



HEMATOPOIETIC & LYMPHATIC SYSTEM

-NACHAT BATCH-

SUBJECT : anatomy

LEC NO. : blood

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وقل رب زدني علماً

The Blood

→ histology of blood cells.

Blood



- It is the red fluid which fills the heart and the blood vessels
- Consists of **formed elements** and **plasma**
- **Formed elements** are: Erythrocytes, Leukocytes, Lymphocytes, Monocytes, and Platelets
- **Hematocrit**
- **Buffy coat** →
- **Functions of the blood**



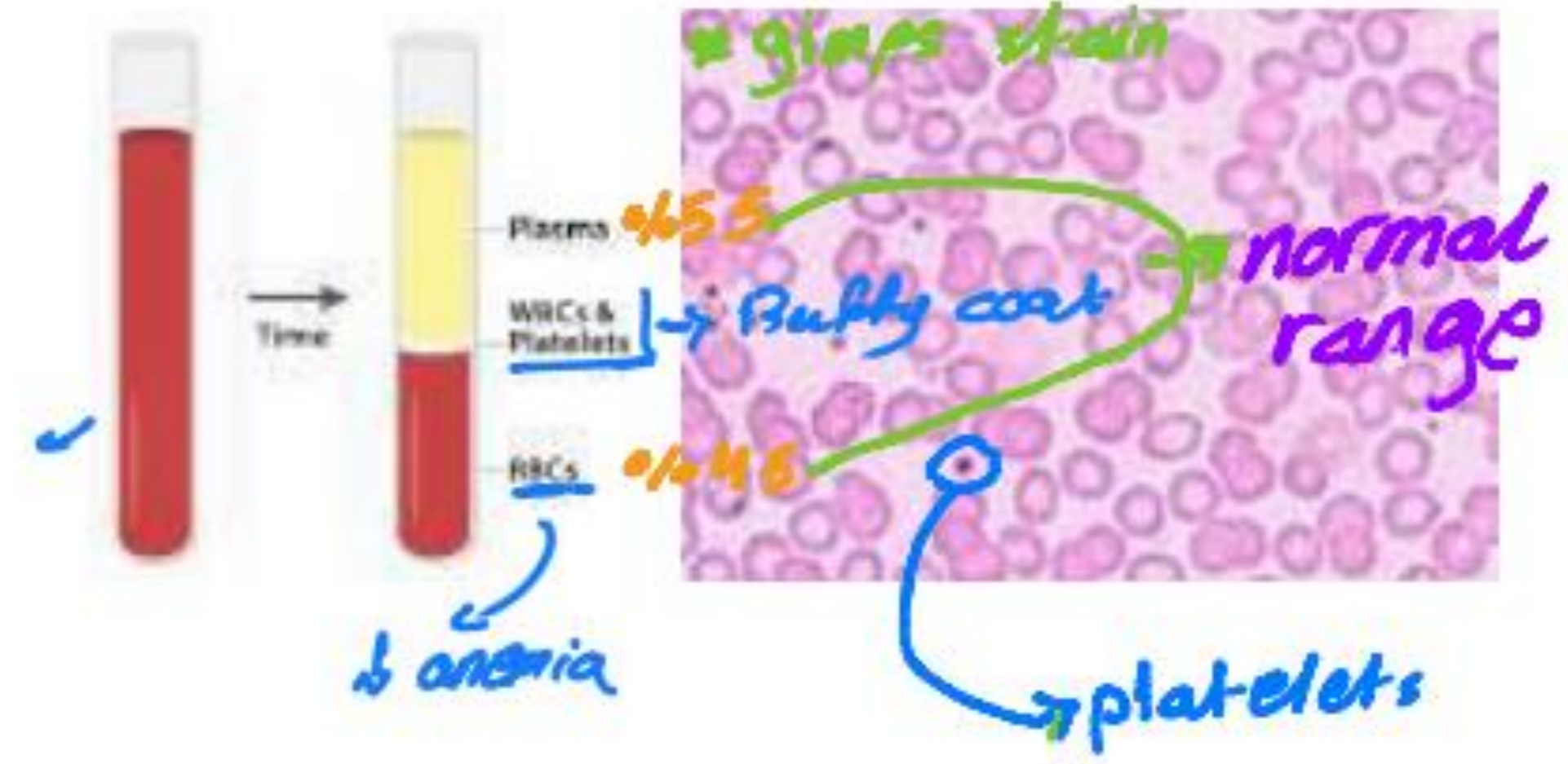
→ plasma

→ RBCs

ca → anticoagulating

- acid base balance
- buffering system.

contain all protein.



ال Fluid في CVS تنقسم الى :-

① unformed elements ← (plasma) ← قنطريه ← Ca^{+2} , hormones, clotting factors, proteins

Glycoprotein, Globulin, albumin
clotting protein

② formed elements

RBCs - P

WBCs - V

- shape of RBCs like coins. (yellow)

انما صجبت دم من حجم و حيزه مباشرة في test tube و تركت لفترة و بعد يكون عذري
blood clot ← bottom ← two layers
serum ← top

• as anti clotting ← (Ca^{+2} , oxalate) test tube في blood
في قنطريه ← RBCs (down) ← bottom ← tube
Buffy coat ← (platelets and WBCs)
plasma ← top

الفرق بين plasma و serum

contain less protein because some proteins such clotting factors it used. ← serum

plasma ← protein

• difference in Quantity of protein

- Function of blood :-

A. carry O_2 from lung
to tissue and CO_2 to
the lung } → most important

B. contain regulatory protein
and enzymes

C. transport hormones

D. acid base balance. → important.

Composition of Plasma

4%

- It is an aqueous solution that contains
7% plasma proteins (albumin, Globulins, immunoglobulins,
Lipoproteins, Coagulation factors, and some regulatory proteins)
0.9% inorganic substances Na^+ , K^+
2% organic substances



ماضي انواع

in some books 7.2 most important

Erythrocytes

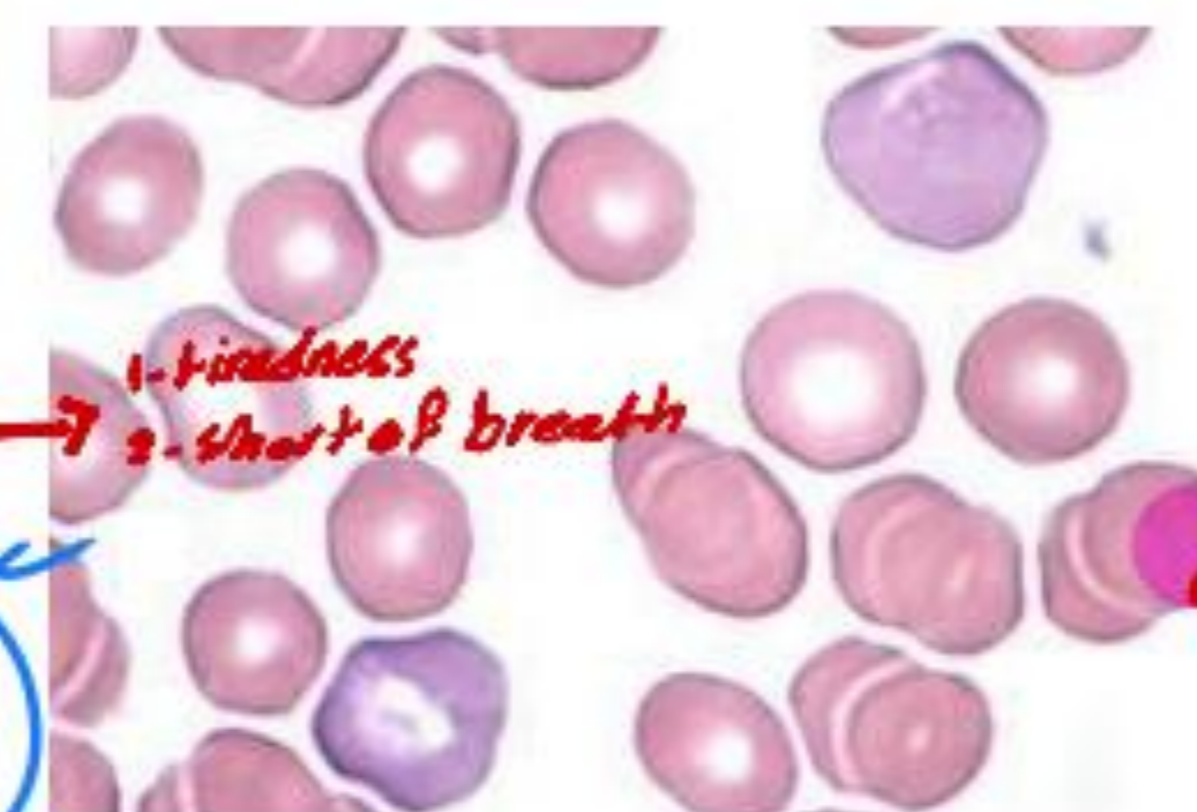
- Anucleated cell packed with O₂ - carrying HB
- It is a biconcave disc 7.5 μm in diameter, 2.6 μm at the periphery, 0.75 μm at the center.



حبة حمراء صغيرة
مختلفة

- ✓ Microcyte- diameter < 6 μm - less
- ✓ Macrocyte- diameter > 9 μm - more (Bigger than normal RBCs)

- Anisocytosis- variation in size → فرقة الحجم
- Poikilocytosis- variation in shape → فرقة الشكل
- Anemia- decrease number of RBCs ✓



1- tiredness
2- short of breath

- Polycythemia- increase the number of RBCs

Bi concave Disc is
anucleated: no nucleus

→ decrease the amount of ^{O₂} ~~oxygen~~ to the tissue.

take long time to take the O₂ to the tissue

increase number of RBCs, increase redness.

ميكينا ال RBCs انما Bi concave disc
الحيوان ال cytoskeleton ال RBCs

- cyto skeleton of RBCs ✓
→ ~~cytoskeleton~~

Erythrocytes Cont.,

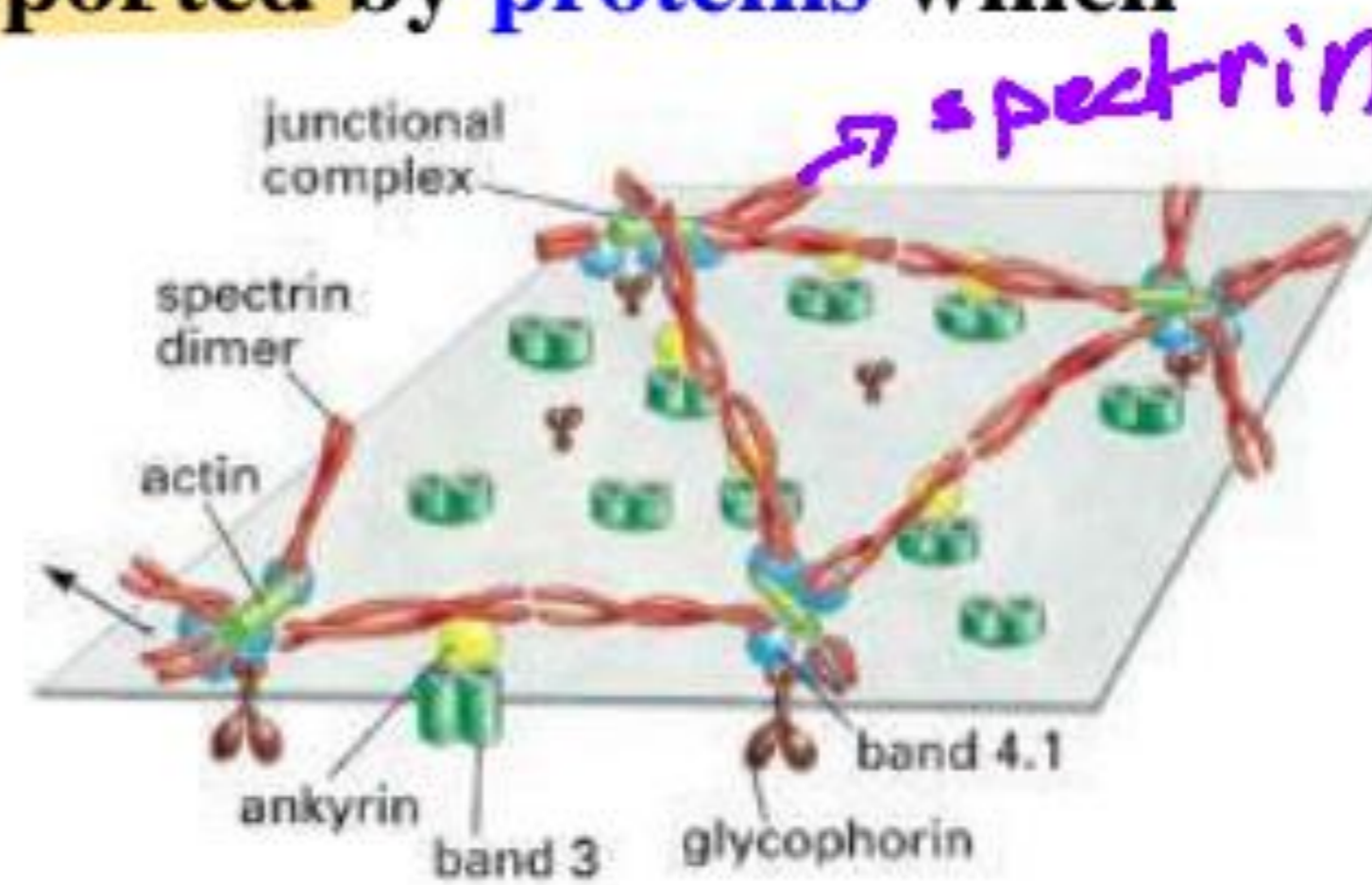
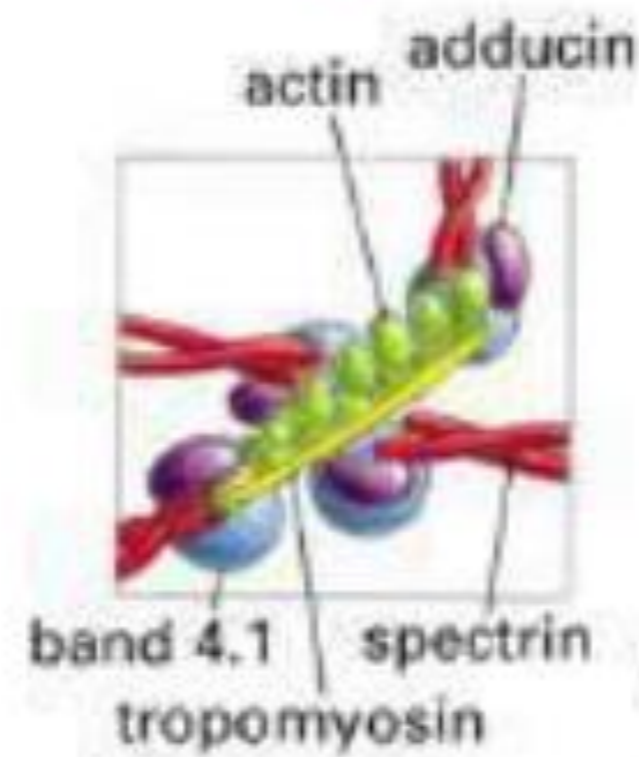
→ concave shape.

ولا

- Erythrocyte is flexible which permits adaptation to irregular and narrow diameters of capillaries
- Surrounded by a **plasmalemma** and **supported** by **proteins** which determine the shape of RBC.

- **Spectrin** links several membrane proteins with **cytoskeletal elements**

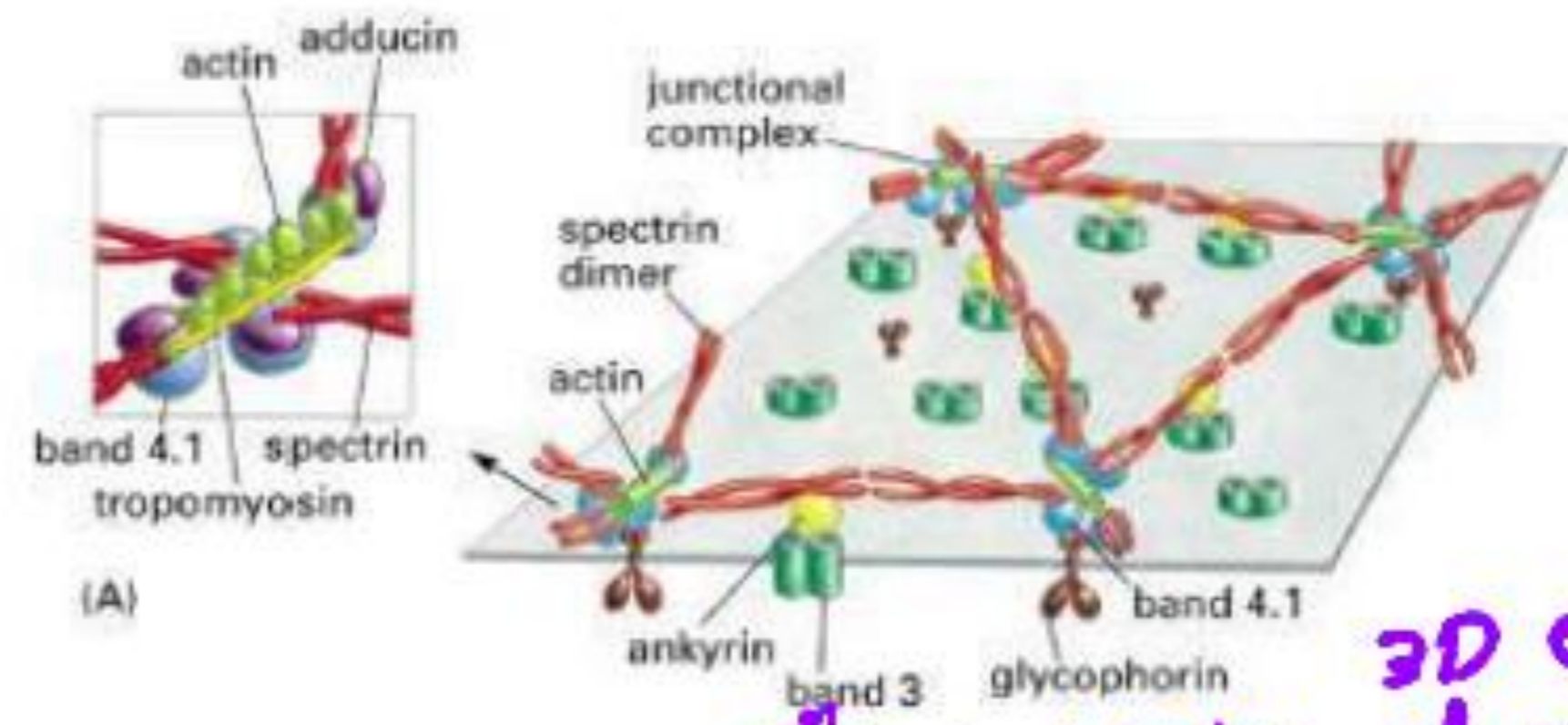
لأنه يربط البروتينات في الغشاء مع عناصر الهيكل الخلوي
spectrin protein



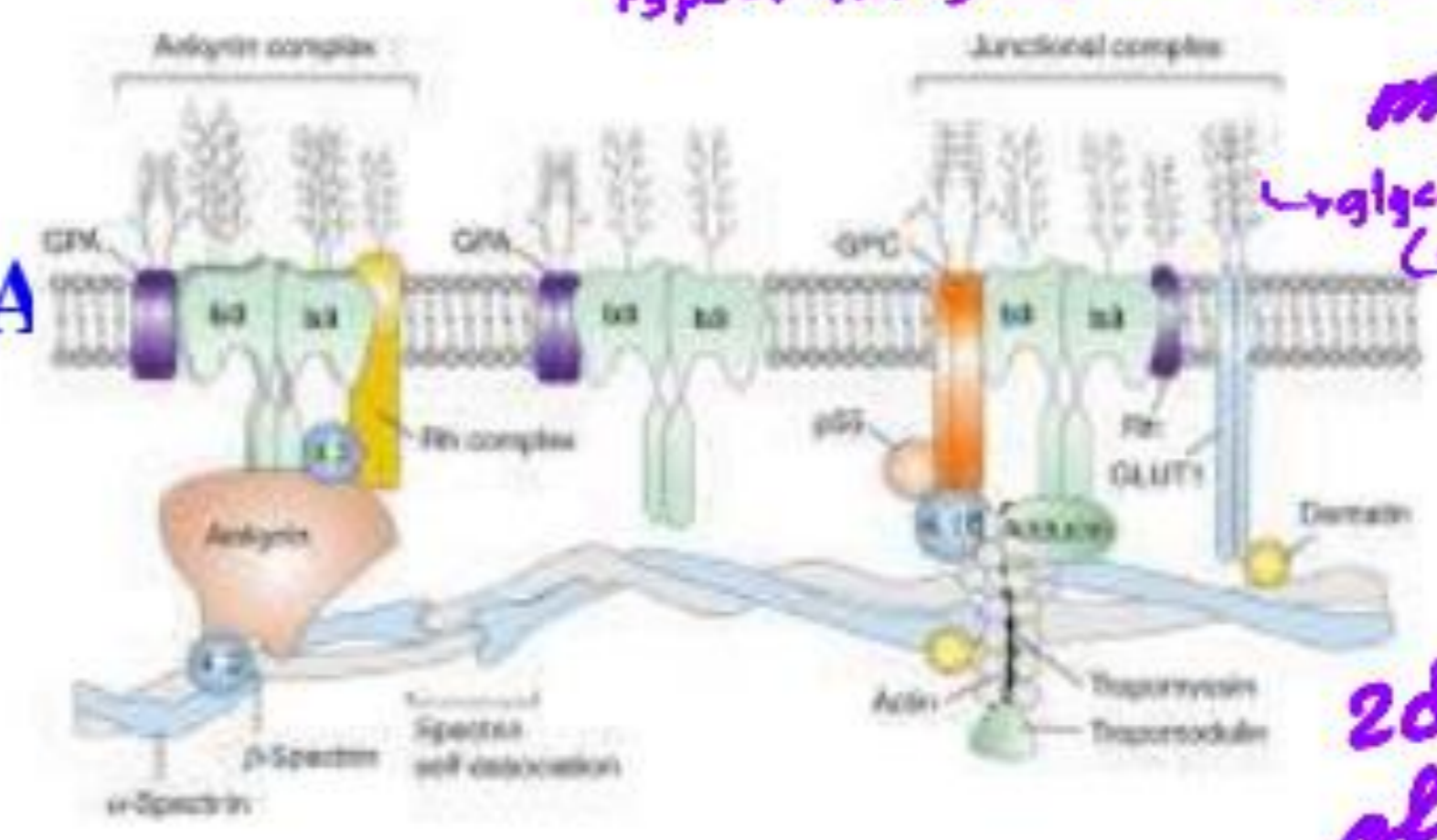


- ✓ Glycophorin A and Band 3 act as ion channels and anion transport
- ✗ Ankyrin, Adducin, and Band 4.1 ^{مربطة} anchor spectrin to glycophorin C and band 3 proteins
- Spectrin forms a lattice and bound to actin filaments
- Glycosylated domains of Glycophorin A and Band 3 includes antigenic sites for ABO blood typing .

- hemoglobin in RBCs → 33%



3D diagram of plasma membrane.
 type of integrin protein



2d picture of plasma membrane.
 ↳ glycoprotein (sugar)

Erythrocytes Cont., *in normal condition RBCs loses.*

- Hb constitutes 33% of RBC
- which accounts for acidophilia
- Reticulocytes
- Sickle Cell Anemia
- Hereditary spherocytosis

next lecture

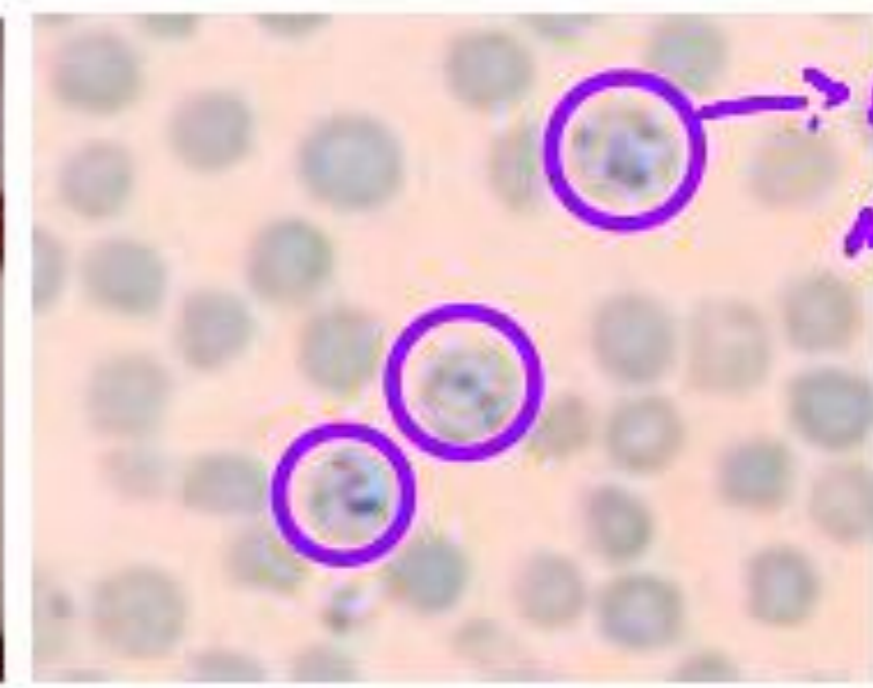
TYPE A

ret color
→ 1% of RBC

→ The RBCs are not mature.

→ RBCs life 120 days and die.

→ Bone marrow synthesizes RBCs.



Sickle Cell Anemia



Hereditary spherocytosis

- genetic
- no spectral formation cause lose the biconcave shape.

↳ HbS

↳ decrease carrying ability leads to anemia



Life span (hours - days) then die in BV

approximately 11 thousand ← Leukocytes → Fewer number than RBCs

- Leave blood to become functionally active *inactive function in blood vessels (BV)*
- Divide into **granulocytes** and **agranulocytes** depending on the density of distribution of granules *is not in diameter / same size* *different in size* → round shape
- They are spherical in plasma and become motile and amoebic in tissues
- Granulocytes possess **Azurophilic granules** (**Lysosomes**) and **specific granules** that stain specifically with neutral, basic, and acidic stains *granules* *WBCs* *primary*
- They are terminally differentiated cells with a short life span (a few days)
- RER and Golgi are poorly developed
- Most white blood cells undergo apoptosis



Leukocytes

Divided into:

take the stain.

- Granulocytes containing specific granules
- Agranulocytes containing **no** specific granules

- Granulocytes include:
 - Neutrophils → *بدون صبغة*
 - Eosinophils → *red*
 - Basophils → *blue.*
- Agranulocytes include:
 - Lymphocytes ✓
 - Monocytes ✓

- most of WBCs ^{Leuk^W} *micro phage* **Neutrophils**

- **Constitute 60-70% of leukocytes in blood**
- They live 4-6 hours in blood and 1-4 days in tissue

not all neutrophils we can find X chromosome

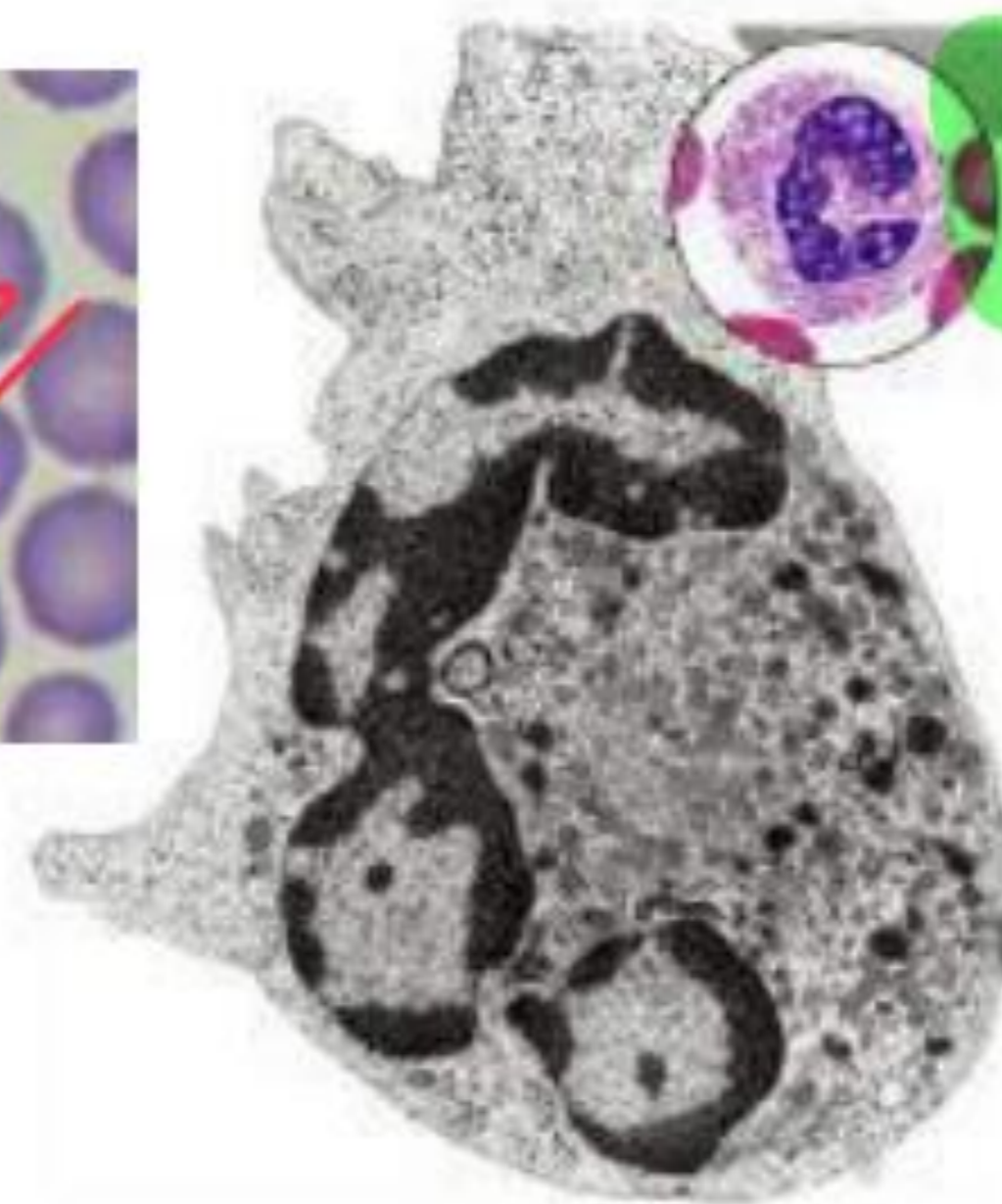
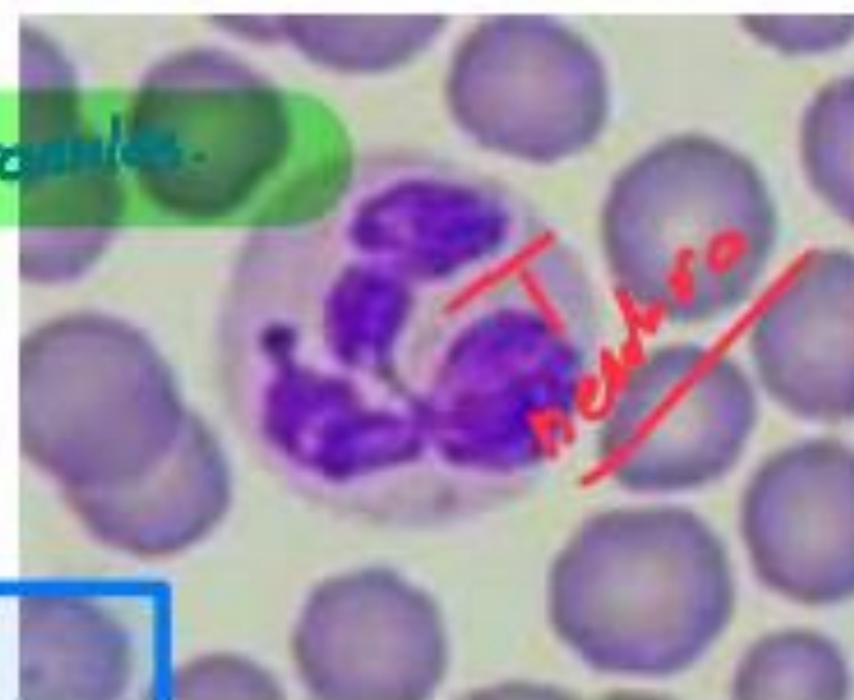
Nucleus with 2-5 lobes *→ oldest*
→ young est.

- In females, inactive X chromosome may appear on one lobe as

drumstick extension *→*

Azurophilic granules: *→ non-specific granules*

- Large dense granules with many enzymes and proteases



-abnormally like young granules with 5 lobes

- They secrete:

- ④ Myeloperoxidase (hypochlorite)
- ② Lysozyme *→ attack cell wall of Bacteria*
- ③ Defensins *↗*

Neutrophils Cont.,

Specific granules

- Small and less dense ✓
- Stain faintly pink ✓
- Contain many ECM components degrading enzymes
- Secrete many chemokines that attract other leukocytes and cytokines
- Secrete lipid mediators

They kill bacteria by:

O₂⁻ ✓ → super oxide

H₂O₂ ✓

Lactoferrin ✓

→ protein that can attached iron (Fe³⁺)

→ inflammatory mediator

~~...~~

Eosinophils

- Constitute 1-4% leukocytes ✓
- Nucleus with 2 lobes ✓ *Bilobbed*
- Contain specific acidophilic granules (200).



→ red color

dense core

Internum with major basic protein (Arginine Rich)

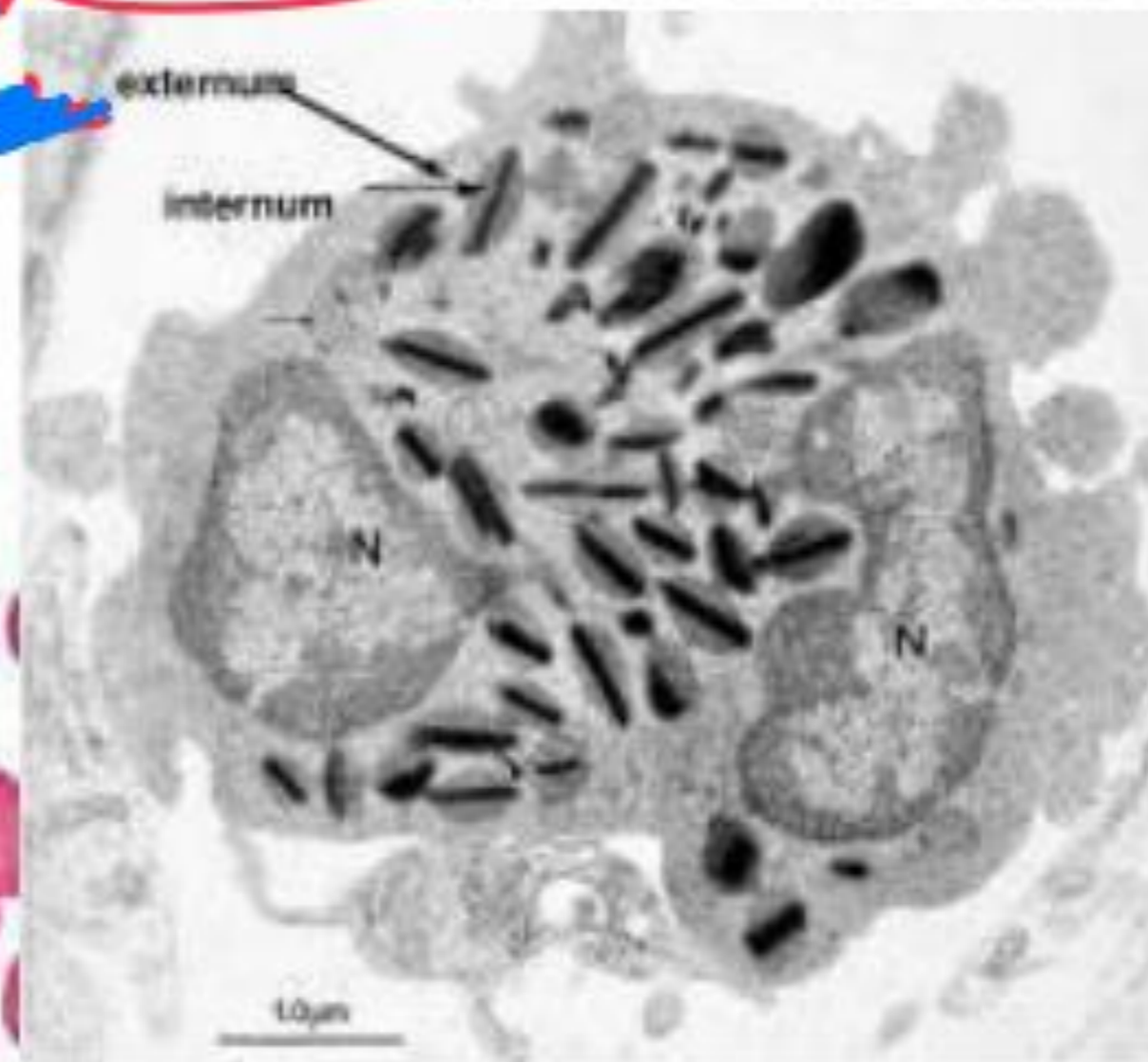
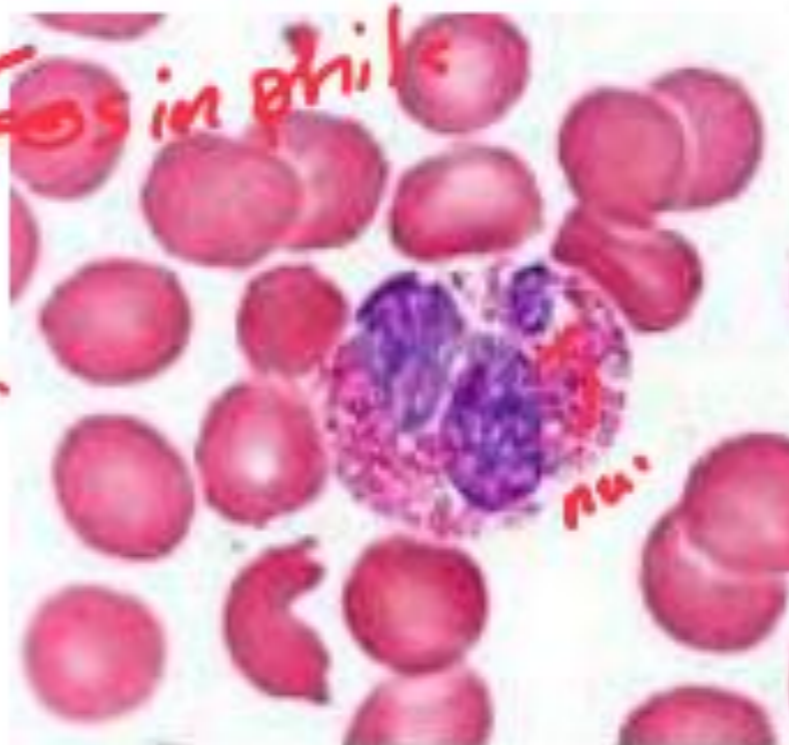
Externum

- Removal of antigen-antibody complex

- Eosinophilia
- Eosinopenia

→ increase number of Eosinophils

→ decrease in Eosinophils



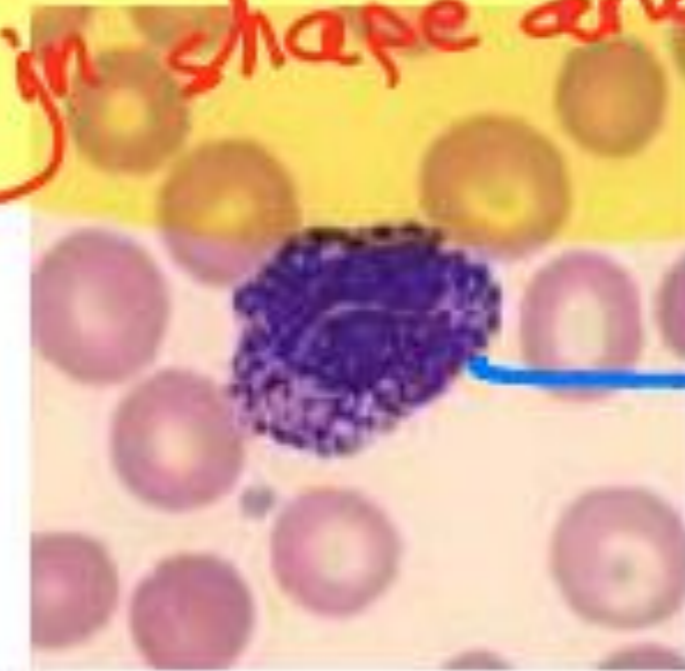
البي عندہ لیڈان فی آء
 لیون فی جندہ Eosinophils
 کثرت

- First respond with mast cells

Basophils

you can ~~count~~ count the granules
large vary in shape and size.

- Constitute <1% of leukocytes ✓
- Nucleus with irregular lobes ✓
- Contain specific basophilic granules (0.5 μm) ✓ (18-20)
- Granules are large, fewer in number and irregular in shape
- They stain purple obscuring the nucleus → anti-clotting factor
- Contain histamine, heparin (Metachromasia) color change
other mediators of inflammation
(platelet-activating factor, eosinophilic chemotactic factor, and phospholipase A)



ما يتقدرون يشرف
بندوة من وراها.



large vary in shape

لو شغها قمره نطاة نيجي
صل قمره النحلة وعضاها بالبروتينات
اوله استجابة لانحلية هي Basophils

23
granules
(large shape)

s-shape

Lymphocytes

- **Constitute 30% of leukocytes**
- **Round or indented nucleus**

- **Divide into:**

Small lymphocytes 6-8 μm *~90% of lymphocytes*
Medium lymphocytes >9 μm
Large lymphocytes 18 μm

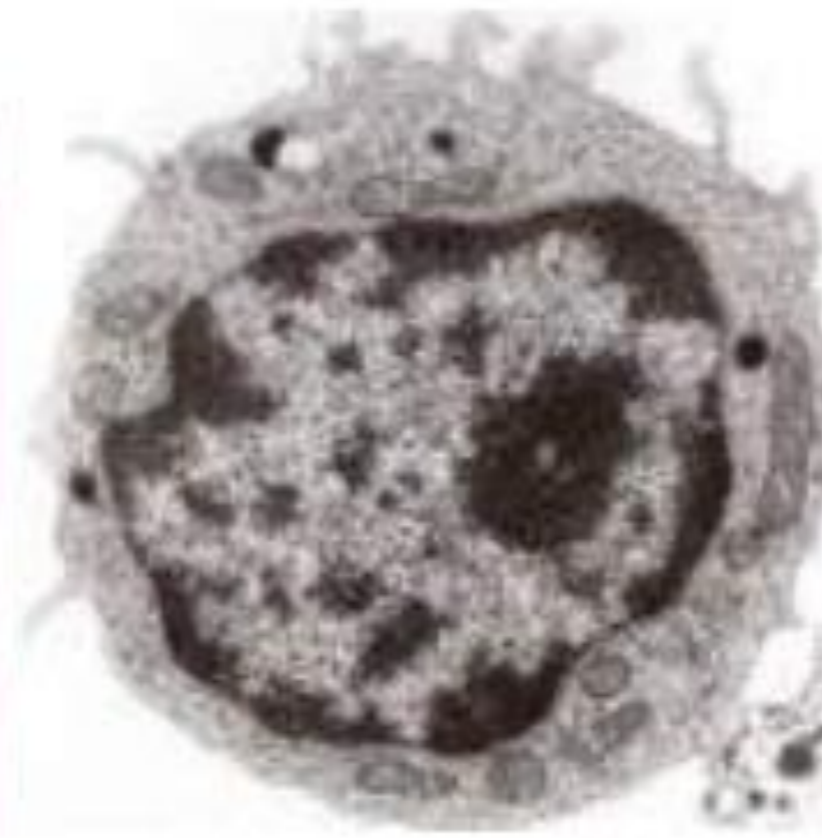
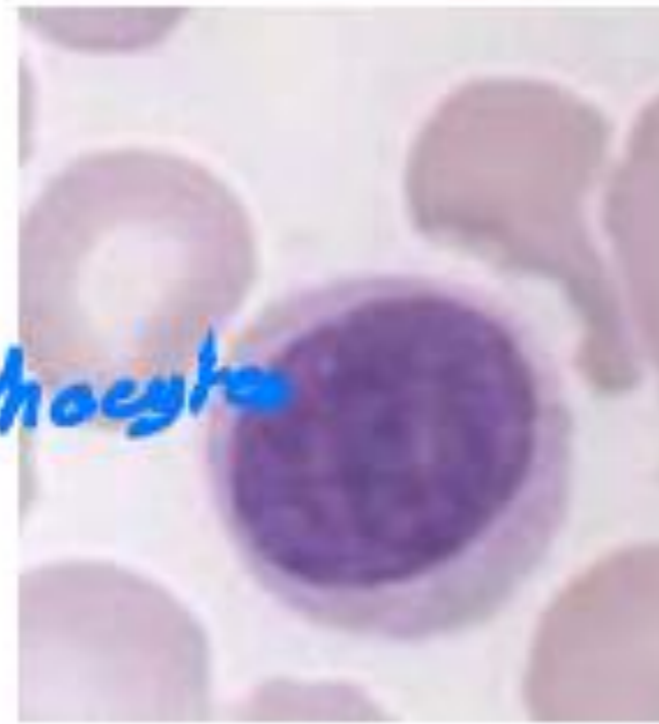
- They are differentiated by cell surface receptors into:

B-lymphocytes *→ contain immunoglobulin*

T-lymphocytes (CD4, CD8, CD25)

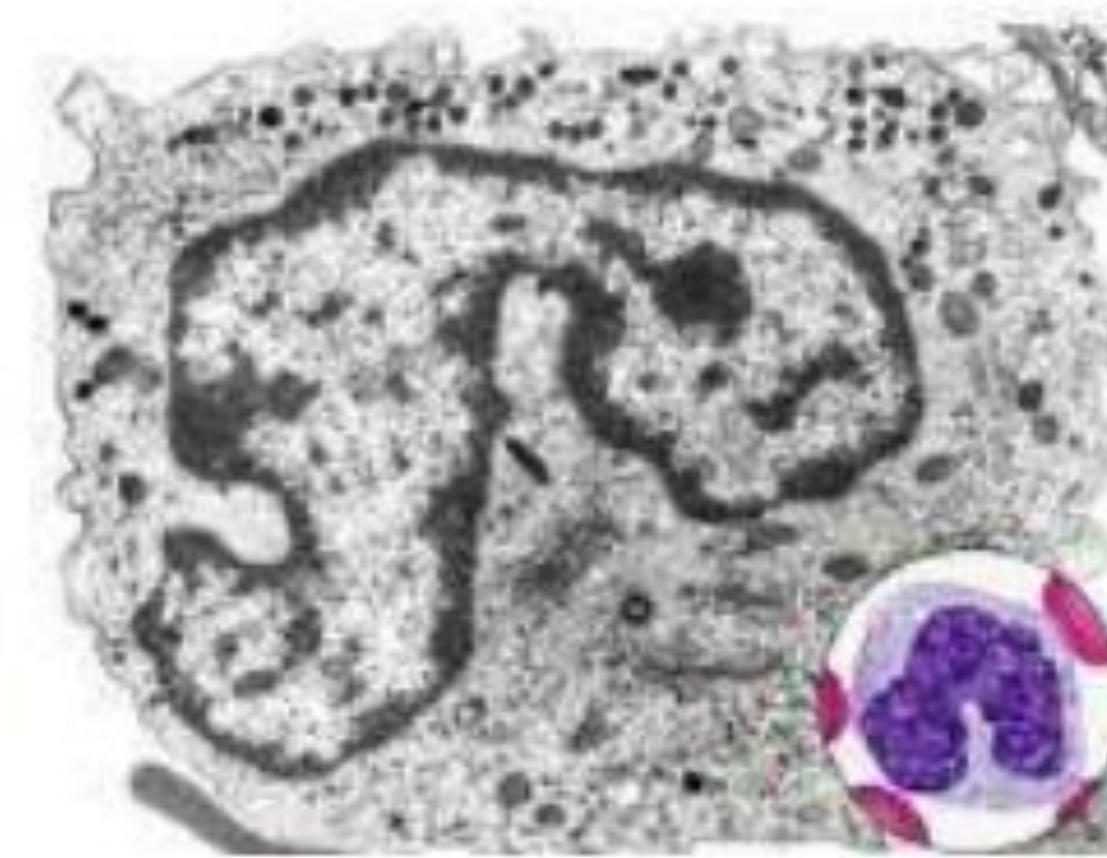
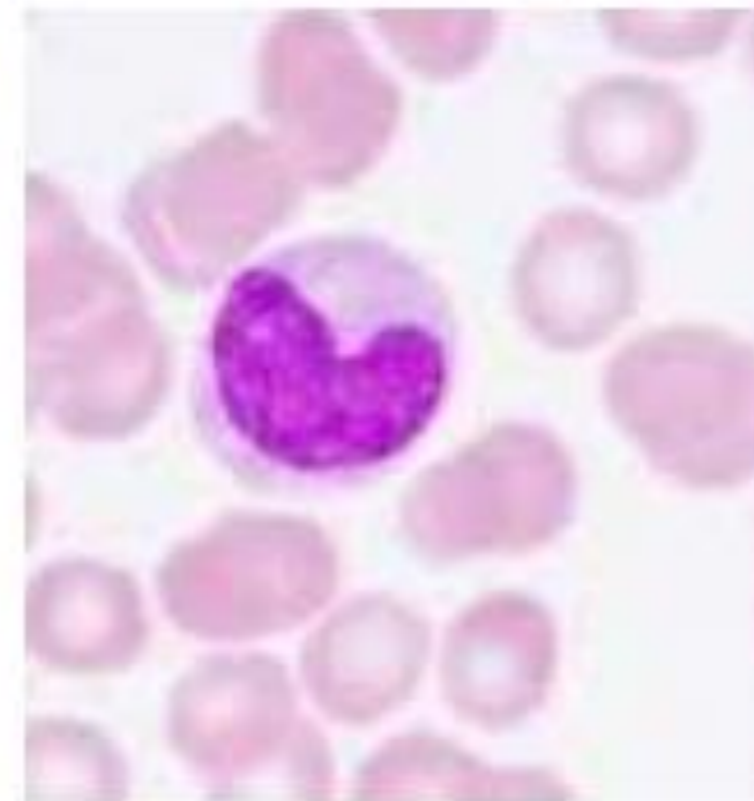
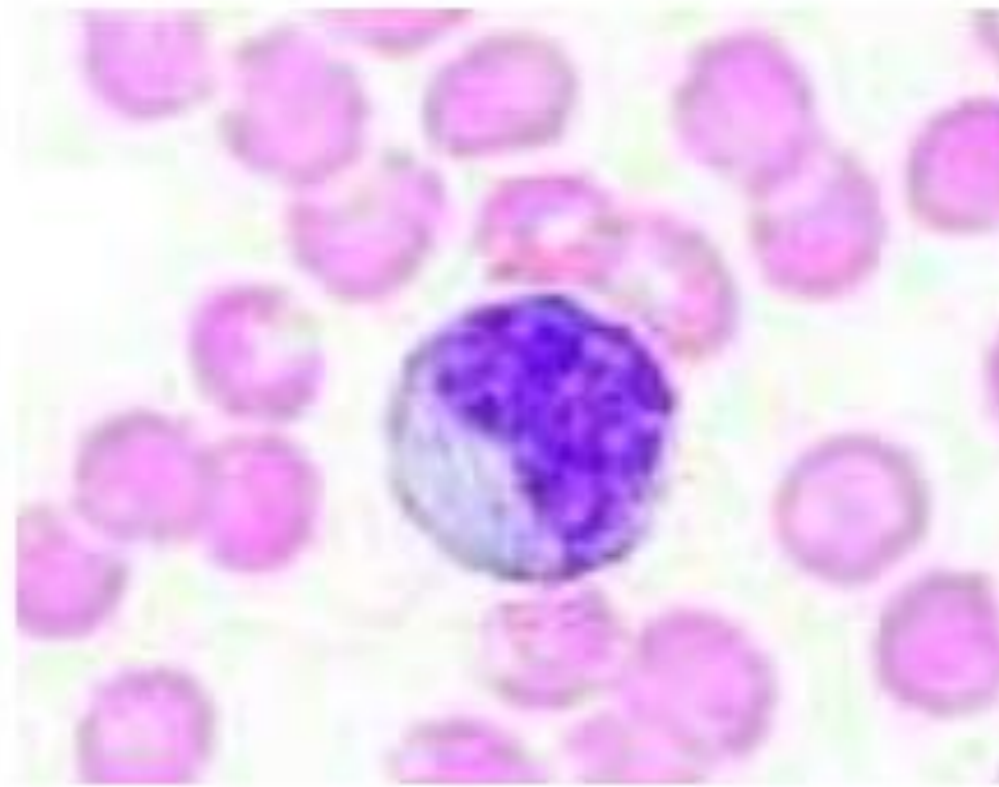
helper *killer* *T-regulatory*

*→ activated to
anti body secreting
plasma cell*



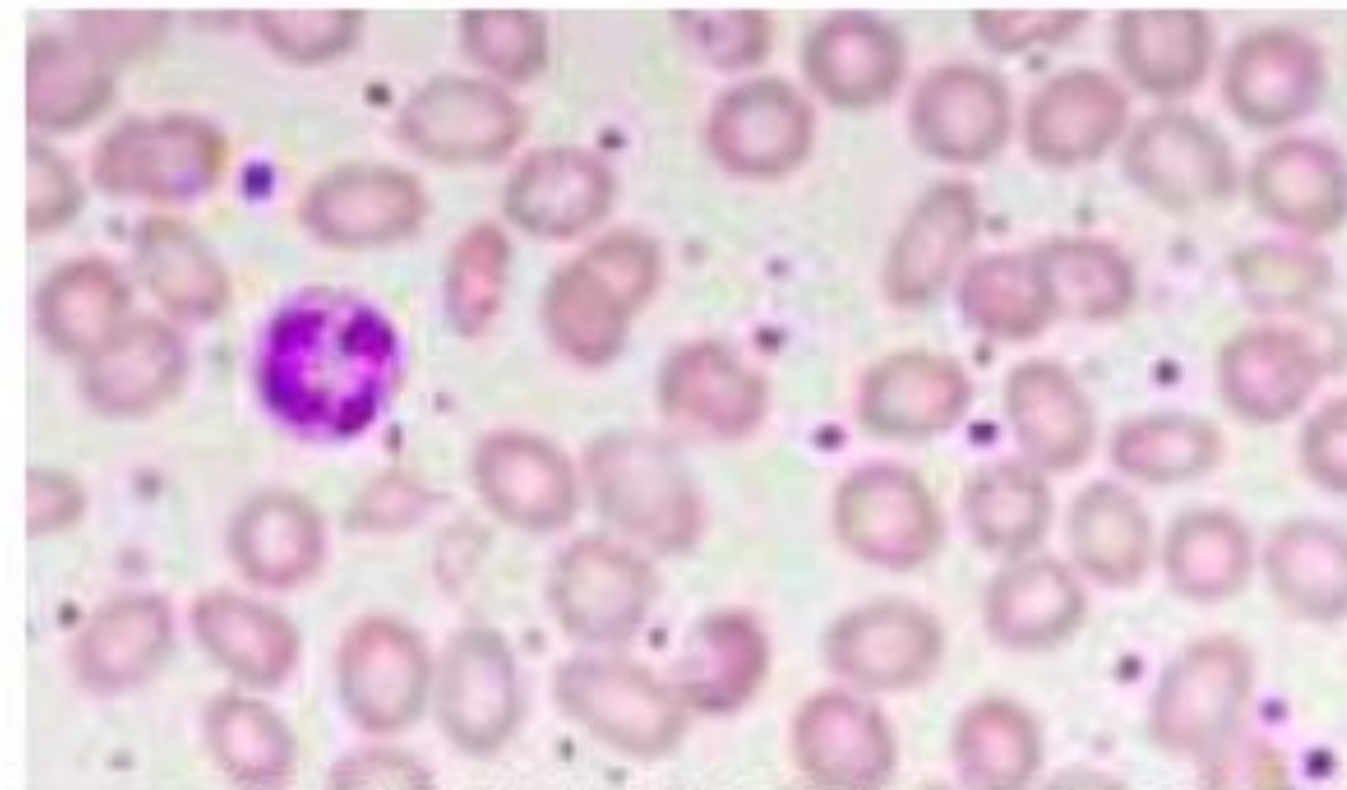
Monocytes

- **Constitute 2-8% of leukocytes**
- **Oval, horse-shoe, or kidney-shaped nucleus**
- **Differentiate into macrophages in connective tissue**
- **It is difficult to differentiate between monocyte and large lymphocyte**



Platelets

- A cell fragment 2-4 μm , non-nucleated
- Promote blood **clotting** and **repair** small tears in blood vessels
- They are 150,000-400,000/ml
- They live for 10 days
- Each platelet is discoid in shape
- It has a lightly stained peripheral zone called **Hyalomere**
- Also has a central dark-stained zone called **Granulomere**
- Spares **Glycocalyx** surrounding plasmalemma for adhesion and activation during coagulation



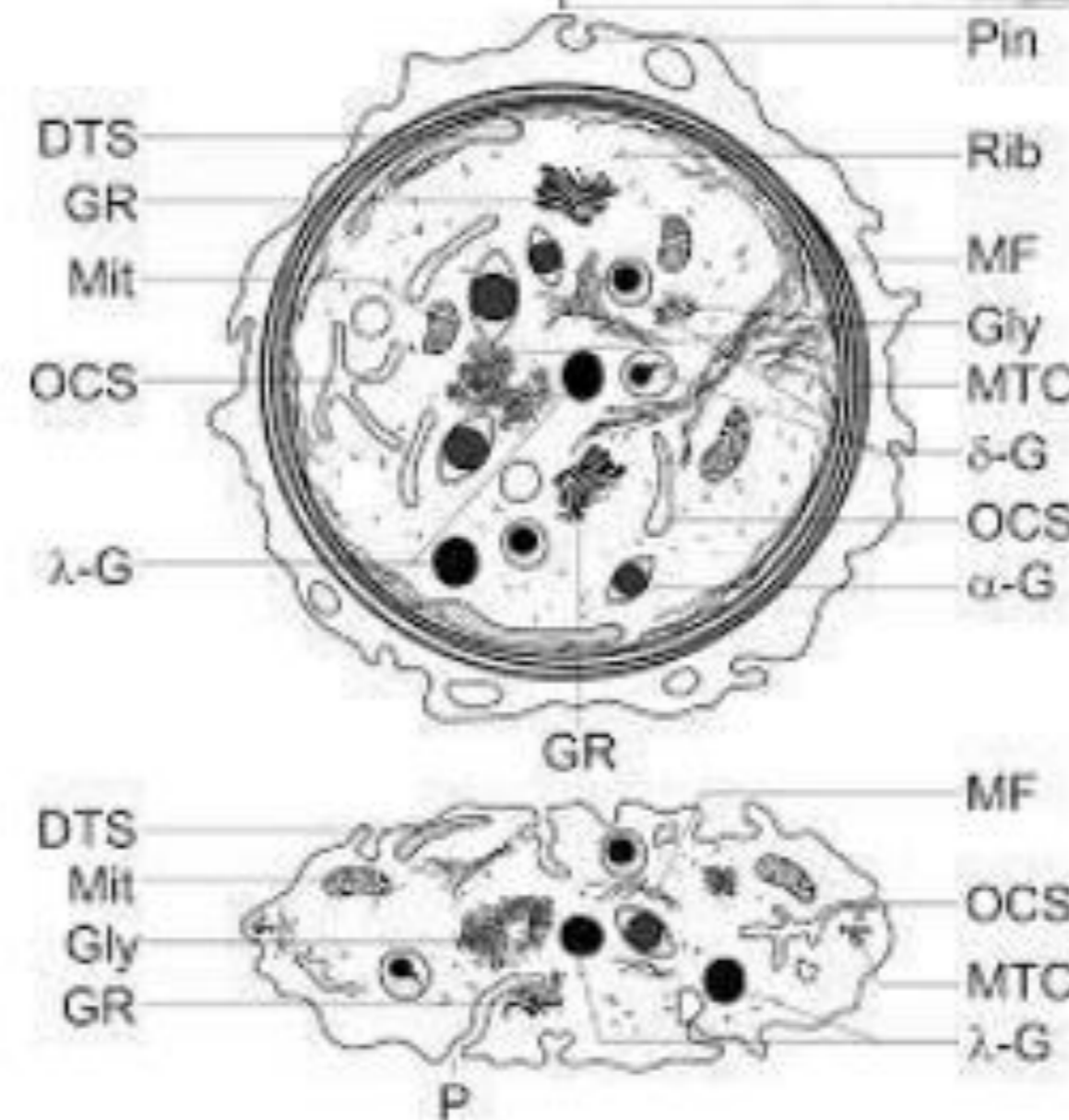
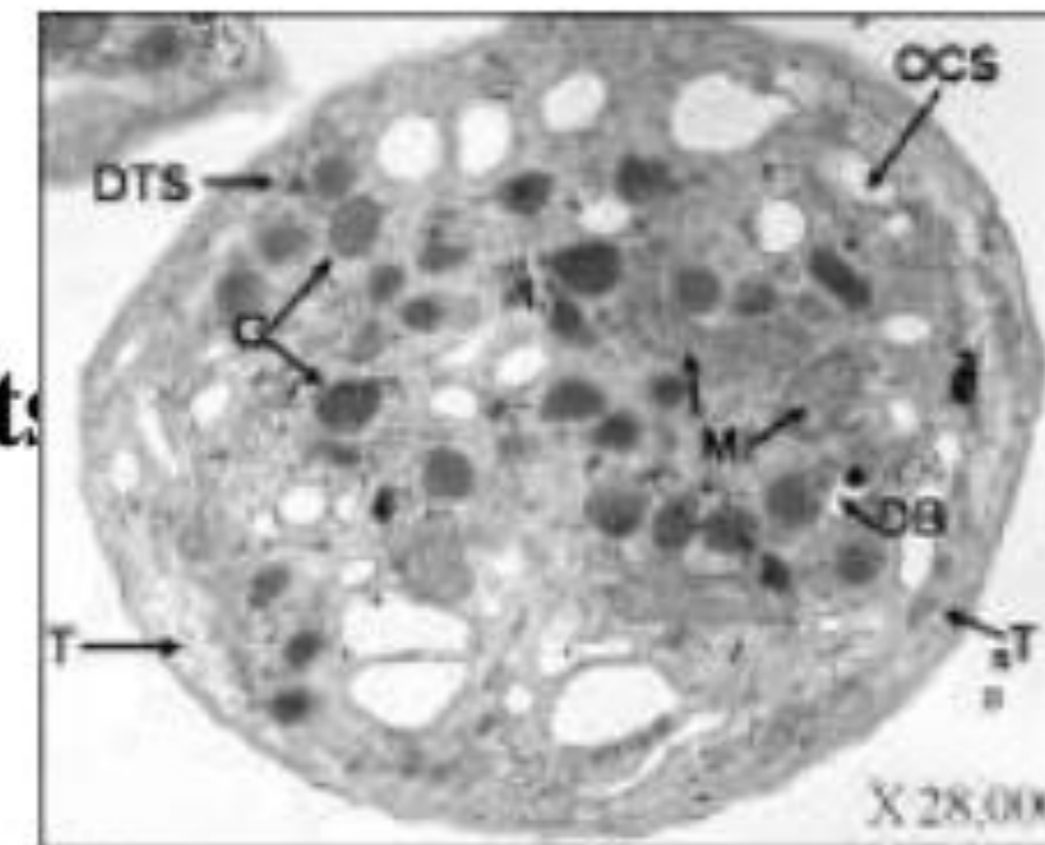
Platelets Cont.,

Hyalomere contains:

- Marginal bundle of microtubule and microfilaments
- Open canalicular system
- Dense tubular system

Granulomere contains:

- δ granules: Serotonin, ADP, ATP
- α granules: fibrinogen, platelet-derived growth factor, platelet specific proteins, platelet factor 4
- λ granules: lysosomes





Thank You

