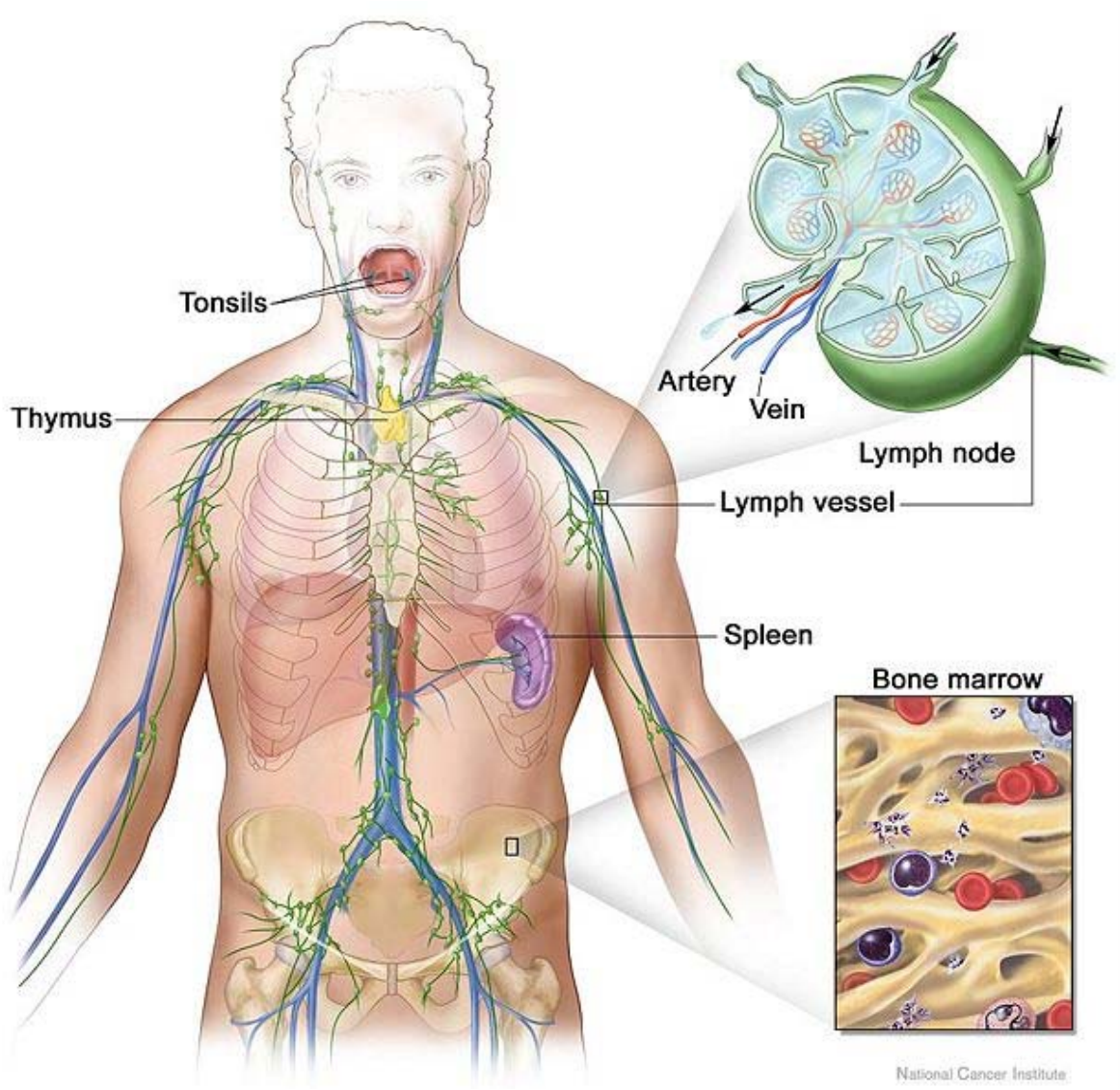
Chapter 14- The Lymphatic System

Honors Anatomy

I. The Lymphatic System

- Lymph
- Lymphocytes
- Lymphatic vessels
- Lymph organs

Closely associated with Cardiovascular System



A. Functions of the Lymphatic System

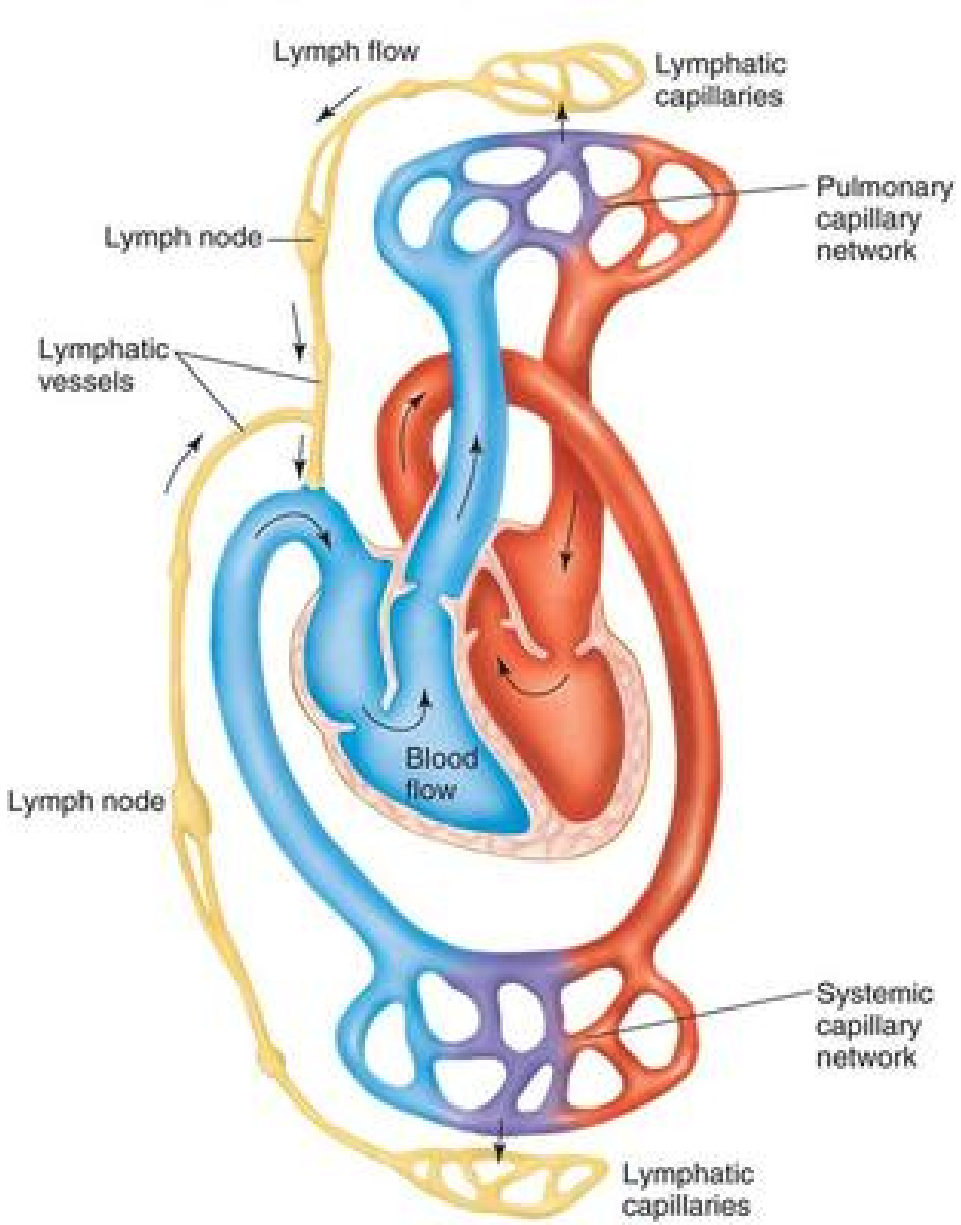
1. Fluid Balance
   - takes up and returns excess fluid to bloodstream
2. Fat Absorption
   - absorbs fats from digestive tract and transports them to bloodstream
3. Defense
   - WBC in lymphatic vessels and organs

B. Lymphatic Vessels

- One-way system
- Returns and recycles fluids leaked out by tissues

Lymphatic Vessels

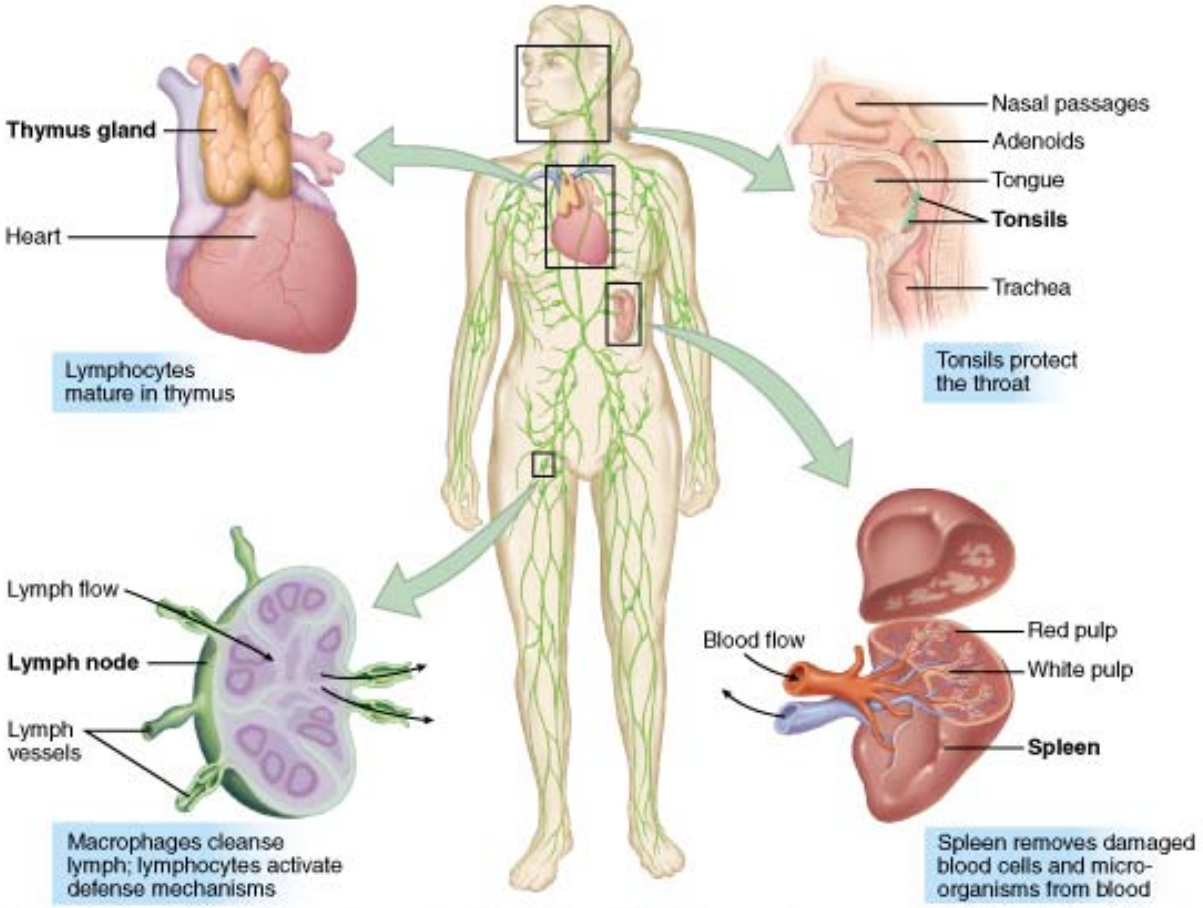
1. Lymphatic Capillaries
   - Simple squamous ET
   - Closed-ended
   - Lymph- fluid
2. Lymphatic Vessels
   - Merging lymphatic capillaries
   - Valves
   - Contain lymph nodes
3. Lymphatic Ducts
   - Merging lymphatic vessels
   - Returns lymph to veins



C. Lymphatic Organs

Lymphatic Organs

1. Tonsils
   - Posterior oral and nasal cavities
   - Lymphatic tissue
2. Lymph nodes
   - Small ovoid structures on lymphatic vessels
   - Contains many lymphocytes
   - Cleanses lymph
3. Spleen
   - Reservoir for blood; filters blood; removes worn-out red blood cells
4. Red bone marrow
   - Production of stem cells, which become lymphocytes
5. Thymus gland
   - Aids in the production and maturation of T-lymphocytes (T-cells)



II. Immunity

Immunity is the ability to resist damage from foreign substances and harmful chemicals.

2 Categories of Immunity

1. Non-specific resistance
2. Specific immunity

III. Non-Specific Resistance (Innate Immunity)

Non-Specific Resistance- the body responds to the infection the same way every exposure.

4 Types of Non-Specific Resistance

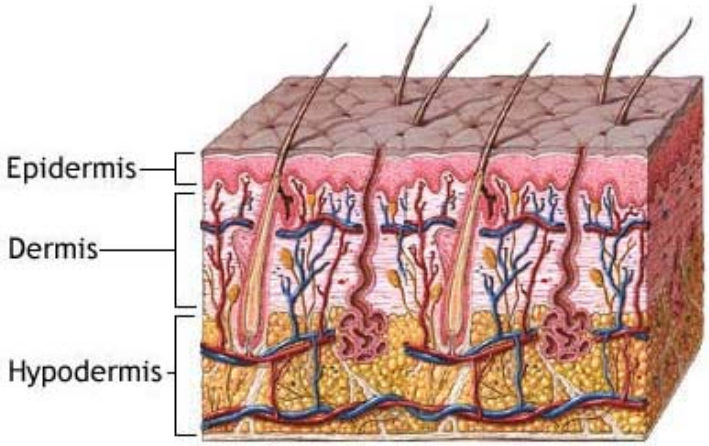
1. Mechanical Mechanisms
2. Chemical Mediators
3. Cells
4. Inflammatory response

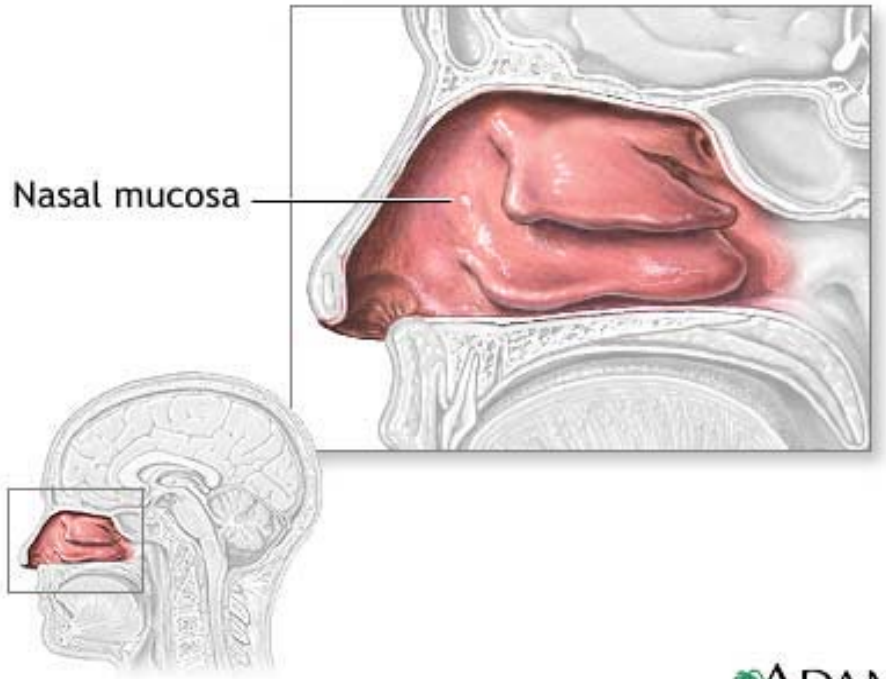
A. Mechanical Mechanisms

- Prevent entry of microorganisms and chemicals into the body.

Types of Mechanical Mechanisms

1. Skin
2. Mucous membranes
3. Tears, saliva, urine



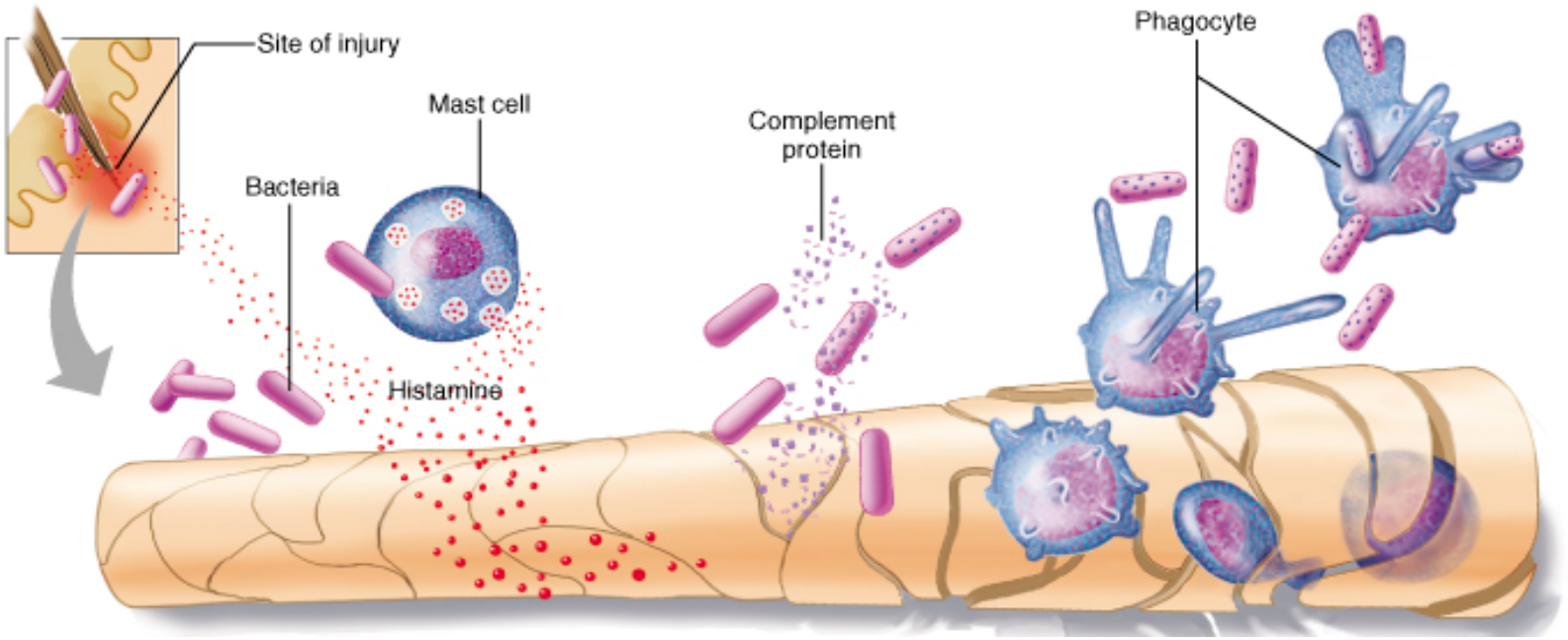


B. Chemical Mediators

- Molecules responsible for some non-specific defenses

Types of Chemical Mediators

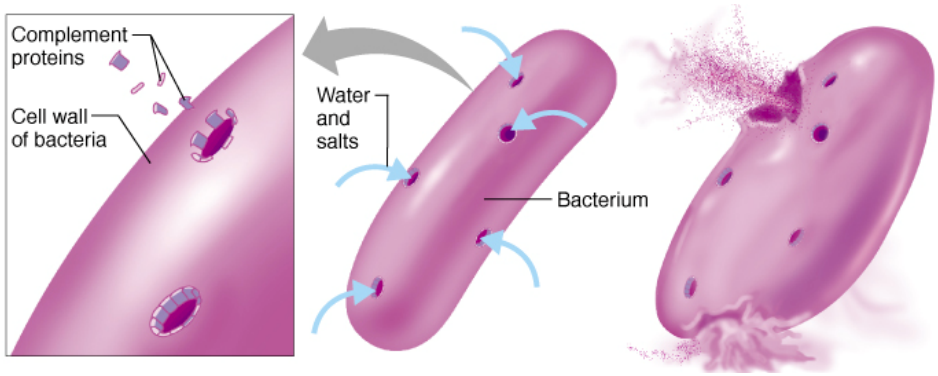
1. Enzymes
   - Lysozyme in tears kills bacteria
2. Cell Secretions
   - Mast cells secrete histamine during inflammatory response



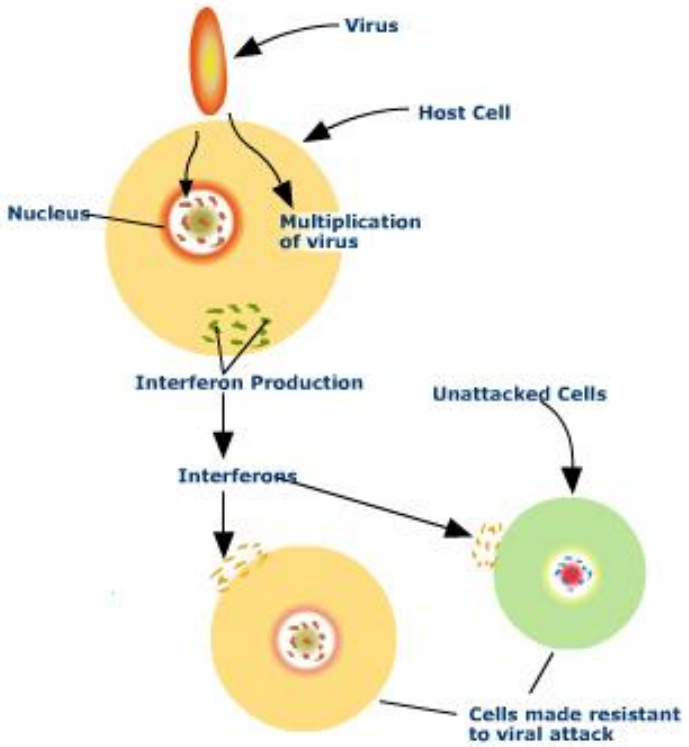
B. Chemical Mediators

Types of Chemical Mediators

3. Complement
   - Plasma proteins activate inflammation, phagocytosis, or lysis



4. Interferons
   - Secretions of an infected cell that triggers cells around it to produce antiviral proteins to inhibit viral reproduction



C. Cells

White blood cells are important components of immunity.

White blood cells are attracted to infected or damaged areas by chemical mediators. (Chemotaxis)

Types of White Blood Cells

1. Phagocytic Cells
   - Phagocytes, macrophages, neutrophils → phagocytosis- "eat," "engulf"
2. Cells of Inflammation
   - Basophils, mast cells (histamine) → increase permeability of blood vessels
   - Eosinophils release enzymes to reduce inflammation
3. Natural Killer Cells
   - Targets virus-infected cells or tumors, secretes chemicals that damage cell membranes

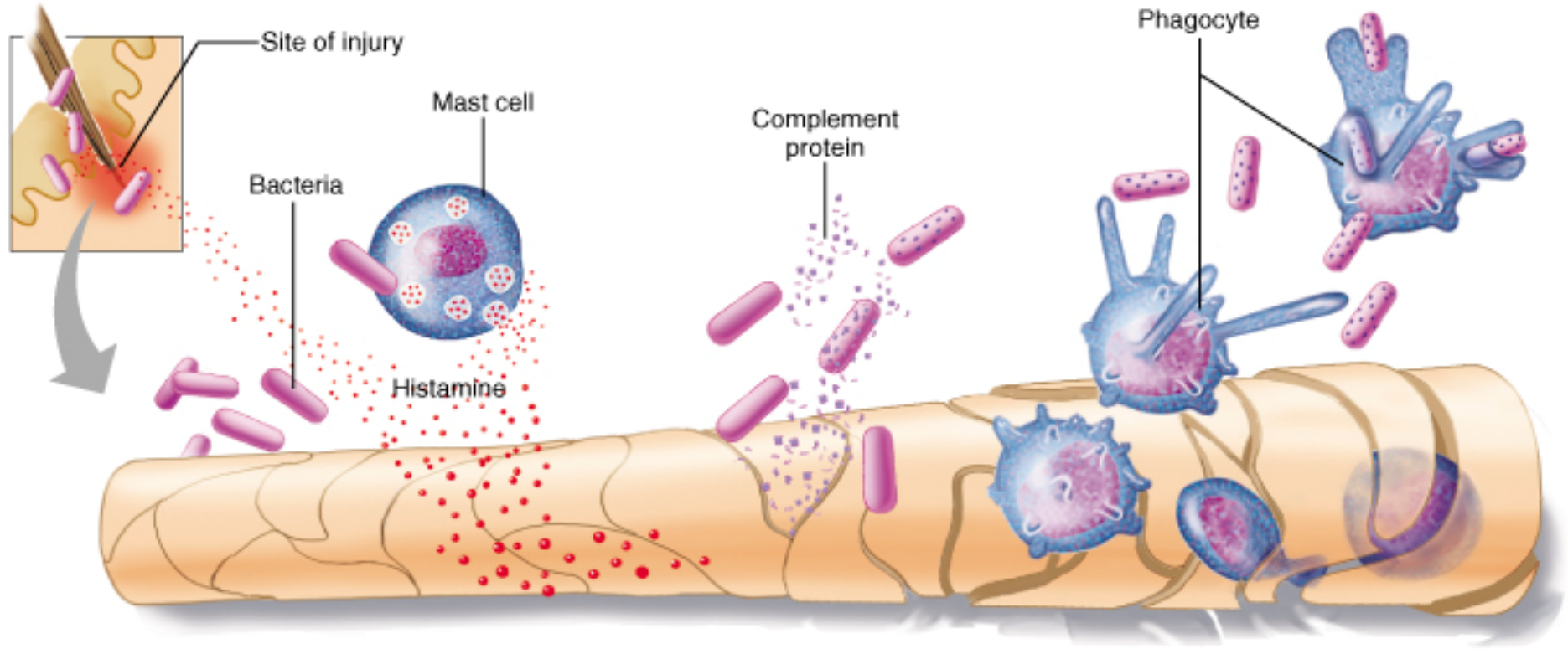
D. Inflammatory Response

Steps of Inflammatory Response

1. Tissue is damaged or infected
2. Cells of inflammation release chemical mediators
   - Mast cells release histamine
3. Vasodilation of blood vessels increases blood flow to area
   - Blood cells delivered to area
4. Chemotaxis by white blood cells to damaged tissue
5. Permeability of blood vessels increased
   - Macrophages and phagocytosis “leak” out of capillaries into tissue

Symptoms- Swelling, redness, pain, loss of function

D. Inflammatory Response



① Damaged cells and mast cells in the area release histamine and other substances. Histamine dilates blood vessels and makes them leaky.

② Complement proteins from plasma diffuse out of leaky capillaries. They mark the bacteria for destruction and sometimes kill them.

③ Attracted by histamine and other chemicals, phagocytes squeeze through the leaky capillary walls and begin attacking and engulfing bacteria and debris.

IV. Specific Immunity (Adaptive Immunity)

Adaptive immunity exhibits specificity and memory.

Specificity- recognition of a particular pathogen/antigen.

Memory- the ability to respond with increasing effectiveness to successive exposures to the antigen.

2 Types of Specific Immunity

1. Antibody-mediated immunity
2. Cell-mediated immunity

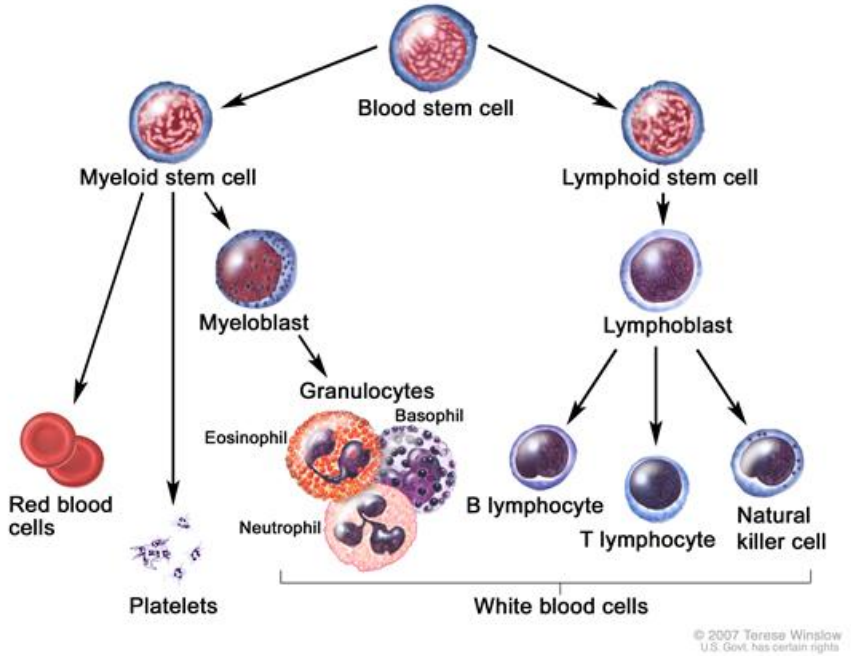
A. Origin and Development of Lymphocytes

Lymphocytes originate from stem cells produced in red bone marrow.

Stem cells become pre-T-cells or pre-B-cells.

Pre-T-cells migrate to Thymus gland and mature → T-cells

Pre-B-cells mature in red bone marrow → B-cells



A. Origin and Development of Lymphocytes

Lymphocytes have antigen receptors specific to binding a particular antigen.

Types of Lymphocytes

1. T-cells
   - Cytotoxic T-cells (cell-mediated immunity)- secretes perforin, which creates pore in a pathogen's cell membrane
   - Memory T-cells (cell-mediated immunity)- dormant until next infection
   - Helper T-cells (cell-mediated & antibody-mediated immunity)- secretes cytokine (interleukin-2) to stimulate proliferation and activate lymphocytes
2. B-cells
   - Plasma B-cells (antibody-mediated immunity)- produce antibodies, which are proteins that neutralize pathogens
   - Memory B-cells (antibody-mediated immunity)- dormant until next infection

B. Activation and Multiplication of Lymphocytes

Cytokines stimulate and activate lymphocytes.

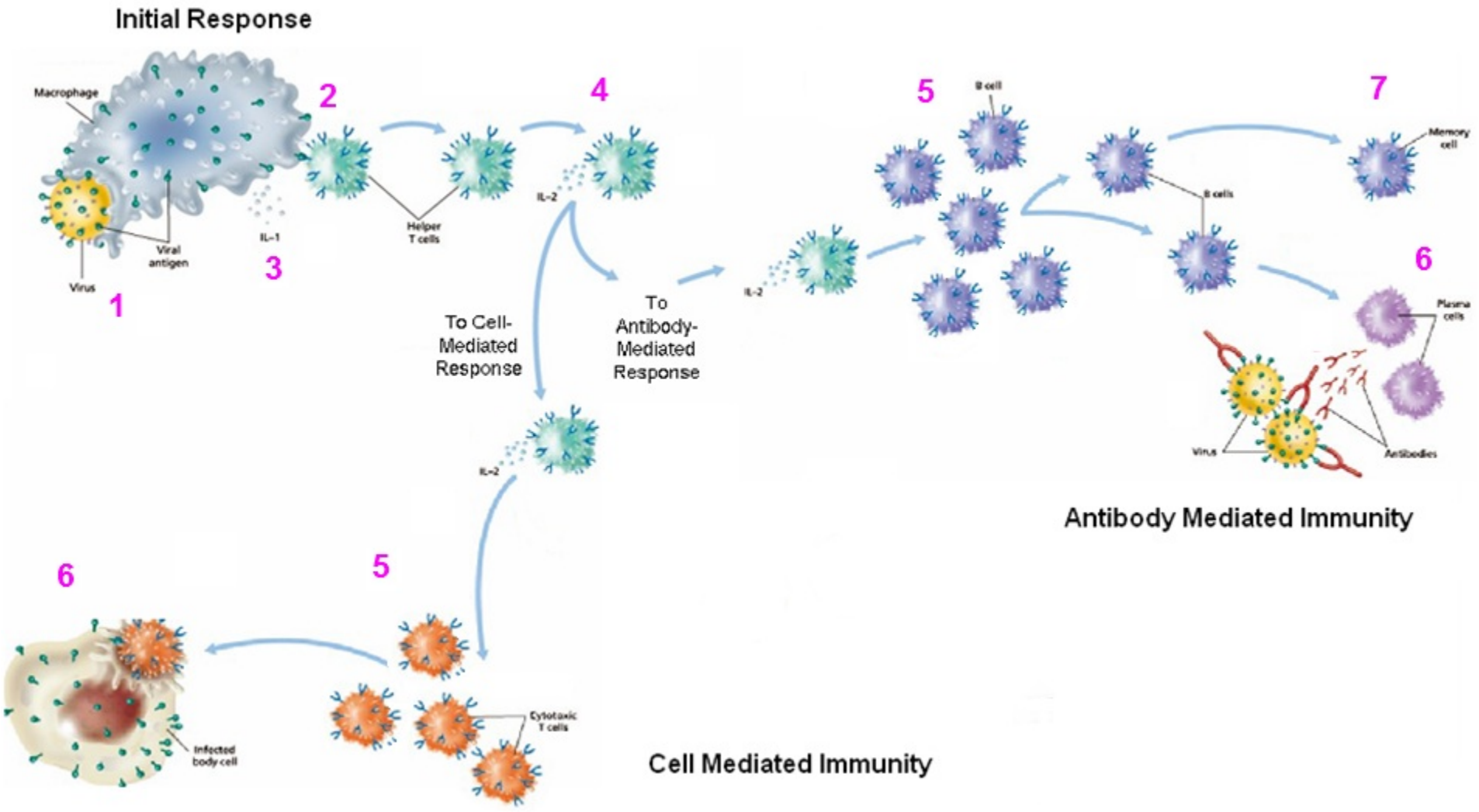
Cytokines stimulate proliferation of lymphocytes.

- Proliferation- process of increasing lymphocyte numbers.

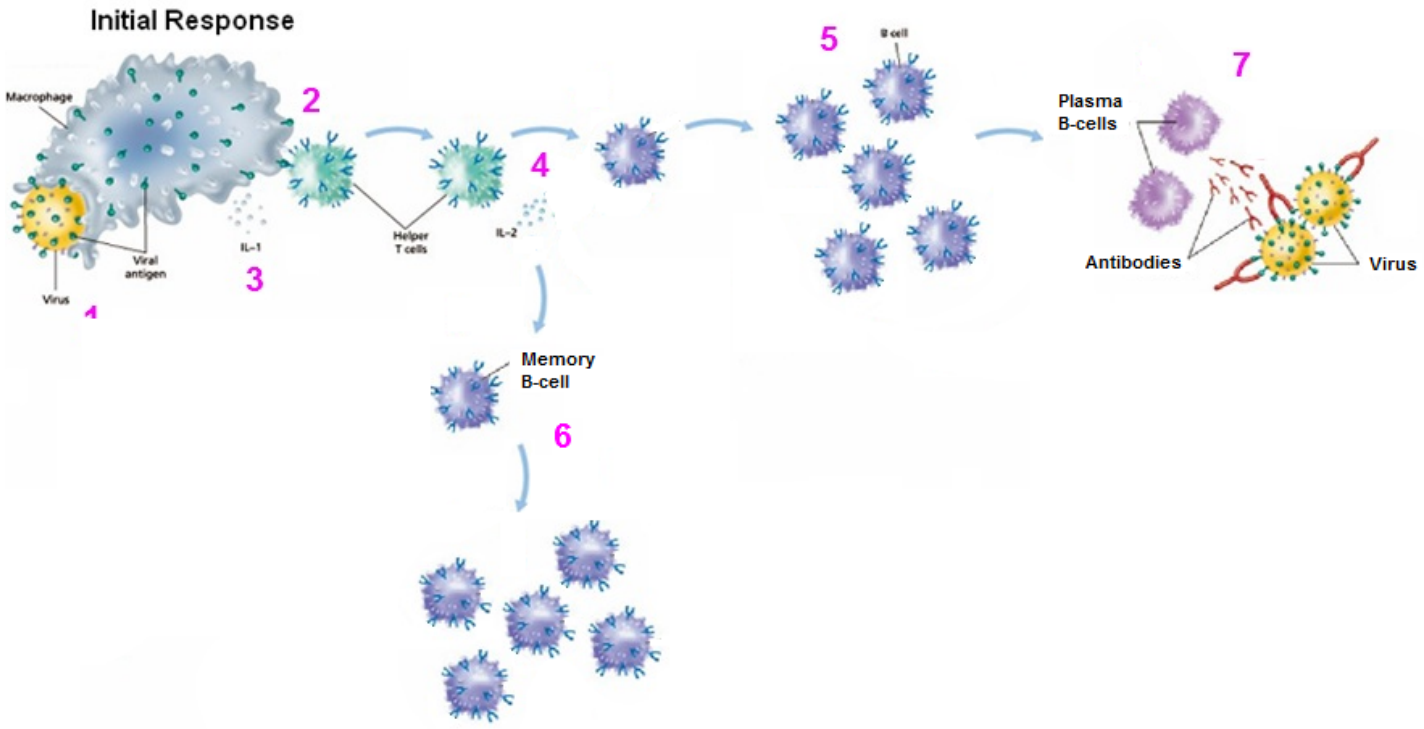
Types of cytokines

1. Interleukin-1- stimulates Helper T-cells.
2. Interleukin-2- stimulates proliferation and activation of T-cells and B-cells

Types of Specific Immunity



D. Antibody-Mediated Immunity



INITIAL RESPONSE

1.Macrophage engulfs pathogen

2.Macrophage presents antigens of pathogen on a Major Histocompatibility Complex (MHC) molecule called a Human Leukocyte-associated (HLA) antigen. Helper T-cell binds to antigen.

3.Binding of Helper T-cell to HLA antigen stimulates the release of Interleukin-1.

4.Interleukin-1 stimulates the Helper T-cell to release Interleukin-2.

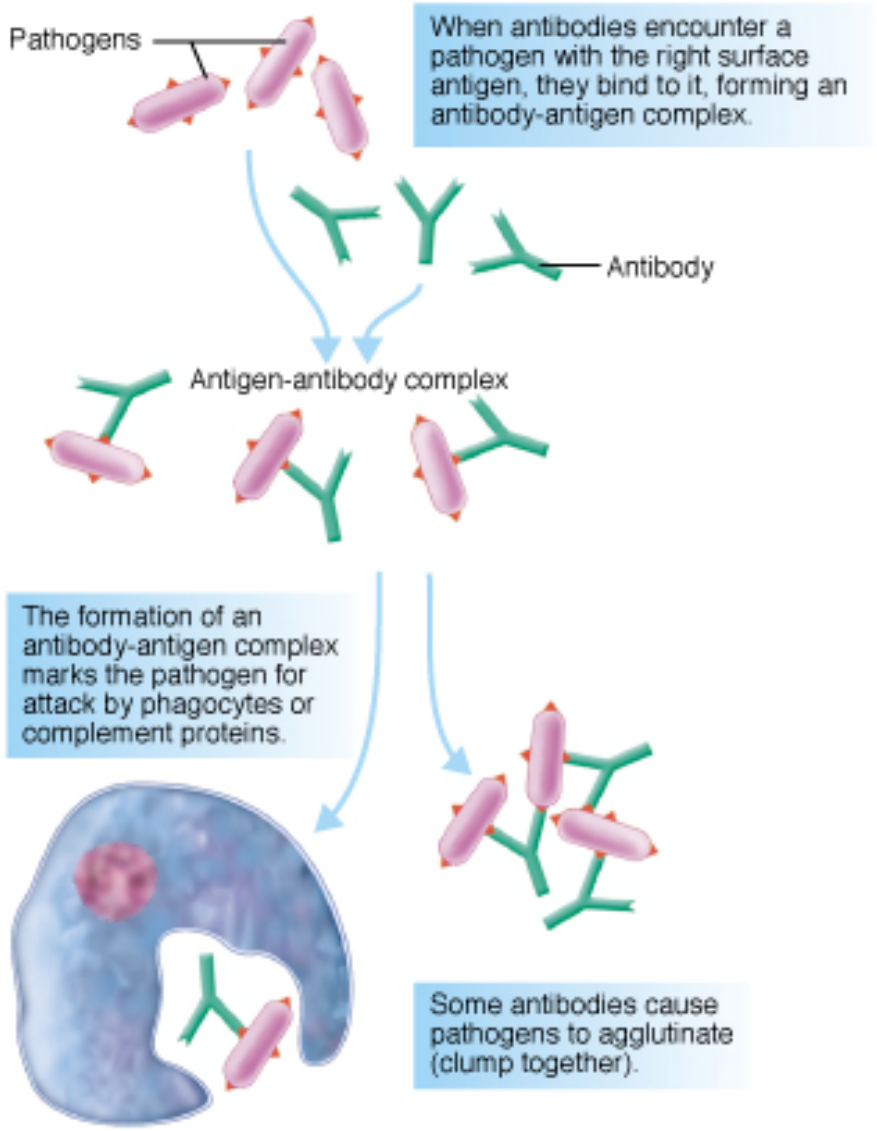
ANTIBODY-MEDIATED IMMUNITY

5.Interleukin-2 stimulates proliferation and activation of B-cells.

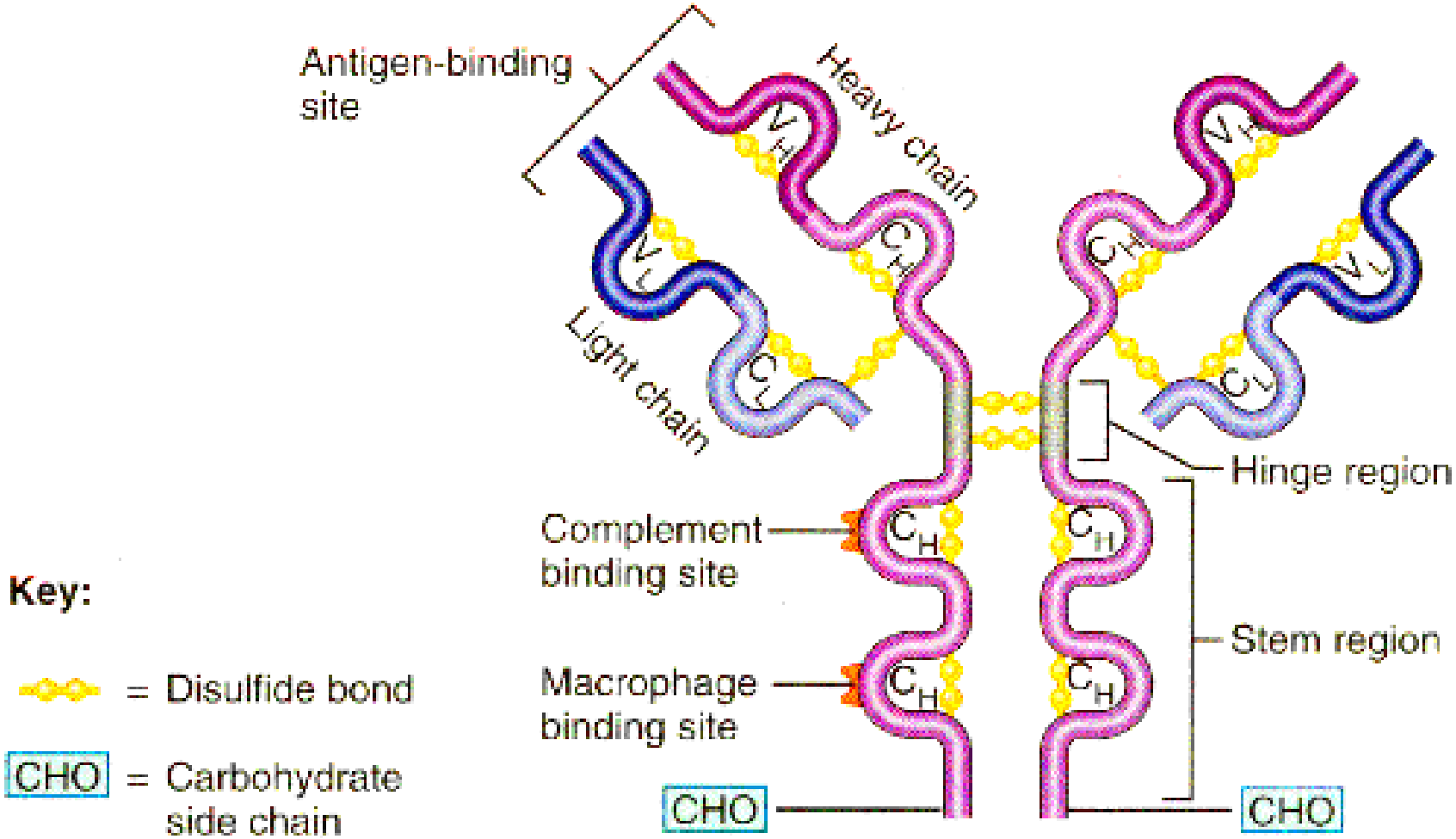
6.Some B-cells become Memory B-cells that wait for the next infection by the same pathogen.

7.Some B-cells become Plasma B-cells which fight pathogens by creating antibodies. Antibodies bind to antigens of pathogens and clump them together or activate compliment proteins to initiate the inflammatory response or phagocytosis by macrophages.

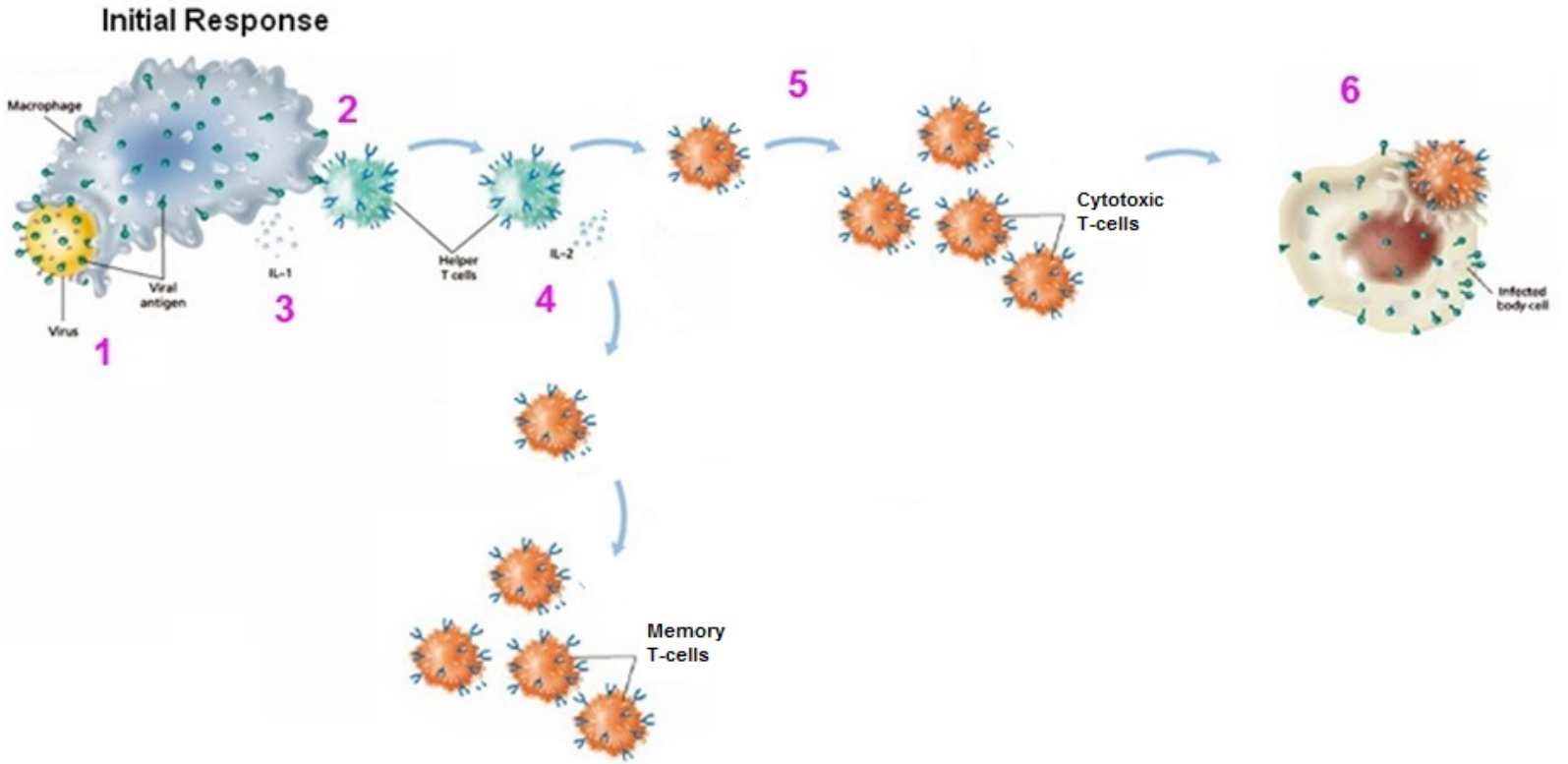
Actions of Antibodies



Structure of an Antibody



E. Cell-Mediated Immunity



INITIAL RESPONSE

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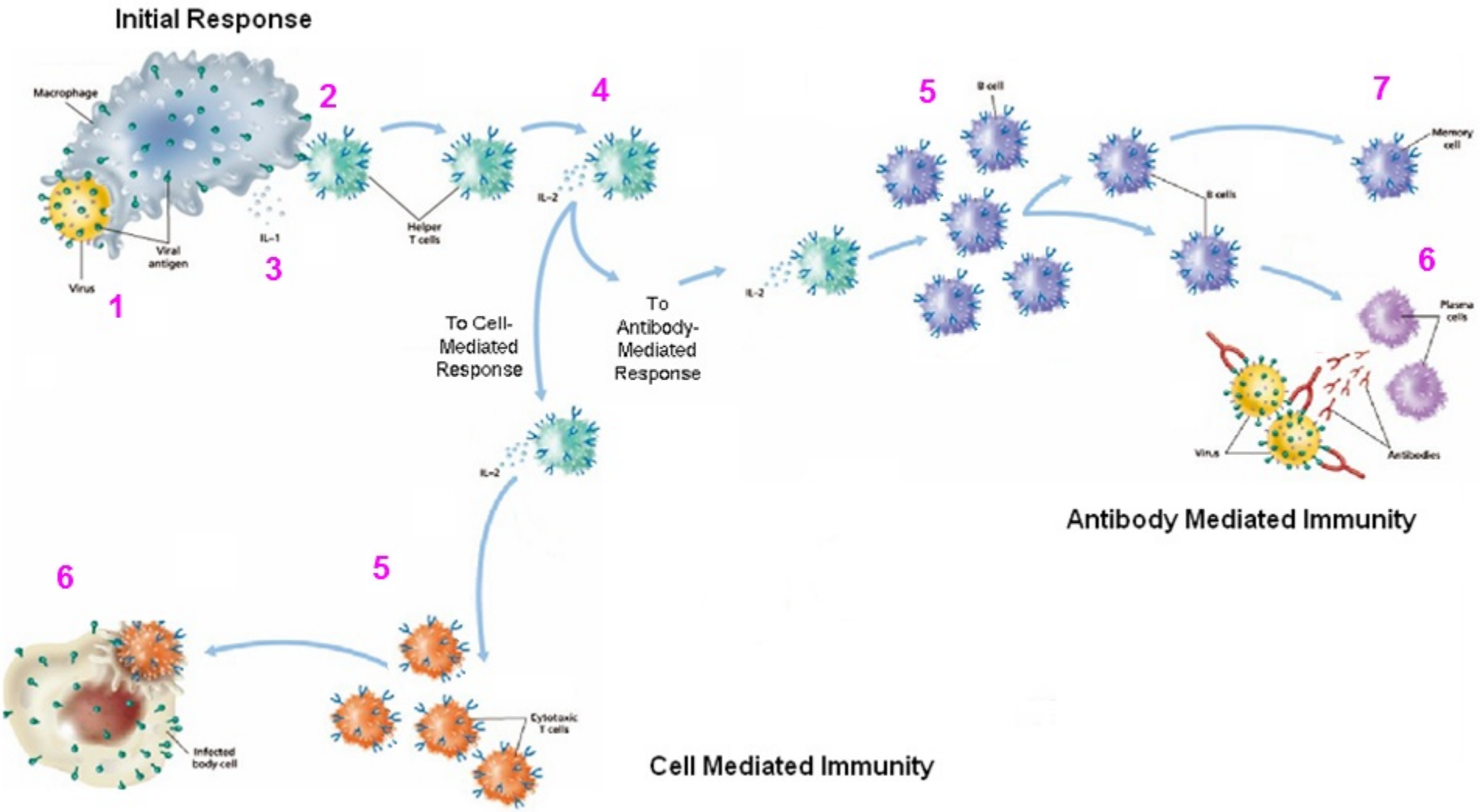
CELL-MEDIATED IMMUNITY

5.Interleukin-2 stimulates proliferation and activation of Cytotoxic T-cells.

6.Cytotoxic T-cells that are active, secrete perforin, which creates a pore in the cell membrane of the pathogen, allowing water and salts to enter, causing the cell to burst (lysis of the cell). Some Cytotoxic T-cells become Memory T-cells that wait for the next infection by the same pathogen.

Recap of Types of Specific Immunity



HIV and AIDS

AIDS- Acquired Immunodeficiency Syndrome

- AIDS is caused by HIV (human immunodeficiency virus)
- People are classified as having AIDS if their white blood cell count falls below 200cells/mL of blood, or if they develop an opportunistic infection, or if they develop Kaposi's sarcoma.
- People do not die from HIV, they die from opportunistic infections, such as pneumonia, or they die from Kaposi's sarcoma, cancer.

HIV and AIDS

HIV- Human Immunodeficiency Virus

- HIV is a retrovirus; RNA is its genetic material instead of DNA
- HIV specifically attacks Helper T-cells and binds to their CD4 receptors.

How HIV attacks a Helper T-cell