1a. Discuss the difficulties of defining the terms 'health' and 'disease'

Health: A state of complete mental, physical and social wellbeing and not just the absence of disease or infirmity

Disease: A condition that impairs the effective functioning of an organism. Can affect physical, emotional or mental wellbeing. A disease usually has **symptoms** (visible signs or sensations experienced by the host) to indicate that something in the organism is not functioning properly.

Difficulties:

- Health can be a state of personal belief, e.g. by the definition, minor conditions such as a cut finger or an ant bite would be considered a disease, but generally society does not consider this to be a disease
- The ability of an organism to function effectively alters with age, therefore ageing would be a disease under this definition and not considered so in society
- It is possible for a person to be healthy and have a disease at the same time, e.g. a person with AIDS may be in a state of complete mental, physical and social well being if the symptoms have not yet appeared

1b. Outline how the function of genes, mitosis, cell differentiation and specialisation assist in the maintenance of health

Genes: Genes are the units of inheritance. They control protein synthesis. They assist the maintenance of health by regulating the cell cycle and limiting the growth and reproduction of cells. Genes provide the code for polypeptides that are needed for growth and repair. Enzymes, which control all body processes, are proteins and thus have been produced from the codes of genes.

Mitosis: Mitosis is cell division that produces identical cells. These cells are important for growth and reproduction. Each day millions of cells die and are replaced by the process of mitosis. E.g. when you cut your skin, your first line of defence is opened, therefore mitosis is required to seal the cut (thereby sealing the 1st line of defence) and preventing bacteria from entering the body. However, when cells divide too quickly they do not differentiate and specialise properly, which can cause cancer.

Cell Differentiation and Specialisation: Cell differentiation is the process undergone by the cells created by mitosis. Normally, each cell differentiates to become a specialised cell, with a specialised structure and function. Cell differentiation enables cells to work together to carry out complex functions in a controlled and coordinated way in order to maintain and repair tissues. E.g. B and T cells are both formed in the bone marrow, and then mature (differentiate) to carry out the third line of defence. Without this, cells would not be able to function effectively and the processes wouldn't be coordinated. Undifferentiated cells can also form tumours.

1c. Use available evidence to analyse the links between gene expression and maintenance and repair of body tissues

Gene Expression:

1. 'Switches on' a segment of DNA to produce a polypeptide
2. Manipulating the polypeptide into the required protein
3. Transporting and manipulating the protein to become either a component of cytoplasm or to function as an enzyme and control the production of other cellular molecules

When there are significant molecules and organelles, mitosis allows the cells to divide. The cells may then continue gene expression to develop specialised structures so that they are differentiated for specific purposes. For some cells, these specific purposes are the maintenance and repair of specific body tissues.

Over 3000 years ago, the Chinese and the Hebrews were advocating cleanliness in food, water and personal hygiene

- Even though they did not know about microscopic disease-causing organisms, many social groups established rules and practices that protected people against infectious diseases.
- The Chinese had sophisticated sewer systems as they had established the connection between water contaminated by faeces and gastrointestinal diseases
- The Hebrews had codes for slaughtering animals that prevented people from eating diseased or unclean animals, as they had established the connection between symptoms of infection by tapeworm and eating undercooked pork
- Both of these methods would have decreased microbial transmission to maintain better health standards

2a. Distinguish between infectious and non-infectious disease

Infectious: Caused by a pathogen

- Bacteria
- Fungi
- Virus
- Protozoans
- Prions
- Macroscopic Organisms

Non-Infectious: Caused by something other than a pathogen

- Genetics
- Environment
- Nutrition

2b. Explain why cleanliness in food, water and personal hygiene practices assist in control of disease

Transmission of Disease

- To control a disease is to prevent it from spreading, i.e. transmitting
- Infectious disease is transmitted through direct contact, indirect contact and vectors
- Infectious disease spreads via a pathogen entering the body
- Most pathogens are microscopic and can enter the body easily, especially via food and water
- By having clean food, via processes such as refrigeration, and water, via processes such as chlorination and filtration, the number of pathogens that can enter our body is minimized
- Personal hygiene is also important in minimizing the number of pathogens that can enter our body, e.g. washing hands after using the bathroom and avoiding contact between infected and non-infected individuals
- Therefore cleanliness in food, water and personal hygiene minimize the amount of possibly infectious pathogens entering the body and thus assists in the control of disease

2c. Identify the conditions under which an organism is described as a pathogen

Pathogen: Disease-causing organism

To be described as a pathogen, an organism must:

- Have enough virulence (the number of a particular pathogen required to cause the disease)
- Enter the host through a certain part of the body and survive on the body without being destroyed by the body's natural acidity and mucus
- Escape from one host to another
- Survive transmission from one host to another

2d. Identify data sources, plan and choose equipment or resources to perform a first-hand investigation to identify microbes in food or in water

Aim: To identify the local water sample that has the most numbers of bacteria and the greatest variety of types of bacteria

Method:

1. Collect water samples from various local water sources
2. For each water sample, use a pipette to add 1mL water to an agar plate. Swish the plate to totally cover the plate with the water, being careful not to get the water on your hands. Make 3 plates for each sample. Also, include an opened control, and a plate that is treated as above but with no water added.
3. Seal the agar plates with parafilm
4. Label each agar plate
5. Place the agar plates in an incubator, agar side up
6. Check for colonies after 2 days and analyse data

Variables kept constant: Amount of water, temperature of incubation, size of agar plate, and same amount of time plates are left for

Accuracy: Pipettes with 0.1mL scale, digital incubator correct to 2 decimal places

Safety: Sealed agar plates with parafilm so it didn't spread onto hands or other people, didn't incubate higher than 25°C so that human pathogens weren't grown

2e. Gather, process and analyse information from secondary sources to describe ways in which drinking water can be treated and use available evidence to explain how these methods reduce the risk of infection from pathogens

Filtration – Water passed through fine sand, gravel and coal filters. It removes nearly all pathogens by having a series of pores small enough that they do not allow them to pass through → less pathogens mean less risk of infection from pathogens

Chlorination – Addition of chlorine kills off remaining bacteria and microbes → less pathogens mean less risk of infection from pathogens

Ozone Technology – Uses oxygen that is subjected to an intense electrical field that separates oxygen molecules into atomic oxygen. This then combines with other oxygen molecules to form ozone, which kills pathogens → less pathogens mean less risk of infection from pathogens

Sedimentation – Coagulated particles fall, by gravity, through water in a settling tank and accumulate at the bottom of the tank, clearing the water of much of the solid debris and pathogens → less pathogens mean less risk of infection from pathogens

In Sydney, drinking water is screened and filtered to remove large and small particles. Chlorine is added to kill bacteria that may cause disease. Samples of drinking water are then tested in laboratories for the presence of microorganisms such as coliform bacteria and giardia.

3a. Describe the contributions of Pasteur and Koch to our understanding of infectious diseases

Koch:

- Was the first person to demonstrate that microbes grown outside the body could cause disease and that specific microbes cause specific diseases
- His first experiments were with the disease anthrax in sheep. Later, he obtained similar results for tuberculosis and cholera.
- First Koch found bacteria in sheep infected with anthrax. Then, he placed the bacteria on agar plates in Petri dishes so that many colonies of the bacteria were produced. He used bacteria from these colonies to infect healthy sheep and found that they became infected.
- After his experiments with anthrax, Koch was able to state a series of steps that are needed to identify the microorganism responsible for a particular disease. These steps are called *Koch's postulates*.

Koch's Postulates:

1. The organisms should be present in all animals suffering from the disease and absent from all healthy animals
2. The organism must be grown in a pure culture outside the diseased animal host
3. When such a culture is inoculated into a healthy, isolated and susceptible host, the animal must develop the symptoms of the disease
4. The organism must be reisolated from the experimentally infected animal and shown to be identical with the original isolate

It is difficult to apply these postulates to pathogenic viruses as they can only grow in living tissue (such as chicken embryo)

Pasteur

- Disproved spontaneous generation – before his work, it was believed that fungi and maggots grew naturally from non-living material
- Showed that microorganisms grew from pre-existing organisms

3b. Distinguish between prions, viruses, bacteria, protozoans, fungi and macro parasites, and name an example of a disease caused by each

	DNA/RNA (Nucleic Acid)	Structure	Nucleus	Cell Wall/ Membrane	Microscopic/ Macroscopic	Disease
Prion	No	Acellular	No	No	Micro	Mad Cow Disease
Bacteria	Both	Cellular	No	Both	Micro	Tetanus
Fungi	Both	Cellular	Yes	Both	Pathogenic – Micro	Ringworm
Virus	Either	Acellular	No	No	Micro	Influenza
Protozoan	Both	Cellular	Yes	Membrane	Micro	Malaria
Multicellular Organism	Both	Multicellular	Yes	Membrane	Macro	Elephantiasis

How they are cultured:

Prions – Can't be cultured
Bacteria – Agar plates
Fungi – Agar plates
Protozoans – Broth
Virus – Living chicken embryo
Multicellular – reproduce themselves


normal prion protein


bacteria

Size order:

Prions → Viruses → Bacteria → Fungi/Protozoans → Multicellular

3c. Identify the role of antibiotics in the management of infectious disease

Antibiotics: Compounds that kill or inhibit pathogens

Some antibiotics act on the structure of the microbe, e.g.

- Penicillin destroys cell walls
- Amphotericin destroys cell membranes
- Streptomycin disrupts protein synthesis

Antibiotics do not have any effect on viruses – only bacteria and sometimes fungi and protozoans

They work to weaken the pathogen, allowing the immune system time to destroy it.

3d. Perform an investigation to model Pasteur's experiment to identify the role of microbes in decay

- Hypothesis: flask S-shaped glass will not show signs of microbial growth. The flask with straight glass tubing that is open to the air will show signs of microbial growth
- Risk assessment:

Potential hazards	Precautions taken:
- Glass breakage→ cuts - Burns may be caused from the Bunsen burner - When heating the S-Shape glass tube be careful as it may start to get floppy→ do not touch as it will be extremely hot	- Safety goggles - Hair tied back & wear protective shoes - All loose clothing removed e.g. scarfs - Handel Bunsen burner with care - Light on safety flame → blue flame

- Materials:
  - Chicken broth → 125 ml with water
  - 2 conical flask
  - S-Shaped tube with a single holes stopper
  - Bunsen burner
  - Gauze mat

- Microbes were found in open neck flask but not found in the swan necked flask

3e. Gather and process information to trace the historical development of our understanding of the cause and prevention of malaria

- Causes death by clogging blood vessels, brain damage
- Affects the brain, liver, lungs, kidneys

18 BC The disease malaria was described by the Romans. Malaria was thought to come from swamps so the name means 'bad air'
1820 Quinine used to prevent the disease
1898 Giovanni Grassi named the mosquito as the carrier of the malarial parasite
1897 Ronald Ross discovered that Plasmodium was the protozoan that caused the disease malaria.
1940 Chloroquinine the first synthetic anti-malarial drug was used

3f. Identify data sources, gather process and analyse information from secondary sources to describe one named infectious disease in terms of its cause, transmission, host response, major symptoms, treatment, prevention, control

Malaria

Cause: Protozoan called plasmodium
Transmission: Anopheles mosquitoes are the hosts that transmit the disease to humans during the blood-sucking process.
Host Response: Host produces antibodies to fight the pathogens, but the antigens have a complex life cycle sometimes hiding in RBC and sometimes swimming freely in the blood, so the immune response is NOT effective.
Major Symptoms: High fever, vomiting, severe headache
Treatment: Drug called Artemisinin
Prevention: Insect repellent, cover up after dark, mosquito nets, vaccine once it is effective (isn't yet)
Control: Draining swamps and still water bodies, spraying insecticides, adding bacteria that produces a protein toxic to mosquito larvae to water body

3g. Problems relating to antibiotic resistance

- Research money must continually be spent on the development of new antibiotics – a race against time
- Antibiotics need to be given in combination to kill bacteria, increasing the chance of multiple resistance
- Superbugs are formed which are resistant to most antibiotics
- Deforestation and pollution are decreasing the biodiversity on earth, decreasing the chance of finding new antibiotics

Strategies to slow the development of antibiotic resistance:

- Don't take antibiotics for viral infections
- Take full dosage
- Antibiotic should target specific pathogen and not be broad-spectrum

4a. Identify defence barriers to prevent entry of pathogens into humans:

First Line of Defence:

Skin

- Oil on skin decomposes so that your skin has an acidic pH, inhibiting the growth of fungi and harmful bacteria

Mucous Membranes

- Found lining the excretory, digestive, respiratory and reproductive systems.
- Phagocytes engulf and destroy foreign bodies (second line of defence).
- Fluids that wash over the mucous membranes, e.g. tears and saliva, often contain lysosomes that cause bacterial cells to disintegrate

Cilia

- Attached to epithelial cells
- Hair-like structures that beat to move the mucus along towards the outside, causing entrapped dead and alive microorganisms to be expelled from the body

Chemical Barriers

- HCl in stomach
- Bile in small intestines
- Produces a pH that destroys or inhibits the growth of pathogens

Other Body Secretions

- Bacteria (microflora) in genital tract
- Acidic sterile urine
- Produce an acidic pH that prevents the growth of fungi and bacteria
- Cleanse urinary tract

4b. Identify antigens as molecules that trigger an immune response

Antigen: A foreign substance that triggers a response from the immune system

The first and second lines of defence are non-specific, as any antigen will stimulate the same generalised response.

The third line of defence is antigen-specific, in that there are specific reactions for each and every different type of pathogen

4c. Explain why organ transplants should trigger an immune response

- Organs from another person are recognised as foreign by the human immune system.
- Due to the different shape of proteins on outside of cells, organ is recognised as “non-self”
- The surfaces of the new organ contain antigens.
- These trigger an immune response and body attacks the new organ as though it were a pathogen

4d. Identify defence adaptations, including inflammation response, phagocytosis, lymph system, cell death to seal off pathogen

Phagocytosis:

- Phagocytes are white blood cells. There are two types:
    - Macrophages (occur in liver, bone marrow, lymph glands and spleen)
    - Neutrophils (occur in blood)
- Both types of phagocytes engulf foreign bodies and destroy them
- Macrophages also act as antigen presenting cells. This means that after the macrophage has engulfed the antigen, bits of the antigen express themselves on the surface of the macrophage, stimulating the 3rd line of defence.

Inflammation Response:

- Antigen enters body
- Damaged tissues release chemicals called histamines
- Histamines cause the blood vessels in the area to dilate
- Increased blood flow brings more phagocytes to the area which engulf and destroy more foreign bodies
- Histamines also cause the blood vessel walls to leak, increasing the numbers of phagocytes that can attack the foreign bodies
- Area becomes red, hot and swollen

Lymph System:

- Consists of a series of vessels that begin near the capillaries and eventually drain into the veins
- Numerous lymph nodes are present in the lymph vessels and these become swollen when the body is fighting off an infection, as they filter microbes and destroy them by phagocytosis
- The spleen also filters microbes out of the blood
- The lymph fluid also contains macrophages as well as lymphocytes

Cell Death to Seal Off Pathogen

- When the phagocytes and the cells of the third line of defence line up around the pathogen, completely sealing it
- In the process these cells die, but the pathogen also dies as it is completely sealed off from its food supply
- These are called granulomas

4e. Gather, process and present information from secondary sources to show how a named disease results from an imbalance of microflora in humans

Thrush

- Thrush is a disease of the mouth, throat or vagina
- Caused by the overgrowth of a yeast called Candida, a unicellular fungus
- Candida grows normally on the skin or mucous membranes and does not cause thrush unless the environment in the mouth, throat or vagina becomes imbalanced
- A healthy immune system normally keeps this organism under control, as do normal microflora
- This yeast becomes pathogenic in the following situations:

- During pregnancy or taking oral contraceptives, the vaginal tract becomes less acidic, allowing the yeast to increase in numbers because it decreases the competition from other normal microflora
- Taking antibiotics decreases normal microflora, allowing the Candida to grow
- Diabetes also increases the risk of Thrush, as the amount of sugar in the vaginal tract increases, decreasing the competition from other normal microflora
- Immunosuppressed patients (e.g. AIDS, organ transplants) have a higher risk of thrush as the immune system can no longer keep the fungi under control

The advances in scientific understanding of antibiotics have changed the direction of scientific thinking. As we now understand that the more antibiotics a person uses the more resistant they become, we know not to overuse antibiotics. The scientific understanding that antibiotics decreases the normal microflora has changed the nature and direction of scientific thinking in that we are now focused on finding a way of maintaining the level of microflora that prevents yeast infection.

MacFarlane Burnet's work in the middle of the twentieth century contributed to a better understanding of the immune response and the effectiveness of immunisation programs

Burnet's Work:

- Burnet developed a theory that explains how an organism's body is able to distinguish between its own cells and those of other organisms.
- He worked out that B and T cells clone themselves, ensuring that they are specific for each individual type of pathogen – this is called the clonal selection theory.
- He also worked out that memory B and T cells form in the body.

5a. Identify the components of the immune response

Antibodies

- Protein called immunoglobulin
- Y-shaped
- Antigen-specific – this means that each antibody has a molecular shape that fits exactly with a specific antigen, allowing them to bind together with that kind of antigen only.
- Combine with antigenic sites on the antigen, inactivating the antigen
- Combine with the toxins produced by the antigen and inactivate them, making them harmless
- Encourage neutrophils and macrophages to carry out phagocytosis
- Encourage complement proteins to destroy the antigen. This is a group of about 20 proteins that cause the lysis of proteins

Lymphocytes (B cells and T cells)

- Both made in the bone marrow
- B-cells mature in bone marrow and T-cells mature in thymus
- Mature cells are then released into the blood, spleen, tonsils and lymph nodes, from where they are transported around the body

B-cells

Plasma B-cells

- Give short term immunity
- Produce antibodies

Memory B-cells

- Give long term immunity
- When a person is re-exposed to an antigen, the memory cells cause more plasma cells to be made, which will produce more antibodies

T-cells

Killer T-cells

- Active T-cells, which:
    - Cause macrophages to ingest foreign cells
    - Produce an antiviral chemical
    - Produce cytotoxins (chemicals that destroy cells that contain certain pathogens)
- Memory T-cells, that function to stimulate the production of active T-cells

Helper T-cells

- Produce interleukin 2 which activates the plasma B cells and killer T cells to clone
- There are memory cells of this type too

Suppressor T-cells

- Supress B cells and other T cells when they are no longer needed
- Live for a short time
- Only produced when needed to supress B and T cells

5b. Describe and explain the immune response in the human body in terms of the following:

Interaction between B and T lymphocytes

T-cells influence and help B-cells. The following mechanisms have been proposed to explain the cooperation between T-cells and B-cells in antibody formation

Mechanisms that allow interaction between B and T lymphocytes

Mechanism 1: The T-cell produces a soluble factor (cytokines) after interaction with an antigen. The B-cell reacts with the soluble factor and the specific antigen to become a functional antibody-producing cell

Mechanism 2: Based on cell contact between the B and T-cells. The close contact comes about because of the interaction with the antigen. This contact allows the T cell to signal to the B cell to become an antibody-producing cell.

5c. Outline the way in which vaccinations prevent infection

Vaccination: the process of artificially exposing an organism to an antigenic substance in a vaccine. This leads to an antibody mediated response and a cell mediated response.

Immunisation: the combination of the vaccination and the resulting immune response

Herd Immunity: If enough people in a community are immunised, the pathogen can no longer be spread from person to person and the disease dies out

Immunity: The ability to resist infection

Natural Immunity: when there is no human intervention, e.g. if you had the disease and developed memory B and T cells or babies getting antibodies through breast milk

Artificial Immunity: when there is immunisation

Active Immunity: produces own antibodies

Passive Immunity: does not produce own antibodies, only lasts a few months

Vaccinations stimulate a person's immune system to develop resistance. Non-virulent strains of the disease are injected into the person, causing an immune response. Due to the memory B and T cells, subsequent exposure to the same antigen will then result in an antibody-antigen response and the antigen is destroyed.

5d. Outline the reasons for the suppression of the immune response in organ transplant patients

- Perfect matching of tissues only occurs if identical twins donate organs to each other.
- If the donor tissue doesn't match the recipient perfectly, the immune system will react against the antigens on the cell surfaces
- The helper T-cells will recognise these non-self antigens and attack the donor organ
- Drugs (such as cyclosporine) are used to suppress the immune system
- These drugs must be taken for the rest of the recipient's life to prevent rejection of the transplanted tissue.
- The problem with this is that by supressing the immune system, the organ recipient becomes much more susceptible to diseases such as pneumonia and thrush.
- Bone marrow is different as it doesn't require anti-rejection drugs
- HIV affects the immune system by destroying helper T-cells, meaning everything else doesn't work as well

5e. Evaluate the effectiveness of vaccination programs for Polio, Smallpox and Diphtheria

- To evaluate the effectiveness of a vaccine, you must know how many people had the disease before the vaccine and how many after
- Polio caused thousands of children to become paralysed every year. A vaccine was introduced in 1955. It became available as an oral vaccine in the 1960s. Worldwide, the number of cases is down by 80%, thus the vaccine was very effective. Side effects are very uncommon, with less than one person per million experiencing severe side effects such as allergic reactions
- Diphtheria vaccine is given as part of a triple antigen injection that protects against diphtheria, tetanus and whooping cough. In 1990, WHO stated that 80% of children had been vaccinated against this disease. There continues to be outbreaks of this disease and continued vaccination is recommended. It is no longer thought of as a major child killer. Side effects are very rare.
- Smallpox was the first disease for which a vaccine was developed. The vaccination program that was started in the 1960s was so successful that the World Health Organisation has declared it eradicated. However, there is a high risk of adverse side effects. In the past, between 14 and 52 people per 1 million people vaccinated for the first time experienced potentially life-threatening reactions such as inflammation of the brain.

6a. Identify and describe the main features of epidemiology using lung cancer as an example

Epidemiology: The study of epidemics. It is the application of scientific methods to the study of disease in populations for the purpose of prevention and control of disease.

An epidemiological study includes:

- Description of the disease
- Possible causes of the disease
- Occurrence and transmission of the disease in the population and the environment
- Consideration of **risk factors** for various members of the population
- Control of the disease
- Prevention of the disease
- Possible elimination of the disease

Lung Cancer

Epidemiologists have managed to find a correlation between incidence of lung cancer and:

- Those who smoke
- The age at which the person started smoking
- High levels of pollution, radiation and asbestos exposure

Example of epidemiological study:

- Conduct a survey
- 10 000 randomly chosen people
- All ages
- Both sexes
- Different socioeconomic backgrounds
- Different ethnicities
- Different locations
- Collect data over a long period of time (e.g. number of years)
- The level of disease must be determined by a medical professional
- Survey using questions which could determine three possible reasons for disease
- Analyse data – average and standard deviation or graph of relationship between disease and factors

6b. identify causes of non-infectious disease using an example from each of the following categories: inherited diseases, nutritional deficiencies, environmental diseases

Inherited Diseases

Inherited diseases result from mutations that lead to the production of different or faulty enzymes, resulting in impaired body function.

E.g. Down syndrome – non-disjunction of chromosome 21

Nutritional Deficiencies

E.g. Scurvy – deficiency of vitamin C, leading to symptoms such as bleeding gums and tooth loss.

Environmental Diseases

Environmentally caused diseases include those due to lifestyle, such as smoking-related diseases, as well as those caused by something in the environment, such as lead or substances that cause allergies.

E.g. Mesothelioma is caused by exposure to asbestos. There is no cure.

6c. Gather, process and analyse information to identify the cause and effect relationship of smoking and lung cancer

Cause

- Tobacco smoke contains many carcinogenic chemicals such as benzene, therefore they cause cancer

Effect

- A tumour grows, the air sacs in the lungs are destroyed
- Breathing becomes difficult.
- The lungs collapse and abscess and the patient may begin coughing up blood.
- The cancer can spread to other vital organs
- Causes death.

2010 Report by Chief Health Officer found that smoking causes 2500 deaths in NSW per year.

6d. Analyse and present information about the occurrence, symptoms, cause, treatment/management of a named non-infectious disease

Disease: Down syndrome

Cause:

- Inherited disease
- Presence of 3 copies of chromosome 21
- Linked to mother's age at conception

Symptoms:

- Lower than average mental ability
- Speech impairment
- Shorter limbs
- Enlarged tongue

Occurrence: 1 in 1,250 for a woman who gets pregnant at age 25, to about 1 in 100 for a woman who gets pregnant at age 40

Management:

- Care and accompaniment with things such as eating and general hygiene
- Physiotherapy for those with weakened muscles
- Lifestyle assistance

7a. Discuss the role of quarantine in preventing the spread of disease and plants and animals into Australia or across regions of Australia

Quarantine: The compulsory isolation, typically to contain the spread of something considered dangerous

Mad Cow Disease:

- Fatal neurodegenerative disease occurring in cows by a specific type of mutant protein or prion
- Transmitted to humans by eating infected meat
- Does not occur in Australia
- Kept out of Australia by total ban of live cattle imports from countries with reported cases of the disease
- Also kept out by national surveillance program testing cattle and sheep brains from animals displaying certain nervous systems
- If the disease occurred in Australia, there would be reduction of demand for Australian beef → economic detriments and job losses in the livestock industry.
- It is also a significant threat to human health, as consumption of infected meat causes a similar disease in humans that is fatal
- If an outbreak occurred in Australia strict biosecurity measures would ensure it did not enter the food chain, and tracing would be undertaken to find the source of the disease

Black Sigatoka:

- Black Sigatoka is a leaf spot disease of banana plants caused by ascomycete fungus
- Plants with leaves damaged by the disease may have up to 50% lower yield of fruit
- A number of outbreaks in Queensland's Cape York Peninsula were eradicated before authorities battled the first incursion in a commercial growing area - near Tully, north Queensland, in 2001
- An intensive surveillance and eradication campaign was undertaken which resulted in the reinstatement of the disease-free status for black Sigatoka in 2005
- Australian Quarantine and Inspection Service (AQIS) surveys banana crops throughout northern Australia and nearby countries for black Sigatoka.
- Import of any banana material that may be carrying black Sigatoka is prohibited.
- If the disease occurred in Australia, there would be reduction of demand for Australian bananas→ economic detriments and job losses in the agriculture industry.

Methods of controlling/preventing disease:

- Public education programs (e.g. Slip, Slop, Slap campaign against skin cancer)
- Pesticides (prevent insect-borne diseases such as malaria)
- Genetic engineering to produce disease-resistant plants (e.g. BT cotton, which contains a gene from a naturally occurring insecticide take from a soil bacterium. The plant can now kill its own pests.)

7b. Gather, process information and use available evidence, to discuss the changing methods of dealing with plant and animal diseases, including the shift in emphasis from treatment and control to management or prevention of disease

- There has been a shift from treatment of diseases to preventing the occurrence of the disease.
- This can be seen in agriculture where genetically resistant crops (such as BT cotton) are grown so that the plants do not have to be sprayed for diseases later in life.
- Cigarette packets must have photographs and warnings about the relationship between smoking and lung cancer (prevention instead of treatment)
- Epidemiological studies of diseases, which did not occur in the past, allow more understanding of the disease hence allowing better prevention and control methods to be developed
- With advances in our understanding of genetics such as data from the Human Genome Project, epidemiology has now reached the field of genetic epidemiology – the analysis in large populations of interactions of genes, genetic variations and environmental factors. Genetic epidemiology will contribute to the discovery of new drug treatments that could be tailored to an individual's future likelihood of getting the disease. This will continue to change the emphasis of healthcare from treatment to prevention.
- Research on the prevention, control and treatment of these diseases must be ongoing in the case an epidemic occurs, and new diseases are constantly occurring due to mutations

Perform an investigation to examine plant shoots and leaves and gather first-hand information of evidence of pathogens and insect pests

Scribbly gums – scribbles under bark trace the path of parasitic moth larvae when invades the plant

Eucalyptus – leaves spotty from fungi and viruses, edges chewed by beetles

Wattle – Resin plugs on branches from witchetty grubs

Rose Leaves – Caterpillars chew semicircular holes from edge of leaf

Past Exam Questions

"Understanding the immune response has been extremely important in the development of an effective vaccination program"

Discuss this statement, using examples to support your answer

Successful vaccination depends on being able to stimulate the immune system to mount a long-term defence against a pathogen by presenting the immune system with a harmless variant or derivative of a pathogen. For example, influenza vaccines contain killed virus and diphtheria vaccine contains purified diphtheria toxoid, both of which act as an antigen to stimulate the immune system. The first vaccines, however, were developed long before the nature of the immune system was known. In 1796, Edward Jenner used material from cowpox to protect people against smallpox and, as a result of vaccination campaigns, smallpox had been eliminated in the US and Europe by 1940, before Macfarlane Burnett had developed his clonal selection theory, for example. Similar stories can be related for the vaccines for Diphtheria and Polio. Similar successful vaccination programs were in place before there was a complete understanding of the immune system. Knowledge of the immune system, however, has helped to develop better vaccines against diseases such as bird flu and HIV. To understand the way that HIV attacks the body, a comprehensive understanding of the way T-cells work was necessary, and a knowledge of the way the immune system recognises non-self antigens on the surface of flu viruses is essential in finding a vaccination for bird flu. Understanding the way that the immune system recognises antigens has allowed researchers to develop conjugated vaccines, acellular vaccines and recombinant vaccines, each of which are more effective and have fewer side effects than previous vaccination programs. Thus, an understanding of the immune response has been important in some aspects of effective vaccination programs, but not as important in others.