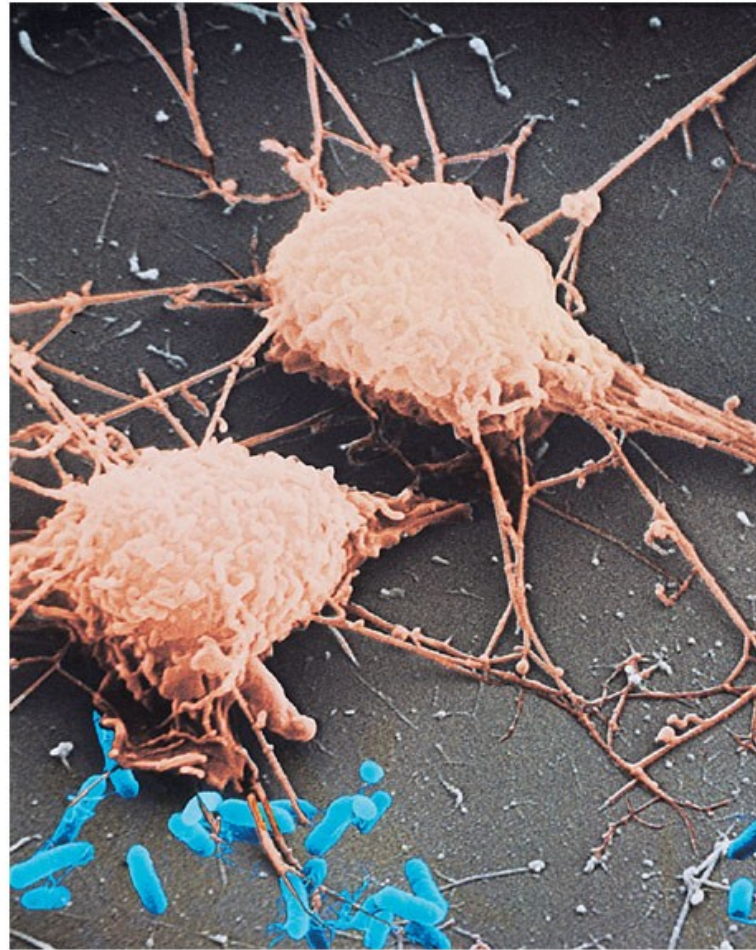


Host Defenses Overview and Nonspecific Defenses I

Immunology

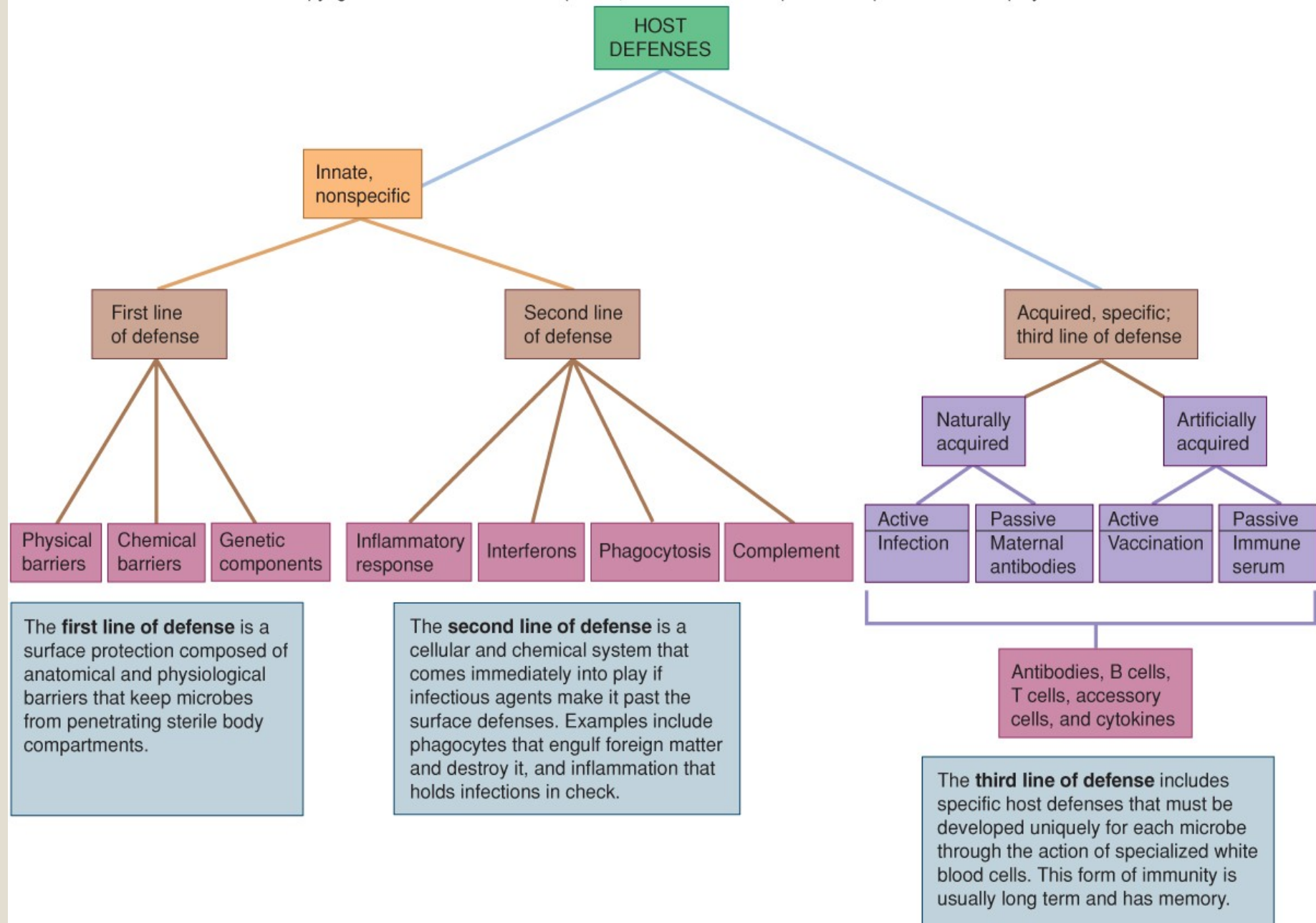
**Prof. Nagwa Mohamed Aref
(Molecular Virologist & Immunology)**



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 Chemical barriers: low pH, lysozyme, digestive enzymes 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

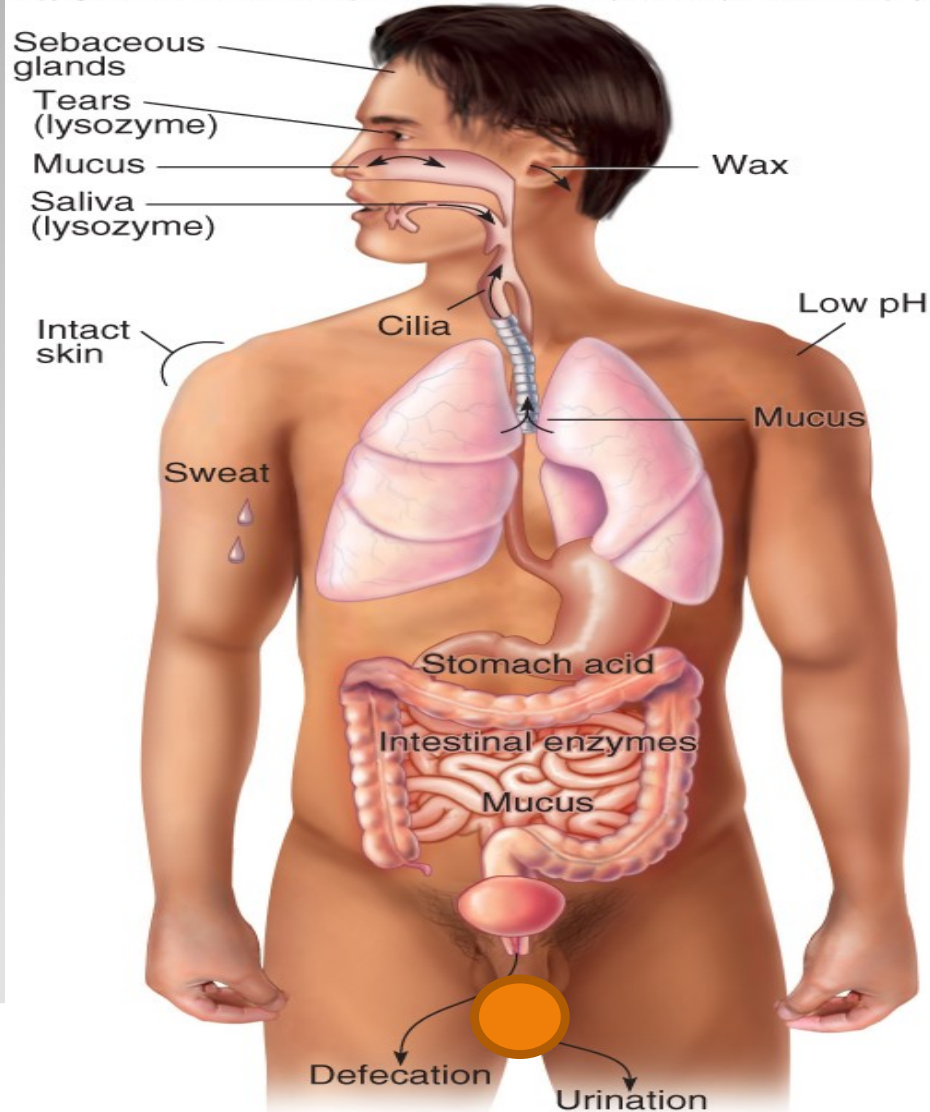
Physical or anatomical barriers

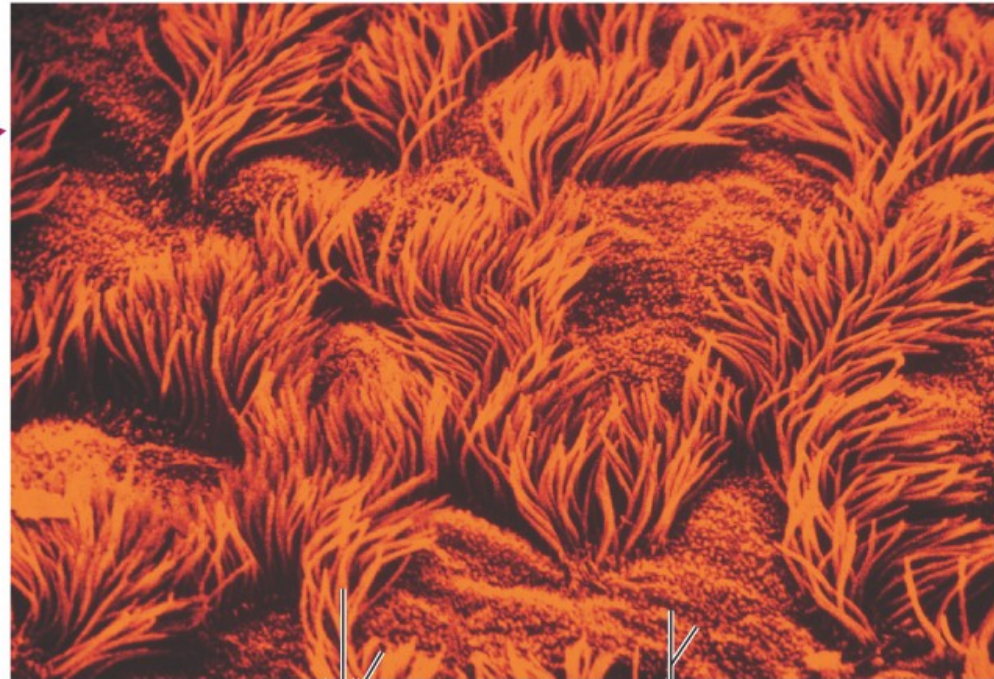
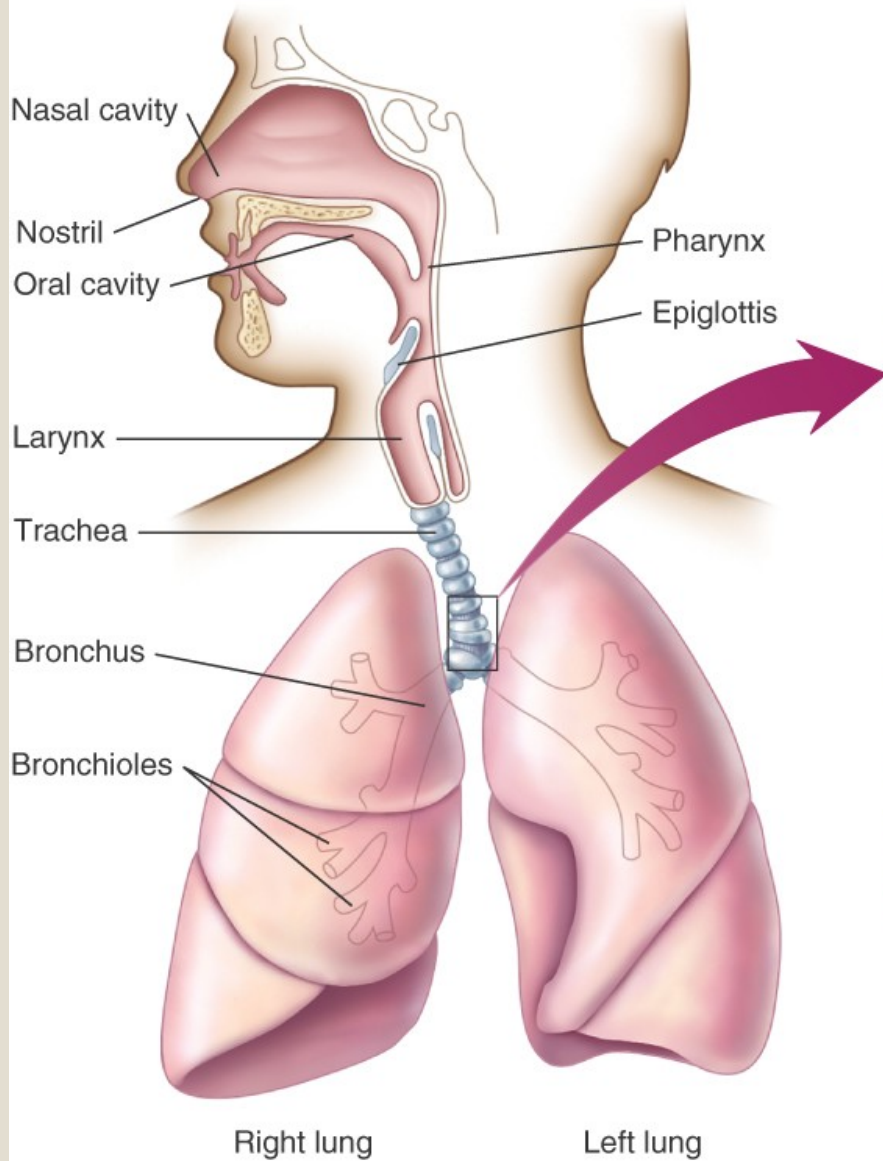
- Sebaceous secretions
- Lysozyme, an enzyme that hydrolyzes the cell wall of bacteria, in tears
- High lactic acid & electrolyte concentration in sweat
- Skin's acidic pH
- Hydrochloric acid in stomach
- Digestive juices and bile of intestines
- Semen contains antimicrobial chemical
- Vagina has acidic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

Chemical defenses

Physical & chemical barriers

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Cilia

Microvilli

- 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

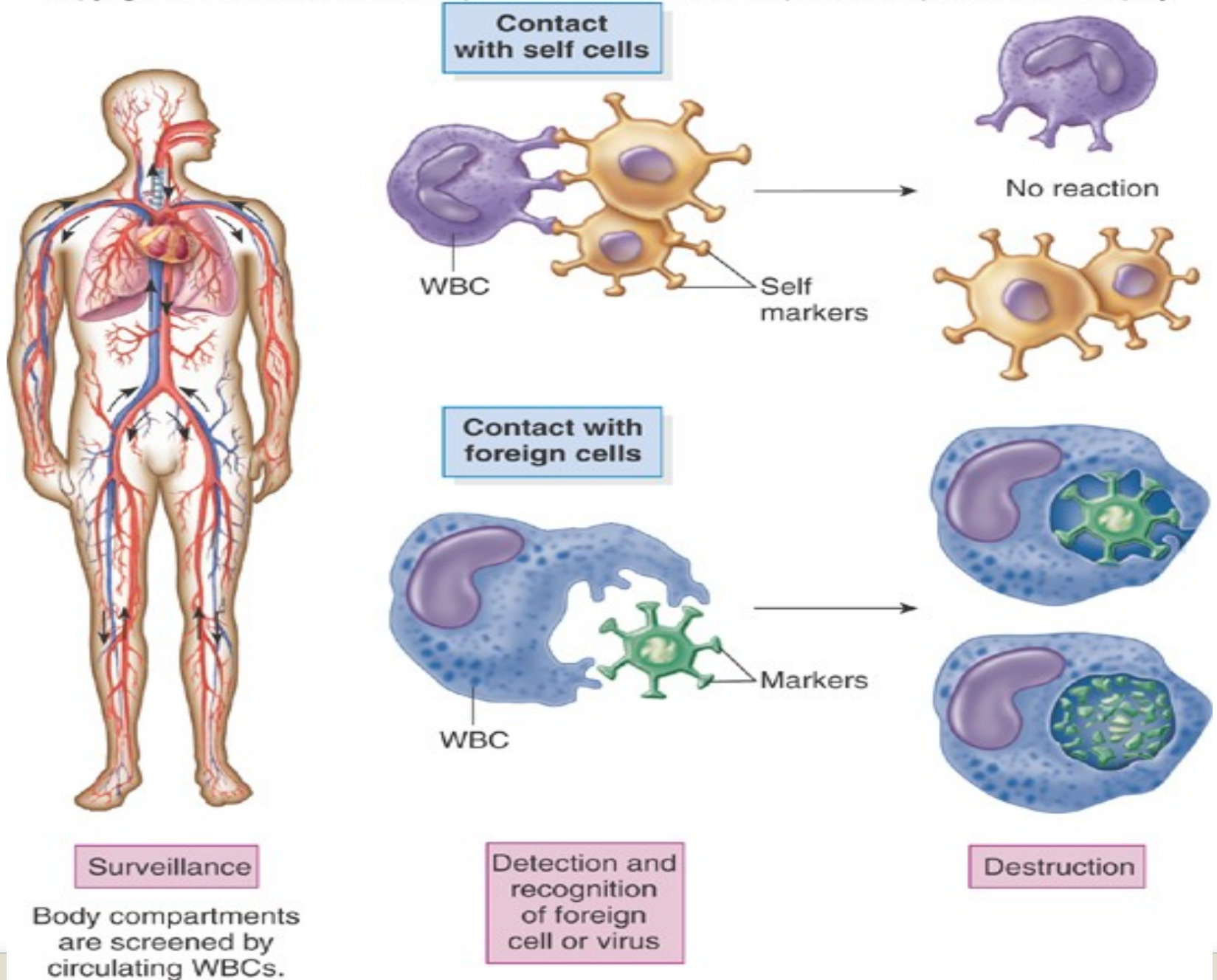
- The study of the body's second and third lines of defense is called **immunology**
- Functions of a healthy functioning immune system:
 1. Surveillance of the body
 2. Recognition of foreign material
 3. Destruction of entities deemed to be foreign

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

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

Self and Nonself



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

Immune Functions of the Reticuloendothelial System

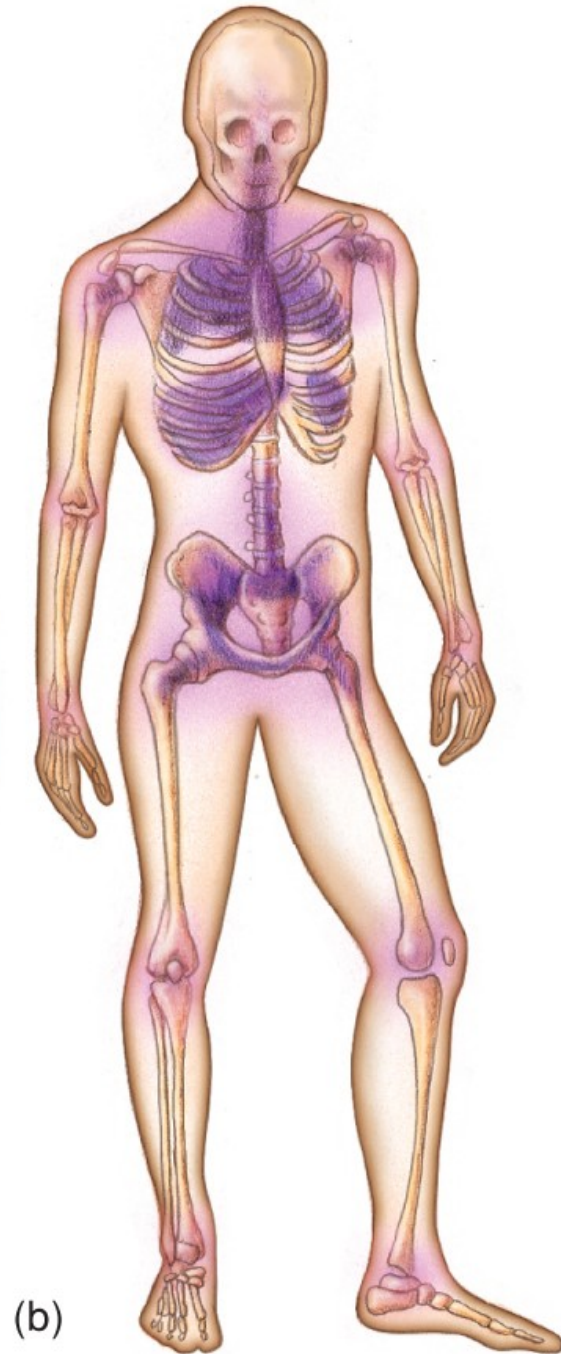
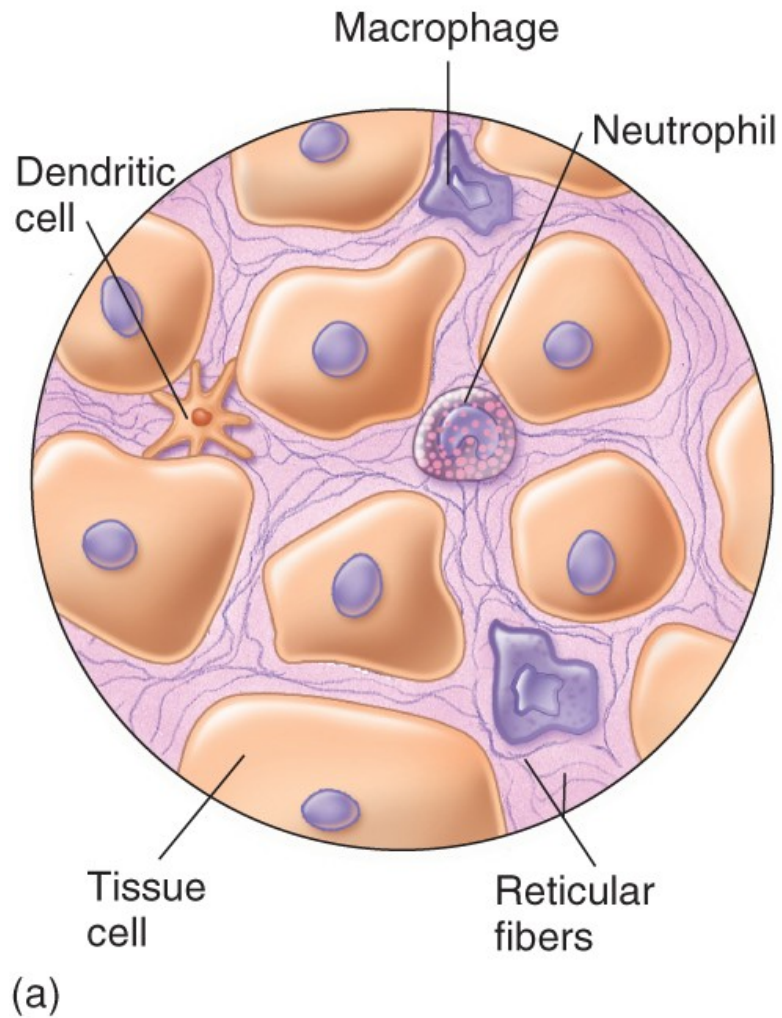


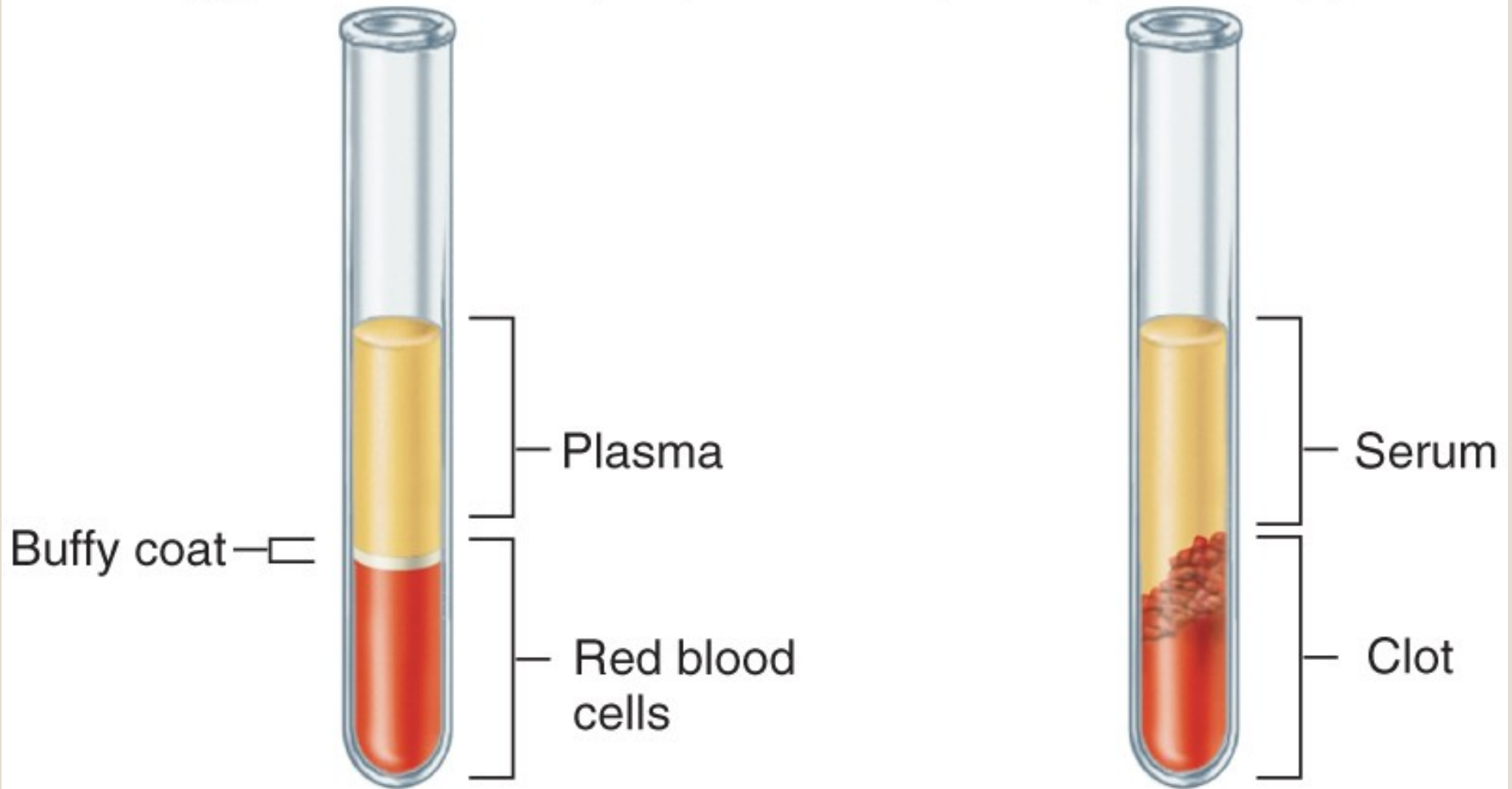
Figure 14.6

- 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



(a) Unclotted Whole Blood

(b) Clotted Whole Blood

- 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

Fundamental Characteristics of Plasma

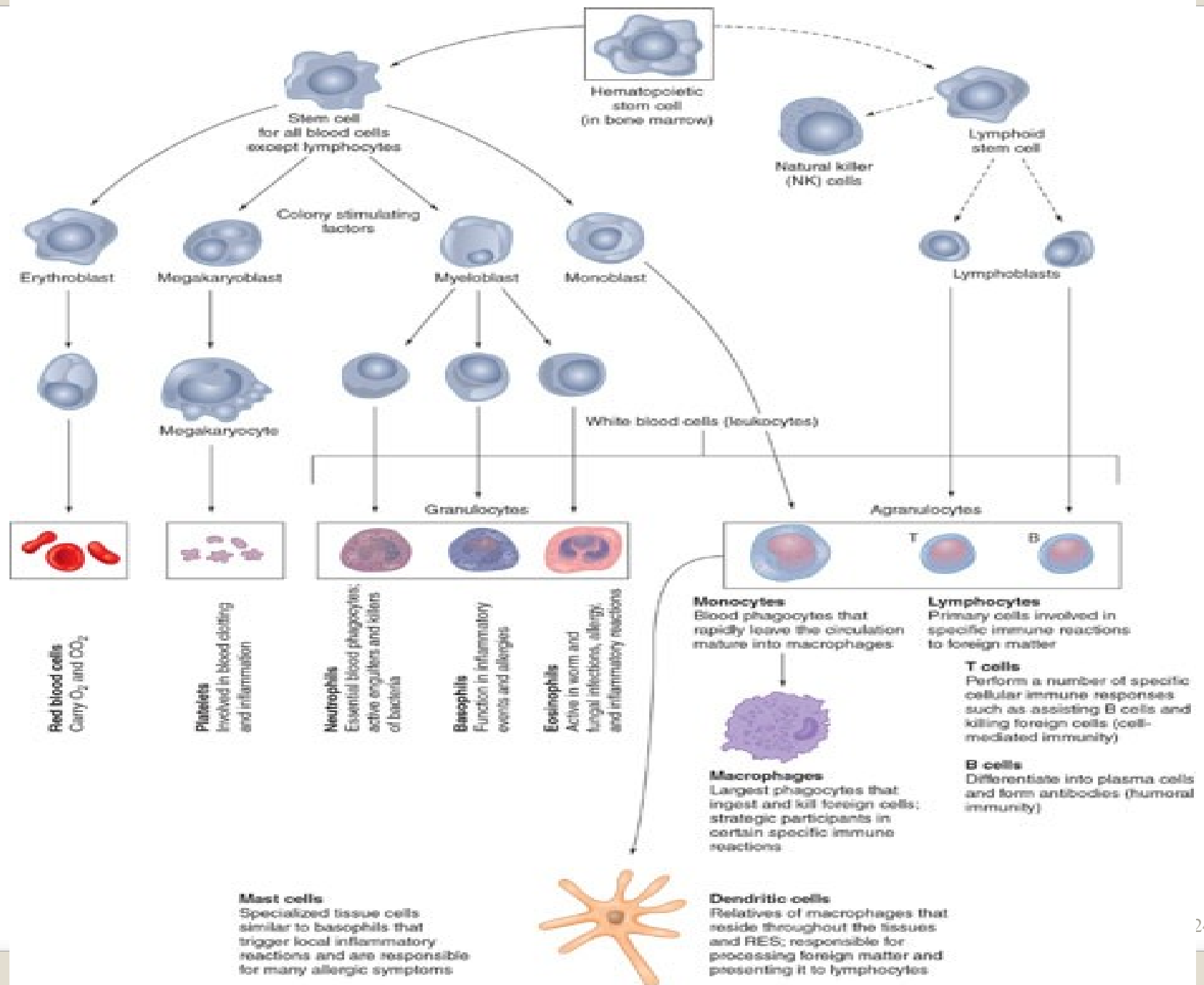
Phagocytes and Phagocytosis

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

- 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

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

Characteristics of leukocytes

- Granulocytes
- Agranulocytes

Leukocytes

- **Neutrophils**

- Phagocytosis

- **Eosinophils**

- Attack and destroy large eukaryotic pathogens
- Also involved in inflammation and allergic reactions

- **Basophils**

- Parallel eosinophils in many actions

Granulocytes

- Monocytes
- Lymphocytes

Agranulocytes

- 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**

Monocytes

- **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

Erythrocyte and Platelet Lines