

T – Lymphocytes and Immune Responses

T cells

T cells or T lymphocytes are a type of lymphocytes (itself a type of white blood cells) that play a central role in cell-mediated immunity. They can be distinguished from other lymphocytes, such as B cells and natural killer cells (NK cells), by the presence of a T-cell receptor (TCR) on the cell surface. They do not have antigen-presenting They are called T cells because they mature in the thymus.

Two Types of T Cells

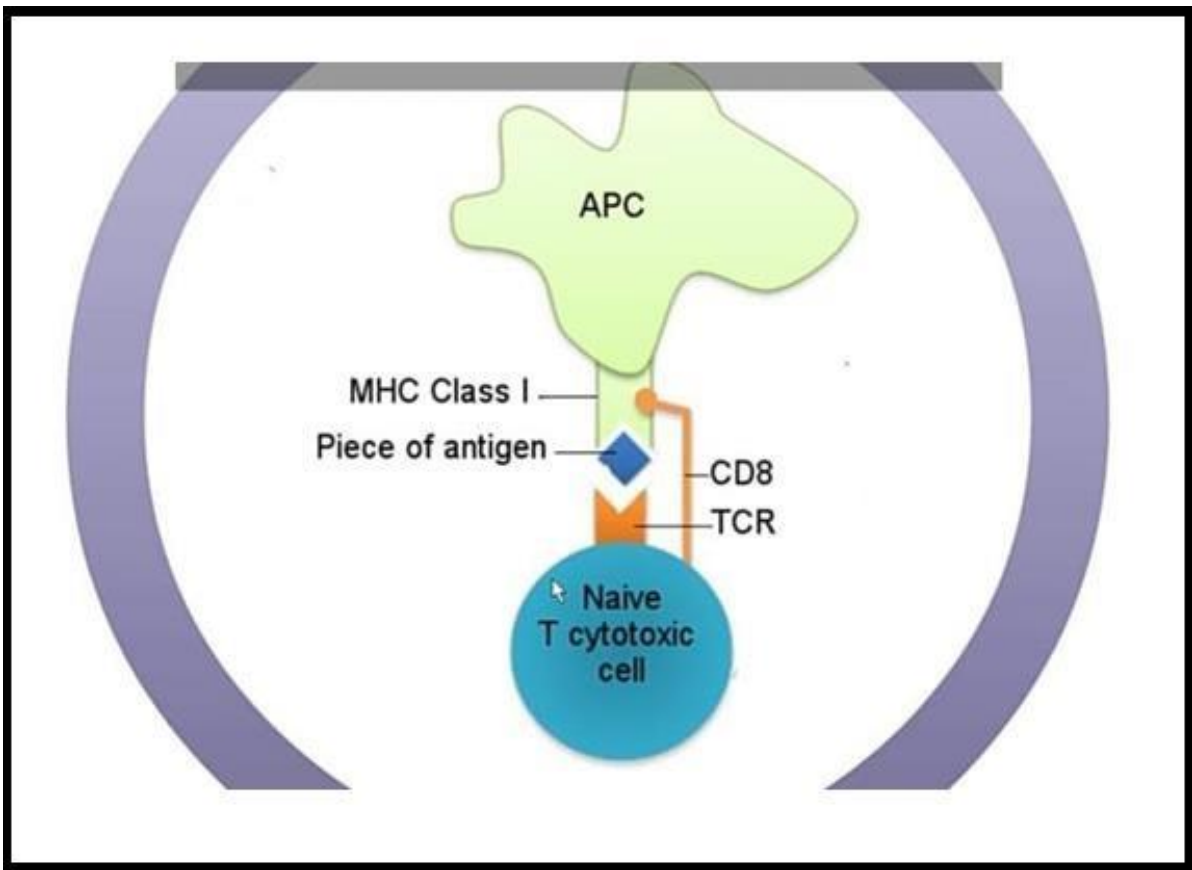
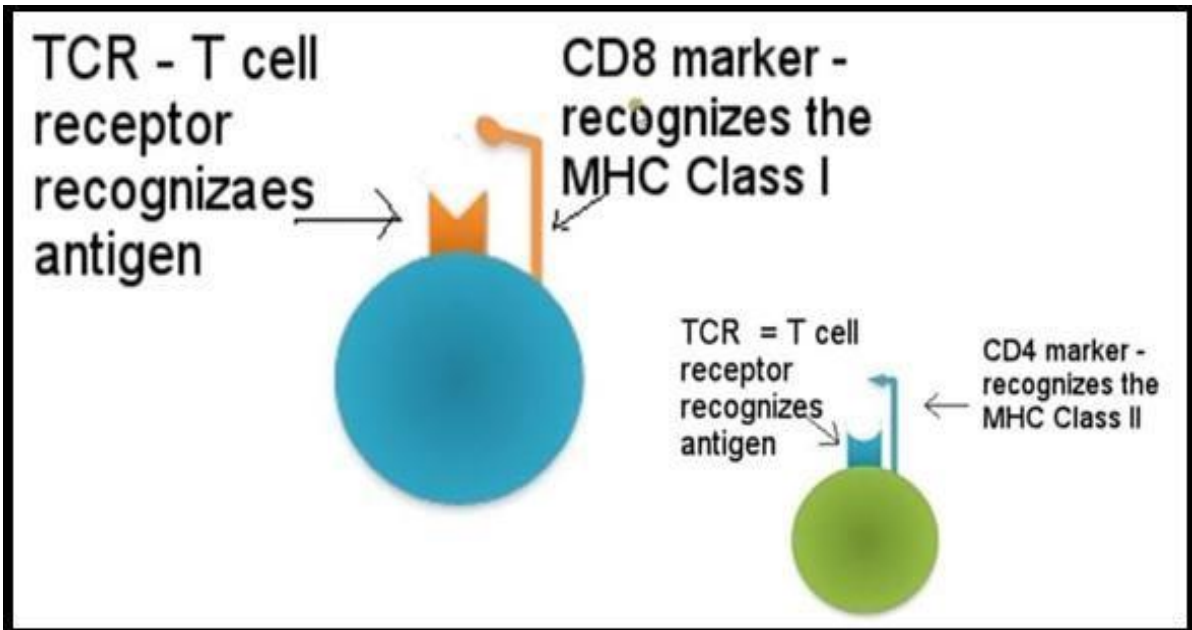
- There are two classifications of T cells
- 1. T Helper Cells (Th) - have CD4 markers on their surface
- 2. T cytotoxic Cells (Tc) - have CD 8 markers on their surface

Cells:	T Helper	T Cytotoxic
Antigens:	Extracellular	Intracellular
MHC Molecule:	MHC Class II	MHC Class I

CYTOTOXIC T CELLS	HELPER T CELLS
A type of immune cell that can kill certain cells, including foreign cells, cancer cells, and cells infected with a virus	A type of T cell that provides help to other cells in the immune response by recognizing foreign antigens and secreting cytokines that activate T and B cells
Contain CD8 receptors	Contain CD4 receptors on the cell membrane
Antigens are presented by virusinfected cells and tumor cells	Antigens are presented by macrophages, dendritic cells, neutrophils, etc.
CD8 receptors can recognize antigens presented with MHC class I molecules	CD4 receptors can recognize antigens presented with MHC class II molecules

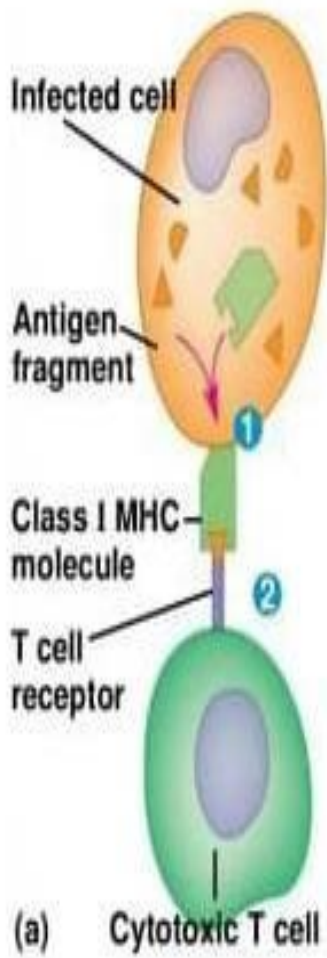
Destroy virus-infected cells and tumor cells

Secrete cytokines to regulate other cells in the immune system and present antigens to B cells



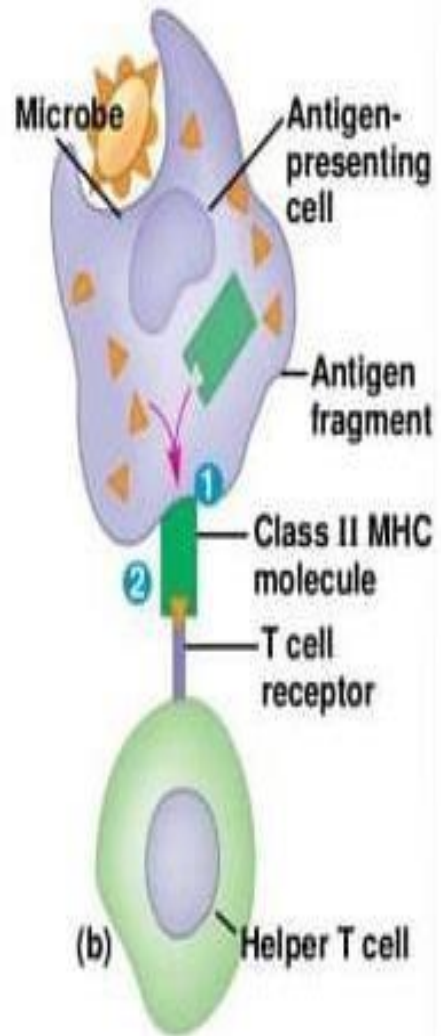
Two Types of Antigen

- The antigen receptor recognizes epitopes on foreign antigens.
- The type of T cell activated and the response initiated depends on the ANTIGEN!
- INTRACELLULAR or endogenous antigens, originating from within the cell.
Ex: virus or cancerous cell. Recognized by T cytotoxic cells.
- EXTRACELLULAR or exogenous antigens, are found OUTSIDE the cell. Ex: bacteria or parasite. Recognized by T helper cells.

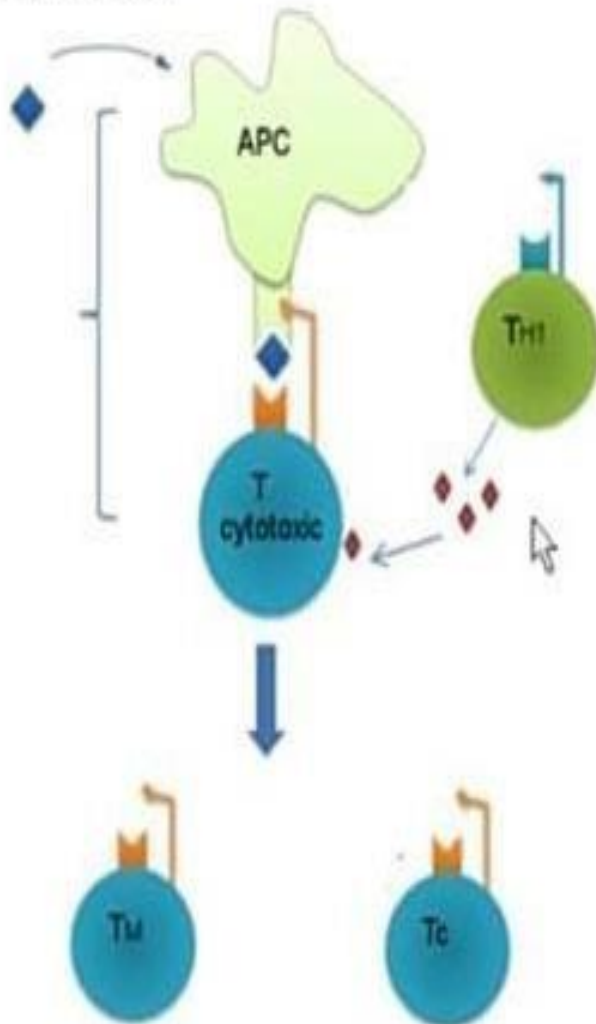


1 Antigen associates with MHC molecule

2 T cell recognizes combination



Intracellular Antigen
(virus, cancer, etc.)



Step 1: An Antigen Presenting Cell (APC) internalizes and processes an antigen, then displays it on its surface using an MHC Class I molecule.

Step 2: The APC presents the processed antigen with the MHC Class I to a naive T cytotoxic (Tc) cell. The Tc cell will recognize the antigen piece and MHC Class I with its TCR and CD8 molecule.

Step 3: Upon recognition of the MHC Class I by the CD8 on the Tc cell, and the piece of antigen by the TCR, interleukin 2 (IL-2) is released by TH1 causing the Tc to undergo proliferation.

T memory cells will be distributed to immune tissues for future protection.

Tc cells will interact with infected cells to destroy them.

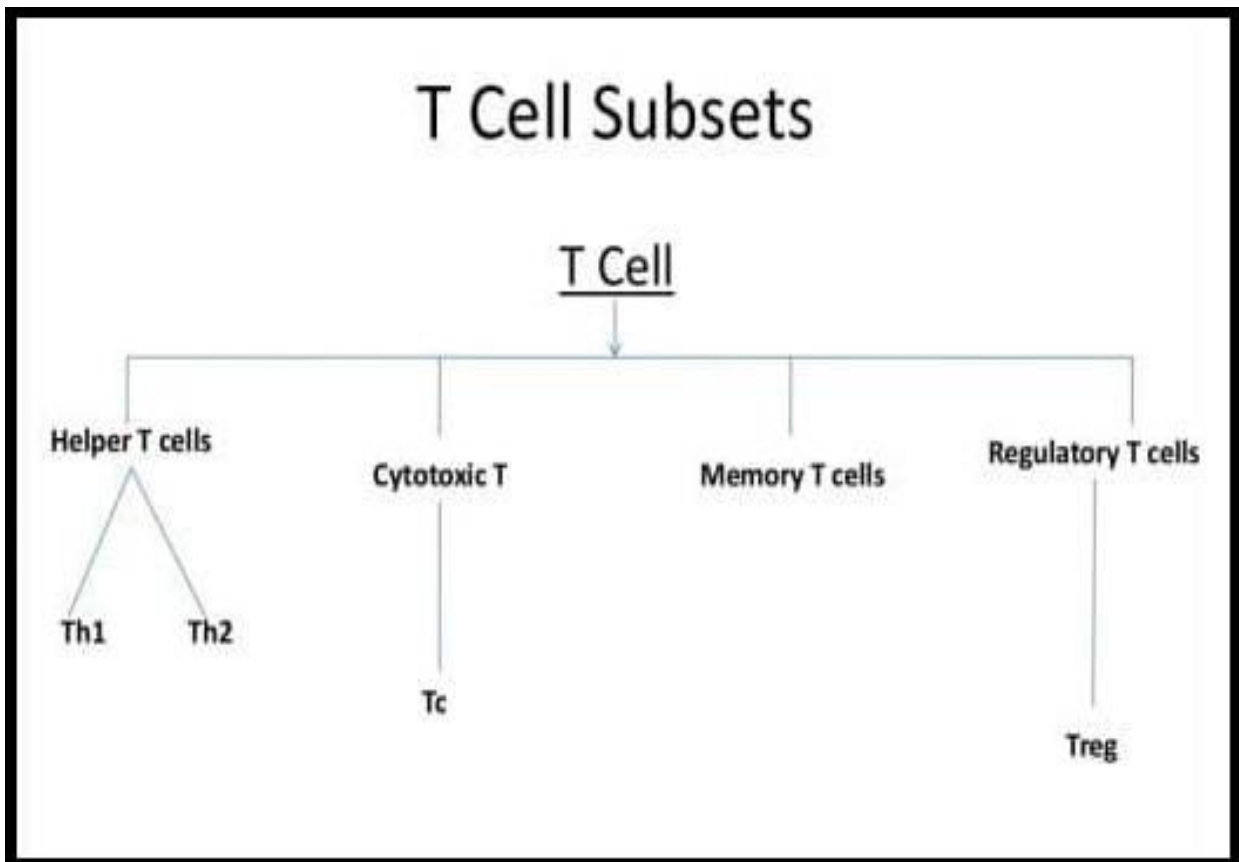
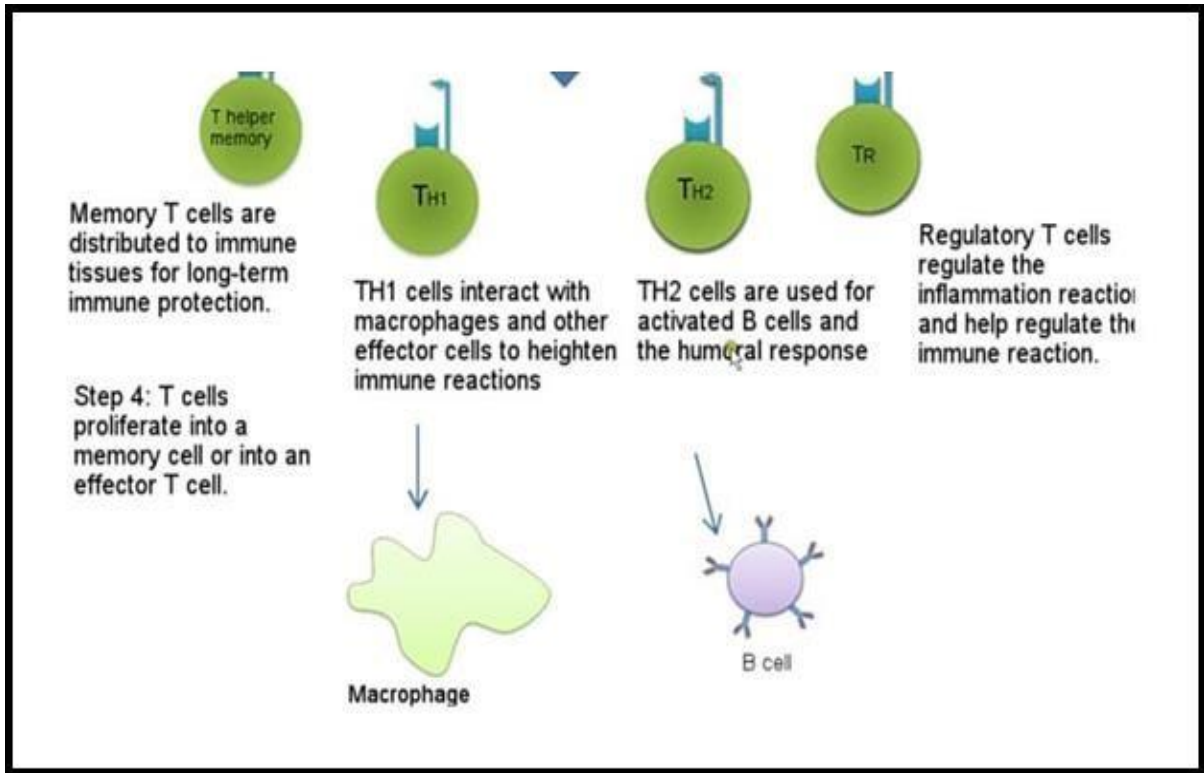


Fig: Different types of T-cells.

Helper T cells ::

There are two different kinds of helper T cells. Th1 and Th2. Th1 functions to empower macrophages so that they can destroy intravesicular pathogens (bacteria).

This is done by two signals, Binding Of CD40L from Thi to CD40LR on the macrophage and by interferon gamma released from Thi,

Th2 cells function to activate B cells. Normally it is insufficient for an antigen alone to stimulate the B cell to activation. The Th2 cell when activated will bind to the B cell (CD40L and CD40LR) and release cytokines

Functions

- Helper T cell

T helper cell (TH cells) 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. These cells are also known as CD4• T cells because they express the CD4 glycoprotein on their surface.

Cytotoxic T

Cytotoxic T (or CD8) cells are activated in your lymph nodes by dendritic cells. Once activated they are sent out to the site of infection and they bind to the cells that express the MHC class I that are presenting the foreign antigen. They will then release perforin (punch holes in the infected cell) and granzymes (induces apoptosis). The infected cells are now destroyed.

Functions

- **Cytotoxic**

Cytotoxic T cells (Tc cells, or CTLs) destroy virally infected cells and tumor cells, and are also implicated in transplant rejection. These cells are also known as CD8 T cells since they express the CD8 glycoprotein at their surface.

Memory T cells

Memory T cells are a subset of antigen-specific T cells that persist long-term after an infection has resolved. They quickly expand to large numbers of effector T cells upon re-exposure to their cognate antigen, thus providing the immune system with "memory" against past infections. Memory T cells comprise two subtypes: central memory T cells (T_{cm} cells) and effector memory T cells (T_{em} cells). Memory cells may be either CD4⁺ or CD8⁺. Memory T cells typically express the cell surface protein CD45RO.

Functions

Memory T cells are a subset of infection- as well as potentially cancer. fighting T cells.

Such T cells can recognize foreign invaders, such as bacteria or viruses, as well as cancer cells.

memory T cells can reproduce to mount a faster and stronger immune response than the first time the immune system responded to the invader.

Regulatory T cells

- Regulatory

Regulatory T cells (T cells), formerly known as suppressor T cells, are crucial for the maintenance of immunological tolerance, Their major role is to shut down T cell-mediated immunity toward the end of an immune reaction and to suppress auto-reactive T cells that escaped the process Of negative selection in the thymus.

Two major classes of CD4* T cells have been described — naturally occurring T cells and adaptive T cells.

Functions

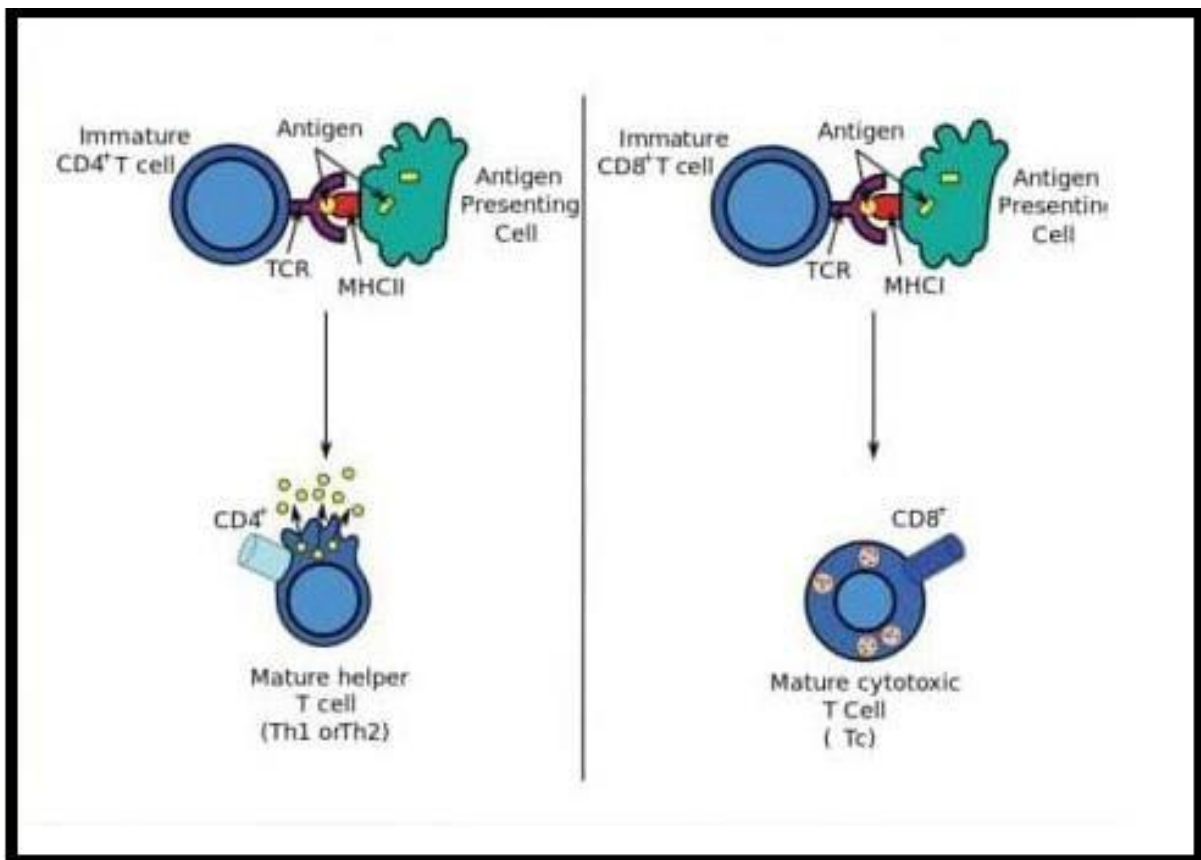
TO function properly, the immune system must discriminate between self and non-self. When self/non-self discrimination fails, the immune system destroys cells and tissues Of the body and as a result causes autoimmune diseases. Regulatory T cells actively suppress activation of the immune system and prevent pathological self-reactivity, i.e. autoimmune disease.

Summary

Name of T Cell Subset	Functions
Helper T Cell	Assist other white blood cells in immunologic processes.
Cytotoxic T Cell	Destroy virally infected and tumor cells.
Memory T Cell	Subset of infection- as well as potentially cancer-fighting T cells.
Regulatory T Cell	Regulatory T cells actively suppress activation of the immune system and prevent pathological self-reactivity.

ROLE OF THE MHC :

- In infected cells, MHC molecules bind and transport antigen fragments to the cell surface, a process called antigen presentation.
- A nearby T cell can then detect the antigen fragment displayed on the cell's surface
- Depending on their source, peptide antigen are handled by different classes of MHC molecules:
- Class I MHC molecules are found on almost all nucleated cells of the body. They display peptide antigens to cytotoxic T cells.
- Class II MHC molecules are located mainly on dendritic cells, macrophages, and B cells.
- Dendritic cells macrophages, and B cells are antigen-presenting cells that display antigens to cytotoxic T cells and helper T cells.



MHC markers

- “Self” proteins found on surface of the body's cells
- Recognized by the CD markers on T cells
- Two Main MHCs
- Class I — all nucleated cells express during intracellular type invaders — cancer/virus
- Class II — macrophages, dendritic cells and B cells express during an extracellular invader — bacteria, parasites

END
