Study Notes: Module 7

Contents:

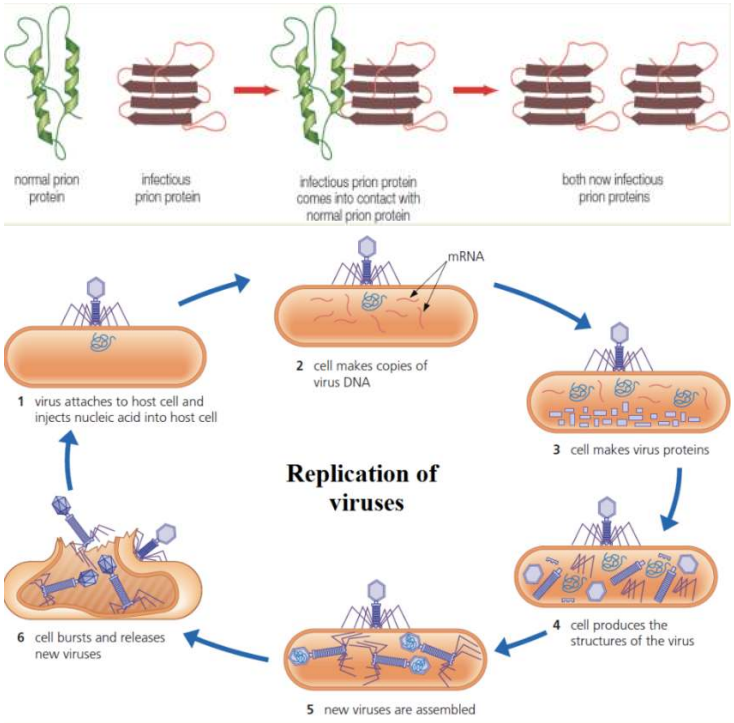
Inquiry Question 1:

How are diseases transmitted?

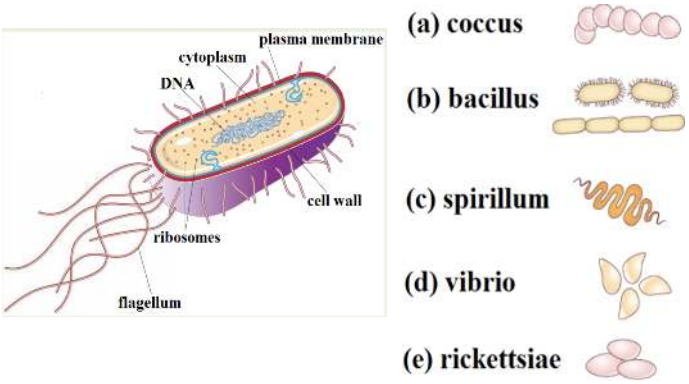
DOT POINTS:

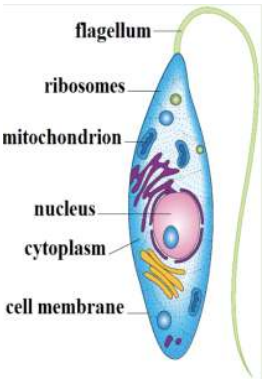
- *describe a variety of infectious diseases caused by pathogens, including microorganisms, macroorganisms and non-cellular pathogens, and collect primary and secondary-sourced data and information relating to disease transmission, including:*
  - *classifying different pathogens that cause disease in plants and animals*
  - *investigating the transmission of a disease during an epidemic*
  - *design and conduct a practical investigation relating to the microbial testing of water or food samples*
  - *investigate modes of transmission of infectious diseases, including direct contact, indirect contact and vector transmission*
- *compare the adaptations of different pathogens that facilitate their entry into and transmission between hosts*

Pathogens That Cause Disease in Plants and Animals	• A pathogen is an infectious agent that causes disease or illness. • An infection is the entry of a pathogen into a body followed by the multiplication of the pathogen. • The host is the organism in which a pathogen multiplies.

Non-Cellular Pathogens
 
	• *Prion*
	  ○ Are proteins that do not contain DNA or RNA
	  ○ Cause nervous diseases in animals
	  ○ Progress rapidly, generally, always fatal
	  ○ Scrapie in sheep, Mad Cow Disease
	• *Virus*
	  ○ Contains DNA and RNA that is enclosed in a protein coat → capsid
	  ○ 30-300nm → cannot be seen with light microscope
	  ○ Require living host to reproduce and are unable to function outside of one
	  ○ Measles, common cold, Corona Virus
	  ○ Since they contain nucleic acid, they can evolve → allows them to change their surface proteins so that they can evade immune system
	  ○ Inject their nucleic acid into the cell to make more viruses → eventually the host bursts releasing more viruses

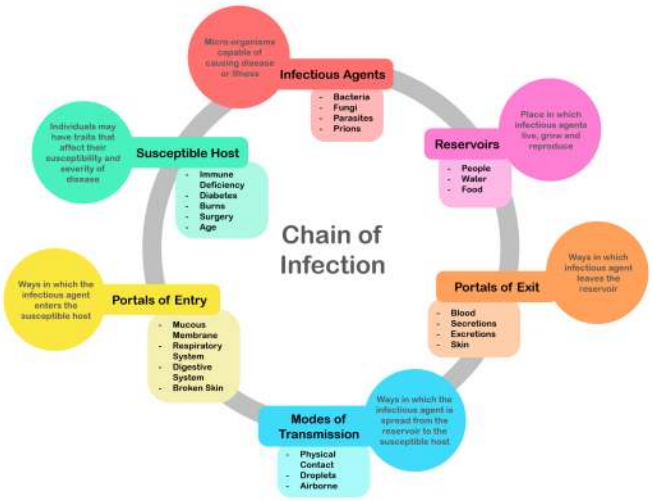
Micro-organism Pathogens





- *Bacteria*
  - Single-celled, prokaryotic (no membrane bound organelles or nucleus)
  - Have one strand of DNA
  - 0.2-10μm
  - Classified on their shape
    - spherical shape (coccus), a rod shape (bacillus), a spiral shape (spirillum), a comma shape (vibrio) or an oval shape (rickettsiae)
  - Some bacterial have mutualistic relationships with their host
  - Boils, cholera, tetanus, tuberculosis
  - Reproduce through binary fission → can reproduce thousands in a short time
- *Protozoa*
  - Unicellular, eukaryotic organisms with membrane bound organelles.
  - 1-300μm
  - Are classified by travel (flagella, cilia, pseudopods or sporozoa).
  - Reproduce by binary fission (dividing into two)
  - Amoebic dysentery, giardia, malaria,
  - Under certain conditions some protozoans produce a protective capsule called a cyst
    - Can survive when there is unsuitable living conditions
- *Fungi*
  - This can also be a Macro-organism
  - Transfer the disease through the use of fungal spores
    - Can spread long distances through air
    - Are very hardy
    - Can survive extreme environmental conditions
  - Fungi that infects skin, hair, or nails produce an enzyme that breaks down keratin → the fungi feeds on the products produce by enzyme

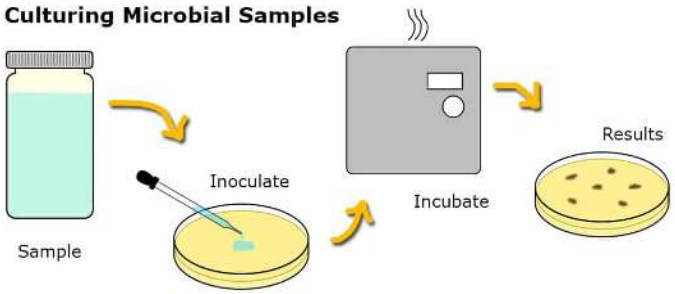
Macro-organism Pathogens	• Multicellular, eukaryotic organisms, that are visible to the naked eye.
	• Some cause disease directly while others are vectors for the transmission of disease
	• *Endoparasites*
	  ○ Live internally in a host
	  ■ Flat worms, tape worms, liver fluke
	• *Ectoparsites*
	  ○ Live externally on a host
	  ■ Fleas, ticks, lice

Transmission of Disease during Epidemics
 
 	
	• A sudden increase in the prevalence of a disease above the endemic rate.
	• An epidemic occurs through the chain of infection when several aspects of the agent (pathogen), population (hosts), and the environment create an ideal situation for spread.
	
	Conditions that Allow Transmission of Diseases
	• Globalisation
	  ○ International travel, shipping etc
	• Overcrowding
	  ○ Refugee camps, areas with an abundance of people
	• Social and environmental interactions
	  ○ Contaminated water supply, poor sanitation facilities
	• Mutation of pathogen
	  ○ Resiting antibiotics and vaccines
	• Natural disasters
	  ○ Contaminate water sources
	• Climate change
	  ○ Water activities → waterborne illnesses

Modes of Transmission of Infectious Diseases

- Direct Contact: involves the transfer of the pathogen by touching the affected area of the infected person.
  Examples:
  - Touching
  - Contact with saliva, mucus, blood or bodily fluids
- Indirect Contact: involves transfer of the pathogen via a non-living object.
  Examples:
  - Contaminated food, water or soil
  - Contaminated objects known as fomites such as door handles
  - Airborn Transmission eg. Droplets
- Vector Transmission: involves organisms assisting in the transfer of pathogens between individuals.
  Examples:
  - Biological vectors, such as mosquitos → Transfer pathogen → **DOES** carry pathogen
  - Mechanical vectors, such as flies, physically transfer the pathogen from one person to another → **DON'T** carry pathogen

Microbial Testing of Water Samples



Aim: To determine if different samples of water from different sources contain microbes

Hazard	Risk	Precaution
Consuming water that contains microbes	Can give the person an illness	Will not consume water
Water spilling	A person may slip and bump their head	Clean all spills immediately

Method:
1. Swab the work surface with disinfectant
2. Light the Bunsen burner
3. Seal one of the agar plates with masking tape to make it a control sample and label it as a control
4. Place 5 drops of de-ionised water sample onto an open agar plate
5. Heat the L-shaped glass spreader over the Bunsen burner for 10 seconds to sterilise it
6. Spread the water evenly over the agar plate
7. Seal the agar plate and label it according to its water source using masking tape and a label pen
8. Repeat steps 4-7 two more times, with the de-ionised water

9. Repeat steps 4-8 with the tap water, creek water and boiled water
10. Place the agar plates upside down into the incubator and leave them inside for 2-3 days

Results:

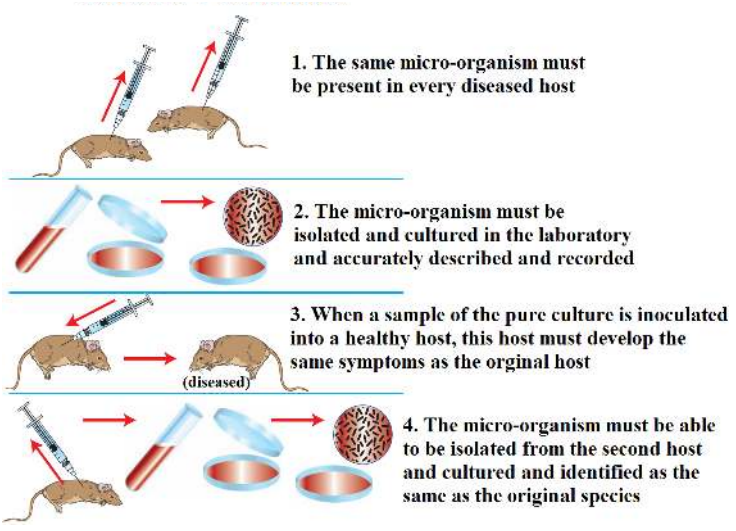
Water Sample	Microbes Present
De-Ionised Water	Yes
Tap Water	No
Boiling Water	No
Creek Water	Yes
Control	No

Reliable? Yes
Valid? Yes

DOT POINTS:

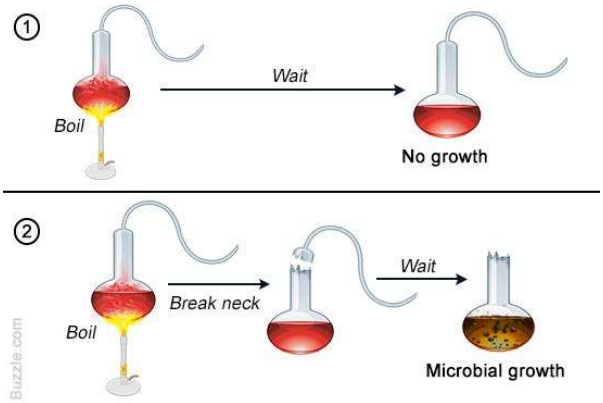
- *investigate the work of Robert Koch and Louis Pasteur, to explain the causes and transmission of infectious diseases, including:*
  - *Koch's postulates*
  - *Pasteur's experiments on microbial contamination*

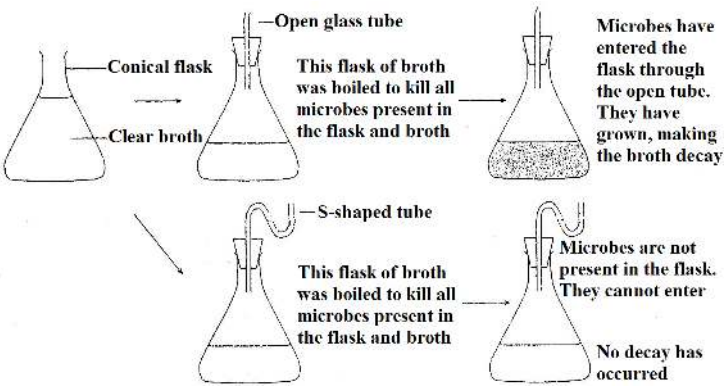
Koch's Postulates



- Are the principles he used to identify the specific micro-organism that was responsible for a disease
- This is still used today to identify the microorganism that causes a disease
- In order to find the microorganism that creates the disease it must:
  - Be present in every diseased host and must show the same symptoms
  - The microorganism must then be isolated and cultured (grown) in the laboratory where it can be described and recorded
  - A healthy host must be found and then a sample of **pure** culture can be inoculated into it
    - The host must develop the same symptoms as the original host
  - The microorganism must once again be isolated from the second host and cultured and identified to be the same microorganism in the original species

Pasteur's Experiments on Microbial Contamination





- Pasteur's experiment disproved the spontaneous generation theory and instead proved germ theory
- He placed the same amount of beef broth into two identical swan-neck flasks
- He then boiled the flasks for a certain amount of time
    - This was to remove any possible microbes that were in the flask already
- He then broke off the neck off of one of the flasks
- After viewing the flasks after a certain amount of time, it could be seen that microbes were only present in the flask that has the swan-neck broken off
    - This disproved spontaneous generation as the germs should've been in both flasks in order for this theory to work

CLASS EXPERIMENT
Aim:

Method:

1. Label each flask A and B
2. Place 200 mL of nutrient broth into each conical flask
3. Place the stopper with the straight glass tube into conical flask A and the s-shaped stopper into flask B
4. Boil the solution vigorously in both flasks for several minutes
5. Cool the solution slowly in both flasks
6. Observe the results in both flasks over a period of 10 days and record observations.

DOT POINTS:

- *assess the causes and effects of diseases on agricultural production, including but not limited to:*
    - *plant diseases*
    - *animal diseases*

Plant Diseases

- Can infect any part of the plant, e.g. roots, stem (including timber), leaves, flower and/or fruit

- Citrus canker
    - **Cause**
        - Caused by the bacterium Xanthomonas citri, forming lesions on stems
        - Was a notifiable disease
    - **Effect**
        - There was no cure for this disease meaning any plant that

	acquired it had to be cut down → Economical impact for farmers ■ If it was established in Australia, trading partners would reject any fruit that could carry the disease to avoid importing it → industry threatened ● Wheat Rusts ○ **Cause** ■ Cause by species of fungi Puccinia leading to stripe, stem, and leaf rust ■ Spores are then created and travel through the air meaning that it can be spread to extensive regions ○ **Effect** ■ An untreated infection could reduce grain yield by up to 90 per cent. → Loss of produce = less money ● Potato Moth ○ **Cause** ■ A destructive pest of potatoes that can also infect tomatoes ■ A caterpillar feeds on the leaves and tubers in the ground or in storage ○ **Effect** ■ Crops that have been eaten by the caterpillar cannot be sold → loss in produce = profit loss ■ Damage by the larvae affects the growth of seedlings and young transplants and may seriously reduce the yield and quality of leaf on older plants
Animal Diseases	● An impairment of the normal state of an animal that interrupts or modifies its vital functions ● Anthrax ○ **Cause** ■ Caused by the bacterium Bacillus anthracis which affects a wide range of animal species ■ Humans can also become infected through contact of an infected animal or the inhalation of spores ○ **Effect** ■ Animals that have the disease generally suddenly die → less produce ● Australian bat lyssavirus

	○ **Cause** ■ Is related to rabies and is transferred by being contamination, being bitten or saliva ○ **Effect** ■ It is quite rare and doesn't have too much of an effect ● Flystrike ○ **Cause** ■ Caused by several species of blowflies ■ Creates a strike in sheep making a damaged wound that attracts other blowflies which lay their eggs in the wound ○ **Effect** ■ costing the Australian sheep industry $280 million a year ■ Causes a loss of productivity from the animal affected → loss of produce = less profit

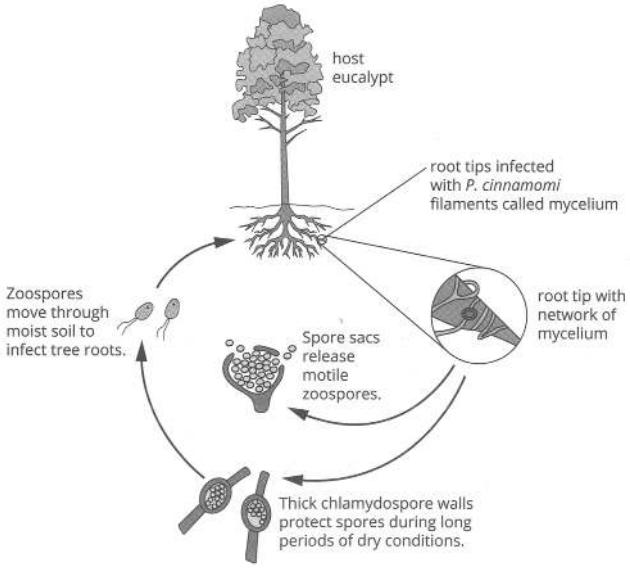
Inquiry Question 2:

How does a plant or animal respond to infection?

DOT POINTS:

- *investigate the response of a named Australian plant to a named pathogen through practical and/or secondary-sourced investigation, for example:*
  - *fungal pathogens*
  - *viral pathogens*

Fungal Pathogens: Phytophthora cinnamomi



- An introduced species of water mould that thrives in Australian conditions

Pathogen:

- It is a fungus that affects the plant Eucalyptus marginate causing the disease Phytophthora Dieback
  - It travels through the soil via zoospores
  - Must survive through wet conditions
  - When living conditions aren't ideal the thick chlamydospore walls protect the spores when the conditions are unfavourable and dry

Symptoms:

- It attaches to the roots of the plant and absorbs its nutrients, causing the tree not to be able to absorb water or its own nutrients from the soil
  - Slowly dying foliage

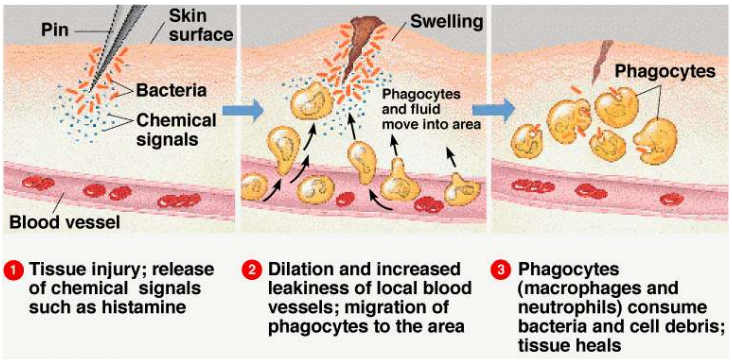
Response:

- The plant has an increase in lignin production to protect the cell wall of plant cells as it is impervious (cannot pass through) to the pathogen

DOT POINTS:

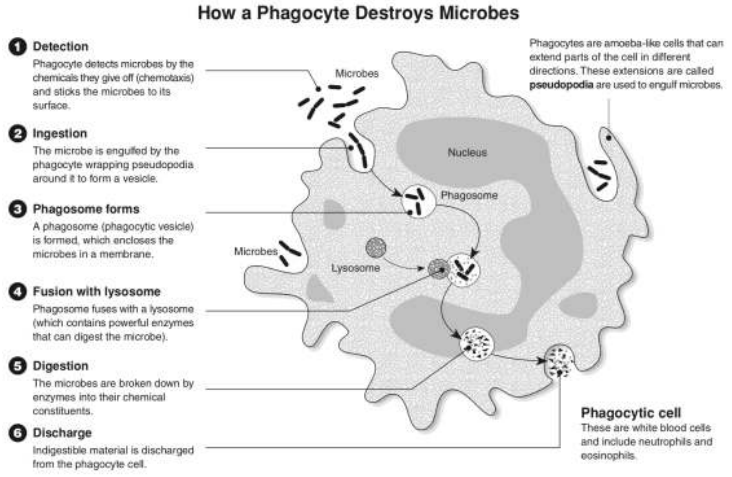
- *analyse responses to the presence of pathogens by assessing the physical and chemical changes that occur in the host animals cells and tissues*

Responses to Presence of Pathogens: Inflammation Response



- Occurs when tissues are injured by bacteria, trauma, toxins, heat, or any other cause
  Physical Changes
  Chemical Changes
- Injuries to body tissues cause mast cells and basophils to release chemical and initiate inflammation
  - Heparin & histamines are released which causes the dilation of blood vessels that are near the damaged site → increases the permeability of blood vessels meaning that things can pass through
- More blood then rushes through the blood vessels and to the site of infection, bringing phagocytes and clotting factors in the process
  - Clotting factors clot the blood, blocking the pathogens from spreading to other parts of the body
  - Phagocytes engulf the pathogen
  - The area becomes red, hot and swollen
- Macrophytes secrete hormones called cytokines
  - Some cytokines inform the hypothalamus to increase body temperature
    - Increases the body's temperature
  - Other cytokines attract immune system cells to the site and activate cells involved in tissue repair

Responses to Presence of Pathogens: Phagocytosis



- Are specialised white blood cells that attack pathogens by engulfing them and destroying them
  Physical Changes
  Chemical Changes
- Once the pathogen is inside the cell, enzymes are released to destroy the pathogen
- The phagocytes can move out of blood and in between blood cells, as well as change their shape so they can move arround the pathogen and completely enclose them.
- The enzyme lysozyme is released to destroy the pathogen.
- Pus can be created as a result of dead phagocytes, bacteria, tissue fluid and dead cells
- Some pathogens have the ability to repel phagocytes

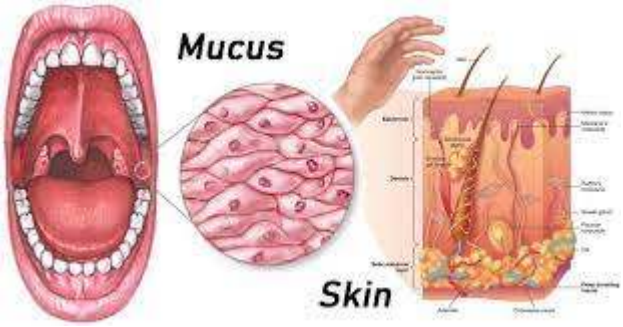
Inquiry Question 3:

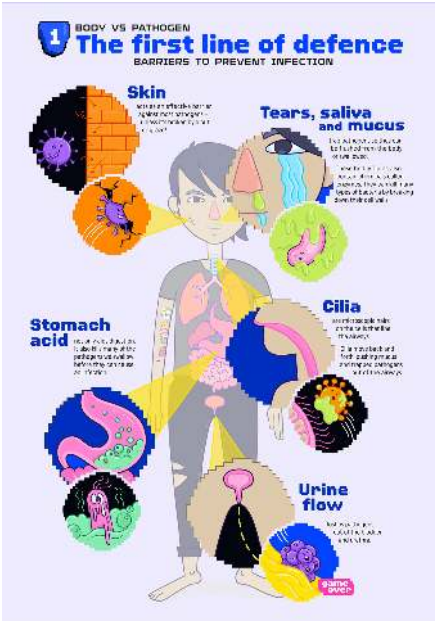
How does the human immune system respond to exposure to a pathogen?

DOT POINTS:

- *investigate and model the innate and adaptive immune systems in the human body*
- *explain how the immune system responds after primary exposure to a pathogen, including innate and acquired immunity*

Immune System: 1st line of Defence





- The body's first line of defence against germs entering the body
- Consists of chemical and physical barriers (things that stop the pathogen from travelling further into the body)

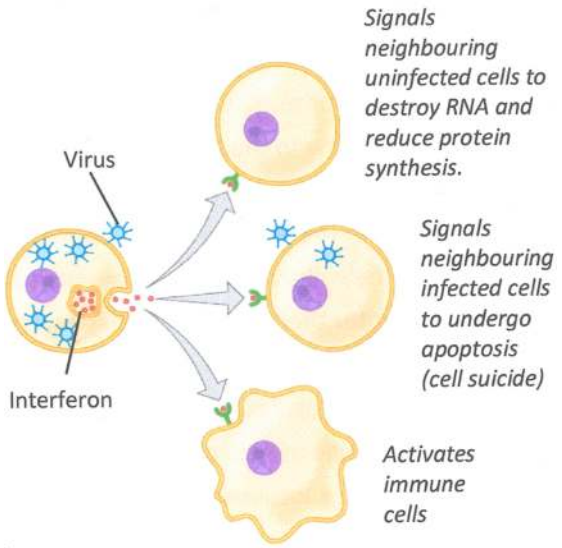
Physical

- Skin
  - Skin is an intact, outer tough layer which prevents penetration
  - Cells fit tightly together to form a protective layer covered by dead cells
  - When intact, prevents the entry of pathogens
  - Pores secrete substances that kill bacteria
  - Skin is dry so it is nearly impossible for pathogens to grow on it
- Mucous membrane
  - Cells lining the digestive and respiratory tract and the openings of the urinary and reproductive systems secrete a protective layer of mucus
  - The mucus is sticky → traps pathogens and other particles
  - It is removed by cilia
  - More mucus is produced when there are many pathogens
  - Can contain an antibody → prevents bacteria from attaching to surfaces
- Cilia
  - Fine hairs on the cells lining the air passages
  - They move in a wavelike motion to work with the mucus to push pathogens that are in the respiratory tract up the throat

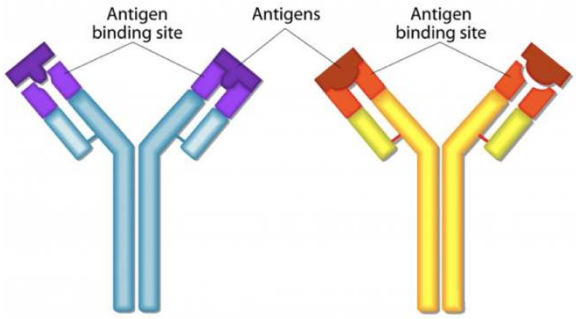
Chemical

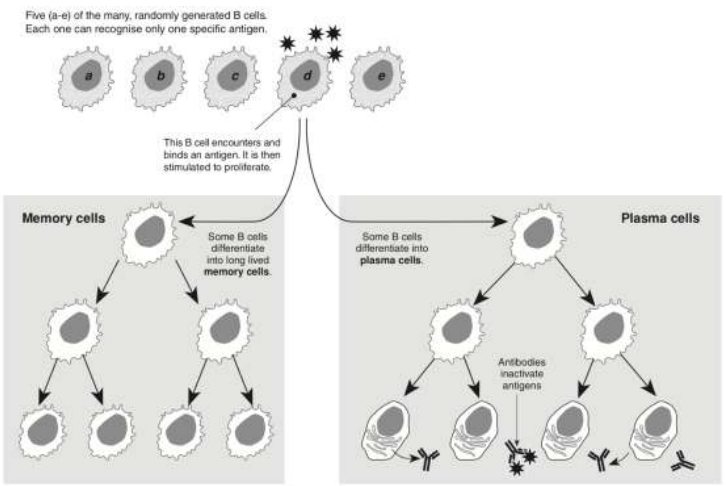
Anti-Microbial Secretions:

- Acid in the stomach and vagina, and on the skin
  - Stomach acid destroys pathogens in food, including those that are carried to the throat by cilia and then swallowed.
- Alkali in the small intestine
  - Destroys acid-resistant pathogens
- Lysozyme - Tears, saliva & sweat
  - Dissolves the cell membranes of bacteria

	Other Body Secretions: ● Urine ○ Cleans and flushes the lower urinary tract; it is sterile and its acidity inhibits bacterial growth ● Secretions from sweat glands and oily secretions from glands in hair follicles ○ Contain chemicals that destroy bacteria and fungi or inhibit their growth
Response of Immune System: 2nd Line of Defence  *Interferon can beneficially signal other cells*	● Nonspecific resistance that destroys invaders in a generalized way without targeting specific individuals ● Includes Inflammation Response and Phagocytosis (see above) ● Lymph system response ○ An intercellular fluid that is collected around the body by lymph vessels ○ Returns the fluid back to the circulatory system near the heart ○ As the fluid travels around the body, the lymph nodes filter to remove microbes, tissue debris and dead cells from circulation ○ Swollen lymph nodes are a good indication of an infection ● Cell Death to Seal off Pathogens ○ When white blood cells (lymph nodes, macrophages) surround a pathogen and die to seal off the infected area → prevent spread ○ If infected cells are surrounded it prevents the spread ○ The wall forms a capsule known as a granuloma or cyst ■ Cells inside die causing the destruction of the pathogen ○ The debris inside the cyst is destroyed by macrophages that surround the walled-off area ● Natural Killer Cells ○ Specialised type of blood cell → recognises body cells that are infected with viruses ○ They attach to the infected cell and release chemicals that cause the cell to undergo apoptosis (cell suicide) ○ Can recognise tumours and apply the same method ● Secretion of antimicrobial proteins ○ Secretes many proteins that provide defence ○ Some directly attack antigens while others trigger immune responses

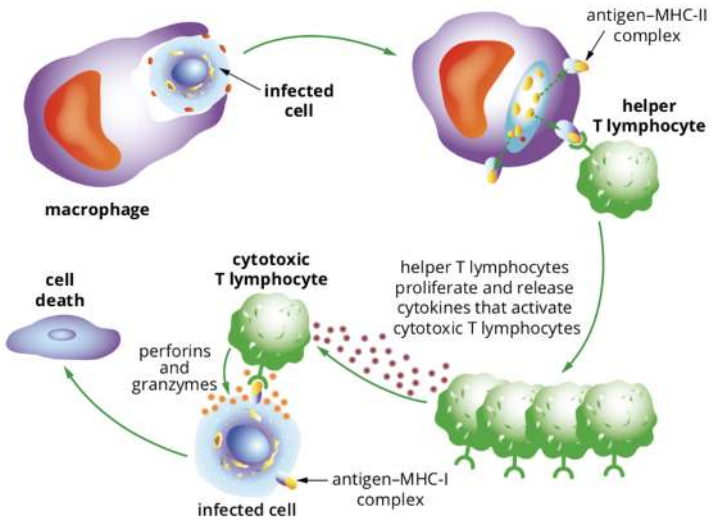
	• Complement Proteins
	  ○ Refers to a series of >20 proteins that circulate in blood and tissue fluid
	  ○ Proteins are generally inactive → activated as part of innate immune system to certain antigens
	  ○ This complements the immune defence mechanisms
	  ○ Help kill foreign cells
	  ■ can destroy bacteria directly by punching holes in their cell walls, causing them to lyse (break down)
	• Cytokines
	  ○ Small proteins secreted by range of cells
	  ○ Are signalling molecules that help cell to cell communication during infection, immune & inflammation response
	  ○ Different kinds of cytokines trigger different responses
	  ○ Infereon - cells that have been infected release this which is a benefit for neighbouring cells, hindering the virus cell replication in them

Response of Immune System: 3rd line of Defence
Humoral (Antibody Mediated) Immune Response
 
 	
	• Specific lymphocytes that produce antibodies as part of the adaptive immune response
	• B cells are lymphocytes that are produced in bone marrow
	• After they have matured they are also released into the blood, spleen, tonsils and lymph nodes.
	• B cells recognise and bind antigens. Each B cell recognises one specific antigen.
	• B cells can be differentiated into one of the two things:
	• Plasma Cells
	  ○ Secrete antibodies into the blood system
	  ○ Can produce thousands of antibodies per second
	  ○ Antibodies are proteins, shaped like a Y and has two binding sites
	  ■ Each binding site is for a specific antigen
	  ○ The antibodies move to the infection site and combine with an antigen at the epitope (part of antigen recognised by the immune system)
	  ■ This forms the antigen–antibody complex
	  ■ This deactivates the antigen, DOES NOT DESTROY IT
	  ○ Antibodies can clump the antigens together or surround them to make it easier for phagocytes to destroy it



- Other ways the antigen can be destroyed is by immobilising it, blocking and neutralising the active binding site of the antigen
- Memory Cells
  - B cells can differentiate into memory cells
  - When they reencounter the same antigen (this can be years or decades later), they can produce into antibody-producing plasma cells.
  - This allows for the destruction of the antigen to occur more quickly than the first time when it wasn't identified.

Response of Immune System: 3rd line of Defence
Cell-Mediated Immune Response



- The adaptive defence when cells become infected
- Defends the body against
  - bacteria and viruses that are inside the cells
  - protozoa, fungi, flatworms and roundworms
  - cancerous cells and transplanted foreign tissue
- T Cells are produced in the bone marrow and mature in the thymus gland
  - Once matured they are released into blood, spleen, tonsils and lymph nodes
- Each T Cell has a surface receptor protein the can recognise a specific antigen
- Helper T Cells (Th Cells)
  - Has a receptor protein on its surface that recognises one type of antigen
  - When it recognises an antigen, it will release a cytokine chemical → activates cytotoxic T cells and B cells → specific to the antigen
  - Cytokine chemicals that stimulate macrophage activity are released
- Cytotoxic T cells (Tc cells)
  - Stimulated to produce clones of themselves when activated by Th cells
  - Detect cells that have displayed on their surface antigen that matches their receptor protein
  - 'Army' of Tc move to site of infection → bind with infected cells → release chemicals to destroy infected cell
- Memory T Cells
  - Produced at the same time as Tc cells
  - Remain in body so it can quickly respond to possible future invasions from the same antigen

- Suppressor T Cells
    - Are responsible for stopping the immune response when the infection has been defeated

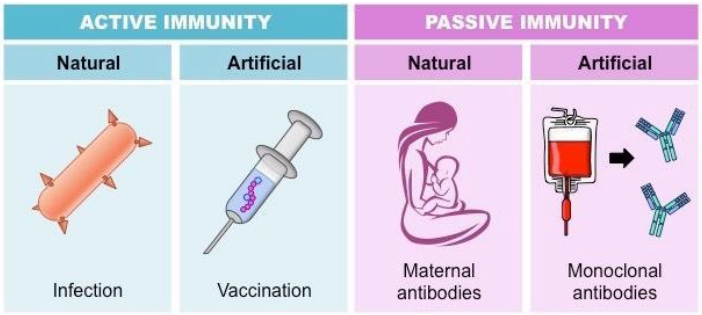
Interaction between B and T Cells

- Helper T-cells induce B-cells to divide and produce large numbers of clones
    - Millions of B-cells can be dedicated to destroying specific antigen
- Helper T cells stimulate the production of antibodies by B-cells
- On the surface of cells there are glycoprotein molecules called MHC → allow recognition of cells from the body
- MHC allows the identification of cells that are foreign
    - Foreign cells have different MHC molecules on their surface
- T and B cells to work together successfully due to their close proximity and regular activities through the secretion of chemicals called cytokines by the helper T cells

Summary

- Antigen is engulfed by a macrophage which then presents a part of the antigen on its surface. This stimulates the T helper cells.
- Free antigens directly activate specific B cells.
- Infected cells display the antigen proteins on their surface. This directly activates cytotoxic T cells.
- A second exposure to an antigen directly stimulates memory T helper cells. T helper cells activate the B and T cells.

Immunity



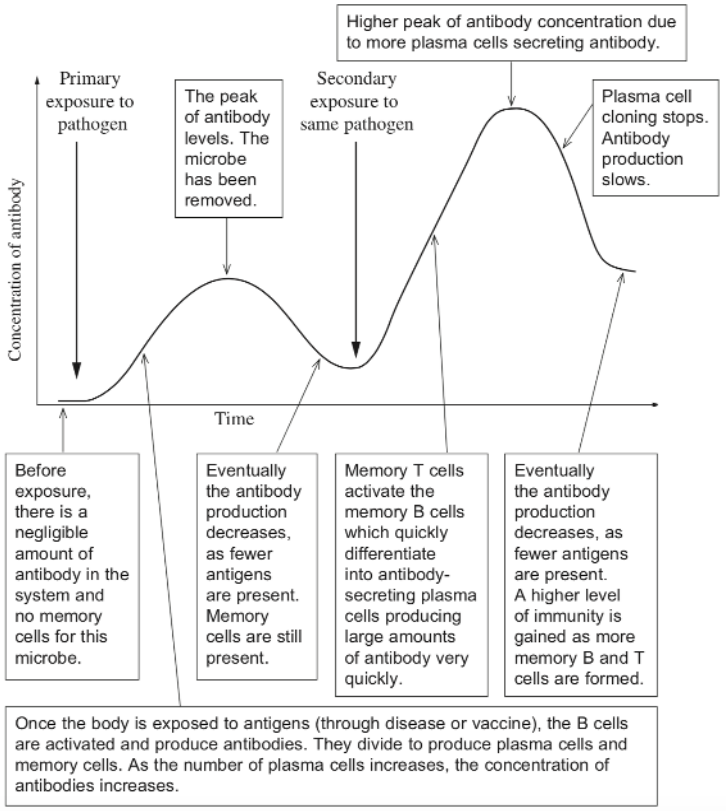
- The body activating the immune response against an invading pathogen
- Natural: Without human intervention
- Artificial: With human intervention

Passive Immunity:

- Occurs for a short time
- Antibodies cross the placenta to the foetus, or when the presence of antibodies in breast milk allows a baby to acquire the resistance of the mother
- Can be artificially induced
- Typically lasts a few weeks
- Does not involve memory cells and humans cannot create their own antibodies

Active Immunity:

- Occurs after the person has been exposed to a pathogen



- Can occur naturally when the person catches the disease and recovers or artificially through a vaccine
- Memory cells are produced and the person is able to produce antibodies for the specific pathogen

Vaccines:

- Can contain either the killed bacteria or viruses, living attenuated forms of the pathogen, or a toxoid
- Genetic engineering allows for the genes of certain microbes or mammals to be made into living factories that mass produced a desired antigen
- Vaccines act as an antigen and induce the immune response, producing plasma and memory cells
- Vaccine doesn't cause the disease or symptoms so plasma cells are readily needed → focus on giving cells a immunological memory for the pathogen
- If the body encounters the pathogen, memory cells can act quick to create antibodies to defeat it so the person doesn't suffer from the disease

Inquiry Question 4:

How can the spread of infectious diseases be controlled?

DOT POINTS:

- *investigate and analyse the wide range of interrelated factors involved in limiting local, regional and global spread of a named infectious disease*

Local Factors involved in Limiting Spread of COVID-19	● Good Hygiene: ○ Sneezing into a tissue ○ Coughing into your elbow ○ Sanitising hands ○ Washing hands for 20 seconds ○ Avoiding touching your face and eyes ● Social Distancing: ○ Keeping 1.5m away from others where possible ○ Avoiding physical greetings such as hugs, handshakes etc ○ Taking extra care on public transport ○ Avoiding large crowds and gathering ○ Getting tested and staying at home if any symptoms show ○ In schools, workplaces and in public masks were worn ● Self-Isolation ○ Self-isolation involves a person who has COVID-19 symptoms to stay at home for roughly 2 weeks until they are no longer contagious (roughly a period of 5 days) ● Environmental cleaning and disinfection in the community ○ Items are categorised into either frequently touched surfaces or minimally touches surfaces. ○ Frequently touched should be frequently, mechanically cleaned or with detergent. ○ Minimally touched surfaces can be cleaned with wipes, mops, and other cleaning products. ● Personal Protective Equipment (PPE) ○ In places of high-risk areas, it is important for everyone to wear masks to protect themselves or other people. ○ Eye shields & gloves are generally worn by workers who are coming into contact with people who may have covid such as testing facilities.

	• Vaccination
	  ○ While the vaccine won't protect you against COVID-19, it will reduce your risk of influenza, protecting the elderly and other age groups.
	  ○ The flu vaccine will help reduce the strain on hospitals and lungs — both seasonal influenza and COVID-19 can cause respiratory problems and even pneumonia.
	  ○ There is also a COVID-19 vaccine that can help lower the risk of catching the virus or minimise the symptoms when it is caught

Regional/Global Factors involved in Limiting Spread of COVID-19	• Border protection and travel bans.
	  ○ Countries around the world increasingly adopted sweeping measures, including full lockdowns, shutting down airports, imposing travel restrictions and completely sealing their borders, to contain the new coronavirus.
	• Communication to transmit accurate and up-to-date data on COVID-19 outbreaks as they occur
	  ○ Communication between scientists is of vital importance in the control of infectious diseases.
	• Distribution of masks, ventilators, gloves, gowns and hand sanitiser from international suppliers.

DOT POINTS:
• *investigate procedures that can be employed to prevent the spread of disease, including but not limited to:*
  ○ *hygiene practices*
  ○ *quarantine*
  ○ *vaccination, including passive and active immunity*
  ○ *public health campaigns*
  ○ *use of pesticides*
  ○ *genetic engineering*	

Hygiene Practices	• Refers to practices and conditions that maintain health and prevent disease by cleanliness and proper sanitation • The need for medical cleanliness was established after Louis Pasteur proposed his germ theory • Hygiene practices are necessary to maintain as they ensure good health and limit the spread of pathogens

Quarantine	• The isolation of an organism that has come into contact with a disease
	• Role in Australia is to minimise the risk of exotic pests and diseases entering the country
	• Strategies include:
	  ○ Border control: checking passengers that enter the country to deter the entry of prohibited material into the country → prevents entry of plant and animal disease
	  ○ Animal quarantine: Involves all animals coming into Australia spending time at quarantine stations to ensure they are free of disease before release
	  ○ Plant quarantine: Examining of all plant parts. (many are refused entry). Live plants must be kept at quarantine stations until any diseases present have the time to develope

Vaccination	• Involves the introduction of a vaccine into the body to cause immunisation via the third line of defence • Preparation of a harmless foreign antigen and is often made from weakened or killed forms of the microbe, its toxins or one of its surface proteins • Can relate to passive immunity when a woman is pregnant as she can pass on the antibodies to her baby • Refer to above for more info
Public Health Campaigns	• Procedures aimed at persuading the public to engage in or stop specific behaviours and to communicate information about symptoms, treatment and public health support • HIV and AIDS Campaign • Childhood Immunisation Campaign • Coronavirus (COVID-19) Campaign • Encourages actions to stop the spread of disease or infection

Pesticides	• Chemicals that destroy organisms considered to be pests
	• Most pests are insects, but other pest groups include ticks, mites, worms, slugs and snails
	• DDT (dichlorodiphenyltrichoroethane) is a pesticide that was used during WWII to destroy body lice in order to control typhus fever
	  ○ Was used to kill mosquitoes to kill malaria
	  ○ Natural selection led to DDT-resistant strains that required stronger pesticide concentrations

	• High levels of DDT caused problems such as: ○ egg shells of Australian peregrine falcons broke before the young could hatch • It has been banned as a pesticide

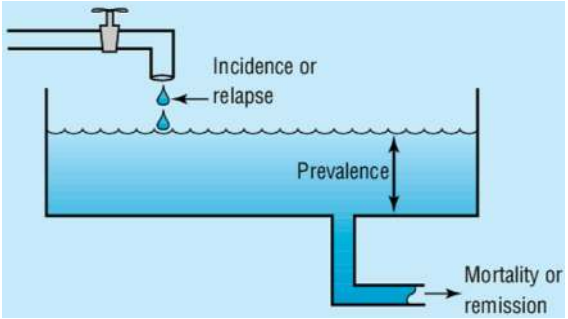
Genetic Engineering	• The alteration of chromosomes by adding or removing genes
	• Can create disease-resistant plants
	  ○ Plant biologists are working on crop plants to delete genes that code for chemicals that attract pests
	  ○ Bt Corn reduces the diseases in corn
	• Engineering can silence genes in targetted pathogens by disabling the gene
	  ○ Researchers have developed gene-silencing spray that shuts down viral genes inside tobacco plant cells
	• Engineering of vectors (eg mosquitoes) allows for the control of the spread of disease
	  ○ Achieved by modifying the mosquitoes genes so they bear sterile offspring or preventing the birth of females so the disease stops spreading

DOT POINTS:
• *investigate and assess the effectiveness of pharmaceuticals as treatment strategies for the control of infectious disease, for example:*
  ○ *antivirals*
  ○ *antibiotics*	

Antivirals	• Do not kill viruses, but inhibit their development inside infected cells • Simply slowing down its progress, allowing the body's natural defences to take over • They stop the spread of viral disease and therefore are a useful addition to the control of disease. • Since viruses rely on host cells to replicate, it can be challenging to develop antivirals that selectively target the virus without harming the host cells. Therefore, antivirals may have more potential for side effects.

Antibiotics	• Antibiotics are chemicals that target the bacteria without destroying the host and are not at all effective against viruses • The overuse of antibiotics has led to the selection of more virulent bacteria that are resistant to antibiotics. • When antibiotics were first introduced, they had a dramatic effect on the pathogens that cause disease. Over time, it became apparent that antibiotics were less effective. • This was because of the development of drug resistance in the pathogen. • Antibiotics target specific components or processes in bacteria, such as cell wall synthesis, protein synthesis, or DNA replication, leading to bacterial death or growth inhibition. • Certain antibiotics can still cause side effects or disrupt beneficial bacteria in the body.
DOT POINTS: • *investigate and evaluate environmental management and quarantine methods used to control an epidemic or pandemic*	

Environmental Management	• Effective environmental management can limit the spread of disease outbreaks and improve the health of those affected
	• Water Supply
	  ○ To prevent/control an infectious disease outbreak water supplies should be protected by:
	  ■ boiling water before drinking
	  ■ chlorinating water
	  ■ importing contained water from safe supplies
	  ■ sealing, containing, and/or draining water bodies to control the spread of disease.
	• Food Sources
	  ○ limiting food preparation to those who are not infected by the contagion (and have not been in contact with those infected)
	  ○ following proper hygiene practices when handling food (e.g. hand washing)
	  ○ importing food from safe supplies
	  ○ storing food in sealed, temperature-controlled containers
	  ○ disposing of all affected food items and avoiding consumption if food is an agent of disease transfer (e.g. a batch of food contaminated by Salmonella sp.)
	  ○ avoiding sharing food with others.
	• Sanitation
	  ○ sealed and functioning sewage systems

	○ safe disposal of animal waste, food scraps, and rubbish (e.g removal of rubbish from towns to a sealed, secure rubbish tip) ○ safe, secure disposal of hospital and health services waste. ● Air Quality ○ Poor air quality and ventilation can facilitate the transfer of infectious diseases that are spread by airborne droplets
Quarantine	● Separates and restricts the movement of people, animals and materials that may spread infectious disease ● Quarantine involves keeping an organism that is infected away from others until it no longer becomes contagious
DOT POINTS: ● *interpret data relating to the incidence and prevalence of infectious disease in populations, for example:* ○ *mobility of individuals and the portion that are immune or immunised* ○ *Malaria or Dengue Fever in South East Asia*	
Incidence number of new cases during a specified time x 100 size of population at start of monitoring period	● The incidence of infectious disease refers to the rate of occurrence of new cases, i.e. the number of new cases occurring during a specified time ● Incidence can be expressed as a percentage (number per 100) or as a fraction of the population (number per 100 000 or 1000 or 10 000 etc). ● It can also be thought of as the infection rate or the probability (risk) of contracting the disease
Prevalence  	● Measures the proportion of cases in the population at a particular point in time ● Prevalence refers to all cases of the disease, both previous and current. ● Prevalence can also be expressed as a percentage ● all new and previous cases during a time period x 100 size of population at risk during that time period
DOT POINTS: ● *evaluate historical, culturally diverse and current strategies to predict and control the spread of disease*	

Control Methods of the Spread of Disease: Historical	• During the Middle Ages, most people believed that diseases such as cholera and bubonic plague were caused and spread by miasma (bad air)
	  ○ Believed that disease could be caused by a 'bad smell'
	• They understood that disease cannot reinfect a person after they had recovered from it
	• Innoculation refers to the introduction of a substance into the body that will cause an immune response that can provide future protection against a specific disease
	  ○ First attempt was with smallpox by the Chinese, where powder made from the scabs of the disease were deliberately inhaled to receive immunity
	  ○ In other countries the preferred method was applying power or pus under the skin rather than inhalation

Control Methods of the Spread of Disease: Culturally Diverse	• Traditional Chinese Medicine
	• Focus on treating illness when it is in the early stages or prevention rather than treating a person after they have had the disease
	• They were able to predict the possible spread of a disease if they observed particular symptoms that they were familiar with in a person
	• Included many control strategies:
	  ○ Acupuncture
	  ○ Herbal medicine
	  ○ Maintaining a specific diet
	  ○ Massage
	  ○ Tai chi
	  ○ Can be shown to alter the activity of the immune system, stimulating the production of immunoglobulins

Control Methods of the Spread of Disease: Current	**Prevention**
	• Current strategies use modelling which can be used to
	  ○ Predict future occurrences of diseases
	  ○ Project and simulate how a disease will progress and spread
	  ○ Simulate the effects of interventions
	  ○ Inform public health interventions and distribution of resources such as mass vaccination programs
	  ○ Identify hotspots of emerging (novel) infectious disease and provide early warnings
	  ○ Increase understanding of human mobility patterns and the impact of mobility restriction measures such as travel restrictions.

Controlling Spread

- Immunisation programs
- Public health campaigns
- Provision of fresh water
- Good sewage treatment and disposal
- Garbage disposal
- Applying good hygiene practices in all situations
- Quarantine and vector control measures

DOT POINTS:

- *investigate the contemporary application of Aboriginal protocols in the development of particular medicines and biological materials in Australia and how recognition and protection of Indigenous cultural and intellectual property is important, for example:*
  - *bush medicine*
  - *smoke bush in Western Australia*

Bush Medicine and Smoke Bush

- Indigenous Australians hold a large amount of knowledge of what medical properties native plants hold

Native Plant	*Use in Bush Medicine*
Tea Tree	Crushed leaves applied in a paste to wounds or tea infusion for sore throat.
Emu Bush	Leaves made into a wash fore sores, colds, headaches, diarrhoea and chest pains.
Gumbi Gumbi	Compress of warmed leaves induces milk flow in new mothers and oily seed ground into a paste and rubbed into the body treats eczema.
Eucalyptus (Oil)	Leaf infusion used to treat aches, pains, fevers and chills
Lemon Grass	Made into a tea or steam inhalation for colds and chest congestion. Rubbed on the body treats aches, pains and skin sores.

- Research into native plants generally requires establishing partnerships between Aboriginal communities and industries or professions
- Aboriginals are worried that their traditional knowledge is being exploited and that their Indigenous cultural and intellectual property rights are not recognised
  - Can be seen through Smoke Bush
  - Was recognised as a possible treatment for HIV/AIDS in late 1980s
  - WA Government allowed pharmacy company to exclusive rights to the compounds → Make profit eventually
  - There was no discussion of acknowledgement or royalties to be given to the Indigenous Australians