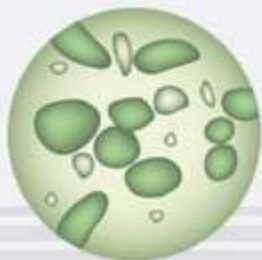




Structure and functions of immune system



Submitted by:

ANKUSHA ARORA
(Saraswati Dental College,
Lucknow)

What is IMMUNE SYSTEM?

The body's defense against disease causing organisms, malfunctioning cells, and foreign particles.



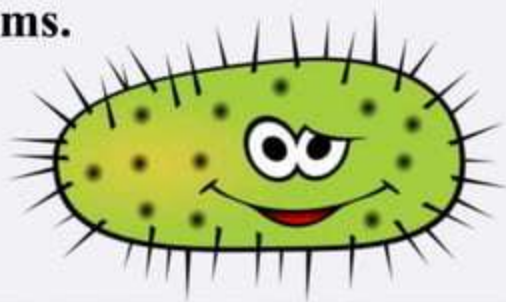
Life is a threat from everything in Nature



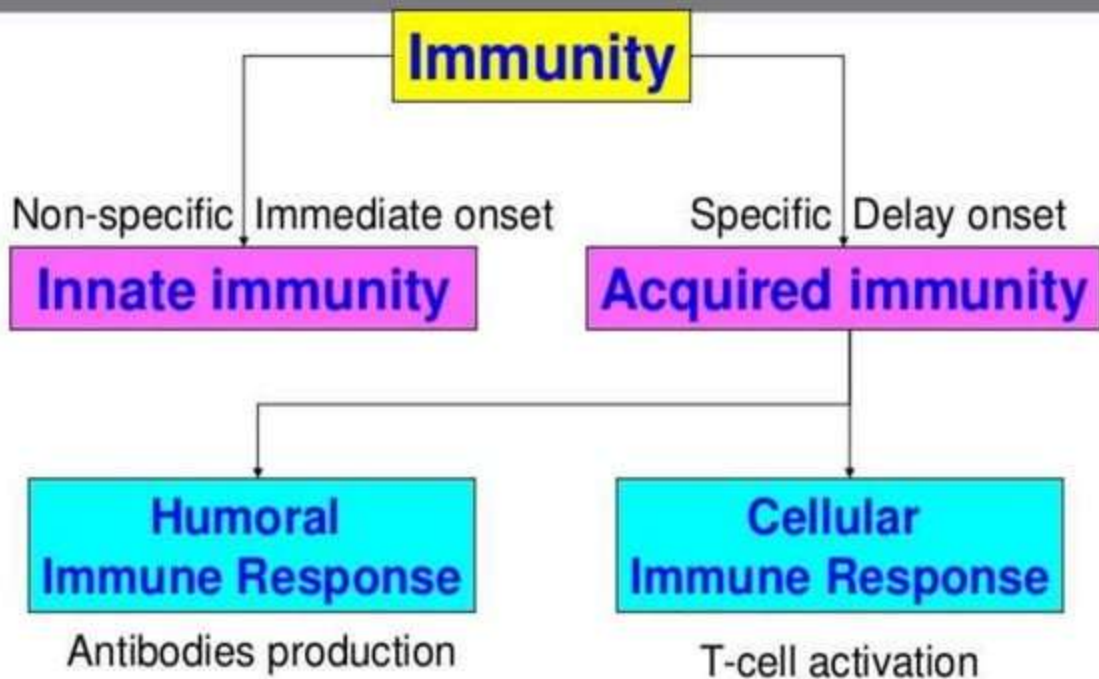
Designed by Dr. T.V.Nago MD

IMMUNITY

- The Latin term “IMMUNIS” means **EXEMPT**, referring to protection against foreign agents.
- **DEFINITION:** - The integrated body system of organs, tissues, cells & cell products that differentiates self from non – self & neutralizes potentially pathogenic organisms.



THE EVOLUTION OF IMMUNITY



ORGANS OF IMMUNE SYSTEM

Primary Lymphoid Organs

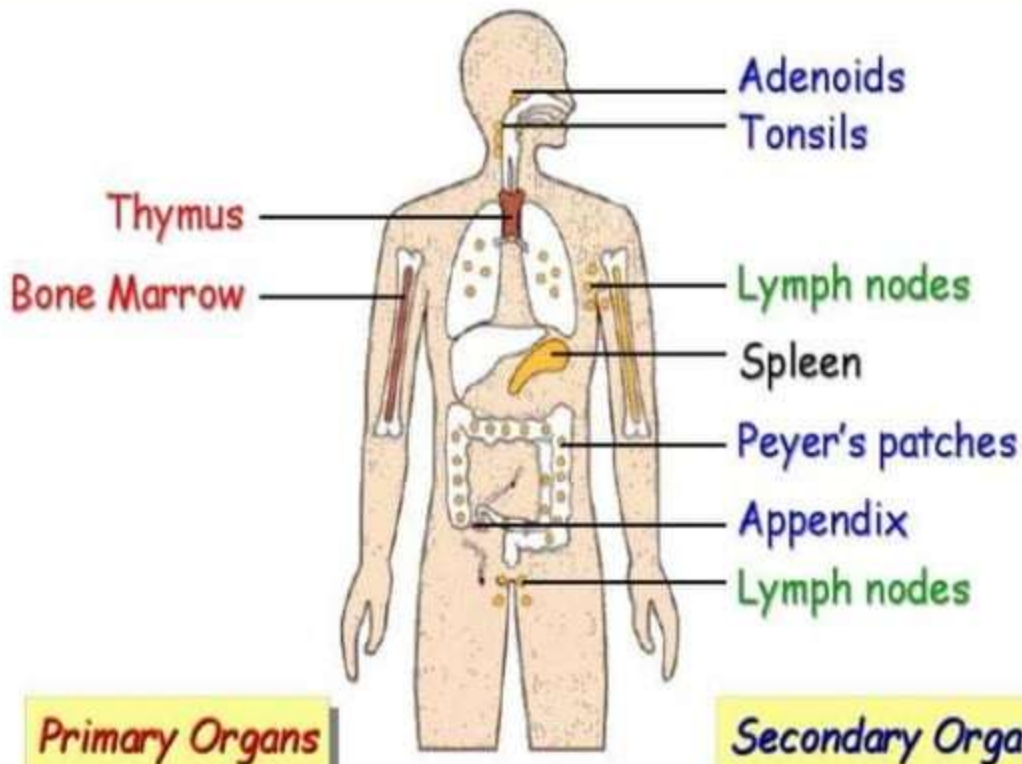
- **Bone Marrow and Thymus,**
- **Maturation Site.**

Secondary Lymphoid Organs

- **Spleen, lymph nodes,**
- **MALT (mucosal associated lymphoid tissue),**
- **GALT (gut associated lymphoid tissue),**
- **BALT (bronchus associated lymphoid tissue):
respiratory tract.**

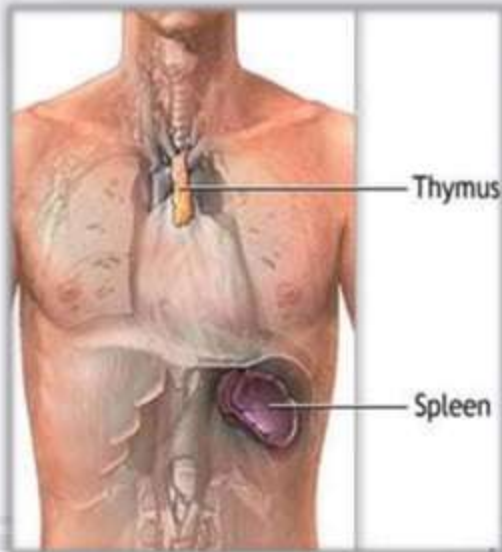


Lymphoid Organs



CENTRAL (PRIMARY) LYMPHOID ORGANS

- THYMUS,
- BONE MARROW.



THYMUS

- **Thymus is the site where a large diversity of T cells are produced – (so they can recognize and act against a large number of antigen)**
- **Thymus induces the death of those T cells that cannot recognize antigen.**
- **Also induces death of those T cells that react with self- Ag.**
- **More than 90% of all thymocytes die by apoptosis in the thymus without ever reaching maturity.**



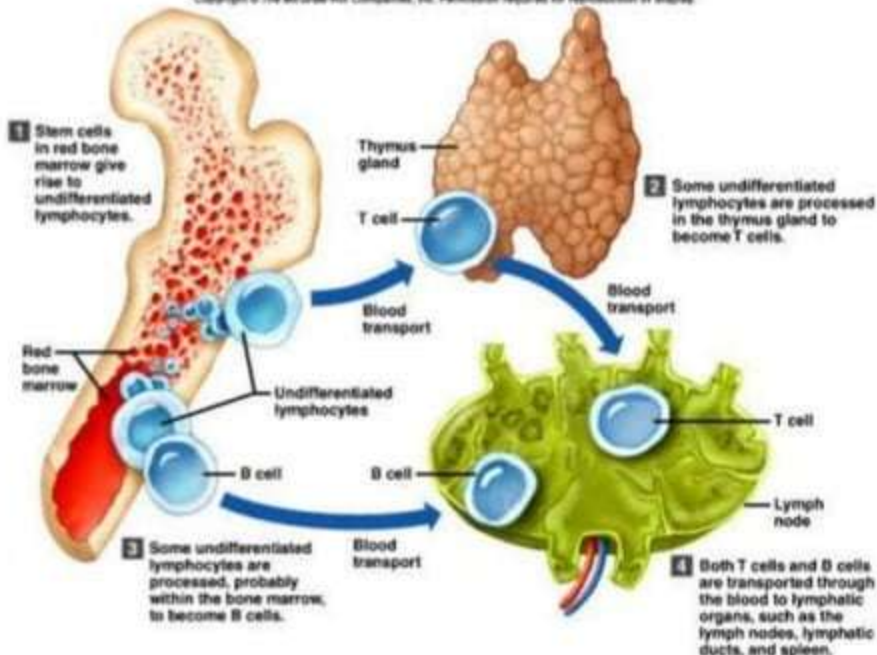
Functions of thymus

- **Primary function**:- production of thymic lymphocytes.
- A major organ for proliferation of lymphocytes in body.
- Plays key role in determining the differentiation of T cell.
- Lymphocytes during maturation acquire new surface antigens (Thy Ag)& are called as T lymphocytes or T cells (thymus dependent).
- Lymphocyte proliferation in thymus is not dependent on antigenic stimulus (unlike in peripheral lymphoid organs).
- T lymphocytes –primarily responsible for Cell-Mediated Immunity.



Lymphocyte Origins

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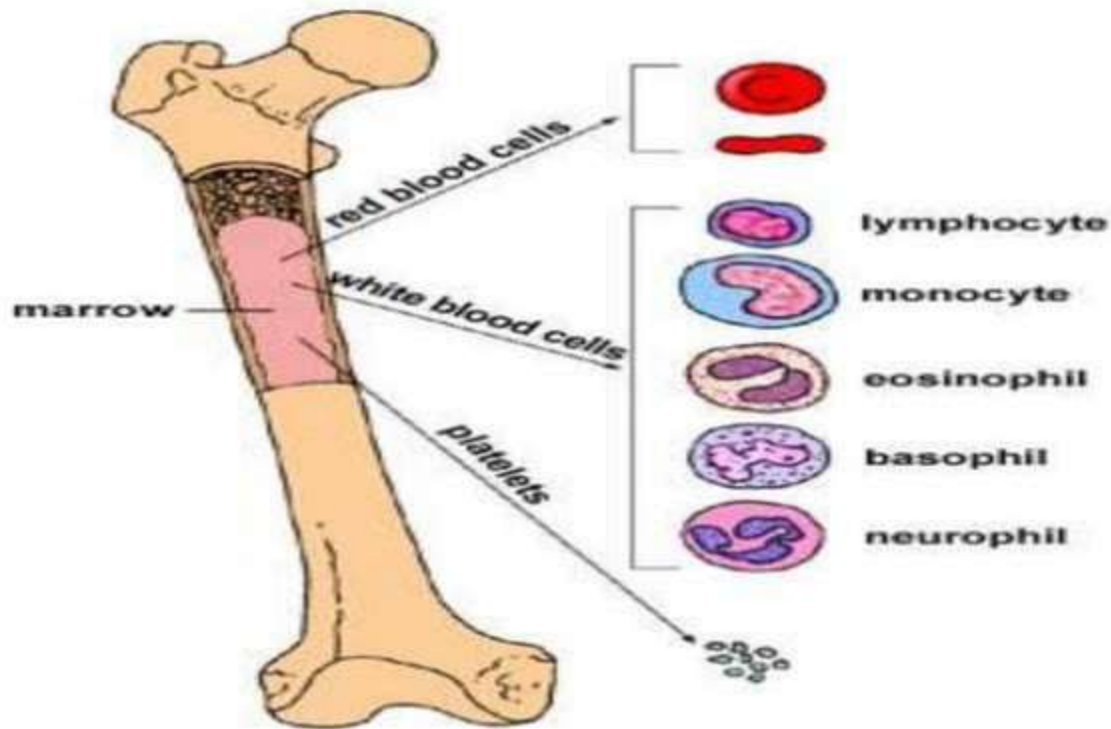


BONE MARROW

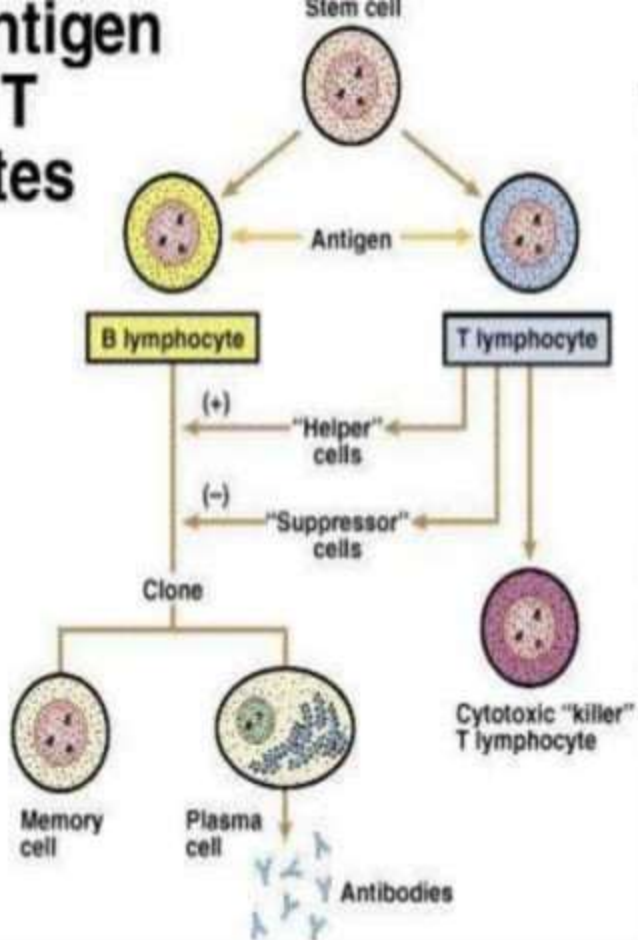
- **Some lymphocytes originate, develop, & mature within the bone marrow – B cells.** (B for Bursa of Fabricius or bone marrow).
- **Site for proliferation of stem cells.**
- **Site for the origin of pre-B cells & their maturation to become immunoglobulin producing lymphocytes (PLASMA CELL).**
- **B lymphocytes are transformed into plasma cells & secrete antibodies, & are primarily responsible for antibody-mediated immunity.**



BONE MARROW



Effect of an Antigen on B and T Lymphocytes



**PERIPHERAL
(SECONDARY)
LYMPHOID
ORGANS**

- Lymph nodes,
- Spleen,
- Mucosa associated lymphoid tissue



Lymph Node

- **Outer cortex-** accumulation of lymphocytes (primary lymphoid follicles) within which germinal centers (secondary follicles) develop during antigenic stimulation. Follicle also contain dendritic macrophages.
- **Inner medulla-** lymphocytes, plasma cells and macrophages are arranged as elongated branching bands (medullary cords).
- **Functions:-** • Phagocytose foreign materials including microorganisms.
- Help in proliferation and circulation of T-cells and B-cells.





Spleen

Largest lymphoid organ.

Functions:- • **Filtering and clearing of infectious organisms.**

- **Serves as a 'graveyard' for affected blood cells.**
- **systemic filter for trapping circulating blood borne foreign particles.**
- **The immunological function of spleen is primarily directed against blood borne antigens.**



EFFECTS OF SPLENECTOMY

- **Depends on the age at which the spleen is removed.**
- **In children, splenectomy often leads to an increased incidence of bacterial sepsis caused primarily by *Streptococcus pneumoniae*, *Neisseria meningitidis*, and *Haemophilus influenzae*.**
- **Splenectomy in adults has less adverse effects, although in some, it makes the host more susceptible to blood-borne bacterial infection.**

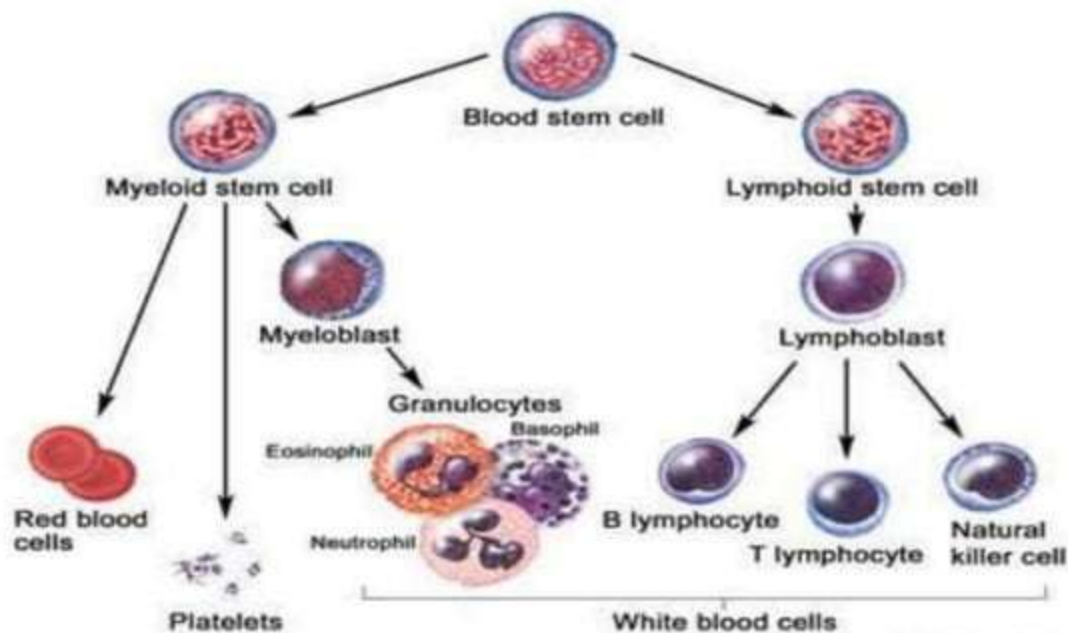


MUCOSA ASSOCIATED LYMPHOID TISSUE (MALT)

- **The mucosa lining the alimentary, respiratory and other lumina are endowed with a rich collection of lymphoid cell aggregates like the Peyer's patches or scattered isolated follicles- collectively called MALT.**
- **MALT contains lymphoid as well as phagocytic cells.**
- **Both B and T cells are present.**
- **While the predominant immunoglobulin produced in the mucosa is secretory IgA, other immunoglobulin classes, IgG, IgM and IgE are also formed locally.**



CELLS OF THE IMMUNE SYSTEM



Difference between B and T cells

B-lymphocyte (B-cells)

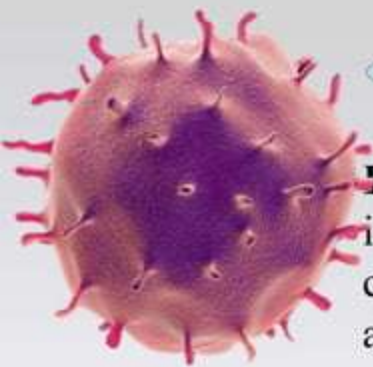
- 1. They arise from bone marrow Bursa of Fabricus (in fowl), gut-associated lymphoid tissue (Peyer's patches).
- 2. B-cells form humoral or antibody-mediated immune system (AMIS).
- 3. They defend against viruses and bacteria that enter the blood and lymph.
- 4. They are formed by the division plasma cells.
- 5. Plasma cells do not move to the site of infection.
- 6. Plasma cells do not react against transplants and cancer cells.
- 7. Plasma cells have no inhibitory effect on immune system.

T-lymphocyte (T-cells)

- 1. They arise from Thymus.
- 2. T-cells form cell-mediated immune system (CSM).
- 3. They defend against pathogens including protists and fungi that enter the cells.
- 4. They are formed by the division of lymphoblasts of three types: killer, helper and suppressor cells.
- 5. Lymphoblasts move to the site of infection.
- 6. Killer cells react against transplants and cancer cells.
- 7. Suppressor cells inhibit immune system.



T- Cells



Helper T-Cell: assist other white blood cells in immunologic processes, including maturation of B cells into plasma cells and memory B cells, and activation of cytotoxic T cells and macrophages.

Cytotoxic T-Cell: destroy virally infected cells and tumor-cells, and are also implicated in transplant rejection.

Regulatory T-Cell: formerly known as suppressor T-cells, are crucial for the maintenance of immunological tolerance.

Memory T-Cell: are a subset of antigen-specific T-cells that persist long-term after an infection has resolved.






B- Cells

Plasma B-Cells: are large B cells that have been exposed to antigen and produce and secrete large amounts of antibodies, which assist in the destruction of microbes by binding to them and making them easier targets for phagocytes and activation of the complement system.

Memory B-Cells: are formed from activated B-cells that are specific to the antigen encountered during the primary immune response.





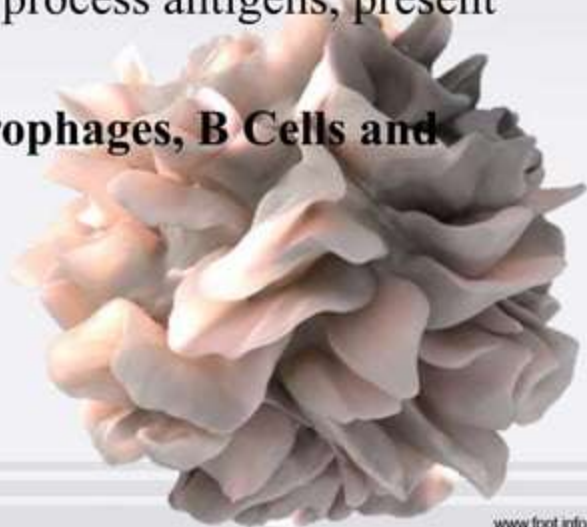
Natural Killer Cells (N K Cells)

- **These cells lack the marker molecules characteristic of B and T cells. They comprise about 10-15% of the lymphocytes of circulating blood.**
- **The role NK cells play is analogous to that of cytotoxic T cells in the vertebrate adaptive immune response. NK cells provide rapid responses to virally infected cells and respond to tumor formation, acting at around 3 days after infection.**
- **NK cells are unique, however, as they have the ability to recognize stressed cells in the absence of antibodies and MHC, allowing for a much faster immune reaction.**
- **They were named “natural killers” because of the initial notion that they do not require activation in order to kill cells that are missing “self” markers of major histocompatibility complex (MHC).**



Antigen- Presenting Cells

- These are group of diverse cell types that assists other cells in the Immune Response.
- Cells which do not have antigen-specific receptors. Instead, they capture and process antigens, present them to T cell receptors.
- These cells include **Macrophages, B Cells and Dentric cells.**



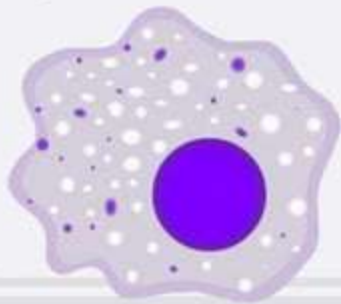
Dendritic Cell

- These cells are immune cells forming part of the Mammalian Immune System.
- Their main function is to process antigen material and present it on the surface to other cells of the immune system.
- They **act as messengers between the innate and adaptive immunity.**
- At certain development stages they grow branched projections, the dendrites.
- While similar in appearance, these are distinct structures from the dendrites of neurons. Immature dendritic cells are also called veiled cells, as they possess large cytoplasmic “veils” rather than dendrites.
- Dendritic cells are present in tissues in contact with the external environment, such as the skin and the inner lining of the nose, lungs, stomach and intestines. They can also be found in an immature state in the blood.
- Once activated, they migrate to the lymph nodes where they interact with T cells and B cells to initiate and shape the adaptive immune response.

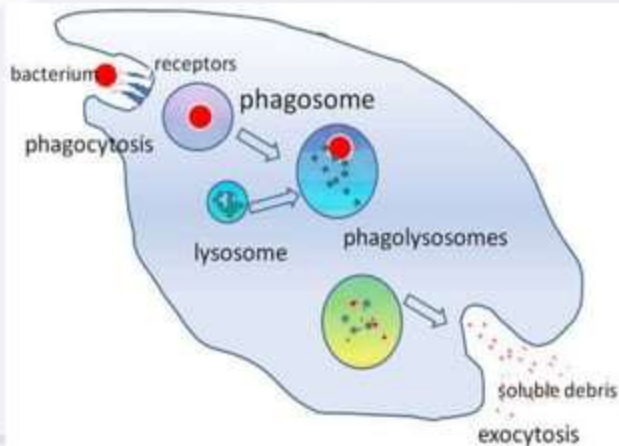


Macrophages

- Macrophages are cells produced by the differentiation of monocytes in tissues. It function in both non-specific defense, Innate Immunity, as well as help initiate specific defense mechanisms, Adaptive Immunity, of vertebrate animals.
- Their role is to "**phagocytose**" (**engulf and then digest**) cellular debris and pathogens, either as stationary or as mobile cells.
- They also stimulate lymphocytes and other immune cells to respond to pathogens. They are specialized phagocytic cells that attack foreign substances, infectious microbes and cancer cells through destruction and ingestion.



Macrophage



MAST CELLS

- These are cells concentrated within the respiratory and gastrointestinal tracts, and within the deep layers of the skin.
- These cells release histamine upon encountering certain antigens, thereby triggering an allergic reaction.
- The mast cell is very similar in both appearance and function to the Basophil, a type of white blood cell.





THANK YOU 😊

