

T Cells and Cellular Immunity

Classes of T Cells

There are classes of T cells that have different functions, rather like the classes of immunoglobulins. For example, T helper cells cooperate with B cells in the production of antibodies.

- T helper cells are an important part of humoral immunity.
- T helper are an even more essential element of cellular immunity.

Primarily, the two populations of T cells that concern us here are T helper cells (T_H cells) and T cytotoxic cells (T_c).

A T_c cell can differentiate into an effector cell called a cytotoxic T lymphocyte (CTL).

T cells are also classified by certain glycoproteins on their surface called clusters of differentiation, or CD. These are membrane molecules that are especially important for adhesion to receptors. The CDs of greatest interest are CD4 and CD8.

T_H cells are classified as CD4+, which bind to MHC class II molecules on B cells and APCs (Figures 17.10). T_c cells are classified as CD8+, which bind to MHC class I molecules

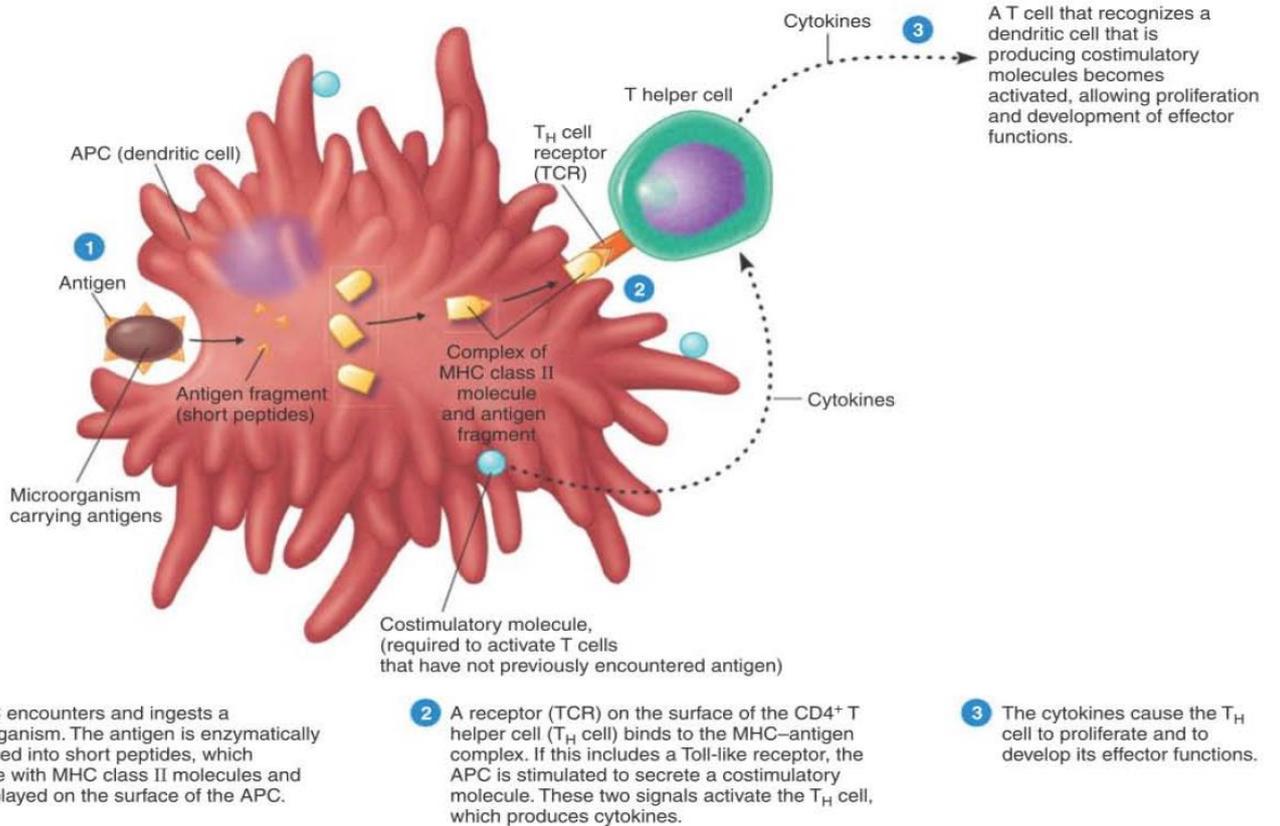


Figure 17.11 Killing of virus-infected target cell by cytotoxic T lymphocyte.

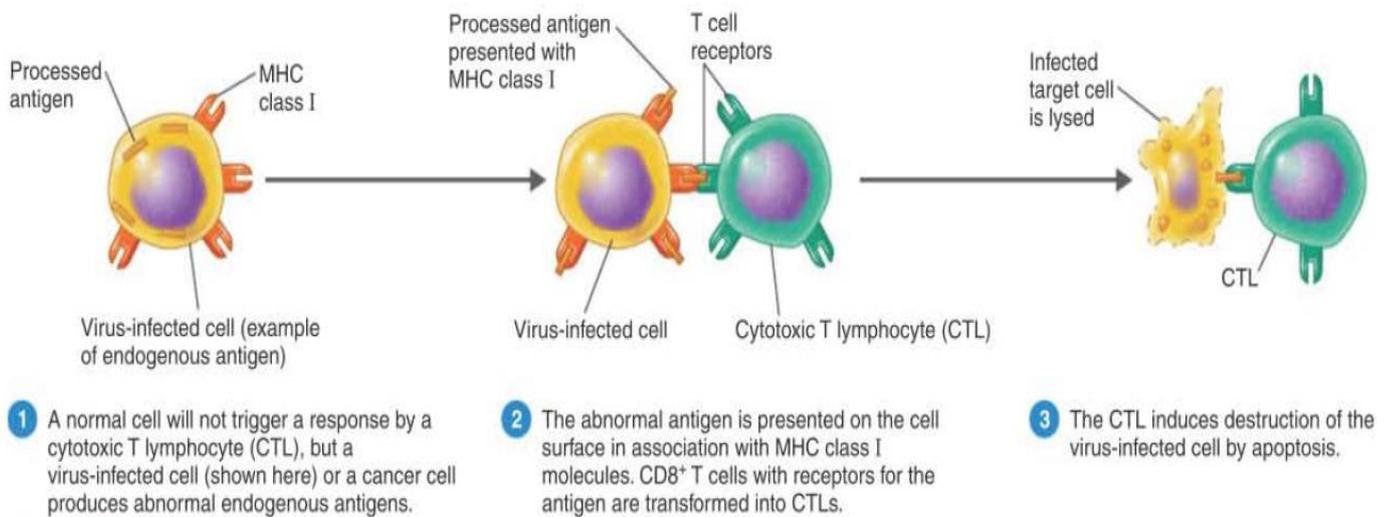


Figure 17.11 Killing of virus-infected target cell by cytotoxic T lymphocyte.

T Helper Cells (CD4⁺ T Cells)

Macrophages, when functioning as APCs, also are important in adaptive cellular immunity. T_H cells can recognize an antigen presented on the surface of a macrophage and activate the macrophage, making it more effective in both phagocytosis and in antigen presentation.

Even more important as APCs are dendritic cells. Dendritic cells are especially important in the activation of CD4⁺ T cells and in developing their effector functions (Figure 17.10).

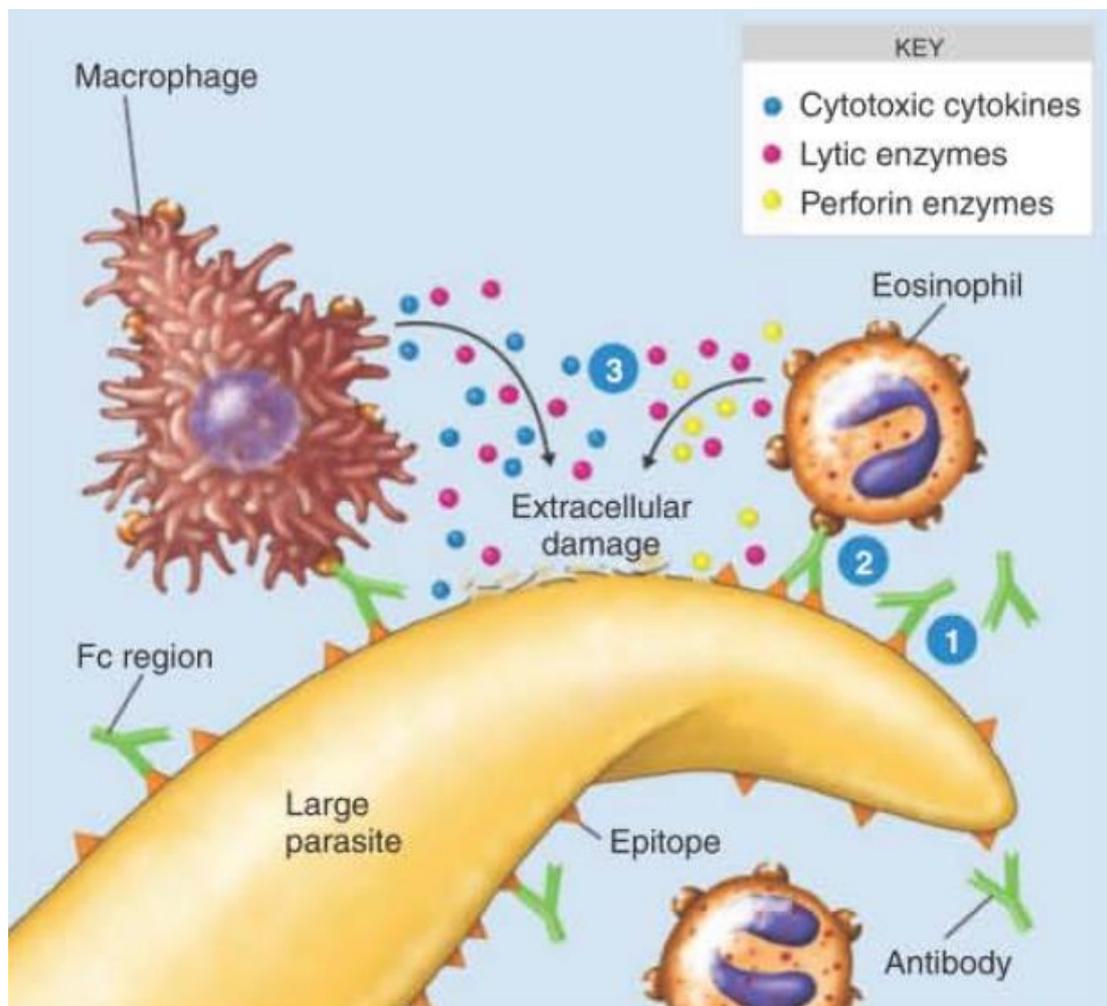
For a CD4 + T cell to become activated, its TCR recognizes an antigen that has been processed and is presented as fragments held in a complex with proteins of MHC class II on the surface of the APC. The activated T_H cell begins to proliferate at the rate of two to three cell cycles a day and to secrete cytokines, which are essential for its effector functions. The proliferating T_H cell differentiates into populations of T_H1 and T_H2 cells; it also forms a population of memory cells.

The function of T_H1 cells:

- 1- The cytokines produced by T_H1 cells, especially IFN - γ , activate mostly those cells related to important elements of cellular immunity.
- 2- They also stimulate the production of antibodies that promote phagocytosis and are especially effective in enhancing the activity of complement, such as opsonization and inflammation.

The function of T_H2 cells:

- 1- T_H2 also produce cytokines that are associated primarily with the production of antibodies, especially IgE, that are important in allergic reactions.
- 2- They are also important in the activation of the eosinophils that defend against infections by extracellular parasites such as helminths.



T Cytotoxic Cells (CD8+ T cells)

T cytotoxic cells, despite their name, are not capable of attacking any target cell as they emerge from the thymus; rather, they are precursors to CTLs, which do have this capability.

This differentiation requires sequential, and complex, activation of the precursor T_c by an antigen processed by a dendritic cell and interaction with a T_H cell and costimulatory signals. The resulting CTL is an effector cell that has the ability to recognize and kill target cells that are considered nonself.

Primarily, these target cells are **self cells** that have been altered by infection with a pathogen, especially viruses. On their surface they carry fragments of endogenous antigens that are generally synthesized within the cell and are mostly of viral or parasitic origin. Other important target cells are tumor cells and transplanted foreign tissue. Rather than reacting with antigenic fragments presented by an APC in complex with MHC class II molecules, the CD8+ T cell recognizes endogenous antigens on the target cell 's surface that are in combination with an MHC class I molecule. MHC class I molecules are found on nucleated cells; therefore, a CTL can attack almost any cell of the host that has been altered. In its attack, a CTL attaches to the target cell and releases a pore-forming protein, **perforin**.

T Regulatory Cells

T regulatory cells (T_{reg}) formerly called T suppressor cells, make up about 5- 10% of the T cell population. They are a subset of the CD4+ T helper cells and are distinguished by carrying an additional CD25 molecule.

Their primary function is to combat autoimmunity by suppressing T cells that escape deletion in the thymus without the necessary "education" to avoid reacting against the body's self. They are also useful in protecting, from the immune system, the intestinal bacteria required for digestion and other useful functions. Similarly, in pregnancy they may play a role in protecting the fetus from rejection as **nonsel**.