

Phagocytosis

Phagocytosis: is one of the most important host defense mechanisms against microbial infections.

Phagocytes: are cells whose function is phagocytosis, include neutrophils and monocytes/macrophages.

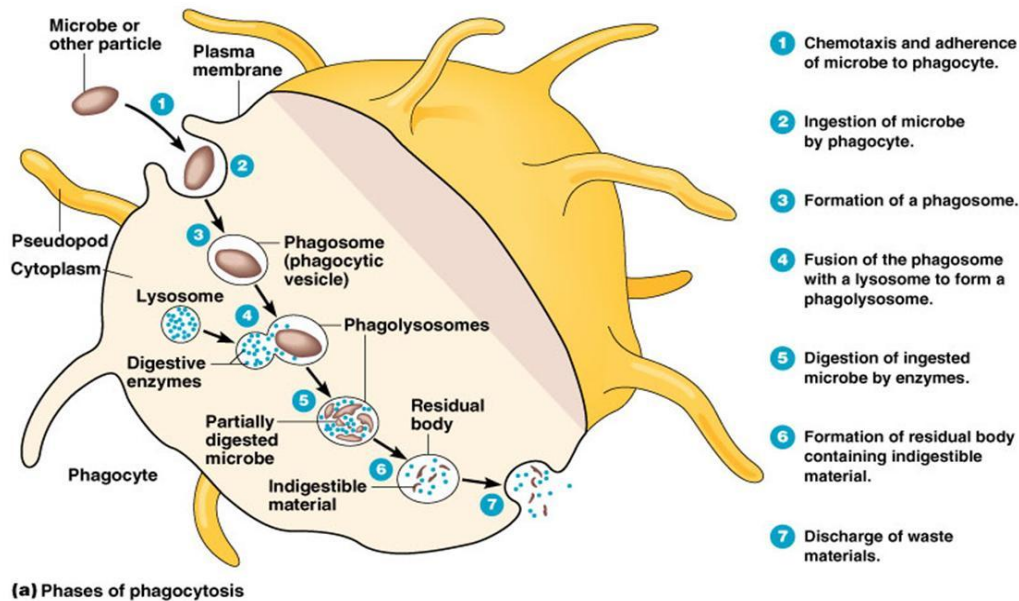
The term **monocyte** refers to immature macrophages. Monocytes are typically found in circulation and have a limited capacity for phagocytosis. When monocytes migrate to different tissues, they mature into macrophages.

Mature **macrophages** exist in tissues and are named according to the particular area of the body

Antigen presenting cells (APC): are cells that endocytose antigen, process it into fragments (peptides), and then display various fragments on the cell surface within the groove of special molecules termed, **class II major histocompatibility proteins** (class II MHC).

Steps of phagocytosis:

- 1. Chemotaxis:** The chemical attraction of phagocytes to a particular location; chemotactic chemicals that attract phagocytes include bacterial toxins, components of damaged tissue cells, complement proteins, and antibodies.
- 2. Adherence or Attachment:** Because adherence of the phagocyte cell membrane to the surface of the microbe may be difficult. Coating the surface of the microorganism with complement proteins and antibody proteins facilitates phagocytosis (process is called **opsonization**; proteins are called **opsonins**).
- 3. Ingestion:** The phagocyte engulfs the microbe with its plasma membrane. The plasma membrane of phagocyte surrounds the microbe and forming a vesicle.
- 4. Digestion:** The microbe-containing vesicle fuses with a lysosome. After digestion, the microorganism is discharge from the phagocyte by exocytosis.



Methods of killing

The killing of microbes is a critical function of phagocytes that is performed either within the phagocyte (intracellular killing) or outside of the phagocyte (extracellular killing).

A) Intracellular killing

1- Oxygen-dependent intracellular by:

- a- Production of a superoxide ($O_2^{\cdot -}$) which is bacterial killing substance.
- b- Use of the enzyme myeloperoxidase from neutrophil granules.

2- Oxygen-independent intracellular

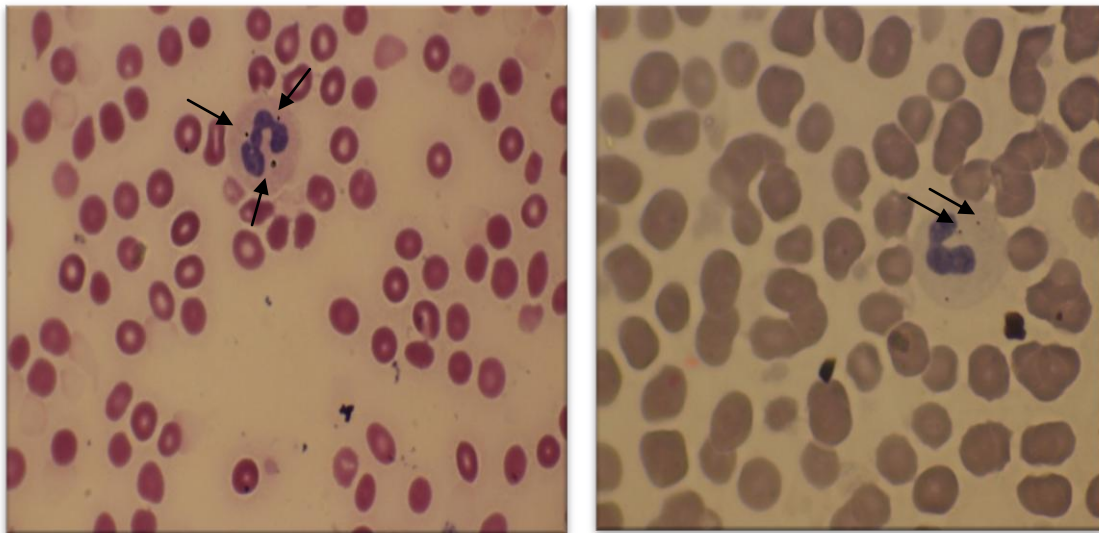
By using enzyme such as: **lysozymes**; these enzymes break down the bacterial cell wall. **lactoferrins**, which are present in neutrophil granules and remove essential iron from bacteria. **proteases** and **hydrolytic enzymes**; these enzymes are used to digest the proteins of destroyed bacteria

B) Extracellular

By using Interferon-gamma which was called macrophage activating factor stimulates macrophages to produce nitric oxide.

Procedure:

- 1- Withdrawn 1 ml of blood and placed in EDTA tube.
- 2- Prepare bacterial broth culture.
- 3- Add 100 μ l of bacteria to 1 ml of blood.
- 4- Incubate the mixture at 37 C° for 30 min.
- 5- After periods of incubation prepare smears of blood.
- 6- Fully cover the smears with Leishman's Stain solution for 2 minutes.
- 7- Add twice the amount of distilled water and mix by swirling.
- 8- Wait for at least 10 min and then wash.
- 9- Dry the slides and Examine under microscope by oil lens.



The figure explain the phagocytosis by neutrophils under microscope