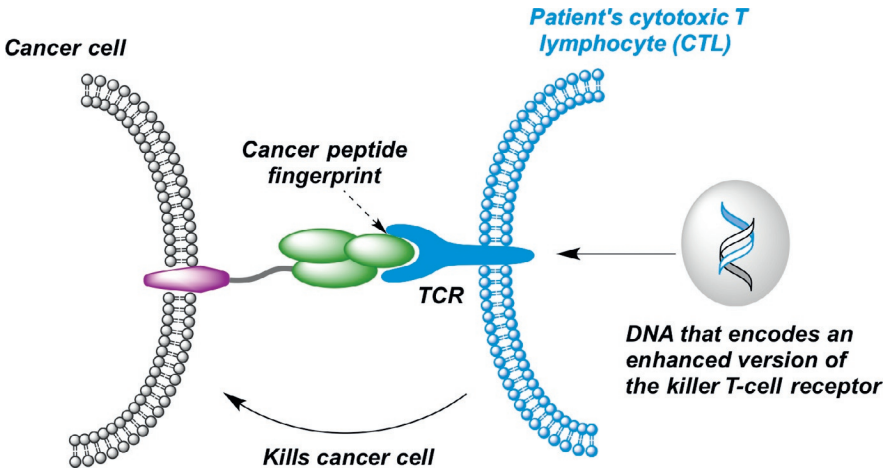

FIGURE 12.6

Cancer treatment with cells modified to prompt an immune response.

4.2 DNA AND RNA CANCER VACCINES

Vaccines for cancer treatment may also use DNA or RNA molecules that encode cancer-associated antigens and are injected into a patient as "naked nucleic acids" or incorporated into harmless viruses. A drawback of DNA vaccines is the potential of the DNA to integrate into the genome of the cell that takes it up, thus potentially promoting malignancy. This integration problem may be avoided in RNA vaccines,[77] but their efficacy can be compromised by degradation by RNAases.

Among the whole-cell-based autologous cell (personalized) vaccines[78] is sipuleucel-T (Provenge®), the first cancer treatment vaccine approved by the FDA in 2010 for patients who have advanced to the late stage of hormone-refractory prostate cancer.[79] This autologous vaccine was designed to stimulate an immune response to prostatic acid phosphatase (PAP), an antigen that is found on most prostate cancer cells. Unlike some other cancer treatment vaccines under development, sipuleucel-T is customized to each patient through a rather complex process. First, the patient's white blood cells, primarily DCs, are extracted in a leukapheresis procedure. This blood product is sent to a factory and incubated with a fusion protein consisting of PAP and an immune signaling factor granulocyte–macrophage colony-stimulating factor (GM-CSF) to help the DCs mature. Finally, this activated blood product is reinfused into the patient, who receives three treatments, usually 2 weeks apart, with each round of treatment requiring the same manufacturing process. Although the precise mechanism of action of sipuleucel-T is not known, it appears that the APCs that have taken up PAP–GM-CSF stimulate T cells of the immune system to kill tumor cells that express PAP. Provenge® is one of the most expensive cancer treatments, and its benefit has been controversial[80] because the vaccine does not cure prostate cancer but helps extend patients' lives by several months on average. Studies to determine if this vaccine can help men with less advanced prostate cancer are in progress.