Chapter four: *Immunity*

Choose the correct answer:-

Lesson 1 : Immunity in plants:-

1. Tyloses are …… methods of structural immunity in plants.
(**Innate** – acquired – pre-existing – chemical)
2. Glycosides and phenols are……...plant defenses.
(innate structural – induced structural – **biochemical** –structural and biochemical)
3. Canavanine and …….. are non – protein amino acids that protect the plant from pathogens (glycosides – **cephalosporin** – phenols – tyloses)
4. ……..... are anti – microbial chemicals in plants.
(Glycosides – canavanine – phenols – **all the previous answers are correct**)
5. ……is a toxic substance and one of the non-protein amino-acids which acts as a protective substance in the plants.
(Glycosides – **canavanine** – phenols – all the previous answers are correct)
6. The life of any living organism is threatened by ……..
(fungi – natural disasters – living factors – **living and non-living factors**)
7. From the immune structures which always present in the plant…….
(Tyloses – **Cell wall** – Gum – Cork)
8. In plant the ……..is covered with waxy layer.
(cell walls – **epidermis** – immune cellular structures – receptors)
9. Tyloses are formed by …… (Xylem vessels – tracheids – **parenchyma cells** – pits)
10. Tyloses protrude into tracheids trough ……....
(**Pits** – vessels – parenchyma cells – protoplast of parenchyma cells)
11.……... react (s) with the toxins produced by pathogens and change it into a non – toxic compounds to the plant.
(Phenols – glycosides – cephalosporin – **anti microbial proteins**)
12. Plants can neutralize the toxins of pathogens by using ……....
(Antimicrobial proteins –detoxifying enzymes – phenols – **antimicrobial Proteins and detoxifying enzymes**)
13. Cuts and wounds in plants are blocked by ……....
(cutting – phellem – **gums** – gums and phellem)
14. If the plant epidermis is not covered with the waxy layer that will lead to…… (the evaporation of the water from the epidermal cells – the water settles on the leaf epidermis – growth of fungi – **all the previous**)

Dr. Mina H. Messiha (01007765878 - 01225768986)

Lesson 2 : Immunity in animals:-

1. Lymphoid organs collectively form what is known as the …….. system.
(immune – **lymphatic** – circulatory – excretory)
2. Blood cells are formed inside the bone marrow of ……..
(skull – sternum – tips of the femur – **all the previous answers are correct**)
3. All of the following are lymphoid organs except ……....
(tonsils – spleen – **liver** – peyer's patches)
4. T cells mature and differentiate into its different types in the ……
(bone marrow – lymph nodes – **thymus gland** – spleen)
5. The most lymphoid organs storing the lymphocytes are ……
(tonsils – **lymph nodes** – peyer's patches – spleen)
6. Antibodies are produced by cells called ……....
(B cells – macrophages – plasma cells – **activated B cells called plasma cells**)
7. 15 % of lymphocytes is ……
(natural killer cells – **B cells** – T cells – T**H** cells)
8. T cells represent about …….... % of lymphocytes. (**80** – 5 – 15 – 10)
9. If the number of white blood cells in blood drop of someone is 8000 cells, so the number of T cells will be ……cells. (600 – 900 – **1600** – 2400)
10. If the number of B-lymphocytes in a blood drop of someone is 400 cells, so the number of T-lymphocytes will be …… (1000 – 1500 – **3000** – 4000)
11. Carcinogenic cells, transplanted organs and cells infected by viruses are destroyed by …….... cells. (**TC** – T**H** – T**S** – NK)
12. The immune response of both B and T cells is inhibited ……... cells.
(T**C** – TH – **TS** – NK)
13. Different types of T cells and B cells are activated by …….... cells.
(T**C** – **TH** – T**S** – NK)
14. ……... can phagocytosis the pathogens.
(basophils – eosinophil's – neutrophils – **all the previous answers are correct**)
15. Pathogens can be engulfed by ……....
(macrophages – B cells – neutrophils – **all the previous answers are correct**)
16. Monocytes can change into ……... when needed, that engulf foreign organisms. (neutrophils – basophils – eosinophil's – **phagocytes**)
17. Macrophages can attack microbes by …….... (engulfing them – introduce information about them to immune cells – form antibodies against them – **engulf them and offer information about them to immune cells**)

Dr. Mina H. Messiha (01007765878 - 01225768986)

18.Circulating macrophages are guided to migrate to the site of infection by the effect of …….. (interferon's – interleukins – complements – **chemokine's**)

19.Communication between different cells of the immune system through ……..
(complements – interferon's – **interleukins** – chemokine's)

20.Cells infected by viruses protect their neighboring healthy cells by releasing...
(cytokines – interleukins – **interferon's** – complements)

21.Communication between immune cells and body cells is mediated through……..
(chemokine's – interferon's – complements – **interleukins**)

22.Each antibody has …….. identical antigen – binding sites.
(three – **two** – four – multiple)

23.The variable region of each antibody is also known as the ……..
(C region – **antigen-binding site** – heavy chains – light chains)

24.The antibody consists of …….. polypeptide chains.
(two – **four** – four pairs – one pair)

25.The four chains of each antibody are joined together by …….. bonds to form a Y – shaped molecule.(**disulphide** – hydrogen – peptide – glycosidic)

26.Antigens have …….. binding sites to antibodies.
(two – three – four – **many**)

27.……work only in the presence of the antibodies.
(Chemokine's – Interleukins – **complements** – interferon's)

28.……are the substance which increases at the site of injury.
(**Chemokine's** – Interleukins – complements – interferon's)

29.There are …….antigen-binding sites in the IgM (2 – 4 – 6 – **10**)

30.The substances which increases with the increase in the plasma B –cells are ……. (Lymphokines – perforin – interferon's – **complements**)

Lesson 3 : The immune system mechanism in Man

1. Interferon's and natural killer cells (NK) are two other components of the ……..
line of defense. (1st–**2nd**–3rd–4th)

2. At the area of inflammation, …….. leak from the blood vessels to fight microbes. (chemicals – cells – histamine – **chemicals and cells**)

3. Humoral immunity is a …….. immunity mechanism.
(nonspecific – natural – innate – **specific**)

4. Both humoral and cell mediated mechanisms are …….. immunity mechanisms
(**acquired** – innate – nonspecific – natural)

5. Antigens are presented on the membrane of the macrophages bound to ……..
(CD4 – **MHC** – CD8 – CD20)

Dr. Mina H. Messiha (01007765878 - 01225768986)

6. Antigen fragments are presented on the plasma membrane of the macrophages to ……....., to activate them.(B cells – **T_H cells** – T_C cells – T_S cells)

7. The antigen MHC complex is formed on the surface of ……...

(macrophages – T helper cells – B lymphocytes – **macrophages and B lymphocytes**)

8. Interleukins are secreted by activated ……..... cells. (B – T_C – T_S – **T_H**)

9. Activated B lymphocytes divide and differentiate into …….. (memory B cells – plasma cells – memory T cells – **memory B cells and plasma cells**)

10. CD 4 is found on the surface of ……..... cells. (**T_H** – T_C – T_S – B)

11. Interleukins secreted by activated T_H cells activate the production of ……...

(plasma cells – memory B cells – memory T_H cells – **all the previous answers are correct**)

12. Activated helper T cells secrete ……...(cytokines – interleukins – **cytokines and interleukins** – none of the previous answers)

13. Cancer cells and cells infected by pathogens can by attacked by ……....

(antibodies – T_H cells – **T_C cells** – T_S cells)

14. CD 8 enable the …….. cells to bind to the infected cells and destroy them.

(T_H – T_S – **T_C** – plasma)

15. The cells that create pores in the membrane of foreign cells are the…….. cells.

(**T_C**– T_H– T_S– B)

16. Cytotoxic T cells can damage transplanted organs by using ……...

(perforin – lymphatic toxins – antibodies – **perforin and lymphatic toxins**)

17. CD 8 protein is found in the membrane of T-cells , except the …….. cells.

(T_C– **T_H** – T_S)

18.....cells secrete lymphokines to inhibit the production of antibodies from plasma B – cells. (T_C – T_H – **T_S**)

19.……protein inhibits the activity of the lymphocytes .

(**Lymphokines** – Cytokines – Chemokine's – Interleukins)

20. The T- helper cell can't identify the antigen except after its binding with …….

(IgM – **MHC** – CD – all the previous)

21. Each of the following prevent the spreading of the carcinogenic cells except …….

(T-cells – **B-cells** – NK – interferon's)

22. All of the following cells their numbers decrease after healing of patient except ……. (B-cells – T_c - T_H –**T_S**)

Dr. Mina H. Messiha (01007765878 - 01225768986)

23.The first line of defense in the body includes all of the following except ……..
(skin – **lymphocytes** – mucus – tears)
24.Sweat and hydrochloric acid of the stomach are ……. defense. mechanisms.
(specific – humoral – **innate** – cell mediated)
25.Both first and second lines of body defenses belong to …….. immunity.
(acquired – humoral – cell mediated cells – **natural**)
26.Skin can prevent the entry of microbes by having ……
(horny layer – sweat – cerumen – **horny layer and sweat**)
27.Cerumen is secreted by the ……..... (skin – **ears** – tear glands – stomach)
28.The …….... system of defense acts if pathogens succeeded in penetrating the first line of defense and invaded body tissues.
(third – **second** – fourth – last)
29.The inflammatory response belongs to the …….... line of body defenses.
(1^{st}–**2^{nd}**–3^{rd}–4^{th})
30.……... are an inflammation – generating substances.
(antibodies – antigens – **histamines** – interferon's)
31.The histamine is secreted by ……....
(macrophages – **basophils and mast cells** – eosinophil's – T - lymphocytes)
32.The white blood cells that rush to the site of inflammation to fight foreign bodies are all of the following except ……....
(neutrophils – monocytes – **mast cells** – macrophages)

Write the scientific term :-

Lesson 1 : Immunity in plants:-

1. The first line of defense that prevents pathogens from entering the plant.
(Structural immunity)
2. Group of natural barriers that prevent pathogens from entering the plant.
(Structural immunity)
3. It is formed to isolate the plant areas that exposed to cutting or tearing.
(Cork or Phellem)
4. Overgrowths of the protoplast of the living parenchyma cells adjacent to xylem vessels and tracheid's, which protrude into these vessels and tracheid's through pits. (**Tyloses**)
5. The substance deposited around the plant cuts or wounds. (**Gum**)
6. Morphological changes taking place in plant cells as a result of their invasion by pathogens. **(Cellular immune structures)**

Dr. Mina H. Messiha (01007765878 - 01225768986)

7. Getting rid of / killing the injured parts of plants. **(hyper-sensitive response)**
8. Chemical compounds secreted by plants to resist pathogens.
(Biochemical immunity)
9. Compounds found in healthy and infected plants but their concentration increases in plants after the infection. **(Receptors)**
10. Compounds recognize the presence of the pathogens and activate the plant defenses by stimulating its innate immune system. **(Receptors)**
11. Compounds that may be found in the plant before the infection or formed due to the infection to resist the pathogen. **(Antimicrobial chemicals)**
12. Compounds some of them were not present in the plant before the infection, but they are produced as a result of infection**.** **(phenols and glycosides)**
13. Toxic chemical compounds that kill pathogens as bacteria or inhibit their growth.
(phenols and glycosides)
14. Compounds act as a protective substance for the plant against the pathogens.
(Non-protein amino-acids: canavanine and cephalosporin)
15. Amino acids that do not enter in the structure of proteins in the plants
(Non-proteins amino-acids)
16. Proteins produced by some plants as a result of infection.
(Antimicrobial proteins)
17. Compounds that are not originally found in healthy plants, but are only formed when the plant is attacked by the pathogen. **(Antimicrobial proteins)**
18. Proteins react with toxins produced by pathogenic organisms and change it into non-toxic compounds. **(Antimicrobial proteins)**
19. Enzymes which react with the toxins produced by pathogens and inhibit their toxicity. **(Detoxifying enzymes)**
20. Stimulating the plant immunity to resist diseases. (**Acquired immunity)**
21. The sum of defense mechanisms in a living organism.
(immune system)
22. The body's ability – through its immune system – to resist diseases.
(The immunity)
23. The body's ability to resist pathogens either by preventing their entry into the body or by attacking and destroying them when entering the body.
(The immunity)
24. Factors that may destroy the plant life or cause dangerous diseases.
(dangerous enemies)
25. Using some of the plant structures to resist pathogens. **(Structural immunity)**
26. The plant responding to the pathogens by secreting chemical substances.
(Bio-chemical immunity)

Dr. Mina H. Messiha (01007765878 - 01225768986)

Lesson 2 : Immunity in animals:-

1. T – Cells which attack foreign cells, transplanted organs and body cells infected with viruses. **(T – Cytotoxic cells)**
2. T cells which inhibit the action of T cells and B cells after the elimination of the pathogen. **(T – Suppressor cells)**
3. They form about 5 % to 10 % of lymphocytes in blood. **(Natural killer cells)**
4. Lymphocytes that are produced and mature in the bone marrow. **(Natural killer cells and B – Lymphocytes)**
5. Lymphocytes that are able to attack cells infected with viruses, carcinogenic cells and destroy them through enzymes secreted by these "killer " cells. **(Natural – killer cells)**
6. Type of white blood cells can change into phagocytes when needed. **(Monocytes)**
7. They are large phagocytic cells; their types and names are different depending on the tissues where they exist. **(Fixed macrophages)**
8. They are found in most body tissues and are ready to engulf foreign particles and microorganisms. **(Fixed macrophages)**
9. Are factors that cause the migration of the circulating macrophages to sites of microbes and foreign particles. **(Chemokine's)**
10. They mediate communication between different types of immune system cells, and also between immune cells and different body cells. **(Interleukins)**
11. They are different types of proteins and enzymes that destroy microbes in the blood after their conjugation with antibodies. **(Complements)**
12. Different types of proteins that are produced and secreted by the cells invaded by viruses. **(Interferon's)**
13. Compounds on the surface of bacterial cells that invade the tissues. **(Antigens)**
14. Specific proteins known as immunoglobulin's (Ig). **(Antibodies)**
15. Antibody – producing cells. **(Plasma B – cells)**
16. Y – Shaped proteins that are present in blood and lymph of human and other vertebrates. **(Antibodies)**
17. The product of binding between an antigen and its specific antibody. **(Antigen – antibody complex)**
18. It consists of four polypeptide chains, two heavy chains and two light chains. **(Antibodies)**
19. Attachment of antibodies to the outer protein coats of viruses and prevent their adhering to the host cell membrane. **(Neutralization)**
20. Attachment of antibodies to the protein coat of a virus and keep this coat sealed to prevent the virus from infecting the host cell. **(Neutralization)**

Dr. Mina H. Messiha (01007765878 - 01225768986)

21. Aggregation of more than one antigen on the same antibody molecule.
(Agglutination)
22. This happens when the binding between antibodies and these soluble antigens forms insoluble antigen – antibody complexes, which is easily engulfed by phagocytes.
(Precipitation)
23. The binding between antibodies and antigens activates complements to lyse the antigen membranes and dissolve their content, which makes them easily engulfed by phagocytes. **(Lysis)**
24. Proteins and enzymes that are stimulated by antibody – antigen binding to lyse the membranes of antigens and dissolve their content, which makes them easily engulfed by macrophages. **(Complements)**
25. Antibody – toxins complexes activate complements to react with them in a chain reaction, which leads finally to detoxifying them and also makes them readily engulfed by macrophages. **(Antitoxins)**
26. The parts of this human body system are scattered, throughout the body.
(Immune system)
27. The home of lymphocytes, and the main components of the lymphatic system.
(Lymphoid organs)
28. Organs that contain large numbers of lymphocytes. **(Lymphoid organs)**
29. A tissue inside the flat bones responsible for the production of red blood cells, white blood cells, and blood platelets. **(Red bone marrow)**
30. Bones containing bone marrow responsible for the formation of blood.
(Flat bones)
31. A gland that is located on the trachea above the heart and behind the sternum.
(Thymus gland)
32. It secretes thymosin hormone that stimulates maturity of lymphoid stem cells into T cells and their differentiation into its different types**.** **(Thymus gland)**
33. A small lymphoid organ, located in the upper left side of the abdominal cavity.
(Spleen)
34. Special proteins produced by lymphocytes, which defend the body against germs and viruses. **(Antibodies)**
35. White blood cells, which phagocytose microbes or foreign bodies or senescent somatic cells. **(Macrophages)**
36. Two specialized lymphoid glands located on both sides of the rear portion of the mouth**.** **(Tonsils)**
37. Small nodes of lymphoid cells that spread in the mucous membrane lining the lower part of the small intestine. **(Peyer's patches)**
38. They purify the lymph from any harmful substances or microbes. **(Lymph nodes)**

Dr. Mina H. Messiha (01007765878 - 01225768986)

39. They store lymphocytes that help in fighting against any disease or infection. **(Lymph nodes)**
40. Are located along the lymphatic vessels located in all body parts especially in the armpits, at the two sides of the neck, in the upper part of the thigh, and near the internal body's organs. **(Lymph nodes)**
41. Transfer the lymph from the tissues to the lymph nodes for filtration of the lymph and to get rid of the pathogens suspended in it. **(Afferent lymph vessels)**
42. They are produced in the bone marrow and form about 20 %: 30 % of the white blood cells**.** **(Lymphocytes)**
43. Lymphocytes that are formed, complete their growth and become mature in the bone marrow**.** **(B – Lymphocytes)**
44. Lymphocytes that are formed in bone marrow, but they mature and differentiate into several types in the thymus gland. **(T – Lymphocytes)**
45. T cells which activate other types of T cells to do their responses, and stimulate B cells to produce antibodies. **(T- Helper cells)**

Lesson 3 : The immune system mechanism in Man

1. White blood cells that leak from the blood capillaries to the site of inflammation to kill microbes. (**Neutrophils – monocytes – macrophages)**
2. Body line of defense that includes lymphocytes that respond to the microbe by a series of specific defense mechanisms. **(3rd line of defense)**
3. The defense mechanisms that include the specific responses of the lymphocytes to the pathogens. **(Immune response for Acquired immunity)**
4. Specific mechanism of immunity that defends the body against pathogens present in the body fluids. **(Humoral or Antibody mediated immunity)**
5. Mechanism of acquired immunity that defends the body by producing antibodies. **(Humoral or Antibody mediated immunity)**
6. Antigen – presenting cells. **(Macrophage)**
7. Antigen presenting protein that is found in macrophages and B lymphocytes. **(MHC)**
8. Substance secreted by the activated T_H cells to activate B cells. **(Interleukin's)**
9. Immunity proteins produced by plasma cells. **(Antibodies)**
10. The immune response done by T- lymphocytes.**(Cellular – Cell mediated immunity)**
11. Each T-cell can produce during its maturation a specific type of receptors which can bind to a single type of antigens. **(Specific response to antigens of T-Lymphocytes)**

Dr. Mina H. Messiha (01007765878 - 01225768986)

12. Pore – making protein secreted by the T_C cells when they bind to the antigen. **(Perforin)**
13. Proteins secreted by T_S cells bound to activated T_H cells, which suppress or inhibit the immune response or stop it. **(Lymphokines)**
14. The resistance of the body to new pathogen or to pathogen that infected the body before. **(Acquired immunity)**
15. The response of the immune system to a pathogen before the appearance of symptoms. **(Secondary immune response)**
16. The cells responsible for the secondary immune response. **(Memory B,T-cells)**
17. Cells which store information about the antigens fought by the immune system in the past. **(Memory B,T cells)**
18. Blood cells that can live for tens of years, and may survive till death. **(Memory B,T cells)**
19. Defense mechanisms characterized by rapid, effective response to destroy any microbe that invades the body. **(Innate (natural) Immunity)**
20. Non – specific immune mechanisms that includes two lines of defense. **(Innate (natural) Immunity)**
21. A line of body defenses, which includes a group of physical or natural barriers in the body. **(1st line of defense)**
22. Is characterized by a tough horny layer on its surface, which prevents the entry of microbes. **(Skin)**
23. A layer of the skin which acts as a barrier that is difficult to be penetrated or to pass through. **(Tough horny layer)**
24. Skin product that can kill most of the microbes because of its salinity. **(Sweat)**
25. A substance secreted by the ears that can kill microbes. **(Cerumen)**
26. A viscous fluid that lines the respiratory bronchi, and microbes adhere to it **(Mucous)**
27. Contains substances that kill microbes, in addition to enzymes that can dissolve such microbes. **(Saliva)**

28. Line of defense stimulated by a slash in the skin and entrance of bacteria. **(2nd line of defense)**
29. A defense mechanisms that prevent the spreading of the invading microbe. **(2nd line of defense)**
30. A non – specific defense mechanism in the area of injury as a response to the damage of tissues caused by the injury or by the infection. **(Inflammatory response)**

Dr. Mina H. Messiha (01007765878 - 01225768986)

Correct the underlined word:-

Lesson 1 : Immunity in plants:-

1. Plants have effectors that can recognize the presence of the pathogen and stimulate the plant immune responses. (**Receptors**)
2. Canavanine and Cephalosporin are phenols that act as a protective substance for the plant. (**Non – protein amino acids)**
3. Producing strains of plants resistant to diseases and insects takes place by cultivating the plant in suitable soil or by using fertilizers.
4. (Plant breeding and genetic engineering) The cork is formed to isolate the areas that are exposed to burns.

(Cut or tearing)

5. Cuts in plants are blocked by cutin. **(Gum)**
6. Lignin is deposited around the cuts or wounds in plants to prevent the entry of microbes. **(gum)**

Lesson 2 : Immunity in animals:-

1. The size of lymphoid organs ranges from a pinhead, to the size of a small bean seed. **(Lymph nodes)**
2. All lymphocytes are formed in the thymus gland.

(Red bone marrow)

3. The function of T lymphocytes is to identify any microbe, adhere to it and produces antibodies to destroy it. **(B – lymphocytes)**
4. The degree of immune response of both B and T cells is regulated by the natural killer cells. (**Suppressor T – cells)**
5. Lymphocytes contain granules that have a main role in the disintegration of the pathogenic cells attacking the body.

(Basophils, Eosinophil's and Neutrophils)

6. Lymphocytes still in the blood circulation for a relatively short period ranging from several hours to several days. **(Basophils, Eosinophil's and Neutrophils)**
7. Complements can destroy pathogens by formation of antibodies.

(Lysis the membrane of them and dissolving their contents)

8. Complements bind to healthy cells neighboring to the infected cells and induce them to produce enzymes that inhibit the action of replication enzymes of the virus. **(Interferon's)**
9. Antigens are recognized by antibodies. **(Receptors of B-lymphocytes)**
10. Antibodies are produced by macrophages. **(Plasma B – cells)**

Dr. Mina H. Messiha (01007765878 - 01225768986)

11. Antibodies and antigens adhere to bacterial cells to offer them to other white blood cells (macrophages) to engulf them. **(Complements)**
12. B – Lymphocytes can attack the antigens found on the surface of microorganisms and foreign bodies by engulfing them. **(Antibodies)**
13. Macrophages are produced by plasma B – cells. (**Antibodies**)
14. The shape of the antigen – binding sites is different from an antigen to another. **(Antibody)**
15. The antigen – binding sites are located at the two tips of the Y – shaped molecule and are known as the constant regions. **(Variable region)**
16. Antigen binding site is mirror image of its antibody, and they fit together like two identical twins. **(Antigen – the lock and its key)**
17. Microbes can clump on the surface of IgA. **(IgM)**
18. The antibodies have triple binding with the antigens. **(Binary)**
19. The organs of the digestive system are not linked to each in a successive anatomical manner. **(Immune system)**
20. Maturation and differentiation of lymphocytes take place in the internal organs of the body. **(Lymphoid organs)**
21. Lymphoid stem cells mature and differentiate into B cells in the thymus gland. **(T – Cells)**
22. Size of thymus gland is not more than the hand fist, and it is dark red. **(Spleen)**
23. The function of B lymphocytes is to engulf microbes and foreign bodies. **(Macrophage)**
24. Senescent red blood cells are destroyed by the tonsils. **(Spleen)**
25. The spleen picks up any microbe or foreign body that may enter with food or air and prevent its entry into the body. **(Tonsils)**
26. Peyer's patches play a role in the immune response against pathogens that enter the mouth. **(Intestine)**
27. The lymph nodes are present along the blood vessels. **(Lymph)**
28. The endocrine glands act to purify the lymph from harmful substances and microbes. **(Lymph nodes)**

Lesson 3 : The immune system mechanism in Man

1. The two separate mechanisms of acquired immunity are independent of each other. **(interconnected with)**
2. T – cells are antigen presenting cells. **(Macrophage)**
3. Antigens are digested inside T helper cells. **(Macrophage)**

Dr. Mina H. Messiha (01007765878 - 01225768986)

4. The T_H cell can recognize antigen only after being processed by the macrophages and presenting it on its outer surface bound to the CD 21. **(MHC)**
5. B lymphocytes are activated by interleukins secreted by phagocytes.
(activated T-helper cells)
6. T lymphocytes can fight microbes found in the blood or lymph.
(in the infected cells)
7. Interleukins can activate the natural killer cells to attack the abnormal body cells like cancer cells or cells infected by pathogens. **(cytokines)**
8. The secondary immune response takes between five to ten days to reach its maximum productivity of B and T cells. **(primary)**
9. Both types of memory B and T cells are produced during the secondary immune response. **(primary)**
10. The main function of the first line of body defenses is killing pathogens that invaded the body. **(Preventing pathogen from entering the body)**
11. Tears contain mucus that protects the eye from microbes. **(enzymes)**
12. The epithelial lining of the stomach secretes mucus that can kill microbes entering with food. **(Strong HCl)**
13. The second line of body defenses is an external one. **(internal)**
14. The mechanisms of the 2^{nd} line of body defenses start by engulfing microbes.
(inflammatory response)

Give reason for:-

Lesson 1 : Immunity in plants:-

1- **The plant leaf epidermis is coated with cutin.** **or**
2- **Adding cutin to the plant epidermis prevents the growth of bacteria and fungi.**
-Because the cutin is a waxy layer which forms a water – repellent surface, so the water doesn't settle on the surface and therefore the environment for the growth of fungi and the reproduction of bacteria isn't available.

3- **The plant stem epidermis may be covered with hairs or thorns.**
-To avoid the accumulation of water or being eaten by grazing animals and thus the chance of infections with disease is decreased.

4- **The cellulose cell wall is thickened with lignin.**
-The cell wall consists mainly of cellulose and then it is thickened with lignin so, it is difficult to be penetrated by pathogens.

Dr. Mina H. Messiha (01007765878 - 01225768986)

5- **Cork is formed in plant parts exposed to cutting.**

-to isolate areas that exposed to cut or tearing to prevent the entry of the pathogen to plant.

6- **The living parenchyma cells adjacent to the xylem tracheids paly important role in protecting the plant.**

-Because when the vascular system is exposed to cut or invasion with a pathogen, the overgrowths of the protoplast of these cells protrude into the xylem vessels and tracheid's through the pits to obstruct the movement of the pathogen to the other plant parts.

7- **Gums are deposited around the plant cuts and wounds.**

-to prevent the entry of microbes inside the plant.

8- **The cell wall of the epidermal cells and the cells under the epidermis swell when a pathogen is penetrating them.**

-to inhibit the penetration process of the pathogen through the infected cells.

9- **The plants surround the fungus mycelium – attacking the plant – with a insulator cover.**

-to prevent the transmission of the fungus from one cell to another.

10- **Plants kill their injured parts.**

- to prevent the pathogen from the spreading to the surrounding tissues, so it gets rid of the pathogen by the death of the injured tissues (hyper sensitive response)

11- **Plants strengthen their defenses after the infection.**

-that is called inducible post – infection as some plants promote and strengthen their defenses after the infection to protect themselves from any new infection.

12- **Immunity mechanisms in living organisms are always changing.**

-To help the living organism to survive as some living organisms : a-change their color (camouflage) b-secretion of toxins to kill their enemies c-running to escape.

13- **Innate and acquired immunity systems work in coordination with each other.**

-As the innate immunity is essential for the acquired immunity to work successfully and vice versa, this correlation allows the body to act against the pathogens.

14- **The structural immunity in plants acts as the first line of defense.**

-as it is a natural barriers which prevent the pathogens from entering and spreading inside the plant.

Dr. Mina H. Messiha (01007765878 - 01225768986)

15- **The epidermal cells acts as the first bulwark in the resistance.**

-Because the epidermis may be covered with:

1. Waxy layer forming water repellent surface so, the water doesn't settle on the surface and therefore the environment for the growth of fungi and the reproduction of bacteria isn't available.
2. Hairs or thorns to avoid the accumulation of water or being eaten by grazing animals and thus the chance of infections with disease is decreased.

16- **The cell wall has a double role in the structural immunity in the plants.**

Because:

a- he cell wall consists mainly of cellulose and then it is thickened with lignin so, it is difficult to be penetrated by pathogens

b- swelling of the cell walls when a pathogen is penetrating them.

-to inhibit the penetration process of the pathogen through the infected cells.

Lesson 2 : Immunity in animals:-

1. **Binding is confirmative between antibodies and their antigens.**
   because the antibodies have two antigen – binding sites and the antigens of microbe have many binding sites, which makes the binding is a confirmative certain between the antibodies and their antigens.
2. **Antibodies bind to the outer coat of the virus.**

- to prevent the viruses from adhering to the membranes of the host's cells and so, prevent the viruses from spreading or passing to inside the cells, and if the virus succeeded in penetrating the host cell membrane, the antibodies will prevent the viral nucleic acid from coming outside its protein coat and from the replication in the host cell by keeping the coat intact or sealed.

3. **IgM can agglutinate microbes.**

-because the IgM antibody has many antigen-binding sites, so it binds to more than one microbe (antigen), this lead to the clumping (collecting) of microbes on the same antibody, this makes microbes weaker and can be engulfed by phagocytes.

4. **The organs of the immune system act as one functional unit.** **Or**
5. **The immune system differs anatomically from functionally.**

-Because although the parts of this system are scattered and are not linked in anatomical succession but they interact and cooperate with each so they functionally act as one unit.

6. **The organs of the immune system are called the lymphoid organs.**

-Because they contain large number of lymphocytes and in these organs maturation and differentiation of lymphocytes take place.

Dr. Mina H. Messiha (01007765878 - 01225768986)

7. **Thymus gland secrets thymosin hormone.** **Or**
8. **Thymosin hormone plays an important role in function of the immune system**

-This hormone stimulates maturity of lymphoid stem cells to T – cells and their differentiation into different types inside the Thymus gland.

9. **Spleen plays an important role in the body's immunity.**

- Because it contains two types of cells:

a) A lot of white blood cells called macrophages which engulf foreign bodies (microbes or senescent somatic cells as the senescent red blood cells) and disintegrate it to its components to be disposed by the body.

b) Contains other white blood cells called lymphocytes.

10. **The spleen is considered to be the graveyard of the red blood cells.**

as the spleen contains a lot of macrophages which engulf the senescent red blood cells and disintegrate it to its components to be disposed by the body.

11. **The iron is transferred from the spleen to the bone marrow.**

as the spleen contains a lot of macrophages which engulf the senescent red blood cells and disintegrate it into its components as the iron which is transferred into the red bone marrow to be used in the production of new red blood cells.

12. **Lymph nodes can purify the lymph from microbes and foreign bodies.**

-because the lymph nodes are divided internally into pockets filled with 1-B – lymphocytes 2-T – lymphocytes and 3-macrophages

-to get rid the lymph of germs and the debris of cells, as each lymph node is connected with several lymph vessels that transfer the lymph from the tissues to the nodes for the filtration of the lymph by getting rid the suspended foreign pathogen.

13. **Lymph nodes are filled with B – lymphocytes, T – lymphocytes, and macrophages.**

-to get rid the lymph of germs and the debris of cells, as each lymph node is connected with several lymph vessels that transfer the lymph from the tissues to the nodes for the filtration of the lymph by getting rid the suspended foreign pathogen.

14. **Each lymph node is connected with several afferent lymph vessels.**

-to transfer the lymph from the tissues to the nodes for the filtration of the lymph by getting rid of the suspended foreign pathogen in it.

15. **Neutrophils can struggle the infection especially, the bacterial infection and inflammations.**

-Because they contain granules which have the main role in the disintegration of the pathogen's cells attacking the body, ingest and digest the pathogens (phagocytosis) so they struggle the infection especially, the bacterial infection and inflammations.

Dr. Mina H. Messiha (01007765878 - 01225768986)

16. **Macrophages are the first to act against microbes.**

-because there are two types of it

a- fixed macrophages: found in most body tissues and are ready to engulf foreign particles as well as micro-organisms.

B-Mobile macrophages: in addition to their ability to engulf the foreign bodies, they also offer the information which are collected about the microbes to the specialized immune cells in the lymph nodes to produce antibodies and specific types of killer cells that deal with these microbes.

17. **Complements make microbes easily engulfed by macrophages.**

- Because they destroy microbes in blood after their conjugation (binding) with antibodies where they lyse the membranes of microbes and dissolve their content which makes them easily engulfed by phagocytes.

18. **Interferon's prevent the virus from reproduction and spreading in the body.**

- Because they bind to healthy cells neighboring to the infected cells and induce them to produce enzymes that inhibit the replication enzymes of the virus, thus preventing the virus from reproduction and spreading in the body.

19. **The two antigen binding sites are considered as the variable regions of each antibody.**

-as they differ from antibody to another due to the difference in the confirmation of amino acids (their sequence, types and spatial shape) at the antigen – binding site so it becomes mirror image to a specific antigen.

Lesson 3 : The immune system mechanism in Man

1. **Blood fluids leak from the blood circulation in the area of inflammation.**

-because the plasma contains:

✓ Chemicals that kill and dissolve bacteria.

✓ White blood cells as neutrophils, Monocytes (Macrophages) to fight and kill foreign bodies and microbes.

2. **The swelling of tissues in the site of injury.**

-because histamine which is secreted in the site of injury from the mast cells and basophils causes increasing in the permeability of blood capillaries to the blood plasma which leaks from the blood circulation to the site of injury causing swelling.

3. **The passage of chemicals that kill and dissolve bacteria to the site of inflammation.**

- because histamine which is secreted in the site of injury from the mast cells and basophils causes increasing in the permeability of blood capillaries to the blood plasma which leaks from the blood circulation to the site of injury and the plasma contains chemicals that kill and dissolve bacteria.

Dr. Mina H. Messiha (01007765878 - 01225768986)

4. **Each B – lymphocytes can recognize a specific type of antigens. Or**
5. **B – lymphocytes are very specific.**

-because receptors on the surface of B-lymphocyte can recognize a single and specific type of antigens and when the B-lymphocytes join with the antigens for the first time they divide many times to produce groups of cells and each group can produce a specific antibody to a specific antigen.

6. **The complex resulting from the binding between the antigen and the MHC transfers to the plasma membrane of the macrophage.**

-to be presented to the helper T- lymphocyte which by the help of its receoptors (CD4) recognizes the antigen displayed on the outer surface of the macrophage combined with the MHC and bind to it, this binding will activate the helper T-lympocyte to stimulate the two mechanisms of the acquired immunity (humoral and cellular immunity)

7. **Memory B cell will remain in the blood for long periods.**

-to recognize the same antigen if it re – entered the body, where they divide and differentiate into plasma cells that secrete antibodies specific for the same antigen making a rapid response. (Faster than the first response of the first infection).

8. **The second reponse for an antigen is faster than the first response to the first infection.**

-as it depends on the memory B and T cells which are produced in the primary immune response and can live for tens of years and may survive till the death as when the same individual is re-infected by the same pathogen , these memory cells respond to it and start dividing quickly to produce within short period of time large amounts of antibodies and active T-cells

9. **Macrophages start the humoral response and end it.**

-because it stars when a pathogen enters the body, the macrophage engulf and digest it by its lysosomal enzymes into fragments of antigens which bind inside the macrophage with the MHC to form antigen-MHC complex which transfers to the plasma membrane of the macrophage to be presented to the Helper T- lymphocytes and it ends with the production of antibodies from the plasma B- cells, the antibodies reach the blood circulation through the lymph, where they bind to the same antigens and that will activate macrophages to re-engulf these pathogens and the steps are repeated.

Dr. Mina H. Messiha (01007765878 - 01225768986)

10. **The antibodies produced by plasma cells are not effective enough to destroy foreign cells.** **Or**

11. **Humoral response cannot fight cells infected by viruses.**

-because antibodies are relatively large sized molecules that cannot reach the virus inside the cell. In this case the foreign cells will be combated by the T – Cytotoxic cells (Cellular or cell – mediated immunity).

12. **T lymphocytes are specific.**

-because each T-lymphocyte can produce during its maturation specific type of receptors which can bind to a single type of antigens.

13. **Cytokines can activate both humoral and cell mediated immunity**

-because cytokines stimulate cytotoxic cells to destroy the foreign cells and also stimulate B lymphocytes to produce antibodies and memory cells. Therefore activating both cellular and humoral immunity.

14. **When somebody is infected with a specific disease like measles, he / she will not be infected again by the same disease along his lifetime.**

- because the individual gained acquired immunity against this disease where the secondary immune response is very fast and destroys the pathogen before the appearance of symptoms as it depends on the memory B and T cells which are produced in the primary immune response and can live for tens of years and may survive till the death as when the same individual is re-infected by the same pathogen , these memory cells respond to it and start dividing quickly to produce within short period of time large amounts of antibodies and active T-cells.

15. **The primary immune response takes a longer time that the secondary one.**

-since the lymphatic cells need time to multiply, so it takes between five to ten days to reach its maximum productivity of B and T cells and during this time, the infection could be widespread and the symptoms of the disease appear.

-While the secondary immune response depends on on the memory B and T cells which are produced in the primary immune response and can live for tens of years and may survive till the death as when the same individual is re-infected by the same pathogen , these memory cells respond to it and start dividing quickly to produce within short period of time large amounts of antibodies and active T-cells.

16. **The skin is characterized by a tough horny layer on its surface.**

-to act as a barrier that difficult to be penetrated or to pass through it.

17. **The sweat can kill most of the microbes.**

-because the sweat that is secreted by the sweat glands on the skin surface, can kill most of the microbes because of its salinity.

Dr. Mina H. Messiha (01007765878 - 01225768986)

18. **Tears protect the eye from microbes.**

- because it contains enzymes that lysis the microbes.

19. **Respiratory tracts secrete mucus and are lined with cilia.**

-because the mucus which lines the respiratory tracts is a viscous fluid so the microbes and foreign bodies which enter with the air will adhere to it and the mucous with the trapped microbes is expelled to the outside by the action of the beating cilia lining these tracts.

20. **Saliva can kill microbes.**

-because it contains substances that kill microbes in addition to enzymes that can dissolve these microbes.

21. **Gastric juice can kill microbes.**

-because it contains strong hydrochloric acid that can kill the microbes entering with food.

22. **The body uses successive nonspecific mechanisms that surround the invading microbes.**

-that represents the second line of defense which acts only if the pathogens succeeded in penetrating the first line of defense through a slash in the skin so, the body uses successive non-specific mechanisms to surround the invading microbes and prevent their spreading and that starts with severe inflammation.

23. **Secreting large quantities of inflammation – generating substances at the area of infection by a microbe.**

-the most important one of these substances is the histamine which causes:

a-local dilation of blood vessels, this increases the amount of blood in the area (redness) and raises the temperature locally

b- increases the permeability of capillaries to blood fluid (plasma) which leaks from the blood circulation to the site of injury causing swelling of tissues in the site of injury,

This plasma contains:

• Chemicals that kill and dissolve bacteria.

• White blood cells as neutrophils, Monocytes (Macrophages) to fight and kill foreign bodies and microbes.

24. **Decrease in the number of antibodies with the increase in the lymphokines in the blood of a person.**

-As the T- suppressor cells bind with the help of its receptors CD_8 with the plasma cells and then secrete proteins called Lymphokines which stop the production of antibodies from plasma B-cells and so it inhibit the immune response after the elimination (destroying) of pathogen

Dr. Mina H. Messiha (01007765878 - 01225768986)

Explain each of the following :-

Lesson 1 : Immunity in plants:-

1. **Cutting or tearing of the plant may occur under various circumstances.**

–because tearing may be resulted from:-

- The increase in the thickening of the plant during its growth.
- The collection of fruits.
- The fall of the leaves in the autumn. - The human and animal encroachment.

2. **Some compounds are found in healthy and infected plants, but their concentration increases in infected plants.**

-these compounds act as a receptors that recognize the presence of the pathogen and then activate the plant defenses by stimulating the innate immune system in the plant.

3. **Some proteins are produced by plants only when they are infected by pathogens. Or**

4. **There are two methods that plants use to detoxify the toxins of pathogens.**

-because the proteins produced by the plant:

a-react with the toxins produced by the pathogen and change it into non-toxic compounds and

b-sometimes the plant produce some enzymes known as detoxifying enzymes which interact with the toxins to invalidate their toxicity.

5. **There are three main reasons for diseases and harms that may afflict plants.**

-these reasons are:

1. The dangerous enemies: including the grazing animals, insects, fungi, bacteria and viruses …. Etc. Causes: a- severe damage destroying the life of the plant. Or

b- Causing dangerous diseases.

2. The unsuitable conditions: including high temperature, excessive cold, increase or decrease in the amount of water and deficiency of nutrients, and unsuitable soil….. Etc.

Causes: damage can be avoided or treated by demise their causes.

3.The toxic substances: such as smoke and toxic fumes, insecticides, the untreated sewage that flowing from factories to the rivers and irrigation water. Causes: a- Damage can be avoided or treated by demise their causes.

b- Damage may be lethal to the plant.

Dr. Mina H. Messiha (01007765878 - 01225768986)

Lesson 2 : Immunity in animals:-

1. **Basophil, eosinophil and neutrophil play an important role in struggling the bacterial infection and inflammation.**

- As the granules of these cells have the main role in disintegration of the pathogen's cells attacking the body as they ingest and digest the pathogens (Phagocytosis) so they struggle the infection especially the bacterial infection and inflammation.

2. **Basophil, eosinophil and neutrophil are distinguishable from each other.**

-are distinguished from each other under the microscope by their size , shape of nucleus and the color of granules inside them.

3. **There are two types of macrophages Or**
4. **Macrophages can fight foreign bodies by two different mechanisms.**

a- fixed macrophages: found in **most** body **tissues** and are ready to **engulf** foreign particles as well as micro-organisms.

b- Mobile macrophages: in addition to their ability to engulf the foreign bodies, they also offer the information which are collected about the microbes to the specialized immune cells in the lymph nodes to produce antibodies and specific types of killer cells that deal with these microbes.

5. **Sometimes the function of antibodies depends on the complements.**

1. because the complements destroy microbes in blood after their conjugation (binding) with antibodies where they lyse the membranes of microbes and dissolve their content which makes them easily engulfed by phagocytes (Lysis)
2. because when the antibodies bind with the toxins of the microbes, they form complexes from the antibodies and the toxins and these complexes activate the complements to react with the toxins in a chain of reaction which finally leads to detoxifying them and also makes them easily engulfed by phagocytes. (Antitoxins)

6. **Complements have a special mechanism of destroying pathogens.**

- because the complements destroy microbes in blood after their conjugation (binding) with antibodies where they lyse the membranes of microbes and dissolve their content which makes them easily engulfed by phagocytes

7. **Secretion of interferon's increases from the cells infected with viruses.**
8. **Cells infected by viruses can protect their neighboring cells from infection.**

-as these cells secrete certain proteins called interferon's which bind to healthy cells neighboring to them and induce these healthy cells to produce enzymes that inhibit replication enzymes of the virus, thus preventing the virus from reproduction and spreading in the body.

9. **There are five classes of antibodies.**

-They are (IgM, IgA, IgG, IgE and IgD).

Dr. Mina H. Messiha (01007765878 - 01225768986)

10. **Each antibody has both variable and constant regions.**

a-constant regions have a constant shape and structure in all types of antibodies. b- variable regions varies from antibody to another and also known as the antigen-binding sites as they determine the specificity of the antibodies by the conformation of amino acids (their sequence, types and spatial shape) in these sites to make them a mirror image to a specific antigen.

11. **Antibodies are specific.** **Or**

12. **Amino acids play an important role in specificity (variety) of antibodies.** **Or**

13. **Variety of antibodies.**

Each antibody has two identical sites at the two tips of its Y-shaped structure which are called antigen-binding sites and the specificity of the antibodies is determined by the conformation of amino acids (their sequence, types and spatial shape) in these sites to make them a mirror image to a specific antigen.

14. **Variable regions of Igs are varied from an antibody to another.**

- as they determine the specificity of the antibodies by the conformation of amino acids (their sequence, types and spatial shape) in these sites to make them a mirror image to a specific antigen.

15. **Antibodies can neutralize their corresponding antigens.** **Or**

16. **Antibodies can prevent viruses from infecting cells before or after penetrating these cells.**

a-as the antibodies adhere to the outer coat of the virus and preventing the virus from adhering the membrane of the host cells, preventing its spreading and

b- if the virus succeeded in penetrating the host cell membrane, the antibodies will prevent the nucleic acid of the virus from coming out of the protein coat and from the replication inside the host cell by keeping the coat intact or sealed.

17. **Some antibodies have more than two antigen – binding sites.**

- such as IgM which has many antigen- binding sites that help one antibody to bind to many microbes that is called agglutination (clumping) and so the microbes become weaker and can be engulfed by the phagocytes.

18. **Is there a relationship between the thymus gland failure and the spreading of cancer disease?**

-Yes, as the thymus gland secretes thymosin hormone that stimulates the maturity of the lymphoid stem cells into T-lymphocytes and their differentiation into their different types such as the T-cytotoxic (T-killer) cells which attack the foreign cells as the carcinogenic cells, so there is a direct relationship between the thymus gland failure and the spreading of the cancer disease.

Dr. Mina H. Messiha (01007765878 - 01225768986)

19. **The human immune system has a major difference with other body systems.**

-Because the parts of the immune system are scattered and are not linked to each other in anatomical succession but they interact and cooperate with each other in coordinated manner.

20. **Lymphatic system is not only built from lymphoid organs.**

Because it also consists of:

a- Lymphocytes (natural killer cells, B-lymphocytes and T-lymphocytes)

b- Other white blood cells: I- single core or mono-nucleated cell called monocyte, II- multi-nucleated cells (neutrophils, eosinophil's and basophils)

c- Macrophages (fixed and mobile)

d- Assisting chemical substances (chemokine's – interleukins – complements – interferon's)

e- Antibodies (IgM, IgA , IgG , IgE and IgD).

21. **T – Lymphocytes mature and differentiate in the thymus gland.**

Because the thymus gland secretes Thymosin hormone that stimulates maturity of lymphoid stem cells to T – cells and their differentiation into different types.

22. **T – lymphocytes are given the letter T to differentiate from B lymphocytes.**

-because T-lymphocytes differentiate and mature in the thymus gland under the effect of its thymosin hormone while the B-lymphocytes are formed and complete their growth to become mature in the bone marrow.

23. **Macrophages and B – lymphocytes defend the body against microbes in different mechanisms.**

-Because B-lymphocyte identify any microbes or foreign particles such as bacteria or viruses, then adhere to it and produces antibodies to destroy it.

-While the macrophages engulf the microbes and foreign bodies and also offer the information which are collected about them to the specialized immune cells found in lymph nodes scattered in different body parts to perform their suitable defense mechanisms such as antibodies production and stimulate specific types of killer cells that deal with these microbes

24. **Lymph nodes are found in large numbers in some parts of the body.** because the lymph nodes are divided internally into pockets filled with

1-B – lymphocytes 2-T – lymphocytes and 3-macrophages

-to get rid the lymph of germs and the debris of cells, as each lymph node is connected with several lymph vessels that transfer the lymph from the tissues to the nodes for the filtration of the lymph by getting rid the suspended foreign pathogen.

Dr. Mina H. Messiha (01007765878 - 01225768986)

25. **Lymph nodes are not equal in size.**

-because their size ranging from a pinhead to the size of small bean seed.

26. **Spleen and lymph nodes are both lymphoid organs.**

-Because the lymphoid organs are the main components of the lymphatic system as they contain large numbers of lymphocytes and the spleen and the lymph nodes store the lymphocytes with large numbers to help in fighting any infection or disease, so they are considered as lymphoid organs.

27. **Ribs share in three different systems.**

1- the skeletal system as it represents part of the axial skeleton.

2- the circulatory system since the red bone marrow inside the ribs (flat bones) produces the red blood cells, white blood cells and platelets.

3- the immune system as the red bone marrow in the ribs produces the lymphocytes and other white blood cells which attack and destroy the microbes.

28. **Lymphocytes do not have any immunization ability at the beginning of their formation.**

- Because all lymphocytes are formed in the red bone marrow and at the beginning of their formation they do not have any immune ability, but they pass in the process of maturation and differentiated in the lymphoid organs after that it changes into cells that have the ability of immunization.

29. **There are three main types of lymphocytes in the human body.**

a-Natural killer cells: (from 5% to 10% of lymphocytes in the blood)

-formed and mature in the red bone marrow.

-attack the body cells which are infected with virus and the carcinogenic cells by secreting enzymes that destroy these infected cells.

b-B-lymphocytes: (from 10% to 15% of lymphocytes in the blood)

-formed and complete their growth to become mature in the bone marrow.

-identify any microbes or foreign particles such as bacteria or viruses, then adhere to it and produces antibodies to destroy it.

c-T-lymphocytes: (about 80% of lymphocytes in the blood)

- formed in the bone marrow and mature in the thymus gland where they differentiate into three types.

30. **There are 3 types of T – lymphocytes.**

I. Helper T – cells (T_H) :

1. Activate other types of T cells to do their responses.
2. Stimulate B cells to produce antibodies.

II. Cytotoxic T – cells or Killer T cells (T_C) :

Attacking to the foreign cells where it kills carcinogenic cells, the transplanted organs and body cells infected with the virus.

III. Suppressor T – cells (T_S) :

1. Regulate the degree of immune response to required limit.
2. Inhibit the action of T cells and B cells after elimination the pathogen.

Dr. Mina H. Messiha (01007765878 - 01225768986)

Lesson 3 : The immune system mechanism in Man

1. **Macrophages are antigen – presenting cells.**

- the Macrophage (APC) engulfs the pathogen and and digest it by its lysosomal enzymes into antigen fragments and then these antigen fragments bind inside the macrophage with a protein called MHC to form antigen-MHC complex which transfers to the plasma membrane of the macrophage to be presented on its outer surface.

2. **Importance of memory B cells.**

- **Memory** B-cells will **remain** in the **blood** for **long periods** (**20 – 30 years**) to **recognize** the **same** antigen if it re – entered the body, where they **divide** and differentiate into **plasma** cells that secrete antibodies **specific** for the **same antigen** making a **rapid response**. (**Faster** than the **first response** of the **first infection**).

3. **The macrophages are attracted to the site of infection in large amounts.**

-As the binding between the helper T- cells and the macrophage presenting the antigen bound to MHC leads to the activation of helper T cells so, the activated helper T-cells secrete cytokines proteins which attract the **macrophages** to the **site** of **infection** in large amounts a**nd also stimulate** the **macrophages**.

4. **Cell mediated immunity can active the humoral one.**

As the secretion of the cytokines from the activated helper T cells during the cell mediated immunity stimulates the plasma B-lymphocytes to secrete antibodies (stimulates the humoral immunity)

5. **Cytotoxic T cells can damage cancer cells.**

- **Create pores** in the **membrane** of the **cancer cell** by secreting a specific protein called **perforin** (perforating protein) and then,
- Secrete lymphatic toxins that activate certain genes in the nucleus of the infected cell, leading to the destruction of the nucleus and its death.

6. **T_S cell can inhibit or stop both humoral and cell mediated immunity.**

-As the **T suppressor** cells (T_S) **bind** with the help of the **receptor CD8** found in its surface, **to plasma cells**, activated **T helper** cells and activated **T cytotoxic** cells, This binding will help the **T suppressor** cells to secrete proteins called **Lymphokines** which **suppress** or inhibit the **immune response** or **stop it**, where

1. **Plasma cells** will **stop** producing **antibodies.**
2. Many of the **activated T helper** cells and the activated **T cytotoxic** cells will **die.**

Dr. Mina H. Messiha (01007765878 - 01225768986)

While Some of the activated **T helper** cells and the activated **T cytotoxic** cells will be **stored** in the **lymphatic organs,** where they **stay** ready to **combat** any **similar infection** when **needed** .

7. **Both first and second lines of body defenses are non – specific**.

-Because they represent together the two lines of innate (natural) immunity which is a group of defense mechanisms which are rapid and effective to resist, fight and destroy any microbe and these mechanisms are non-specific against specific type of antigen.

8. **The skin has two different ways of defending the body.**

1. - A tough **horny layer** on the skin surface which acts as **a barrier** that **difficult** to be **penetrated** by the pathogens.
2. The **sweat** that secreted by the sweat glands on the skin surface, can **kill** most of the **microbes** because of **its salinity**.

9. **Saliva is a natural defense mechanism.**

-Because it contains substances that **kill microbes** in addition to **enzymes** that can **dissolve** such **microbes**.

10. **Increasing the permeability of capillaries to blood fluids in the area of inflammation.**

-Because when the body **tissues injured** by a foreign body like **bacteria**, this causes secreting **large** quantities of **inflammation – generating substances** such as **histamine** from special cells like **mast** cells and basophils and the histamine increases the permeability of blood capillaries in the site of inflammation.

11. **Redness swelling and pain in the area of inflammation.**

- Because when the body **tissues injured** by a foreign body like **bacteria**, this causes secreting **large** quantities of **inflammation – generating substances** such as **histamine** from special cells like **mast** cells and basophils and the histamine causes local dilation of blood vessels, this increases the amount of blood in the area (redness) and raises the temperature locally and also the histamine increases the permeability of the blood vessels to the blood plasma in the site of injury causing swelling and pain.

12. **There are two different mechanisms of specific immunity.**

-because the acquired (specific) immunity is **done** through **two separate mechanisms** but they are **actually interconnected** with each other,

-The **two mechanisms are** :

1-**Humoral** or **antibody – mediated** immunity which defend the body against pathogens present in the body fluid and that done by B-lymphocytes by secreting the antibodies.

2-Cellular or **cell – mediated** immunity which done by the T-lymphocytes by attacking and destroying the foreign cells (virus-infected cells – transplanted organs – carcinogenic cells).

Dr. Mina H. Messiha (01007765878 - 01225768986)

13. **The decrease in the amount of the antibody after the healing of patients.**

-That is due to the activity of the Ts cells which bind by the help of their CD8 receptors to the plasma B-cells and secrete lymphokines to inhibit their production of antibodies and antibodies decreases.

14. **The acquired immunity passes through two stages.**

a-the first stage which is the primary immune response takes place when the immune system faces a new pathogen, the B and the T cells will attack it until it is destroyed.

1. The first response takes a longer time since the lymphatic cells need time to multiply, so it takes between five to ten days to reach its maximum productivity of B and T cells.
2. During this time, the infection could be widespread and the symptoms of the disease appear.

b-the second stage which is the secondary immune response takes place when the same individual is infected by the same disease(pathogen) again, the immune response will be very fast so, the pathogen is destroyed before the appearance of the symptoms, as the memory B and T cells respond to the pathogen once it enters the body again, where they start dividing quickly to produce within short period of time:

a. Large amounts of antibodies (humoral immunity) and

b. large number of active T cells (cellular immunity)

What happens when:-

Lesson 1 : Immunity in plants:-

1. **A plant cell is invaded by a pathogen.** **Or**
2. **The plant is infected with toxic bacteria.**

The plant will secrete anti-microbial chemicals such as phenols, glycosides and non-protein amino acids as canavanine and cephalosporin which kill the pathogen or inhibit its growth and also the plant will produce anti-microbial proteins (detoxifying enzymes) which react with the toxins produced by the pathogen and convert it into non-toxic compounds or invalidate their toxicity.

3. **A fungus mycelium is attacking a plant.**

-The plant surrounds the mycelium of the fungus with insulator cover to prevent the transmission of the fungus from one cell to another.

Dr. Mina H. Messiha (01007765878 - 01225768986)

4. **A part of the plant body is exposed to tearing** **Or**
5. **A part of the plant is cut or wound.**

-that leads to the formation of cork to isolate areas that exposed to cut or tearing or -deposition of gum from the cells surrounding the site of infection to prevent the entry of the pathogen to inside the plant.

6. **Increase in the plant diameter during its growth.**

-that causes tearing of the plant which leads to the formation of cork to isolate areas that exposed to cut or tearing to prevent the entry of the pathogen to inside the plant.

7. **Xylem is exposed to invasion by a pathogen.** **Or**
8. **Plant vascular tissues are exposed to a cut.**

- That leads to formation of Tyloses that protrude into xylem vessels or tracheid's through pits to obstruct the movement of pathogens to the other plant parts.

Lesson 2 : Immunity in animals:-

1. **When B – lymphocytes join with antigens for the first time.**

-they will divide many times to produce groups of cells and each group of B – lymphocytes will produce a specific type of antibodies against a specific type of antigen.

2. **Antibodies bind to their corresponding antigens.**

-they form together antigen – antibody complex and after the binding of the antibodies with the antigens of the pathogen it becomes weaker and can be easily engulfed by the phagocytes.

-Also, the antigen – antibody complex activates some proteins and enzymes called complements to lyse the membrane of microbes (pathogens) and dissolve their contents to make them easily engulfed by the phagocytes.

3. **If the viruses, to which antibodies are attached succeeded in penetrating the host cell membrane in the body.**

- the antibodies will prevent the nucleic acid of the virus from coming out of the protein coat and from the replication inside the host cell by keeping the coat intact or sealed.

4. **IgM binds to many antigens.**

-as this type of antibodies has many antigen binding sites so, one antibody binds to more than one microbe and that leads to clumping of microbes on the same antibody, this makes the microbes weaker and can be easily engulfed by phagocytes.

5. **Clumping of microbes on the same antibody.**

-as the IgM antibody has many binding sites so one antibody binds to more than one microbe and that leads to clumping of microbes on the same antibody, this makes the microbes weaker and can be easily engulfed by phagocytes.

Dr. Mina H. Messiha (01007765878 - 01225768986)

6. **Antibodies bind to toxins and form complexes of antibodies and toxins.**

- These complexes activate the complements to react with toxins in a chain reaction which finally leads to detoxifying them and also makes them easily engulfed by phagocytes.

7. **Absence of the complements - binding sites from the structure of the antibodies.**

-In this case the complements will not bind with the antibodies and the complements will not be activated so,

a- the complements will not lyse the antigens or dissolve its contents to be easily engulfed by the phagocytes.

b-the complements will not react with the toxins in a chain of reactions to detoxifying them to be engulfed by the phagocytes.

8. **Some of lymphocytes which are produced by bone marrow pass through the thymus gland.**

-as the thymus gland secretes thymosin hormone so, the immature lymphoid stem cells produced in the bone marrow will mature in the thymus gland by this hormone into T-lymphocytes and differentiate to their types.

9. **The thymus glands stopped secreting thymosin.**

That will inhibit (stop) the acquired (specific) immunity of the human as Thymosin hormone of thymus gland is responsible for the maturation of the lymphoid stem cells into T – lymphocytes and their differentiation into different types, such as the T- helper cells which activate the B- cells to produce antibodies (humoral immunity) and activate the T-cytotoxic cells to attack and destroy the foreign cells (cellular immunity)

10. **The lymph passes through the lymph nodes.**

The lymph node will purify the lymph from harmful substances and microbes as it contains macrophages and B – lymphocytes, T – lymphocytes that help in fighting any disease or infection.

11. **Absence of chemokine's.**

The large circulating phagocytes will not be attracted to the site of the existence of microbes and that leads to the reproduction of the microbe and its spreading.

12. **A cell is infected with a virus**

-The infected cell will secrete interferon's which bind to healthy cells neighboring to the infected cell and induce them to produce enzymes that inhibit replication enzymes of the virus, thus preventing the virus from reproduction and spreading in the body.

-Also, the virus infected cells will be attacked and destroyed by the natural killer cells and cytotoxic T-cells

Dr. Mina H. Messiha (01007765878 - 01225768986)

Lesson 3 : The immune system mechanism in Man

1. **T_H cells are activated.**

1- the activated helper T cells binds to the antigen MHC2 complex that presented on the surface of B cell and release Interleukins which activate the B cell to divide, multiply and differentiates into memory cells and plasma cells which produce the antibodies (humoral or antibody mediated immunity) and also,

2- **the activated helper T – cells secrete cytokines which:**

a- attract the macrophages with large numbers to the site of infection. b-stimulate the macrophages to engulf the pathogens

c-stimulate the plasma B-cells to secrete the antibodies (humoral immunity)

d-stimulate the T-cytotoxic cells to attack and destroy the foreign cells (cellular immunity)

e-stimulate the Natural Killer cells to attack and destroy the body cells infected with virus or carcinogenic cells.

2. **B cells divide, multiply and differentiate.**

a-B cells divide, multiply and differentiate into memory cells and plasma cells. b-Plasma cells produce large amounts of antibodies, Which reach the blood circulation through the lymph, where they bind to the same antigens found on the surface of the invading pathogens, this will activate the macrophages to re – engulf these pathogens.

3. **The body is infected with the same type of antigens.**

- Memory B-cells and memory T-cells which remain in the blood for long periods tens of years or survive till the death will recognize the same antigen if it re – entered the body, and the secondary immune response will be very fast so, the pathogen is destroyed before the appearance of the symptoms, as the memory B and T cells start dividing quickly to produce within short period of time:

a. Large amounts of antibodies (humoral immunity) and

b. large number of active T cells (cellular immunity)

4. **The antibodies produced by the plasma cells bind to the antigens found on the surface of the invading pathogens.**

- this will activate the macrophages to re – engulf these pathogens and that will continue for days or weeks till the elimination of pathogen.

Dr. Mina H. Messiha (01007765878 - 01225768986)

5. **The antigens – MHC complex presented on the surface of macrophages binds to the CD 4 found on the surface of T_H cells.**

-this binding will stimulate the T helper cell to release interleukin's to divide and to form a strain of activated T helper cells and memory T cells that last in the blood long time to recognize the previous antigen if it entered the body again.

6. **The activated T helper cells become unable to secrete cytokines.**

-that will stop the functions of the cytokines which are:

a- attract the macrophages with large numbers to the site of infection.

b-stimulate the macrophages to engulf the pathogens

c-stimulate the plasma B-cells to secrete the antibodies (humoral immunity)

d-stimulate the T-cytotoxic cells to attack and destroy the foreign cells (cellular immunity)

e-stimulate the Natural Killer cells to attack and destroy the body cells infected with virus or carcinogenic cells.

7. **When T_C cells bind to the antigen.**

- The cytotoxic cell (killer T cells) will :

-Create pores in the membrane of the foreign body (microbe or cancer cells) by secreting a specific protein called perforin (perforating protein) and then

-Secrete lymphatic toxins that activate certain genes in the nucleus of the infected cell, leading to the destruction of the nucleus and its death.

8. **Lymphatic toxins are secreted by T_C cells.**

- that activate certain genes in the nucleus of the infected cell, leading to the destruction of the nucleus and its death.

9. **After destroying the antigens, the T suppressor cells bind to plasma cells, T helper cells and T cytotoxic cells.**

-This binding will help the T suppressor cells to secrete proteins called

Lymphokines which suppress or inhibit the immune response or stop it, where:

-Plasma cells will stop producing antibodies.

-Many of the activated T helper cells and the activated T cytotoxic cells will die.

While Some of the activated T helper cells and the activated T cytotoxic cells will be stored in the lymphatic organs, where they stay ready to combat any similar infection when needed.

Dr. Mina H. Messiha (01007765878 - 01225768986)

10. **When the immune system encounters a new pathohgen.**

- the B and the T cells will respond to the antigens of this pathogen and attack it until it is destroyed.

-The first response takes a longer time since the lymphatic cells need time to multiply, so it takes between five to ten days to reach its maximum productivity of B and T cells.

During this time, the infection could be widespread and the symptoms of the disease appear.

11. **If the same individual is infected by the same disease again.**

- Memory B-cells and memory T-cells which are produced during the primary immune response will remain in the blood for long periods (tens of years) or survive till the death will recognize the same antigen if it re – entered the body, and the secondary immune response will be very fast so, the pathogen is destroyed before the appearance of the symptoms, as the memory B and T cells start dividing quickly to produce within short period of time:
- a. Large amounts of antibodies (humoral immunity)
- b. large number of active T cells (cellular immunity)

12. **Microbes are trapped by the mucus secreted by the respiratory tracts.**

- the mucus together with the trapped microbes is expelled to the outside of the body by the action of the beating cilia lining these tracts.

13. **A microbe succeeded in penetrating the 1st line of body defenses.**

-the body will use the second line of defense which is successive non-specific mechanisms that surround the invading microbes within seconds or minutes to prevent microbes from spreading and starts with severe inflammation and also contains interferon's and the natural killer cells

14. **The blood vessels dilate to the maximum in the area of injury.**

- this increases the amount of blood in the area (redness) and raises the temperature locally.

15. **The increase in the permeability of blood vessels at the sites of injury.**

-the blood fluid (plasma) which leaks from the blood circulation to the site of injury causing swelling of tissues in the site of injury,

This plasma contains:

-Chemicals that kill and dissolve bacteria.

-White blood cells as neutrophils, Monocytes (Macrophages) to fight and kill foreign bodies and microbes.

16. **If the second line of defense failed in getting rid of the foreign body.**

- the body will use the third line of defense that called Acquired (Specific) immunity and the immune response will be a series of specific defense mechanisms which resist the pathogens and that is occurred by the lymphocytes.

Dr. Mina H. Messiha (01007765878 - 01225768986)

17. **When a pathogen enters the body carrying on its surface a specific antigen.**

1- The B – lymphocytes recognize the antigen which is specific to it.

2- The B – lymphocyte attaches itself to the antigen by using the immune receptors present on its outer surface.

-The antigen binds to MHC, then the complex resulting from the binding transfers to the plasma membrane of the B- lymphocytes to be presented on its outer surface to the activated T helper lymphocytes (T_H).

18. **The B – lymphocyte recognizes its specific antigen.**

-The B – lymphocyte attaches itself to the antigen by using the immune receptors present on its outer surface.

-The antigen binds to MHC, then the complex resulting from the binding transfers to the plasma membrane of the B- lymphocytes to be presented on its outer surface to the activated T helper lymphocytes (T_H).

19. **Macrophages engulf the antigen.**

- the macrophages digest it by its lysosomal enzymes into fragments.

The fragments of antigen bind inside the macrophages to a protein called major histocompatibility complex (MHC), then the complex resulting from the binding between the antigen and the MHC transfers to the plasma membrane of the macrophage to be presented on its outer surface.

20. **Antigens are digested inside macrophages by lysosomal enzymes.**

- The fragments of antigen bind inside the macrophages to a protein called major histocompatibility complex (MHC), then the complex resulting from the binding between the antigen and the MHC transfers to the plasma membrane of the macrophage to be presented on its outer surface.

21. **The binding of the T_H cells to the antigen MHC complex present on the surface of macrophages.**

-this binding will activate the helper T cells and then the activated helper T cells binds to the antigen MHC complex that presented on the surface of B cell and release Interleukins which activate the B cell to divide, multiply and differentiates into memory cells and plasma cells.

22. **Absence of lysosomes from the macrophages.**

-As the macrophages are responsible for the engulfing of the pathogens and digest them by the lysosomal enzymes and then the antigens of the pathogens bind to the MHC protein inside the macrophages to form antigen-MHC complex which is displayed on the surface of the cell membrane of the macrophage to activate the T-helper cell to stimulate the two mechanisms of acquired immunity (humoral and cellular) and so, the absence of lysosomes from the macrophages will stop their engulfing to the antigen which cause spread of the pathogen and its antigens wouldn't be displayed on the surface of the macrophages.

Dr. Mina H. Messiha (01007765878 - 01225768986)

23. **Absence of antigens from the surface of some microbes**

-in this case these microbes wouldn't be recognized by the B- and T- lymphocytes and so, the mechanisms of acquired and specific immunity will not work causing spreading of the microbe in the body.

24. **Activated T_H cells release interleukins.**

-the Interleukins will activate the B cell to divide, multiply and differentiates into memory cells and plasma cells and the plasma B-cells will produce a large amounts of the antibodies which reach the blood circulation through the lymph to bind with the same antigens and that will activate the macrophages to re-engulf them.

25. The binding between the antibodies and the virus-infected cells.

The antibodies produced by plasma B-cells are not effective enough to destroy foreign cells as the antibodies are relatively large sized molecules that cannot reach the virus inside the cell. In this case the foreign cells will be combated by the T – Cytotoxic cells (Cellular or cell – mediated immunity).

Important Essay questions:-

Lesson 1 : Immunity in plants:-

1. **What is meant by each other following:**

1. **Gum:** chemical substance is secreted by some plants when the plant is exposed to cut or wound to prevent the entry of the microbes to inside the plant.
2. **Hyper-sensitive response:** the plant kills the injured tissues and so gets rid of the pathogen and prevent its spreading.

2. **Mention three different immune structures which prevent the *entry* of pathogens to the plant tissues?**

1. The cell wall which represents the outer protection of the cells as it consists mainly of cellulose and then it thickens by the lignin so, it is difficult to be penetrated by the pathogens.
2. **Cork formation** to isolate the areas that exposed to cut or tearing to prevent the entry of the pathogens to inside the plant.
3. **Deposition of gum** which is secreted from the cells surrounding the site of infection to prevent the entry of the pathogens through the cuts or wounds.

Dr. Mina H. Messiha (01007765878 - 01225768986)

3. **Mention three different immune structures which prevent the *spreading* of pathogens through the plant tissues.**

1. **Formation of tyloses** which protrude into xylem vessels and tracheids to obstruct the movement of pathogens to the other plant parts.
2. **Surrounding the mycelium** of the fungus attacking the plant with insulator cover to prevent the transmission of the fungus from cell to another.

Hyper-sensitive response: the plant kills the injured tissues and so gets rid of the pathogen and prevent its spreading.

4. **Name the three main reasons of disease in plants.**

a-Dangerous enemies (grazing animals, insects, viruses, bacteria, and fungi) b-Unsuitable conditions (high temperature – excessive cold – increase or decrease in the amount of water – deficiency of nutrients - unsuitable soil)

c-Toxic substances (smoke – toxic fumes – insecticides – untreated sewage that flowing from factories)

5. **Give examples of :**

1. **Innate (pre-existing) structural immunity mechanisms in plants.**

- the epidermis which is covered with the waxy layer (cutin) or hairs and thorns
- the cell wall which consists mainly of cellulose and then thickened by lignin.

2. **Induced structural immunity methods in plants.**

1-cork (Phellem) formation 2-formation of Tyloses

3. deposition of gum
4. cellular immune structures (swelling of cell wall – surrounding the mycelium of the fungus)
5. Hyper sensitive response (getting rid of pathogen by the death of the infected plant tissues to prevent the spreading of pathogen to the other tissues.)

3. **Biochemical defense mechanisms in plants.**

1-receptors

2- Anti-microbial chemicals (phenols – Glycosides – canavanine – cephalosporin)

3- Anti-microbial proteins (detoxifying enzymes) 4-Inducible post – infection.

4. **Anti – microbial chemicals in plants**

(phenols – Glycosides – canavanine – cephalosporin)

5. **Non – protein amino acids in plants.**

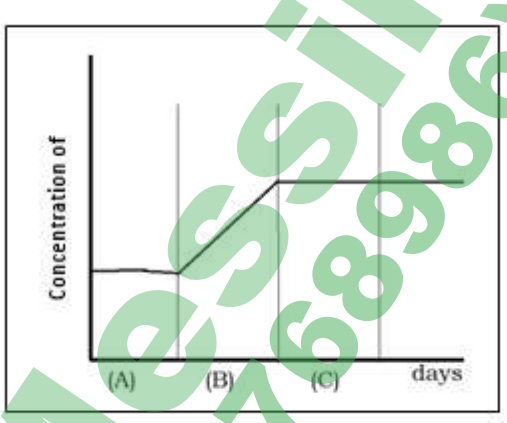
(Canavanine – cephalosporin)

Dr. Mina H. Messiha (01007765878 - 01225768986)

Graphs and Figures:-

Lesson 1 : Immunity in plants:-

Examine the opposite diagram, and answer the following:



1-Is the canavanine structural or biochemical immunity? And why?

-It is a biochemical immunity, because it is a kind of the non-protein amino-acids which don't enter in building of proteins in the plant, but they are toxic chemical compounds to the pathogens which invade the plant.

2- What is the cause of the increase of the canavanine in the stage (B)?

-Due the infection of the plant by pathogens and these compounds are toxic chemical compounds to the pathogens which invade the plant.

3- What is the chemical structure of the canavanine?

–Non-protein amino acid.

4- Mention the name of another compound from the anti-microbial compounds?

– Cephalosporin.

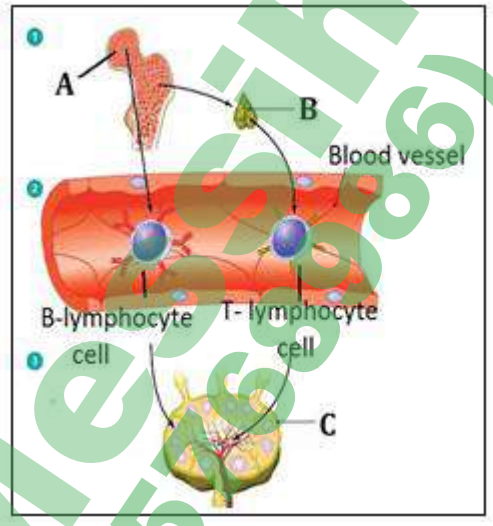
5- What is the reason for the presence of canavanine in stage (C)?

-To be used in the inducible post-infection as the plants promote and strengthen their defenses after the infection to protect themselves from any new infection.

Dr. Mina H. Messiha (01007765878 - 01225768986)

Lesson 2 : Immunity in animals:-

The opposite figure shows the sites of formation and maturation of Lymphocytes:



1) Both B lymphocytes and T lymphocytes are formed in the **Bone marrow**

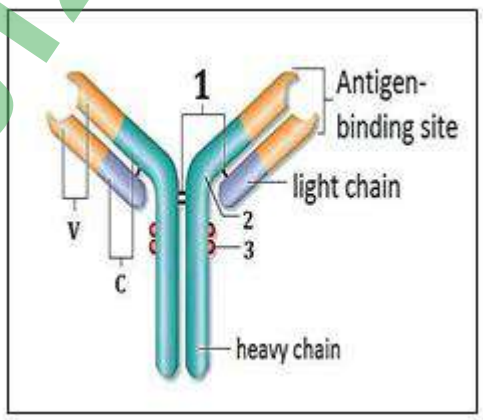
2) B lymphocytes mature in the **Bone marrow**, whereas T lymphocytes mature in the **Thymus gland**

3) Mature lymphocytes are housed in the **Lymph nodes** and also circulate in the **Blood**, to fight microbes.

4) Write the labels A, B and C?

a-Red bone marrow **b-Thymus gland** **c- Lymph node**

The opposite figure shows :



1) The structure of the **Antibody,** which is also known as **Immunoglobulin's**

2) Write the labels 1, 2 and 3?

1-Disulphide bonds. 2-Hinge region. 3-Complements.

3) The letter V indicates to **Variable regions**. whereas the C letter indicates to **Constant regions**.

4) Different types of this molecules are varied from each other in **Their antigen binding sites**

5) This molecule is built from four **Polypeptide chains** two of them are **long (heavy chains)..,** while the other two are **short (light chains)**

6) How many disulphide bonds are shown in this molecule? And what is their function?

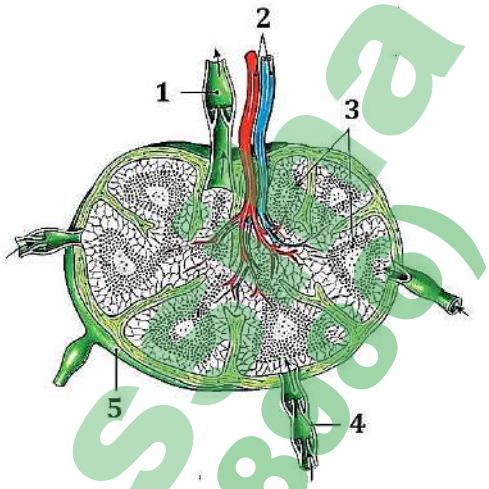
- **4 bonds.**
- **their function: they bind the 4 polypeptide chains together to form the antibody.**

7) Explain how the specificity of this structure is determined?

- **The specificity of the antibody is determined by the conformation of the amino-acids (their types, sequence and spatial shapes) in the antigen –binding sites and the change in these variable regions makes it a mirror image to a specific antigen.**

Dr. Mina H. Messiha (01007765878 - 01225768986)

Look at the figure and answer :



1) The opposite figure shows the structure of the

Section of lymph node

2) Label the diagram.

1-Efferent lymph vessel

2-lymph node artery and vein

3-Clusters of immune cells which intercept the pathogens that invade the interstitial fluid.

4-Afferent lymph vessels

5-Capsule

3) State the function of this organ.

a- **Store white blood cells (lymphocytes) that help in fighting against any disease or infection.**

b- **Purify the lymph from any harmful substances or microbes.**

4) Where this organ is located in the body?

Present along network of the lymphatic vessels that located in all the body parts (under the armpits, at the two sides of the neck, in upper thigh and near the internal body's organs).

5) Explain why this organ is considered as lymphoid organ?

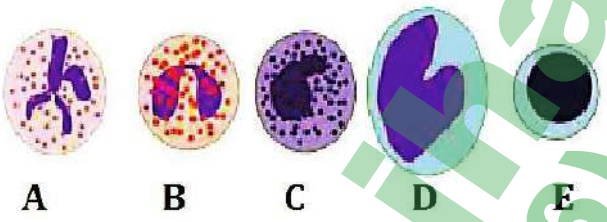
-Because it store large numbers of lymphocytes which help in fighting any infection or disease.

Dr. Mina H. Messiha (01007765878 - 01225768986)

The opposite figure shows:

1) Different types of **White blood cells**
2) Write the labels?

A-Neutrophils **B-Eosinophil's**
C-Basophils **D-Monocytes**
E-Lymphocytes



3) Which of these cells are distinguishable based on the colour of their granules?
- **A, B and C**

4) Which of these cells can develop into macrophages?
- **D**

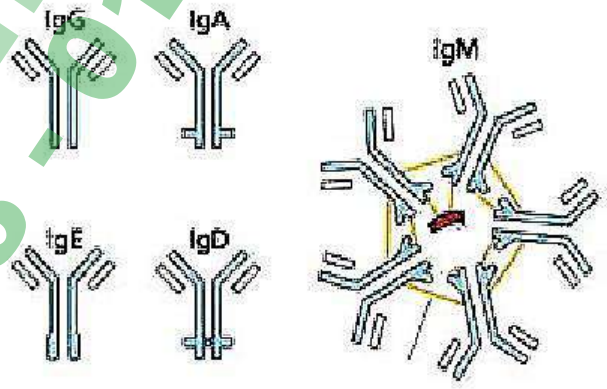
5) Which of these cells can survive only for a relatively short period?
- **A, B and C**

6) Which of these cells is distinguished into 3 different main types?
- **E**

7) Which of these cells produce antibodies?
- **E**

The opposite figure shows :

1. different types of **Antibodies**
2. These proteins are also known as **Immunoglobulin's** and there are **Five** types of them.
3. These proteins are secreted by **Plasma B – cells** to fight microbes.
4. Giving immunity through these proteins is known as **humoral** immunity (humoral – cell mediated).



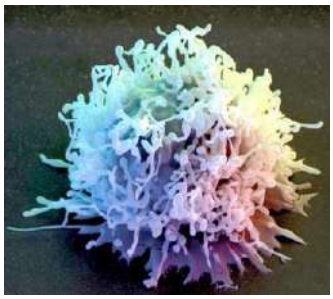
From the opposite diagram:

1- The opposite diagram represents **Natural killer cells**
2- what is the site of the formation and maturation of this cell?

Red bone marrow

3- What is the immune importance of this kind of cells?

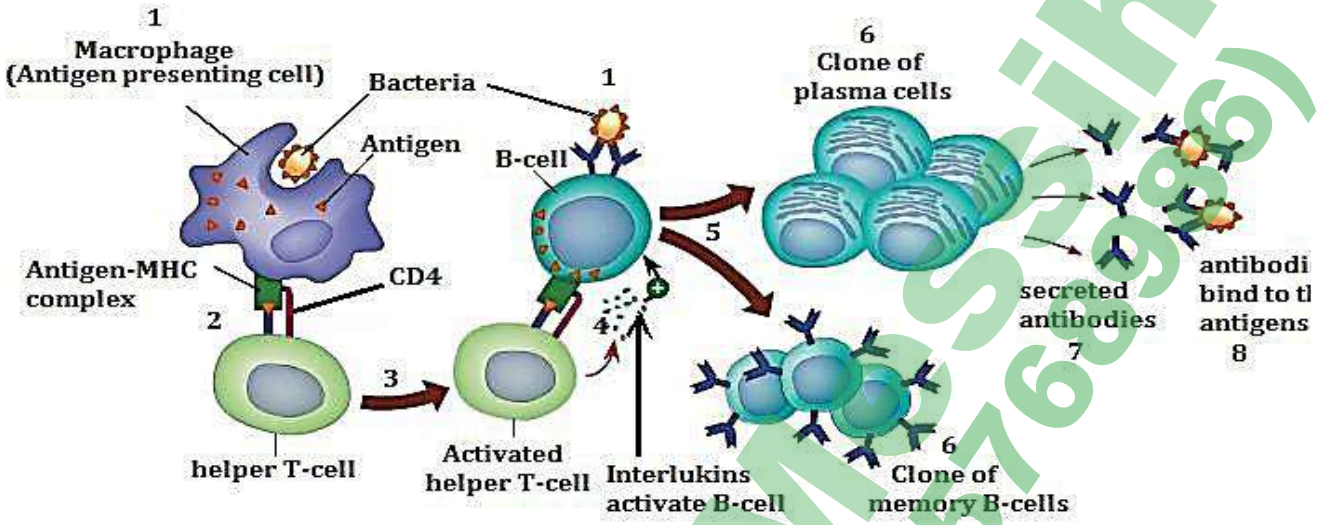
- They attack the body cells infected with the virus and the carcinogenic cells by secreting enzymes which destroy (lysis) these infected cells.



Dr. Mina H. Messiha (01007765878 - 01225768986)

Lesson 3 : The immune system mechanism in Man

Look at the figure and answer :



1- The following figure illustrates the stages of **Humoral or Antibody mediated immunity**

2- This immunity belongs to …….. Immunity (natural – **acquired**).

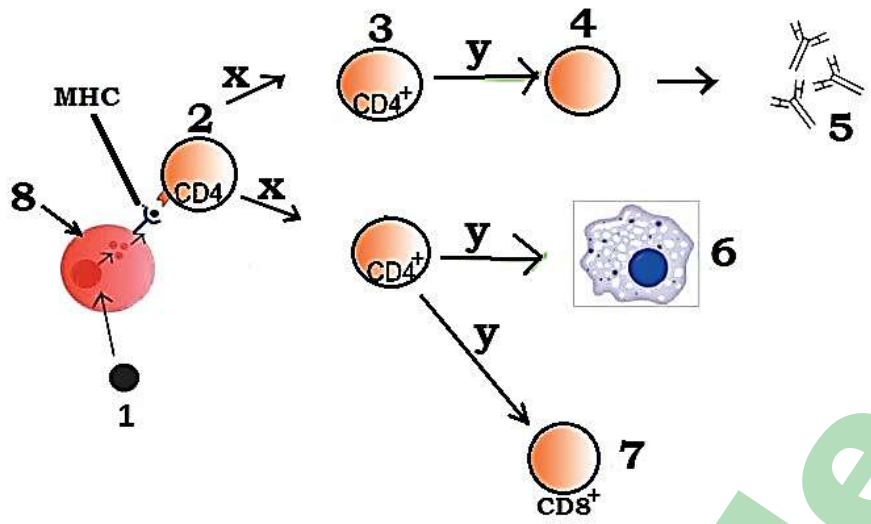
3- This immunity represents the **3rd** Line of body defenses.

4- This immunity attacks pathogens by formation of **Antibodies**

5- The APC in the figure is the **Macrophage**

Dr. Mina H. Messiha (01007765878 - 01225768986)

Examine the opposite diagram and answer the following:



1. What is the name of cells Number (4) and (6)?
- **4 : Plasma B-cells**
- **6 : Macrophage**

2. What is the name of the activating substances (X) and (Y)?
- **X : Interleukin's**
- **Y : Cytokine's**

3. What is the type of the immune response of cells (4)?
- **Humoral or Antibody mediated immunity**

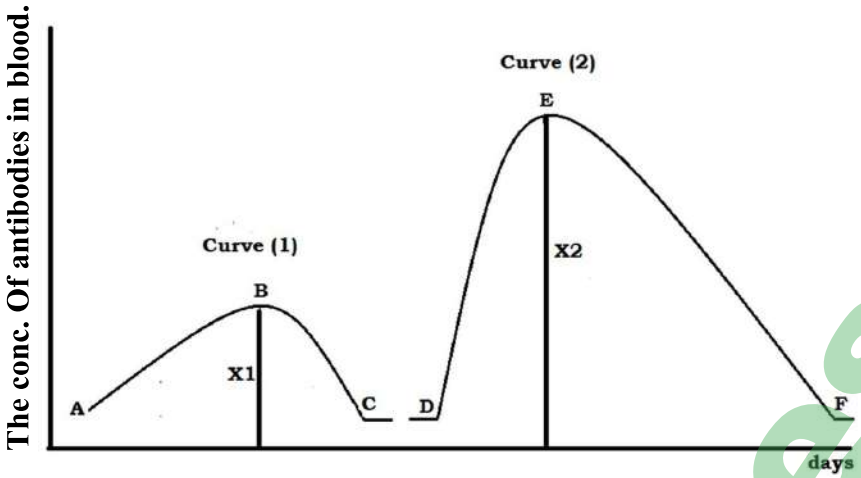
4. What is the name of the substances which are secreted by the cells number (7)?
- **Perforin and Lymphatic toxins**

5. Write the labels number (1, 2, 3, 5 and 8)?

1-Antigen **2-T-helper cells** **3-Activated T-helper cells**
5-Antibodies **8-Macrophage (APC)**

Dr. Mina H. Messiha (01007765878 - 01225768986)

The opposite diagram shows the primary and the secondary immune response to the same pathogen, examine it and then answer the following:



I. Mention the name of the cells responsible for the production of antibodies in case of curve (1) and curve (2)?

- **In curve (1) : plasma cells of B-lymphocyte**
- **In curve (2) : plasma cells of memory B-lymphocytes**

II. Mention the name of the cells which their number increases and the cells which their number decreases in period from (B – C)?

- **The cells which increase in their no. is the T-suppressor**
- **The cells which decrease in their no. is :**

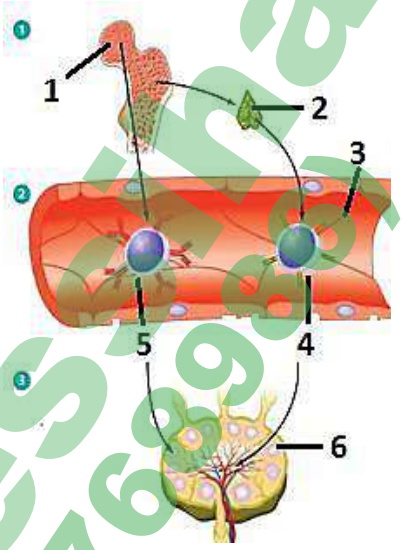
1-Plasma B-cells 2-Activated T-helper cells 3-Activated T-cytotoxic cells

III. In which curve, the symptoms of the disease will appear and why?

- **In curve (1) , Because the primary immune response takes long time as the lymphatic cells (B and T-cells) need from 5 to 10 days to multiply and to reach their maximum productivity , during this time the infection could be wide spread and the symptoms of disease appears**

Dr. Mina H. Messiha (01007765878 - 01225768986)

Examine the opposite figure and then answer the following:-



a- What is the name of cells (4) and (5)?

- 4 : T-Lymphocytes

- 5 : B-Lymphocytes

b- What is the importance of part (1)?

- Bone marrow that produce red blood cells , white blood cells and blood platelets

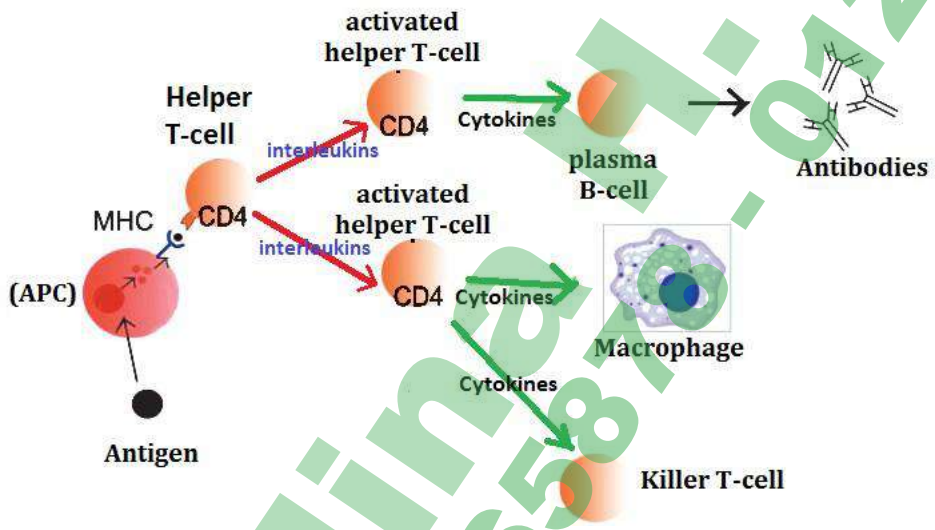
c- Where is the part (2) located in the body?

-On the trachea above the heart and behind in the sternum bone

d- Why do the cells number (4) pass through the part number (2)?

- As the Lymphoid stem cells produced by the bone marrow and mature in T-Lymphocytes and differentiate into their (3) types by the effect of Thymosin H. secreted inside the Thymus gland

Examine the figure and then answer the following :



1. The opposite figure illustrates the stages of ……. immunity.
2. APC stands for …….. and its function is …….
3. MHC 2 stands for …… and its function is …….
4. CD 4 stands for …… And its function is ……..
5. Which cells are activated by the T helper cells ?
6. T helper cells activate other lymphocytes by ……
7. This figure shows how …… cells can activate both humoral and cell mediated immunity cells.

Dr. Mina H. Messiha (01007765878 - 01225768986)

Answer:

1. **cellular or cell – mediated immunity.**
2. **Macrophages (Antigen presenting cell)**

-function : macrophage engulfs the pathogen and digest it by its lysosomal enzymes into antigen fragments and then these antigen fragments bind inside the macrophage with a protein called MHC to form antigen-MHC complex which transfers to the plasma membrane of the macrophage to be presented on its outer surface.

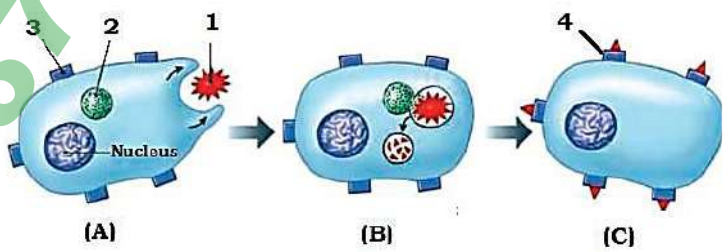
3. **Major histocompatibility complex. -function: bind inside the macrophage into the antigen fragments to form antigen-MHC complex which transfers to the plasma membrane of the macrophage to be presented on its outer surface.**
4. **receptors on the outer surface of the helper T – lymphocytes.**

-function of CD4: they act as receptors on helper T cells and so it enables the Helper T-cells to recognize and bind the antigen-MHC complex that presented on the outer surface of the macrophage.

5. **B-lymphocytes, Plasma B-cells and Cytotoxic T-cells, macrophages and natural killer cells.**
6. **interleukin's and Cytokines**
7. **Activated helper T-lymphocyte.**

The opposite diagram shows stage of acquired immunity, Explain the following:

a) Does this stage take place in humoral immunity only or in cellular immunity only or in both?
-Both of them



b) labels 1, 3 and 4?
1-Pathogen carries antigen
2-Lysosome 3-Receptors
4-Antigen MHC-complex

c) What is the importance of the organelle no.(2)?
-After the macrophage engulf the pathogen (antigen) will be digested by the lysosomal enzymes into antigen fragments

Dr. Mina H. Messiha (01007765878 - 01225768986)

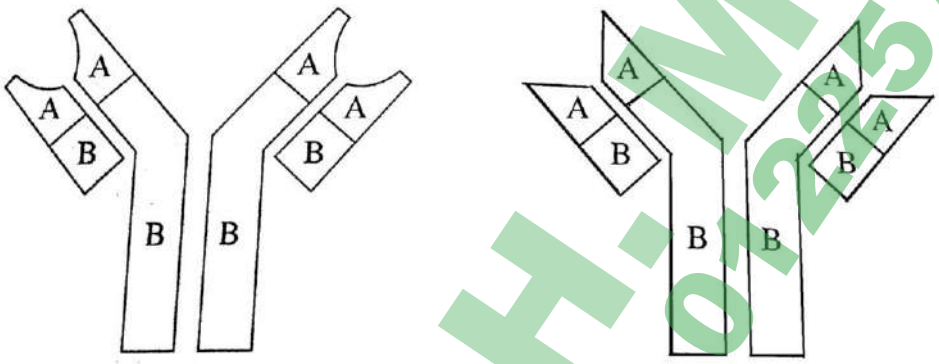
d) What is the importance of the major histocompatibility complex (MHC)?

-It is the protein inside presence inside the macrophage which bind with the antigen fragments of the pathogen to form Antigen MHC-complex

e) Why does the complex of antigen-MHC complex transfer into the surface of the cell membrane?

-To be presented on the outer surface of the macrophage and so can be recognized by the CD_4 receptors of T-helper cells which bind with it and this binding will activate the T-helper cells to stimulate Humoral and cellular immunity

Examine the following diagram and answer the following:



(1) **(2)**

1. What is the difference between diagram (1) and diagram (2)? Explain the reason of the difference and its importance?

-They different in part (A) which is Antigen-binding site

-They different according to confirmation of amino acids (types, sequence , spatial shape)

-The difference makes each antibody is specific to single type of antigen (specifity of Antibodies)

2. what is the result in case of disturbance in the structure of part (A) in the opposite diagrams?

-In this case the antibody can't bind with it's antigens as this sites are mirror image to specific antigens and the binding between antibody and it's antigen is similar to the lock and key model and as a result , the pathogen will not be destroyed.

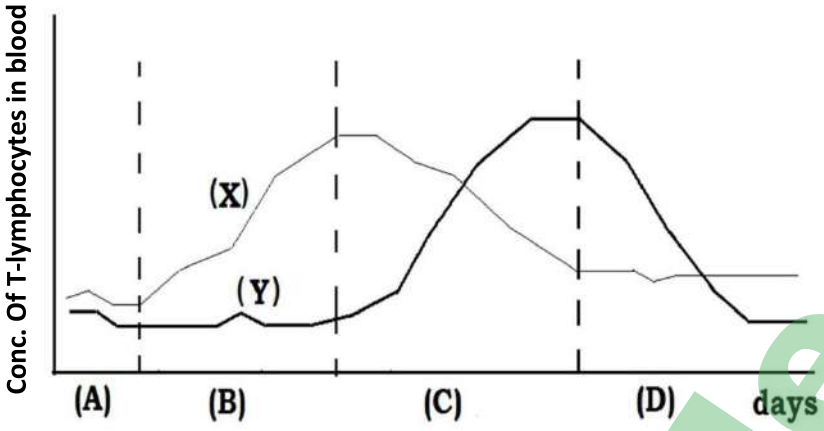
3. What would happen when the opposite structures bind with their specific antigens?

-1) This binding will activate the macrophage to re-engulf the pathogen

-2) As a result of information of Antigen-Antibody complex

Dr. Mina H. Messiha (01007765878 - 01225768986)

Examine the opposite graph which shows the concentration of two types of T-lymphocytes in blood of individual and then answer the following:



1- What is the type of cells (X) and (Y)?

- **X : T-cytotoxic**
- **Y : T-suppressor**

2- Explain the increase in the concentration of cells (X) in stage (B)?

- **Because during stage (B) the spreading of Pathogen takes place and so the no. of T-cytotoxic cells increases to destroy the foreign cells (carcinogenic cells – virus infected cells – transplanted organs)**

3- Explain the increase in the concentration of cells (Y) and the decrease in the concentration of cells (X) in stage (C)?

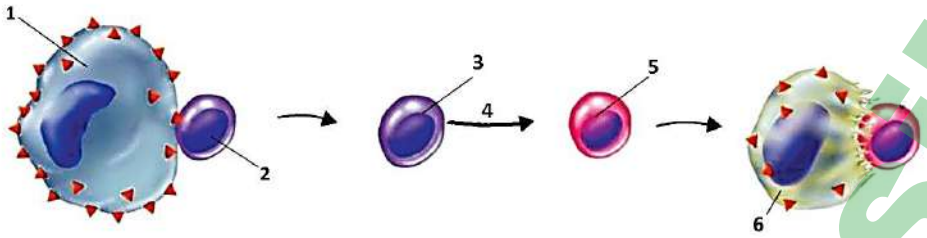
- **Because after the destroy of pathogen in stage (C) : the T-suppressor increases to inhibit the immune response and so many of the activated T-cytotoxic die and as a result their no. decreases in the blood**

4- What is the name of the substances secreted from cells (X) and (Y)?

- **X : Secrets perforin and lymphatic toxins**
- **Y : Secrets Lymphokines**

Dr. Mina H. Messiha (01007765878 - 01225768986)

The following diagram shows the steps of the cellular immunity, answer :



1. Write the labels from (1 – 6)?

   1-Macrophage
   2-T-helper cells
   3-Activated T-helper cells
   4-Cytokine's
   5-Activated T-cytotoxic cells
   6-Foreign cell or Carcinogenic cell

2. what are the compounds on the surface of the cell number 1?

   -Antigen MHC-complex

3. What is the importance of the cells number (3) and number (5)?

   - 3 : Secrets the cytokine's + Function (4 points)

   - 4 : Destroy the foreign cells by secreting perforin proteins + Function

Dr. Mina H. Messiha (01007765878 - 01225768986)