



**FIGURE 26.2** Dendritic cell (DC) acquires antigen, processes the antigen, and presents the processed antigen to a  $CD8^+$  T cell. Antigen processing and presentation by a DC that is poorly activated. The DC shown in this figure can present antigen to T cells, resulting in an activated T cell, but activation is not optimal, and the T cell cannot mount an effective and vigorous immune response.

antigens to the other type of T cell, namely,  $CD4^+$  T cells, resulting in the activation and proliferation of these  $CD4^+$  T cells.

The following diagrams illustrate further details of the immune system, showing the activation of DCs, where the consequence of this activation is that the DC more effectively activates the T cell. The first picture shows a nonactivated DC, where formation of the immune synapse results in a *poorly activated T cell*. The second picture shows the activation of a DC by an immune adjuvant, where this particular immune adjuvant is a TLR-agonist, and where the consequence is a *highly activated T cell*. The third picture shows the activation of a DC by a  $CD4^+$  T cell, where the consequence is a *highly activated T cell*. A property of a poorly activated  $CD8^+$  T cell is that it may be stimulated to proliferate, but it will function poorly in killing target cells. A property of a highly activated  $CD8^+$  T cell is that it is stimulated to proliferate, and that it can also function effectively in killing target cells.  $CD4^+$  T cells are also called helper T cells.  $CD8^+$  T cells function to kill other cells and for this reason are also called CTLs. The little arrays of lines represent the binding interaction between two proteins. This binding involves the formation of hydrogen bonds. It is conventional, in organic chemistry, to use an array of parallel lines to represent a hydrogen bond. The

segmented ribbon represents a peptide, that is, an oligomer of about 10 amino acids (Figures 26.2–26.4).

This concerns NK cells and antibodies. NK cells kill cells by way of antibody-dependent cell cytotoxicity (ADCC). In ADCC, an antibody binds to the surface of a human cell that is infected with a virus or bacteria, to form a complex. This complex mediates the binding of the NK cell to the infected cell, where the result is that the NK cell kills the infected human cell, thereby curing the infection. NK cells can kill tumor cells by the same mechanism, that is, where a tumor-specific antibody binds to the tumor cell. ADCC involves a sandwich of two cells, where the antibody resides inside the sandwich. B cells produce antibodies.

## X. DRUGS THAT MODULATE THE IMMUNE SYSTEM

### a. Introduction

In autoimmune diseases and inflammatory disorders, the relevant drugs are intended to inhibit the immune system, whereas in cancer and chronic infections, the drugs are intended to stimulate the immune system. Drugs that modulate the immune system are indicated by