The immune system

1. **The *immune system*** protects the body against disease-causing organisms and certain toxins
    - Disease-causing organisms, or *pathogens*, include viruses, bacteria, fungi, and protozoa
    - They enter the body and may overcome the internal defenses, causing diseases
2. ***Immunology*** is the study of internal defense systems of humans and other animals.
3. ***Immune responses*** are the body's defensive responses recognizing foreign or dangerous macromolecules and responding to eliminate them:
    - *Nonspecific immune responses*, or *innate immunity*, provide general and immediate protection against pathogens, parasites, some toxins and drugs, and cancer cells.
    - Natural barriers
    - *Phagocytosis*
    - *Specific immune responses*, *adaptive* or *acquired immunity*, target distinct antigens, molecules recognized as foreign or dangerous by cells of the immune system.
4. **Nonspecific Immune Responses:**
    - Physical and chemical barriers, involving a variety of molecules and cells
    - Enzymes and stomach acid destroy ingested pathogens
    - Nose hairs, mucous lining of the respiratory/reproductive tracts trap pathogens, that are then phagocytized
    - When pathogens break through these first-line defenses, other nonspecific defenses are activated by phagocytes and certain other types of cells
    - *Inflammatory response* begins immediately after pathogen invasion or physical injury, it is characterized clinically by heat, swelling, redness, and pain
    - Phagocytes: cells that phagocytose (Macrophage, Granulocyte)
5. **Specific Immune Responses:**
    - Specific immune responses are highly effective against the spread of infection, but require several days to be activated
    - Specific immune responses include
      -Cell-mediated immunity
      -Antibody-mediated (humoral) immunity
    - Two main types of cells participate in specific immune responses
        - *Lymphocytes* (principal warriors in specific immune responses)
        - *Antigen-presenting cells*
6. **Lymphocytes:**

The two types of lymphocytes are:

a. *T lymphocytes* (*T cells*)
    i. responsible for *cell-mediated immunity*
    ii. mature in the thymus gland
    iii. they travel to the site of infection and attack infected cells, foreign cells (grafts or transplants), and cells altered by mutation (cancer)
b. *B lymphocytes* (*B cells*)

i. responsible for *humoral immunity*
ii. complete their development in the adult bone marrow
iii. differentiate into *plasma cells*, which produce antibodies that bind to specific antigens, neutralizing them or marking them for destruction

7. Antibody Substructure:

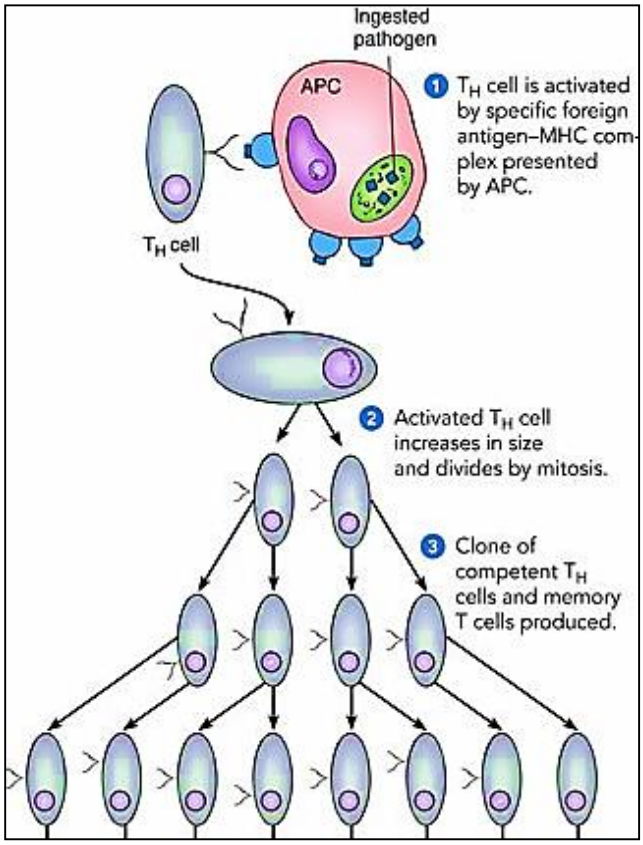
- *Immunoglobulin*, or antibody, is a protein that consists of four polypeptide chains
- It combines with antigen and activates processes that destroy the antigen that binds to it
- Typically Y shaped proteins
- Each chain has a *constant (C) region* and a *variable (V) region*

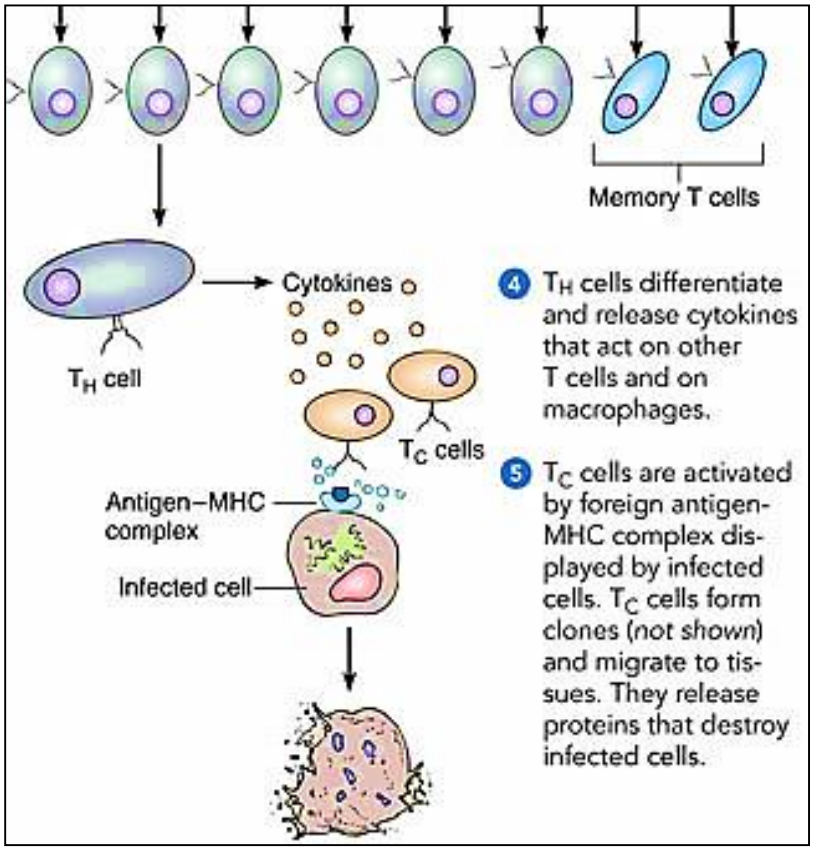
8. Elimination of the immune complex:

An antibody combines with a specific antigen to form an antigen-antibody complex (immune complex), which may:

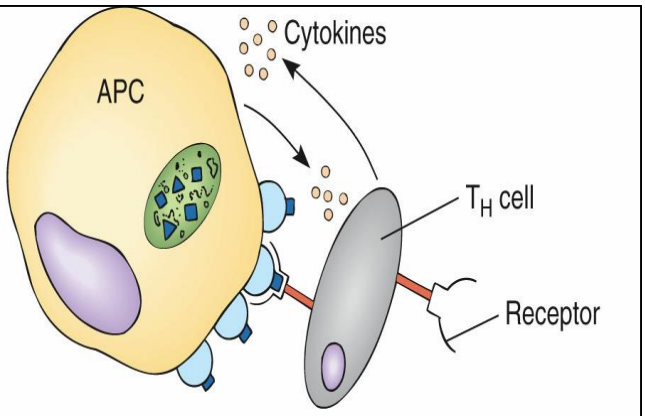
- inactivate the pathogen (or its toxin)
- stimulate phagocytosis
- activate the complement system

9. Cell-Mediated Immunity:



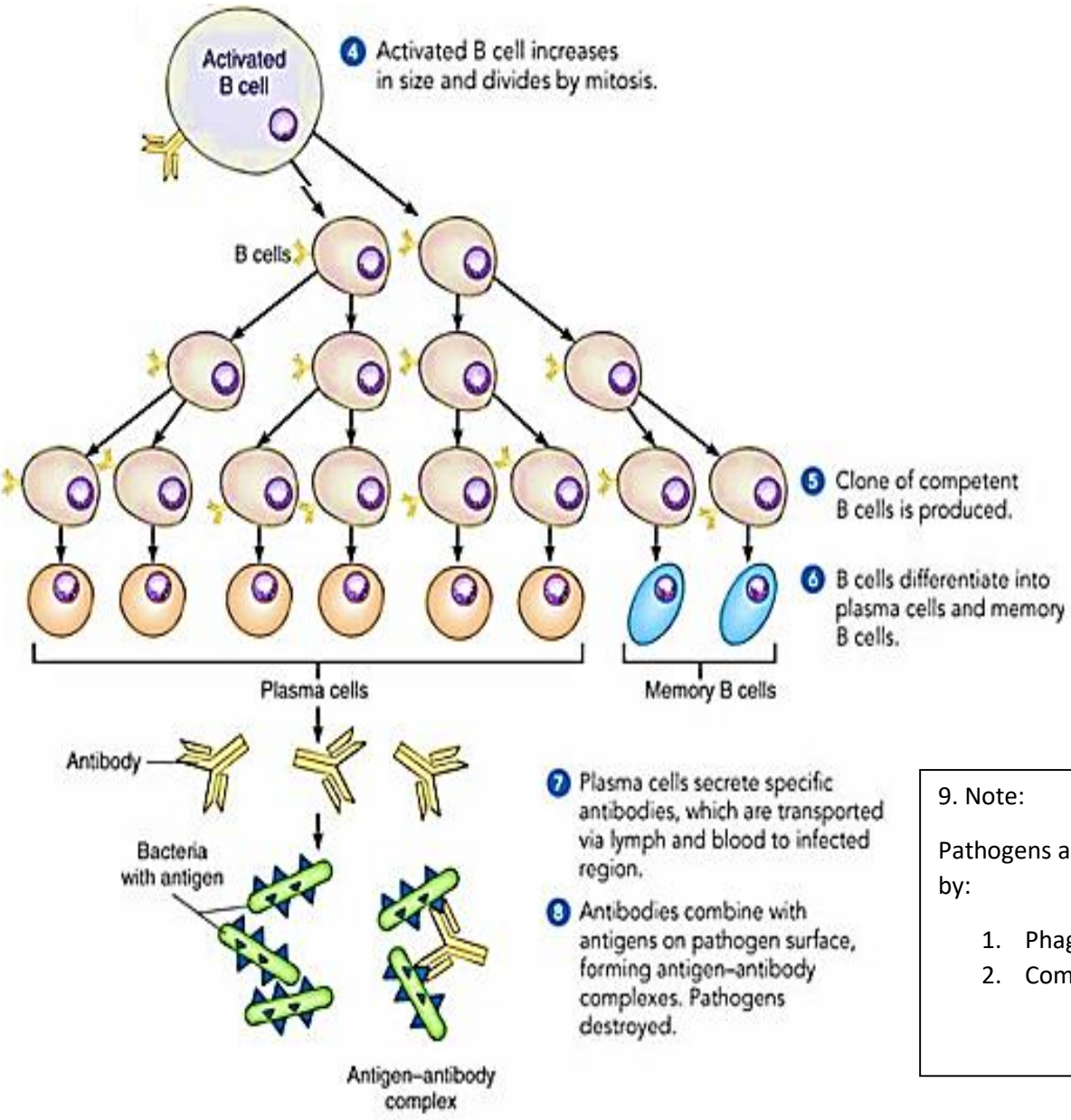


10. B-Cell Activation:



2 T_H cells are activated when their receptors combine with foreign antigen–MHC antigen complexes on APC. Signaling takes place via cytokines secreted by both cells.

Activated TH cells secrete IL4 that activate B lymphocytes.



9. Note:

Pathogens are later destroyed by:

1. Phagocytosis.
2. Complement cascade.

11. Immunological Memory:

After an infection, memory B cells and memory T cells remain in the body. These cells are responsible for long-term immunity

a. Memory T cells (with their specific T cell receptors) station strategically in many nonlymphatic tissues

    i. They rapidly become T_C cells in response to antigen

b. Memory B cells small amounts of antibody long after the body has overcome an infection

    i. Specific memory cells are stimulated to divide, producing new clones of plasma cells that produce the same antibody.

12. Primary and Secondary Immune Responses:

- The first exposure to an antigen stimulates a *primary immune response*
- A second exposure to the same antigen evokes a *secondary immune response*, which is more rapid and more intense than the primary response
    - Much less antigen is necessary to stimulate the immune response, and much more antibodies are produced (with enhanced affinity)