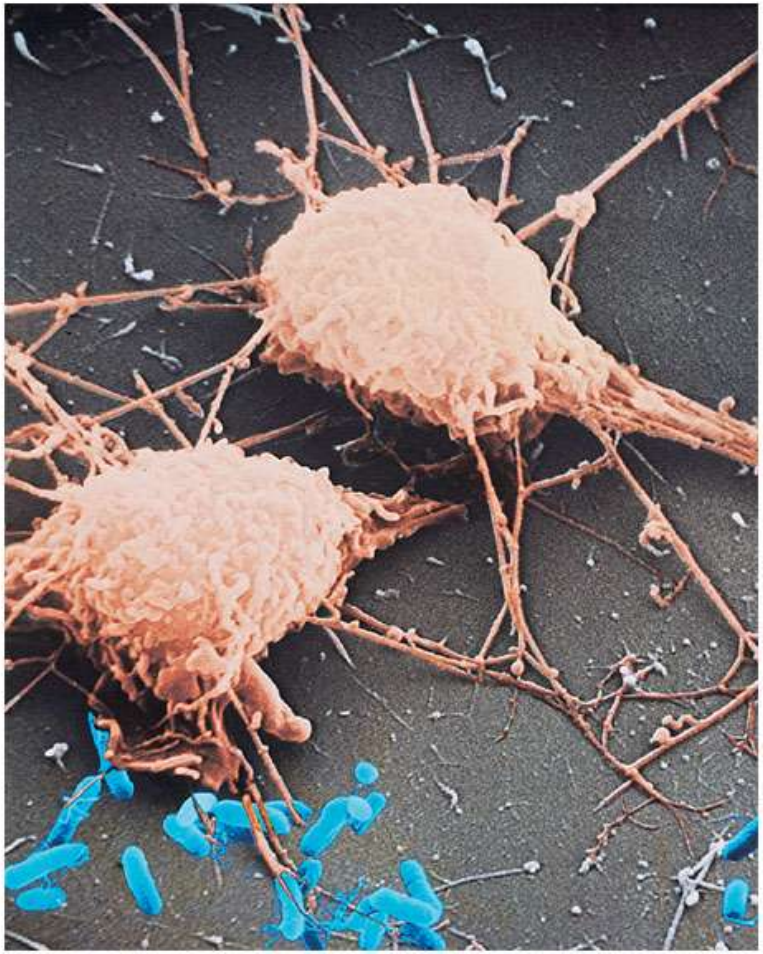
# Host Defenses Overview and Nonspecific Defenses I

## MIcro451 Immunology

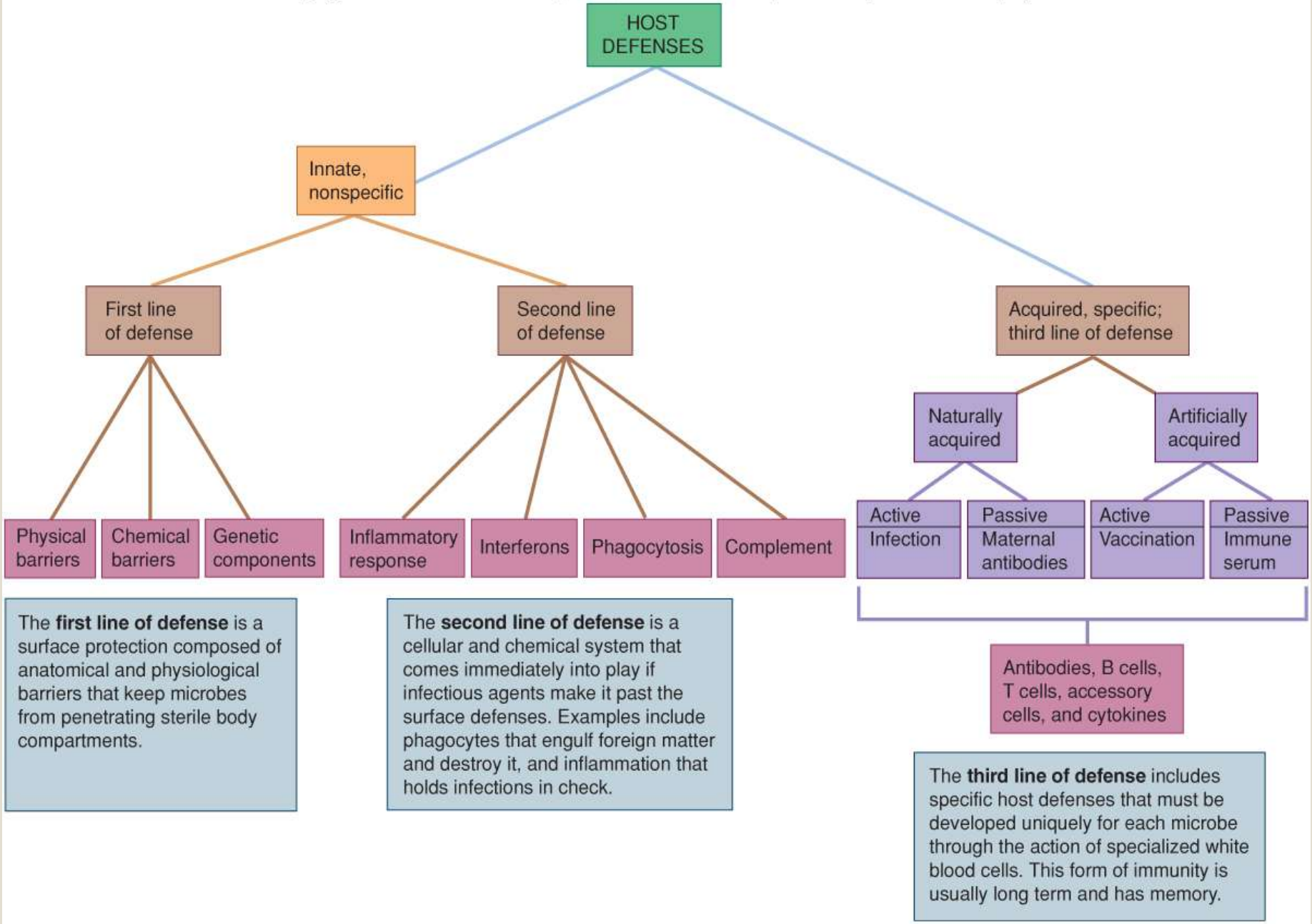
Prof. Nagwa Mohamed Aref
(Molecular Virologist & Immunology)



# The Nature of Host Defenses

## TABLE 14.1 General Features of Host Defenses

| Line of Defense | Innate/ Acquired | Specific or Nonspecific | Development of Immunologic Memory | Examples |
|---|---|---|---|---|
| First | Innate | Nonspecific | No | Physical barriers: skin, tears, coughing, sneezing<br>Chemical barriers: low pH, lysozyme, digestive enzymes<br>Genetic barriers: resistance inherent in genetic makeup of host (pathogen cannot invade) |
| Second | Innate | Mostly nonspecific | No | Phagocytosis, inflammation, fever, interferon |
| Third | Acquired | Specific | Yes | T lymphocytes, B lymphocytes, antibodies |



- **1st line of defense** -
  - intact skin
  - mucous membranes & their secretions
- **2nd line of defense** -
  - phagocytic white blood cells
  - inflammation -complement
  - fever -interferon

***nonspecific***

- **3rd line of defense-**
  - B & T lymphocytes

***specific***

  - antibodies

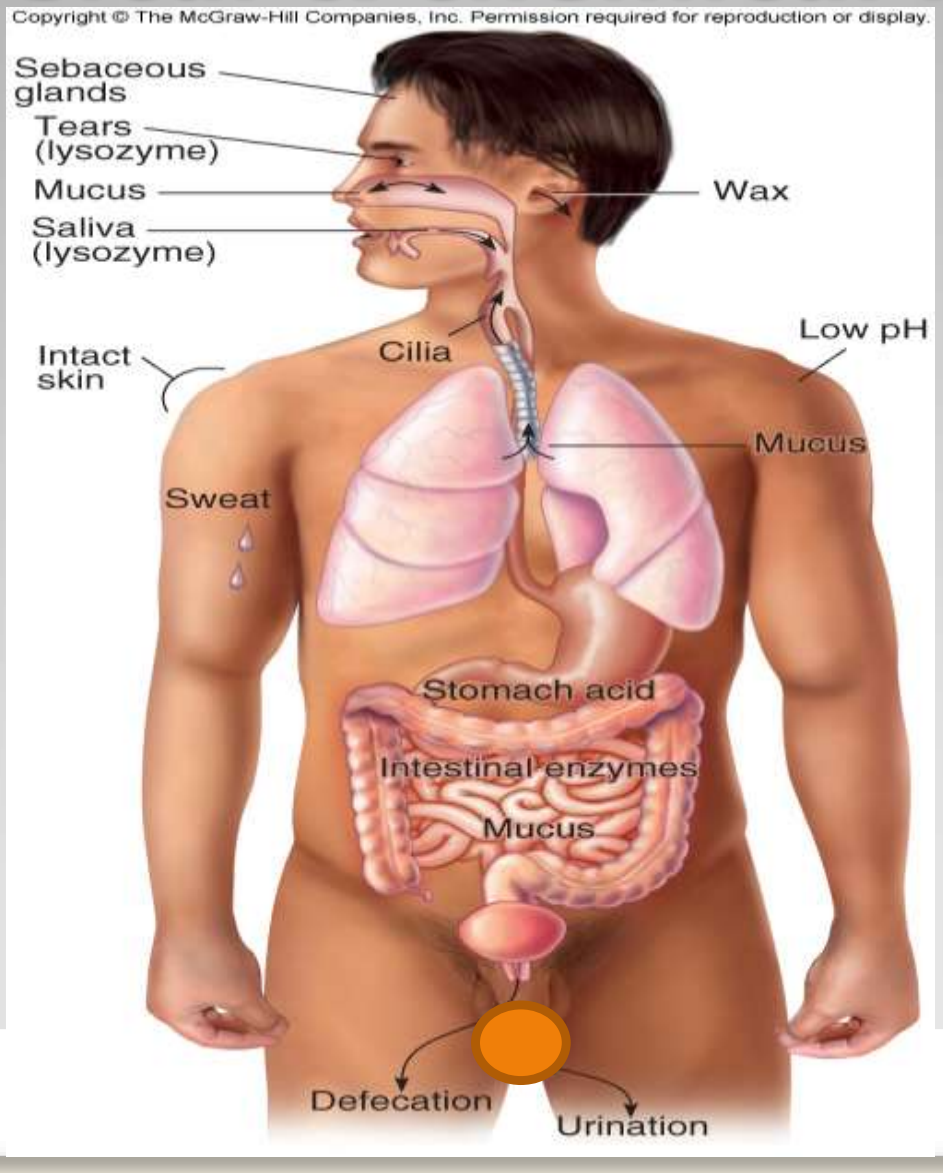
- Outermost layer of skin is composed of epithelial cells compacted, cemented together & impregnated with keratin
- Flushing effect of sweat glands
- Damaged cells are rapidly replaced
- Mucous coat impedes attachment & entry of bacteria
- Blinking & tear production
- Stomach acid
- Nasal hair traps larger particles

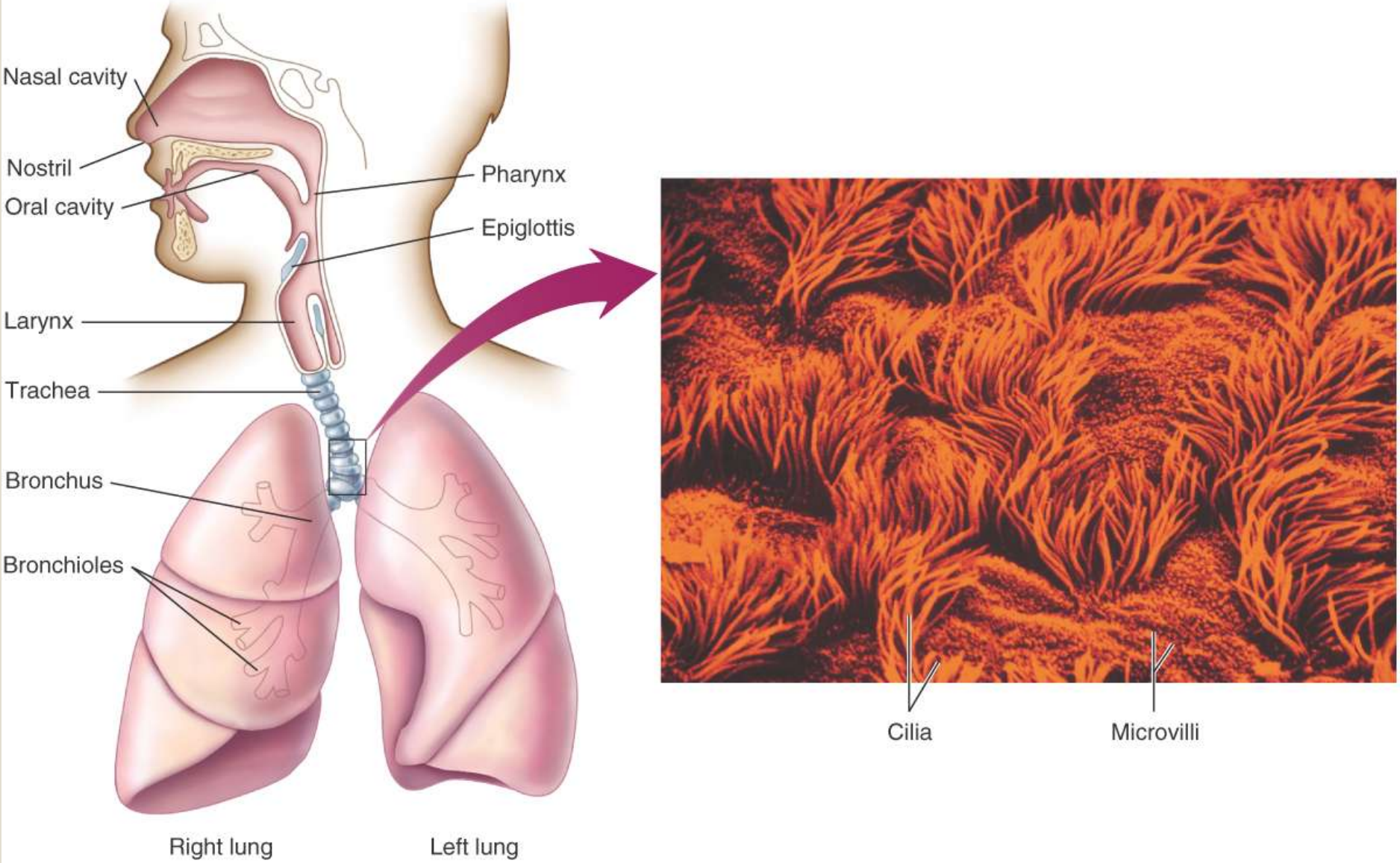
# Physical or anatomical barriers

# Chemical defenses

- Sebaceous secretions
- Lysozyme, an enzyme that hydrolyzes the cell wall of bacteria, in tears
- High lactic acid & electrolyte concentration in sweat
- Skin's acidic pH
- Hydrochloric acid in stomach
- Digestive juices and bile of intestines
- Semen contains antimicrobial chemical
- Vagina has acidic pH

# Physical & chemical barriers





- Some hosts are genetically immune to the diseases of other hosts.
- Some pathogens have great specificity
- Some genetic differences exist in susceptibility

# Genetic defenses

1. Surveillance of the body
2. Recognition of foreign material
3. Destruction of entities deemed to be foreign

# A healthy immune system is responsible for

# Structure and Function of the Organs of Defense and Immunity

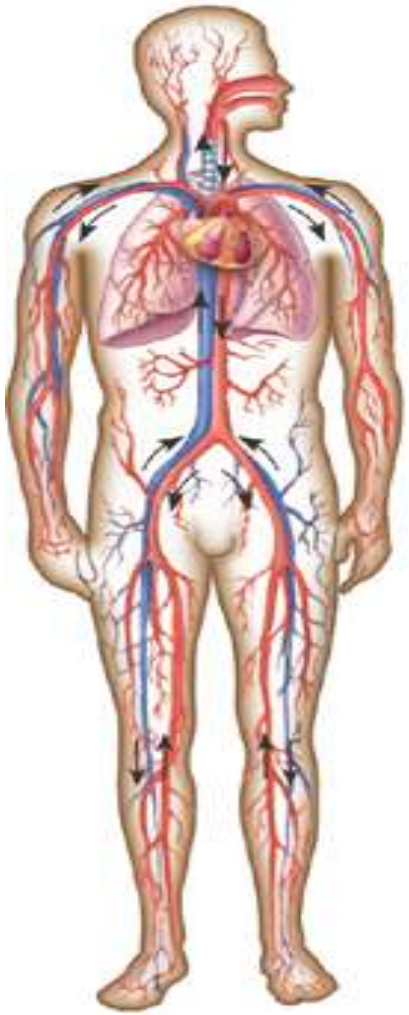
- The study of the body's second and third lines of defense is called **immunology**
- Functions of a healthy functioning immune system:
  1. Surveillance of the body
  2. Recognition of foreign material
  3. Destruction of entities deemed to be foreign

# Immune System

- Large, complex, and diffuse network of cells and fluids that penetrate into every organ and tissue
- Four major subdivisions of immune system are:
  1. Reticuloendothelial system (RES)
  2. Extracellular fluid (ECF)
  3. Bloodstream
  4. Lymphatic system

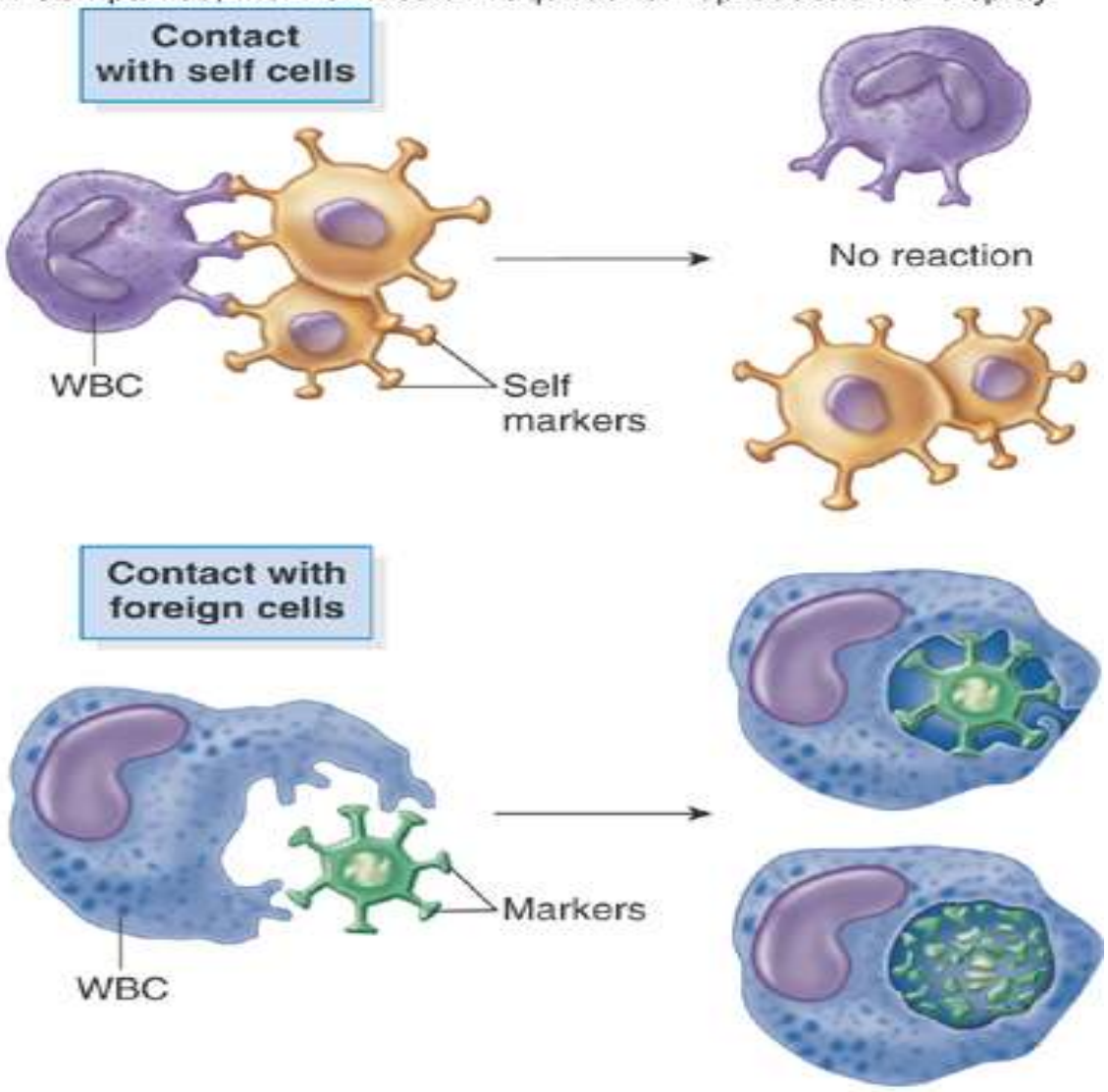
# Self and Nonself

- White blood cells must distinguish **self** from **nonself** cells
- Evaluates cells by examining **markers** on their surfaces



Surveillance

Body compartments are screened by circulating WBCs.




Detection and recognition of foreign cell or virus

Destruction

- Provides a passageway within and between tissues and organs
- Coexists with the **mononuclear phagocyte system**

# Immune Functions of the Reticuloendothelial System

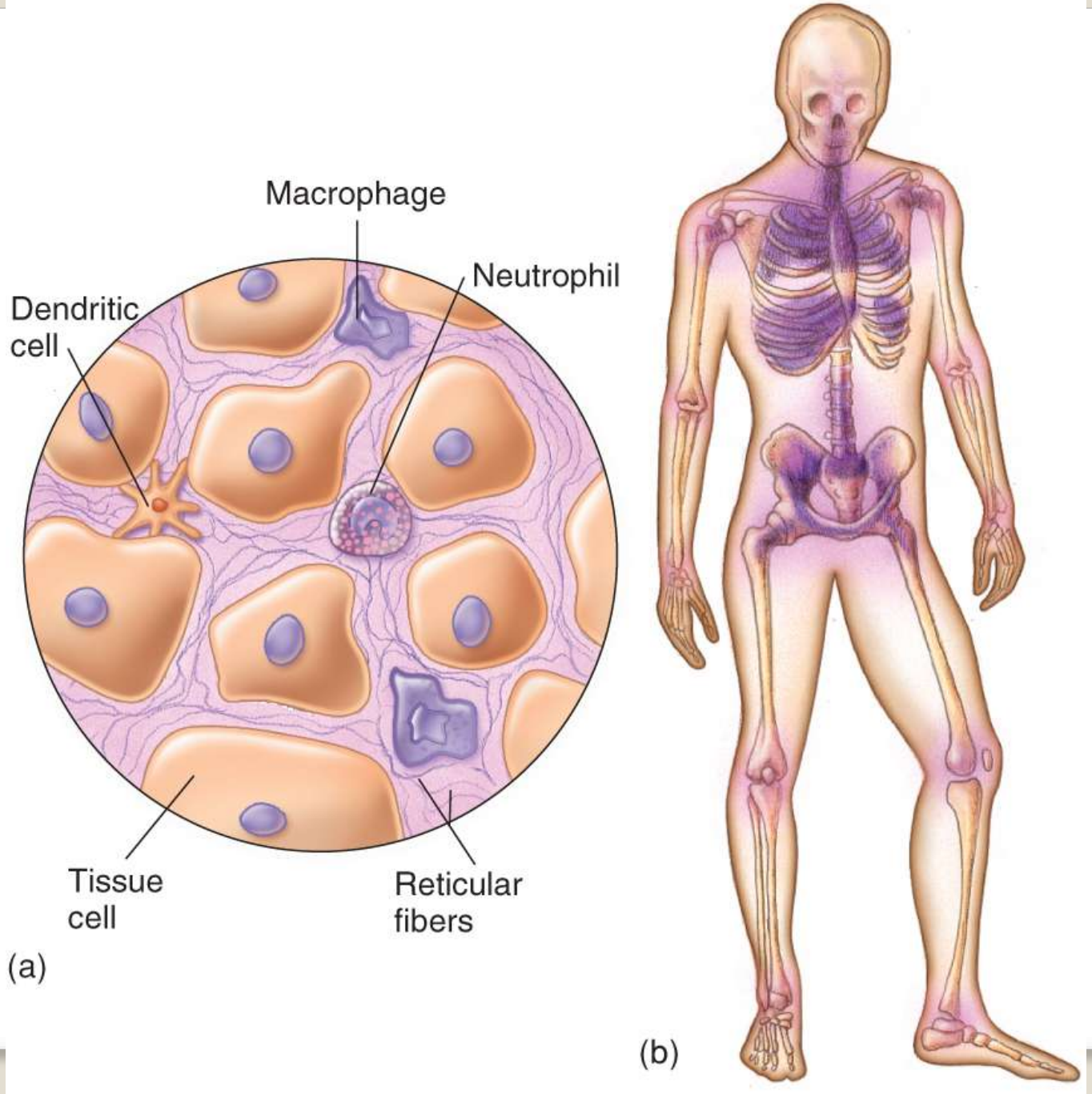



Figure 14.6

- Circulatory system
  - Circulatory system proper
  - Lymphatic system

# Origin, Composition, and Functions of the Blood

# Actions of the Second Line of Defense

- Recognition
- Inflammation
- Phagocytosis
- Interferon
- Complement

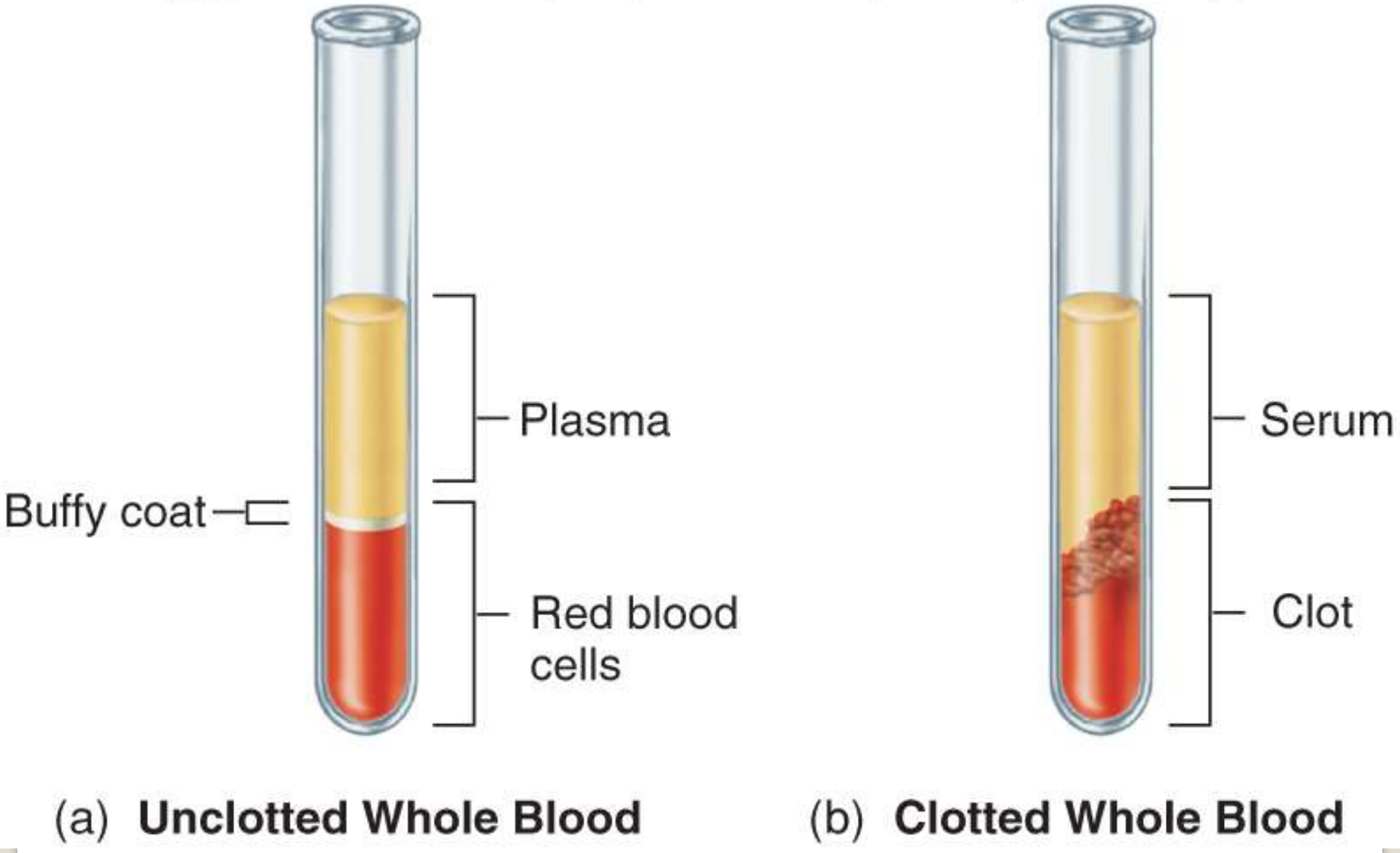



Figure 14.7

# Fundamental Characteristics of Plasma

- Hundreds of different chemicals
- Main component is water (92%)
- Proteins such as albumin and globulins, immunochemicals, fibrinogen and other clotting factors, hormones, nutrients, dissolved gases, and waste products

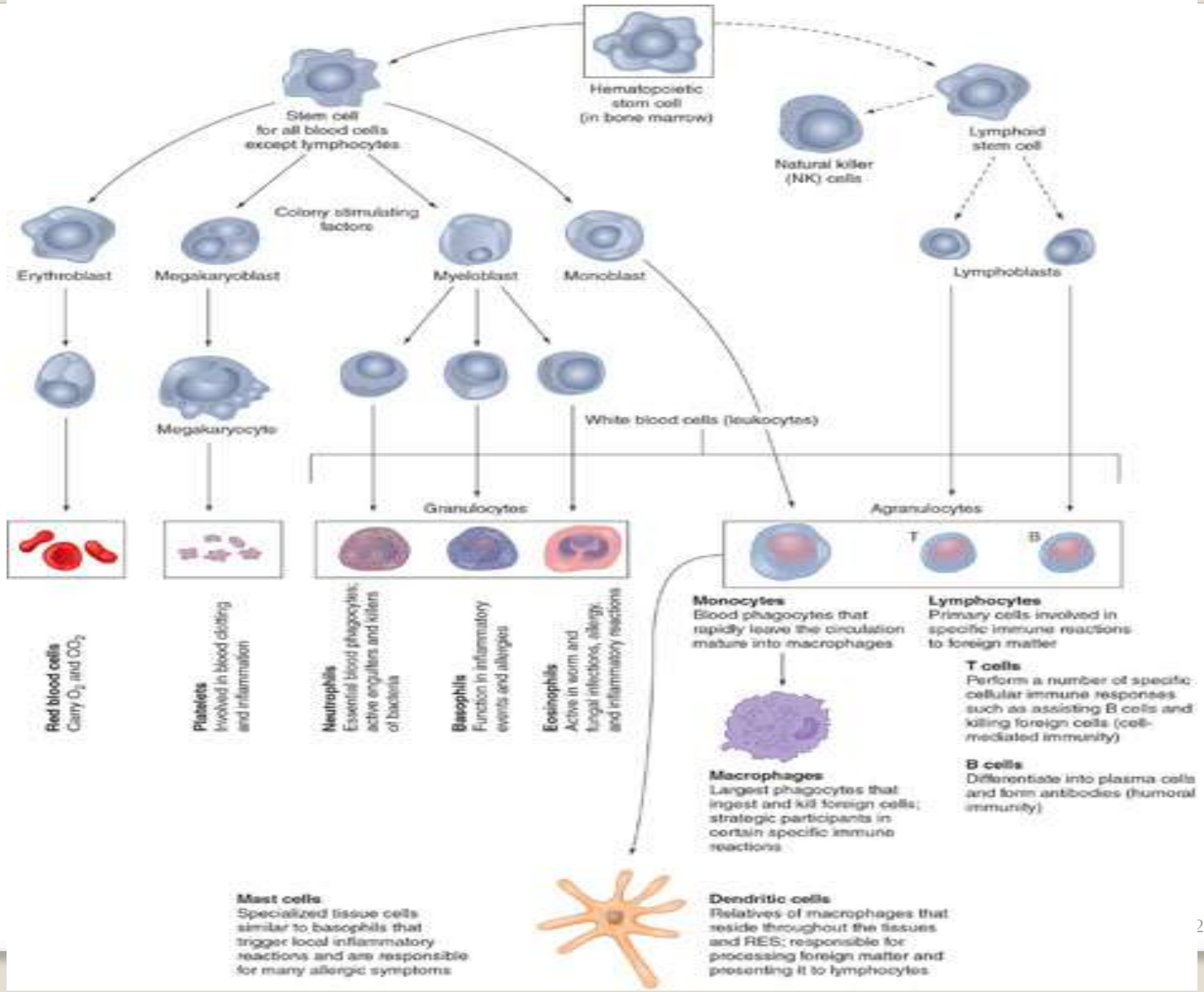
# Phagocytes and Phagocytosis

Main types of phagocytes:

1. Neutrophils – general-purpose; react early to bacteria and other foreign materials, and to damaged tissue
   - Eosinophils – attracted to sites of parasitic infections and antigen-antibody reactions
2. Macrophages – derived from monocytes; scavenge and process foreign substances to prepare them for reactions with B and T lymphocytes

# Leukocytes

- Neutrophils- 55-90% - lobed nuclei with lavender granules; phagocytes
- Eosinophils – 1-3% - orange granules & bilobed nucleus; destroy eucaryotic pathogens
- Basophils, mast cells – 0.5% constricted nuclei, dark blue granules; release potent chemical mediators
- Lymphocytes – 20-35% - large nucleus B & T cells involved in the specific immune response
- Monocytes, macrophages – 3-7%- large nucleus; phagocytic



# Characteristics of leukocytes

- Diapedesis – migration of cells out of blood vessels into the tissues
- Chemotaxis – migration in response to specific chemicals at the site of injury or infection

- Granulocytes
- Agranulocytes

# Leukocytes

# Granulocytes

- **Neutrophils**
  - Phagocytosis
- **Eosinophils**
  - Attack and destroy large eukaryotic pathogens
  - Also involved in inflammation and allergic reactions
- **Basophils**
  - Parallel eosinophils in many actions

- Monocytes
- Lymphocytes

# Agranulocytes

# Monocytes

- Discharged by bone marrow into bloodstream, live as phagocytes for a few days, then differentiate into **macrophages**
- Responsible for
  - Many specific and nonspecific phagocytic and killing functions
  - Processing foreign molecules and presenting them to lymphocytes
  - Secreting biologically active compounds that assist, mediate, attract, and inhibit immune cells and reactions
- **Dendritic cells**

# Erythrocyte and Platelet Lines

- **Erythrocytes**
  - Develop from stem cells in the bone marrow
  - Lose their nucleus just prior to entering circulation
  - Transport oxygen and carbon dioxide to and from the tissues
- **Platelets**
  - Formed elements in circulating blood
  - Not whole cells
  - Function primarily in hemostasis and in releasing chemicals for blood clotting and inflammation