

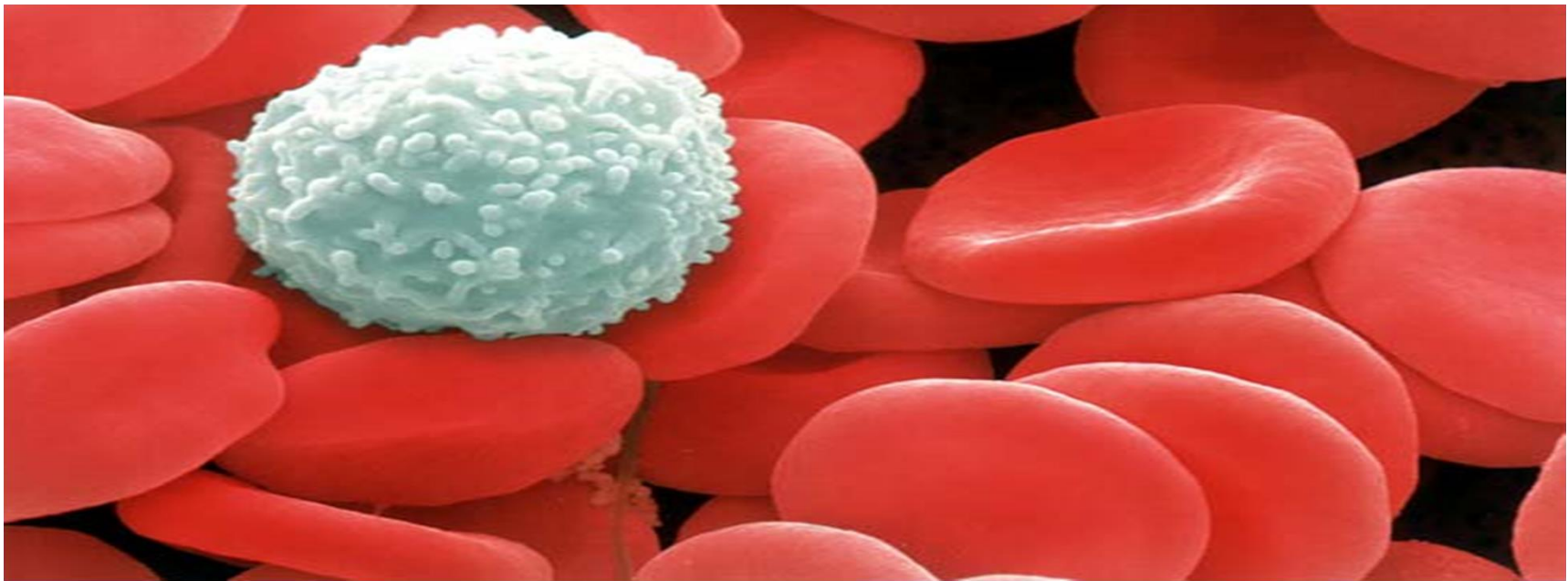
Innate and Adaptive Immunity

Curriculum: Phase 1/ Semester2/ TOB / Session 10

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Learning outcomes

Having revised this lecture you should be able to:

- Briefly describe the cellular and humoral components of the innate and adaptive immune systems
- Describe the main differences between the innate and adaptive immune responses
- Give examples of the cooperation and interdependence of the innate and adaptive immune systems

immune system

- The body's defense against disease causing organisms. The immune system recognizes foreign bodies by structures on their cell walls and responds with the production of immune cells and proteins

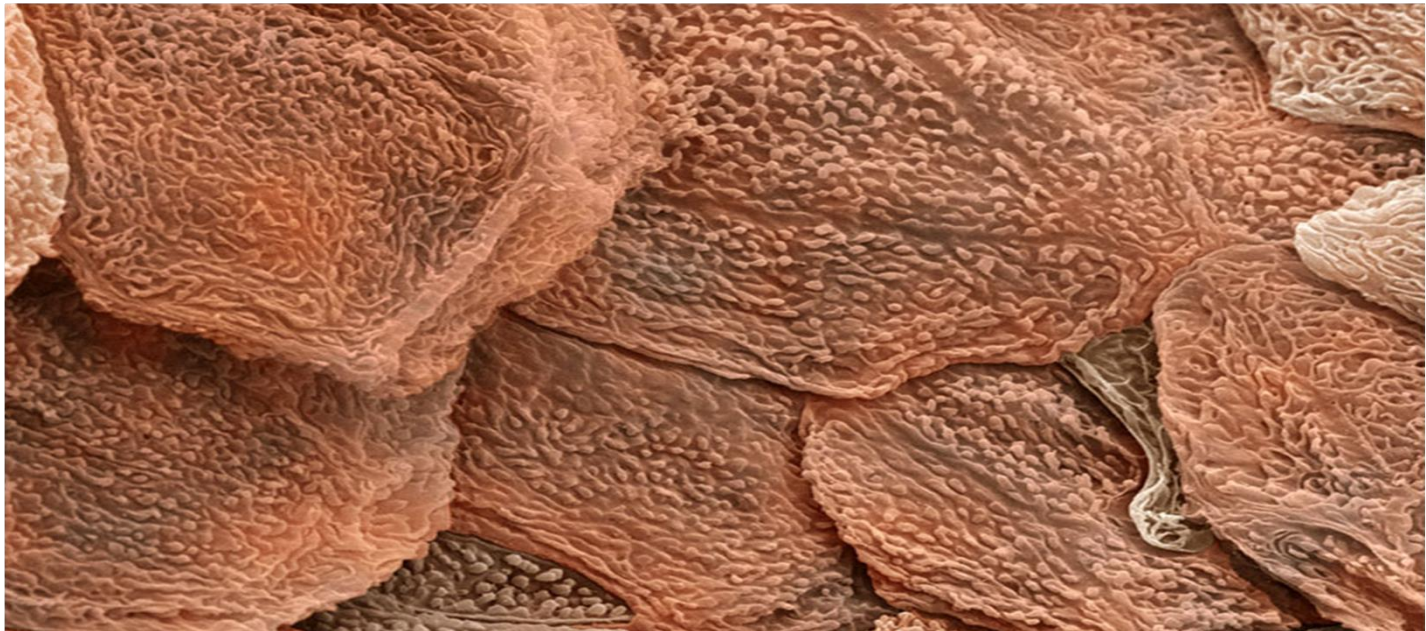
Innate immunity

- is present before any exposure to pathogens and is effective from the time of birth
- It involves nonspecific responses to pathogens
- Innate immunity consists of external barriers plus internal cellular and chemical defenses

The First Line of Defense

Skin

- The dead, outer layer of skin, known as the **epidermis**, forms a shield against invaders and secretes chemicals that kill potential invaders



Mucus and Cilia

- Breathe in, foreign particles and bacteria bump into **mucus** throughout your respiratory system and become stuck
- Hair-like structures called **cilia** sweep this mucus into the throat for coughing or swallowing

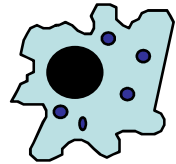


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Saliva

- **Saliva** contains many chemicals that break down bacteria
- **Stomach Acid**
 - Swallowed bacteria are broken down by strong acids in the stomach that break down your food

Cells Involved in Innate Immunity



Macrophage
Monocyte

Phagocytosis
Presentation to lymphocytes



Neutrophil
PMN

Phagocytic
Anti-bacterial



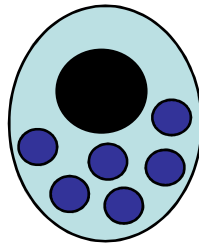
Eosinophil

Anti-parasite
Immunity - Allergy



Basophil

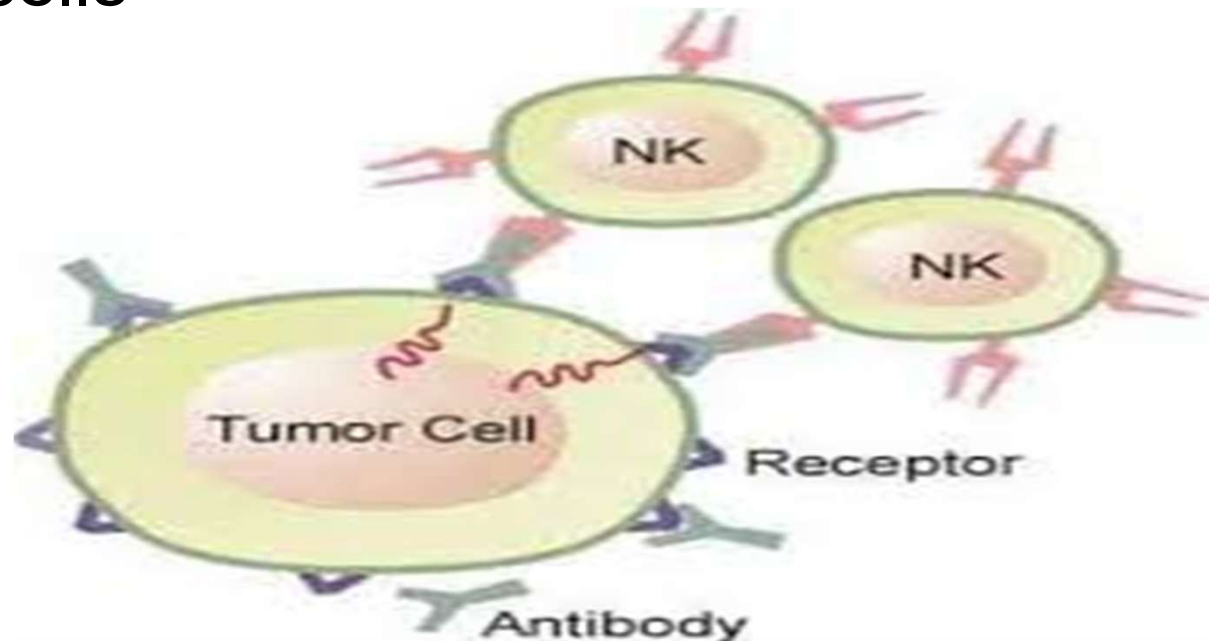
Protection of mucosal surfaces - Allergy



Mast cell

Protection of mucosal surfaces - Allergy

- Cellular innate defenses also involve **natural killer cells**
- These circulate through the body and detect abnormal cells
- They release chemicals leading to cell death, inhibiting the spread of virally infected or cancerous cells



Cellular Innate Defenses

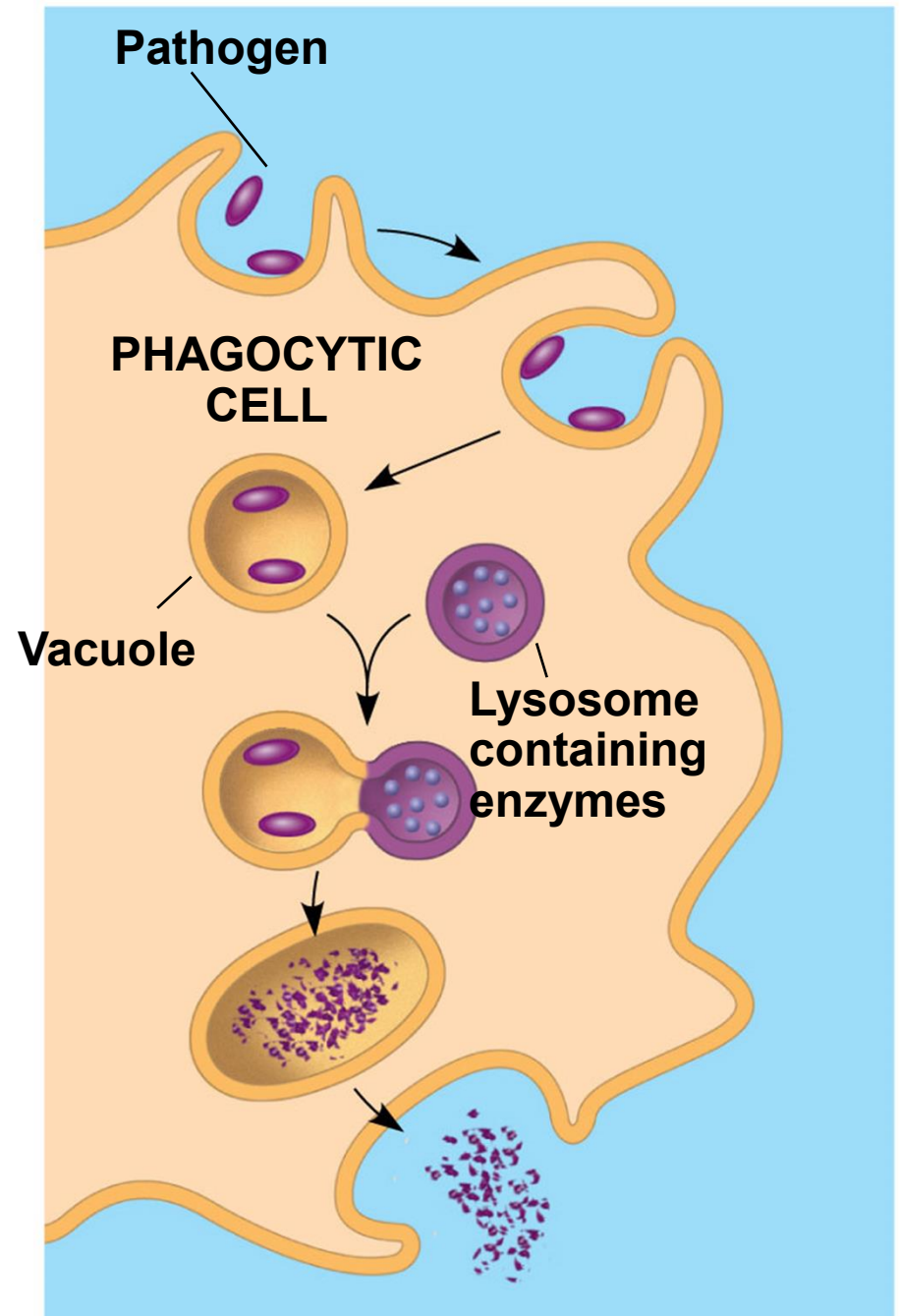
White Blood Cells

- If invaders actually get **within** the body, then your white blood cells (WBCs) begin their attack
- WBCs normally circulate throughout the blood, but will enter the body's tissues if invaders are detected
- A white blood cell engulfs a microbe, then fuses with a lysosome to destroy the microbe

White Blood Cells

Phagocytes

These white blood cells are responsible for eating foreign particles by engulfing them. Once engulfed, the phagocyte breaks the foreign particles apart in organelles called **Lysosomes**.



- There are different types of phagocytic cells
 - **Neutrophils** engulf and destroy pathogens
 - **Macrophages** are found throughout the body
 - **Dendritic cells** stimulate development of adaptive immunity
 - Eosinophils discharge destructive enzymes

Antimicrobial Peptides and Proteins

- Peptides and proteins function in innate defense by attacking pathogens or impeding their reproduction
- **Interferon** proteins provide innate defense, interfering with viruses and helping activate macrophages

Adaptive immunity

- Adaptive immunity, or acquired immunity, develops after exposure to agents such as microbes, toxins, or other foreign substances
- It involves a very specific response to pathogens

Innate immunity

- Natural immunity present from birth
- Not specific for any particular microbial substance
- Not enhanced by second exposure
- Has no memory
- Uses cellular and humoral components
- Is poorly effective without adaptive immunity

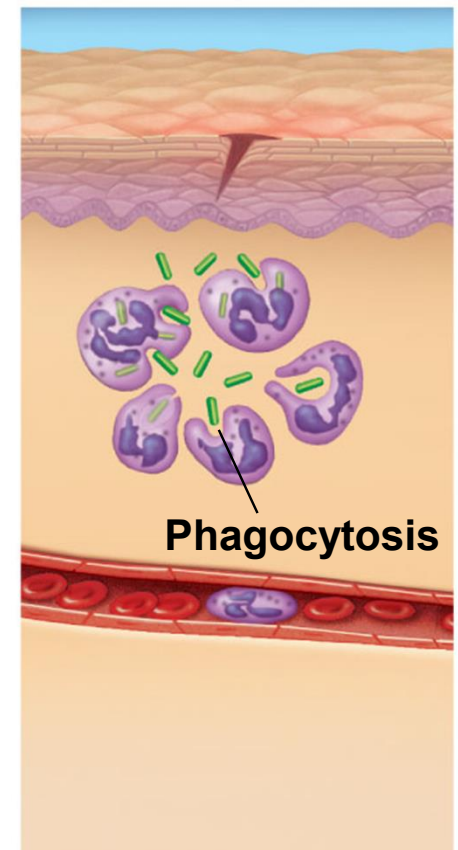
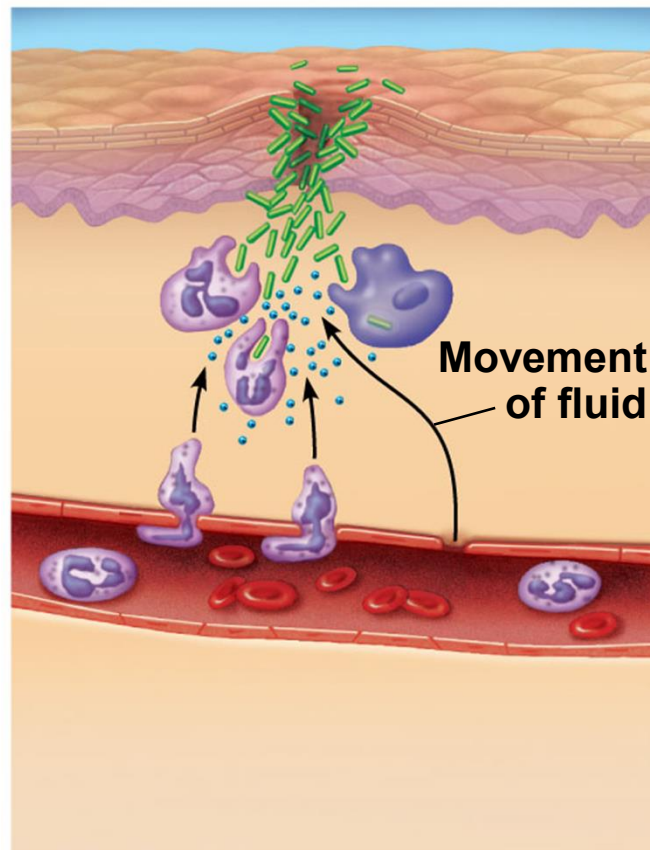
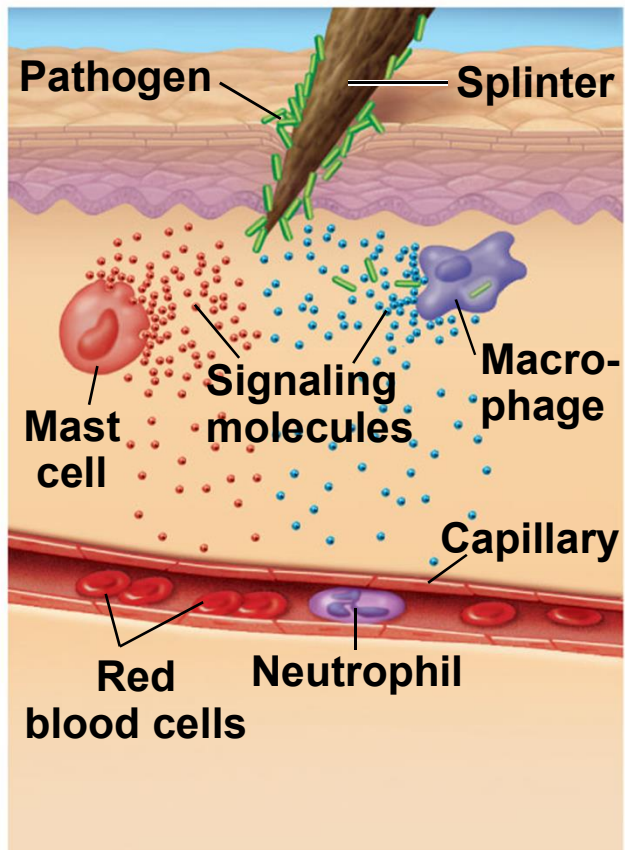
Adaptive immunity

- Immunity established to adapt to infection
- Learnt by experience
- Confers pathogen-specific immunity
- Enhanced by second exposure
- Has memory
- Uses cellular and humoral components
- Is poorly effective without innate immunity

Inflammatory Responses

- The **inflammatory response**, such as pain and swelling, is brought about by molecules released upon injury or infection
- **Mast cells**, a type of connective tissue, release **histamine**, which triggers blood vessels to dilate and become more permeable
- Activated macrophages and neutrophils release **cytokines**, signaling molecules that enhance the immune response

Figure 43.8-3

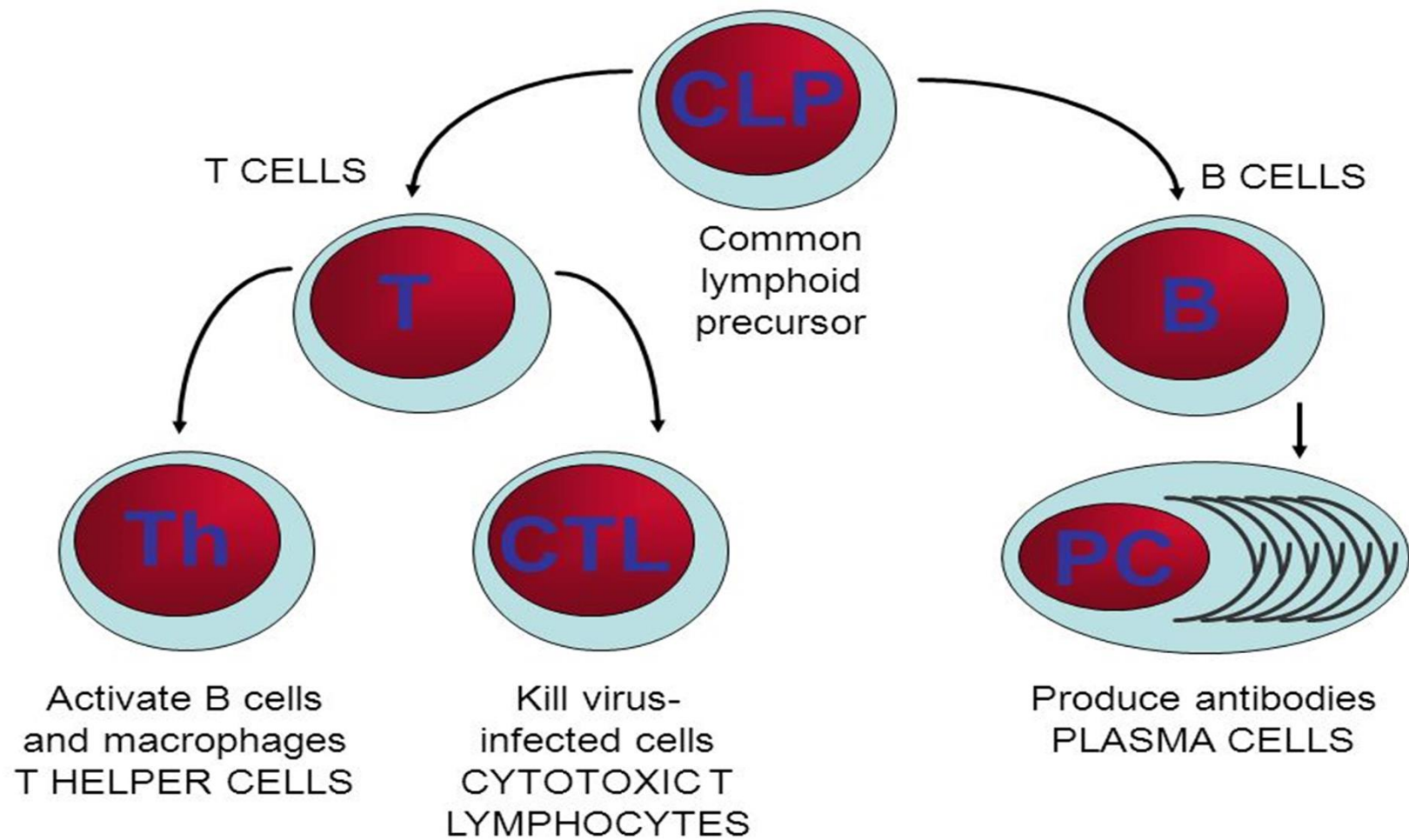


Cells of the Adaptive Immune Response

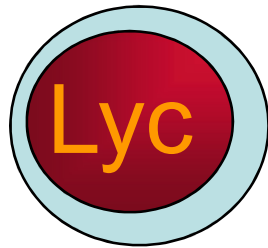
T and B lymphocytes

respond to antigen (molecules that elicit a specific immune response when introduced into the tissues of an animal).

Lymphocyte subsets



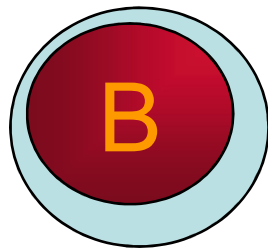
Lymphocyte antigen receptors



Until the 1960's, lymphocytes had no known function.

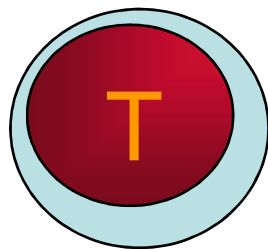
T and B cells are essentially inactive until they encounter antigen.

T and B cells express **ANTIGEN RECEPTORS**



The B cell antigen receptor is a membrane-bound antibody

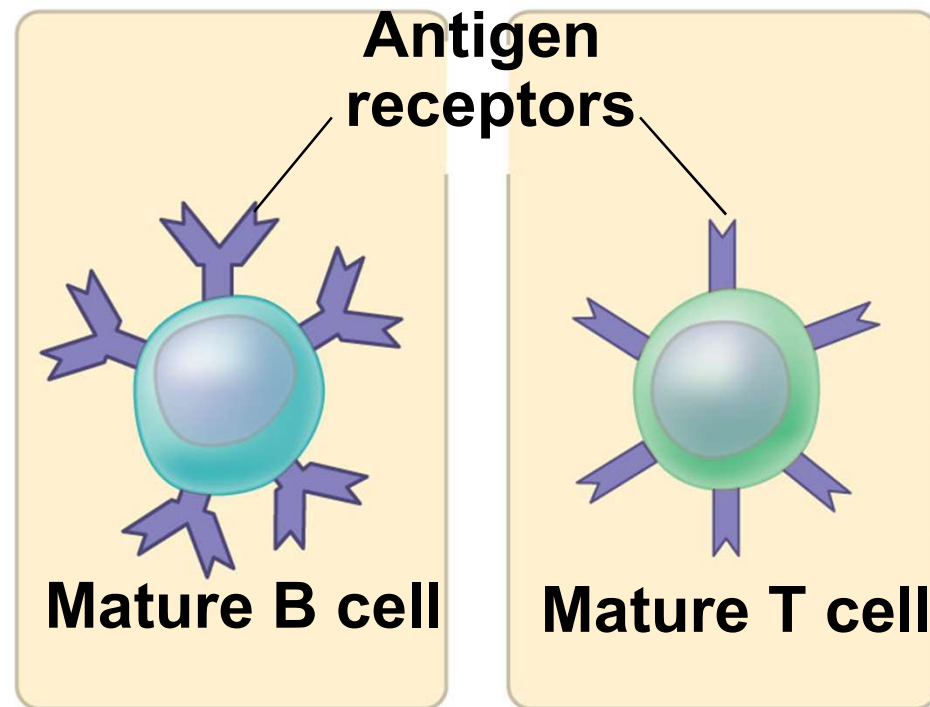
SURFACE IMMUNOGLOBULIN



The T cell antigen receptor IS NOT membrane bound antibody but a distinct molecule

T CELL ANTIGEN RECEPTOR

Figure 43.UN01



- **Antigens:** are substances that can elicit a response from a B or T cell
- Exposure to the pathogen activates B and T cells with **antigen receptors** specific for parts of that pathogen
- The small accessible part of an antigen that binds to an antigen receptor is called an **epitope**
- **Antibody**
 - Y-shaped antigen receptor (protein), made only by B cells, that binds only to the antigen that prompted its synthesis
 - Facilitates phagocytosis, or neutralizes pathogens or toxins

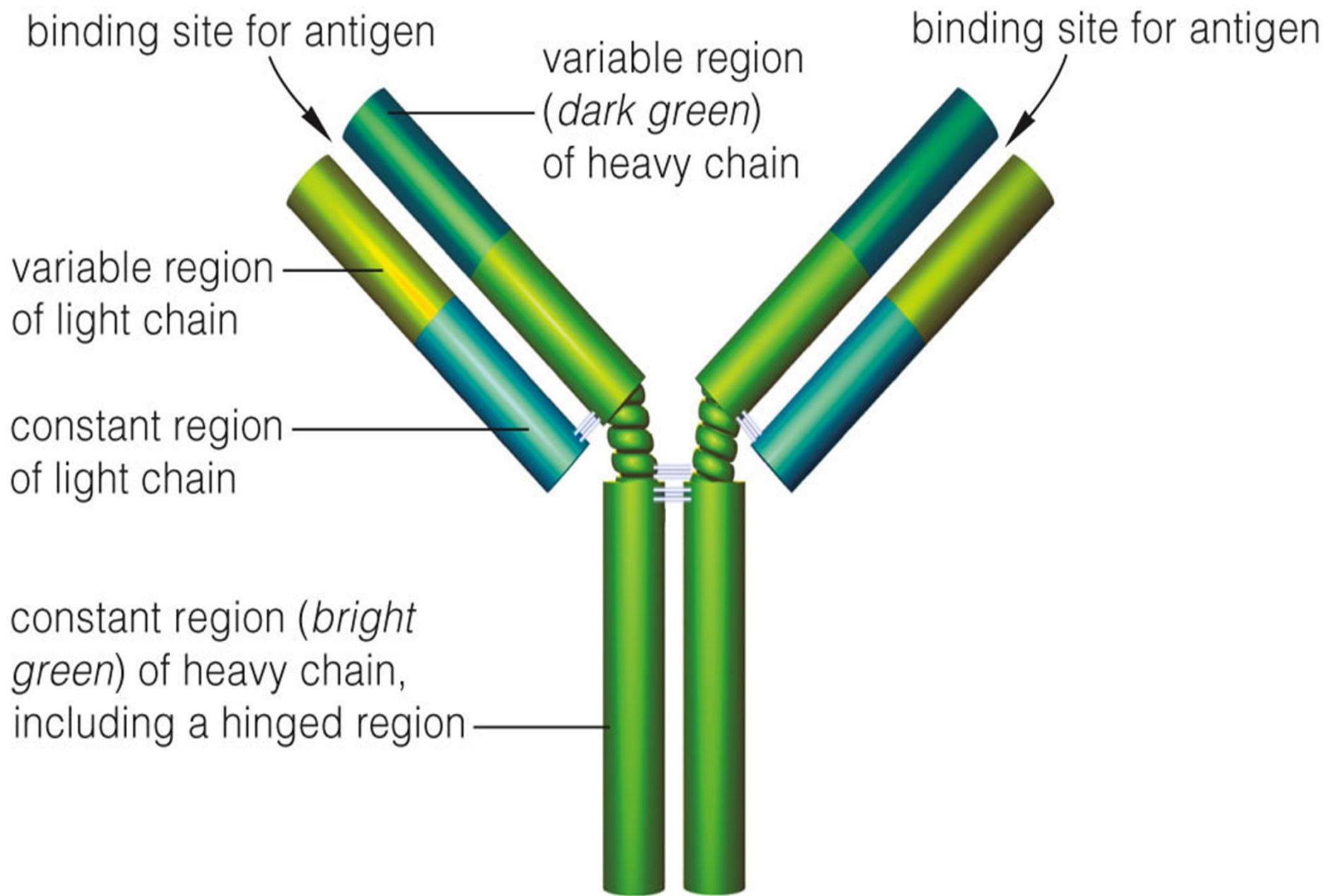
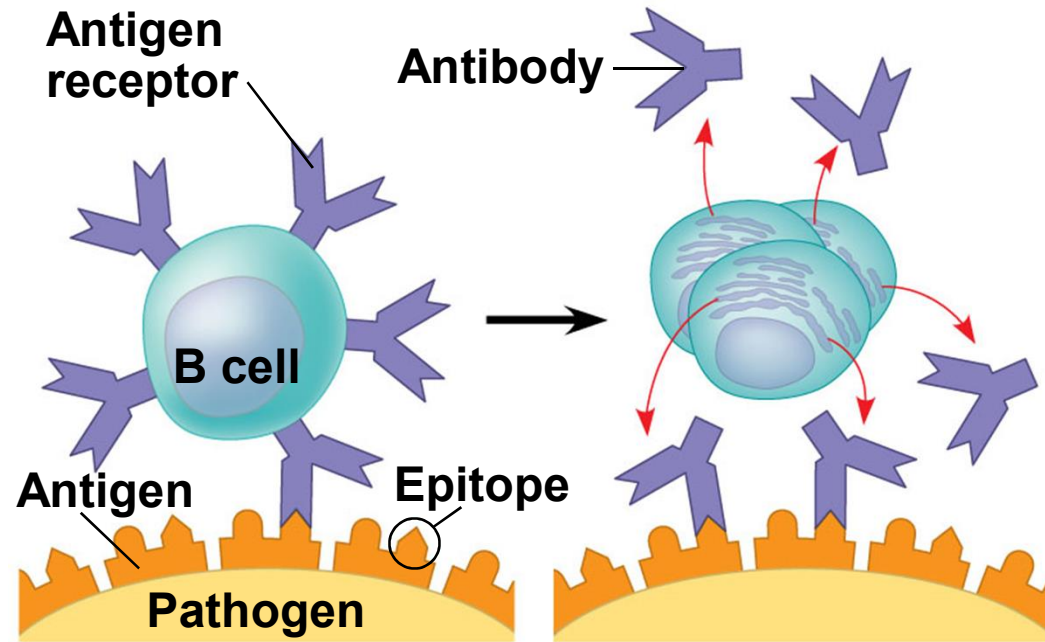
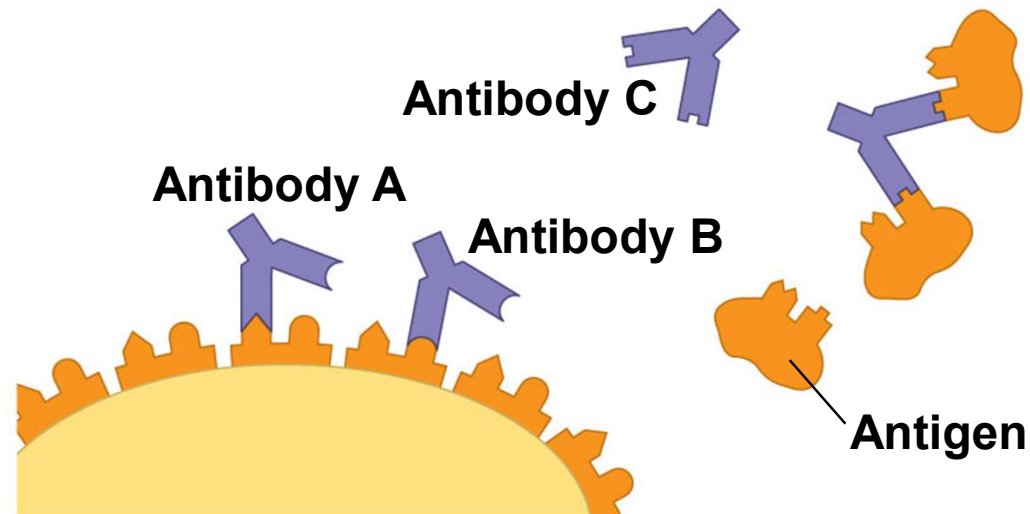


Figure 43.10

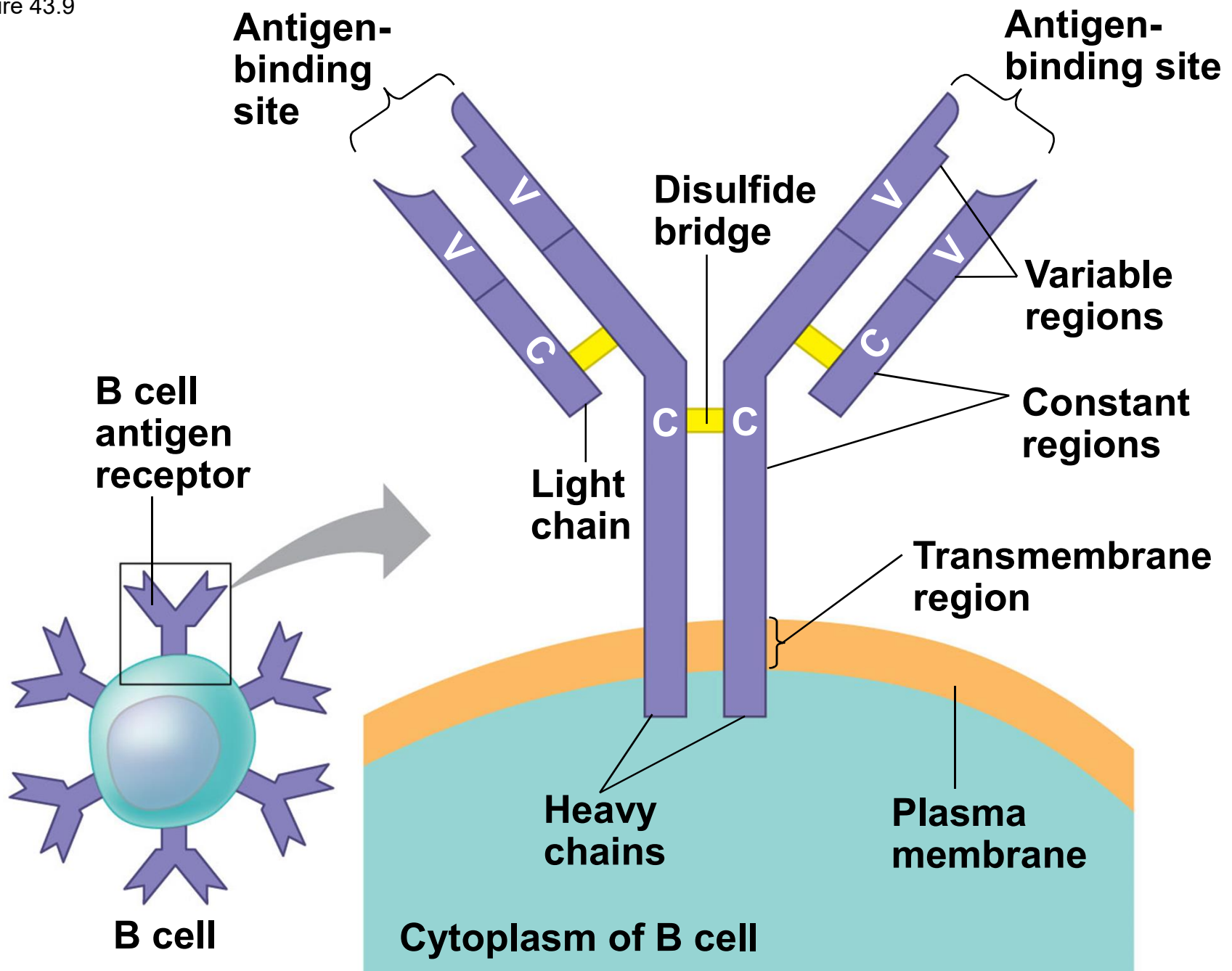


(a) B cell antigen receptors and antibodies



(b) Antigen receptor specificity

Figure 43.9



Antigen Recognition by B Cells and Antibodies

- Each B cell antigen receptor is a Y-shaped molecule with two identical **heavy chains** and two identical **light chains**
- The constant regions of the chains vary little among B cells, whereas the variable regions differ greatly
- The variable regions provide antigen specificity

- Binding of a B cell antigen receptor to an antigen is an early step in B cell activation
- This gives rise to cells that secrete a soluble form of the protein called an **antibody** or **immunoglobulin (Ig)**
- Secreted antibodies are similar to B cell receptors but lack transmembrane regions that anchor receptors in the plasma membrane

Antigen Recognition by T Cells

- Each T cell receptor consists of two different polypeptide chains (called α and β)
- The tips of the chain form a variable (V) region; the rest is a constant (C) region
- T cell and B cell antigen receptors are functionally different

Figure 43.11

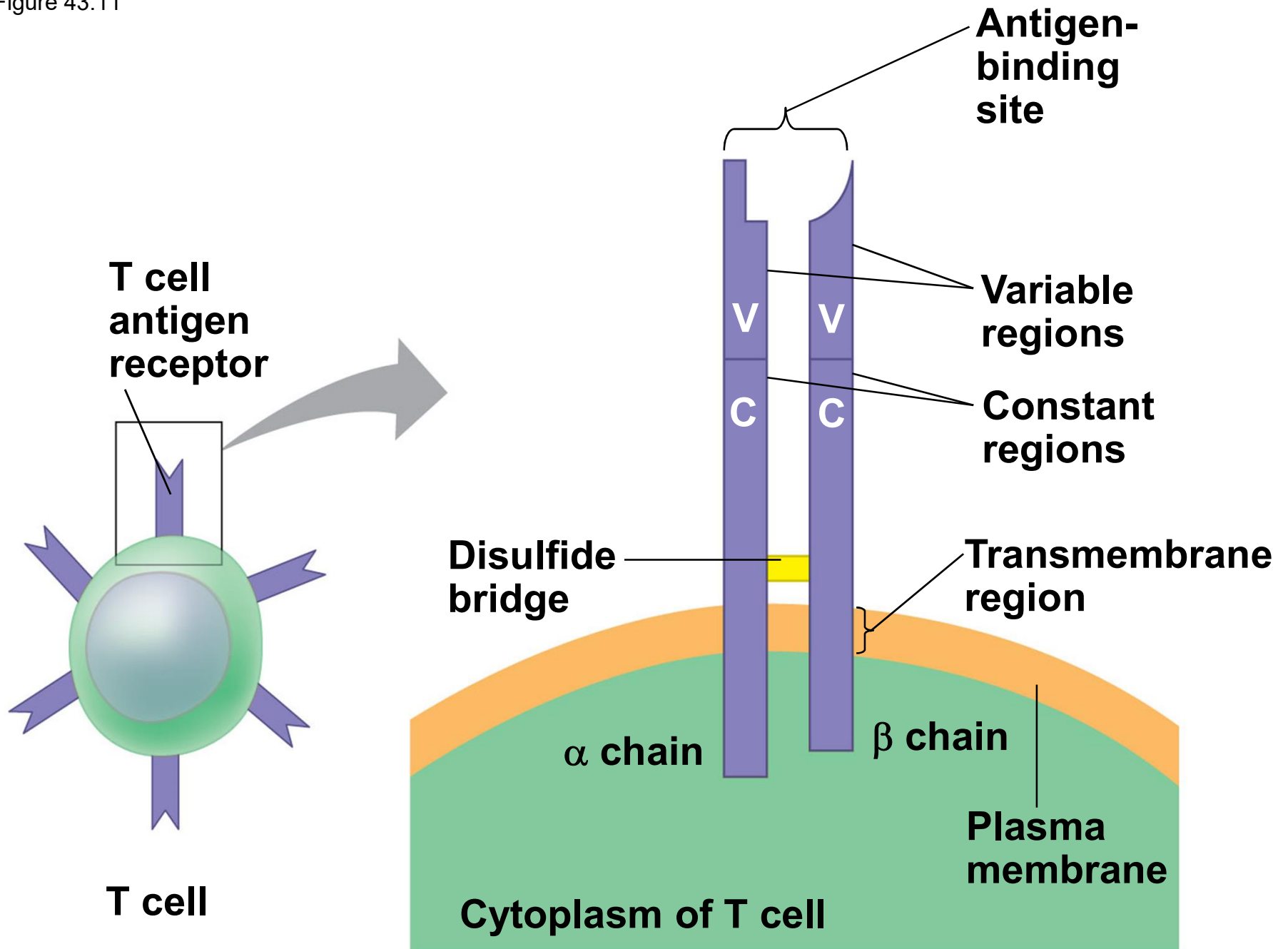


Figure 43.2

