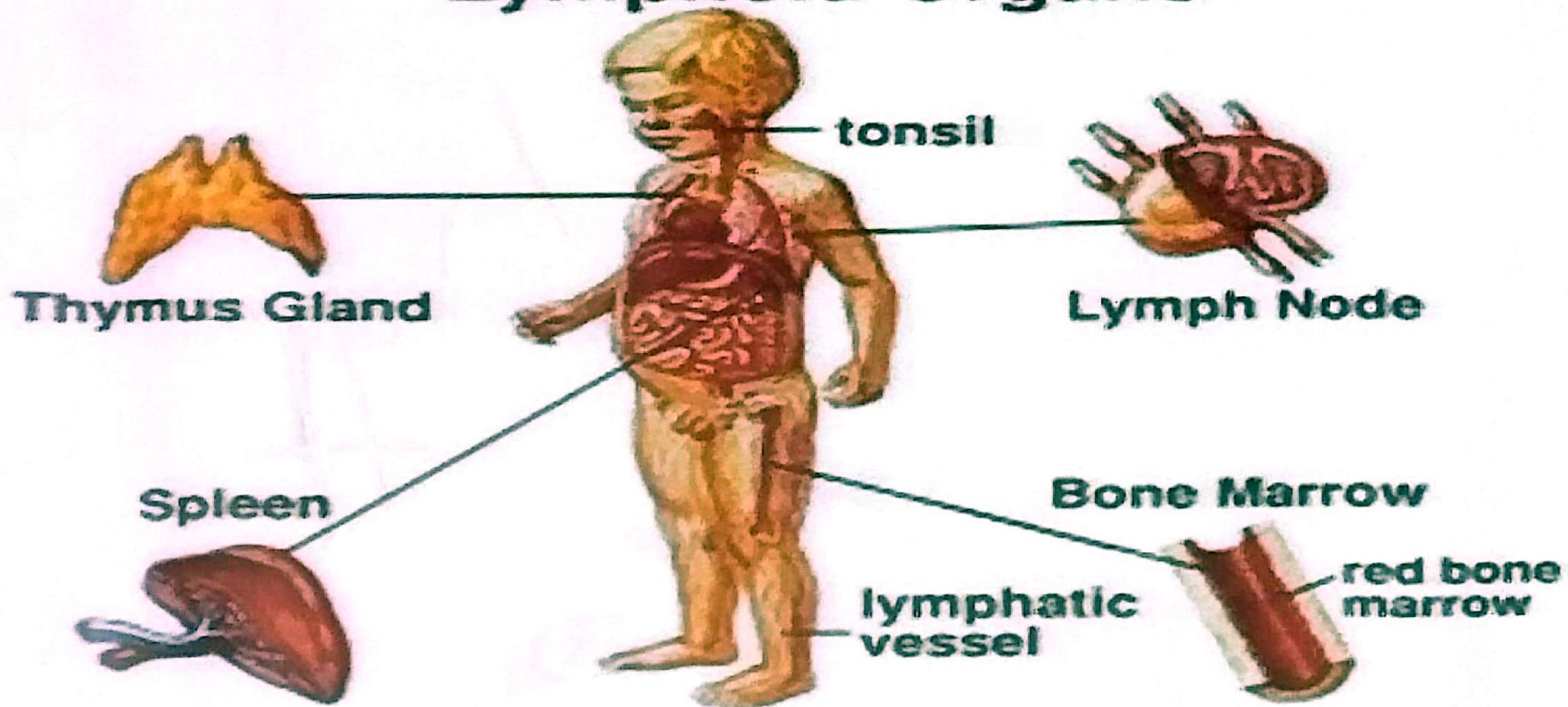


lymphoid organs

Lymphoid Organs



Origin of Immunocompetent Cells

- In intra-uterine life: from stem cells in foetal liver & yolk sac
- In postnatal life: from stem cells in bone marrow
- Stem cells differentiated into erythroid, myeloid, or lymphoid series
- The lymphoid series evolves into 2 main lymphocyte populations

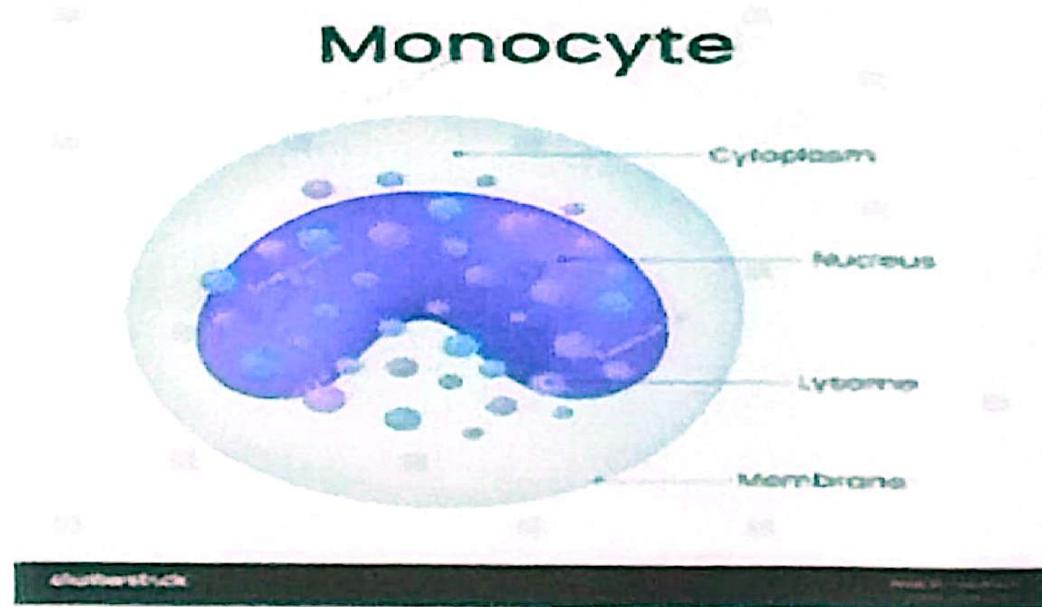
T&B lymphocyte

Macrophages

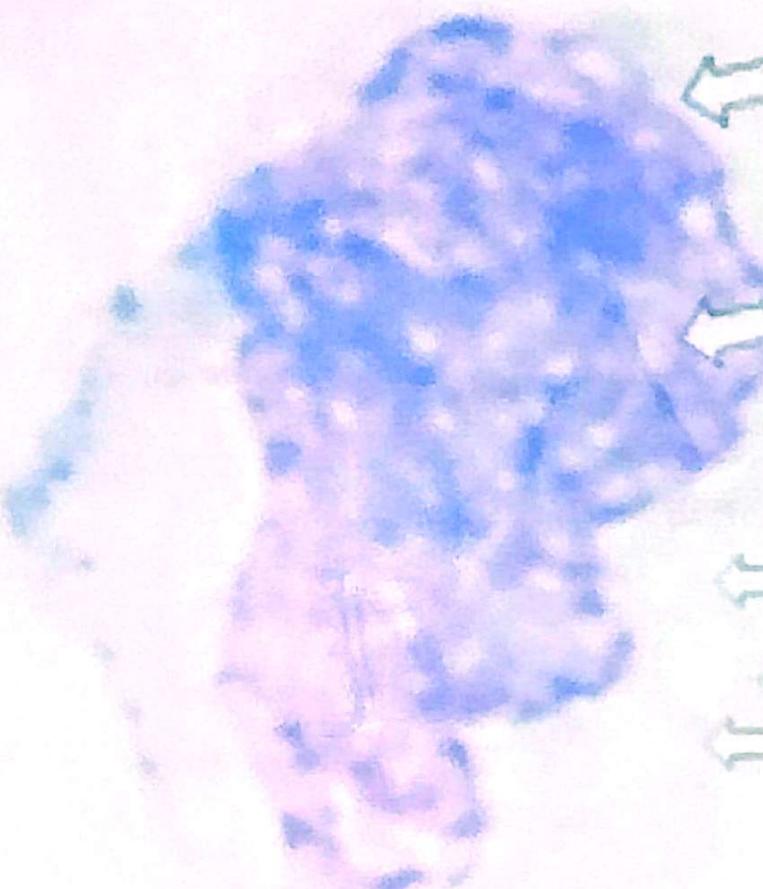
- Derived from bone marrow
- Promonocytes, which differentiate to blood Monocyte
- Finally settle in various tissues as mature macrophages

Monocytes

- Present in blood
- Largest blood cells measuring 12-20 μm
- Average transit time -8hours in blood ; then they migrate to tissues transform into macrophages



Macrophage



Irregular nuclear contour

Granular to linear
chromatin

Cytoplasmic granules

Cytoplasmic vacuoles

Types of macrophages

Body sites	Macrophages
Peripheral blood	Monocyte
Tissues	Macrophages
liver	Kupffer cells
Brain	Microglial cells
Kidney	Mesangial cells

Types of macrophages

Body sites	Macrophages
Lungs	Alveolar macrophages
Bone	Osteoclasts
Inflammation site	Epithelioid cells Multinucleated cells
Connective tissues	Histiocyte

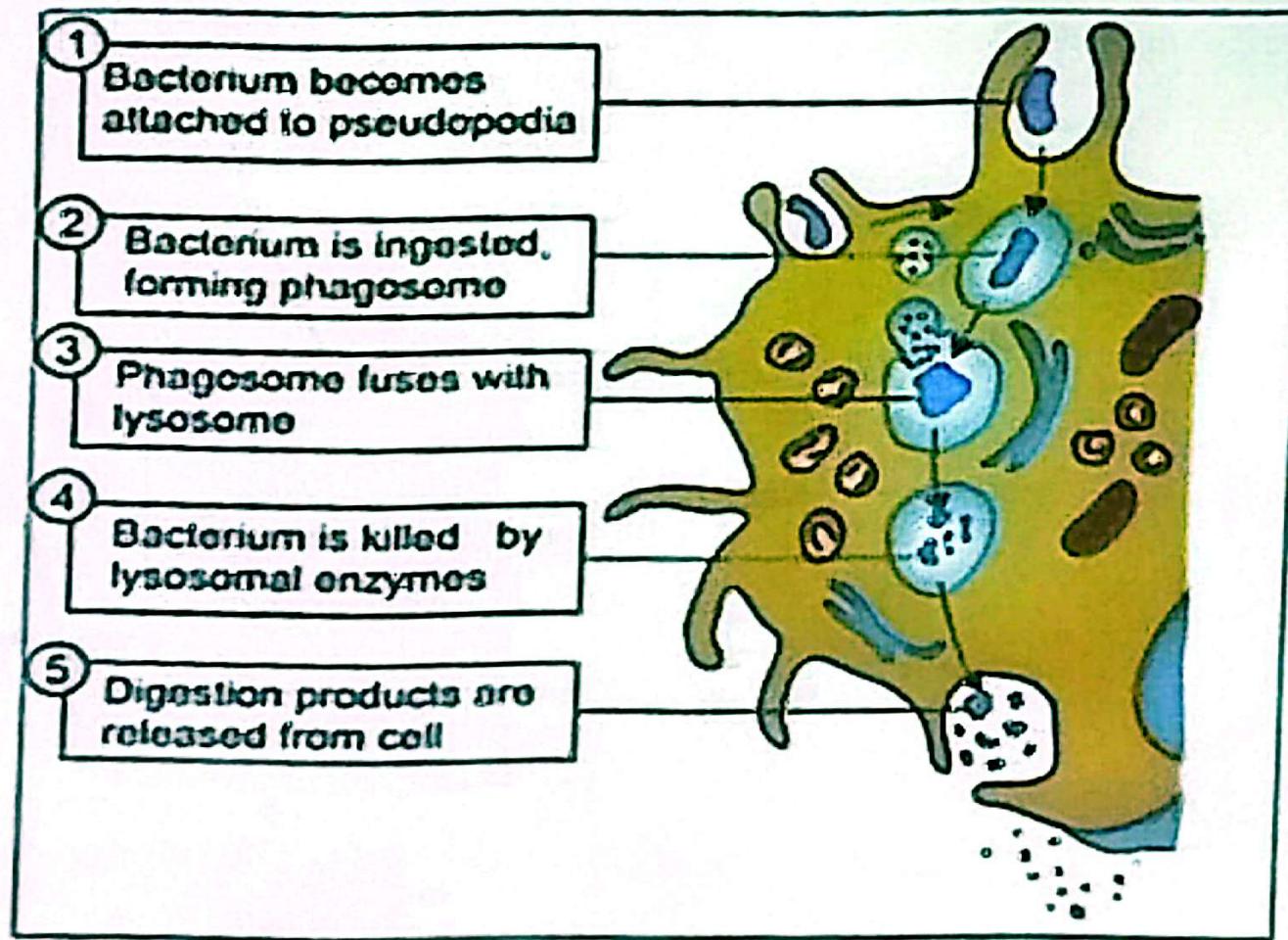
Functions of macrophages

Important Features of Macrophages

Function	Mechanisms
Phagocytosis	Ingestion and killing of microbes in phagolysosomes. Killing caused by reactive oxygen intermediates such as superoxides, reactive nitrogen intermediates such as nitric oxide, and lysosomal enzymes such as proteases, nucleases, and lysozyme.
Antigen presentation	Presentation of short peptide antigens in association with class II MHC proteins to helper T cells. Co-stimulatory signals are also required
Cytokine production	Synthesis and release of cytokines, such as IL-1, IL-6, IL-8, and TNF.

IL = interleukin; MHC = major histocompatibility complex; TNF = tumor necrosis factor.

- **Phagocytosis:**
 - Macrophages are the principle cells involved in phagocytosis.
 - Steps:



Functions of macrophage

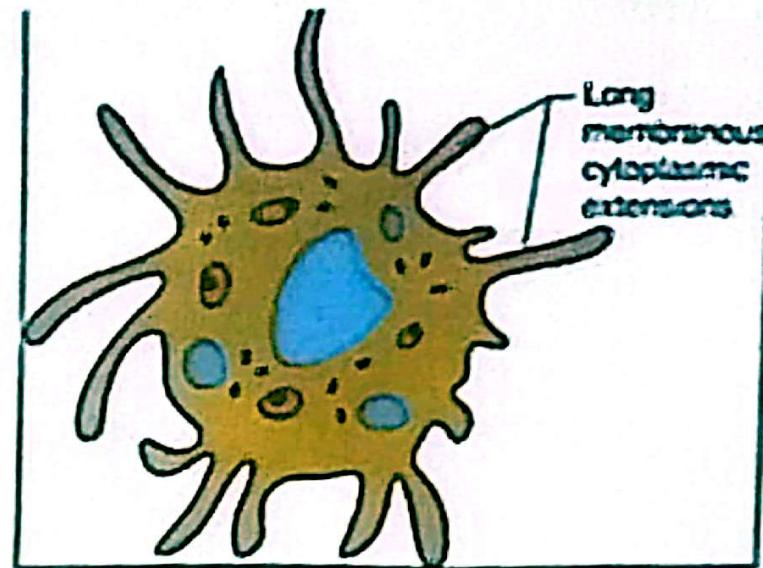
Activated macrophages:

- On exposure to cytokines such as *interferon-γ*, macrophages become activated → greater phagocytic ability → produce many cytokines → act against intracellular bacteria, virus infected cells and tumor cells.
- Also express higher level of MHC class II, hence can act as efficient APCs.

Functions of macrophage

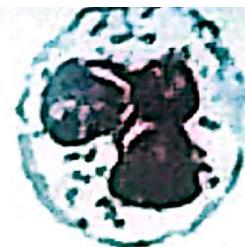
- **Secretory products-**
 - Interleukin 1 (IL-1): Promotes inflammatory responses, fever and activate helper T cells.
 - IL-6 & TNF- α : Promote innate immunity, (inflammation & fever) and eliminate the pathogens.
 - Interferon α & β -have *antiviral* activity.
 - TNF- α : Lyse the tumor cells (*anti-tumor* activity)
 - Growth factors such as CSF (colony stimulating factor): promote hematopoiesis.

Dendritic cells



- Possess long membranous cytoplasmic extensions resembling dendrites of neurons - hence named as dendritic cells.
- Originate from bone marrow. Dendritic cells are primarily located in barrier tissues, including the skin and the mucosa of the gastrointestinal, respiratory, and genitourinary tracts.
- Main inducers of the primary adaptive immune response, thus serving as a bridge between innate and adaptive immunity.
- As with macrophages, dendritic cells engulf foreign material, process it into peptide fragments, or antigens,

Neutrophils



- Neutrophils are a very important component of our innate host defenses
- Principal phagocytes of innate immunity.
- The granules are lysosomes, which contain a variety of degradative enzymes
- Like macrophages, neutrophils have surface receptors for IgG, making it easier for them to phagocytize opsonized microbes.
- do not display class II MHC proteins on their surface and therefore do not present antigen to helper T cells.
- Engulf and kills bacteria and fungi, digest cellular debris

Types of lymphocytes

- Based on function and cell membrane structure:
 - T lymphocytes
 - B lymphocytes
 - NK (natural killer) cells.
- Lymphocytes can also be classified into:
 - Naive lymphocytes
 - Lymphoblasts.

Naive lymphocytes

- Resting B and T lymphocytes that have not interacted with antigen
- Short life span (1-3 months).

Effector lymphocytes

- Effector B cells - Antibody producing plasma cells
- Effector T cells - Helper T cells and cytotoxic T cells.

Memory cells

- Remain dormant like naive cells.
- Capable of transforming into effector cells rapidly on subsequent antigenic challenge.
- Longer life span; providing long term immunity to many pathogens.

T Lymphocytes

- T cells constitute 70–80% of blood lymphocytes.
- Bear specialized surface receptors called T cell receptors (TCR).
- Main function - antigen recognition.
- Unlike B cell receptor which binds to antigen directly, TCR does not recognize antigen by itself.
- Can only respond to an antigen which is processed and presented by the antigen presenting cells such as macrophages.