



451 MBIO
Immunology

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Lab 3
Human defense

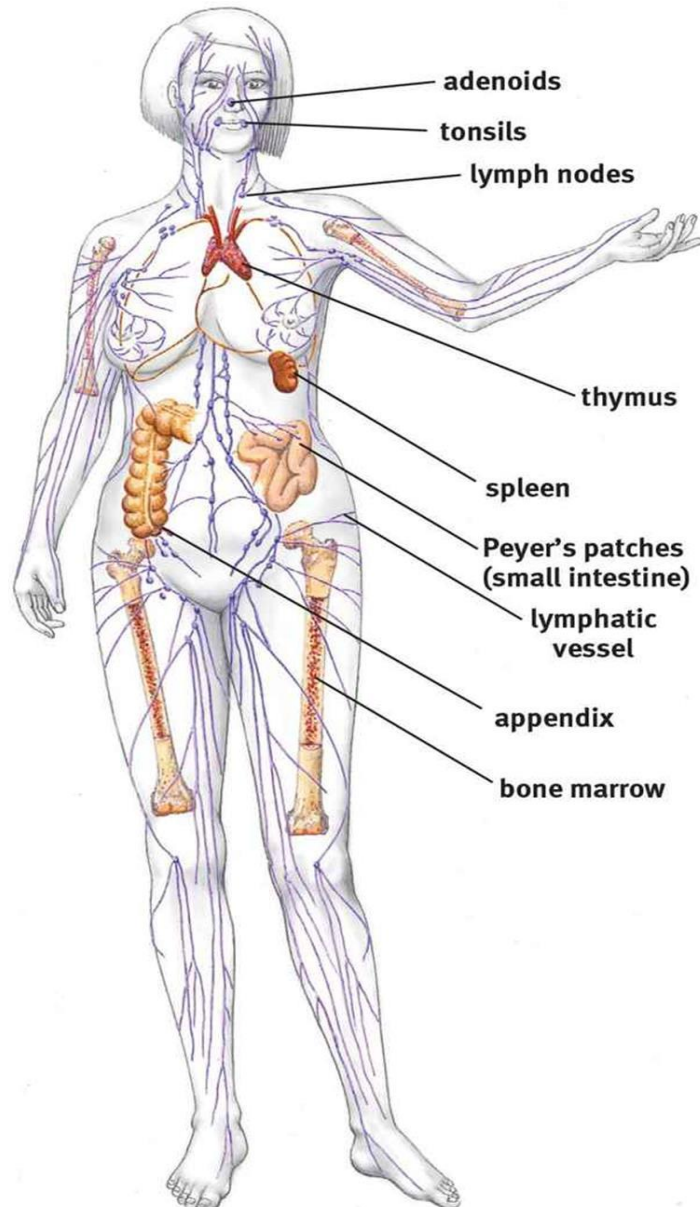
❖ Introduction

- The immune system is a network of cells, tissues and organs that work together to defend the body against attacks by “foreign” invaders.



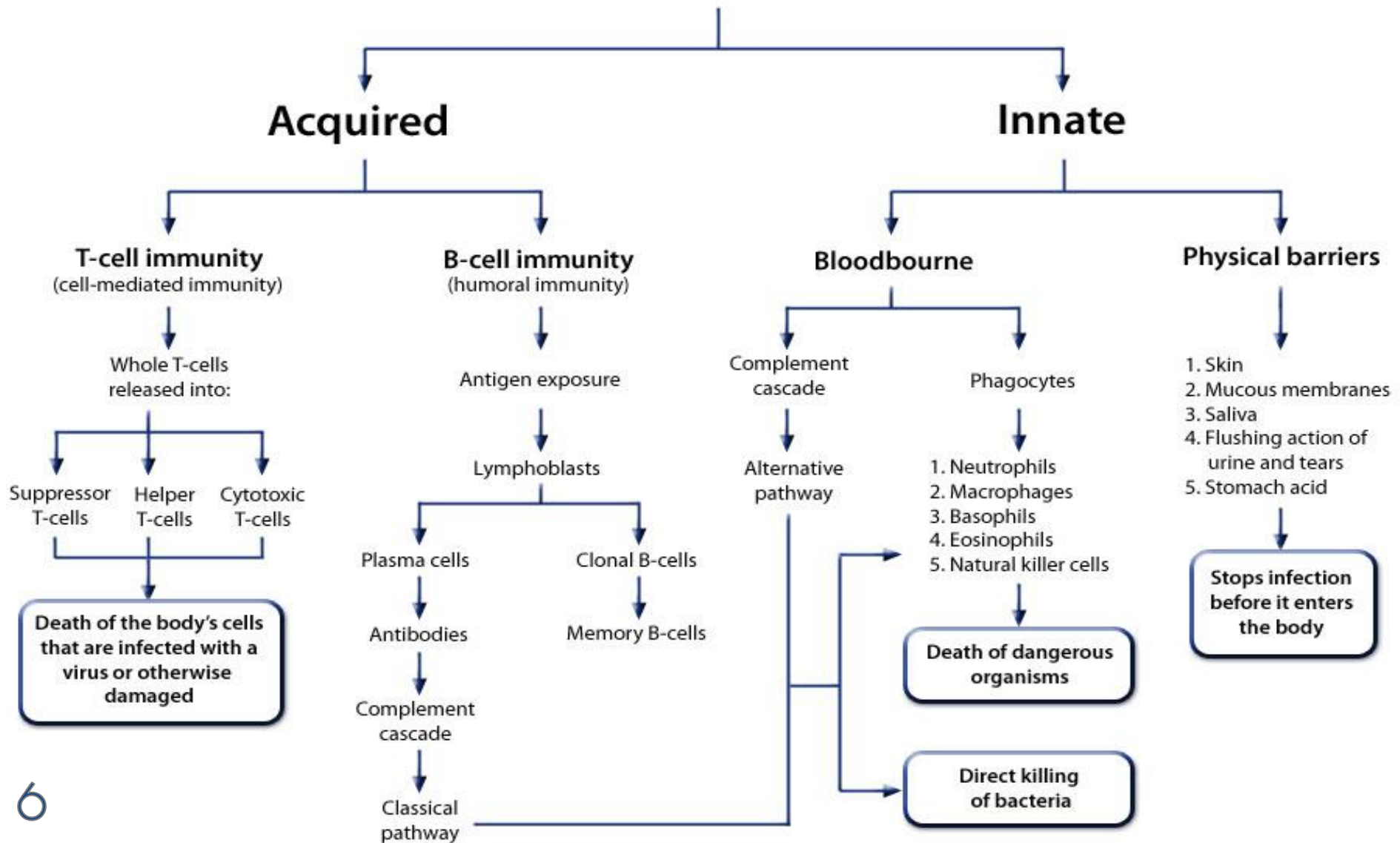
- When the immune system hits the wrong target, however, it can unleash a torrent of disorders, including allergic diseases, arthritis, and a form of diabetes.
- If the immune system is crippled, other kinds of diseases result.





Immune System

Immune system



Three Lines of Defense Against Infection

Nonspecific Defense

Specific Defense

First line of defense

Second line of defense

Third line of defense

- Skin
- Mucous membranes
- Normal flora
- Stomach acid
- Lysozyme.

- Phagocytic WBC
- Natural Killer Cell
- Complement proteins & interferon
- Inflammatory response
- Fever

- Lymphocytes (T-Cell)
- Antibodies (B-Cell)

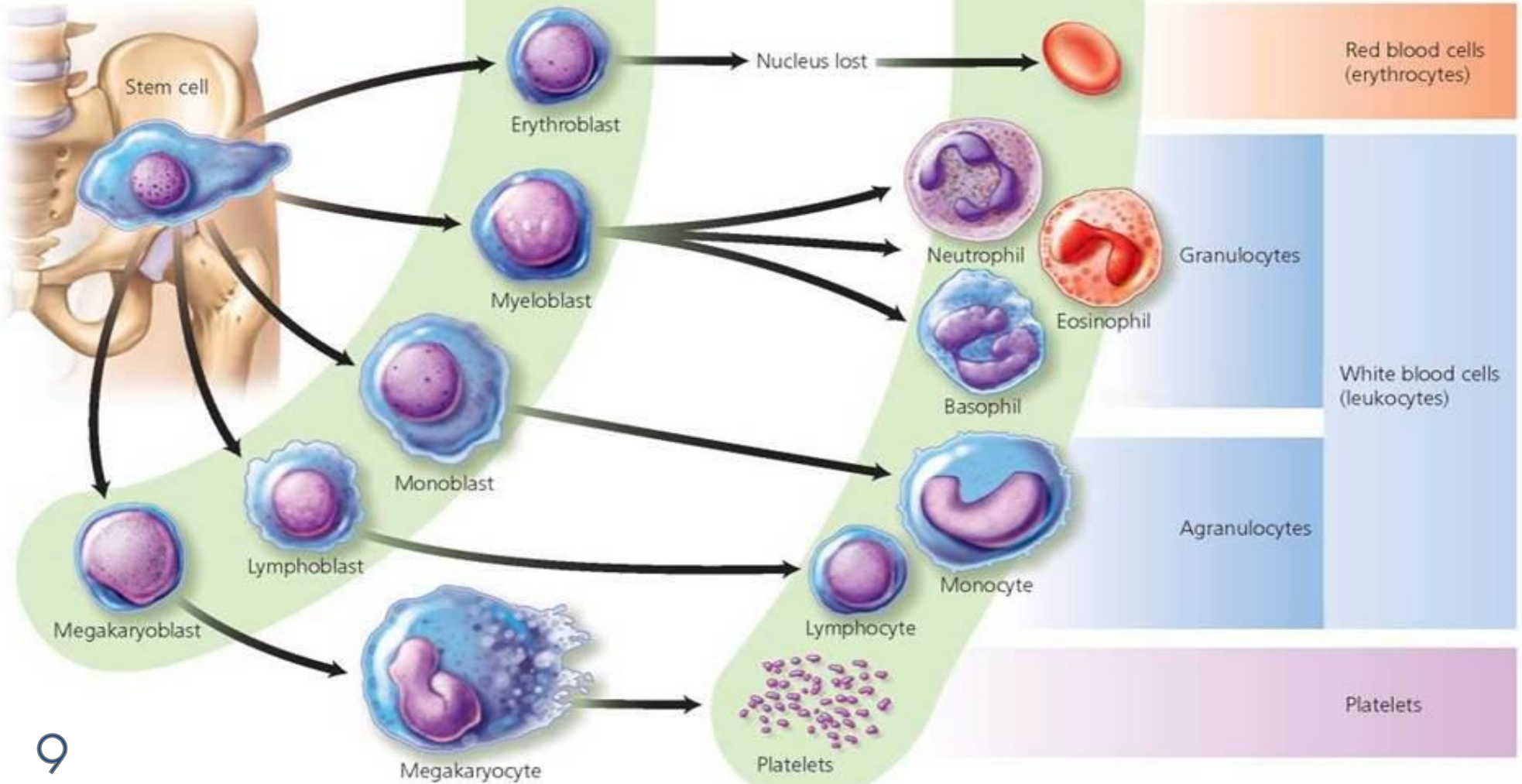
Type of White Blood Cells

	Granular	A granular
Types	<ul style="list-style-type: none"> ▪ Neutrophils ▪ Eosinophils ▪ Basophils 	<ul style="list-style-type: none"> ▪ Lymphocytes ▪ Monocytes
Mature	<ul style="list-style-type: none"> ▪ In red bone marrow, granules are actually vesicles filled with proteins and enzymes. 	<ul style="list-style-type: none"> ▪ Monocytes mature in red bone marrow → Macrophage. ▪ Lymphocytes mature in the thymus gland.

Stem cells are undifferentiated cells in the red bone marrow that give rise to all the formed elements.

Stem cells divide and become specialized.

Mature formed elements are specialized for specific functions.

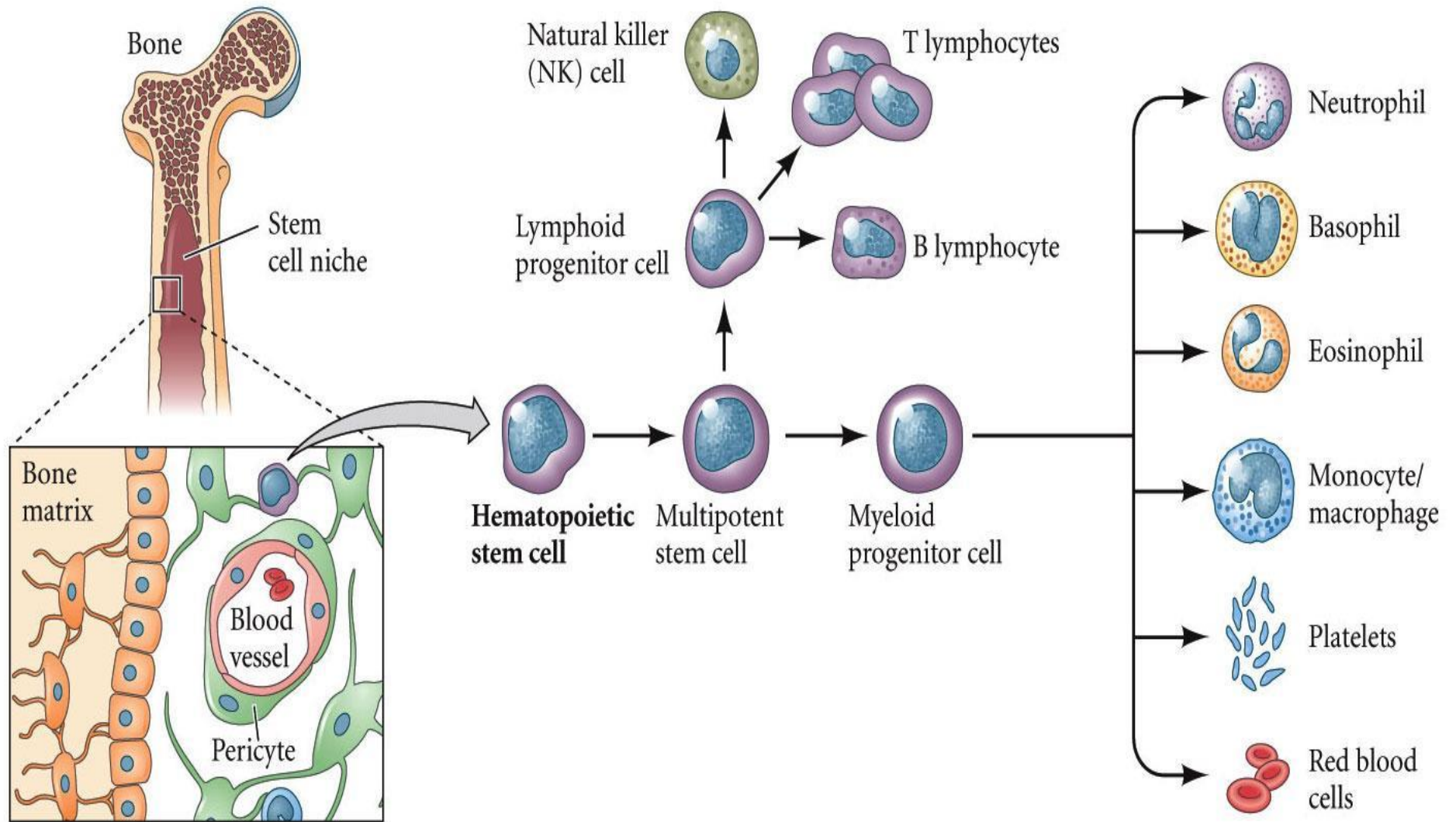


White Blood Cells's Function (Granulocytes)

Types	Description	Function
Neutrophil	<ul style="list-style-type: none"> ▪ Multilobed nucleus ▪ Unclear cytoplasmic granules 	Phagocytize bacteria
Eosinophil	<ul style="list-style-type: none"> ▪ Bilobed nucleus ▪ Red cytoplasmic granules 	<ul style="list-style-type: none"> ▪ Kill parasitic worms ▪ Complex role in allergy
Basophil	<ul style="list-style-type: none"> ▪ Bilobed nucleus ▪ Large purplish-black cytoplasmic granules 	<ul style="list-style-type: none"> ▪ Release histamine, heparin and anticoagulant.

White Blood Cells's Function (A granulocytes)

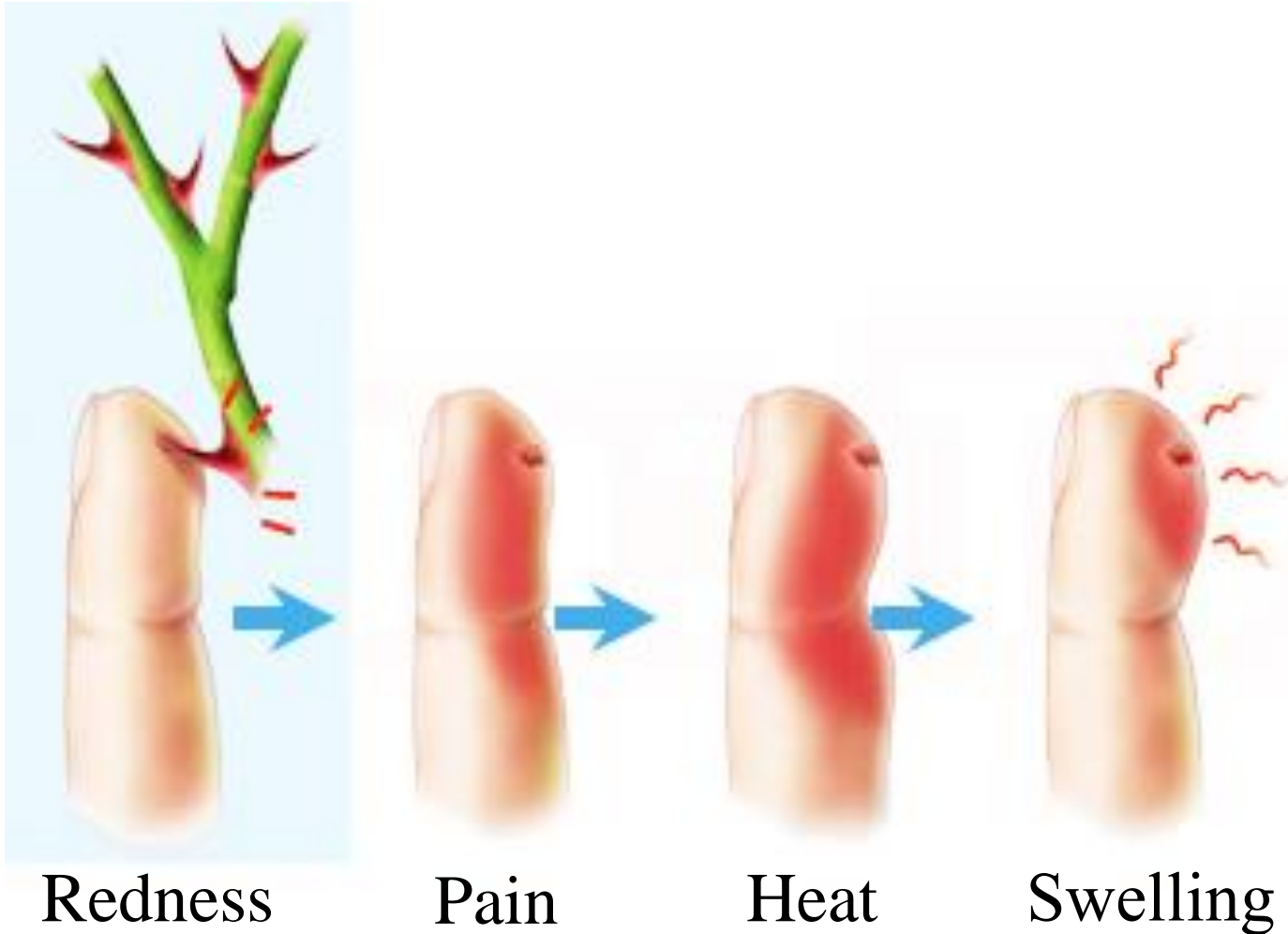
Types	Description	Function
Lymphocyte	<ul style="list-style-type: none"> ▪ Spherical or indented nucleus. ▪ Pale blue cytoplasm 	Mature to T-Cell or B-Cell
Monocyte	<ul style="list-style-type: none"> ▪ U or kidney shaped nucleus ▪ Gray-blue cytoplasm 	<ul style="list-style-type: none"> ▪ Phagocytosis ▪ Develop into macrophage in tissue



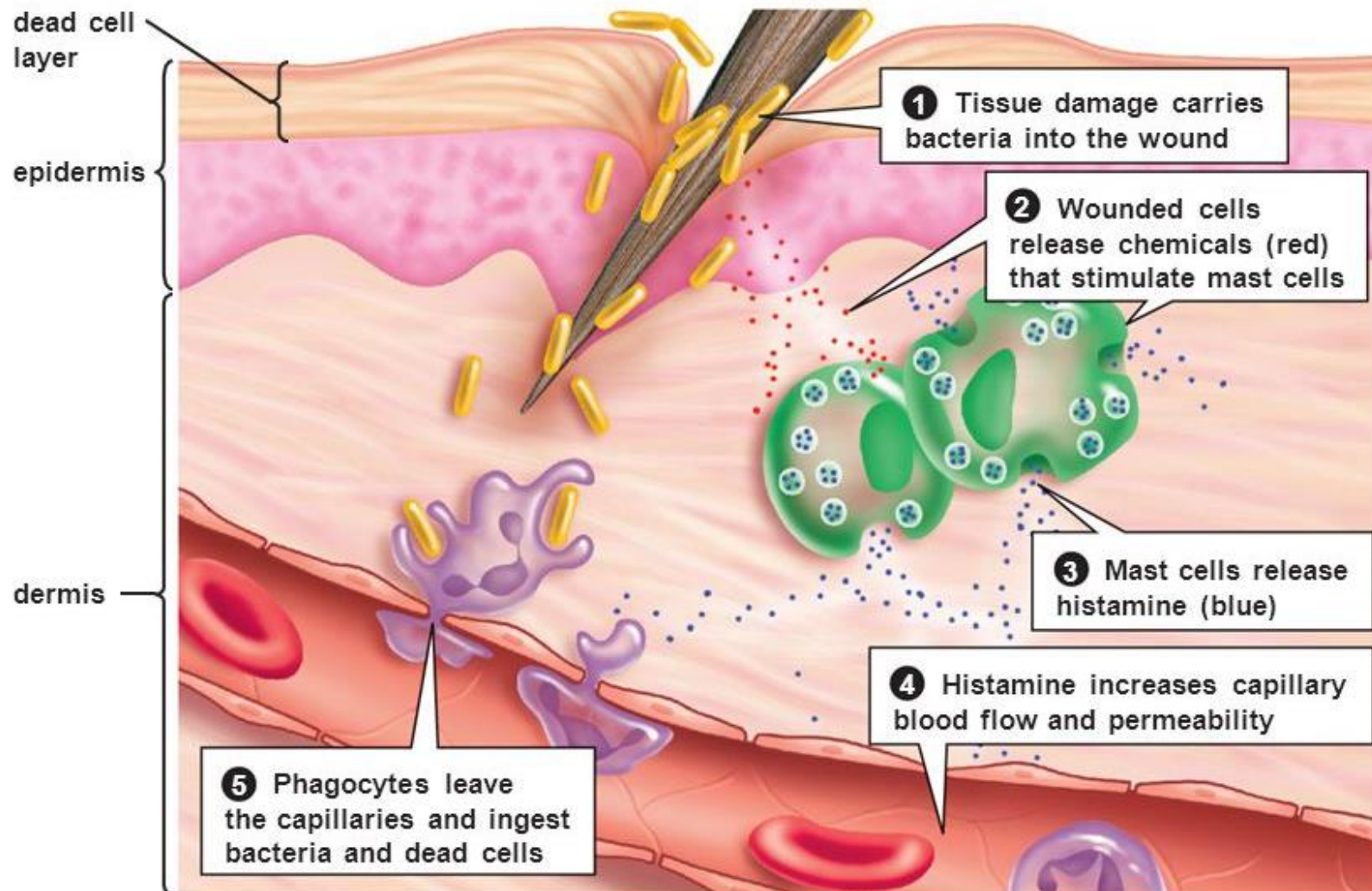
❖ Inflammation

- Inflammation is a localized nonspecific response to tissue damage that may be caused by heat, chemicals mechanical damage, as well as by microbial infection.
- When used against infection, it is a process to confine the agent of injury, destroy the agent, and repair the damaged tissue.

- The symptoms of inflammation includes :

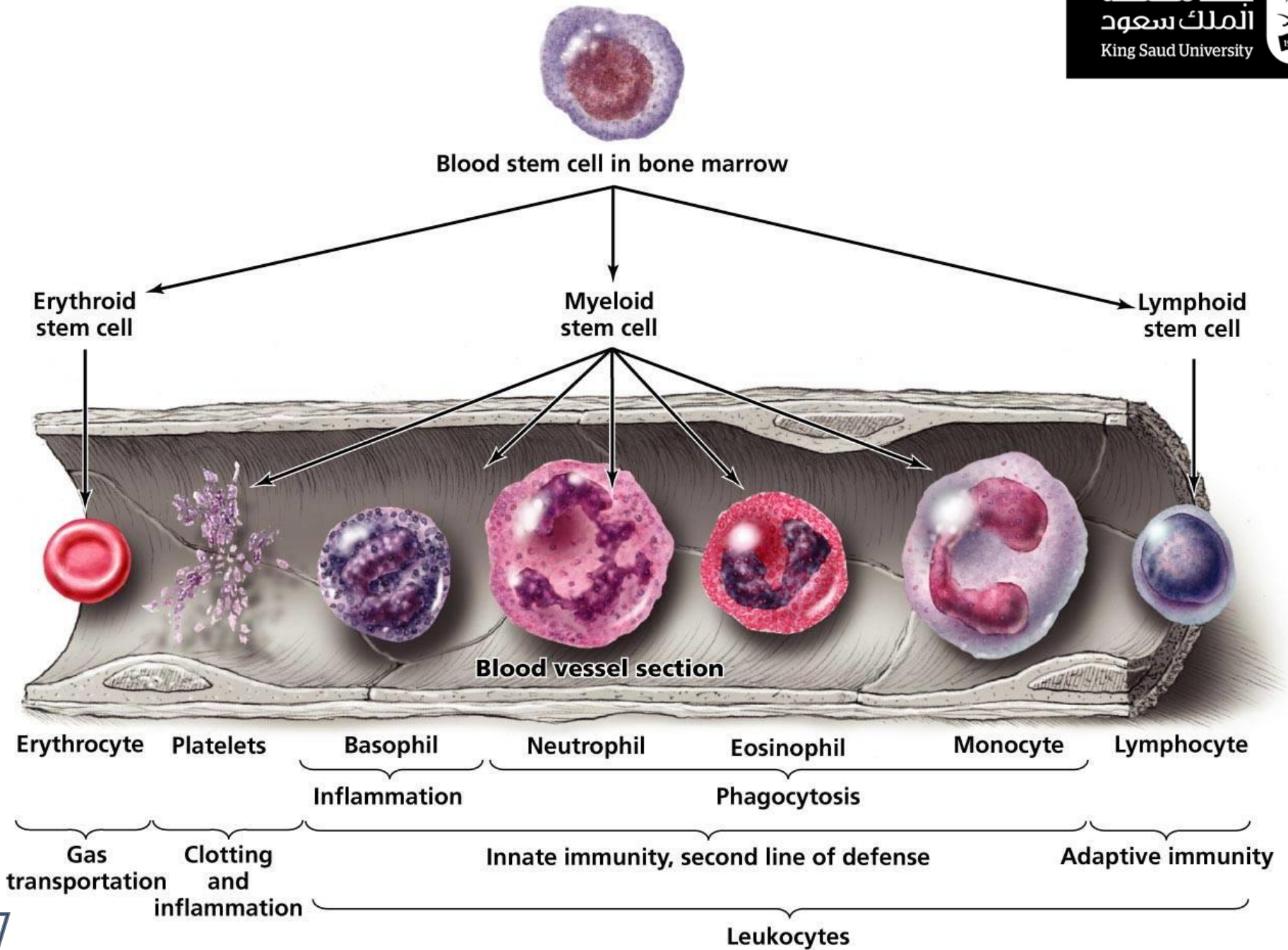


The Inflammatory Response



❖ Phagocytosis

- It is the process when phagocytes ingest, kill and digest infectious organisms and unwanted cellular debris such as old cells particulate matter.
- Phagocytosis by neutrophils, eosinophils and mono/macrophages occur in **five phases**.



■ Phagocytosis Phases

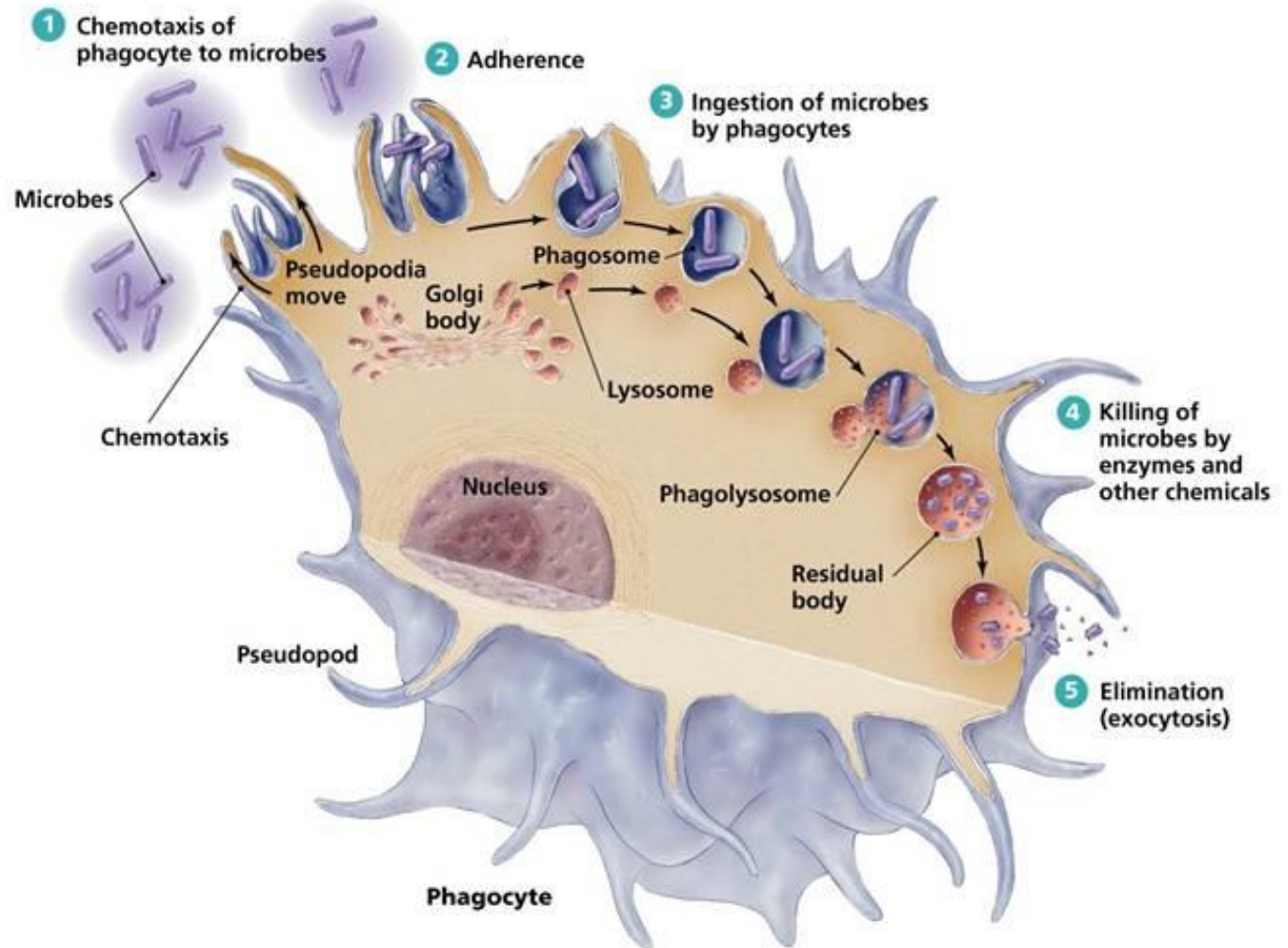
1. Attraction

2. Adherence

3. Ingestion

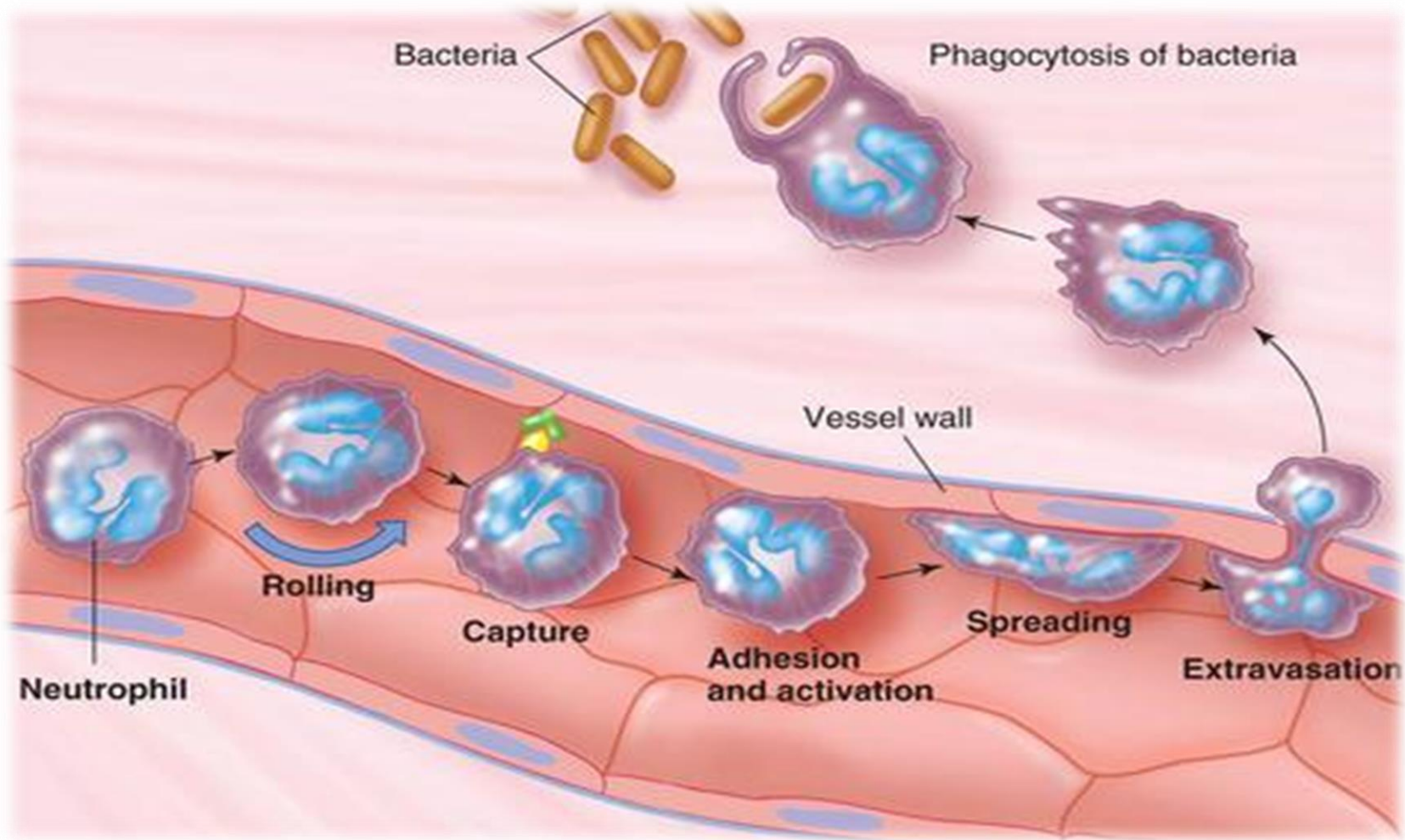
4. Digestion or Killing

5. Elimination



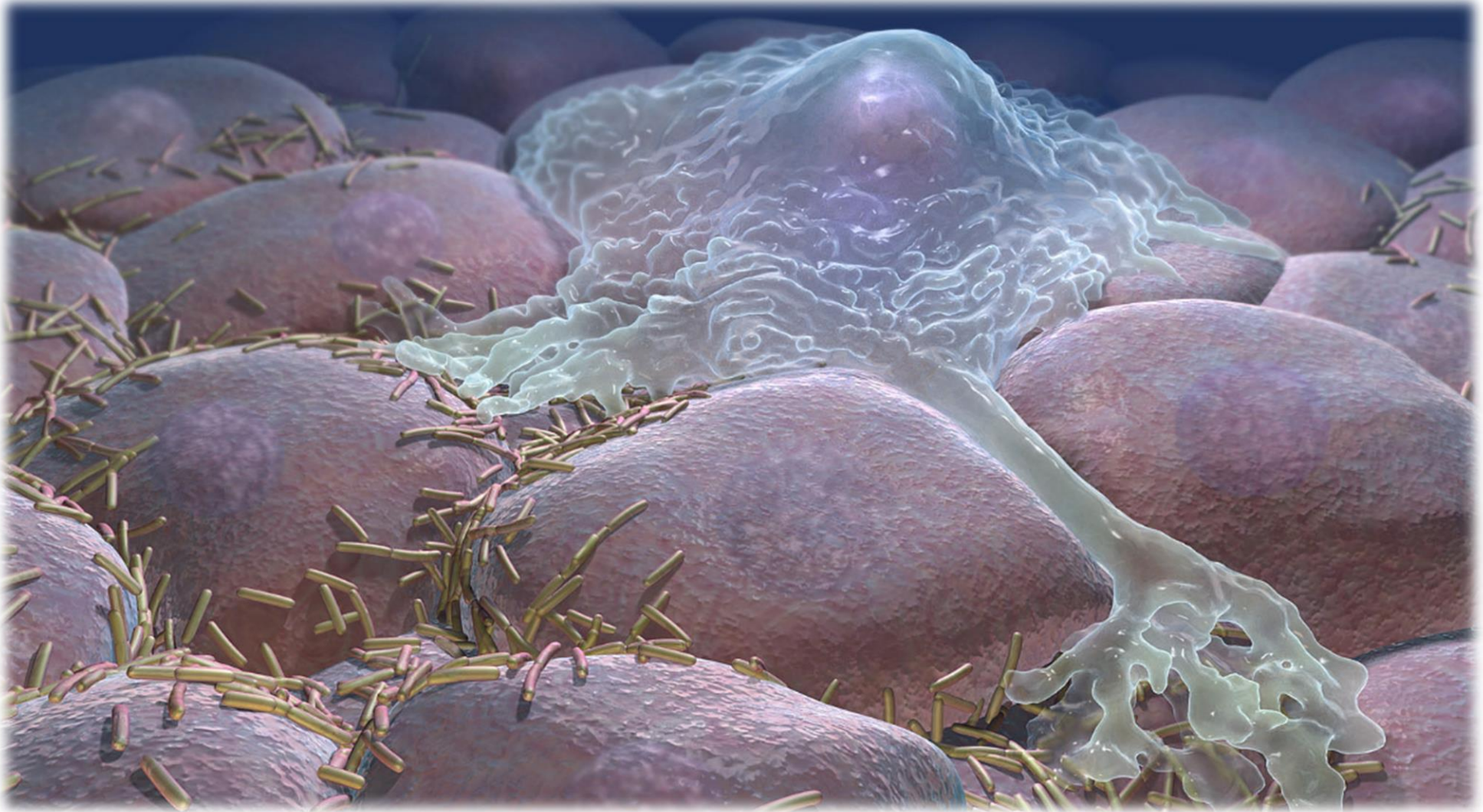
Phagocytosis Phases

Phase	Description
1. Attraction	<ul style="list-style-type: none"> ▪ the phagocyte is attracted to the microbe. This is called chemotaxis. ▪ Compounds produced by the microorganism and damaged host cells attract the phagocytes. ▪ Compliment proteins (Other chemotactic factors) and cytokines secreted from leukocytes can also attract phagocytes to an infection site.



Phagocytosis Phases

Phase	Description
2. Adherence	<ul style="list-style-type: none"> ▪ The phagocyte must then adhere to the microbe . ▪ If a microbe is first coated by an opsonin protein, the phagocyte more readily adheres to it. ▪ The coating of microbes with opsonin proteins (antibodies and certain complement proteins) is called opsonization.



Phagocytosis Phases

Phase	Description
3. Ingestion	<ul style="list-style-type: none"> ▪ The phagocyte ingests the microbe, surrounding it by a sac called a phagosome.
4. Digestion or Killing	<ul style="list-style-type: none"> ▪ Phagosomes fuse with lysosomes containing lysozyme which hydrolyze the macromolecules of the microorganism. ▪ The residual body is the undigested material left from the process.

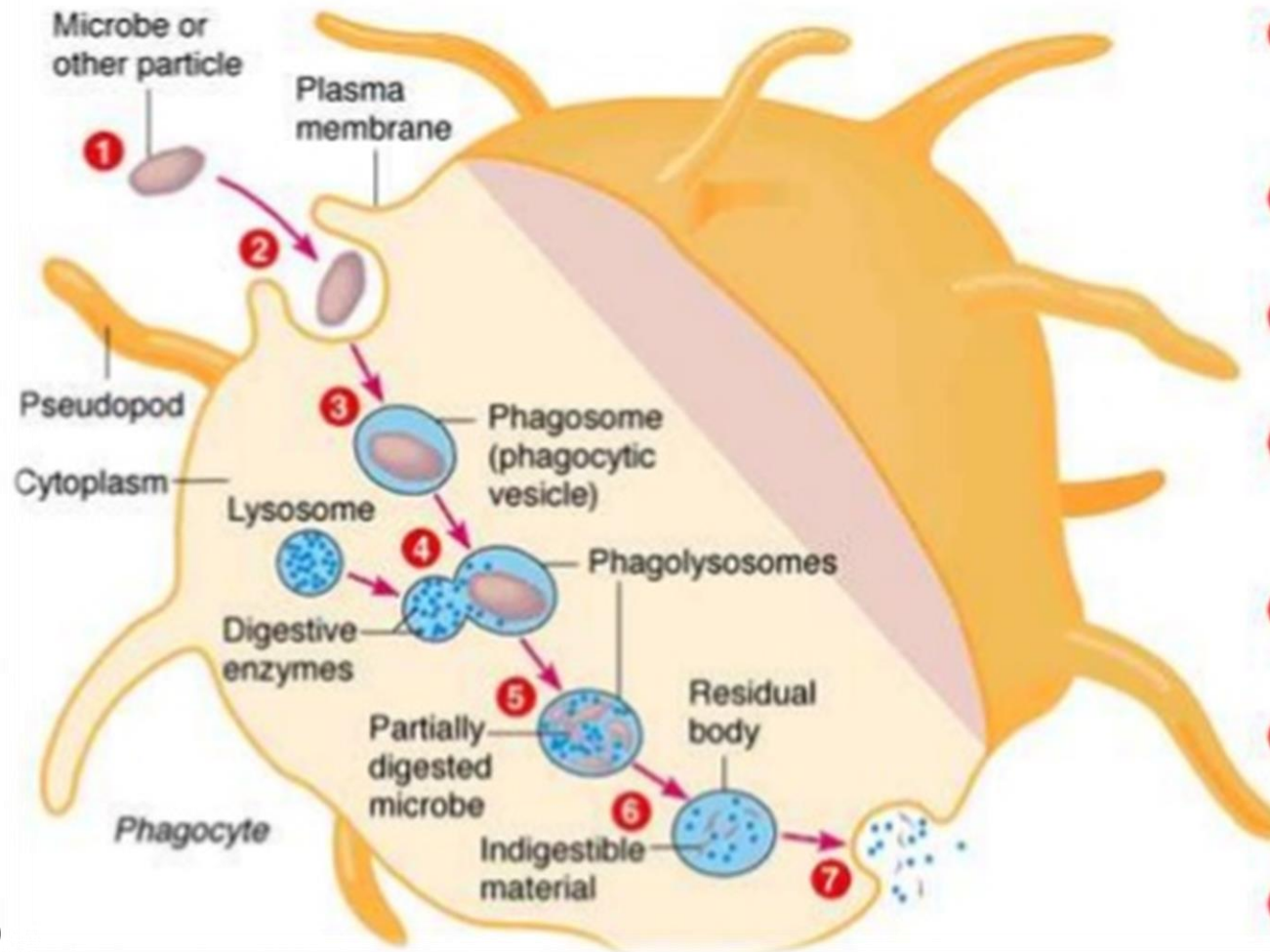
Phagocytosis Phases

Phase	Description
5. Elimination	<ul style="list-style-type: none"> ▪ The residual body (the digested phagosome) moves to the plasma membrane and is discharged outside the cell by exocytosis.

NOTE : A few pathogens manage to live inside cells including phagocytes. For example, Chlamydia, *Mycobacterium tuberculosis*, and malarial parasites.

These microbes prevent the fusion phagosome and lysosome and keep the pH of the phagosome too high for the digestive enzymes to work.

Process of Phagocytosis



- 1 Chemotaxis and adherence of microbe to phagocyte.
- 2 Ingestion of microbe by phagocyte.
- 3 Formation of a phagosome.
- 4 Fusion of the phagosome with a lysosome to form a phagolysosome.
- 5 Digestion of ingested microbe by enzymes.
- 6 Formation of residual body containing indigestible material.
- 7 Discharge of waste materials.

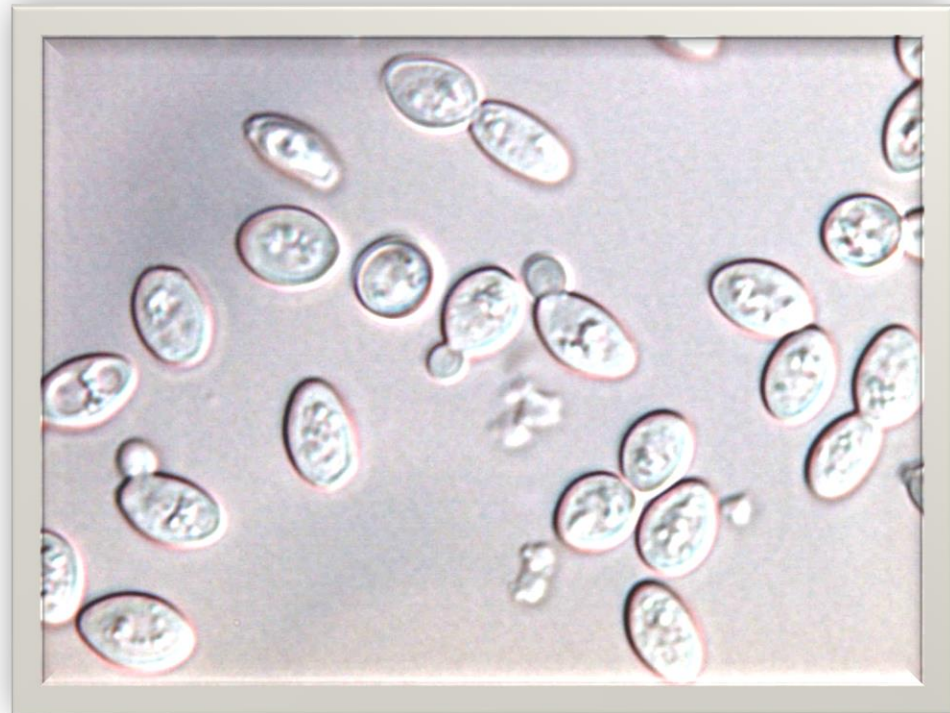
- The particulate susceptible to the phagocytosis can be :
 1. **Intracellular** → such as *Mycobacterium tuberculosis*. The Intracellular pathogen are ingested by macrophage when they are released from a dying cells.
 2. **Extracellular** → such as *Streptococcus pneumonia*.

❖ The Experiment

• **Aim :** Detection of phagocytosis.

■ **Material :**

- Yeast.
- Serum.
- Slide.
- Toothpick.



■ Procedure

1

- Put one drop of yeast on a clean slide.

2

- Add same amount of serum, then mix it well with a toothpick.

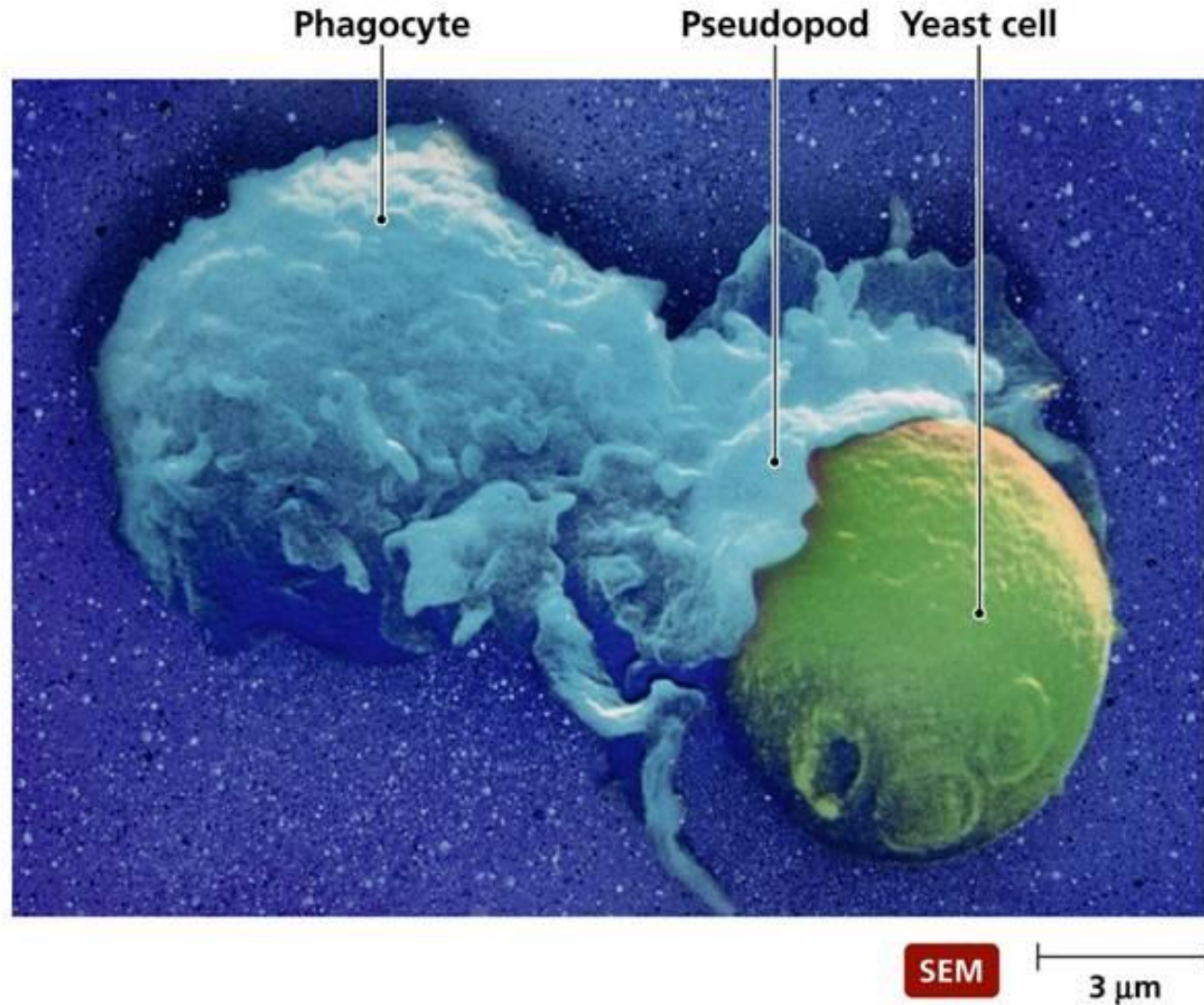
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- Incubate for 5 – 10 minutes at 37 °C.

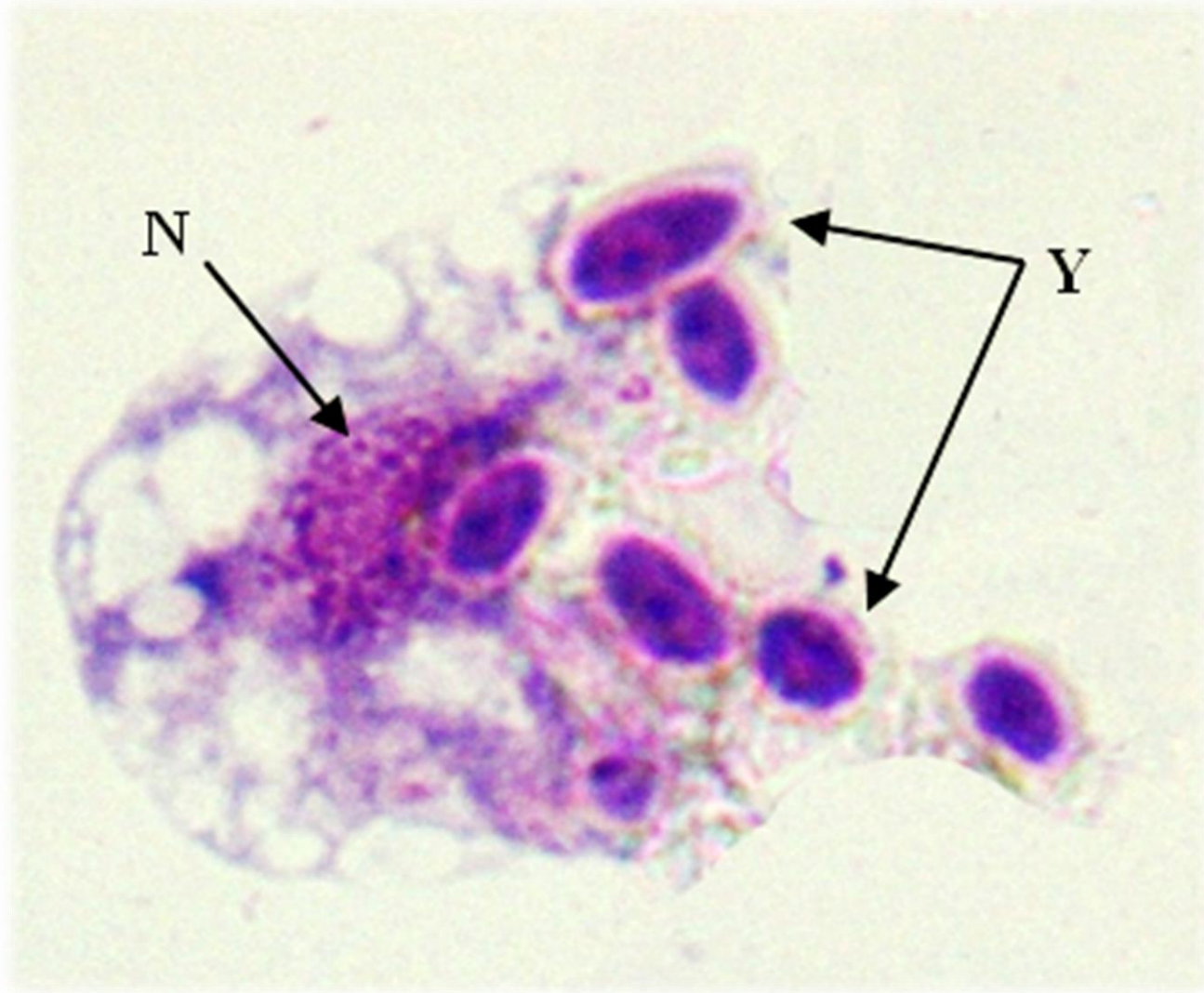
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- Stain it with a simple stain (Safranin or Crystal violet)

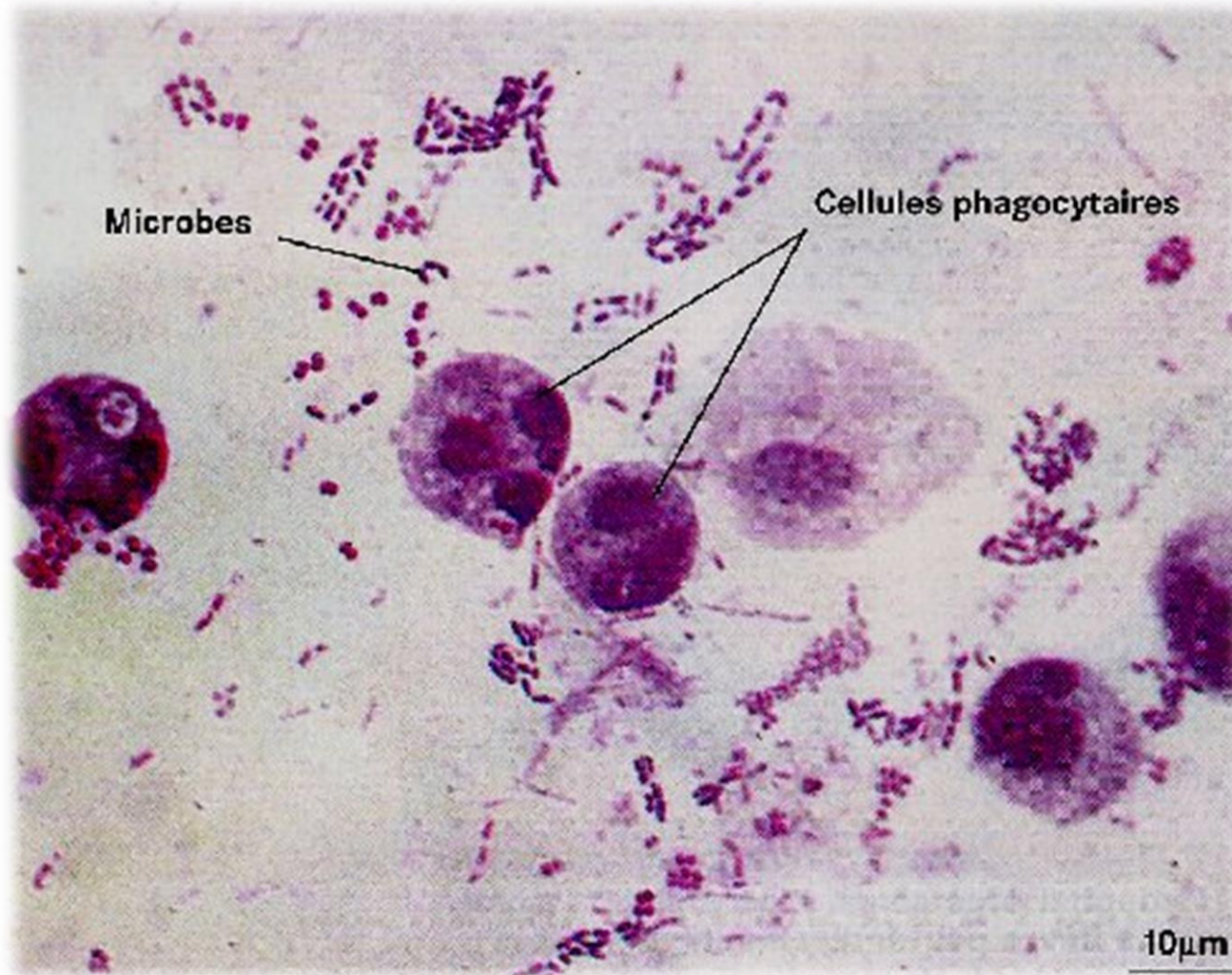
Results



■ Results



Results





Any Questions

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