

## The Immune System: Cellular Immunity

1. Cytokines are small proteins that transfer information within the immune system. List the actions of cytokines given in this Topic:

- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_

2. Interleukin-1, a cytokine, acts as a chemical alarm to alert the immune system to the presence of a pathogen. List the three actions given for interleukin-1 in this Topic:

- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_

3. Interleukin-2, released by helper T cells, causes proliferation of activated lymphocytes. This process is called \_\_\_\_\_.

4. The two major classes of lymphocytes that mediate cellular immunity are based on the presence of surface proteins called \_\_\_\_\_ proteins. The most common are those with the \_\_\_\_\_ markers.

5. Below are the two major classes of cells with CD protein markers. List what the cells become and what class of MHC proteins they bind.

CD4 cells: - most become \_\_\_\_\_ cells but some become \_\_\_\_\_ cells  
- bind to \_\_\_\_\_ MHC proteins

CD8 cells: - all become \_\_\_\_\_ cells  
- bind to \_\_\_\_\_ MHC proteins

6. The HIV virus binds to CD4 surface proteins and destroys the \_\_\_\_\_ cells.

7. The \_\_\_\_\_ proteins are one major class of self-antigens. Thus, before an organ transplant, the donor's \_\_\_\_\_ and the recipient's \_\_\_\_\_ proteins are matched as closely as possible to decrease the chance of organ \_\_\_\_\_.

8. \_\_\_\_\_ cells circulate through the body searching for infected or cancerous cells by examining the antigenic determinant on \_\_\_\_\_ MHC proteins on the cell surface. Fragments of \_\_\_\_\_, degraded proteins are loaded onto these proteins in the endoplasmic reticulum. If the antigenic peptide is a \_\_\_\_\_ antigen, the body cell will be destroyed.

9. Unlike class I MHC proteins, which can be displayed on any nucleated cell, class II MHC proteins are only displayed on select cells. Name the antigen-presenting cells that have class II MHC proteins:

- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_

These cells communicate with CD4 cells, which will become \_\_\_\_\_ cells. Antigens presented on class II cells are \_\_\_\_\_ antigens.

10. Class II MHC's are produced in the \_\_\_\_\_ and pick up the exogenous antigens when they fuse with the \_\_\_\_\_.

11. Name two results of presenting the exogenous antigen on class II MHC proteins:

- CD4 cells are converted to helper T cells when \_\_\_\_\_ cells and \_\_\_\_\_ present the antigen.
- \_\_\_\_\_ cells and \_\_\_\_\_ present antigens to helper T cells to request further activation.

12. Dendritic cells are responsible for activating most T cells. Choose the correct answer for each of the following:

- They can capture antigens found \_\_\_\_\_ (extracellularly, intracellularly, or both).
- They can activate \_\_\_\_\_ (CD4, CD8, or both CD4 and CD8) cells.
- They can express \_\_\_\_\_ (MHC I, MHC II, or both MHC I and MHC II) proteins.

13. Exception: Normally, when cells express endogenous foreign antigens on class I MCH proteins on their cell membrane, they are marked for destruction. This is not true for \_\_\_\_\_ cells. On these cells the presentation acts as an activation signal for \_\_\_\_\_ cells.
14. List the two steps necessary for T cell activation:
- \_\_\_\_\_
  - \_\_\_\_\_
15. Once T cells are activated they undergo proliferation (called: \_\_\_\_\_ ) and differentiation. \_\_\_\_\_, a type of cytokine, is necessary for the proliferation.
16. Antigen-presenting cells will express co-stimulatory molecules when they have been signaled by the \_\_\_\_\_ defense mechanisms that an infection is present. However, if there is no infection, the antigens on the MHC protein are likely to be \_\_\_\_\_. Thus, without co-stimulation, the T cells become inactivated, a process called \_\_\_\_\_.
17. There are two ways to induce a process of self-destruction in a cell, which is called \_\_\_\_\_:
- *Cytotoxic T* cells look for the presence of MHCs with foreign antigens and release \_\_\_\_\_ and \_\_\_\_\_ or they bind to an \_\_\_\_\_ receptor (Fas receptor) on the surface of the cell.
  - *Natural killer cells* look for the absence of \_\_\_\_\_ and are thus able to eliminate abnormal cells that cytotoxic T cells cannot detect.
18. Helper T cells are critical for the activation of \_\_\_\_\_ cells and \_\_\_\_\_ T cells.
19. The helper T cell can help activate the CD8 cell to become a \_\_\_\_\_ T cell in two ways:
- It stimulates the dendritic cells to express additional \_\_\_\_\_ molecules
  - It secretes \_\_\_\_\_ (including interleukin-2) to help activation
20.  $T_H1$  cells secrete \_\_\_\_\_ interferons, which increase the effectiveness of \_\_\_\_\_ and \_\_\_\_\_ T cells.  $T_H2$  cells secrete interleukins \_\_\_\_\_ and \_\_\_\_\_, which promote activation of B cells.

21. Regulatory T cells suppress the activity of other T cells by direct \_\_\_\_\_ contact or by releasing \_\_\_\_\_. They are important in helping to prevent \_\_\_\_\_ diseases.