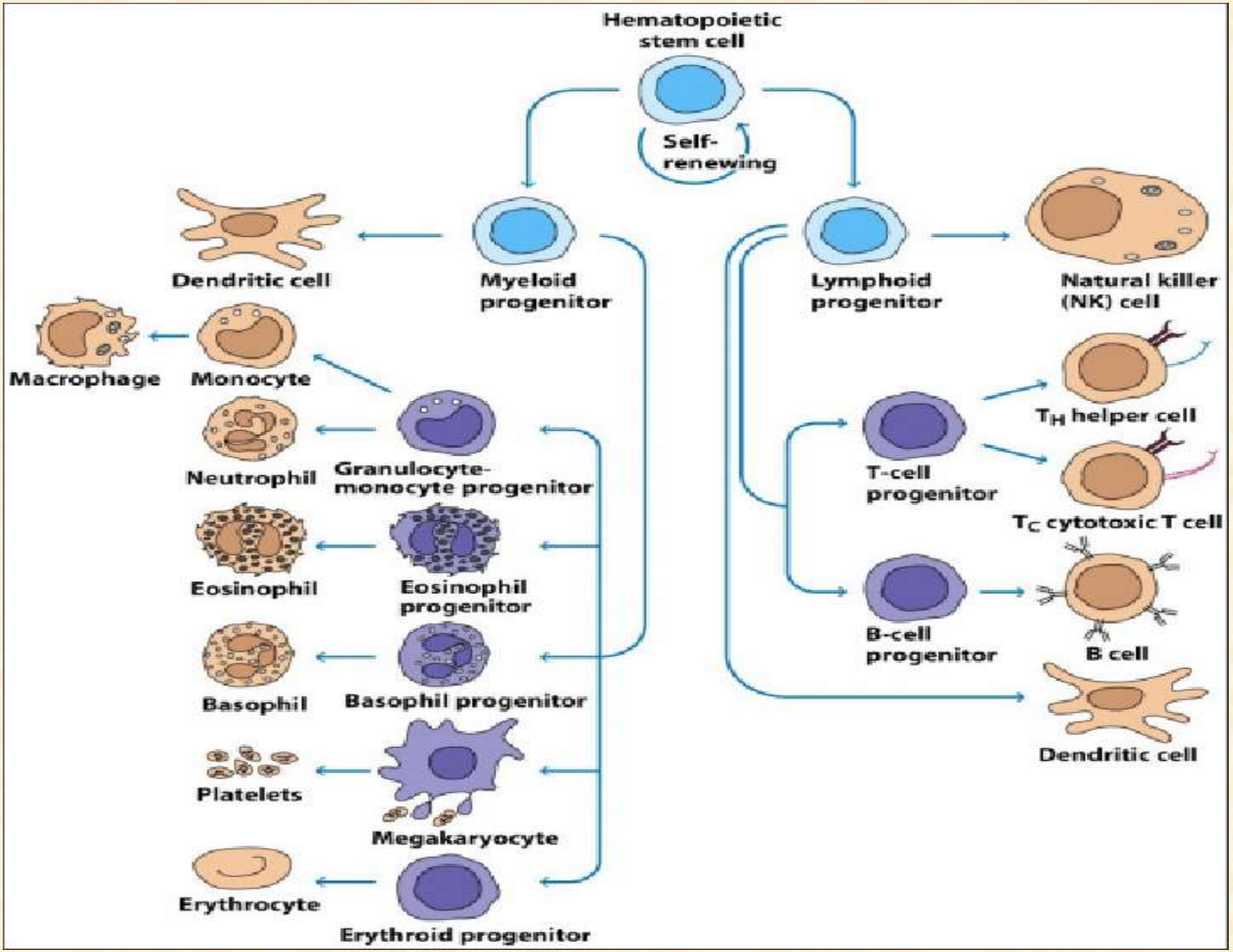
Haematopoesis

-Ms. Sanchari Sarkar
Department of Microbiology
Shivaji Science College, Nagpur

➢ Hematopoesis :

• An HSC that is induced to differentiate (undergo hematopoiesis) loses its self-renewal capacity and makes one of two broad lineage commitment choices .

• It can become a common myeloid-erythroid progenitor (CMP), which gives rise to all red blood cells (the erythroid lineage), granulocytes, monocytes, and macrophages (the myeloid lineage), or it can become a common lymphoid progenitor (CLP), which gives rise to B lymphocytes, T lymphocytes, and NK cells.


Hematopoietic stem cell
Self-renewing
Myeloid progenitor
Lymphoid progenitor
Dendritic cell
Natural killer (NK) cell
Macrophage
Monocyte
Neutrophil
Granulocyte-monocyte progenitor
T_H helper cell
T-cell progenitor
T_C cytotoxic T cell
Eosinophil
Eosinophil progenitor
B-cell progenitor
B cell
Basophil
Basophil progenitor
Dendritic cell
Platelets
Megakaryocyte
Erythrocyte
Erythroid progenitor

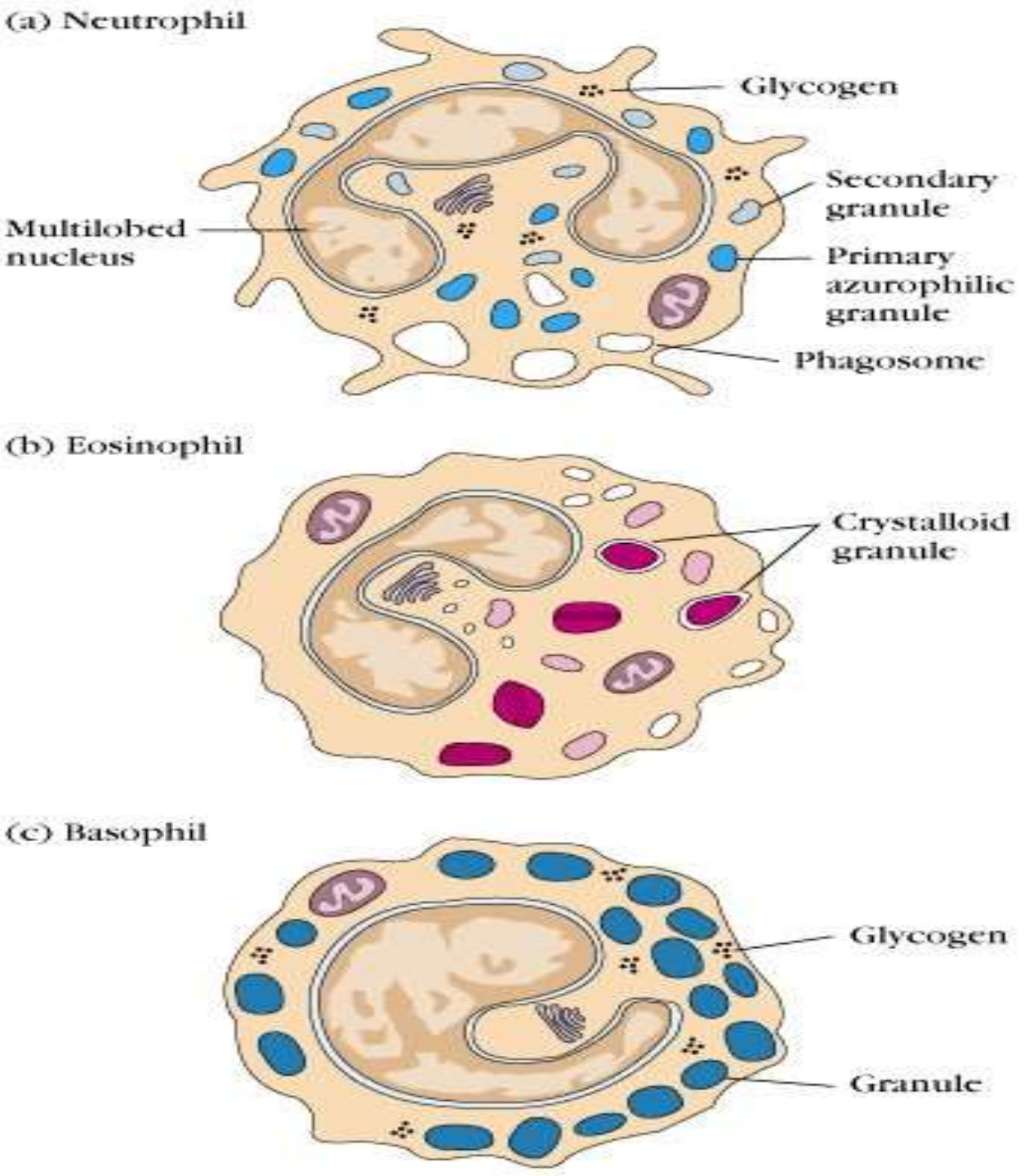
• Myeloid cells and NK cells are members of the innate immune system, and are the first cells to respond to infection.
• Lymphocytes are members of the adaptive immune response and generate a refined antigen specific immune response that also gives rise to immune memory.
• Both myeloid and lymphoid lineages give rise to dendritic cells, antigen-presenting cells with diverse features and functions that play an important role in initiating adaptive immune responses.

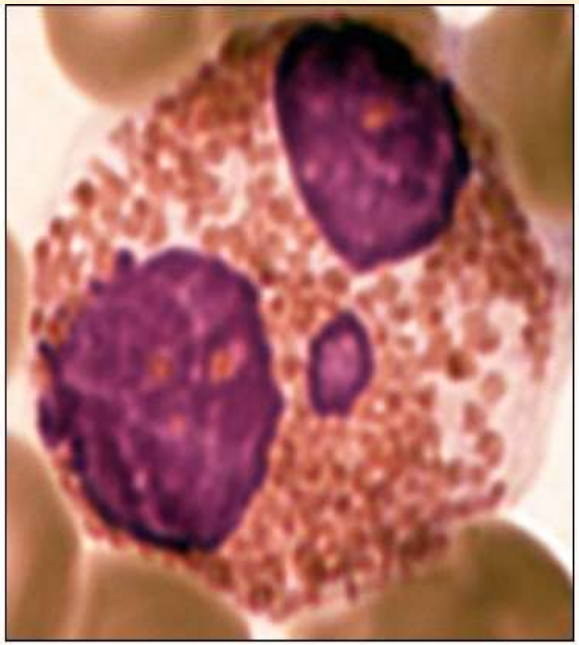
❑Common Myeloid progenitor cells:

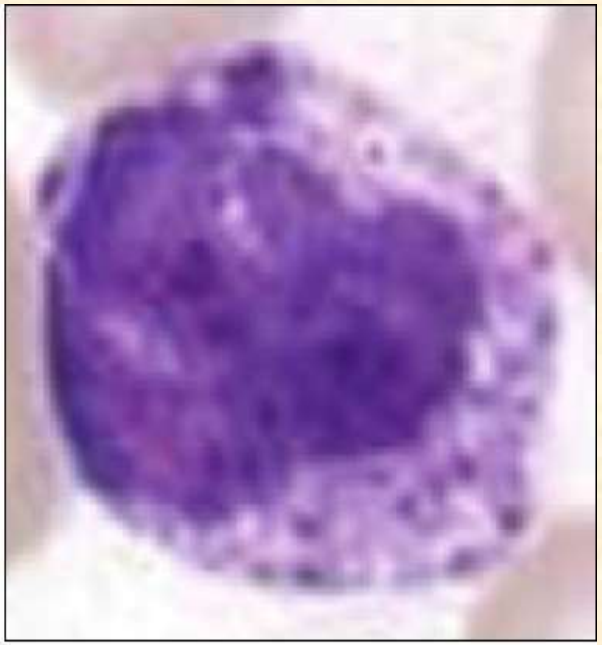
• Cells of the myeloid lineage are the first responders to infection.

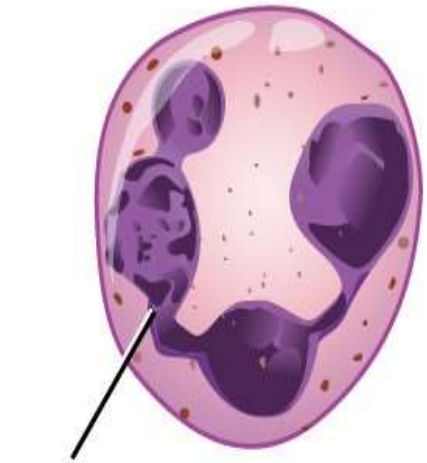
• Cells that arise from a common myeloid progenitor (CMP) include red blood cells (erythroid cells) as well as various types of white blood cells (myeloid cells such as granulocytes, monocytes, macrophages, and some dendritic cells).

• Myeloid cells are the first to respond to the invasion of a pathogen.

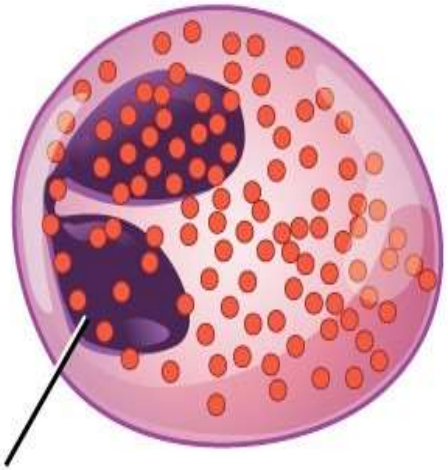

(a) Neutrophil
Glycogen
Secondary granule
Multilobed nucleus
Primary azurophilic granule
Phagosome
(b) Eosinophil
Crystalloid granule
(c) Basophil
Glycogen
Granule



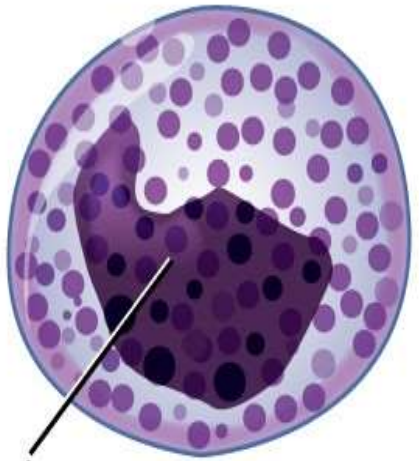




neutrophil



eosinophil



basophil

❖ Granulocytes:

• Granulocytes are at the front lines of attack during an immune response and are considered part of the innate immune system.

• Granulocytes are white blood cells (leukocytes) that are classified as neutrophils, basophils, mast cells, or eosinophils on the basis of differences in cellular morphology and the staining of their characteristic cytoplasmic granules.

• All granulocytes have multilobed nuclei that make them visually distinctive and easily distinguishable from lymphocytes, whose nuclei are round.

• The cytoplasm of all granulocytes is replete with granules that are released in response to contact with pathogens.

• These granules contain a variety of proteins with distinct functions: Some damage pathogens directly; some regulate trafficking and activity of other white blood cells, including lymphocytes; and some contribute to the remodeling of tissues at the site of infection.

- Neutrophils:

• Neutrophils constitute the majority (50% to 70%) of circulating leukocytes and are much more numerous than eosinophils (1%–3%), basophils (1%), or mast cells (1%).

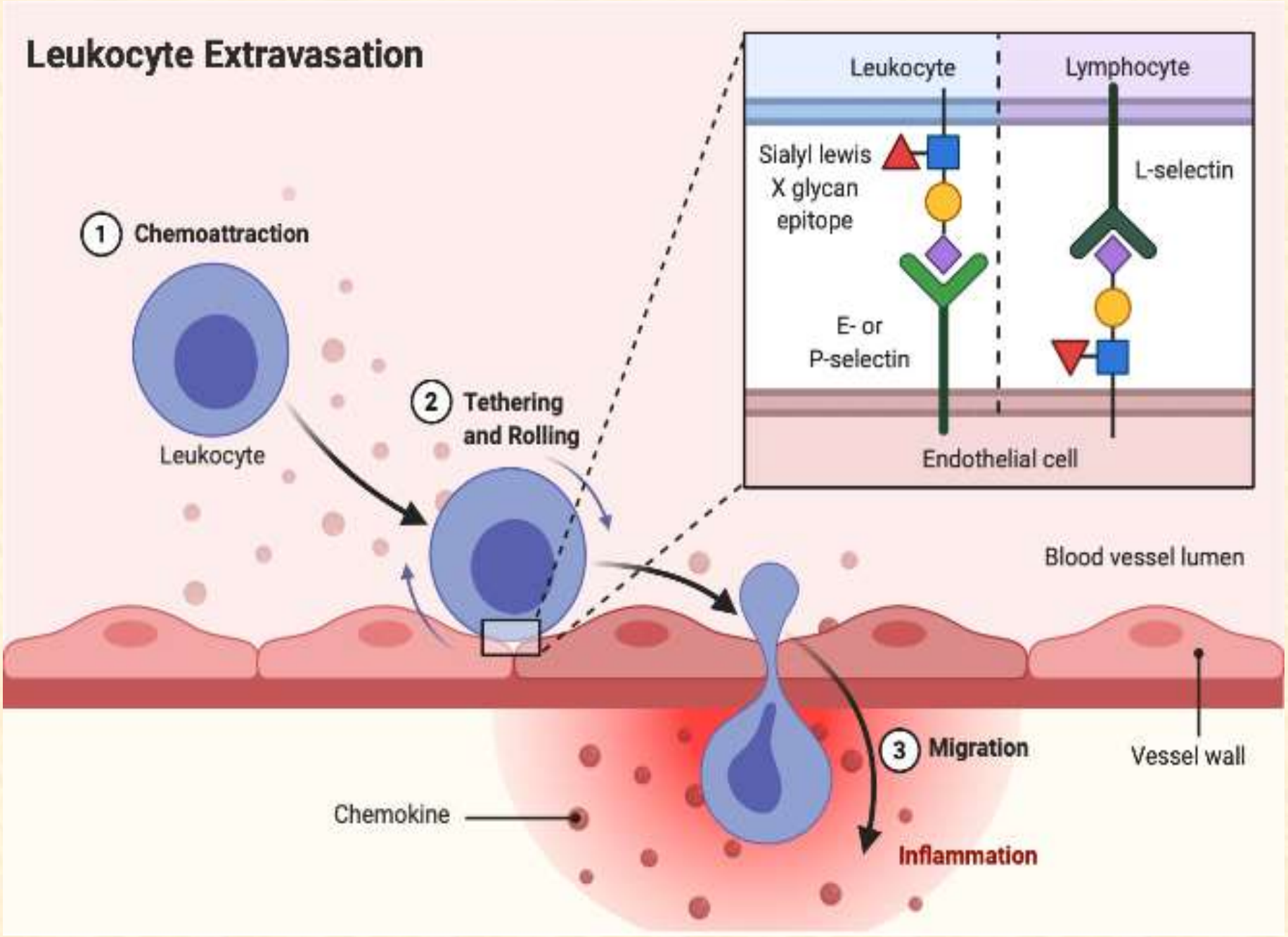
• After differentiation in the bone marrow, neutrophils are released into the peripheral blood and circulate for 7 to 10 hours before migrating into the tissues, where they have a life span of only a few days.

• Movement of circulating neutrophils into tissues, called extravasation, takes several steps:

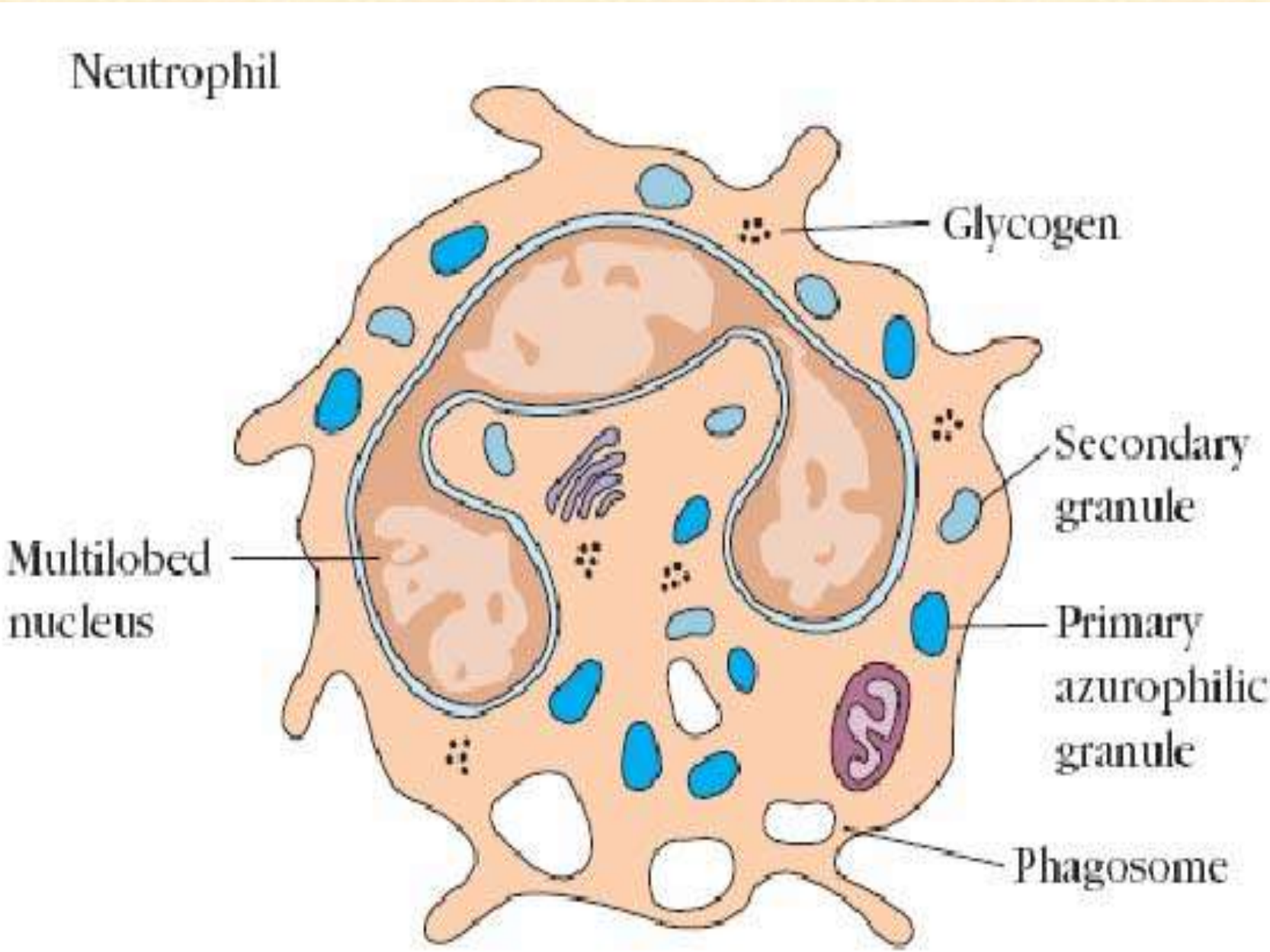
❖ the cell first adheres to the vascular endothelium.

❖ penetrates the gap between adjacent endothelial cells lining the vessel walls.

❖ Finally, penetrates the vascular basement membrane, moving out into the tissue spaces.


Leukocyte Extravasation
Leukocyte
Lymphocyte
Sialyl lewis X glycan epitope
L-selectin
E- or P-selectin
Endothelial cell
1 Chemoattraction
Leukocyte
2 Tethering and Rolling
Blood vessel lumen
3 Migration
Vessel wall
Chemokine
Inflammation

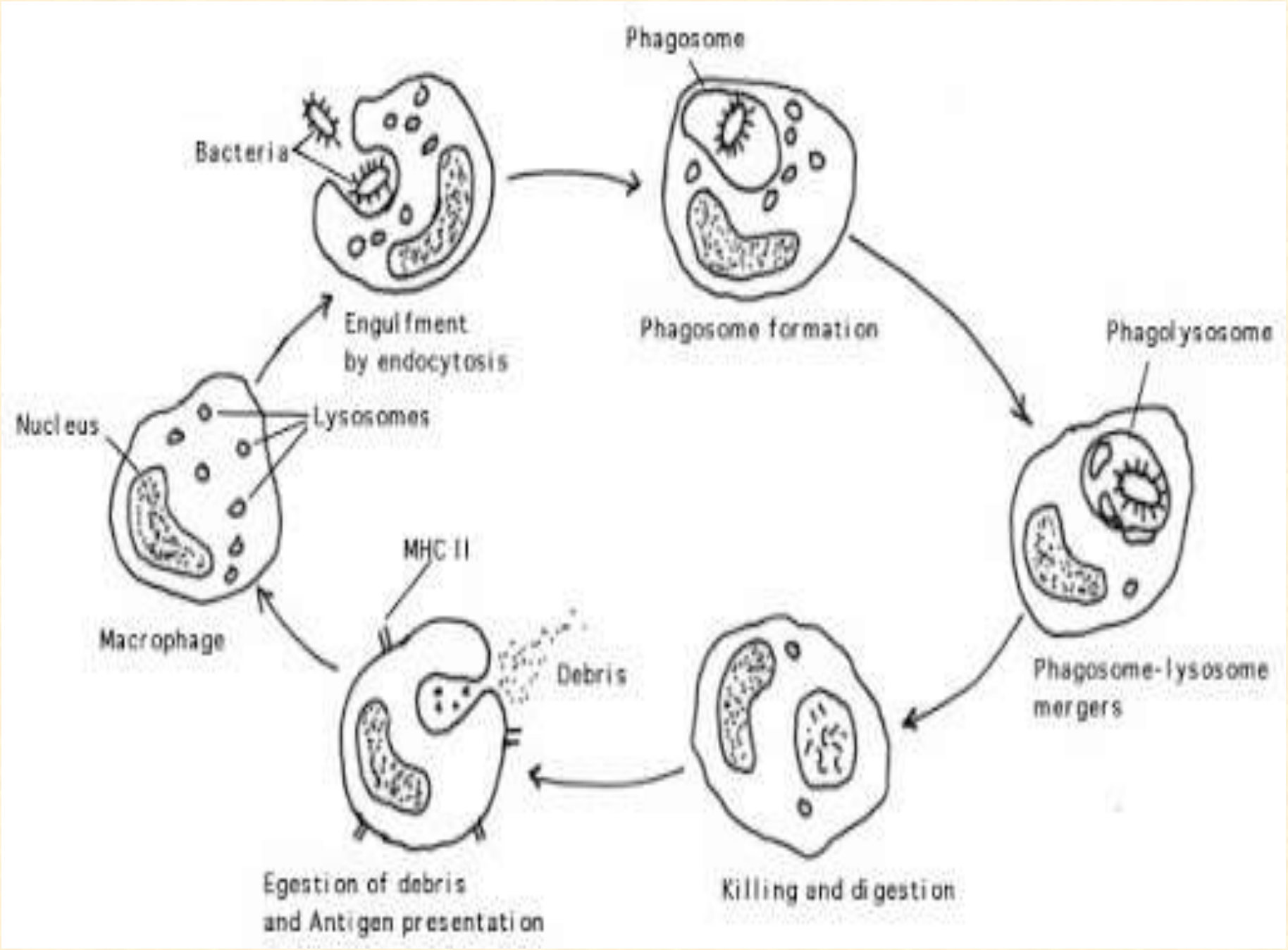
• In response to many types of infections, the number of circulating neutrophils increases significantly and more are recruited to tissues, partially in response to cues the bone marrow receives to produce and release more myeloid cells.
• The resulting transient increase in the number of circulating neutrophils, called leukocytosis, is used medically as an indication of infection.
• Neutrophils are recruited to the site of infection in response to inflammatory molecules (e.g., chemokines) generated by innate cells (including other neutrophils) that have engaged a pathogen.


Neutrophil
Glycogen
Secondary granule
Multilobed nucleus
Primary azurophilic granule
Phagosome

• Once in tissues, neutrophils phagocytose (engulf) bacteria very effectively, and also secrete a range of proteins that have antimicrobial effects and tissue remodeling potential.

• Neutrophils are the dominant first responders to infection.

• Neutrophils are professional phagocytes : they are ferocious eaters and rapidly engulf invaders coated with antibodies and complement, as well as damaged cells or cellular debris.


Phagosome
Bacteria
Engulfment
by endocytosis
Phagosome formation
Phagolysosome
Nucleus
Lysosomes
MHC II
Macrophage
Debris
Phagosome-lysosome
mergers
Egestion of debris
and Antigen presentation
Killing and digestion