IMMUNE RESPONSE

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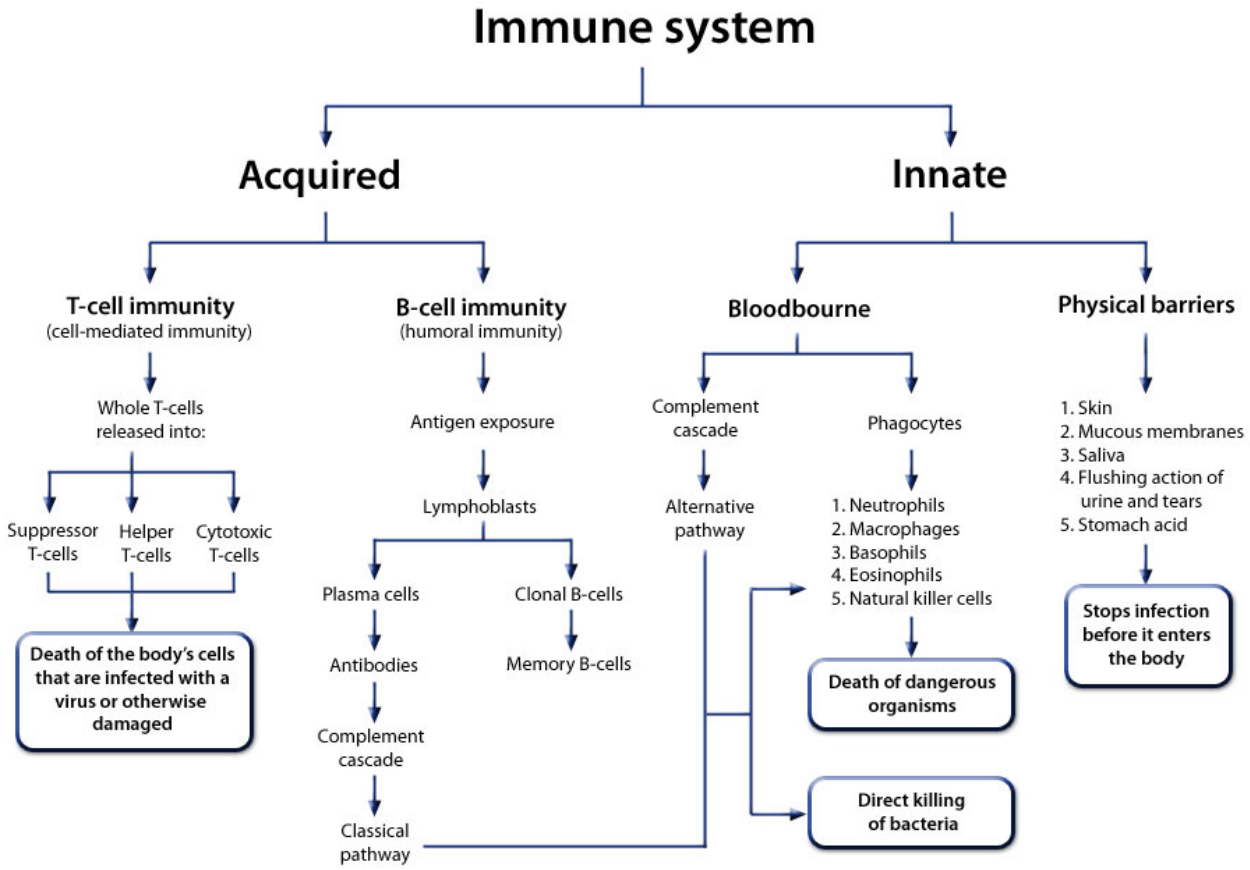
OVERVIEW:

Immune system flowchart



Note. By Nicole Chalmers.2015, October 30. image found on Meducation

The immune system is a complex network of organs, cells, and proteins that defends the body from infection. White blood cells, antibodies, the complement system, the lymphatic system, the spleen, the thymus, and the bone marrow are the key components of the immune system. Antibodies are a kind of protein found on the surface of B cells that detect and destroy antigens, which are foreign or dangerous substances that trigger an immune response in the body (Hoffman et al., 2015). Innate immunity and active immunity are the two forms of immunity.

Innate Immunity

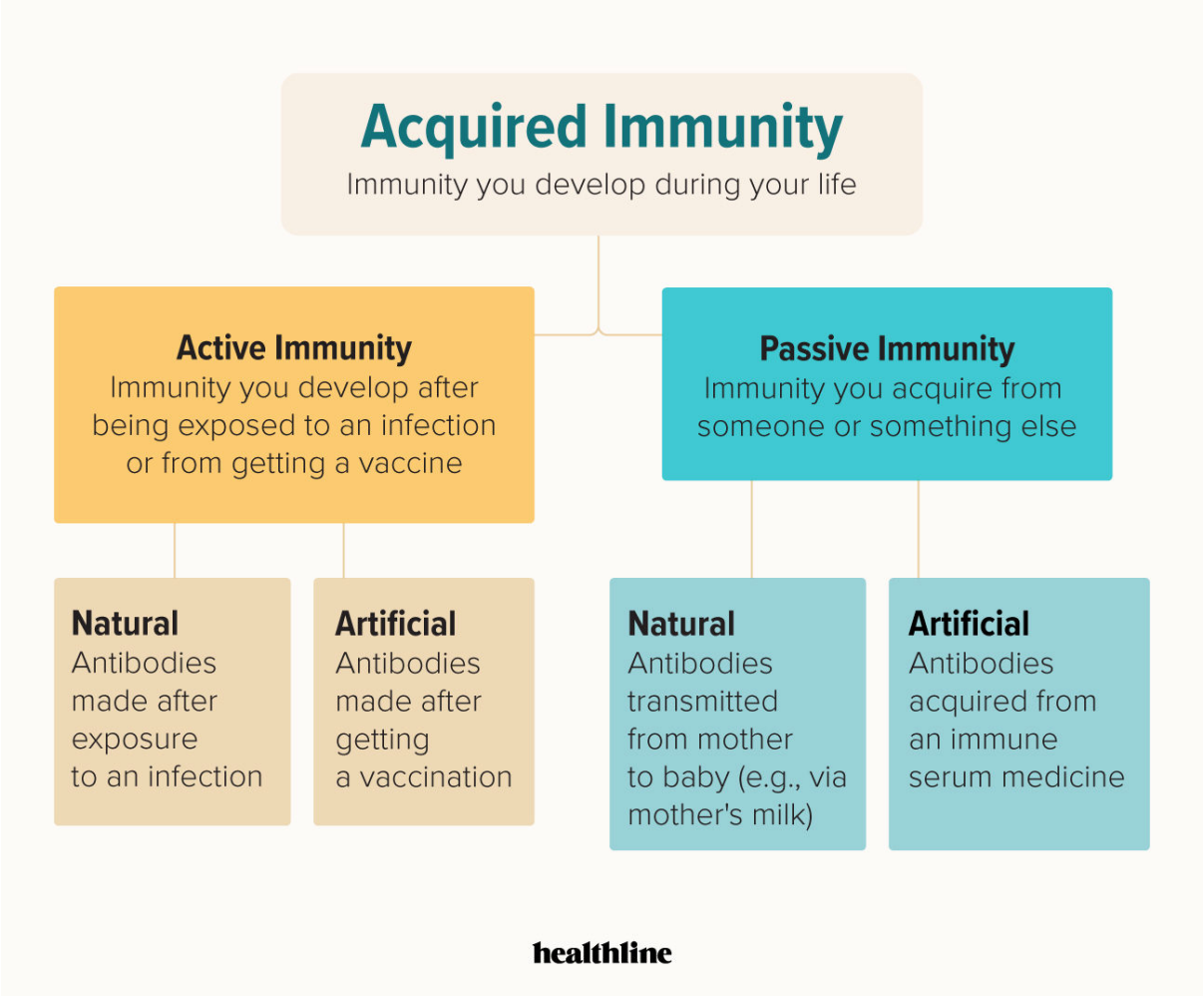
Innate immunity, also known as nonspecific immunity, is your body's innate defence system. Innate immunity is a set of defences that prevent hazardous substances from entering your body. In the immunological response, these barriers are the initial line of protection. Mucus, for example, is a nasal barrier that prevents germs and other disease-causing bacteria from entering the body.

Physical barriers, phagocytic barriers, blood proteins, and cytokines are the four basic barriers that make up the innate immune defence system (Chonkar, 2016). An organism's first line of defence against infection includes physical and chemical barriers that tend to inhibit pathogen invasion. Pathogens can be physically blocked from entering the body by mechanical barriers like the skin, mucous membranes, and urine, whereas pathogens can be

killed by chemical barriers like the enzymes in saliva and semen. Phagocytic Barriers are the use of phagocytes such as neutrophils and macrophages to eat and eliminate microbes. Cytokines are proteins present in macrophages, neutrophils, and even certain endothelial cells that mediate and control immunological and inflammatory processes in response to microorganisms and other antigens.

Acquired Immunity

Active immunity and passive immunity are the two types of acquired immunity

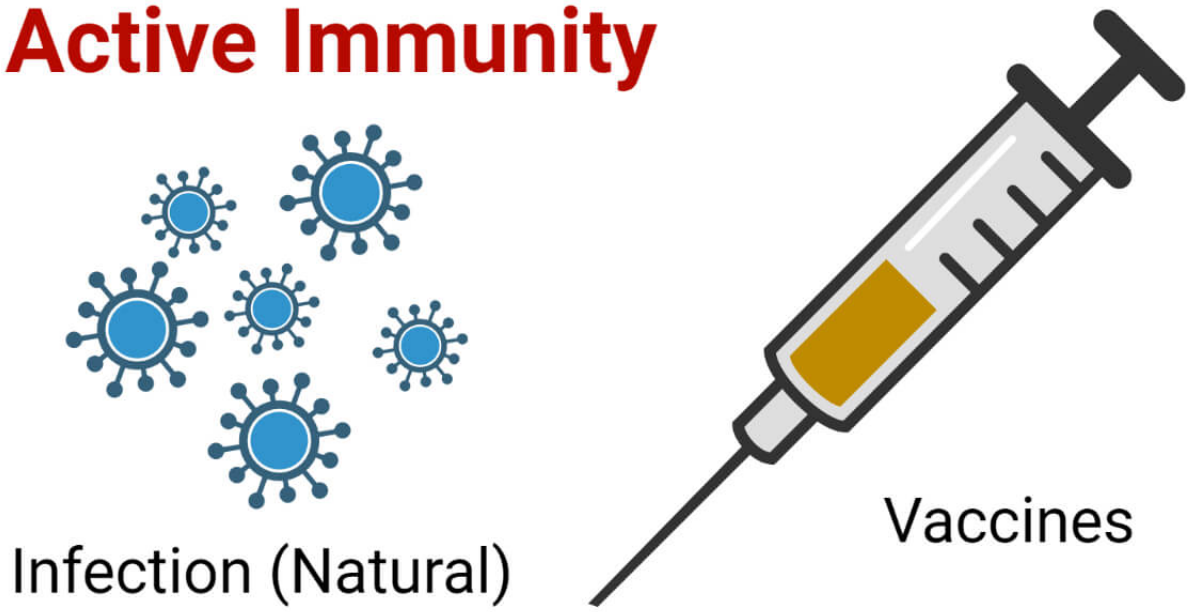


Note. Image found on Healthline

A person's immune system responds to potentially harmful external chemicals or microbes after birth, resulting in acquired immunity. It involves macrophages and dendritic cells, as well as B and T cell activation and reproduction, antibody synthesis, and cytokine production. The two types of acquired immunity are active and passive acquired immunity.

Active Acquired Immunity

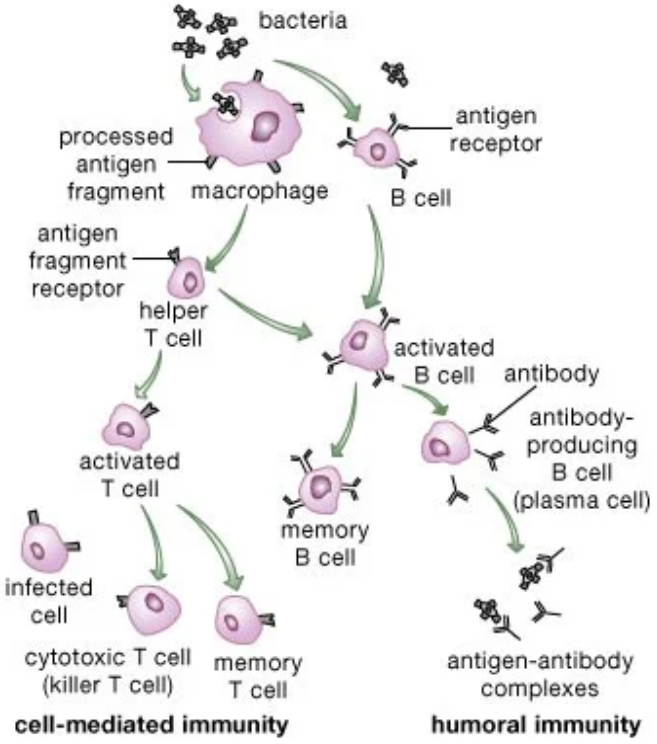
Active Immunity



Note. By Faith Mokobi. 2022, May 16, image found on Microbe Notes.

Active immunity is a sort of adaptive immunity that develops as a result of one's own body producing antibodies. When a person comes into touch with a disease or its antigen, they develop this form of immunity, which can continue for a long period. An initial response occurs when active immunity occurs for the first time. When a body is exposed to a virus for the first time, it stores part of the defense antibodies in case it is attacked again. Natural active immunity is the term for this. Artificially acquired active immunity provides instant, but temporary, protection by exposing a person to antigens in a vaccination in order to elicit a long-lasting immune response.

diagram of the activities of T and B cells

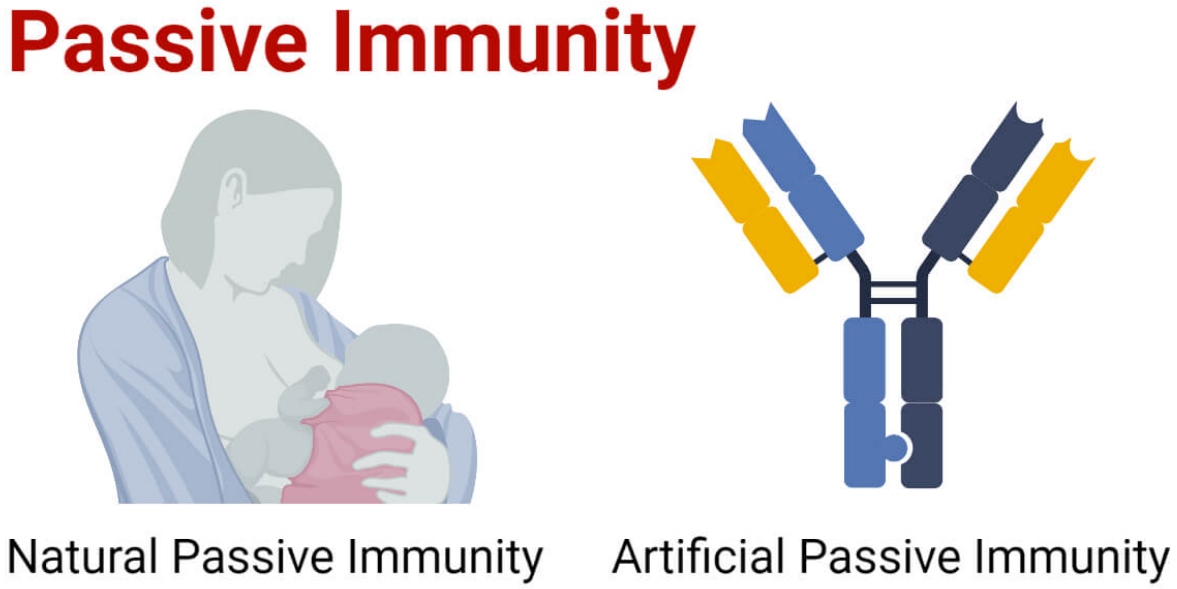


Note. By Encyclopædia Britannica. .n.d., image found on Encyclopædia Britannica.

Humoral and cell-mediated immunity, as well as its components, have a role in active immunity. The generation of antibodies by B cells is one aspect of acquired immunity known as humoral immunity. T cells play a role in the other half of cell-mediated immunity. The use of antibodies present in blood and mucosal secretions to detect foreign microorganisms, neutralize their pathogenicity, which is their ability to infect, and target them for destruction by other phagocytes is known as humoral immunity. While both activated helper T cells and cytotoxic T lymphocytes are involved in cell-mediated immunity. Helper T cells release cytokines that activate phagocytic cells, allowing them to engulf and destroy germs. Against a range of bacterial and protozoal infections, this sort of cell-mediated immune response is particularly important. Cytotoxic T lymphocytes are essential in the destruction of virus-infected cells and tumor cells, which are cells in the body that have been infested.

Passive Acquired Immunity

Passive Immunity



Note. By Faith Mokobi. 2022, May 16, image found on Microbe Notes.

When antibodies are delivered into the body from an external source, such as immunizations for adults, passive immunity is acquired. Since it does not generate immunological memory, it delivers a fast response to infection and lasts for a few weeks or months and the patient is at danger of contracting the same infection in the future. An example of passive immunity are antibodies that are introduced to a fetus through the placenta and to a child through the mother's milk.

Maternal passive immunity is a type of natural passive immunity in which antibodies such as IgG are transmitted to a growing fetus by its mother during pregnancy through the placenta. It's worth noting that it's the only antibody family that can cross the placenta. Since passive protection is only temporary because maternal antibodies generally only cover the initial immune response, the child's immune system can learn to generate its own B cells to produce antibodies. To avoid illnesses including TB, hepatitis B, and polio, immunization is

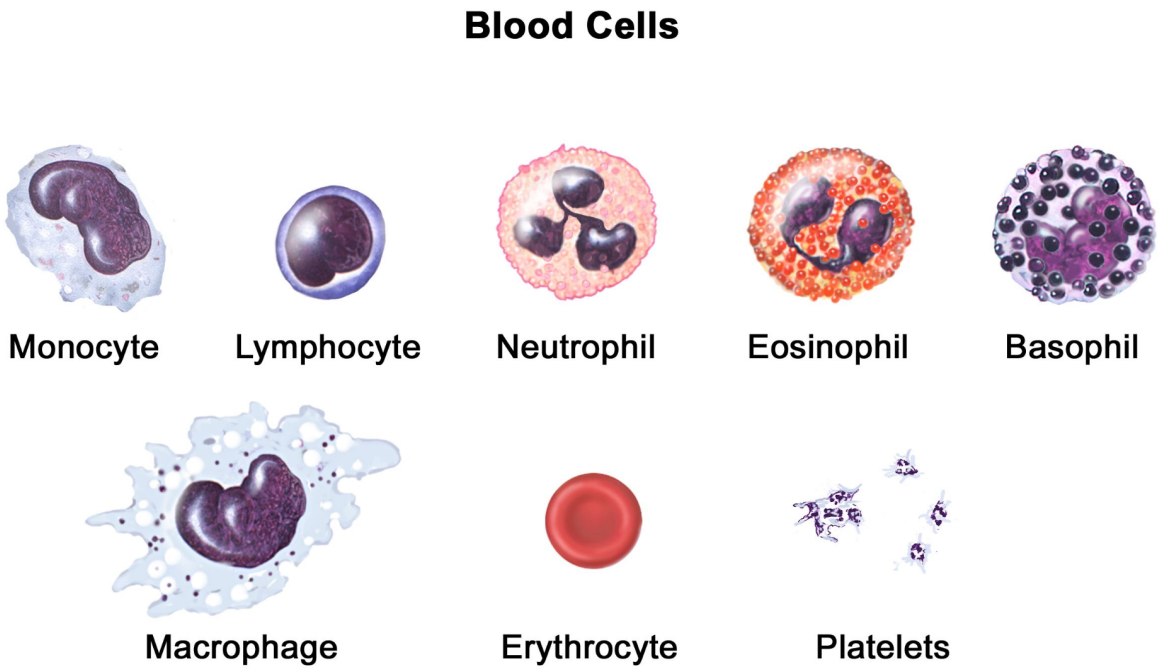
frequently necessary soon after birth. IgA antibodies, another antibody family present in breast milk, are examples of maternal antibodies (MedLibreTexts., 2015).

The transfer of antibodies from human or animal blood plasma or serum, especially monoclonal antibodies, to be delivered via vein or muscle, is known as artificially acquired passive immunity. Antibodies that are mass-produced artificially from a single B cell clone after it has been exposed to a particular viral protein are known as monoclonal antibodies (Lloyd et al., 2021). Passive transfer is used to treat immunodeficiency and a range of severe acute illnesses for which there is no vaccination, such as the Ebola virus.

However, monoclonal antibodies have several drawbacks, such as their limited lifetime and the risk of serum sickness when antibodies manufactured from different animal species are administered to persons who are hypersensitive to animal plasma in serum treatment.

White Blood Cells

Blood cells

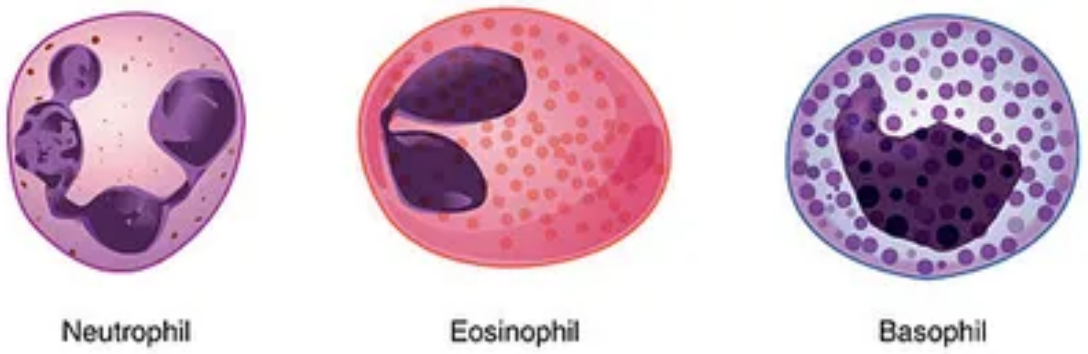


Note. By National Cancer Institute.n.d., image found on Concer.gov.

White blood cells, or leukocytes, are cells that are responsible for the body's first line of defense against germs and foreign substances. There are two types of white blood cells found in the body: granulocytes and agranulocytes.

Granulocytes

Granulocytes



Note. By OpenStax College.n.d., image found on Microscope Master.

These are white blood cells that are produced in the bone marrow and contain enzymatic granules in their cytoplasm that release enzymes during infections, allergic reactions, and asthma attacks. Neutrophils, eosinophils, basophils, and mast cells are examples of these cells. Granulocytes are phagocytes because they can absorb and digest foreign cells such as bacteria, viruses, and parasites with their granules, making them the first line of defense after the physical barrier.

Neutrophils

The smallest and most numerous of the three granulocytes are neutrophils. They have a lot of granules with microbicidal substances in them. Their nuclei are classified as multi-lobed because they have between 3 and 5 lobes that are connected by thin strands of genetic material. Since these cells have a brief half-life outside of the bone marrow, they commit suicide by activating apoptosis, an intracellular death mechanism, after they have destroyed invading bacteria by phagocytosis.

Eosinophils

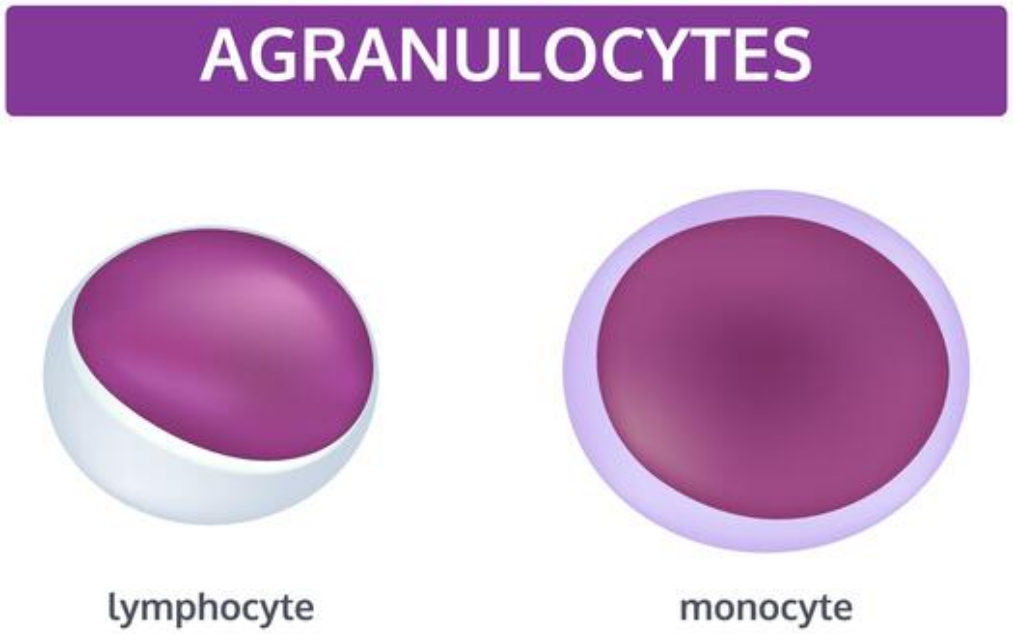
Eosinophils are short-lived granulocytes that are small and oval in shape with a bi-lobed nucleus, meaning their nuclei are lobed into two. They, like neutrophils, contain enormous cytoplasmic granules and are present in the bone marrow. Their role in the immune system is comparable to that of neutrophils in aiding the body's fight against parasitic infections, particularly multicellular parasites like worms, but they also play a role in the allergic reaction by regulating mast cell activation and production.

Basophils

Basophils are one of the five white blood cell types that protect the body from infections or respond to intruders like parasites, fungi and cancer cells, and drive the body's reaction to allergens. They have a multilobed nucleus and no evidence of nucleoli and contain histamine and serotonin granules which mediate the immune response upon release. They also have the ability to help detect and destroy some early cancer cells.

Agranulocytes

Vector set of white blood cells - agranulocytes: monocyte and lymphocyte. Medical concept.



Note. By Inna Vostrikova.2019, April 23, image found on Alamy Stock Vector.

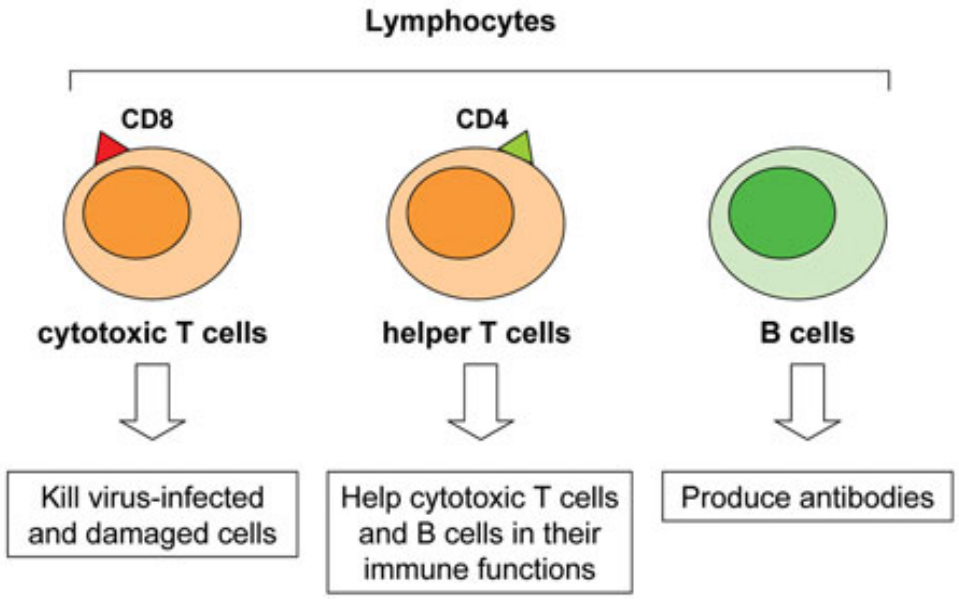
Small granules in the cytoplasm of agranulocytes are not visible under a light microscope. Agranulocytes have similar functions to granulocytes in that they mediate an immune response to invading bacteria, malignant and tumor cells, and remove dead damaged cells. Unlike granulocytes, however, they produce antibodies that directly bind to cells rather than granules. Lymphocytes and monocytes are the two kinds of agranulocyte cells.

Monocytes

Monocytes can be differentiated into two types of cells: dendritic cells and macrophages. Dendritic cells are antigen-presenting cells that can identify cells that are antigens (foreign bodies) that lymphocytes must destroy, and macrophages are phagocyte cells that are larger and live longer than neutrophils. Macrophages can also operate as antigen-presentation cells, displaying antigens on the surface of other cells in order to provoke an immune response.

Lymphocytes

Three types of lymphocytes are involved in the immune response against infectious agents in the human body.

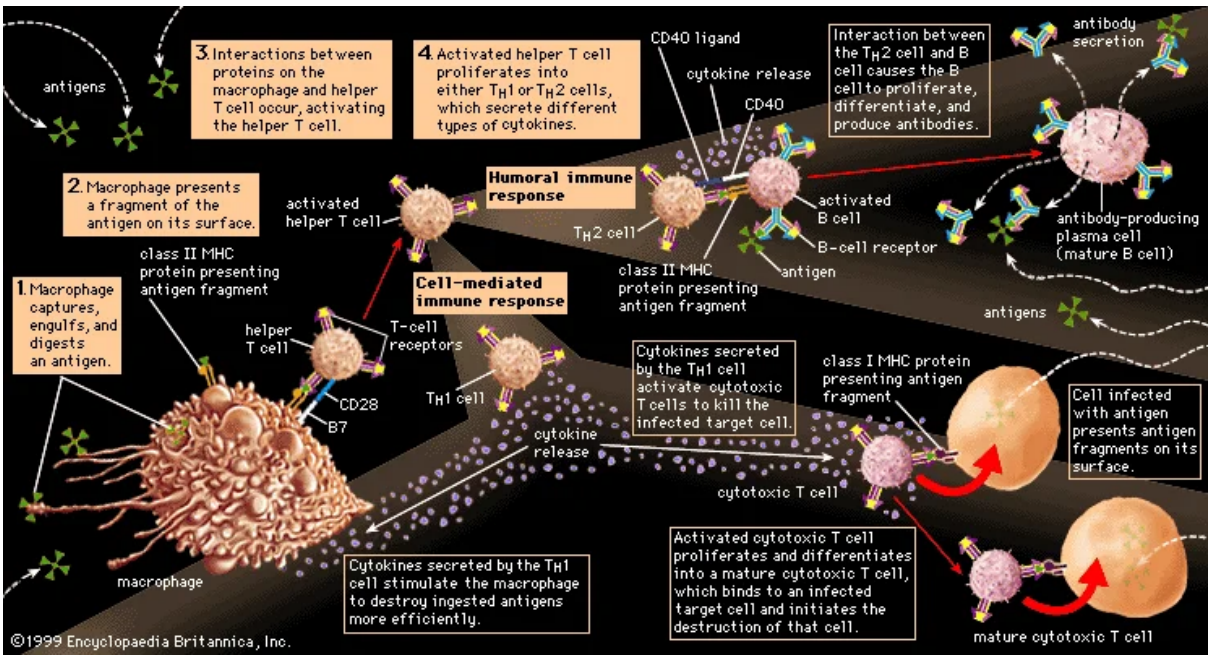


Note. By Ignacio Romero.n.d., image found on OpenLearning Centre.

B and T cells, both cytotoxic and helper cells, as well as natural killer (NK) cells, belong to the lymphocytes group of white blood cells, that are made up of stem cells from the bone marrow They produce antibodies and direct cell-mediated death of virus-infected and tumor cells, as well as a memory that protects against such antigens in the future. Antibodies, which are produced by B cells in response to invading infectious pathogens, are produced by B cells. Killer T cells, also known as cytotoxic T cells, have the ability to attack and destroy other cells that show targets they recognize. Helper T cells aid the immune system by triggering the production of antibodies and attacking invading infectious pathogens via a particular protein on their surface called CD4.

Steps in the Immune Response

immune stimulation by activated helper T cells



Note. By Encyclopædia Britannica. .n.d., image found on Encyclopædia Britannica.

If a disease manages to enter the body, secondary nonspecific protections termed the immunological response kick in to combat it. Here's how someone's immune system would react if someone were cut:

1. When the physical barrier, in this case the skin, is breached, microorganisms gain access and an inflammatory reaction ensues, with increased blood flow to the infected region, causing swelling and discomfort. It also gets heated because many of the phagocytes' granules produce substances that raise the body's temperature, resulting in a fever.
2. Dendritic cells, which are continually scouting about and may connect with up to 200 other cells at once, may discover the pathogen and take a portion to deliver to T helper cells that gather in the body's lymph nodes.
3. A T helper cell will recognize just one pathogen. If the T helper cell recognizes the intruder, it will rapidly clone to boost its numbers. The T helper cell then stimulates the proper immune cells for the attack.
4. If the invading organism is a virus, the T helper cell will alert the killer T cells to come to the invading virus-infected host cells and poke holes in their walls, killing the cells and eradicating the virus.
5. B cells are then triggered to create antibodies that bind to free viruses, designating them for engulfment by macrophages.
6. If the intruder is bacterial, however, B cells are frequently lured to the task. They coat the bacteria in IgG antibodies to bind everything together and make it simpler for macrophages to engulf. If it is a gut microbe, B cells will produce IgA antibodies, which will prevent the bacterium from attaching to the gut cells and thereby preventing infection.
7. The body will recover from the illness after a few days of fighting off the bacteria. T suppressor cells are activated by the immune system at this stage. These cells emit slow down' signals, which suppress the immune system.

ACTIVITY 1:

Types of Immunity

Name: _____

Date: _____

Fill in the blank with the missing word.

Barriers	Phagocytic		pregnancy
nonspecific	IgG	initial	placenta

1. Innate immunity is also known as _____ immunity.
2. _____ immunity and _____ immunity are the two types of acquired immunity.
3. _____ _____ are the use of phagocytes such as neutrophils and macrophages to eat and eliminate microbes.
4. An _____ response occurs when active immunity occurs for the first time.
5. When _____ are delivered into the body from an external source, such as immunizations for adults, passive immunity is acquired.
6. _____ passive immunity is a type of natural passive immunity in which antibodies such as _____ are transmitted to a growing fetus by its mother during _____ through the _____.

Unscramble each word and write it in the blank provided.

7. vcaeti _____
8. caeudriq _____
9. muniyitm _____

10. iondbeiast _____

11. oecstmlhpyy _____

12. aimoigmnculol _____

Match the word on the left side to its definition on the right side.

1. _____	a sort of adaptive immunity that develops as a result of one's own body producing antibodies	A.	passive immunity
2. _____	acquired when antibodies are introduced into the body from an external source, such as vaccines for adults.	B.	developed immunity
3. _____	a type of natural passive immunity	C.	active immunity
4. _____	includes the use of barriers to prevent dangerous substances from entering your body.	D.	strong immunity
5. _____	when a person acquires antibodies from a different source	E.	controlled immunity
		F.	innate immunity
		G.	acquired immunity
		H.	maternal passive immunity

ACTIVITY 2:

Immune System

Name: _____

Date: _____

Circle the correct answer for each question below.

1. **What category is the lymphocyte group a part of?**

   A. Red blood cells B. Dendritic cells

   C. White blood cells D. Phagocytic cells

2. **What are the two types of agranulocyte cells?**

   A. Lymphocytes and phagocytes B. Lymphocytes and monocytes

   C. Granulocytes and monocytes D. Leukocytes and lymphocytes

3. **What type of white blood cell increases in number when a patient is fighting a virus?**

   A. Basophils B. Killer T cells

   C. Helper T Cells D. B cells

4. **What agranulocyte cells produce antibodies in response to invading infectious pathogens?**

   A. Helper T cells B. Natural Killer cells

   C. Cytotoxic C cells D. B cells

5. **What is a particular protein on the agranulocyte's surface called?**

   A. p53 B. EGFR

   C. CD4 D. CD36

6. **Where are neutrophils produced?**

   A. bone marrow B. spinal cord

   C. brain D. lymph nodes

7. **What is triggered to create antibodies that bind to free viruses?**

   A. Helper T cells B. Natural Killer cells

   C. Cytotoxic C cells D. B cells

8. **How many pathogens will a T helper cell recognize?**

   A. One (1) B. Four (4)

   C. Two (2) D. Eight (8)

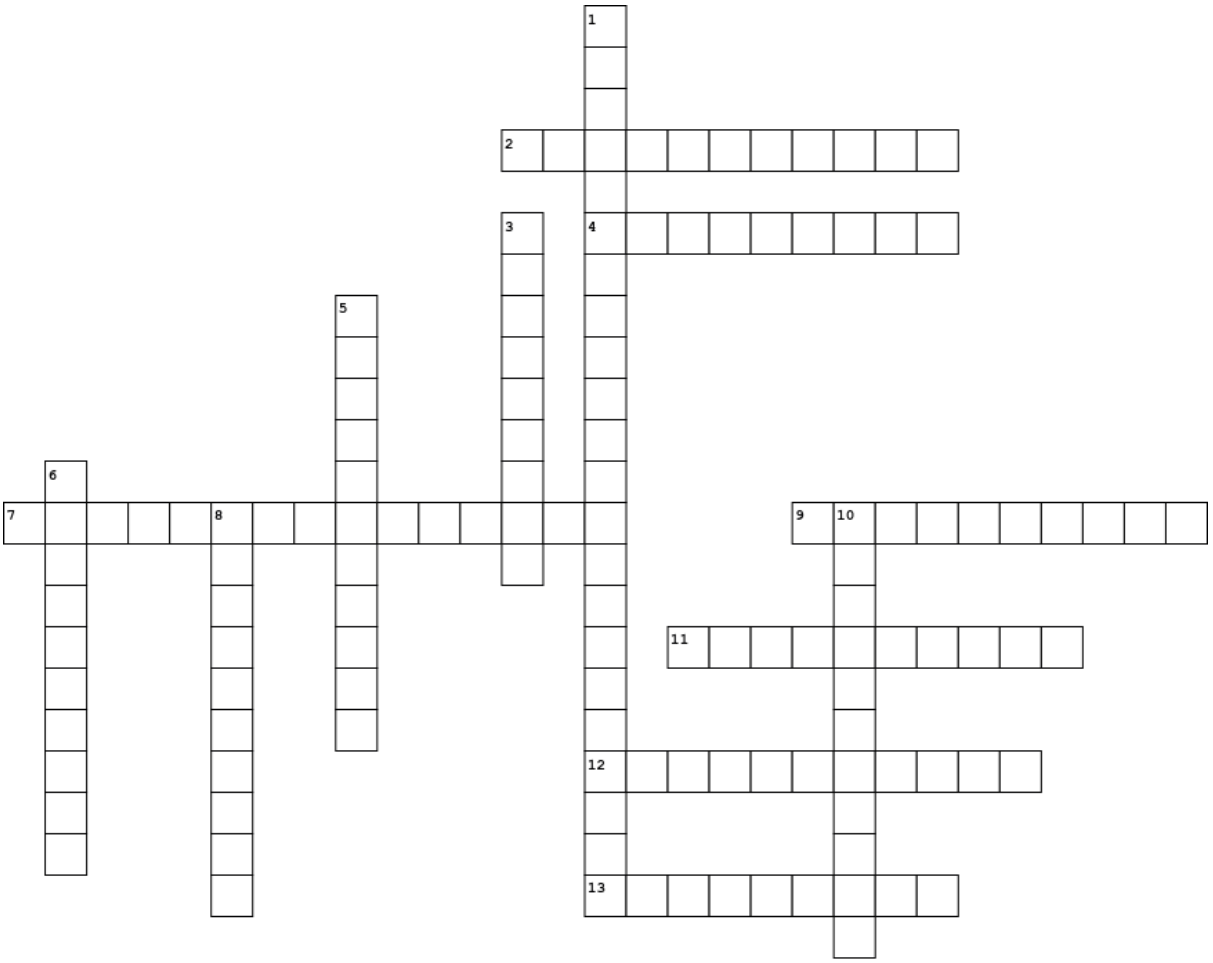
9. **What does the T helper cell do?**

   A. Produces antibodies to attack B. Activates the immune cells for the attack

   C. Engulf and ingest bacteria D. Recognize and kill infected bodily cells

ACTIVITY 3:

Granulocytes



Across

2. how many lobes do granulocytes have?
4. ___protect the body from infections or respond to intruders like parasites, fungi and cancer cells
7. granulocytes are_____that are produced in the bone marrow
9. ___can cause granulocytes
11. Esoinophils are_____granulocytes
12. what is the smallest and most numerous of the three granulocytes?
13. what are granulocytes made of?

Down

1. what type of granules do neutrophils have?
3. ___is known as a granulocytes
5. the most abundant granulocyte
6. Granulocytes are_____because they can absorb and digest foreign cells
8. granulocytes are formed in_
10. ___destroy invading bacteria by phagocytosis

ACTIVITY 4:

Immune Response

Name: _____

Date: _____

1. **What immunological response kicks into combating disease?**

2. **Give two things that occur in an inflammatory reaction.**

3. **What is used to connect the lobes of the nucleus?**

4. **Why does a fever or heat around the area of broken skin occur?**

5. **What substance do the granules of basophils contain?**

6. **Differentiate between an eosinophil and a neutrophil. Give at least 2 differences.**

7. **Give two characteristics of the most numerous white blood cell in the body.**

8. **Describe the isotype (class) of antibody is used in the stomach. Ensure to include what produces such antibody and its function.**

9. **What is the importance of dendritic cells in immune response?**

10. **Give the roles of the 3 T lymphocytes in the immune response system.**

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