Objective Sheet 4

RESPONSE TO INFECTION **HUMAN PERSPECTIVES CHAPTER 10-11**

1. EXPLAIN WHAT IS MEANT BY THE TERM INFECTIOUS DISEASE.

Infectious disease - A disease passed from one person to another by infection with micro-organism, also called communicable disease or transmissible disease

2. DEFINE THE TERM PATHOGEN AND BRIEFLY DESCRIBE THE CHARACTERISTICS OF THE FOUR TYPES OF PATHOGENS (BACTERIA, VIRUSES, FUNGI AND ANIMAL PARASITE)

PATHOGENS

Infectious diseases are caused by living organisms (Eg- bacteria, fungi, protozoa, worms, flukes) or infectious agents not capable of independent reproduction and metabolism (Eg- viruses and prions).

Bacteria

The greater majority if bacteria are harmless to humans these are called non pathogenic

- All bacteria consist of one cell which can be seen through a microscope
- Bacteria can be shaped like spheres, rods or spirals.
- They usually have a rigid cell wall but lack a nucleus and other cell organelles.
- They reproduce asexually by cell division.
- Many bacteria are beneficial but some cause diseases.
- Bacterial illnesses can be treated with antibiotics

Virus

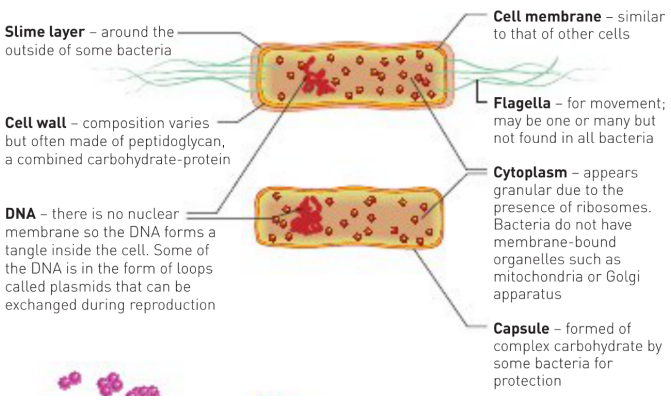
- Many infectious diseases are caused by viruses.
- Viruses are too small to be seen with a light microscope.
- Viruses are non-cellular
- They consist of a core of DNA or RNA surrounded by a protein coat.
- They contain DNA or RNA never both
- Viruses can only reproduce inside a living host cell.
- The DNA or RNA tells the cells to make more virus particles when infecting a living cell
- The new virus particles are then able to ;eave the host cell to infect others
- Viruses are be treated with antivirals

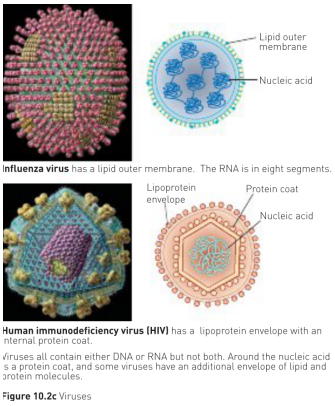
Fungi

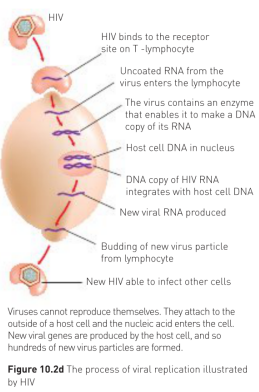
Microscopic fungi are responsible for diseases such as thrush, ringworm and tinea.

Animal parasite (Protozoa)

- Protozoa are a diverse group of microscopic, one-celled animals.
- Larger and more complex than bacteria
- They have a nucleus and cell organelles







3. LIST THE MAIN DIFFERENCES BETWEEN BACTERIA AND VIRUSES (SIZE, REPRODUCTION AND STRUCTURE

	Bacteria	Virus
What is it	A bacteria is a living organism that has DNA and RNA. It has a cell wall and cell membrane	A virus is a small, infectious agent which has DNA and RNA but never both.No cellular structure and only lives inside the living cells of the organism
Size	Bacteria are larger than viruses 1000nm	Viruses are smaller than bacteria 20-400nm
Structure	Bacteria contain organelles such as cytoplasm, cell wall and nucleus	Viruses consist only of genetic material and protective coating, the have no cell wall
Number of cells	One cell	Not living, no cells
Cellular functions	Bacteria are able to grow, feed and excrete	Viruses lack any metabolic function so they do not grow feed or secret
Reproduction	Bacteria are self producing, with out a host	Viruses are not self-reproducing as they need a host cells to multiple
Reproduction rate	Bacteria mutate/multiple slower than viruses	Viruses mutate/multiple much faster than bacteria
Good or bad	90% good 10% bad	All bad
Treatment	Antibiotics or antibacterial	Antiviral sand vaccines

4. LIST THE CURRENT TREATMENTS FOR BACTERIA AND VIRAL INFECTIONS

ANTIBIOTICS

- Antibiotics are drugs that are used to fight infections of micro-organisms, particularly bacteria
- They interfere with the protein synthesis in the common if the target bacteria
- Each antibiotic is effective for only certain types of bacterial infection and cannot be used to treat viral infections

Bactericidal antibiotics

- Kill bacteria by changing the structure of the cel, wall or membrane, or by disrupting the action of the essential enzymes.

Bacteriostatic antibiotics

- Stop bacteria from reproducing, usually by distrusting protein synthesised

Broad-spectrum antibiotics

- An antibiotic that affects many types of bacteria

Narrow-spectrum antibiotics

- An antibiotic that affects only a particular type of bacteria

ANTIVIRAL
- Are used specifically for treating viral infections
- Viruses enter the host cell and the virus DNA and RHA induces the cell to produce new virus particles. These particles can then leave the cell and infect news host cells
- The way in which viruses replicate make it difficult to find drugs that interfere with virus replication
- Because the host cell produces the new virus particles, any drug that interferes with virus replication is likely to be toxic to the host

5. UNDERSTANDS ANTIBIOTICS RESISTANCE AND IT'S IMPLICATIONS FOR FUTURE EFFECTIVENESS

- Some bacteria that antibiotics are used to kill have gradually evolved and become resistant to them
- Multiple drug resistance has been cause by the overuse of antibiotics in medicine and agriculture
- Preventing the misuse and abuse of antibiotics will slow the development of resistance but there is no way of stopping it all together

Multiple drug resistance
- Resistance of some strain of bacteria to most of the available antibiotics

Total drug resistance
- Rests inane of some strains of bacteria to all antibiotics

6. DESCRIBE THE DIFFERENT METHODS BY WHICH PATHOGENS MAY BE TRANSFERRED

Transmission by contact
- Involves the spread if pathogens by physical contact. The contact may be direct, actually touching an infected person, or indirect, touching an object that has been touched by an infected person

Transmission by body fluid
- When blood or other body fluids from an infected person comes into contacts with either the bloodstream or mucous membrane (Eg- nose, mouth, throat and gentlest) of an uninflected person, such as through a needle stick or a break in skin, then pathogens can enter the body of the person.

Infection by droplets
- When tiny droplets of moister, harbouring pathogenic organisms, are emitted when breathing talking, sneezing, or couching. The droplets May be breathed i it may settle on food to be later ingested.

Ingestion
- When food or drinks contaminated with pathogen are ingest it may result in disease

Airborne transmission
- When moisture in exhaled droplets evaporates, many bacteria are killed, but viruses and some bacteria remain viable and can cause infection when inhaled.

Transmission by vectors
- The transfer of pathogens by other animals, such as insects, ticks and mice. Some vectors transfer pathogens directly, however many spread the pathogens to food or water, which is then ingested.

7. DESCRIBE THE PHYSICAL BARRIERS THE BODY HAS TO DEFEND EXTERNALLY AGAINST PATHOGENS

Skin
- Skin is very good at stoping the entry of micro organisms, providing it is not broken by cuts or abrasions.
- Sebum is produced by the oil gland in the skin. It contains substance that kill some pathogenic bacteria
- Sweat secreted onto the skin contains salts and fatty acid that prevents growth of many micro organism

Mucous membrane
- Line cavities that open to the exterior. They secret mucus, which inhibits the entry of micro-organism to the organ of the body.
- The whole digestive, urinary and reproductive tracts are protected with may

Hairs
- Found in the nose cavity and the ears
- In the nose, jar and a layer of mucus enable to the nose to trap up to 90% of particle inhaled when breathing

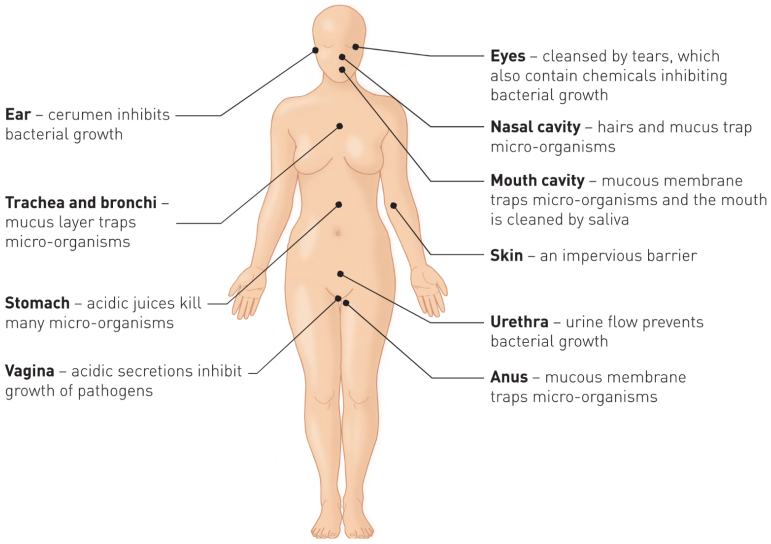
Cilia
- The mucus membrane lining the nose cavity, the trachea and other air passages have cilia.
- The beating of cilia moves mucus containing trapped particles and micro organism, towards the throat where it may be coughed up or swallowed

Acids
- The acids kill many if the bacteria taken in with food or those contained in mucus swallowed from nose or windpipe
- The vagina has acid secretion that reduces the growth of micro organisms
- Sweat is slightly acidic

Lysozyme
- Is and enzyme that kills bacteria
- The eye are protected by the flushing action of tears, which contains lysozyme
- It is found in saliva, sweat, secretions of the nose and tissue fluid

Cerumen (Ear Wax)
- Protects the outer ear against
- It is slightly acidic and contains lysozyme

Flushing action
- Helps keep some areas relatively free of pathogens
- Urine flowing through the urethra has a cleansing action.
- This prevents bacterial growth and helps stop bacteria reaching the bladder and kidneys



8. EXPLAIN THE INFLAMMATORY RESPONSE AS A NON SPECIFIC IMMUNE RESPONSE, USING TERM SUCH AS MAST CELLS, HISTAMINE, HEPARIN AND MACROPHAGES

Inflammation is the response to damage to a tissue: which involves swelling, heat, pain and redness

1) When stimulated by mechanical damage or by local chemical change, mast cells release histamine, heparin and other substance into the tissue fluid. **Mast cells** are present in most tissue. They stimulate and co-ordinating inflammation by releasing chemical
2) **Histamine** increase blood flow through the area (vasodilation) and caused the walls of the blood capillaries to become more permeable so that the fluid is filtered from the blood. It is the increased blood flow that causes heat and redness associated with inflammation, and the escape of fluid from the blood causes the swelling
3) **Heparin** prevents clotting in the immediate area of the injury. A clot of fluid around the damaged area does form and this slows the spread of the pathogen into healthily tissues
4) The chemicals released by the mast cells attract phagocytes. Macrophages and leukocytes actively consume micro-organisms and debris by phagocytosis
5) The abnormal condition in the tissue stimulate pain receptors, and so the person feels pain in the inflammation area
6) The phagocytes, filled with bacteria, debris and dead cells, begin to die. The dead phagocytes and tissue fluid form a yellow liquid called pus
7) New cells are produced by mitosis and repair of the damages tissue take place

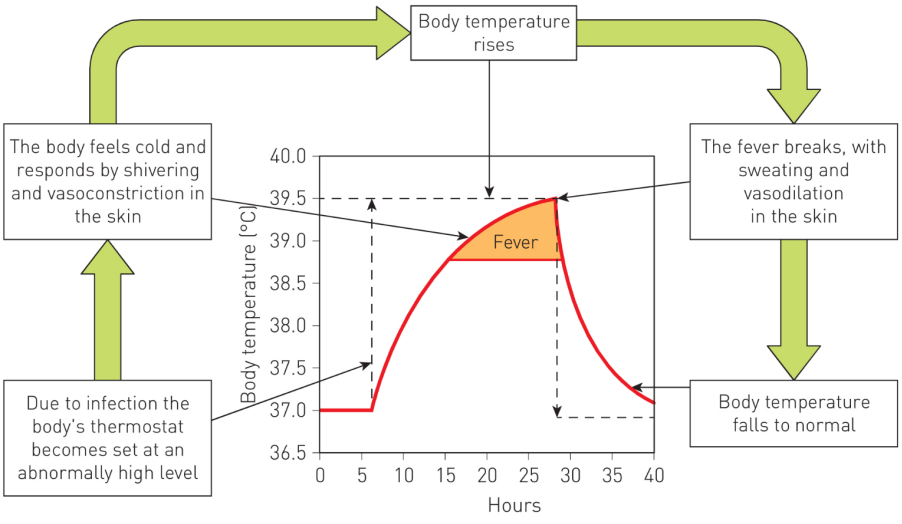
9. EXPLAIN THE CAUSES AND BENEFITS OF A FEVER

FEVER

- An evaluation of the body temperature above the normal 37*C
- This change in body temperature is due to a resetting of the body's thermostat, controlled by the hypothalamus, to a higher level
- The onset of fever is frequently gradual, but it is most striking when it occurs rapidly.
- The person feels cold and as a consequence, vasoconstriction in the skin and shivering occurs. Both mechanism designed to increase heat production, driving the temperature up rapidly
- When the fever breaks, it is as though the body's thermostat has be reset back to normal. This situation the person feels hot and appears flushed, as the skin vasoconstriction and sweating take place. The fever is beneficial up until this point
- The resetting of the body's thermostat is due to substance call pyrogens
- Pyrogens are released by leucocytes and macrophages during inflammatory response to a foreign intruder

Benefits

- The high body temperature inhibits the growth of some bacteria is and virus,
- It speeds up the rate of chemical reaction, which may in turn help body cells repair themselves more quickly during an infection



10. EXPLAIN THE ROLE PLAYED BY THE LYMPHATIC SYSTEM, MACROPHAGES AND PHAGOCYTES IN DEPENDING THE BODY AGAINST INVASION BY PATHOGENIC MICRO-ORGANISMS

THE FUNCTION OF THE LYMPHATIC SYSTEM ARE:

- To return excess tissue fluid to the circulation.
- To filter out cellular material, including pathogens and cancer cells.
- To activate the immune system.

PHAGOCYTES

Leucocytes

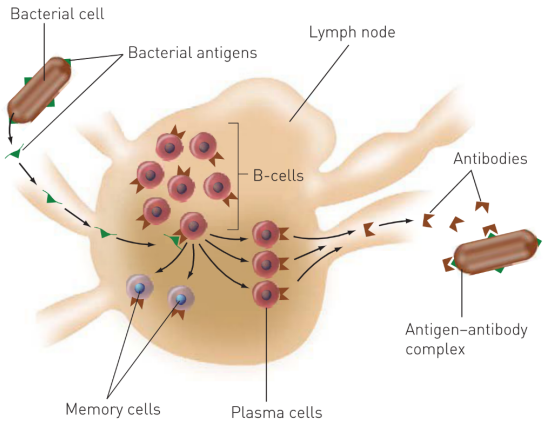
- White blood cells
- Leave the blood capillaries and migrate through the tissue t8 places if infection or injury
- They either; secrete substances that destroy bacteria before engulfing them. Or engulf live bacteria and digest them

Macrophages

- Large phagocytes cells that developed from some leucocytes
- During the Non specific defence they either; move around through the tissue looking for pathogens and destroying them. Or are fixed to one plate and only deal with phagocytes that come to them
- They engulf and digest phagocytes to release a substance that destroys them
- During the specifics defence they alert the immune system to the presence of foreign material

11. DESCRIBE HOW LYMPH NODES HELP TO PROTECT THE BODY AGAINST DISEASE

- The lymphatic system is a one-way drainage system that carries lymph from body tissues back to the general circulation
- Lymph is a clear yellow liquid that carries white blood cells, especially lymphocyte
- Lymph entering the lymph node contains cell debris, foreign particles and micro organisms that have penetrated the bodies external defences,
- Some of theses micro organisms may be able to cause diseases and must therefore be destroyed
- Large particles, such as bacteria, are trapped in the mesh work of fibres as the lymph flows though the space in the lymph node
- Phagocytes, including leucocytes and macrophages ingest and engulf these particles through phagocytosis
- When infection occurs, the formation of lymphocytes increases and the lymph nodes become swollen and sore

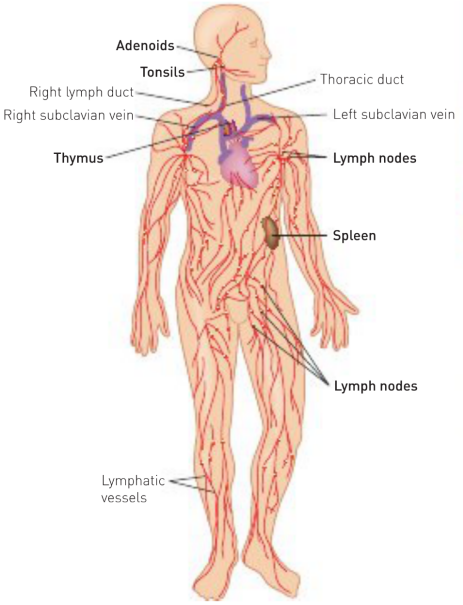


- Most of the lymphoid tissue is composed of B-lymphocytes, provide antibody mediated immunity and T-lymphocytes, provide cell mediated immunity. Both of these are produced in bone marrow and both end up in lymphoid tissue

12. DESCRIBE WHERE LYMPHOID TISSUE IS FOUND AND ITS ROLE

The lymphatic system consists of

- A network of Lymph capillaries joined to large lymph vessels
- Lymph vessels pass through a series of lymph nodes
- Lymph vessels are thin-walled vein like tubes that carry lymph
- Lymph nodes are small bean-shaped structure that contain high concentration of macrophages and lymphocytes. Which play a large role in the both the non specific and specific immune response.



Structures in the body that contain lymphatic tissue, but are not apparent of the lymphatic system include;

- The spleen
- Thymus gland
- Tonsils
- Peters patches in the gut
- The appendix

13. EXPLAIN WHAT IS MEANT BY THE STATEMENT 'THE IMMUNE RESPONSE IS SPECIFIC'

SPECIFIC IMMUNITY

- Specific immunity protects the body against specific substances (antigens).
- There are two types of specific immunity;
  - cellular response/immunity
  - antibody mediated (humoral) immunity
- Specific immunity is acquired through natural infection or immunisation.

NON SPECIFIC IMMUNITY

- Works against pathogens
- First line of defence
  - External defence
  - Protective reflex
  - Internal defence

14. IDENTIFY THE TWO PARTS OF THE IMMUNE RESPONSE - ANTIBODY MEDIATED VS CELL MEDIATED

ANTIBODY MEDIATED

- A response triggered by foreign substances or micro organism entering the body
- Also called humoral response

CELL MEDIATED

- The part of the immune response in which T-cells attach to antigens to destroy them
- Also called cellular immunity

Antibody mediated immunity	Cell mediated immunity
Work against bacteria; toxins and viruses before they enter the body's cells; also against red blood cells of a different blood group than the person	Work against transplanted tissue and organs, cancer cells and cells that have been infected by viruses or bacteria; also provides resistance to fungi and parasite

Antibody mediated immunity	Cell mediated immunity
1) Foreign antigens reaches lymphoid tissue	1) Foreign antigens reaches lymphoid tissue
2) Certain B-Lymphocytes are stimulated to undergo rapid cell division	2) Certain T-Lymphocytes are stimulated to undergo rapid cell division
3) Most B-cells develop into plasma cells, which produce antibodies and release them into blood and lymph	3) Most T-cells develop into killer T-cells or helper T-cells, which migrate to the site of infection
4) Antibodies combine with the specific antigen and inactive or destroy it,	4) Killer T-cells destroy the antigen, while helper T-cells promote phagocytosis by macrophages
5) Some of the new B-cells dorm memory cell	5) some sensitised T-cells form memory cells

15. DEFINE ANTIGEN AND ANTIBODY

ANTIGEN
Any substance capable of causing formation of antibodies when introduced into the tissues

ANTIBODY
A substance produced in response to a specific antigen; combines with the antigen to neutralise or destroy it

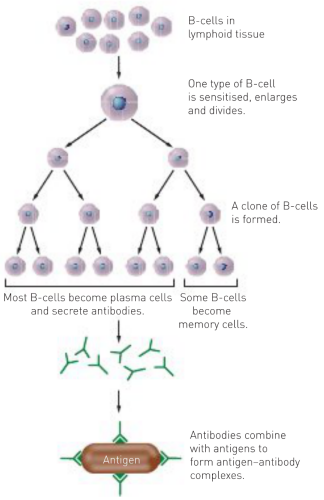
16. DESCRIBE WHERE T AND B CELLS ARE MADE IN THE BODY

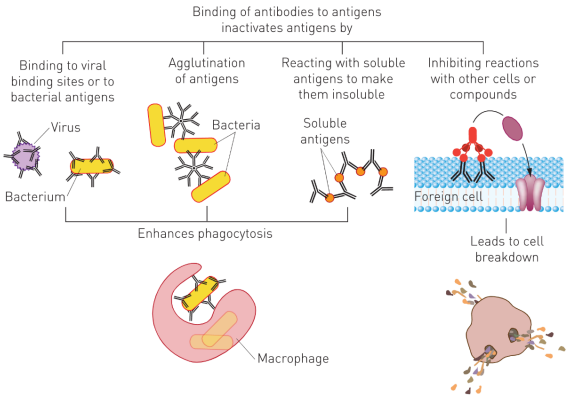
- There are two types of lymphocytes; B lymphocytes (B cells) and T lymphocytes (T cells)
- They are both produced in bone marrow
- B lymphocytes are matured in bone marrow
- T lymphocytes are matured in the thymus

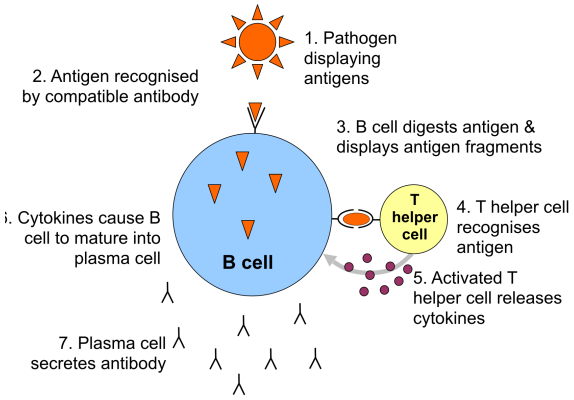
B cells	T cells
•Antibody mediated immunity	•Cell mediated immunity
Chemical-based system	Cell-based system
Produce antibody (Ig)	Produce killer cells
Lymphocytes educated in bone marrow	Lymphocytes educated in thymus

17. EXPLAIN THE MAIN EVENTS THAT OCCUR IN ANTIBODY-MEDIATED (HUMORAL RESPONSE) IMMUNITY

- Antigens on foreign cells, such as bacteria, are recognised by receptors on specific B cells.
- The antigen is digested by the B cell and antigen fragments are displayed on the cell surface.
- The helper T-cells with matching receptors become activated when they lock onto the antigen fragment.
- The activated T cells secrete cytokines
- Cytokines stimulate the B cell to enlarge and divide, producing numerous plasma cells some become memory cells
- The plasma cells secrete specific antibody capable of attaching to the active site of the antigen, into circulation
- The antibodies attach to the antigen forming the antigen-antibody complex
- The memory cells spread to all body tissue to allow the response to occur more rapidly should the antigen ended the body again







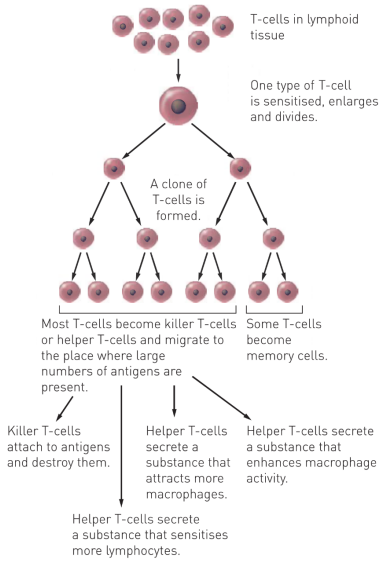
18. DESCRIBE HOW ANTIBODIES MAY RENDER AN ANTIGEN ACTIVE

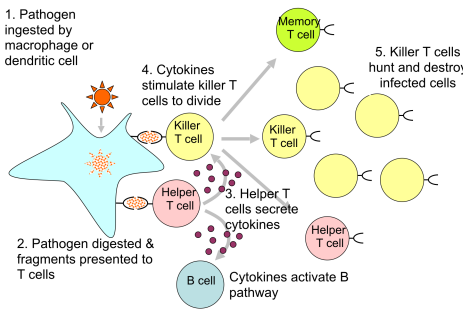
- Combine with foreign enzymes or bacterial toxins, or inactivate them by inhibiting reaction with other cells or compounds
- Bind to the surface of viruses and prevent the viruses from entering cells
- Coat bacteria so that the bacteria are more easily consumed by phagocytes
- Agglutination - cause particles such as bacteria, viruses or foreign blood cells to clump together
- Dissolve organism
- React with solvable substances to make them insolvable and thus more easily consumed by phagocytes

19. EXPLAIN THE MAIN EVENTS THAT OCCUR IN CELL MEDIATED IMMUNITY

Major histocompatibility complex (MHC) is a group of genes that are unique in every individual.
They code for small protein molecules that act as ‘self’ markers on all body cells.
MHC molecules initiate the immune response by presenting antigen fragments to T cells

- A ‘sick’ cell is ingested by an antigen presenting cell (macrophage or dendritic cell).
- Antigen fragments bound to (MHC) molecules are displayed on surface of antigen-presenting cell (APC)
- Compatible T cells lock onto antigen-MHC complex and secrete cytokines.
- Major histocompatibility complex (MHC) is a group of genes that are unique in every individual.
- They code for small protein molecules that act as ‘self’ markers on all body cells.
- MHC molecules initiate the immune response by presenting antigen fragments to T cells.
- Cytokines stimulate T cells to divide and differentiate into killer cells, helper cells and memory cells.
- Killer cells (cytotoxic T cells) destroy body cells infected by viruses or transformed by cancer.
- Helper T cells perform many immune functions. They are essential for activating cytotoxic T cells, and B cells.
- Memory cells remain in the body and enable the immune system to react rapidly should it encounter those same antigens again





20. DESCRIBE HOW KILLER T CELLS MAY DEAL WITH AN INVADING ANTIGEN

Cytokines stimulate T cells to divide and differentiate into killer cells, helper cells and memory cells.

Killer T-cells (cytotoxic T cells)
- Migrate to the site of infection
- Attract to the invading cell and secrete a substance (cytokines) that will destroy them

Helper T-cells
They secrete a number of substances that;
- Cause lymphocytes at the site of infection to become sensitised, thus intensifying the response
- Attach to macrophages to that place if infection is that macrophages can destroy the antigens by phagocytosis
- Intensify the phagocytise activity of macrophages

Suppressor T-cells
- Act when the immune activity becomes excess or the infection. Has been dealt with successfully
- They release substance that inhibits T-cells and B-cells activity, slowing down the immune response

21. EXPLAIN THE ROLE PLAYED BY THE MEMORY CELL

MEMORY CELLS
- Remain in the body and enable the immune system to react rapidly should it encounter those same antigens again.

Primary response
- Cells need to differentiate so antibodies don't appear immediately
- Peak in antibody production about 1-2 weeks
- Decreases in exposer causes a decrease in antibody production
- Plasma cells have short life span
- Production of cells suppressed

Secondary response
- Response is immediate because of memory cells
- Antibodies increase rapidly. Antibody numbers are much larger than primary response
- Can occur many year after primary response
- Memory cells can survive more than 20 years

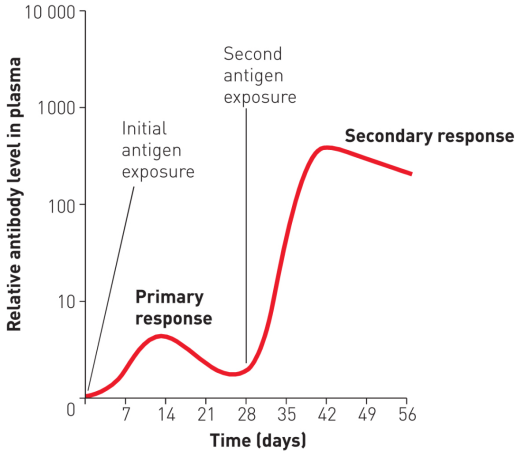


Figure 11.7 The antibody level in blood plasma after a first and a second exposure to an antigen

The primary response takes about two weeks to peak and antibody levels do not remain high. During the secondary response, antibody levels rise faster, reach higher concentrations and remain elevated for an extended period

22. DEFINE IMMUNITY

IMMUNITY
Resistance to infection from invading micro-organism

23. DISTINGUISH BETWEEN THE FOUR DIFFERENT TYPES OF IMMUNITY - PASSIVE NATURAL, PASSIVE ARTIFICIAL, ACTIVE NATURAL AND ACTIVE ARTIFICIAL. GIVE AN EXAMPLE OF EACH TYPE

Passive immunity
Passive immunity is when a person does not create the antibody themselves but it is given to them

Active immunity
Active Immunity is produced by the body to manufacturing antibodies against a foreign antigen

Natural immunity
- Is immunity that occurs without any human intervention

Artificial immunity
- Is immunity that occurs due to human intervention such as giving people the antibody or antigen

Active immunity (antigen activated) - Immune system activated - memory cells produced (= immunity acquired) - protection slow to develop but permanent	**Natural** – involves B & T cells Ability to manufacture antibodies results from an attack of a disease **Artificial** – vaccines (dead or attenuated) Ability to manufacture antibodies, results from being given an antigen by vaccination
Passive immunity (antibody activated) - immune system NOT activated - NO memory cells formed (= NO immunity acquired) - protection immediate but only temporary	**Natural** – IgG cross placenta or IgA in breast milk Antibodies enter the bloodstream across the placenta or in Brest milk **Artificial** -antibiotic Antibodies are infected into the bloodstream

24. DISTINGUISH BETWEEN THE THREE DIFFERENT TYPES OF VACCINES THAT ARE AVAILABLE

LIVE-ATTENUATED MICRO-ORGANISMS
- Live attenuated vaccines use micro-orgainism with a reduced ability to produce disease symptoms, so that the immunised person does not contract the disease but manufactures antibodies against the antigen.
- These vaccines are so similar to the natural infection that they help prevent, they create a strong and long-lasting immune response.
- Just 1 or 2 doses of most live vaccines can give you a lifetime of protection

Eg- measles, mumps, rubella, rabies, TB, chicken pox, smallpox and yellow fever

DEAD MICRO-ORGANISMS
- Dead micro organisms vaccines use a dead version of the organism that causes a disease.
- Inactivated vaccines usually don't provide immunity that's as strong as live-attenuated micro organisms vaccines, but they are still recognised as antigen.
- They require several booster shots to get ongoing protection against diseases

Eg- cholera, typhoid, plague, whooping couch

TOXOID
- Toxoid vaccines use an inactive toxin made from bacteria.
- They create immunity to the parts of the organism that cause a disease instead of the organism itself. This means the immune response is targeted to the toxin instead of the whole cell.

Eg- diphtheria, tetanus

SUBUNIT
- Sub unit vaccines use a fragment of the organism to provoke the immune response
- They require several booster shots to get ongoing protection against diseases

Eg- human papillomavirus (HPV), hepatitis B, pneumococcal disease, meningococcal disease

25. LIST SOME OF THE RISKS ETHICAL CONCERN ASSOCIATED WITH USING VACCINES

- How the vaccines are manufactured
- How it was tested
- The risks associated with the use of the vaccine
- The treatment of animals in the production of vaccines
- The way in which cells are obtained for vaccines
- Young children not understanding the benefits and risks of vaccinations, how can they then give consent to be vaccinated
- The equitable distribution of vaccines.

26. KNOW THAT VACCINES ARE DEVELOPED USING RECOMBINATION DNA (DETAILED IN SEMESTER 2)