

CHAPTER 12

The Lymphatic System and Immunity

The lymphatic system is a system similar to the circulatory system. Lymph, like blood, flows through an elaborate route of vessels. In addition to lymphatic vessels, the lymphatic system consists of lymph nodes, lymph, and the spleen. Unlike the circulatory system, the lymphatic vessels do not form a closed circuit. Lymph flows only once through the vessels before draining into the general blood circulation. This system is a filtering mechanism for microorganisms and serves as a protective device against foreign invaders, such as cancer.

The immune system is the armed forces division of the body. Ready to attack at a moment's notice, the immune system defends us against the major enemies of the body: microorganisms, foreign transplanted tissue cells, and our own cells that have turned malignant.

The most numerous cells of the immune system are the lymphocytes. These cells circulate in the body's fluids seeking invading organisms and destroying them with powerful lymphotoxins, lymphokines, or antibodies.

Phagocytes, another large group of immune system cells, assist with the destruction of foreign invaders by a process known as phagocytosis. Neutrophils, monocytes, and connective tissue cells called macrophages use this process to surround unwanted microorganisms, ingest and digest them, and render them harmless to the body.

Another weapon that the immune system possesses is complement. Normally a group of inactive enzymes present in the blood, complement can be activated to kill invading cells by drilling holes in their cytoplasmic membranes, allowing fluid to enter the cell until it bursts.

Your review of this chapter will give you an understanding of how the body defends itself from the daily invasion of destructive substances.

TOPICS FOR REVIEW

Before progressing to Chapter 13, you should familiarize yourself with the functions of the lymphatic system, the immune system, and the major structures that make up these systems. Your review should include knowledge of lymphatic vessels, lymph nodes, lymph, antibodies, complement, and the development of B and T cells. Your study should conclude with an understanding of the differences in humoral and cell-mediated immunity.

THE LYMPHATIC SYSTEM

Fill in the blanks.

1. _____ is a specialized fluid formed in the tissue spaces that will be transported by way of specialized vessels to eventually reenter the circulatory system.
2. Blood plasma that has filtered out of capillaries into microscopic spaces between cells is called _____.
3. The network of tiny blind-ended tubes distributed in the tissue spaces is called _____.
4. Lymph eventually empties into two terminal vessels called the _____ and the _____.
5. The thoracic duct has an enlarged pouch-like structure called the _____.
6. Lymph is filtered by moving through _____, which are located in clusters along the pathway of lymphatic vessels.
7. Lymph enters the node through four _____ lymph vessels.
8. Lymph exits from the node through a single _____ lymph vessel.



If you have had difficulty with this section, review pages 308-310.

THYMUS TONSILS SPLEEN

Select the correct term from the options given and write the letter in the answer blank.

- A. Thymus B. Tonsils C. Spleen
- _____ 9. Examples are palatine, pharyngeal, and lingual
- _____ 10. Largest lymphoid organ in the body
- _____ 11. Destroys worn out red blood cells
- _____ 12. Located in the mediastinum
- _____ 13. Serves as a reservoir for blood
- _____ 14. T-lymphocytes
- _____ 15. Largest at puberty



If you have had difficulty with this section, review page 311-312.

THE IMMUNE SYSTEM

Match the term on the left with the proper selection on the right.

- _____ 16. Nonspecific immunity
- _____ 17. Inherited immunity
- _____ 18. Specific immunity
- _____ 19. Acquired immunity
- _____ 20. Immunization
- A. Inborn immunity
- B. Natural immunity
- C. General protection
- D. Artificial exposure
- E. Memory

IMMUNE SYSTEM MOLECULES

Choose the term that applies to each of the following descriptions. Write the letter for the term in the appropriate answer blank.

- | | |
|-----------------------|------------------------|
| A. Antibodies | F. Complement fixation |
| B. Antigen | G. Complement |
| C. Allergy | H. Humoral immunity |
| D. Anaphylactic shock | I. Combining site |
| E. Monoclonal | J. hCG |

- _____ 21. Hypersensitivity of the immune system to harmless antigens
_____ 22. Life-threatening allergic reaction
_____ 23. Type of very specific antibodies produced from a population of identical cells
_____ 24. Protein compounds normally present in the body
_____ 25. Also known as antibody-mediated immunity
_____ 26. Combines with antibody to produce humoral immunity
_____ 27. Antibody
_____ 28. Process of changing molecule shape slightly to expose binding sites
_____ 29. Pregnancy test kits
_____ 30. Inactive proteins in blood

Circle the one that does not belong.

- | | | | |
|----------------|----------------|--------------------|----------------|
| 31. Antibody | Allergy | Protein compound | Combining site |
| 32. Antigen | Invading cells | Foreign protein | Complement |
| 33. Monoclonal | Antibodies | Antigen | Specific |
| 34. Allergy | Complement | Anaphylactic shock | Antigen |
| 35. Monoclonal | 14 | Complement | Proteins |



If you have had difficulty with this section, review pages 311-316.

IMMUNE SYSTEM CELLS

Circle the correct answer.

36. The most numerous cells of the immune system are the:
- A. Monocytes
 - B. Eosinophils
 - C. Neutrophils
 - D. Lymphocytes
 - E. Complement
37. Which of the terms listed below occurs third in the immune process?
- A. Plasma cells
 - B. Stem cells
 - C. Antibodies
 - D. Activated B cells
 - E. Immature B cells

38. Which one of the terms listed below occurs last in the immune process?
- Plasma cells
 - Stem cells
 - Antibodies
 - Activated B cells
 - Immature B cells
39. Moderate exercise has been found to:
- Decrease white blood cells
 - Increase white blood cells
 - Decrease platelets
 - Decrease red blood cells
40. Which one of the following is part of the cell membrane of B cells?
- Complement
 - Antigens
 - Antibodies
 - Epitopes
 - None of the above
41. Immature B cells have:
- Four types of defense mechanisms on their cell membrane
 - Several kinds of defense mechanisms on their cell membrane
 - One specific kind of defense mechanism on their cell membrane
 - No defense mechanisms on their cell membrane
42. Development of an immature B cell depends on the B cell coming in contact with:
- Complement
 - Antibodies
 - Lymphotoxins
 - Lymphokines
 - Antigens
43. The kind of cell that produces large numbers of antibodies is the:
- B cell
 - Stem cell
 - T cell
 - Memory cell
 - Plasma cell
44. Just one of these short-lived cells that make antibodies can produce _____ of them per second.
- 20
 - 200
 - 2000
 - 20,000
45. Which of the following statements is *not* true of memory cells?
- They produce large numbers of antibodies.
 - They are found in lymph nodes.
 - They develop into plasma cells.
 - They can react with antigens.
 - All of the above are true of memory cells

46. T cell development begins in the:
- Lymph nodes
 - Liver
 - Pancreas
 - Spleen
 - Thymus
47. Human immunodeficiency virus (HIV) has its most obvious effects in:
- B cells
 - Stem cells
 - Plasma cells
 - T cells
48. Interferon:
- Is produced by T cells within hours after infection by a virus
 - Decreases the severity of many virus-related diseases
 - Shows promise as an anticancer agent
 - Has been shown to be effective in treating breast cancer
 - All of the above
49. B cells function indirectly to produce:
- Humoral immunity
 - Cell-mediated immunity
 - Lymphotoxins
 - Lymphokines
50. T cells function to produce:
- Humoral immunity
 - Cell-mediated immunity
 - Antibodies
 - Memory cells

Fill in the blanks.

51. The first stage of development for B cells is called the _____
52. The second stage of B cell development changes an immature B cell into a/an _____
53. _____ secrete copious amounts of antibody into the blood—nearly 2000 antibody molecules for every second they live.
54. T cells are lymphocytes that have undergone their first stage of development in the _____
55. _____ blocks HIV's ability to reproduce within infected cells.
56. _____ is a disease caused by a retrovirus that enters the bloodstream and integrates into the DNA of T cell lymphocytes.
57. Like many viruses, such as the common cold, HIV changes rapidly so the development of a _____ may not occur for several years.



If you have had difficulty with this section, review pages 310-322.

66. WORD FIND

Can you find 14 terms from this chapter? Words may be spelled top to bottom, bottom to top, right to left, left to right, or diagonally.

I N F L A M M A T O R Y F C G
Q N L O Y Z O C C P A O F S X
M W T A A M N J X Q K R N P H
U R L E R M P X B R U I A L C
C M A C R O P H A G E I E D Z
X M N D K F M N O T U C R N M
A E O R E Z E U O C F B Y E B
Y P L E B G G R H T Y T S E D
Y S C R I S P J O E I T M L A
Z M O T J X E T O N A E E P X
T O N S I L S S U M Y H T S Y
W A O C J N I M W K O Z E N D
D W M K W R M O I P S H Y B G
F H W U J I Z F V D Z L Y T X

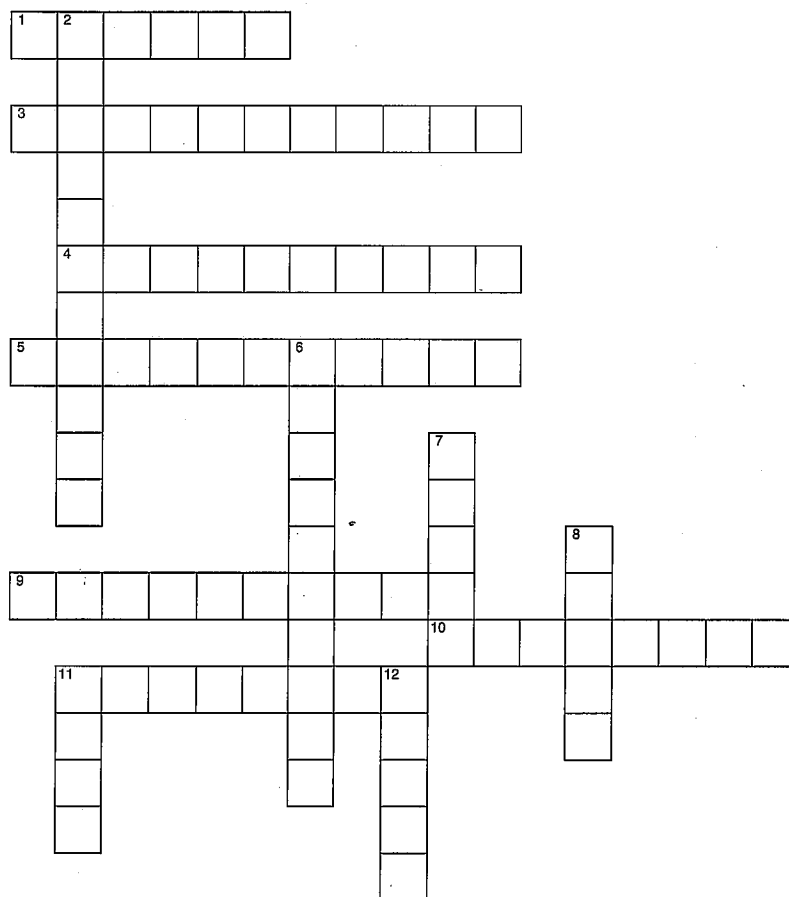
Acquired	Interferon	Proteins
Antigen	Lymph	Spleen
Humoral	Lymphocytes	Thymus
Immunity	Macrophage	Tonsils
Inflammatory	Monoclonal	

DID YOU KNOW?

In the United States, the HIV infection rate is increasing four times faster in women than in men. Women tend to underestimate their risk.

LYMPH AND IMMUNITY

Fill in the crossword puzzle.



Across

1. Largest lymphoid organ in the body
3. Connective tissue cells that are phagocytes
4. Protein compounds normally present in the body
5. Remain in reserve then turn into plasma cells when needed (two words)
9. Synthetically produced to fight certain diseases
10. Lymph exits the node through this lymph vessel
11. Lymph enters the node through these lymph vessels

Down

2. Secretes a copious amount of antibodies into the blood (two words)
6. Inactive proteins
7. Family of identical cells descended from one cell
8. Type of lymphocyte (humoral immunity; two words)
11. Immune deficiency disorder
12. Type of lymphocyte (cell-mediated immunity; two words)

CHECK YOUR KNOWLEDGE

Multiple Choice

Circle the correct answer.

1. T cells do which of the following?
 - A. Develop in the thymus.
 - B. Form memory cells.
 - C. Form plasma cells.
 - D. All of the above
2. Lymph does which of the following?
 - A. Forms as blood plasma filters out of capillaries.
 - B. Empties into the heart.
 - C. Flows through lymphatic arteries.
 - D. All of the above
3. Acquired immune deficiency syndrome is characterized by which of the following?
 - A. Caused by a retro virus.
 - B. Causes inadequate T-cell formation.
 - C. Can result in death caused by cancer or infection.
 - D. All of the above
4. Interferon is:
 - A. Produced by B cells
 - B. A protein compound that protects other cells by interfering with the ability of a virus to reproduce
 - C. A group of inactive enzyme proteins normally present in blood
 - D. All of the above
5. B cells do which of the following?
 - A. Develop into plasma cells and memory cells.
 - B. Establish humoral immunity.
 - C. Develop from primitive cells in bone marrow called stem cells.
 - D. All of the above
6. Which of the following kills invading cells by drilling a hole in the plasma membrane?
 - A. Interferon
 - B. Complement
 - C. Antibody
 - D. Memory cell
7. Which of the following cell types functions in the immune system?
 - A. Macrophages
 - B. Lymphocytes
 - C. T cells
 - D. All of the above

8. Which of the following are phagocytes?
 - A. Kupffer's cells
 - B. Dust cells
 - C. Macrophages
 - D. All of the above
9. What is a rapidly growing population of identical cells that produce large quantities of specific antibodies called?
 - A. Complementary
 - B. Lymphotoxic
 - C. Chemotactic
 - D. Monoclonal
10. Which of the following is a form of passive natural immunity?
 - A. A child develops measles and acquires an immunity to subsequent infection.
 - B. Antibodies are injected into an infected individual.
 - C. An infant receives protection through its mother's milk.
 - D. Vaccinations are given against smallpox.

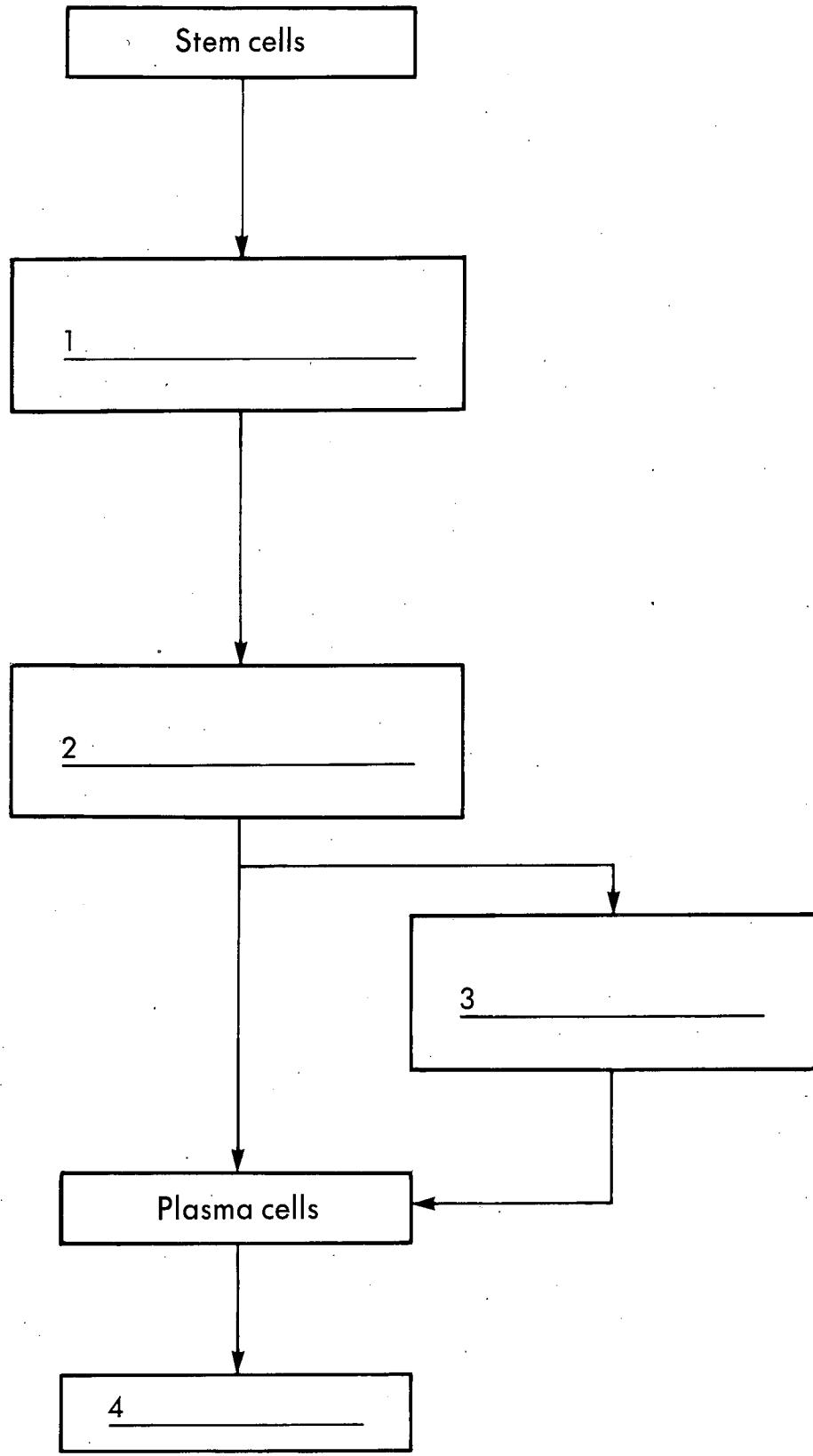
Matching

Select the most appropriate answer from column B for each item in column A. There is only one correct answer for each item.

Column A	Column B
_____ 11. Adenoids	A. Thoracic duct
_____ 12. B cell	B. Lymph node
_____ 13. Clone	C. Artificial immunity
_____ 14. HIV virus	D. Humoral immunity
_____ 15. Complement	E. Pharyngeal tonsils
_____ 16. Filtration	F. Foreign protein
_____ 17. Cisterna chyli	G. Inactive enzymes
_____ 18. T cell	H. AIDS
_____ 19. Vaccination	I. Identical cells
_____ 20. Antigen	J. Cell-mediated immunity

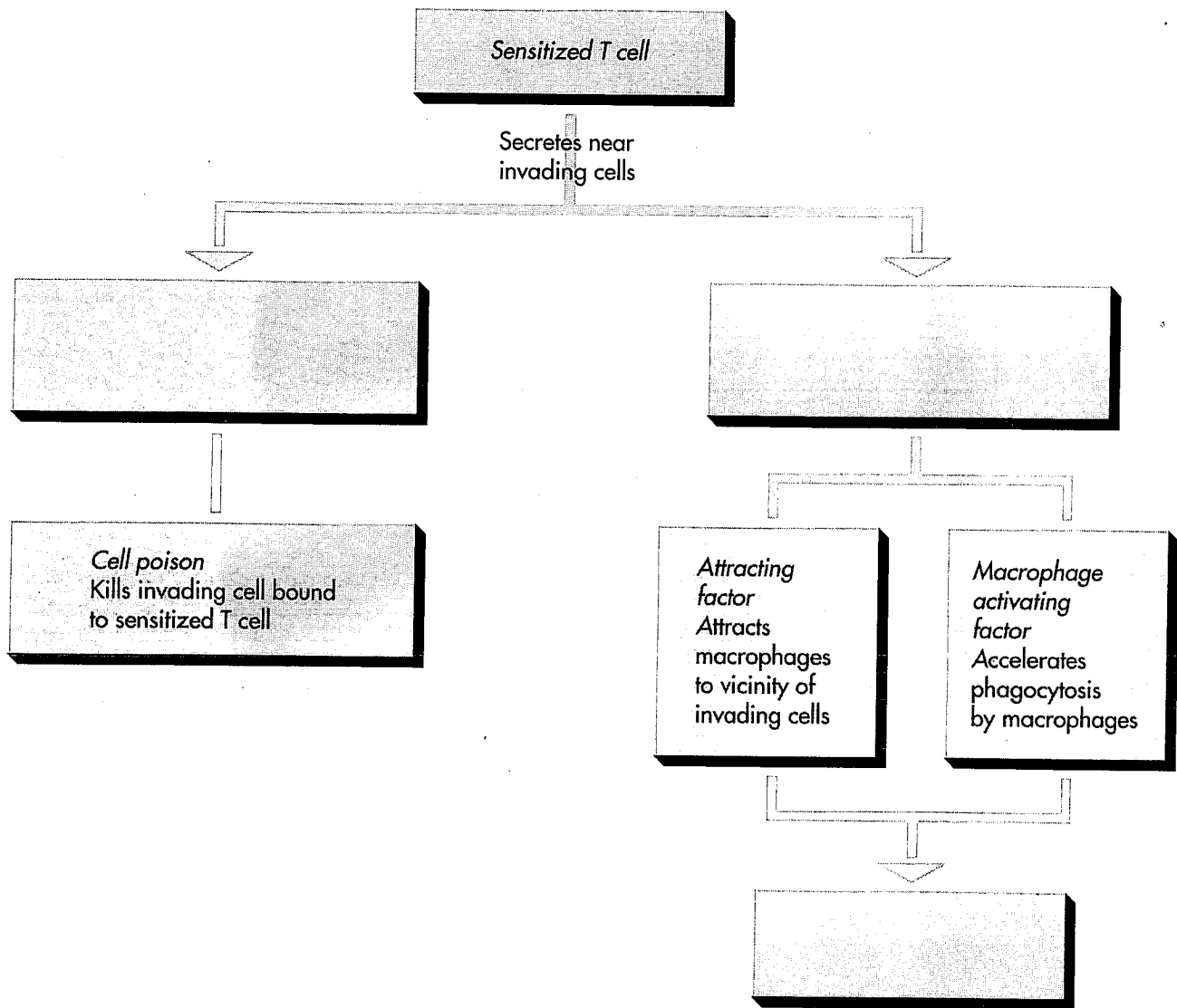
B Cell Development

Complete the diagram:

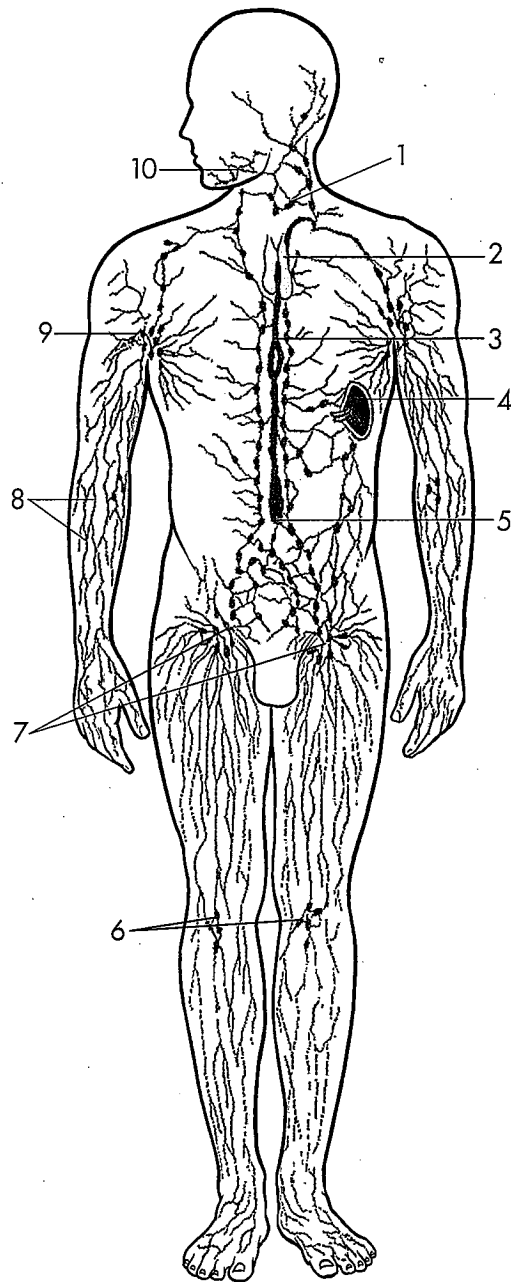


Function of Sensitized T Cells

Complete the diagram:



Principal Organs of the Lymphatic System



1. _____

2. _____

3. _____

4. _____

5. _____

6. _____

7. _____

8. _____

9. _____

10. _____

