learning channel
defining your destiny.

Life Sciences

Learner's Workbook

Grade 11

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How to use the Learning Channel Life Sciences programme for Grade 11

Congratulations and thank you for choosing this Learning Channel Life Sciences Grade 11 programme.

This Life Sciences programme is comprehensive and covers all the Learning Outcomes, Assessment Standards, knowledge, key concepts and skills for this subject as stated in the National Curriculum Statement – everything you need to make a success of your world. However, it does not replace your teacher or textbook!

This Learning Channel programme is for everyone … you may be using this at home or in your classroom with your teacher and classmates. You may have chosen this programme because you are struggling with Life Sciences and as a result you're not achieving the grades you know you deserve. Or, you may be using it because it will help you earn the distinction you've set as your goal. Wherever you are and whatever your reason, this programme will give you the head start you need.

The Learning Channel programme consists of three components:

- Lessons to watch on DVD;
- A learner workbook, with exercises and activities for you to complete; and
- If you are connected to the Internet, the Learning Channel website.

Here are some tips on how to make the most of this programme

Before sitting down to study, make sure you have the following at hand:

- The Learning Channel Life Sciences for Grade 11 DVD;
- The Learning Channel Life Sciences for Grade 11 Workbook;
- Pen and paper; and
- Your DVD remote control – if you are watching this on a DVD player.
  - Insert the Learning Channel Life Sciences for Grade 11 DVD disc into your computer or DVD player. Press play.
  - The subject name and grade will appear followed by the title of the lesson, the lesson number, and the duration of the lesson.
  - Next, you will be told what page to turn to in your workbook.
  - The Learning Outcomes and Assessment Standards will appear, followed by the lesson overview. This will tell you exactly what you will be expected to do by the end of the lesson.

We suggest that you watch the entire lesson before working in the workbook. While watching the lesson you can stop the DVD when you need to review or refresh what has been said or if you want to take down notes.

While watching the lesson you will also see the PAUSE icon. This alerts you to an activity you can complete in the workbook. If you feel that you are ready to try this concept or skill related activity press the PAUSE button on your remote control, television or computer screen. Press PLAY once you have completed the activity.

At the end of the lesson you will see a summary of the key concepts covered. If you've been taking notes you can jot these down or find them in your workbook.

- All the exercises and activities are designed so that you can complete them on your own. Some activities, however, can also be completed with a partner, in a group or as a class. These opportunities are clearly indicated with icons (see page vi).
- Check your answers against the solutions provided at the end of the workbook. Errors may indicate that you have missed or not understood key concepts. Watch the lesson again, refer to any notes you have made and redo the activities you did not master.

The Learning Channel website offers extra features, like subject glossaries, past exam papers, study tips and the National Curriculum Statement. Visit the website to make use of the extra features.

If you are a teacher using this programme with your class, you will find teacher tips at the end of the Learner's Workbook. These tips will help you facilitate the use of the AV lesson and convey its content to your learners.

What the icons mean

DVD – watch the lesson

Individual work – do this activity on your own

Pair work – do this activity with a partner

Group work – do this activity in a group

Class work – do this activity as a class

Self-assessment – assess yourself

Baseline assessment – what I know before starting (prior knowledge)

Formative assessment – how I am progressing

Summative assessment – a check of what I know

Project – a project to research and present

Collection of evidence activity – include in your portfolio

Your Learning Channel presenters

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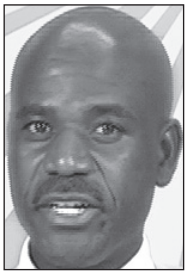
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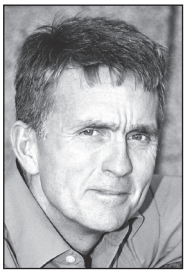
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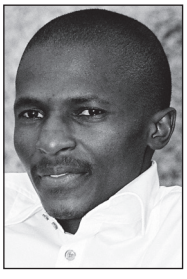
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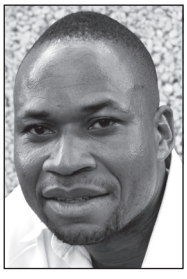
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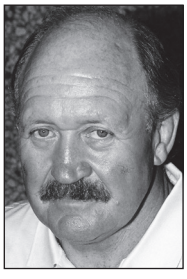

Peter Glover

Other Learning Channel products

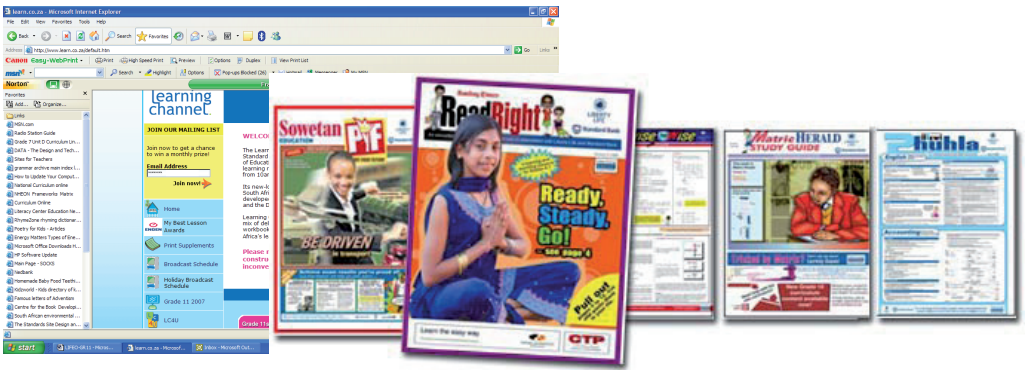
Other products in the Learning Channel Grade 11 series

- Learning Channel Physical Sciences for Grade 11 DVD lessons and Learner's Workbook
- Learning Channel Mathematics for Grade 11 DVD lessons and Learner's Workbook
- Learning Channel Mathematical Literacy for Grade 11 DVD lessons and Learner's Workbook
- Learning Channel English Home Language for Grade 11 DVD lessons and Learner's Workbook
- Learning Channel Life Orientation for Grade 11 DVD lessons and Learner's Workbook
- Learning Channel Business Studies for Grade 11 DVD lessons and Learner's Workbook
- Afrikaans First Additional Language for Grade 11 DVD lessons and Learner's Workbook
- Learning Channel Accounting for Grade 11 DVD lessons and Learner's Workbook
- Learning Channel English First Additional Language for Grade 11 DVD lessons and Learner's Workbook

The Learning Channel (in conjunction with Liberty Life, Standard Bank, SABC Education and the Department of Education) is one of the world's leading televised learning resources, broadcast on SABC1 on Lessondays from 10am to noon.

Its new-look, new-generation content – reflecting South Africa's updated curriculum – has been developed in close collaboration with SABC Education and the Department of Education.

Learning Channel's latest broadcasting endeavours are also supported by a potent mix of delivery platforms – including web, newspapers, hi-tech audio-visual aids, workbooks and SMS – to ensure it maximizes its much-needed reach to South Africa's learners.



Learning Channel offers an extensive range of educational material on video or DVD. You can order 15-20 hours of interactive learning with a tutor, accompanied with a workbook to be used in the privacy of your own home or school.

CDs with digitised video lessons are also available.

To order your Learning Channel CDs, DVDs, videos and workbooks, please contact Takalani. E-mail: info@learn.co.za Phone: (011) 639-0170

TISSUES, CELLS AND MOLECULAR STUDY

Micro-organisms – Viruses

Lessons 1–2

Learning Outcomes and Assessment Standards

Learning Outcome 1
Scientific inquiry and problem solving skills
The Learner is able to confidently explore and investigate phenomena relevant to Life Sciences by using inquiry, problem solving, critical thinking and other skills
Assessment Standards
AS1 *Identify phenomena involving one variable to be tested*
AS2 *Systematically and accurately collect data using selected instruments and/or techniques. Select a type of display that communicates the data effectively*
AS3 *Compare data and construct meaning to explain findings. Draw conclusions and recognise inconsistencies in the data. Assess the value of the experimental process and communicate the findings*
Learning Outcome 2
Construct and apply Life Science knowledge
The Learner is able to access, interpret, construct and use Life Science concepts to explain phenomena relevant to Life Sciences
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AS1 *Use various methods and sources to access information*
AS2 *Identify, describe and explain concepts, principles, laws, theories and models by illustrating relationships. Evaluate concepts, principles, laws, theories and models*
AS3 *Analyse and evaluate the costs and benefits of applied Life Sciences knowledge*
Learning Outcome 3
Life Science, technology, environment and society
The Learner is able to demonstrate an understanding of the nature of science, the influence of ethics and biases in Life Sciences and the inter-relationship of science, technology, indigenous knowledge, the environment and society
AS1 *Compare scientific ideas and indigenous knowledge of the past and the present culture*
AS2 *Compare different ways in which resources are used in the development of biotechnological products and analyse the impacts on the environment and society*
AS3 *Compare the influence of different beliefs, attitudes and values on scientific knowledge and its application in society*

Overview

In this lesson we will focus on viruses. We will learn about their structure and the way in which they function.

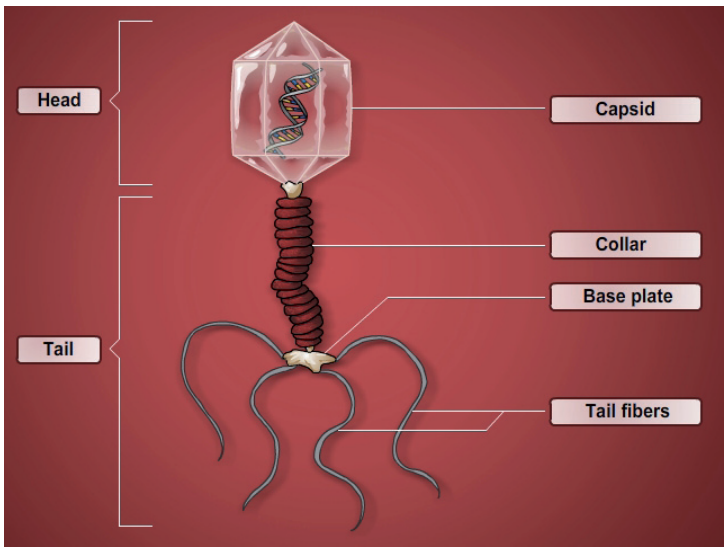
Lesson 1

L C DVD

A virus is very small and can only be seen through an electron microscope. Viruses are acellular because they do not have a nucleus, cytoplasm or organelles. They have no metabolism and do not grow or respire. Under unfavourable conditions, a virus will crystallise. Viruses are classified as parasites because they can only reproduce inside a host. Viruses cause disease and are called antigens.

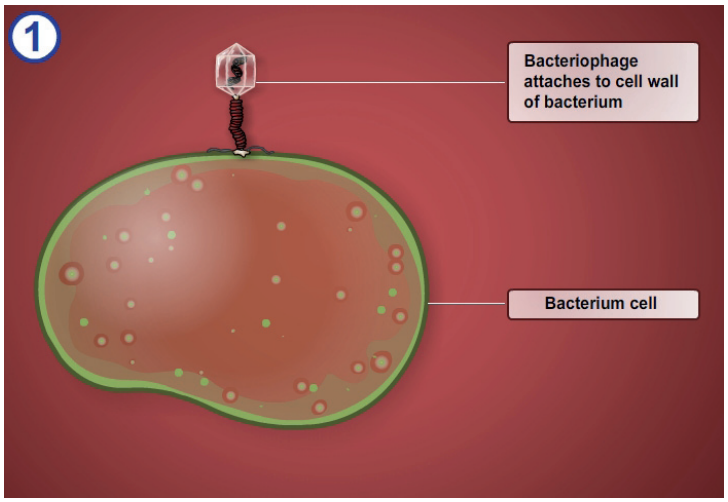
Structure

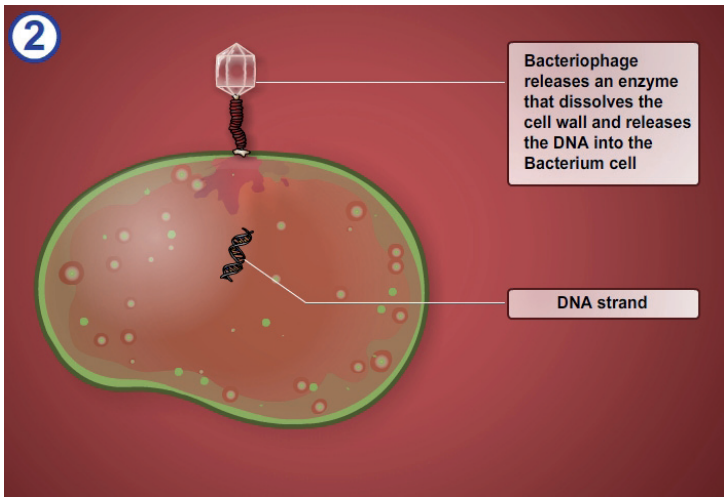
Viruses have many shapes. They have an outside protein capsule called a capsid, surrounding a central core. The central core contains either DNA or RNA. This makes up the head. It has a short collar region which attaches the head to the tail region. The tail has a base plate which contains tail fibres.

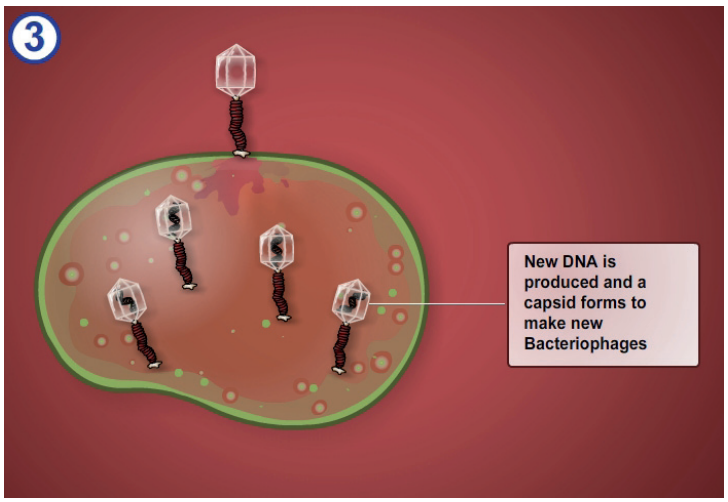


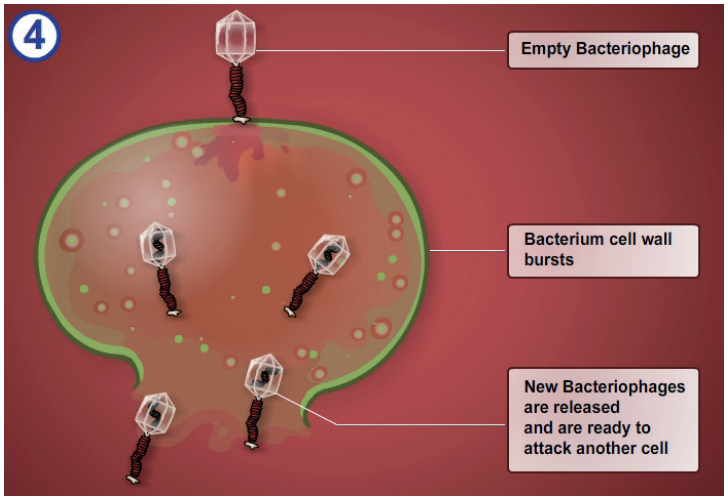
Replication of viruses

A virus needs a host cell to reproduce. The virus penetrates the host cell and introduces its own RNA or DNA into the cell. It uses the host cell's DNA and proteins to produce new virus structures. Each new virus develops a capsid. The host cell membrane splits releasing the viruses into the organism. This is called lysis. The release of the viruses results in the symptoms of the viral diseases.









Viral control

Viruses can be controlled in two ways:

1. Prevention

Avoid contact with an infected organism. When coughing or sneezing, cover your mouth and nose with your hand or a tissue. Keep open cuts and wounds covered and sterile. Get vaccinated for childhood diseases.

2. Immunity

Active Immunity: A virus enters the body. Our immune system detects the antigen and the produces a substance called interferon. This causes the body temperature to rise which is one of the symptoms of an infection. Interferon prevents the virus from reproducing, allowing antibodies time to destroy the virus.

Passive Immunity: A weak strain of the virus is introduced into the body. This is called immunization. Babies and small children must be inoculated by law against childhood illnesses like Measles, Mumps, Polio and Chickenpox. The body responds by producing antibodies. When the child becomes infected, the antibodies are produced again and kill the virus.

Viral diseases in man

- **Influenza:** This is commonly called flu. Symptoms are a fever, headache, sore throat, runny nose and aching muscles. Secondary infections like bronchitis and ear infection are common and caused by bacteria.
- **Poliomyelitis:** The polio virus causes a fever, headache and stiff muscles to start with. Later, the muscle nerve cells are damaged and destroyed, causing paralysis.
- **Measles:** Symptoms are similar to flu with a fever, sore throat, cough and runny nose to begin with. After two days, the body is covered with red spots.
- **Mumps:** Symptoms are a fever and swelling of the glands in the body. In young males, severe swelling of testes may cause sterility as adults.
- **HIV/AIDS:** A retrovirus called the Human Immunodeficiency Virus (HIV) causes this dreaded disease. Once symptoms appear, the disease has progressed to Acquired Immune Deficiency Syndrome (AIDS). AIDS is the final stage of HIV infection.

The virus attacks the immune system. Without an immune system, the infected person is unable to resist diseases that attack the body. The HIV person will become ill with flu, TB, diarrhoea, pneumonia or some cancers. When the immune system is broken down completely, any infection will cause death because the person is too weak to withstand the infection.

How is HIV transferred? HIV survives in body fluids like sperm, breast milk, vaginal fluid and blood. Infection results when a person comes into direct contact with these fluids.

HIV is transferred from an infected mother to her unborn child. AZT is a drug that is given to an infected mother, to prevent the virus from being passed to her unborn child. The mother may not breastfeed after birth. AZT does not make the baby immune to HIV but prevents the virus from entering the baby's blood supply via the placenta.

HIV is not spread by touching, shaking hands, tears, sneezing, coughing or mosquitoe bites.

For several weeks after infection, the body does not show signs of infection. This is called the "window period" and all tests will show negative. It may take up to 6 months for the HIV test to show positive. There may be no symptoms for up to 10 years. When symptoms appear, the disease has progressed to AIDS.

Common symptoms of AIDS are:

- Severe loss of weight;
- Diarrhoea and fevers;
- Skin cancer;
- Organs and lymph glands swell; and
- Secondary infections.

There is no known cure for HIV/AIDS.

Viral animal disease

- **Rabies**: This virus is transmitted to humans by the bite of an infected dog, rat, cat or other infected mammals. The symptoms of the infected animal is a foaming mouth and wild, aggressive behaviour. If a person is infected, the

symptoms are severe headaches, sore body and muscles, convulsions and vomiting. The bite must be cleaned and sterilised. A vaccine injection must be administered by a doctor as soon as possible. Infected animals must be put down.

Viral plant disease

- **Tobacco Mosaic Virus**: This virus contains RNA and infects tobacco and tomato plant leaves. Infected leaves have a spotted appearance. Healthy plants are infected when Aphids transfer the sap of an infected plant. Entire infected crops are burned to destroy the virus. Biotechnology and Genetic Engineering have ensured the development of virus-resistant strains of important crops.

Genetic engineering

This is the transfer of genes from one organism to another, to increase immunity. For immunity against Hepatitis B, the gene for the protein capsid of the virus is inserted into yeast cells. The yeast cells produce the same protein when cultured. The yeast cells are injected into people to stimulate the production of antibodies against the virus.

Biological importances

- Viruses are **parasites** because they require a host cell to reproduce
- Viruses are transferred by **direct contact**, **sneezing**, **coughing**, **blood** and **disease vectors** (mosquitoes, ticks and aphids)
- Viruses are used in Genetic Engineering to transfer **recombinant DNA** into a cell to create a new, useful vaccine or product.

Activity 1

LC INDIVIDUAL

LC SELF ASSESSMENT

Analysis of disease occurrence

1. Carry out a survey within your neighbourhood or amongst your family members and friends, enquiring who has had any of the following diseases: measles, mumps, flu. Record the information in a table.
2. From the data in the table draw a bar graph to display the information.
3. Which of the three diseases infected the most people? Why do you think this is so? Calculate the percentage of the infections.

Activity 2

Viral replication

Draw a flow chart/concept map to show the replication process of viruses.

Activity 3

LC SUMMATIVE ASSESSMENT

Summative assessment

1. Provide a labelled diagram of the structure of a virus. (7)
2. List THREE Biological Importances of viruses. (3)
3. Describe the process of replication in a virus. (8)

4. In South Africa and developing countries, millions of people are dying due to a pandemic which destroys the immune system.

   (a) Name this pandemic. (1)

   (b) Provide the name for this virus causing the pandemic mentioned in 4 a. (1)

   (c) List three ways in which a person can become infected with the virus mentioned in 4 b. (3)

   (d) Name the two main components of a virus. (2)

TISSUES, CELLS AND MOLECULAR STUDY:
Bacteria

Lesson 3

Learning Outcomes and Assessment Standards

Learning Outcomes 1
Scientific inquiry and problem solving skills
The learner is confidently able to explore and investigate phenomena relevant to Life Sciences by using inquiry, problem solving, critical thinking and other skills
Assessment Standards
AS1 *Identify phenomena involving one variable to be tested*
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LEARNING OUTCOME 3
Life Science, technology, environment and society
The learner is able to demonstrate an understanding of the nature of science, the influence of ethics and biases in Life Sciences and the inter-relationship of science, technology, indigenous knowledge, the environment and society
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AS2 *Compare different ways in which resources are used in the development of biotechnological products and analyse their impacts on the environment and society*
AS3 *Compare the influence of different beliefs, attitudes and values on scientific knowledge and its application in society*

Overview

In this lesson we will focus on bacteria and how they spread.

Lesson

LC DVD

Introduction

Bacteria are found everywhere on earth, in water, soil and air. Disease-causing bacteria are called pathogens. Some bacteria are parasites while others are useful. Bacteria are spread by air, water, food, sores, cuts, flies and sexual contact.

Structure

Bacteria are unicellular and live as single cells or in a colony. They are prokaryotic because they have no nucleus. The bacterium is surrounded by a cell wall which is covered with a slime capsule to prevent the bacterium from drying out. The cell has no organelles such as mitochondria, vacuoles or plastids.

DNA strands are found in one area called a nucleoid.

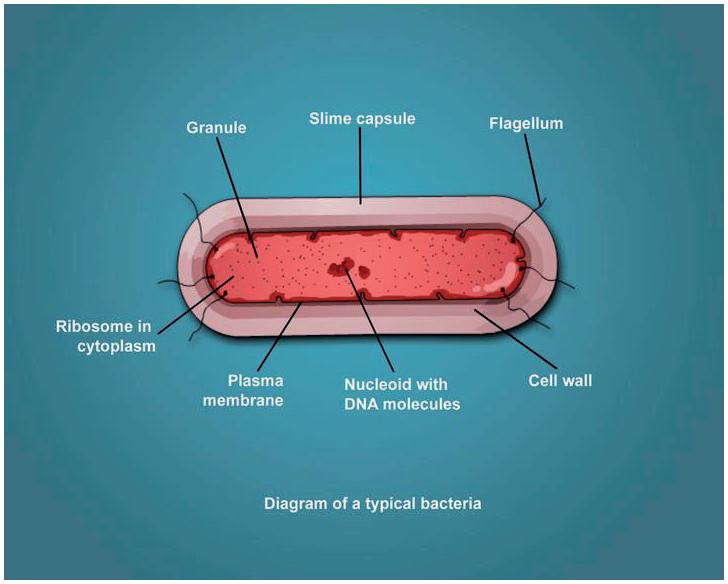


Diagram of a typical bacteria

Bacteria have four shapes:

- **Coccus** – sphere-shaped;
- **Bacillus** – rod-shaped;
- **Vibrio** – comma-shaped; and
- **Spirillium** – spiral or corkscrew-shaped

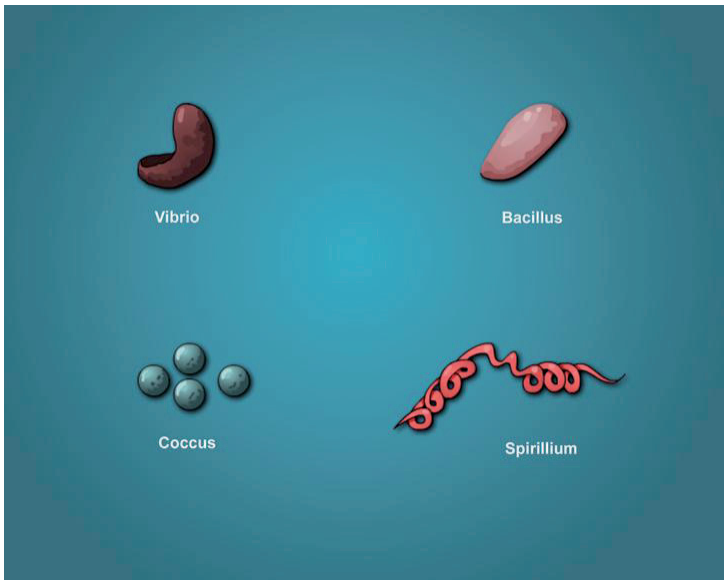


Diagram of various bacteria

Reproduction

Under favourable conditions, bacteria reproduce asexually by a process called binary fission. The reproduction process take about 20 minutes. It begins when the DNA duplicates and moves apart. A transverse membrane develops to separate the cytoplasm and two identical cells result.

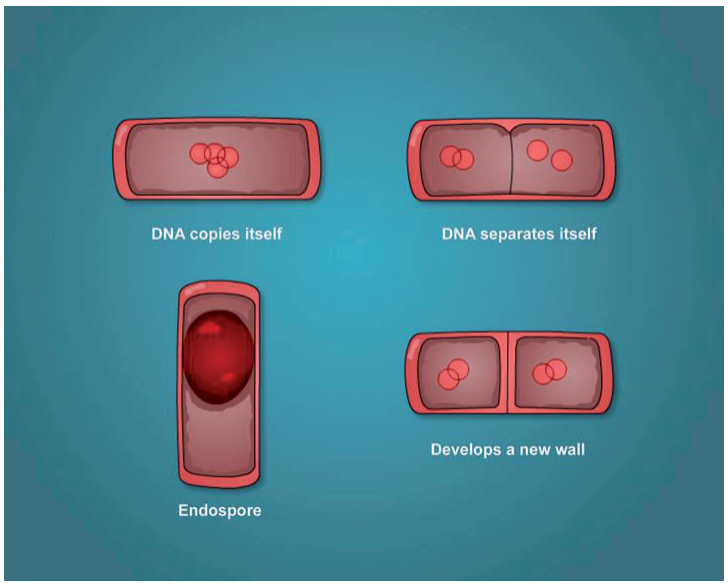


Diagram of the reproduction of bacteria

If conditions are unfavourable, the bacteria forms a structure called an endospore by forming a thick cell wall. The endospore is protected against high temperatures and dehydration. This is why it requires temperatures of 120°C to destroy bacteria.

Treatment of bacterial infections

Bacterial infections must be treated with antibiotics. Antibiotics are produced by bacteria and fungi that live in the soil and produce chemicals to eliminate the competition of rivals. A mould fungus produces penicillin, a substance used in most antibiotics. Antibiotics either stop the bacterial cell wall from developing or they stop protein production in the bacteria. The bacteria need proteins to grow. A lack of protein eventually causes cell death. The course of antibiotics must be completed by an infected person because, if any bacteria survive, reinfection will occur.

Diseases

Cholera: A disease caused by a bacterium that attacks the alimentary canal resulting in severe diarrhoea and vomiting. Infected people become weak and dehydrated. Cholera is spread by ingestion of food and drinking water contaminated with urine and faeces. Prevention of infection: correct sewage disposal and good general hygiene. It is good practice to wash hands after using the bathroom and to wash vegetables and fruit before eating.

Tuberculosis (TB): The tuberculosis bacteria attack the lungs, kidneys and bones. An infected person will run a fever, feel chest pains, cough, lose weight and have difficulty breathing. As the infection progresses, the lungs become blocked with mucus. The pressure causes the alveoli to burst and blood is coughed up. This results in the person becoming very weak, as the absorptive surface for oxygen is reduced. TB is easily transmitted by air when coughing and also by infected milk. Infected people should be isolated. A course of antibiotics must be taken for a minimum of six months. Children are inoculated at local clinics to ensure passive immunity against TB.

Genetic engineering

Genetic engineering is a process by which genes are transferred from one organism to an unrelated species.

Diabetes is a disease that results when the pancreas does not produce the hormone insulin. This is a problem as insulin is required to regulate a person's blood sugar. A lack of blood sugar can result in seizures, coma and possible death.

Biochemists, after much research, are able to produce artificial insulin. Restriction enzymes are removed from bacteria. The biochemists then remove DNA from a healthy person's pancreas cells. The restriction enzymes "cut" pieces of the DNA containing the genes required to produce insulin. The genes are placed inside a plasmid. The plasmid is then absorbed by a healthy bacterium. The genes on the piece of DNA produce proteins, which are converted into insulin. The insulin is then extracted from the bacterium cell. Diabetics inject the insulin into their body every day, and together with a proper diet, they are able to control their blood sugar.

Biotechnology

Bacteria are used to ferment pasteurised milk to produce cheese. The process begins when milk is separated into whey and curd. Bacterial enzymes partially digest the proteins and fats in the curd. Different bacteria are used to produce the different flavours of cheese. Penicillium spores are added to produce the varieties of "blue" cheeses.

Biological importances

Bacteria are saprophytic decomposers and produce humus which makes the soil fertile.

- Bacteria are essential in the nitrogen cycle for nitrification, denitrification and nitrogen-fixing processes.
- Bacteria are used:
  - to produce butter, yoghurt, cheese and maas;
  - to produce vinegar by a process of bacterial fermentation; and
  - by farmers to produce silage for feeding cattle.
- Bacteria decompose and convert urine and faeces into harmless substances such as sulphates and nitrates during sewage treatment.

Activity 1

Prepare bacteria cultures

Work in pairs or groups of four.

You will need:

Nutrient agar plates, two sterile cotton swab sticks, wax crayon, transparent tape, 75% ethanol solution and masking tape.

Method:

1. Choose an area in your school environment which may contain bacteria, e.g., floors, laboratory benches, doorknobs, desks, chairs, etc.
2. Rub a swab over this area and brush the entire surface of the agar in the plate with the swab. Cover the plate with its lid.

3. On the under surface of the agar plate, divide the surface in half by drawing a line down the middle with wax crayon. Write the word 'alcohol' in one half.
4. Dip the second swab in ethanol, remove the lid from the agar plate and brush the alcohol half of the agar with this swab.
5. Cover the plate with the lid again and seal it with tape.

Caution

The bacteria in the plate may be pathogenic. Do not open the plate after step 5. At the end of the investigation, your teacher will dispose of the agar plates.

6. Place the agar plate upside down at room temperature for about 48 hours.
7. Observe the plate and carefully draw the shapes and textures of the different bacterial colonies.

Answer the following questions

1. Describe the appearances of the colonies you drew in step 7.
2. Compare the number of bacterial colonies in the alcohol half of the plate with the number in the other half.
3. What area of your school environment produced the greatest variety and number of bacterial colonies found by your group, and the other groups in your class?
4. What effect did the ethanol have on the growth of the bacteria?

Activity 2

LC INDIVIDUAL

LC PROJECT

Research assignment

Choose any one topic from the table below. Find out how bacteria plays a major role in our lives.

Topics	Elaboration	Questions
1. The problem of food spoilage	a. Food poisoning b. Botulism	1. What is it? 2. What steps in handling food are most likely to cause food poisoning? 3. How do you know if you have food poisoning? 4. Describe how botulism is caused. 5. Is botulism caused by a parasite or a poison?
2. Food preservation methods	a. Refrigeration and freezing b. Canning c. Chemical preservation d. Dehydration	1. How does refrigeration and freezing help? 2. Describe canning as a process for food preservation. 3. Why do dehydrated foods keep longer? 4. How do salt, sugar and vinegar keep food from spoilage? 5. What other food chemicals are used for food preservation?
3. Economic importance of bacteria	a. Vinegar and pickling b. Dairy products c. Sewage disposal d. Production of silage	1. Describe the product of the following: a. vinegar b. cheese/yoghurt 2. What role do bacteria play in sewage disposal?
4. The good earth	a. Enriching the soil by bacterial decay b. Nitrogen fixation	1. How do bacteria enrich the soil by decay? 2. Describe nitrogen fixation in the soil.

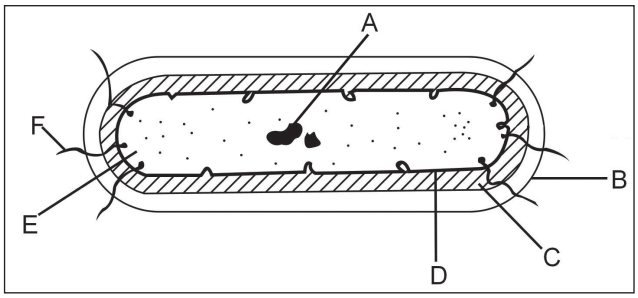
INDIVIDUAL

SUMMATIVE ASSESSMENT

Activity 3

Summative assessment: Bacteria

1. The diagram below represents a single bacterial cell.



(a) Provide labels for parts C, D, E and F. (4)

(b) State the function/s of part A and part F. (2)

(c) Suggest a reason why disease-causing bacteria have a thick layer (part B). (1)

2. List four features that enable bacteria to survive in a wide variety of habitats. (8)

3. Explain the reproduction process in bacteria. (5)

4. Tabulate THREE differences between viruses and bacteria. (6)

5. Study the graph below showing the change in the number of live bacteria in a colony during a six-day period, and answer the questions that follow.

(a) What is the highest number of bacteria recorded? (1)

(b) How long did it take the bacteria to reach that figure? (1)

(c) Suggest TWO reasons why the number of living bacteria fell after day 5. (2)

TOTAL – 30

TISSUES, CELLS AND MOLECULAR STUDY
Fungi

Lesson 4

Learning Outcomes and Assessment Standards

Learning Outcome 1
Scientific inquiry and problem solving skills.
- Microscopic skills or other comparative methods and resources must be used and shown.
- The Learner is able to confidently explore and investigate phenomena relevant to Life Sciences by using inquiry, problem solving, critical thinking and other skills
- Research tissue growth
- Collect latest data regarding a disease

Assessment Standards
AS2 *Systematically and accurately collect data using selected instruments and/or techniques. Select a type of display that communicates the data effectively, e.g. Graphs*
AS3 *Compare data and construct meaning to explain findings. Draw conclusions and recognise inconsistencies in the data. Assess the value of the experimental process and communicate the findings*

Learning Outcome 2
Construct and apply Life Science knowledge
- The Learner is able to access, interpret, construct and use Life Science concepts to explain phenomena relevant to Life Sciences
- Study Fungi, structure, characteristics and value
- Choose one related disease and outline causes, effects and management e.g.: rusts, Candida and mildew

Assessment Standards
AS1 *Use various methods and sources to access information*
AS2 *Identify, describe and explain concepts, principles, laws, theories and models by illustrating relationships*
- Evaluate concepts, principles, laws, theories and models

Learning Outcome 3
Life Science, technology, environment and society.
- The Learner is able to demonstrate an understanding of the nature of Science, the influence of ethics and biases in Life Sciences and the inter-relationship of science, technology, indigenous knowledge, the environment and society
- Tissue sampling, tissue cultures, Micro-organisms in food industry, Medical Biotechnology e.g. antibiotics
- Beliefs and attitudes concerning diseases

Assessment Standards
AS1 *Compare scientific ideas and indigenous knowledge of the past and the present culture*
AS3 *Compare the influence of different beliefs, attitudes and values on scientific knowledge and its application in society*

Overview

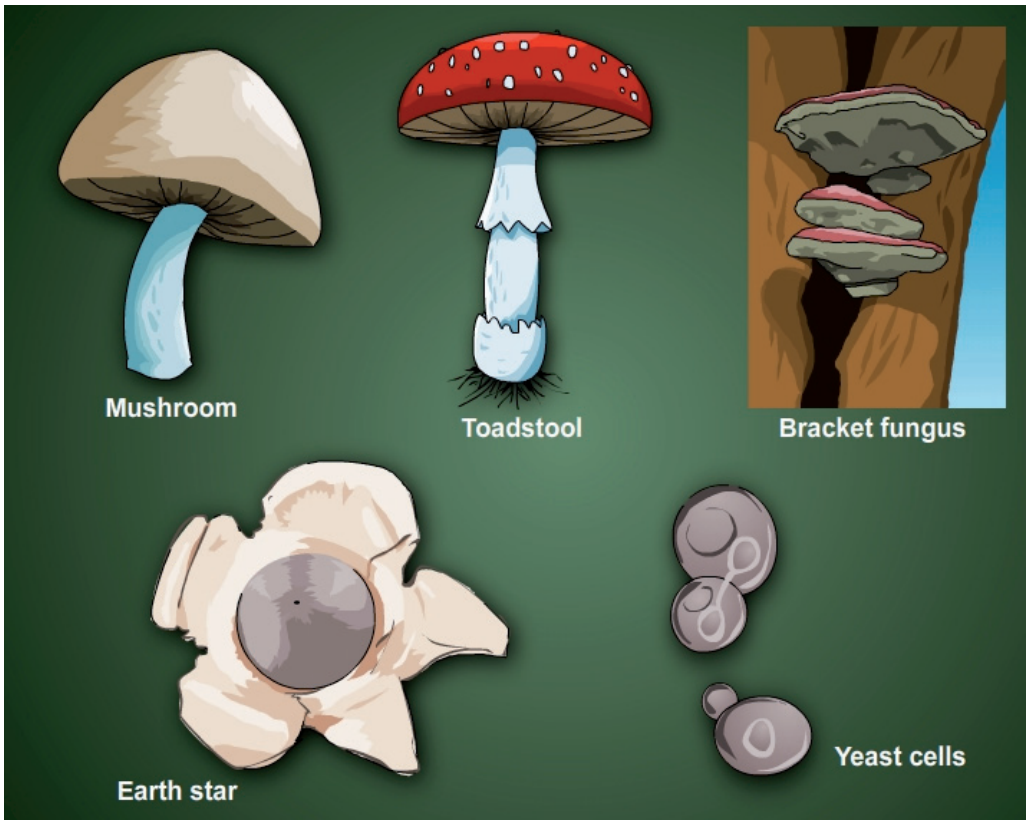
In this lesson we will focus on fungi. We will learn about how and where they grow.

LC DVD

Lesson

Introduction

Fungi belong to the called Kingdom Mycophyta. All Fungi flourish in a warm, dark and moist environment e.g. mushrooms, yeast (used in the baking of bread), toadstools and moulds. Mould can be found growing on stale bread, cheese, rotting fruit, in the soil and also on dead wood.



A variety of Fungi

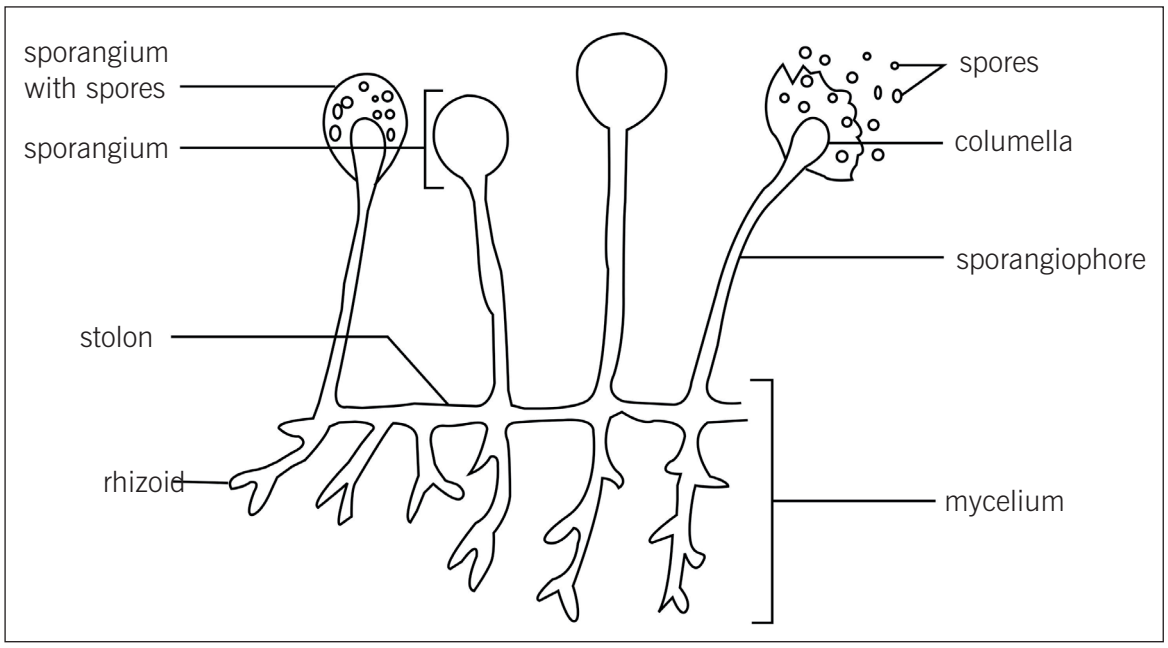
Structure

Fungi have a definite nucleus so they are called eukaryotic and are classified as plants because they have a cell wall. Fungi have no chloroplasts so they must obtain food from their environment. They are therefore classified as heterotrophic.

Generally fungi has a thallus structure. This means that they have no true leaves, stems or roots. Most fungi consist of threadlike hyphae, rather than individual cells. The hyphae are coenocytic, which means that the cytoplasm and nuclei are distributed throughout the structures, with no cross walls to divide it into separate cells.

Types of hypha are:

- **Rhizoids** – hyphae that grow into root-like structures and absorb nutrients;
- **Stolons** – hyphae that grow sideways along the substrate;
- **Sporangiophores** – hyphae that grow upwards; and
- **Mycelium** – the total mass of all the hyphae together.



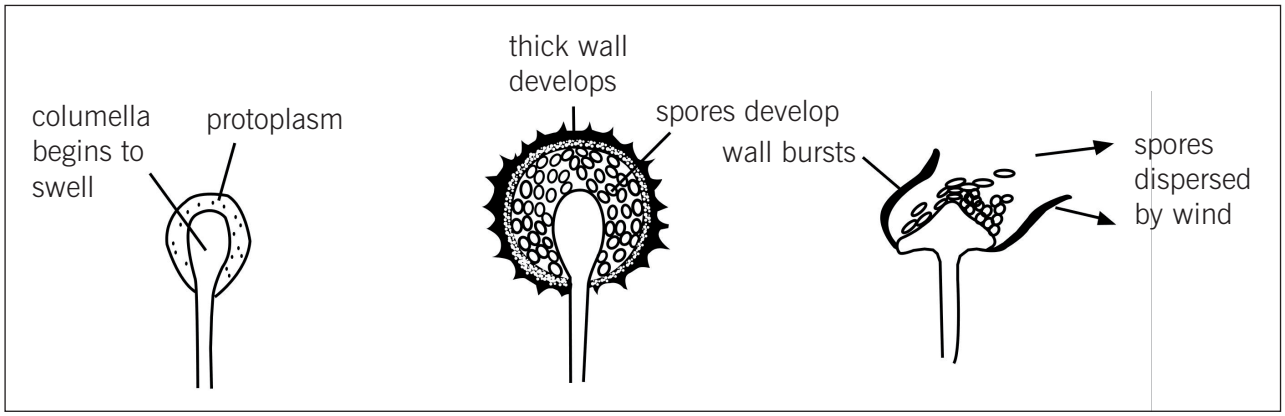
Typical rhizopus

Yeast cells have no hyphae. They are separate cells enclosed by a cell wall and contain one nucleus, a vacuole and cytoplasm.

Reproduction

Asexual reproduction

Asexual reproduction occurs when conditions are favourable. A swollen tip develops on the end of the sporangiophore, called a sporangium. A cross wall called the columella separates the sporangiophore from the sporangium. The sporangium contains spores. When it is ripe, the sporangium bursts, releasing the spores into the air. The spores land on a substrate like bread and germinate into promycelium.



Sexual reproduction of bread mould

Sexual reproduction takes place when conditions are unfavourable. Two erect hyphae (a + and a – hyphae) grow next to each other. A swelling called the gametangium, develops on each hypha and contains a gamete. The gametangia grow until they touch. The cell wall dissolves and the two gametes fuse to form a diploid zygote. A thick coat develops around the zygote called a zygospore. When conditions are favourable again, the diploid zygote will undergo meiosis to halve the chromosomes, resulting in haploid structure. The zygospore will burst open to release haploid spores. The spores develop into promycelium.

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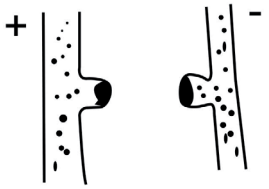
<tr>
<td>1.
 

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 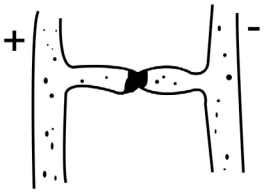

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 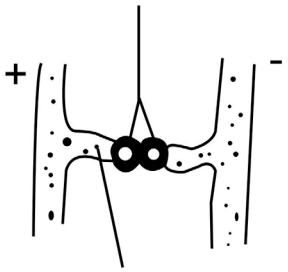

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 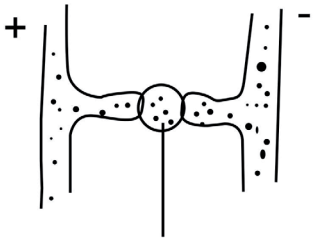

fertilisation occurs in fused gametangia</td>
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 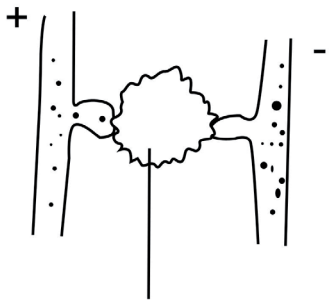

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 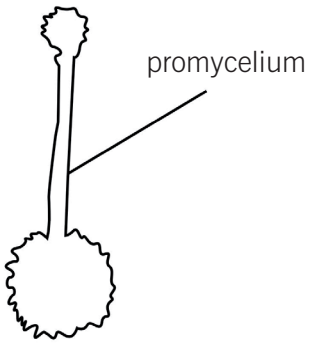

zygospore germinates when conditions are suitable</td>
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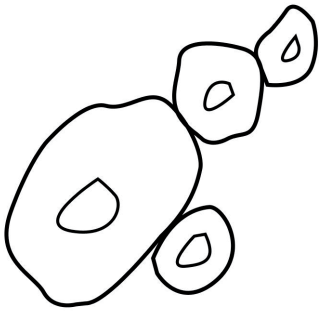
Yeast reproduces asexually

Yeast cells reproduce asexually by making buds. A bud is an outgrowth which develops on the side of the mother cell. This bud breaks off and a new independent yeast cell results.



yeast cells budding

Nutrition

Fungi are heterotrophic and must take their food into their body. Some species are parasitic and obtain nutrition from a host. These fungi will cause diseases. Some species are saprophytic and live on dead organic matter. The saprophytic fungi are important because they decompose dead organisms to provide nutrients to the soil.

Bread mounds spread across the surface of the bread. Each rhizoid secretes enzymes called cellulase to break down cellulose and amylase to break down starch into glucose. The glucose is absorbed into the cells through the rhizoid hyphae, so digestion is extracellular. Yeast is used in the fermentation process to produce alcohol, carbon dioxide and energy by breaking down glucose. The process is called Fermentation and occurs during anaerobic respiration. Yeast is used to produce beer, spirits and wine.

Diseases

In plants, fungal hyphae penetrate the tissue of their host and digest the cells. Sporangia produce fine spores on the surface of the leaves. The spores germinate and absorb nutrients from the leaves, until the infection causes the death of the plant. Parasitic fungi e.g.: blight, mildews and rusts cause losses to plant crops. Through Biotechnology, new varieties of plants are developed that resist fungal diseases. Fungicides are developed to kill fungal infestations. In humans, Tinea causes ringworm and athlete's foot. The skin becomes infected resulting in skin irritation, swelling and redness. Tinea is contagious and is spread by direct contact with the spores or infected people. Fungicidal ointments or powders are applied directly to the infected area and this kills the fungus. Traditional healers advise infected people to soak feet in a solution of potassium permanganate or to rub peeled cloves of garlic, aloe sap or grated ginger root onto the infected area. Gentian Violet solution is also known to cure ringworm effectively.

Candida is a yeast that lives in the human body. Natural bacteria control the Candida population. When a person is ill or has been on antibiotics, their immunity is low and the Candida take advantage growing out of control. A yeast infection like vaginal thrush, oral thrush, generalised Candida and skin thrush result. Symptoms are red inflamed areas with a yellowish discharge; the skin becomes itchy and inflamed. Vaginal and oral thrush are spread by physical contact. A person can take interflora or eat yoghurt when taking a course of antibiotics. Once Candida has caused infection, anti-yeast creams and prescription tablets must be taken and used. Traditional Healers advise the use of a tea made of myrrh or marigold flowers. The tea can be used as a mouth wash for oral thrush or by adding a teaspoon of salt to the mixture; as a vaginal wash.

Biological importances

- Fungi are used to produce antibiotics. Blue mould is used to produce penicillin and soil fungus is used to produce streptomycin.
- Yeast is used to make bread.
- The fermentation process is used to produce beer, spirits and wine.
- Mushrooms, truffles and morels are used in cooking.
- Biotechnology: a fungus called Fusarium graminearum is used to produce a food product rich in myco-proteins which is high in protein and dietary fibre but low in fat, so it makes a very good meat supplement.

INDIVIDUAL

FORMATIVE ASSESSMENT

Activity 1

Growth of fungal mould

Place a piece of moistened bread in an open Petri dish or a small Tupperware. Leave it exposed for about 10 minutes. Cover the dish to prevent the bread from drying out. Place the dish in a warm, dark place. Leave for a few days.

(a) Why was the piece of bread moistened?

(b) Why was the bread exposed to air for a few minutes.

(c) Describe what you observe growing on the bread.

(d) Now proceed with the microscopic investigation.

Aim: To observe the structure of the mycelium.

Apparatus: Glass slide, cover slip, Petri dish, water, microscope, bread mould.

Method: Place a piece of fungal thread on a slide in a drop of water. Tease the threads apart with dissecting needles. Cover with a cover slip. Observe L.P. and then H.P.

QUESTIONS:

(a) Are the fungal threads branched or unbranched?

(b) These threads are said to be coenocytic. What is meant by this term?

(c) Name the different hyphae that are visible. Give one function of each.

(d) Are sporangia visible? If yes, how do they appear?

(e) Give a labelled diagram of a portion of the mycelium.

INDIVIDUAL

PROJECT

Activity 2

Growth of a fungal disease

- Research one disease from the list below:

Candida fungus, athlete's foot, ringworm or any other fungal diseases that you are aware of.

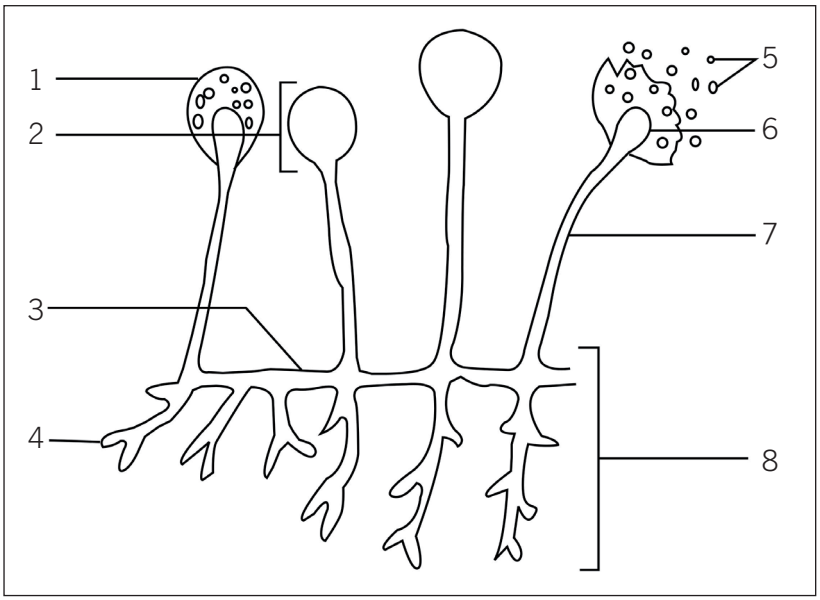
- You need to prepare a poster on the disease you have chosen, ensure that the following aspects are covered:
  - signs and symptoms
  - cause/s of the disease
  - treatment of the disease

Activity 3

LC SUMMATIVE ASSESSMENT

Summative assessment: Fungi

1. The following diagram shows a mould fungi:



   (a) Provide labels for the parts 6, 7, 3 and 4. (4)

   (b) State ONE function for each part labelled 4, 7 and 1. (3)

   (c) What type of nutrition occurs in this plant? Give a reason. (2)

   (d) Which reproductive process is responsible for the formation of the part labelled 5? (1)

   (e) What special name is given to the part labelled 8. (1)

2. Describe sexual reproduction in Fungi. (8)

3. Give the correct biological term for each of the following.

   (a) Type of nutrition in the bread mould.

   (b) The absence of cross walls in the hyphae of the bread mould.

   (c) A plant body where no true roots, stems and leaves can be distinguished.

   (d) An enzyme occurring in fungal filaments.

   (e) Structure in sexual reproduction of the bread mould that contains gametes. (5)

4. Name TWO fungal diseases. (2)

5. State the importance of each of the following:

   (a) Yeast

   (b) Bread mould

   (c) Penicilium

   (d) Ringworm fungus. (4)

Lesson 5

TISSUES, CELLS AND MOLECULAR STUDY

Protozoa

Learning Outcomes and Assessment Standards

Learning Outcome 1
Scientific inquiry and problem-solving skills
- Microscopic skills or other comparative methods and resources must be used and shown
- The learner is confidently able to explore and investigate phenomena relevant to Life Sciences by using inquiry, problem solving, critical thinking and other skills
- Research cell structures and tissue growth
- Collect latest data regarding information about diseases

Assessment Standards
AS1 *Systematically and accurately collect data using selected instruments and/or techniques. Select a type of display that communicates the data effectively, e.g. graphs*
AS2 *Compare data and construct meaning to explain findings. Draw conclusions and recognise inconsistencies in the data. Assess the value of the experimental process and communicate the findings*

Learning outcome 2
Construction and Application of Life Sciences knowledge
- The learner is able to access, interpret, construct and use Life Sciences concepts to explain phenomena relevant to Life Sciences
- Study protozoa: structure, characteristics and value
- Choose one related disease and outline causes, effects and management, e.g.: malaria or amoebic dysentery

Assessment Standards
AS1 *Use various methods and sources to access information*
AS2 *Identify, describe and explain concepts, principles, laws theories and models by illustrating relationships*
Evaluate concepts, principles, laws, theories and models

Learning Outcome 3
Life Science, technology, environment and society
- The learner is able to demonstrate an understanding of the nature of science, the influence of ethics and biases in Life Sciences and the inter-relationship of science, technology, indigenous knowledge, the environment and society
- Tissue sampling, tissue cultures, micro-organisms in food industry, medical biotechnology, e.g. antibiotics
- Beliefs and attitudes concerning diseases

Assessment Standards
AS1 *Compare scientific ideas and indigenous knowledge of past and present cultures*
AS2 *Compare the influence of different beliefs, attitudes and values on scientific knowledge*

Overview

In this lesson we will focus on protozoa. We will learn about where they live and how they function.

LC DVD

Lesson

Introduction

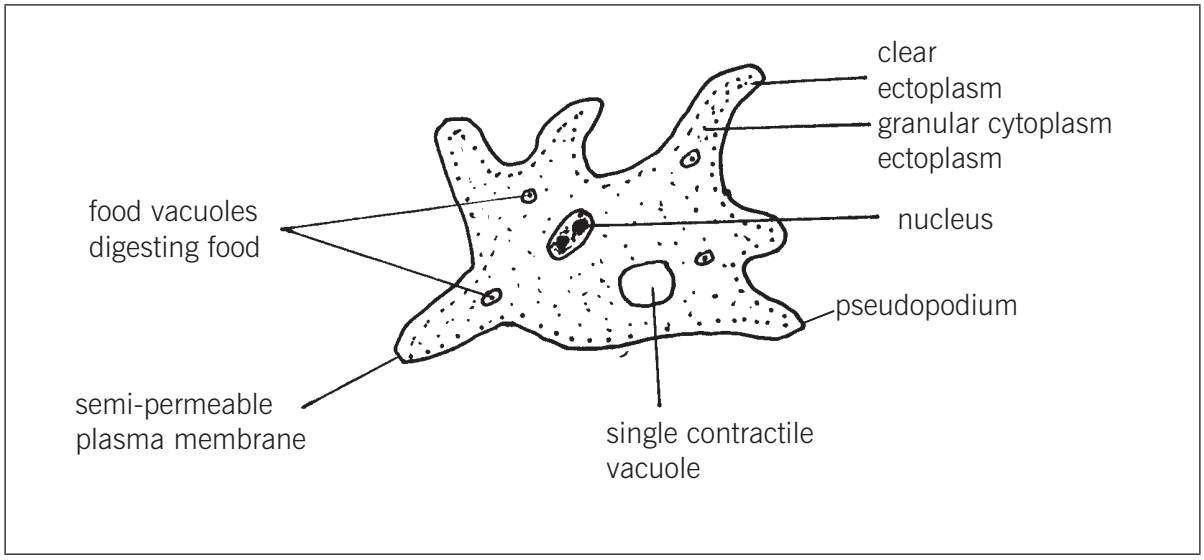
The word protozoa means “first animal”. They belong to the kingdom of protista. They are mostly single-celled organisms that are found in fresh water, sea water or blood. Organisms such as amoeba, euglena, paramecium, plasmodium and chlamydomonas are all protozoans.

Structure

Protozoans are eukaryotic because they have a nucleus and membrane-bound organelles. They move by means of pseudopodia, cilia or flagella depending on the species. Gaseous exchange occurs directly through the cell membrane which

encloses the cell. Gases such as oxygen and carbon dioxide simply diffuse from a higher concentration to a lower concentration.

An amoeba has pseudopodia which it uses to move through the water. The word pseudopodia means “false feet”.



Example of a protozoa: amoeba sp

Reproduction

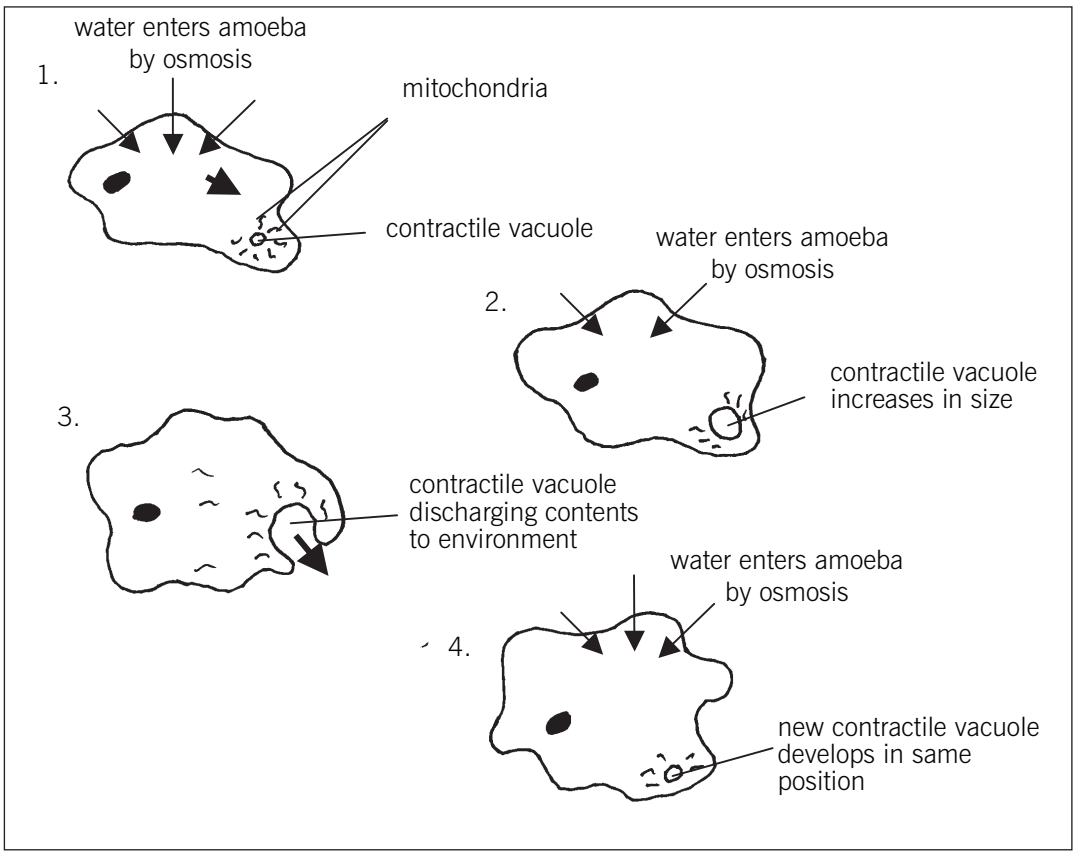
Under favourable conditions amoebas reproduce by a process called binary fission. This process is asexual and similar to mitosis. The nucleus divides to form two identical daughter nuclei, which move to opposite ends of the cell. The cytoplasm splits and two new amoebas are formed.

Under unfavourable conditions, an amoeba forms an encystment to protect itself from adverse conditions. The amoeba becomes a round structure and secretes a waterproof capsule. This structure protects it against dehydration and high/low temperatures. As soon as conditions become favourable again, the cyst bursts and the amoeba is released to reproduce by binary fission.

Nutrition

Some protozoans contain chloroplasts and are able to photosynthesise. They are autotrophic because they produce their own food, e.g. euglena and chlamydomonas.

Some protozoans, such as amoebas, are heterotrophic and ingest food particles. Amoebas use their pseudopodia to engulf the food by a process called phagocytosis. The food particle is surrounded by the pseudopodia and pulled into the body. Inside the cell, a lysosome attaches to the food vacuole and releases enzymes. The enzymes digest the food particle and the nutrients are moved around the cytoplasm for assimilation by the organelles.



Osmoregulation and excretion

Paramecium and vorticella have a special method of drawing food towards them. They have cilia and create a current around their body. The food is taken into the cytoplasm as a food vacuole. The lysosome digests the food particle.

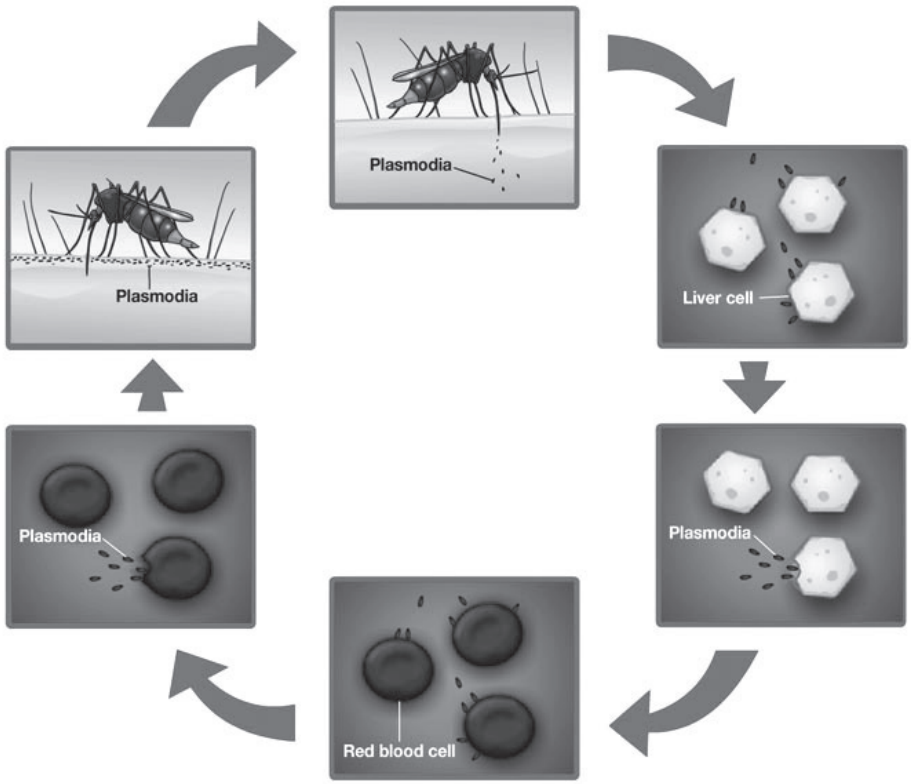
Diseases

Malaria

Approximately two million people die from malaria each year. A protozoan called plasmodium causes the malarial disease. The plasmodium is transferred to humans by the bite from an infected mosquito. Mosquitoes are called vectors because they are organisms that transmit parasites and diseases.

1. The mosquito has sharp mouthparts that are "injected" through the skin of a human or animal. This tube reaches into a capillary. Mosquito saliva contains an anticoagulant which stops blood from clotting so that it can be sucked up freely. An infected mosquito carries plasmodium in its saliva, and so these organisms enter the blood.
2. The plasmodium makes its way to the liver where it reproduces and causes the liver cells to burst. The daughter plasmodium cells are released back into the bloodstream and now enter the red blood cells. Here they reproduce quickly inside the red blood cells. They cause the red blood cells to burst open and the infected person experiences the symptoms of malaria. The patient will get cold chills which are followed by very high temperatures. With the destruction of thousands of red blood cells by these explosions, the patient becomes anaemic.
3. When a mosquito bites an infected person, the plasmodium parasites are sucked up by the mosquito. The plasmodium reproduce inside the

mosquito and move to the salivary glands. When the mosquito bites another person, the cycle is repeated.



Plasmodium life cycle

Control of malaria outbreaks

- Destruction of mosquito larvae with insecticides.
- Oil may be sprayed onto breeding areas to smother the larvae.
- Breeding areas where water collects, such as in old tin cans or discarded car tyres, should be drained.
- Citronella candles may be burned to repel mosquitoes.
- Mosquito repellant products may be applied directly to the skin.
- People travelling to areas known for malaria can take a preventative drug called chloroquinine to destroy plasmodium as soon as it enters the bloodstream.
- Once infected, drugs such as primaquinine are used to kill the plasmodium in the blood.

Amoebic dysentry

Amoebic dysentery is a disease associated with poor hygiene and sanitation. Consuming water or food that is contaminated with entamoeba causes dysentry. Water can become contaminated by sewage, and food by dirty hands or flies. Entamoeba live commensally in the intestines of humans. They feed on bacteria found in the gut. Entamoeba invade the lining of the intestines and become parasites. The symptoms of dystentery are ulcers, bleeding, severe abdominal pain, high temperatures, vomiting and diarrhea. The patients become dehydrated from all the vomiting and diarrhea. When patients are not treated for dehydration, the kidneys will fail. This could result in death.

Control of dysentry

- Drink water from safe sources or boil it first.
- Sangomas advise that, to treat dehydration, a mixture of 250 ml water, ½ teaspoon salt and ½ teaspoon sugar is mixed. The mixture is easily absorbed by the stomach.
- Good sanitation practices are important, such as washing hands after using the toilet.
- Control of vectors such as flies.
- Drugs such as metronidazole and diloxanide furoate are used to kill entamoeba.

Biological importances

- Protozoans are an important link in the food chain as they are a food source for larger organisms.
- Deposits of limestone, chalk and flint are created as a result of the encystment shells formed by protozoans. When the protozoans die, their shells dry out and harden, forming the deposits.
- Protozoans assist with digestion in animals such as cattle.

Activity 1

Graph skills

1. A study was made on large groups of amoeba species, which were kept in different salt solutions. The rate of elimination of water by their contractile vacuoles was measured and the results recorded in a table.

% of salt solution	Rate of elimination
5	3
10	6
15	5
20	3
25	1

   (a) Plot a graph using the data in the table. Determine the dependent and independent variables. Ensure you use the correct scale.

   (b) What can you deduce from the graph?

   (c) What function of amoeba is referred to by the graph?

Activity 2

Research on malaria

Research the disease malaria considering the following:

- What causes malaria?
- How is malaria spread?
- Life cycle of the malaria parasite.
- Symptoms of malaria.
- High-risk malaria areas.
- Preventing malaria.
- Treatment of malaria.

Activity 3

INDIVIDUAL

SUMMATIVE ASSESSMENT

COLLECTION OF EVIDENCE

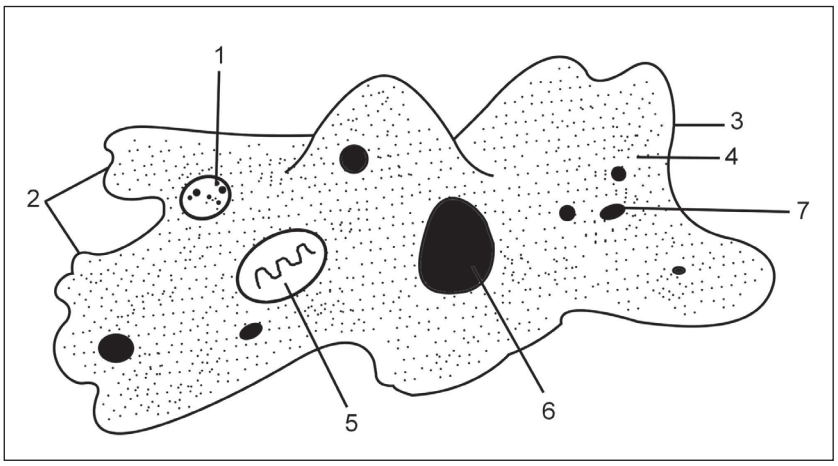
Summative assessment: Amoeba

1. For each of the phrases in column I, state whether it applies to A only or, B only, both A and B or none in column II. Write down A only, B only, A and B, or none in your answer book.

COLUMN I	COLUMN II
1.1 used in osmoregulation	A contractile vacuole B lysosome
1.2 outermost layer in amoeba	A cell membrane B endoderm
1.3 elimination of metabolic waste	A ingestion B excretion
1.4 contents of amoeba	A ectoplasm B endoplasm
1.5 diffusion in amoeba	A taking in O2 B eliminating CO2

(10)

2. Study the diagram of an amoeba and answer the questions that follow.



(a) Identify parts numbered 1 to 7 (7)

(b) What type of digestion occurs in amoeba? Describe this process?

(c) How is phagocytic feeding achieved in amoeba?

(d) Explain how amoebas are able to survive when conditions become unfavourable. (6)

3. Name two diseases caused by protozoa. (2)

4. What are the symptoms of the diseases you have mentioned in question 3?

Lessons 6 – 8

STRUCTURE, CONTROL AND PROCESSES IN BASIC LIFE SYSTEMS OF PLANTS AND HUMANS

Structure and support

Learning Outcomes and Assessment Standards

Learning Outcomes 1
Scientific inquiry and problem-solving skills
- Investigate through dissections and/or comparative techniques, using models and charts
- The learner is confidently able to explore and investigate phenomena relevant to Life Sciences by using inquiry, problem solving, critical thinking and other skills
- Design a model: anatomy of systems
- Conduct research into the latest medical practices

Assessment Standards
AS1 *Systematically and accurately collect data using selected instruments and/or techniques. Select a type of display that communicates the data effectively, e.g. Graphs and models*
AS2 *Compare data and construct meaning to explain findings. Draw conclusions and recognise inconsistencies in the data. Assess the value of the experimental process and communicate the findings*
Learning Outcomes 2
Construct and apply Life Science knowledge
- The learner is able to access, interpret, construct and use Life Science concepts to explain phenomena relevant to Life Sciences
- Study skeletal structure, bones, joints, muscles and disorders

Assessment Standards
AS1 *Use various methods and sources to access information*
AS2 *Identify, describe and explain concepts, principles, laws, theories and models by illustrating relationships*
Evaluate concepts, principles, laws, theories and models
Learning Outcomes 3
Life Science, technology, environment and society
- The learner is able to demonstrate an understanding of the nature of science, the influence ethics and biases in Life Sciences and the inter-relationship of science, technology, indigenous knowledge, the environment and society
- Bone tissue, plant tissues, hormones
- Diseases associated with the skeleton and how to prevent these

Assessment Standards
AS1 *Compare scientific ideas and indigenous knowledge of past and present cultures*

Overview

In this lesson we will focus on the human skeleton.

L C DVD

Lesson

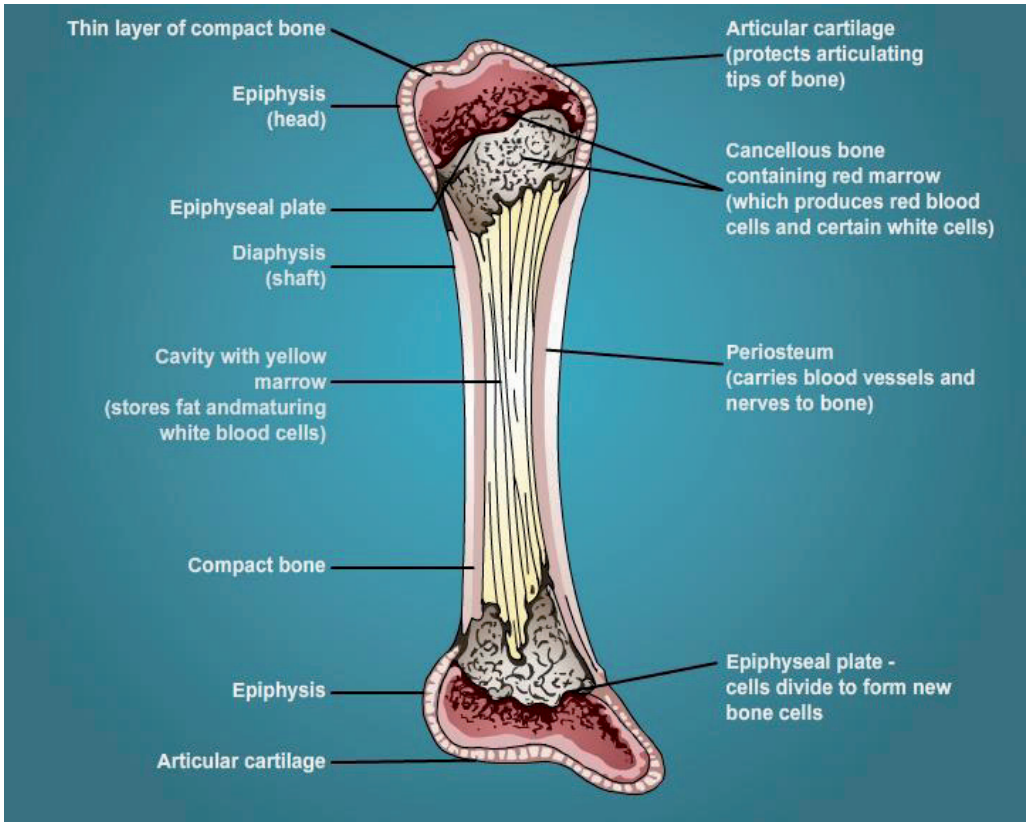
Introduction

Animals are able to move to look for food, shelter and mates. Structure and support is important for movement. There are two main types of skeletons: exoskeletons and endoskeletons. Insects and snails have exoskeletons with a hard outer shell. Endoskeletons are inside the body and provide internal support and continuous growth until adulthood. Endoskeletons consist of bone (vertebrates), cartilage (sharks) or hydrostatic fluid (earthworms).

Human skeleton

Humans have an internal skeleton consisting of bone, cartilage and connective tissue.

- the skeleton gives shape and support
- protects vital organs
- muscles allow for movement
- red bone marrow in long bones produce red blood cells

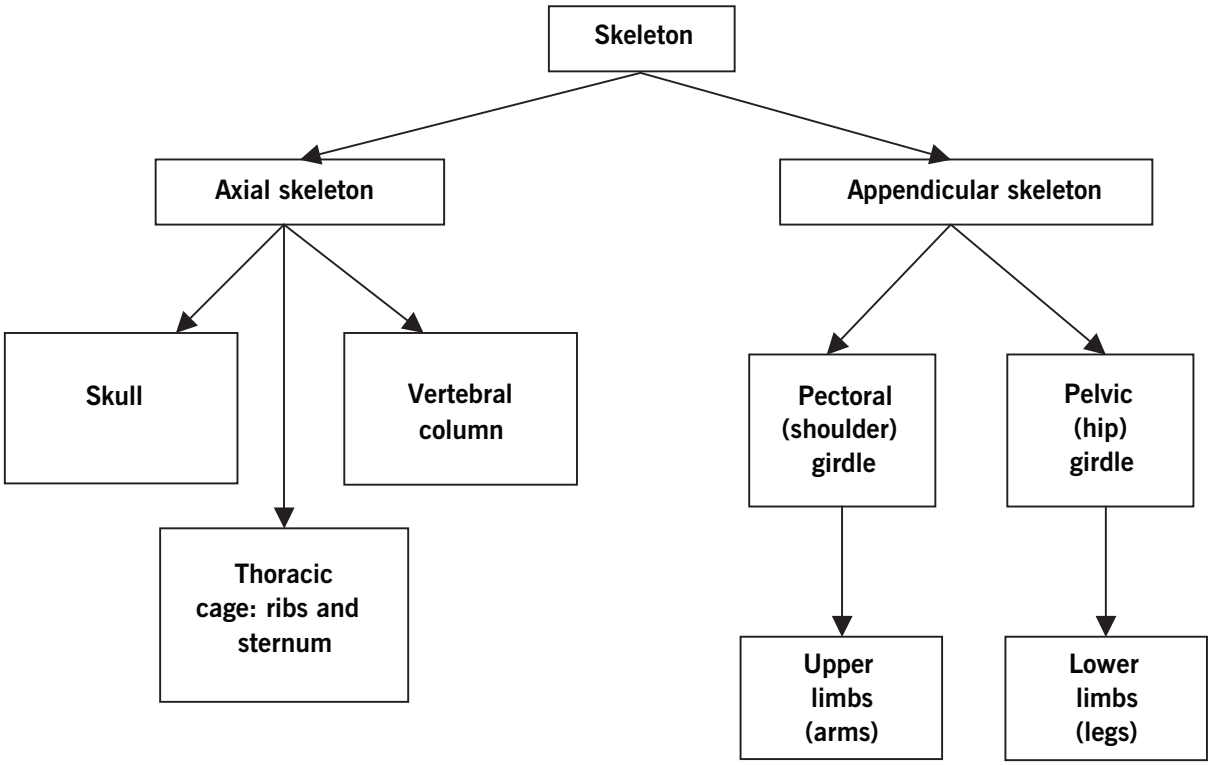


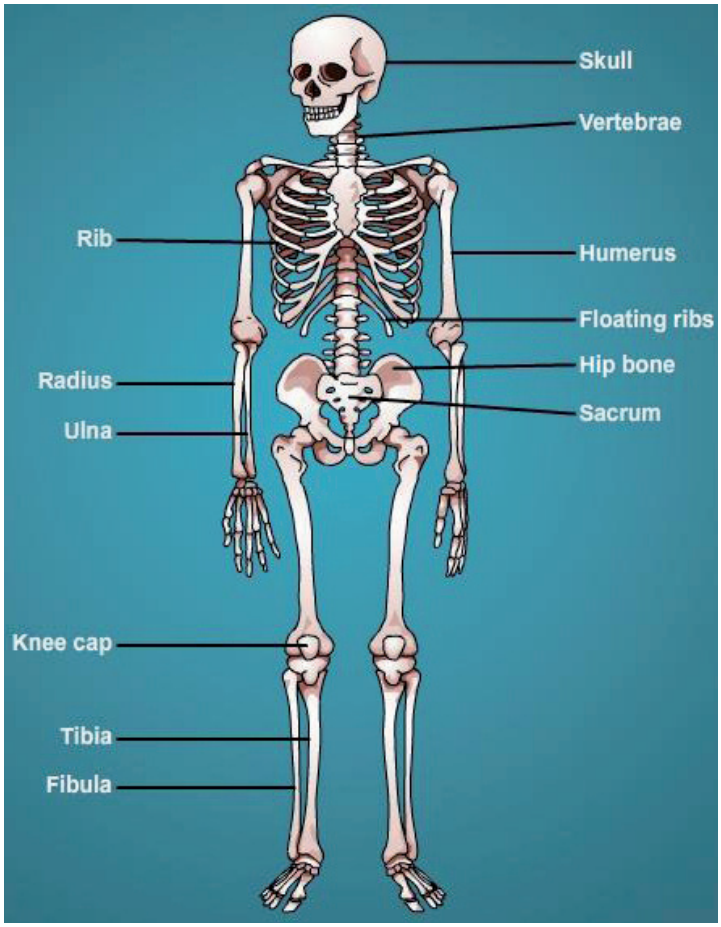
Types of bones

- **Long bones** – consist of a central shaft and two heads, one at each end, e.g. the femur (longest bone in the body).
- **Flat bones** – have two layers of compact bone on the outside with a layer of spongy bone on the inside, e.g. the shoulder blades.
- **Irregular bones** and **short bones** – have a thin layer of compact bone covering spongy bone on the inside, e.g. the vertebrae of the spine and the small bones in the hands and feet.

The skeleton

The human skeleton consists of 206 bones, which are divided into two main zones: the **axial** and **appendicular** skeleton.





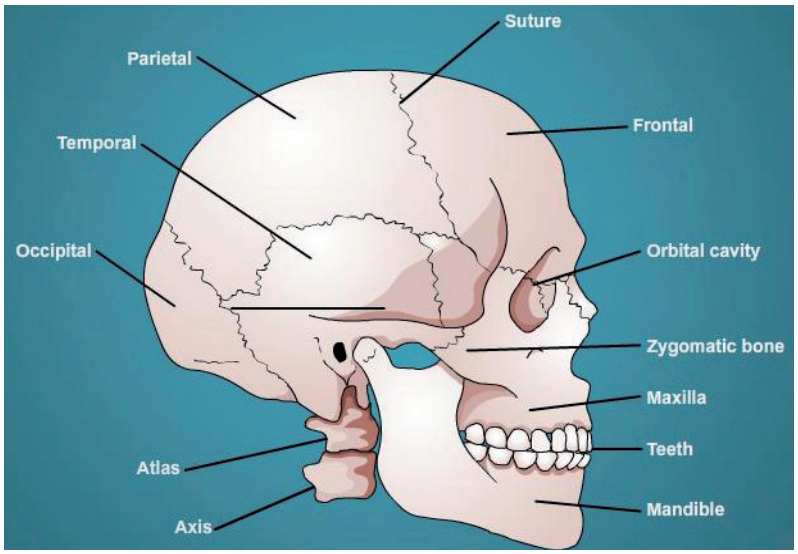
The axial skeleton

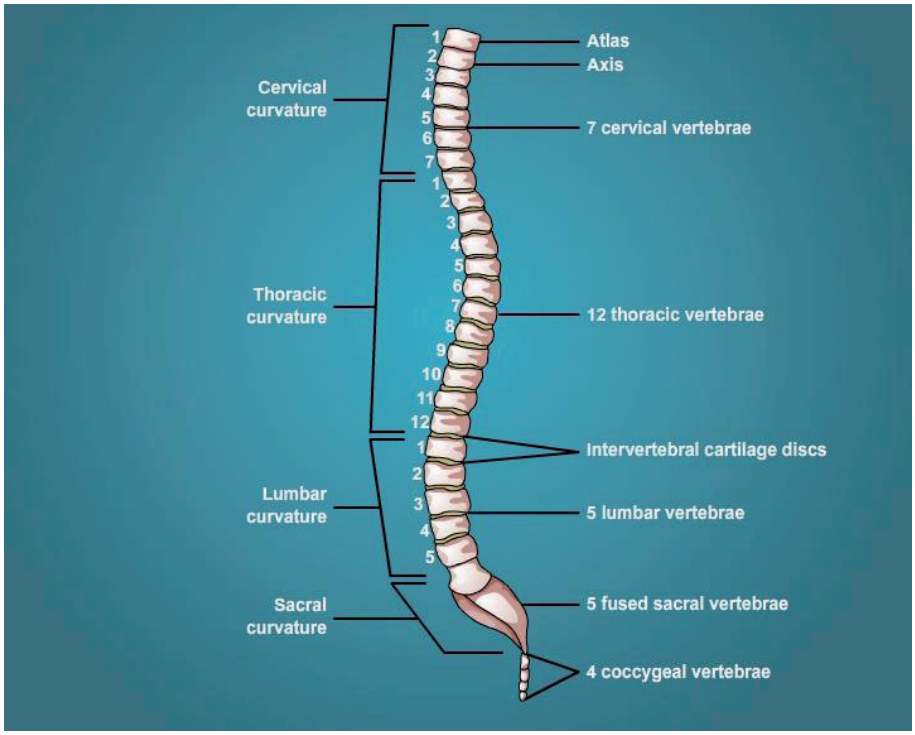
The axial skeleton

The skull is made up of bony plates with joints called sutures.

The skull consists of:

- The **cranium** – protects the brain and the internal ears. The orbits protect the eye balls;
- The **zygomatic bones** (facial bones) – protect the nasal cavity and sinuses;
- The **maxillary bones** (upper jaw)– have cavities for the teeth; and
- The **movable mandible bones** (lower jaw) – also have cavities for the teeth and make movement possible when chewing food.

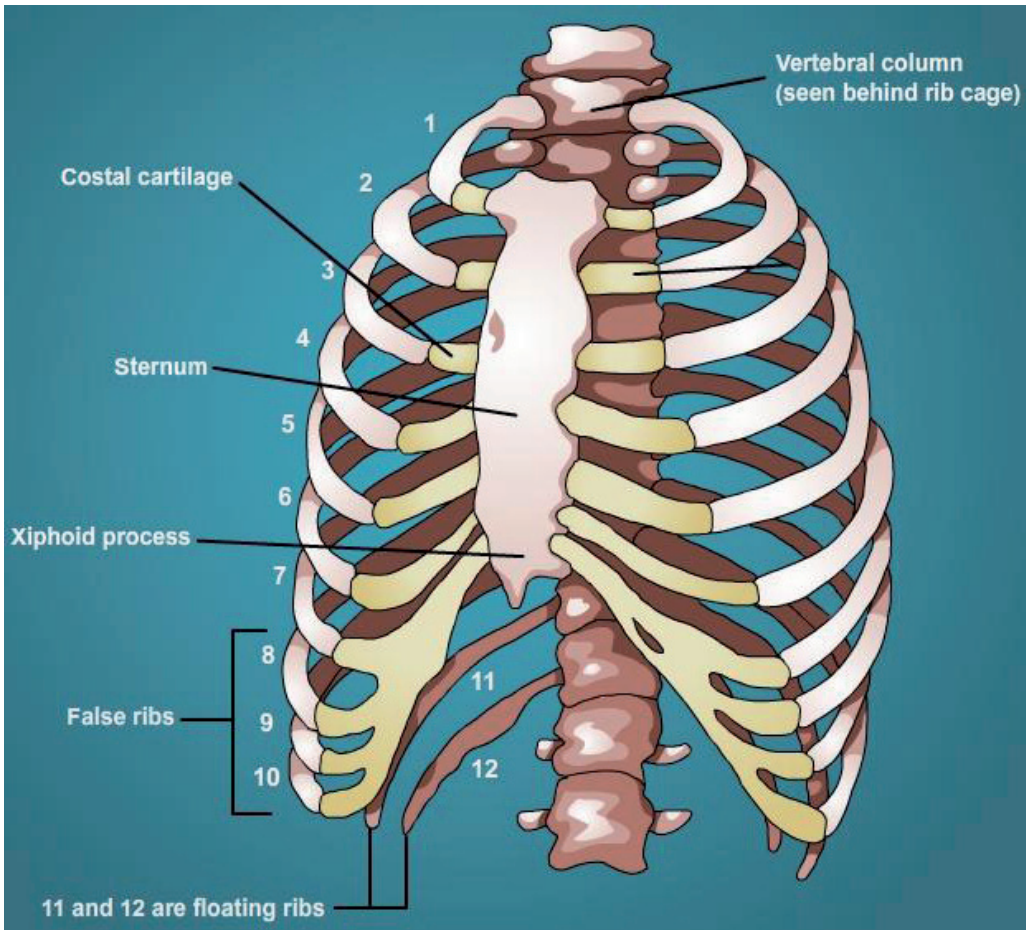




The **vertebral column** forms the central support structure and consists of 33 individual vertebrae, separated by discs of cartilage. The discs allow movements such as bending forwards, backwards and sideways and act as shock absorbers. The cavity through the centre protects the spinal cord. The first vertebra is called the atlas and connects the skull to the spine. When discs are injured, it is termed

a “slipped disc” and is very painful. A person becomes paralysed when the spinal cord is damaged badly.

The **thoracic cage** (rib cage and sternum) consists of 12 pairs of ribs. The first seven pairs are connected to the sternum and are called true ribs. The next five pairs are called floating ribs because they are attached to the vertebrae at the back, but are free in the front. The ribcage protects the internal organs such as the heart, lungs and the liver. The muscles between the ribs are called intercostals muscles which contract and relax during the process of breathing.

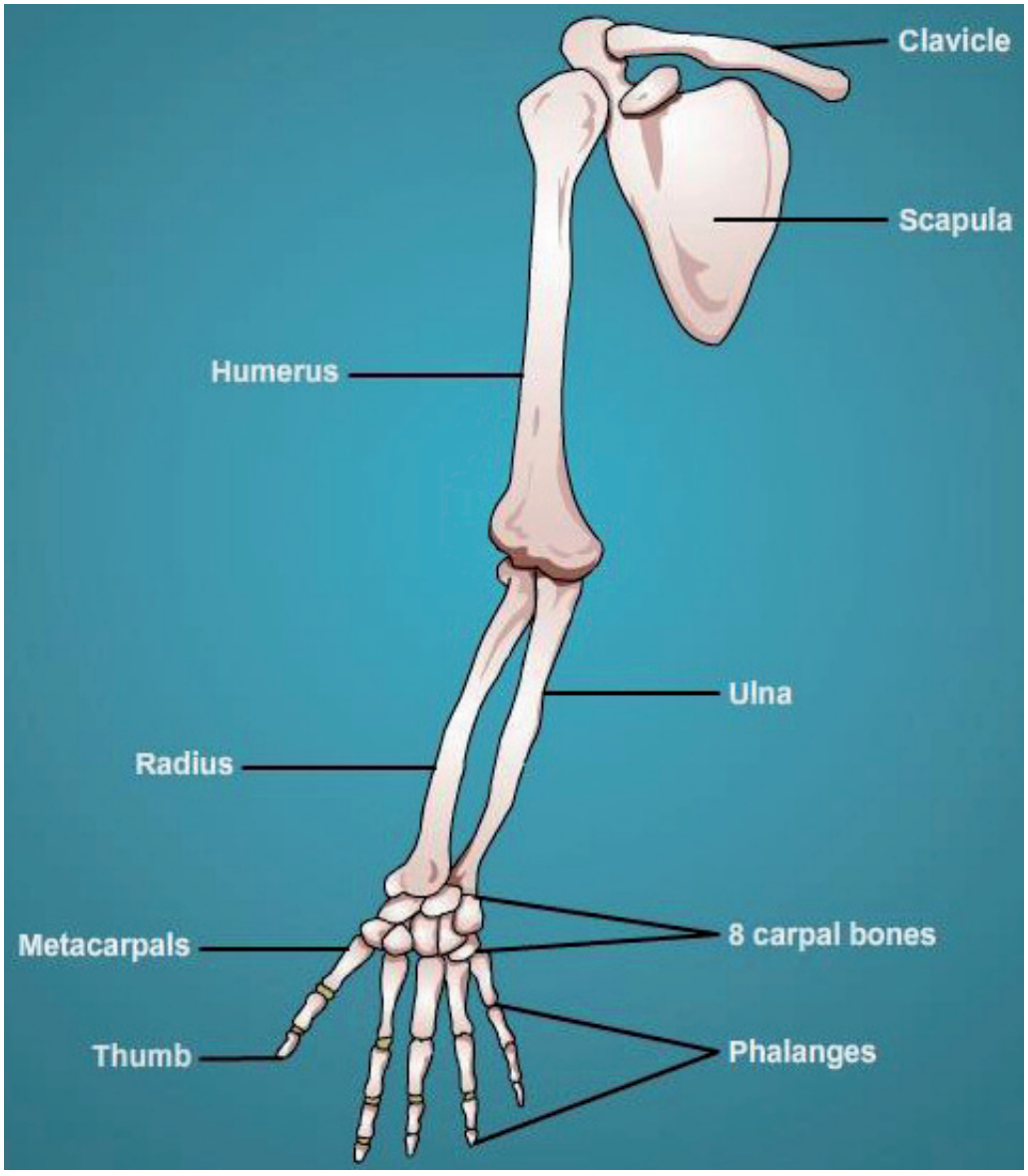


The appendicular skeleton

The legs and arms are attachments to the axial skeleton.

The **pectoral girdle** is a structure to which the arms are attached. Muscles are attached to the scapulae (shoulder blades) and to the clavicle (collar bone) to control the movement of the arms. Each arm consists of:

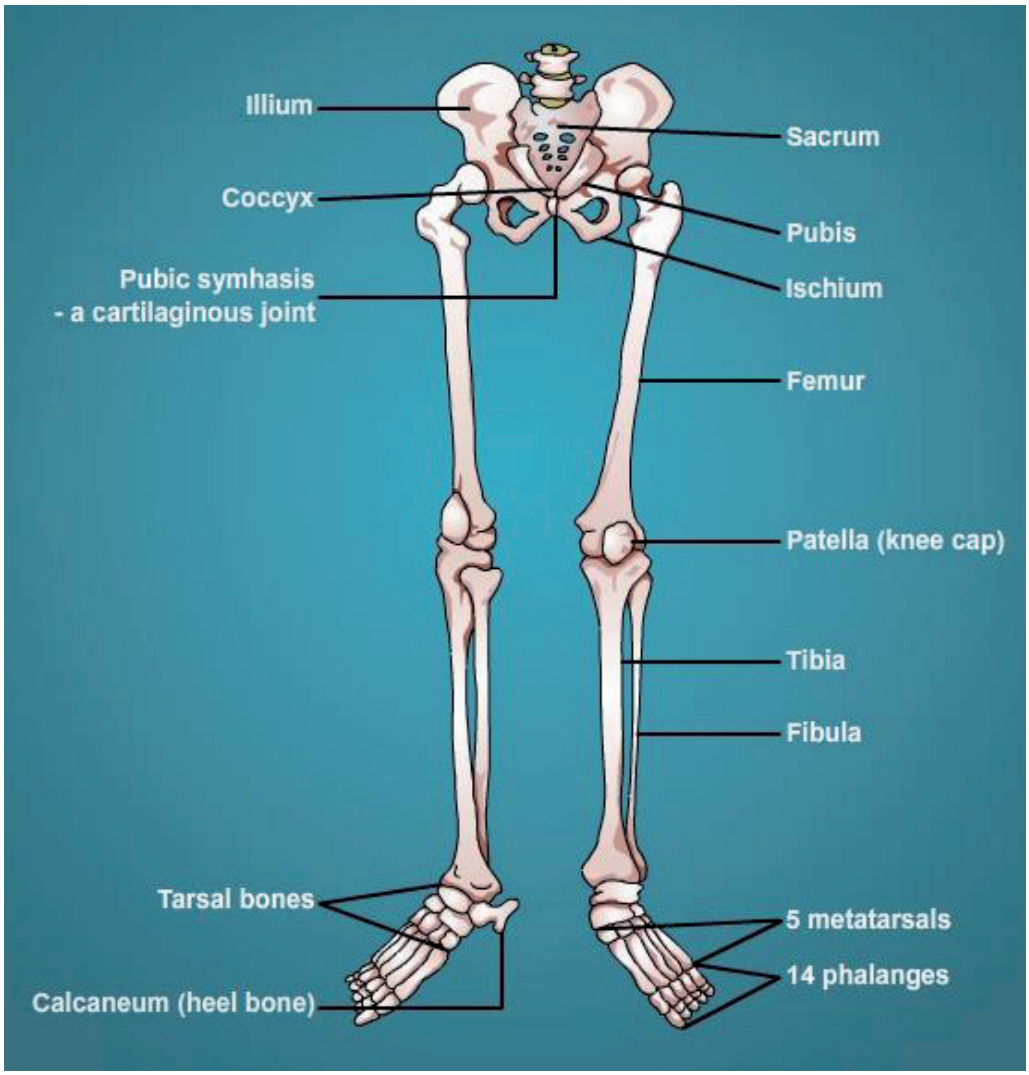
- **Humerus** – the upper arm. Is a long bone connected to the scapula by means of a ball-and-socket joint to allow free movement;
- **Radius** and **ulna** – the forearm;
- **Carpals** – the wrist;
- **Metacarpals** – the palm of the hand; and
- **Phalanges** – the four fingers and thumb.



The pelvic girdle forms the structure to which the legs are attached. The back of the pelvic girdle is attached to the sacrum of the spinal vertebrae. Each leg consists of:

- **Femur** – the upper leg, a long bone attached to the pelvic girdle by means of a ball-and-socket joint to allow free movement;
- **Tibia** and **fibula** – the lower leg, attached to the femur at the knee;
- **Patella** (knee cap) protects the knee joint;
- **Tarsals** – ankle and heel;
- **Metatarsals** – the foot; and
- **Phalanges** – the five toes.

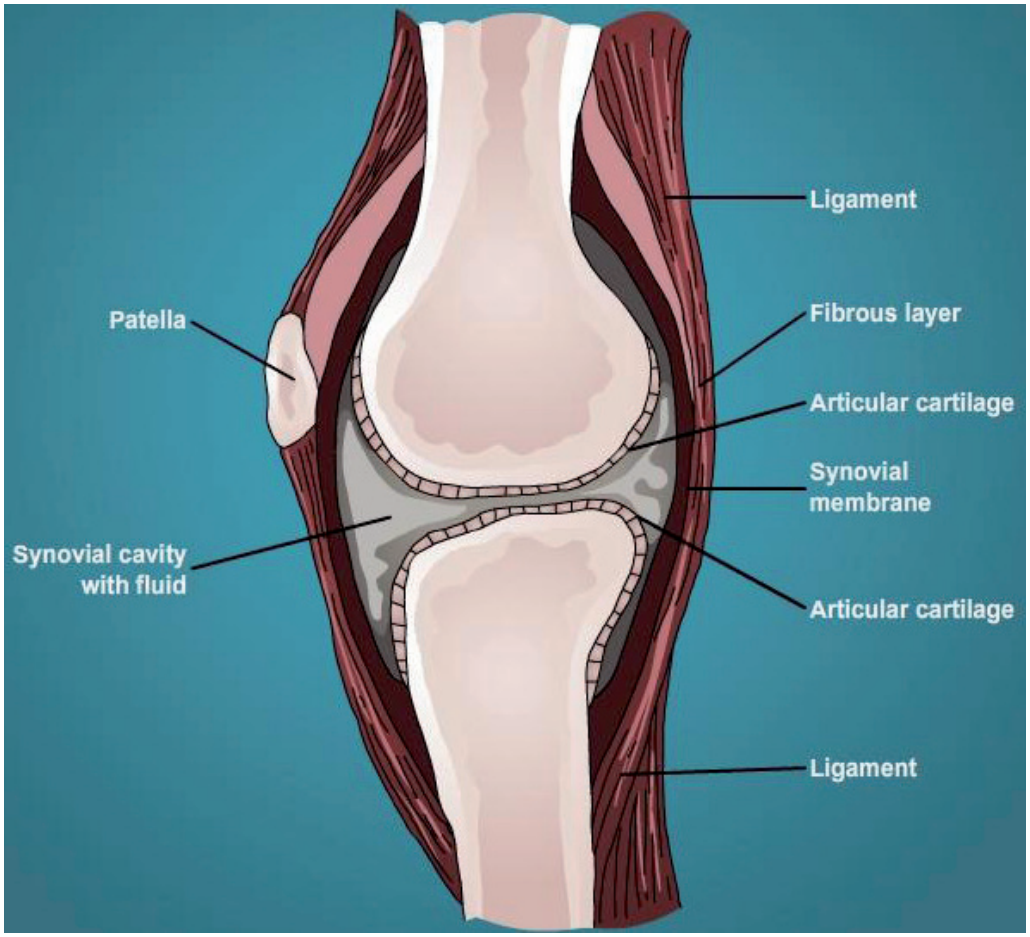
The pelvic girdle protects the reproductive systems. The ball-and-socket joint at the hip makes it possible to sit, walk, turn and run.



Joints

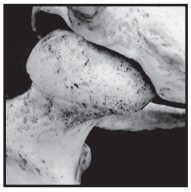
A joint occurs when two bones are joined. Ligaments, which consist of fibrous connective tissue, hold the bones together. Tendons attach the muscles. Joints are classified as fibrous joints, cartilaginous joints and synovial joints.

Fibrous joints	No movement. Bones are joined by fibrous tissue, e.g. the sutures of the skull.
Cartilaginous joints	Cartilage allows for slight, restricted movement, e.g. the discs between the vertebrae of the spine and the cartilage between the two pubic bones.



Synovial joints

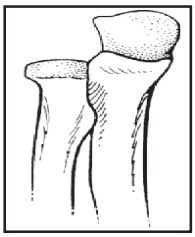
Ball-and-socket joints: Allow movement in all directions, such as swinging and rotating:
The hip and leg
The shoulder and arm



Gliding joints: The flat surface of the one bone links with the surface of the opposing bone, e.g.:
Wrist and ankle bone
Metacarpals
Metatarsals

Hinge joints: Allows a bending movement in one direction only, like the hinge of a door or window, e.g.:
Elbow
Knee
Fingers
Toes

Pivot joint: Allows a rotating movement as one bone pivots around another, e.g.:
The atlas and the axis bones of the vertebral column
The radius and ulna bones with the wrist bones



Levers

Voluntary skeletal muscle covers the skeleton and gives the body shape. The point where the muscle is attached to an immovable bone is called the **origin**. The point where the muscle attaches to the movable bone is called the **insertion**. **Tendons** attach the muscles to the bones. Remember that **ligaments** attach bone to bone.

Many muscles contract and relax to allow movement of the skeleton. Muscles on opposite sides of a bone will work together. This is called the antagonistic movement. This movement of the bones is as a result of leverage.

When an action is performed with antagonistic muscle movement:

- Mass of structure that is moved = resistance
- Joint = fulcrum
- Muscles contracting = effort

Lever of the first class

The head moves forward, backwards and sideways:

- The fulcrum lies in the middle of the resistance and the effort.
- The skull rests on the atlas, which is the fulcrum.
- The mass of the head acts as the resistance.
- The neck muscles provide the effort.

Lever of the second class

Lifting the heel off the ground in the action of walking:

- The resistance lies between the fulcrum and the effort.
- The ball of the foot is the fulcrum and pushes against the ground.
- The mass of the body provides the resistance.
- The calf muscles contract and provide the effort.

Lever of the third class

Bending the elbow to lift the hand towards the mouth:

- The effort lies in the middle of the fulcrum and the resistance.
- The elbow joint is the fulcrum and the mass of the hand is the resistance.
- The bicep muscle contracts and provides the effort.

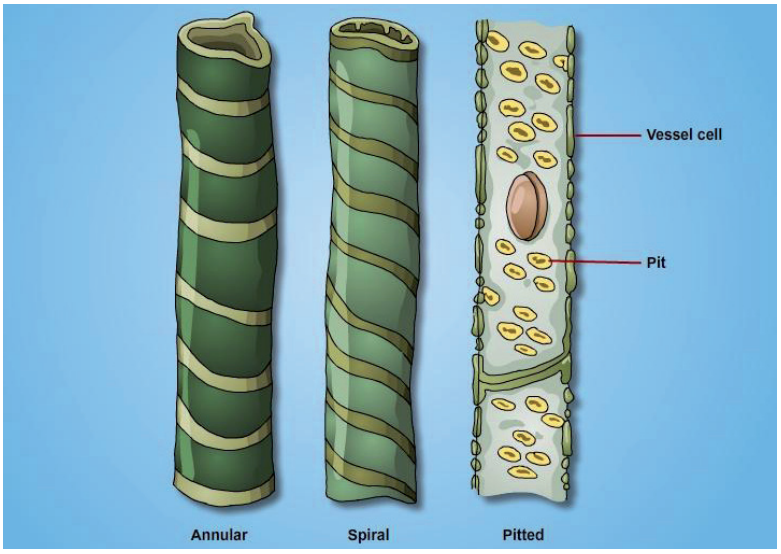
Lesson 8

Diseases

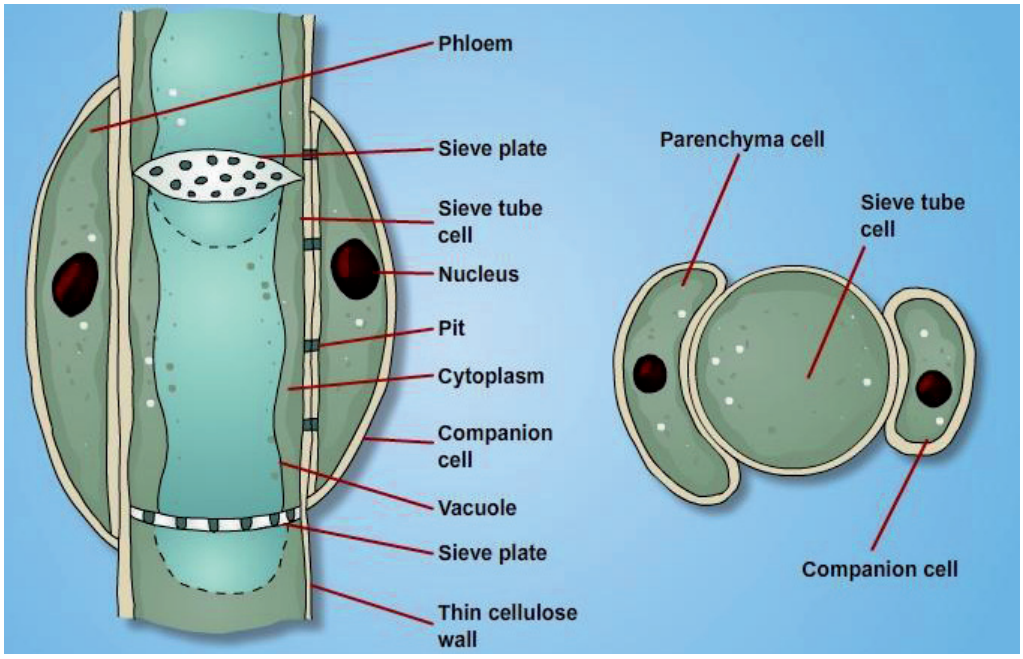
- **Rickets:** A deficiency disease caused by a lack of Vitamin D. The bones become soft. Occurs in young children. Their weight causes the soft bones to deform.
- **Osteomalacia:** A deficiency of Vitamin D in adults. It results when the bones are unable to hold the body's weight and fractures result.
- **Osteoporosis:** Occurs from the age of about 40 years. It is as a result of calcium not being replaced in the bones and this leads to osteoporosis. Women are four times more vulnerable than men, especially after the onset of menopause. Bones become brittle and vertebrae can become weak, causing compression of the spine and discs.
- **Rheumatoid arthritis:** Results when joints degenerate. It occurs mainly in older people. The body's immune system attacks its own tissue causing the joints to become painful, swollen and inflamed. In severe cases, the joints become completely immobile.

Plant skeletons

Plants have an internal skeleton, which consists of strengthening tissue such as xylem and schlerenchyma. Water and the turgidity of the cells play a major role in providing the support and structure. Plant cells contain cell walls made of cellulose. Cellulose provides structure to the cell. When a plant has sufficient water, the vacuoles become filled with cell sap. This creates pressure from the inside called turgor pressure. It provides support for herbaceous plants. When cells loose turgor pressure, they begin to droop and wilt.



Xylem



Phloem

Herbaceous stems

Vascular bundles occur randomly within the herbaceous stems. The **xylem vessels** contain cell walls that are thickened with lignin and provides internal support. **Schlerenchyma cells**, which provide strengthening and support to the stem, enclose each vascular bundle. Herbaceous plants do not grow very tall because they do not have much internal support.

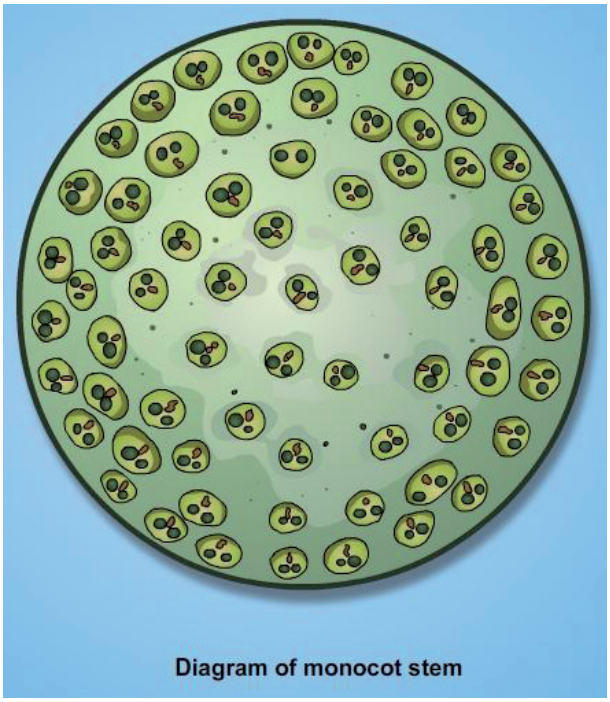
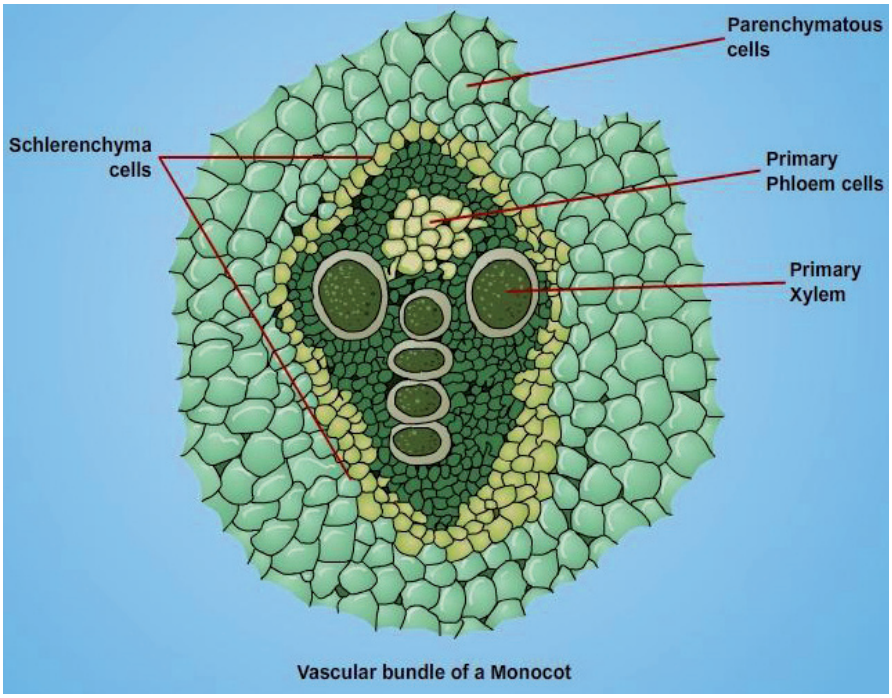


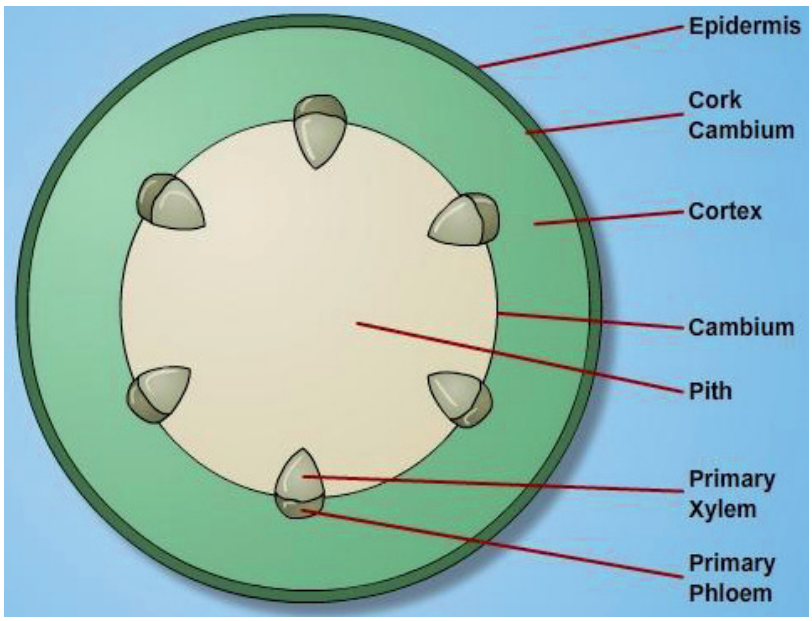
Diagram of monocot stem

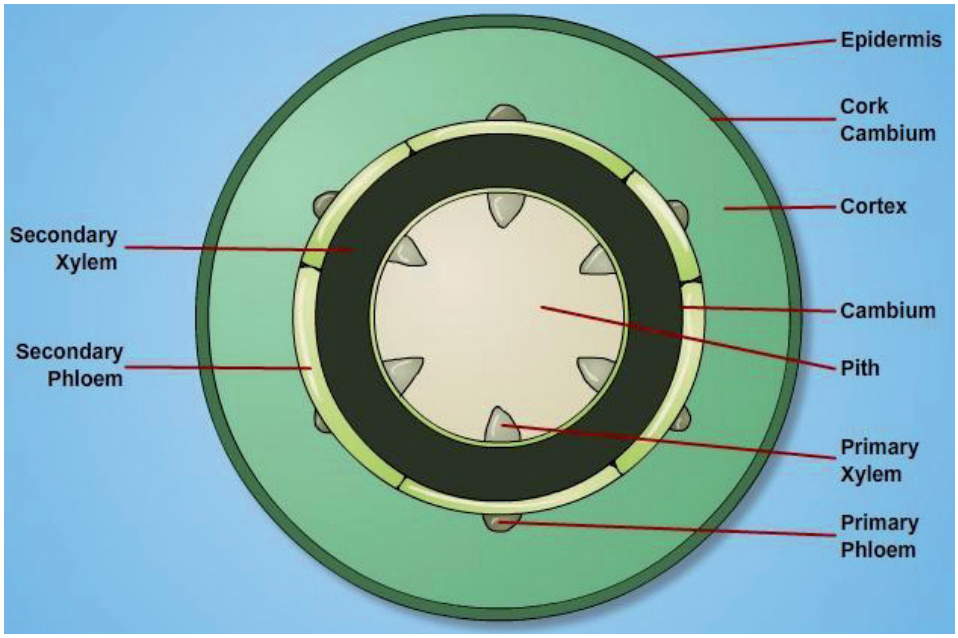


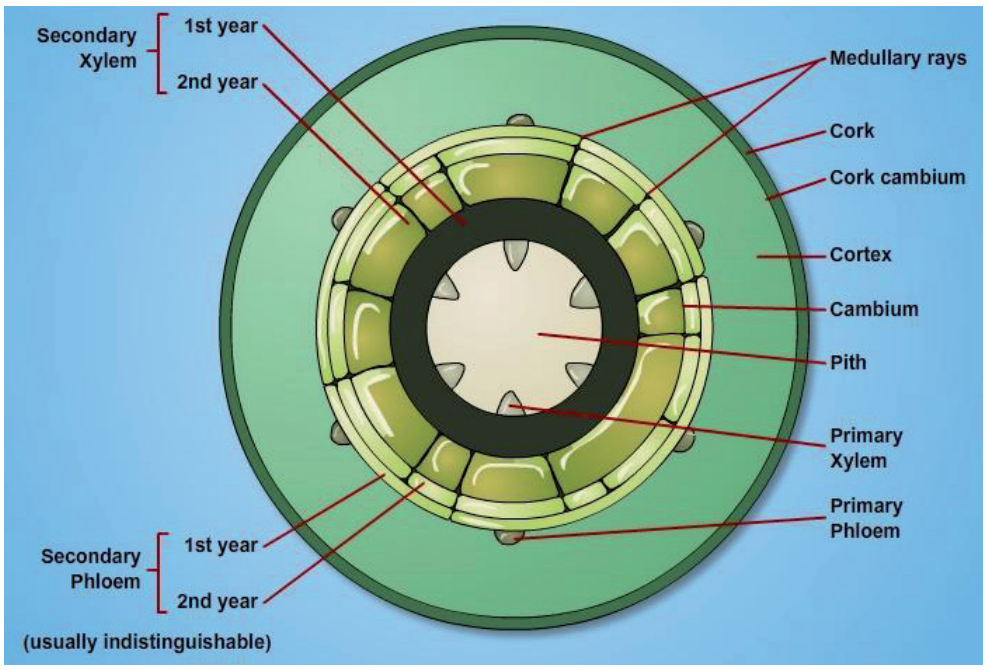
Vascular bundle of a Monocot

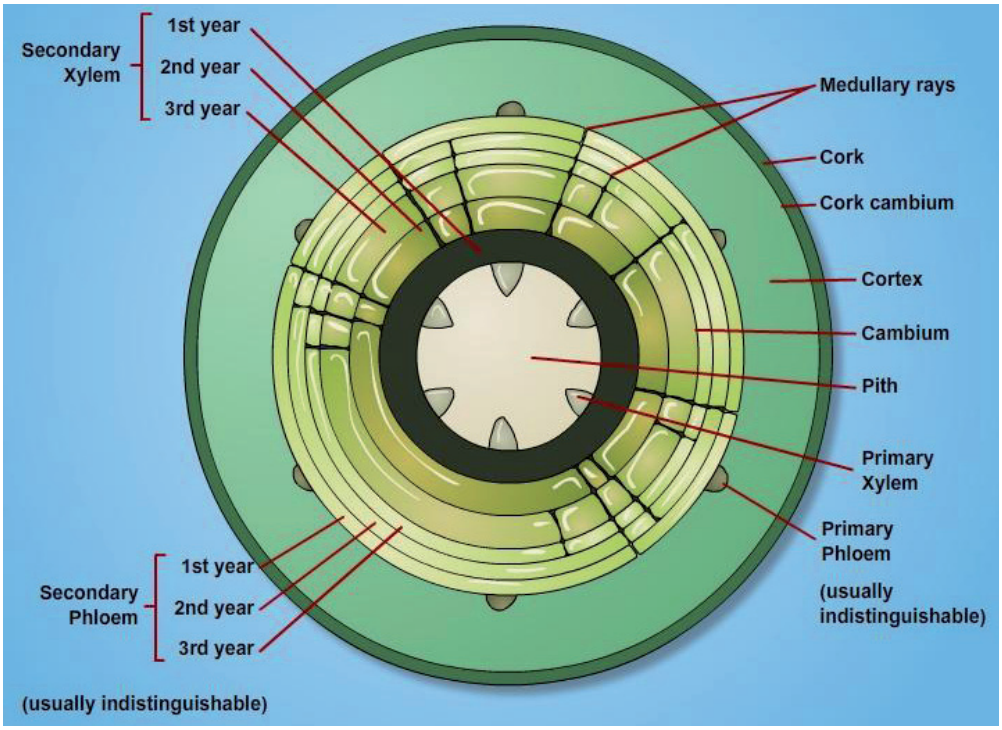
Woody stems

Trees have woody stems, are able to grow to great heights and require a lot of support. Transport tissues are well protected and the stem is strengthened to keep the tree upright. Secondary thickening makes this possible. Each **vascular bundle** is arranged to form a circle around the inside of the stem. The vascular bundle consists of **xylem** on the inside, **cambium** in the middle and **phloem** on the outside. Cambium is **meristematic tissue** and undergoes cell division to produce new xylem and phloem tissue. The cambium forms an inner and an outer ring of secondary xylem and phloem. This is what gives wood the rings that can be seen when the stem is cut through. These rings are called annual rings and tell you how old the tree is.


Epidermis
Cork Cambium
Cortex
Cambium
Pith
Primary Xylem
Primary Phloem


Epidermis
Cork Cambium
Cortex
Secondary Xylem
Cambium
Secondary Phloem
Pith
Primary Xylem
Primary Phloem


Secondary Xylem
1st year
2nd year
Medullary rays
Cork
Cork cambium
Cortex
Cambium
Pith
Primary Xylem
Primary Phloem
Secondary Phloem
1st year
2nd year
(usually indistinguishable)



Activity 1

CLASS

FORMATIVE ASSESSMENT

Identify the different types of bones

- Obtain a few cow, sheep or chicken bones (about 5 – 6) from home or a butcher.
- Identify the bones as part of the axial or appendicular skeleton.
- Name each of the bones and indicate where exactly in the human body this bone could be found.
- Draw a concept map and show the information you have gathered from the bones you have studied.

Activity 2

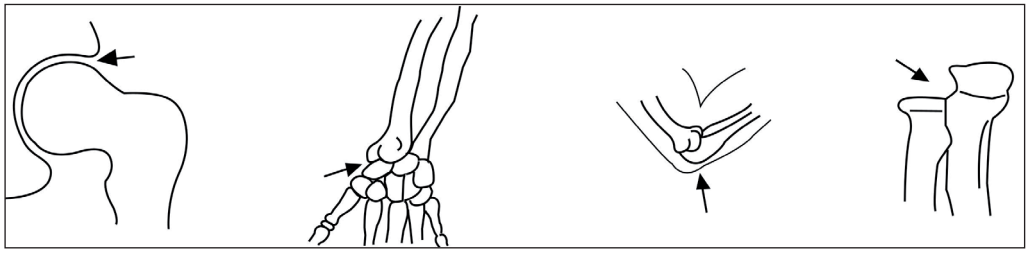
INDIVIDUAL

FORMATIVE ASSESSMENT

COLLECTION OF EVIDENCE

Types of joints

Study the diagrams below.



A B C D

1. Draw a three-column table and complete the table with the following headings:

   First column – type of joint

   Second column – range of motion

   Third column – other examples of this joint

2. Use a picture from any newspaper or magazine showing range of movements. Indicate the type of joint/s shown in the picture and explain the type of movement the joint allows.

Activity 3

Bone disease – osteoporosis

Read the extract below, taken from a pamphlet supplied by Ayerst Laboratories.

Osteoporosis, a major health problem in this country, has received much attention in recent years. Worldwide it affects millions of people, primarily older women. This disease is caused by a thinning of the bones after menopause, which makes them brittle.

Bone is a living tissue that is constantly being broken down and rebuilt, even in adults. An adequate supply of calcium is very important to maintain a strong skeleton.

In every person, some thinning of the bone is inevitable as a result of the ageing process. However, in women, the hormone oestrogen helps to maintain the bone balance.

Bones need calcium, other nutrients, and a certain amount of physical stress to help them form and grow. Physical stress is provided by exercise – in particular, weight-bearing exercise. If your lifestyle is sedentary, as many older people's are, or if you have undergone a period of immobilisation such as prolonged bed rest, you are at greater risk for osteoporosis. It is known that excessive use of alcohol can lead to bone deterioration.

Getting enough calcium, exercising and not smoking before menopause are just a few ways you can reduce your chances of osteoporosis. Even if you do develop osteoporosis, there are treatments available, such as oestrogen therapy, which may slow your rate of bone loss if combined with proper diet including sufficient calcium.

QUESTIONS:

1. How can you support someone who has osteoporosis?
2. Do you know of any alternative methods of treating osteoporosis? If not, research alternative methods and discuss with your class.
3. Design a poster to make people aware of osteoporosis and point out which measures one can take to prevent getting osteoporosis.

Activity 4

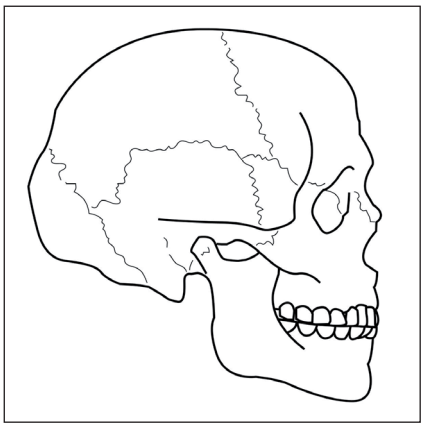
INDIVIDUAL

SUMMATIVE ASSESSMENT

Summative assessment: Support

1. List FOUR functions of the human skeleton. (4)

2. The diagram shows the human skull. Study the diagram and answer the questions that follow.



   (a) Name TWO types of bones which are found in the human skull. (2)

   (b) How are these bones joined together? (1)

   (c) What is/are the function/s of the

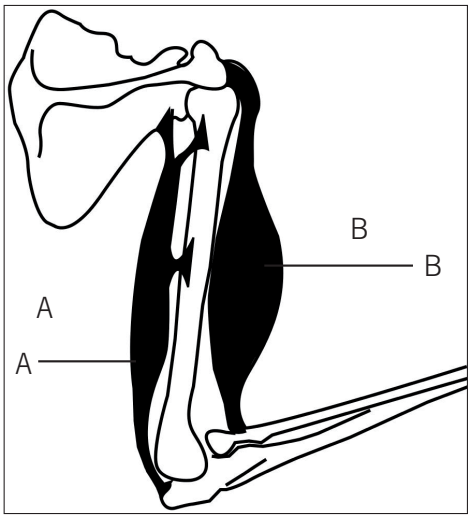
   – foramen magnum

   – condyles of the skull? (2)

3. Draw a labelled diagram to show a typical thoracic vertebra. (7)

4. The diagram below illustrates muscles and bones in the human arm.

   Study the diagram and answer the questions that follow.

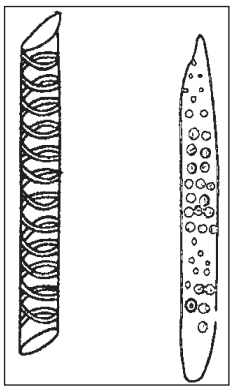


   (a) Identify the muscles labelled A and B. (2)

   (b) Which muscle must contract to allow the arm to be straightened at the elbow? (1)

5. What is the difference between a sprain and a fracture? (2)

6. The accompanying diagram shows cells from a tissue from a flowering plant. Study the diagram and answer the following:



A B

(a) Identify cell A and cell B. (2)

(b) In which way does the wall of cell A differ from cell B? (1)

(c) In which tissue are these cells found? (1)

(d) List two functions of this tissue. (2)

(e) Name another tissue that has the same function as the tissue mentioned in c. (1)

(f) In which way does the tissue name in e differ from the tissue named in c? (2)

TOTAL – 30

STRUCTURE, CONTROL AND PROCESSES IN BASIC LIFESYSTEMS OF PLANTS AND HUMANS

Transport

Lessons 9-11

Learning Outcomes and Assessment Standards

Learning Outcomes 1
Scientific inquiry and problem-solving skills
The learner is confidently able to explore and investigate phenomena relevant to Life Sciences by using inquiry, problem solving, critical thinking and other skills by:
- Studying the structure of systems
- Conducting dissections
- Design a model to show the anatomy of the heart
- Conduct medical research on the latest medical practices

Assessment Standards
AS1 *Systematically and accurately collect data using selected instruments and/or techniques. Select a type of display that communicates the data effectively*
AS2 *Compare data and construct meaning to explain findings. Draw conclusions and recognise inconsistencies in the data. Assess the value of the experimental process and communicate the findings*
Learning Outcome 2
Construct and apply Life Science knowledge
The learner is able to access, interpret, construct and use Life Science concepts to explain phenomena relevant to Life Sciences:
- Structure of the heart
- Cardiac cycle
- Structure of blood vessels
- Disorders and diseases
- Transport in plants

Assessment Standards
AS1 *Use various methods and sources to access information*
AS2 *Identify, describe and explain concepts, principles, laws, theories and models by illustrating relationships. Evaluate concepts, principles, laws, theories and models*
Learning Outcome 3
Life Science, technology, environment and society
The learner is able to demonstrate an understanding of the nature of science, the influence of ethics and biases in Life Sciences and the inter-relationship of science, technology, indigenous knowledge, the environment and society
- Ethics and beliefs
- Life support systems
- Organ transplants

Assessment Standards
AS1 *Compare scientific ideas and indigenous knowledge of past and present cultures*
AS2 *Compare different ways in which resources are used in the development of biotechnological products and analyse the impacts on the environment and society*
AS3 *Compare the influence of different beliefs, attitudes and values on scientific knowledge and its application in society*

Overview

In these lessons we will focus on the circulatory system which transports waste from the cells and delivers oxygen and nutrients to them.

Lesson 9

LC DVD

43

Introduction

All living cells need nutrients and oxygen to survive. Metabolic wastes are produced and must be removed from the cells. Unicellular organisms absorb and remove wastes by diffusion. In the human body there are millions of cells, bathed

by tissue fluid. Substances diffuse into and out of the cells. Oxygen and nutrients must be transported to the tissue fluid and wastes removed. This takes place through the circulatory system which consists of the heart and blood vessels. Organs such as the liver, kidneys and lungs remove the wastes from the blood.

The structure of the blood circulatory system

Mammals have a **CLOSED** blood system, in which all the blood is contained in blood vessels. This closed blood system has two parts and is called a **DOUBLE** circulatory system. The blood passes through the heart twice:

- Through pulmonary circulation, when blood is pumped from the heart to the lungs to remove CO_2 and add oxygen; and
- Through systemic circulation, when blood is pumped from the heart to all the systems and back to the heart again.

Arteries carry blood **AWAY** from the heart. Veins carry blood **TO** the heart.

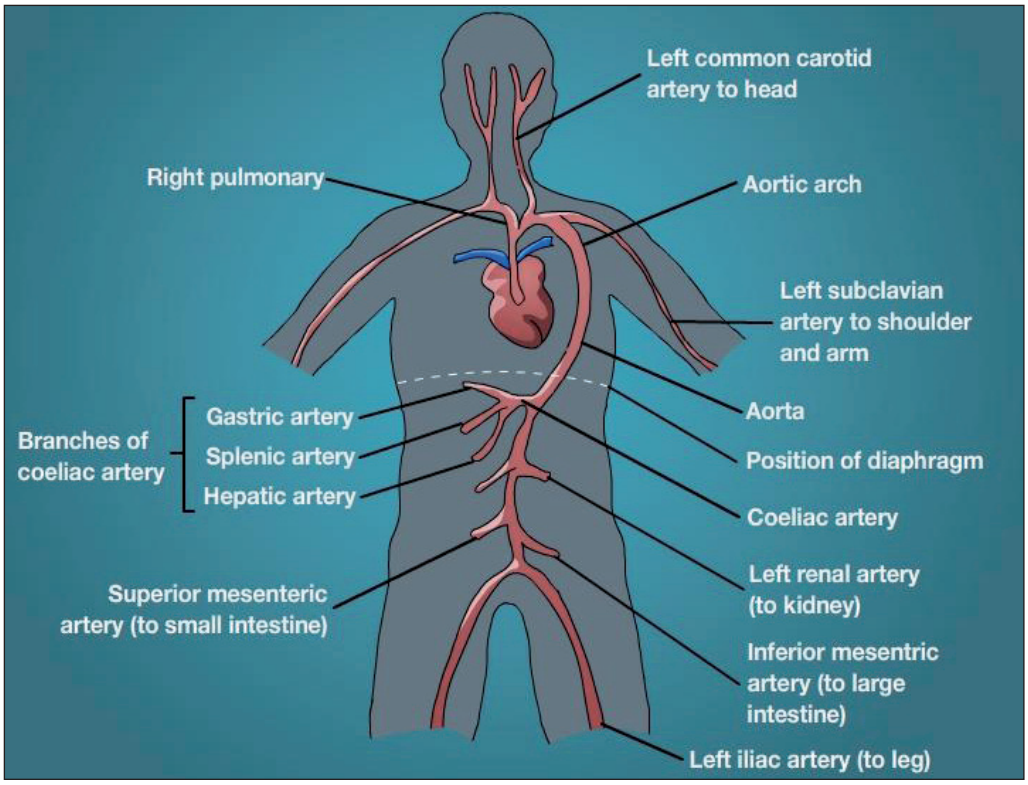


Diagram to show arteries

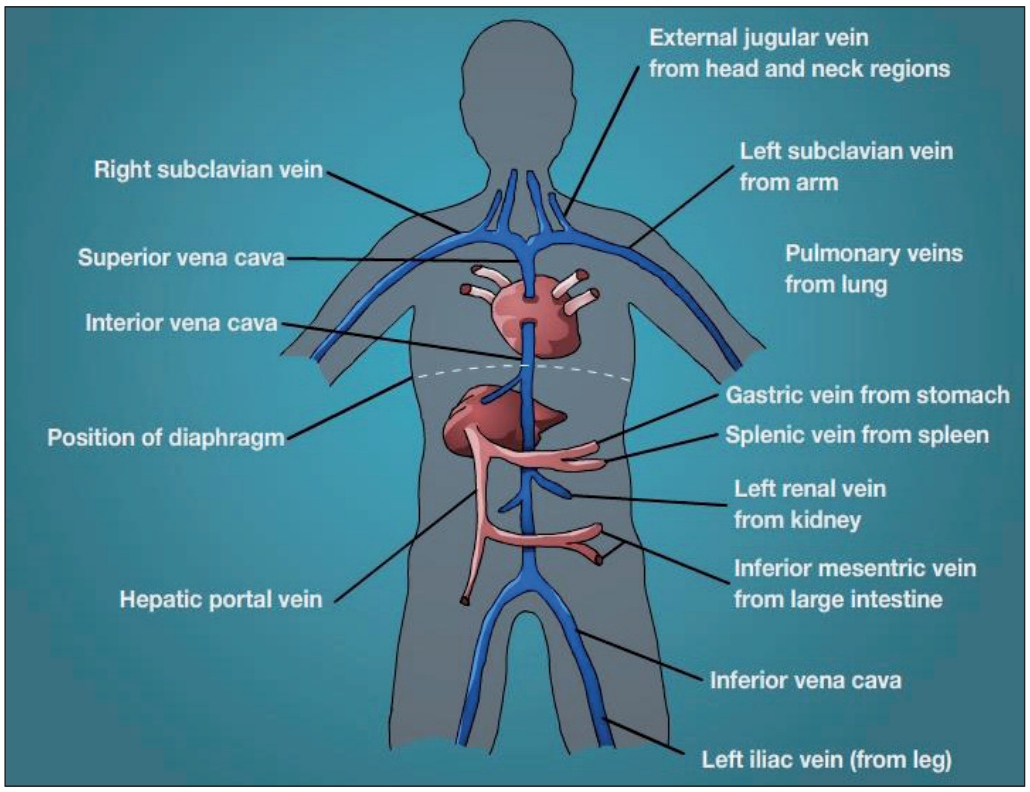
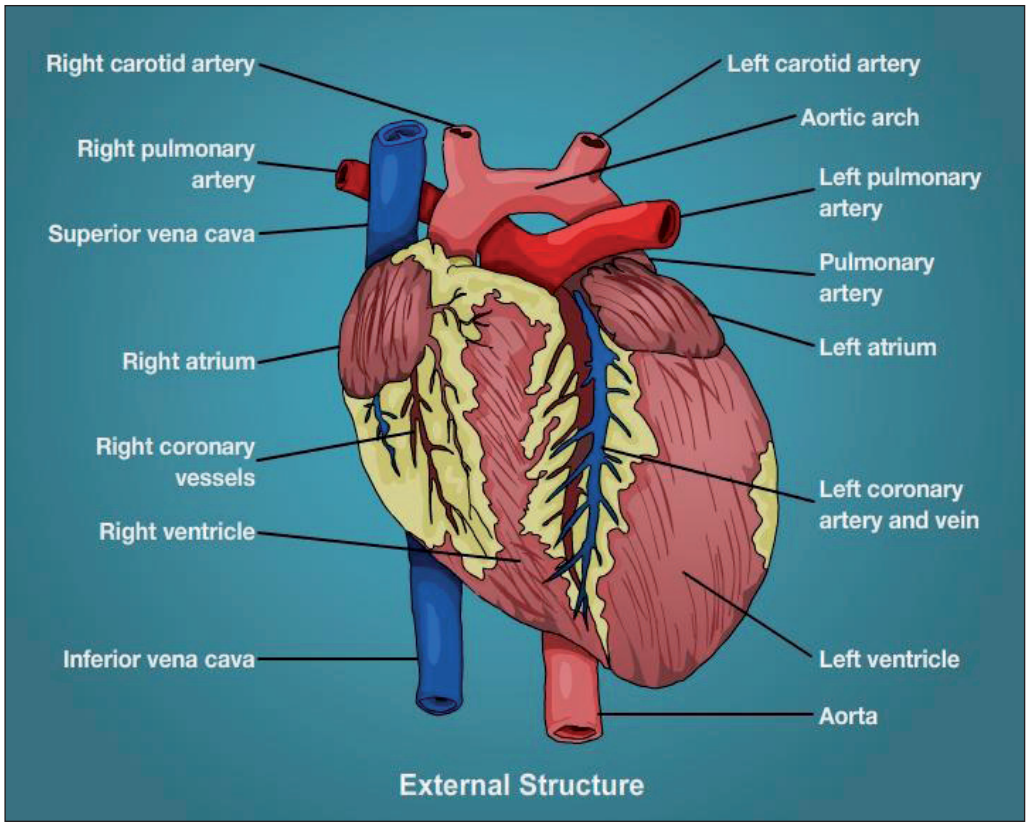
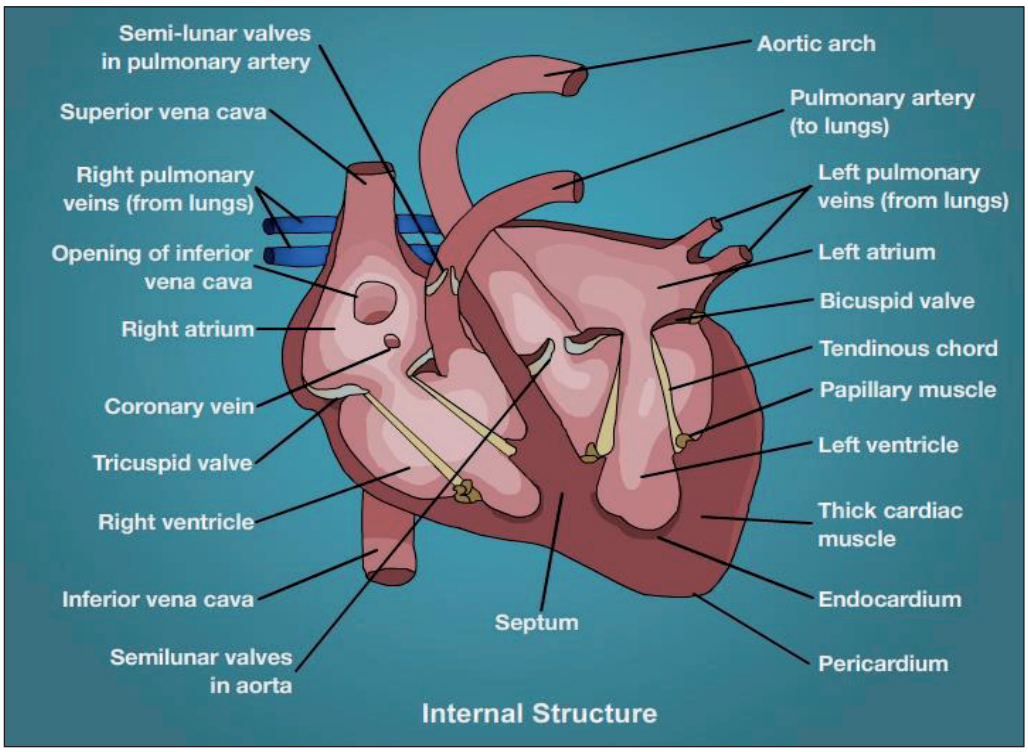


Diagram to show veins



External structure of the heart

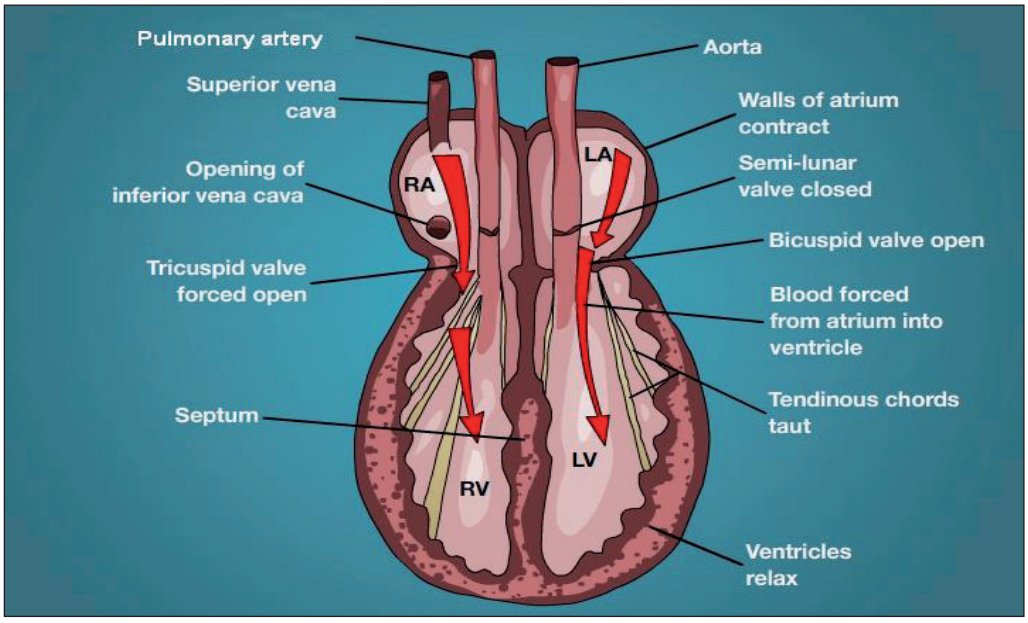


Internal structure of the heart

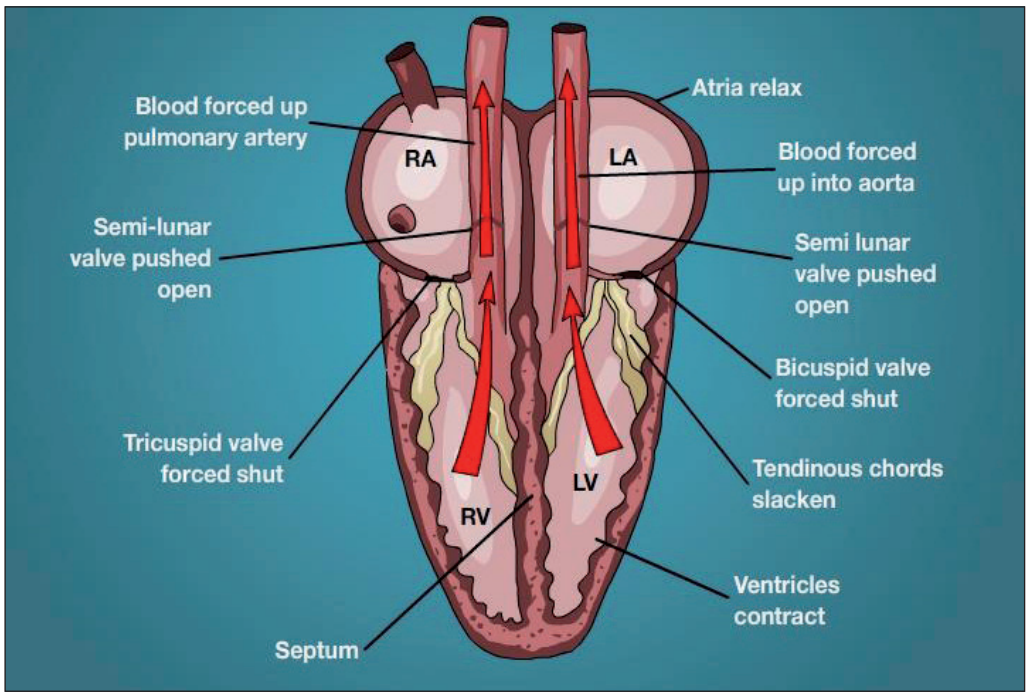
The cardiac cycle

The atria and the ventricles work separately. The sino-atrial node (pacemaker) is located in the right atrium and regulates the contraction and relaxing of the atria. The cardiac cycle:

- Each heartbeat takes approximately 0,8 secs
- Normal heartbeat is 72 beats per minute
- **SYSTOLE** – heart muscle contracts
- **DIASTOLE** – heart muscle relaxes



Atrial systole



Ventricular systole

Phase 1: Atrial systole (atrium contracts)

Blood from the superior and inferior vena cava flows into the right atrium. Blood from the pulmonary veins flows into the left atrium. The atria contract at the same time. This contraction lasts for about 0,1 seconds. Blood is forced through the tricuspid and bicuspid valves into the ventricles.

Phase 2: Ventricular systole (ventricle contracts)

Ventricles are relaxed and fill with blood. The ventricles contract for 0,3 seconds. Blood is forced upwards, closing the bicuspid and tricuspid valves. The blood travels up into the pulmonary artery (on the right) and the aorta (on the left). The atria are relaxed during ventricular systole.

Phase 3: General diastole (general relaxation of the heart)

The ventricles relax, decreasing the flow from the ventricles. Once there is no pressure, the blood flow closes the semi-lunar valves in the aorta and the pulmonary artery, closing them. General diastole lasts for about 0,4 seconds.

The stroke volume is the amount of blood pumped through the heart during each cardiac cycle. Exercise causes the stroke volume to increase. The muscles need more oxygen and glucose to produce energy. When a person is fit, they have a greater stroke volume.

The sound the heart makes:

- The heart makes two beating sounds. One is loud and one is soft. We call this the lub/dub sound.
- The lub sound is caused by the pressure of the ventricles contracting, forcing the atrio-ventricular valves shut.
- The dub sound is caused by the lack of pressure in the ventricles which causes the blood to flow back and close the semi-lunar valves in the pulmonary artery and aorta.
- A doctor uses a stethoscope to listen to the heart.

- To find a person's pulse, press a finger (but not a thumb) against the brachial artery in the wrist or the carotid artery next to the trachea.

LC DVD

Lesson 10

Blood pressure

Blood pressure is caused by the size of the blood vessels. Pressure ensures that blood flows to all the parts of the body. Blood pressure can be increased by smoking, stress, adrenalin surges, water retention, high cholesterol, obesity and lack of exercise. High blood pressure is dangerous and can cause blood vessels to burst.

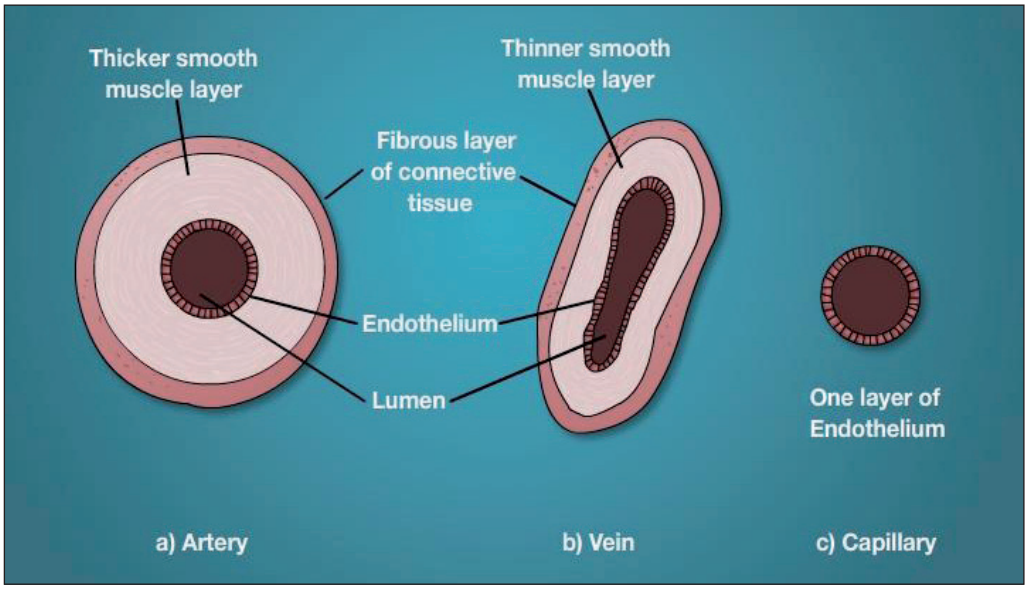
- Normal blood pressure is 120/80 (120 over 80) measured in units of mercury.
- The 120 represents the systolic pressure, which is when the ventricles contract.
- The 80 represents the diastolic pressure, which is when the ventricles relax (general diastole occurs).
- Hypertension – blood pressure is high.
- Hypotension – blood pressure is low.

Blood vessels

Mammals have a closed blood system, which means that blood flows inside tubes called blood vessels. The blood vessels are arteries, veins and capillaries.

- Arteries carry blood away from the heart.
- Veins carry blood back to the heart.
- Capillaries are found at tissue level and link the arteries to the veins.

heart → artery → arterioles → capillaries → veinules → vein → heart → lungs → heart



Comparison between arteries and veins

Arteries	Capillaries	Veins
1. Blood away from the heart	1. Blood supply at tissue level	1. Blood back to the heart
2. Thick middle layer of involuntary muscle to increase or decrease diameter	2. One layer of endothelium with very small diameter	2. Thin middle layer as pressure is reduced
3. Inner layer of endothelium which reduces friction	3. Only endothelium layer present	3. Larger diameter of inner cavity, lined with endothelium to reduce friction
4. Situated deeper in the tissue to maintain body temperature	4. Situated at tissue level only	4. Situated near the surface of the skin to release heat
5. No valves except in the base of the aorta and the pulmonary arteries	5. No valves present	5. Semi-lunar valves are present at intervals, to prevent back flow of blood
6. Blood always under much pressure	6. Blood is under high pressure and red blood cells are forced to flow through in single file	6. Blood is under low pressure
7. A pulse can be felt as blood flows	7. No pulse	7. No pulse can be detected

Disease

Cardiovascular disorders cause many deaths in modern society. When the heart muscle does not get enough blood, an angina results, which is a cramp in the chest area. It is very painful.

Myocardial infarction: This is a heart attack. The person will experience severe pain in the chest area, which radiates down the left arm. Severe heart attacks can result in death. When people have an unhealthy lifestyle, which includes bad eating habits, lack of exercise, stress and smoking, they can develop hypertension, obesity and high levels of cholesterol in the blood, which could lead to a heart attack.

Atherosclerosis: Excess calcium and cholesterol are sometimes deposited on the walls of the arteries. This decreases the diameter of the walls, which become harder and lose elasticity, and also create rough patches (plaque), on which blood itself can get caught on, leading to the formation of blood clots. When a person is diagnosed with atherosclerosis, a surgeon may perform a coronary bypass to remove the blockage. In some cases, laser angioplasty is prescribed, which uses laser beams to dissolve the blockage. Sometimes, if the blockage is minor, a balloon is inflated in the artery. This is called a percutaneous transluminal coronary angioplasty (PTCA). In traditional cultures, healers give the bark of the silverwood tree to people to chew, to reduce high cholesterol levels, unclog arteries and thin the blood.

Arrhythmia: When there is a problem with the sino-atrial node (pacemaker), the heart rhythm is abnormal. Surgeons place an artificial pacemaker under the skin to regulate the heartbeat.

Lesson 11

Transport in plants

Plants must transport water from the roots to the leaves where it is needed for the process of photosynthesis. Nutrients produced in the leaves by photosynthesis are transported to all the parts of the plant. The phloem carries nutrients up and down the plant. The xylem only carries water up the plant.

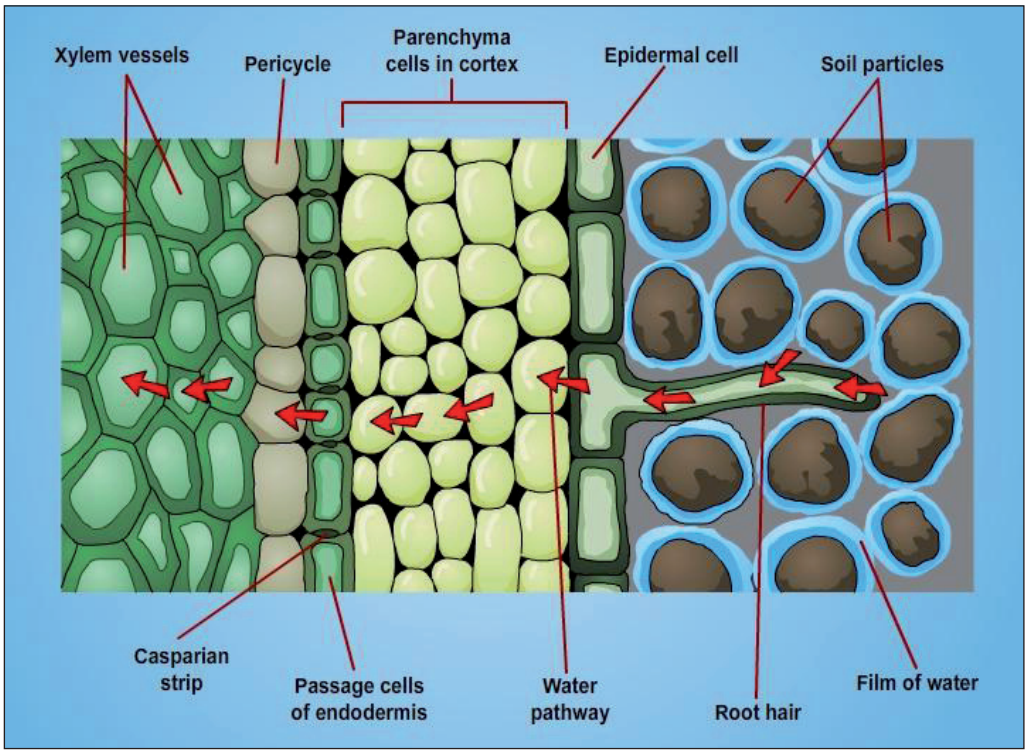
The movement of water through the plant

Three processes are necessary to absorb and transport water, namely:

- Root pressure;
- Capillarity; and
- Transpiration.

Root pressure

The water potential of the soil is always higher than that of the root hair because the root hair contains solutes in the large vacuole. Water moves by endosmosis through the cell wall, semi-permeable cell membrane, the cytoplasm and the tonoplast into the vacuole of the root hair. The water then moves intracellularly (through the cell) or intercellularly (around the cell walls) towards the xylem. The pathway is as follows: water moves through the cortex parenchyma, the endodermis with casparian strips and into the vascular stele to the xylem. A high water potential develops in the root xylem to draw the water from the root hair towards the xylem.



The structure of the root hair

Root hairs are adapted to perform their function by:

- Increasing the surface area for absorption because they extend beyond the cell.
- Cell walls are thin and permeable for quick diffusion.
- Root hairs contain a very large vacuole to maintain the concentration gradient.
- There is no cuticle present on any root cells.

Capillarity

The water moves into the xylem. From there a force called capillarity takes place which consists of **cohesion** and **adhesion** forces. Cohesion causes the water molecules to stick to each other. Adhesion causes water molecules to stick to the walls of the narrow vessels and tracheids. Both forces ensure upward movement of water in the stem.

Structural suitability of the xylem

- **Tracheids** and **vessels** are non-living, elongated tubes, with no cross-walls, which assist the water's movement.
- Tracheids and vessels have walls thickened with lignin to withstand the tension of adhesion and cohesion.
- Cell walls contain bordered pits that allow the lateral movement of water between adjacent tracheids and vessels.
- The tracheids and vessels have large lumens to allow for unrestricted water flow.
- The vessels and tracheids are rounded, making them a strong structure.

Transpiration pull

Stomata are found on the leaf surface. The suction force of transpiration is caused by the loss of water vapour through the stomata. Transpiration pull is the force responsible for moving water all the way up the stem to the leaves and is the most powerful of the three forces. Water moves from the xylem in the main vein of the leaf through the **spongy parenchyma**, into the intercellular air spaces, into the substomatal chamber and out through the stoma as water vapour. The water moves from the leaf surface by evaporation. This creates a water potential around the leaf, resulting in a negative pressure developing in the xylem. This suction force is transferred along the leaves and stem resulting in a decrease in the water potential of the roots. Transpiration may lead to excess water loss, causing the plant to wilt. Excessive wilting will cause death.

Environmental factors that affect transpiration rates

- **Temperature** – high temperatures result in a higher rate of transpiration.
- **Humidity** – dry air causes an increase in the rate of transpiration. If the air is very moist, water takes much longer to evaporate.
- **Wind** – moves moist air away from the leaf, maintaining the concentration gradient.
- **Light** – affects the size of the stomata because the greater the light intensity, the larger the stoma size will be until it reaches a maximum size.
- **Availability of water** – water must be available in the soil. If the soil is dry, the plant will dehydrate and wilt.
- **Altitude** – the atmospheric pressure is lower at high altitudes, which causes an increase in the transpiration rate.

Activity 1

LC GROUPS

LC COLLECTION OF EVIDENCE

Structure of the heart

Obtain a sheep or an ox heart from your local butcher. Using a scalpel, divide the heart longitudinally.

- Identify the atria and ventricles. How do they appear to you?
- Look for the SVC and IVC. What kind of blood do these veins carry?
- Describe the aortic arch. What is the destination of this artery and what kind of blood does it transport?
- The pulmonary artery and pulmonary veins carry blood to and back from the lungs. What is the purpose of this?
- List the other structures available and describe these structures.

PAIRS

FORMATIVE ASSESSMENT

Activity 2

To find the effect of exercise on the heart rate

To measure the rate of your heart, you need to take your pulse. To take the pulse, you need to use the first two fingers of your right hand and place them on the inside of your left wrist. Feel for the tendon near the outside of your wrist. Rest your fingers lightly over the tendon. You can feel the artery in your wrist pulsating as your heart pumps blood through it.

Now proceed as follows:

- Both you and your partner need to sit for two minutes to make sure you are both completely relaxed.
- Now take each other's pulse rate and record this in a table.
- After you have recorded the first pulse rates, do some vigorous exercise, such as stepping up and down a chair or steps, for two minutes. At the end of this time, sit down again, and immediately take the pulse rate. Record this as the second pulse rate.
- Take another four readings while doing some vigorous exercise and record your results in a table.
- Draw a graph of your results.

QUESTIONS

1. Why does the pulse rate increase during exercise?
2. Why did the pulse rate not go back to the first pulse rate after you had finished exercising?
3. Work out how many minutes it took your pulse rate to return to normal after exercise.

INDIVIDUAL

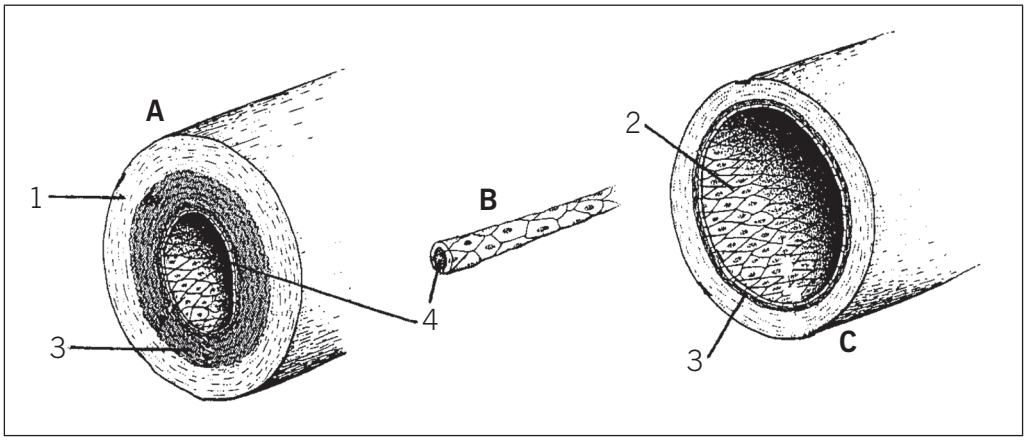
SUMMATIVE ASSESSMENT

COLLECTION OF EVIDENCE

Activity 3

Summative assessment: Transport

1. Study the diagrams, which show cross-sections of mammalian blood vessels, and answer the questions that follow.



(a) Identify vessels A, B and C. (3)

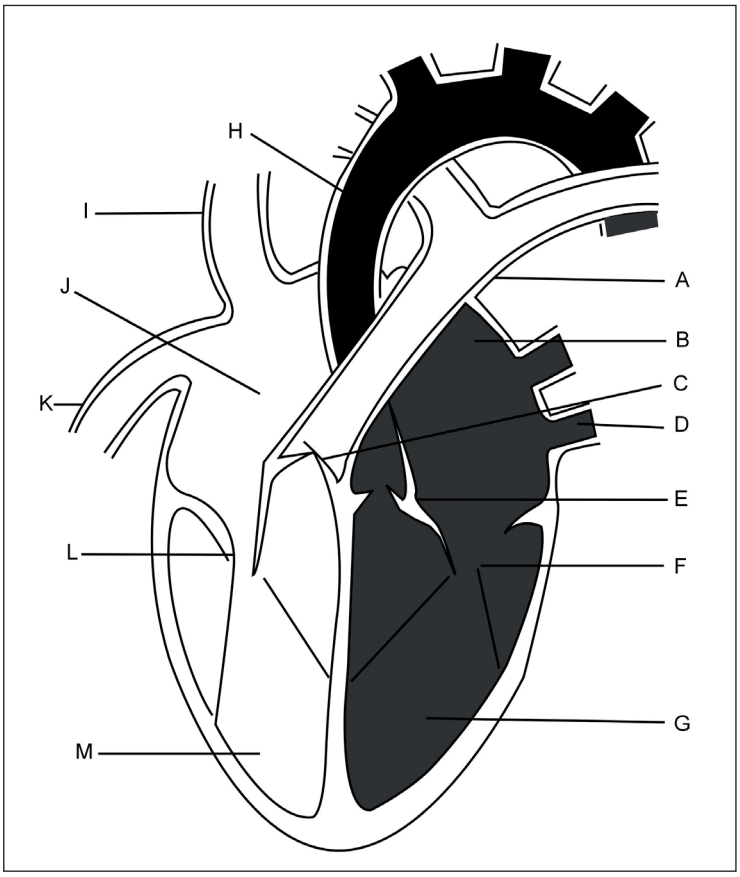
(b) Provide labels for parts 1, 2 and 4. (3)

(c) Identify the part labelled 3 and provide a reason for this part being thicker in blood vessel A than in blood vessel C. (2)

(d) How does blood vessel B differ from blood vessel A and C? (1)

(e) In which blood vessel do you expect to find valves? What is the function of these valves? (3)

2. Study the diagram of a cross-section of a mammalian heart and answer the questions that follow.



(a) (i) Write down the letter and the name of the artery that carries deoxygenated blood. (2)

(ii) Where is this deoxygenated blood going and what is the purpose thereof? (2)

(b) Write down the letters and the names of veins as shown in the diagram. (6)

(c) Identify structures M and state the function of these structures. (2)

(d) Provide labels for structures F and L. What do you think would happen if these structures were missing? (3)

(e) What would happen if the coronary arteries, which branch from part H, become blocked because of high cholesterol levels in the bloodstream? (2)

(f) Provide labels for parts B, C, E, G, H, J and N. (7)

3. The heartbeat of an athlete was recorded before, during and after a race for a total time of 100 minutes. The results are shown in the table below.

Time/min	0	10	20	30	40	50	60	70	80	90	100
Heartbeat per minute	60	60	61	62	84	105	108	100	88	70	64

(a) Use the data from the table and draw a graph. Use the *x*-axis for time in minutes and the *y*-axis for heartbeat at rest. (6)

(b) What is the heartbeat at rest? (1)

(c) After how many minutes:

(i) Did the athlete start the race? (1)

(ii) Was the athlete's heartbeat 84 times per minute? (1)

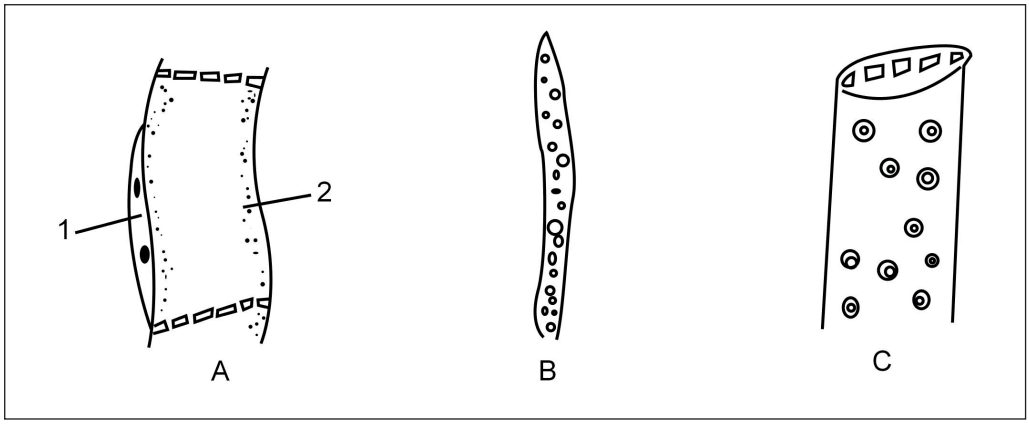
(iii) Did the athlete stop running? (1)

(d) How long does one complete heartbeat last at:

(i) rest, and

(ii) the end of the race? Show your calculations. (2)

4. Study the following plant tissues and answer the questions that follow.



(a) Identify tissues A, B and C. (3)

(b) What is the function of tissue A? (1)

(c) Provide labels for parts numbered 1 and 2. 2)

(d) What is the function of tissue B and C? (1)

(e) Discuss THREE ways in which tissues B and C are structurally adapted to perform their functions. (3)

STRUCTURE, CONTROL AND PROCESSES IN BASIC LIFE SYSTEMS OF PLANTS AND HUMANS: Excretion

Lessons 12-14

Learning Outcomes and Assessment Standards

Learning Outcome 1
Scientific inquiry and problem- solving skills
The learner is confidently able to explore and investigate phenomena relevant to Life Sciences by using inquiry, problem solving, critical thinking and other skills:
- Structure of the excretion system
- Investigate by dissecting the kidney to study the macroscopic structure
- Design a model of a dialysis machine
- Conduct research in the latest medical practices

Assessment Standards
AS1 *Systematically and accurately collect data using selected instruments and/or techniques. Select a type of display that communicates the data effectively*
AS2 *Compare data and construct meaning to explain findings. Draw conclusions and recognise inconsistencies in the data. Assess the value of the experimental process and communicate the findings*

Learning Outcome 2
Construct and apply Life Science knowledge
The learner is able to access, interpret, construct and use Life Science concepts to explain phenomena relevant to Life Sciences
- Understand structures versus function
- The process of removal of wastes
- The four excretory organs and their functions
- Macroscopic structure of the kidney
- Microscopic structure of the nephron

Assessment Standards
AS1 *Use various methods and sources to access information*
AS2 *Identify, describe and explain concepts, principles, laws, theories and models by illustrating relationships. Evaluate concepts, principles, laws, theories and models*
AS3 *Analyse and evaluate the costs and benefits of applied Life Sciences knowledge*

Learning Outcome 3
Life Sciences, technology, environment and society
The learner is able to demonstrate an understanding of the nature of science, the influence of ethics and biases in Life Sciences and the inter-relationship of science, technology, indigenous knowledge, the environment and society.
- Legislation regarding kidney transplants and ethics
- Life-support systems such as the dialysis machine process

Assessment Standards
AS1 *Compare scientific ideas and indigenous knowledge of past and present cultures*
AS3 *Compare the influence of different beliefs, attitudes and values on scientific knowledge and its application in society*

Overview

In this lesson we will focus on how the body excretes metabolic waste.

Lesson 12

LC DVD

Introduction

Metabolic wastes are produced by all living cells during normal living processes. The wastes must be removed or they will upset the body's normal functioning, causing illness and disease, and can even lead to death. The process of removing waste substances from the body is called excretion.

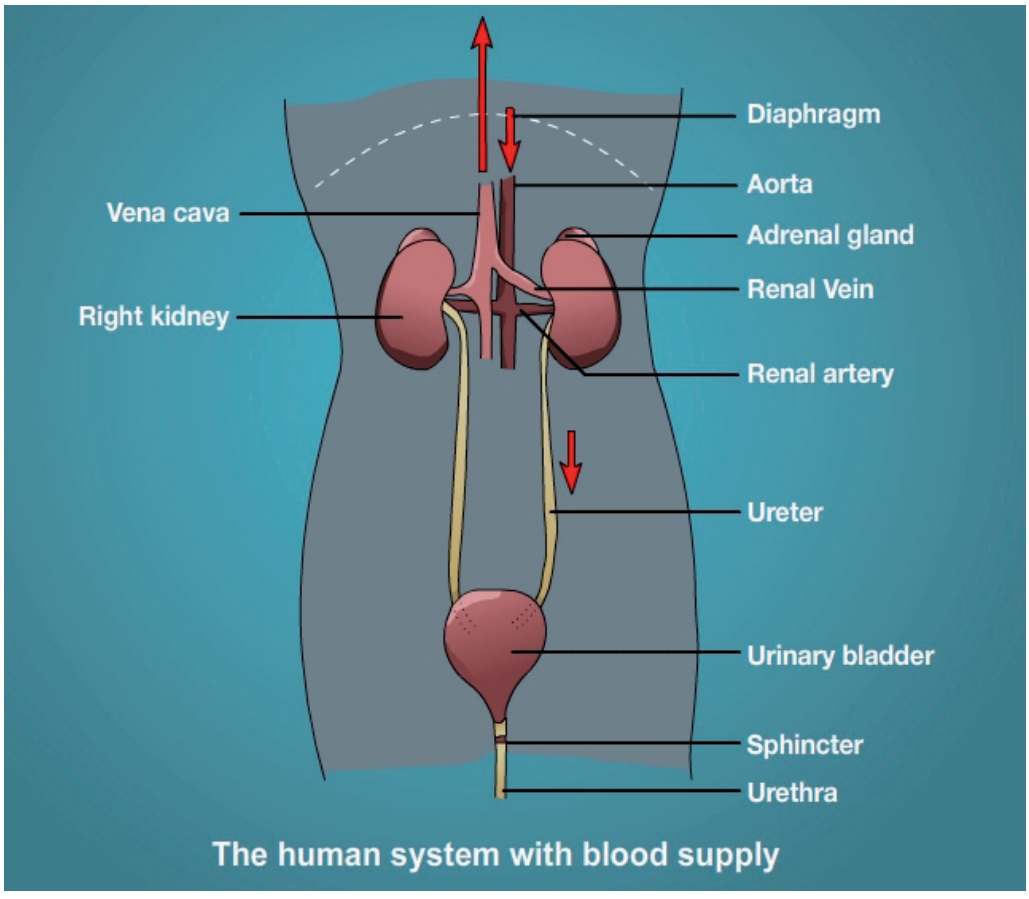
Four organs play a vital role in the removal of waste from the body:

- **The kidneys** – excrete urine (excess water, mineral salts, urea, uric acid, hippuric acid, ammonia and creatinine). The kidneys filter these substances from the blood and selectively re-absorb some of them.
- **The lungs** – excrete carbon dioxide and water vapour.
- **The skin** – excretes sweat (water, mineral salts and wastes). Sweating also plays a role in regulating the body's temperature.
- **The liver** – detoxifies poisonous substances in the blood such as alcohol and secretes bile, which is excreted into the duodenum, where it plays a role in digestion.

The kidneys and the urinary system

The two **kidneys** are part of the **urinary system**. Each kidney is bean-shaped, and is situated either side of the spinal column, at the back of the abdomen, inside the rib cage. They are protected against injury and heat loss by the ribs and a mass of adipose tissue called renal fat. They are connected by the two ureters to the bladder, where **urine** is stored, before being passed out of the body along the **urethra**.

Above each kidney are the **adrenal glands** (also called the suprarenal glands) , which play many roles, but what will concern us most in this lesson is their role in regulating the **electrolytic balance** of the body.

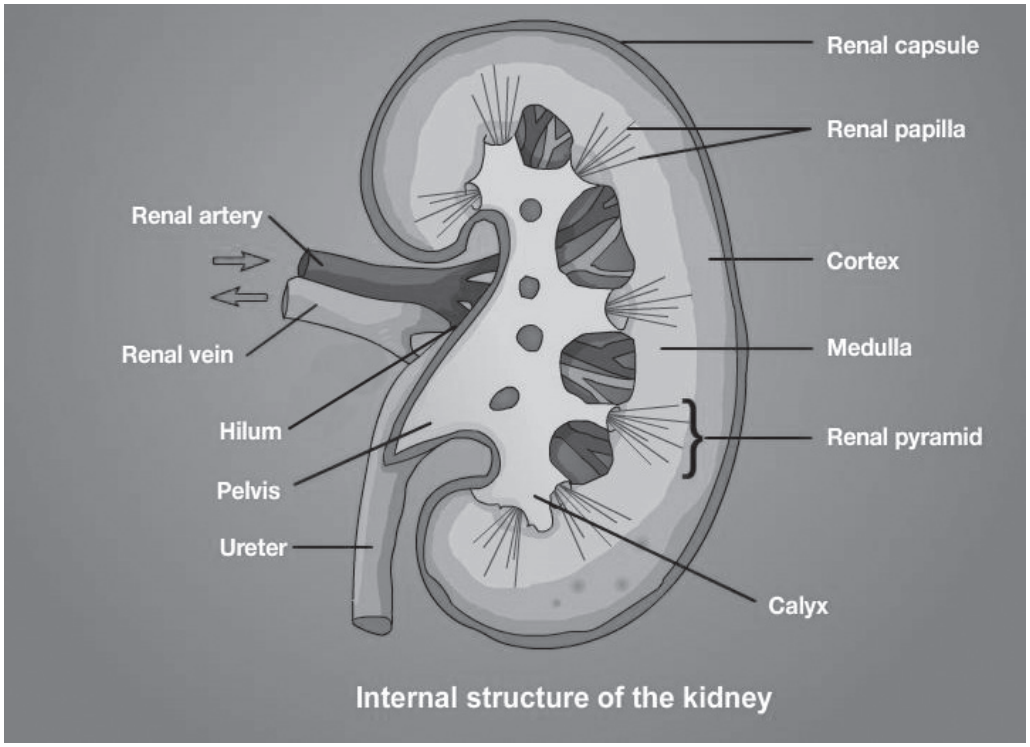


The human system with blood supply

The macroscopic structure of the kidneys

The kidneys are enclosed in a **capsule of fibrous tissue**. When cut longitudinally, the kidneys have two distinct regions. The outer area, known as the **cortex**, is reddish brown. The inner section, called the **medulla**, is a lighter pinkish-purple colour. The medulla is made up of pale conical striations called the **renal pyramids**. On one side of each kidney is a concave area known as the **hilum**, which is

where the **renal artery** and **renal nerves** enter the kidney, and the **renal vein** leaves. The upper, expanded part of the ureter, called the pelvis, is where the ureter leaves the kidney. Inside the kidney, each renal pyramid converges towards the **calyx** and forms a **papilla**. Between each calyx are areas known as renal columns.



Internal structure of the kidney

Lesson 13

LC DVD

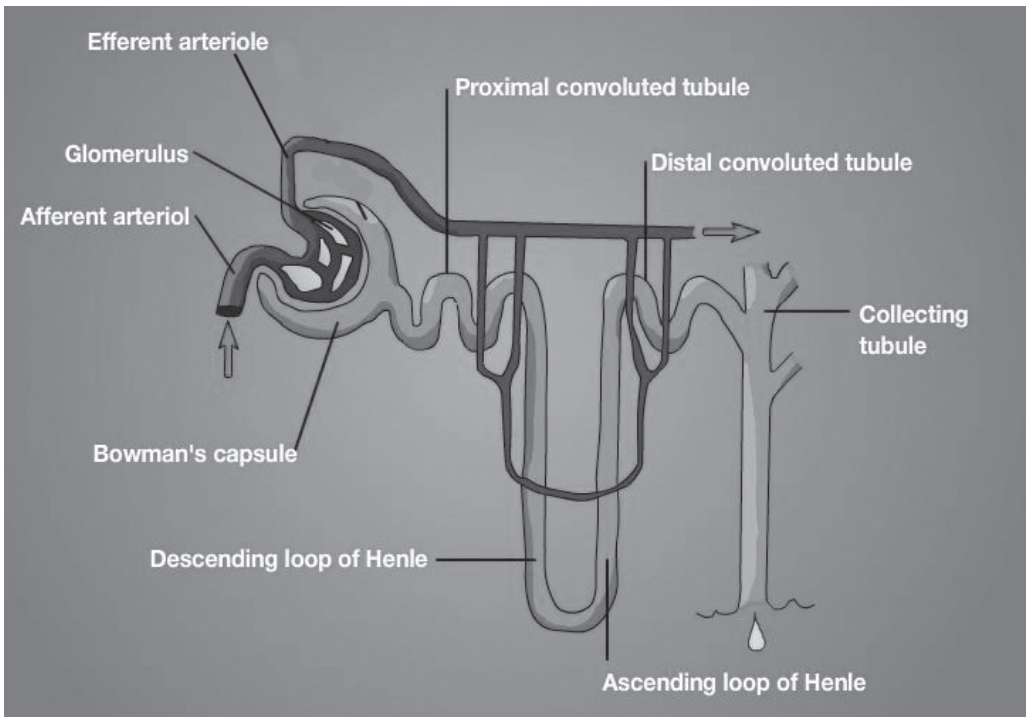
The microscopic structure of the kidneys

Each kidney contains large numbers of microscopic structures called **nephrons** and **collecting tubules**. The nephron is the functional unit of the kidney, where there is an estimated one million per kidney.

A nephron consists of a:

- **Collecting tubule**, closed on one end. The closed or blind end is indented to form a cup-shaped glomerular capsule, which almost completely encloses a network of arterial capillaries called the **Glomerulus**.
- Continuing from the glomelular capsule, the rest of the nephron contains three parts: the **proximal** (nearest) **convoluted tubule**, the **loop of Henle** and the **distal** (furthest) **convoluted** tubule, which leads into the collecting tubule.

  The walls of the glomerulus and the glomerular capsule are made up of a single layer of **flattened epithelial cells**. The rest of the nephron and the collecting tubule consist of a single layer of highly specialised cells. The nephrons lie in connective tissue which contains sympathetic and parasympathetic nerves.



How nephrons work

After entering the kidney at the hilum, the renal artery divides into small arteries and arterioles. In the cortex, **afferent** (leading into) arterioles enter each glomerular capsule, where each arteriole divides to form the glomerulus. Leading out of each glomerulus are the **efferent** (leading out of) arterioles, which break up into a second capillary network to supply the remainder of each nephron with oxygen and nutritional materials. Venous blood drains away from this capillary network and leaves the kidney through the renal vein, which empties into the inferior vena cava.

Functions of the kidneys

The kidneys play a vital role in the overall health of an individual. It maintains the balance of fluid and electrolytes in the body and disposes of waste material dissolved in the urine.

Formation of urine

This occurs in three phases:

- simple filtration
- selective re-absorption
- secretion

Simple filtration

Filtration takes place through the **semi-permeable walls** of the glomerulus and the glomerular capsule. What passes through the walls is determined by the **molecular size** of a substance present in the blood. What allows this process to take place is the difference between the blood pressure in the glomerulus and the filtrate pressure in the glomerular capsule. Because the calibre (width) of the efferent arteriole is smaller than that of the afferent arteriole, **a capillary hydrostatic pressure** builds up in the glomerulus. This pressure is opposed by the **osmotic pressure** of the blood and by filtrate hydrostatic pressure inside the glomerular capsule.

Substances in the blood with a low molecular weight which filter into the glomelur capsule include: water, salts, amino acids, fatty acids, glucose, urea, uric acid, creatinine, hormones and toxins.

The normal contents of the blood with a high molecular weight, such as red and white blood cells and plasma proteins, do not filter through the semi-permeable membrane.

Selective re-absorption

After substances have passed into the glomelular filtrate, as described above, as the filtrate passes through the convoluted tubules, the loop of Henle and on into the collecting tubule, a process of selective re-absorption takes place. What is **re-absorbed** from the filtrate are all those substances that are essential to the body, either to maintain the fluid and electrolyte balance, or to maintain the alkalinity of the blood. These substances include: glucose, amino acids, keto acids, Vitamin C and some mineral salts. They are described as having **high threshold values** and are not normally found in the urine. But when an illness such as, for example, diabetes mellitus raises the level of glucose in the blood beyond the capacity of the cell walls to re-absorb all the glucose, some glucose will be present (and can be tested for) in the urine.

Some substances, such as creatinine, sulphates and many drugs, are not re-absorbed and are described as **non-threshold substances**. This is why it is possible to test athletes for the presence of illegal performance-enhancing drugs.

Secretion

Filtration takes place as the blood flows through the glomerulus. Non-threshold substances may not stay in the glomerulus for long enough to be removed from the blood by simple filtration, so these may be cleared from the blood by direct secretion into the convoluted tubules and so into the urine for excretion.

Lesson 14

LC DVD

Water balance

All animals, including humans, need to drink a certain amount of water a day to enable them to stay alive. Most of the water in our bodies is absorbed through the alimentary canal (digestive system), but a small amount is also formed by metabolic processes.

We excrete excess water in a variety of ways: by breathing out water vapour through the lungs, by perspiration and sweating through the skin, and as a constituent of faeces and urine.

The amount lost by breathing out, and the amount lost in faeces remains fairly constant, but the amount lost through the skin by perspiration and sweating fluctuates, because it is linked to the maintenance of body temperature. The key role in maintaining the balance between input and output is therefore regulated by the kidneys, and the kidneys need an absolute minimum input of about 500 ml of water per day to be able to play their essential role of removing waste materials from the body through the urine. That's just two glasses of water!

What controls any amount of water in excess of the minimum 500 ml is the **antidiuretic hormone (ADH)**, which is released into the blood by the posterior lobe of the **pituitary gland** in the brain, which does this in tandem with the **hypothalamus**, also in the brain. The hypothalums has cells called **osmo-receptors** which are sensitive to changes in the **osmotic pressure** of the blood.

If the osmotic pressure of the blood becomes raised, the osmo-receptors are stimulated, leading to an increase in the output of ADH by the pituitary. You will also feel thirsty: your body's way of telling you it needs more water. As soon as the osmotic pressure drops, ADH production will be reduced. This cyclic process keeps the concentration of the blood within functional limits.

ADH also acts on the tubules of the kidneys by increasing the permeability of the distal and collecting tubes, so that **MORE** water is re-absorbed and returned to the blood. ADH levels will also increase if there is an increase in the concentration of dissolved substances in the blood, so that there is more water to keep the blood diluted. This is why a high concentration of a drug like alcohol in the blood can lead to that notorious morning-after babelaas feeling of intense thirst!

ADH functioning:

On a HOT day, a person needs:	**On a COLD day, a person needs:**
∴ MORE sweat to cool the body	∴ LESS sweat to cool the body
∴ MORE water in the blood to make sweat	∴ LESS water in the blood to make sweat
∴ MORE ADH so that more water is reabsorbed	∴ LESS ADH so that less water is reabsorbed
∴ MORE concentrated urine is produced	∴ LESS concentrated urine is produced
(same amount of wastes + less water)	(same amount of wastes + more water)

Electrolyte balance

To be able to perform all its physiological processes at an optimal level, the body uses mechanisms to maintain the balance between the amount of water available and the concentration of **electrolytes** (sugars and salts) in the blood. Ordinary table salt (sodium), the kind we add to our food to give it flavour, is the most common salt that is found in the extracellular fluid of the body. Besides what we add to our food in cooking, it also exists naturally in many foods (that salty packet of crisps is NOT a natural food!).

For most people, therefore, there is little danger of taking in too little salt (in fact, with the modern salt-saturated diet of convenience foods, for many people there is a danger of taking in too much). Still, there are times when people can lose too much salt so rapidly that it becomes life-threatening, such as taking part in an extreme form of exercise, like running the Comrades Marathon, or if they are injured and lose a lot of blood.

The body loses sodium by means of two main routes:

- through the **skin** as a constituent of **sweat**, and
- through the **kidneys** as a constituent of **urine**.

The kidneys play an active role in maintaining the concentration of sodium in the body. What controls how much salt is excreted into the urine is a substance called aldosterone, a hormone produced by the cells of the cortex of the **adrenal gland**.

Kidney transplants

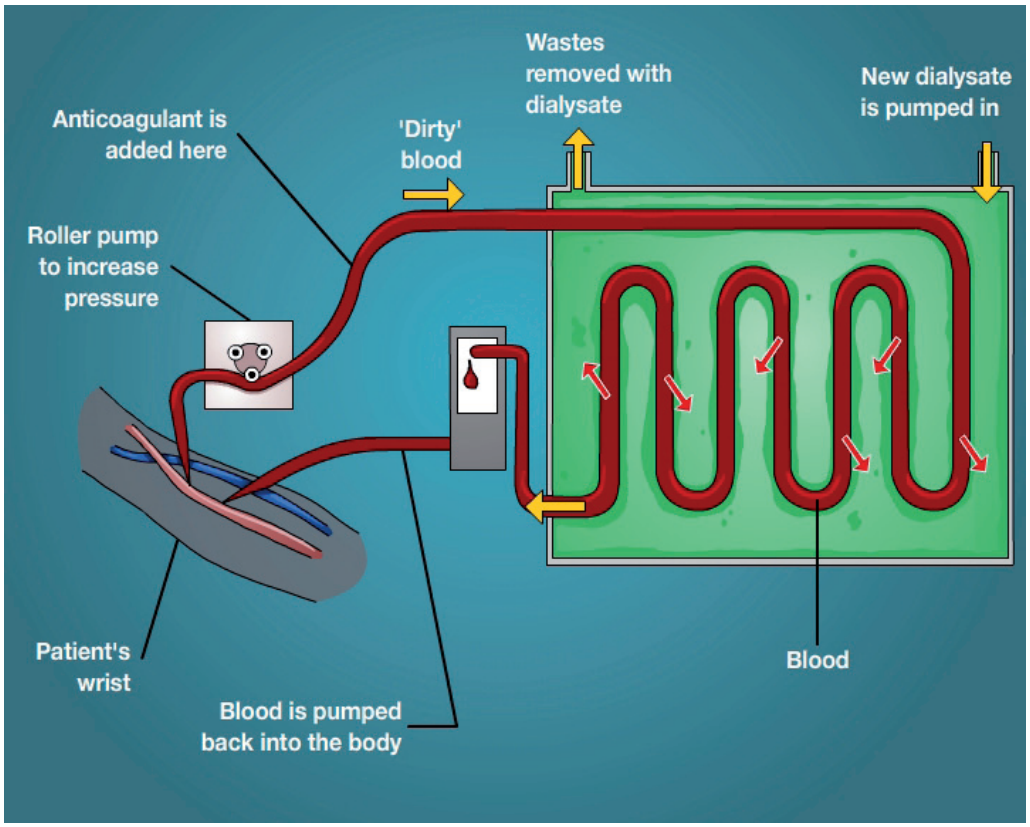
When kidneys are damaged by injury, disease or genetic weakness, they will malfunction. Kidney failure can result in death as wastes accumulate and poison the tissues. Kidneys also remove excess water from the tissues, if this does not happen, severe swelling (oedema) results, causing tissue damage.

A kidney transplant is a difficult process, as is finding a suitable donor. The donor must have the same blood type and very similar tissue to the recipient. Blood relatives are the best candidates, but when they are not available, the patient must rely on a matched donor. Many people donate their organs in the event of their death from an unexpected accident or from natural causes.

The process begins with tissue typing to determine whether a potential donor's kidney matches the recipient's tissue. When a close match is found, the kidney can be transplanted. Transplant patients have to take long-term medication to prevent their immune system from rejecting the organ.

Renal dialysis

While an afflicted person waits for a suitable donor kidney to be found, kidney failure must be addressed or the person will die. A procedure called haemodialysis (dialysis for short) "washes" the impurities out of the blood. A shunt is inserted into their arm that will allow their blood to flow along plastic tubes into the dialysis machine. A roller pump helps to increase the pressure of the blood drawn from a vein. The machine contains tubing which is semi-permeable (like the glomerulus) to allow waste products, excess water and minerals to diffuse out of the blood into the dialysate. The dialysate also contains ions and small molecules to prevent the loss of glucose and amino acids from the blood. Saturated dialysate is continuously pumped out of the machine and replaced with fresh fluid. The cleansed blood is returned to the person's body.



The dialysis machine

GROUPS

CLASS

COLLECTION OF EVIDENCE

Activity 1

External and internal structure of the kidney

1. Work in groups of 2.
2. Obtain a sheep's kidney from the butcher.
3. Ensure that you have a hand lens, dissecting needle, sharp knife/scalpel and a dissecting board.
4. Place the kidney on the board.
5. Examine the external structure of the kidney. Identify the hilum, renal artery, renal vein and renal capsule.
6. Remove the fat around the kidney.
7. Measure the length and width of the kidney in mm.

   Length: _____ Width: _____
8. Using the sharp knife/scalpel, cut a longitudinal section (L/S) through the kidney. Make a clean, smooth cut from top to bottom.
9. Make an accurate drawing of the internal structure of the kidney as you observe it.

INDIVIDUAL

FORMATIVE ASSESSMENT

Activity 2

How does the kidney function?

1. Set up a concept map showing the functions of the human kidney.
2. Use a double A4 page.
3. Study the assessment criteria and then plan your work accordingly.
4. Originality is important.
5. Neatness and clarity of presentation are vital.

Activity 3

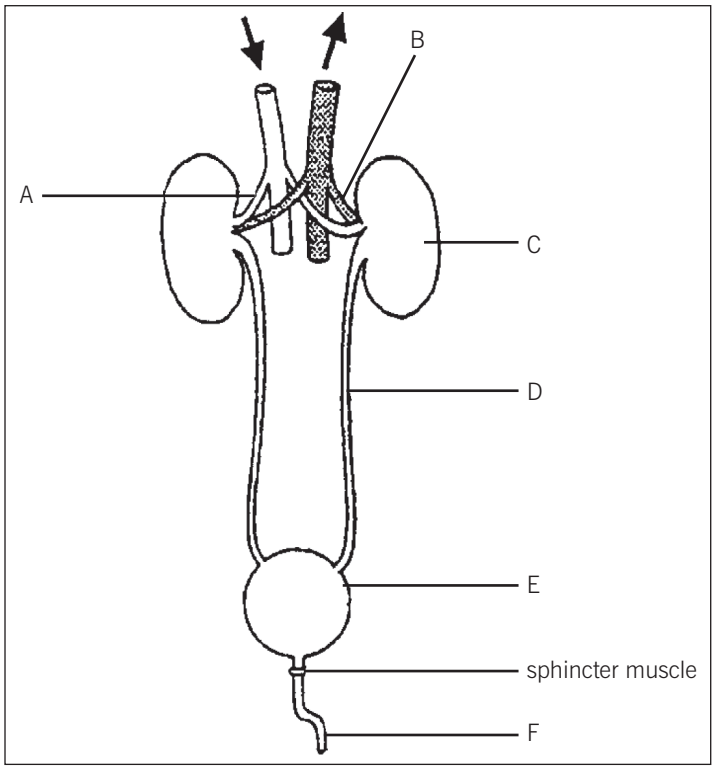
INDIVIDUAL

SUMMATIVE ASSESSMENT

COLLECTION OF EVIDENCE

Summative assessment: Kidney

1. Study the diagram below and answer the questions that follow.



1.1 Label parts B and F. (2)

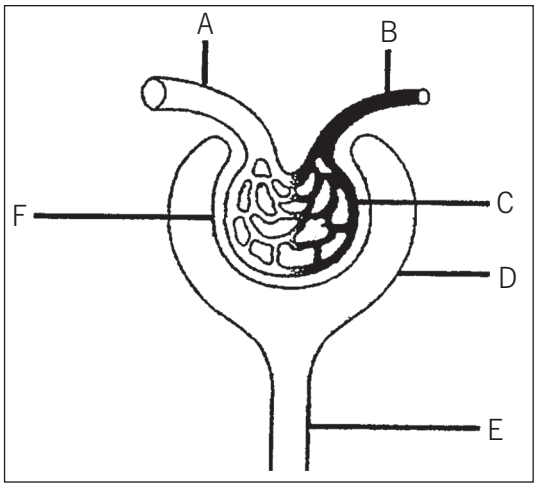
1.2 List TWO substances present in A which are normally absent in D. (2)

1.3 State ONE function of E. (2)

1.4 State the function of the sphincter muscle. (2)

1.5 List THREE functions of C. (3)

2. Study the diagram of a glomerulus and answer the questions that follow.



2.1 Label parts A, B, C and D. (4)

2.2 Measure the diameter of vessel A as drawn in this diagram. (2)

2.3 Explain how A and B are responsible for the process that occurs in the glomerulus. (2)

2.4 List FOUR substances which will be filtered out from C. (4)

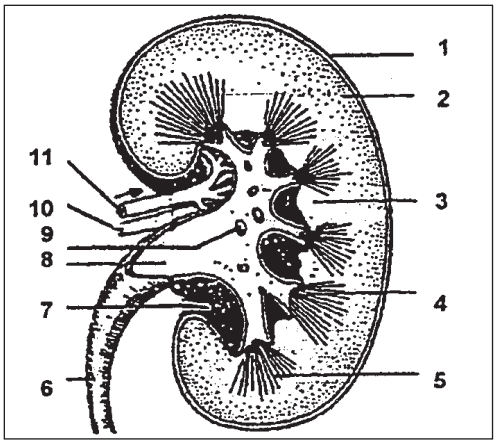
2.5 Name the type of cells found in:

(i) Part E (1)

(ii) Part F (1)

3. Tables A and B list the percentages of certain components found in certain structures of the kidney. The diagram shows a kidney and associated structures.

A	
Component	Concentration %
Urea	0,03
Glucose	0,10
Amino acids	0,05
Salts	0,72
Proteins	8,00
B	
Component	Concentration %
Urea	2,00
Glucose	0,00
Amino acids	0,00
Salts	1,50
Proteins	0,00



3.1 Identify parts 4, 5 and 8. (3)

3.2 Name ONE place where the contents of B might be found. Explain your answer. (4)

3.3 Which structures, shown in the diagram, may be associated with table A? Give reasons for the answer. (3)

3.4 Which numbers of the diagram refer to the:

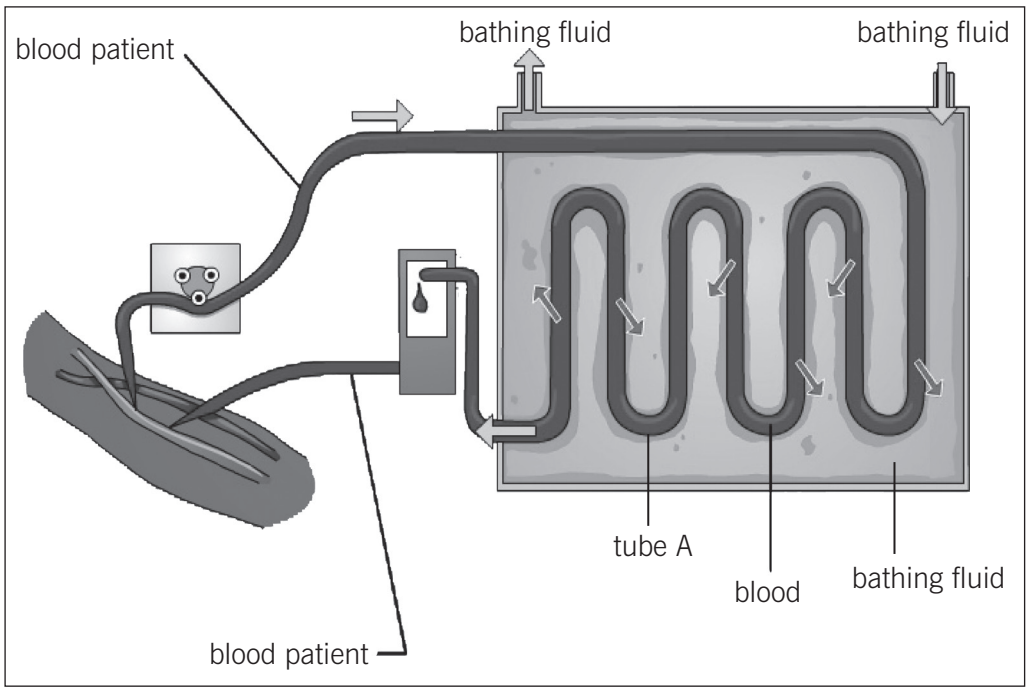
(i) Ducts of Bellini (1)

(ii) Glomerulus (1)

(iii) Loop of Henle (1)

3.5 Explain how the kidneys ensure that a person does not dehydrate on a hot day. (6)

4. When a person's kidneys do not function as a result of a disease or injury, the blood must be cleansed artificially by dialysis. One method of dialysis is the usage of an artificial kidney machine as shown in the diagram that follows.



4.1 What particular property must the wall of tube A have? (1)

4.2 Suggest why tube A is coiled rather than straight. (3)

4.3 Name ONE constituent of the blood plasma that does not pass into the bathing fluid. (1)

4.4 Name TWO substances, other than salts, which pass into the bathing fluid. (2)

4.5 Explain why the bathing fluid must already contain essential salts before it enters the machine. (2)

5. Study the table below and answer the questions that follow.

Daily filtration, re-absorption and excretion rates of certain substances in the human kidney

	Rate (arbitrary units) per 24 hours		
Substance	**A Filtration**	**B Re-absorption**	**C Excretion**
Water	8 720 000	7 840 000	?
Sodium	24 310	24 060	250
Glucose	900	890	0

5.1 What quantity of water will pass out in the urine during a 24-hour period? (1)

5.2 Explain the difference in the re-absorption and excretion rate of glucose in B and C. (2)

5.3 Apart from urea, name TWO other nitrogenous waste products, which can be excreted by the kidney. (2)

5.4 Name the disease associated with the presence of glucose in C. (1)

5.5 Name the hormone influencing the permeability of kidney tubules to water. (1)

TOTAL – 60

Lessons 15-19

TISSUES, CELLS AND MOLECULAR STUDY

Nervous and Chemical Co-ordination

Learning Outcomes and Assessment Standards

Learning Outcomes 1
Scientific inquiry and problem solving skills.
The Learner is able to confidently explore and investigate phenomena relevant to Life Sciences by using inquiry, problem solving, critical thinking and other skills by:

- Studying the structure of the Nervous and Endocrine systems
- Conducting dissections
- Design a model to show the anatomy of the Brain
- Conduct medical research on the latest medical practices

Assessment Standards
AS2 *Systematically and accurately collect data using selected instruments and/or techniques. Select a type of display that communicates the data effectively*
AS3 *Compare data and construct meaning to explain findings. Draw conclusions and recognise inconsistencies in the data. Assess the value of the experimental process and communicate the findings.*
Learning Outcome 2
Construct and apply Life Science knowledge.
The Learner is able to access, interpret, construct and use Life Science concepts to explain phenomena relevant to Life Sciences

- Endocrine Glands and their function
- Hormones and the target organs
- Structure of the Neuron, Brain and Spinal cord
- Reflex arc
- Disorders and diseases

Assessment Standards
AS1 *Use various methods and sources to access information*
AS2 *Identify, describe and explain concepts, principles, laws, theories and models by illustrating relationships. Evaluate concepts, principles, laws, theories and models*
Learning Outcome 3
Life Science, technology, environment and society.
The Learner is able to demonstrate an understanding of the nature of science, the influence of ethics and biases in Life Sciences and the inter-relationship of science, technology, indigenous knowledge, the environment and society.

- Ethics and beliefs
- Life support systems
- Hormone replacement – Insulin

Assessment Standards
AS1 *Compare scientific ideas and indigenous knowledge of the past and the present culture*
AS2 *Compare different ways in which resources are used in the development of biotechnological products and analyse the impacts on the environment and society*
AS3 *Compare the influence of different beliefs, attitudes and values on scientific knowledge and its application in society*

Overview

In this lesson we will focus on the endocrine system.

LC DVD

Lesson 15

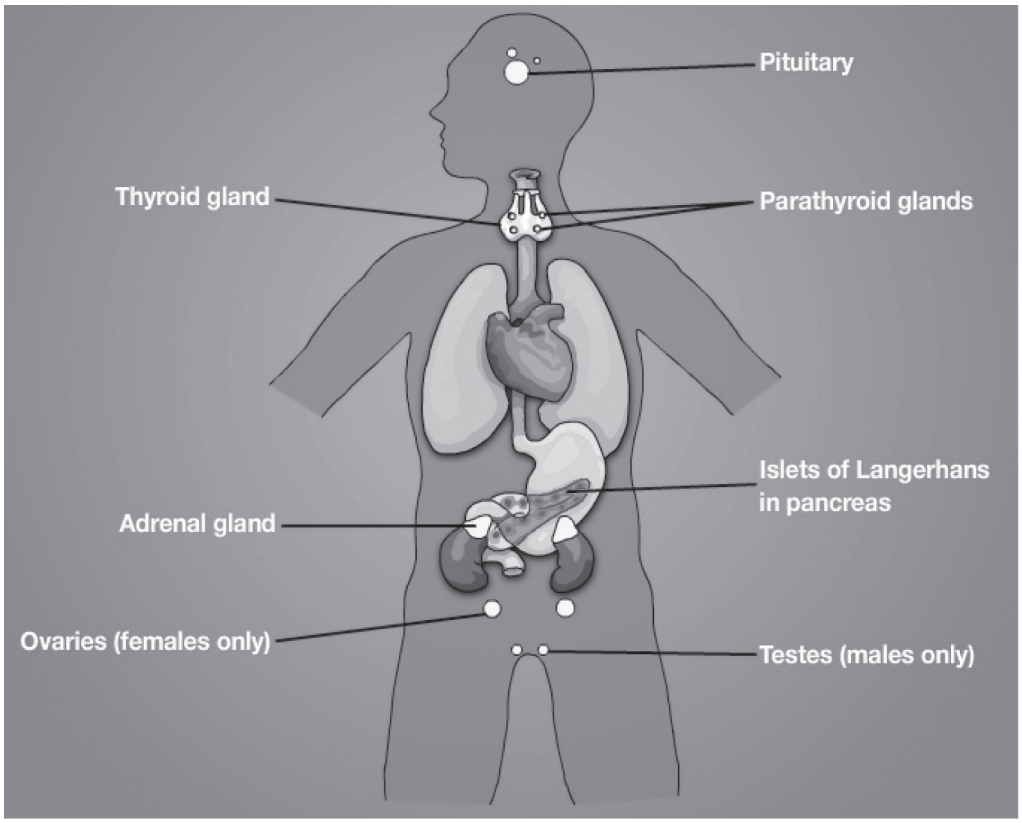
Introduction:

The Endocrine system and the Nervous system work together, to co-ordinate the systems of the body so that everything works together. This ensures homeostasis. The Hypothalamus in the brain controls the co-ordination of both the systems.

The Endocrine system

The Endocrine glands produce hormones. Endocrine glands are ductless, so hormones are secreted directly into the blood. There is a very good supply of blood to transport the hormones to the target organs.

Hormones are made up of proteins and lipids (fats). They are chemical messengers that control the activities of a target organ to ensure normal functioning of all the systems. Hormones work together to stimulate or inhibit organs. Hormones regulate processes like growth and metabolism.

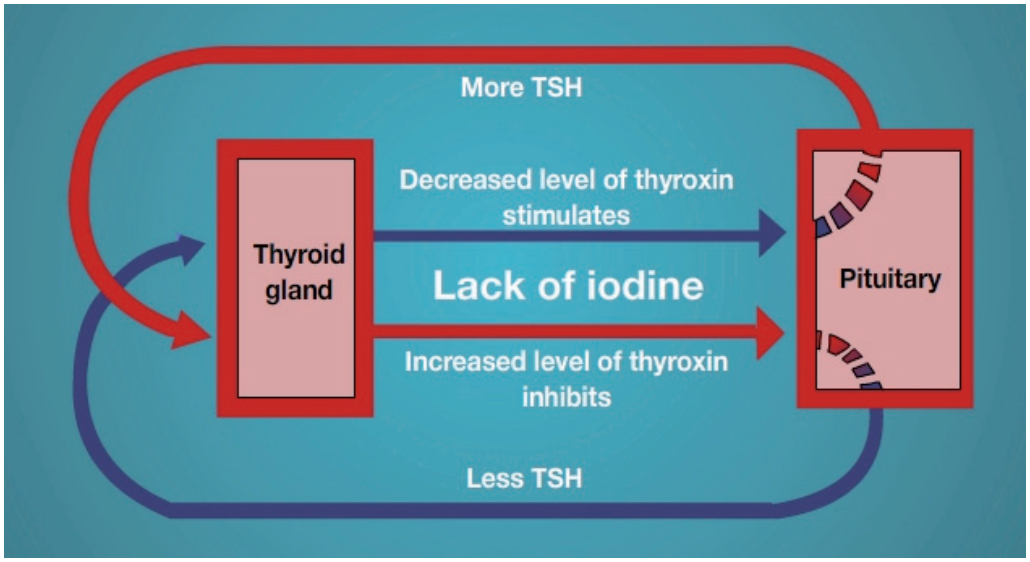


Endocrine glands and hormones

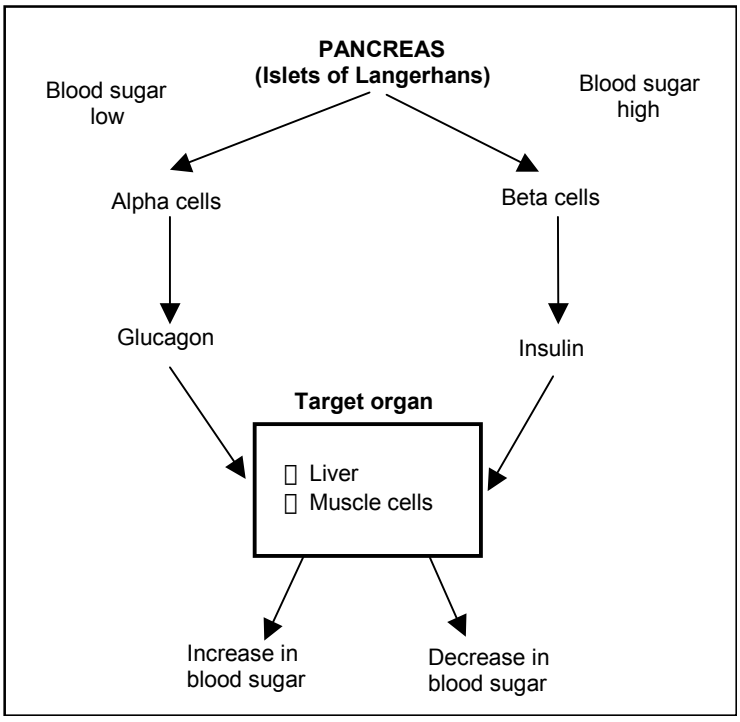
Gland	Location	Hormone	Function	Over and Under Secretion
Anterior lobe –pituitary gland	Below frontal lobe of the brain	Growth hormone	Growth, repair and replacement of cells	Over secretion: Children – giantism Adults – acromegaly Under secretion: Children – pituitary dwarf Adults – premature senility
Anterior lobe –pituitary gland	Below frontal lobe of the brain	Thyroid stimulating hormone (TSH)	Stimulates the production of thyroxin by the thyroid gland	Over secretion: goitre Under secretion: Children – cretinism Adults – myxodema
Posterior lobe –pituitary gland	Base of the brain and attached to the Hypothalamus	Antidiuretic hormone (ADH)	Regulates osmoregulation in the kidneys	Over secretion: water retention and swelling Under secretion: dehydration
Thyroid gland	Neck region.	Thyroxin	Regulates metabolism, growth, body temperature and functioning of the heart and nervous system Stimulates growth of foetal tissue	Over secretion: goitre Under secretion: Children – cretinism Adults – myxodema
Cortex of Adrenal gland	On top of the kidney	Aldosterone	Aids the uptake of sodium in the Loop of Henle	Over secretion: oedema Under secretion: Addison's disease
Medulla of the Adrenal gland	On top of the kidney	Adrenalin	Prepares the body to deal with stress: • Increase in heart beat rate and breathing rate • Increase in blood pressure to improve muscle tone • Increase in blood sugar levels • Decrease in blood supply to the skin and digestive system • Pupils dilate	Controlled by the sympathetic and parasympathetic nervous system. Over secretion: extreme nervousness, aggression Under secretion: lethargy
Islets of Langerhans – alpha cells	Endocrine cells of the pancreas	Glucagon	Controls the increase of blood sugar levels	No over or under secretion
Islets of Langerhans – beta cells	Endocrine cells of the pancreas	Insulin	• Controls blood sugar by causing the conversion of glucose into glycogen • Inhibits the functioning of glucagon	Over secretion: obesity Under secretion: diabetes

Hormonal control in the body

Homeostasis takes place as a negative feedback mechanism. Feedback systems ensure that all the systems are co-ordinated. When there is an increase from normal, a hormone will correct the system and cause a decrease and vice versa. This results in a balance in the body. Two negative feedback mechanisms that are very important are the regulation of thyroxin and the regulation of blood sugar.



Hormone control in the body



Feedback mechanism controlling thyroxin production

Lesson 17

The nervous system

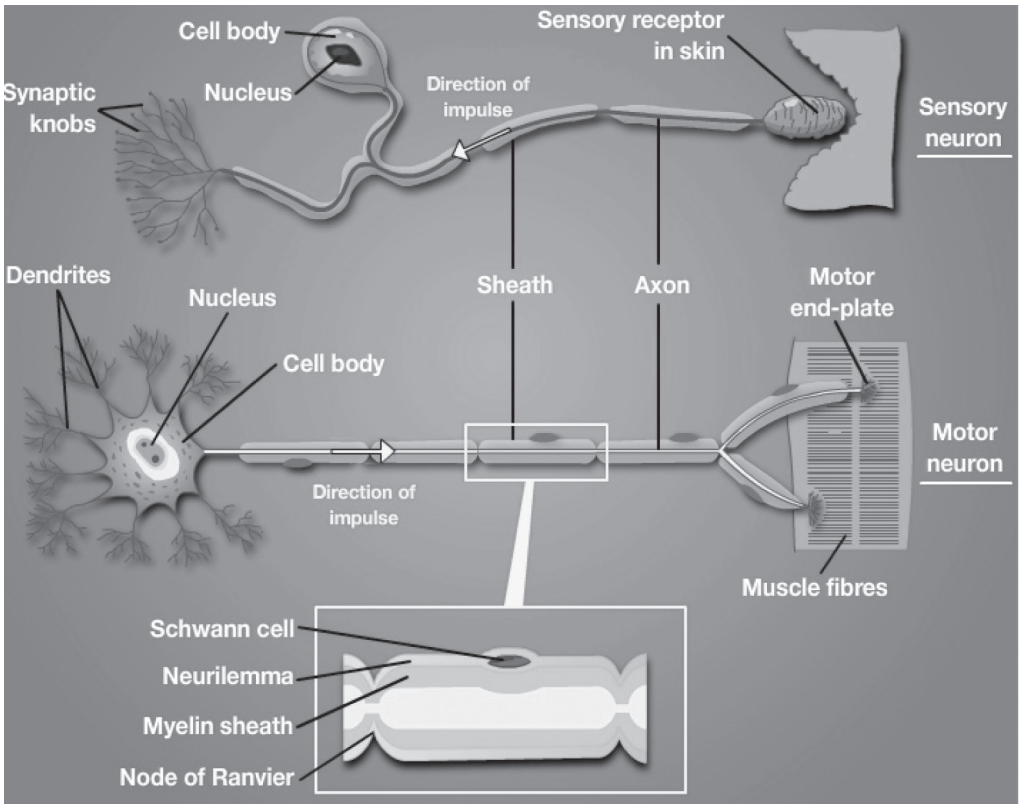
The nervous system is divided into THREE systems, which together co-ordinate the functioning of the body

Nervous tissue

Nervous tissue consists of neurons. One nerve consists of millions of neurons. Receptors receive the stimulus and convert it to an impulse. The impulse travels along the neurons to the central nervous system.

Each neuron has a large cell body and one or more extensions called dendrites. Impulses enter the dendrite at one end, travel along the axon at the other end called the terminal end plate.

- **Sensory neurons** convey impulses to the Central Nervous System
  Sensory neurons are unipolar or bipolar neurons
- **Motor neurons** convey impulses away from the Central Nervous System to a muscle or a gland. Motor neurons are multipolar
- **Connector neurons** connect sensory neurons to motor neurons in the spinal cord and in the brain.



Synapses: A synapse is the transfer of the impulse from one neuron to the next. Neurons do not touch each other. A space called the synaptic gap is in between the neurons. The impulse must be carried across this gap. Chemical neurotransmitters carry the impulse from one neuron to the next, across the gap so that impulses only travel in one direction. When the neurotransmitter has passed across the gap, an enzyme destroys it. Neuro-toxins like strychnine, found in rat poison, will cause impulses to move back and forth across the synapse. This causes uncontrolled muscle spasms.

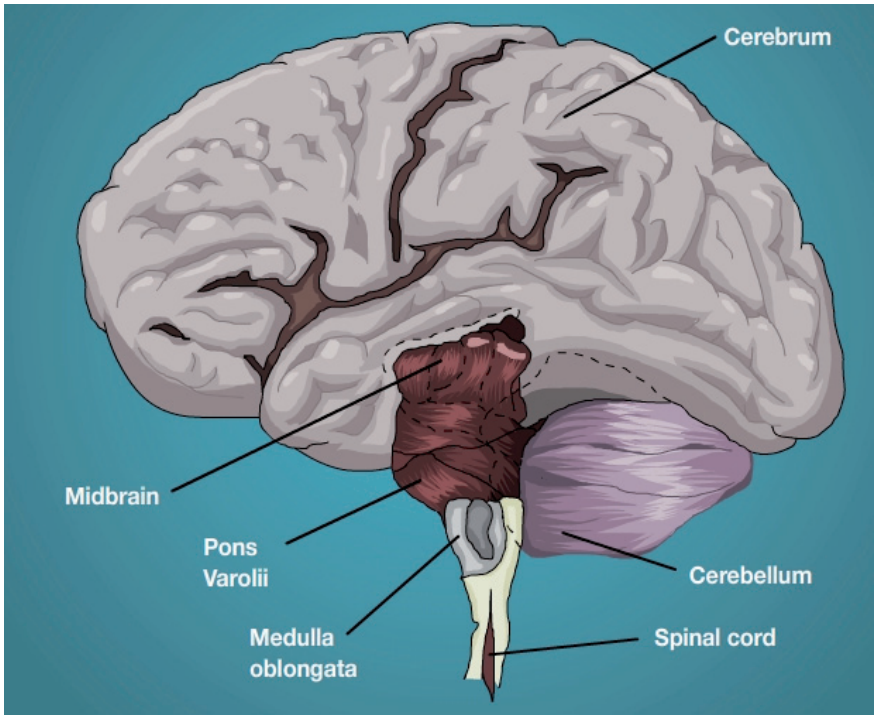
LC DVD

The brain

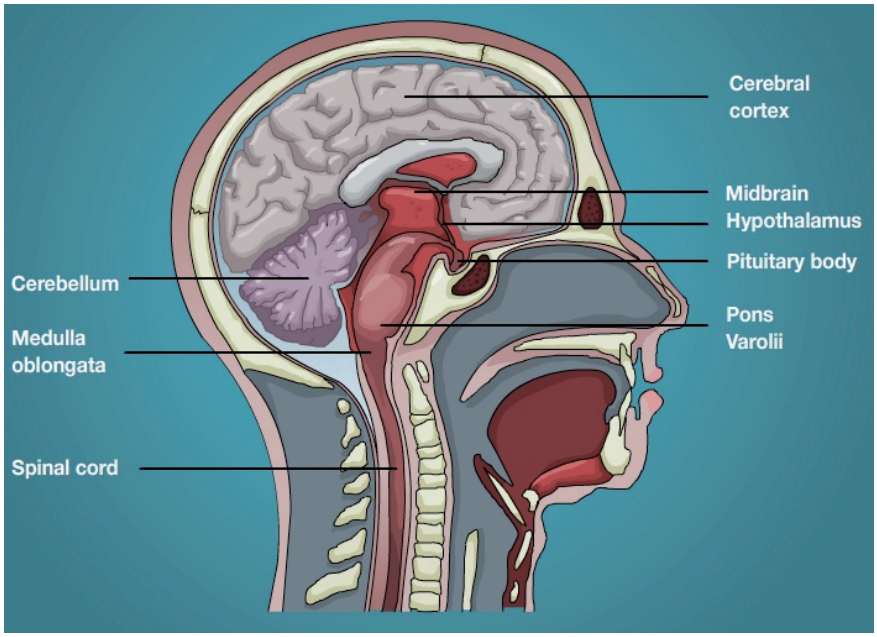
The brain is the control centre of the body. It is very well protected by the bones of the cranium. Under the bone, three layers of membranes called meninges line the brain. The dura mater lines the bone. The second layer is called the Arachnoid. The third layer is called the pia mater.

The brain is divided into the left and the right hemispheres. If the left hemisphere is dominant, you will be right handed and vice versa. A "crossing over" takes place at the Medulla oblongata. So what you feel on the left side of the body is interpreted in the right side of the brain.

The cortex is called the grey matter and it consists of cell bodies. The medulla is called the white matter and it consists of the nerve fibres.



External structure of the brain



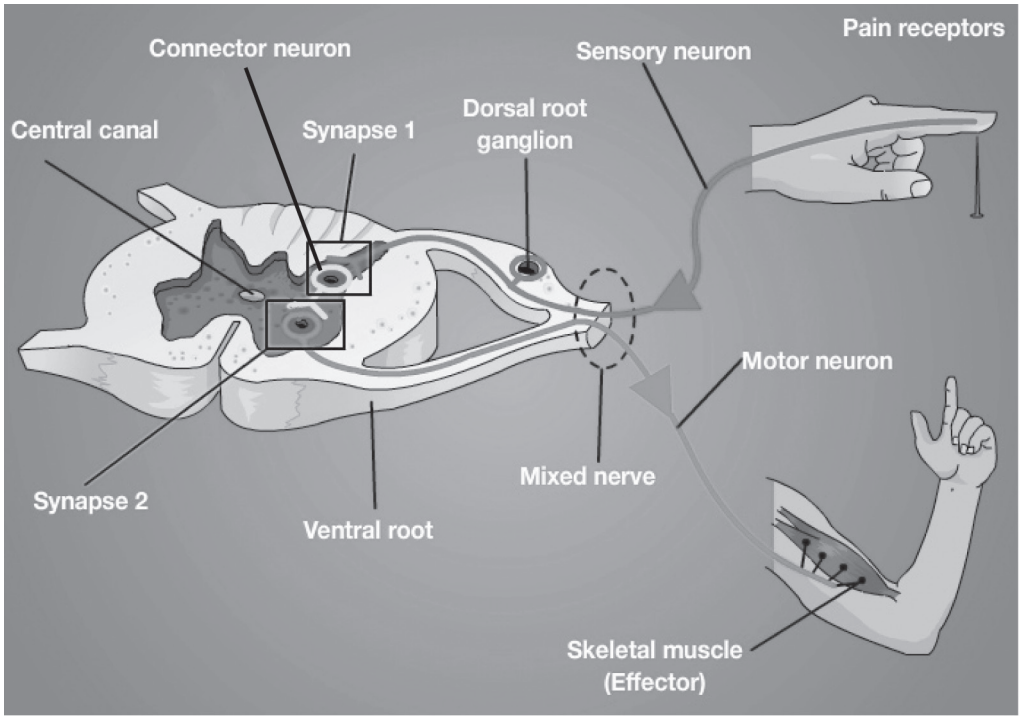
Internal structure of the brain

The spinal cord

The spinal cord is part of the Central Nervous System. It is protected by the vertebrae and cerebro-spinal fluid. The spinal cord is like a highway where all the impulses travel to and from the brain. Reflex actions result because of the reflex arc which passes through the spinal cord. Sympathetic and Parasympathetic nerve impulses pass through the spinal cord.

The reflex arc

A reflex arc is the path of the nerve impulses and causes a rapid automatic response to a stimulus. The reflex arc results in a reflex action allowing the body to respond very quickly to protect the body.



The process begins when the finger is pricked:

- Sensory receptors in the skin receive the stimulus.
- The stimulus is converted to a nerve impulse.
- The sensory neuron carries the impulse to the spinal cord.
- The impulse enters the dorsal root of the spinal cord and passes into the cell body of the sensory neuron in the dorsal root ganglion.
- The impulse moves through the axon into the dorsal horn of the grey matter.
- It is then transmitted over the synapse to the dendrite of the connector neuron and travels along the axons of the connector neuron.
- The impulse is carried over the synaptic connection to the dendrites of the motor neuron cell body.
- The impulse is carried away from the spinal cord by the axon of the motor neuron and exits the cord through the ventral root.
- The terminal end plate of the motor neuron ends in the muscles of the forearm.
- The impulse causes the muscles to contract and pull the hand away.

The autonomic nervous system

The autonomic nervous system ensures homeostasis is maintained and is controlled by the Hypothalamus. This system functions involuntarily and is not

controlled by the will. It is divided into the sympathetic and parasympathetic nervous systems which function antagonistically.

The sympathetic nerves stimulate organs and the parasympathetic nerves inhibit organs to bring them back to a state of rest. Each organ in the body is supplied with nerves from both systems and termed double innervation.

Functions like the heartbeat and breathing rate, digestion, peristalsis, pupil size, bladder size, sweat gland function, liver function, constriction and dilation of blood vessels, are all regulated by the Autonomic nervous system.

Diseases

- **Parkinson's Disease**

It is a neurodegenerative disorder which causes the muscles to shake involuntarily and become rigid. Normally people over the age of 50 are affected. It is caused by a lack of dopamine production in the neurons.

- **Stroke**

The brain needs a constant supply of blood. A stroke occurs when the blood flow to the brain is restricted because a blood vessel becomes blocked or when a blood vessel bursts. A lack of blood for a minute causes loss of vision and possibly a black out. If blood flow is restricted for 2 or more minutes, death of neurons and irreversible brain damage results. A mild stroke can leave the patient unable to speak or read. A more severe stroke often results in facial paralysis on one side. A major stroke results in death.

Activity 1

What is the endocrine system?

1. Draw a concept map of the endocrine system in the human body.
2. Use a double A4 or an A3 page.
3. Study the assessment criteria and then plan your work accordingly.
4. Originality is important
5. Neatness and clarity of presentation are vital.

Activity 2

To investigate the structure of the brain.

1. Work in groups of 2 – 4.
2. Obtain a sheep's brain from the butcher.
3. Identify the different parts of the brain, i.e. the cerebrum, cerebellum, and medulla oblongata.
4. Use a sharp scalpel/knife and cut the brain lengthwise in half from top to bottom.
5. Can you identify the white and grey matter.
6. Make a labelled drawing of one half of the brain.

GROUPS

PROJECT

Activity 3

How are reflex actions carried out in various actions?

1. Work in groups.
2. Draw a table and record the observations for each reflex action as indicated in the following procedure:
   - Use a torch/candle and move the light at various distances from the eye. Record your observations noted at the various distances.
   - Use a plastic or a toy hammer and knock the knee or elbow of each other. Record the observation.
   - Now face each other and observe the number of times the eyes would blink. Record this. Why does the eye blink?
   - What would likely happen when one touches a baby's face, especially near the mouth? Record your prediction.

INDIVIDUAL

SUMMATIVE ASSESSMENT

Activity 4

Nervous and Endocrine System

1. Study the passage below on chemical co-ordination and answer the questions that follow.

> A gland situated on the kidneys produces a hormone that prepares the body for emergencies. In such a case another gland, the islets of Langerhans, produces a hormone that converts glycogen into a simple carbohydrate to be used in respiration. A third gland produces a hormone that increases the rate of respiration, making more energy available.

Name the:

(a) Gland situated on the kidney (1)

(b) Hormone produced by the gland named in (a) above and referred to in the passage (1)

(c) Hormone produced by the islets of Langerhans referred to in the passage (1)

(d) Simple carbohydrate formed from glycogen (1)

(e) Hormone responsible for increasing the rate of respiration (1)

2. Answer the following questions on hormones

(a) Name the endocrine gland which secrete each of the following:

(i) TSH

(ii) Thyroxin

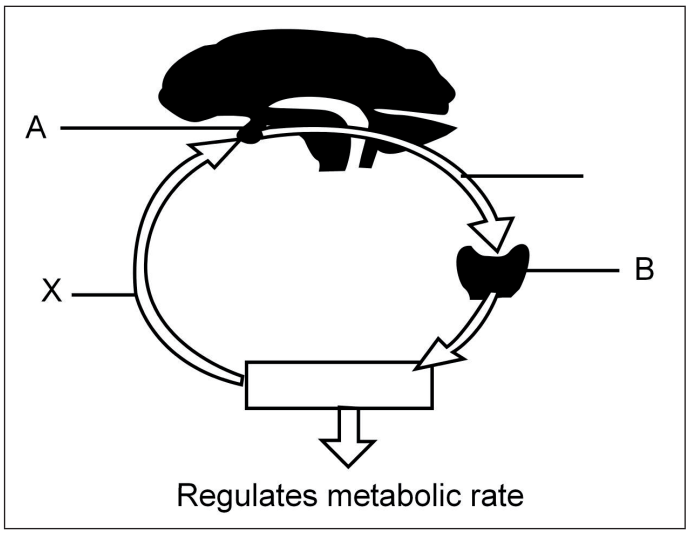
(iii) Growth hormone (3)

(b) It was found that the thyroxin concentration of a healthy adult remained very low for a period of three months.

(i) Will the person gain or lose weight if he continued with his normal diet during this period. (1)

(ii) Explain your answer in (i) (2)

3. Study the diagram which illustrates the interaction between two endocrine glands and answer the questions that follow.



(a) Identify the endocrine glands numbered A and B. (2)

(b) Which interaction is depicted by this diagram. (1)

(c) Name the hormones numbered 1 and 2 which are involved in this interaction. (2)

(d) Hormone number 2 performs several functions in the body. What do you think is its function as indicated by the letter X? (2)

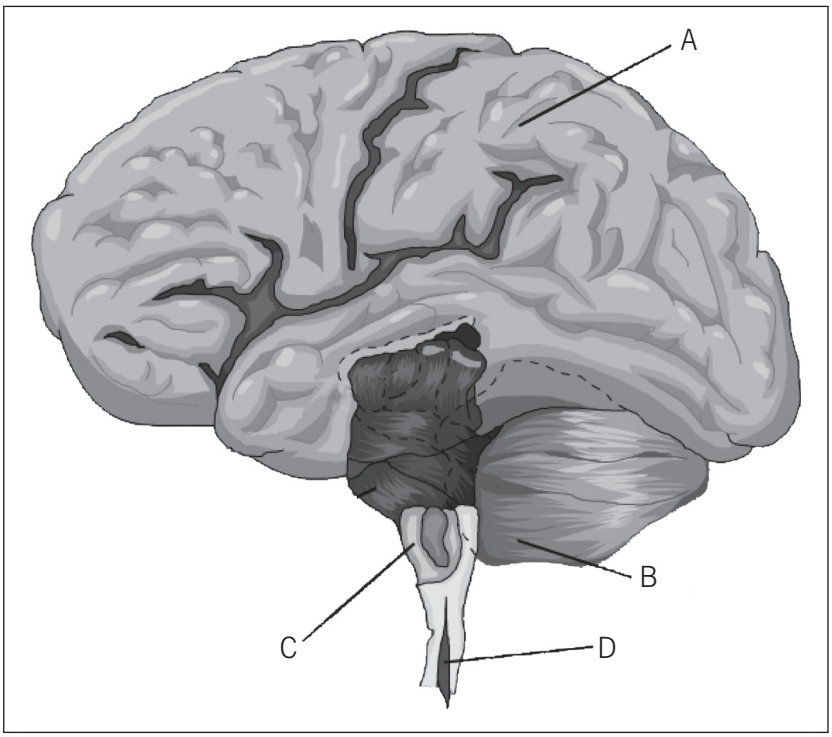
(e) What effect does:

(i) an over-secretion, and

(ii) an under-secretion of hormone numbered 2 have on the production of hormone numbered 1. (2)

(f) Name the hormone secreted by endocrine gland A that is necessary for normal growth and development. (1)

4. Study the diagram below and answer the questions that follow.



(a) Identify the parts labelled A, B, C and D. (4)

(b) State TWO functions of part D. (2)

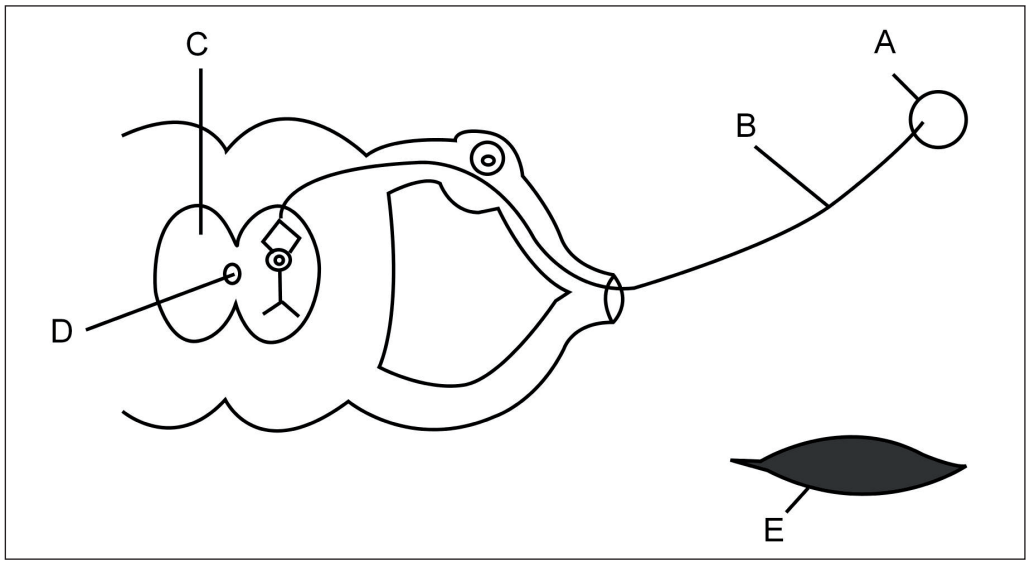
(c) If someone accidentally touches a hot plate on the stove, the hand is immediately lifted without thinking of the action. Name the structure which brings about the rapid unconscious action. (1)

(d) Describe the path followed by the impulse to bring about the action mentioned in (c) (6)

(e) Describe ONE advantage of the action referred to in (c) (2)

(f) Give the function of the parts labelled A, B and C. (6)

5. Study the diagram below and answer the questions that follow.



(a) Label the parts marked A, B, C, D and E. (5)

(b) Draw a labelled diagram indicating the detailed structure of one of the neurons not included in the above diagram. (8)

6. State whether for each of the phrases in COLUMN II, it applies to A only, B only, both A and B or none in COLUMN I. Write A only, B only, A and B or none next to the appropriate question number.

	COLUMN I	COLUMN II
6.1.	A – cranial nerves B – spinal nerves	Peripheral nervous system
6.2.	A – cerebellum B – cerebrum	Play
6.3.	A – spinal cord B – cerebellum	Respiratory centre
6.4.	A – hypothalamus B – spinal cord	Control centre for temperature, sleep, etc.

(4)

TOTAL – 80

ENVIRONMENTAL STUDIES

Human influence on the environment

Lessons 20-21

Learning Outcomes and Assessment Standards

Learning Outcome 1
Scientific inquiry and problem-solving skills
The learner is confidently able to explore and investigate phenomena relevant to Life Sciences by using inquiry, problem solving, critical thinking and other skills

- Plan an environmental study
- Systematically and accurately collect data
- Analyse, synthesise and evaluate data
- Draw graphs to reflect findings and results
- Describe and explain concepts, theories and models, and organise and manage activities responsibly

Assessment Standards
AS1 *Identify phenomena involving one variable to be tested by planning, conducting and reporting on an investigation into the effect of pollutants*
AS2 *Systematically and accurately collect data using selected instruments and/or techniques. Select a type of display that communicates the data effectively – present a survey on issues about water, air and soil and the legislation regulating these*
AS3 *Compare data and construct meaning to explain findings. Draw conclusions and recognise inconsistencies in the data. Assess the value of the experimental process and communicate the findings*
Learning Outcome 2
Construct and apply Life Science knowledge
The learner is able to access, interpret, construct and use Life Science concepts to explain phenomena relevant to Life Sciences

- The human influence on air
- The human influence on soil.
- The human influence on water.
- The impact of industrialisation on the environment

Assessment Standards
AS1 *Use various methods and sources to access information*
AS2 *Identify, describe and explain concepts, principles, laws, theories and models by illustrating relationships and the damage created by abusing the environment. Evaluate concepts, principles, laws and legislation, theories and models*
AS3 *Analyse and evaluate the costs and benefits of applied Life Sciences knowledge*
Learning Outcome 3
Life Science, technology, environment and society
The learner is able to demonstrate an understanding of the nature of science, the influence of ethics and biases in Life Sciences and the inter-relationship of science, technology, indigenous knowledge, the environment and society
Assessment Standards
AS2 *Compare different ways in which resources are used in the development of biotechnological products and analyse the impacts on the environment and society*
AS3 *Compare the influence of different beliefs, attitudes and values on scientific knowledge and its application on society, especially with regard to the environment. Show respect of different viewpoints on environmental issues by debating topics. Evaluate environmental issues and consider opposing opinions*

Overview

This lesson will focus on how humans impact on the environment.

Lesson 20

Introduction

In Grade 10, you learnt that we create the environment in which we can live. We need air, water, food and a warm, protected place to sleep. All living organisms rely on the sun, air, soil and water to stay alive. The **biotic** (having life) and **abiotic** (inanimate, having no life) factors in an environment are necessary to ensure their survival. Humans disturb the balance and affect all the systems. We are going to look at the impact and influence of humans on the environment.

Natural distribution

Abiotic factors such sun, air, soil fertility and water are distributed variably over the Earth. Climate affects all these factors. Temperature, rainfall and soil conditions determine where plants and animals are found.

Humans tend to move to areas where it is easiest to survive, so they look for a place to find or grow food and where there are natural resources. Towns and cities develop. Humans take what they need from the environment and dispose of their wastes, both of which have an impact on the environment.

Exploitation of the environment

The human population is increasing rapidly. Resources are used and are either not given a chance to be replenished or they get used up. Humans exploit the environment:

- Rapid increases in populations cause environmental degradation.
- Problems associated with population increase:
  - Deforestation – loss of habitat for plants and animals, resulting in extinction.
  - Soil erosion because people cut down trees and plants.
  - Urbanisation causes pollution of air, water and soil.
  - Demands on water and mineral resources.
  - Increased food production to feed all the people means that we use monocultures (planting one type of crop as mass production).
  - Increased diseases result because we abuse the environment.

Soil pollution

Fertile soil supports the roots of plants and supplies the nutrients needed for healthy growth. Plants in turn provide us with food, fuel, timber and medicines. They also protect the soil against erosion and water loss and forests increase rain fall.

Animals need plants for food. They in turn provide us with meat, dairy products, eggs, skins, trophies and an income as tourist attractions. Remember the food pyramids you did in Grade 8. Each layer is important. The decomposers are at the bottom and ensure that all dead organisms are decomposed and that the nutrients are returned to the earth. The producers (plants) provide food for the herbivores, the herbivores are food for the carnivores, etc. When this food pyramid is affected and organisms are removed, it not only impacts on all the levels but also on their survival.

Factors effecting soil

- **Deforestation**
  - Forests are cleared to make space for homes or fields to grow food. The natural habitat of plants and animals is removed.
  - Immigration: when animals move from an area because of human intervention, causing imbalances and extinction.
  - Rainfall patterns and water cycles are affected.
- **Farming**
  - Monocultures (planting just one species of crop, e.g. maize or wheat) are grown to meet the need for food, resulting in an artificial imbalance in food chains. Pests and parasites increase, which means an increase in the use of pesticides.
  - Farmers should use crop rotation to prevent infertility of the soil, but this is often not the case so soil becomes infertile and results in soil erosion.
  - When livestock is allowed to overgraze an area, it causes a decrease in the carrying capacity on the area resulting in environmental degradation and possible animal starvation.
- **Soil Erosion**
  - Plant roots bind the soil and keep it from washing away.
  - Animals eat vegetation and trample soil when areas are overgrazed.
  - Veld fires destroy vegetation.
  - Eroded soil is washed into rivers, causing them to silt up. Floods result because there is no natural way for the water to flow.
  - The carrying capacity of the environment is reduced because of environmental degradation.
- **Fertilisers**
  - Fertilisers are used to increase crop yields.
  - Nitrates in fertilisers dissolve and are washed away by rainwater. This is called leaching and creates imbalances in rivers, lakes and dams, killing fish and aquatic life.
- **Mining**
  - Humans mine for coal, oil, natural gas and minerals. As the population increases, so the demand increases.
  - Fossilisation to produce the coal, oil and gas takes a long time, so we need to conserve our resources and use them sparingly.
- **Plastics**
  - These are useful but non-biodegradable, making plastics hard to dispose of and ending up as litter.
  - Toxic fumes are released when plastic is burned.
- **Chemical wastes**
  - Factories – tons of toxic waste is produced annually.
  - Chemical waste must be disposed of and is often dumped illegally.
  - Government legislation has been passed to regulate the dumping of toxic waste. Wastes should be buried in leak-proof containers in specially

designed sites. This is often expensive so the legislation is ignored, resulting in leaks and the poisoning of the soil and the environment.

Lesson 21

When procedures are ignored

Toxic, non-biodegradable chemicals leak into the environment and contamination occurs.

- Micro-organisms die, soil pH is changed and soil fertility is ruined.
- Bioaccumulation: non-biodegradable chemicals may accumulate in plant and animal tissues and cause death.
  - Plants absorb chemicals → eaten by animals/people.
  - Chemicals washed into the water table → seas/oceans affect aquatic plants and animals.
- Biomagnification: toxins are magnified as they pass through the food web in the environment.

Water pollution

- **Industrial wastes:** This happens when waste products are dumped into water sources such as streams and rivers. Industrial wastes such as cyanide, lead, copper and zinc are poisonous and non-biodegradable. When ingested, these poisons can collect in animal or human tissues and become toxic at high levels of concentration. These toxins can then spread through the food chain. This accumulation affects food webs and therefore all the systems. When waste water is warm it changes the natural water temperature, causing thermal pollution, which in turn kills off aquatic plants and animals as well as excessive growth of bacteria and other micro-organisms.
- **Sewage:** If raw sewage is pumped into water sources it can cause diseases such as cholera, typhoid and poliomyelitis. Sewage is broken down by saprophytic bacteria which grow out of proportion and use up the oxygen in the water, suffocating and killing aquatic life such as fish.
- **Oil spills:** Oil tankers can leak oil into the ocean, especially when they run aground (get shipwrecked) on the coast and are damaged. Oil is not only poisonous to sea organisms. It also pollutes beaches, causing the death of coastal and marine life: birds, mammals such as seals, shellfish such as oysters and mussels, etc. Sea birds such as penguins become covered with oil and are unable to dive, so they starve to death. In trying to clean themselves, they ingest the oil, which poisons them.

Air pollution

- **Air and pollution:** The burning of fossil fuels releases carbon and sulphur dioxide into the atmosphere. Sulphur dioxide is an irritant to the lungs and can cause bronchitis, asthma and lung cancer. Sulphur dioxide oxidises to form sulphur trioxide. This results in acid rain when it mixes with water vapour. Acid rain changes the pH of the soil, and burns the roots of many plants (most plants prefer alkaline soils, but some plants like acidity). It also burns their leaves, so they lose the ability to transpirate and photosynthesise, and the plants die.
- **Carbon soot:** Industrial sites can release carbon soot which collects on plant leaves, allowing too little light through for photosynthesis. The stomata in the

leaves can also get blocked so the plants cannot breathe (transpirate), resulting in death.

- **Exhaust fumes:** Exhaust fumes contain carbon monoxide. The haemoglobin in red blood cells has an affinity for (likes) carbon monoxide, so instead of taking up oxygen, they bond with the carbon monoxide, leading to oxygen starvation in the body's the cells. In excessive amounts, this leads to tissue, lung and brain damage.

Nuclear pollution

Radiation: If the reactors used in nuclear plants are damaged, radioactive substances can leak out. If these substances get into the atmosphere, they can be blown many hundreds of miles away from the site of the reactor before coming down to Earth. This is termed nuclear fall-out. Ionising radiation such as alpha, beta and gamma radiation results causes damage to DNA, and can cause birth deformities and many kinds of cancer. Chernobyl (Russia), is a reminder of the damage caused by a nuclear fall-out.

Activity 1

Effects of human population on the environment

Study the table below and answer the questions that follow:

Population size over time

Time (years)	1940	1950	1960	1970	1980	1990	2000
Population size (millions)	1,5	1,8	2,2	3,1	3,7	4,4	5,5

1. Draw a graph showing the results of the table above.
2. What was the population size in 1945?
3. Do you think there will be an increase or decrease in the population size in 2010?
4. List one factor that needs to be considered to avoid over-population.
5. What methods would you employ to avoid over-population?

Activity 2

Human influence on the environment

Research and write a 1-2 page report or essay on one of the following topics:

- Deforestation
- Use of insecticides/pesticides
- Culling of animals
- Collection of evidence

INDIVIDUAL

COLLECTION OF EVIDENCE

SUMMATIVE ASSESSMENT

Activity 3

Monoculture

Write an essay on monoculture under the following headings:

(a) What is meant by the term monoculture?

(b) What causes/effects do monoculture bring about?

(c) What are the alternatives to monoculture?

The summative assessments for Lessons 20, 21, 22 and 23 are at the end of lesson 23.

ENVIRONMENTAL STUDIES

Sustaining our environment

Lessons 22-23

Learning Outcomes and Assessment Standards

Learning Outcome 1
Scientific inquiry and problem-solving skills
The learner is confidently able to explore and investigate phenomena relevant to Life Sciences by using inquiry, problem solving, critical thinking and other skills

- plan an environmental study
- systematically and accurately collect data
- analyse, synthesise and evaluate data
- draw graphs to reflect findings and results
- describe and explain concepts, theories and models, and organise and manage activities responsibly, and solve land issues

Assessment Standards
AS1 *Identify phenomena involving one variable to be tested by planning, conducting and reporting on an investigation into the effect of pollutants*
AS2 *Systematically and accurately collect data using selected instruments and/or techniques. Select a type of display that communicates the data effectively – present a survey on issues about water, air and soil and the legislation regulating these*
AS3 *Compare data and construct meaning to explain findings. Draw conclusions and recognise inconsistencies in the data. Assess the value of the experimental process and communicate the findings*
Learning Outcome 2
Construct and apply Life Science knowledge
The learner is able to access, interpret, construct and use Life Science concepts to explain phenomena relevant to Life Sciences

- the inter-relationships between humans and the environment
- sustainability of our valuable resources and the difference between exploitation and sustainability
- the importance of nature and game reserves
- the role of legislation to preserve the natural environment
- the importance of preserving our natural habitat
- rehabilitation of the environment
- how to manage waste issues
- land issues and influences

Assessment Standards
AS1 *Use various methods and sources to access information*
AS2 *Identify, describe and explain concepts, principles, laws, theories and models by illustrating relationships and the damage created by abusing the environment. Evaluate concepts, principles, laws and legislation, theories and models*
AS3 *Analyse and evaluate the costs and benefits of applied Life Sciences knowledge*
Learning Outcome 3
Life Science, technology, environment and society
The learner is able to demonstrate an understanding of the nature of science, the influence of ethics and biases in Life Sciences and the inter-relationship of science, technology, indigenous knowledge, the environment and society
Assessment Standards
AS2 *Compare different ways in which resources are used in the development of biotechnological products and analyse the impacts on the environment and society*
AS3 *Compare the influence of different beliefs, attitudes and values on scientific knowledge and its application on society especially with regard to the environment. Show respect of different viewpoints on environmental issues by debating topics. Evaluate environmental issues and consider opposing opinions*

Overview

In this lesson we will focus on finding solutions to the environmental destruction caused by humans.

Lesson 22

Introduction

The influence of humans on the environment and the use of the natural resources, often result in the destruction of the environment. We need to find solutions that will stop the destruction and not only sustain the environment but also maintain the carrying capacity of the planet. If we do not, food, water and habitats will be lost. In order to survive, we must conserve natural resources by using resources economically and by preventing wasting what we have. Added to this, we must look to replenishing resources that have been damaged and destroyed or we will impact on the natural distribution of biotic and abiotic factors.

Socio-economic environment

Social development is vital to ensure that the population has food, health care, clean water, proper sanitation and electricity.

- Economic development and growth is necessary to ensure not only the production of foods and goods but also the export of trade to ensure an inflow of capital and investment. A strong economy creates jobs and reduces unemployment.
- Environmental development and protection is needed to protect natural fauna and flora; manage soil, air and water resources properly; reduce pollution and to rehabilitate the environment where necessary and to ensure the ecological balance by replacing lost resources.

Soil rehabilitation

Soil fertility must be maintained. Soil management systems increase plant growth so that food production can be increased to meet population growth. The following can be implemented:

Forestation

- Tree roots stabilise soil and help to prevent soil erosion.
- Tree plantations should be harvested sustainably and new trees planted to replace those cut down.
- Paper recycling reduces the need for using virgin wood pulp to manufacture paper and cardboard products and also uses less energy and water.

Farming

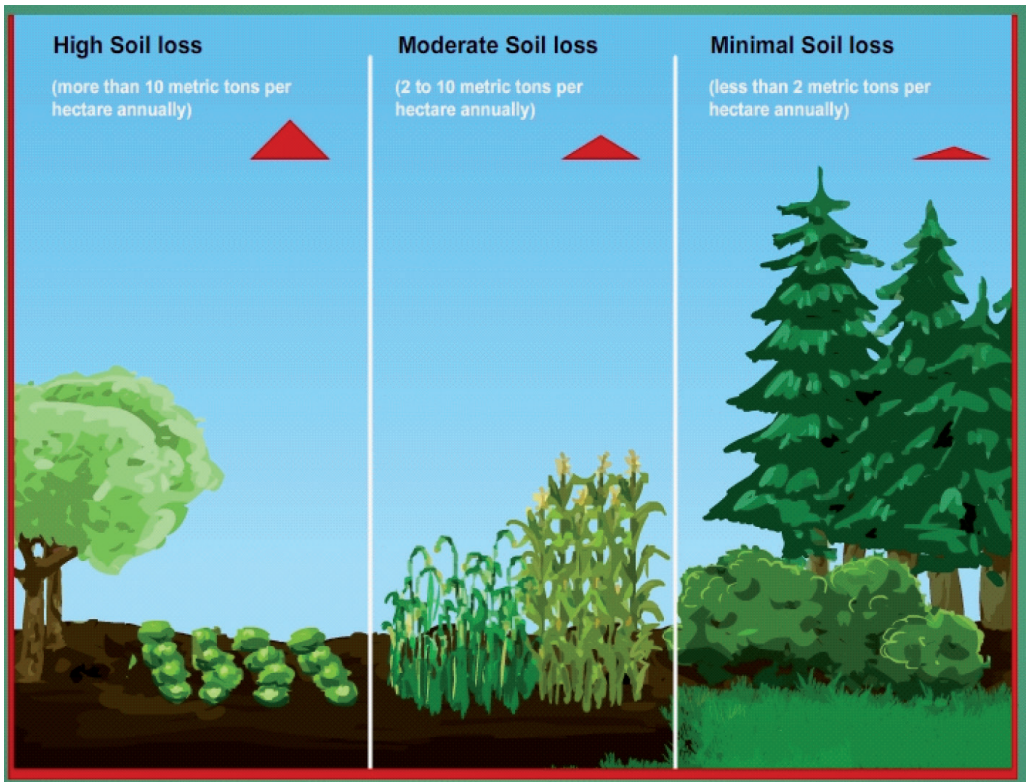
Good farming practices such as crop rotation, organic manuring, strip farming, fallowing and contour farming are needed to ensure soil fertility and increase crop yields.

- **Crop rotation** – different crops are planted either in the same field at different times of the year, or in successive years. Each crop takes different nutrients from the soil while replacing other necessary minerals, e.g. leguminous plants such as beans and peas "fix" nitrogen in the soil and make it available to other crops, e.g. leafy crops such as spinach or lettuce
- **Strip farming** involves growing crops in strips in one field. The strips of crops are planted across the direction of the prevailing wind or rainwater run-off. This ensures that when soil is blown off one strip it will be trapped by the plants in the next strip, thus preventing soil erosion. In the same way, any soil that is washed from one strip ends up in the next.

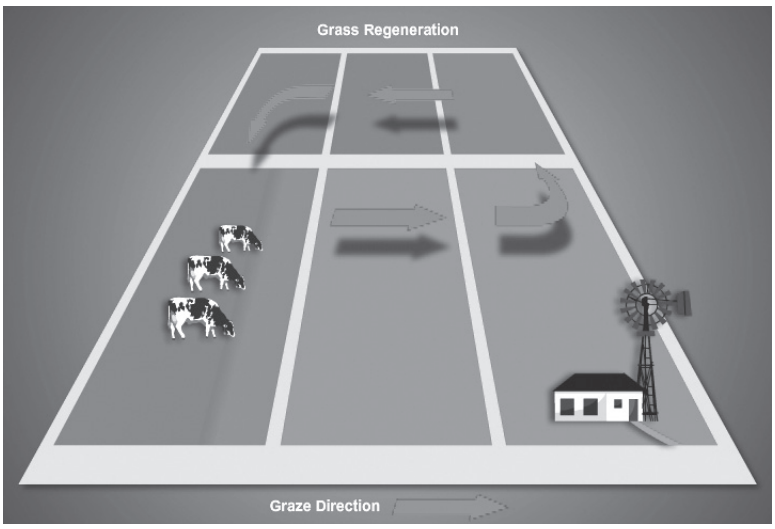
- **Fallowing** – a field is not planted for at least one season or year to allow it to "rest". Farmers often put their livestock to graze on fallow fields which also helps to add manure to the soil.
- ***Contour farming*** prevents soil erosion because ploughing is done across slopes instead of from top to bottom. The ridges caused by the ploughing stops rainwater from flowing away and washing soil with it.
- **Animal manure and compost** should be used to replace lost nutrients. It is natural and inexpensive. The nitrates in inorganic fertilisers can cause problems if they leach into underground water sources or rivers, leading to other environmental problems.
- **Monocultures** provide a lot of food in one crop, but the risk is that insects or plant diseases can invade an entire crop and destroy it. Many pesticides and fungicides have been developed to combat various plant problems but they can have severe environmental consequences if not used with care. Alternative methods such as introducing predator insect species (natural enemies), e.g. praying mantis, ladybird beetles, etc, can be used instead of pesticides and are far more environmentally friendly. The predator species only target the pests and do not disturb the natural food chains.

Soil erosion

- Plants and trees help to stabilise the soil – the roots hold the soil in place.
- Overgrazing should be avoided.
- Use compost and manure to improve soil fertility.
- Contour plowing helps to prevent soil erosion from rainwater run-off.
- Terraces can be cut into steep slopes to reduce not only rainwater run-off but also the silting of rivers.



Plants and trees stabilize the soil – the roots hold the soil in place



Mining

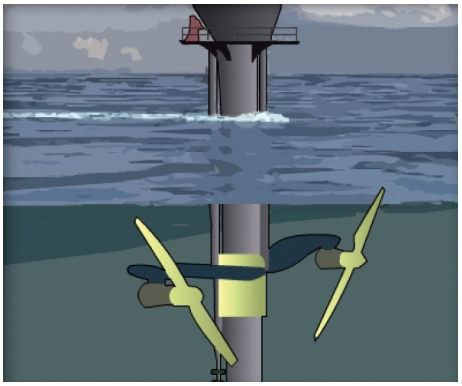
- Fossil fuels such coal, oil and natural gas are mined from the soil to provide energy.
- The processes that created fossil fuels took place many millions of years ago. The sources of these fuels are beginning to be depleted and cannot last forever.
- We must find ways to reduce the rate at which we are using up these fossil fuels and to replace them with renewable or sustainable sources of energy, such as hydro-electricity, wind power, wave/tidal power, solar power and nuclear power.

Solar power

Nuclear plant

Hydro electricity

Wind power



Tidal power

Plastics

- Most plastics are not biodegradable, but manufacturers now add agents to certain types of plastic (especially thin plastic bags) that make them disintegrate when exposed to ultraviolet light, or make them edible to micro-organisms in landfills.
- Many non-biogradable plastics can be recycled. A good example is PET (PolyEthylene Terephthalate). All plastic soda bottles and many other plastic items we use every day are made from PET. They can be recycled to make polyester fibres to use as fillings in pillows and mattresses; roof insulation fabrics or to be woven into mats and carpets, and even into clothes.

Chemical wastes

- Wastes can be treated to reduce toxicity before being dumped.
- Containers should be leak-proof.
- Dumping should be done at regulated dumping sites only.
- Culprits should not only be held accountable for illegal dumping, but also for cleaning up their illegal sites and legal action should be taken against them.
- Maximum fines should be given when regulations are broken.

Water rehabilitation

Saving water

We all have a responsibility to use water wisely. We should:

- Fix dripping taps and leaks as soon as possible.
- Never leave taps running when we brush our teeth or rinse dishes.
- Shower rather than bath.
- Never pour toxic substances such as paint, chemicals or car oil down our drains but rather take them to a municipal recycling centre to be disposed of properly.
- Choose our detergents and household cleaning products carefully.
- Use so-called “grey” water from bathing to water our gardens.
- Even switching off unnecessary lights to conserve electricity helps to save water, because a lot of water is used to generate electricity in the first place.
- Recycle everything we can because this also saves water and electricity (see the topic on waste management below).

Industrial wastes

- Industry is very important to economic growth, but industrial sites produce many waste products.
- Cooling systems should be put into waste-water outlets to prevent thermal pollution.
- Filtering units should be fitted to outlets to purify waste water before it is released into rivers and streams.
- Harmful chemicals such cyanides, lead, copper, mercury and zinc should be removed chemically before water is released into the environment.

Sewage treatment plant

Sewage

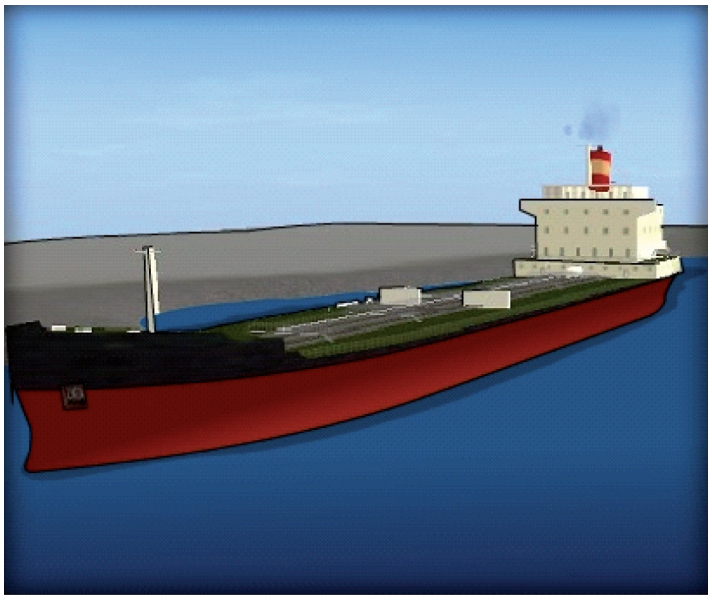
- In municipal areas, water-borne sewage is treated in sewerage works, before the water is released into the environment. In some countries, treated sewage is used as an organic fertiliser.
- Treating sewage reduces the spread of diseases such cholera, typhoid and poliomyelitis.
- Untreated sewage causes abnormal algae growth which removes the much-needed oxygen from the water, resulting in the death of aquatic plant and animal life.

Agricultural wastes

- Reducing the use of artificial insecticides, fungicides and fertilisers as well as using them with the proper care will help to prevent these substances leaching into water sources, such as streams, rivers, dams and even the underground water table.
- Predators or natural enemies to control pests and insects can be introduced.
- Home gardeners could make natural fungicides by using non-harmful substances such as tobacco leaves, dishwashing liquid, garlic, khakibos.
- Consumers should support organic farmers by buying their products.

Oil spills

- Oil spills can be prevented by the proper maintenance of oil tankers and regular inspections.
- Oil holds should be flushed out under controlled conditions in harbours so that the wastes are not pumped into the sea. Enzymes can be added to reduce the oil mass.



Oil tanker

Air rehabilitation

Factory emissions

- Extractors and stacks should be fitted with air filters to remove carbon dioxide, sulphur dioxide, nitrogen oxide and soot from smoke emissions before it can escape into the atmosphere.
- Desulphurisation helps to prevent the formation of acid rain.
- Emissions should be checked regularly to ensure that they are within the limits laid down by government regulation.
- The maximum fines should be levied on transgressors.

Carbon monoxide emissions

- Car engines should be kept properly tuned to minimise emissions.
- Design and use of electrical and solar engines to replace petrol engines

Waste management

Advantages of recycling

- Reduces the amount of waste that must be collected and buried in landfill sites. In many cities worldwide, space for landfill sites is fast running out.
- Resources can be reused.
- Recycling uses less energy (water, electricity) to create new products (paper, cans, bottles) than it does to grow, mine and process the original raw materials (trees, metals, silica sand).
- Litter and pollution are reduced.

Waste separation

Householders can keep separate containers for collecting glass, paper, plastics and tins. Organic waste such as kitchen scraps and garden refuse can be composted for use in the garden, which saves on having to buy commercial compost. In many towns and cities, recycling bins can be found at locations such

as supermarkets and schools. Many schools use recycling as a way to raise funds. Many municipalities also run recycling centres where people can take all their recyclable materials, as well as hazardous domestic waste (old batteries, aerosol cans, car oil, old paint, etc). Phone your local council's garbage removal division to find out more. Recycling at home requires some organisation to start with, and a lot of discipline, but once your family gets into the habit, it soon becomes part of daily life.

Glass and paper collection domes

Waste incineration

This could be used to burn wastes and use the resultant energy to power generators to produce electricity which can be used by households. This would reduce the demand on fossil fuels.

Methane production

The organic waste in landfills produces large amounts of methane gas which is highly flammable and one of the so-called greenhouse gases responsible for global warming. Recovery systems can be constructed to collect the methane gas which can then be used to generate electricity and reduce air pollution.

LC DVD

Lesson 23

Introduction

Diseases cause illness. Environmental conditions increase the chances of diseases being transmitted by air, water, insects and parasites, some are land-borne. Diseases are influenced by a number of factors such as:

- poverty
- malnutrition
- pathogens
- pollution
- genetic disorders

Disease-causing organisms

Infectious diseases are cause by **pathogens**. When diseases are passed from one organism to another, they are termed contagious or communicable diseases.

Pathogens are:

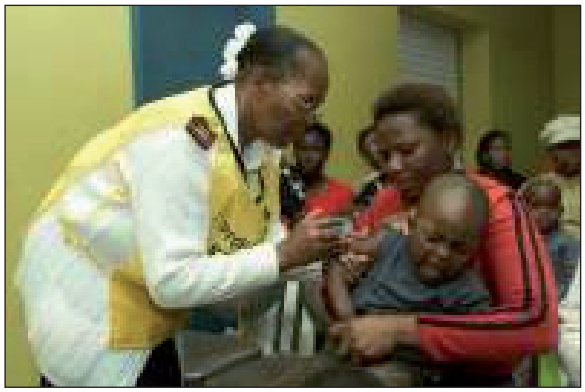
- **viruses**
- **bacteria**
- **protozoans**
- **fungi**
- **worms**

Pathogens are located in **air**, **water**, **soil** and **food**. **Virulence** is the ability to cause disease. **Resistance** is the organism's ability to fight the infection. **Pathogens** cause damage to the cells and may also produce **toxins** which affect the normal functioning of body cells. Pathogens go through an **incubation period**. Once incubation is complete, the infected host will become ill with symptoms such as nausea, headache, fever or vomiting.

Disease transmission

Direct transmission: This is when a pathogen is transmitted from one host to the next by coughing, sneezing, blood transfusion, touch.

Physical contact: Spreads diseases such as leprosy, mumps, chicken pox, smallpox, measles and many various skin diseases. Bites from infected animals such as dogs, cats or bats will transfer rabies to humans. Sexual contact will transmit sexually transmitted diseases (STDs), e.g. gonorrhoea, syphilis, HIV/AIDS and genital herpes.



Indirect transmission: Pathogens are passed to an intermediate organism called a vector. Vectors such as mosquitoes carry malaria, tsetse flies carry sleeping sickness and rat fleas carry bubonic plague. Lifestyle plays a role in the transmission of certain diseases – think of examples.

When fighting diseases, social, economic and medical interventions are necessary. Hygiene, sanitation, housing and nutrition can reduce diseases and outbreaks. Direct medical intervention includes prevention, vaccinations and the treatment of diseases with medicines such as antibiotics.

Air-borne diseases

Pneumococcal diseases

This is one of the causes of lobar pneumonia of the lungs. The most common of the pneumoccal pathogens is called Diplococcus pneumoniae. Other causes of pneumonia are the different types of staphylococci, influenzal bacilli and certain viruses. Infection occurs from the direct exposure to respiratory droplets expelled into the air when an infected person coughs. The incubation period is one to three days but the onset is usually sudden. Symptoms include fever and chills, a flushed face, fever blisters around the mouth, severe chest pains, rapid and shallow breathing, suppressed coughing and cyanosis (blueness of lips and fingertips, from lack of oxygen). As the bacteria multiply, the alveoli in the lungs become congested with mucus. After a few days, the cough becomes moist and a rusty (tinged with blood), sticky sputum is coughed up. Double pneumonia means that both lungs are infected.

Meningococcal diseases

These pathogens affect the membranes (the meninges) of the brain and spinal cord and is also called cerebrospinal fever. Although meningococcal meningitis is the most common form of pyogenic meningitis, it can also be caused by pneumococci, streptococci, staphylococci, and the bacilli of influenza and tuberculosis. Meningococcal meningitis often occurs in epidemics. The disease is transmitted by air-borne bacteria and direct exposure to droplets. The incubation period is two to 10 days, but the onset is sudden. Symptoms include a persistent and severe headache, often associated with vomiting, drowsiness and even delirium, convulsions or fits and marked stiffness of the neck. This stiffness is characteristic, because flexing the neck muscles causes the affected person severe pain. If untreated, the person will lapse into a coma and die. Meningitis is treated with antibiotics but 10 to 15% of infected people die. Those who survive may suffer permanent brain damage, loss of hearing, loss of sight or other problems of the nervous system.

SARS (Severe Acute Respiratory Syndrome)

This respiratory illness is caused by a coronavirus called SARS-associated coronavirus (SARS-CoV). The first cases of SARS were reported in Asia in February 2003. Within a few months, the World Health Organisation (WHO) reported that the illness had spread to more than 20 countries across the globe. More than 8 000 people were infected with 774 fatalities. SARS is transmitted by close person-to-person contact, mostly by inhaling infected respiratory droplets but also by contact with objects contaminated by the droplets. The incubation period is two to seven days. Symptoms: a high fever, headache, an overall feeling of discomfort and body aches. Some people also have mild respiratory symptoms at the outset. About 10-20% also have diarrhoea. After a few days, a dry cough may develop. Most people develop pneumonia. Prevention and control: avoid close contact (kissing, hugging, or sharing of food utensils) with people known to be infected, wear masks in public places and wash hands frequently after touching potentially contaminated surfaces.

Activity 1

LC INDIVIDUAL

LC GROUPS

LC PROJECT

LC COLLECTION OF EVIDENCE

Sustaining our environment

Choosing one of the topics below and draw a poster by to make people aware of how we can improve and sustain our environment.

- Forestation
- Rehabilitation of soil
- Oil spills
- Factory emissions
- Waste management

Activity 2

LC INDIVIDUAL

LC SUMMATIVE ASSESSMENT

Summative assessment: Environment

1. Differentiate between biotic and abiotic factors.
   Give TWO examples of each. (6)
2. Study the following food chain:
   Grass insect frog bird
   (a) What will happen to the food chain if the frog population is removed? (4)
   (b) If insecticide sprayed on grass harms the grass growth, explain what will happen to the food chain mentioned in (a). (4)
3. The following table shows the results obtained by a scientist on the resistance of mosquito larvae to an insecticide (DDT).

SOLUTION NUMBER	PERCENT DDT	SAMPLE A MORTALITY RATE %	SAMPLE B MORTALITY RATE %	SAMPLE C MORTALITY RATE %
1	0,00	0	0	0
2	0,25	4	17	24
3	0,50	7	34	47
4	1,00	12	68	87
5	2,00	24	84	100
6	3,50	36	85	100

   Using the data from the table, draw graphs on the same system of axes to illustrate the scientist's experimental results. (8)
4. Write a short essay on the causes and effects of acid rain on humans and other organisms. (8)

TOTAL – 30

Lesson 24

ENVIRONMENTAL STUDIES

Diseases and their impact on the environment

Learning Outcomes and Assessment Standards

Learning Outcome 1
Scientific inquiry and problem-solving skills
The learner is confidently able to explore and investigate phenomena relevant to Life Sciences by using inquiry, problem solving, critical thinking and other skills to:

- analyse, synthesise and evaluate data
- apply learned knowledge by conducting surveys
- draw bar graphs to reflect findings and results
- formulate environmental strategies to combat diseases
- describe and explain concepts and theories
- organise and manage activities responsibly

Assessment Standards
AS1 *Identify phenomena involving one variable to be tested by planning, conducting and reporting on an investigation into the effect of pollutants*
AS2 *Systematically and accurately collect data using selected instruments and/or techniques. Select a type of display that communicates the data effectively – present a survey on issues about water, air and soil and the legislation regulating these*
AS3 *Compare data and construct meaning to explain findings. Draw conclusions and recognise inconsistencies in the data. Assess the value of the experimental process and communicate the findings*
LEARNING OUTCOME 2
Construct and apply Life Science knowledge
The learner is able to access, interpret, construct and use Life Science concepts to explain phenomena relevant to Life Sciences, including:

- the effect of air-borne diseases
- the effect of water-borne diseases
- the effect of land-borne diseases

Assessment Standards
AS1 *Use various methods and sources to access information*
AS2 *Identify, describe and explain concepts, principles, laws, theories and models by illustrating relationships and the damage created by abusing the environment. Evaluate concepts, principles, laws and legislation, theories and models*
AS3 *Analyse and evaluate the costs and benefits of applied Life Sciences knowledge*
Learning Outcome 3
Life Science, technology, environment and society
The learner is able to demonstrate an understanding of the nature of science, the influence of ethics and biases in Life Sciences and the inter-relationship of science, technology, indigenous knowledge, the environment and society by:

- working as a group to implement a strategy
- learning to express a viewpoint
- learning the importance of education to combat transmission of diseases
- actively strategise about reducing disease transmission
- learning the importance of negotiations
- learning to respect and work with legislated laws

Assessment Standards
AS2 *Compare different ways in which resources are used in the development of biotechnological products and analyse the impacts on the environment and society*
AS3 *Compare the influence of different beliefs, attitudes and values on scientific knowledge and its application on society especially with regard to the environment. Show respect of different viewpoints on environmental issues by debating topics. Evaluate environmental issues and consider opposing opinions*

Overview

In this lesson we will focus on how pathogens cause illness. We also examine how environmental conditions exacerbate the chance of disease transmission.

Water-borne diseases

Typhoid fever

This is a bacterial infection of the intestinal tract caused by the thyphoid bacillus Salmonella typhosa. Typhoid fever is spread mainly by the contamination of water, milk or food with sewage. Human carriers excrete the organisms in their faeces or urine, the lack of proper hygiene or sanitation is a factor that contributes to its spreading. Flies can also play a role in contaminating food if they come into contact with infected human wastes. The bacilli enter the bloodstream from the bowel and cause septicaemia and fever. The incubation period is 10 to 14 days. The bacilli settle mainly in the small intestine where they cause inflammation, leading to ulcering. They may also invade the gall bladder and even the bones. The heart may also be affected by bacterial toxins. The onset is gradual, with a slowly rising fever, severe frontal headache, nose bleeds and marked weakness and fatigue. The abdomen becomes distended and tender, and the mouth is characteristically dry. By the end of the first week, the typical rose spots appear on the chest and abdomen. At the outset, there is usually constipation, which, if the infection remains untreated, in the second or third week turns into typical "pea soup" diarrhoea, that can be streaked with blood and accompanied by severe abdominal pains. In very severe infections, delirium may occur. If left untreated, there is a danger of the bowel becoming perforated, which will lead to peritonitis. Typhoid is treated with antibiotics but approximately 10% of infected people die. Prevention is better than cure and relatively simple: ensure that food and drinks are uncontaminated, wash hands, use proper sewage disposal, etc. Typhoid often occurs amongst soldiers during times of war or in areas that have suffered major natural disasters.

Cholera

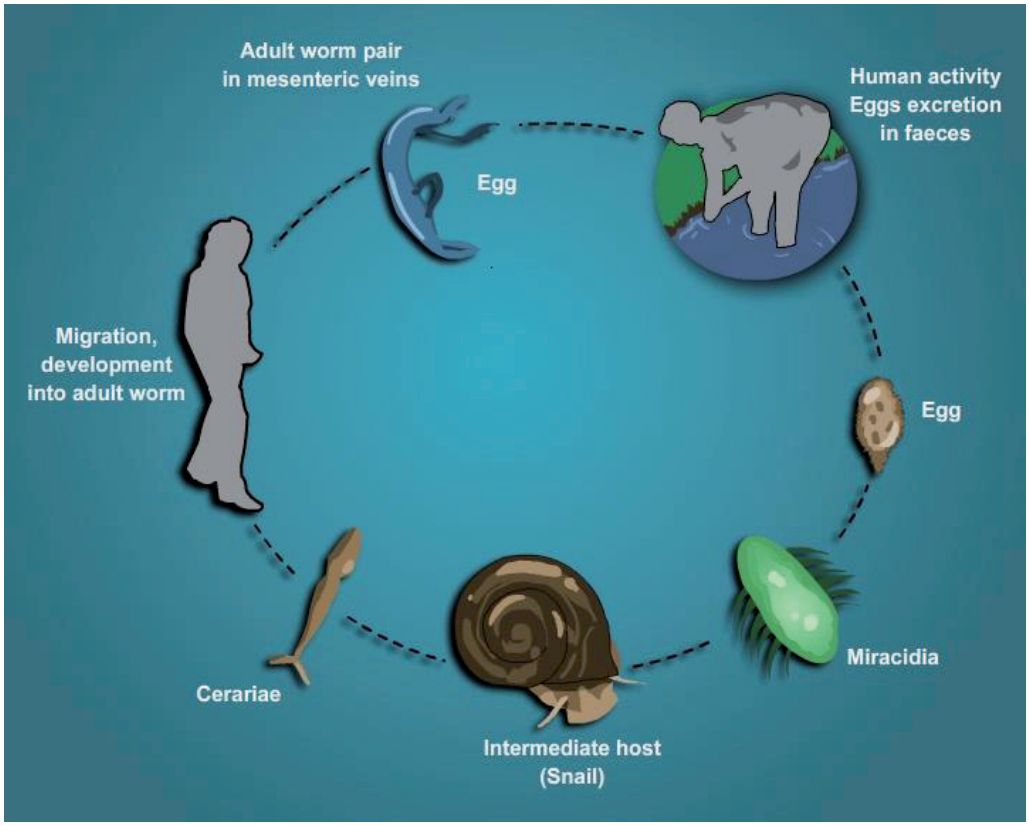
Cholera can be an extremely severe and sometimes fatal disease usually found in tropical areas. It is caused by a bacillus called the Vibrio comma or the cholera vibrio. Infection is spread mainly by the contamination of water. It can also be spread by food. It can occur as in large epidemics, especially after major natural disasters. Cholera attacks the digestive tract. It has an incubation period of one to five days. Symptoms are: intense watery diarrhoea, containing shreds of mucus membrane from the intestinal wall – the typical "rice water" stools of cholera. Severe and rapid dehydration occurs, causing the eyes to become sunken, the skin pinched and dry. There is severe cramping of the muscles from the loss of fluids and electrolytes, and blood pressure and metabolic acidosis fall. Treatment must include the rapid relief of dehydration by intravenous fluids and antibiotics. Approximately 8% of infected people will die, but if untreated, up to 50% will die. Cholera vaccines are available which last up to six months but are only 60% to 80% effective. Cholera occurs mainly in areas where sewage disposal is lacking, together with unhygienic sanitation practices.

Bilharzia or schistosomiasis

The pathogen is a parasitic flatworm of the genus Schistosoma (blood flukes). Bilharzia is the common name for the disease called schistosomiasis. The disease affects millions worldwide and is common in developing countries, especially in Asia, Africa and South America. It occurs especially in areas where ponds, streams and irrigation canals contain fresh-water snails. There are two hosts:

humans and snails – schistosoma larvae live in snails and the adult worms develop in humans.

Life cycle: the adult worm lays eggs → passed out through human faeces and urine into water → eggs hatch into tiny ciliated larvae called miracidia → larvae invade host snail → larvae develop into adults → leave the snail and swim in the water → larvae pierce the skin and enter human body → migrate to liver via the lymphatic system → develop in the liver causing fever and severe abdominal pains → mature larvae migrate from the liver through the hepatic portal vein to the bladder or intestinal walls → adults lay eggs with sharp spines that pierce the walls of the bladder, the intestines and the rectum.



Schistosomiasis is a chronic disease that is often subclinically symptomatic, meaning that infected people are not aware that they are actually ill, although they will have mild anaemia, suffer from malnutrition because of absorption problems and will feel vaguely fatigued all the time. Acute symptoms often only appear weeks after the initial infection. Acute symptoms include abdominal pains, with enlargement of the liver and spleen, fever, a cough, diarrhoea and chronic fatigue. Urination may become painful because the eggs have spines that cause irritation, and there may be traces of blood in the faeces and urine. Blood tests will reveal extremely high levels of eosinophil granulocytes (a type of leucocyte or white blood cell).

Prevention and control

- Bilharzia and mosquito larva are found in the same, generally stagnant or sluggishly flowing water sources.
- Breeding areas can be sprayed to kill snails.
- Introduce ducks to the ecosystem as they eat snails and are eco-friendly.
- Avoid swimming or washing in ponds, rivers or streams that may be infested.
- Boil water before drinking and washing, especially in areas that are known for Bilharzia infestation.

- More information about schistosomiasis can be found Wikipedia at http://en.wikipedia.org/wiki/Schistosomiasis.

Soil-borne and other diseases

These diseases are caused by micro-organisms that live in soil or develop in food products.

Tetanus (commonly called Lockjaw)

Caused by a bacterium called Clostridium tetani which usually gains entrance to the body through wounds, especially deeply penetrating stab wounds, e.g. from metal nails. The bacillus is most commonly present in soil and manure, and wounds infected in this way are particularly dangerous. The incubation period is three to four days. The main symptoms are severe muscular spasms which usually start in the jaw muscles, causing difficulty in opening the mouth – hence the term "lockjaw". Spasms spread to other muscles and become generalised. If untreated, death results from exhaustion, usually within seven to 14 days. The widespread use of preventative inoculation with tetanus toxoid, usually combined with other vaccines, to babies has reduced the incidence of tetanus markedly. Disinfecting all cuts and wounds as soon as possible is important, but if there is the slightest possibility of tetanus infection, a doctor should be consulted, who will give an anti-tetanus injection. If the signs of tetanus infection have already set in, sedation is also given to control the severe spasms and bed rest is recommended. In severe cases, a tracheostomy may be necessary to ensure a clear airway and prevent the infected person from suffocating.

Botulism (also called food poisoning)

Food poisoning is usually caused by the contamination of food with bacteria, or with the toxins of bacteria. The most common organisms are the Salmonella group of bacilli (especially in eggs, poultry and even honey), the toxins produced by staphylococci, or the bacterium Clostridium botulinum. Botulism is the term used for food poisoning caused by the improper canning of foods. Food poisoning may arise from the ingestion of food contaminated in a variety of ways, such as food prepared by people whose unwashed hands carry organisms from:

- Their faeces.
- Flour or sugar which contain the faeces of animals such as rats and mice.
- From reheating pies or cooked meats.
- Using frozen food, especially meat, that has been defrosted and then refrozen again. It is also important to ensure that unpeeled fruits and vegetables, especially root vegetables, are washed before being eaten or cooked.

For food poisoning, the incubation period is from six to 24 hours. Symptoms and onset depend on the type of organism involved. Staphylococcal toxins cause a severe, acute gastroenteritis with vomiting, abdominal colic (cramps) and diarrhoea. This usually starts within a few hours of eating the contaminated food. Usually, everyone who has eaten the same food will be affected. Salmonella poisoning produces similar symptoms, but the onset is slower, and the symptoms may persist for several days.

Dysentery, another bacillary infection, which also causes abdominal colic and diarrhoea, is differentiated from food poisoning by the absence of vomiting and the presence of blood in the stools, which is rarely seen in food poisoning. Most people with food poisoning recover quite quickly with bedrest and a fluid diet once the initial stage of purging is over.

Botulism, however, is far more serious. Symptoms usually take 24 hours to develop, and the predominant symptoms are various forms of paralysis, blurred vision, slurred speech, difficulty in swallowing and breathing, and general muscle weakness. For botulism, hospitalisation is essential and, with early diagnosis, it is treated with an antitoxin. The antitoxin blocks the action of the toxin circulating in the blood. In severe cases, patients are placed on a ventilator (breathing machine) because lungs collapse and the body becomes paralysed. Recovery can take two to three months of intensive medical care. Precautions and control: canned and preserved food must be properly processed, especially when done at home. Never eat food from a dented, damaged, rusted or bulging can. Certain home-preserved foods are more prone to developing botulism, such as bottled green beans. Home-made jams and chutneys are usually safer because sugar and vinegar act as preservatives.

Traditional healers use antitoxins produced from specific mushrooms, leaves and roots. The recipes are kept secret and only handed on from healer to trainee. The ingredients are ground into a paste and applied to wounds. Some of the paste is eaten by the patient as well. Large doses of Epsom salts and liquorice root are given to the patient to cleanse the bowels and detoxify the blood.

Activity 1

Diseases and their impact on the environment

1. In groups, research one of the three types of infectious diseases:
   one air-borne (pneumonia/meningitis), one water-borne (typhoid fever/ bilharzia) and one soil-borne (tetanus/botulism).
   Your information should include:
   - Symptoms
   - Prevention
   - Treatment
2. Prepare a poster on the chosen disease to create an awareness of the disease.

Refer to the end of Lesson 23 for summative assessment.

DIVERSITY, CHANGE AND CONTINUITY
Population studies

Lessons 25-26

Learning Outcomes and Assessment Standards

Learning Outcomes 1
Scientific inquiry and problem-solving skills
The learner is confidently able to explore and investigate phenomena relevant to Life Sciences by using inquiry, problem solving, critical thinking and other skills to:
- plan and conduct investigations
- systematically and accurately collect data
- analyse, synthesise and evaluate data using various techniques
- draw graphs to reflect findings and results
- research and record findings
- describe and explain concepts, theories and models
- organise and manage activities responsibly

Assessment Standards
AS1 *Identify phenomena involving one variable to be tested by planning, conducting and reporting on an investigation into the effect of pollutants*
AS2 *Systematically and accurately collect data using selected instruments and/or techniques. Select a type of display that communicates the data effectively – present a survey on issues about water, air and soil and the legislation regulating these*
AS3 *Compare data and construct meaning to explain findings. Draw conclusions and recognise inconsistencies in the data. Assess the value of the experimental process and communicate the findings*

Learning Outcome 2
Construct and apply Life Science knowledge
The learner is able to access, interpret, construct and use Life Science concepts to explain phenomena relevant to Life Sciences:
- characteristics of populations
- population parameters
- population growth and growth patterns
- survivorship curves
- fluctuations in populations
- density-dependent factors
- density-independent parameters
- limiting factors and population changes over time

Assessment Standards
AS1 *Use various methods and sources to access information*
AS2 *Identify, describe and explain concepts, principles, laws, theories and models by illustrating relationships and the damage created by abusing the environment. Evaluate concepts, principles, laws and legislation, theories and models*
AS3 *Analyse and evaluate the costs and benefits of applied Life Sciences knowledge*

Learning Outcome 3
Life Science, technology, environment and society
The learner is able to demonstrate an understanding of the nature of science, the influence of ethics and biases in Life Sciences and the inter-relationship of science, technology, indigenous knowledge, the environment and society by:
- working together in groups
- learning to share idea and resources
- learning the value of diverse scientific theories
- discussing problems associated with the population growth worldwide
- learning to listen to and evaluate other viewpoints
- learning the value of taking responsibility and accountability for one's actions
- learning the importance of inter-relationships
- learning to sustain and respect the environment

Assessment Standards
AS2 *Compare different ways in which resources are used in the development of biotechnological products and analyse the impacts on the environment and society*
AS3 *Compare the influence of different beliefs, attitudes and values on scientific knowledge and its application on society especially with regard to the environment. Show respect of different viewpoints on environmental issues by debating topics. Evaluate environmental issues and consider opposing opinions*

Overview

In this lesson we will focus on the interdependence of all species on sustainable environments for their survival.

Lesson 25

Introduction

Ecosystems are found within the biosphere. Different species depend on one another for survival. The loss of one species affects the entire balance of an ecosystem. Survival of each individual species depends on the sustainability of the environment which ensures that the carrying capacity can be maintained.

Characteristics of populations

Population dynamics means the study of the changes in numbers of a population and the factors that affect the population numbers. The growth, maintenance and decline of populations will depend on:

- behaviour,
- food needs,
- preferred habits,
- distribution within the environment,
- diseases, and
- evolutionary history.

Definition of a population: A population is a group of individuals of all ages, belonging to the same species, living in the same area, that interbreed.

The neo-Darwinian (modern) theory of evolution

This theory is based on Darwin's principles of variation, natural selection and over-production of offspring. Individuals in a species are not all the same. Variations include genetic differences, strength, dominance and fertility. Species change to adapt to the environment when genes that mutate by accident give individuals an adaptive advantage, for instance, a darker skin in very hot climates to block out excessive solar rays and a paler one in cooler climates, to allow more solar rays to be absorbed. Over time, natural selection creates a population in which these characteristics become dominant. It must be stressed that these changes take place over incredibly long periods of time. If mutations are good, the species may survive, but if mutations are detrimental, extinction will result.

Population size

Population size may be expressed in either numbers or biomass.

Numbers: The number of organisms in a specific ecosystem.

Biomass: Multiply the number of organisms with the average mass of the individuals in the population:

e.g. 10 rats × 100 g (average weight of each rat) = 1000 g (1 kg) biomass

Population increase: Birth rate or natality: the natural ability of a population to increase in numbers. Birth rate is dependant on female fertility. Fecundity is the ability of a female to produce fertile egg cells. Immigration: individuals move into a region from another.

Population Decrease: Death rate or mortality causes population decrease. Factors such as lack of food, shelter, space, increases in disease and predation will cause mortality. Decrease results because individuals are not replaced at the same rate as the death rate. Emigration: conditions become unfavourable so individuals leave the habitat permanently in favour of a better one.

Environmental resistance

When organisms compete for food, water, shelter and space, the abundance or lack of resources regulates their populations. The carrying capacity of an area is the number of organisms that can survive on the natural resources in that area. Environmental resistance is a lack of resources, which prevents the population from increasing when the carrying capacity of the habitat has been reached. This carrying capacity will change according to food supply, competition, seasonal weather patterns and the impact of disease. The key factors responsible for fluctuations in populations are rainfall, cold and drought. If population density varies greatly from one year to the next year, then the population is regarded as unstable. If the population density does not change much from year to year, then we say the population is stable.

Population stability

When the population is stable, natality equals mortality. Stability is created over long periods of time because the environment is never constant and is affected by:

- food, shelter, disease and predation changes
- seasonal changes – animals may die in winter (decrease in numbers) and in spring new babies are born (increase in numbers)

Growth patterns of bacteria

Geometric growth pattern

Exponential growth results in the shape of a "J"-shaped graph. At first there is a rapid increase in population but then population growth stops abruptly. Environmental resistance results because of a lack of resources, seasonal changes and/or pollution by faeces and toxins. This growth pattern is characteristic of organisms which reproduce by binary fission/asexually by mitosis. With bacteria, if an antibiotic is introduced, the population dies, resulting in a rapid halt to population growth. If only one bacterium survives, however, population will begin to grow again.

Lesson 26

Logistic growth pattern

This pattern is also called a sigmoid graph or "S"-shaped graph. There are five distinct stages/phases:

- Initial lag phase – acclimatising and finding mates, gestation period.
- Accelerated growth phase (geometric growth phase) – population growth is at a maximum. Little or no environmental resistance is present. The natality rate is high.
- Deceleration growth phase – the birth rate slows down – environmental resistance such as competition for food, space, increased predation and/or parasitism.

- Equilibrium phase – the population is stable. Natality = Mortality. The carrying capacity of the environment is reached at this phase.
- Death phase – graph shows a sharp downward slope after the equilibrium phase has been reached – extreme environmental resistance because of disease, pollution, drought or human impact.

Density parameters

There are usually fluctuations within a population close to the equilibrium phase. To remain stable, each pair of sexually reproducing individuals must produce at least two surviving offspring in their lifetime. These two offspring must survive to sexual maturity. This will keep most species at a constant density year on year and prevent over-depletion of resources. Density is the number of individuals in a population, located in the same area within a specific period of time. Factors that regulate population growth when the population density is high are called density-dependent factors. Factors that regulate population size that are NOT related to population density are called density-independent factors.

Density-dependant factors

Density-dependent factors prevent over-population and maintain a stable population. The larger the population number, the more the population will be affected as mortality increases, causing the population density to decrease. The population stabilises and the carrying capacity is maintained.

Density-dependent factors are:

- **Food and water:** The more individuals, the more food and water are needed.
- **Competition:** The more individuals, the more competition for resources to survive, ensuring survival of the fittest.
- **Space and shelter:** The more individuals, the less space and shelter available, resulting in higher levels of stress. Stress causes a decrease in the fertility and natality rate of the population.
- **Predation:** The more prey the better the chances of survival of predators. Less prey result in predators having to work harder to catch food.
- **Disease:** Disease spreads quickly when overcrowding occurs.

Density-independent factors

Density-independent factors are not related to population density. These factors are independent of the numbers within a population. A population will be effected regardless of the number of individuals causing a drastic decrease in the population size. The population is able to recover after the event and stabilise at the carrying capacity.

Density-independent factors are:

- **Natural catastrophes:** This will include droughts, hurricanes, earthquakes and floods. Population density is reduced non-biologically.
- **Climate:** Severe temperatures affect population numbers:
  - very cold winters – individuals die even though food is available – the strongest survive – natural selection occurs
  - adverse climates – food shortage – weaker individuals die of starvation

Activity 1

INDIVIDUAL

COLLECTION OF EVIDENCE

Population growth forms

A farmer has an enclosure of 5 km^2 in which he has kept springbuck since 1970. Predators are kept out of this area, but organised hunting was allowed on two occasions. The number of buck at the end of the year is shown in the table below.

YEAR	No. of buck
1970	10
1975	127
1980	160
1985	153
1990	150

1. Draw a graph to show the changes in population size since 1970.
2. Determine the number of buck population in the year 1983.
3. Explain the reason/s for the decrease in the population of the buck in 1985 and 1990.
4. Give one reason for the high increase of buck in 1975.
5. During which years did hunting take place?

Activity 2

INDIVIDUAL

FORMATIVE ASSESSMENT

COLLECTION OF EVIDENCE

Density parameters

Draw a concept map in which you are able to distinguish clearly between density-dependent and density-independent parameters. Use examples to enhance your understanding of these concepts.

Lessons 27-28

DIVERSITY, CHANGE AND CONTINUITY

Social Behaviour

Learning Outcomes and Assessment Standards

Learning Outcomes 1
Scientific inquiry and problem-solving skills
The learner is confidently able to explore and investigate phenomena relevant to Life Sciences by using inquiry, problem solving, critical thinking and other skills to:

- plan and conduct investigations
- systematically and accurately collect data
- analyse, synthesise and evaluate data using various techniques
- draw graphs to reflect findings and results
- research and record findings
- describe and explain concepts, theories and models
- organise and manage activities responsibly

Assessment Standards
AS1 *Identify phenomena involving one variable to be tested by planning, conducting and reporting on an investigation into the effect of pollutants*
AS2 *Systematically and accurately collect data using selected instruments and/or techniques. Select a type of display that communicates the data effectively – present a survey on issues about water, air and soil and the legislation regulating these*
AS3 *Compare data and construct meaning to explain findings. Draw conclusions and recognise inconsistencies in the data. Assess the value of the experimental process and communicate the findings*
Learning Outcome 2
Construct and apply Life Science knowledge
The learner is able to access, interpret, construct and use Life Science concepts to explain phenomena relevant to Life Sciences, including.

- symbiosis – mutualism, commensalism and parasitism
- interspecific competition
- intraspecific competition
- territoriality
- predation
- Red Data listing – endangered species and extinction

Assessment Standards
AS1 *Use various methods and sources to access information*
AS2 *Identify, describe and explain concepts, principles, laws, theories and models by illustrating relationships and the damage created by abusing the environment. Evaluate concepts, principles, laws and legislation, theories and models*
AS3 *Analyse and evaluate the costs and benefits of applied Life Sciences knowledge*
Learning Outcome 3
Life Science, technology, environment and society
The learner is able to demonstrate an understanding of the nature of science, the influence of ethics and biases in Life Sciences and the inter-relationship of science, technology, indigenous knowledge, the environment and society by:

- working together in groups
- learning to share idea and resources
- learning to listen to and evaluate other viewpoints
- learning the importance of inter-dependence
- learning to respect and nurture the environment

Assessment Standards
AS2 *Compare different ways in which resources are used in the development of biotechnological products and analyse the impacts on the environment and society*
AS3 *Compare the influence of different beliefs, attitudes and values on scientific knowledge and its application on society especially with regard to the environment. Show respect of different viewpoints on environmental issues by debating topics. Evaluate environmental issues and consider opposing opinions*

Overview

In this lesson we will focus on 'The Cycle of Life'. We will examine the relationships between living and non-living systems.

Lesson 27

Introduction

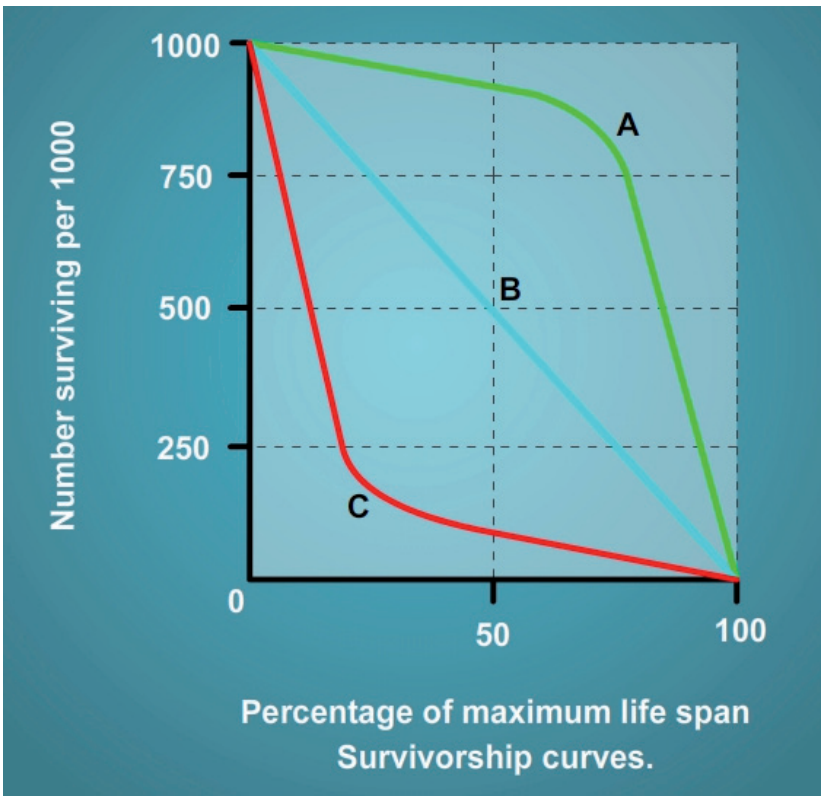
Ecosystems consist of both the biotic (living or organic) and abiotic (non-living or inorganic) organisms. Relationships between biotic and abiotic factors determine social behaviour.

Plants photosynthesise to produce nutrients. They absorb mineral salts and water from the soil. They use carbon dioxide from the air. They use the organic food substances produced and store the excess in the plant body. Herbivores feed on the plants. The energy from the plants is transferred to the herbivores. Carnivores feed on the herbivores and when the carnivores die, saprophytes decompose the dead organic material and the minerals in the soil are replenished. This is the cycle of life. Animals exhibit social behaviour to obtain nutrients and ensure survival.

Limiting factors

Remember that a population consists of individuals in various stages of their life-cycles:

- **Misdistribution of resources:** Individuals are not evenly spread in the habitat. This can be overcome with education in correct farming methods, pest control and conservation of natural resources.
- **Abiotic factors:** Rainfall, temperature, light intensity and fertility of the soil will affect animal, plant and human populations.
- **Biotic factors:** Plants are affected when leaves are eaten by animals or insects or caterpillars because there is a reduction in their ability to photosynthesise. Plants are also affected by parasites, fungus infections and diseases. Animals are affected by the availability of food, shelter, predation, parasitism and diseases – only the fittest and hardiest of the species survive.
- **Potential lifespan:** In more complex species, mortality is high among the very young and the very old as a result of predation, availability of food, competition, accidents or natural disasters such as earthquakes, forest fires or floods. The potential lifespan of an individual is usually longer than the actual lifespan. Humans are supposed to live to about the age of 70 years, the biblical "fourscore and ten", yet some individuals live to be more than 100, while others die before the age of 30. HIV/AIDS has made an impact on the actual lifespan of many people.



Survivorship curve graph explained

Type 1: Many individuals are born and survive to old age. The curve represents the typical survivorship of K-strategy species, i.e. animals with extended parental care and humans living in first-world countries such as the United Kingdom, the United States of America and Western Europe.

Type 2: There are losses throughout the lifespan of the individual, but the mortality rate is evenly distributed between young and old. It is typical of animals with selective parental care and humans living in second-world countries such as China, Russia and Rumania.

Type 3: Many organisms die during the first stage of life and few survive to old age. The curve represents the typical survivorship of R-strategy species, i.e. animals with no parental care (eggs are laid and left to hatch) and humans living in third-world countries such as Ethiopia, Zimbabwe and Kenya.

Survival

- **Agricultural, medical and economic developments:** As populations increase, natural resources such as food, water and space become limited.
- **Competition** within the population increases and environmental resistance results in a high death rate.
- **Poverty and hunger** lead to overcrowding, lack of hygienic conditions and the spread of infectious diseases.
- The mortality rate increases when the size of the population exceeds the food supply (carrying capacity and environmental resistance). Survival rates are improved by developments in agricultural, medical and economic systems:
- increased food supply, proper housing, good sanitation and clean water supplies
- spread of infectious diseases is reduced by the use of vaccines, modern drugs and proper education and improved primary health care

- pesticides used correctly; soil erosion reduced by educating farmers
- economic growth – natality rate decreases
- education and career focus – job creation, birth control and sex education

BIOTIC RELATIONSHIPS

Unrelated species of living organisms have evolved ways of living off and with each other in various ways which stand outside complete predation (actual killing for food) and range from positively beneficial to negatively harmful. Biotic relationships include:

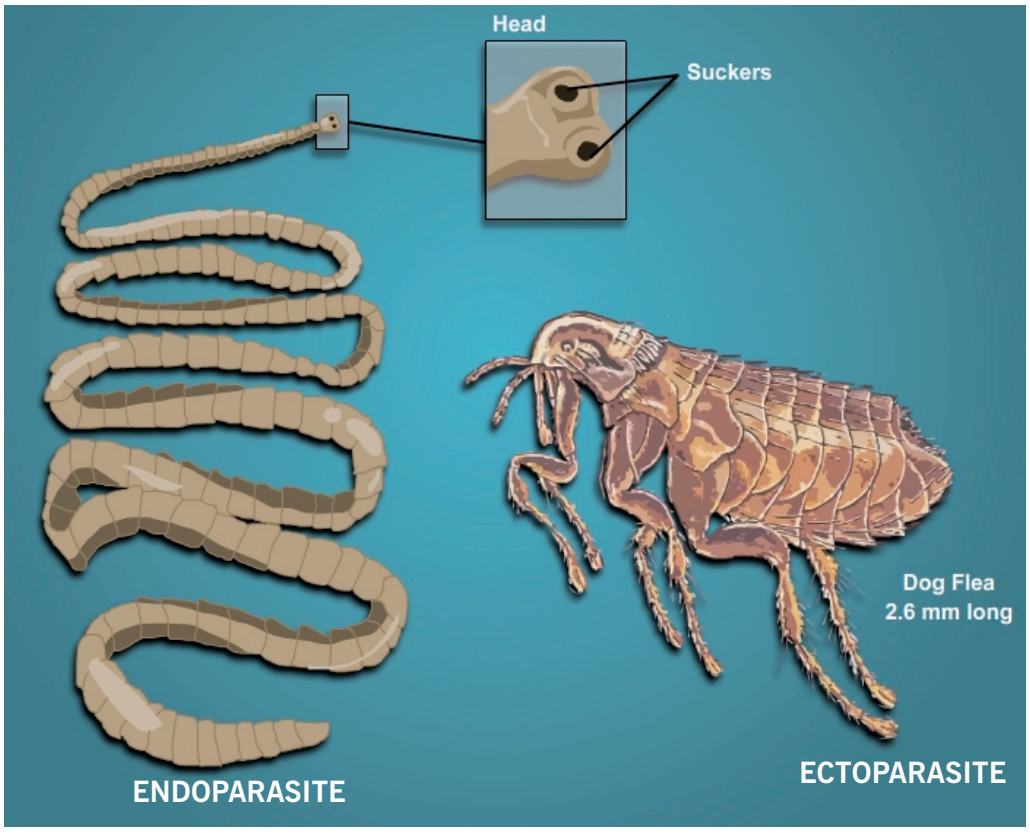
- partial and complete parasitism,
- symbiosis, and
- epiphytism and commensalism.

Parasitism

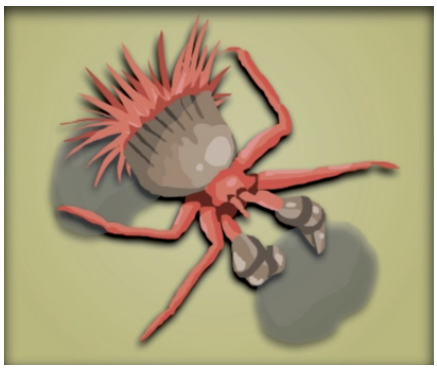
This is a relationship between two organisms of different species in which one organism benefits (the parasite) and the other is used as a source of nourishment (the host) without the host plant receiving any benefits from the coexisting organism. Some parasitic relationships do little harm to the host, e.g. mistletoe, which is only a partial parasite, does no harm to its hosts. True parasites tend to do their hosts harm and can even lead to the death of the host.

The two types of true parasites are:

- **Endoparasites** that live inside the host, e.g. tapeworm, threadworm, bilharzia and malaria, and
- **Ectoparasites** that live on the surface of the body of the host, e.g. fleas, lice and ticks.



Tapeworm **Flea**

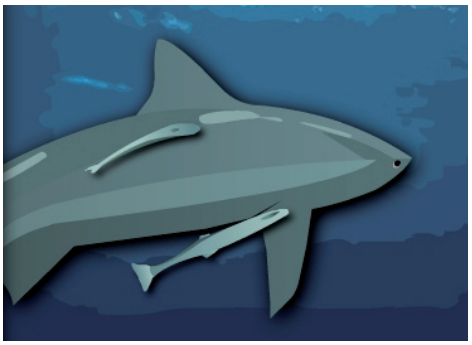


Symbiosis

Symbiotic relationships are characterised by a mutually beneficial partnership between two unrelated species. These range from the "good" bacteria that live in the digestive system of many animals and assist with digestion to the nitrogen-fixing bacteria on the root nodules of leguminous plants.

Commensalism

Commensalism literally means "eating at the same table". These relationships between two different species can be in two ways: either one organism benefits without the other either being harmed or benefiting, e.g. epiphytic plants such as tree orchids, which exploit the nutrients and moisture that accumulate in the nooks and crannies of tree trunks, or birds nesting in trees and bushes, or where both species benefit in some way, e.g. the small remora fish that "service" larger predators such as sharks by removing (eating) harmful parasites off their skins. With this last example, the difference between symbiosis and commensalism is that the latter is not a permanent relationship.



Shark with remora fish

Epiphytes growing on a tree trunk

Bird's nest in a tree

Competition

All organisms compete for food, water, shelter and space. All resources are limited therefore organisms have to compete with each other for survival. More organisms will mean that more will compete and this will ensure the survival of the fittest.

Two types of competition exists:

- intraspecific competition
- interspecific competition

Intraspecific competition

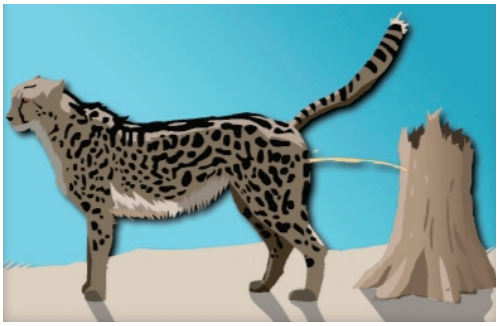
Competition exists between the individuals within a species – for food, living and breeding space and for the most suitable mates. When individuals compete for mates, the best genes are passed on to the next generation. This is in line with Darwin's theory of natural selection. Valuable characteristics are passed to the next generation which will ensure a better chance of survival. The weak will die or be eaten.

Interspecific competition

Competition exists between different species for food and water, shelter and space. When there are enough natural resources, the different species may cohabit and an equilibrium is reached (e.g. zebras, buffalo, springbok). If one species is more dominant, the other species will be forced to migrate to another area in order to survive or they will die. This will minimise competition, e.g. two types of algae inhabiting the same pond in which the more adapted species will survive if the available resources begin to reduce. The weaker species will decline in numbers and eventually die out. This is an example of competitive exclusion.

Territoriality

Territory: an area within a habitat where an organism lives. Territoriality is expressed when individuals mark, usually with hormone-rich urine, but sometimes with specially adapted scent glands, to protect their territory against intruders, e.g. lions, leopards, cheetahs, hyenas, wild dogs, even really small creatures such as the banded mongoose, which urinate to demarcate their territory; or bears rub their backs on tree trunks; and birds sing from telephone poles and trees to proclaim the area within earshot as theirs. Even the visual display of a robin's red chest is a way of asserting a claim on a specific territory.



Cheetah catching prey

Predation

Predation is a density-dependent factor. Predators regulate the population numbers of prey and help to keep them in line with the carrying capacity of an area. Predators catch, kill and eat prey. They are either carnivores or omnivores. There is no competition between predators and prey.

Predators ensure survival of the fittest prey because they tend to target the weakest and oldest, thereby regulating populations naturally. As population size among prey increases, the population of predators increases exponentially because there is more available food. When the prey population decreases, because of seasonal drought or other factors, less food becomes available to the predators so their population will also decrease. This results in a cyclic fluctuation. When predators are removed from an area, the prey population can explode in numbers because there is no naturally stabilising factor. Overgrazing and severe damage to the habitat causes environmental resistance and so a decrease in the carrying capacity of an area results. A population crash will occur because of starvation and disease.

Red data list

Humans have caused the extinction of thousands of species, from the prehistoric woolly mammoth to, more recently, the Cape quagga, the Mauritian dodo and myriad other species, both big and small. It has been estimated that at least one species is lost every day. In 1963, the IUCN (International Union for Conservation of Nature and Natural Resources) created a list of animal and plant species that are in danger of becoming extinct. The IUCN makes people aware of the necessity of conservation to reduce the possibility of the loss of species to the world. The IUCN identifies species at risk, investigates why these species have become vulnerable and then attempts to make the public aware so that the problems can be remedied. [**Find out more about what the IUCN does at www.iucn.org.**]

The criteria used by the IUCN are:

- rate of decline of a population,
- population size, and
- how the population is distributed within a geographical area.

Species are classified according to nine groups, namely:

- **Extinct:** No individuals exist either in their natural habitat or in captivity anywhere on Earth.
- **Extinct in the wild:** Only a few individuals of the species are in captivity. None survive naturally in the wild.
- **Critically endangered:** A critically low number of individuals of the species survive in the wild. Unless drastic measures are taken, this dwindling population will not survive.
- **Endangered:** Population numbers have declined drastically and the species is in danger of becoming critically endangered.
- **Vulnerable:** Numbers are declining unsustainably and the species is under threat.
- **Near threatened:** Numbers are declining but have not yet reached vulnerable levels.

- **Least concern:** Stable, healthy populations; no cause for concern.
- **Data deficient:** Too little information to make any judgement.
- **Not evaluated**

The IUCN encourages people to protect and restore natural habitats for animals and plants by interacting with government, private-sector environmental initiatives, relevant non-governmental bodies and communities to:

- Help to establish protected parks and reserves around the world.
- Encourage the control and reduction of modern intensive agriculture and the use of pesticides.
- Work with governments and customs officials to restrict the trade in endangered species.
- Establish sperm banks and seed stores to maintain a wide range of genetic diversity across all species.
- Encourage assisted breeding programmes for endangered species.

Conservation

In general, most people understand the need to conserve and to maintain our environment but often they feel helpless in the face of what seems to be huge and insurmountable problems, and they don't either know what they can do in their personal capacity. As a starting point, there are five reasons why conservation is necessary, namely:

- **Ecological or scientific:** Pollution causes acidification and eutrophication as well as the Earth's climatic systems. Deforestation and desertification result in soil erosion and changes in the rainfall and climate patterns.
- **Utilitarian:** We use micro organisms in many biotechnological processes. We use natural predators for pest control. Insects are necessary for the pollination process. When a species is lost, many other species are affected.
- **Ethical:** Our attitude to nature is shaped by our cultural and religious beliefs. Many people believe that all living things have a right to coexist with humans and should be respected. Some believe that it is our duty to pass all the diversity of life to the next generation.
- **Aesthetic:** Humans enjoy and appreciate nature, whether we are outside or in it or find it reflected in art and literature. We need contact with our natural environment to stay balanced. Many people enjoy visiting nature reserves and looking at wild animals and plants.

INDIVIDUAL

FORMATIVE ASSESSMENT

COLLECTION OF EVIDENCE

Activity 1

Biotic relationships

Biotic relationships refer to the intimate "living together" arrangements of two unrelated organisms. Discuss this statement with reference to the different types of biotic relationships you have studied. Provide suitable examples from the plant and animal spheres for each type of biotic relationship discussed.

INDIVIDUAL

FORMATIVE ASSESSMENT

COLLECTION OF EVIDENCE

Activity 2

Threats to biodiversity

Prepare a poster to make people aware of the threats to our biodiversity, especially the affects on South African flora and fauna.

INDIVIDUAL

FORMATIVE ASSESSMENT

Activity 3

Survivorship curves

Draw the different survivorship curves and give detailed explanations for what each curve denotes.

DIVERSITY, CHANGE AND CONTINUITY

Managing populations

Lessons 29-30

Learning Outcomes and Assessment Standards

Learning Outcomes 1
Scientific inquiry and problem-solving skills
The learner is confidently able to explore and investigate phenomena relevant to Life Sciences by using inquiry, problem solving, critical thinking and other skills to:

- plan and conduct investigations
- systematically and accurately collect data
- analyse, synthesise and evaluate data using various techniques
- draw graphs to reflect findings and results
- research and record findings
- describe and explain concepts, theories and models
- organise and manage activities responsibly

Assessment Standards
AS1 Identify phenomena involving one variable to be tested by planning, conducting and reporting on an investigation into the effect of pollutants
AS2 Systematically and accurately collect data using selected instruments and/or techniques. Select a type of display that communicates the data effectively – present a survey on issues about water, air and soil and the legislation regulating these
AS3 Compare data and construct meaning to explain findings. Draw conclusions and recognise inconsistencies in the data. Assess the value of the experimental process and communicate the findings
Learning Outcome 2
Construct and apply Life Science knowledge
The learner is able to access, interpret, construct and use Life Science concepts to explain phenomena relevant to Life Sciences through:

- abiotic analysis
- biotic analysis
- direct methods of establishing numbers
- indirect methods of establishing numbers
- population changes over time

Assessment Standards
AS1 Use various methods and sources to access information
AS2 Identify, describe and explain concepts, principles, laws, theories and models by illustrating relationships and the damage created by abusing the environment. Evaluate concepts, principles, laws and legislation, theories and models
AS3 *Analyse and evaluate the costs and benefits of applied Life Sciences knowledge*
Learning Outcome 3
Life Science, technology, environment and society
The learner is able to demonstrate an understanding of the nature of science, the influence of ethics and biases in Life Sciences and the inter-relationship of science, technology, indigenous knowledge, the environment and society by:

- working together in groups
- learning to share idea and resources
- learning to listen to and evaluate other viewpoints
- learning the importance of inter-dependence
- learning to respect and nurture the environment

Assessment Standards
AS2 Compare different ways in which resources are used in the development of biotechnological products and analyse the impacts on the environment and society
AS3 Compare the influence of different beliefs, attitudes and values on scientific knowledge and its application on society especially with regard to the environment. Show respect of different viewpoints on environmental issues by debating topics. Evaluate environmental issues and consider opposing opinions

Overview

In this lesson we will focus on methods of investigation when acquiring data for research so as to monitor, evaluate and manage our ecology.

Lesson 29

Introduction

The principles of ecology are based on qualitative and quantitative data obtained from studies carried out on animals, plants and the abiotic environment. Based on the findings of this research, environments and the inhabiting populations can be monitored, evaluated and managed. It is important to identify the objectives and a degree of accuracy before attempting an investigation, to establish numbers of a population. The results of the findings can then be used to determine survival strategies and to manage population changes over time.

Abiotic analysis

Abiotic factors

These determine the carrying capacity of an area, i.e. the number of organisms that can survive comfortably in that environment. Factors such as soil, water, humidity, temperature and light will affect the population sizes of animal and plant species in any given environment. When these factors are affected in any way, environmental resistance results and impacts on plant and animal population sizes.

Soil factors

The structure and chemical composition of any particular type of soil will determine the amount of water that it can retain. The pH of the soil affects which plants will grow there as some plants prefer acid and others alkaline soil. In turn, the plants will determine the animal species that live in the area because animals feed on specific plants. With monocultures, crop rotation is needed to prevent depletion of nutrients and to prevent soil deterioration.

Water factors

Water is needed for the survival of both plants and animals. Plants need water for photosynthesis. Both plant and animal cells need water to maintain the basic functioning of cells and many other processes. The pH, chlorine (salt) content and oxygen content of the water will influence aquatic plant and animal life. Abnormally high or low pH values or high chlorine content causes death of aquatic plants and animals. Oxygen content is also affected by bacterial growth as the bacteria use up all the oxygen that is available.

Humidity

Relative humidity is the measure of the moisture content of the air. The relative humidity is affected by temperature. Warm air holds more water; cold air holds less. Humidity affects the rate of transpiration of plants. If the air is very moist, water cannot move freely from the leaves.

Temperature

The temperature of the soil, water and air affects plants and animals. They are able to adjust if they are homoeothermic (warm-blooded), but poikilothermic animals (cold-blooded) cannot adjust to temperature changes well. They become inactive. Temperature affects the rate of transpiration in plants and also the rate at which it absorbs water from the soil. Minimum and maximum temperatures are recorded and used to explain the disappearance, immigration or emigration of plant and animal species into or out of an area.

Light

The intensity, duration and wave length of light will determine the plant and animal species in any ecosystem. Certain plants and animals have adapted to surviving in poor light, or living in very deep water or in caves and crevices. Nocturnal animals see well in the dark so that they are able to hunt, e.g. an owl. Some plants require high light intensities to photosynthesise, while others, which live on forest floors, require far less light. The duration of daylight varies with the changing seasons. The change from short winter days to long summer days is called photoperiodism.

Population size

How individuals are distributed in any population affects how we determine population size. First, we count the total number of individuals in a population, then we look at their pattern of distribution. The three main types of distribution are:

- **Regular distribution:** Individuals are evenly distributed throughout a given area. Certain animals define a small area around themselves and defend this area with a high degree of territoriality, e.g. antlions, trapdoor spiders, many kinds of fish and birds, some male buck.
- **Random distribution:** Animals use much larger areas in which to find food and water, covering from a few square kilometres to hundreds of kilometres, often according to the dictates of the seasons, e.g. solitary individuals such as sea turtles, albatrosses, tigers, that show little or no sense of territoriality, except in the breeding season, or social animals, such as a pride of lions or a herd of elephants, which stick together yet can roam over vast areas.
- **Cluster distribution:** Among other types of social creatures, they form groups that stay within defined terrains, such as colonies of mussels on seaside rocks or communally nesting birds. Among plants, specific species tend to favour certain habitats within a landscape, such as trees that only grow along watercourses or in kloofs.

When determining the size of a population, the choice of method will depend on:

- the **accuracy** required,
- the **type of organism**, and
- the specific **habitat** involved.

Direct techniques

The census method is used when the organisms are large enough to count accurately and when the individuals do not move around too much instead they remain within a given area. In South Africa, we have a national census of the human population every five to ten years. Each home is provided with a form to complete with information about the number of people living in the household on a specific date. From the results of the national census, population numbers are established for each suburb, town, city and province. On an ongoing basis, the Department of Home Affairs registers all births and deaths as well as most of the people who emigrate or immigrate out of or into the country This assists the government in establishing population numbers for the periods in between the census. The census helps the government to determine the needs of the people in the country for example homes, health care, water, sewage, electricity, schools, telecommunications, roads, transport and much else.

In the case of animals:

- The area must be defined or enclosed.

- The individuals should be counted as quickly as possible.
- If the area is very large or the animals move too rapidly within the borders of the area, aerial photos can be used.
- Game rangers are able to determine the population numbers by counting footprints and animal droppings at water holes.

The census method is used when:

- The animals are large enough;
- They inhabit a fixed area; and
- They can be counted quickly and easily.

Indirect techniques

Indirect techniques involve estimating the population size where the population cannot be physically counted. A sample of the individuals is counted and the total population is calculated using a formula.There are two methods that you should know by now: the quadrant method and the mark-recapture-mark method.

Quadrant method

If you wanted to establish the number of daisies, or grass or weeds in a given area, the quadrant method would be used. It can be used to determine the:

- **Species density:** the number of individual species found in a given area. Different areas and different species can be compared once the results are obtained.
- **Species frequency:** the number of individual species found in each quadrant. It is calculated on the distribution of the species. Thus, if individuals are found in every tenth quadrant, then the frequency of the species is 10% of the total area.For plants or insects, the quadrant method involves counting individuals found in a number of 1 m $\times$ 1 m squares that are randomly spaced over a given area. Nails and string may be used to mark out these squares. One has to adhere to certain specifications for this method to be successful.
- You must know the total area.
- Each quadrant must be selected at random.
- At least 10% of the total area must be covered.
- Accuracy is very important when you count samples in each quadrant.

For calculations of the total estimated population, the following formula must be used:

Estimated population =
number in sample $\times$ total size of area $\times$ size of quadrant

E.g.: an average of six crickets per 0,01m^2 in a total area of 1 000m^2

For the average number of crickets:

Add all the crickets for the 10% quadrants that were covered and divide by the number of quadrants so: 3, 5, 6, 8, 1, 6, 7, 5, 3, 4, 8, 10 in 12 quadrants = a total of 66 crickets in 12 quadrants = six crickets on average per quadrant.

$$\text{Estimated population} = \frac{6 \text{ crickets} \times 1\ 000\text{m}^2}{0.01\text{m}^2}$$

$$= 600\ 000 \text{ crickets}$$

[Six crickets per $0.01m^2$ (6×100 to make $0.01 = 1m^2$) $\rightarrow$ 600 crickets per m^2, therefore 1 000 m^2 = 600 000 crickets ($600 \times 1\ 000$)]

Mark–recapture–mark method (Peterson's index)

This method is used to establish the estimated population size of animals that do not remain in the same area permanently or animals that are not always visible. Animals are caught, marked and released. They are allowed time to mix back into the rest of the population and then a second sample is captured and counted. In the second catch, you will find both animals you marked in the first catch and some unmarked animals.

The following formula is used to calculate the estimated population size:

$$\text{Estimated population} = \frac{\text{total of second catch} \times \text{total of first catch}}{\text{marked in the second catch}}$$

Example:

We want to establish the number of impala on a game farm. On a set date, we build an enclosure into which the animals will be herded. We set out on horseback and round up 50 impala. Once they are safely in the enclosure, we mark the animals and then set them free. After two weeks, we set out again and round up our second catch of 42 impala. There are 10 marked animals in the second catch.

$$\text{Estimated population} = \frac{\text{total of second catch} \times \text{total of first catch}}{\text{marked in the second catch}}$$

$$= \frac{42 \times 50}{10}$$

$$= 210 \text{ Impala}$$

The reliability of this method improves with each recapture of the individuals,

i.e: $$\frac{\text{total of the third catch} \times \text{total of the second catch}}{\text{marked in the third catch}}$$

Always mark captured animals in such a way that will not harm them, or prevent them from living normally or risk their survival. The marking method must stay visible for long enough to allow for several sessions of recapture.

Methods of tagging are:

- use paint that is non-toxic and waterproof (snails, tortoises),
- rubber rings on the legs of birds,
- plastic tags through the ears of buck,
- brand an emblem on the animal's rump,
- shave hair in a distinctive pattern,
- aluminium discs on the operculum of fish, etc.

The Mark-Recapture-Mark method can only be used on organisms where:

- The population numbers will not change quickly.
- The area must be closed with no immigration or emigration.
- The individuals must have a lifespan which is long enough for you to capture, mark, release and recapture.
- The recapture process must be completed in a period which is long enough to ensure that the marked individuals have time to mix with the rest of the population.

Population changes over time

Charles Darwin and Alfred Russel Wallace both observed the phenomenon of hereditary variation as the mechanism of natural selection. Understanding populations and how they change is important for survival. The increased growth of one population can cause the decrease and death of another. The growth of the human population has disturbed and disrupted the balance of the biosphere. The growth rate of a population and also the distribution of individual characteristics such as colour, sex, size and age is important when studying changes within communities.

The way in which this distribution changes over time is what gives rise to new species.

- Density-dependant and density-independent factors control population growth and also changes that occur within populations.
- Many studies have been conducted to show the physiological changes that take place in individuals of a population because of overcrowding. In many species, natality decreases and mortality increases as the population density increases.
- Social aggression can result in a fight for food and survival. Fecundity decreases with the stress. Females miscarry and those not pregnant may become infertile.
- Diseases can be transmitted rapidly within the community.
- Malfunctioning of the endocrine system may result as well.

Thomas Malthus argued in 1798 that in every species, more offspring are produced than what can survive to reproduce. He argued that human population growth will always increase more than the food that is available. Darwin and Wallace agreed with some of the Malthusian argument as it aligned with the mechanisms of evolution and diversity. Because all species produce more offspring than an environment can support, the population grows exponentially.

This will happen until an increase in mortality and a decrease in fecundity sets in, because the carrying capacity has been passed. All the individuals in a population are not equally affected. Some individuals are better adapted to survive. This is termed differential mortality. Diversity results in changes in the population and eventual evolution of the species.

In nature, restrictive factors such as food, water, shelter, space and predation will control the population size and generally keep population numbers within the carrying capacity of the environment. When a population increases or decreases in numbers, it is a natural cycle. Human intervention has caused some populations to flourish and others to become endangered or extinct, thereby disrupting the natural cycle.

In the human population over time, factors such as war, disease and hunger has impacted on human numbers and created a pattern of uncontrolled population growth periods.

In past years, wars were responsible for a large number of deaths. Think about all the wars that have affected populations through the ages. After World War I and World War II, there was a population explosion.

Viral and bacterial diseases have caused many deaths over the ages. The 1918 Spanish influenza (flu) epidemic caused the deaths of almost 20 million people worldwide.

Today, the effect of diseases has decreased because of immunisations, improved sanitation and health regulations. But TB, malaria and HIV/AIDS still continue to

have an impact on the human population. Starvation causes the deaths of many. As humans, we have established feeding programmes to assist countries in need of aid.

Activity 1

INDIVIDUAL
FORMATIVE ASSESSMENT
COLLECTION OF EVIDENCE

Effects of abiotic factor on biotic organisms

Write an essay discussing the effects of abiotic factors on plants and animals. In your essay, discuss the following abiotic factors: soil, water, humidity, temperature and light.

Activity 2

INDIVIDUAL
FORMATIVE ASSESSMENT
COLLECTION OF EVIDENCE

Estimate population size

AIM: Estimation of the number of beans in a bottle by the mark-recapture technique.

APPARATUS: Beaker or plastic bottle, beans, marker

METHOD:

1. Remove 30 beans from the bottle, mark clearly with the marker and place them back in the bottle.
2. Shake the bottle well.
3. Remove a sample of 40 beans from the bottle at random. Count the number of beans in this sample.
4. Estimate the total number of beans by using the Peterson index formula.
5. Replace the beans and repeat the procedure nine more times.
6. Calculate the average estimate of the number of beans.
7. Show all your results in a table.

Summative assessment: Diversity, change and continuity

SUMMATIVE ASSESSMENT

1. Study the mid-year statistics of the AIDS death rate on an island.

YEAR	Number of deaths
1982	84
1983	92
1984	105
1985	134
1986	195
1987	204
1988	211
1989	230

(a) In which year was the death rate the highest? (1)

(b) In which year was the death rate the lowest? (1)

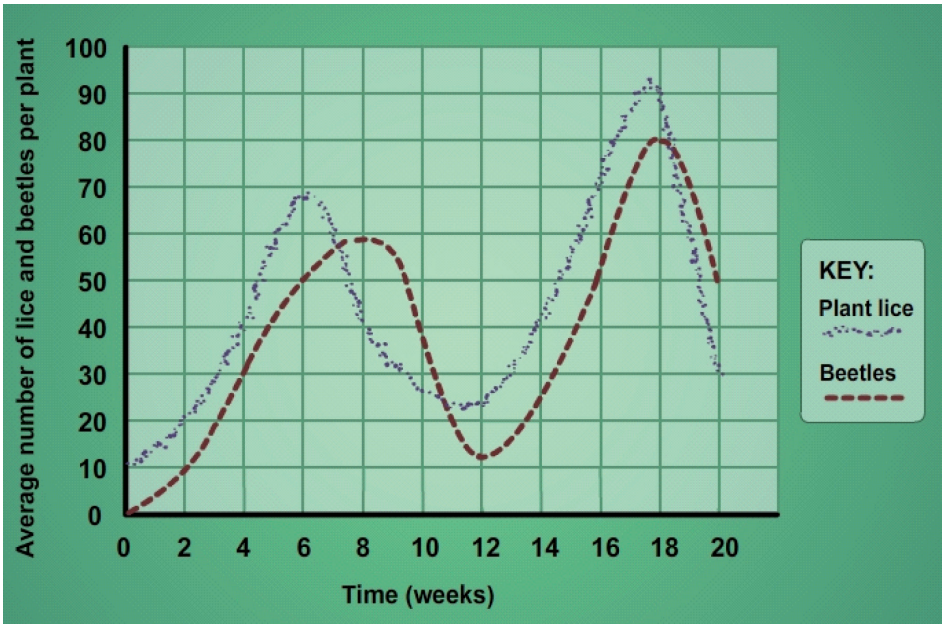
(c) What do you understand by the word mortality? (1)

(d) State the type of counting method most commonly used to determine the size of the population. (1)

(e) Draw a line graph for the information provided in the table. (5)

(f) Name the type of growth curve represented by the graph. (1)

2. The owner of a nursery has a large number of plants in his garden. He suddenly experiences trouble with plant lice on his plants and decides to try and control this pest with the aid of ladybird beetles instead of insecticides. The results are given in the graph below.



(a) Use the graph to determine which animal is a predator and which is prey. (2)

(b) Give a reason for your choice in 'a' above. (2)

(c) What was the maximum number of plant lice per plant during the period of the investigation? (1)

(d) After approximately six weeks, the number of plant lice started to decrease. Give ONE possible reason for the decrease. (2)

(e) Give ONE possible reason why the number of plant lice started increasing again after about 12 weeks. (2)

3. (a) Name TWO growth form curves. (2)

(b) State ONE difference between the two curves mentioned in 'a'. (2)

4. Define the term "population". (3)

5. In an attempt to estimate the number of fish in a dam, 600 fish were caught, marked and released. One week later, 800 fish were caught and of these 100 had been marked.

(a) Determine the potential number of fish in the dam. Show ALL the calculations. (5)

6. Differentiate between the following pairs of terms:

(a) Intraspecific competition and interspecific competition. (2)

(b) Density-dependent factors and density-independent factors. (2)

TOTAL – 35

ANSWERS AND ASSESSMENT

LESSONS 1 & 2

Activity 1

RUBRIC – TABLE

Criteria	Performance levels			
	0	1	2	Comments
Heading	Not present	Incomplete	Complete	
Descriptive column headings	Not present	Incomplete	Complete	
Descriptive row headings	Not present	Incomplete	Complete	
Format of table	No horizontal and vertical lines in borders	Incompletely drawn	Table completely drawn	
Data entered in table	Incomplete	Some correctly placed	All correctly placed	
Total: 10				

RUBRIC – GRAPH

Criteria	Performance levels			
	0	1	2	Comments
Correct type of graph	Incorrect type	Correct type		
Heading	Not present	Incomplete	Complete	
Labelling both axes	No labels	Only one axis	Both axes	
Plotting points	Incorrect	Some correct	All correct	
Neatness	Untidy	Tidy		
Analysing graph	Not analysed	Incorrectly analysed	Correctly analysed	
Total: 10				

Activity 2

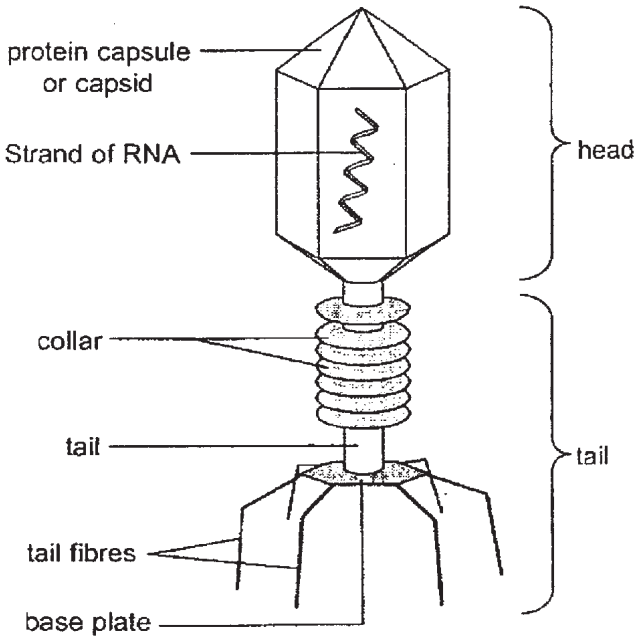
RUBRIC – CONCEPT MAP/FLOW CHART

Criteria	Performance levels			
	0	1	2	Comments
Use of concepts/ keywords	None correct	Some correct	All correct	
Layout and spatial organisation	Too small and cramped	Some parts clear and some parts cramped	Clearly laid out	
Logical flow/use of links	None correct	Some errors	All correct	
Use of colours/ highlights	Not used	Colours used but not in a logical way	Colours used are linked to the logic	
Neatness	Untidy	Neat at some places	Neat throughout	
Total : 10				

Activity 3

SUMMATIVE ASSESSMENT

1.



2. (a) Viruses are parasites and are specific when they choose their host cell (1)

   (b) Difficult to control as they are transferred by various methods, such as, direct contact, sneezing, coughing, blood and disease vectors. (1)

   (c) Viruses are used as vectors in genetic engineering to transfer recombinant DNA into a cell to create a new, useful vaccine or product. (1)

3. Viruses attach to a host cell (1) and penetrate (1) the host cell injecting (1) the DNA/RNA (1) into the host cell. Viral DNA/RNA replicates (1) in the host cell producing a number of viruses (1). The host cell bursts (lysis) (1) and releases all the viruses (1).

4. (a) AIDS (1)

   (b) HIV (1)

   (c) Unprotected sex (1)

   Infected mother to the unborn child (1)

   Contaminated injection or blood transfusion (1)

   (d) Protein (1) and nucleic acid/DNA/RNA (1)

LESSON 3

Activity 1

ASSESSMENT RUBRIC

PERFORMANCE LEVELS

Criteria	0	1	2	Comments
1. Ability to follow instructions	Unable to follow	Instructions followed with regular supervision	Able to work completely on their own	
2. Ability to observe safety precautions	Unable to observe safety precautions	Observes safety precautions at times	Follows safety precautions completely	
3. Results	No results	Partially correct	All correct	
4. Ability to work tidily; organised	Unable	Work at times tidy/organised	Works tidily and organised throughout	
5. Response to questions based on experiment	None correct	Two or less correct	All correct	
Total: 10				

Activity 2

ASSESSMENT RUBRIC

Criteria	0	1	2	3	Comments
1. Ability to select scientific facts and concepts relevant to topic	Not relevant	Very few facts relevant	Most facts relevant	All facts relevant	
2. Ability to use correct grammar and spelling	Many grammatical and spelling errors	Very few grammatical and spelling errors	No grammatical and spelling errors		
3. Presentation of work	Very untidy and disorganised	Some organisation; tidy at some places.	Organised and tidy throughout		
4. Response to questions	None correct	Only one correct	More than one correct	All correct	
Total: 10					

MEMORANDUM – SUMMATIVE ASSESSMENT

1 (a) C – cell wall

D – cell membrane

E – cytoplasm

F – flagella (4)

(b) A – responsible for transmission of hereditary characteristics to the next generation (1)

F – used to move in liquid medium/swim (1)

(c) It protects the bacterium against the enzymes secreted by the host. (1)

2. Microscopic and therefore capable of living in the smallest of spaces.

Reproduces very rapidly by binary fission.

Can produce a thick protective wall to protect the bacterium against unfavourable conditions.

Capable of various types of nutrition: autotrophic, parasitic and saprophytic. (4 x 2 = 8)

3. Asexual reproduction (1) – conditions are favourable (1) and undergoes binary fission (1) where cell contents divide by forming two identical bacteria cells (1). This occurs every 20 minutes (1). When conditions become unfavourable (1) a wall is secreted around the bacterium to protect it against adverse conditions (1). It is now called a spore (1). When conditions are favourable, the wall disintegrates and the bacterium undergoes binary fission (1) (any 5 = 5)

4.

Viruses	Bacteria
1. Acellular	1. Unicellular – Prokaryotic
2. Contains DNA or RNA	2. Has a nucleoid of DNA + RNA
3. Can only reproduce in another living cell	3. Can reproduce on its own

(6)

5. (a) Four million (1)

(b) About three days (1)

(c) Insufficient food (1) insufficient space (1)

LESSON 4

Activity 1

ASSESSMENT RUBRIC

Criteria	Performance levels			
	0	1	2	Comments
1. Ability to follow instructions	Unable to follow	Instructions followed with regular supervision	Able to work completely on their own	
2. Ability to observe safety precautions	Unable to observe safety precautions	Observe safety precautions at times	Follows safety precautions completely	
3. Results	No results	Partially correct	All correct	
4. Ability to work tidily and organised	Unable	Work at times tidily/organised	Works tidily and organised throughout	
5. Response to questions based on experiment	None correct	2 Or less correct	All correct	
Total: 10				

Activity 2

ASSESSMENT RUBRIC

Criteria	Performance level				
	0	1	2	3	Comments
1. Ability to select scientific facts and concepts relevant to topic.	Not relevant	Very few facts relevant	Most facts relevant	All facts relevant	
2. Ability to use correct grammar and spelling	Many grammatical and spelling errors.	Very few grammatical and spelling errors	No grammatical and spelling errors		
3. Presentation of work.	Very untidy and disorganised	Some organisation and tidy at some places	Organised and tidy throughout		
4. Response to questions	None correct	Only one correct	More than one correct	All correct	
Total:10					

MEMORANDUM – SUMMATIVE ASSESSMENT

1. (a) 3 – Stolon (1)

   4 – Rhizoid (1)

   6 – Columella (1)

   7 – Sporangiophore (1)

   (b) 1 – to store/ keep spores (1)

   4 – to anchor the mould/ to absorb the nutrients from the bread (1)

   7 – for dispersal of spores (1)

   (c) Saprophytic (1) – derives nutrients from dead organic material (1)

   (d) Asexual reproduction (1)

   (e) 8 – mycelium (1)

2. Sexual reproduction

   Unfavourable conditions i.e. cold, dry and shortage of food. (1)

   Two erect hyphae (a+ and a- hyphae) (1) grow next to each other and produce gamentangia (1). Each gametangium contains gametes. (1)

   The wall between the two gametangia dissolves and the gametes fuse to form a diploid zygote (1). A thick coat develops around the zygote (1) which is now called a zygospore (1). When conditions are favourable meiosis occurs and the zygospore bursts and a promycelium develops. (1)

3. (a) Saprophyte/ heterotrophic (1)

   (b) coenocytic (1)

   (c) thallus (1)

   (d) amylase/ cellulase (1)

   (e) gametangium (1)

4. athletes foot (1)
   ringworms (1)
   or thrush
5. (a) alcohol fermentation/baking (1)
   (b) decomposition (1)
   (c) antibiotic/ production of certain cheese (1)
   (d) pathogenic (1)

LESSON 5

Activity 1

ASSESSMENT RUBRIC – GRAPH

Criteria	Performance levels			
	0	1	2	Comments
Correct type of graph	Incorrect type	Correct type		
Heading	Not present	Incomplete	Complete	
Labeling both axes	No labels	Only one axis	Both axes	
Plotting points	Incorrect	Some correct	All correct	
Neatness	Untidy	Tidy		
Analysing graph	Not analysed	Incorrectly analysed	Correctly analysed	
Total: 10				

Activity 2

ASSESSMENT RUBRIC

Criteria	Performance level				
	0	1	2	3	Comments
1. Ability to select scientific facts and concepts relevant to topic	Not relevant	Very few facts relevant	Most facts relevant	All facts relevant	
2. Ability to use correct grammar and spelling	Many grammatical and spelling errors	Very few grammatical and spelling errors	No grammatical and spelling errors		
3. Presentation of work	Very untidy and disorganised	Some organisation and tidy at some places	Organised and tidy throughout		
4. Response to questions	None correct	Only one correct	More than one correct	All correct	
Total: 10					

SUMMATIVE ASSESSMENT

1. 1.1 A only (2)

   1.2 A only (2)

   1.3 B only (2)

   1.4 Both (2)

   1.5 Both (2)

2. (a) 1 – nucleus (1)

   2 – pseudopodia (1)

   3 – ectoplasm (1)

   4 – endoplasm (1)

   5 – mitochondria (1)

   6 – contractile vacuole (1)

   7 – food vacuole (1)

   (b) Intracellular digestion (1)

   Lysosomes (1) secrete enzymes (1) which digests food in the food vacuole (1)

   (c) Phagocytic feeding is when pseudopodia (1) are formed which engulf the food particle (1). This food particle and a few drops (1) of water form a food vacuole(1) in the cytoplasm(1) of amoeba.

   (d) During unfavourable conditions, amoeba rounds up (1) and secretes a waterproof capsule (1) which protects it against drought, high and low temperatures (1). This process is called encystment (1). When conditions are favourable, the cyst burst (1) and the amoeba is released, when it will undergo binary fission (1).

3. • Malaria (1)

   • Amoebic dysentery (dysentery) (1)

4. Malaria – symptoms:

   Fever, headache, chills, sweating, muscular pains, diarrhoea, abdominal pain, nausea, loss of appetite, cough. (Any 3)

   Amoebic dysentery – symptoms:

   Ulceration bleeding, severe abdominal pain, fever, vomiting, diarrhoea. (Any 3)

LESSONS 6, 7 & 8

Activity 1

RUBRIC – GRAPH

Criteria	Performance levels			
	0	1	2	Comments
Correct type of graph	Incorrect type	Correct type		
Heading	Not present	Incomplete	Complete	
Labeling both axes	No labels	Only one axis	Both axes	
Plotting points	Incorrect	Some correct	All correct	
Neatness	Untidy	Tidy		
Analysing graph	Not analysed	Incorrectly analysed	Correctly analysed	
Total: 10				

Activity 2

RUBRIC – TABLE

Criteria	Performance levels			
	0	1	2	Comments
Heading	Not present	Incomplete	Complete	
Descriptive column headings	Not Present	Incomplete	Complete	
Descriptive row headings	Not Present	Incomplete	Complete	
Format of table	No horizontal and vertical lines in borders	Incompletely Drawn	Table completely drawn	
Data entered in table	Incomplete	Some correctly placed	All correctly placed	
Total: 10				

Activity 3

RUBRIC: – POSTER

Criteria	Performance levels			
	0	1	2	Comments
Expressing facts	Incorrect	Some correct	All correct	
Headings	Not descriptive	Partially descriptive	Descriptive	
Organisation/ layout	Muddled	Organisation clear at some places	Organisation clear and logical throughout	
Use of colour and public appeal	No colour or appeal	Poor	Good	
Response to question	No attempt	Partly correct	All correct	
Total: 10				

MEMORANDUM – SUMMATIVE ASSESSMENT

SUPPORT

1.
   - Support and shape to the body (1)
   - Protects delicate organs, e.g. stomach, brain, etc (1)
   - Attaches muscle to soft organs (1)
   - Produces blood corpuscles (1)

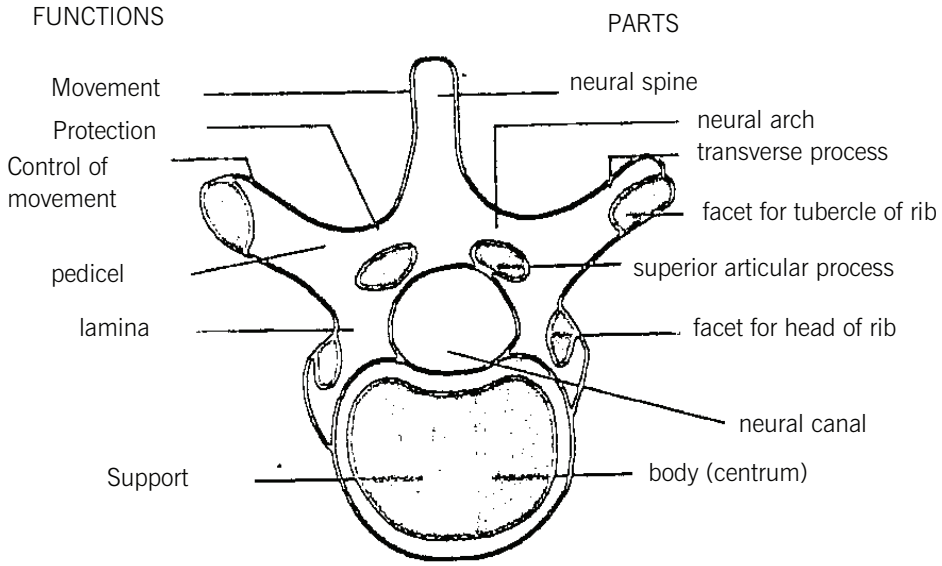
2. (a) Flat bones (1), irregular bones (1)

   (b) Joined by sutures held together by a thin layer of white fibrous connective tissue (1)

   (c) Foramen magnum – opening in the cranium which allows the spinal cord to run through (1)

   Condyles – forms a joint with the atlas allowing nodding movement of the head (1)

3.



4. (a) A – triceps (1)

   B – biceps (1)

   (b) The triceps/A (1)

5. (a) Cell A – xylem vessel (1)

   (b) Cell B – xylem tracheid (1)

   (c) A – spiral thickening and B has pitted thickening (1) xylem (1)

   (d) Transports water and mineral salts from roots to leaves (1) to provide strength and support to the plant (1)

   (e) Sclerenchyma (1)

   (f) It has stone cells (1) and fibres (1)

6. Sprain – when ligaments and tendons are overstretched followed by swelling and pain (1) Fracture – occurs when a bone is cracked or broken (1)

LESSONS 9, 10 & 11

Activity 1

RUBRIC

Criteria	Performance levels			
	0	1	2	Comments
1. Ability to follow instructions	Unable to follow instructions	Instructions followed with regular supervision	Able to work completely on their own	
2. Ability to follow safety measures. (E.G. Safe use of scalpel)	Unable to follow safety measures	Careless at times	Follows safety measures at all times	
3. Efficient use of time	Could not complete on time	Completed on time		
4. Ability to work tidily	Untidy work	Worked neatly		
5. Identification of structures	Unable to identify any part	Able to identify some parts	Identified all parts	
6. Response to questions	All answers incorrect	Some answers correct	All answers correct	
Total: 10				

Activity 2

RUBRIC

Criteria	Performance levels			
	0	1	2	Comments
Heading	Not present	Incomplete	Complete	
Descriptive column headings	Not present	Incomplete	Complete	
Descriptive row headings	Not present	Incomplete	Complete	
Format of table	No horizontal and vertical lines in borders	Incompletely Drawn	Table completely drawn	
Data entered in table	Incomplete	Some correctly placed	All correctly placed	
Total: 10				

RUBRIC – GRAPH

Criteria	Performance levels			
	0	1	2	Comments
Correct type of graph	Incorrect type	Correct type		
Heading	Not present	Incomplete	Complete	
Labelling both axes	No labels	Only one axis	Both axes	
Plotting points	Incorrect	Some correct	All correct	
Neatness	Untidy	Tidy		
Analysing graph	Not analysed	Incorrectly analysed	Correctly analysed	
Total: 10				

MEMORANDUM – SUMMATIVE ASSESSMENT

TRANSPORT

1. (a) A – Artery (1)

   B – Capillary (1)

   C – Vein (1)

   (b) 1 – Connective tissue (1)

   2 – Endothelium (1)

   4 – Lumen (1)

   (c) 3 – Muscular layer (1)

   Blood vessel A is an artery, which has a thicker muscular layer to withstand the pressure exerted by the pumping action of the heart (1)

   (d) Blood vessel B is only one cell-layer thick compared to A and C (1)

   (e) Blood vessel C/ veins (1)

   Valves prevent the back flow (1) of blood and permit the flow of blood in one direction only (1)

2. (a) (i) A (1) pulmonary artery (1)

   (ii) To the lungs (1) to be oxygenated (1)

   (b) D (1) – pulmonary veins (1)

   I (1) – superior vena cava (1)

   K (1) – inferior vena cava (1)

   (c) M – chordae tendinae (1)

   Controls the opening of the tricuspid valves and prevents them from being pushed into the atrium when the ventricles contract (1)

   (d) F – bicuspid valves (1)

   L – tricuspid valves (1)

   If these structures are missing, the blood would push back into the atria when the ventricles contract instead of flowing into the arteries (1)

   (e) The cardiac muscles will receive no oxygen and will stop functioning (1)

   (f) B – left atrium (1)

   C – semi-lunar valves (1)

   E – semi-lunar valves (1)

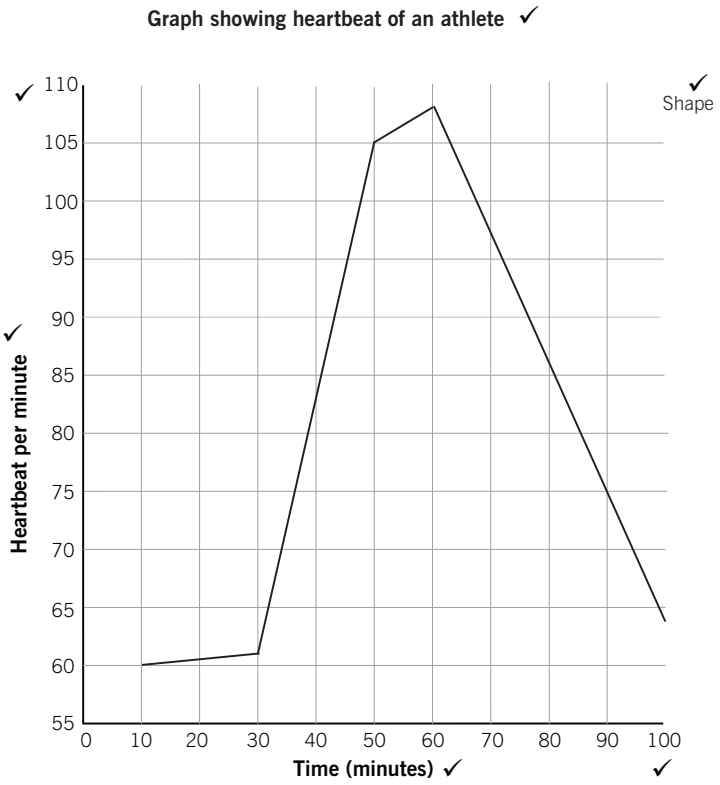
   G – left ventricle (1)

   H – aorta (1)

   J – right atrium (1)

   N – left atrium (1)

3. (a) (6)



(b) 60 times per minute (1)

(c) (I) After 30 minutes (1)

(II) After 10 minutes (40 – 30) (1)

(III) After 30 minutes (60 – 30) (1)

(d) (I) 60/60 (1) = 1,0 seconds (1)

(II) 60/108 (1) = 0,55 seconds (1)

4. (a) A – phloem tissue (1)

B – xylem tracheid (1)

C – xylem vessel (1)

(b) Tissue A – transports organic food (1)

(c) 1 – companion cell (1)

2 – sieve tube (1)

(d) Transports water and mineral ions (1)

(e) Cells are elongated (1) to allow transport in a column. Walls are thickened with lignin (1) in various ways to strengthen and support the cell. Lumen is hollowed to allow easy transport of water. (1)

TOTAL: 60

LESSONS 12, 13 & 14

Activity 1

RUBRIC – DIAGRAM

ASSESSMENT CRITERIA	PERFORMANCE LEVEL INDICATOR			
	0	1	2	COMMENTS
Caption	Absent	Correct but incomplete	Complete with all info	
Magnification/ scale provided	Absent	Present but incorrect	Present and correct	
Accuracy – shape	Incorrect	Correct		
Accuracy – proportion	Incorrect	Correct		
Label lines – solid, distinct, neat and do not overlap	Not clear	Clear		
Results/final product	Incorrectly dissected	Correctly dissected		
Visible parts labelled accurately	No labels	Some labels correct	All labels correct	
TOTAL: 10				

Activity 2

RUBRIC: – CONCEPT MAP/FLOW CHART

CRITERIA	Performance Levels			
	0	1	2	COMMENTS
Use of concepts/ keywords	None correct	Some correct	All correct	
Layout and spatial organisation	Too small and cramped	Some parts clear and some parts cramped	Clearly laid out	
Logical flow/ use of links	None correct	Some errors	All correct	
Use of colours/ highlights	Not used	Colours used but not in a logical way	Colours used are linked to the logic	
Neatness	Untidy	Neat at some places	Neat throughout	
TOTAL: 10				

MEMORANDUM TO SUMMATIVE ASSESSMENT

1. 1.1 B renal vein ✓
   F urethra ✓ (2)

   1.2 – proteins ✓
   – glucose ✓
   – vitamins ✓
   – amino acids✓ Any (2)

   1.3 stores urine ✓✓ (2)

   1.4 controls✓movement of urine out of the bladder ✓ (2)

1.5

- excretion ✓
- osmoregulation ✓
- regulate pH✓
- regulate salt/ion content ✓ Any (3)

2. 2.1 A afferent arteriole✓

B efferent arteriole✓

C glomerulus/capillaries ✓

D Bowman's capsule ✓ (4)

2.2 4 – 5✓ mm ✓ **OR** 0.4 – 0.5✓ cm ✓ (2)

2.3 A has a larger/wider diameter✓ while B has a smaller/narrower diameter✓ **OR** A has a larger/wider diameter than B It increases the pressure in the glomerulus for filtration (2)

2.4 urea✓, uric acid✓, water✓, glucose✓, amino acids, salts , vitamins, creatine, toxins, hormones , hippuric acid Any (4)

2.5 (i) cuboidal/epithelium ✓ (1)

(ii) squamous/epithelium/podocytes ✓ (1)

3. 3.1 4 – (renal) calyx✓/ pyramid/ tubules/ ducts of Bellini/ papillae
5 – pyramid✓/ renal tubules/ ducts of Bellini
8 – (renal) pelvis/ureter✓ (3)

3.2 Ureter✓/ renal pelvis/ renal calyx/ renal pyramids/ collecting tubule – urea and salts are present✓, glucose/ amino acids are re-absorbed✓, proteins are macromolecules not found in urine. ✓ (4)

3.3 Renal artery✓/ 11 OR cortex/2 The blood entering the kidney contains urea/ waste products✓, glucose, salts, proteins/ useful substances✓to be filtered by the kidney (3)

3.4 (i) 3✓/ 4/ 5 (1)

(ii) 2✓ (1)

(iii) 3✓/ 4/ 5 (1)

3.5 Osmoreceptors✓ are influenced by a drop in the osmotic pressure/ water content ✓ of the blood/low water potential of the blood when a person loses water on a hot day due to sweating.✓ These receptors stimulate the hypophysis/pituitary gland/master gland✓ to secrete more ADH.✓ The tubule becomes more permeable,✓ more water is reabsorbed from the distal convoluted tubules and collecting duct and the urine gets more concentrated/more hypertonic,✓ ensuring the correct osmotic balance is maintained. Any (6)

4. 4.1 Differentially permeable✓/ selectively permeable/ semi-permeable/ must not allow proteins to pass through (1)

4.2 To ensure a large contact surface area✓ for osmosis✓ in the bathing fluid to allow longer time✓ for the blood to be filtered (3)

4.3 Plasma proteins✓/ fibrinogen/ albumin/ globulin (1)

4.4 Water✓, glucose✓/ amino acids/ urea/ uric acid/creatinine/ ammonia Any (2)

4.5 To provide the correct osmotic balance✓ to supply a concentration gradient for osmosis✓/ to prevent essential salts from being removed from the blood. (2)

5. 5.1 880 000 arbitrary units✓ (1)

5.2 Glucose is completely reabsorbed✓ from the proximal convoluted tubules, therefore no glucose is excreted. ✓ (2)

5.3 Uric acid✓/ creatinine✓/ ammonia/ hippuric acid (2)

5.5 ADH✓/vasopressin

LESSONS 15, 16, 17, 18 & 19

Activity 1

RUBRIC – CONCEPT MAP/FLOW CHART

Criteria	Performance levels			
	0	1	2	Comments
Use of concepts/ keywords	None Correct	Some Correct	All Correct	
Layout and spatial organisation	Too small And cramped	Some parts clear and some parts cramped	Clearly laid out	
Logical flow/use of links	None Correct	Some Errors	All Correct	
Use of colours/ highlights	Not Used	Colours used but not in a logical way	Colours used are linked to the logic	
Neatness	Untidy	Neat in some places	Neat throughout	
Total : 10				

Activity 2

RUBRIC: DIAGRAM

Assessment criteria	Performance level indicator			
	0	1	2	Comments
Caption	Absent	Correct but incomplete	Complete with all info	
Magnification/ scale provided	Absent	Present but incorrect	Present and correct	
Accuracy – shape	Incorrect	Correct		
Accuracy – proportion	Incorrect	Correct		
Label lines – solid, distinct, neat and do not overlap	Not clear	Clear		
Results/final product	Incorrectly dissected	Correctly dissected		
Visible parts labelled accurately	No labels	Some labels correct	All labels correct	
Total : 10				

Activity 3

RUBRIC – TABLE

CRITERIA	Performance Levels			
	0	1	2	COMMENTS
Heading	Not present	Incomplete	Complete	
Descriptive column headings	Not present	Incomplete	Complete	
Descriptive row headings	Not present	Incomplete	Complete	
Format of table	No horizontal and vertical lines in borders	Incompletely drawn	Table completely drawn	
Data entered in table	Incomplete	Some correctly placed	All correctly placed	
TOTAL : 10				

Activity 4

MEMORANDUM SUMMATIVE ASSESSMENT

1. (a) Stems – negatively geotropic✓ – grows upwards✓
   Roots – positively geotropic✓ – grows downwards✓ (4)

   (b) Stems grow away✓ from gravity since stems require light✓ for photosynthesis. Roots grow towards✓ gravity to anchor the plant and to absorb water✓. (6)

   (c) Auxins move to the lower side✓ of the roots and stems due to the force of gravity. ✓ In stems auxins stimulate✓ the growth and this results in the stem to curve upwards✓ In roots auxins inhibits✓ growth and this results in the root to curve downwards✓. (6)

2. (a) clinostat✓ (1)

   (b) Leaves and stems of plant A grow in the direction of the light ✓ source, since the clinostat is stationary. ✓ The stem of plant B grows straight up✓ since the clinostat is rotating✓ and eliminates the light source. (4)

3. (a) adrenal/supra-renal ✓ (1)

   (b) adrenalin✓ (1)

   (c) glucagon✓ (1)

   (d) glucose✓ (1)

   (e) thyroxin✓ (1)

4. (a) (i) Hypophysis/ PG✓

   (ii) Thyroid✓

   (iii) Hypophysis/ PG ✓ (3)

   (b) (i) Gain✓ (1)

   (ii) Thyroid controls metabolic rate; a low metabolic rate because of low thyroxin concentration✓, less food oxidized(broken down), less glycogen converted to glucose, and excess food accumulates as fat. ✓ (2)

5. (a) A – hypophysis✓

B – thyroid gland✓ (2)

(b) Negative feedback mechanism ✓ (1)

(c) 1 – TSH✓

2 – Thyroxin✓ (2)

(d) Inhibits✓ hypophysis to secrete less TSH✓ (2)

(e) (i) less TSH✓

(ii) more TSH✓ (2)

(f) Growth hormone /somatotropin✓ (1)

6. (a) A – cerebrum✓

B – cerebellum✓

C – medulla oblongata✓

D – spinal cord✓ (4)

(b) Transmits impulses to/ from the brain✓ It contains reflex centres✓ (2)

(c) Reflex arc ✓ (1)

(d) The receptor converts the stimulus to an impulse ✓ which is transmitted to the sensory✓/afferent neuron along the dorsal root of the spinal nerve. The sensory neuron makes a synapse✓ with the interneuron/connector neuron✓ which makes a synapse with the axon of the motor/ efferent neuron✓. The motor neuron transmits the impulse along the ventral root of the spinal nerve to the muscle/ effector which lifts the hand. ✓ (6)

(e) To allow an individual to react or respond fast enough ✓ to a stimulus to prevent further damage to the tissues. ✓ (2)

(f) A – (cerebrum) – it controls all voluntary actions✓ – it receives and interprets all the sensations viz. sight, hearing, smell, taste and touch. ✓(any 2) – it controls all the higher thought processes, such as, memory, judgement, reasoning, etc.

B – (cerebellum) – it is responsible for co-ordination of voluntary movements✓ – it maintains muscle tone, balance and equilibrium✓

C – (medulla oblongata) – it contains reflex centres responsible for breathing, regulation of the heartbeat, dilation and constriction of the blood vessels, salivation, swallowing, i.e. all involuntary actions. ✓ – it conducts impulses from the spinal cord to the higher parts of the brain and vice versa ✓ (6)

7. (a) A – receptor✓

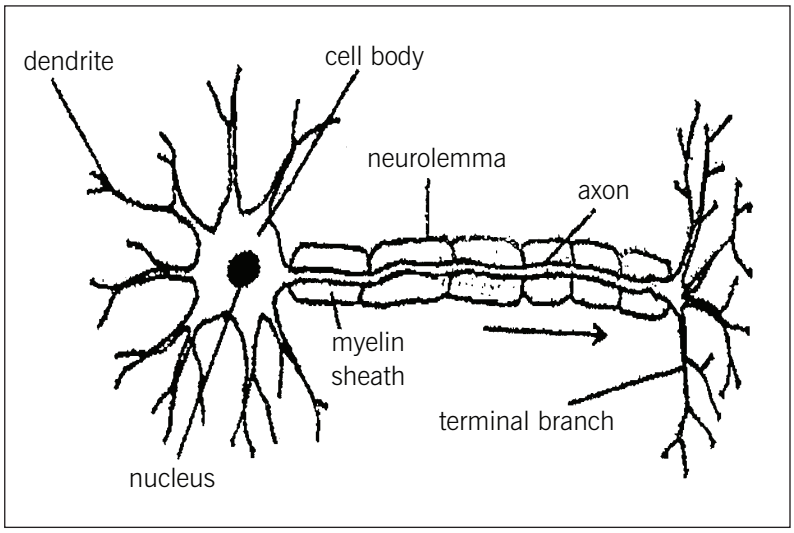
B – sensory neuron✓

C – central canal✓

D – grey matter✓

E – effector✓ (5)

(b)



(8)

8. (a) Both A and B✓
   (b) Both A and B✓
   (c) None✓
   (d) A only

LESSONS 20 & 21

Activity 1

RUBRIC – GRAPH

CRITERIA	Performance levels			
	0	1	2	Comments
Correct type of graph	Incorrect type	Correct type		
Heading	Not present	Incomplete	Complete	
Labelling both axes	No labels	Only one axis	Both axes	
Plotting points	Incorrect	Some correct	All correct	
Neatness	Untidy	Tidy		
Analysing graph	Not analysed	Incorrectly analysed	Correctly analysed	
Total: 10				

Activities 2 and 3

RUBRIC – WRITING SKILLS

CRITERIA	Performance levels				
	0	1	2	3	Comments
Ability to select scientific facts and concepts relevant to topic	Not relevant to topic	Some parts relevant	Most parts relevant	All parts relevant	
Ability to use correct grammar and spelling	Many grammatical and spelling errors	Few grammatical and spelling errors	No grammatical or spelling errors		

Ability to organise new ideas into paragraphs	No paragraphs	2 paragraphs	3 or more paragraphs, including an introduction and conclusion		
Ability to link concepts and facts to form a coherent essay	Unable to link concepts, essay recorded as arbitrary sentences with no association; disorganised and lacks focus	Attempt made to link concepts; lacking in detail; some loss of focus	Good essay; analysis is vague at places without the eloquence and style of the excellent category	Excellent essay; critical concept analysis linked clearly; flow from one idea to the next	
Total: 10					

LESSONS 22 & 23

Activity 1

RUBRIC – poster

CRITERIA	Performance indicator levels			
	0	1	2	Comments
Title	No title	Complete title		
Main points	Not relevant	Some points relevant	All points relevant	
Organisation/ layout	Organisation/ layout muddled	Organisation partially clear and logical	Organisation clear and logical	
Diagram/ picture appeal/ attractiveness	Not appealing/ not attractive	Has some appeal/ attractiveness	Appealing/ attractive	
Impact of poster	Does not make an impact	Makes an impact		
Creativity of poster	No new ideas	Some signs of creativity/new ideas	Very creative and original	
Total				10

Activity 2

SUMMATIVE ASSESSMENT

1. Biotic – living factors✓ e.g. any plant✓, any animal✓ (3)

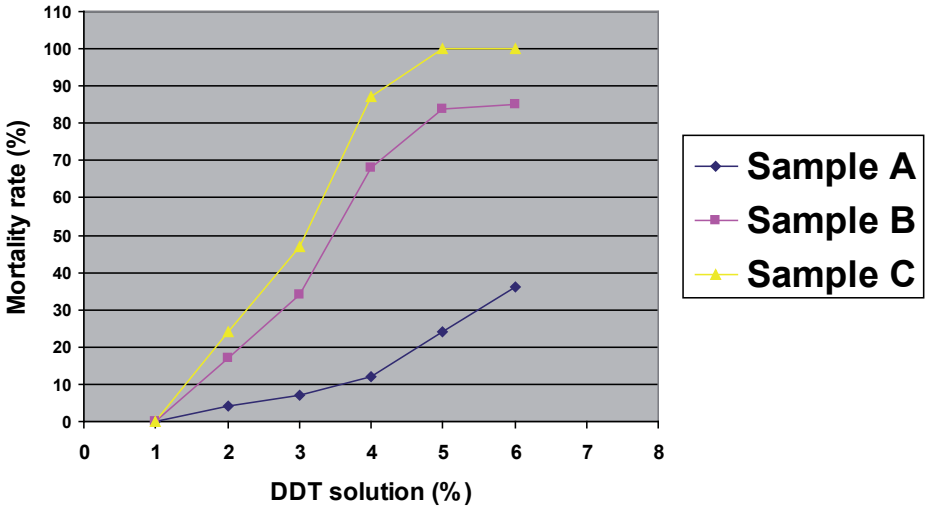
   Abiotic – non-living factors✓ e.g. soil✓,water✓, air, wind, light, rainfall (any 2) (3)

2. (a) If the frog is removed the trophic level preceding the frog, i.e. the insect will increase✓ therefore eating all the grass✓ which will reduce tremendously. The bird population will die off✓ as there is no food available. The food chain will be destroyed.✓ (4)

   (b) Grass will definitely decrease✓ its population size, which in turn would decrease each level of consumer✓ as there is not enough food✓. The food chain will be destroyed.✓ (4)

3.

Different samples of mortality rate of a mosquito larvae in different concentrations od DDT



2 marks for heading	= 2
1 mark each for scale on X and Y	= 2
2 marks each for labels on X and Y	= 4
1 mark each for unit in label X and Y	= 2
1 mark each for each line graph	= 3
Total	=13

4. CAUSES

– Nitrogen oxides and sulphur dioxides are primary causes. ✓

– Burning fossil fuels such as coal contributes to the above gases✓

– Winds can carry these gases far and wide✓

– These oxides react with water, oxygen and other chemicals to form acidic compounds✓

EFFECTS

– Damage to forests, soil and animals✓

– Damage to materials and buildings✓which are hazardous to health✓

– Cause poor visibility✓ (8)

LESSON 24

Activity 1

RUBRIC – POSTER

Criteria	Performance indicator levels			
	0	1	2	Comments
Title	No title	Complete title		
Main points	Not relevant	Some points relevant	All points relevant	
Organisation/ layout	Organisation/ layout muddled	Organisation partially clear and logical	Organisation clear and logical	
Diagram/ picture appeal/ attractiveness	Not appealing/ not attractive	Has some appeal/ attractiveness	Appealing/ attractive	
Impact of poster	Does not make an impact	Makes an impact		
Creativity of poster	No new ideas	Some signs of creativity/new ideas	Very creative and original	
Total				10

LESSONS 25 & 26

Activity 1

RUBRIC – GRAPH

CRITERIA	Performance Levels			
	0	1	2	Comments
Correct type of graph	Incorrect type	Correct type		
Heading	Not present	Incomplete	Complete	
Labeling both axes	No labels	Only one axis	Both axes	
Plotting points	Incorrect	Some correct	All correct	
Neatness	Untidy	Tidy		
Analysing graph	Not analysed	Incorrectly analysed	Correctly analysed	
TOTAL: 10				

Activity 2

RUBRIC – CONCEPT MAP

Criteria	Performance levels			
	0	1	2	Comments
Use of concepts/ keywords	None Correct	Some Correct	All Correct	
Layout and spatial organisation	Too small And cramped	Some parts clear and some parts cramped	Clearly laid out	
Logical flow/ use of links	None Correct	Some Errors	All Correct	
Use of colours/ highlights	Not Used	Colours used but not in a logical way	Colours used are linked logically	

Neatness	Untidy	Neat in some places	Neat throughout	
Total: 10				

LESSONS 27 & 28

Activity 1

RUBRIC – WRITING SKILLS

CRITERIA	Performance levels				
	0	1	2	3	Comments
Ability to select scientific facts and concepts relevant to topic	Not relevant to topic	Some parts relevant	Most parts relevant	All parts relevant	
Ability to use correct grammar and spelling	Many grammatical and spelling errors	Few grammatical and spelling errors	No grammatical or spelling errors		
Ability to organise new ideas into paragraphs	No paragraphs	Two paragraphs	Three or more paragraphs, including an introduction and conclusion		
Ability to link concepts and facts to form a coherent essay	Unable to link concepts, essay recorded as arbitrary sentences with no association; disorganised and lacks focus	Attempt made to link concepts; lacking in detail; some loss of focus	Good essay; analysis is vague in places without the eloquence and style of the excellent category	Excellent essay; critical concept analysis linked clearly; flows from one idea to the next	
TOTAL: 10					

Activity 2

RUBRIC – POSTER

CRITERIA	Performance Levels			
	0	1	2	COMMENTS
Expressing facts	Incorrect	Some correct	All correct	
Headings	Not descriptive	Partially descriptive	Descriptive	
Organisation/ layout	Muddled	Organisation clear at some places	Organisation clear and logical throughout	
Use of colour and public appeal	No colour or appeal	Poor	Good	
Response to question	No attempt	Partly correct	All correct	
TOTAL: 10				

Activity 3

RUBRIC – DIAGRAM

Assessment criteria	Performance level indicator			
	0	1	2	Comments
Caption	Absent	Correct but incomplete	Complete with all info	
Magnification/ scale provided	Absent	Present but incorrect	Present and correct	
Accuracy – shape	Incorrect	Partly correct	Totally correct	
Graph lines – solid, distinct, neat and do not overlap	Not clear	Partially clear	Totally clear	
Visible parts labelled accurately	No labels	Some labels correct	All labels correct	
Total : 10				

LESSONS 29 & 30

Activity 1

RUBRIC – WRITING SKILLS

CRITERIA	Performance levels				
	0	1	2	3	Comments
Ability to select scientific facts and concepts relevant to topic	Not relevant to topic	Some parts relevant	Most parts relevant	All parts relevant	
Ability to use correct grammar and spelling	Many grammatical and spelling errors	Few grammatical and spelling errors	No grammatical or spelling errors		
Ability to organise new ideas into paragraphs	No paragraphs	Two paragraphs	Three or more paragraphs, including an introduction and conclusion		
Ability to link concepts and facts to form a coherent essay	Unable to link concepts, essay recorded as arbitrary sentences with no association; disorganised and lacks focus	Attempt made to link concepts; lacking in detail; some loss of focus	Good essay; analysis is vague at places without the eloquence and style of the excellent category	Excellent essay; critical concept analysis linked clearly; flow from one idea to the next	
TOTAL: 10					

Activity 2

RUBRIC – TABLE

CRITERIA	Performance Levels			
	0	1	2	COMMENTS
Heading	Not present	Incomplete	Complete	
Descriptive column headings	Not present	Incomplete	Complete	
Descriptive row headings	Not present	Incomplete	Complete	
Format of table	No horizontal and vertical lines in borders	Incompletely drawn	Table completely drawn	
Data entered in table	Incomplete	Some correctly placed	All correctly placed	
TOTAL: 10				

Activity 3

Summative Assessment

DIVERSITY, CHANGE AND CONTINUITY

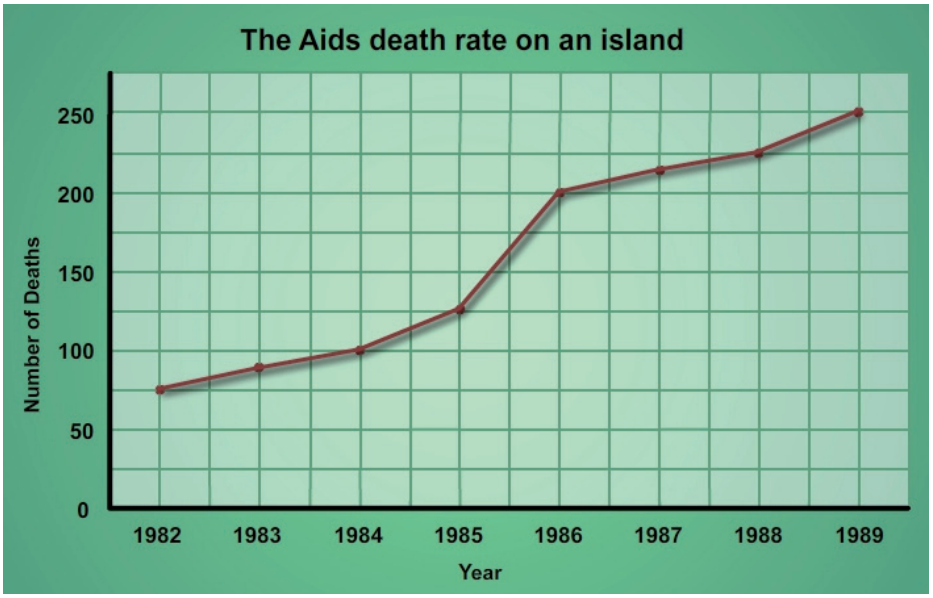
1. (a) 1989✓ (1)

   (b) 1982✓ (1)

   (c) Mortality is the death rate of a population✓ (1)

   (d) Census✓ (1)

   (e)



   (5)

   (f) Logistic growth curve ✓ (1)

2. (a) Predator – beetles✓

   Prey – plant lice✓ (2)

   (b) More✓ prey is present in the start✓ of the graph (2)

   (c) Between 90 – 93✓ (1)

   (d) Predation has occurred✓✓ (2)

   (e) Beetle population has decreased✓✓ (2)

3. (a) Logistic growth curve✓ and geometric growth curve✓ (2)

(b) Logistic – s-shape curve✓

Geometric – j-shape curve✓ (2)

4. Population – a group of organisms of the same species✓ occupying and living in a certain defined area✓ where interbreeding✓ can occur. (3)

5. $N = C \times \frac{M}{R}$✓

$= 800$✓ $\times \frac{600}{100}$✓

$= 4800$ fish✓ (5)

6. (a) Intraspecific – competition between the same species✓

Interspecific – competition between different species✓ (2)

(b) Density-dependent – deaths caused by the number of organisms✓

Density-independent – deaths caused by natural disasters, e.g. floods✓ (2)

TIPS FOR TEACHERS

LESSONS 1 & 2

Concentrate on the diseases that are caused by viruses, especially HIV/AIDS and the impact it has on society. Learners should research immunization and childhood illnesses. Learners could also be tasked to research the Historical impact of viral childhood illnesses during the 18th and 19th Century, before inoculation.

LESSON 3

VIRUSES

1. Ensure that the learners understand why there is a debate about whether viruses can be classified as living or non-living. Perhaps go through examples of what distinguishes living and non-living structures.
2. The difference between active and passive immunity can be confusing. It is suggested that learners are encouraged to visit the local clinic and talk to the staff there regarding the process of passive immunity. It is also suggested to discuss why people generally do not become ill a second time after having had mumps, chickenpox, etc.
3. Educators are advised to stress HIV/AIDS, especially with regard to the methods of transfer and actions that will not cause the transfer of this disease. Learners need to be made aware of the human aspect with regard to a person who has contracted this disease, so that, with understanding, fear will be replaced with sympathy/empathy.

BACTERIA

1. Ensure that learners understand how bacteria reproduce as this will ensure that they comprehend the effects of not completing a full course of antibiotics.
2. When conducting Activity 1, please emphasise the need for good hygiene practices personally as well as in their surroundings.
3. It is suggested that emphasis is placed on biotechnology and its impact on everyday life. This will provide learners with an understanding of how science impacts on us. Perhaps discuss careers available in this field as a matter of interest.

LESSON 4

- It is suggested that 2 to 3 diseases are covered and that Learners are encouraged to visit their local clinics, to increase awareness of fungal infections.
- Basic personal hygiene should be stressed.
- Explain how Candida infections occur and stress the need to address infections as soon as possible to prevent transfer to others. Perhaps reassure the learners that thrush is not as a result of poor personal hygiene and does not mean the person is dirty.
- It is suggested that Biotechnological advances are stressed and that the Learners are encouraged to research new trends either by visiting the media centres at the schools, the Public Libraries or the Internet.

LESSON 5

- Ensure that the plasmodium life cycle is understood.
- Basic personal hygiene should be stressed.
- Demonstrate phagocytosis by placing your hand into a plastic bag. Place a small object on the desk in front of you. Reach out with your hand inside the plastic bag. Wrap your fingers around the object. Then pull the plastic bag over your hand (inside out). The object will be inside the plastic bag.
- Explain how entamoeba are transferred to drinking water and the importance of ensuring that flies are kept away from food.
- Encourage learners to research sickle-cell anaemia and the impact of malaria by visiting media centres at their schools, public libraries and also searching on the internet.

LESSONS 6, 7 & 8

- Learners usually enjoy this section. There are many activities to assist learners to get to know the names of the bones. One exercise would be to divide learners into groups and ask them to make a moving skeleton. Each learner makes a set of bones which they attach with drawing pins and string. These can be hung up around the class.
- Many learners will have aunts, uncles and grandparents that suffer from various bone diseases. Learners can get first-hand knowledge of the symptoms, medications and remedies that are used to alleviate pain.
- Ask learners who have old X-rays to bring them to school. Hold these up to the light and get learners to identify the injuries.
- When studying the joints, get learners to perform tasks which require balance or simply to move in a certain way. Ask them to identify which joints are being used and also the class of lever involved. This will assist learners to apply their knowledge.
- Inform learners, especially the girls, of the importance of including calcium in their diet to prevent osteoporosis.

LESSONS 9, 10 & 11

- Obtain an ox heart from the butcher. Show the learners all the structures. Insert pieces of hose-pipe into the aorta, inferior and superior vena cava structures. Allow one of the learners to blow into each of the tubes in turn. It will show where the air exits. Use a sharp knife and cut the heart into two halves longitudinally. Show the learners where all the internal structures are situated.
- Ensure that the learners understand the two circulatory systems and how they inter-relate/interact.
- Stress the fact that arteries always carry blood away from the heart, irrespective of whether it is oxygenated or deoxygenated blood. Veins always carry blood back to the heart.
- Discuss medical advances with the learners and task them to conduct research on new medical findings and procedures regarding the circulatory system.

LESSONS 12, 13 & 14

- Explain the function of water in the body and the importance in removing wastes. Ensure that the learners understand that the water taken into the body each day must be used for many processes including the production of sweat to cool the body down and also for the production of urine.
- Explain the process of sweat and urine production on hot and cold days and the impact on the concentration of the urine.
- Ensure that the learners understand the term dehydration and discuss remedies – especially indigenous remedies.
- When explaining the dialysis process, ensure that the learners understand that even though the process is the exact reverse of what takes place in the body, the result is clean blood in both processes.
- Discuss the ethics, belief systems and legislation surrounding kidney transplants, especially with regard to the use of organs from deceased people.

LESSONS 15, 16, 17, 18 & 19

- Ensure that the learners understand the relationship between the nervous and chemical co-ordination.
- Explain the function of the hypothalamus in regulating homeostasis and ensure that the learners understand how essential negative feedback is to meet the requirements of homeostasis.
- When discussing the reflex arc and reflex action, get the learners to find a way to induce a reflex action such as sniffing pepper and sneezing, a knee-jerk action, pupil dilation, and constriction using a flash light etc.
- Discuss the effects of a nervous response versus hormonal responses.
- Discuss the sensations felt by learners when they have been is situations which create anxiety and stress so that they are able to relate to the action of adrenalin.
- Ensure that learners understand the function of insulin and the effects of diabetes where there is a lack of insulin production.

LESSONS 20 & 21

- This section lends itself to research, data collection and debates. Consider giving learners short tasks such as planning, conducting and reporting on the effects of pollution. It is suggested that a specific pollutant is given to a group to research.
- Learners can be instructed to draw up a table of the main causes, effects and possible solutions to major environmental issues or types of pollution. It will then represent a summary of this section.
- DDT can be explored as a non-biodegradable toxin that has impacted on the environment in many ways. This will allow learners to understand the consequences of using chemicals on a large scale before their impact on the environment is properly understood. Learners could also find out what methods indigenous people used to combat insect plagues.
- The writing of an essay, as a magazine or newspaper article, teaches learners to articulate their views.

- Learners should be encouraged to think about the impact of environmental abuse on their own lives and explore what is being done to address these issues. They could see what government is attempting to do by reading environmental legislation. They could then debate whether these laws are effective or not and provide their own suggestions, perhaps in the form of a letter to their provincial premier about how things may be improved.

LESSONS 22 & 23

- In this section, learners will find much to debate about. Learners could also be encouraged to research various methods to save on fossil fuels, conserve energy resources and to formulate and design reports on waste management.
- Learners should be encouraged to think of the impact of environmental abuse and address strategies to ensure that corrective measures are put in place. Learners can suggest ways in which to prevent misconduct and ensure conservation. They need to be encouraged to read legislated laws and understand what measures the government has put in place to address these issues. Learners can then debate whether these laws need to be re-addressed. They can provide suggestions, possibly in the form of a letter to their mayor or provincial premier.

LESSON 24

- Ensure that learners are able to separate the various types of diseases and how they are transmitted. Learners could be tasked to make a table which indicates the type of disease, how it is transmitted, the incubation period, symptoms and special precautions. This will act as a summary for this unit and prevent confusion.
- Encourage discussion on how to ensure that the spread of diseases is prevented as this will make learners aware of their usual behaviour, but also the level at which they risk exposure and will encourage them to take preventative measures.

LESSONS 25 & 26

- Ensure that the learners know the meaning of the terms, especially density-dependent and density-independent factors, as these two terms are often confused.
- Learners must be able to apply the various growth patterns to the data provided and be able to plot this data on a graph.
- When explaining population studies, tell the learners to think in terms of animals and plants and not humans. Human population factors will only apply when reference is specifically made, as in the case of HIV infections.

LESSONS 27 & 28

- Encourage learners to research South African plant and animal species that have become extinct. Allow discussion about how this will impact on future generations.
- Ensure that the learners understand the difference between terms such as intra- and interspecific competition.

- Discuss the need for predation and the impact of restricted areas on populations. This will also bring about discussions regarding culling as well as the ethics and legal regulations of this practice.

LESSONS 29 & 30

- Discuss the role of the environment for the survival of all species. Point out changes in climate, the impact of natural disasters, human impact on natural habitats and the adaptability of species.
- Ensure that learners are able to calculate indirect methods, quadrant and mark-recapture-mark methods accurately as these are always questions in the examinations.
- Discuss population changes over time and encourage learners to research diseases and other reasons for major declines in populations, such as SARS, bird flu, foot-and-mouth, flu epidemics, measles epidemics, TB, HIV/AIDS, polio virus, etc.