THE IMMUNE SYSTEM

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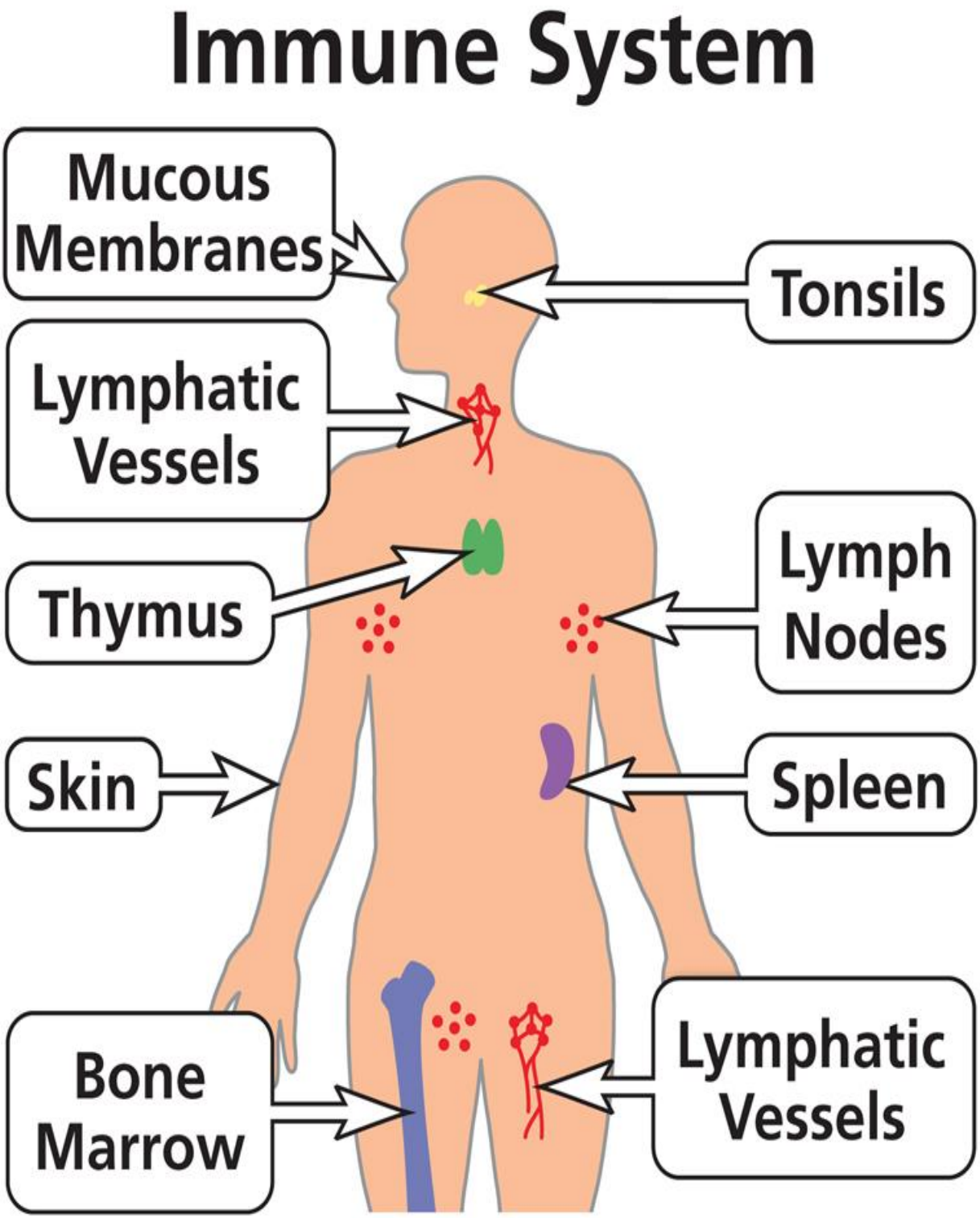
Introduction

Our immune system is essential for our survival. Without an immune system, our bodies would be open to attack from bacteria, viruses, parasites, and more. **Therefore, the immune system is responsible for maintaining health**.

If the immune system encounters a pathogen, for instance, a bacterium, virus, or parasite, it mounts a so-called **immune response**.

Origin of immunology attributed to **Edward Jenner**, where Jenner tested that **<u>infection with cowpox protected against infection with smallpox.</u>**

- The English word 'immunity' refers to all mechanisms used by the body as protection against environmental agents (microorganisms or their products; foods; chemicals; drugs; pollen; animal hair) that are foreign to the body. Arose from the Latin 'immunize' meaning 'exempt'
- The immune system must differentiate between an individual's own cells and those of harmful invading organisms. Must not attack commensal **flora** that inhabits the gut, skin, and other tissues to the host's benefit.


Immune System
Mucous Membranes
Tonsils
Lymphatic Vessels
Thymus
Lymph Nodes
Skin
Spleen
Bone Marrow
Lymphatic Vessels

Natural barriers & the immune system

Natural barriers and the immune system defend the body against organisms that can cause infection.

Natural barriers include the **skin, mucous membranes, tears, earwax, mucus, and stomach acid**. Also, the **normal flow of urine** washes out microorganisms that enter the urinary tract.

The immune system uses **white blood cells** (WBC) and **antibodies** to identify and eliminate organisms that get through the body's natural barriers.

Natural Barriers

Usually, the **skin** prevents invasion by microorganisms unless it is damaged (for example, by an injury, insect bite, or burn).

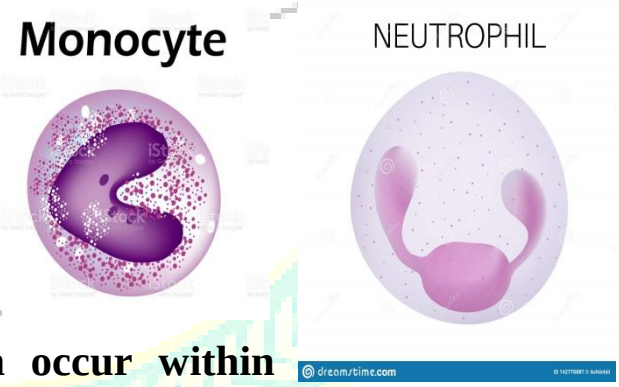
Mucous membranes, such as the lining of the mouth, nose, and eyelids, are also effective barriers. Typically, mucous membranes are coated with secretions that fight microorganisms. For example**, the mucous membranes of the eyes are bathed in tears, which contain an enzyme called lysozyme that attacks bacteria and helps protect the eyes from infection.**

The **airways filter** out particles that are present in the air that is inhaled. The walls of the passages in the nose and airways are coated with mucus. Microorganisms in the air become stuck to the mucus, which is coughed up or blown out of the nose.

The digestive tract has a series of effective barriers, including stomach acid, pancreatic enzymes, bile, and intestinal secretions. These substances can kill bacteria or prevent them from multiplying.

The urinary tract also has several effective barriers. The bladder is protected by the urethra, the tube that drains urine from the body. In males, the urethra is long enough that bacteria are seldom able to pass through it to reach the bladder unless the bacteria are unintentionally placed there by catheters or surgical instruments. In females, the urethra is shorter, occasionally allowing external bacteria to pass into the bladder. In both genders, when the bladder empties, it flushes out any bacteria that reach it.

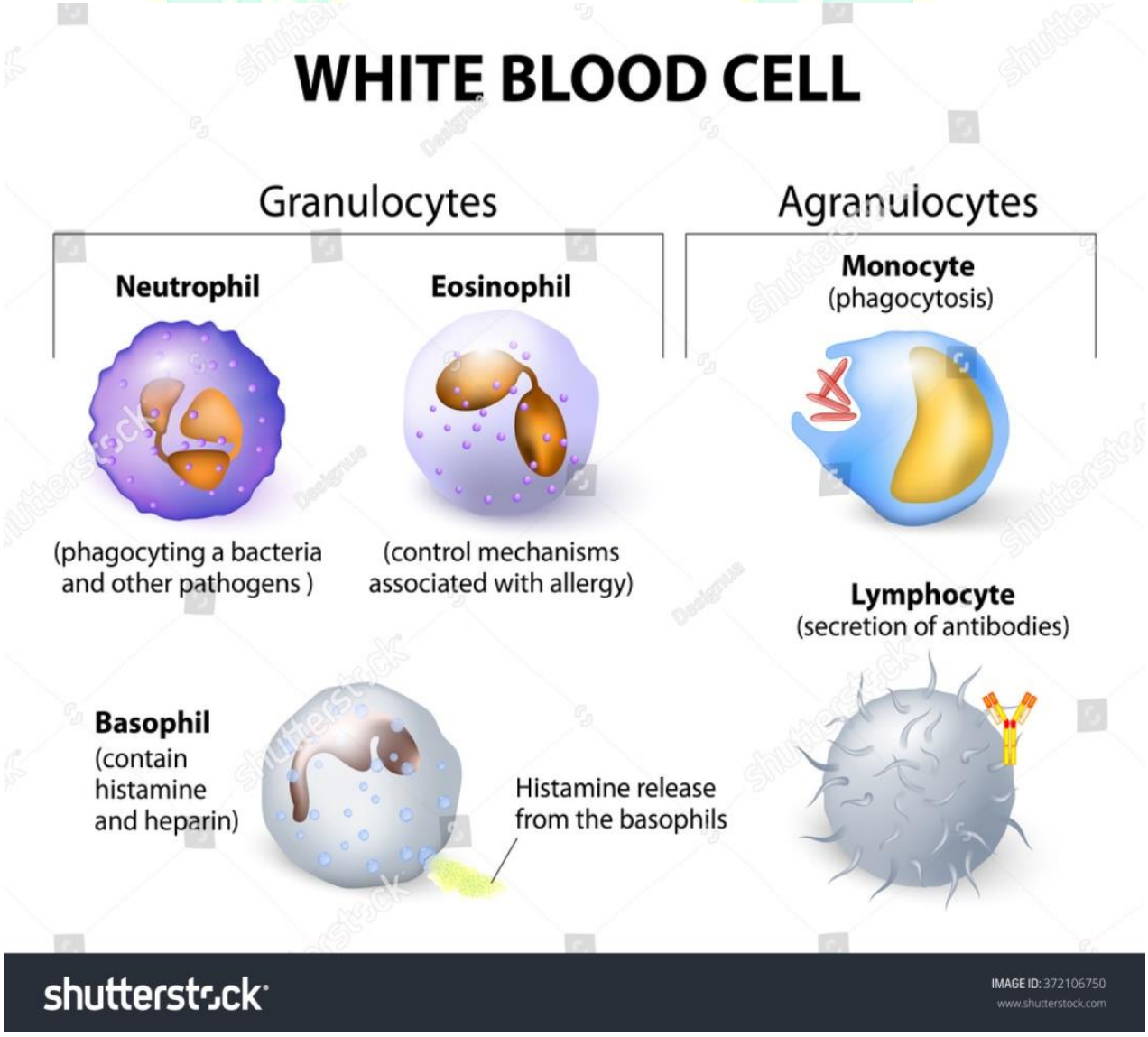
The vagina is normally acidic. The acidity of the vagina prevents harmful bacteria from growing and helps maintain the number of protective bacteria.



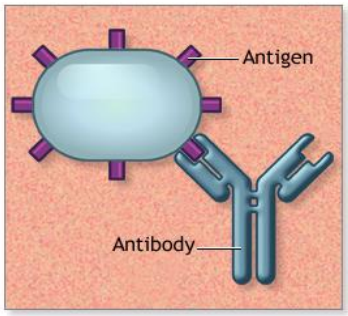
The blood in the body also defends against infection by increasing the number of certain types of white blood cells (**neutrophils** and **monocytes**), which engulf and destroy invading microorganisms. **The increase can occur within several hours, largely because white blood cells are released from the bone marrow**, where they are made. The number of neutrophils increases first. **If an infection persists, the number of monocytes increases. The blood carries white blood cells to sites of infection.**

The number of eosinophils, another type of white blood cell, increases in allergic reactions and many parasitic infections, but usually not in bacterial infections.

However, certain infections, such as typhoid fever, viral infections, and bacterial infections that overwhelm the immune system, can lead to a decrease in the white blood cell count.



How an immune response works



An antibody is a protein produced by the immune system in response to the presence of an antigen.

ADAM.

Antibodies that target the specific invading microorganism and attach to and immobilize microorganisms.

An antigen is any substance that can spark an immune response.

The immune system needs to be able to tell self from non-self. It does this by detecting proteins that are found on the surface of all cells.

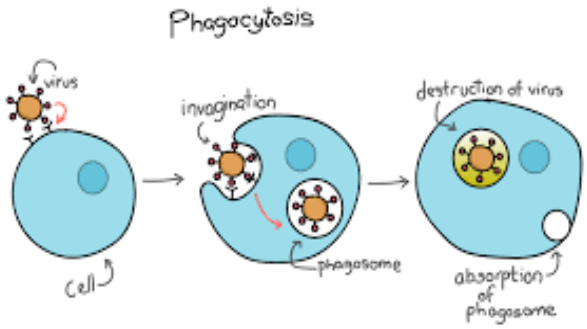
When an infection develops, the immune system also responds by producing several substances and agents that are designed to attack the specific invading microorganisms. Examples are Killer T cells (a type of white blood cell) that can recognize and kill the invading microorganism

In many cases, an antigen is a bacterium, fungus, virus, toxin, or foreign body. But it can also be one of our own cells that is faulty or dead. Initially, a range of cell types works together to recognize the antigen.

Once an antibody has been produced, a copy remains in the body so that if the same antigen appears again, it can be dealt with more quickly. That is why with some diseases, such as chickenpox, you only get it once as the body has a chickenpox antibody stored, ready, and waiting to destroy it the next time it arrives. This is called immunity.

Everyone's immune system is different but, as a general rule, it becomes stronger during adulthood as, by this time, we have been exposed to more pathogens and developed more immunity.

There are three types of immunity in humans called **innate**, **adaptive**, and **passive**:



Innate immunity

Innate, or nonspecific, immunity is the defense system with which you were born. It protects you against all antigens. Innate immunity involves barriers that keep harmful materials from entering your body. These barriers form the first line of defense in the immune response. Examples of innate immunity include:

- ✔ Cough reflex
- ✔ Enzymes in tears and skin oils
- ✔ Mucus, which traps bacteria and small particles
- ✔ Skin
- ✔ Stomach acid

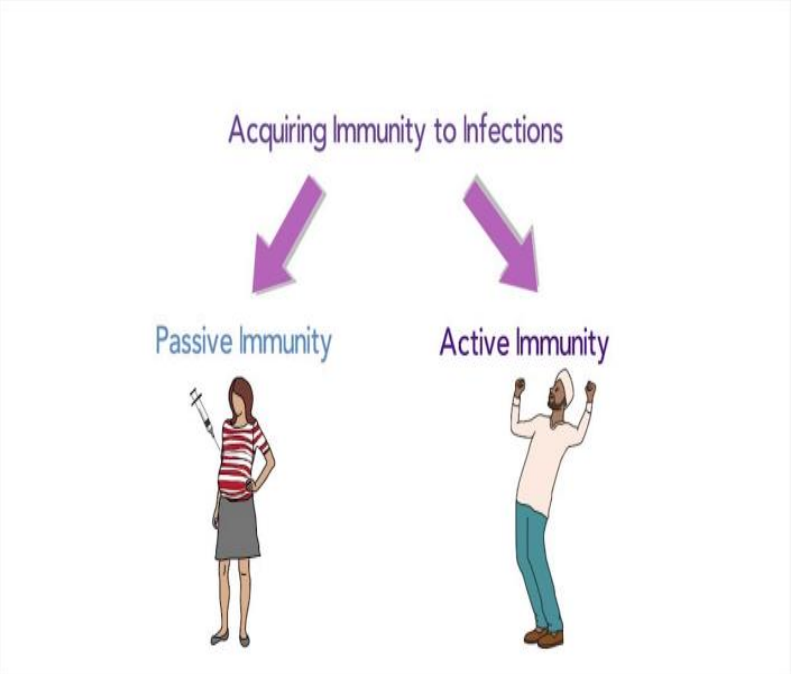
If an antigen gets past these barriers, it is attacked and destroyed by other parts of the immune system.

Adaptive (acquired) immunity

This protection from pathogens develops as we go through life. As we are exposed to diseases or get vaccinated, we build up a library of antibodies to different pathogens. This is sometimes referred to as immunological memory because our immune system remembers previous enemies.

Adaptive immunity is an organism's acquired immunity to a specific pathogen. As such, it's also referred to as acquired immunity.

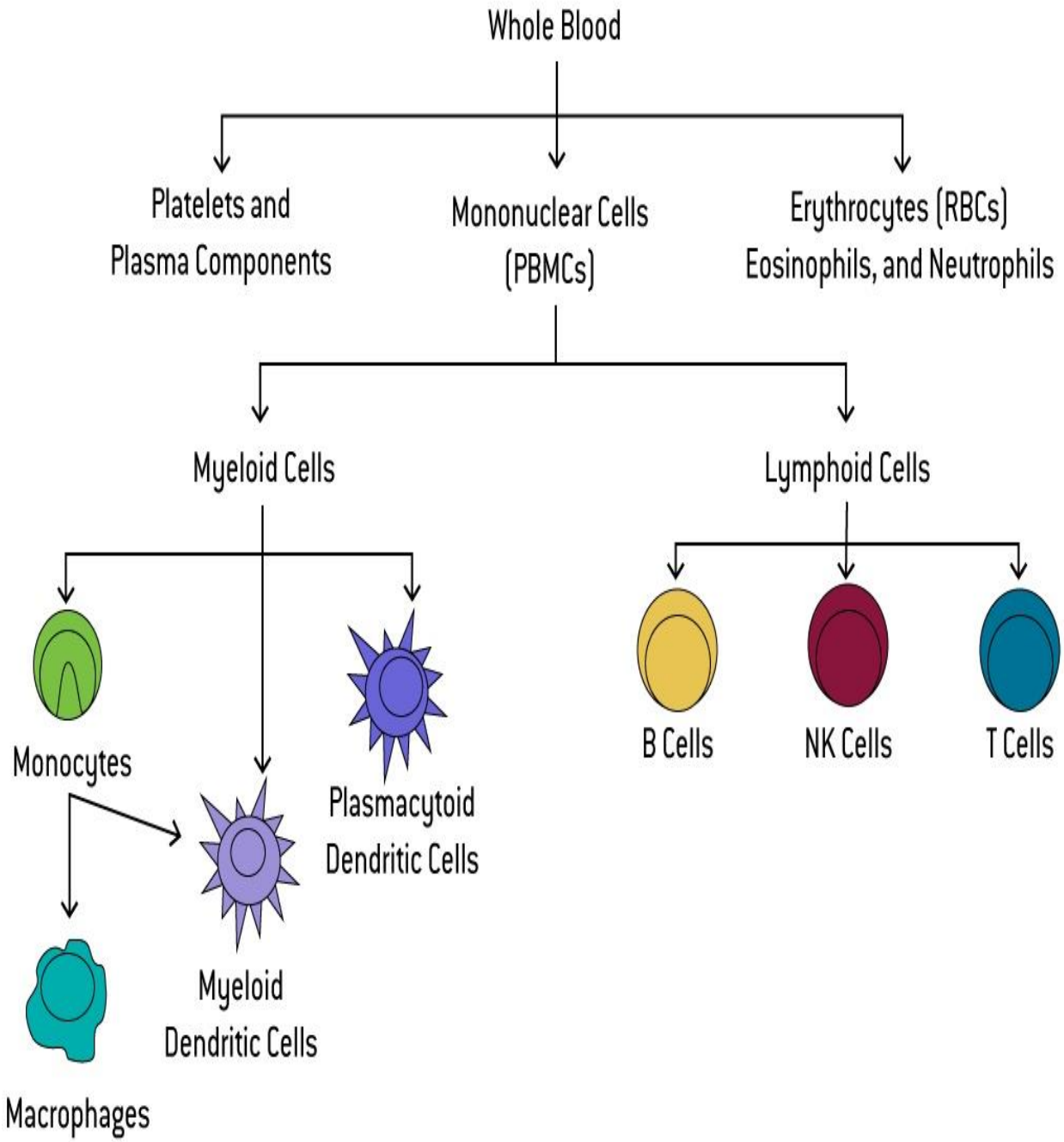
Adaptive immunity, nor does it always last throughout an organism's entire lifespan



Passive immunity

A type of immunity acquired by the transfer of antibodies from one individual to another, such as from mother to offspring.

This type of immunity is "borrowed" from another source, but it does not last indefinitely. For instance, a baby receives antibodies from the mother through the placenta before birth and in breast milk following birth. This passive immunity protects the baby from some infections during the early years of their life.


Whole Blood
Platelets and
Plasma Components
Mononuclear Cells
(PBMCs)
Erythrocytes (RBCs)
Eosinophils, and Neutrophils
Myeloid Cells
Lymphoid Cells
Monocytes
Plasmacytoid
Dendritic Cells
B Cells
NK Cells
T Cells
Myeloid
Dendritic Cells
Macrophages