



Western Cape
Government
Education

Directorate: Curriculum FET

TELEMATICS 2017

LIFE SCIENCES

Grade 11

LIFE SCIENCES PROGRAMME FOR GRADE 11

Date	Time	Topics
14 February 2017	15:00 – 16:00	Hypothesis testing
2 August 2017	15:00 – 16:00	Homeostatic control of blood sugar levels, breathing, water and salts
8 August 2017	15:00 – 16:00	Human impact on the environment

INTRODUCTION

Life Sciences is the scientific study of living things from molecular level to their interactions with one another and their environments. To be successful in the subject you need to understand the processes of scientific inquiry, problem-solving, critical thinking and applying your knowledge. To assist you in developing these skills in preparation for your examinations, the telematics platform will allow you an opportunity to interact with expert teachers in a stimulating and fully interactive virtual learning space.

This Life Sciences telematics resource provides you with:

- Key summaries including diagrams of some of the content areas which were identified as challenging in 2014 and 2015 and content that will prepare you for Grade 12.
- Sample questions and answers that will assist you in answering different types of questions.

Life Sciences learners are expected to bring the following to each session:

- A Life Sciences textbook
- Notebook, pen and pencil
- Non-programmable calculator, protractor and compass for possible calculations, drawing of graphs and diagrams.

SCIENTIFIC METHOD

In this section you will learn:

- To state/formulate a hypothesis;
- To identify the correct dependent and independent variables;
- What is reliability
- What is validity

What is a hypothesis?

A hypothesis is an attempt to explain some event or observation using whatever information is currently available. It is a testable statement that may be accepted or rejected.

How to state a hypothesis

A hypothesis must:

- (a) have two variables (dependent and independent variables);
- (b) state the relationship between the two variables;
- (c) be testable; and
- (d) state the independent variable first (cause) and then the dependent variable (effect).

An example of a hypothesis question is as follows:

Scenario:

A scientist conducted an investigation to determine the effect of sulphur dioxide on the growth of young roots of bean seeds. He took three gas jars and placed a germinating bean seed in each jar. A different number of sulphur dioxide bubbles were passed through each jar. Each jar was sealed with a cover glass. The increase in length of each young root was measured after 5 days.

Formulate a hypothesis for the above investigation.

If germinating bean seeds are exposed to sulphur dioxide the growth of the roots of beans will slow down ✓✓

OR

If germinating bean seeds are exposed to sulphur dioxide the growth of the roots of beans will increase ✓✓

OR

If germinating bean seeds are exposed to sulphur dioxide there will be no growth of the roots of beans ✓✓

You should be able to differentiate between the three types of variables as follows:

Controlled / fixed variable – refers to the factors that should be kept constant so that the results of an investigation can be considered valid.

Independent variable – refers to the factor that is being investigated. This factor is usually manipulated by the investigator either at the start of or during the course of the investigation. The independent variable appears on the X-axis of a graph.

Dependent variable – refers to the effect of the independent variable. This effect is usually measured in some way and appears on the Y-axis of a graph.

What is reliability?

- The idea behind reliability is that any significant results of an investigation must be more than a once-off finding and be repeatable.
- Other researchers must be able to perform exactly the same experiment, under the same conditions, and generate the same results.
- This would reinforce the findings of the experiment and ensure that the wider scientific community accepts the hypothesis.
- For the questions which required learners to state how the **reliability** of the investigation could have been improved, the following answers apply: Repeat the investigation OR Increase the sample size.

What is validity?

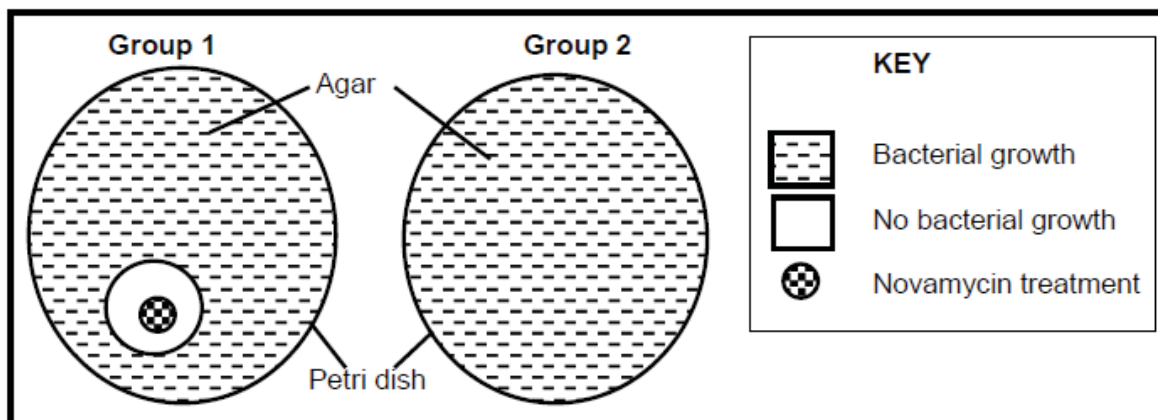
- Validity questions show how the experiment/investigation was carried out. It is important to be sure that all the factors/variables have been controlled/ fixed except the variable/factor being tested.
- The samples must be chosen randomly.
- The design for the investigation must be appropriate.
- Validity therefore speaks to whether the scientific research method was used with the appropriate degree of care and diligence.
- In questions which require learners to suggest some factors that might have decreased the **validity** of an investigation, the answers should centre on the criticism of the scientific process; for example, some factors/variables that were not fixed/controlled when carrying out the investigation.

Exemplar question

- 1.1 A scientist wanted to test whether a new antibiotic, called Novamycin, could restrict the reproduction of a population of bacteria which was resistant to other antibiotics.

The investigation was set up as follows:

- The bacteria were cultured in the same type of agar medium in 20 petri dishes of the same size and then divided into 2 groups:
 - Group 1: 10 petri dishes were treated with Novamycin of the same concentration
 - Group 2: 10 petri dishes were given no treatment
- The petri dishes were then incubated under the same conditions and examined for bacterial growth.
- The diameter of the area where no bacteria grew, was measured for each petri dish.



1.1.1 For the investigation above identify:

- The dependent variable
- THREE factors that should have been kept constant during the investigation, other than those mentioned above

1.1.2 Why did the scientist use more than one petri dish in each group?

1.1.3 What was the purpose of Group 2 in the investigation?

1.1.4 A similar experiment was done in which the cultured bacteria were divided into 5 groups. These groups were then treated with different concentrations of Novamycin.

- Formulate a hypothesis for the above investigation.
- State ONE factor related to Novamycin that must be kept constant.

Possible answers:

1.1.1

- Growth of bacteria ✓ / the diameter of the area with no bacterial growth ✓
- Same strain of bacteria ✓
Same amount of bacteria in all the petri dishes ✓
Same amount of agar medium ✓
ALL measurements of the diameter should be done by the same person ✓ / instrument ✓

1.1.2 To increase the reliability of the results ✓

1.1.3 To verify that any difference in bacterial growth is due to the action of Novamycin ✓ / Acts as a control

1.1.4

- An increase in the concentration of Novamycin will increase bacterial growth ✓ ✓
OR
An increase in the concentration of Novamycin will decrease bacterial growth ✓ ✓
OR
An increase in the concentration of Novamycin will have no effect on bacterial growth ✓ ✓
- Amount ✓ / mass of Novamycin

HOMEOSTATIC CONTROL OF BLOOD SUGAR LEVELS, BREATHING, WATER AND SALTS

Homeostasis is the process of maintaining a constant internal environment within the body. The internal environment refers to the blood and tissue fluid that surrounds the cells of the body. Homeostasis enables the body to function efficiently, despite changes that might occur in the external or internal environment.

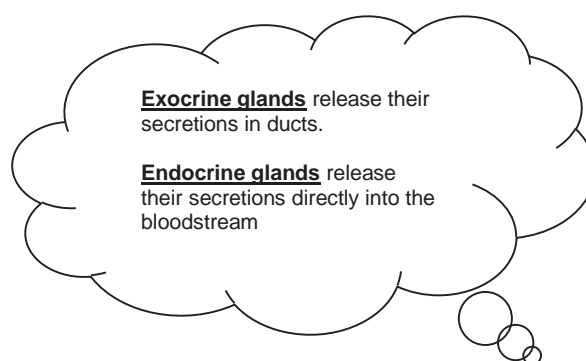
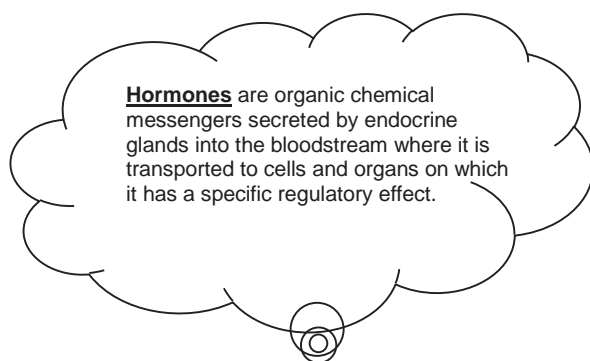
Changes in temperature, **glucose levels, carbon dioxide levels, water levels and salt levels** of the internal environment affects the homeostatic balance of the body. Negative feedback mechanisms operate in the human body to detect changes or imbalances in the internal environment and to restore the balance.

Homeostatic control of blood sugar levels

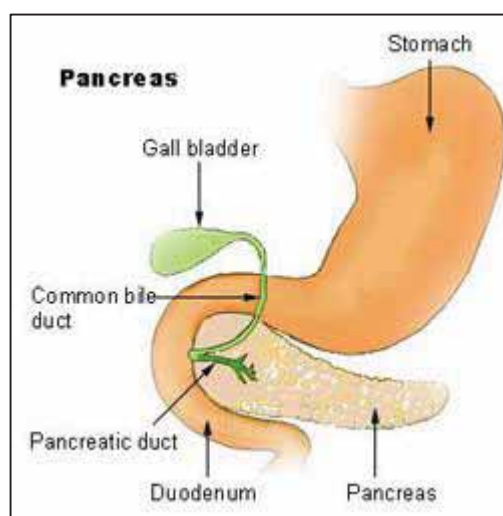
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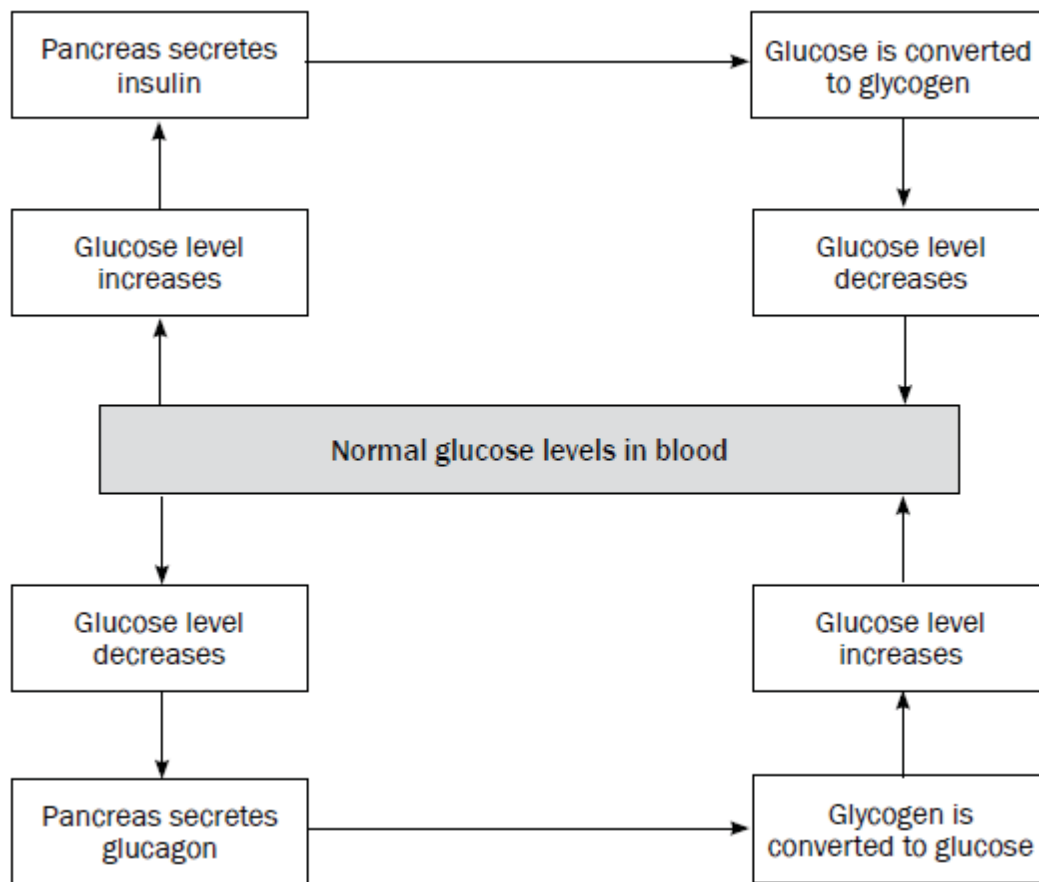
The pancreas, located just below the stomach, is composed of two types of cells:

- Normal pancreatic cells that secrete digestive juice (pancreatic juice) which contains enzymes for digestion.
- The **islets of Langerhans** that secrete two **hormones**, namely **insulin** and **glucagon**.



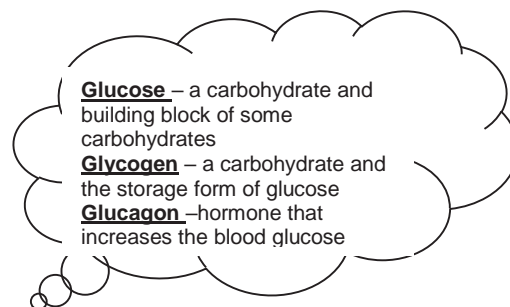
The pancreas is both an **exocrine** gland (secretes pancreatic juice into a pancreatic duct which opens in the duodenum) and **endocrine** gland (secretes the hormones namely, insulin and glucagon directly into the bloodstream).

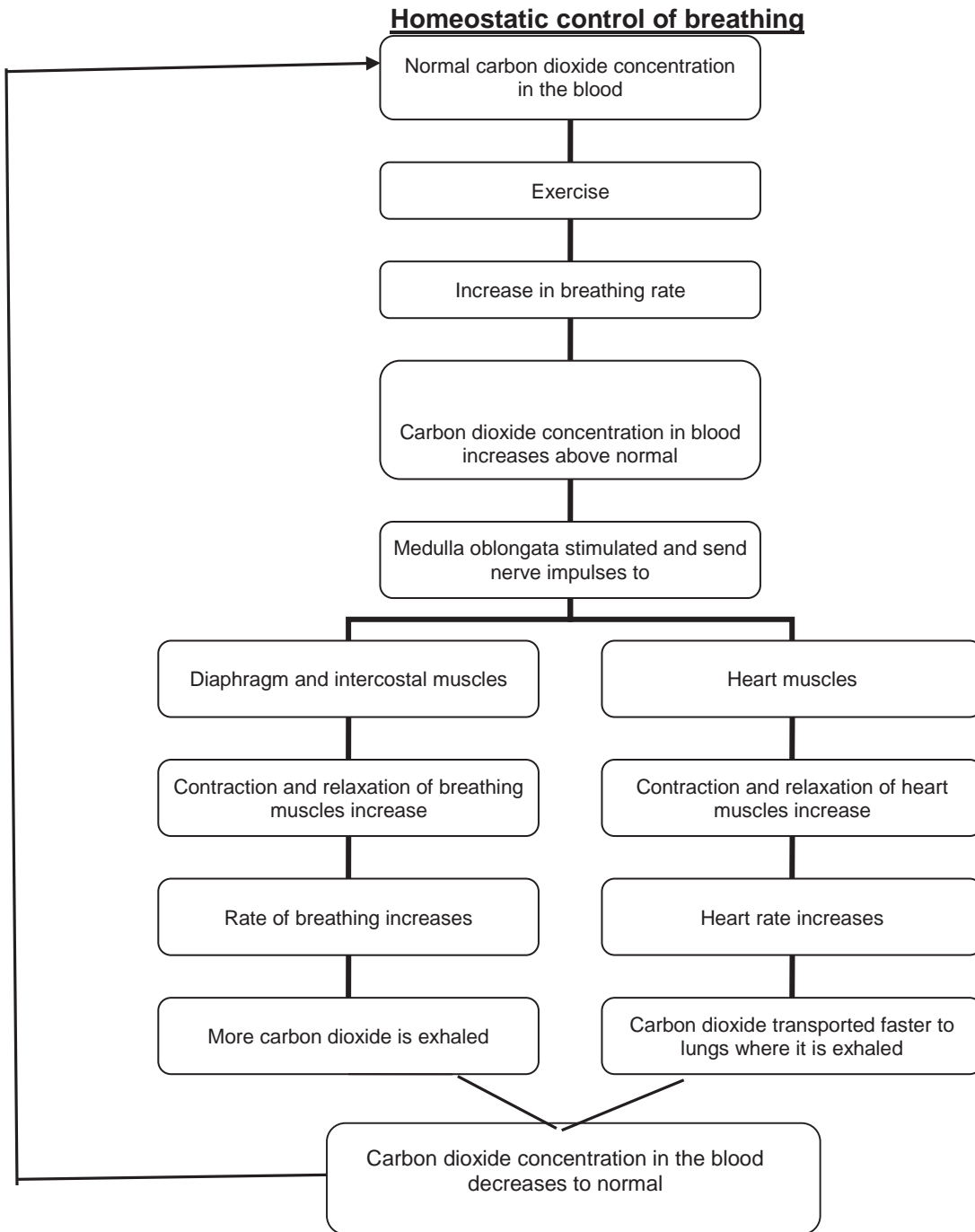


Control of blood sugar levels (glucose concentration in blood)

- When the **glucose level in the blood increases above normal**, the pancreas is stimulated
- The pancreas secretes insulin into the blood
- Insulin travels in the blood to the liver and stimulates the conversion of glucose to glycogen which is then stored
- The glucose level in the blood decreases and returns to normal

- When the **glucose level in the blood decreases below normal levels**, the pancreas is stimulated
- The pancreas secretes glucagon into the blood
- Glucagon travels in the blood to the liver and stimulates the conversion of stored glycogen to glucose
- The glucose level in the blood increases and returns to normal.

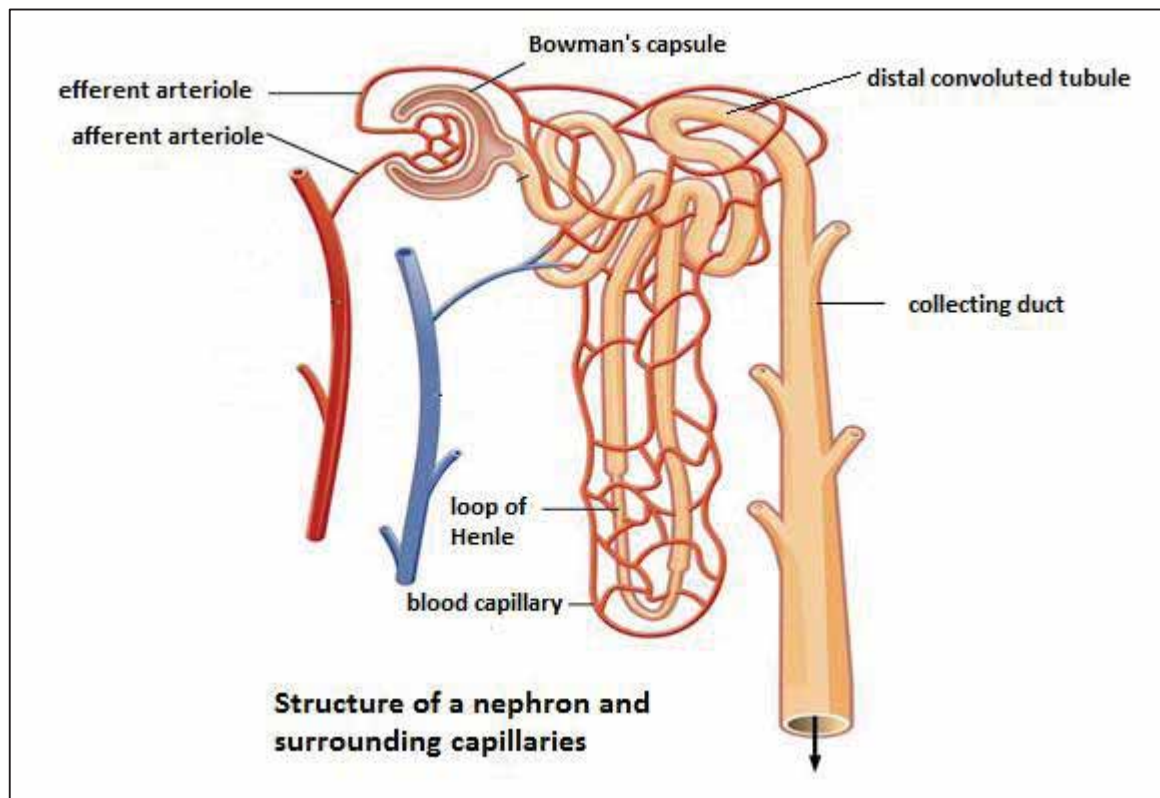
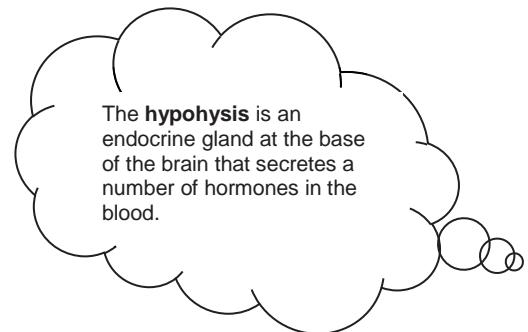
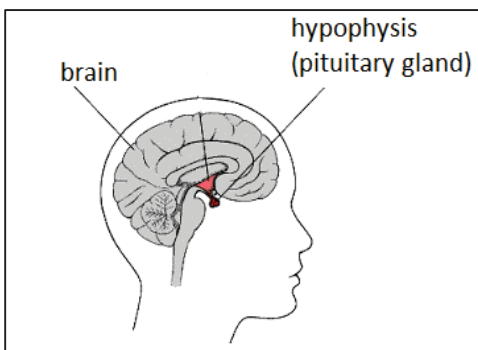


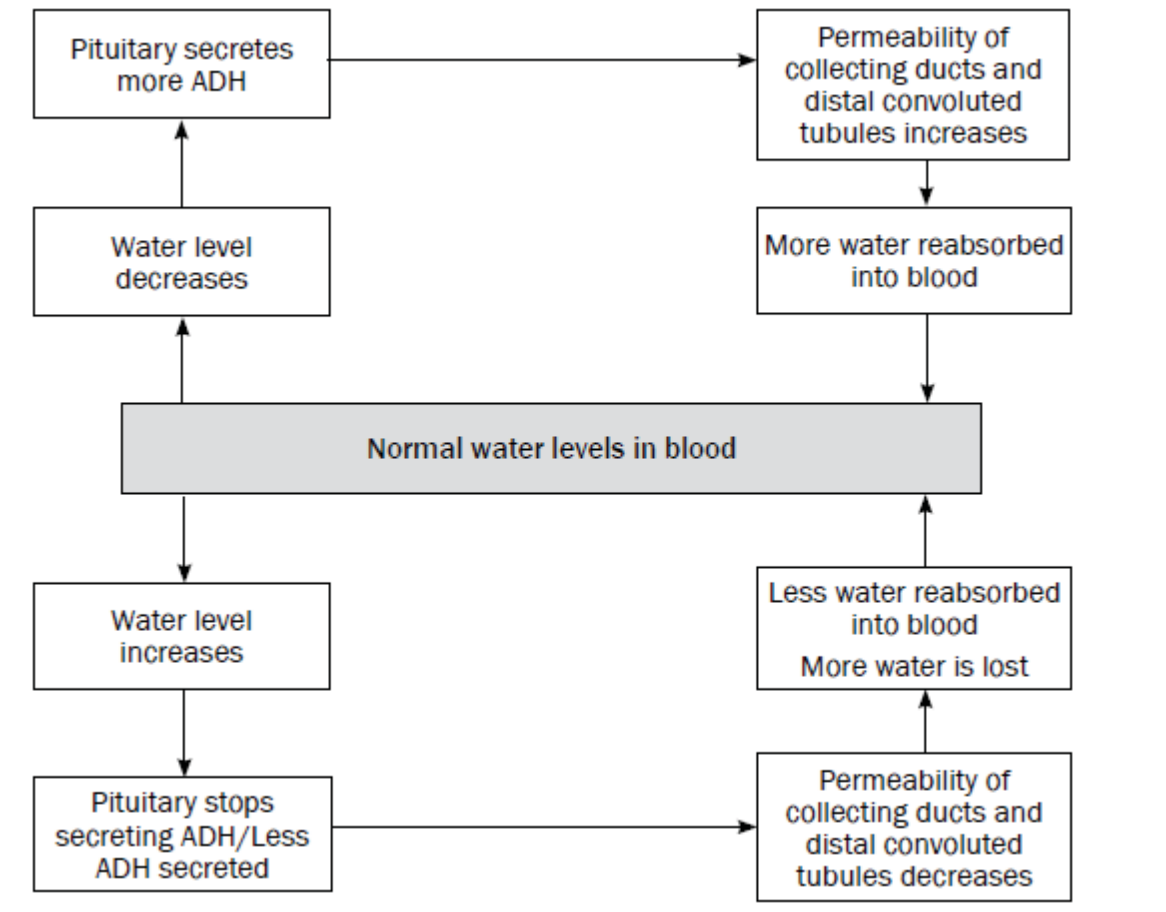


- Receptor cells in the carotid artery and in the wall of the aorta are very sensitive to changes in the carbon dioxide concentration in the blood.
- When the carbon dioxide level in the blood increases e.g. after or during exercise, the receptor cells in the carotid artery and wall of the aorta are stimulated
- These receptors send nerve impulses to the medulla oblongata in the brain
- The medulla oblongata sends nerve impulses to the diaphragm and intercostal muscles (breathing muscles) to contract more actively and increasing the rate and depth of breathing
- The medulla oblongata also sends nerve impulses to the heart muscle to increase the heart rate
- More carbon dioxide is transported to the lungs and exhaled from the lungs
- The carbon dioxide level in the blood returns to normal.

Homeostatic control of water content of the blood (osmoregulation)

- The hormone **ADH (anti-diuretic hormone)**, secreted by the **hypophysis(pituitary gland)**, regulates the water content of the blood.

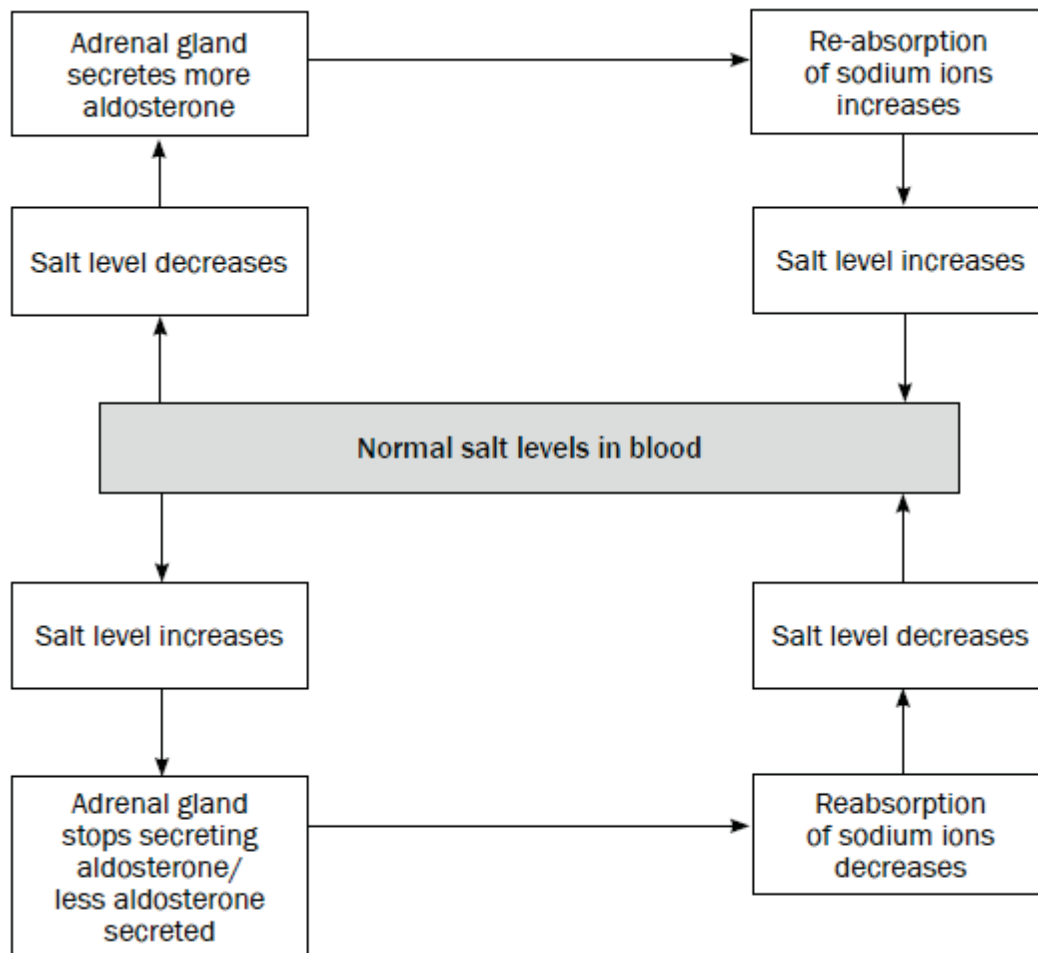
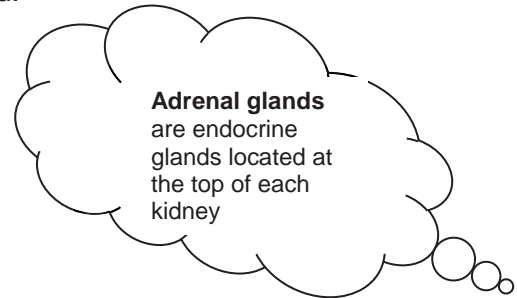
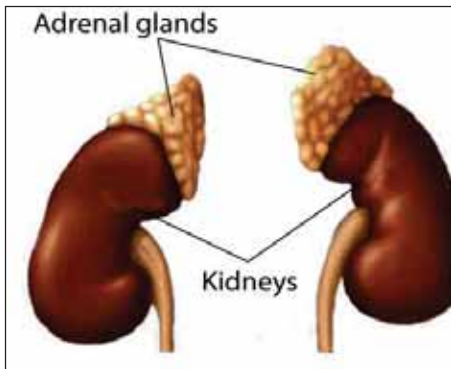




- **When the blood has less water than normal** e.g. when a person is active and sweating a lot or taking in very little liquids
 - The hypothalamus is stimulated and sends impulses to the hypophysis to secrete more ADH
 - ADH travels in the blood to the kidneys and makes the walls of the distal convoluted tubules and collecting ducts more permeable to water
 - More water is re-absorbed from the tubules and is passed to the surrounding blood vessels
 - Urine becomes more concentrated and its volume decreases
 - The water level in the blood increases and returns to normal
-
- **When the blood has more water than normal** e.g. when a person is inactive and sweating less or taking in a lot of liquids
 - The hypothalamus is stimulated and sends impulses to the hypophysis to secrete less ADH
 - Less ADH travels in the blood to the kidneys and the walls of the distal convoluted tubules and collecting ducts become less permeable to water
 - Less water is re-absorbed from the tubules and is passed to the surrounding blood vessels
 - Urine becomes less concentrated (dilute) and its volume increases
 - Large amount of water is excreted in the urine
 - The water level in the blood decreases and returns to normal

Homeostatic control of salt balance of the blood

- The hormone **aldosterone**, which is secreted by the **adrenal gland** regulates the concentration of salts e.g. sodium ions in the blood.



- When the **salt concentration** in the blood becomes **too low**
- The adrenal gland is stimulated to secrete more aldosterone
- Aldosterone increases the re-absorption of sodium ions from the distal convoluted tubules and collecting duct into the surrounding blood vessels
- The concentration of sodium ions in the blood vessels increases and returns to normal.

- When the **salt concentration** in the blood becomes **too high**
- The adrenal gland is stimulated to secrete less aldosterone
- The re-absorption of sodium ions from the distal convoluted tubules and collecting duct into the surrounding blood vessels decreases
- The concentration of sodium ions in the blood vessels decreases and returns to normal.

HUMAN IMPACT ON THE ENVIRONMENT (examined in Grade 11 and 12)

1.1 THE ATMOSPHERE AND CLIMATE CHANGE

Introduction

Climate refers to the long-term weather conditions of an area. The atmosphere is made up of nitrogen, oxygen and other gases, which include the greenhouse gases such as carbon dioxide and methane. Greenhouse gases absorb infrared (long wave radiation) long wave radiation emitted from the Earth and prevent it from escaping back into the atmosphere. This is known as the '**greenhouse effect**'.

The greenhouse effect is important in keeping the Earth warm so that it can sustain life. However, an increase in the concentration of greenhouse gases leads to the '**enhanced greenhouse effect**'. As a result, there may be a significant rise in the average temperature of the surface of the Earth over a period of time. This is known as '**global warming**'.

Increased concentration of carbon dioxide in the atmosphere is due mainly to:

- **Burning of fossil fuels** (for electricity, to power vehicles and for industrial processes): Combustion of carbon-rich fuels such as coal or plants (wood) releases carbon that was stored in them, as carbon dioxide.
- **Deforestation**: Cutting down trees and removing vegetation from the land decreases the amount of carbon dioxide taken up by plants during photosynthesis. This increases the amount of carbon dioxide available in the atmosphere.

Increased concentration of the methane in the atmosphere is due mainly to:

- **the increased number of landfills**: decaying organic matter in waterlogged soils such as landfills releases methane.
- **the increased number of livestock**: ruminants such as cows release methane gas through their digestive tracts.
- Mining of coal.

Increased temperatures may lead to:

- More evaporation of water which can lead to increased precipitation which eventually increases the potential for flooding.
- Rising sea levels caused by melting ice in the glaciers which can eventually increase the potential for flooding.
- Increased wildfires that increase the chances of soil erosion and eventually desertification.
- Increased loss of biodiversity, as species are unable to cope with rapidly rising temperatures, eventually leading to desertification.
- Increased droughts in some areas leading to desertification and food insecurity.

Carbon footprint

This is a measure of the total amount of carbon dioxide emissions of an individual, a defined population or a company per year.

Strategies to reduce the carbon footprint include the following:

- **Reuse and recycle:** less fossil fuels burnt in the production of some of the material.
- **Drive less:** by using public transport, walking, bicycles.
- **Reduce the need for heating:** insulating walls and building energy efficient homes.
- **Carbon offsetting:** by using alternative energy (solar and wind) and reforestation to act as a carbon reservoir.

Destruction of the ozone layer

Ozone is a greenhouse gas that is found at low concentrations 15 – 50 km above the Earth's surface. It absorbs the ultraviolet rays from the sun. The ultraviolet rays damage the DNA and cause skin cancer. Measurements in certain areas have shown a significant decrease in the amount of ozone layer. The damage to the ozone layer is caused mainly by chemicals called CFCs (chlorofluorocarbons), released by refrigerators, aerosol sprays and fast-food packaging.

If the measures to reduce the destruction of ozone layer fail there will be a significant increase in the number of skin cancer cases.

1.2 WATER QUALITY AND WATER AVAILABILITY

It is estimated that as many as 2 billion people won't have sufficient access to clean water by 2050. There are many efforts directed towards making good quality water available.

1.2.1 Availability of water

The availability of water may be influenced by the following factors:

Construction of Dams

- The construction of additional dams plays a major role in increasing the quantity of water stored and made available for later use by people and in agriculture.

Destruction of wetlands

- Wetlands should not be destroyed because they influence both the availability and quality of water.

Water wastage

- A large amount of water used for irrigation is lost due to poor farming practices. The use of water for irrigation further up a river decreases the availability of water for other users lower down the river.
- Availability is also affected by wastage of water through leaking taps and toilets and faulty pipelines.
- Wastage of water can be reduced by reducing the pressure in the pipes, by educating people to use water wisely and by maintaining all plumbing in good condition.

Cost of water

- The cost per kilolitre (kl) of water increases with the increased use of water.
- A certain amount of water is available free to all citizens to ensure that water is available to the poorest.

Poor farming practices

- Contamination of water sources by fertilizers and pesticides has decreased the amount of clean water available, thus increasing the costs involved in purification.
- Over-grazing leads to soil erosion. On land that is eroded, water runs off rapidly rather than soaking into the ground, and is thus wasted.

Droughts and floods

- During periods of drought, water availability decreases. Water used from dams during the drought periods cannot be easily replaced.
- Natural vegetation can hold back water from floods. If the natural vegetation is removed, flood waters are lost.

Boreholes and their effect on aquifers

- Boreholes have been used to increase water availability in areas that do not have direct access to other sources of water.
- Constant use of boreholes eventually leads to the drying up of aquifers (the source of borehole water) thus decreasing water availability in the future.

Water recycling

- The availability of water can be increased if existing water is used for more than one purpose. For example, some water used in the household can be used for the garden.

Exotic plantations and the depletion of the water table

- Some exotic plants use a large quantity of water from the ground. As a result, this decreases the level of the water table, making less water available to other vegetation in the area.

1.2.2 QUALITY OF WATER

The quality of water may be influenced by the following factors:

Eutrophication and algal bloom

- Water used for agriculture may contain pesticides, herbicides and fertilizers which pollute the water in rivers, dams and lakes, causing **eutrophication**. The added nutrients lead to an increase in algal growth (algal bloom). These algae over-use and thus deplete the oxygen in the water, thus reducing the potential for life in such water.

Thermal pollution

- Thermal pollution refers to the heating of water caused by the use of water for cooling in power-stations and industries.
- The quality of water is affected because heated water has lower oxygen content, making it difficult to support life.

Pollution of water through domestic, agricultural and industrial use

- After water is used for domestic purposes it may contain detergents (such as from washing) and pathogenic bacteria (such as in sewage). This polluted water has to be treated before it can be used again.
- After water is used for industrial purposes it may contain many heavy metals, oil, heat and fertilizers.
- Fertilisers and pesticides may run off into rivers, ponds and dams and pollute the water.

Mining

- Water returned to the environment from mines is generally acidic and toxic. This water is hot and thus also contributes to thermal pollution.

Alien Plants

- Alien invasive water plants block the waterways, reducing light to other aquatic plants. These plants eventually die and decompose. Bacteria that decompose these plants eventually deplete the oxygen supply in the water.

Water purification

- The quality of water is improved through purification methods. Undrinkable water can be made drinkable.

1.3 FOOD SECURITY

Food security refers to the access, by all people at all times, to adequate, safe and nutritious food for a healthy and productive life. Food security may be influenced by the following factors:

Exponential growth of the human population

- The world's population is growing at an exponential rate (very rapidly) and as a result some countries cannot produce enough food to feed their growing population. Food production needs to increase as rapidly as the world population; otherwise many countries will experience food insecurity.

Droughts and floods

- Climate change has led to more frequent and severe droughts and floods. Droughts result in crop losses and livestock death which reduce the food available in an area. Floods cause extensive damage in a short period of time and decrease the amount of farmland available to grow crops. People also usually lose their homes, possessions and economic security during floods, further impacting on food security.

Poor farming practices – monoculture, pest control, loss of topsoil and the need for fertilizers

- **Monoculture** is the growing of one type of crop over large areas of land year after year. Monoculture depletes nutrients and water supplies and therefore impacts negatively on the quality of the topsoil.
- **Pest control** involves the use of pesticides (chemicals) to kill pests that compete with humans for food. Pesticides may kill or get into the tissues of healthy plants. This may reduce crop production and, since pesticides are expensive, increase the cost of food and thus reduce access to poor consumers. Many farmers now use **biological control**, which uses a natural predator/parasite to get rid of the pest instead of using expensive pesticides.
- **Topsoil** is the top 1.5 metres of soil that contain the nutrients that plants require for growth. The tilling of the soil between plantings and heavy rainfall cause much of the topsoil to be lost, leading to the loss of valuable nutrients over time, reducing crop yields.
- **The use of fertilisers**, both inorganic (chemical) and organic (compost and manure) can increase the nutrients in the soil and keep soil fertile. This replaces nutrients in the soil that are lost when crop plants absorb them. Fertilizers can be expensive, contributing to the high cost of food, thus reducing access to poor consumers.

Alien plants and reduction of agricultural land

- Alien plants deplete the topsoil of water and nutrients. These alien plants out-compete indigenous plants because they have no natural predators, grow rapidly and invade land that could be used to grow crops.

The loss of wild varieties and the impact on gene pools

- Crop plants have replaced wild varieties. The preservation of wild varieties is important

because, if changing environmental conditions destroy the present crop plants, then wild varieties could be used as alternative sources of food. If wild varieties are wiped out, it will reduce the genetic diversity and thus the gene pool.

Genetically engineered food

- Genetically engineered food is produced from genetically modified organisms (GMOs). Genetic engineering involves the inserting of a gene (with a desired characteristic) from one organism into another organism to increase the yield. For example, a gene for drought resistance could be inserted into a crop plant that grows in areas where water is scarce.

Food wastage

- Wastage could occur during the storage, production and processing of food. Wastage includes food thrown away and food not eaten. Wastage increases the prices of food to consumers and could reduce food security in a country.

1.4 LOSS OF BIODIVERSITY

Biodiversity refers to the variety of plant and animal species on Earth. Biodiversity ensures that we have food, fresh water, medicines and fuel that we obtain from our environment. It also ensures that the climate is regulated, floods are controlled (wetlands), diseases are kept in check (predators eat the sick animals) and water is purified (filtering by wetlands). Biodiversity ensures that seeds are dispersed, nutrients are cycled (e.g. nitrogen and phosphorus) and oxygen and soil continue to form. It also helps improve our quality of life by providing us with forms of recreation and ecotourism. As biodiversity declines, these things do not occur as they should and the survival of humans becomes threatened.

1.4.1 FACTORS THAT REDUCE OUR BIODIVERSITY

Habitat destruction through: Farming methods

Monoculture: Monoculture is the growing of one type of crop over large areas of land year after year. Monoculture replaces indigenous plants and reduces biodiversity. Insects that specialise in feeding on one type of crop spread rapidly because there are no natural enemies or barriers to stop them. This means the farmer needs to use more pesticides to kill them. Intensive use of agrochemicals such as fertilisers and pesticides often end up in rivers, streams and groundwater, poisoning species in the area and causing eutrophication. This results in a large loss of biodiversity.

Overgrazing: It occurs when livestock such as sheep or cattle are kept in an area for too long; the vegetation is grazed to a point where it will not grow back. It causes soil erosion by removing the plants that bind the soil together with their roots. Topsoil is lost during rainstorms. This can lead to the extensive destruction of land through desertification which results in loss of biodiversity. Sometimes overgrazed land becomes subject to alien plant invaders which destroy habitats by taking over the land.

Golf Estates

Developments such as golf estates are a form of monoculture that requires large amounts of water, pesticides and fertilisers which may runoff and poison aquatic ecosystems. Housing associated with golf developments replaces large areas of natural vegetation.

Mining

Mining alters the environment and can negatively affect the biodiversity in an area. Pollutants in the form of dust and smoke may be released into the air while vegetation is removed and replaced with rock and waste dumps. Underground water may be poisoned because of sulphates and heavy metals released into them.

Urbanisation

The growth of large cities (urbanisation) also negatively impacts on biodiversity. Surfaces are covered with concrete, and natural habitats are destroyed to build houses and businesses. Habitat fragmentation causes the loss of biodiversity, as natural plants are replaced by exotic trees and plants.

Deforestation

Deforestation is the permanent destruction of indigenous forest and woodland areas. Deforestation is caused by human activities such as agriculture, logging, and using trees as firewood. Deforestation leads to the destruction of the habitats of other organisms, like frogs and insects, and this leads to the loss of biodiversity.

Loss of wetlands and grasslands

Grasslands and wetlands have unique plant and wildlife and provide many ecological services to humans. Destruction of these habitats will lead to the loss of species.

Poaching

Poaching refers to the illegal hunting of animals, either for food or because certain body parts can be sold for money. 'Poaching' may also be applied to plants that are removed and sold for profit e.g. medicinal plants. Some wild animals are hunted for food ('bush meat') and are on the verge of extinction. Elephants are poached for their tusks to make carvings and jewellery and rhinos are hunted for their horns which are used in the Far East for medicinal reasons.

Alien plant invasions

These plants are species that have been introduced into an area and which compete with the natural plants in the area. They can outcompete indigenous plants, thus reducing the biodiversity.

1.4.2 WAYS IN WHICH OUR BIODIVERSITY CAN BE MAINTAINED**Control of alien plant invasions**

Alien invasive species may be controlled by mechanical, chemical and biological methods. Mechanical methods involve chopping down plants or physically removing them by hand and is very time consuming. Chemical control involves spraying herbicides onto the plants; this can pollute the environment and is expensive. Biological methods involve introducing a natural enemy from the alien plant's environment and allowing it to reproduce and feed on the invasive plant.

Sustainable use of the environment

Sustainable use of the environment means using resources without harming the ability of future generations to use that resource. Substances from indigenous plants such as the African potato, Hoodia, rooibos and Devil's claw all have economic and medicinal value. These indigenous plants can be used sustainably by encouraging traditional healers to grow their own plants and through improving education of the women who generally gather the plants in the wild. Encouraging traditional healers to be part of formal medical programmes would encourage training to be on-going and help establish sustainable use of medicinal plants. Legislation should be passed to limit the numbers of plants that can be harvested at one time and seeds of medicinal plants could be collected and distributed to increase plant numbers.

1.5 SOLID-WASTE DISPOSAL

Solid waste is any solid material that is of no use to humans and which needs to be disposed of in a safe and environmentally friendly way.

Managing dumpsites for rehabilitation and prevention of soil and water pollution

The simplest and most cost effective way of disposing of solid waste is to bury it in landfill sites. A landfill site is a hole where solid waste is dumped and then covered by soil. However, this way of disposing of solid waste contributes to soil and groundwater pollution because rain seeps through the waste to produce a toxic substance called leachate. To prevent the toxic leachate from reaching the groundwater, a plastic liner is placed under the dumpsite area.

Rehabilitation of landfill sites occurs before they are closed down. This involves the covering of the old landfill site with clay soil, which is impermeable to water, and then it is covered with topsoil. Grass or other vegetation is then planted on the old landfill site. The growth of the plants stabilises the area and the old landfill site may be used as a recreational area such as a park or a golf course.

The need for recycling

Various methods may be used to manage solid waste, they include the reduction of waste, re-using waste and recycling of waste.

- **Re-using** waste products includes re-using plastic shopping bags re-using glass and plastic containers – this helps to reduce the waste produced.
- **Recycling** is a process whereby used materials/waste products are recycled to make new products, for example plastic, glass, tin and paper. The advantage of recycling is that it provides employment, reduces the use of raw materials and energy, and reduces air, ground and water pollution.

Using methane from dumpsites for domestic use: heating and lighting

Methane is a gas produced as a result of the decomposition of organic waste. The methane gas can be used as a fuel. Methane can be collected from landfill sites and used to generate electricity for domestic use – heat for cooking and electricity for lighting.

Safe disposal of nuclear waste

South Africa also uses radioactive material such as uranium to power its nuclear power station at Koeberg in the Western Cape. Unfortunately, a by-product of using uranium is nuclear waste that is still radioactive and therefore dangerous to living organisms. The nuclear waste is stored in thick steel drums and buried in trenches at special protected sites.

Exemplar questions:

- 1.1 Read through the extract below and answer the questions that follow.

CAPE TOWN'S LANDFILL CRISIS

Approximately 6 000 tons of waste are currently generated daily within the City of Cape Town. Fifty-five percent of waste ending up at the Council's six landfill sites is directly received from the industrial and commercial sectors, whereas the domestic waste from households account for approximately 30% of the waste stream.

A total of 1, 7 million tons of waste was received in landfill sites in Cape Town during 2002 compared to the 1, 6 million tons in 2001 and the 1, 5 million tons in 2000. This is roughly an annual increase of 7%.

Waste from lower income households are shown to contain about 80% organic waste compared to that from affluent suburbs, which typically contains about 60–70% of packaging waste. Of the total amount of waste produced, more than 90% is landfilled by the City of Cape Town.

There is an urgent need for a new regional landfill site as the city faces the closure of most of its current landfill sites. Clean-up costs of litter and dumping exceed R100 million a year. This is money that could be put to far greater use within the city, particularly given the housing crisis.

[Adapted from: www.capetown.gov.za/en/SolidWaste]

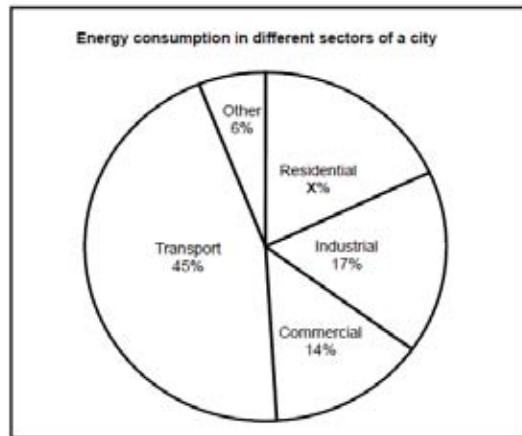
- 1.1.1 Calculate how many tons of waste from households are produced per day. Show all working.
- 1.1.2 Landfills are known to cause pollution to the environment. Briefly describe TWO possible ways in which this could happen.
- 1.1.3 Give ONE way in which lower income households could reduce the amount of waste that they send to landfills.

Possible answer:

$$1.1.1 \quad \frac{6000}{100} \times 30 = 1800 \text{ tons}$$

- 1.1.2 There could be littering when wind blows ✓
 The groundwater could be polluted when chemicals drain through the bottom of the landfill when it rains ✓
 Air pollution can occur when waste is burned ✓
- 1.1.3 They could have compost heaps and not throw away organic waste ✓ OR
 They could re-use and recycle waste ✓

- 1.2 Energy in South Africa is mainly generated from coal power stations. The pie chart below shows the energy consumption in different sectors of a South African city in 2007.



- 1.2.1 Determine the value of X. Show ALL calculations.
 1.2.2 Which sector consumes the most energy in this city?
 1.2.3 The residential energy consumption in this city increased by 3% in 2009. Give TWO possible reasons for this increase.
 1.2.4 Explain the impact of the increased use of energy generated from coal power stations on climate change.

Possible answers:

- 1.2.1 $100 - (17+14+45+6) \checkmark / 82\% = 18 \checkmark \%$
 1.2.2 Transport \checkmark
 1.2.3 Increased number of houses built \checkmark / increased population
 More houses received electricity connectivity \checkmark
 More street lamps provided by municipality \checkmark
 A very cold winter \checkmark
 1.2.4 It creates more CO₂ \checkmark which is released into the atmosphere. CO₂ traps more heat within the atmosphere \checkmark causing the 'enhanced greenhouse effect' \checkmark which causes a rise in the average global temperature. \checkmark This is known as 'global warming' \checkmark

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