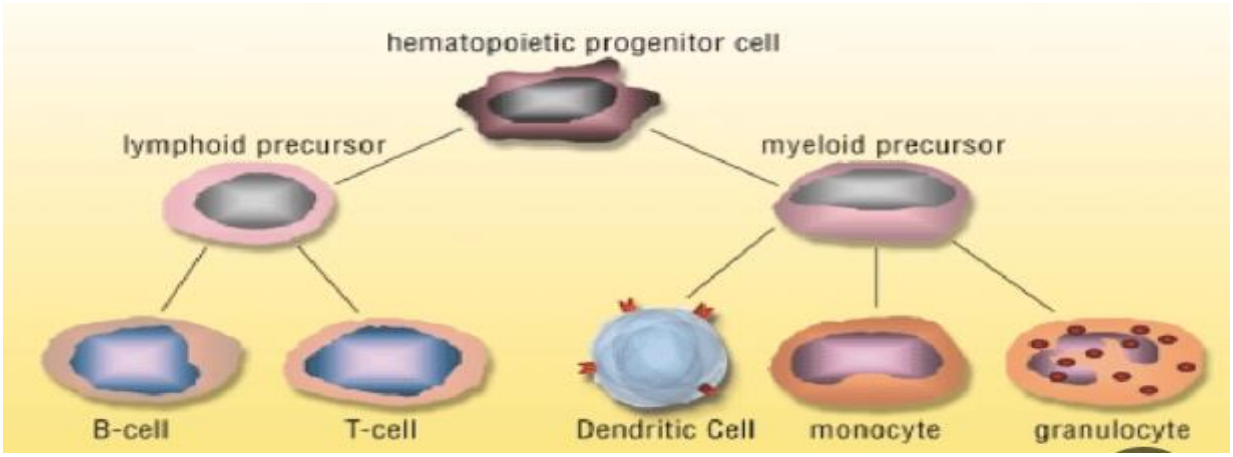
Monocytes and Phagocytosis

Monocytes are a type of leukocyte or white blood cell. They are the largest type of leukocyte in blood .As a part of the vertebrate innate immune system , monocytes also influence adaptive immune responses .

Monocytes are amoeboid in appearance, mononuclear cells and have nongranulated cytoplasm. Monocytes compose 2% to 10% of all leukocytes in the human body.

Development

Monocytes are produced by the bone marrow from precursors **called monoblasts**, that differentiated from hematopoietic stem cells. Monocytes circulate in the bloodstream for about one to three days and then typically migrate into tissues throughout the body where they differentiate into macrophages. Thus, macrophages take different names according to their tissue location, such as **osteoclasts (bone**), **alveolar macrophages (lung)**, **microglial cells (brain), histiocytes (connective tissue), Kupffer cells (liver), Langerhans cells (LC) (skin)**, **Monocytes (blood ,bone marrow).**



Function

Monocytes are mechanically active cells and migrate from blood to an inflammatory site to perform their functions. In general, monocytes and their macrophage and dendritic cell progeny serve three main functions in the immune system. These are **phagocytosis, antigen presentation, and cytokine production.**

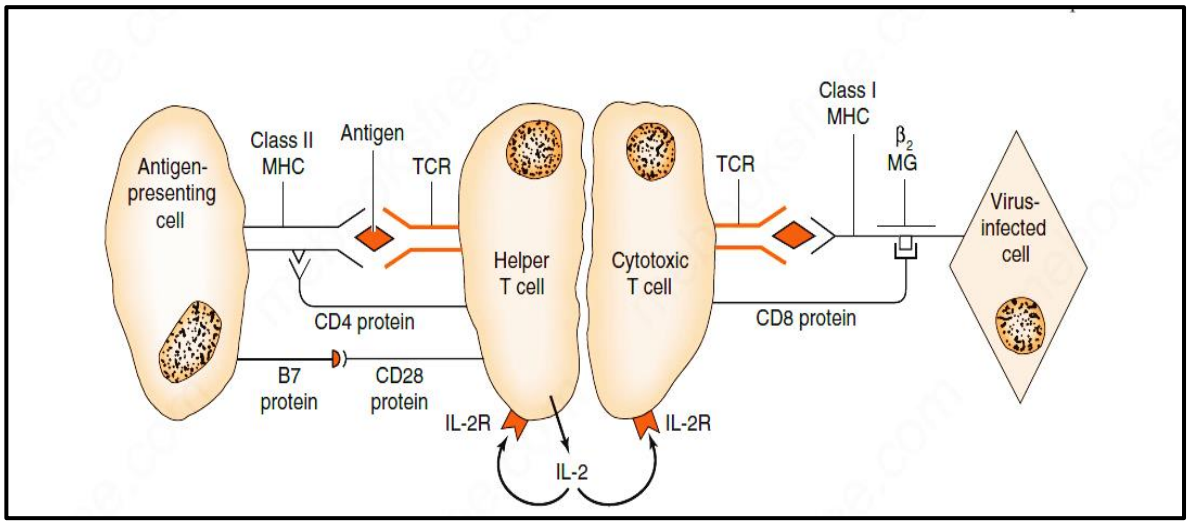
- **B CELLS**

B cells perform two important functions: **(1) they differentiate into plasma cells and produce antibodies**, and (**2) they can present antigen to helper T cells.**

B cells also present antigen to helper T cells. IgM on the surface of B cells serves as the antigen receptor. The captured antigens are typically proteins rather than bacteria that usually enter the antigen-presenting cells (APCs) by phagocytosis. The proteins are degraded within the B cells into smaller peptides (epitopes) that are presented in the context of Class II MHC proteins to helper T cells. The epitope is recognized by the TCR of the helper T cells. The helper T cells are then activated to produce **IL-2, IL-4, and IL-5** that **promote the growth and differentiation of the B cells into antibody producing plasma cells**

Activation of T Cells

The activation of helper T cells requires that their TCR recognize a complex on the surface of antigen-presenting cells (APCs) (e.g., dendritic cells) consisting of both the antigen and a class II MHC protein. The activation of cytotoxic T cells requires that their TCR recognize a complex on the surface of APCs consisting of both the antigen and class I MHC protein. **Note that this can occur because APCs have both class I and class II proteins on their surface. Dendritic cells, macrophages, and B cells are the most important antigen-presenting cells .**

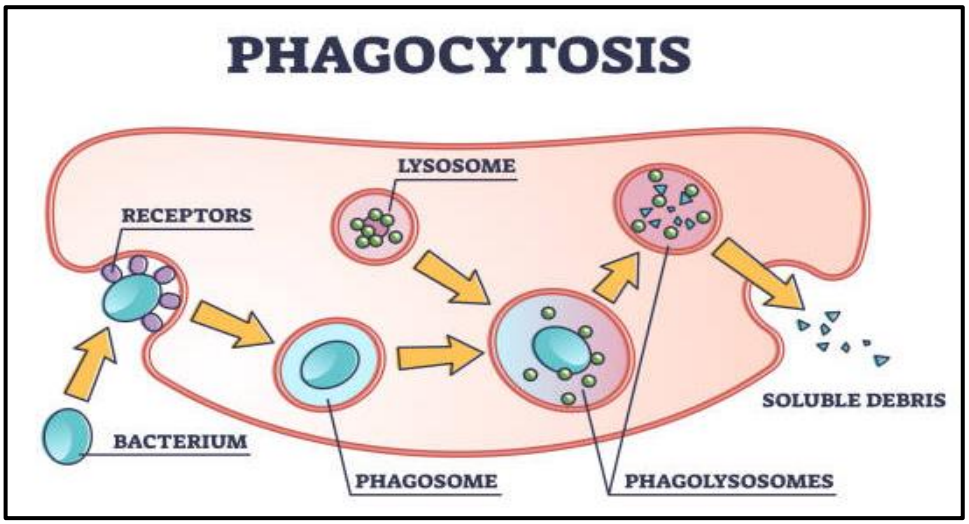


Phagocytosis :

Phagocytosis is the process by which a cell uses its plasma membrane to engulf a large particle (≥ 0.5 μm), giving rise to an internal compartment called the **phagosome**. It is one type of endocytosis. A cell that performs phagocytosis is called **a phagocyte** .

In a multicellular organism's immune system, phagocytosis is a major mechanism used to remove pathogens and cell debris. The ingested material is then digested in the

phagosome. Bacteria, dead tissue cells, and small mineral particles are all examples of objects that may be phagocytized.



Types of Th Cells

T cells are subdivided into two major categories on the basis of whether they have **CD4 or CD8** proteins on their surface. Mature T cells have either CD4 or CD8 proteins but not both. **CD4 lymphocytes** perform the following **helper** functions:

(1) they help B cells develop into antibody-producing plasma cells; **(2)** they help CD8 T cells to become activated cytotoxic T cells; and **(3)** they help macrophages kill ingested microbes. These functions are performed by three distinct subpopulations of **Th- CD4 cells:**

(1) The Th-1 cell subpopulation produces **gamma interferon that activates macrophages** to become more effective killers of intracellular microbes such as *Mycobacterium tuberculosis*, also gamma interferon help B cells to class switch to produce two subclasses of IgG (namely IgG 1 and IgG 3) that are very effective opsonizers of bacteria.**Th-1 cells** are an important source of **IL-2 which is T-cell growth factor**, that is, it stimulates the growth of both CD4 and CD8 T cells

(2) The Th-2 cell subpopulation performs the B-cell helper function primarily by producing **IL-4 and IL-5**. **IL-4 and IL-5 enhance the growth and differentiation of B cells into plasma cells.**

One important regulator of the balance between Th-1 cells and Th-2 cells is

IL-12 which is produced by macrophages. IL-12 increases the number of Th-1 cells, thereby enhancing host defenses against organisms **.**

Property	Th-1 Cells	Th-2 Cells
Produces IL-2 and gamma interferon	Yes	No
Produces IL-4, IL-5, IL-6, and IL-10	No	Yes
Enhances cell-mediated immunity and delayed hypersensitivity primarily	Yes	No
Enhances antibody production primarily	No	Yes
Stimulated by IL-12	Yes	No
Stimulated by IL-4	No	Yes

Comparison of Th-1 Cells andTh-2 Cells

(3) The Th-17 cell: subpopulation produces **IL-17** that recruits neutrophils to a site of inflammation. Th-17 cells enhance mucosal immunity, especially in the gastrointestinal tract .