BLOOD

By

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Blood

Blood is a specialized connective tissue in which cells are suspended in fluid extracellular material called plasma . It is about 5 L of blood in an average adult

Functions of the blood:

1- Acid-base balance maintenance.

2- Control body temperature

3- Defense against infection

4- Transport oxygen, carbon dioxide and hormones.

5-Removal of waste products of cell metabolism.

Components of Blood

Blood cells 45%

1- Red blood cells (corpuscles) or erythrocytes.

2- White blood cells or leukocytes.

3- Platelets.

Blood plasma 55%

It is a *yellow* fluid in which the blood cells are suspended.

1- Water 90 % .

2- Plasma proteins 7% (albumin, globulin,
-fibrinogen and prothrombin) .

3- Small amounts of
- Ca
- sodium chloride,
- bicarbonate
- phosphate.

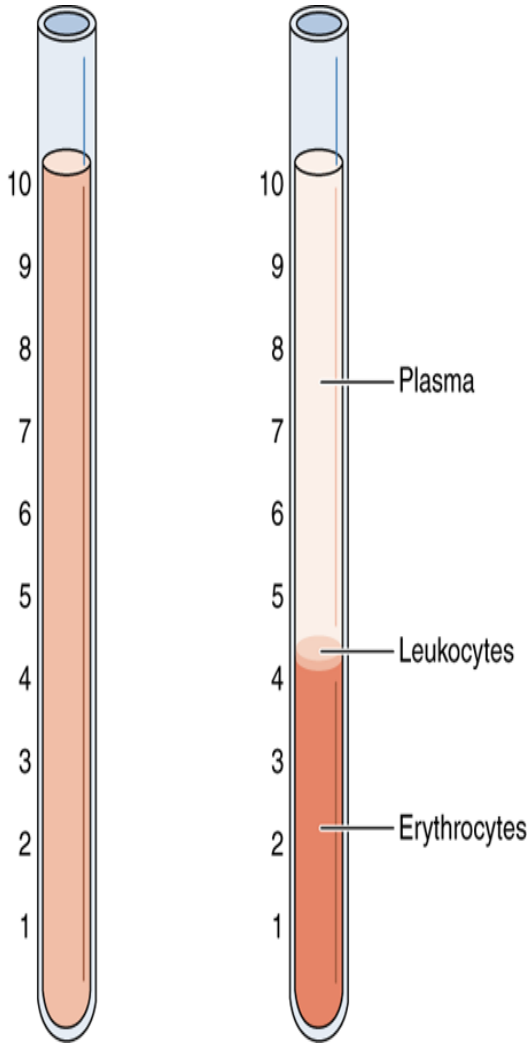
Blood cells

1-True: have nucleus.

- White blood cells or leukocytes (1%).

2-Not True:

- Red blood corpuscles or erythrocytes (44%).
- Platelets or thrombocytes (less than 1%).



Erythrocytes (RBCs)

- **Erythrocytes** (red blood cells or RBCs) are lacking nuclei and completely filled with the O2 carrying protein **hemoglobin**.
- RBCs are the only blood cells whose function does not require them to leave the vasculature.

- **Number of RBCs**

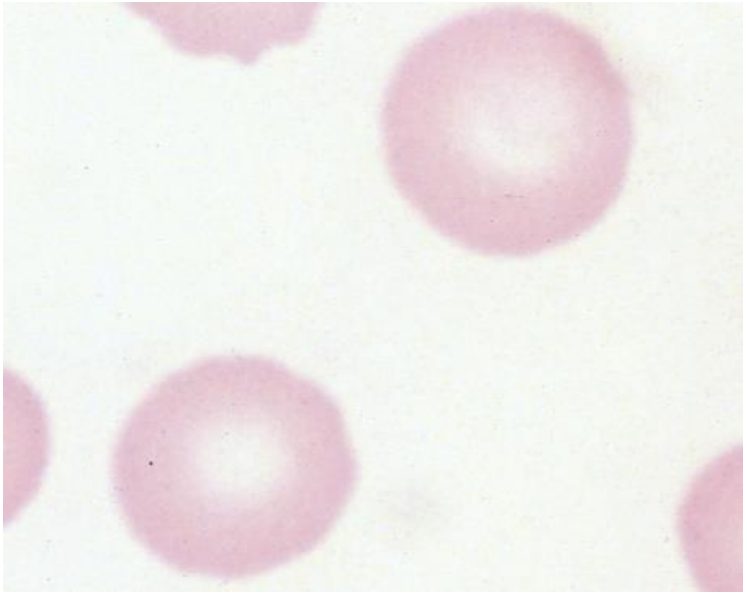
  - males 5 million / cubic millimeter of blood

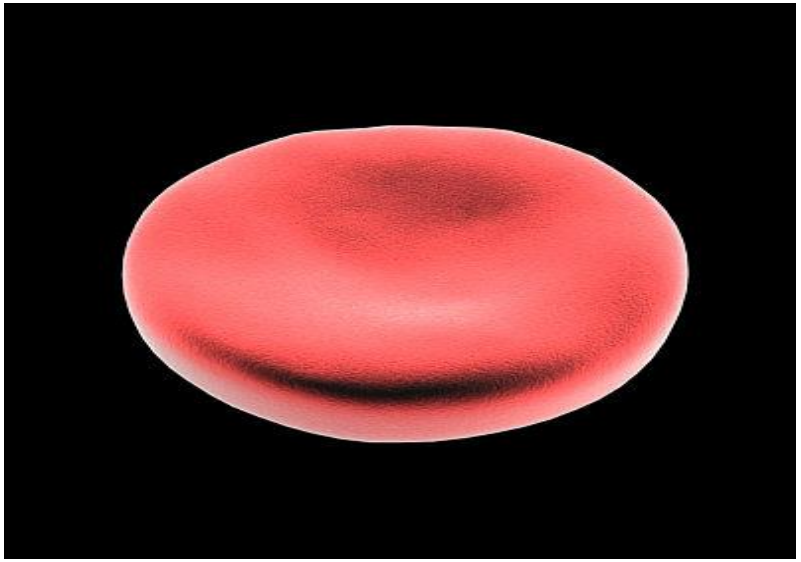
  - females 4.5 millions / cubic millimeter of blood

- **Abnormal number**

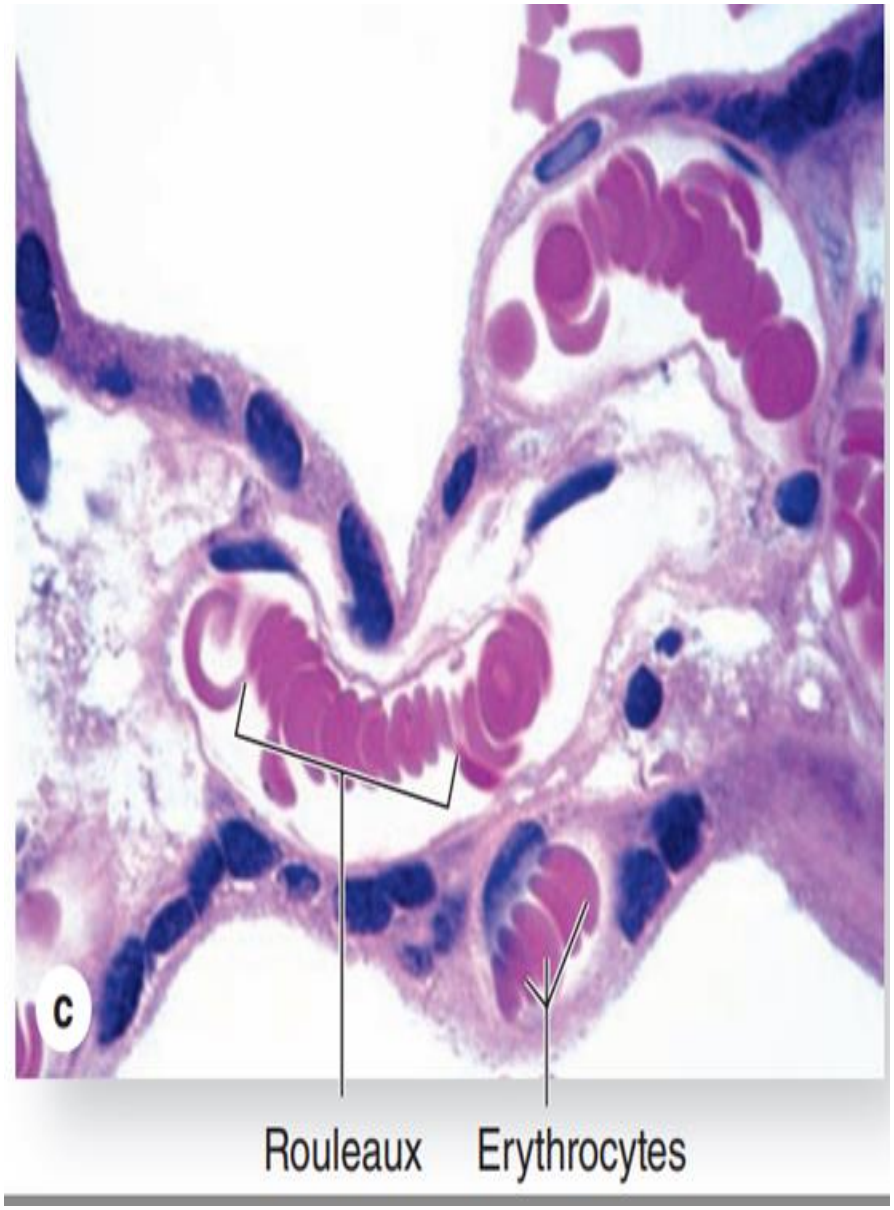
  Decrease in the number of RBCs is known as ***anemia***.

  Increase in their number is known as ***polycythemia***.

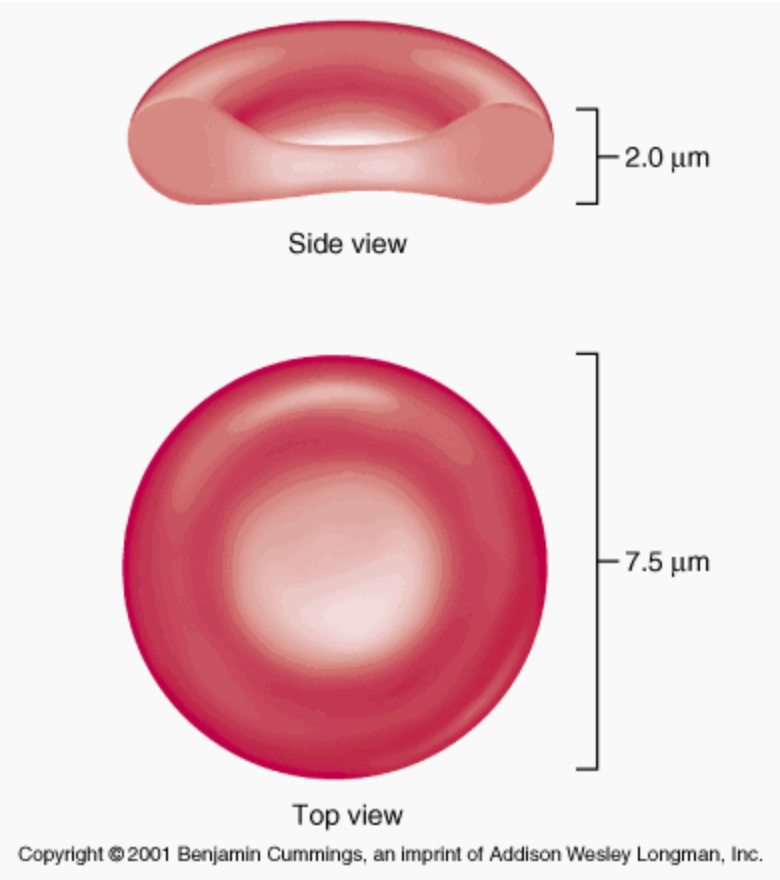




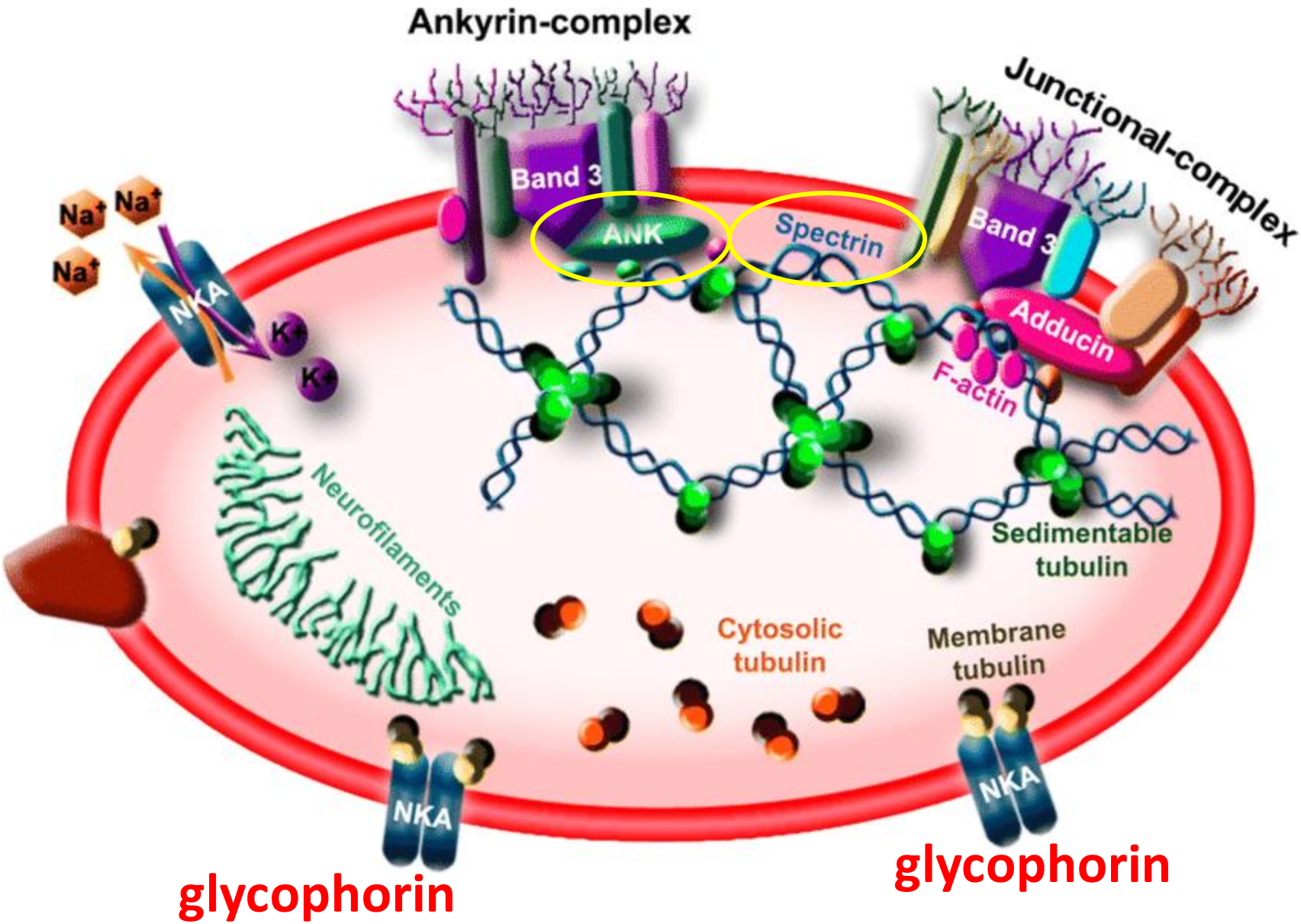
- **Shape :** biconcave discs.
- Erythrocytes are normally quite flexible, which permits them *to bend* and adapt to the irregular turns and small diameters of capillaries.
- In larger blood vessels RBCs often adhere to one another loosely in stacks called rouleaux


c
Rouleaux
Erythrocytes

- **Size of RBCs:**
  7.2 microns in diameter and 1.9 microns in thickness
- **Abnormal shape and size of RBCs: .**
  - ***Macrocytic anemia***, diameter of RBCs increases.
  - ***Microcytic anemia***, their diameter decreases.
  - ***Anisocytosis,*** abnormal sizes of RBCs may appear in the circulation.



- **Colour:** Unstained erythrocytes have greenish yellow colour due to their content of hemoglobin.
- Hemoglobin = the iron ("heme"), oxygen transport protein, ("globin").
- Normally, the erythrocytes in a dry smear of peripheral blood stain *deep pink or salmon colour* with Wright's stain.
- In hyperchromic anemia, the RBCs are darkly stained and contain more Hb % than normal.
- In hypochromic anemia, RBCs are faintly (lightly) stained and contain less Hb % than normal.


Ankyrin-complex
Junctional-complex
Band 3
ANK
Spectrin
Band 3
Adducin
F-actin
Na+
Na+
Na+
NKA
K+
K+
Neurofilaments
Sedimentable tubulin
Cytosolic tubulin
Membrane tubulin
NKA
NKA
glycophorin
glycophorin

- **The plasmalemma** of the erythrocyte consists of about 40% lipid, 10% carbohydrate, and 50% protein.

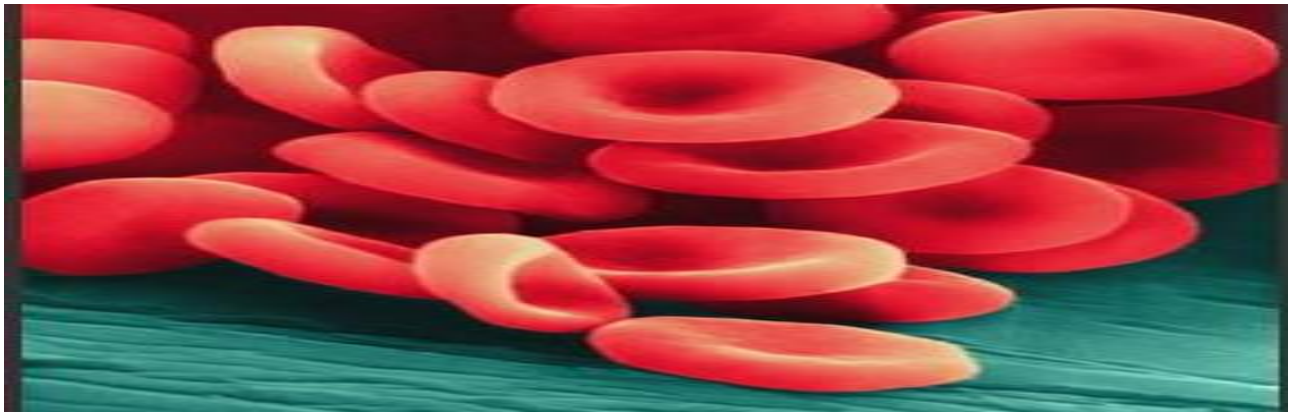
- Most of them are **integral membrane proteins**, including glycophorin (antigenic sites that form the basis for the ABO blood system).

- **Several peripheral proteins** are associated with the inner surface of the membrane, including spectrin and ankyrin, which *stabilizes the membrane*, maintains the cell shape, and provides the *cell elasticity* required for passage through capillaries.

- During **differentiation and maturation** processes (bone marrow), erythrocytes synthesize large amount of Hb, before they are released into the systemic circulation, the nucleus is extruded from the cytoplasm and the mature RBCs assumes a biconcave shape. This shape provides more surface area for carrying respiratory gases.
- Mature RBCs are highly specialized to transport O2 & Co2.
- Iron molecules in Hb bind with O2 and most of the O2 in the blood is carried to tissues in the form of **oxyhemoglobin**.
- Co2 from the cells and tissues is carried to the blood with Hb (**carbaminohemoglobin**). These reactions are reversible.

- **Life-span of RBCs:**
- 100-120 days.
- Old RBCs are removed from the circulation mainly by macrophages of the spleen and bone marrow.

- **Functions:** Transport of oxygen from lung to tissues and carbon dioxide from tissues to lung.

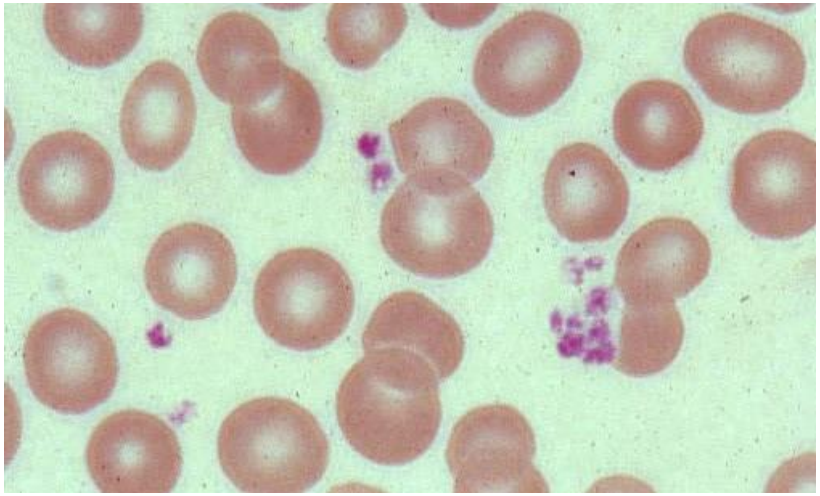


Reticulocytes:

- The younger erythrocytes (**immature**) Their cytoplasm is basophilic
  - having no nuclei
  - some free ribosomes in the form of a net like structure
  - few mitochondria are present.
- Their diameter is 8 µm.
- Percentage: about **1%** of the total blood number of circulating RBCs.
- Stain: **supravital stains** (brilliant cresyl blue).
- Abnormalities: reticulocytosis

Increase the number of reticulocytes indicates a demand for increased O2-carrying capacity as in *haemorrhage* and in *high altitude.*

Platelets (Thrombocytes)

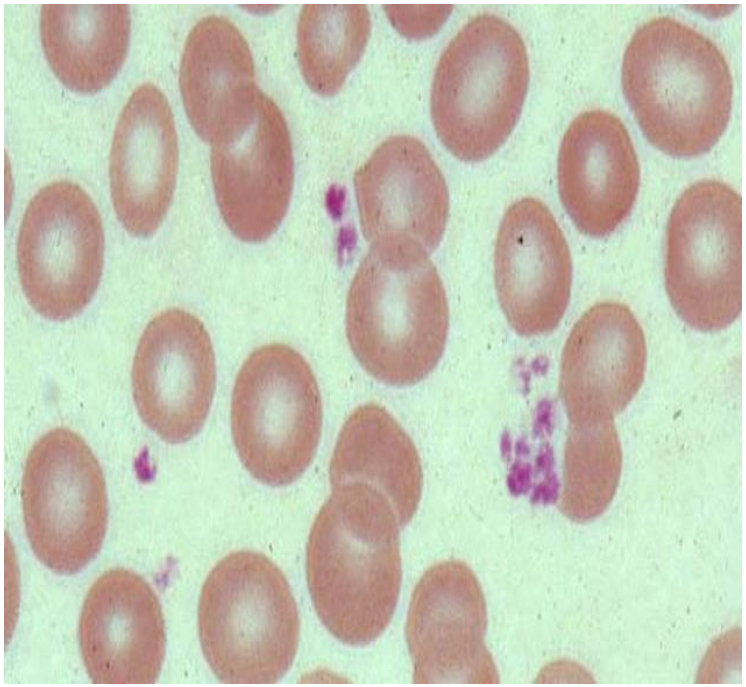


- **Origin:** **Megakaryocytes (B.M)**
- **Shape:** cytoplasmic fragments
- **Size:** 2-5 micron
- **Count:**150,000 – 400.000 / cubic millimeter of blood.
- **Life span:** is about 10 days.
- **Function:**

- Promote blood clotting, so preventing loss of blood.

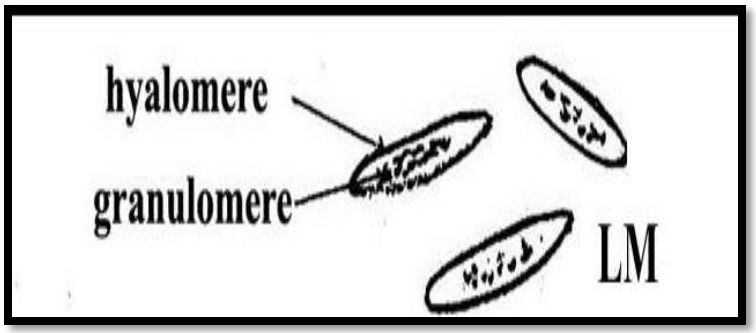
- wound healing.

Platelets

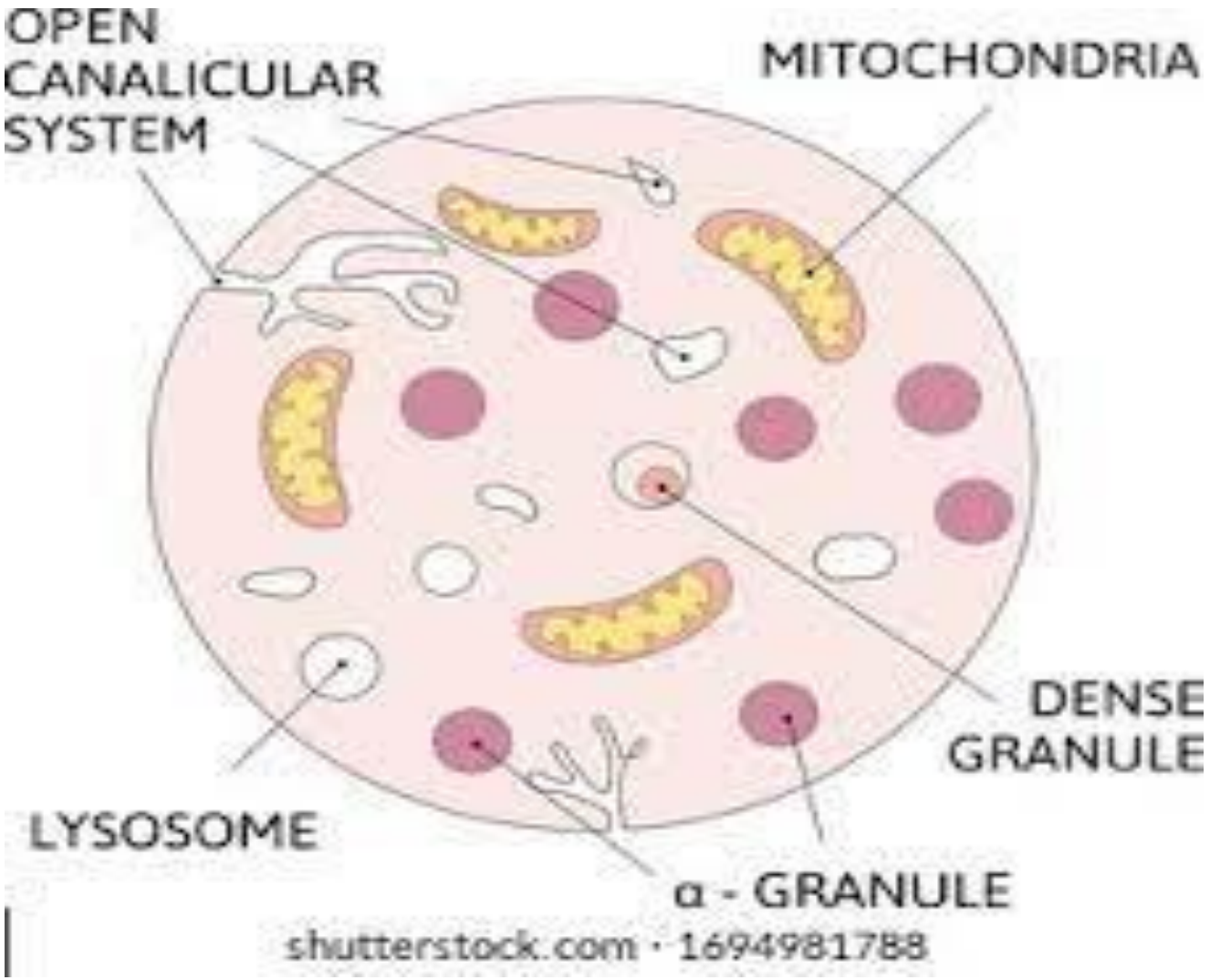


L/M:

- in stained blood smears, they often appear in clumps.
- Each platelet has a *peripheral* light blue-stained transparent zone (hyalomere),
- and a *central* zone containing purple granules (granulomere).




ER
δG
αG
ER
G
OCS
Microtubules&
microfilaments


OPEN
CANALICULAR
SYSTEM
MITOCHONDRIA
DENSE
GRANULE
LYSOSOME
α - GRANULE
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- **E/M:** platelets are surrounded by cell membrane, covered by a thick glycocalyx (cell coat).
- The **hyalomere** contains:

electron dense **tubular system**,

- bundles of microtubules (to maintain the oval shape),
- and microfilaments (help in platelet movement and aggregation).

- two systems of membrane channels ,
- **open canalicular system of vesicles** which is invaginations of the plasma membrane
- much less prominent set of **irregular tubular vesicles** which derived from the ER and stores Ca2+ ions.

- The **granulomere** contains:

- one or two mitochondria,
- numerous small clear vesicles, glycogen
- and varying numbers of membrane bounded dense granules named **alpha** (platelet-derived growth factor (PDGF), platelet factor 4), **delta** (ADP, ATP, and serotonin) and **lambda** granules.

Thank You