Department Of Biotechnology

CELLS OF IMMUNE SYSTEM

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Cells of immune system

- WBCs are the principle cells of immune system formed hematopoietic stem cell by the process of *hematopoiesis.*
- Hematopoiesis *occurs in yolk sac during 1st week of gestation.*
- After 3rd month of gestation, hematopoiesis occurs in liver and spleen of fetus and after birth, it occurs in bone marrow.

dendritic cells, mast
more imp player in immune system

Hematopoiesis - The process by which the blood cells grow, divide & differentiate is called hematopoiesis.

Three classes of blood cells produced from the hematopoietic stem cells

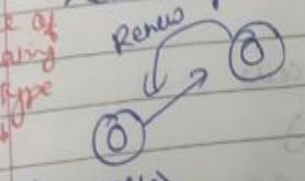
1. Erythrocytes (RBCs) - Responsible for oxygen & carbon di oxide transport.

2. Leucocytes (WBC) - involved in host defense. Types - Neutrophils, basophils eosinophils, monocytes & lymphocytes.

3. Platelets (thrombocytes) - Play imp role in blood coagulation & responsible for arresting the bleeding from blood vessels.

All red & white blood cells develop from pluripotent Hematopoietic stem cells during a highly regulated process called hematopoiesis

A cell capable of generating diff type of cells like blood plasma Platelets WBC RBC



→ different are → functional maturity

Undifferentiated → daughter

↓

High division property but NO function

↓

If both form functional cell ↓

the pool of cells is end

Lymphoid organ → Specialized tissue

↓

Reticular

HSC

Blood → RBCs

Blood plasm

platelets

WBCs

Immune cells

Granulocyte

↳ Neutrophils

↳ Basophils

↳ Eosinophils

Agranulocyte

↳ lymphocyte

T lym

B lym

↳ monocytes

macrophage

Dendritic cells

HSC

Myloid cells

Granulocytes

↳ Neutrophils

↳ Basophils

↳ Eosinophils

↳ Mast cells

Antigen presenting cells

↳ monocytes

↳ macrophage

↳ Dendritic cells

lymphoid cells

↳ B lymphocytes

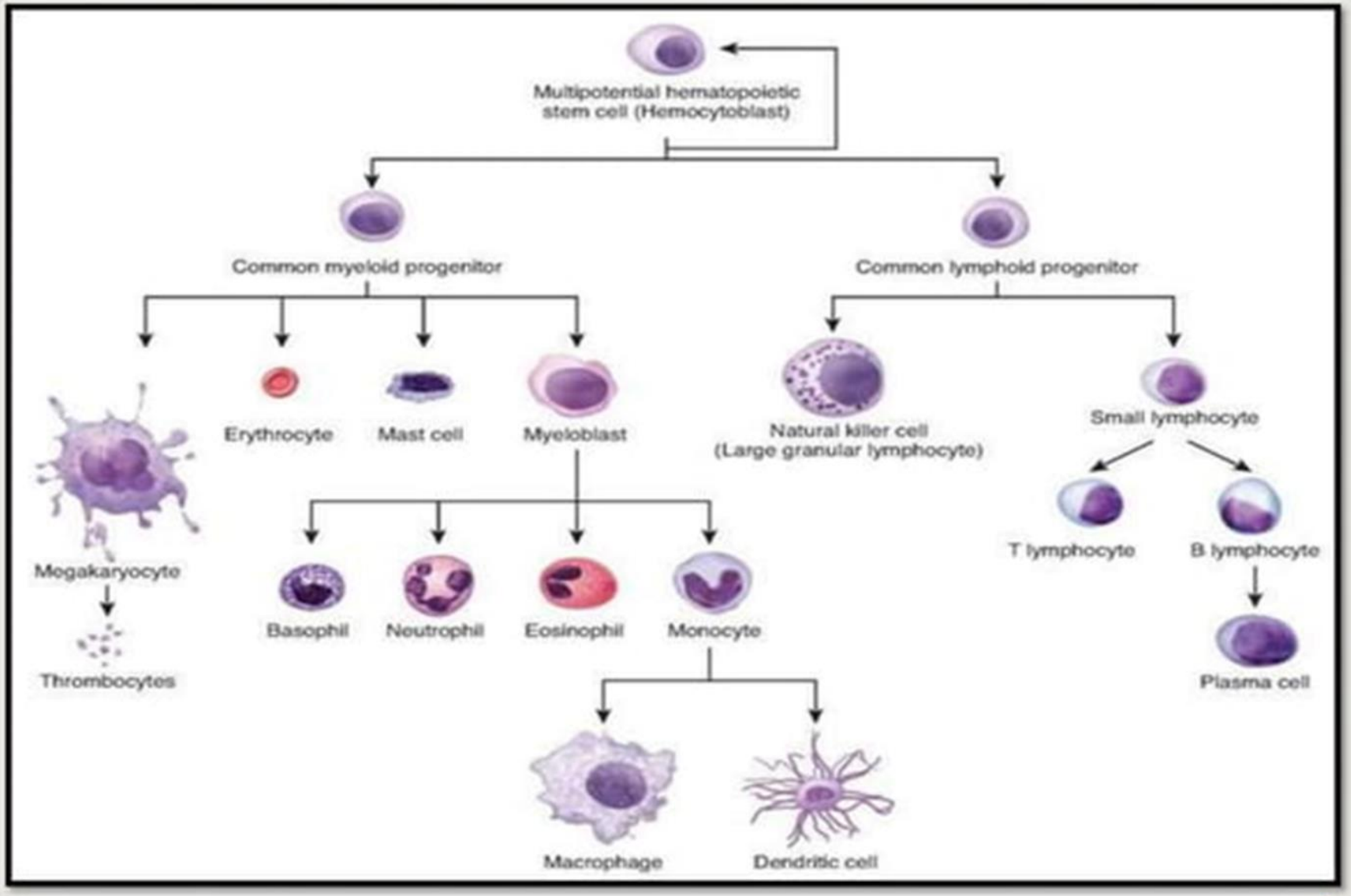
↳ T lymphocytes

↳ NKT cells

↳ Innate lymphoid cells (ILCs)

⇒ Cells of the myeloid lineage are the first responders to infection

→ myeloid lineage cells include all RBCs, monocytes & macrophages. within this


Multipotential hematopoietic stem cell (Hemocytoblast)
Common myeloid progenitor
Common lymphoid progenitor
Erythrocyte
Mast cell
Myeloblast
Natural killer cell (Large granular lymphocyte)
Small lymphocyte
Megakaryocyte
Thrombocytes
Basophil
Neutrophil
Eosinophil
Monocyte
T lymphocyte
B lymphocyte
Plasma cell
Macrophage
Dendritic cell

Cells of immune system are:

1. Lymphocytes

- T-lymphocytes
- B- lymphocytes
- NK cell

2. Phagocytic cells

- Monocytes
- Macrophages

3. Granulocytic cells

- Neutrophils
- Basophils
- Eosinophils
- Mast cells

4. Dendritic cells

I. LYMPHOCYTES

- Lymphocytes are small, round cells ***found in peripheral blood, lymph, lymph nodes, lymphoid organs and in tissues.***
- Lymphocytes represent 20-45% of total cells in peripheral blood and 99% of total cells in lymph and lymph node.
- According to side lymphocytes are divided into small (5-8µm), medium (8-12µm) and large (12-15µm).
- Depending on life span lymphocytes are classified into short lived (2 weeks) and long lived (3 years or more or even lifelong).
- Broadly lymphocytes are divided into three sub-populations, on the ***basis of function and cell membrane components.***
  - **T-lymphocytes**
  - **B-lymphocytes**
  - **Natural killer cell**

B lymphocytes :-

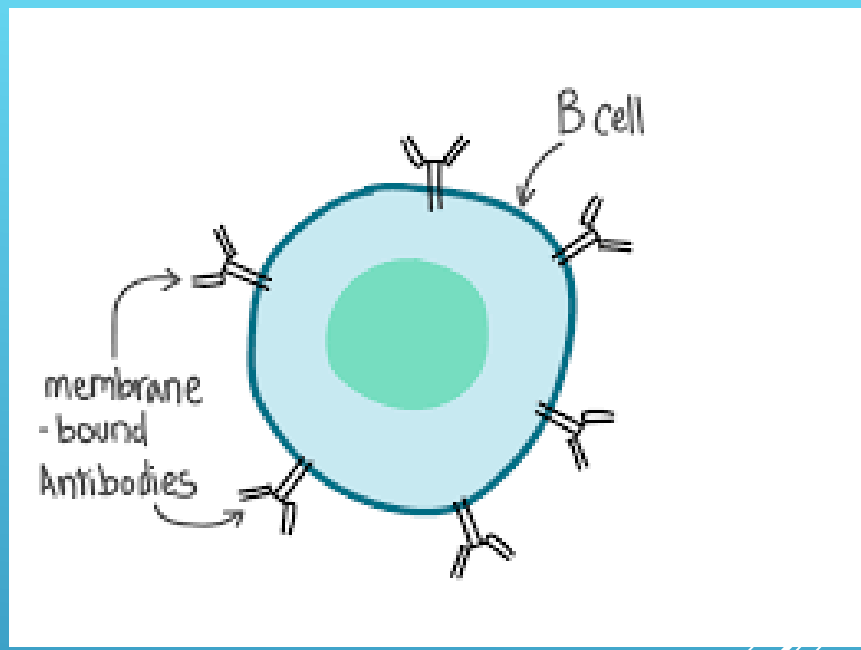
HSC → myloid cell

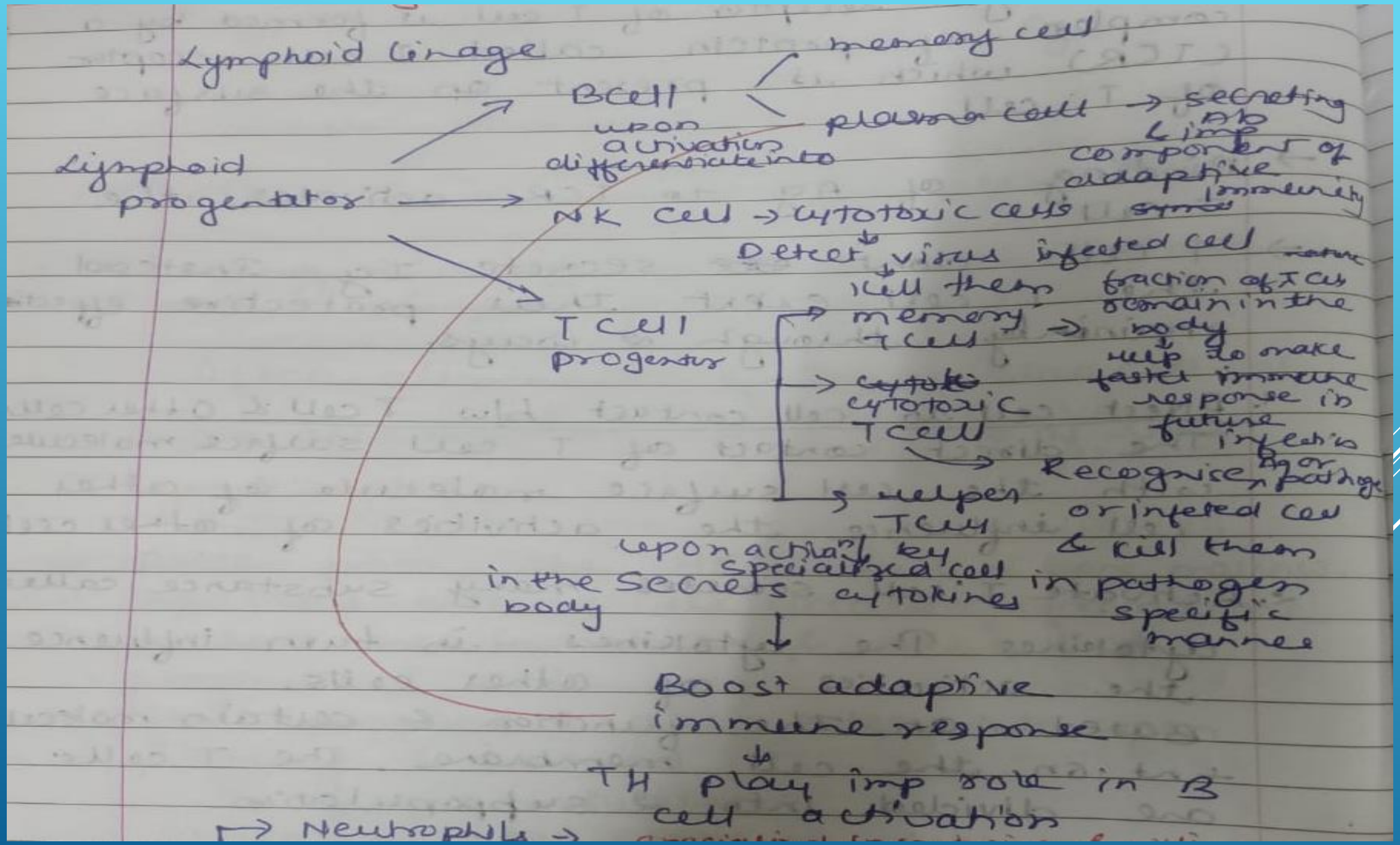
HSC → lymphoid cell → lymphocyte → B
(Adaptive immune response) → T

B cell synthesized & mature → Bone marrow
→ Bursa of fabricius (In Birds)

→ B cell have 2 form → membrane bound form (BCR (B cell Recep
→ secret form or soluble → Plasma cell → Abs secreting (Proteins)

Properties of B cell / B lymphocytes
→ They are APCs




Lymphoid lineage
Lymphoid progentator
B cell
upon activation differentiate into
memory cell
plasma cell → secreting Ab & imp component of adaptive immunity
NK cell → cytotoxic cells
Detect virus infected cell
kill them
T cell progentor
memory T cell → fraction of TCs remain in the body help to make faster immune response in future infection
cytotoxic T cell → Recognise pathogen or infected cell & kill them in pathogen specific manner
helper T cell
upon activation by specialized cell in the body
secrets cytokines
Boost adaptive immune response
TH play imp role in B cell activation

II. PHAGOCYTIC CELLS

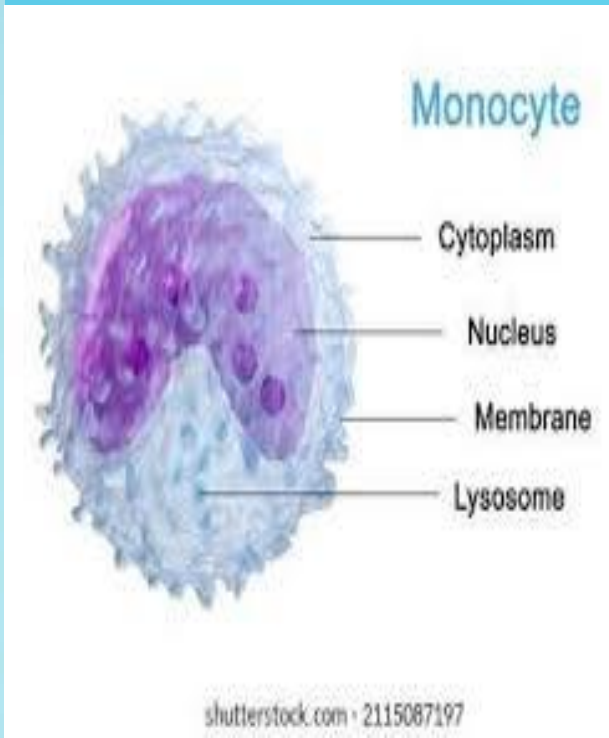
- ***Monocytes*** and ***macrophages*** are mononuclear phagocytic cells.
- Granulocyte-monocyte progenitor cell differentiates into promonocytes and neutrophil.
- Promonocytes leaves the bone marrow and enter into blood stream where they differentiate into mature monocytes.
- Monocytes circulates in blood for about 8 hours, during which they enlarges and then enter into tissues and differentiates into specific macrophages and dendritic cells.

1. Monocytes

- Blood monocytes measure 12-15 µm with a single lobed kidney shaped nucleus.
- It accounts for (2-8%) of blood leucocytes.

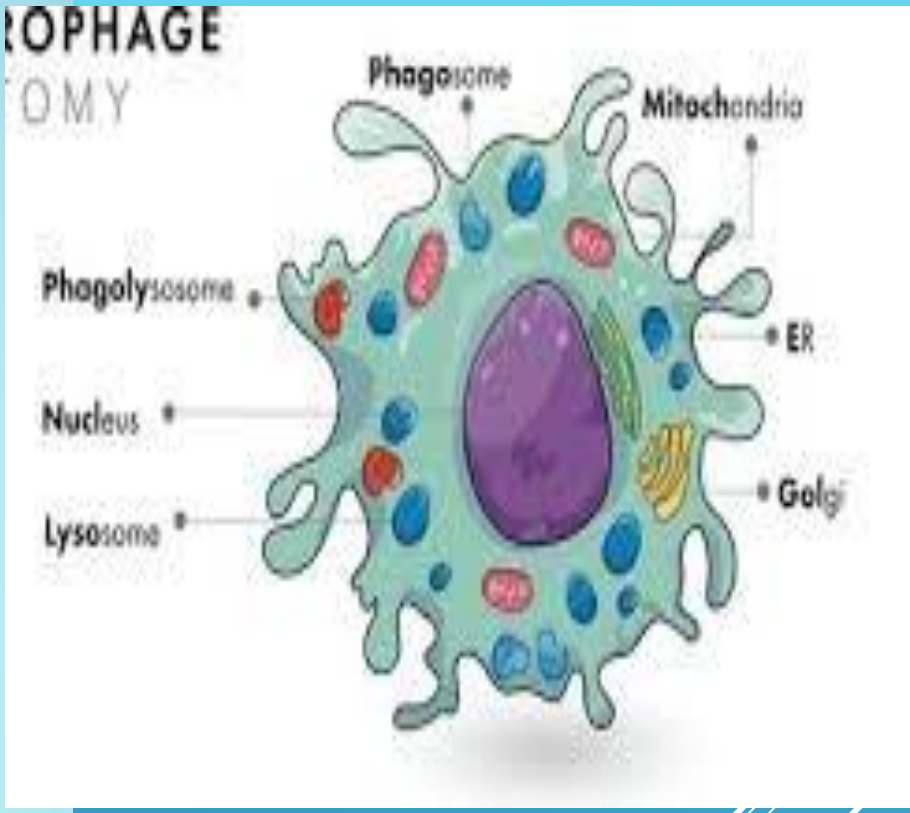
Immunological Functions of monocytes:

- Helps in antigen processing and presentation
- Releases cytokines
- Specialized function in tissues
- Cytotoxicity



2. Macrophages:

- Monocyte migrates to tissue and differentiates into macrophages.
- Differentiation of monocytes into macrophages involves following changes:
- Cell enlarges 5-10 folds
- Intracellular granules increases in number and complexity
- Increase phagocytic ability
- Produces higher level of hydrolytic enzymes and cytokines
- Macrophages serve different functions in different tissues.
  - **Alveolar macrophages : in lungs**
  - **Histiocyte: connective tissue**
  - **Kuffer cell: liver**
  - **Messangial cell: kidney**
  - **Microglial cell: brain**
  - **Osteoclast: bone**



Immunological functions of macrophages:

- Phagocytosis
- Antigen presentation to T-cell
- Secretion of lymphokines IL-1, IL-6. IL-12. TNF-α etc. to activates inflammatory response
- Secretion of granulocyte monocyte colony (GMC) stimulating factors.

III. GRANULOCYTIC CELLS

1. **NEUTROPHIL:**

A. Neutrophils are (11-14μm) in diameter with multilobed nucleus with granules in cytoplasm.

B. It constitutes 50-70 % of total circulating WBC and remains for 7-8 hours in blood and then migrates to tissues

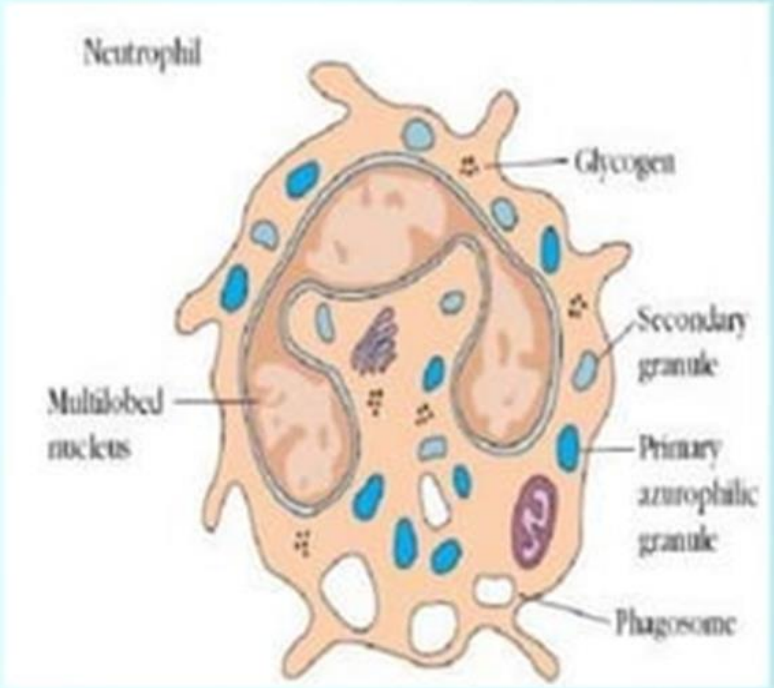
C. Life span is 3-4 days.

D. Also known as polymorph nuclear (PMN) leucocyte.

E. Neutrophils is stained by both acidic and basic dye.

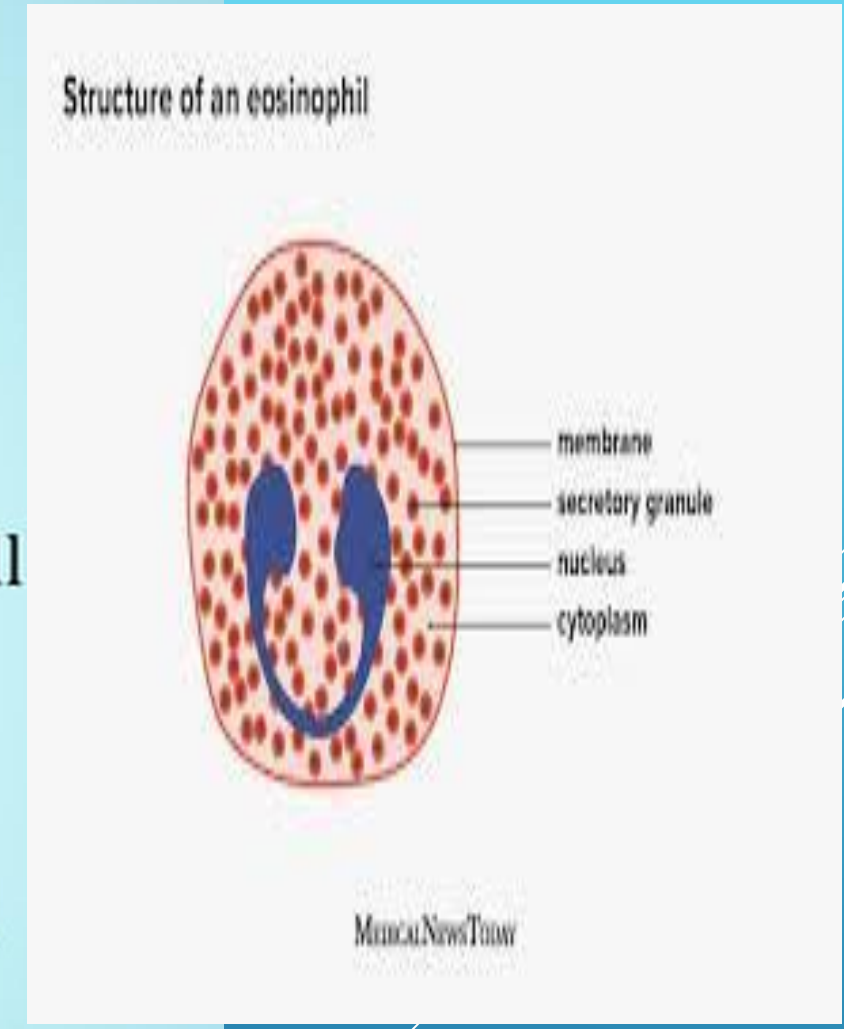
Immunological functions of neutrophils:

- ***Phagocytic role in acute inflammatory response.***
- ***It is the first immune cell to responds in inflammation.***



2. Eosinophils:

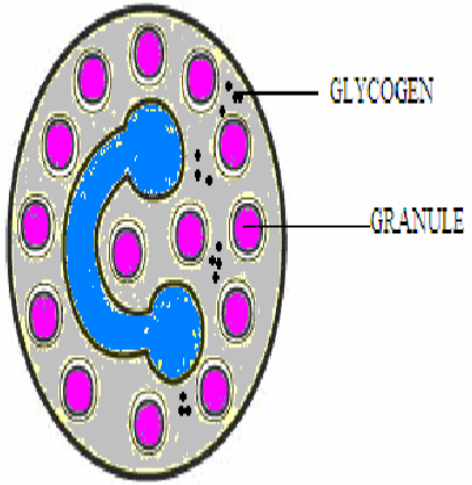
- Eosinophil's are (11-15µm) in diameter, heavily granulated with bilobed nucleus
- It is stained by acidic dye i.e. ***Eosin***
- They are phagocytic and motile (migrate from cell into tissue space).
- Comprise 2-5% of WBCs.
- Imp. Role in **defense** against *protozoan and helminth parasite by releasing cationic peptides & reactive oxygen intermediates into extracellular fluids.*



Immunological functions of eosiniphils:

- Granules contain various hydrolytic enzymes that kill parasites which are too large to be phagocytosed by neutrophils.
- Provide allergic inflammation.

3. Basophils:



- Basophils are ***non-phagocytic cell*** found in small number in blood and tissue
- Cytoplasm contains large number of prominent basophilic granules containing histamine, heparin, serotonin, and other hydrolytic enzymes
- Stained by basic dyes

Immunological functions:

- Provide anaphylactic and atopic allergic reaction

(parasitic worms)

→ when they bind circulating ab/Ag complexes basophils release the contents of their granules.

→ Histamin, compound in basophilic granules increase blood vessel permeability & smooth muscle activity & allow immune cells access to a site of infection

→ It also release cytokines that can recruit other immune cells including eosinophils & lymphocytes.

→ Imp role in allergy symptoms

) Mast cell -

→ Play

4. Mast cells

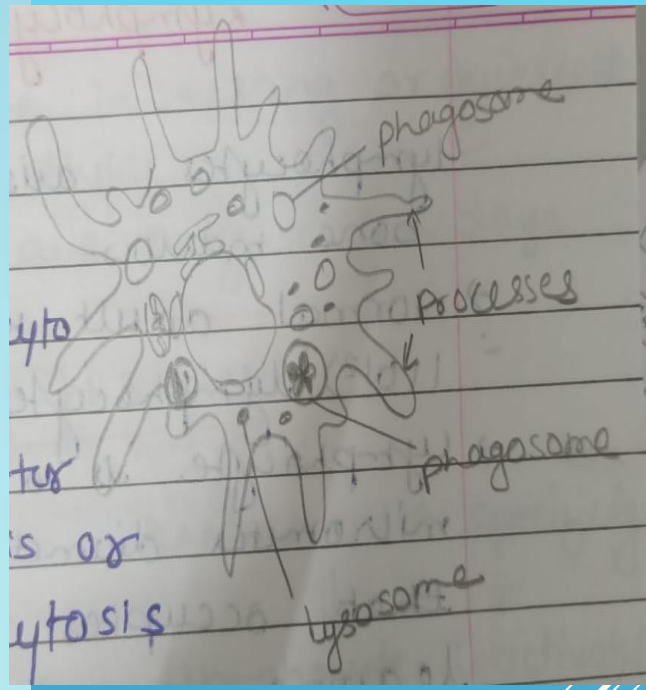
- Precursures are formed in bone marrow and released into the blood in an undifferentiated state, until they rach the tissues.
- They have ;large numbers of cytoplasmic granules containing *histamine.*
- Mast cells and basophils play role in allergic reactions.

IV. DENDRIATIC CELLS

- Dendritic cells have long cytoplasmic externsions that resembles to dendrites of nerve cell.
- They have highly pleomorphic with a small central body and many long needle like processes.
- Dendritic cells are antigen presenting cell (APC) because they possess MHC class.

Immunological functions:

- Involved in antigen presentation to T-cells during primary immune response.
- Very little role in phagocytosis.



	Basophils and mast cells	*Neutrophils*	*Eosinophils*	*Monocytes and macrophages*	*Lymphocytes and plasma cells*	*Dendritic cells*
						
Primary function(s)	Release chemicals that mediate inflammation and allergic responses	Ingest and destroy invaders	Destroy invaders, particularly antibody-coated parasites	Ingest and destroy invaders Antigen presentation	Specific responses to invaders, including antibody production	Recognize pathogens and activate other immune cells by antigen presentation

THANK YOU