

Supplemental Material

CBE—Life Sciences Education

Su et al.

APPENDIX

Human Body's Immune System Test

This test consists of 31 questions, with only 1 answer to be selected for each question. Please select the most appropriate answer. (The correct answer is underlined.)

1. Which of the below is **not** a part of the first line of defense for the Human Body?
 - (a) Stratum corneum preventing alien microbes from invading
 - (b) Antibodies defending against foreign antigens
 - (c) Tracheal cilia expelling foreign matters
 - (d) Gastric acid secretion
2. In regards to inflammation and inflammation-related substances, which of the below descriptions is correct?
 - (a) This type of substance is secreted by mast cells, and no other cells can perform this function
 - (b) This type of substance causes blood flow to be slowed, making invading micro-organisms unable to rely on blood flow to spread
 - (c) Damaged tissue cells and mast cells all will excrete such substance
 - (d) This substance does not originally exist within the blood, and is only produced by the liver when it is required
3. Which of the substances below has the closest relationship to inflammation?
 - (a) plasmodial liquid
 - (b) ammonium
 - (c) histamine
 - (d) nitrate
4. Which of the statements below correctly describes inflammation?
 - (a) If the epithelial tissue is damaged, micro-organisms can cause this type of reaction.
The epithelial tissue is the first line of defense for the human body and can exhibit the possible symptoms of redness of area, sensation of heat, swelling, pain, and itch
 - (b) The tissue fluid at the inflamed area shows signs of increasing
 - (c) Blood flow through the capillaries at the inflamed area decreases, preventing pathogens from spreading
 - (d) Histamine is one of the inflammatory mediators, and can cause capillaries to shrink
5. Paul accidentally cut his finger tip with an art knife during arts class, and when he got home the wound was red and swollen. The cause of the wound becoming red and swollen is due to which of the reasons below?

- (a) Phagocytes were unable to reach the affected area, causing blockage from accumulation which then led to the redness and swelling
 - (b) Inflammation stops the wound from swiftly healing. Hence, it becomes easier to leave a scar
 - (c) Phagocytes change shape to penetrate into the inflamed area so that they can devour the foreign bacteria
 - (d) Histamine increases the capillaries' permeability to allow phagocytes to arrive at affected area more quickly
6. Phagocytes have all but which one of the following abilities?
- (a) production of antibodies
 - (b) activation of B cells
 - (c) secretion of perforin
 - (d) phagocytosis of pathogens
7. In regards to Phagocytes, which of the descriptions below is **incorrect**?
- (a) Phagocytes can use their stored enzymes to break down the intruders
 - (b) Phagocytes can also exist within "pus"
 - (c) Phagocytes can travel through capillaries or a lymphatic capillary to enter into interstitial space
 - (d) Phagocytes only exist within interstitial space
8. Local inflammation increases vascular permeability. What is the cause of this effect?
- (a) local increase in erythrocytes
 - (b) partially broken capillaries at the inflamed area
 - (c) the injured area releasing histamine
 - (d) plasma cells increase, producing antibodies
9. Which of the below is **not** the reason why tissues will be red and swollen when inflamed?
- (a) vasodilation of capillaries near injured cells
 - (b) increase in permeability of capillaries
 - (c) increase in the amount of capillary plasma exudation
 - (d) tissue fluid decreases
10. We use the characteristics of the immune system to create vaccine. The main principle of this process is due to the existence of which cell in the human body?
- (a) plasma cells
 - (b) helper T cells
 - (c) cytotoxic T cells
 - (d) memory cells

11. Which of the following comparisons of antigen and antibody is **incorrect**?

antigen	antibody
(a) <u>Non-protein</u>	<u>Protein</u>
(b) Tends to be foreign substances	Mainly produced by plasma cells
(c) Can stimulate specific defense	Can participate in specific defense
(d) Can cause cell and humoral immune response	Can participate in humoral immune response

12. When Lin was infected with some form of pathogen, which cells in the body produced large amounts of antibodies?

- (a) memory cells
- (b) plasma cells
- (c) cytotoxic T cells
- (d) helper T cells

13. At this time, the humoral and cellular immune response in Lin's body will produce which one of the following reactions?

Humoral Immunity	Cellular Immunity
(a) Will produce memory cells	Will not produce memory cells
(b) Uses antibody to execute immune response	Uses Helper T lymphocytes to destroy targeted cells
(c) Does not require antigen to cause response	Requires antigen to cause response
(d) <u>Can become activated through Helper T Cell</u>	<u>Can become activated through Helper T Cell</u>

14. If Lin was re-infected with the same pathogen not long after recovery, the immune response will have which one of the following symptoms?

- (a) plasma cells can more rapidly divide into B lymphocytes and perform defense
- (b) because of memory cells, antibodies can be produced more quickly
- (c) cytotoxic T cells can directly produce antibodies without going through plasma cells
- (d) helper T cells can activate antibodies for defense faster than before

15. Which of the cells and their described function below is **incorrect**?

- (a) plasma cells - produce antibodies and directly contact with the invading microorganisms to destroy their structures
- (b) phagocytes - engulf bacteria and viruses
- (c) cytotoxic T cells - release perforin, causing infected cells to dissolve
- (d) helper T cells - assist with the activation and maturation of B lymphocytes

16. T cells participate in immune response. Which of the following descriptions regarding T cells is correct?–
- (a) are not involved in humoral immune response
 - (b) can produce antibodies
 - (c) are involved in cellular immune response
 - (d) can bind to mast cells to cause allergic reaction
17. When regulating immune response, the helper T cell will use its receptor to come into direct contact with which of the below and be activated?
- (a) infected cells
 - (b) macrophages
 - (c) invading microorganisms
 - (d) tumor cells
18. Which of the following statements regarding cytotoxic T cells and helper T cells is **incorrect**?
- (a) Foreign antigen can activate helper T cells
 - (b) cytotoxic T cells can kill infected target cells
 - (c) both types of T cells can produce memory cells
 - (d) cytotoxic T cells use mucus to coat pathogens to make it harmless
19. Which of the below statements regarding immunization is correct?
- (a) immune response must cause the formation of antibodies
 - (b) stimulation caused by antigens will affect the production of antibodies
 - (c) any substance that can cause individual immune response can be called allergens
 - (d) immune response is specific immunity, and is performed together by all white blood cells
20. Which of the below statements regarding the functions of specific immunity is correct?
- (a) includes both the cell immunity performed by B lymphocytes, and the humoral immunity performed by T lymphocytes
 - (b) does not work with specific immunity in combating invading pathogens
 - (c) B lymphocytes can divide into plasma cells and produce a specific antibody
 - (d) allergic reaction is caused by perforin that is secreted by the T lymphocytes
21. Which of the statements below regarding the functions of immunity is correct?
- (a) B lymphocytes is responsible for cell immunization, allowing cells to have immunity
 - (b) when performing foreign organ or tissue transplantation, rejection is caused by T lymphocytes triggering off antibodies immunization response
 - (c) inflammatory reaction is a form of specific defense
 - (d) obtained by BCG immunization, is an active immunization

22. Which of the B lymphocytes and T lymphocytes comparison below is correct?

	B Lymphocytes	T Lymphocytes
(a)	Cannot produce memory cells	Can produce memory cells
(b)	Dominant cell immunity	Dominant humoral immunity
(c)	<u>Can differentiate into plasma cells to produce antibody</u>	<u>Cannot differentiate into plasma cells to produce antibody</u>
(d)	Belongs to the 2 nd line of defense	Controls all specific immunity

23. Which of the following comparisons regarding specific and non-specific defense is accurate?

	Specific Defense	Non-specific Defense
(a)	Includes phagocytosis	Mainly uses antibodies to defend against pathogens
(b)	Is mainly directed by T lymphocytes	Is mainly directed by B lymphocytes
(c)	<u>Targets specific antigens</u>	<u>Does not target any specific antigen</u>
(d)	Has white blood cell involved	Does not have white blood cell involved

24. A foreign object from a certain protein has invaded William's body, and his body has produced specific antibody to combat this protein. William's immune system requires (W) plasma cells, (X) antigen-presenting cells, (Y) B cells, and (Z) helper T cells to be involved in the response. Disregarding the fact that the receptor of B cell will bind to the antigen first, which of the below describes the correct order in which the cells participate in the reaction?

- (a) (W), (X), (Y), (Z)
- (b) (X), (Z), (Y), (W)
- (c) (Z), (W), (X), (Y)
- (d) (X), (W), (Z), (Y)

25. Which of the below symptoms is mainly caused by antigen and antibody?

- (a) all immune responses
- (b) organ transplant rejection
- (c) fever caused by the common cold
- (d) allergic reaction

26. Which of the below substances is the main cause of allergic reaction?

- (a) anaphylatoxin

- (b) antibody
- (c) allergen
- (d) toxin

27. In regards to "allergic reaction", which of the below statements is correct?

- (a) allergic reactions will also cause inflammation
- (b) allergic reaction is also an autoimmune disease
- (c) allergy is one of the effects caused by T cell's specific defense when it stimulates white blood cells into releasing inflammatory mediators
- (d) the allergens that causes allergic reaction are all microorganisms, such as dust mites.

28. Wilma lacks normal phagocytes, hence when her body is attacked by bacteria. Which of the below situations may occur?

- (a) B lymphocytes shift to attack invading pathogens using hydrolytic enzymes
- (b) T lymphocytes can directly recognize the foreign substance and produce the required antibody
- (c) The first line of defense for the body's immune system loses its original function
- (d) The defeated white blood cells or the debris of pathogens will be difficult to clean up

29. If your B lymphocytes undergoes pathological changes and is unable to perform its original function, when the body is attacked by pathogen which of the following events will occur?

- (a) the body will not be able to produce any memory cells
- (b) the body will not be able to produce antibodies, nor produce memory B cells
- (c) plasma cells will divide into killer T cells to increase defense
- (d) cytotoxic B cells will completely lose their ability to directly attack pathogens

30. Which of the below statements regarding allergic reactions is **incorrect**?

- (a) there are specific antibodies involved
- (b) there are non-specific, inflammation-related substances involved
- (c) allergic asthma occurs because allergens are directly stimulating the tracheal smooth muscle
- (d) may have redness, sensation of heat, swelling, pain and other symptoms

Open-ended question

Please write down as detailed as possible the functions of each line of defense and the processes and connections among them.