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. (7.4)

2- Control body temperature → عالجات ، armpit ، inner thigh ، forehead [highly vascular]

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 % .

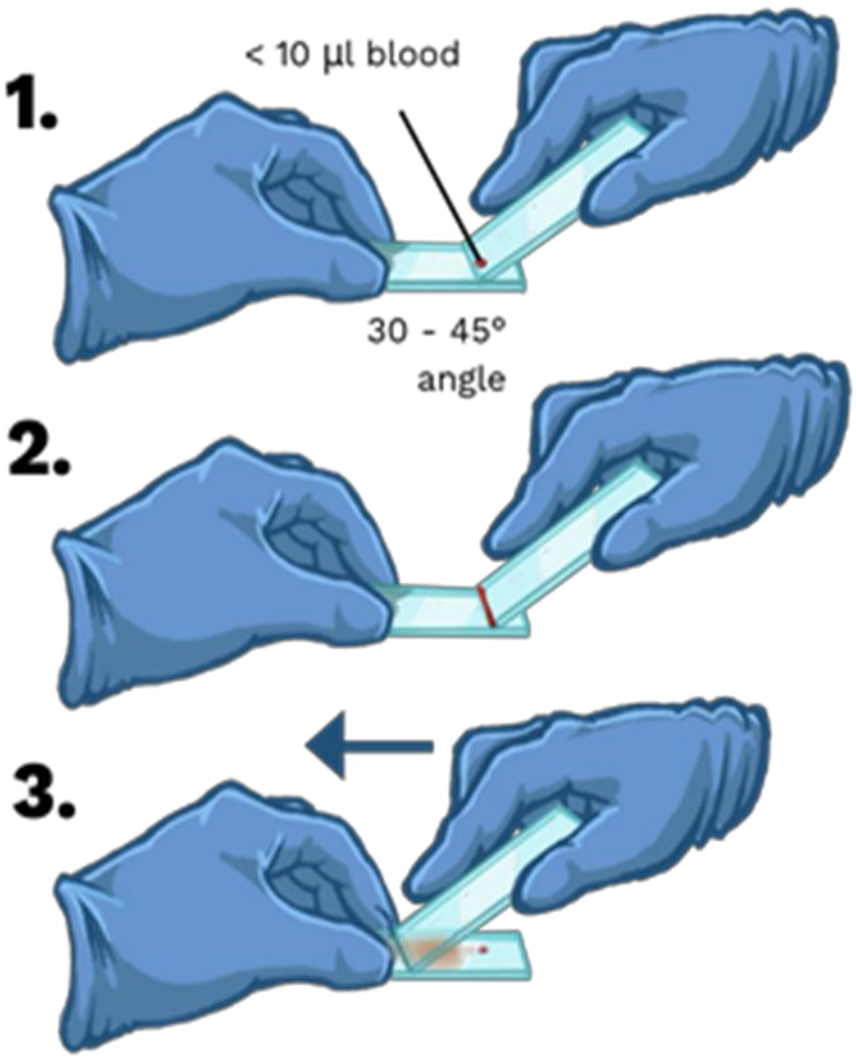
2- Plasma proteins 7% (albumin, globulin,
-fibrinogen and prothrombin) .

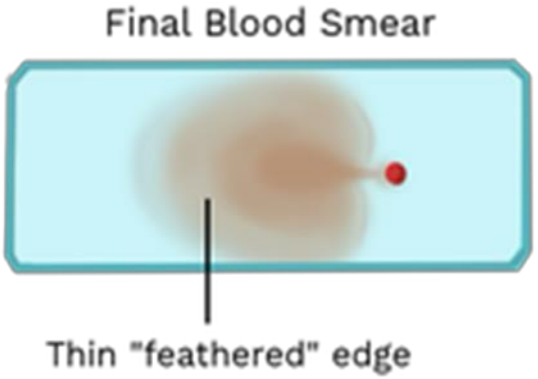
3- Small amounts of
- Ca
- sodium chloride,
- bicarbonate
- phosphate.

Blood film or peripheral blood smear

CBC: add to tube w/ anticoag. "EDTA"

liver/ kidney/ full chem test: → any tube





Blood film or peripheral blood smear

-It is a thin layer of blood smeared on a glass microscopic slide to be stained to allow the various blood cells to be examined microscopically.

-Preparation of blood film:

1-A drop of blood is placed on a clean microscopic slide.

2-Another slide (spreader slide) is used to disperse the blood over the slide's length.

3-The blood film is left to dry for 5 minutes.

4-The dried blood film is then stained to be examined by light microscope.

acido base

Leishman's stain or Giemsa stain is a neutral stain formed of a mixture of the following components: a. Eosin (an acidic stain). b. Methylene blue (a basic stain).

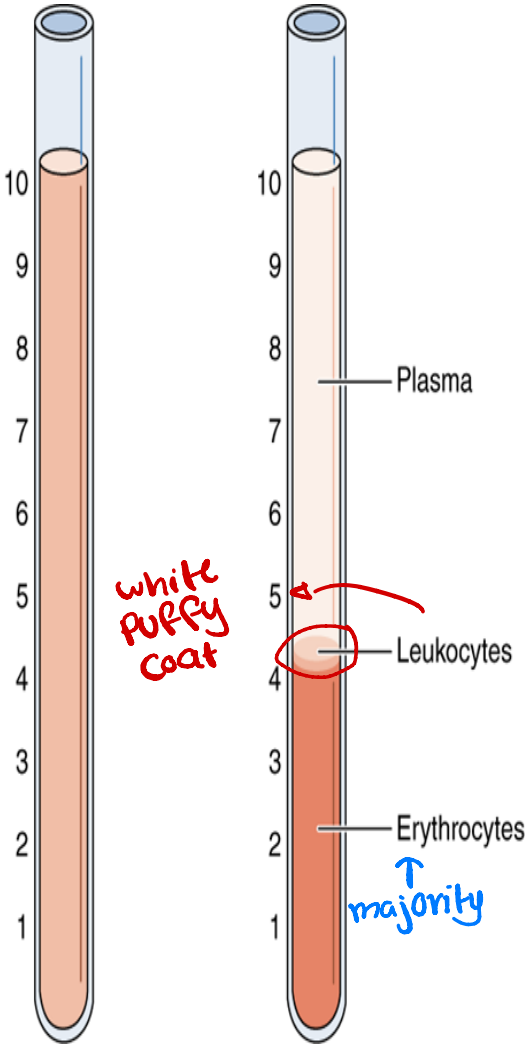
Blood cells

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 terminally differentiated structures 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. → function INside capillary
- **Number of RBCs**

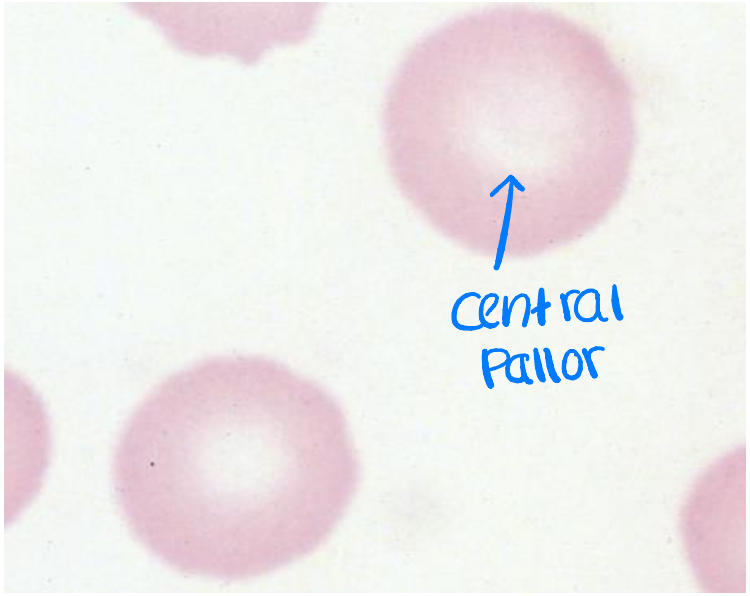
  - males 5 million / cubic millimeter of blood

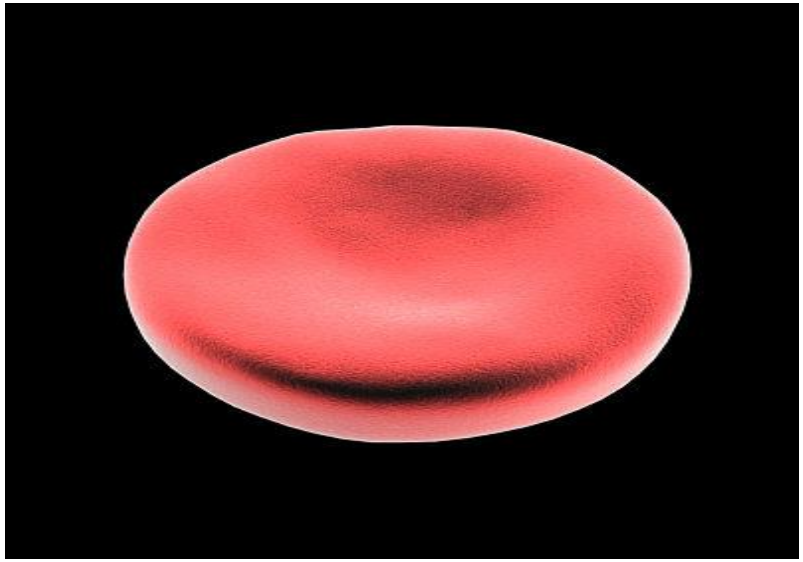
  - females 4.5 millions / cubic millimeter of blood

- **Abnormal number**

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

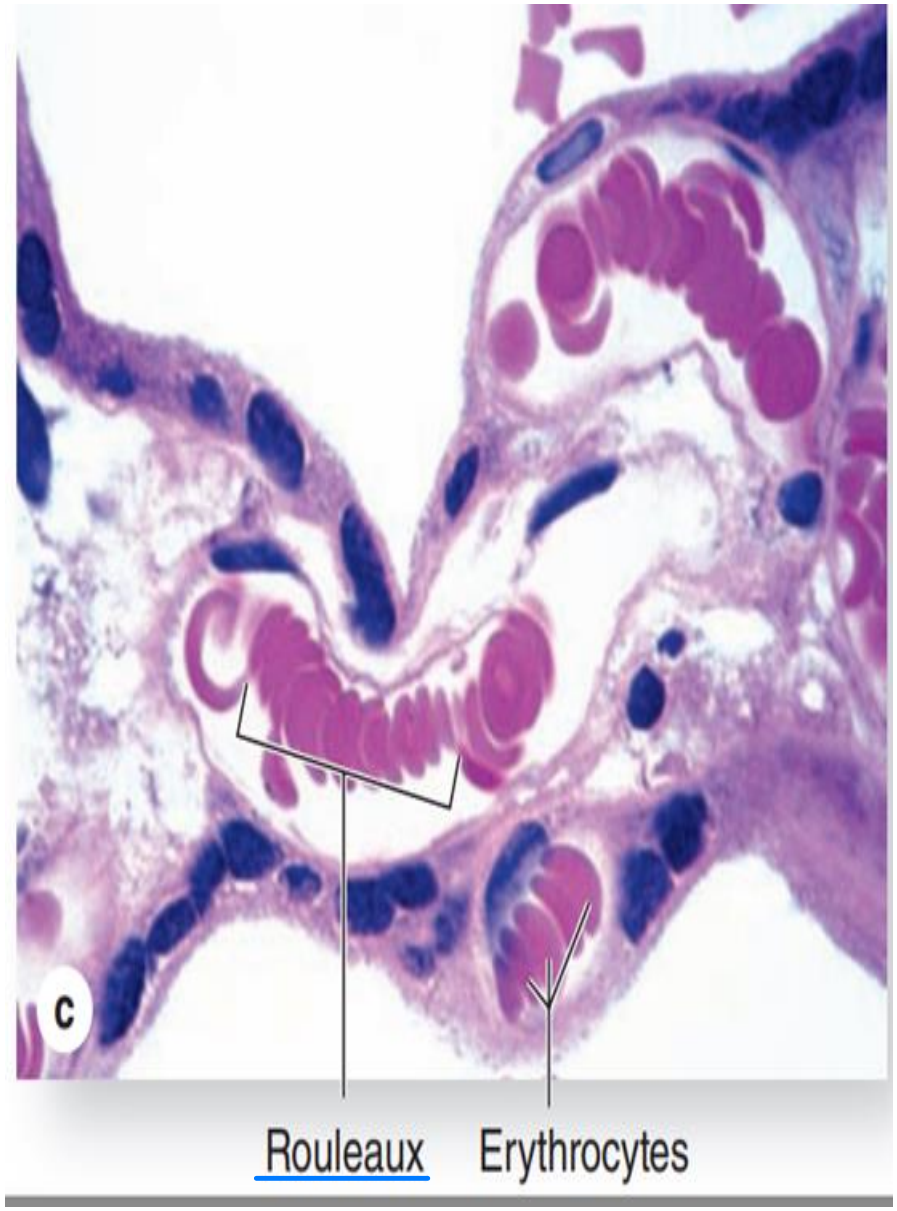
  Increase in their number is known as ***polycythemia***.





- **Shape :** biconcave discs to increase the surface area for exchange of gases. They are soft and plastic and can change their shape as they pass through small capillaries.
- In larger blood vessels RBCs often adhere to one another loosely in stacks called rouleaux

→ RBC adhering & stacking

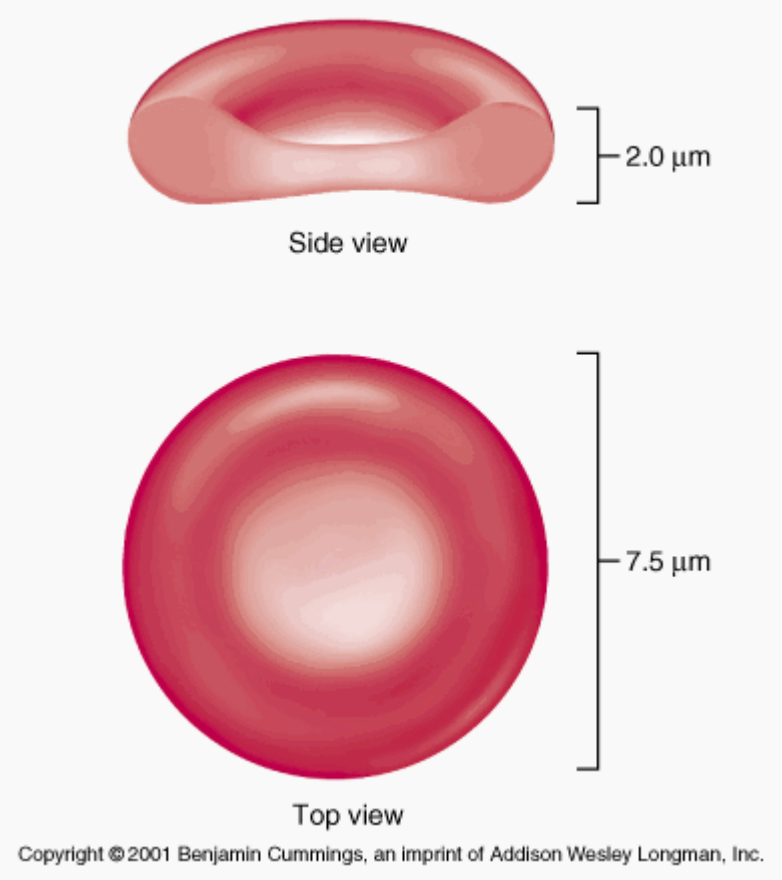


- **Size of RBCs:**

  7.5 microns in diameter and

  2 microns in thickness

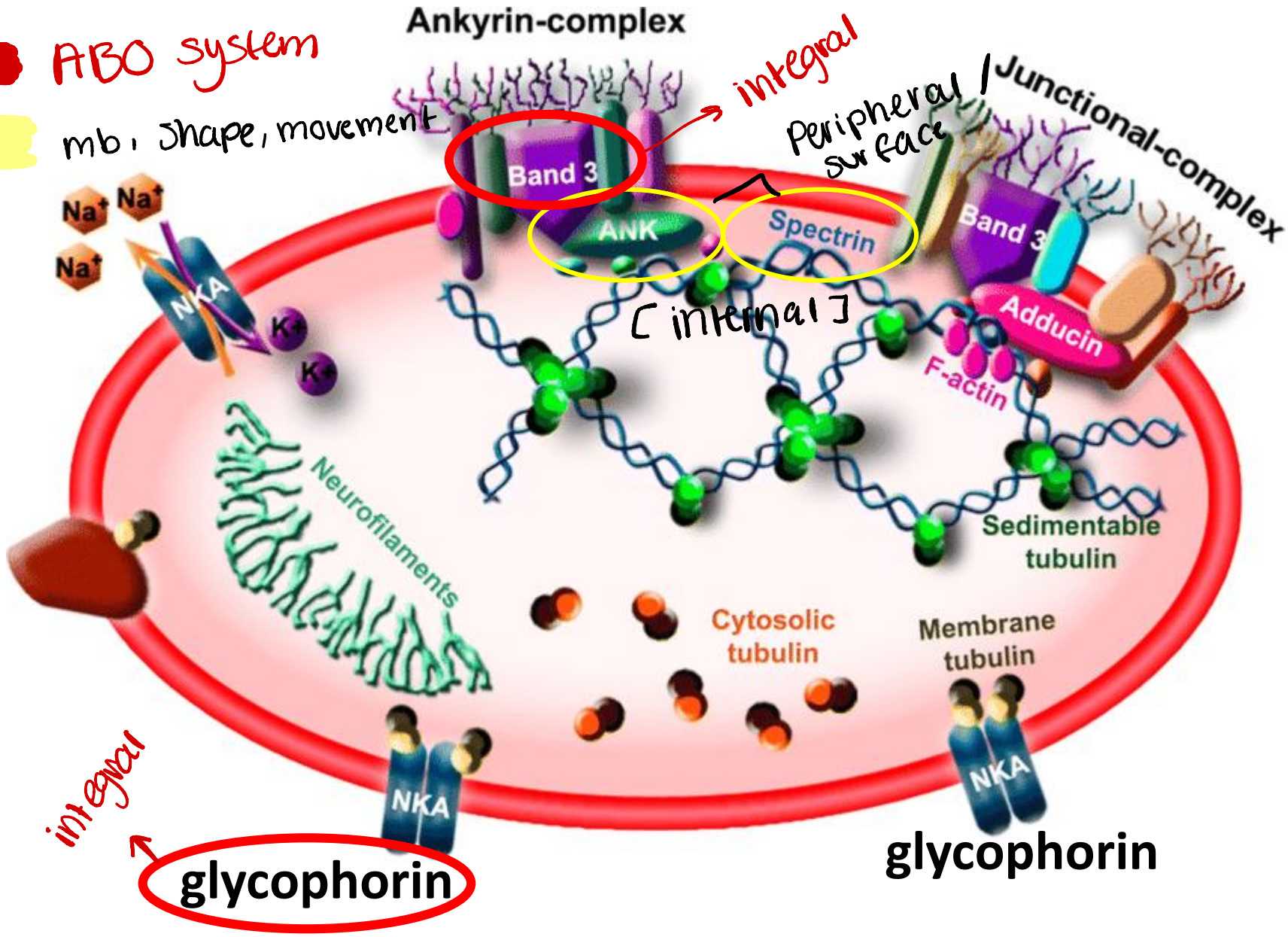
- **Abnormal shape and size of RBCs: .**
  - ***Macrocytic anemia***, diameter of RBCs increases.
  - ***Microcytic anemia***, their diameter decreases.
  - ***Anisocytosis,*** abnormal sizes of RBCs may appear in the circulation.



- **Colour:** Red 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

- 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.

- **Structure:**


ABO system
mb, shape, movement
Ankyrin-complex
integral
Band 3
ANK
Spectrin
peripheral / Junctional-complex
surface
Band 3
Adducin
[internal]
F-actin
Na+
Na+
Na+
NKA
K+
K+
Neurofilaments
Sedimentable tubulin
Cytosolic tubulin
Membrane tubulin
NKA
NKA
integral
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 and band 3 protein, (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**, dimers which form a lattice bound to underlying actin filaments, and **ankyrin**, which anchors the lattice to the glycophorins and band 3 proteins. This submembranous meshwork 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.

- Lacking mitochondria, erythrocytes rely on anaerobic glycolysis for their minimal energy needs. Lacking nuclei, they cannot replace defective proteins.

- 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.

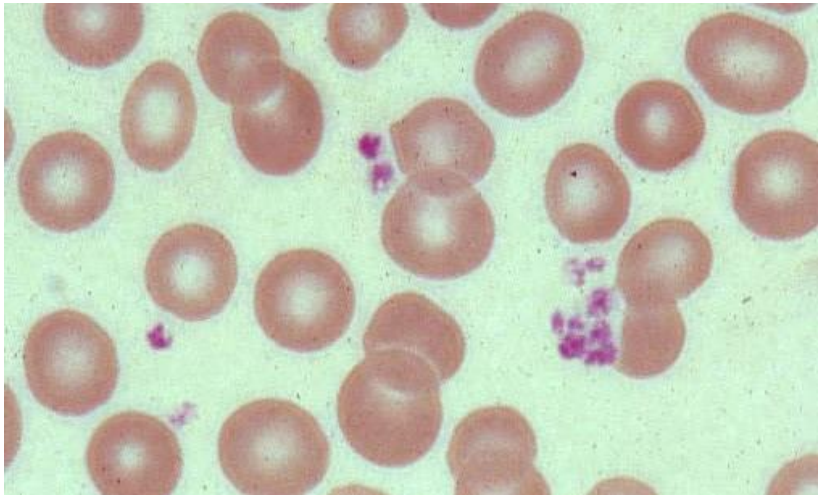
- **Life-span of RBCs:** 100-120 days. By this time defects in the membrane's cytoskeletal lattice or ion transport systems begin to produce swelling or other shape abnormalities. Senescent or worn-out RBCs displaying such changes are removed from the circulation, mainly by macrophages of the spleen, liver, and bone marrow.

Reticulocytes:

- The younger erythrocytes (**immature**) are called reticulocytes. Their cytoplasm is basophilic having no nuclei, some free ribosomes in the form of a net like structure and few mitochondria are present. Their diameter is 8 µm.
- They normally constitute about **1%** of the total blood number of circulating RBCs.
- They are stained by **supravital stains** (brilliant cresyl blue).
- Increase the number of reticulocytes indicates? a demand for increased O2-carrying capacity as in hemorrhage and in high altitude.

BM compensatory mechanism

Platelets (Thrombocytes)



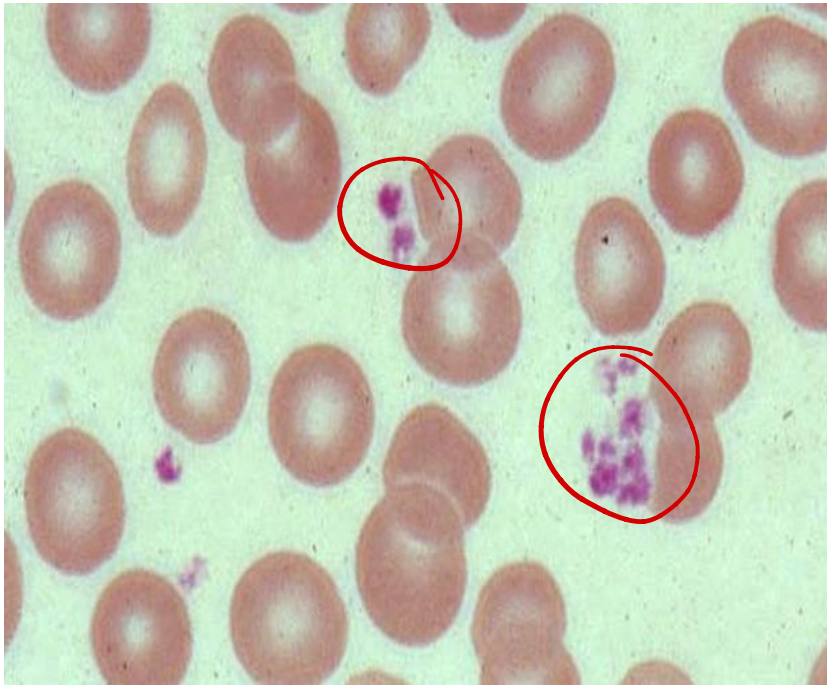
- **Origin:** **Megakaryocytes (B.M)**
- **Shape:** cytoplasmic fragments
- **Size:** 2-5 micron
- **Count:**150,000 – 400.000 / cubic millimeter of blood.
- **Life span:** is about 10 days.
- **Function:**

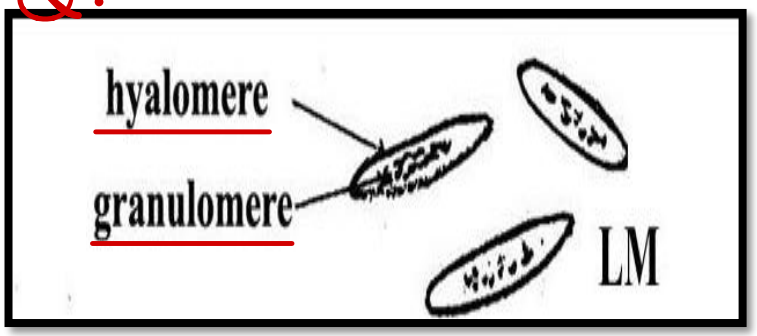
- Promote blood clotting, so preventing loss of blood.

- 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).





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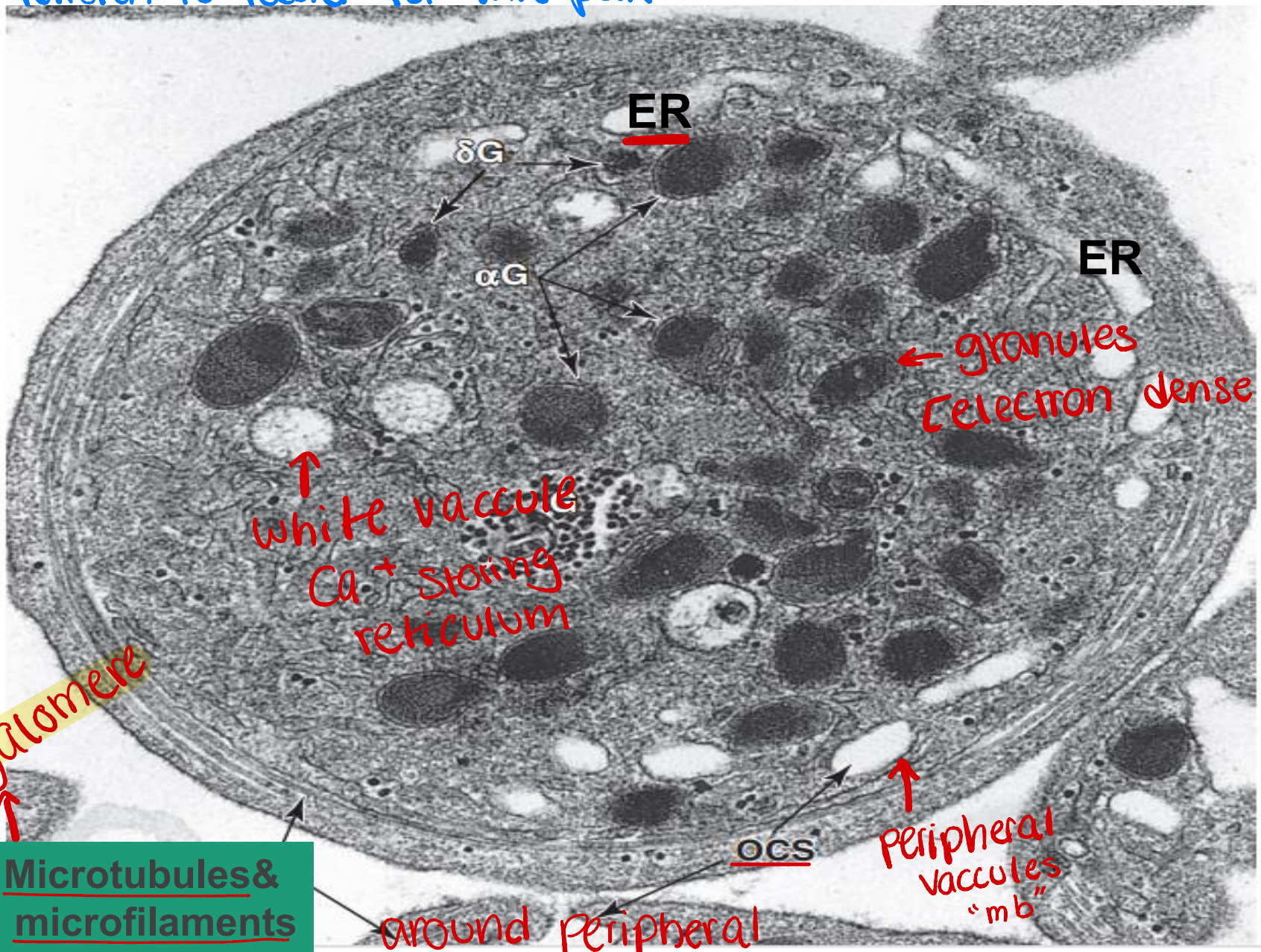

- **E/M:** platelets are surrounded by cell membrane, covered by a thick glycocalyx (cell coat) which is involved in adhesion and activation during blood coagulation.

- The **hyalomere** reveals peripheral marginal bundles of microtubules (to maintain the oval shape), and microfilaments (help in platelet movement and aggregation).
- Also in the hyalomere are two systems of membrane channels ,**open canalicular system of vesicles** which is invaginations of the plasma membrane and much less prominent set of **irregular tubular vesicles** which derived from the ER and stores Ca2+ ions.

- Together, these two membranous systems facilitate the extremely rapid exocytosis of proteins from platelets (degranulation) upon adhesion to collagen or other substrates outside the vascular endothelium.

- 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.
- Most of the stained granules seen in platelets with the light microscope are alpha granules