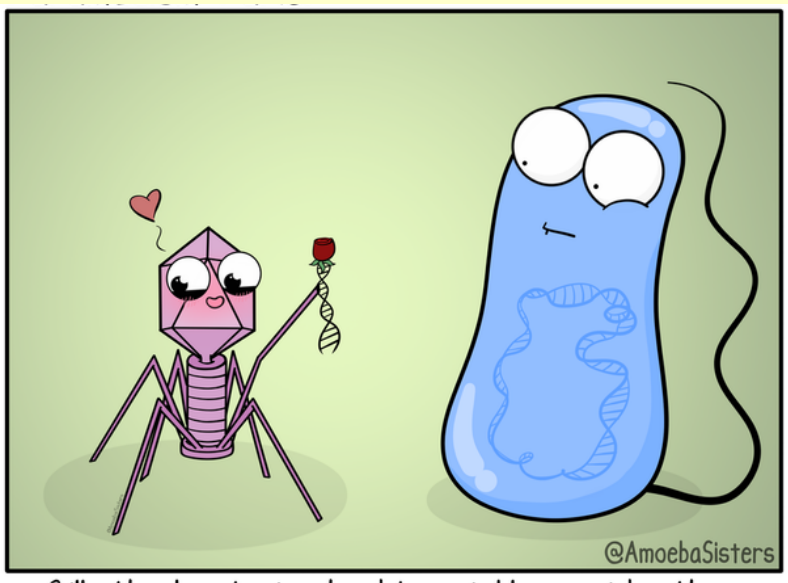


Billy the bacterium had to quickly consider the etiquette for declining a bacteriophage's valentine.

Mrs Lawrence's 9/10-1

Science

FIGHTING DISEASE

Name: _____

HOW TO USE THIS BOOKLET:

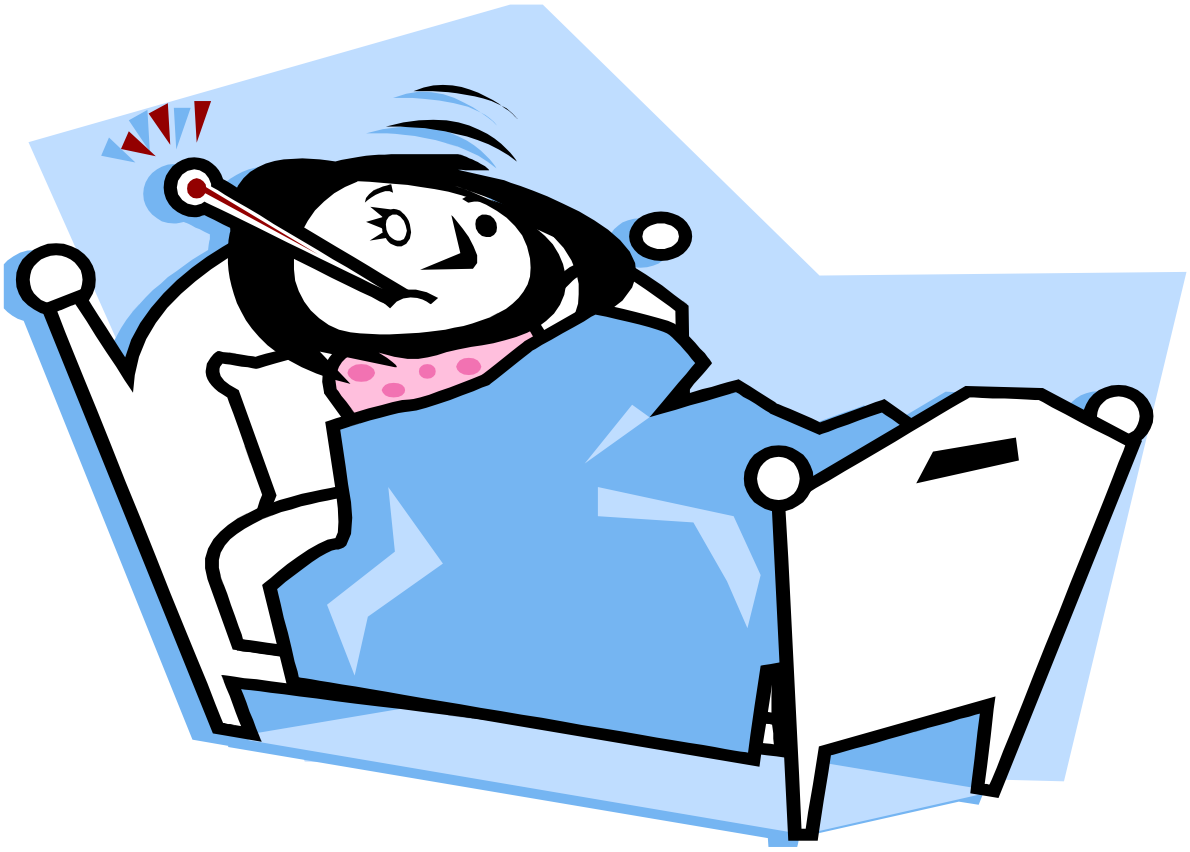
- Read the information provided within this booklet
- Answer the guided activities
- Where you have the required equipment, try to complete the prescribed activities.

  This will make the lesson content much more interesting, and will help you to understand the concepts being covered.
- Complete the matching questions within this Theory & Assignment Booklet

  If you are having trouble answering them, you can:
  - ✓ *Call Mrs Lawrence at school on 6785 1184*
  - ✓ *Email Mrs Lawrence at Ariana.lawrence@det.nsw.edu.au*
  - ✓ *FB Messenger Mrs Lawrence as Ariana Lawrence*
  - ✓ *Arrange for a tutorial session with Mrs Lawrence at the school library*
- Submit this Theory & Assignment Booklet to Mrs Lawrence for Marking

DUE: Friday 26th June 2020

Science
Stage 5
Fighting disease
Part 1



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Writer: Science Teachers, Sydney Distance Education High

Editor: Science Teachers, Karabar Distance Education High

Version date: August 2015

Reproduced by: Sydney Distance Education High School, Locked Bag 5000, Potts Point, NSW, 1335

Telephone: 9383 0200 Fax: 9383 0222

Email: sydneyh-d.school@det.nsw.edu.au

Website: sydneyh-d.schools.nsw.edu.au

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Contents

Outcomes

By completing this unit, you are working towards achieving the following outcomes:

- presents science ideas and evidence for a particular purpose and to a specific audience, using appropriate scientific language, conventions and representations
- analyses interactions between components and processes within biological systems
- explains how biological understanding has advanced through scientific discoveries, technological developments and the needs of society

(Outcomes taken from the BOSTES NSW Syllabus for the Australian Curriculum SCIENCE Years 7 - 10, 2013)

Content Statements:

1VA, 2VA, 3VA, WS7.1a, WS7.1c, WS8d, WS9a, LW1a, LW1b, LW1c, LW1d, LW1e

Resources

There is no mini-kit with this topic

No additional items are needed for Part 1

Icons

Write a response.

Compare your response with the one in the suggested answers section. Give yourself a tick if you were correct. Make any corrections.

Complete the Send-in exercises corresponding to the lesson.

Perform a practical task or investigation.

Glossary

The following words, listed here with their meaning, are found in the learning material in this unit.

antibody protein produced by white blood cells to bind to surface of antigens so they can be engulfed by phagocytes

antigen foreign molecule in the body

bacteria microorganisms that have a wide range of shapes, ranging from spheres to rods and spirals. They exist everywhere on earth.

DNA deoxyribonucleic acid, the chemical that genes are made of

engulf swallow up

enzyme protein that controls chemical reactions in the body

fungi plural of fungus

fungus an organism consisting of a visible body (which produces spores for reproduction) and much smaller often microscopic threads which spread throughout its food source.

immune able to resist infection

infectious disease caused by the invasion of the body by a disease-causing organism

microbes microscopic organisms, microorganisms

mucus slimy secretion

parasite an organism that lives on or in another organism (the host) from which it obtains nutrients

pathogen infectious organism that causes disease or illness to its host

phagocyte white blood cell that can ingest particles

protozoan single celled organism

toxin poison

vaccine material containing dead microbes or modified toxin to induce immunity

virus a small infectious agent that can replicate only inside the living cells of another organism

Lesson 1: Things that make us sick

Being healthy is a state of physical and mental wellbeing when all cells, tissues and organs are functioning well.

What causes us to become sick?

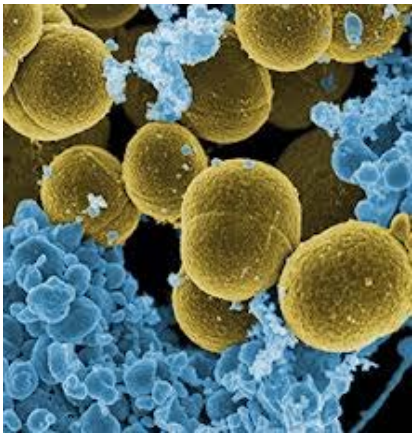
Sickness or disease occurs when the body or parts of the body do not function properly. Disease could indicate the impairment of a person's physical or emotional wellbeing.

What is a pathogen?

Many diseases are caused by micro-organisms or microbes. Microbes are tiny organisms which cannot be seen by the naked eye.

The microbes which kill or damage our cells, or impair functioning of the cells and tissues, are called pathogens. We commonly call them 'germs'.

Disease-causing microbes (or pathogens) can be transmitted from person to person. The diseases they cause are called infectious diseases. The pathogens can be 'caught' from an infected person.



Some bacteria are pathogens

Activity 1: Health and disease

Fill the gaps to complete the summary:

(i) Being healthy is when all c_____, t_____ and o_____ are functioning well.

(ii) D_____ occurs when the body does not function properly.

(iii) Disease-causing microbes are called _____.

(iv) _____ diseases are those which are

_____ from person to person.

Compare your responses with the ones in the suggested answers section

Types of Pathogens

Microscopic pathogens

Most infectious diseases are caused by microscopic pathogens (also known as microbes). Microscopic pathogens cannot be seen with the naked eye. They have to be viewed under a microscope.

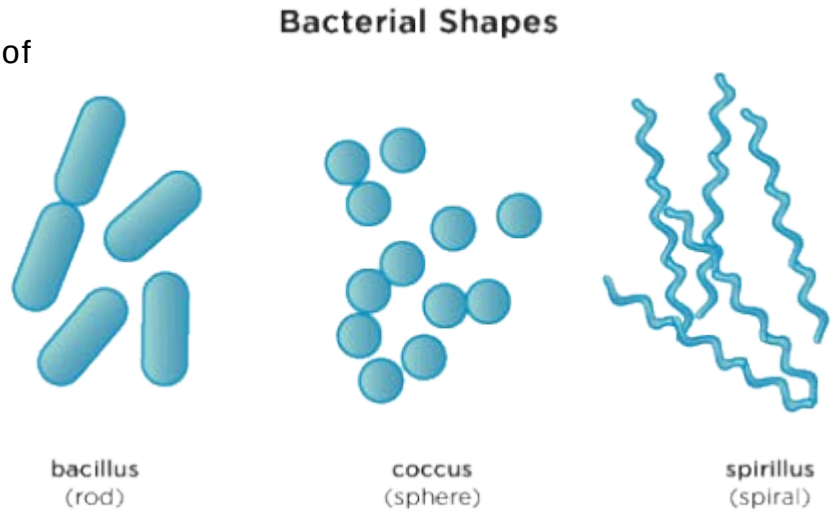
Microscopic pathogens include the following groups:

1. Bacteria
2. Viruses
3. Fungi
4. Protozoans

Bacteria:

These are single celled organisms which can only be seen under a microscope.

There are different types of bacteria such as cocci, bacilli and chains which have different sizes and shapes. Bacteria are tiny. Over 500 000 can fit on a pin head. Some diseases caused by bacteria include tetanus, cholera, meningococcal, tuberculosis, some throat and middle ear infections.

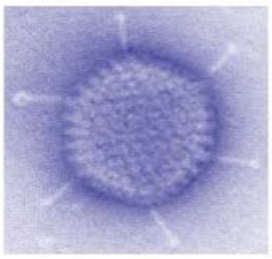


Viruses:

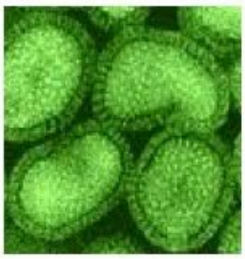
Viruses are much smaller than bacteria. They are about one hundred times smaller than bacteria.

Viruses can be many different shapes. Below are diagrams of a few different types of virus.

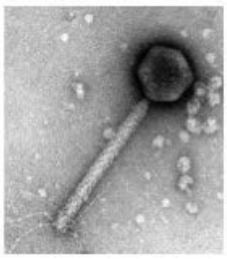
Tobacco Mosaic Virus



Adenovirus



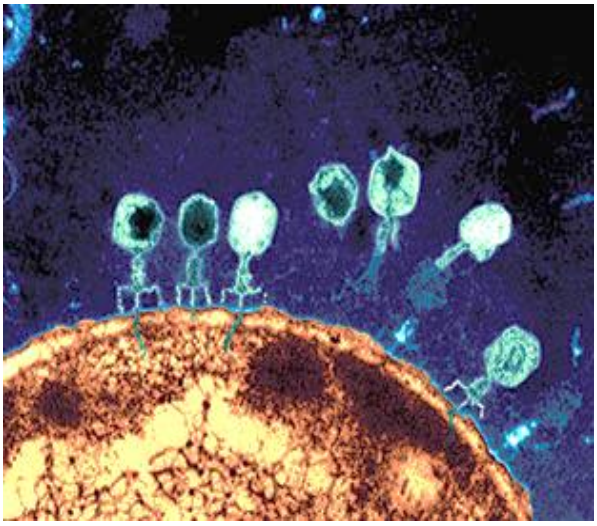
Influenza Virus



Bacteriophage

Different types of viruses

A virus is very unusual. It cannot reproduce to make new viruses. It has to make use of a cell called the host cell to produce new viruses.



This is a picture taken showing many viruses attacking a bacteria cell.

The viruses look like little space ships.

They land and inject their genetic material into the bacteria. The genetic material is the green thread.

Some of the known diseases caused by viruses are the common cold, nfluenza, AIDS, measles, ebola and hepatitis.

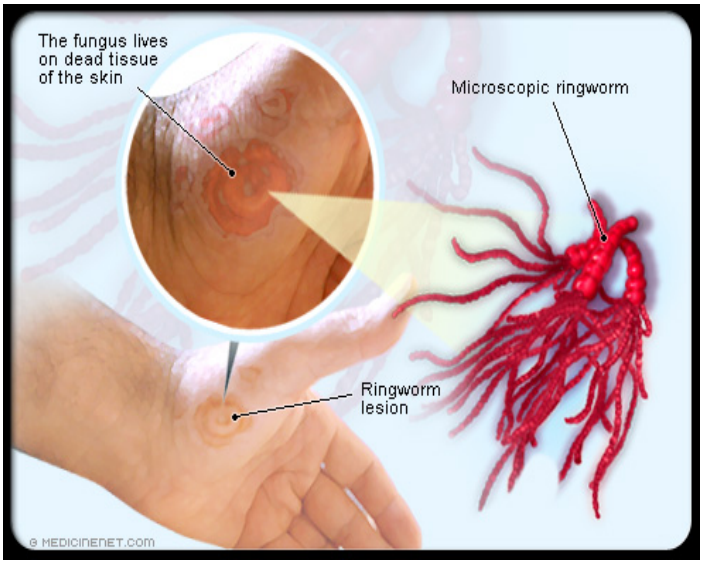
Fungi:

Fungi are a diverse group of organisms that live by decomposing and absorbing the organic material in which they grow. Examples of fungi are mushroom or moulds such as the ones in the pictures below.

Mushroom - an example of fungi

Mould growing on an orange

It is the microscopic fungi, however, that can make you sick. The spores produced by some pathogenic fungi are responsible for the spread of many common infectious diseases such as thrush, ringworm and athlete's foot.



Ringworm

Athlete's foot. This is the fungus causing athlete's foot. The fungus grows on the skin and causes itchiness.

Protozoans:

Protozoans are also microscopic single celled organisms common in water and moist soil.

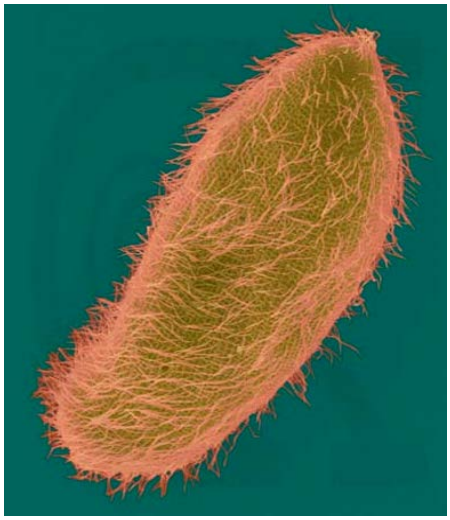


Figure 9a: Microscopic protozoa

Some common diseases caused by protozoans include malaria, amoebic dysentery and cryptosporidium.

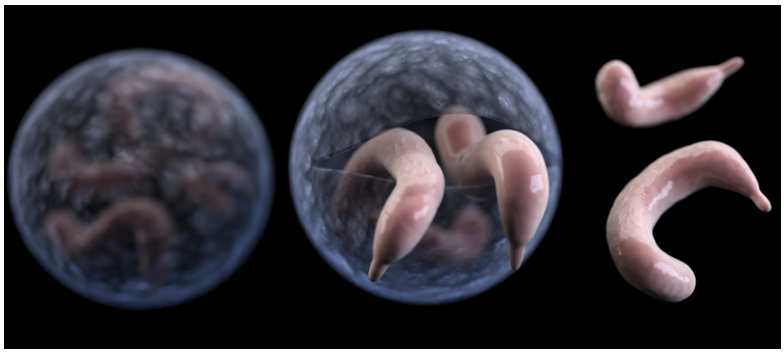


Figure 9b: **Cryptosporidium** ***is a microscopic parasite that causes the diarrheal disease cryptosporidiosis***

Macroscopic pathogens

There are some larger organisms that are pathogens. Some parasites called macro-parasites can make us sick.

Macro-parasites, like tape worms and liver flukes, cause illness.

Figure 10: Tapeworm

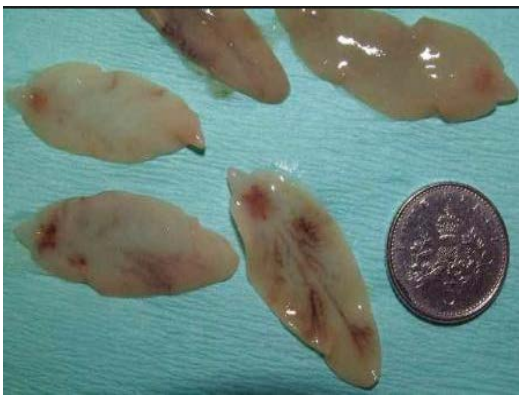


Figure 11: Liverfluke

The photographs above are parasitic worms that are pathogens. They live inside a host. These parasites can enter the body via water, soil or other infected food items.

Activity 2: Types of pathogens

1. What is a pathogen?

   _____

2. Name the four groups of microscopic pathogens.

   _____

   _____

   _____

   _____

3. Name a macroscopic pathogen (macro-parasite).

   _____

Compare your responses with the ones in the suggested answers section

How infectious diseases are spread

Infectious diseases are spread when the microbe or pathogen is passed from person to person.

Coughing and sneezing can spread microbes to others. The microbes can be spread to about two metres from a sneeze. Anyone within two metres of a sick person who is sneezing or coughing can inhale the pathogen.

Spreading disease by coughing

Some pathogens can be transmitted in bodily fluids like blood.

Spreading infectious disease by sharing needles

Spreading infectious disease by a mosquito

Other diseases can be spread by consuming contaminated food and/or water.

Some pathogens are spread by insects.

Once inside your body, the pathogens multiply rapidly in the warm, moist conditions there, feeding on your body tissues and cells. Sometimes the pathogen produces a poison or toxin that damages or destroys your body cells, making you sick.

Activity 3: Spreading disease

1. List 3 different ways diseases can be transmitted.

_____

_____

2. What is a ‘toxin’?

_____

Compare your responses with the ones in the suggested answers section

EXERCISE

Complete the Send-in exercises for Lesson 1

Lesson 2: Types of infectious diseases

Diseases caused by bacteria

Bacteria are simple, single-celled organisms. They inhabit almost every place on Earth – in air, water, soil, most surfaces and in the bodies of plants and animals. Bacteria are also important decomposers, breaking down dead organic matter and returning the nutrients to the soil.

Less than 1 % of bacteria can invade our body (the host) and make us ill. These can attack and destroy our cells and they can release toxins.

Diseases caused by bacteria include:

Tetanus	Gangrene	Food poisoning
Pneumonia	Tuberculosis	Leprosy
Cholera	Sexually transmitted diseases: For example - gonorrhoea and syphilis	Boils

Syphilis lesions on a person's back

A leprosy patient in India

Gangrene caused by bacteria

Diseases caused by viruses

Viruses can infect all living things – humans, plants, animals, and even bacteria. They can be carried about in the air, soil and water and can be spread by insects.

Diseases caused by viruses include:

Common cold

Chicken pox

Rabies

Cold sores

Warts

Hepatitis

Small pox

Influenza

Ebola

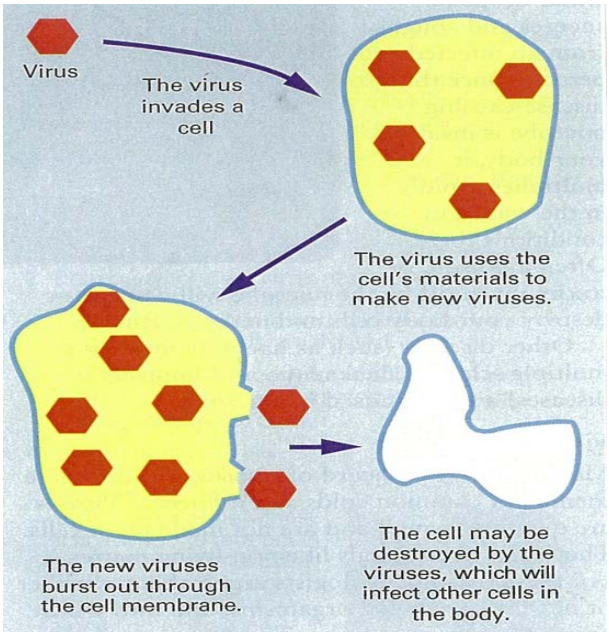
Polio

Measles

Tonsillitis

HIV

Chicken pox in an unvaccinated person



Measles rash

Diseases caused by fungi

Fungi cause diseases like:

ringworm	athlete's foot (tinea)	thrush

Ringworm is actually not caused by a worm but by a fungus

Athlete's foot (tinea)

Fungus infection on the tongue

Some fungal infections affect the surface of the body, the skin, the nails, and the hair. They most often occur in moist areas, such as between the toes, in the crotch, or in the mouth. The thread-like parts of the fungus feed on the tissues.

Other fungal infections are more serious. They can start in the lungs by breathing in the fungus, but in severe cases may spread to the blood, heart, brain, kidneys, liver or other parts of the body.

Diseases caused by protozoans

Protozoans are single-celled organisms. They have a nucleus and are able to move. They are not big enough to be seen without a microscope as they are 0.01 - 0.05 mm in size. Protozoans that could cause disease may be spread in water or by insect bites.

Protozoans may cause diseases like:

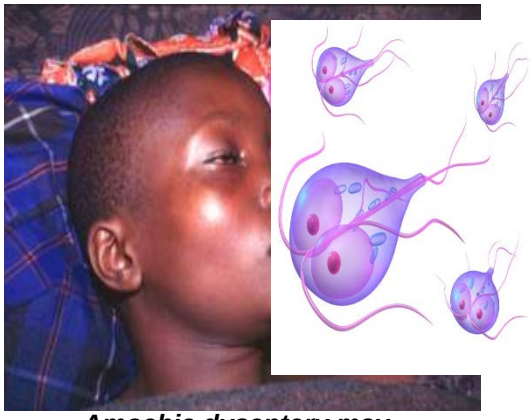
African sleeping sickness

African sleeping sickness

giardia

Giardia parasite

amoebic dysentery



Amoebic dysentery may be caused by drinking polluted water

malaria

Many of these protozoa are carried by a host or carrier. The malaria parasite (Plasmodium) is carried by a specific mosquito named Anopheles. When the infected mosquito bites a healthy person the pathogen is then transmitted and malaria is spread.

Diseases caused by larger parasites

Some diseases may be caused by tapeworms, round worms, bilharzia worms, hydatid worms and liver flukes.

A child with bilharzia

People usually get sick when the worm eggs are eaten and then hatch inside them. Eggs can be transferred from infected pets and other animals by people's hands if a person doesn't wash their hands before eating or handling food.

Others can come from infected meat or fish that is not cooked well.

Activity 4: Infectious diseases

a) Give 2 examples of infectious diseases caused by pathogens.

_____

_____

b) Explain how these infectious diseases can be transmitted.

_____

_____

_____

Compare your responses with the ones in the suggested answers section

EXERCISE

Complete the Send-in exercises for Lesson 2

Lesson 3: Fighting infectious diseases

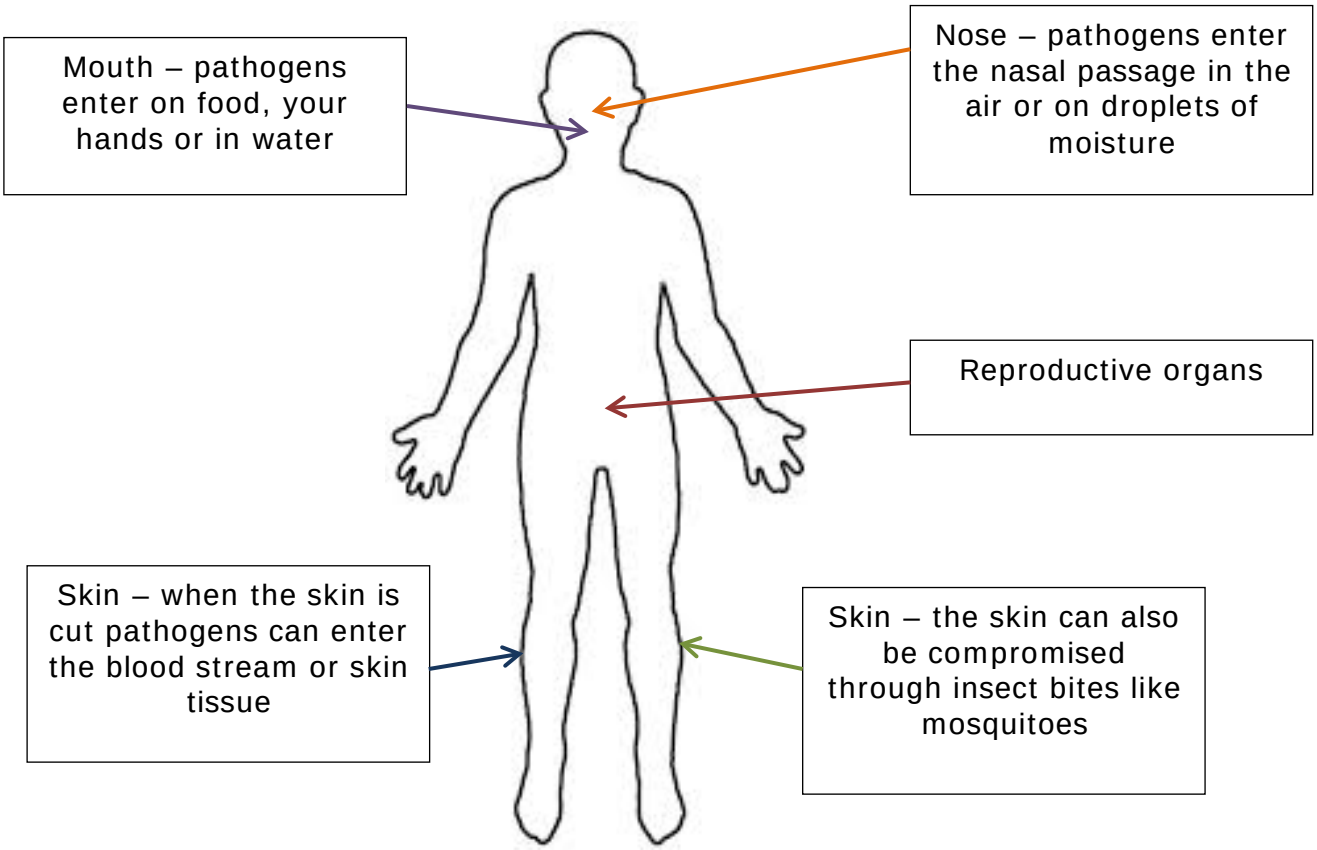
There are so many micro-organisms and pathogens around us in water, food, the air, insects and even in our pets, that it is a wonder that we are not sick all the time!

Did you know that our bodies have defences against pathogens? In this lesson we are going to learn about these, but firstly we are going to learn about how pathogens get into our bodies.

How do pathogens get into our bodies?

There are many points in our body through which microbes can enter.

The diagram below shows these points of entry:



Activity 5: Diseases

Read through the information in the table below and determine where the pathogen for these diseases would enter the body.

Name of disease		Part of the body that the disease enters
common cold	A virus that travels on water molecules.	
whooping cough	Spread when you come in contact from fluids from the nose or mouth of infected people.	
tetanus	Tetanus bacteria are everywhere in the environment, including soil, dust and manure. They cause disease through wounds contaminated with dirt or manure.	
cholera	The bacteria are usually transmitted by drinking contaminated water but the bacteria can also be ingested by eating contaminated food, especially seafood such as raw oysters.	
gonorrhoea	Gonorrhoea is transmitted through contact with infected reproductive organs. Gonorrhoea can also be transmitted from a pregnant woman to her baby during a vaginal delivery.	
ringworm	Ringworm spreads from person to person by touch. When someone with ringworm touches or scratches the rash, the fungus sticks to the fingers or gets under the fingernails. The fungus is then spread when that person touches someone else. Ringworm of the scalp can also spread if combs and hairbrushes are shared.	

Compare your responses with the ones in the suggested answers section

What happens after the pathogen enters your body?

How does the human body respond to a pathogen when it enters your body? The body has many barriers to try and stop pathogens from entering, such as the skin, mucus and hairs in the nose to trap microbes. If microbes enter the human body, then the immune system acts to try and fight the pathogen. There are three lines of defence against pathogens.

First Line of Defence

These are the first things that the pathogen encounters when it tries to enter your body. The pathogen encounters physical barriers such as the skin and chemical barriers like saliva and mucus in our nose, airways and digestive system.

Skin*:* The skin and other body surfaces are natural barriers. It has a toughened outer layer of dead, dry cells making it hard for microbes to penetrate.

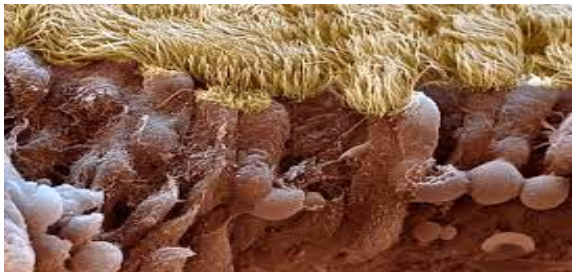
Dry skin makes it hard for microbes to penetrate.

Sweat and oil glands produce acids, as well as antibacterial and antifungal chemicals which kill many microbes. We also have 'good' bacteria on our skin which inhibit the growth of other organisms.

Mucus: Sticky mucous is excreted along the inner surface of the nose, throat, windpipe and the digestive system. The mucus traps foreign particles and pathogens.

When you cough up the mucus or sneeze, you are clearing the microbes out of your body.

Hairs and cilia: Nasal hairs and tiny hair-like cilia lining the air passages can trap foreign particles and then direct them out of the body.



Cilia are hair-like strucutres on the surface of our windpipe and nose that move the mucous and trapped microbes from the windpipe to the throat where it can be coughed up.

Gastric juice, vaginal secretions and urine*:* These fluids are acidic. They prevent microbes from growing.

Tear ducts and salivary glands: These produce anti-bacterial chemicals, such as lysozymes, which destroy microbes.

Activity 6: First line of defence

a) What is the 'first line of defence'?

_____

_____

b) Give 3 examples of the 'first line of defence'.

_____

_____

Compare your responses with the ones in the suggested answers section

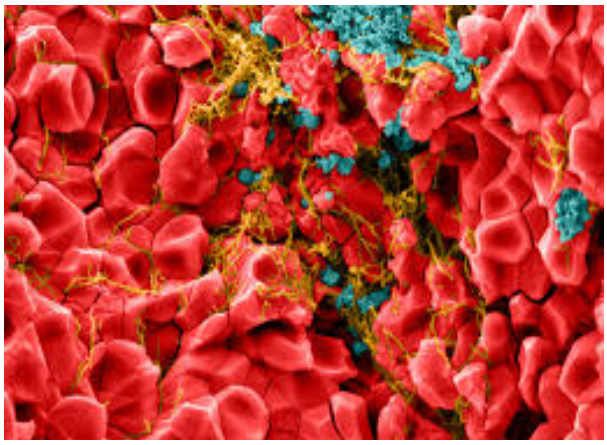
Second Line of Defence

If the pathogens or microbes get past the first line of defence, the body's second line of defence becomes activated. When a wound becomes red, hot, inflamed and releases pus then you know that your body's second line of defence is being activated.

What happens in the second line of defence?

1: The wound is quickly closed so that no more pathogens can enter. Platelets and fibrin in the blood mesh the wound closed.

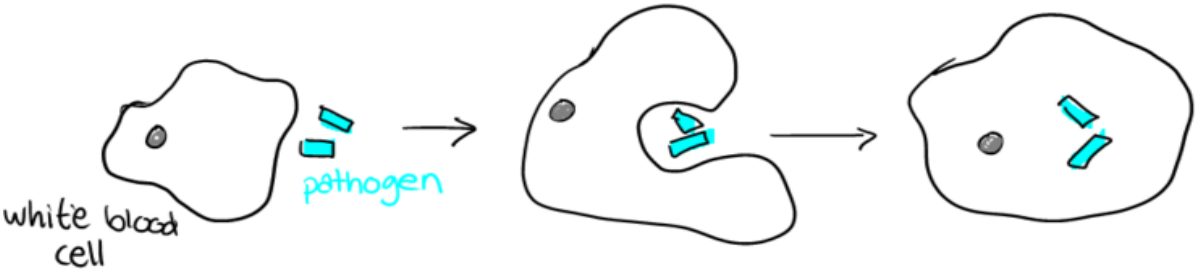
2: Inflammation: The blood vessels near the wound allow more blood to enter the area. More blood reaches the wound making it appear red and swollen. The wound becomes hotter. This increase in temperature helps kill the bacteria.



Red blood cells held together by platelets in blue and fibrin in yellow

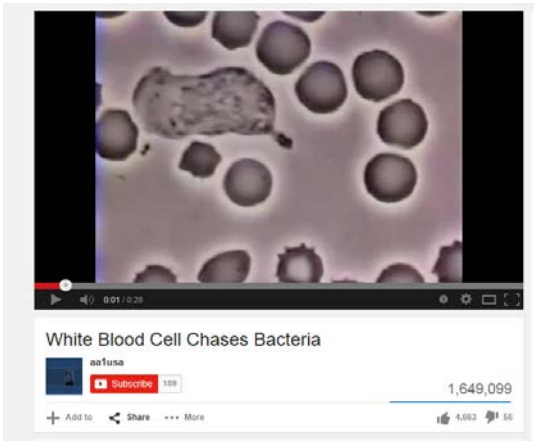
3: The extra blood reaching the wound also brings a special type of white blood cell called a phagocyte. Phagocytes seek and destroy pathogens. They move out of blood vessels and squeeze between cells, engulfing and destroying bacteria and dead body cells. These phagocytes may then burst and the mixture of dead phagocytes, dead body cells and microbes appear as pus at the infection site.

This picture shows the phagocytes engulfing and destroying the bacteria (coloured blue).



Watch a video showing a white blood cell (called a phagocyte) chasing after bacteria.

Scan the QR code OR watch it on elearning OR search on YouTube.



Activity 7: Second line of defence

a) What are the different steps in the second line of defence?

_____

_____

b) What is pus?

_____

_____

Compare your responses with the ones in the suggested answers section

EXERCISE

Complete the Send-in exercises for Lesson 3

Lesson 4: Immune response

If the pathogen gets past the first and second line of defence in your immune system and gets into the blood, then the third line of defence gets activated.

What is the third line of defence?

Have you heard of the word 'antibodies'? They are an essential part of the third line of defence in our immune system.

White blood cells carrying a very specific type of antibody travel through the blood stream. When the antibody recognises the foreign object, like a specific bacterium, the white blood cell rapidly reproduces and releases many copies of the antibody.

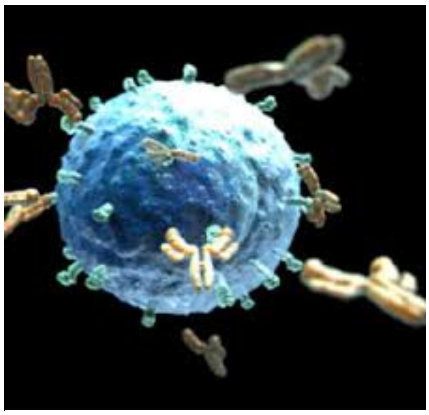
What do antibodies do?

The antibodies can then:

- bind to the pathogen and kill them
- coat the pathogen and make them clump together so they can be eaten by phagocytes
- bind to any toxins that the pathogen releases and stop it from damaging the body.

The white blood cells can also release other chemicals to attract more phagocytes.

When your body has developed an antibody, it 'memorises the recipe' so that if the body is infected by the same microbe again, lots of antibody can be made quickly. This is one way you can build up immunity to a disease.



A pathogen being attacked by antibodies

Response to infection by our body systems

Body System		Response
respiratory system		removes microbes with mucus, coughing and sneezing
digestive system		removes microbes by vomiting and diarrhoea
immune system		white blood cells destroy microbes with antibodies and phagocytes
circulatory system		brings more white blood cells to infected area
skeletal system		blood cells are made in long bones
nervous system		our brain controls our temperature. Fever helps kill microbes

Activity 8: Immune response

Describe what happens in the third line of defence.

_____

_____

_____

Compare your responses with the ones in the suggested answers section

EXERCISE

Complete the Send-in exercises for Lesson 4

Lesson 5: Non-infectious diseases

In the previous lessons we have been learning about diseases caused by microorganisms called pathogens. We call these diseases infectious diseases as they can be transmitted from one person to another.

Some diseases of the human body cannot be transmitted from one person to another. These are called non-infectious diseases.

Non-infectious diseases are those which are not caused by any microbes or pathogens.

What causes non-infectious diseases?

If non-infectious diseases are not caused by a pathogen then what causes them? A wide range of factors are responsible for non-infectious diseases. They include:

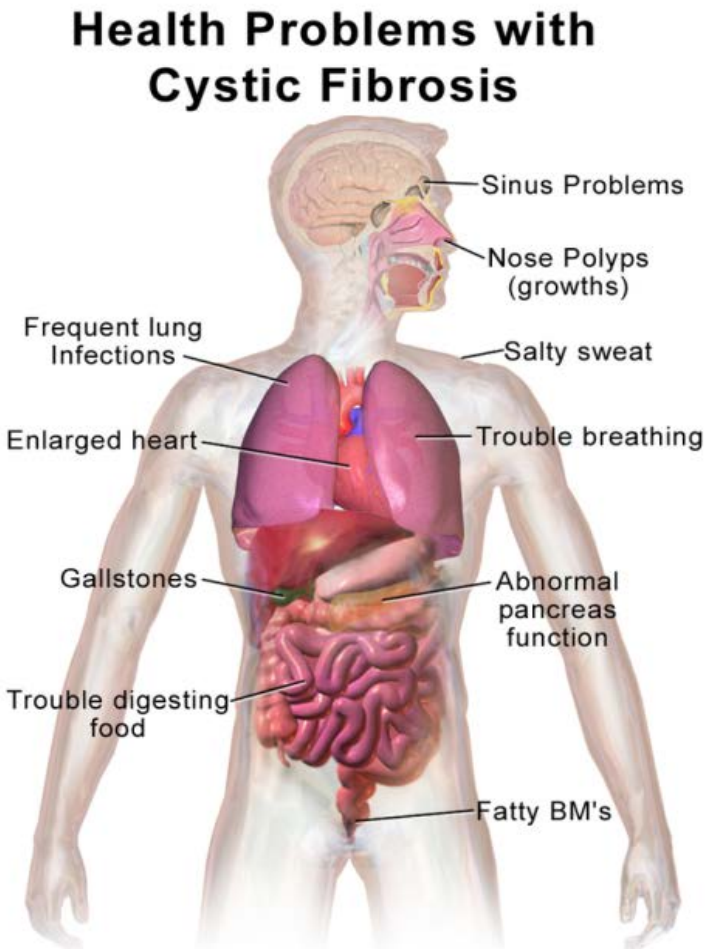
1. Genetic diseases
2. Environmental diseases
3. Nutritional or lifestyle diseases
4. Autoimmune diseases

1. Genetic diseases

Genetic material (genes, chromosomes or DNA) containing faulty information can cause disease.

These diseases are also called inherited diseases and can be inherited within a family.

For example, Cystic Fibrosis is a disease that is caused by a faulty gene. It is the most common life threatening genetic disorder affecting Australians. It causes the cells that line various ducts and tubes throughout the body to secrete sticky mucus that clogs the lungs and digestive system.



Activity 9: Cystic Fibrosis

Look at the diagram showing the health problems associated with Cystic Fibrosis.

List 3 problems that Cystic Fibrosis patients might suffer.

_____

_____

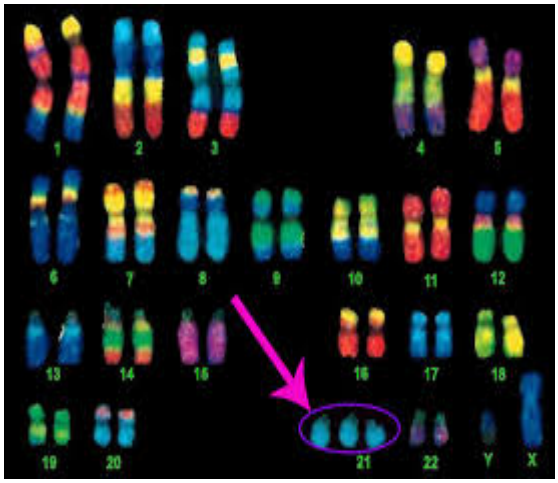
_____

Compare your responses with the ones in the suggested answers section

Down syndrome is another example of a genetic disease. It is due to an extra chromosome being present in every cell of the person's body.

The symptoms of Down Syndrome can include changed head and body shape, reduced height, extra skin on the eyelids, a large tongue, heart defects and learning difficulties.

Down syndrome is due to an extra chromosome being present in every cell of the person's body.



Each human body cell should contain 46 chromosomes. These chromosomes can be arranged into 23 pairs.

Can you see that there are 3 copies of chromosome number 21?

2. Environmental diseases

Sometimes there may be something in the environment that can change the way our cells work and cause a disease.

For example, exposure to asbestos can cause asbestosis – a fatal disease of the lungs.

Exposure to loud noise can cause industrial deafness.

Exposure to cigarette smoke may cause lung cancer, strokes and heart disease.

Exposure to toxic chemicals or radiation can cause poisoning, cancer and genetic damage.

3. Nutritional or lifestyle diseases

Examples of nutritional or lifestyle diseases include such things as anorexia nervosa, obesity, diabetes and scurvy.

Consider the person in the picture to the right. Due to lifestyle factors, this person could have a number of diseases as listed below:

- Being overweight may cause heart disease and increase the risk of diabetes
- A poor diet may cause vitamin deficiency, blocked circulatory system and cancer
- A lack of exercise may cause diseases of the circulatory system and diseases of the skeletal system

4. Autoimmune diseases

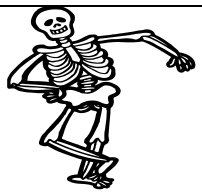
Rheumatoid arthritis

Blood sugar levels being tested using a blood glucose meter

These are diseases where your body starts to respond to itself as if it is fighting an infection. Some examples are diabetes (type 1), multiple sclerosis and rheumatoid arthritis.

Scientists believe some autoimmune diseases are triggered by viruses. For example, the HIV virus causes AIDS. AIDS is an infectious disease.

Our body systems usually respond to non-infectious diseases to try to overcome or prevent each disease. Some examples are listed below:

Environmental factor that may affect your body	Body system that responds	Responses by the body systems
Smoke, dirt and particles in air	 respiratory system	coughing and sneezing
'Poisons' accidentally swallowed with food or drink	 digestive system	diarrhoea and vomiting
Damage to joints from jogging or other physical activities	 skeletal system	inflammation and swelling around the knees

Activity 10: Non-infectious diseases

Name some health risks a person being overweight may experience.

_____

_____

Compare your responses with the ones in the suggested answers section

EXERCISE

Complete the Send-in exercises for Lesson 5

Send-in exercises:
Fighting disease Part 1

Lesson 1

a) What are pathogens? Give two examples.

_____

_____

_____

b) Explain why the human body is ideal for pathogens to survive.

_____

_____

_____

_____

Lesson 2

Complete the table by drawing a line to match the pathogen with the diseases caused by them:

Pathogen	Disease
Virus	Malaria, sleeping sickness
Bacteria	Tinea, ringworm
Fungi	Whooping cough, tetanus
Protozoa	Bilharzia
Macro-parasite	Chicken pox, common cold

Lesson 3

Winter is often a time when people get a ‘cold’ and/or ‘the flu’. The symptoms could include a sore throat, runny nose and mucous in the nose, throat and lungs, coughing and sneezing as well as watery eyes. There is sometimes a fever.

Colds and flu are caused by viruses.

The virus attacks the tissues and cells in the respiratory system. Areas affected include the nose, throat and lungs.

Our immune system fights these diseases.

i) What role does mucus have?

_____

_____

ii) Why do we cough and sneeze?

_____

_____

iii) How can having a fever help?

_____

_____

iv) Pus appears at the site of infection in a cut. Explain how this pus is evidence that your immune system is working?

_____

_____

_____

_____

_____

_____

Lesson 4

Describe how our immune response (the 'third line of defence') works.

_____

_____

_____

_____

_____

_____

_____

Lesson 5

Complete the following sentences using the words listed below. Use each word once only.

rheumatoid arthritis	non- infectious	circulatory	obesity	cancer
environmental	Down syndrome	respiratory	digestive	

There are some diseases that are not caused by organisms. These are called _____ diseases. Genetic diseases and _____ diseases are types of non-infectious diseases.

_____ is an example of a genetic disease. _____ is an example of an auto immune disease where the body attacks itself.

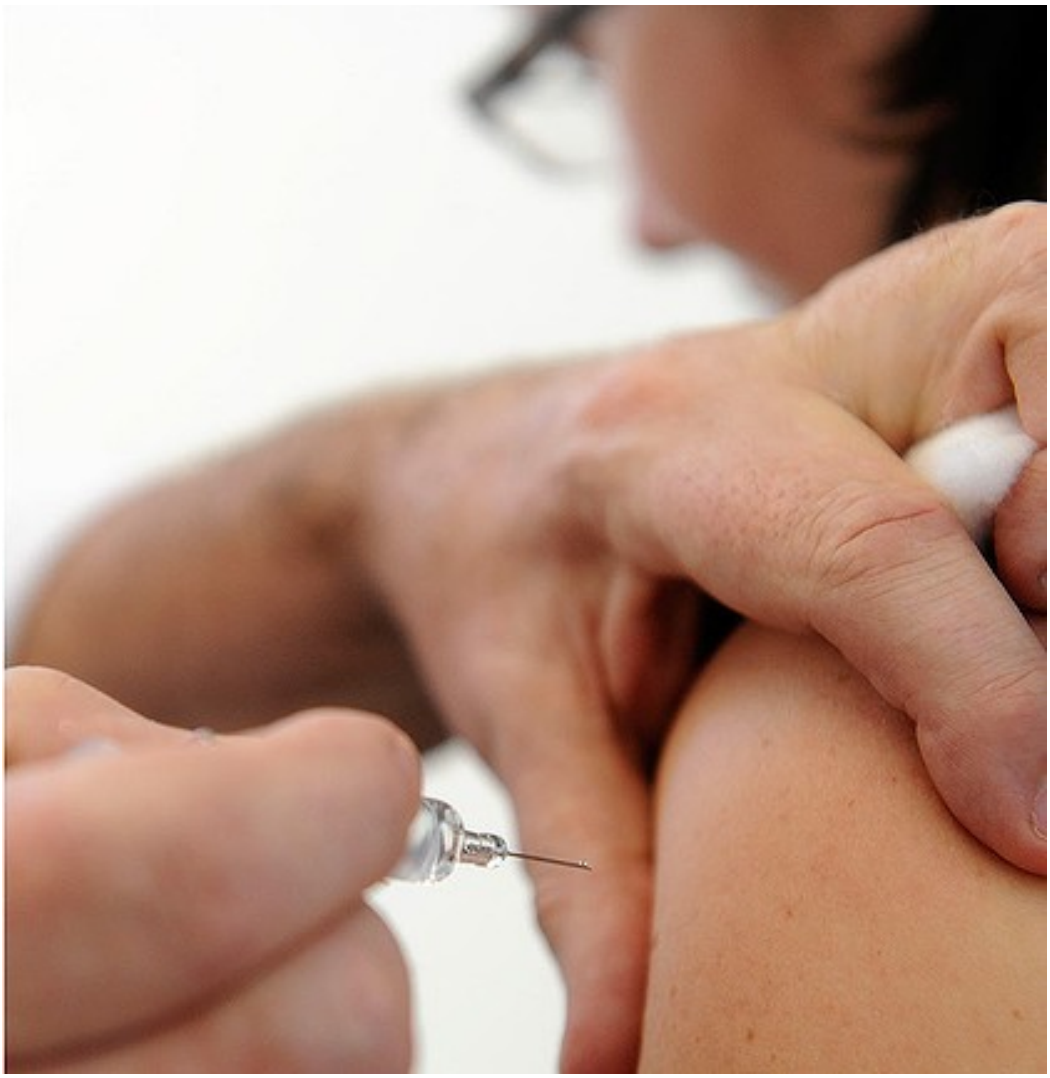
Lung _____ is caused by breathing in tobacco smoke and is an example of an environmental disease.

The body has a number of systems that try to overcome the effects of diseases. Coughing and sneezing are how the _____ system responds.

When you have diarrhoea or you vomit, your _____ system may be responding to a disease.

The _____ system and the skeletal system can also respond to changes in the body due to disease. _____ is a lifestyle disease caused by poor diet and lack of exercise.

Science
Stage 5
Fighting disease
Part 2



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Writer: Science Teachers, Sydney Distance Education High

Editor: Science Teachers, Karabar Distance Education High

Version date: August 2015

Reproduced by: Sydney Distance Education High School, Locked Bag 5000, Potts Point, NSW, 1335

Telephone: 9383 0200 Fax: 9383 0222

Email: sydneyh-d.school@det.nsw.edu.au

Website: sydneyh-d.schools.nsw.edu.au

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Contents

Outcomes

By completing this unit, you are working towards achieving the following outcomes:

- presents science ideas and evidence for a particular purpose and to a specific audience, using appropriate scientific language, conventions and representations
- analyses interactions between components and processes within biological systems
- explains how biological understanding has advanced through scientific discoveries, technological developments and the needs of society

(Outcomes taken from the BOSTES NSW Syllabus for the Australian Curriculum SCIENCE Years 7 - 10, 2013)

Content Statements:

VA1, VA2, VA3, WS7.1a, WS7.1c, WS8d, WS9a, LW1a, LW1c, LW1d, LW1e, LW3E, LW3F

Resources

There is no mini-kit in this topic.

No additional items are needed for Part 2

Icons

Write a response.

Compare your response with the one in the suggested answers section. Give yourself a tick if you were correct. Make any corrections.

Complete the Send-in exercises corresponding to the lesson.

Perform a practical task or investigation.

Glossary

The following words, listed here with their meaning, are found in the learning material in this unit.

AIDS	acquired immune deficiency syndrome
endemic	a disease regularly found among particular people in a certain area.
epidemic	an infectious disease that spreads rapidly among many people in a community at the same time
evaluate	determine the value of
fermentation	the process of converting sugar to alcohol using yeast or bacteria
genetic modification	altering the genetic code (DNA) of an organism
HIV	human immunodeficiency virus (causes AIDS)
immune	having resistance to infection
ingestion	swallowing
inhalation	breathing in
outline	indicate the main features of
pandemic	an epidemic (a sudden outbreak) that becomes very widespread and affects a whole region, a continent, or the world.
pasteurization	sterilization by heating
sterilization	make free from microbes
vaccination	injection of a killed microbe in order to stimulate the immune system against the microbe, thereby preventing disease
viral disease	disease caused by a virus

Lesson 1: Striving to solve problems

Discovering vaccination against disease

Scientific research is often undertaken to solve problems people are facing. For hundreds of years, doctors and scientists have been trying to understand disease and relieve people's suffering. It had been observed that people who recovered from an attack of certain diseases were immune to further attacks of the same disease.

Edward Jenner and small pox

In 1796, an English doctor named Edward Jenner discovered that if some cowpox pus was injected into people, they would then become immune to smallpox (a disease that had been a dreaded killer for centuries). Vaccination had been discovered.

Watch a really good video about Edward Jenner's work with smallpox by either scanning the QR code, finding the video on YouTube (by searching for *GCSE Science Revision - The discovery of Vaccination)* or watch it on elearning.

Louis Pasteur

In 1854, Louis Pasteur was asked by a wine maker in France to find out why wine sometimes goes bad. Pasteur discovered that microbes were responsible by looking through a microscope. He went on to discover that microbes caused fermentation, decay and disease. He also developed the process of pasteurisation to treat wine and milk to kill the microbes.

Pasteur, although ridiculed by other scientists, believed that microbes were responsible for disease in humans just like microbes were the cause of food spoilage. Through experimentation he found that injections of weakened pathogens for rabies, cholera and anthrax allowed animals to live while animals not injected died of the diseases. This delivery of a weakened form of the disease he called a vaccine. He later developed vaccines for rabies and anthrax.

Dr Joseph Lister

In 1867, Dr Joseph Lister read about Pasteur's work. At that time many people died following surgery as their wounds 'went bad' or putrefied. He reasoned that microbes were responsible. He developed sterilisation techniques using carbolic acid to sterilise the air surrounding patients, the surgical instruments and wound dressings. He instructed surgeons to wash their hands in a solution of carbonic acid.

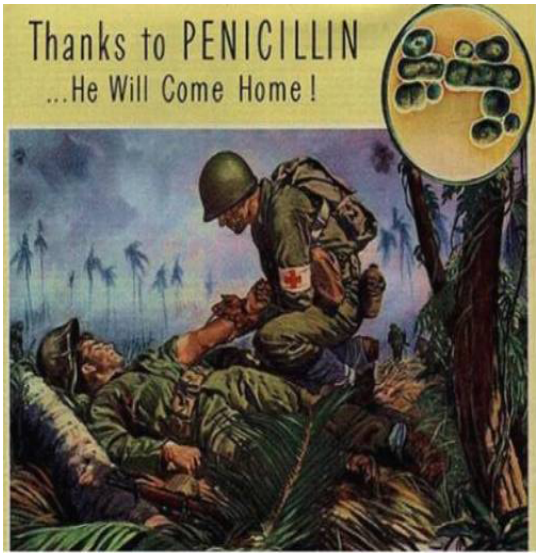
World Wars

The terrible loss of life during World War 1 (1914 – 1918) led scientists to research ways to prevent soldiers from dying of blood loss on the battle field and in hospitals. Doctors had experimented with blood transfusions for nearly 300 years but the results were usually fatal.

During World War 1, scientists applied the recent discovery of blood types and anti-clotting agents to try to save lives.

Researchers during World War 2 (1939 – 1945) discovered better ways of blood transfusion and ways to store, treat and transport blood and blood products safely.

At the same time, many soldiers and surgical patients were dying of wounds that became infected. This led to the research by Australian Howard Florey and his team into recently discovered penicillin. They tested it and found ways to make large quantities of it. Penicillin is an antibiotic that kills bacteria or prevents bacteria making cell walls so they cannot reproduce.



Activity 1: Solving Problems

a) What did Edward Jenner discover?

_____

b) What did Pasteur discover?

_____

_____

c) What was Joseph Lister's contribution in preventing infections?

_____

_____

_____

Compare your responses with the ones in the suggested answers section

EXERCISE

Complete the Send-in exercises for Lesson 1

Lesson 2: Epidemics and pandemics

An **epidemic** is a disease that spreads rapidly among many people in a community at the same time. For example, cholera epidemics occur in densely populated areas.

Cholera outbreak (epidemic) in Haiti 2010

A **pandemic** occurs when a disease spreads rapidly across the world.

The Influenza Pandemic of 1918 killed more people than those who died in World War 1.

Red Cross workers during the 1918 influenza pandemic

It killed an estimated 50 million people. One fifth of the world's population was attacked by this deadly virus. Within months, it had killed more people than any other illness in recorded history.

Today we are threatened by influenza viruses causing *swine flu* and *avian (bird) flu* that could be just as deadly.

Swine flu and Avian flu diseases have jumped species – from animals to humans.

The symptoms are:

- high fever
- cough
- nasal secretions
- fatigue
- headache

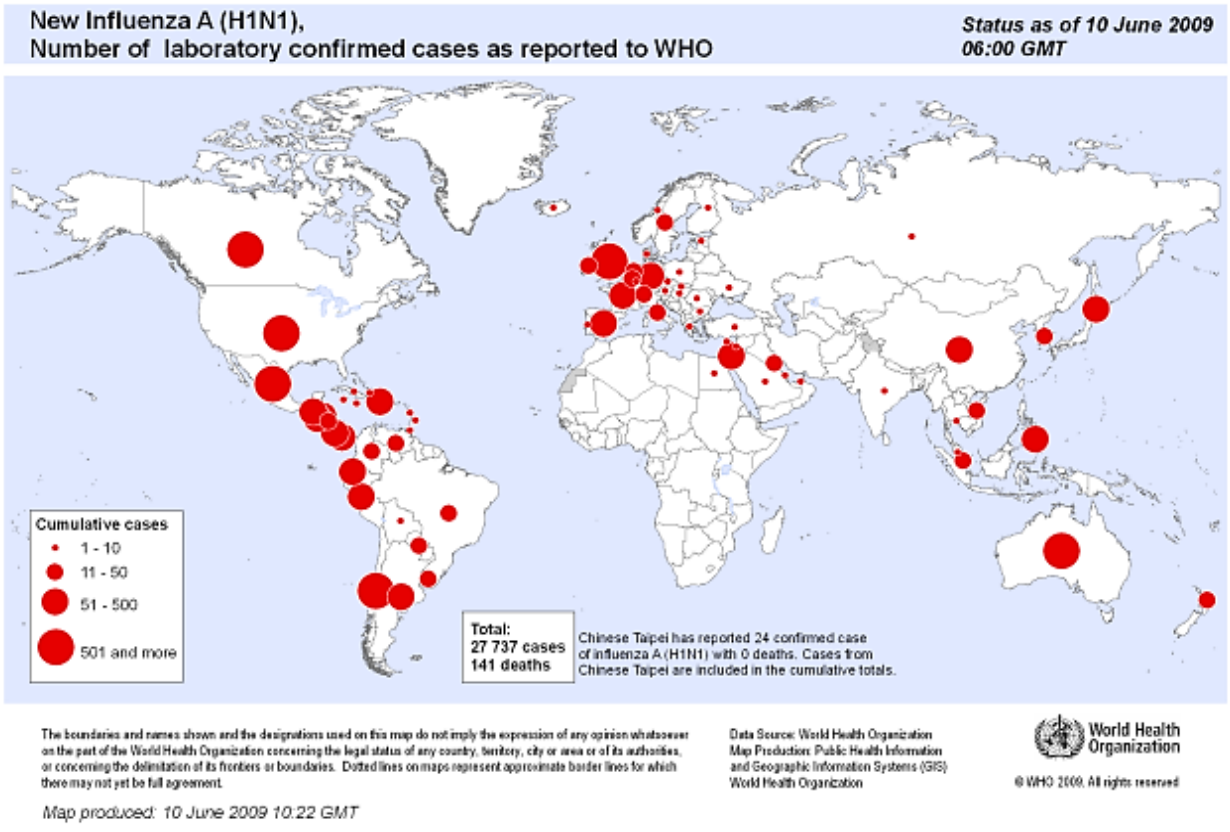
The virus is transmitted from pigs or birds, then person to person via inhalation or ingestion of droplets containing the virus from people sneezing or coughing.

These viruses can be deadly to the very young, the elderly or to people with other illnesses.

The most recent influenza pandemic occurred in April 2009. It was caused by an influenza virus called the H1N1 virus. It was referred to as 'swine flu'. The virus was an assortment of a combination of bird, swine (pig) and human flu viruses.

It started in Mexico but quickly spread worldwide. The virus was spread through moisture droplets. The disease would spread when infected people coughed or sneezed and other people inhaled these droplets or put their hands in their mouth.

The map below shows the cases of flu caused by the H1N1 virus as of June 2009.



A vaccine was developed against this new strain of virus. People were vaccinated against the virus and it reduced the number of people hospitalised and saved lives.

During this time, the World Health Organisation declared that preventing the Swine flu from spreading around the world was not possible. Some countries responded by:

- Inspecting people on incoming planes for flu symptoms.
- Using thermal imaging cameras in airports to detect elevated body temperatures, one of the symptoms of flu.

Research to control epidemics and pandemics involves:

- identifying the bacteria or virus
- discovering how the disease is transmitted and how to prevent the transmission
- developing vaccines
- developing drug treatments

Activity 2: Epidemics and pandemic

What is the main difference between epidemic and pandemic diseases?

_____

_____

Compare your responses with the ones in the suggested answers section

SARS (Severe acute respiratory syndrome)

This is a serious form of pneumonia that causes severe breathing difficulty and sometimes death. This virus quickly spread around the world.

The symptoms include:

- cough
- difficulty breathing
- fever greater than 38ºC
- chills and shaking
- headache
- muscle aches

When someone with SARS coughs or sneezes, infected droplets spray into the air. You can catch the SARS virus if you breathe in or touch these particles. The SARS virus may live on hands, tissues, and other surfaces for up to 6 hours in these droplets and up to 3 hours after the droplets have dried.

People with SARS are kept isolated in hospital.

***Treatment**:*

Researchers have developed the following:

- Antibiotics to treat bacteria that cause pneumonia
- Antiviral medications (still being tested)
- High doses of steroids to reduce swelling in the lungs
- Oxygen and breathing support (mechanical ventilation)

Prevention:

Research has shown reducing contact with people who have SARS lowers your risk for the disease. Avoid travel to places where there is a SARS outbreak.

Hand hygiene is the most important part of SARS prevention. Wash your hands or clean them with an alcohol-based instant hand sanitizer

Cover your mouth and nose when you sneeze or cough. Droplets that are released when a person sneezes or coughs are infectious.

Do not share food, drink or utensils

Clean commonly touched surfaces with a disinfectant

Masks and goggles help prevent the spread of the disease

Use gloves when handling any items that may have touched infected droplets.

Research to control epidemics and pandemics involves:

- identifying the bacteria or virus
- discovering how the disease is transmitted and how to prevent the transmission of this disease
- developing vaccines
- developing drug treatments

The world's deadliest infectious diseases **HIV (AIDS)** and **malaria** continue to cause mass suffering, especially in poorer nations around the world.

Right now, about half of the world's population is at risk of contracting malaria, which kills about 1.5 million people a year. About the same number of people die from AIDS-related illnesses.

Map showing areas where malaria is prevalent

Recent developments have increased hopes that a new generation of vaccines will protect against these big killers. Both HIV and the malaria parasite are very complex, and traditional methods of vaccine development do not work.

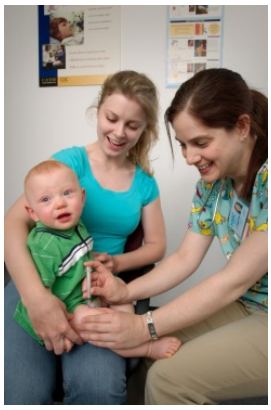
Research into vaccine development continues and some promising trials are underway.

EXERCISE

Complete the Send-in exercises for Lesson 2

Lesson 3: Immunisation

What is immunisation?



Have you been immunised before? Have you received an injection or were you given a vaccine (like the polio vaccine) as drops in your mouth?

Immunisation protects people from harmful infectious diseases.

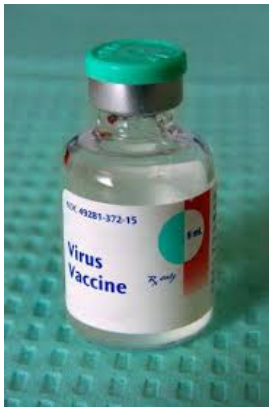
The difference between vaccination and immunisation

Vaccination is a treatment which makes the body stronger against a particular infection. It involves the injection of a vaccine. It enables the body to fight infection using the immune system.

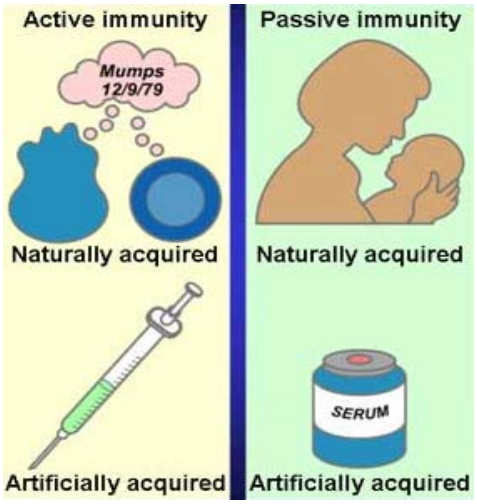
Immunisation is the process of getting the vaccination and then your body becoming immune to the disease.

What is in vaccines?

Some vaccines can contain a very small dose of a live but weakened form of a virus. Some vaccines have a very small dose of killed bacteria, small parts of bacteria, or proteins of a virus. Vaccines may also contain either a small amount of preservative or a small amount of antibiotic to preserve the vaccine. For example, most influenza (flu) vaccines are made using eggs which are injected with a living influenza virus. The eggs allow the virus to grow to a very high concentration. The virus is then extracted and purified from the egg. The virus is killed and becomes inactive. The mixture is then treated with a detergent which splits the protein parts of the virus from the rest of the mixture. Do you sometimes hear people say that they got 'the flu' after receiving the flu vaccine? This is impossible as the process of



inactivation and separation by detergent ensures that the final vaccine has no live virus in it.



Passive immunity occurs naturally. It can happen when the mother's antibodies are transferred to the unborn baby through the placenta.

How does the vaccine make you immune?

When you receive the vaccination your body starts the immune response as it recognises the contents of the vaccine as foreign. The body starts to react in the same way as if the person was actually exposed to the disease.

Vaccination enables the white blood cells (that make antibodies) to recognise the foreign substance and destroy them.

An Australian company making the flu vaccine

The antibodies remain in your blood to protect you for many months and years. This is called active immunity. Sometimes booster shots are needed.

If you get exposed to the disease in the future, the body is able to make an immune response to fight the disease quickly and therefore preventing the person from getting sick.

In this way, the body builds up immunity against particular diseases.

Activity 3: Immunisation

a) What is a vaccine?

_____

_____

_____

_____

b) What does your body do after it receives a vaccine?

_____

_____

Compare your responses with the ones in the suggested answers section

Immunisation programs

Most developed countries have established immunisation programs for many childhood diseases which may be life-threatening.

These programs are used because immunisation is considered the safest and most effective way of giving protection against disease. Scientists and doctors maintain that the benefit of protection against disease outweighs the very small risks of immunisation.

Australian Government
Department of Health

National Immunisation Program Schedule

From 1 July 2013

Child programs	
Age	**Vaccine**
Birth	• Hepatitis B (hepB) [a]
2 months	• Hepatitis B, diphtheria, tetanus, acellular pertussis (whooping cough), *Haemophilus influenzae* type b, inactivated poliomyelitis (polio) (hepB-DTPa-Hib-IPV) • Pneumococcal conjugate (13vPCV) • Rotavirus
4 months	• Hepatitis B, diphtheria, tetanus, acellular pertussis (whooping cough), *Haemophilus influenzae* type b, inactivated poliomyelitis (polio) (hepB-DTPa-Hib-IPV) • Pneumococcal conjugate (13vPCV) • Rotavirus
6 months	• Hepatitis B, diphtheria, tetanus, acellular pertussis (whooping cough), *Haemophilus influenzae* type b, inactivated poliomyelitis (polio) (hepB-DTPa-Hib-IPV) • Pneumococcal conjugate (13vPCV) • Rotavirus [b]
12 months	• *Haemophilus influenzae* type b and Meningococcal C (Hib-MenC) • Measles, mumps and rubella (MMR)
18 months	• Measles, mumps, rubella and varicella (chickenpox) (MMRV)
4 years	• Diphtheria, tetanus, acellular pertussis (whooping cough) and inactivated poliomyelitis (polio) (DTPa-IPV) • Measles, mumps and rubella (MMR) (to be given only if MMRV vaccine was not given at 18 months)
School programs	
10–15 years (contact your State or Territory Health Department for details)	• Hepatitis B (hepB) [c] • Varicella (chickenpox) [c] • Human papillomavirus (HPV) [d] • Diphtheria, tetanus and acellular pertussis (whooping cough) (dTpa)
At-risk groups	
6 months and over	• Influenza (flu) (people with medical conditions placing them at risk of serious complications of influenza)
12 months	• Pneumococcal conjugate (13vPCV) [e] (medically at risk)
12–18 months	• Pneumococcal conjugate (13vPCV) (Aboriginal and Torres Strait Islander children in high risk areas) [e]
12–24 months	• Hepatitis A (Aboriginal and Torres Strait Islander children in high risk areas) [f]
4 years	• Pneumococcal polysaccharide (23vPPV) [e] (medically at risk)
15 years and over	• Influenza (flu) (Aboriginal and Torres Strait Islander people) • Pneumococcal polysaccharide (23vPPV) (Aboriginal and Torres Strait Islander people medically at risk)
50 years and over	• Pneumococcal polysaccharide (23vPPV) (Aboriginal and Torres Strait Islander people)
Pregnant women	• Influenza (flu)
65 years and over	• Influenza (flu) • Pneumococcal polysaccharide (23vPPV)

Activity 4: Immunisation in Australia

a) Look at the National Immunisation Program Schedule on the previous page and name three diseases that children are vaccinated against in their first year.

_____

b) What vaccines should you receive between 10 and 15 years old?

_____

_____

Compare your responses with the ones in the suggested answers section

EXERCISE

Complete the Send-in exercises for Lesson 3

Lesson 4: Diseases in animals and plants

As diseases arise in our animal and plant populations, researchers strive to discover the cause and transmission of the diseases and to develop effective treatments. This enables conservation of our native species and protection of our agricultural products and food supply.

Current research

Current areas of research include:

- facial tumour disease in Tasmanian Devils
- chlamydia in koalas
- equine (horse) flu
- lyssavirus and Hendra virus in bats (flying foxes)
- foot and mouth disease in livestock
- diseases of native plants and agricultural crops

Tasmanian Devils

Tasmanian devils are endangered animals. Their numbers are declining.

Facial tumour disease is a cancer that can spread like a contagious disease. It has wiped out about 85 percent of the Tasmanian devil population.

Tasmanian devil with facial tumour disease

Studies are underway to find out the cause of the disease and how it is transmitted from devil to devil.

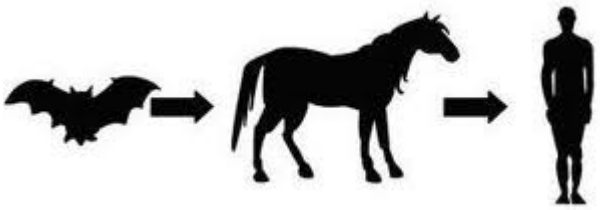
Scientists working on saving the Tasmanian Devil have had some success with a recent trial of a drug from a Queensland rainforest plant.

Watch the video about the research into facial tumour disease of the Tasmanian Devil conducted at the University of Tasmania.

Scan the QR code, OR search on YouTube for the video OR click on the link in elearning

Flying foxes

The Hendra virus is transmitted from flying fox to horse, horse to horse, and sometimes horse to human. It is deadly to horses and sometimes to humans.



Researchers think that horses contract the Hendra virus by ingesting food or water contaminated with flying fox body fluids and excretions. The virus can then be passed to humans if they come in contact with an infected horse's nasal discharge, blood, saliva or urine.

Researchers started trying to develop a vaccine for this virus when many horses and humans became sick. A Hendra virus horse vaccine has been developed. Researchers have been working on a human vaccine but as yet there is no approved treatment. Scientists are also working to develop drugs to treat Hendra virus infections.

The lyssavirus which is similar to rabies can be spread to people via the bite or scratch from a bat.

Agricultural animals

There are many diseases that can affect livestock on farms. Foot-and-mouth disease is a highly infectious and sometimes fatal viral disease affecting sheep, cattle, goats, pigs, water buffalo, antelope, deer, bison, llamas and alpaca.

There is strict monitoring of herds and when the disease is identified, trade restrictions and quarantines apply. Occasionally millions of animals have to be slaughtered to contain the disease.

Researchers have discovered the disease can be spread by infectious droplets in the air, by contact with contaminated farming equipment, soil, vehicles, clothing or feed and by domestic and wild predators.

They have established control measures and disinfecting techniques, and are working to develop effective vaccines.

Activity 5: Animal disease

a) Name one animal disease.

_____

b) Why is it important to research animal disease?

_____

_____

Compare your responses with the ones in the suggested answers section

Plants

Plants can also contract diseases caused by microbes such as viruses, bacteria, fungi, protozoans and by larger parasites.

Agricultural crops and native forests can be at risk. In each case, researchers identify the disease as well as the microbe or parasite that causes it.

They then establish control measures, such as quarantine or fumigation (using smoke or gas to kill pests), and sometimes burning. They work to develop resistant species, sometimes through genetic modification. Another area of research involves good crop nutrition and good farming practices.

Bacterial diseased apples

Mosaic virus

Corn smut – a fungal disease of corn

Activity 6: Plant disease

Explain what a researcher could do once a plant disease has been identified.

_____

_____

_____

Compare your responses with the ones in the suggested answers section

EXERCISE

Complete the Send-in exercises for Lesson 4

Lesson 5: How to keep healthy

In our society, we now have access to more food and more types of food including processed food (which is generally high in sugar and fat), than ever before. We get less exercise due to our comfortable lifestyle. We use a car rather than walk and have many labour saving devices at home and at work. We entertain ourselves sitting in front of computers or the television rather than actively playing.

The result is an increase in lifestyle diseases such as obesity, diabetes, heart disease and high blood pressure. There may also be a decrease in mental well-being.

Ease of travel, both local and international, aids the spread of infectious diseases.

All this puts a lot of pressure on our health services and the costs are increasing. Due to this increasing cost and because we all want to be healthy and free of disease, research into healthy lifestyles has produced some guidelines for us.

Eat well

- Eat lots of vegetables, salads and fruit
- Choose low fat dairy products when consuming milk, yogurt and cheese
- Eat small amounts of wholemeal bread, pasta, cereal and rice
- Eat small amounts of lean meat, fish, eggs and nuts
- Use olive oil instead of butter, margarine or other oils
- Drinks lots of water. Don't drink soft drink or juices as they are very high in sugar. Don't add sugar to your tea or coffee.

- Avoid high sugar and high fat foods (biscuits, cakes, pastries, pies, chips, chocolate and lollies). Check the sugar content of your breakfast cereal – some contain up to 37% sugar!
- Make sure you wash fruit and vegetables and cook meats and fish well to kill microbes and any parasites.

Sleep well

- 8 or more hours a night for teenagers

Exercise regularly

- For health benefits, young people aged 13–17 years should accumulate at least 60 minutes of moderate to vigorous intensity physical activity every day.
- On at least three days per week, young people should engage in activities that strengthen muscle and bone.

Don't smoke

- In adults, cigarette smoking causes heart disease and stroke. Studies have shown that early signs of these diseases can be found in adolescents who smoke
- Smoking at an early age increases the risk of lung cancer. For most smoking-related cancers, the risk rises as the individual continues to smoke

Wash hands often:

- to wash off bacteria and viruses with soap.
- before touching food, cooking or eating
- after going to the toilet
- before and after visiting sick people
- more often if you have a cold

- is thought to be the best way to limit the spread of 'super bugs' (strains of bacteria that are resistant to powerful antibiotics).

Cover your mouth and nose when you sneeze

- Cover your mouth and nose with a tissue when you sneeze.
- If you don't without a tissue, sneeze into your sleeve at the top of your arm to avoid spreading infection to others.

Help prevent the spread and proliferation of 'super bugs'

'Super bugs' are strains of antibiotic resistant bacteria.

- Always take all prescribed antibiotics to be sure **all** bacteria are dead – not just the more susceptible ones
- Don't use antibacterial gels, wipes or household cleaners. These will kill the non-dangerous, susceptible bacteria which keep the numbers of dangerous bacteria in check. If you were to kill all these non-dangerous bacteria then you are left with the dangerous, resistant bacteria populating your home.

Get vaccinated

Keep your own records so you will know when you need your **boosters**. This will help eradicate diseases like polio, tetanus, diphtheria, whooping cough, measles, mumps, rubella and chicken pox.

Activity 7: Revision crossword

Do you remember what you learnt in Part 1 and Part 2 of this topic?

Complete the crossword on the next page.

Across:

2. When the body builds up the ability to fight disease in the future.

6. _____ (AIDS) is the most deadly infectious disease in the world.

9. A disease that can be passed on from one person to another

10. Scientists and doctors maintain that the benefit of _____ _____ _____ outweighs the very small risks of immunisation

13. Microbes like bacteria that cause disease

15. A pathogen that causes the flu

16. Some people worry about _____ _____ to vaccines such as a slight fever.

19. _____ are made by white blood cells

20. The disease affecting Tasmanian devils

22. Edward _____ discovered that if some cowpox pus was injected into people, they became immune to smallpox

Down:

1. A plant disease caused by fungus on corn

3. This category of diseases are not caused by pathogens. An example is genetic diseases

4. A pathogen that causes athlete's foot or thrush

5. The _____ vaccine is made initially using eggs

7. A vaccine that can be given at birth *(see the immunisation program schedule)*

8. These cells engulf bacteria and destroy them in our immune system.

9. _____ is the process of getting a vaccination and your body becoming immune to the disease

11. G_____ - a disease caused by bacteria

12. A p_____ occurs when a disease spreads rapidly across the world

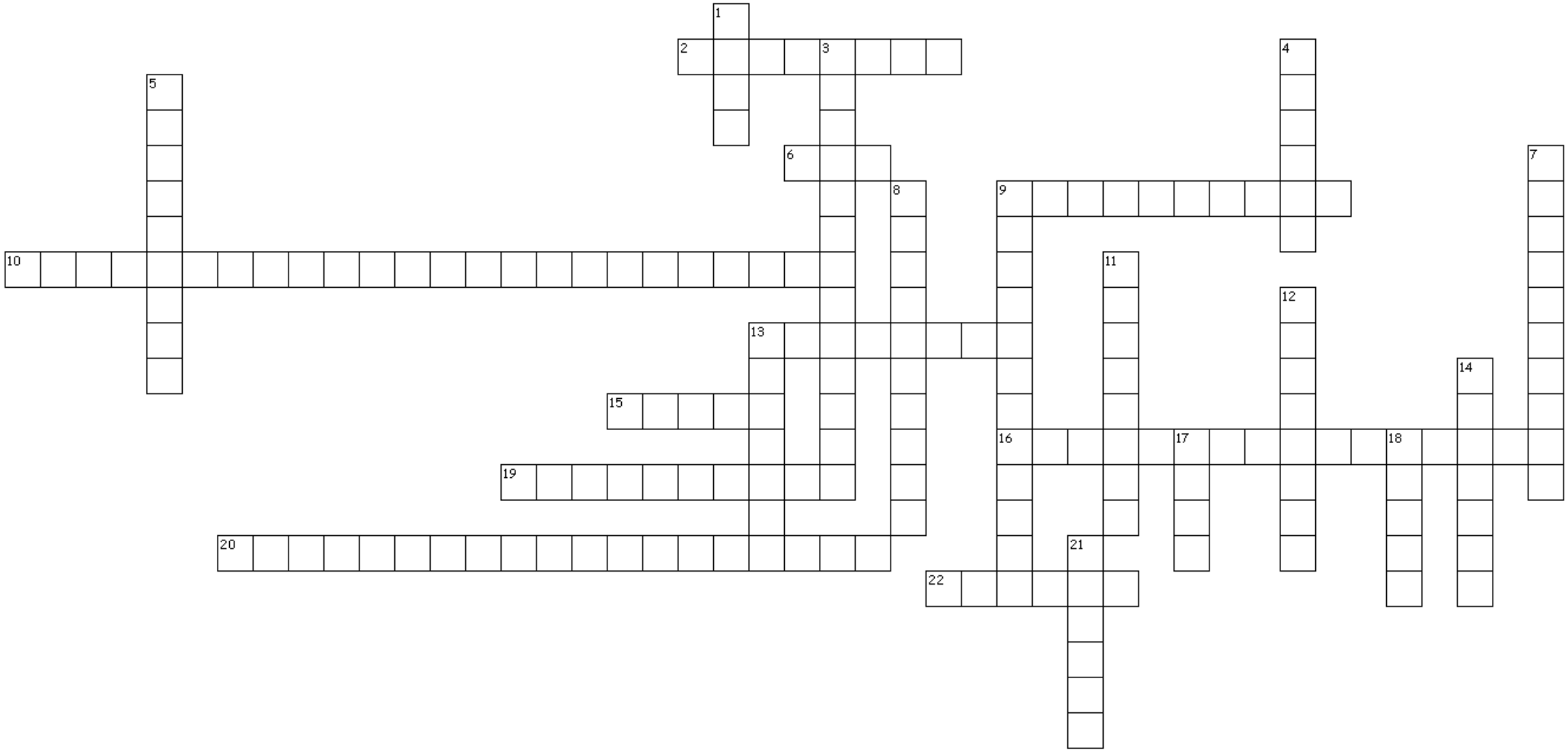
13. _____ immunity is where the antibody is given to the person rather than their immune system making it.

14. C_____ - a disease where the bacteria are transmitted via drinking water

17. S_____ - a natural barrier to stop pathogens from entering the body

18. There are _____ lines of defence in the body's immune system

21. The virus that is passed from flying foxes to horses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Send-in exercises:
Fighting diseases Part 2

Lesson 1

Scientific research is often undertaken to solve a need or problem. Choose one example discussed in *Lesson 1* and answer the following questions.

a) With reference to one area of research, state the need or problem that was identified.

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b) Outline the research.

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c) Explain how our understanding of the human body and disease was advanced through this scientific research.

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Lesson 2

Modern farms involve intensive farming techniques. Instead of farmers having small farms with small numbers of animals like chickens, ducks, sheep, cows or pigs, we have very large farms with huge numbers of animals of the one species, for example chicken farms or piggeries.

Modern lifestyles often involve travel. We travel to school or work, travel interstate and overseas for business or holiday. We enjoy travel by car, fast train and planes.

Explain why modern society could be in danger of a pandemic that spreads rapidly.

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Lesson 3

Compare the advantages and disadvantages of immunisation.

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Lesson 4

Explain how animal and plant diseases are being controlled.

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Lesson 5

Discuss three things that you could do that would help to keep you healthy.

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