

Introduction to Immunology

CLS 212: Medical Microbiology

What is Immunity?

Immunity:

- Is a biological term that describes a state of having sufficient **biological defenses** to avoid infection, disease, or other unwanted biological invasion.
- In other words, it is nothing but the **capability of the body to resist harmful microbes from entering the body.**

Immunology:

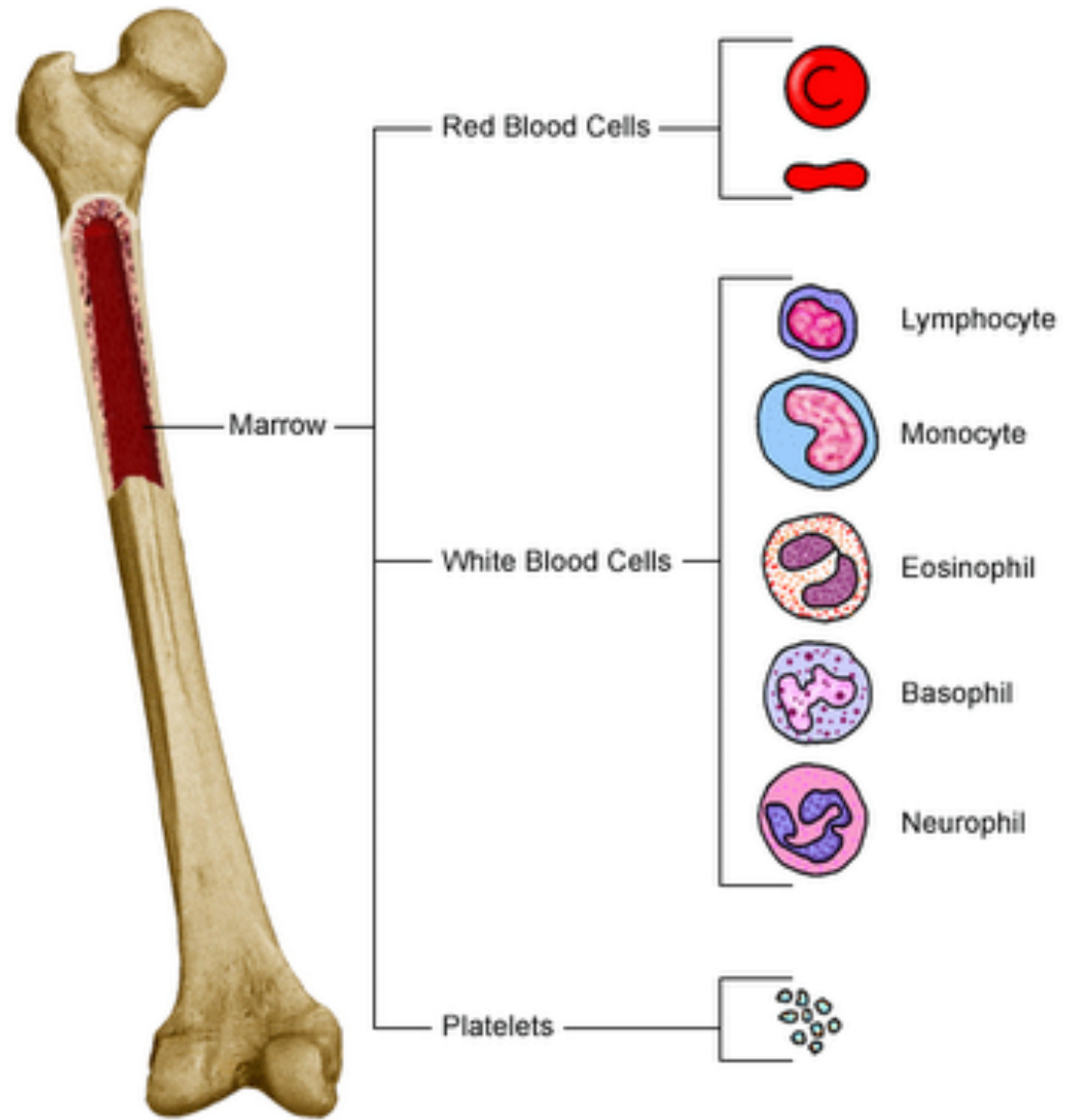
The study of all aspects of the immune system in all organisms.

Types of Immunity

- non-specific (innate) immunity:
 - Natural resistance, people are borne with it.
 - It includes the role of →
 - Physical barrier (eg. Skin & mucus membranes).
 - Cellular system (eg. phagocytic cells).
 - Chemical system (circulating glycoproteins such as complement)
 - Inflammation.
 - Fever
- Specific(Acquired/Adaptive immunity) immunity:
 - It has the ability to develop new responses that are highly specific to molecular components of infectious agent called antigen (Ag)
 - Cellular response
 - Humeral response (Antibody production Ab)

Innate (Nonspecific) Immunity

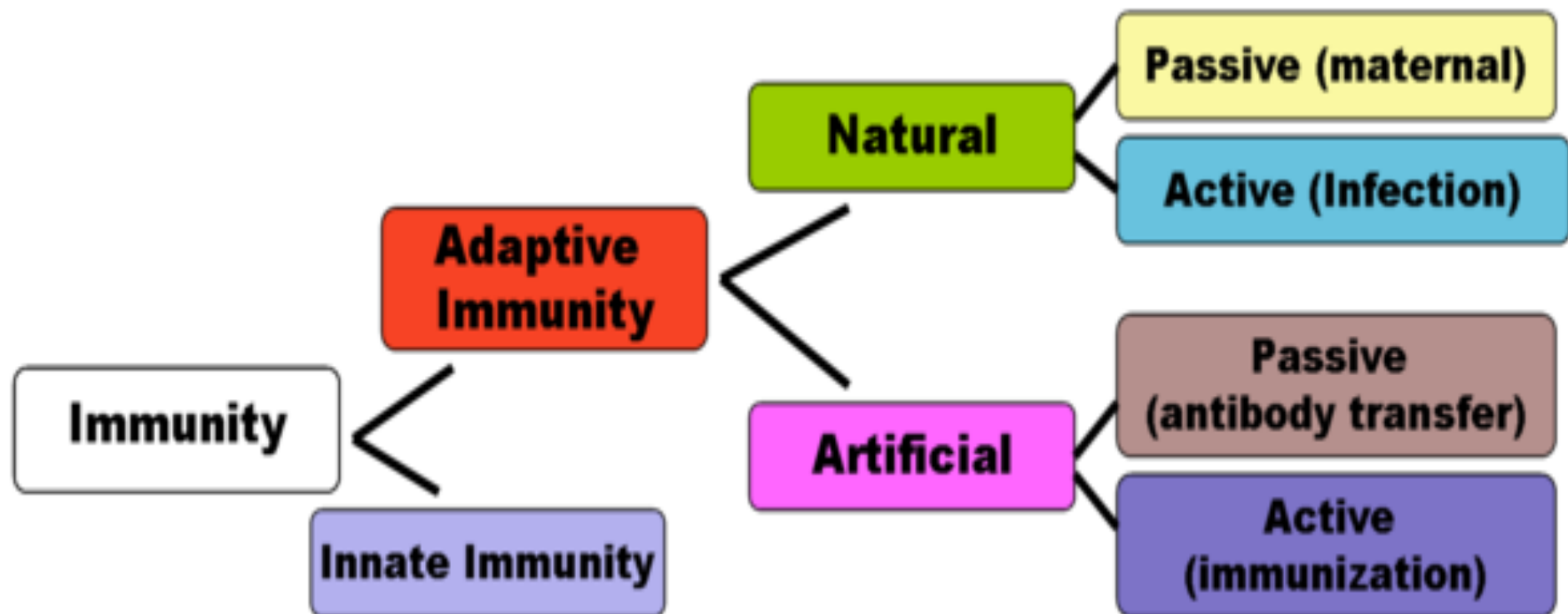
- Cellular Response:



Adaptive (specific) immunity:

Is often sub-divided into two major types depending on how the immunity was introduced:

- **Naturally acquired immunity:** occurs through contact with a disease causing agent, when the contact was not deliberate.
- **Artificially acquired immunity:** develops only through deliberate actions such as vaccination.



Three Lines of Defense Against Infection

NONSPECIFIC DEFENSE MECHANISMS		SPECIFIC DEFENSE MECHANISMS (IMMUNE SYSTEM)
First line of defense	Second line of defense	Third line of defense
<ul style="list-style-type: none">• Skin• Mucous membranes• Secretions of skin and mucous membranes	<ul style="list-style-type: none">• Phagocytic white blood cells• Antimicrobial proteins• The inflammatory response	<ul style="list-style-type: none">• Lymphocytes• Antibodies

1st Line of Defense

- 1. Skin and mucous membranes.**
- 2. Cellular and chemical factors.**
- 3. Microbial antagonism.**

Skin and Mucous Membranes

- The intact (unbroken) skin or mucous membranes serves as a physical or mechanical barrier to pathogens.
- Very few pathogens can penetrate intact skin **e.g.** parasites like schistosomes and hookworms.
- Mostly pathogens can get entry only when skin or mucous membranes are **cut, scratched, or burned**. Or through skin **injections** by needles or insects.
- Even the smallest cut (e.g. paper cut) can serve as an entry for pathogens.
- The sticky mucus produced by special cells in the mucous membranes will trap invaders.

I- Skin Cellular and Chemical Factors

1. Dryness of the skin.
 2. Temperature of the skin (<37°C).
 3. Acidity of the skin (\approx 5.0 pH).
 4. Oil production by sebaceous glands.
 5. Sweat flushes pathogens and contain *Lysozyme enzyme* which kills pathogens.
 6. Shedding of dead skin.
- All these factors will inhibit the growth of pathogens.

II- Mucous Membranes Cellular and Chemical Factors

1. **Mucus:** sticky and contain enzymes (Lysozyme, Lactoferrin, Lactoperoxidase).
2. **Eyes:** tears (Lysozyme enzyme), mucus, and oil.
3. **Respiratory System:**
 - a. Nose hair.
 - b. Irregular nose chambers.
 - c. Nasal secretions.
 - d. **Cilia:** push foreign bodies (dust, smook, pathogens) up the to the throat where they are swallowed or expelled by coughing and sneezing.

II- Mucous Membranes Cellular and Chemical Factors

4. Digestive System:

- a. Oral saliva.
- b. Digestive enzymes.
- c. Stomach acidity .
- d. Intestinal alkalinity by liver bile.

5. **Urinary System:** flow of acidic urine and mucus.

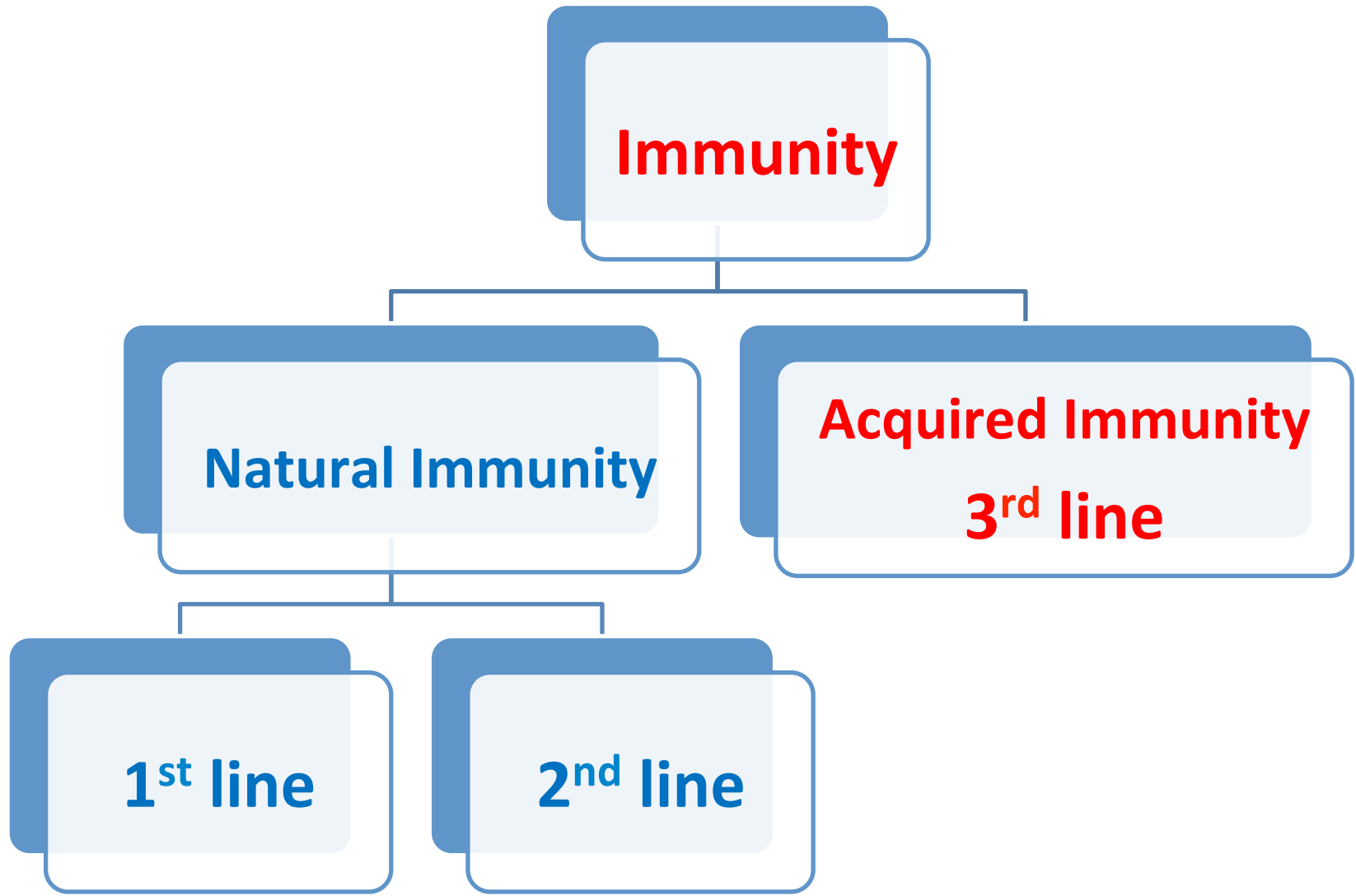
6. **Female vagina:** low pH of vaginal fluids.

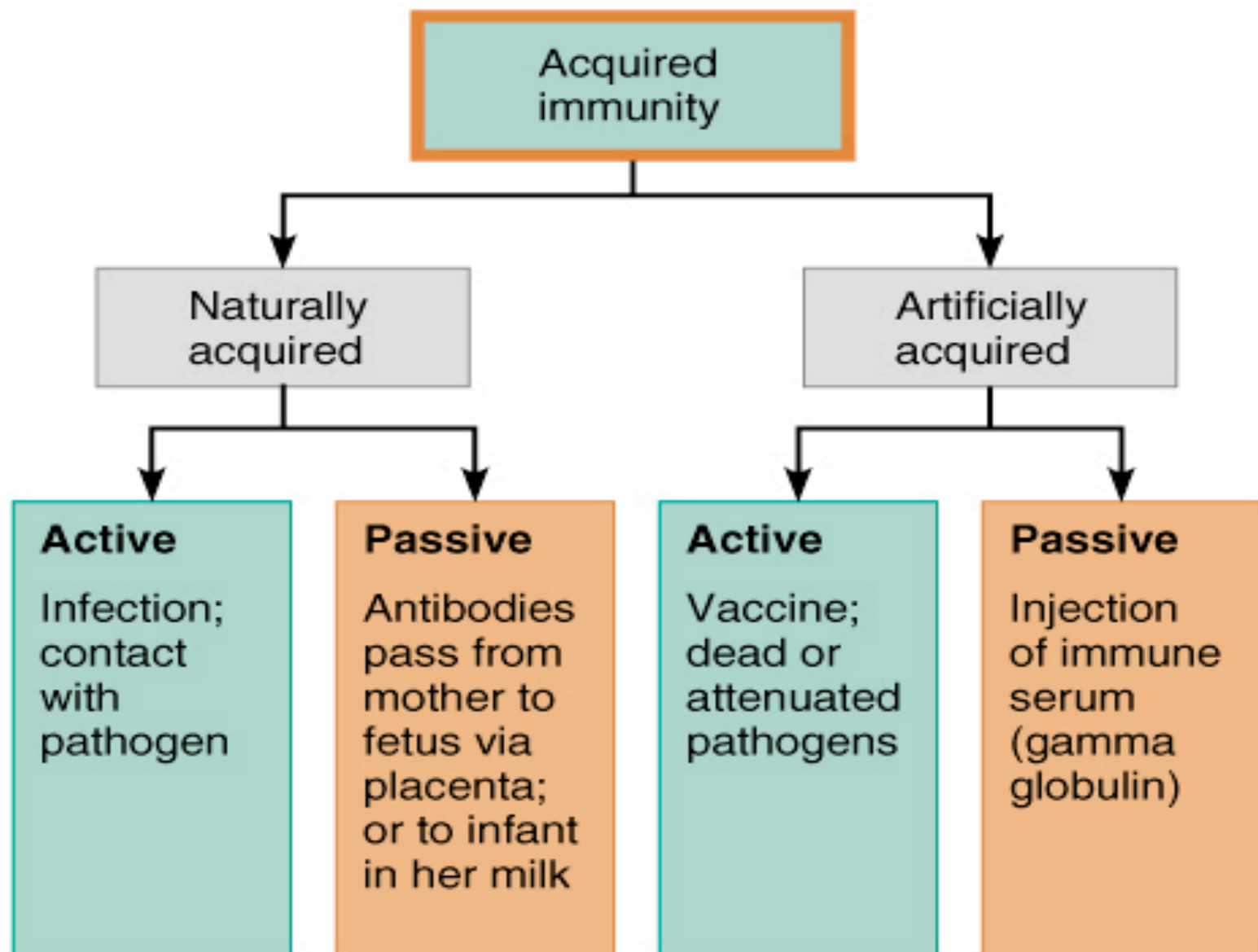
III- Microbial Antagonism

Microbial Antagonism:

When one microorganism kill, injure, or inhibit the growth of another microorganism.

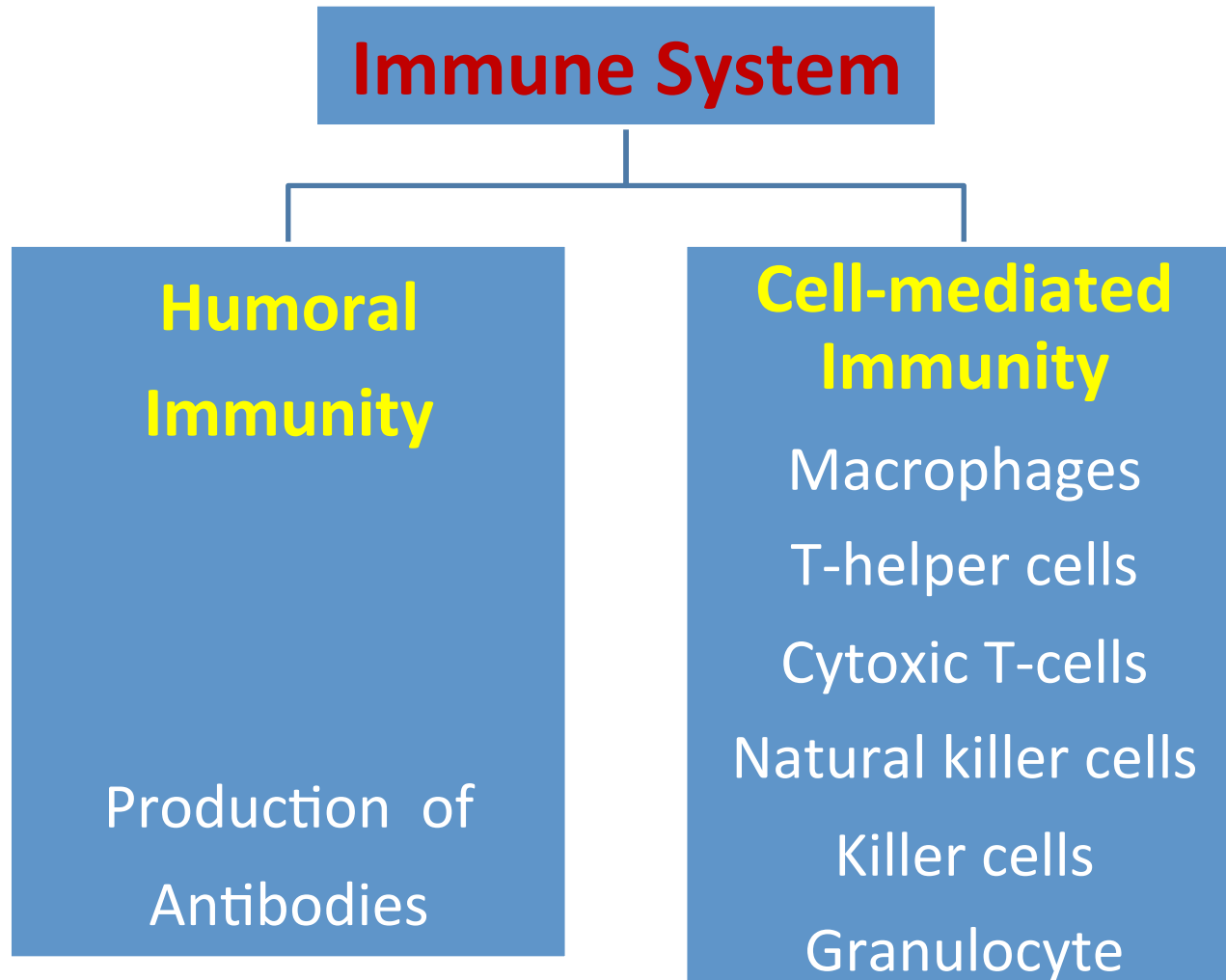
- This is done by resident **Normal Flora** that prevent colonization of pathogens in a body site by:
 1. Competition for colonization sites.
 2. Competition for nutrition.
 3. Production of substances that kills pathogens.
- Antagonism decreases after prolonged use of broad-spectrum antibiotics.





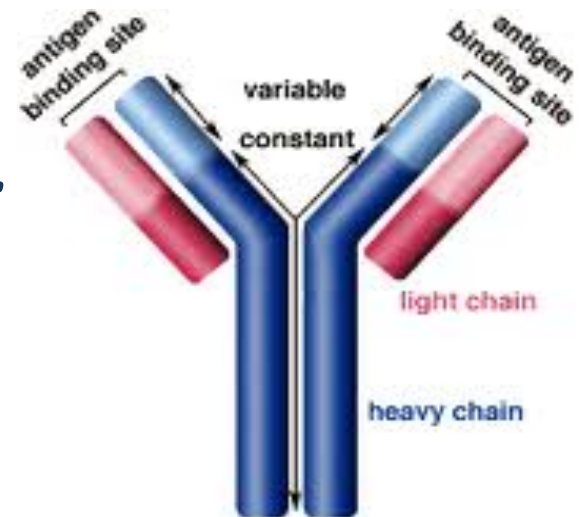
Types of Acquired Immunity

Based on Cell Response

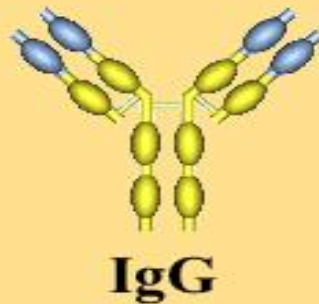
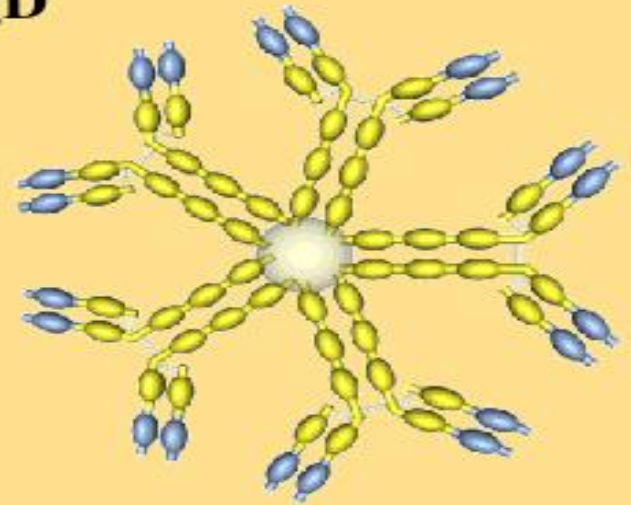
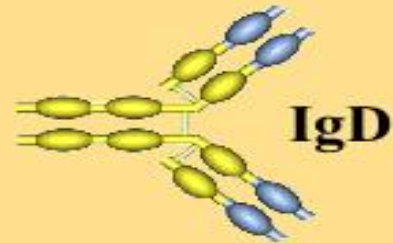
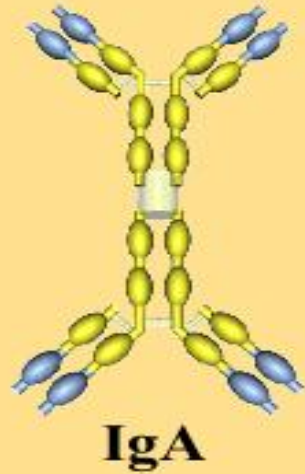


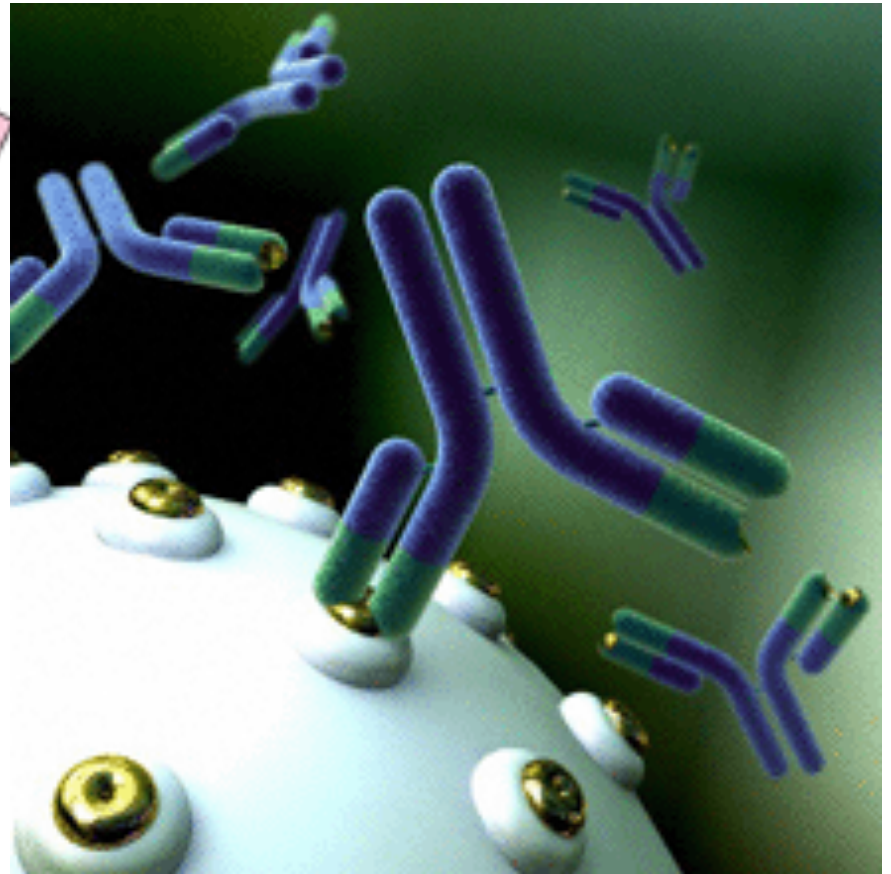
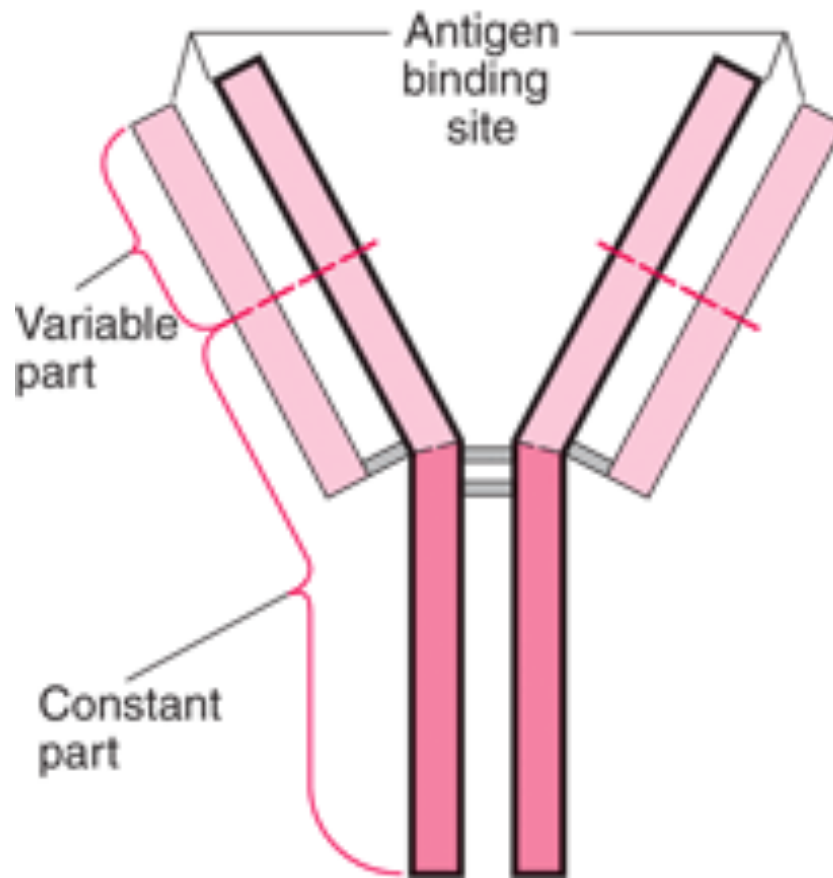
1-Humoral Immunity

- **Antigens:** any agent (microorganism, molecule, protein... etc) that can stimulate the production of antibodies.
 - **Antibodies** Specific glycoproteins produced by **lymphocytes** in response to the presence of an antigen.
- *All antibodies are in a class of proteins called **Immunoglobulins**.*
- *Each antibody is specific to the antigen that stimulates its production.*



Different Classes of Immunoglobulins





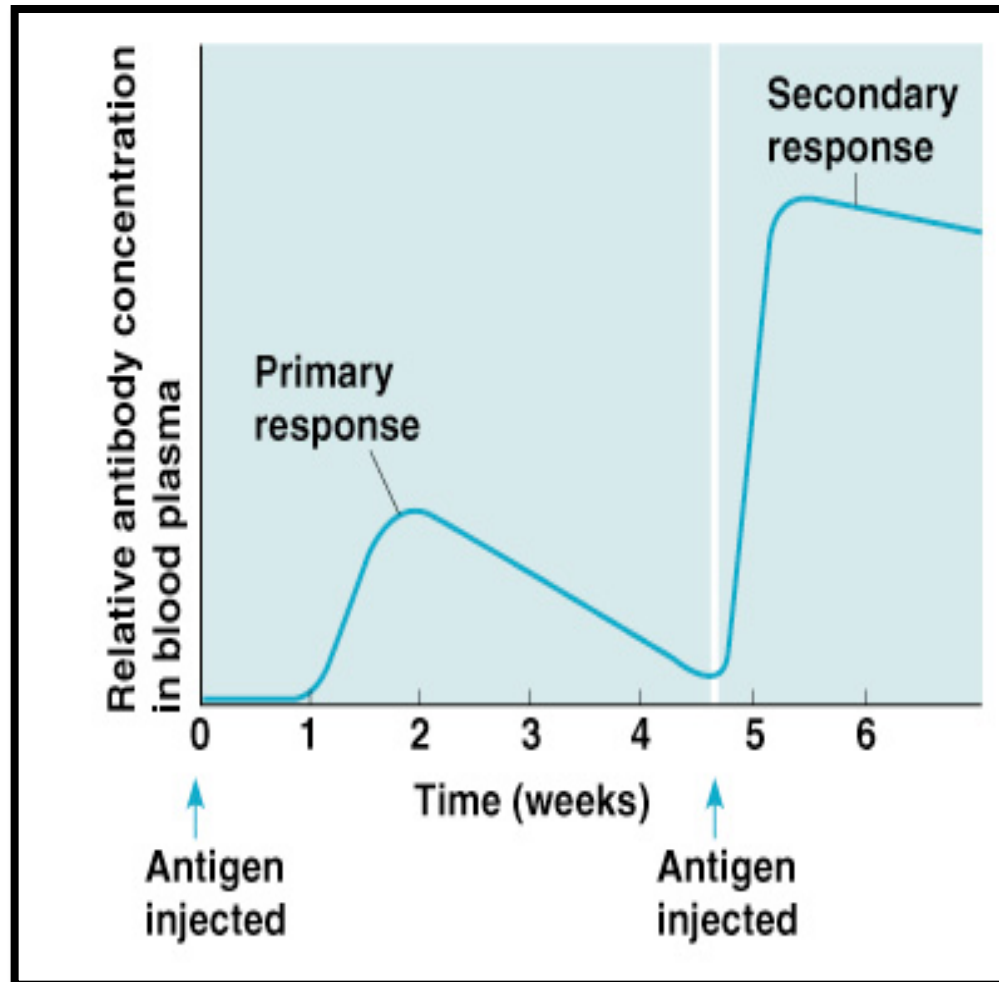
Primary vs. Secondary Immune Response

The initial immune response to a particular antigen is called **Primary Response**,

It takes approximately 10 to 14 days for antibodies to be produced.

Primary response result in the production of memory cells

The second immune response to the same antigen is called **Secondary Response**, it is characterized by large quantities of antibodies which take less time to be developed than primary immune response.



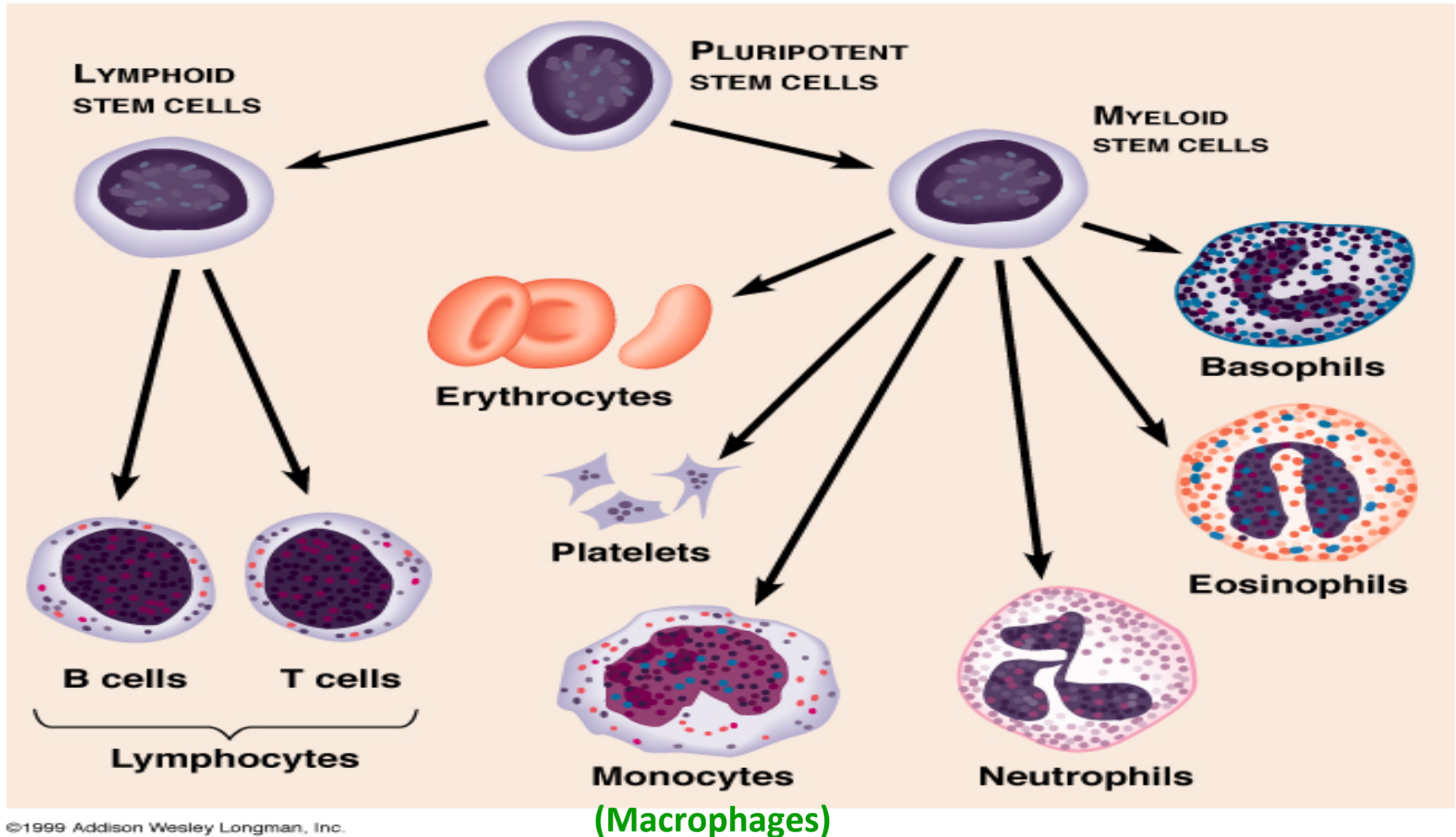
2- Cell-Mediated Immunity

- Antibodies are unable to enter cells, including cell containing intracellular pathogens. Fortunately, there is a part of the immune system capable of controlling chronic infections caused by intracellular pathogens. It is called **Cell Mediated Immunity (CMI)**- *a complex system of interactions between many types of cells and cellular secretions (cytokines).*

Cells that Participate in CMI

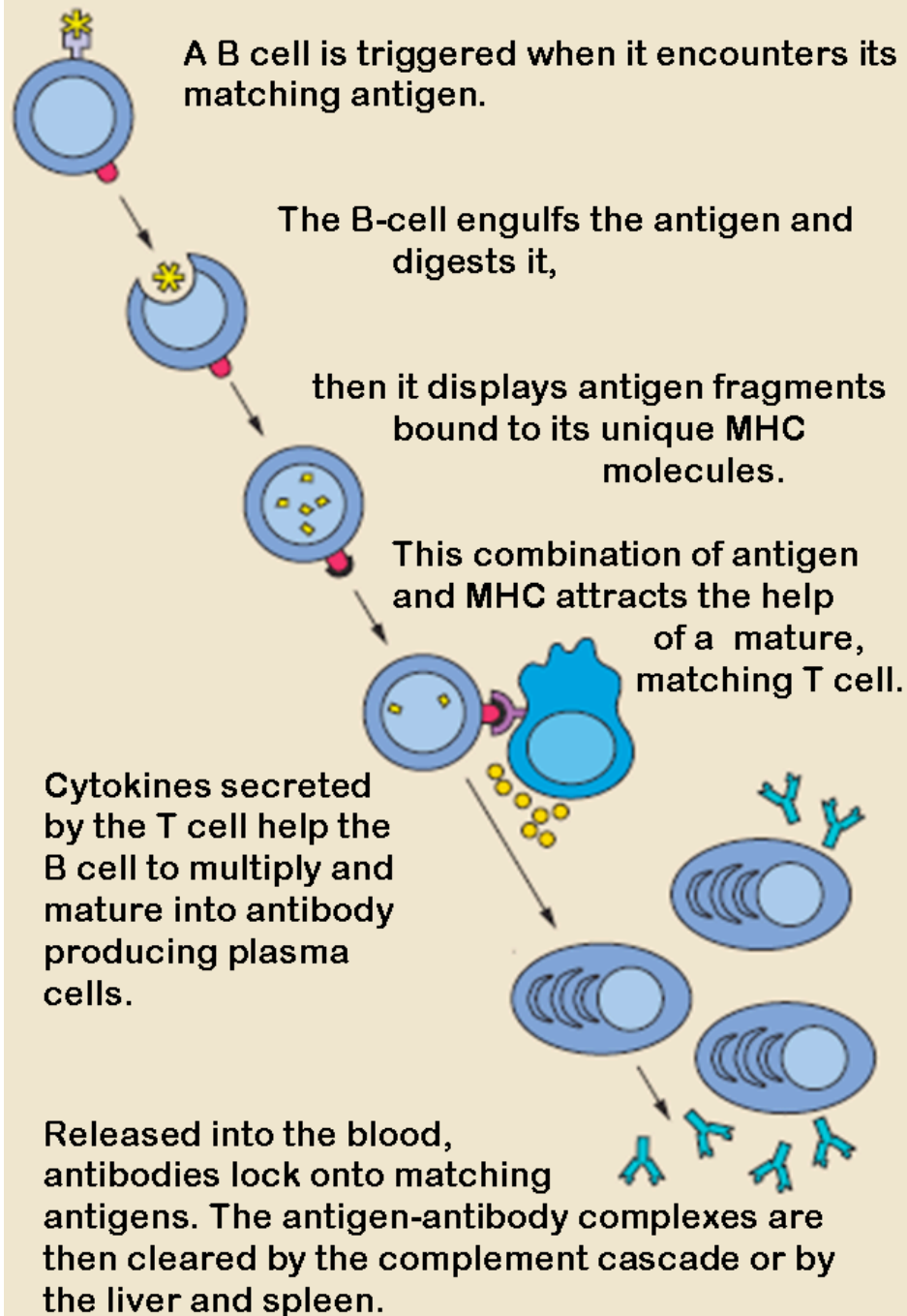
- Macrophages
- Natural killer cells (NK)
- Granulocytes
- T-Lymphocytes:

Phagocytic Cells: Macrophages (Monocytes), Neutrophils, and Eosinophils



Relationship Between Cell-Mediated and Humoral Immunity

- Although **CMI** does not involve the production of antibodies, antibodies produced during humoral immunity may play a minor role in some cell-mediated responses.
- *The AIDS virus (HIV) that targets Th cells impairs both humoral and cell-mediated immunity, making person with AIDS very susceptible to many opportunistic infections and malignancies.*



Immunosuppression

- If a person's immune system is functioning properly, that person is said to be an **immunocompetent** person. If a person's immune system is not functioning properly, that person is said to be **immunosuppressed**, *immunodepressed* or *immunocompromised*.

