

Chapter 43

The Immune System

PowerPoint® Lecture Presentations for

Biology

Eighth Edition

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Overview: Reconnaissance, Recognition, and Response

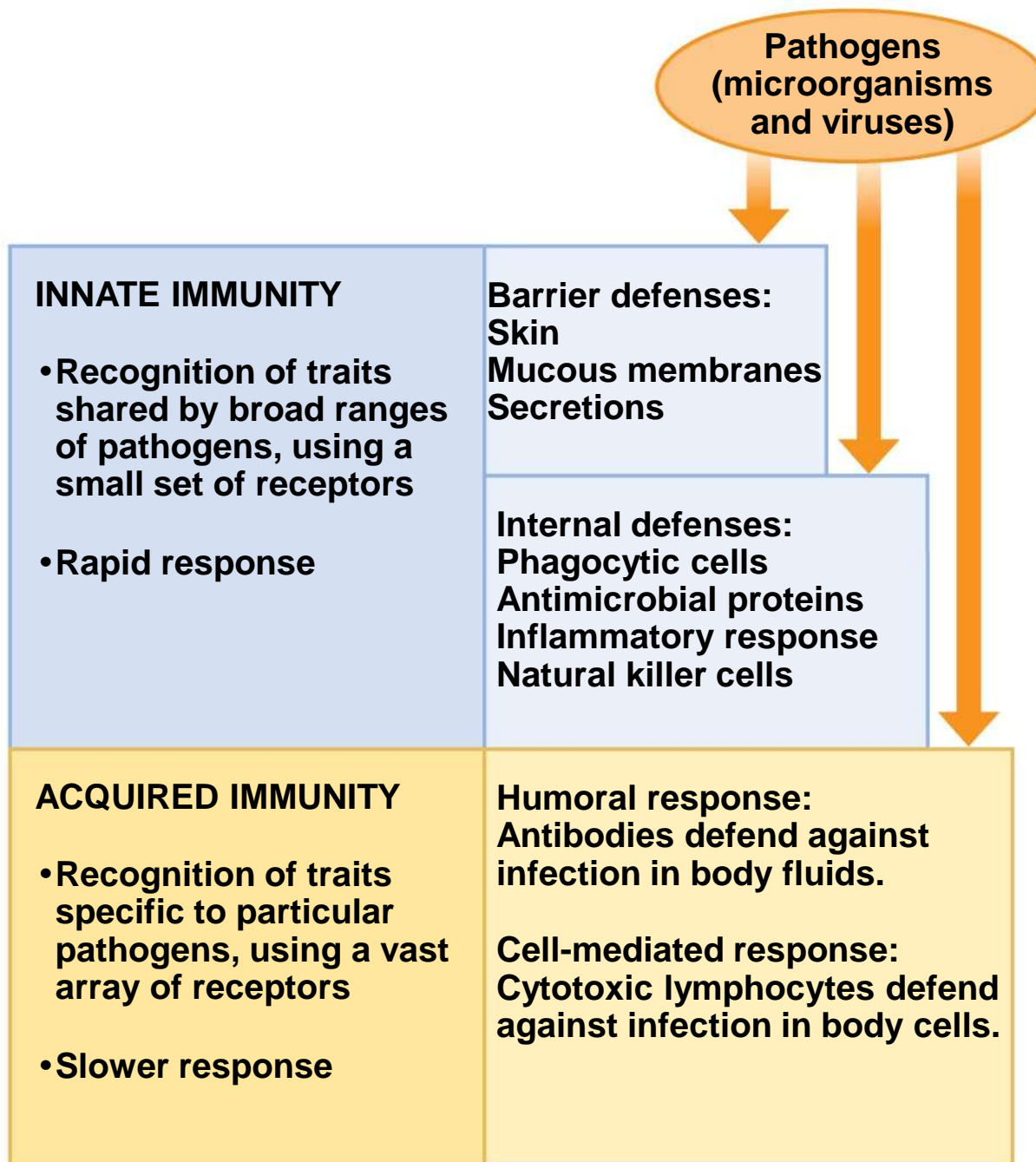
- Barriers help an animal to defend itself from the many dangerous **pathogens** it may encounter
- The **immune system recognizes foreign bodies and responds with the production of immune cells and proteins**
- **Two** major kinds of defense have evolved: **innate immunity** and **acquired (adaptive) immunity**

- **Innate immunity** is present before any exposure to pathogens and is effective from the time of birth
- It involves nonspecific responses to pathogens
- **Acquired immunity**, or adaptive immunity, develops after exposure to agents such as microbes, toxins, or other foreign substances
- It involves a very specific response to pathogens

Innate Immunity of Vertebrates

- The **immune system** of mammals is the best understood of the vertebrates
- **Innate defenses** include barrier defenses, phagocytosis, antimicrobial peptides
- Additional defenses are unique to vertebrates: the **inflammatory response** and **natural killer cells**

Fig. 43-2



Barrier Defenses

- **Barrier defenses** include the skin and mucous membranes of the respiratory, urinary, and reproductive tracts
- *Mucus* traps and allows for the removal of microbes
- Many body fluids including saliva, mucus, and tears are hostile to microbes
- The *low pH of skin* and the digestive system prevents growth of microbes

Antimicrobial Peptides and Proteins

- Peptides and proteins function in innate defense by attacking microbes **directly** or **impeding their reproduction**
- **Interferon** proteins provide innate defense **against viruses** and help activate macrophages

Inflammatory Responses

- Following an injury, **mast cells** release **histamine**, which promotes changes in blood vessels; this is part of the **inflammatory response**
- These changes **increase local blood supply** and **allow more phagocytes and antimicrobial proteins to enter tissues**
- ***Pus***, a fluid rich in white blood cells, dead microbes, and cell debris, accumulates at the site of inflammation

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- Inflammation can be either **local** or **systemic** (throughout the body)
 - **Fever** is a systemic inflammatory response triggered by **pyrogens** released by **macrophages**, and toxins from pathogens
 - **Septic shock** is a life-threatening condition caused by an overwhelming inflammatory response

Natural Killer Cells

- All cells in the body (except red blood cells) have a **class 1 MHC** (Major histocompatibility complex) protein on their surface
- Cancerous or infected cells no longer express this protein; **natural killer (NK) cells** attack these damaged cells

Concept 43.2: In **acquired immunity**, lymphocyte receptors provide pathogen-specific recognition

- White blood cells called **lymphocytes** recognize and respond to **antigens**, foreign molecules
- Lymphocytes that mature in the **thymus** above the heart are called **T cells**, and those that mature in **bone marrow** are called **B cells**
- Lymphocytes contribute to **immunological memory**, an enhanced response to a foreign molecule encountered previously

Acquired Immunity: *An Overview*

- **B cells** and **T cells** have receptor proteins that can bind to foreign molecules
- Each individual lymphocyte is specialized to recognize a specific type of molecule
- An **antigen** is any foreign molecule to which a lymphocyte responds
- A single **B cell** or **T cell** has about 100,000 identical **antigen receptors**

Acquired Immunity: *An Overview*

- **Lymphocytes** bind to **specific** antigens in blood, lymph nodes, spleen, tonsils, mucosa
 - **B cells:**
 - Provide **humoral immunity**
 - Plasma cells secrete **antibodies**

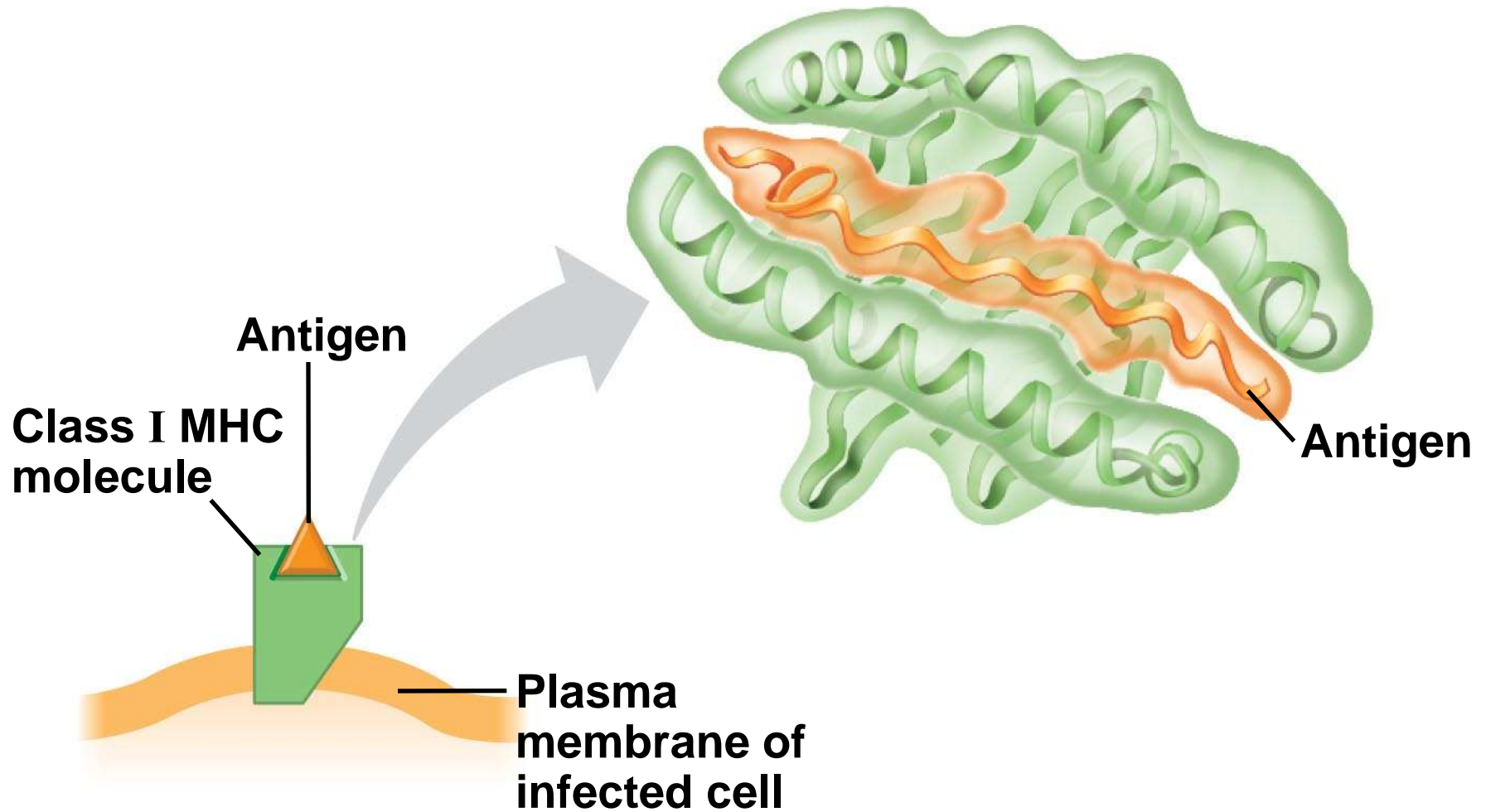
Acquired Immunity: *An Overview*

- **Functions of antibodies**
- Antibodies activate **complements** – groups of plasma proteins
- Antibodies block sites on viruses and bacterial exotoxins
- Antibodies cause **agglutination** – (clumping of cells) and **precipitation** (soluble molecules come out of solution)

Acquired Immunity: *An Overview*

- **T-cells**
- T-cells provide **cell-mediated immunity**
- Activated by **antigen-presenting cells** (APCs)
- APCs phagocytize antigens, thus presenting antigen to T-cells to activate them

Antigen presentation by an MHC molecule



Acquired Immunity: *An Overview*

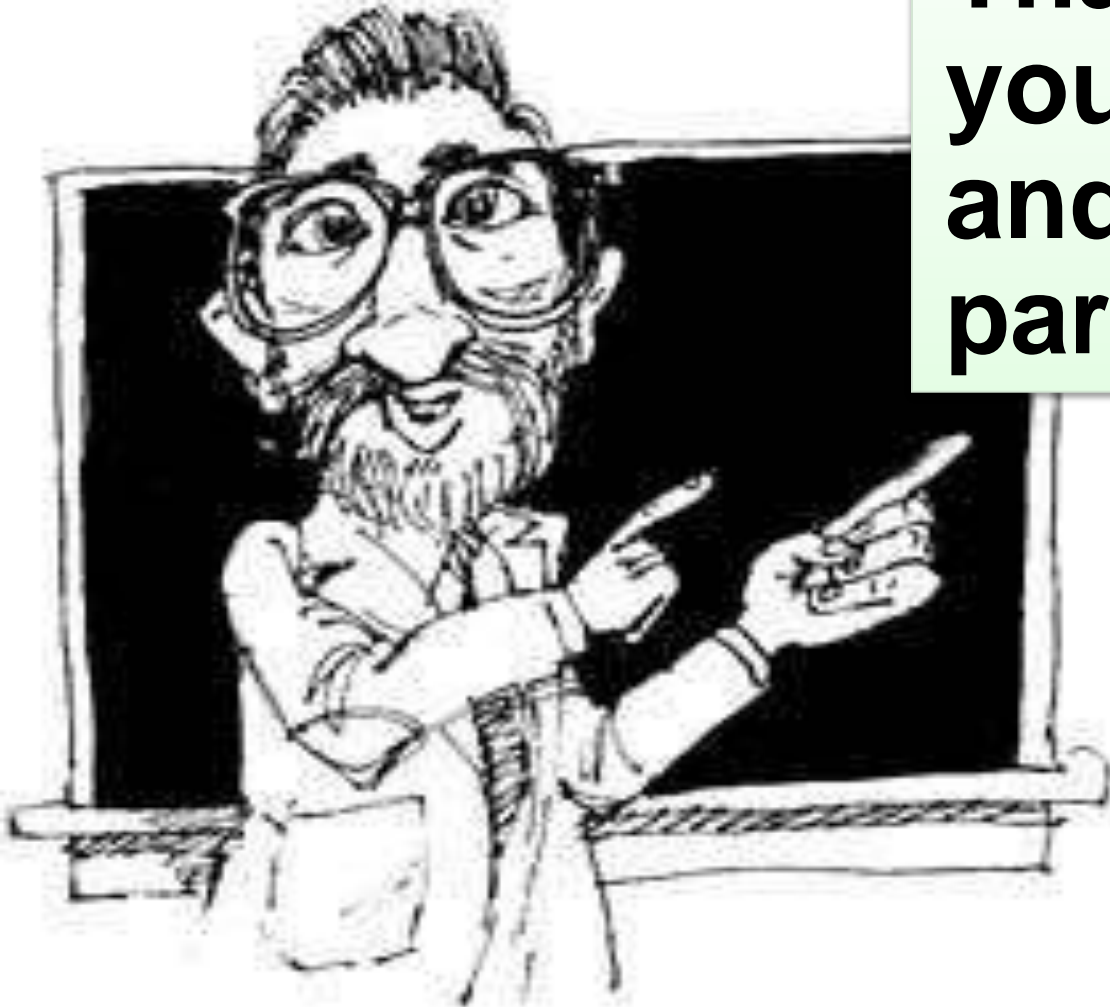
- **Helper T cells**: **stimulate proliferation** of other T cells and B cells, signaling antibody production to begin
- **Cytotoxic T cells**: attack and kill foreign cells
- The first exposure to a specific antigen represents the **primary immune response**
- Next exposures to the same antigen are called **secondary immune response**
- **Memory T cells**: in the secondary immune response, memory cells facilitate a faster, more efficient response



Questions?

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**Thank you for
your attention
and
participation!**



You should now be able to:

1. Distinguish between innate and acquired (adapted) immunity
2. Describe the inflammation response
3. Distinguish between the following pairs of terms: antigens and antibodies; B lymphocytes and T lymphocytes; primary and secondary immune responses; humoral and cell-mediated response;
4. Describe the cellular basis for immunological memory