SNS COLLEGE OF ALLIED HEALTH SCIENCE

Affiliated to The Tamil Nadu Dr. M.G.R Medical University, Chennai

DEPARTMENT OF RADIOGRAPHY AND IMAGING TECHNOLOGY

COURSE NAME : HUMAN ANATOMY AND PHYSIOLOGY

RELEVANT TO RADIOLOGY

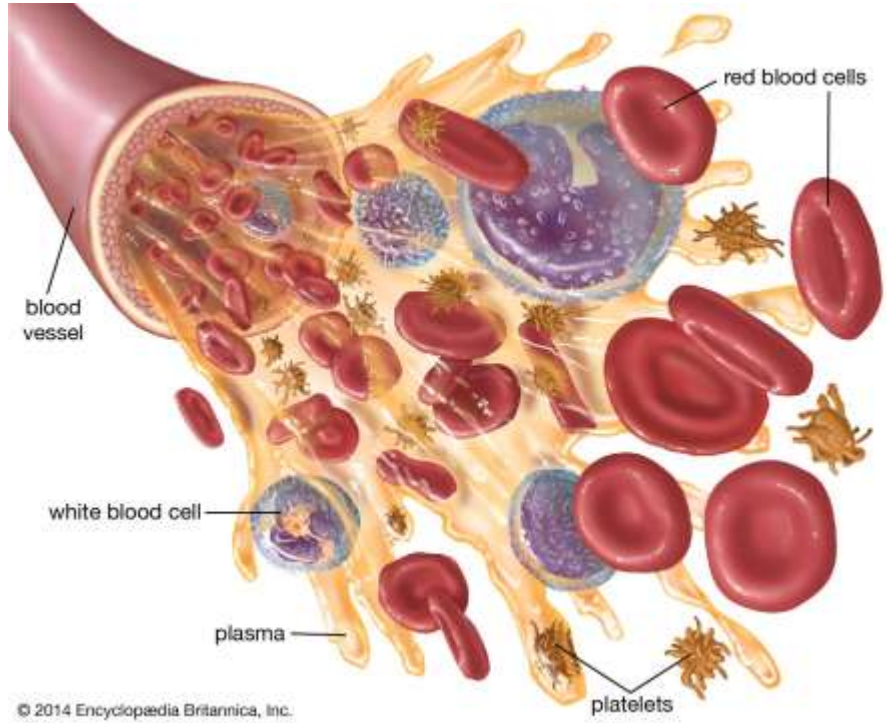
UNIT : HEMATOLOGY

TOPIC : COMPOSITION OF BLOOD AND ITS FUNCTIONS

FACULTY NAME : MRS.G.HELANA JOY

INTRODUCTION (Define)

- Hematology is the study of blood, blood-forming organs, and blood diseases.
- Blood is a specialized connective tissue crucial for life, performing many vital functions.
- Circulates through the cardiovascular system, delivering essentials and removing waste.
- Average adult has ~4.5–6 liters of blood (about 7–8% of body weight).

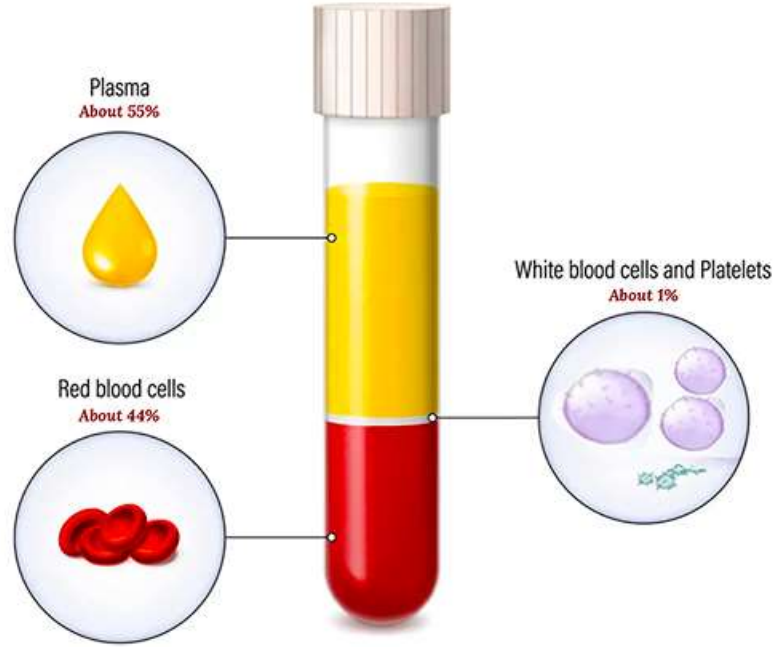


FUNCTIONS OF BLOOD

- Transports oxygen, nutrients, hormones, and waste products.
- Regulates body temperature, pH, and fluid balance.
- Protects against infection and participates in clotting to prevent blood loss.

COMPOSITION OF BLOOD

- Blood consists of plasma (~55%) and formed elements (~45%): red blood cells (RBCs), white blood cells (WBCs), and platelets.
- Each component has unique and essential functions.

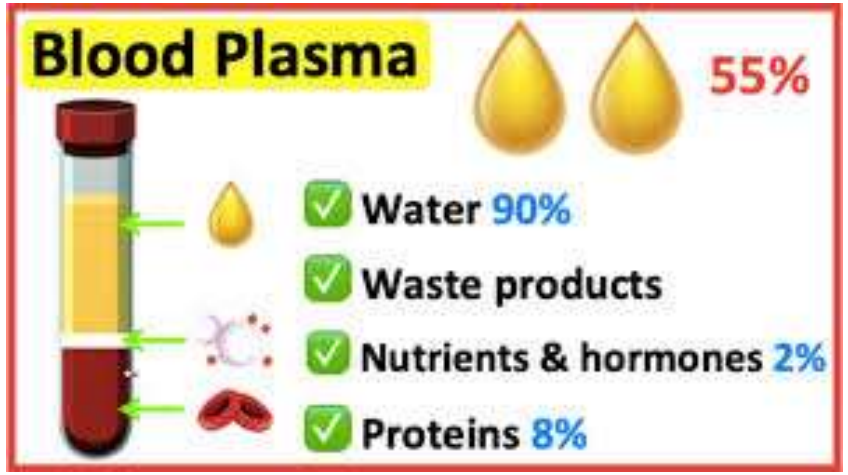


PLASMA – THE LIQUID MATRIX

- Plasma is the liquid part of blood and makes up about 55% of total blood volume.
- Straw-colored fluid composed mainly of water, proteins, and other solutes.

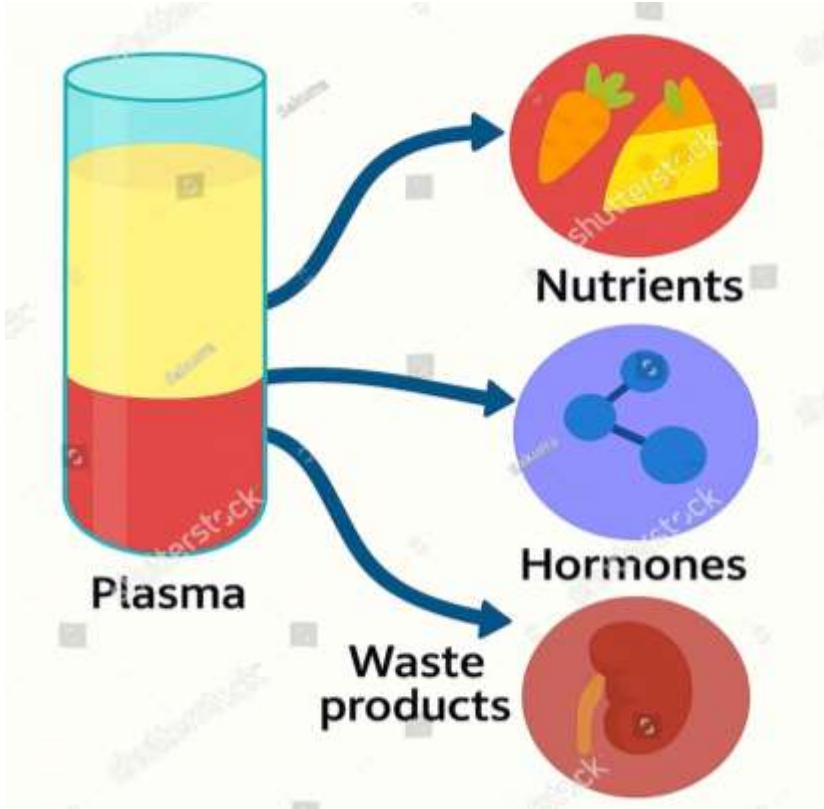
PLASMA - COMPOSITION DETAILS

- Comprised of 90-92% water.
- 8-10% solutes: proteins (albumin, globulins, fibrinogen), electrolytes, nutrients, waste products, and gases.
- Carries hormones, enzymes, and vitamins



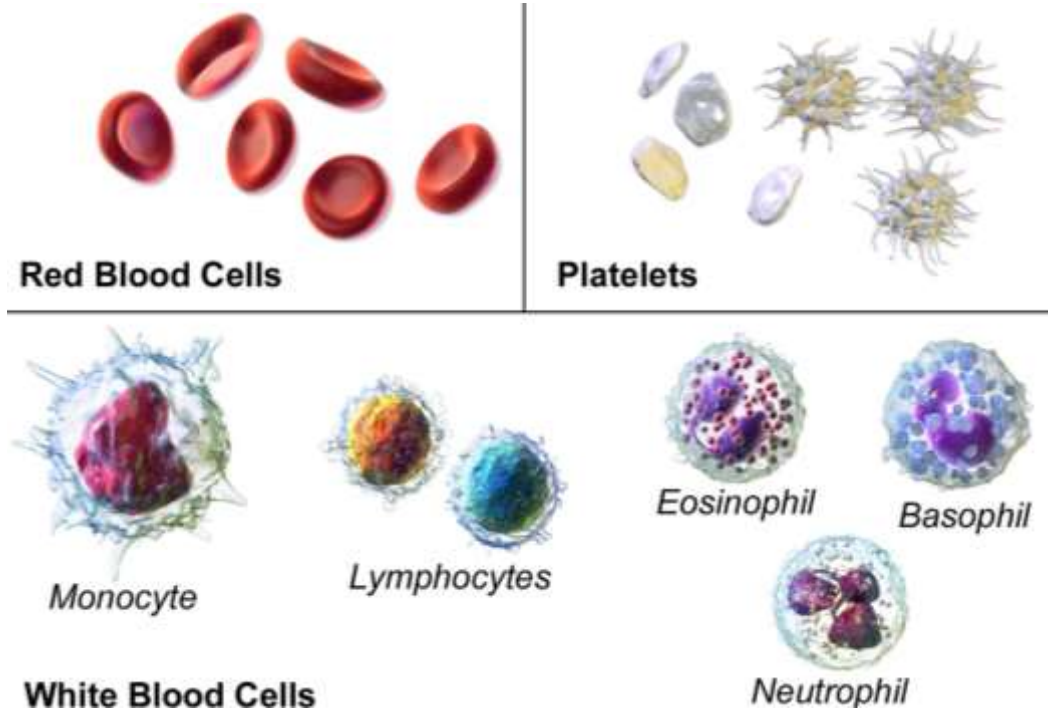
PLASMA – FUNCTIONS

- Transports nutrients, hormones, and waste products.
- Contains proteins required for blood clotting and immune functions (antibodies).
- Maintains osmotic and pH balance



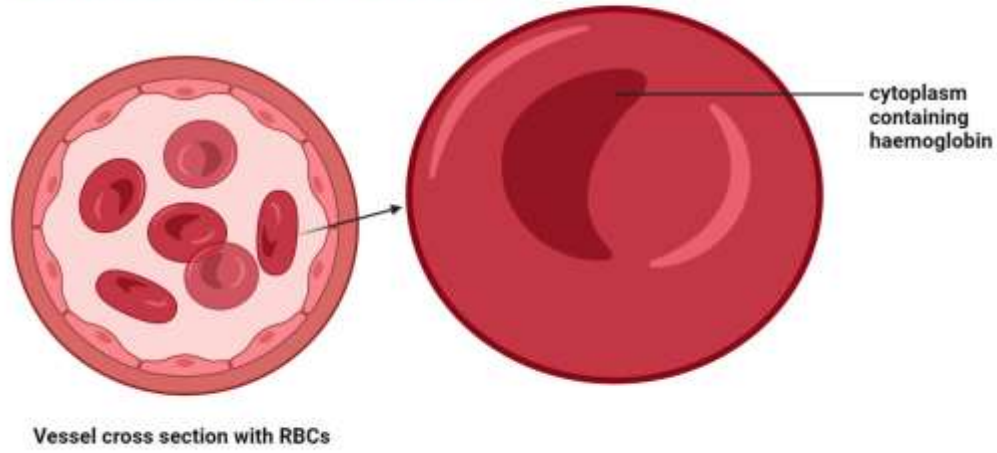
FORMED ELEMENTS OF BLOOD

- Three main types: Erythrocytes (RBCs), Leukocytes (WBCs), and Thrombocytes (platelets).
- Suspended in plasma and visible after centrifugation



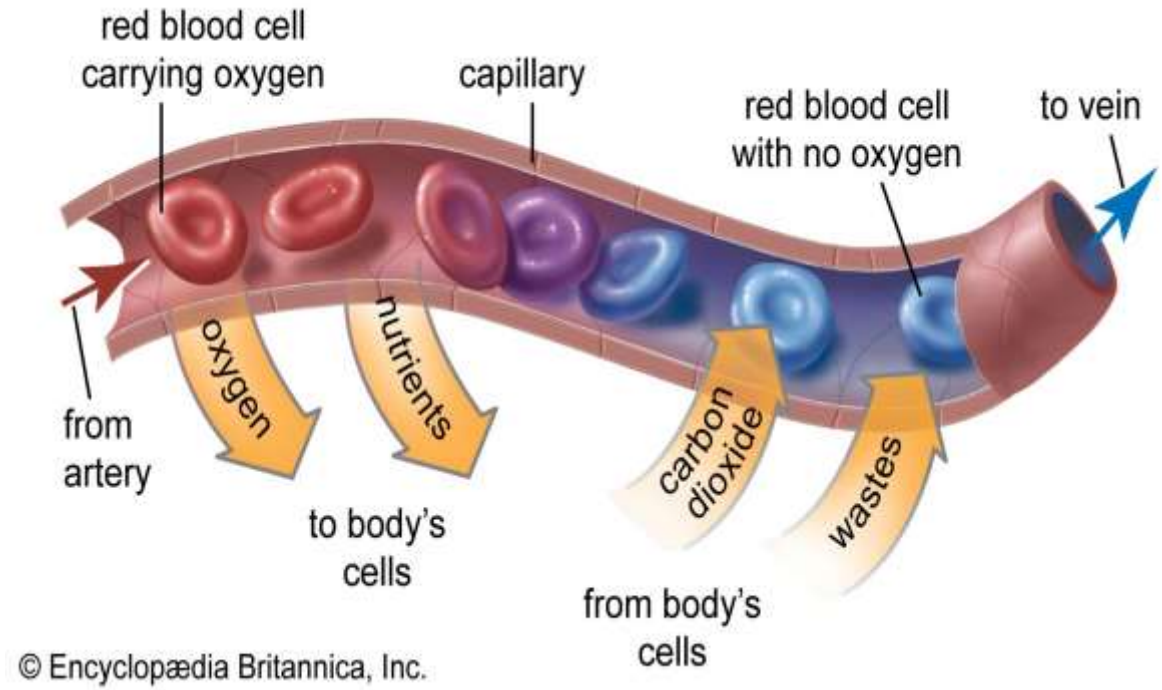
RED BLOOD CELLS (ERYTHROCYTES) - STRUCTURE

- Biconcave, disc-shaped cells without a nucleus.
- Contain hemoglobin, a red pigment crucial for oxygen transport.
- Majority of formed elements (~99%).
- Quantity: ~4.5–6 million per microliter.
- Lifespan: ~120 days, recycled in spleen/liver



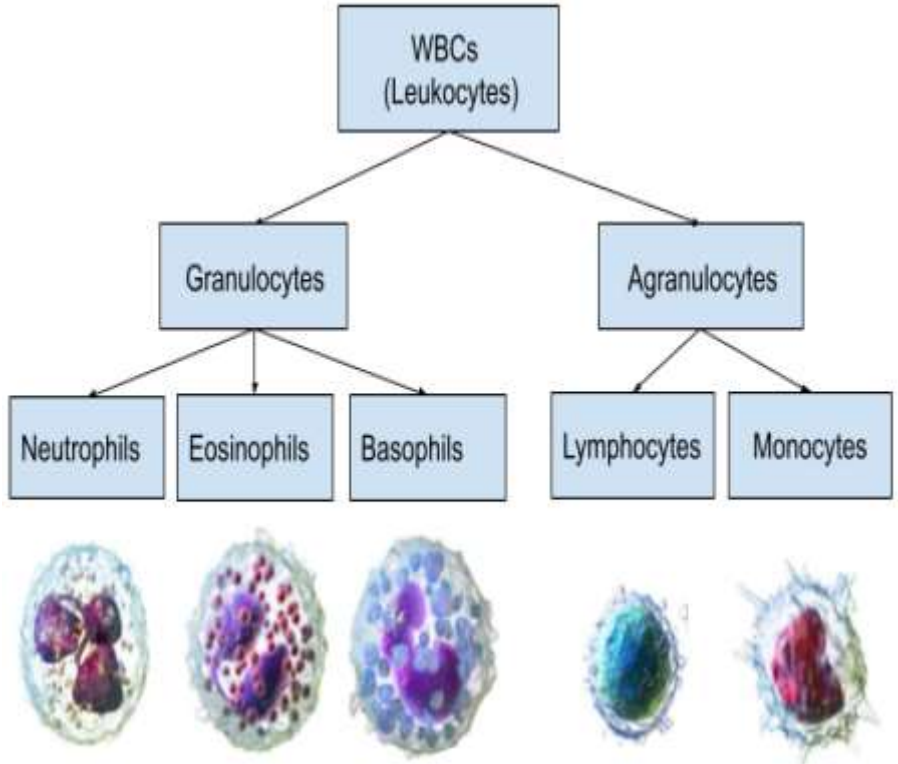
RED BLOOD CELLS - FUNCTIONS

- Primary transporters of oxygen from lungs to tissues.
- Carry carbon dioxide from tissues to lungs for exhalation.
- Contribute to blood viscosity and pH regulation.



WHITE BLOOD CELLS (LEUKOCYTES)
TYPES & STRUCTURE

- Make up less than 1% of blood cells, but pivotal for immunity.
- Larger than RBCs, contain nuclei, and can move independently.
- Quantity: ~4,000–11,000 per microliter (1% of blood volume).
- Life span : Most WBCs live for a few days to a few weeks, except some memory lymphocytes which persist for years.

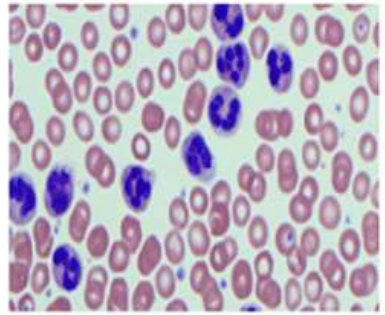


TYPES OF WHITE BLOOD CELLS

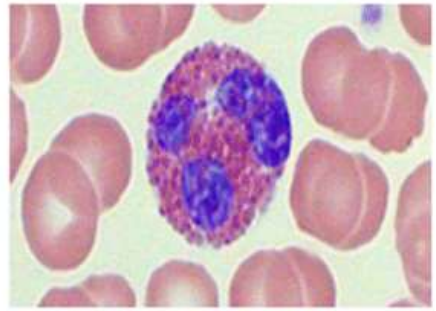
WBCs are subdivided into two major groups — granulocytes (with granules in their cytoplasm) and agranulocytes (without visible granules):

Type	Appearance	Percentage	Key Functions
Neutrophils	Multi-lobed nucleus, fine pale granules	55-70%	First responders; engulf and destroy bacteria, fungi (phagocytosis)
Eosinophils	Bi-lobed nucleus, large red granules	1-4%	Combat parasites; modulate allergies, inflammation
Basophils	Lobed nucleus, large blue/purple granules	<1%	Release histamine, trigger inflammation/allergies
Monocytes	Large kidney-shaped nucleus, ample cytoplasm	4-8%	Become macrophages in tissue; engulf pathogens, clean debris
Lymphocytes	Large round nucleus, thin rim cytoplasm	20-30%	B cells produce antibodies; T cells destroy infected/cancer cells; regulate immunity

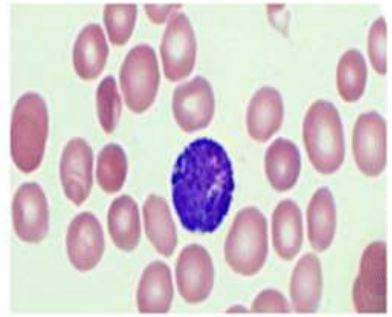
WHITE BLOOD CELLS



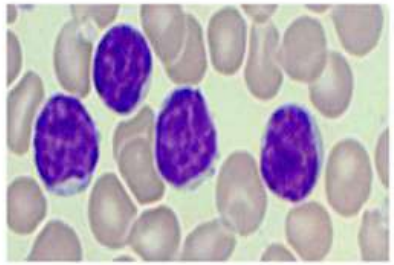
(a) neutrophils



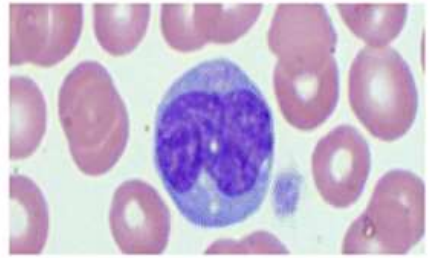
(b) eosinophils



(c) basophils



(d) lymphocytes

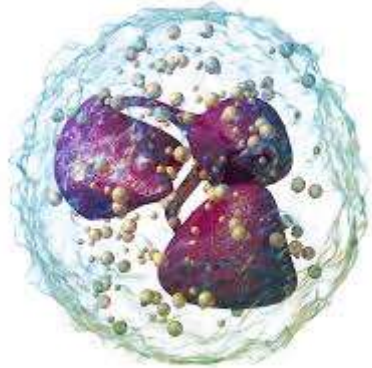


(e) monocytes

WHITE BLOOD CELLS - FUNCTIONS

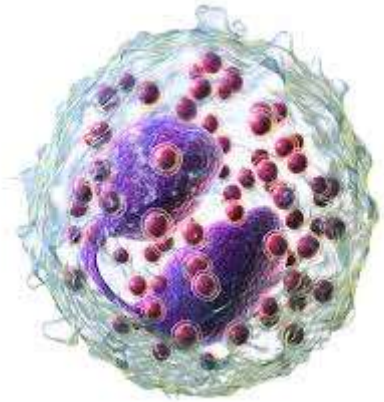
Neutrophils

- Make up the majority of WBCs.
- Highly mobile and first to reach infection sites, where they engulf microbes and debris (phagocytosis).
- Main defense against bacterial infections.



Eosinophils

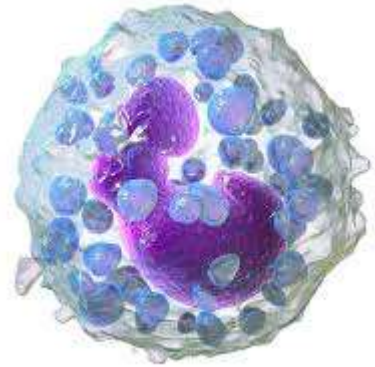
- Respond to parasitic infections.
- Regulate allergy and asthma responses by moderating inflammation.



WHITE BLOOD CELLS - FUNCTIONS

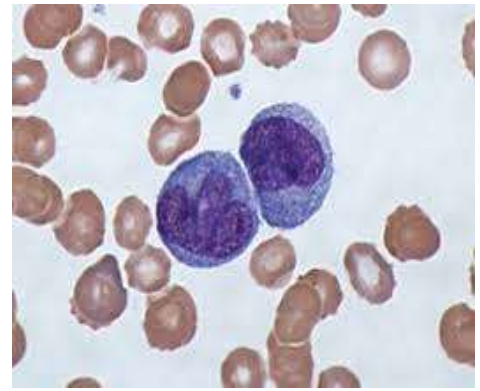
Basophils

- Involved in inflammatory and allergic responses.
- Release histamine to dilate blood vessels and heparin to prevent clotting.



Monocytes

- Largest white blood cells.
- Move from blood to tissues, where they mature into macrophages and dendritic cells.
- Macrophages are scavengers, removing pathogens and debris and presenting antigens to lymphocytes.

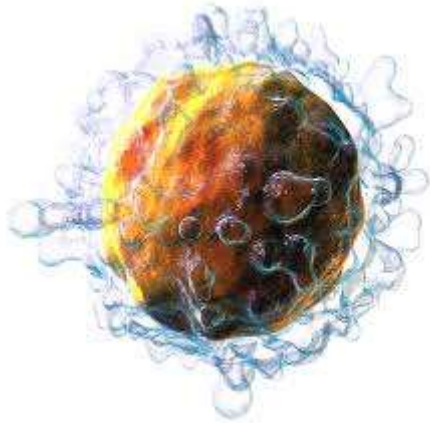


WHITE BLOOD CELLS - FUNCTIONS

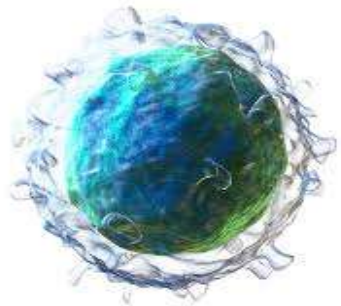
Lymphocytes

- Divided into B cells, T cells, and natural killer (NK) cells.
- B cells: produce antibodies, humoral immunity.
- T cells: kill infected or cancerous cells, regulate immune functions.
- NK cells: attack virus-infected and tumor cells

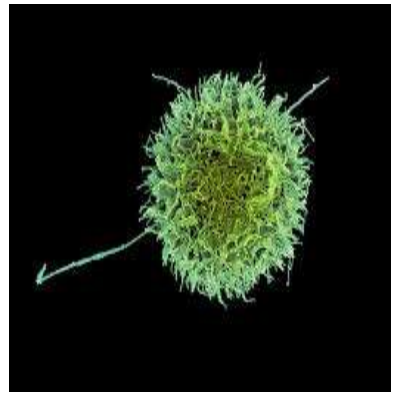
T cells



B cells

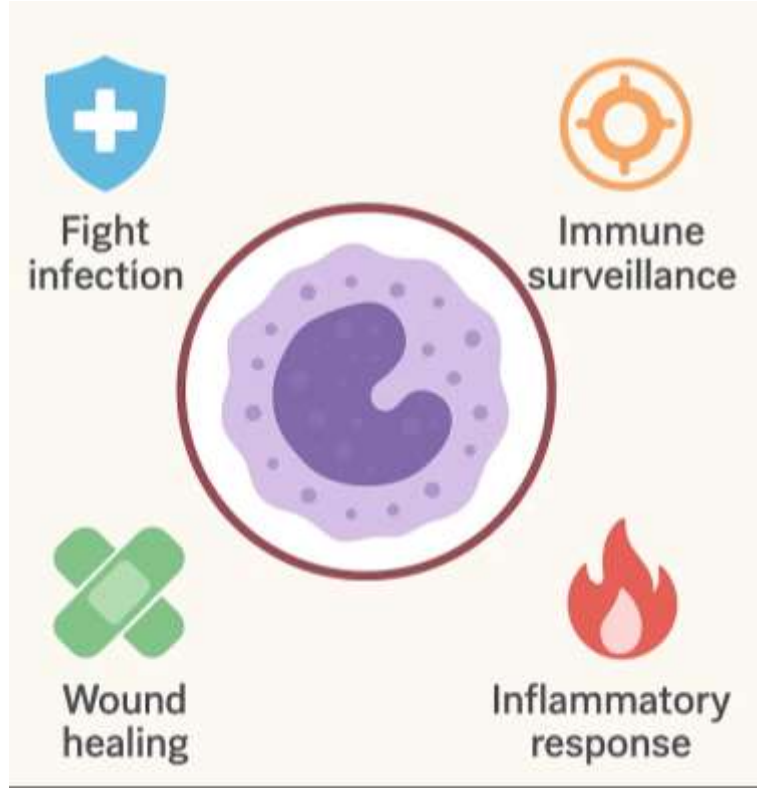


NK cells



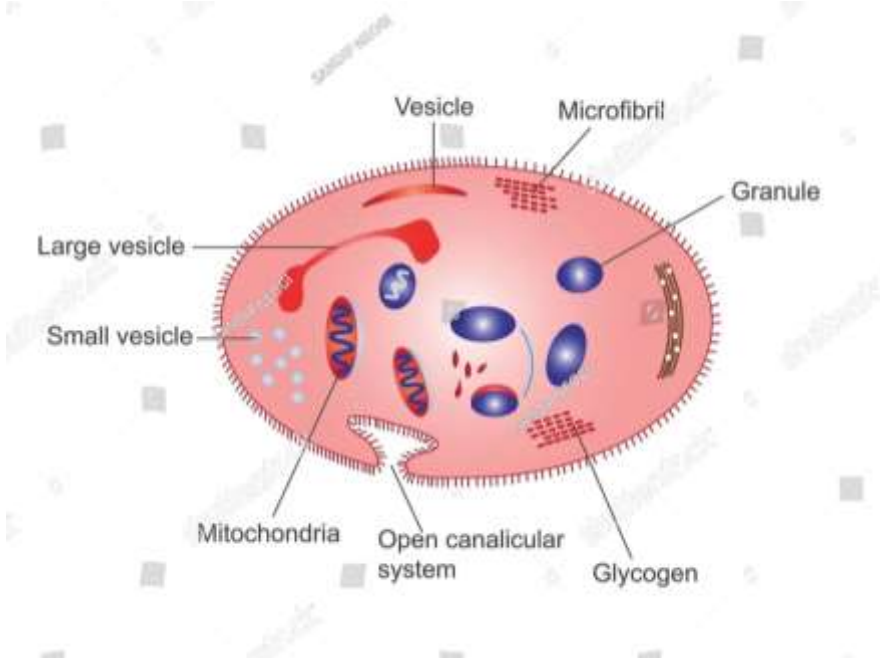
WHITE BLOOD CELLS - FUNCTIONS

- Fight infections and foreign invaders (immune response).
- Neutrophils: Phagocytize bacteria.
- Lymphocytes: Adaptive immunity (B and T cells).
- Others: Allergic responses, parasite defense.



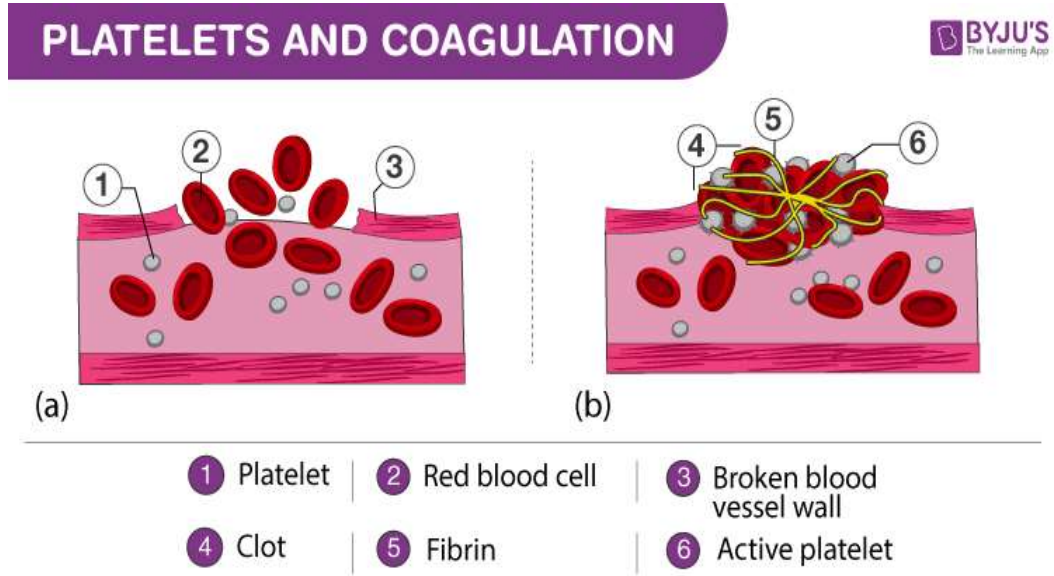
PLATELETS (THROMBOCYTES) STRUCTURE

- Small, irregularly shaped cell fragments without a nucleus.
- Originate from larger bone marrow cells called megakaryocytes.
- Present in lower numbers compared to RBCs and WBCs.
- Quantity: ~150,000–450,000 per microliter.
- Lifespan: ~7–10 days.

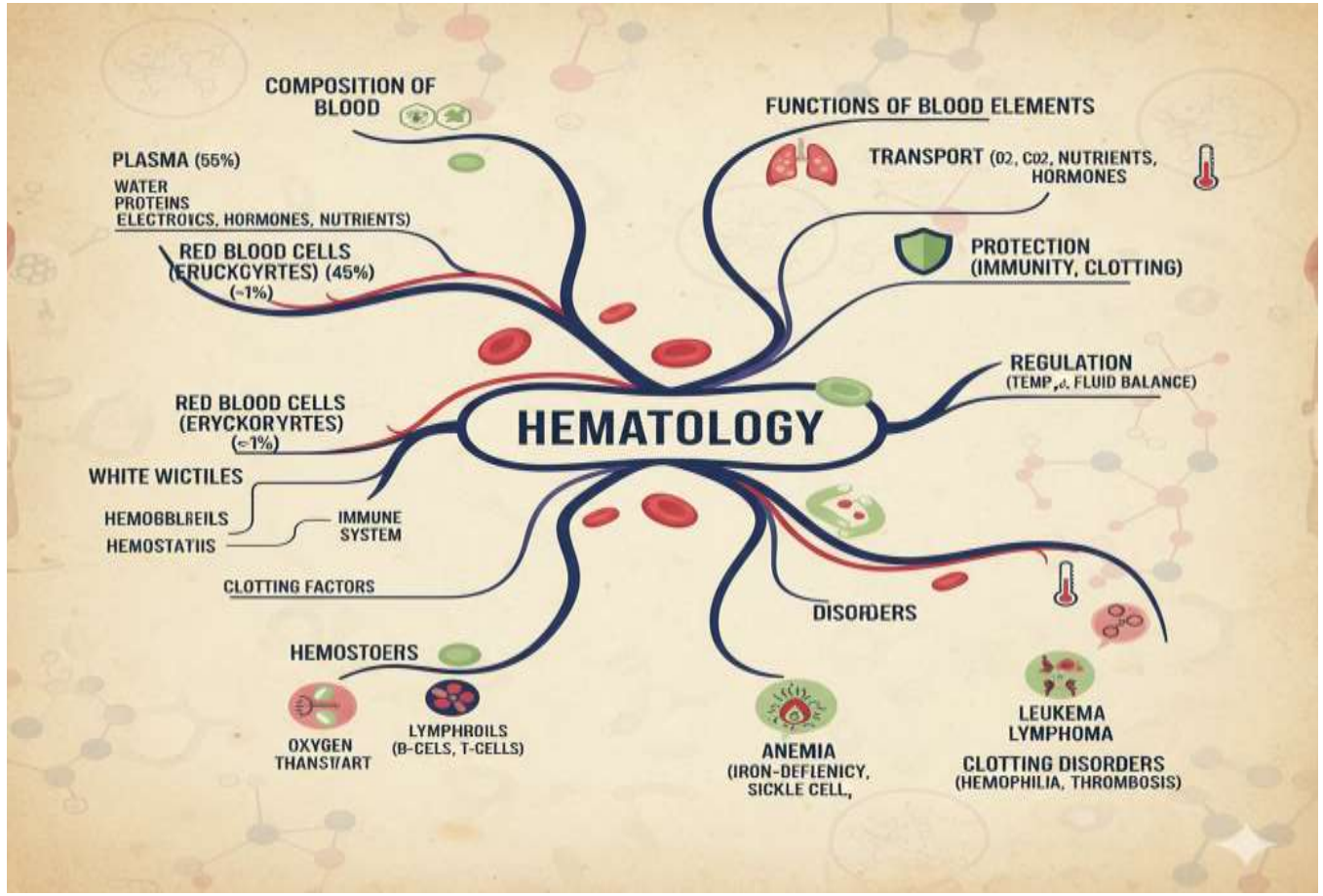


PLATELETS - FUNCTIONS

- Essential for blood clotting (hemostasis); form plugs that seal vessel injuries.
- Release chemicals that help in clot formation and vessel repair.
- Prevent excessive bleeding and contribute to wound healing.



SUMMARY


HEMATOLOGY
COMPOSITION OF BLOOD
PLASMA (55%)
WATER
PROTEINS
ELECTROICS, HORMONES, NUTRIENTS)
RED BLOOD CELLS (ERUCKCYRTES) (45%)
(~1%)
RED BLOOD CELLS (ERYCKORYRTES)
(~1%)
WHITE WICTILES
HEMOBBLREILS
HEMOSTATIIS
IMMUNE SYSTEM
CLOTTING FACTORS
HEMOSTOERS
OXYGEN THANSTART
LYMPHROILS (B-CELS, T-CELLS)
FUNCTIONS OF BLOOD ELEMENTS
TRANSPORT (02, C02, NUTRIENTS, HORMONES
PROTECTION (IMMUNITY, CLOTTING)
REGULATION (TEMP, FLUID BALANCE)
DISORDERS
ANEMIA (IRON-DEFLENICY, SICKLE CELL,
LEUKEMA LYMPHOMA
CLOTTING DISORDERS (HEMOPHILIA, THROMBOSIS)

References

- https://www.medicalnewstoday.com/articles/196001#structure
- https://www.physio-pedia.com/Blood_Physiology
- https://www.ncbi.nlm.nih.gov/books/NBK2263/