

Lesson 21 – Basic immunology: The second line of defense



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

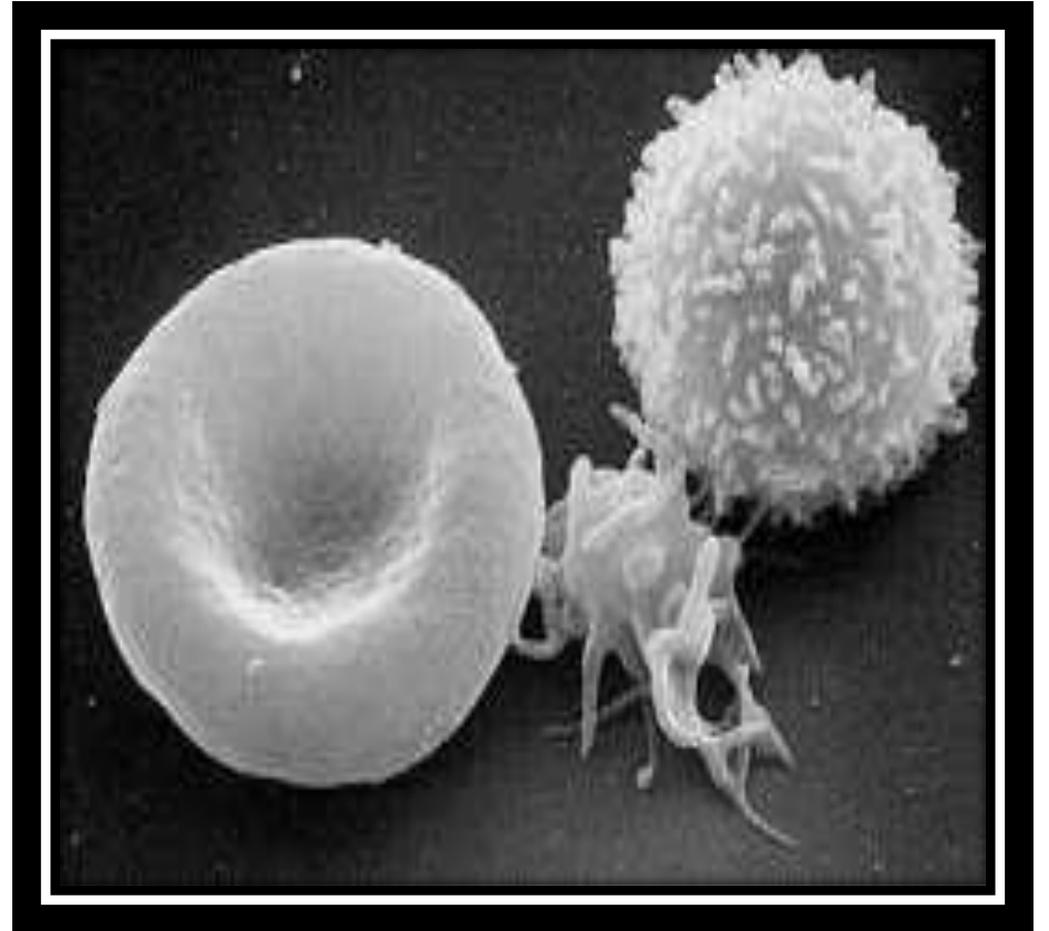
- Operates when pathogens penetrate skin or mucous membranes
- It involves **cells, antimicrobial chemicals, and processes**, but no physical barriers
- Many of these components are contained or originate in the blood from its **formed elements**



From blood formed elements to SLD

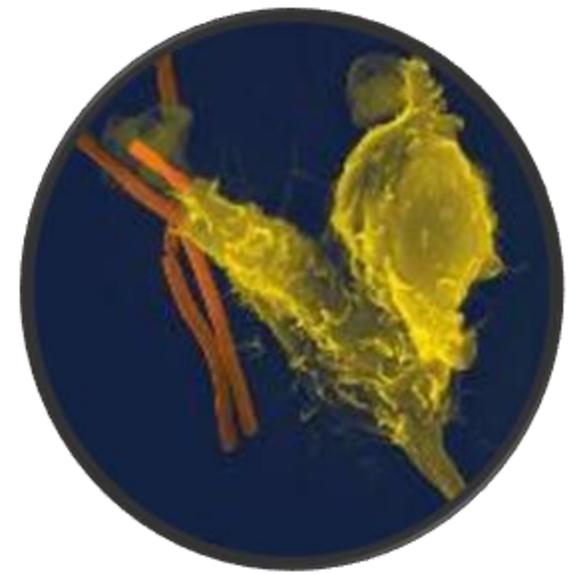
Three types of formed elements

- **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**

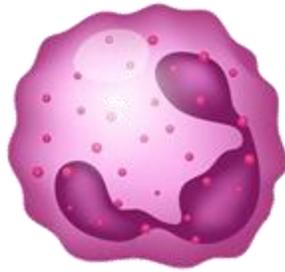


Leukocytes - granulocytes

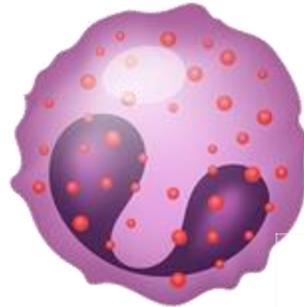
- Category of **white blood cells (WBCs)** characterized by the **presence of granules** in their cytoplasm
- 3 types:



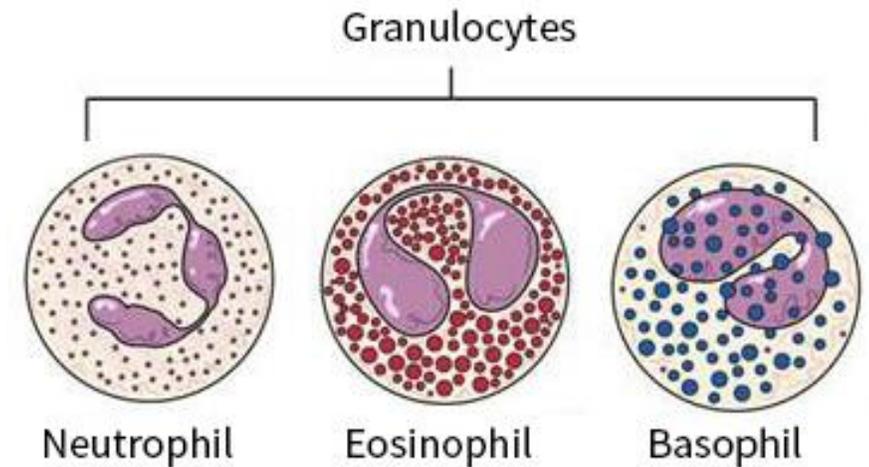
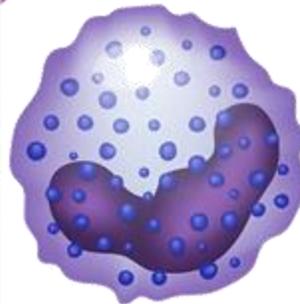
- **Neutrophils**



- **Eosinophils**



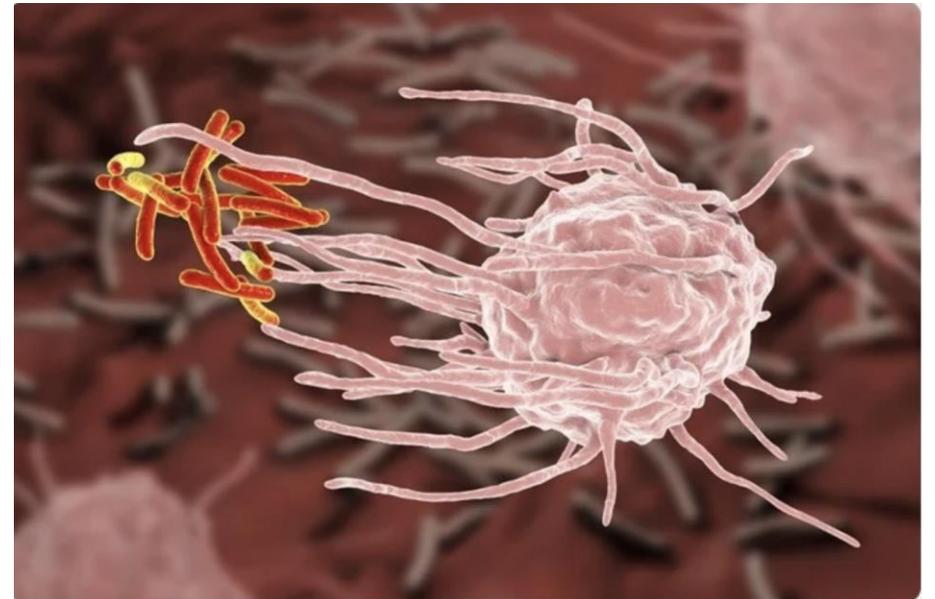
- **Basophils**



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

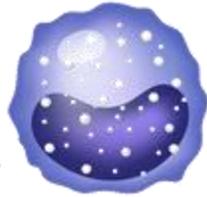
Neutrophils and eosinophils can phagocytize pathogens



Leukocytes - agranulocytes

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

- **Lymphocytes**

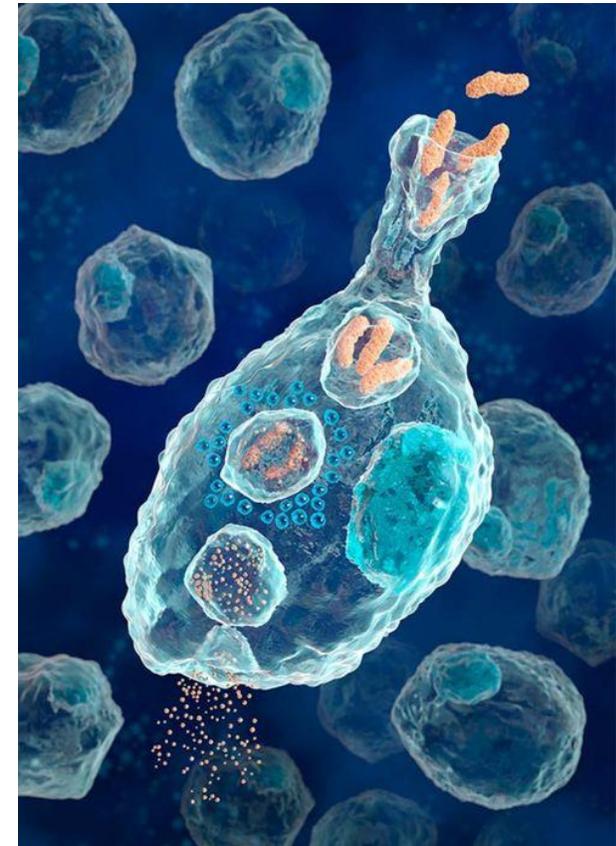


- most involved in the **SPECIFIC IMMUNITY** (3rd line of immune defense - TLD)

- **Monocytes**



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

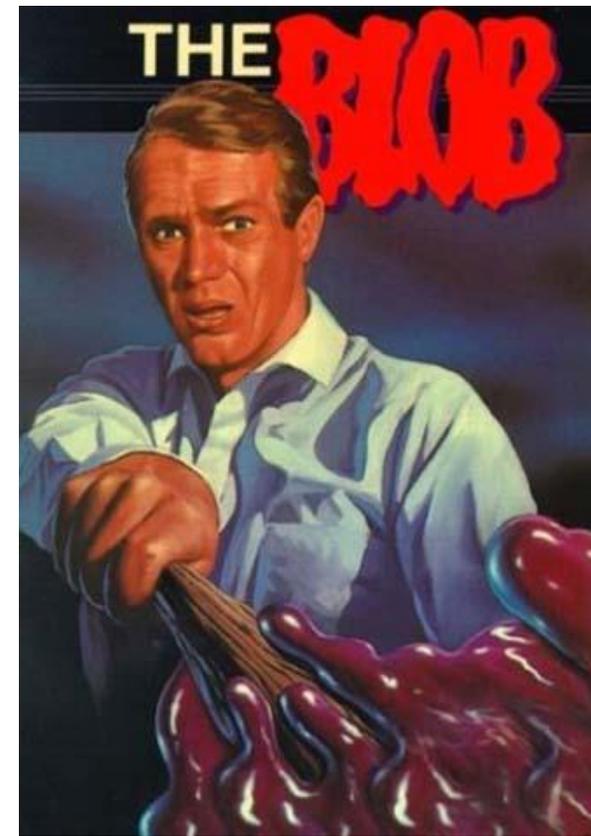
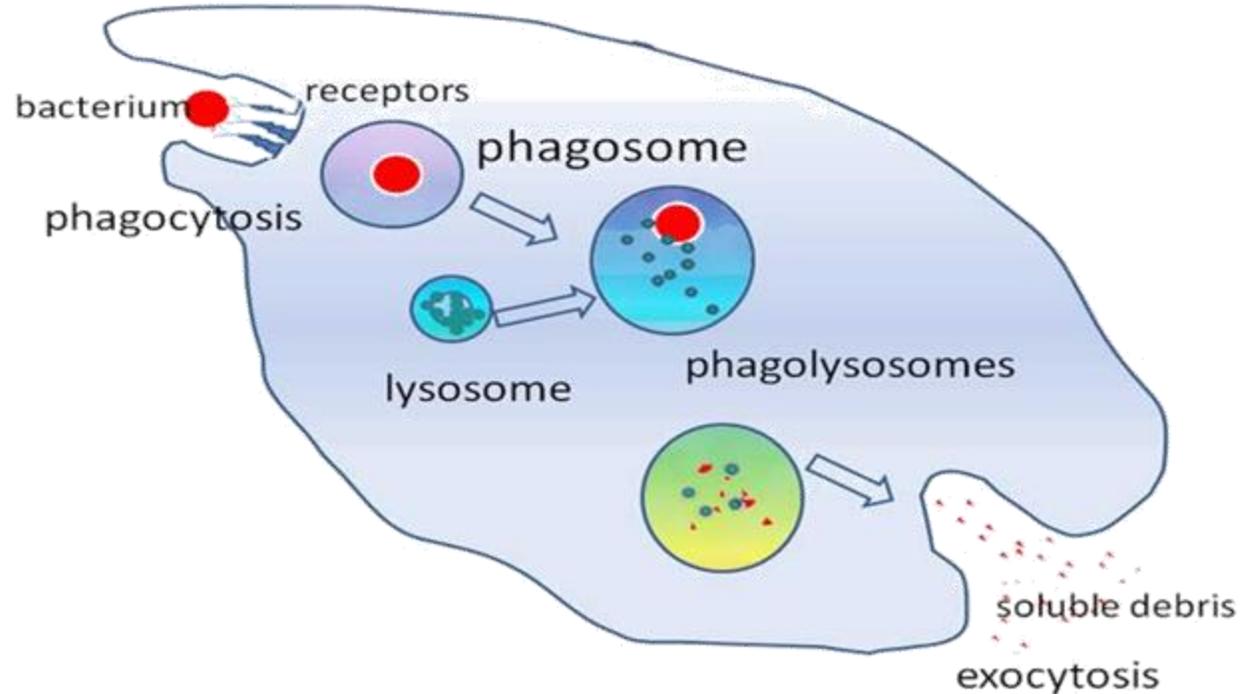


Components of the SLD

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

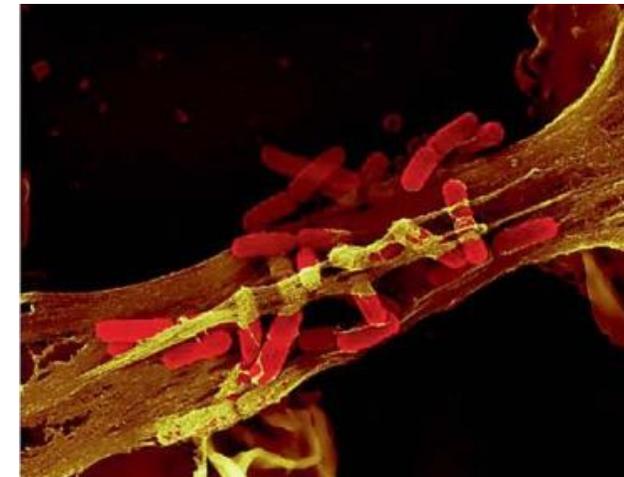
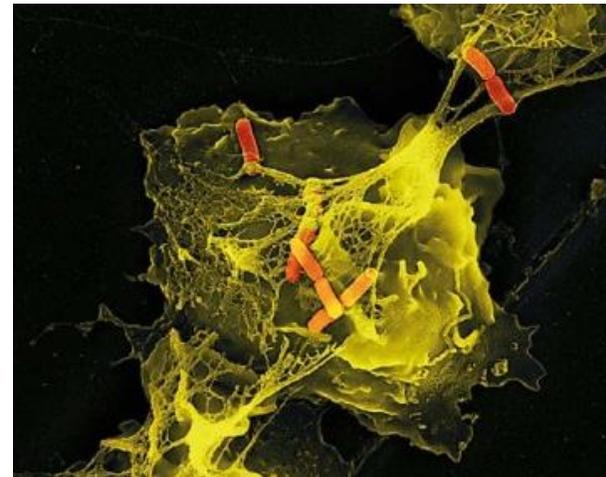
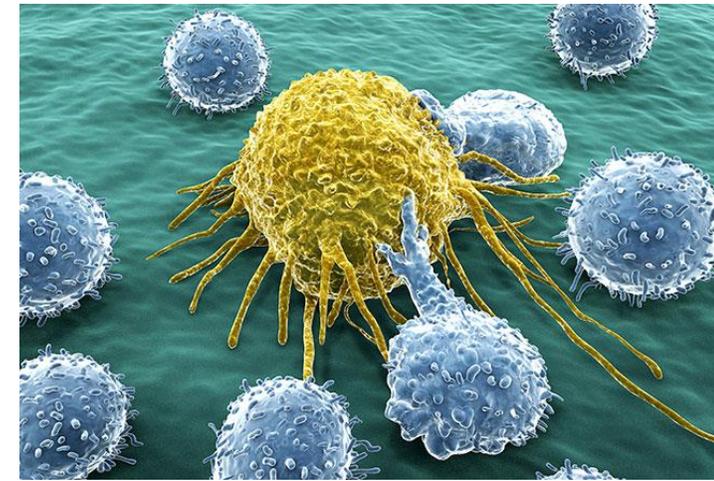
Leukocytes - SLD

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

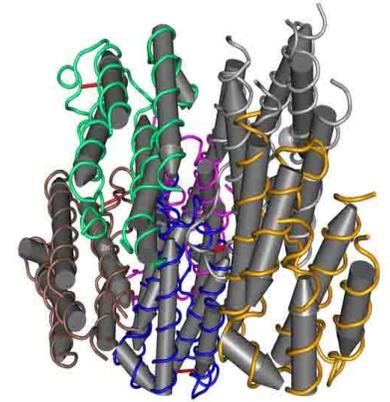


Leukocytes - SLD

- 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

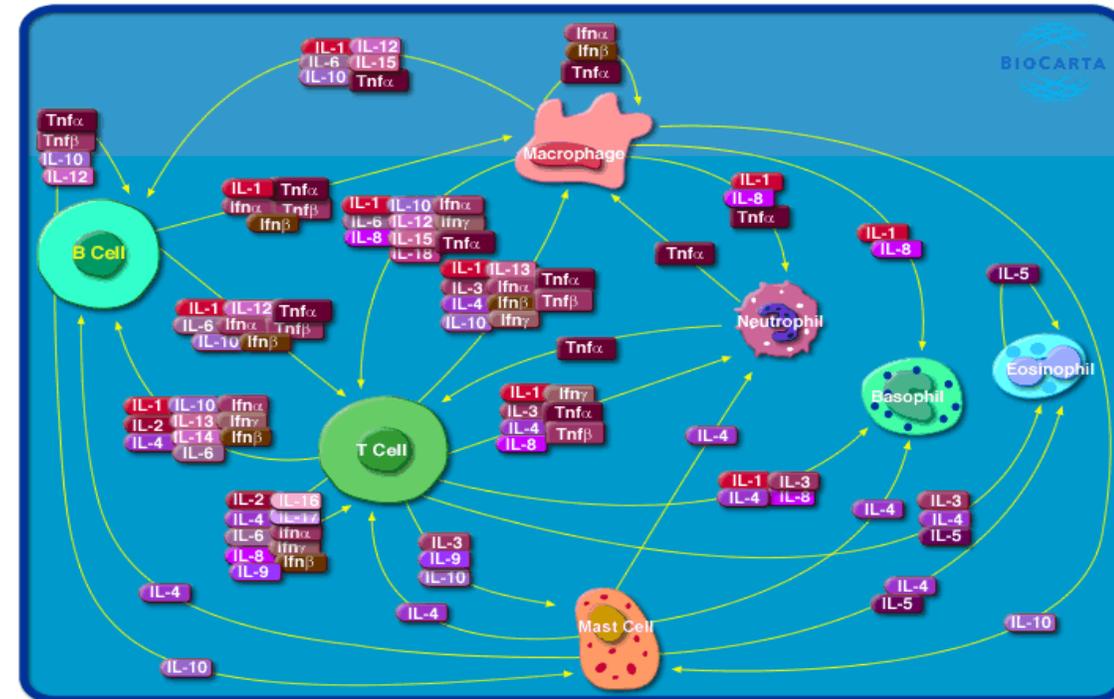


Nonspecific chemical defenses - SLD



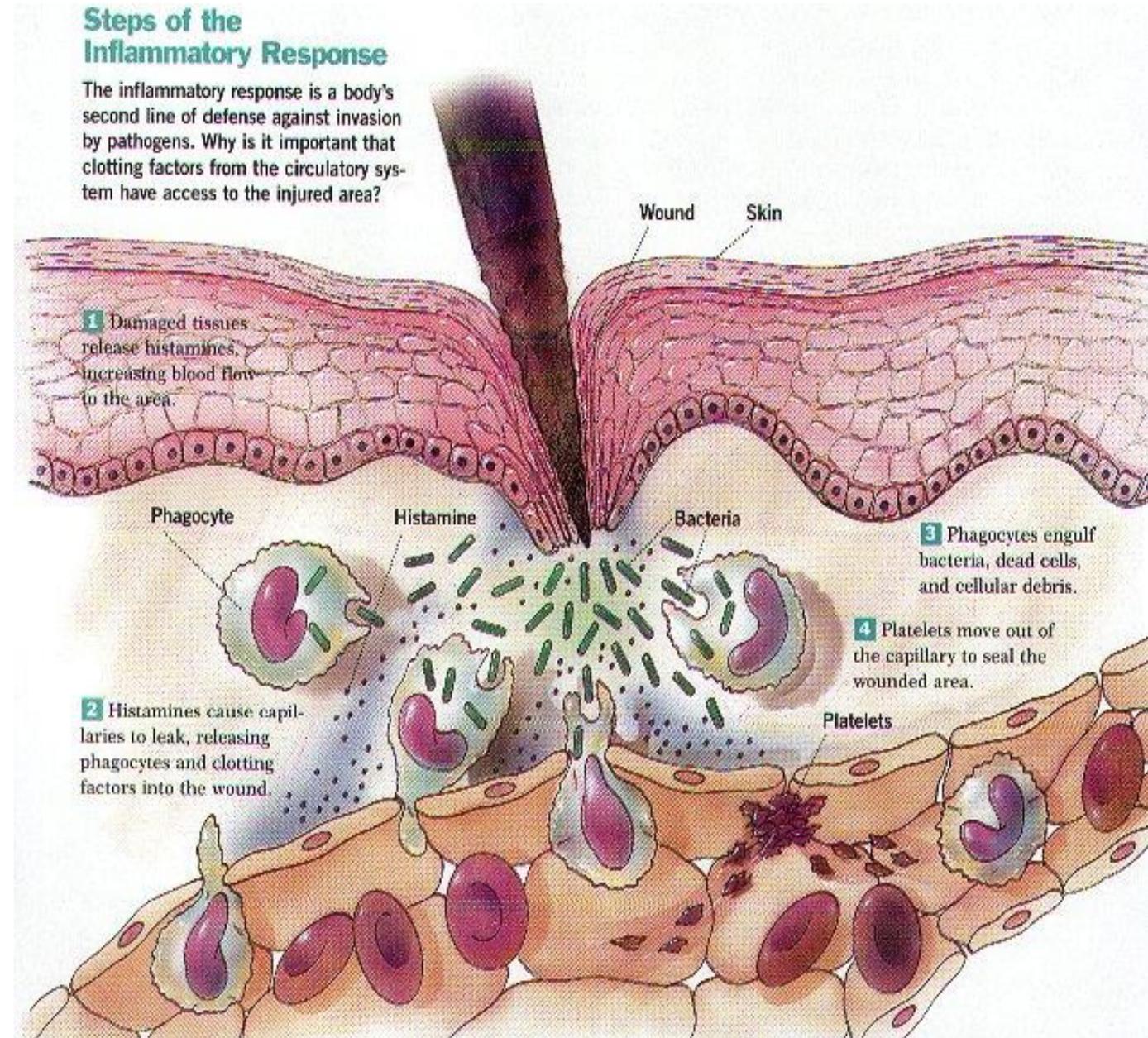
Lysozyme, Defensins and Cytokines (including interferons and interleukins)

- 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

