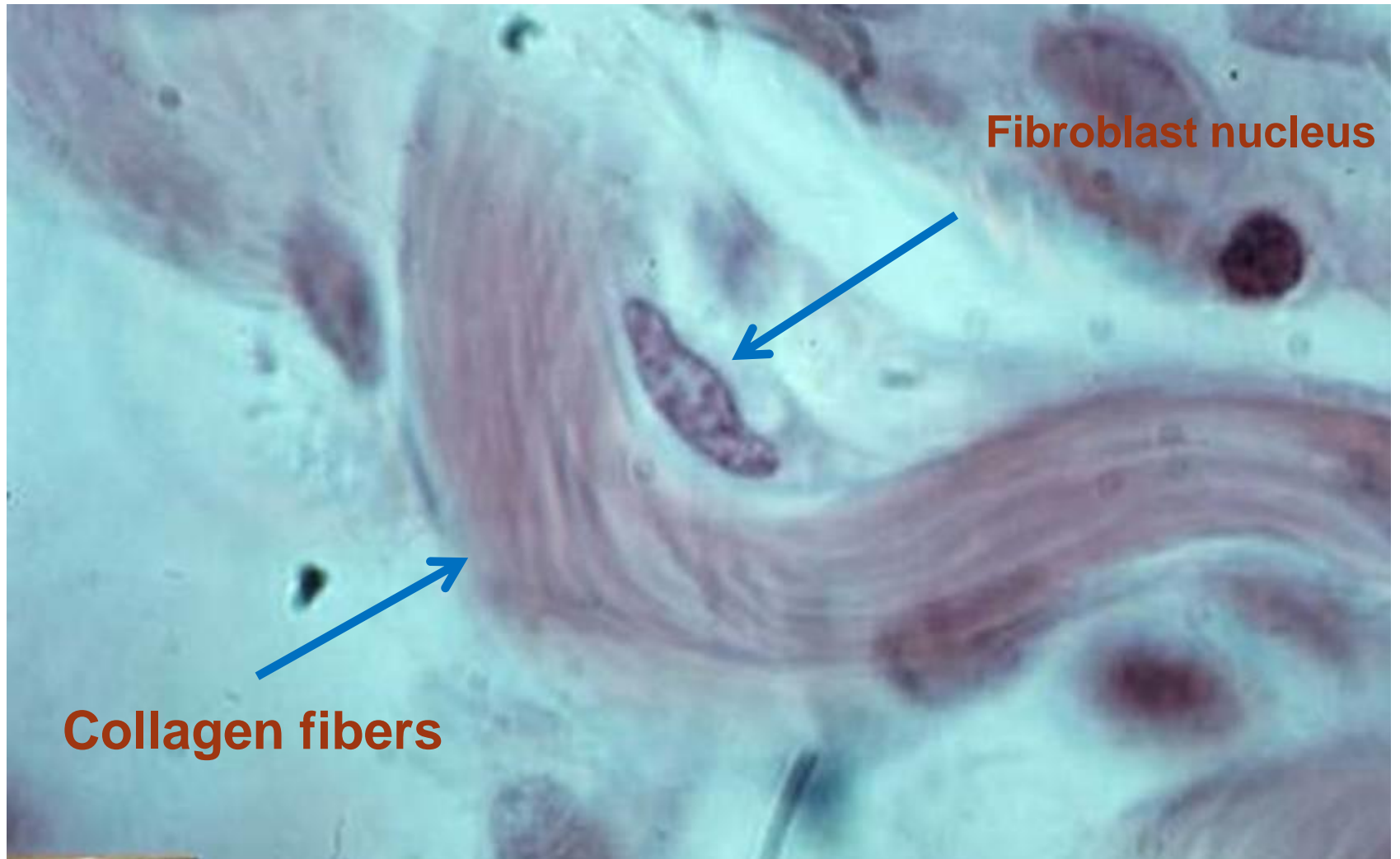
Function

Formation of:

- Components of connective tissue **matrix**
- Collagenic, elastic and reticular **fibers**.



**Protein  
synthesizing  
cell**

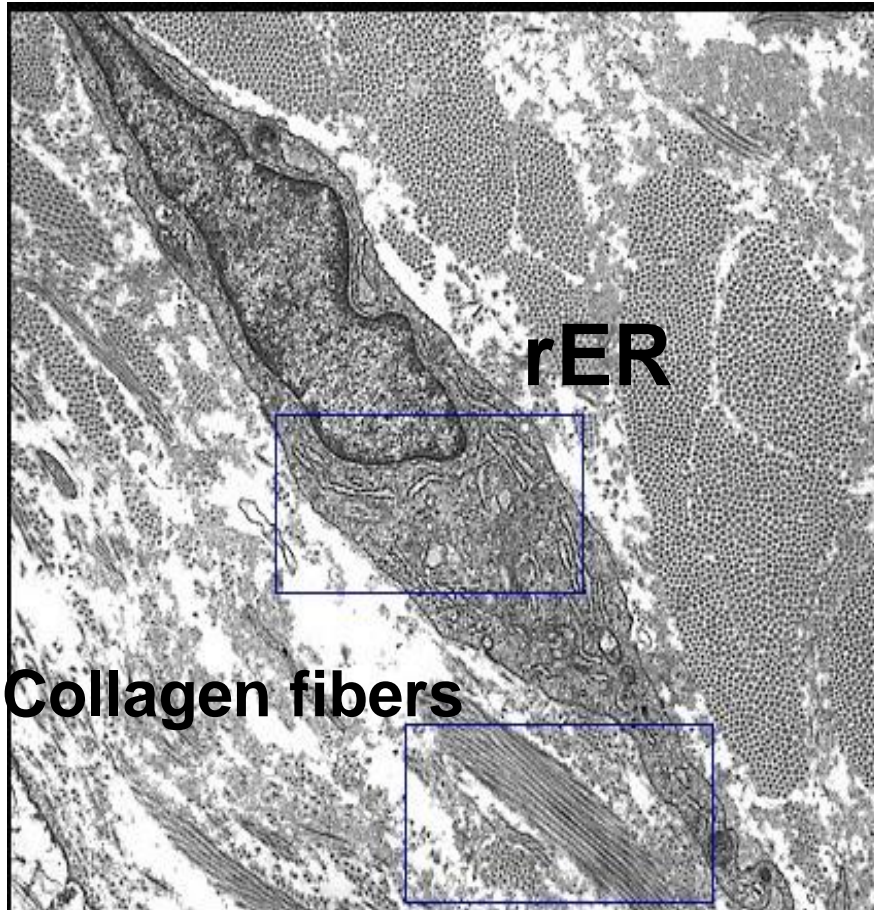


**Fibroblast nucleus**

**Collagen fibers**

**Fibroblast and collagen fibers**

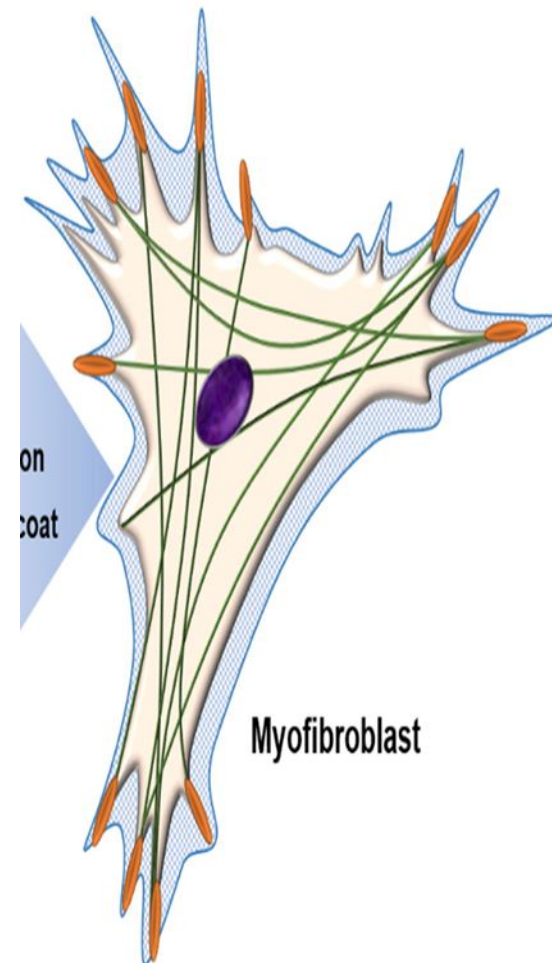
**Myofibroblast** : contains actin & myosin inside it. Myofibroblast is responsible for wound closure.



**Collagen fibers**

**rER**

**Fibroblast and collagen fibers**





# Fibrocyte

Old or  
inactive  
fibroblast

Shape

Spindle shaped with fewer processes.

Size

Smaller than fibroblast

Nucleus

Smaller, dark elongated

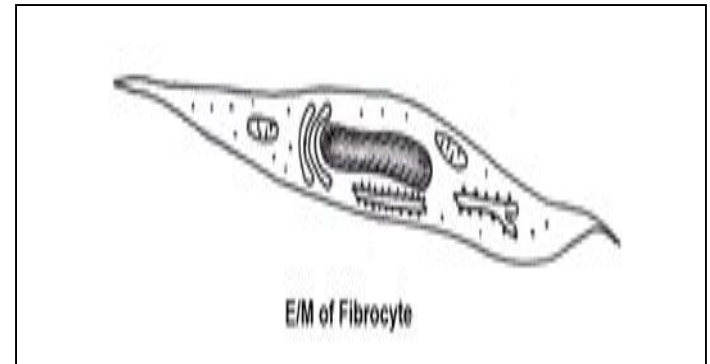
Cytoplasm

L.M: Less basophilic  
(nearly acidophilic)

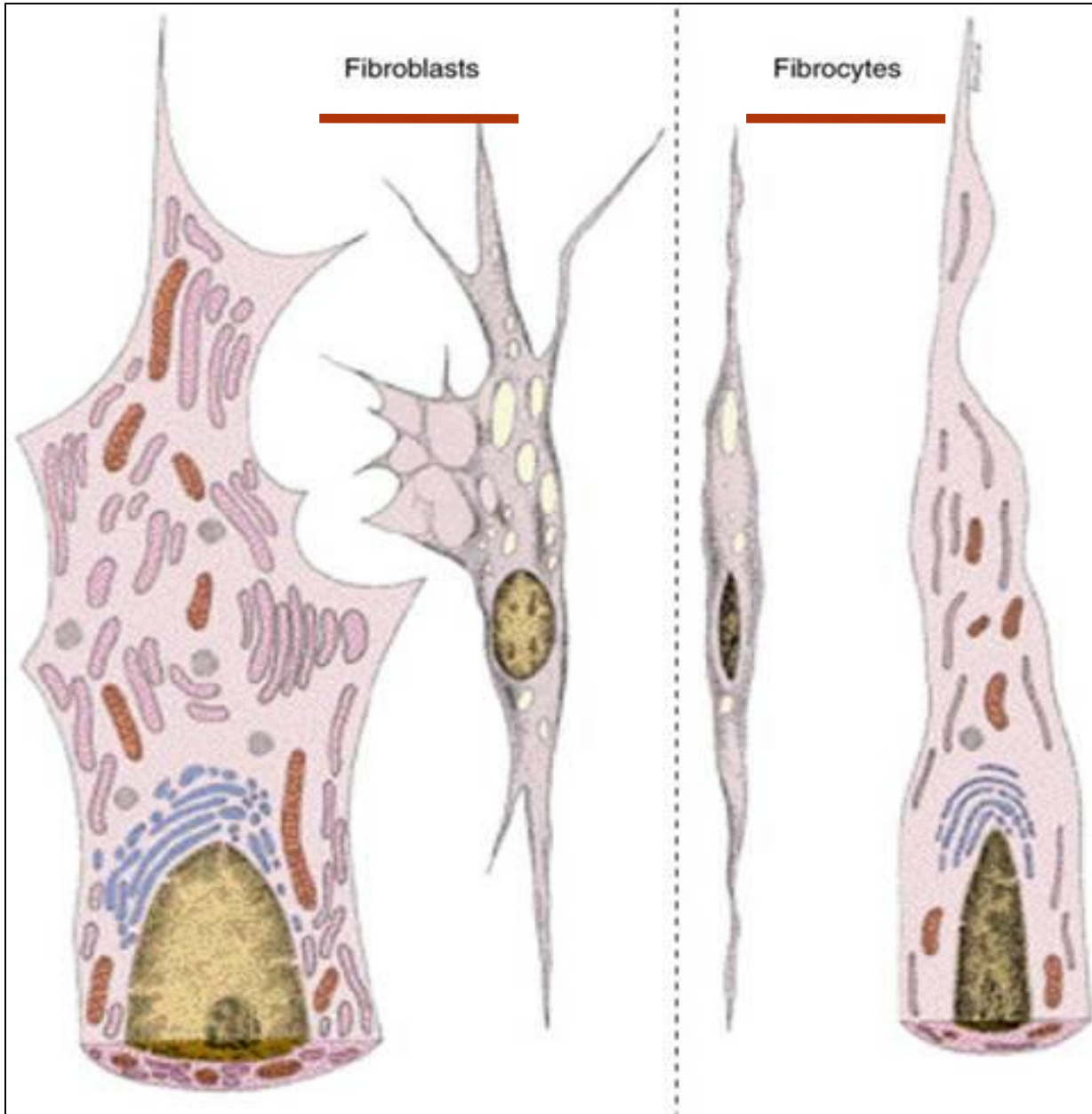
E/M: - Few RER

Function

It maintains components of connective tissue. Fibrocytes when activated, it converted into fibroblast.







Branched

Many rER

Ovoid pale nucleus

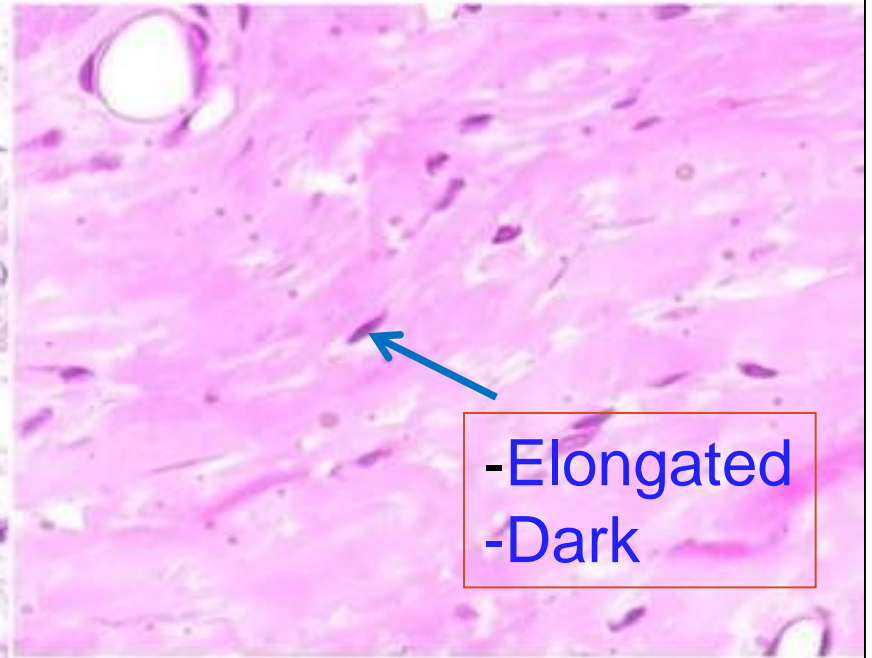
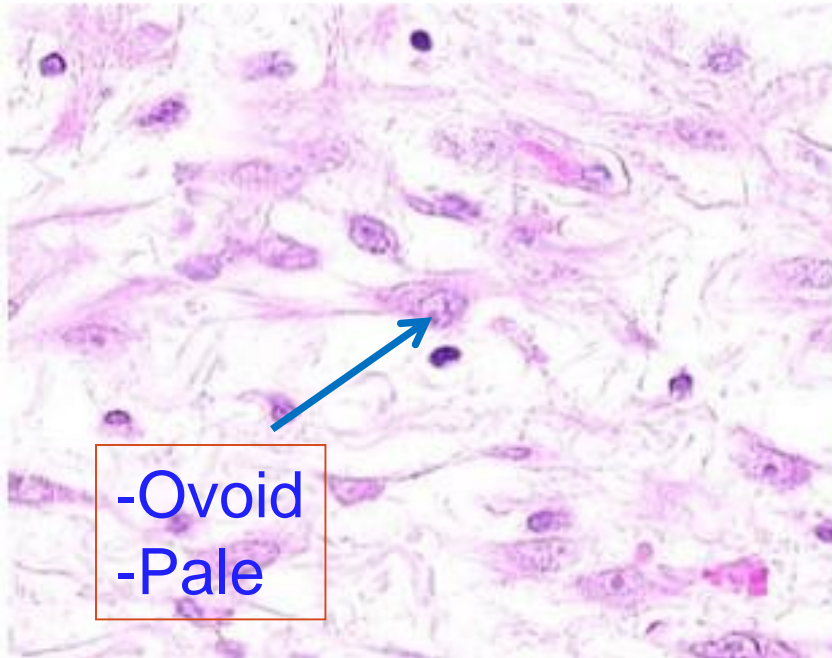
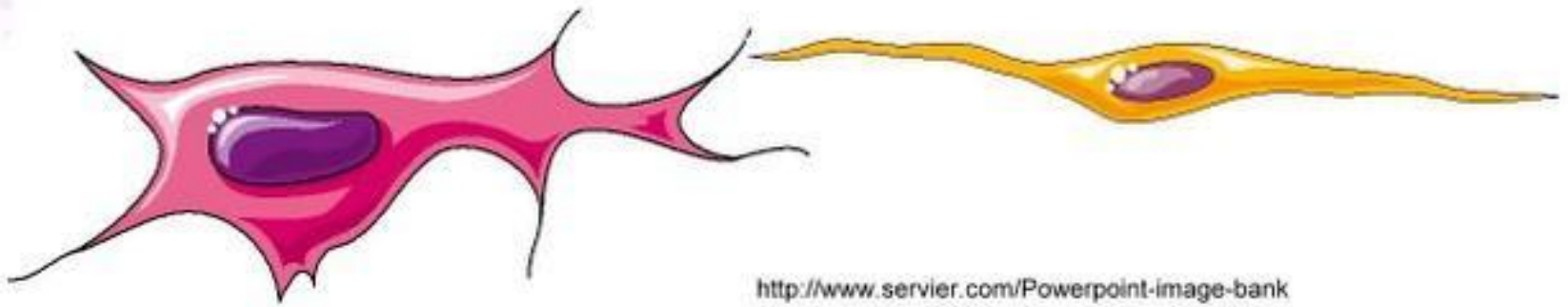
Spindle

Few rER

Elongated dark nucleus

# Fibroblast

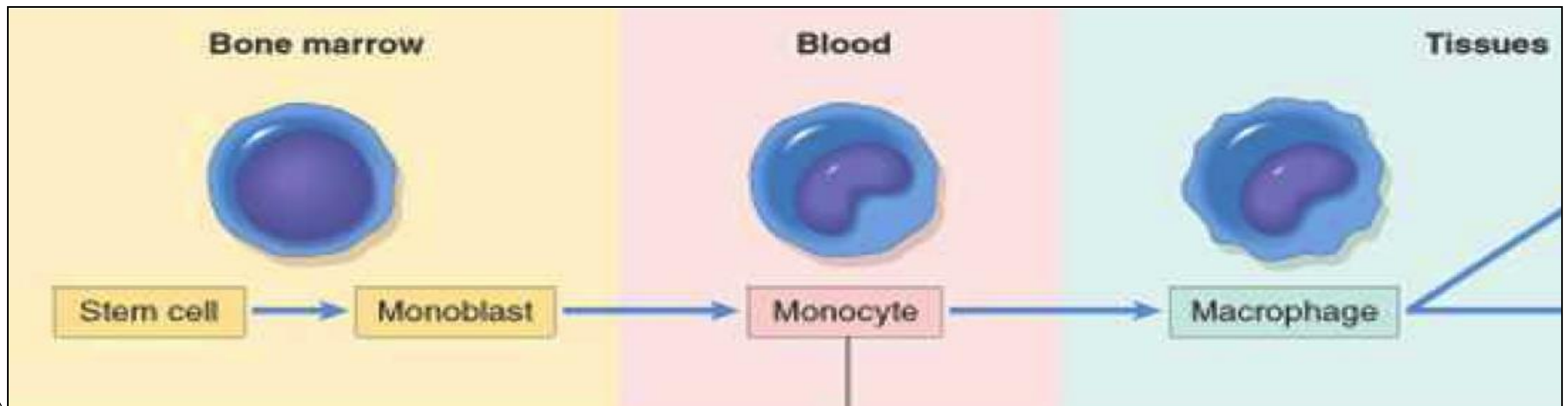
# Fibrocyte



# Macrophage

## Origin

- Derived from **bone marrow precursor cell** that divide, producing **monocyte** that circulate in the blood.
- Then, these cells **cross** the wall of capillaries to **penetrate** the connective tissue, where they mature and **acquire** morphological features of macrophages.



# Macrophage

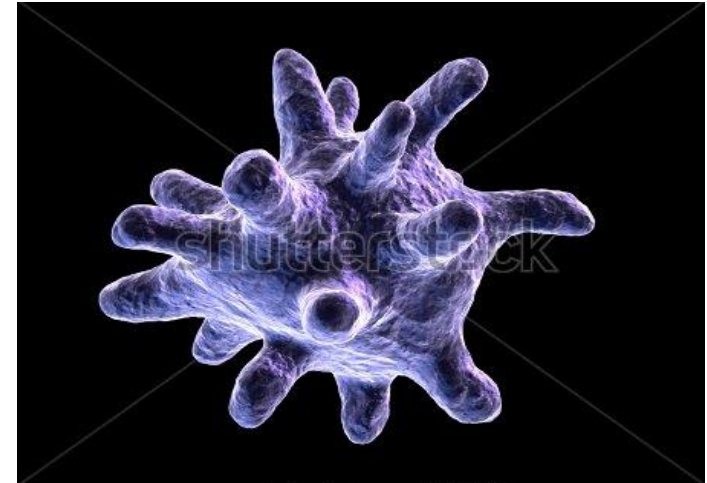
- **Shape:** large oval cell  
Irregular surface with protrusions (pseudopodia)
- **Nucleus :**
  - Eccentric
  - Oval or kidney shaped.
- **Cytoplasm:**

## L.M:

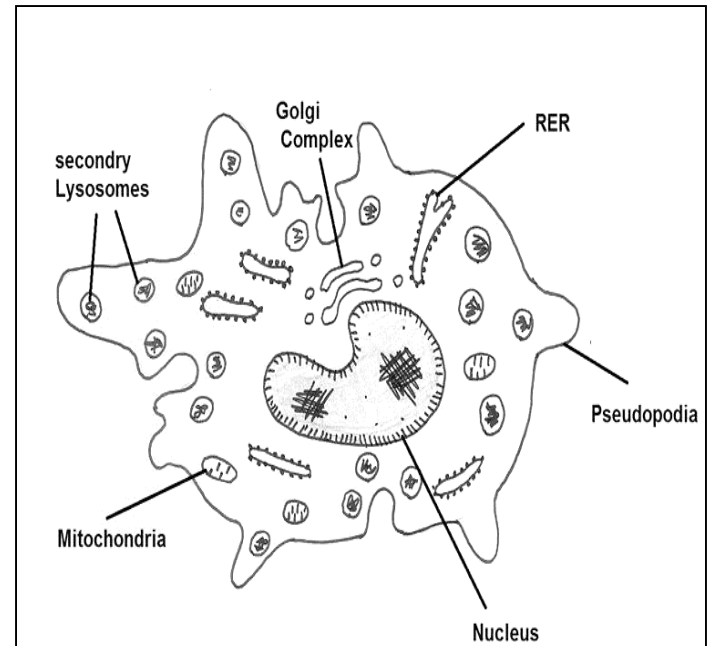
- Basophilic
- Contains many small vacuoles.

## E.M :

- **Many lysosomes.**
- Well-developed Golgi.
- Prominent RER.

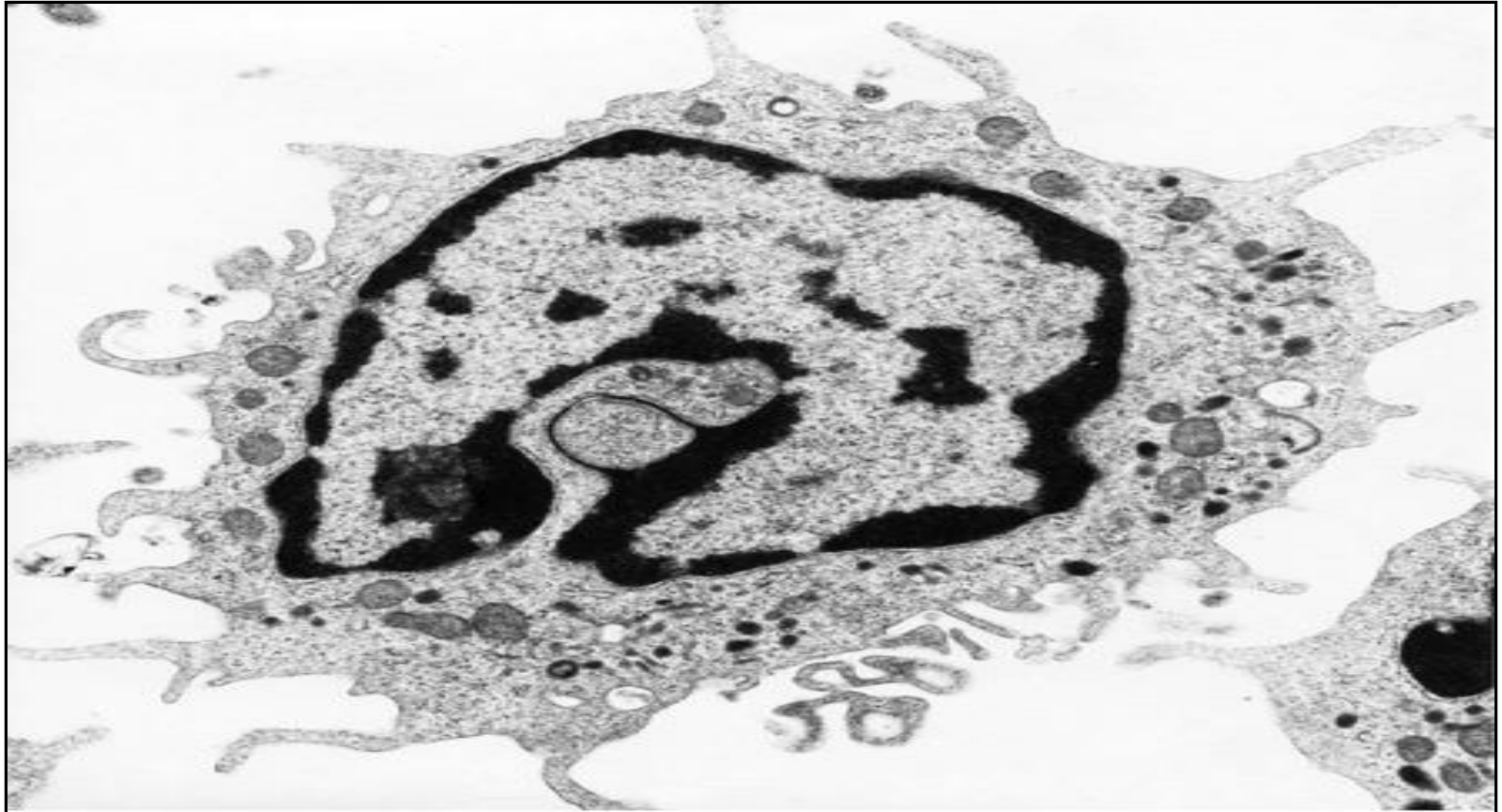


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# Macrophage)M.E)



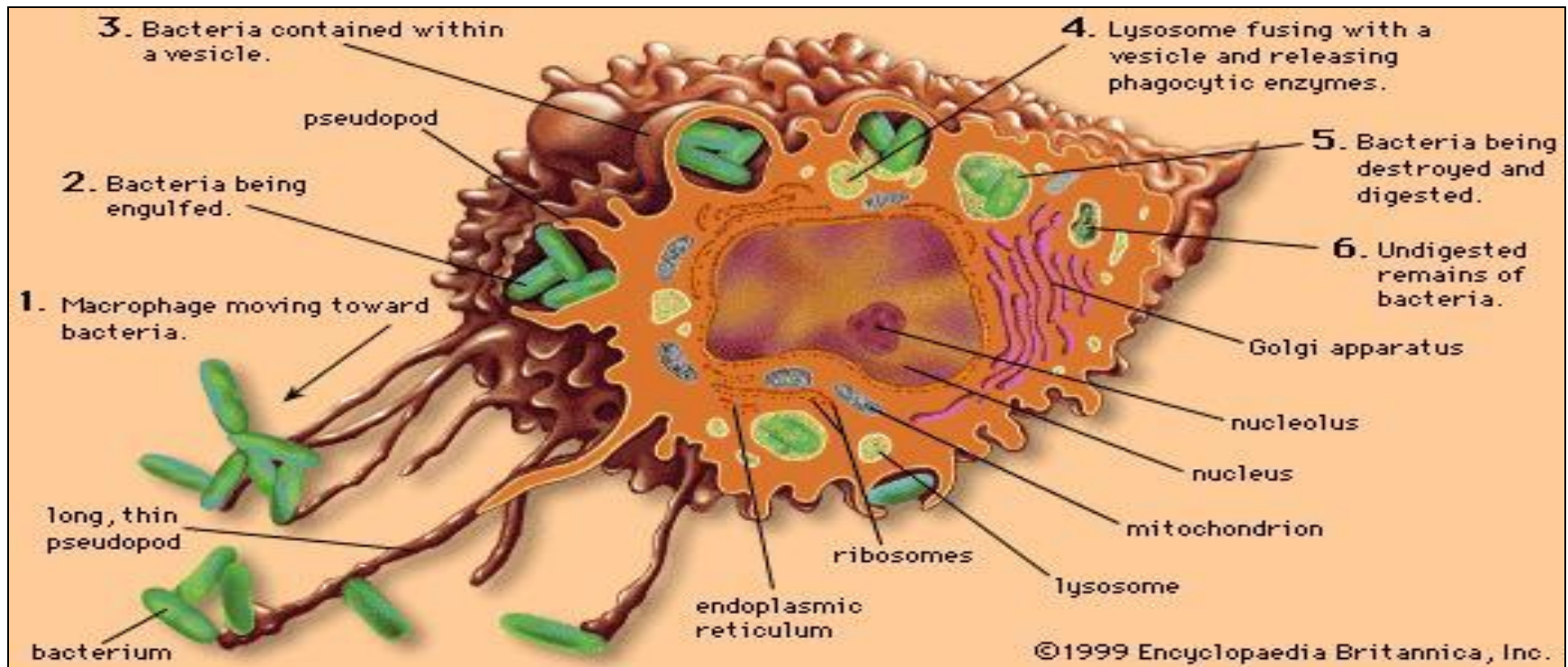
Source: Lichtman MA, Shafer MS, Felgar RE, Wang N:  
*Lichtman's Atlas of Hematology*: <http://www.accessmedicine.com>  
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## :Function

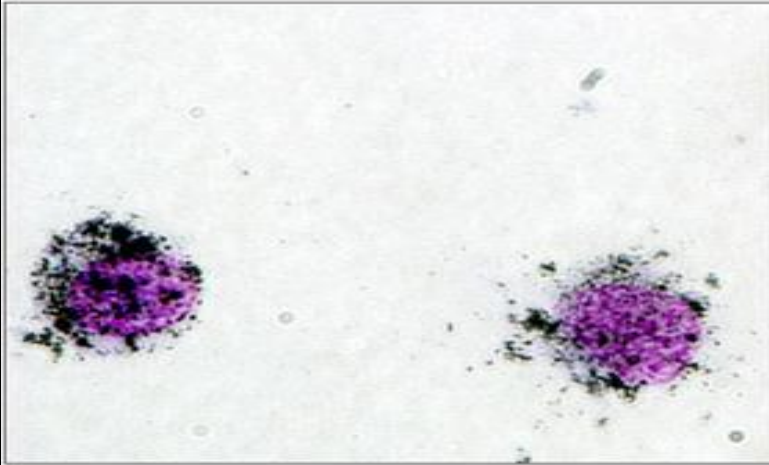
1. **Ingestion** of foreign particles (phagocytosis).
2. **Digestion** of foreign particles by lysosomes.
3. **Antigen processing and presentation** to lymphocytes.

**N.B:** Macrophages have different names in different organs, for example Kupffer cells in the liver, microglial cells in the central nervous system, Langerhans cells in the skin, and osteoclasts in bone tissue.

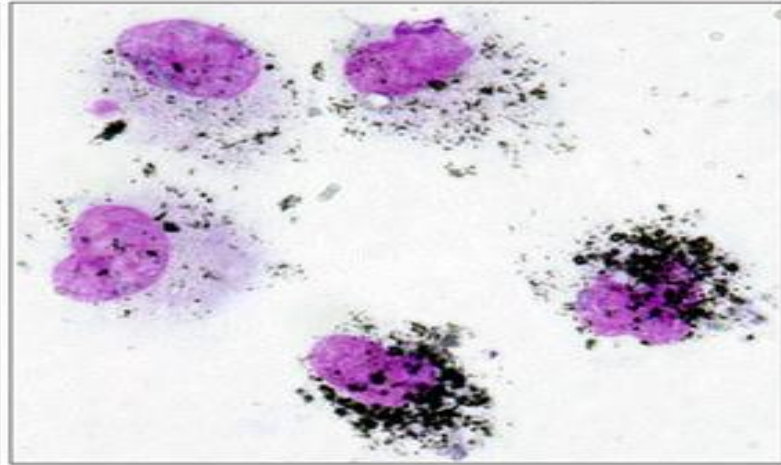


*Staining:* demonstrated by injection of Indian ink or trypan blue

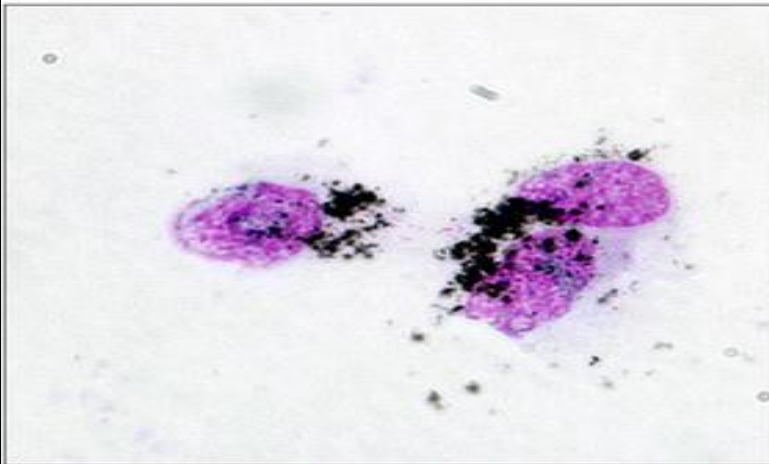
Mononuclear cells  
from blood



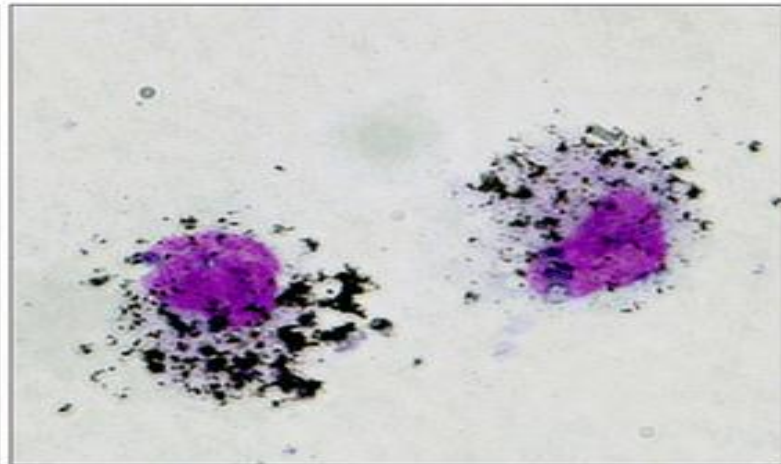
Alveolar macrophages



Peritoneal macrophages



Kupffer cells



# Mast cell

- Origin:

From stem cells in bone marrow.

- Sites:

They are widely distributed in C.T usually in close relation with blood vessels.

- Shape :

Oval to round

- Nucleus :

- Small, spherical
- centrally located.
- **Obscured** by cytoplasmic granules.

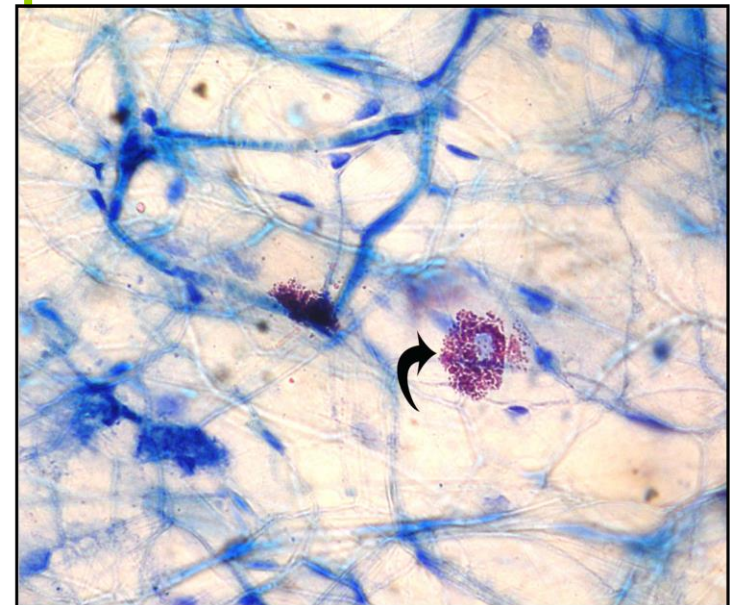
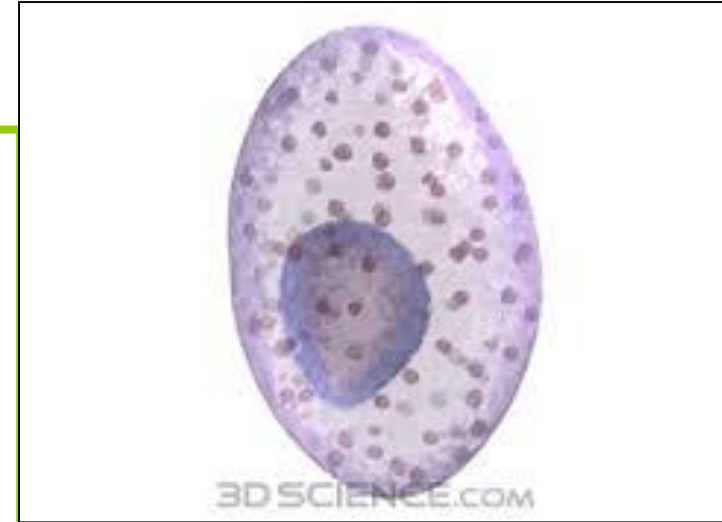
- Cytoplasm:

:L.M

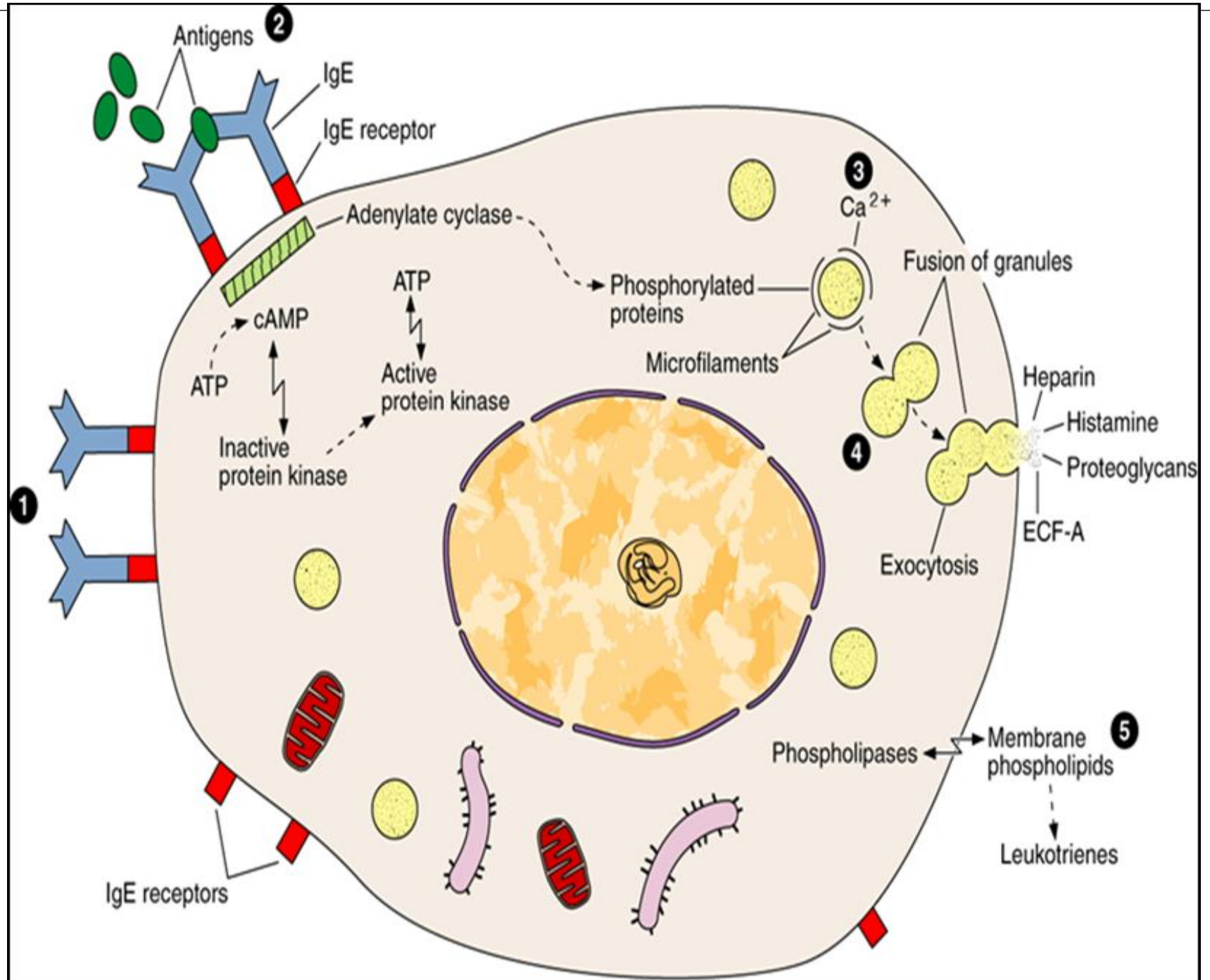
\_coarse granules

Staining:

The granules are **metachromatic** granules because they are stained **red** with toluidine blue.

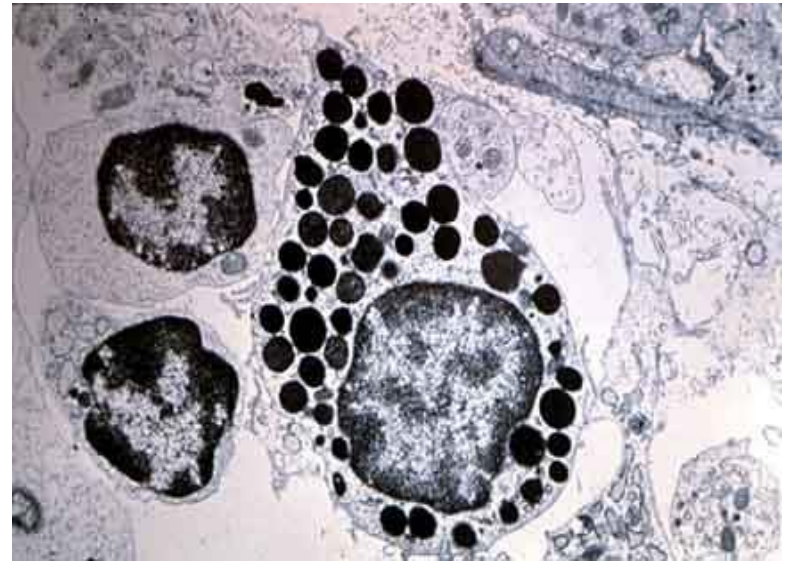






## E/M:

- Well - developed Golgi.
- Heterogeneous **granules** which are membrane limited.
- Few mitochondria.
- RER



## Function:

### 1-The contents of Mast cell granules:

- Histamine** which causes increase of vascular permeability, vasodilatation and bronchospasm [allergic reactions].
- Heparin** which act as anticoagulant.

2-Surface of mast cells contains specific receptor for IgE.

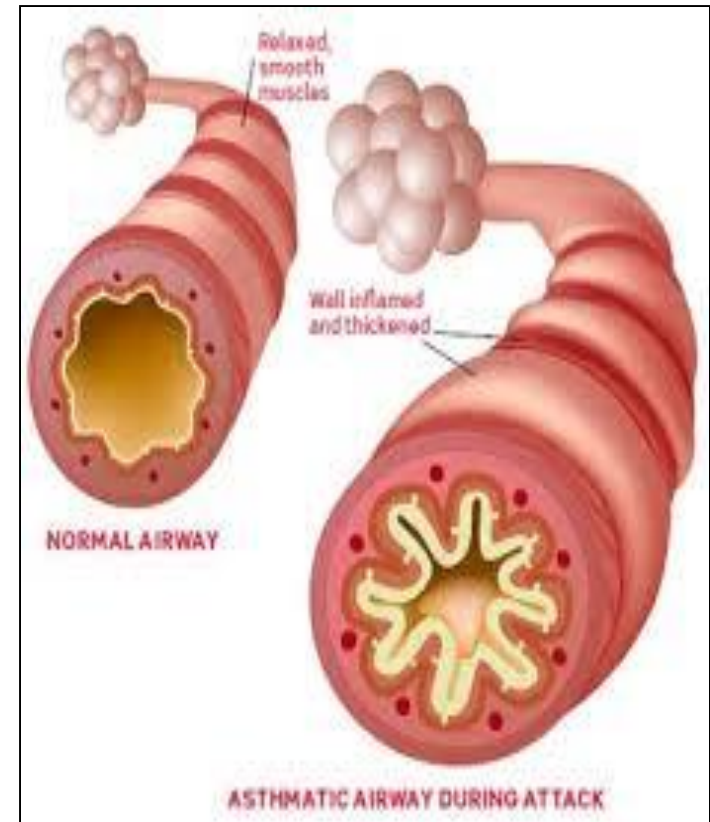
3- Responsible for an allergic reaction known as immediate hypersensitivity reaction (anaphylactic shock).



# Bronchial asthma

Allergic condition occurs due to secretion of large amount of histamine by mast cells triggered by subsequent exposure to the same allergen.

-Leads to **bronchospasm** and *difficulty in breathing*.



# Plasma cell

- Origin:

B-lymphocyte

- Shape :

large and oval

- Nucleus :

- Spherical

- Eccentrically placed.

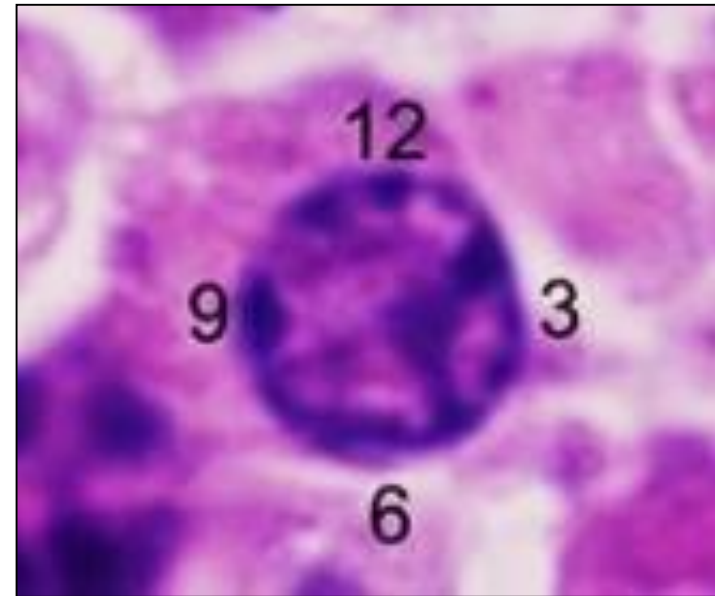
- Contains **compact** coarse chromatin alternating with **light-areas** of equal size that gives **(clock-face appearance) or (cartwheel)**

- Cytoplasm :

-L.M:

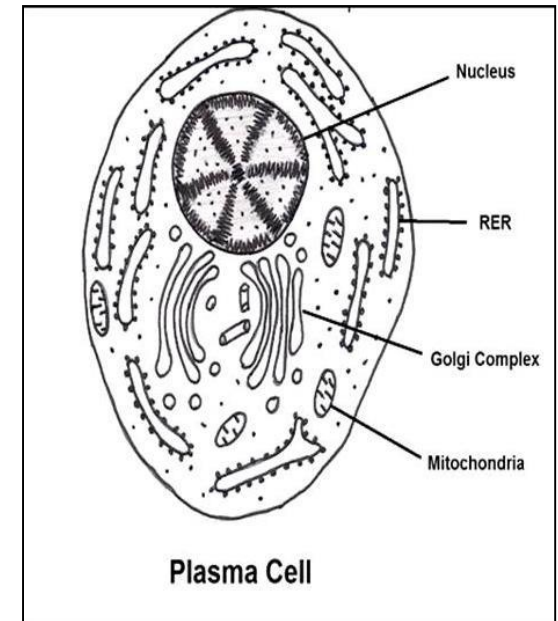
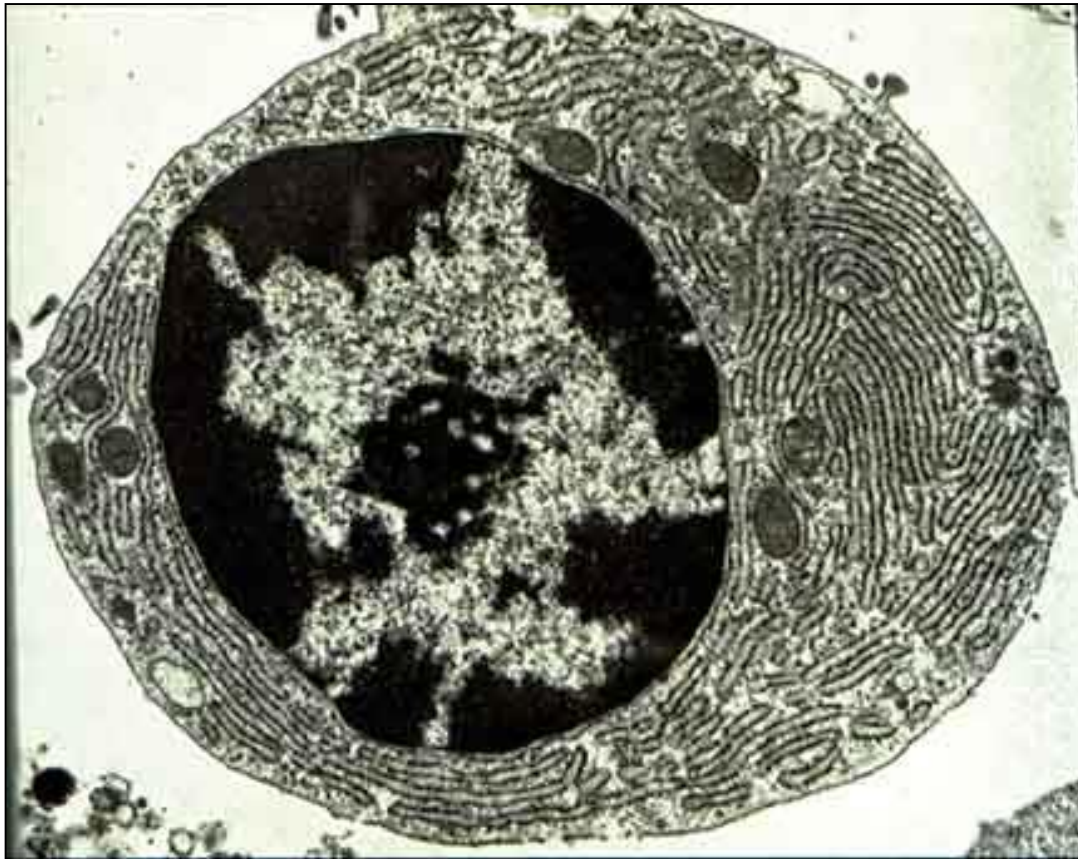
- Basophilic

- Contains *pale area near the nucleus (- ve Golgi image)*

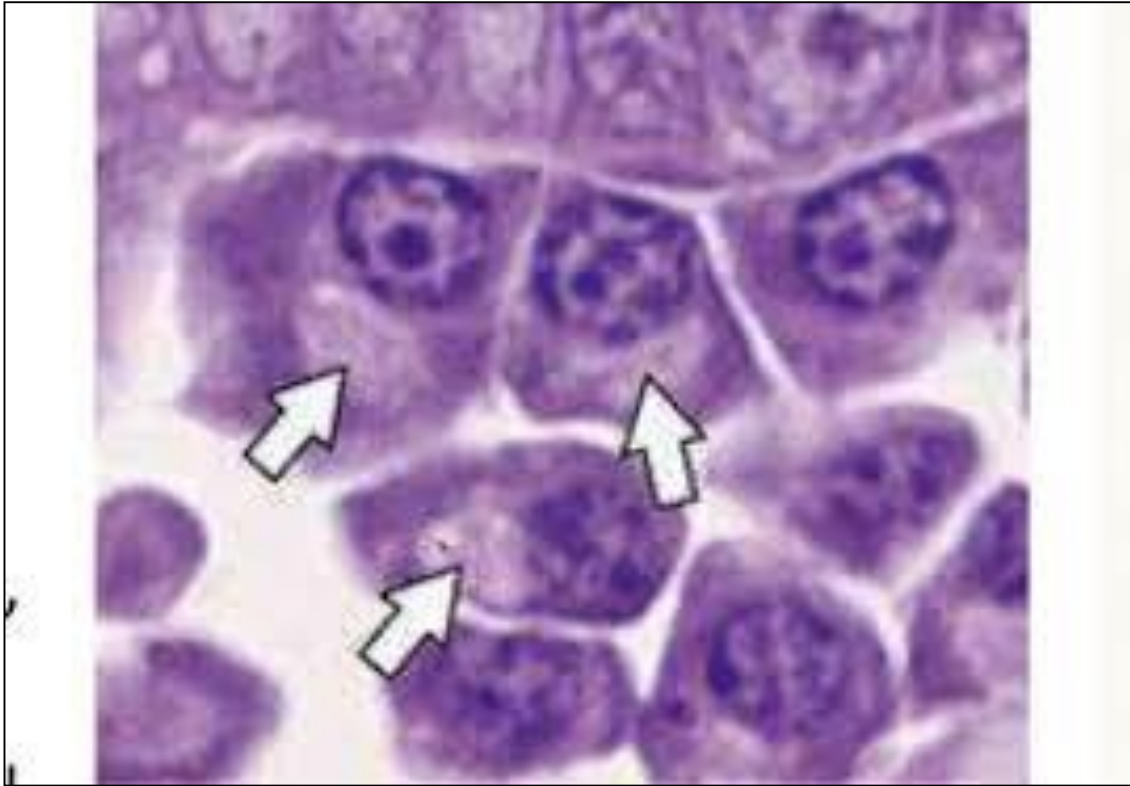


## E/M:

- Rich in RER
- Well developed Golgi
- centriole are present at the juxtannuclear region.



# Negative Golgi image



## Function:

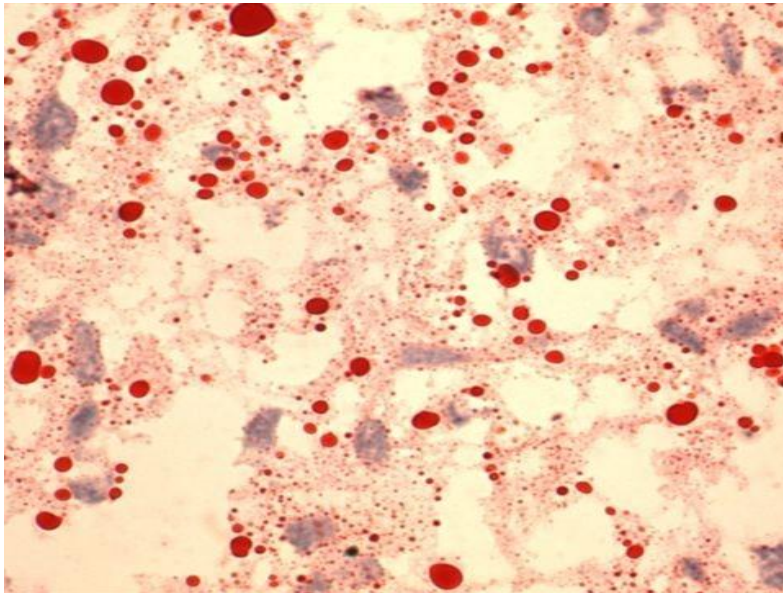
### Production of antibodies

- Specific globulins produced in response to penetration by antigen.
- Each antibody is specific for one antigen that gives rise to its production



# Adipose (fat) cell

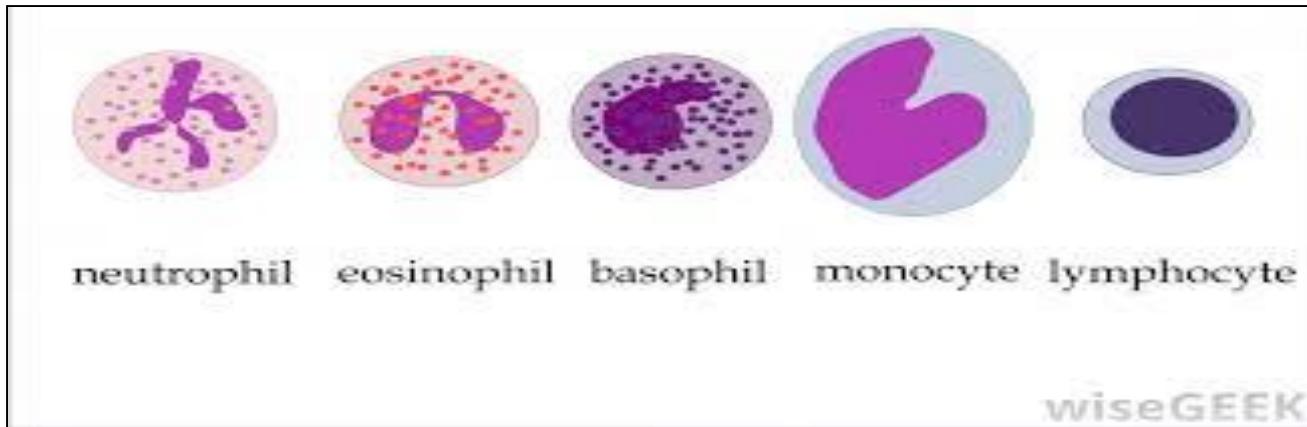
- - It is oval or rounded cell with flat nucleus.
- - It has one or more droplets of fat.
- -In haematoxylin & eosin stain it appears vacuolated and stained orange with Sudan III.
- Function: Storage of fat.



**Adipose (fat) cells**

# Blood leucocytes

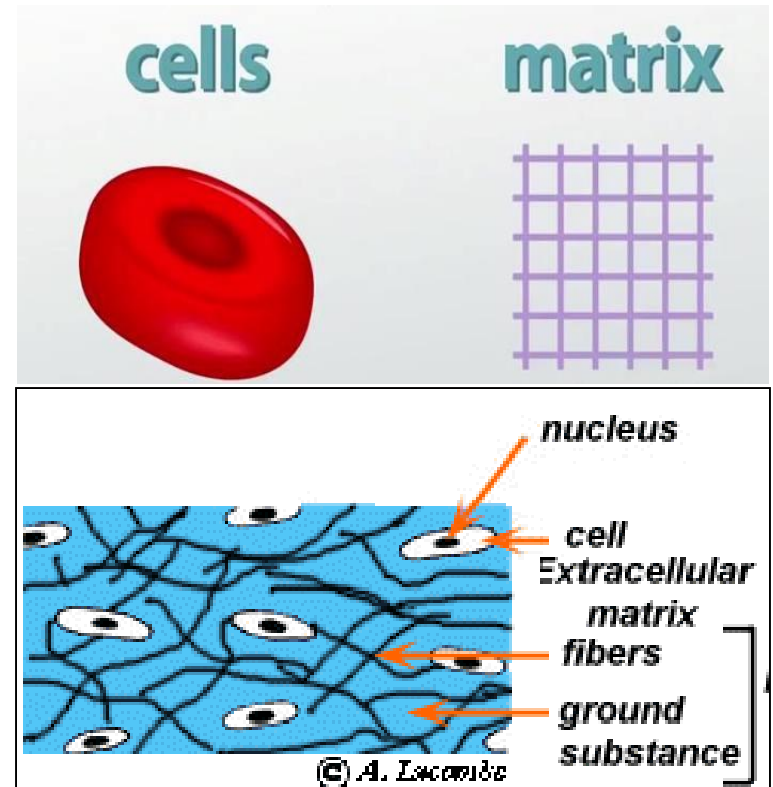
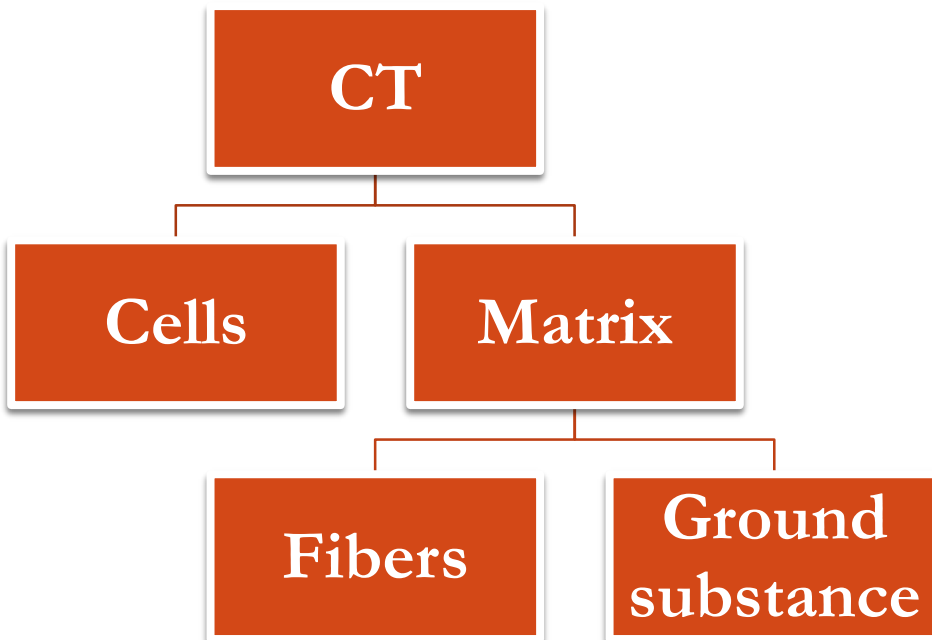
- **White blood cells** migrate to connective tissue where they perform their functions e.g. lymphocytes and eosinophils .



# Structure of C.T.

a - Connective tissue cells (less.)

b - Intercellular substance (Matrix) (More).

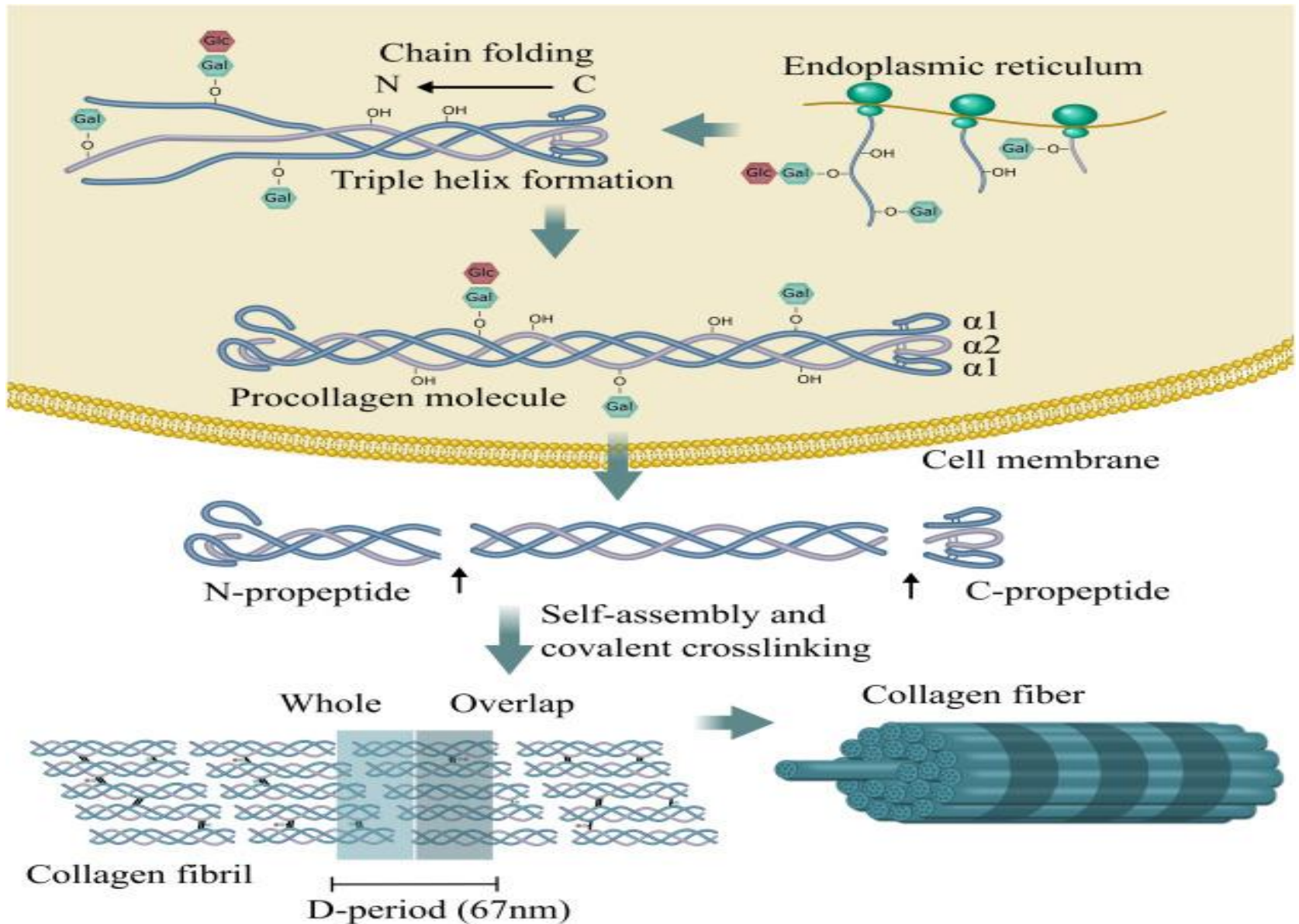


# Collagen fibers

- They are the most numerous fibers of connective tissue.
- When present in great amount, they give the tissue a white color (e.g. tendon).
- They are inelastic, but highly resistant to stretch.
- They are formed of protein called collagen.
- In the light microscope, collagen fibers are acidophilic; they stain pink with eosin and blue with Mallory trichrome stain, and red with Sirius red.



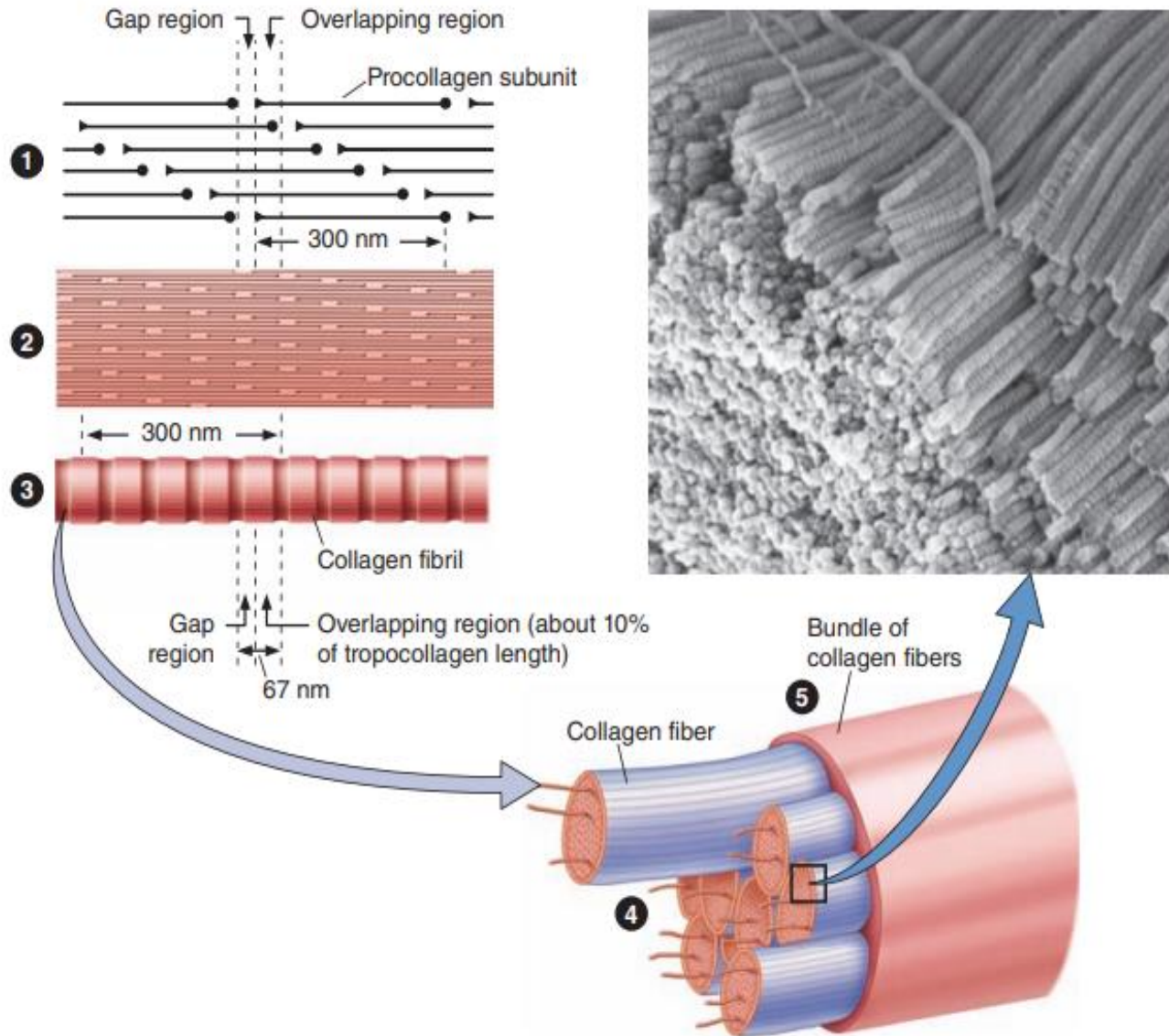
# Collagen synthesis



## Collagen synthesis

- Collagen synthesis occurs in many cell types. The initial procollagen  $\alpha$  chains are made in RER. The collagen gene family is very large, and many different  $\alpha$  chains have been identified, varying in length and sequence.
- In the RER **three  $\alpha$  chains** are selected, aligned, and stabilized by **disulfide bonds**, and folded as a triple helix. **The triple helix** undergoes exocytosis and is cleaved to a rodlike procollagen molecule that is the basic subunit from which the fibers or sheets are assembled.
- These subunits may be **homotrimeric**, with all three chains identical, or **heterotrimeric**, with two or all three chains having different sequences. Different combinations of procollagen  $\alpha$  chains produce the various types of collagen with different structures and functional properties.

# Collagen type I



## Types of collagen:

There are many (28) collagens, the most important are 6 types of collagen:

**1- Collagen type I** (90% of collagens): It is a basic protein that resists tension and presents in CT proper and Fibrocartilage

- Adjacent rodlike collagen subunits of the fibrils have small gaps (lacunar regions) between their ends. This structure produces a characteristic feature by EM (transverse striations with a regular periodicity). Type I collagen fibrils assemble further to form large, extremely strong collagen bundles.

## Medical applications:

- **Osteogenesis imperfecta:** Defective formation of collagen type I will cause spontaneous fractures and cardiac insufficiency.
- **Keloid** is a disfiguring local swelling caused by abnormal amounts of collagen in skin scars.
- **Scurvy:** Lack of vitamin C (essential for collagen synthesis), will lead to formation of defective collagens that cause ulceration of gums and hemorrhage.



**2- Collagen type II:** Resists pressure and present in Hyaline and elastic cartilage. It occurs as fibrils but does not form fibers or bundles.

**3- Collagen type III:** Supportive in expansible organs and present in Loose and reticular CT and Blood vessels.

**4- Collagen type IV:** Acts as a filter and present in Basal laminae.

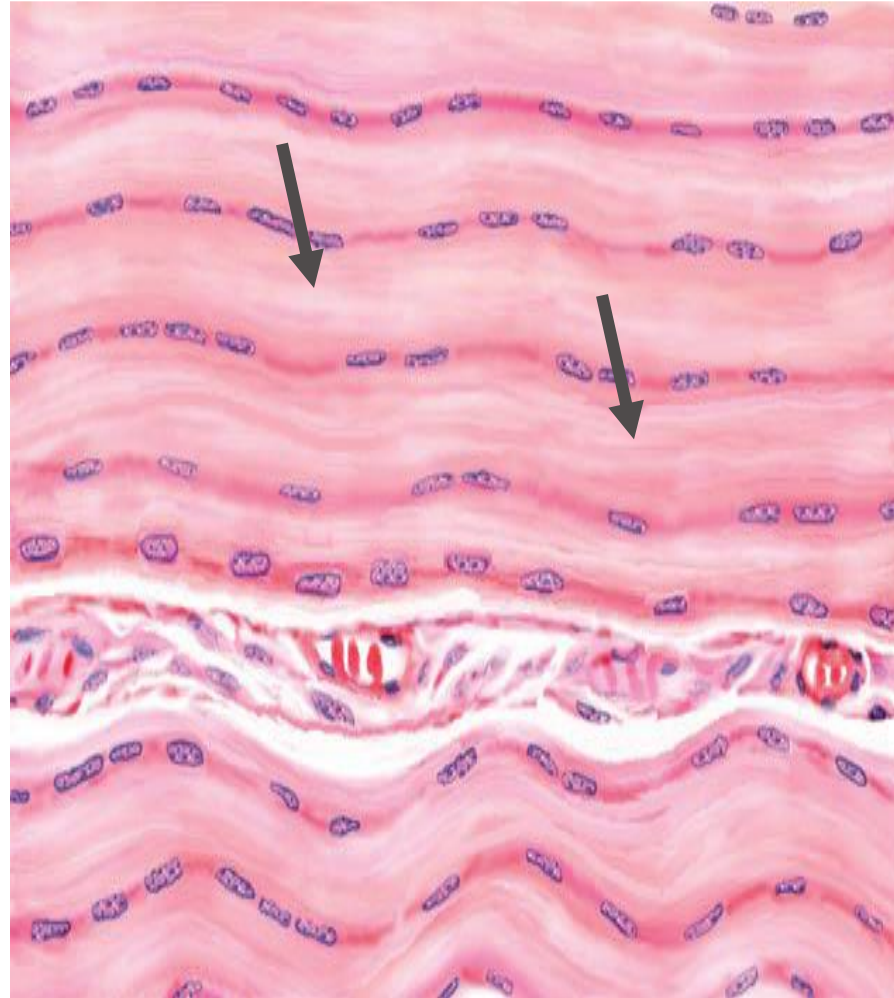
**5- Collagen type V:** Is associated with collagen type I and present in Fetal membranes and Basement membranes.

**6- Collagen type VII (Anchoring/ Linking collagen):** present in basement membranes.

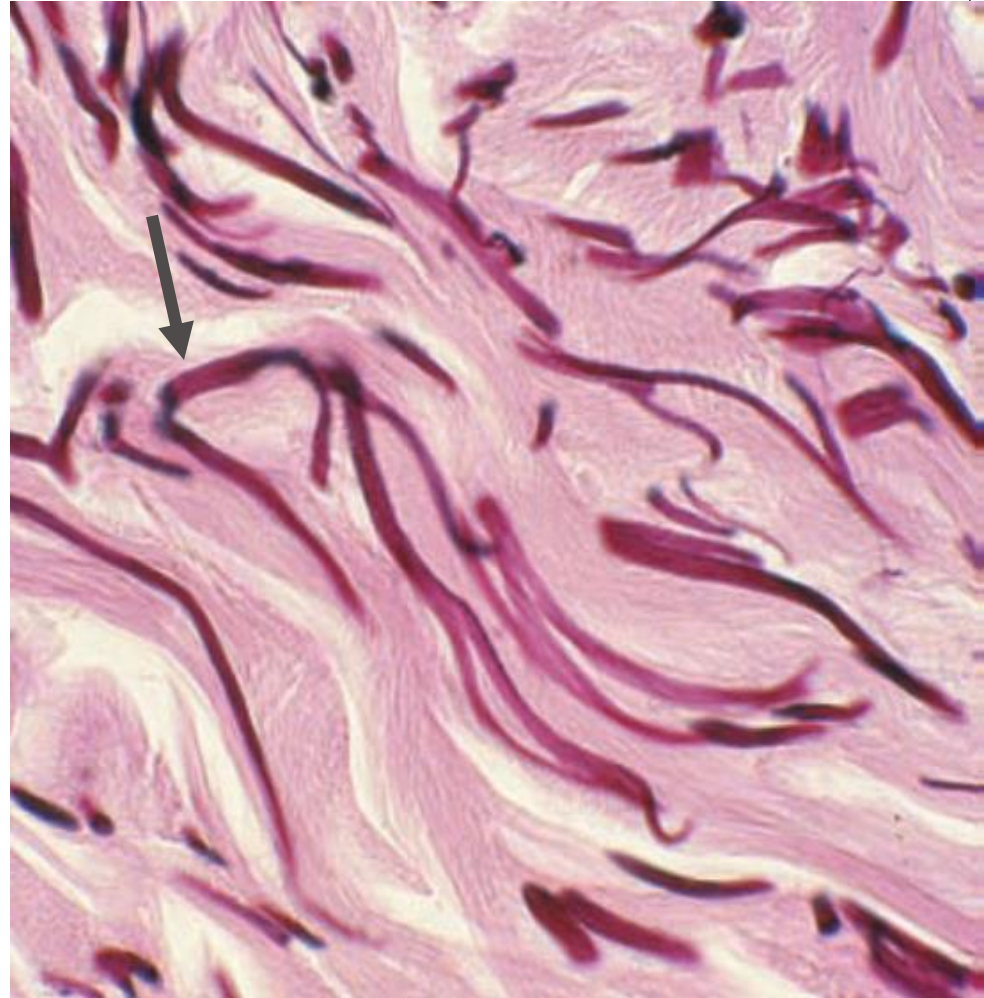
# Elastic fibers

- Elastic fibers are fine, usually present singly and can branch and anastomose.
- When present in large amounts, they give the tissue a yellow color.
- They are soft, flexible and elastic
- They are formed of a protein called elastin
- They stain brown with orcein.
- They are found in lung, skin, and walls of blood vessels.

# Collagen fibers

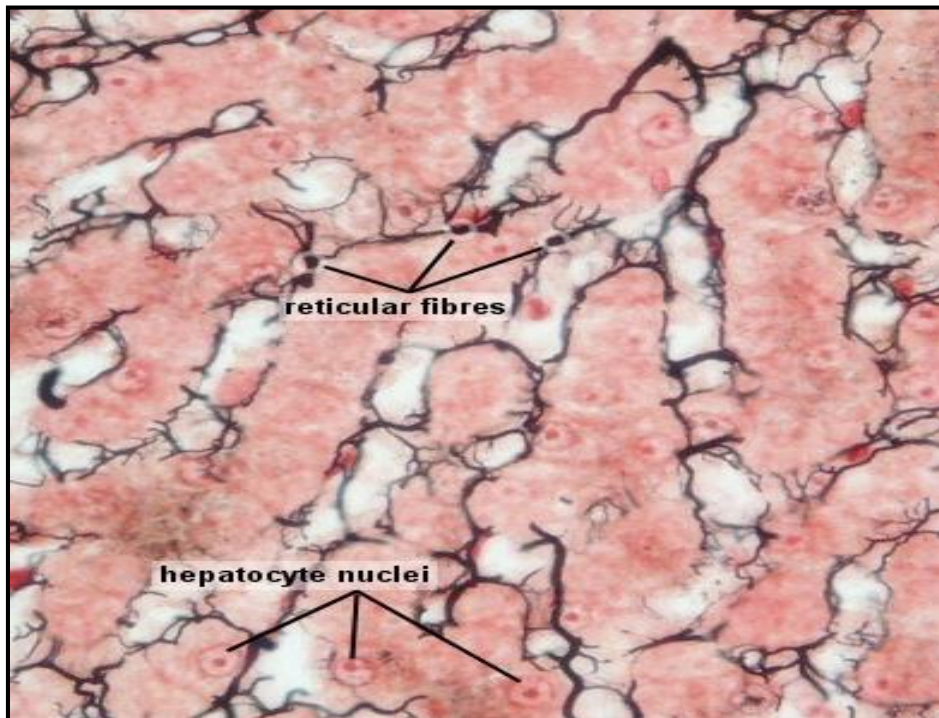


# Elastic fibers



# Reticular fibers

- They are very fine fibers, branch and reunite to form a network supporting highly cellular tissues (endocrine glands, lymph nodes, liver, bone marrow, spleen, smooth muscle).
- They are composed mainly of collagen type III.
- They are stained black with silver.





A white, hand-drawn style thought bubble sticker is pinned to a brown corkboard. The bubble has a small tail pointing downwards. Inside the bubble, the words "Thank you!!" are written in a bold, black, sans-serif font. "Thank" is on the top line and "you!!" is on the bottom line, slightly indented to the right.

Thank  
you!!