جامعة المستقبل
AL MUSTAQBAL UNIVERSITY
كلية العلوم
قسم الأنظمة الطبية الذكية

General Anatomy and Physiology

(L7) Blood Cells, Immunity, and Blood Coagulation

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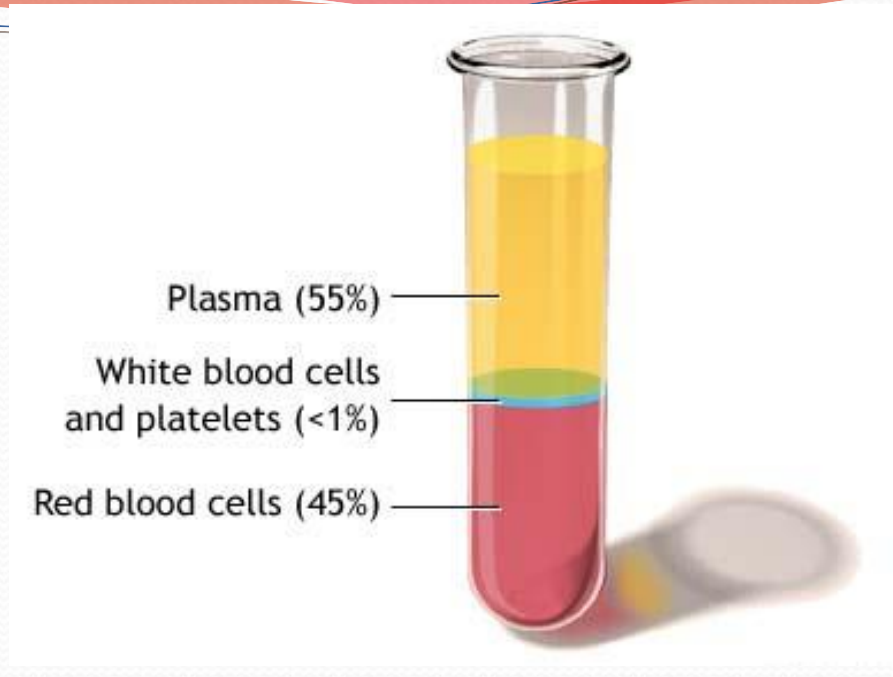
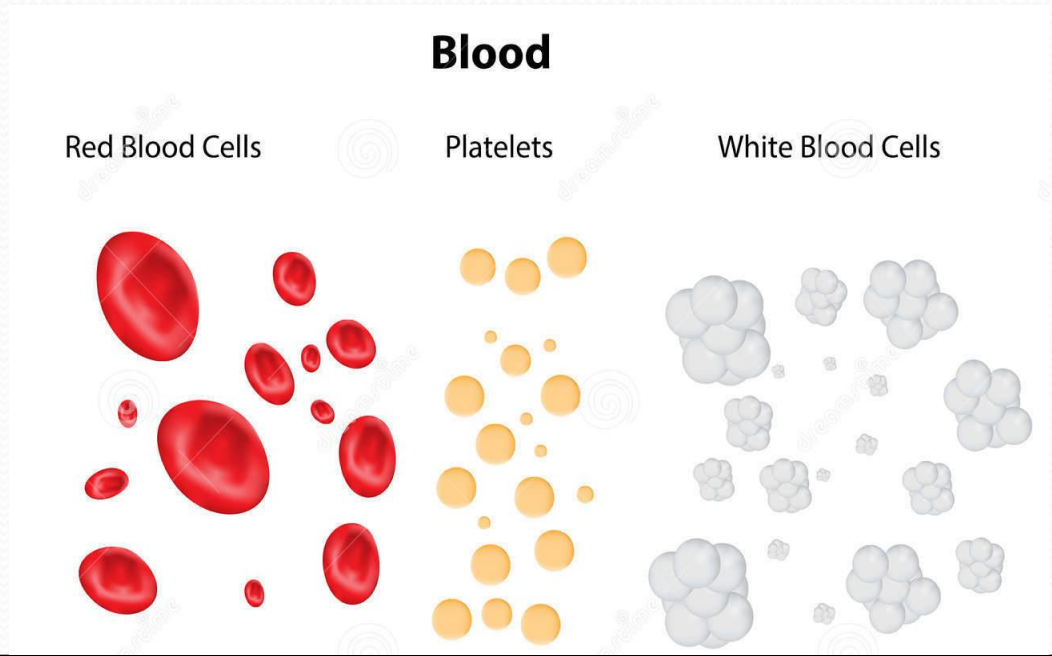
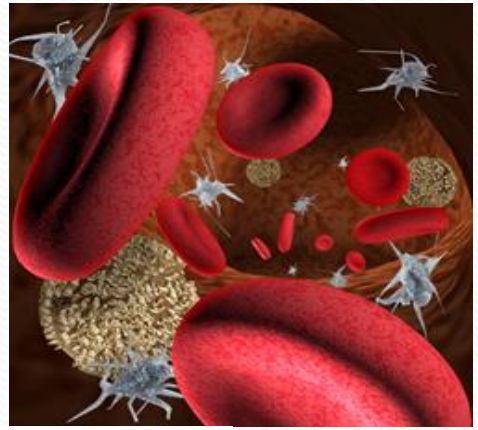
Composition of Blood

- The blood is made up of cells that are suspended in liquid called plasma.
- Plasma makes up 55% of the blood.
- Plasma is made of 90% water and 10% proteins, lipids, carbohydrates, amino acids, antibodies, hormones, electrolytes, waste, salts, and ions
- Blood cells make up the remaining 45% of the blood.
- Red blood cells make up 99% of the blood cells.
- White blood cells and platelets make up the other 1%.

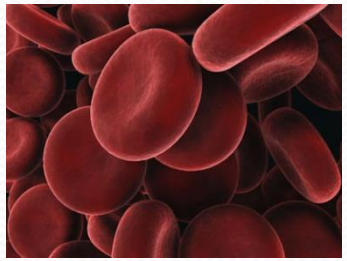




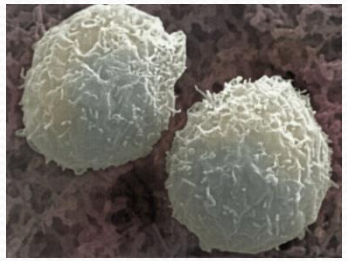
Each type of blood cell performs a different function.



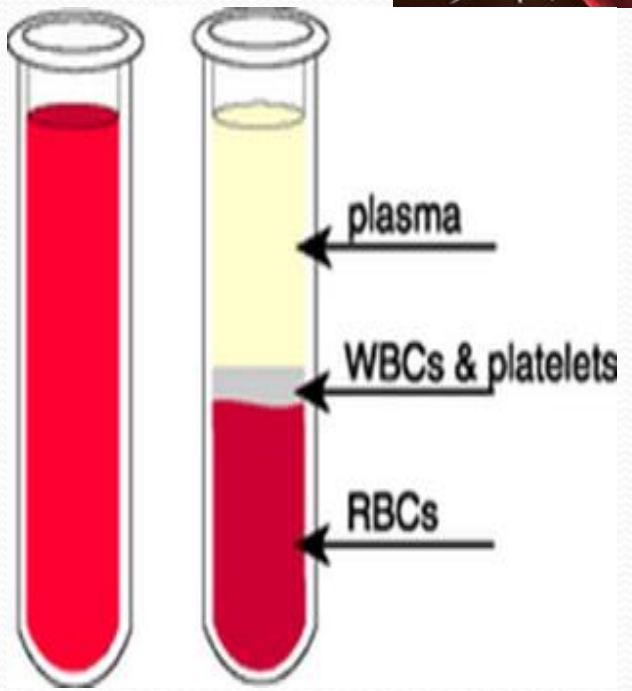
- Red blood cells (Erythrocytes)



- White blood cells (Leukocytes)

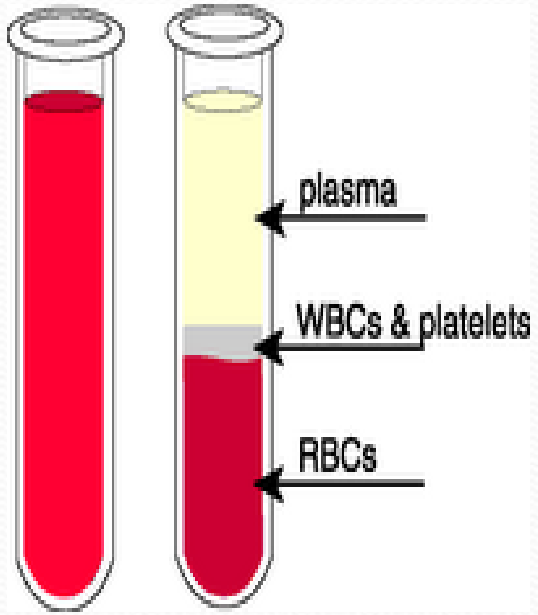


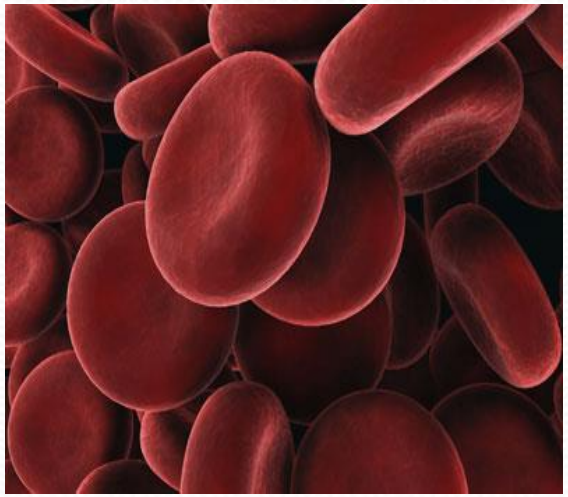
- Platelets (Thrombocytes)

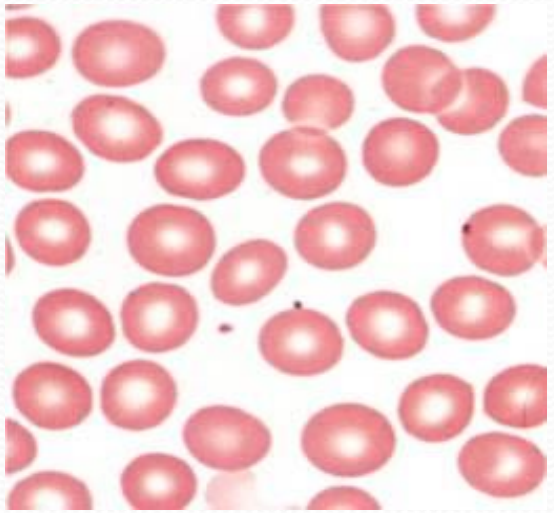


Red Blood Cells

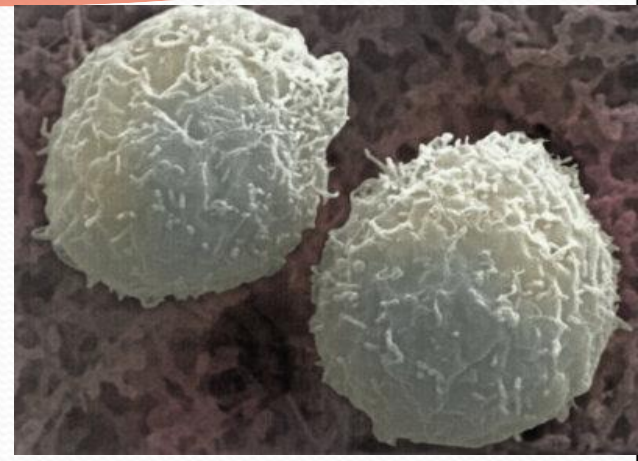
- Erythrocytes or RBCs
  - Most abundant cell in the blood
    (4 million – 6 million per microliter of blood)
  - Formed in the bone marrow
  - Mature forms do NOT have a nucleus
  - Shaped as biconcave disks
  - 6-8 micrometers in diameter
  - Life span of about 120 days
  - Hemoglobin (iron protein) is found in the RBC
  - Hemoglobin carries oxygen from the lungs to the rest of the body and carbon dioxide binds to the RBC and is taken to the lungs to be exhaled.





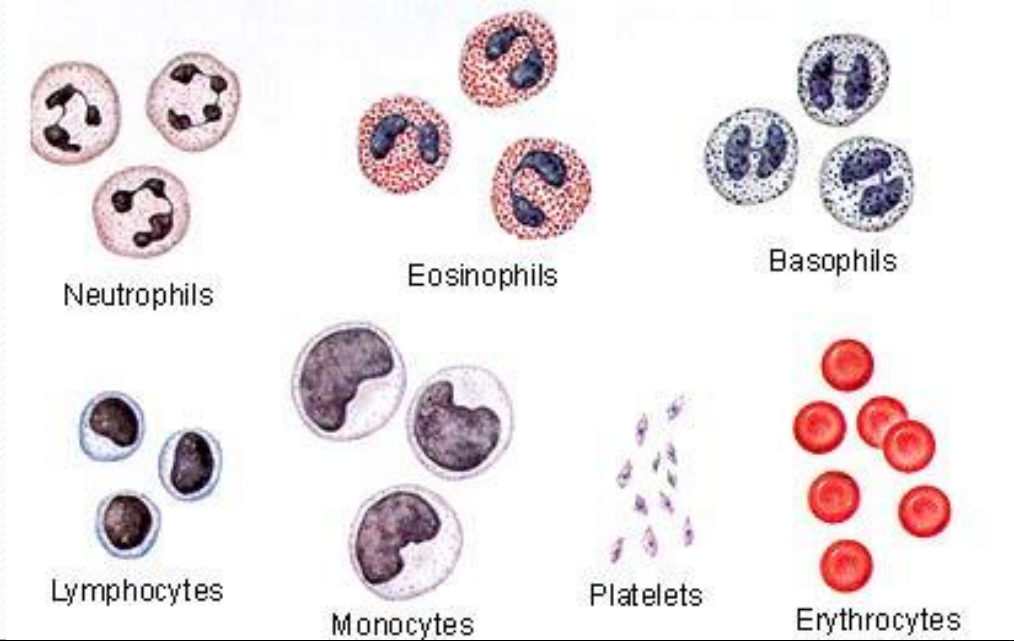


White blood cells (Leukocytes)



- Leukocytes or WBCs
– Largest sized blood cells
– Lowest numbers in the blood (4,500 – 11,000 per microliter)
– Formed in the bone marrow and some in lymph glands
– Primary cells of the immune system
– Fights disease and foreign invaders
–Contain nuclei with DNA, the shape depends on type of cell
– Certain WBCs produce antibodies
– Life span is from 24 hours to several years
–Size is 8-20 micrometers in diameter
–There are five different types of WBCs

1. Neutrophils
2. Eosinophils
3. Basophils
4. Lymphocytes
5. Monocytes



Immunity

- Definition: The ability of the body to resist all types of organisms or toxins that damage the tissues.

- Types:
  - **Natural (innate):** general protective mechanisms e.g. phagocytosis, acidic secretion and digestive enzymes of the GIT, resistance of the skin to invasion, etc…
  - **Acquired**: the ability to develop powerful protective mechanisms against specific invading agents e.g. lethal bacteria and viruses.

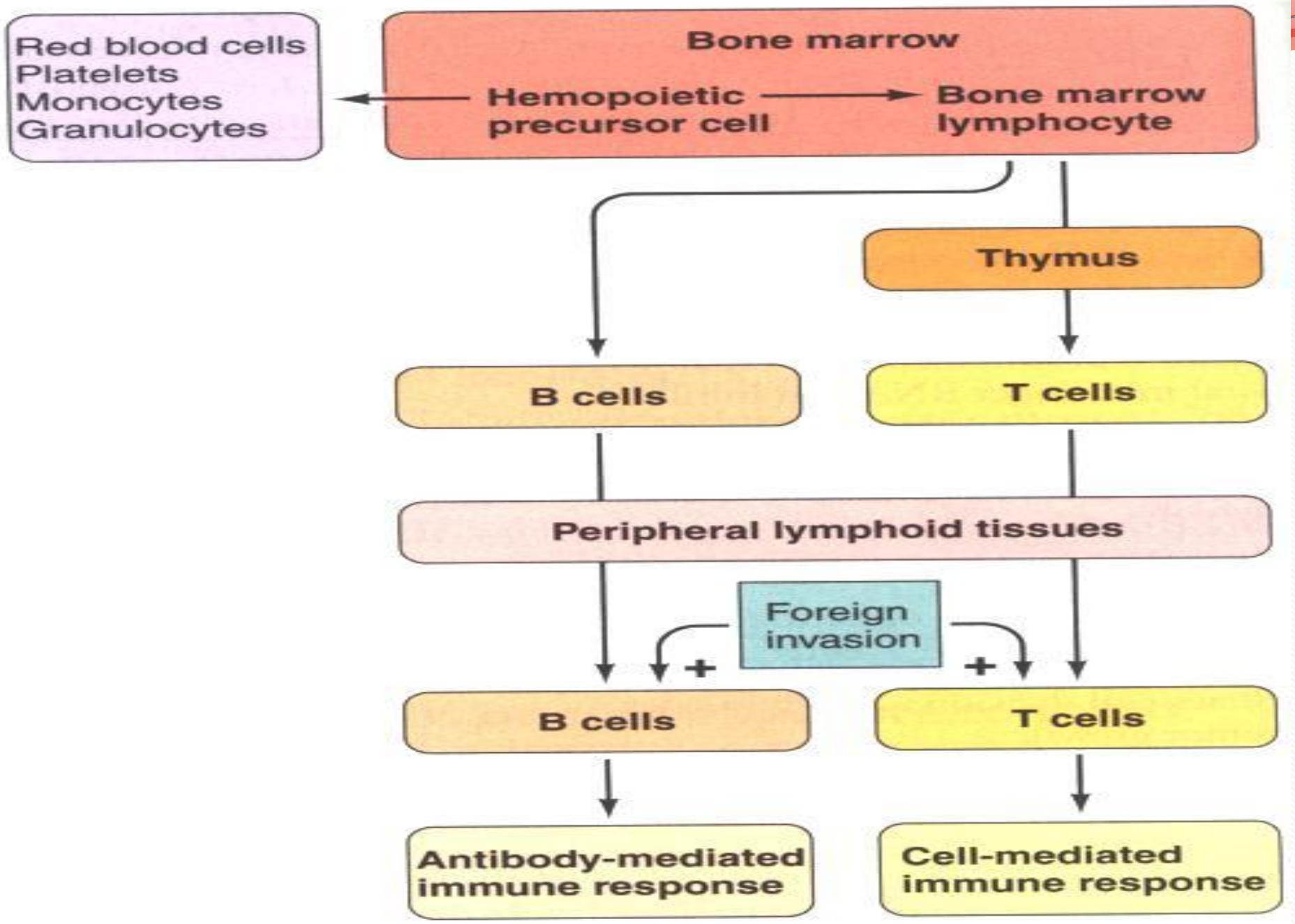
Types of Acquired Immunity

- **Humoral or B-cell immunity:** involves the development of circulating Ab that are capable of attacking an invading agent.

- **Cell mediated or T-cell immunity:** is achieved through the formation of large numbers of activated lymphocytes that are specifically designed to destroy the foreign agent.

Lymphocytes

- Lymphocytes are responsible for acquired immunity. They are present in lymph nodes and other lymphoid tissues throughout the body.
- **B lymphocytes:** Processed in bone marrow. When exposed to an Ag, they differentiate to plasma cells that produce antibodies (gamma globulins). This initiates the destruction of the antigen.
- **T lymphocytes:** Processed in thymus. They release chemicals that destroy target cells with which they make contact such as virus infected cells and cancer cells


Red blood cells
Platelets
Monocytes
Granulocytes
Bone marrow
Hemopoietic precursor cell
Bone marrow lymphocyte
Thymus
B cells
T cells
Peripheral lymphoid tissues
Foreign invasion
+
+
B cells
T cells
Antibody-mediated immune response
Cell-mediated immune response

Phagocytosis

- **Definition**: Cellular ingestion of the offending agent.
- Most important function of neutrophils and macrophages.
- Selective process.
- Phagocytosis is increased if:
  - Surface of particle is rough.
  - Lacks protective protein coat.
  - Binding of antibodies to antigen (opsonization).

Phagoytosis by neutrophils

•Also called polys: first line of defense in bacterial infections.

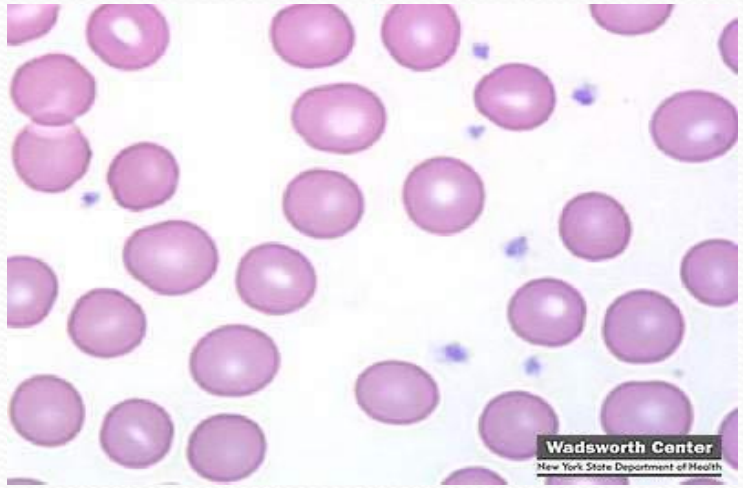
•Mature cells that can attack and destroy bacteria even in the circulating blood.

•Attach to the particle and project pseudopodia around it→ an enclosed chamber that contains the phagocytized particle which breaks away → free floating phagosome.

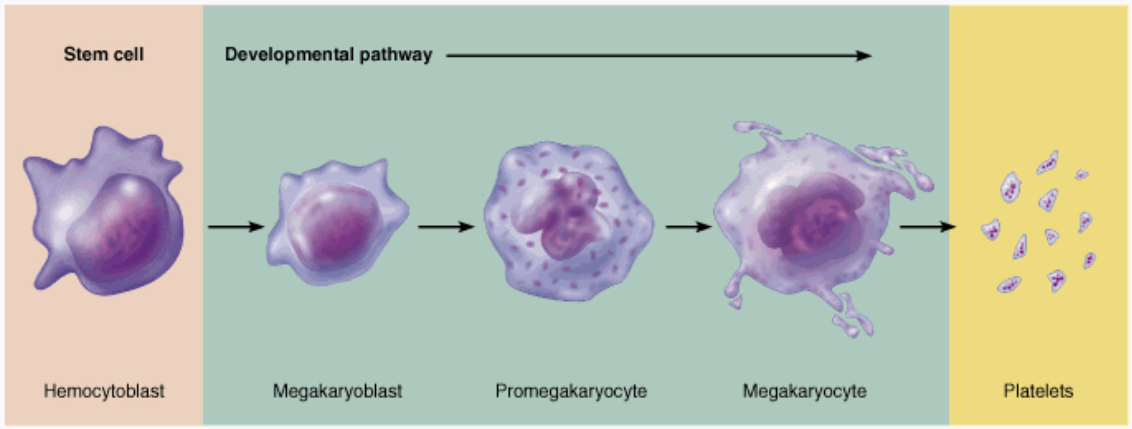
•Can phagocytize 3-20 bacteria before it dies.

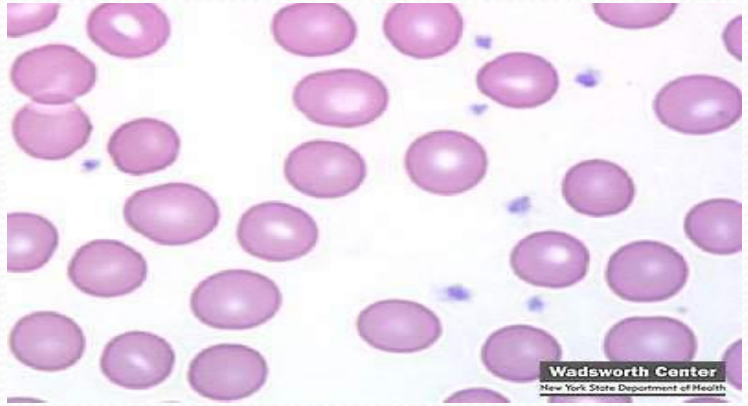
Platelets

- Thrombocytes or PLTs
- Formed in the bone marrow
- Fragments from the cytoplasm of megakaryocytes
- Smallest of the blood cells
- 1-4 micrometers in diameter
- Shape can be round, oval, or appear spiky



- **Platelets**
  - Involved in the clotting process
  - Seal wounds and prevent blood loss
  - Help repair damaged vessels
  - 150,000 – 400,000 per microliter of blood
  - Platelets stain bluish with reddish or purple granules





Normal Count

Normal platelet count is 2,50,000/cu mm of blood. It ranges between 2,00,000 and 4,00,000/cu mm of blood.

Life Span

Life span of platelets varies from 8 to 12 days with an average of 10 days. Platelets are destroyed by macrophage system in spleen.

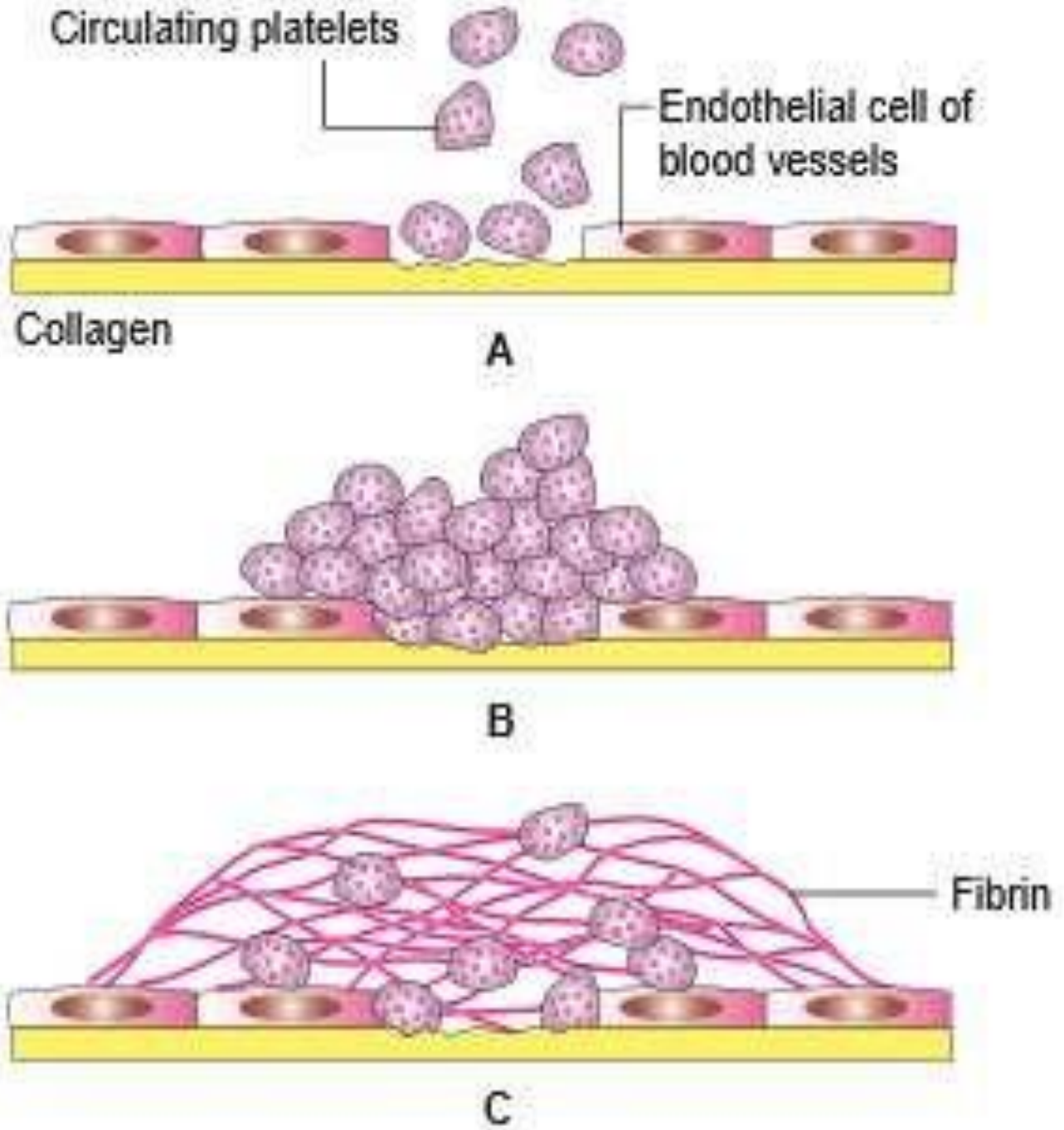
PROPERTIES OF PLATELETS

Platelets have three important properties (three 'A's):

1. Adhesiveness
2. Aggregation
3. Agglutination

ADHESIVENESS

- Adhesiveness is the property of sticking to a rough surface.
- During injury of blood vessel, endothelium is damaged and the subendothelial collagen is exposed.
- While coming in contact with collagen, platelets are activated and adhere to collagen.
- Other factors which accelerate adhesiveness are collagen, thrombin, ADP, Thromboxane A2, calcium ions, P-selectin and vitronectin.
- **Aggregation:** is the grouping of platelets.
- **Agglutination** is the clumping together of platelets.


Circulating platelets
Endothelial cell of blood vessels
Collagen
A
B
Fibrin
C

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THANK YOU!