



Mustansiriyah
University

Introduction to Immunity

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Overview

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Background

Definition:

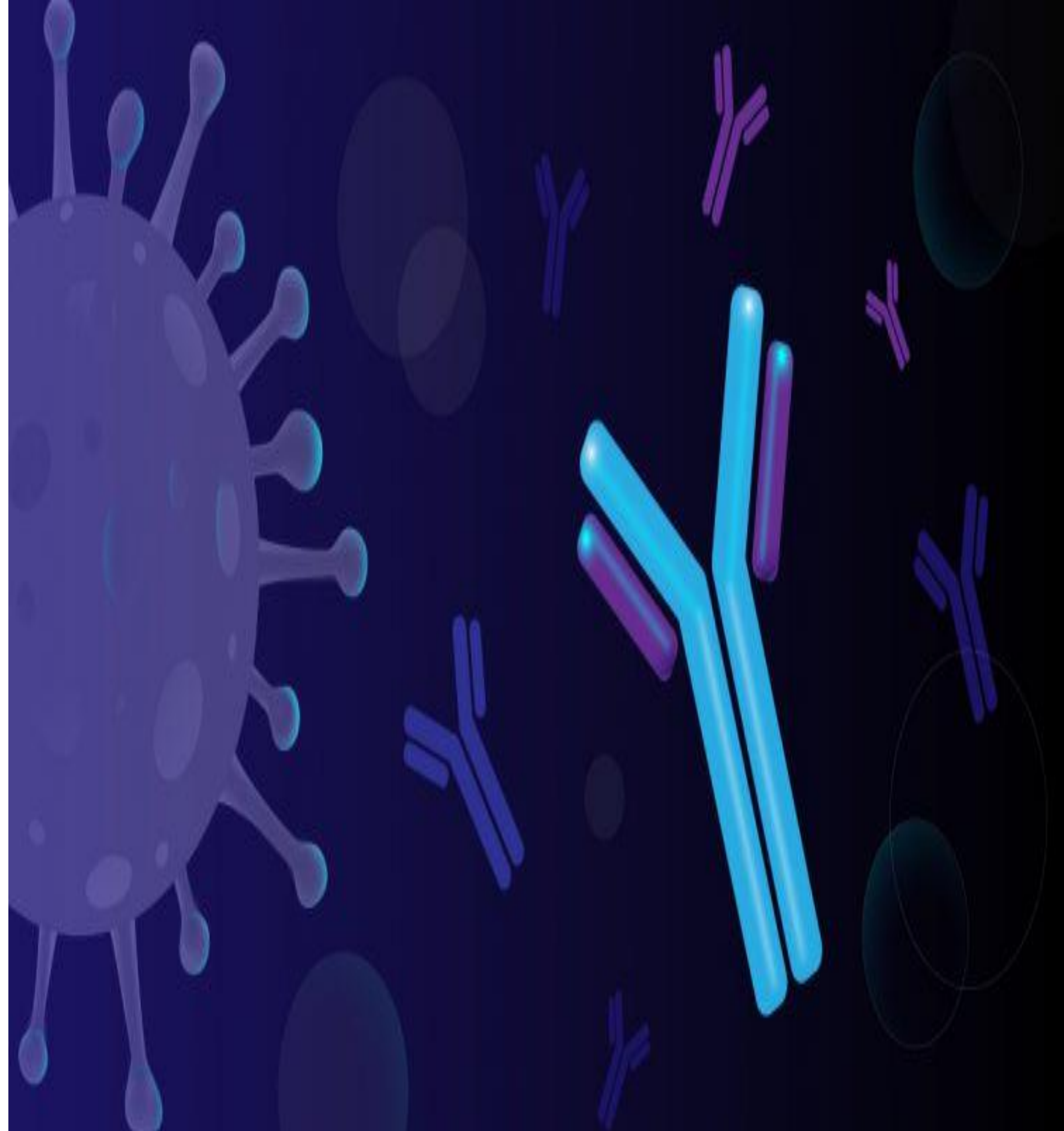
Immunity is the body's ability to recognize and defend itself against harmful substances, such as pathogens (bacteria, viruses, fungi), toxins, and foreign bodies.

Role of Immunity:

Protects the body from infections and diseases, maintains internal balance by eliminating harmful invaders and differentiates between self and non-self elements.

Importance in Health:

- Prevents disease onset and progression.
- Important in vaccine effectiveness.
- Plays a role in inflammation and immune surveillance.



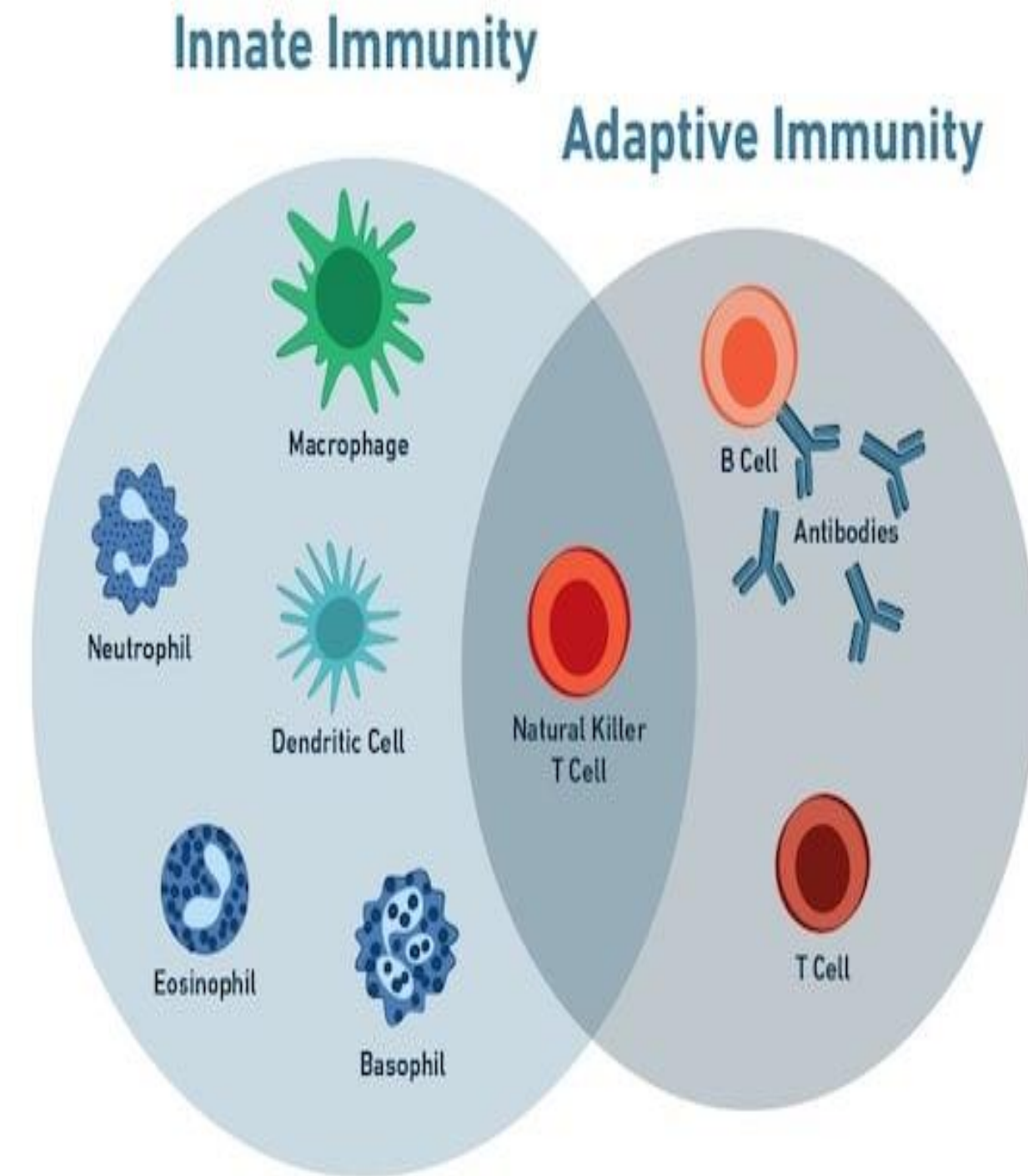
Types of Immunity

1. Innate Immunity (Non-specific):

- Existing from birth.
- Responds rapidly to a broad range of pathogens.
- Includes physical barriers (skin), chemical barriers (enzymes), and immune cells (phagocytes, natural killer cells).

2. Adaptive Immunity (Specific):

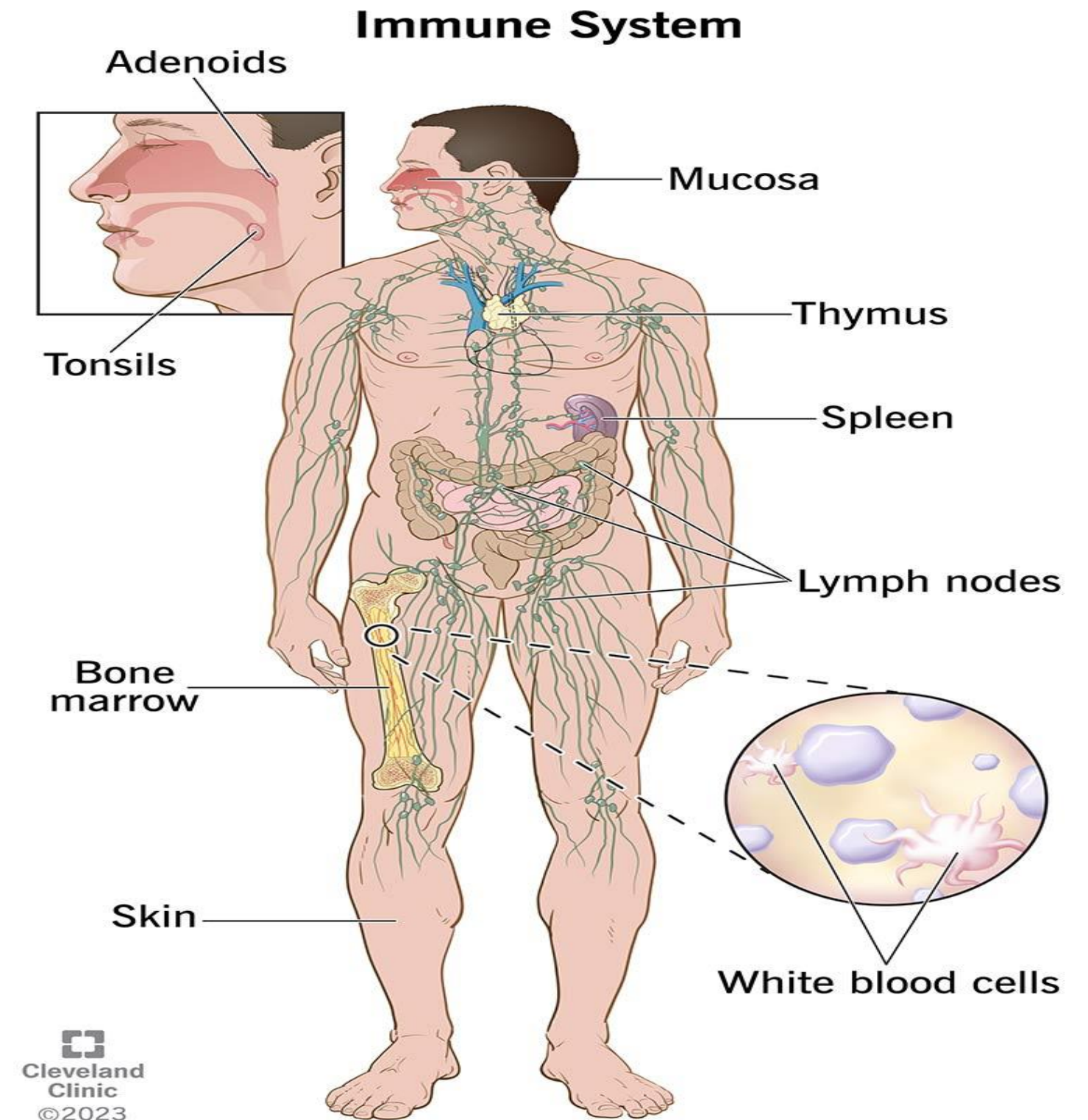
- Develops after exposure to specific antigens.
- Involves lymphocytes (T cells and B cells).
- Has memory — provides long-term protection.



Components of the Immune System

The immune system is a complex network of cells, tissues, and organs that work together to defend the body against harmful pathogens.

It consists of two main components: the **innate** and **adaptive** immune systems. The innate immune system is the body's first defense, using physical barriers (like skin), chemical defenses (such as stomach acid), and immune cells (like macrophages and neutrophils) that respond quickly to infections. The adaptive immune system provides a more targeted, long-lasting defense, involving B cells that produce antibodies and T cells that attack infected cells. These systems work together with the lymphatic (the spleen, lymph nodes, and bone marrow) helping produce, mature, and transport immune cells. This coordinated response offers both immediate and lasting protection against pathogens.

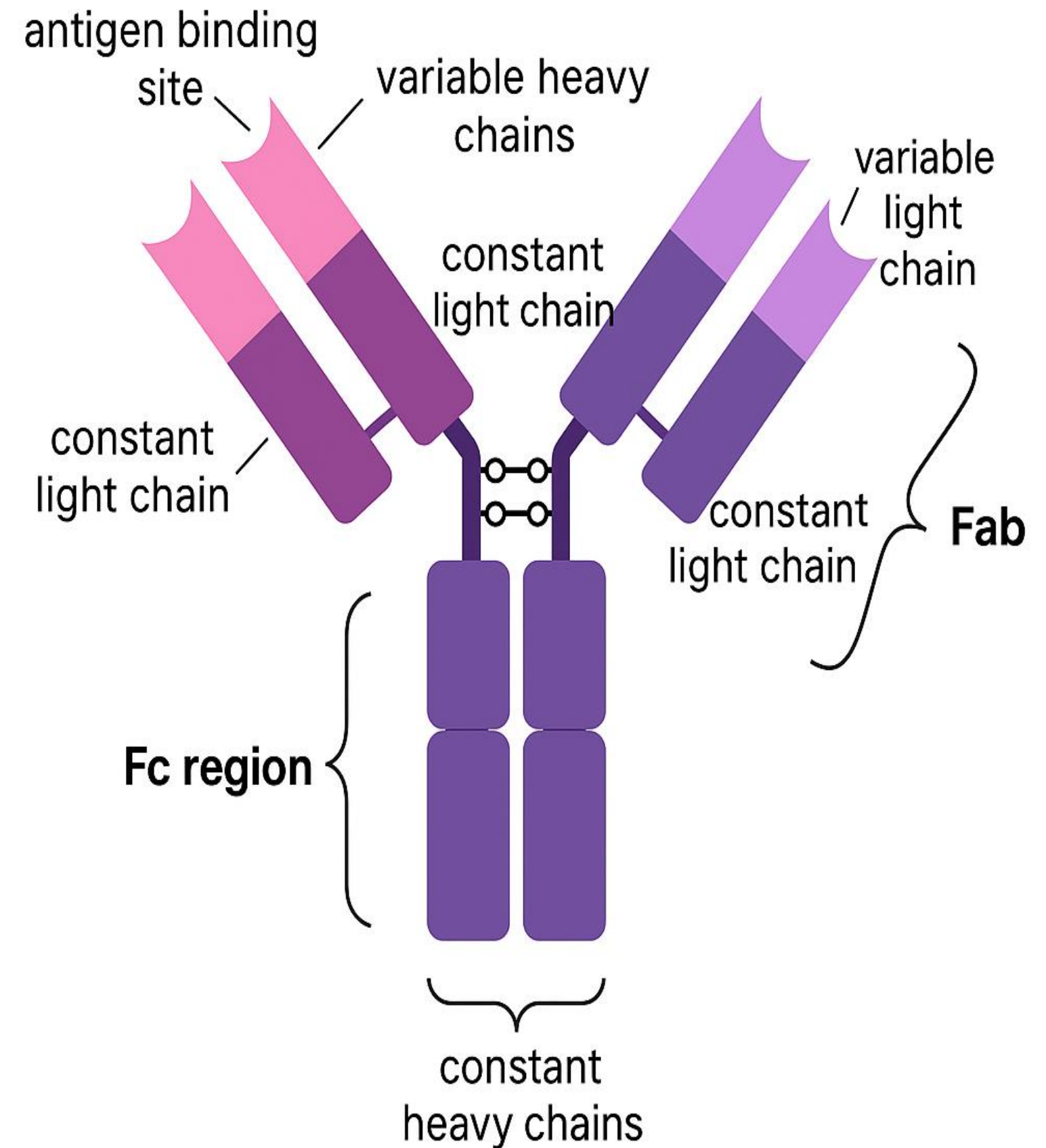


Innate vs. Adaptive Immunity

Feature	Innate Immunity	Adaptive Immunity
✓ Response Time	Immediate (minutes to hours)	Delayed (days to weeks)
✓ Specificity	Non-specific (general response to pathogens)	Highly specific to particular antigens
✓ Memory	No memory; same response each time	Has memory; faster and stronger on re-exposure
✓ Cells Involved	Macrophages, neutrophils, dendritic cells, NK cells	B cells, T cells (helper and cytotoxic)
✓ Recognition Mechanism	Recognizes common pathogen-associated patterns	Recognizes specific antigens via receptors
✓ Evolutionary Origin	More ancient, present in all multicellular organisms	More recent, present only in vertebrates
✓ Activation	Always present and ready to act	Requires activation and clonal expansion
✓ Effectors	Phagocytosis, inflammation, antimicrobial peptides	Antibodies, cytotoxic T cells, memory cells

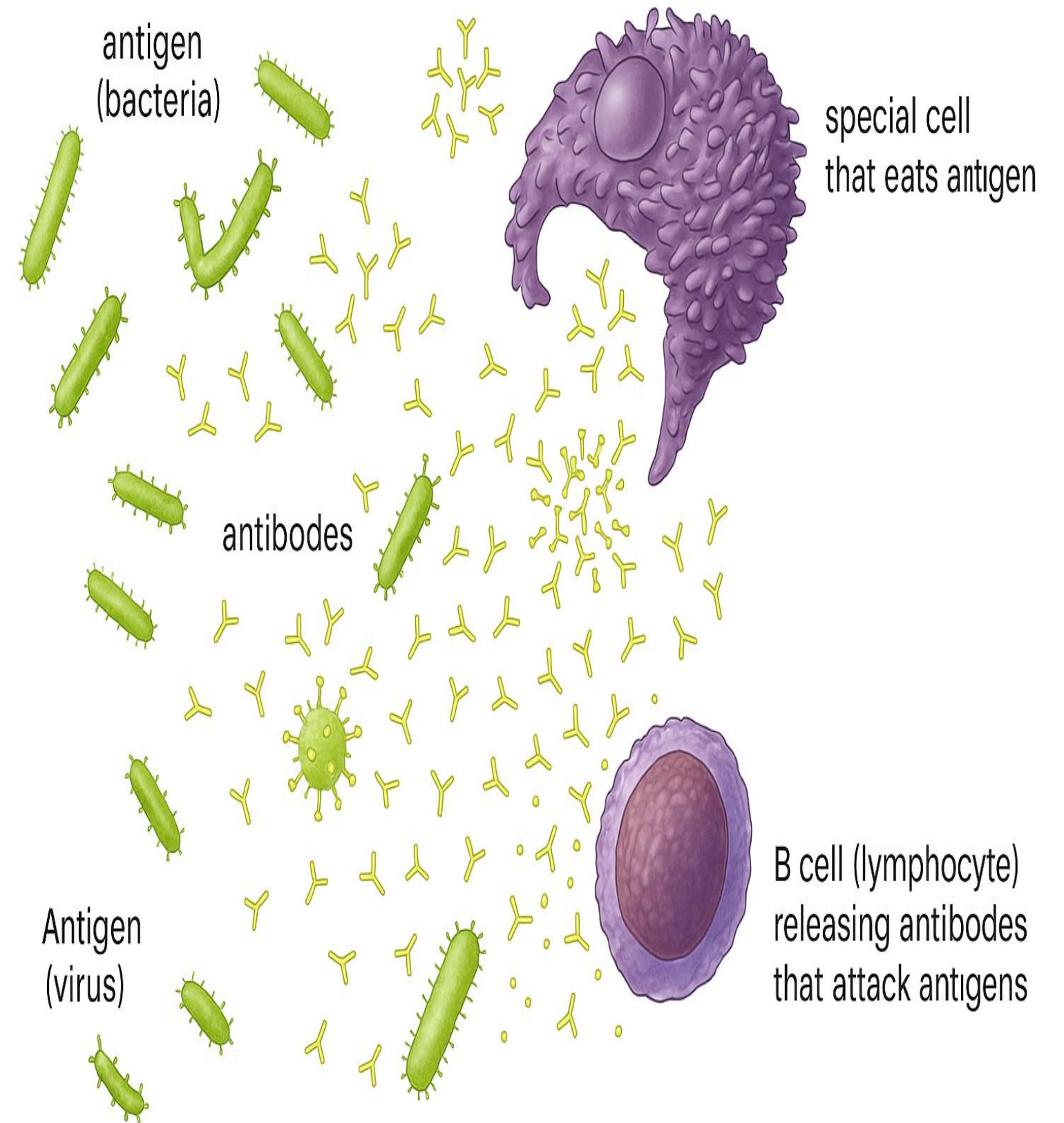
Antibody vs. Antigen

An antibody: also known as an immunoglobulin, is a specialized protein produced by **B lymphocytes** (a type of white blood cell) in response to the presence of an antigen. Antibodies are Y-shaped molecules that recognize and bind specifically to a particular part of an antigen called the **epitope**. Once bound, antibodies help neutralize the antigen directly or mark it for destruction by other immune cells. They play a crucial role in the **adaptive immune system**, offering targeted defense and long-term immunity by remembering past infections. There are several types of antibodies (**IgG, IgA, IgM, IgE, and IgD**), each with specific functions in immune defense.



Antibody vs. Antigen

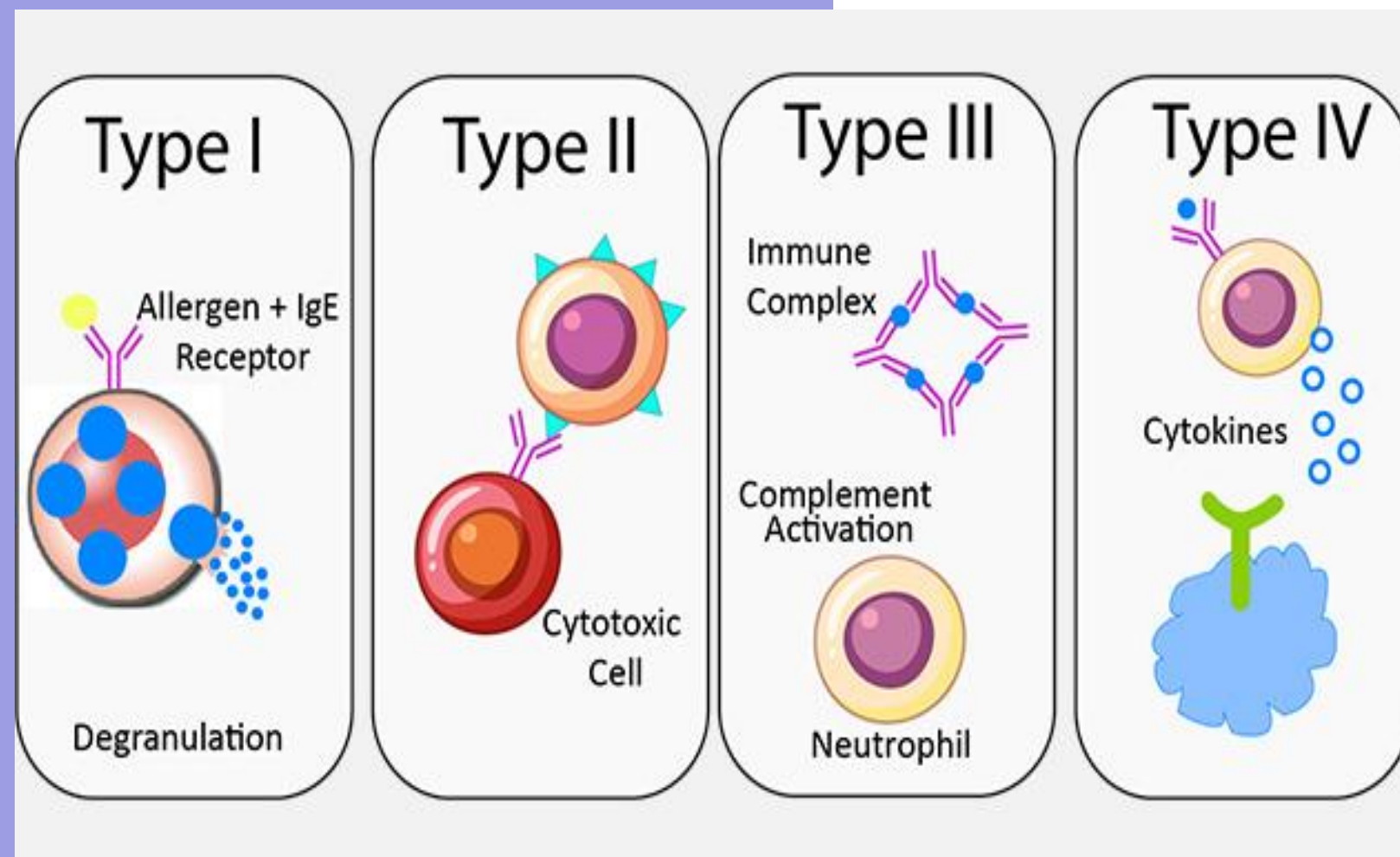
Antigen: is any **foreign substance** that can provoke an immune response in the body. Antigens are usually **proteins** or **polysaccharides** found on the surface of pathogens such as bacteria, viruses, fungi, or even non-living substances like pollen and toxins. When the immune system detects an antigen, it recognizes it as non-self and initiates a defensive response, often involving the production of antibodies. Each antigen has unique molecular structures that allow the immune system to distinguish between different threats, ensuring **specific and effective immune responses**.



Antibody vs. Antigen

Feature	Antigen	Antibody
➤ Definition	A foreign substance that triggers an immune response	A protein produced by B cells in response to an antigen
➤ Nature	Typically proteins, polysaccharides, or other biomolecules	Y-shaped protein (immunoglobulin)
➤ Function	Stimulates the production of antibodies	Binds specifically to antigens to neutralize or mark them
➤ Origin	Comes from pathogens like bacteria, viruses, or allergens	Produced by the immune system (specifically plasma B cells)
➤ Specificity	Each antigen has specific sites (epitopes)	Each antibody is specific to a particular epitope of an antigen
➤ Role in Immunity	Triggers immune response	Acts in defense by targeting and helping eliminate the antigen

Hypersensitivity

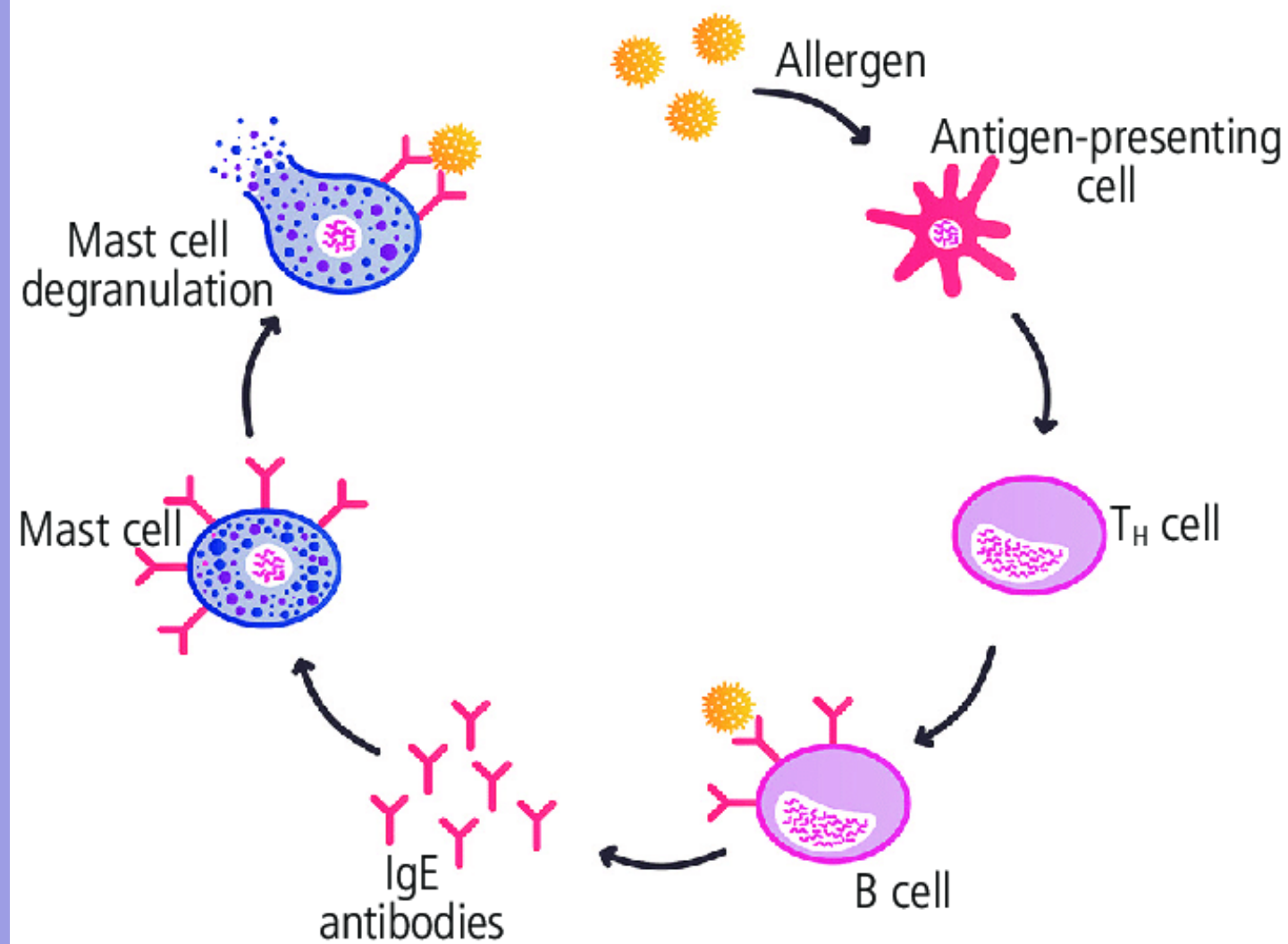


Hypersensitivity is an overreaction of the immune system to a normally harmless substance, which can cause tissue damage, disease, or even life-threatening reactions

Classification :

- ❖ **Type I hypersensitivity**
- ❖ **Type II hypersensitivity**
- ❖ **Type III hypersensitivity**
- ❖ **Type IV hypersensitivity**

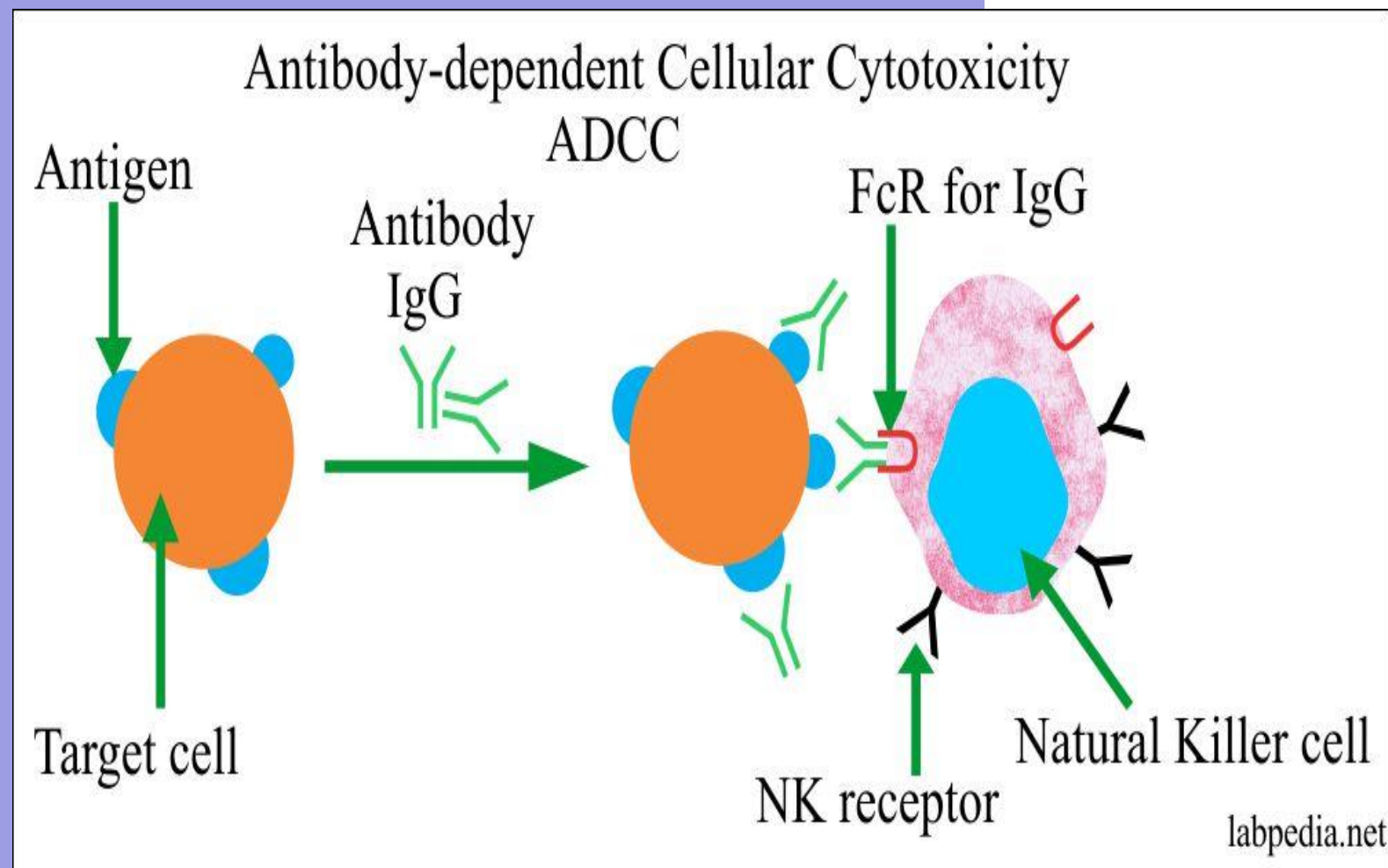
Type I hypersensitivity



Type I hypersensitivity, also known as anaphylactic or immediate hypersensitivity.

It is a fast allergic reaction caused by exposure to allergens like pollen or peanuts. It involves the production of **IgE** antibodies that attach to mast cells and basophils. When re-exposed, these cells release substances like histamine, leading to allergy symptoms such as hives or anaphylaxis. In some cases, a delayed reaction occurs hours later, causing prolonged inflammation and tissue damage. This response is mainly driven by **Th2** cells and certain cytokines, and may lead to chronic conditions like asthma.

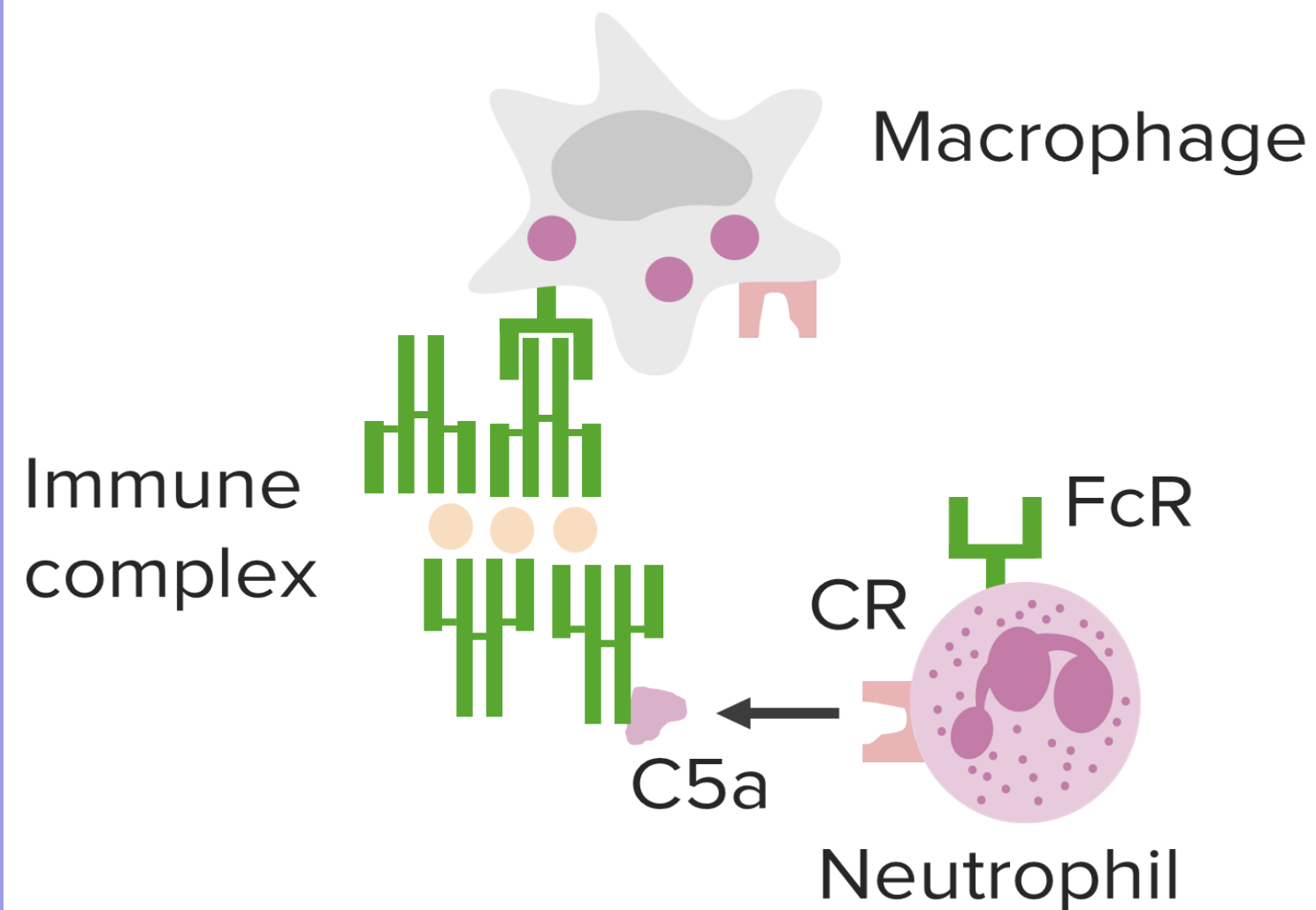
Type II hypersensitivity



Type II hypersensitivity, also called antibody-mediated cytotoxic hypersensitivity.

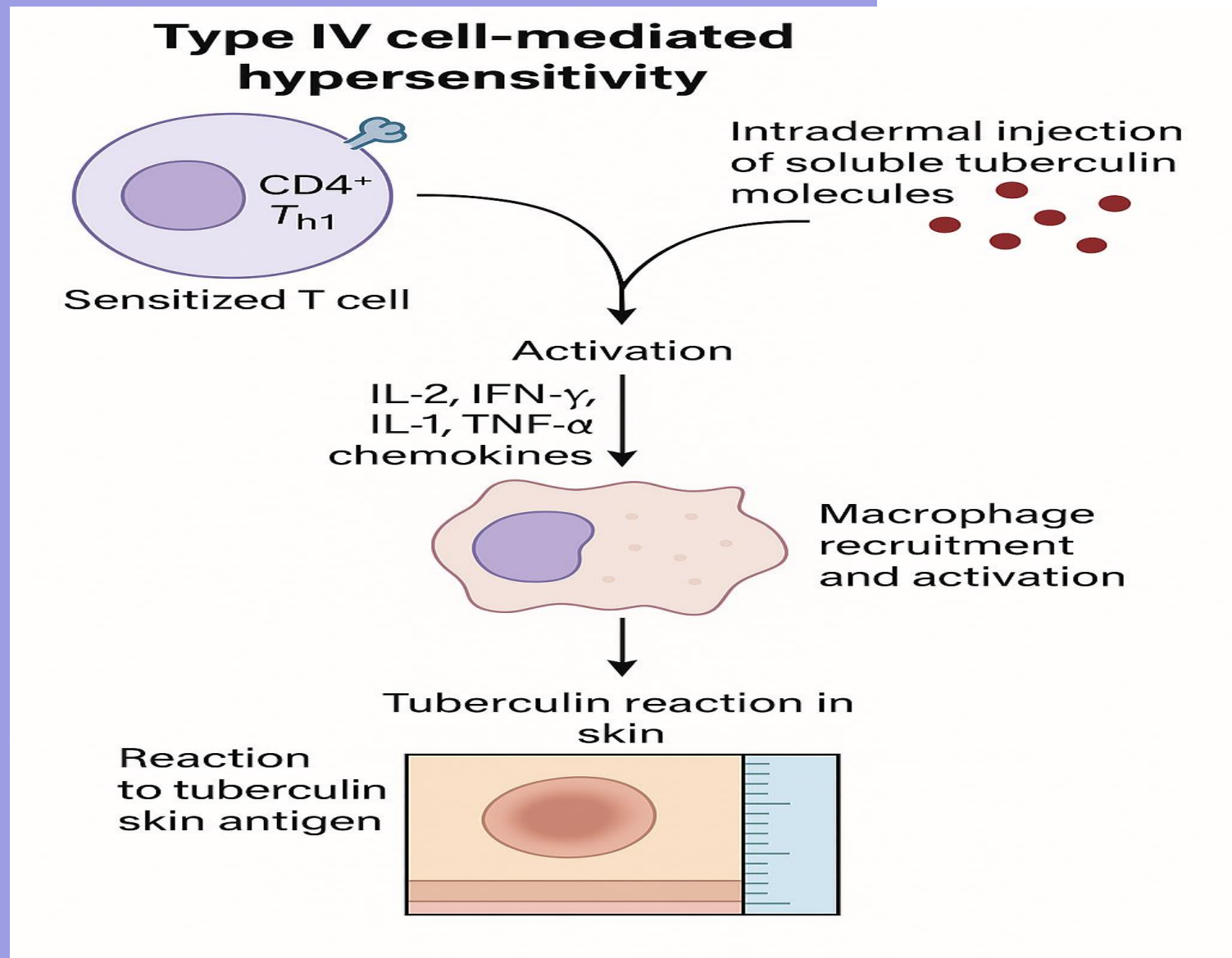
It is a rapid immune response that occurs within hours of antigen exposure. It involves **IgG** and **IgM** antibodies targeting antigens on cell surfaces, which may be self-antigens or foreign ones, such as in blood transfusion reactions. This binding can lead to cell destruction, impaired function, or abnormal activation. Cell damage occurs through complement activation, opsonization, or antibody-dependent cellular cytotoxicity (ADCC), where immune cells release toxic substances to kill the target cell. Examples include autoimmune hemolytic anemia, hemolytic disease of the newborn, and transfusion reactions.

Type III hypersensitivity



Type III hypersensitivity, or immune complex–mediated hypersensitivity, is a rapid immune response that occurs a few hours after exposure to a soluble antigen. It involves IgG or IgM antibodies forming antigen–antibody complexes that, if not cleared, deposit in tissues such as blood vessels, kidneys, joints, and lungs. These deposits activate complement, leading to inflammation and tissue damage through the release of immune mediators and enzymes. This reaction can be localized or systemic, and is seen in conditions like serum sickness, the Arthus reaction, systemic lupus erythematosus (SLE), and rheumatoid arthritis, as well as in response to certain drugs, infections, or insect stings.

Type IV hypersensitivity



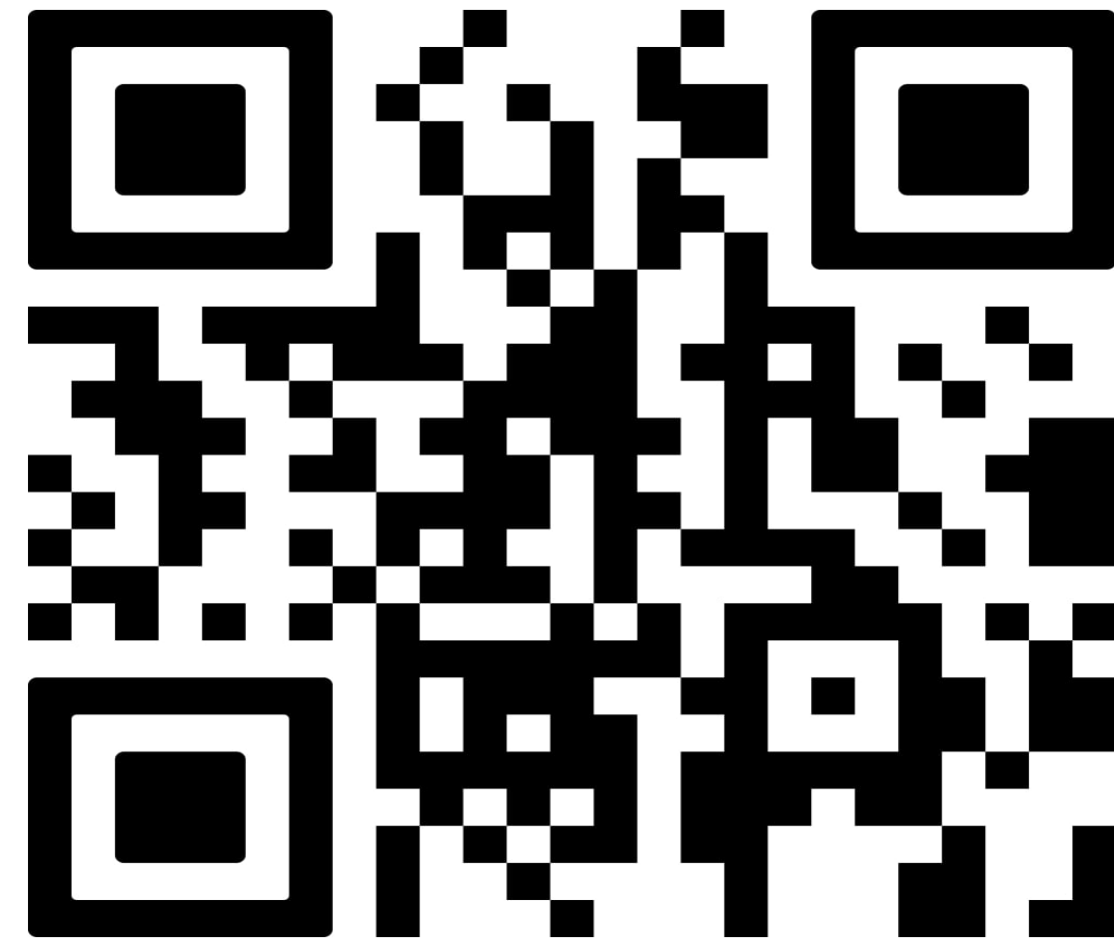
Type IV hypersensitivity, also known as cell-mediated or delayed hypersensitivity, is an immune response driven by sensitized T cells rather than antibodies. Symptoms typically appear 48–72 hours after antigen exposure. The response begins with an initial sensitization phase where antigen-presenting cells (like Langerhans cells and macrophages) present the antigen to naïve T cells in lymph nodes, promoting their differentiation into Th1 cells. These Th1 cells then migrate to the antigen site and release cytokines, triggering inflammation. If the antigen persists, it can lead to chronic inflammation and the formation of granulomas.

CONCLUSIONS

- ✓ **Immunity:** is the body's way of protecting itself from harmful things like germs (viruses, bacteria, parasites) and other foreign substances.
- ✓ **Innate Immunity:** This is the natural defense you are born with. It includes things like your skin, mucus, and special cells that quickly attack invaders.
- ✓ **Adaptive Immunity:** This develops as you grow and get exposed to germs. It uses special white blood cells (B cells and T cells) to remember and fight off specific germs if they come back.
- ✓ **Antibodies (Ab):** are proteins produced by B cells that specifically recognize and bind to antigens, neutralizing or marking them for destruction.
- ✓ **Antigens (Ag):** are foreign substances (like viruses, bacteria, or toxins) that trigger an immune response.
- ✓ **Hypersensitivity:** is an overreaction of the immune system to harmless substances, causing damage to the body's own tissues. It can lead to conditions like allergies, asthma, or autoimmune diseases.
- ✓ **Types of Hypersensitivity:** There are four types of hypersensitivity (I-IV), ranging from immediate allergic reactions (Type I) to delayed responses involving T cells (Type IV). Each type involves different immune components and mechanisms, leading to various symptoms and disease outcomes.

Home work

How are the four types of hypersensitivity (Type I, II, III, and IV) different in how they work, the symptoms they cause, and examples of each? Compare their main differences.



References

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Thank You

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