

# Lesson 21 – Basic immunology: The second line of defense



# The second line of defense (SLD) (non specific)

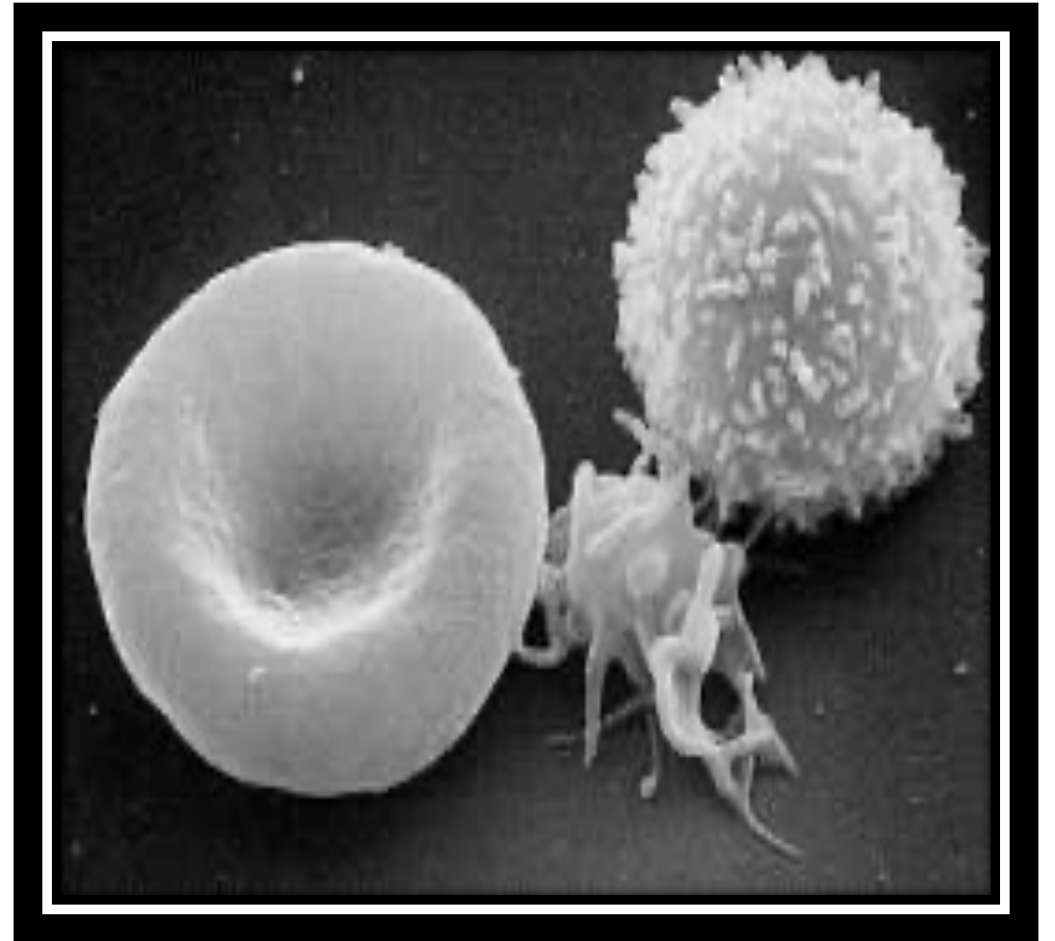
- Operates when pathogens penetrate skin or mucous membranes
- It involves **cells, antimicrobial chemicals, and processes**, but no physical barriers
- Many of these components are contained or originate in the blood from its **formed elements**



# From blood formed elements to SLD

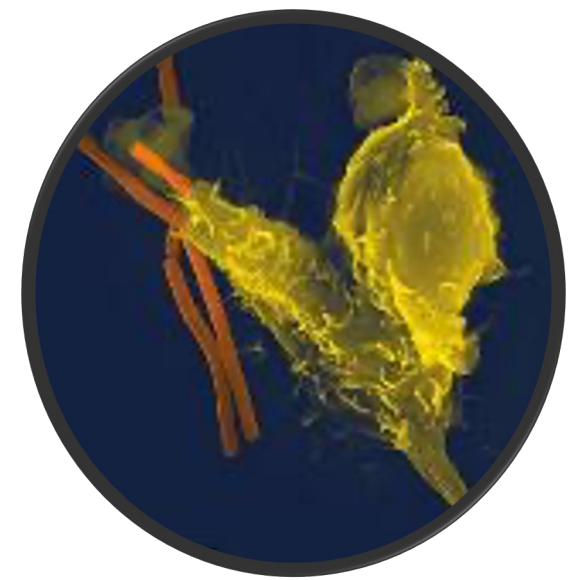
## Three types of formed elements

- **erythrocytes** - red blood cell, carry oxygen & carbon dioxide in the blood
- **platelets** (also called thrombocytes) - involved in blood clotting
- **leukocytes (aka white blood cells)** - involved in defending the body against invaders
  - 2 groups
    - **granulocytes**
    - **agranulocytes**

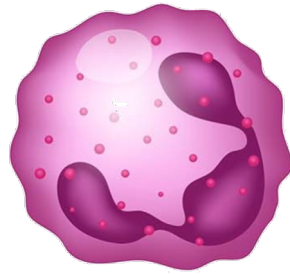


# Leukocytes - granulocytes

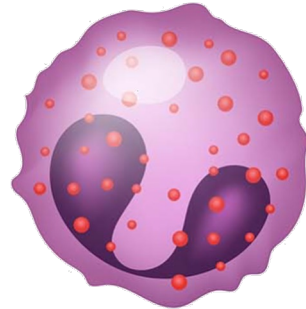
- Category of **white blood cells (WBCs)** characterized by the **presence of granules** in their cytoplasm
- 3 types:



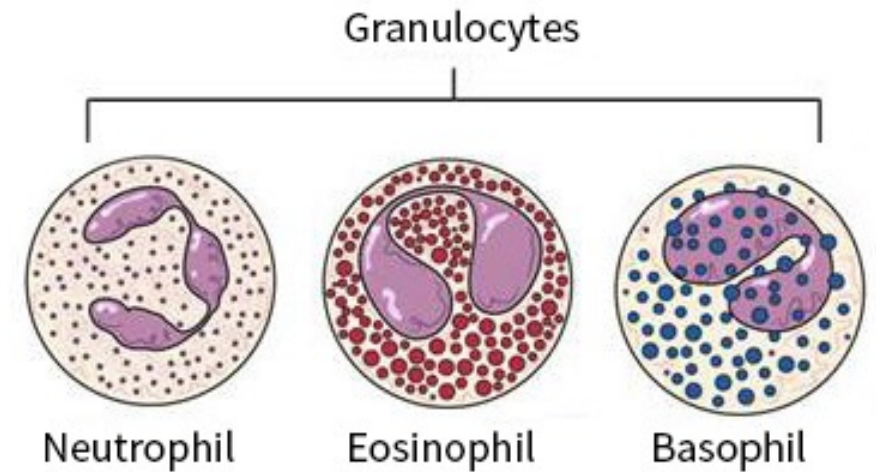
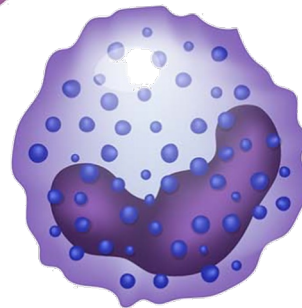
- **Neutrophils**






- **Eosinophils**



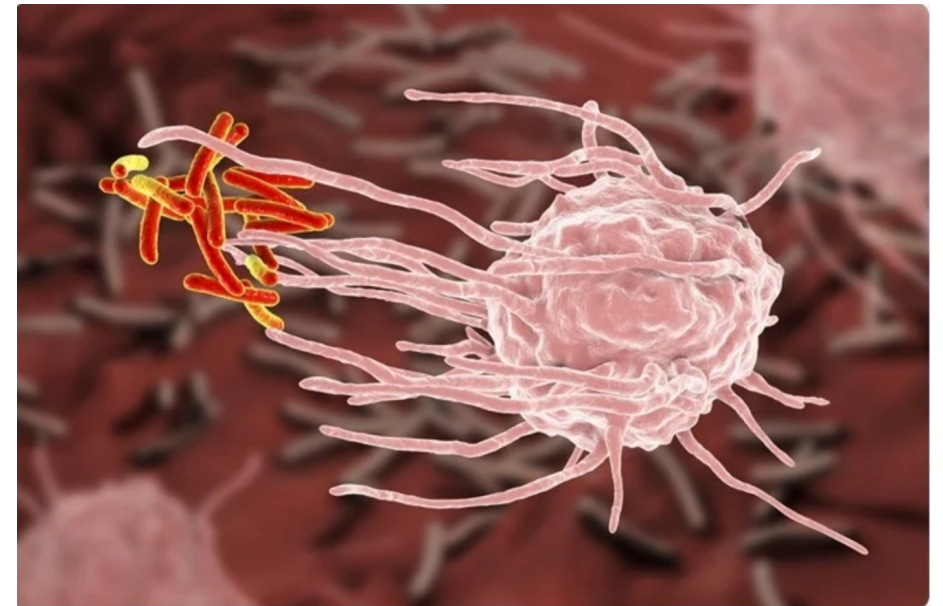
- **Basophils**



# Leukocytes - granulocytes

- **Neutrophils** 
  - Most abundant WBCs
  - Predominant cells in purulent exudate (or *liquor puris*), accounting for its whitish appearance
  - Respond quickly following tissue injury
  - Hallmark of acute inflammation
- **Eosinophils** 
  - Main effector cells in allergic responses and asthma
  - Also fight helminth (worm) colonization
- **Basophils** 
  - Least common granulocyte
  - When activated, release inflammatory and pro-inflammatory compounds

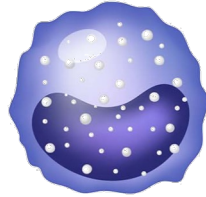
**Neutrophils and eosinophils can phagocytize pathogens**



# Leukocytes - agranulocytes

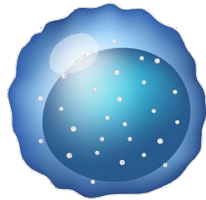
- Category of **WBCs** characterized by the **absence of granules** in their cytoplasm
- 2 types:

- **Lymphocytes**

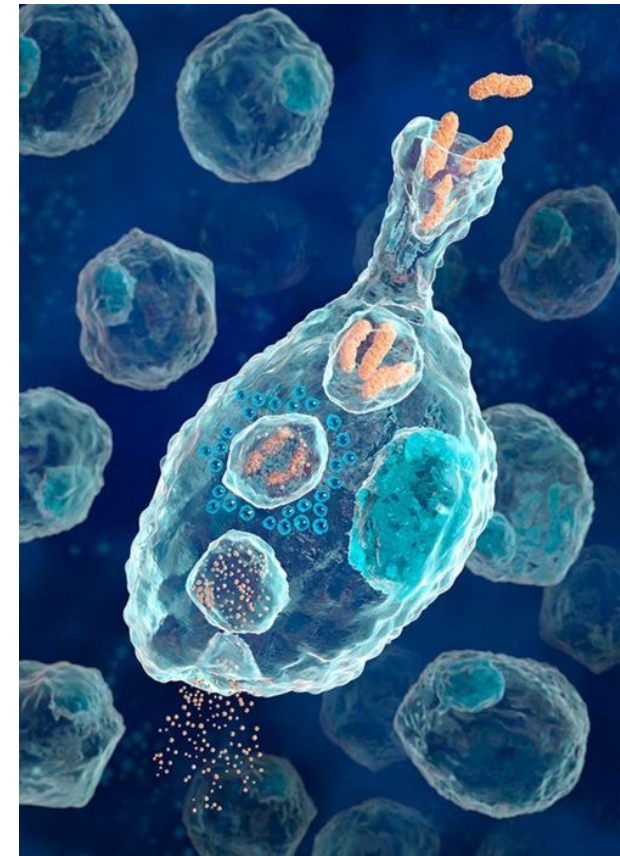


- most involved in the **SPECIFIC IMMUNITY** (3<sup>rd</sup> line of immune defense - TLD)

- **Monocytes**



- leave the blood and mature into **macrophages** (phagocytic cells of the SLD)

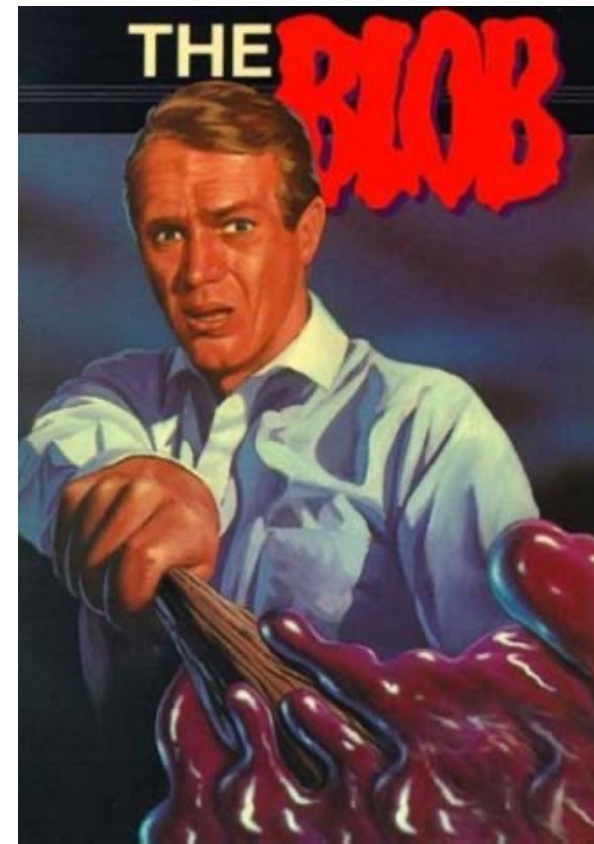
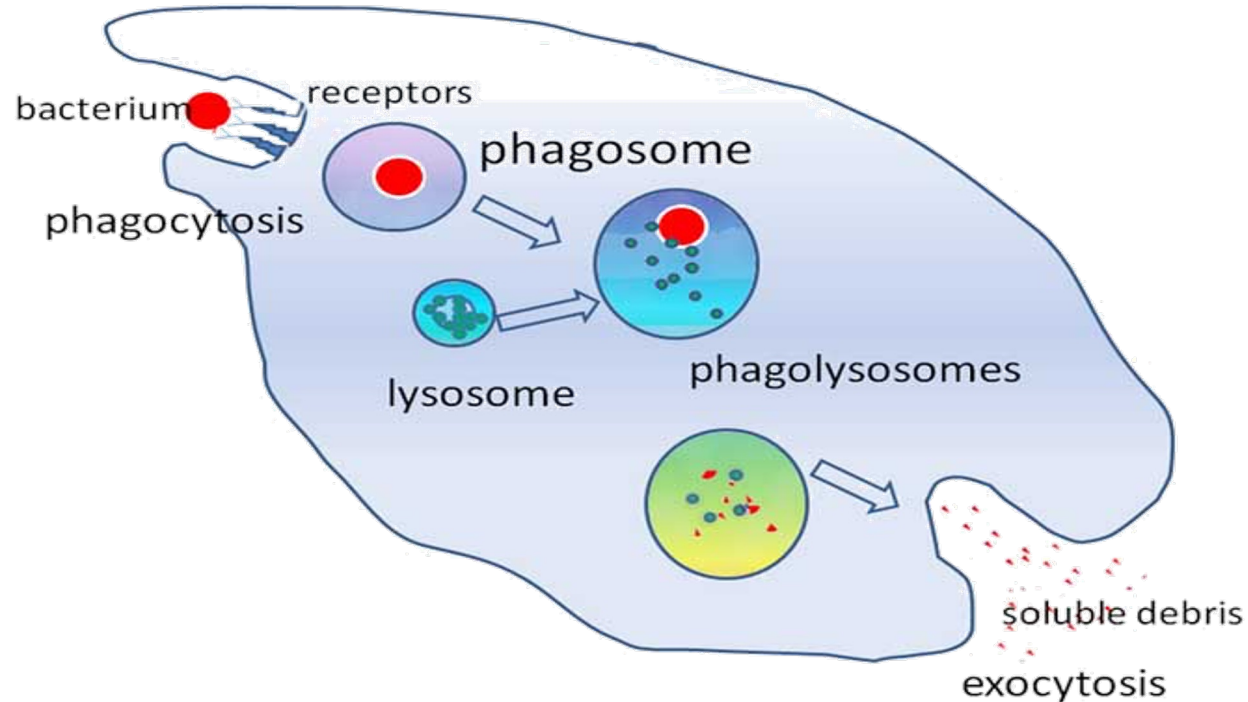


# Components of the SLD

- **Leukocytes**
- **Nonspecific chemical defenses**
- **Inflammation**
- **Fever**

# Leukocytes - SLD

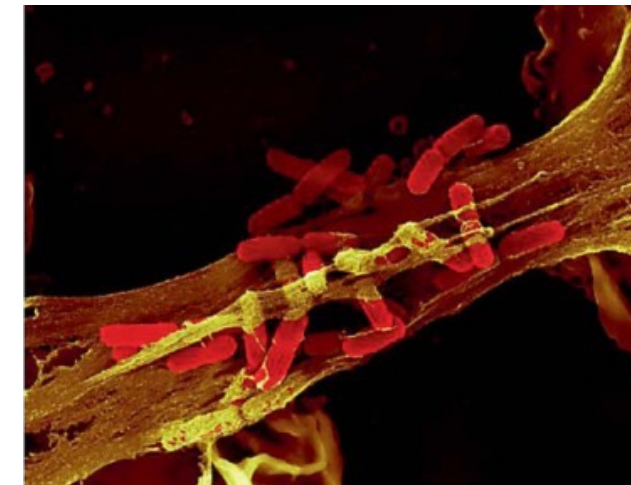
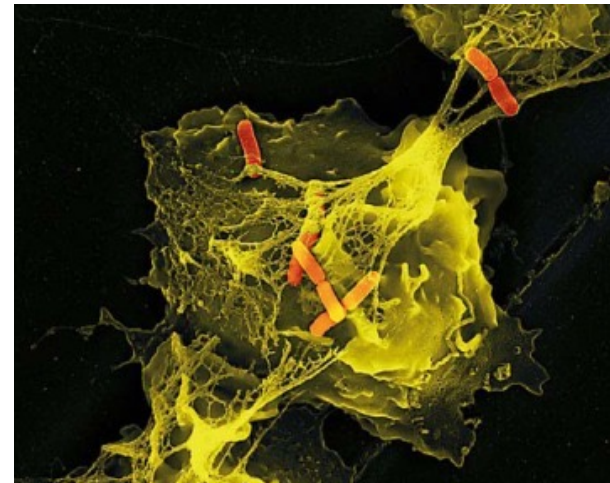
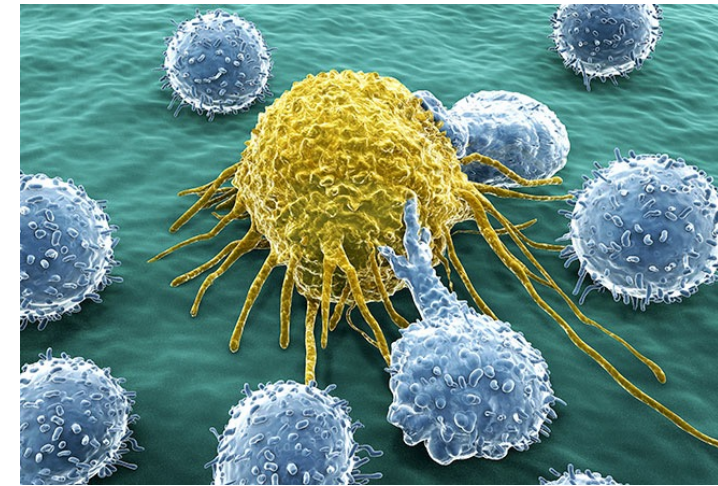
- Leukocytes (WBCs) as **intracellular killers**
- **Phagocytosis**
  - These cells ingest and destroy foreign microorganisms



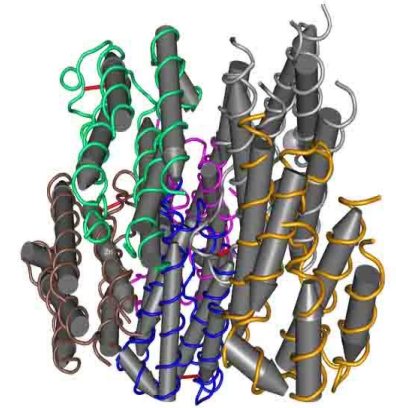


# Leukocytes - SLD

- Leukocytes as **extracellular killers**
- **Natural killer lymphocytes (NK cells)**
  - Secrete toxins onto surface of virally infected cells or cancer cells
  - Differentiate normal body cells because they have membrane proteins similar to the NK cells
- **Neutrophils and eosinophils**
  - They can also ensnare and kill pathogens by capturing them in extracellular structures called web-like **extracellular traps (NETs)**
    - made of DNA and antimicrobial proteins
    - bind, disarm and kill pathogens extracellularly

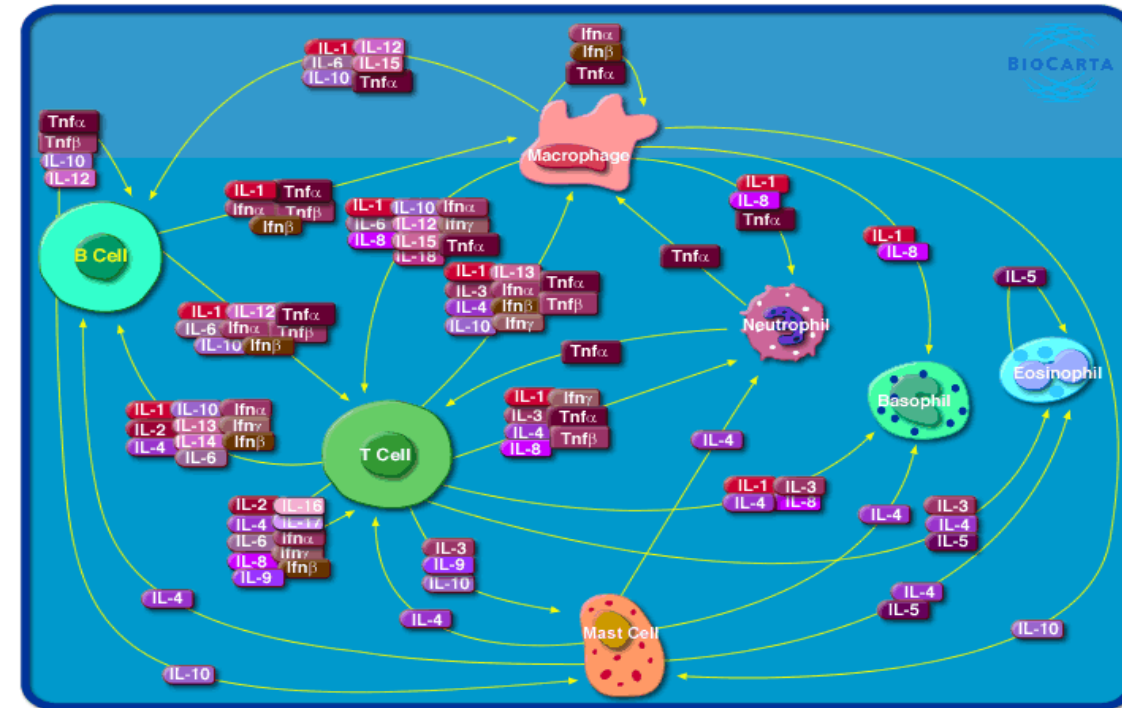


# Nonspecific chemical defenses - SLD



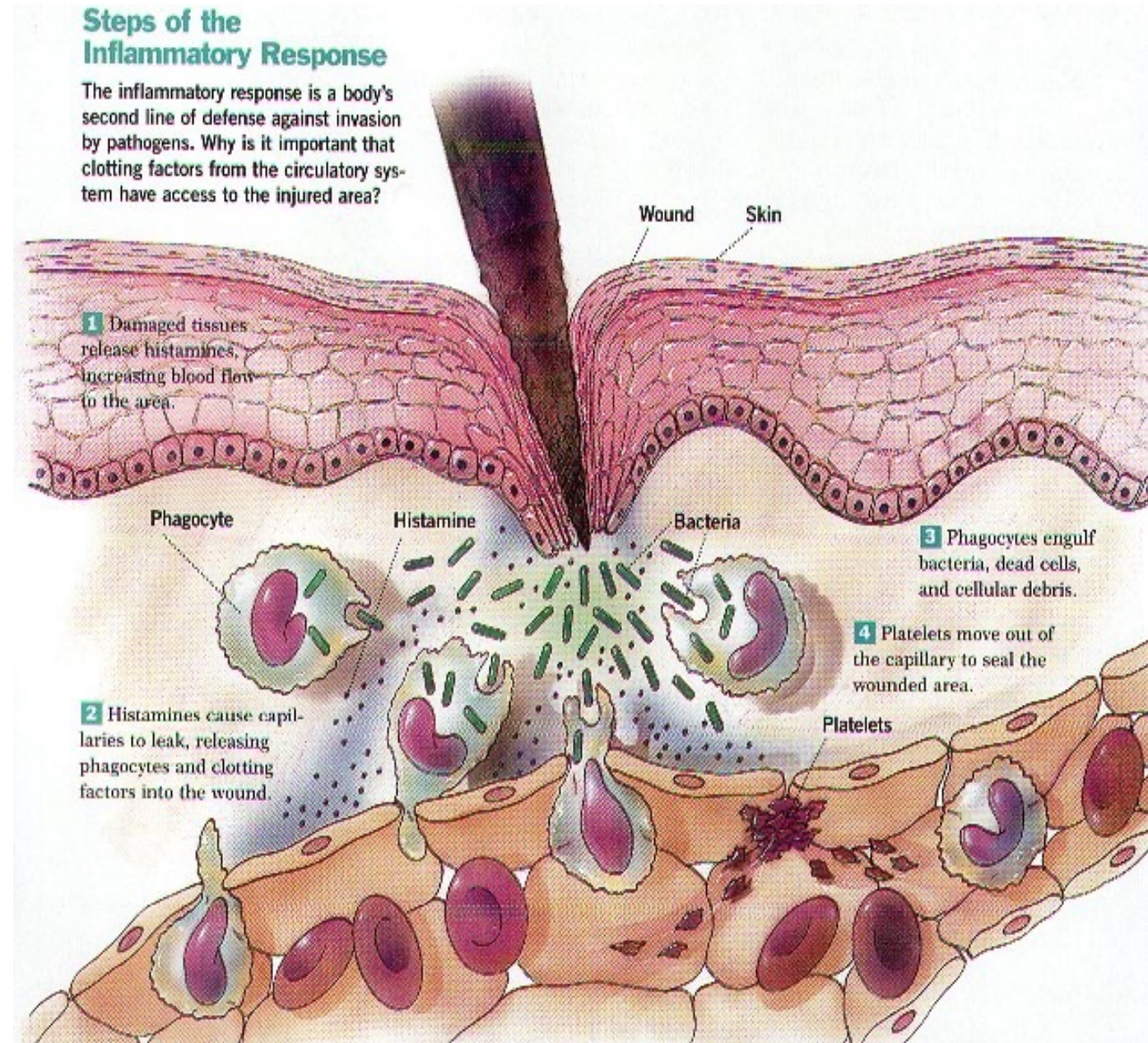
## Lysozyme, Defensins and Cytokines (including interferons and interleukins)

- Augment phagocytosis
- Some attack pathogens directly
- Some enhance features of nonspecific resistance



# Inflammation - SLD

- Nonspecific response to tissue damage
- important microcirculatory events that occur during the inflammatory process include
  - vascular permeability change due to release of histamines
  - **leukocyte recruitment and accumulation** and
  - release of inflammatory mediators
- Associated with heat, swelling and pain



# Fever - SLD

- Body temperature above normal range of **36.5–37.5 °C** (98–100 °F)
- **Various types of pyrogens**
  - Bacterial toxins
  - Cytoplasm of bacteria released by lysis
  - Antibody-antigen complexes
  - Interleukin-1 (IL-1, a cytokine)
- **Benefits**
  - Speed of immune system reaction increased
  - Inhibits growth of some temperature sensitive microorganisms
  - Increase perspiration

