



Western Cape
Government
Education

Directorate: Curriculum FET

TELEMATICS 2019

LIFE SCIENCES

Grade 12

Date	Time	Topics
18 February 2019	16h00 – 17H00	Scientific investigations, Protein synthesis, mutations
04 March 2019	15h00 – 16h00	Meiosis
15 April 2019	16h00 – 17h00	Senses and homeostasis
22 July 2019	15H00 – 16h00	Natural selection, Punctuated equilibrium and speciation

1. TIPS FOR WRITING LIFE SCIENCES

- The external examination for Life Sciences consists of two (2) question papers of 150 marks each. Each question paper covers a variety of content topics. Ask your teacher for an outline of the content topics and weighting of each topic in each question paper.
- The duration of each question paper is 2½ hours and all questions are COMPULSORY.
- Each Life Sciences question paper consists of THREE sections i.e. SECTION A (50 marks), SECTION B (two questions of 40 marks) and SECTION C (20 marks).
- When answering a multiple choice question in Section A read the question and four options carefully, evaluate each option and eliminate each incorrect option.
- In questions that require only a LETTER you only need to write down a LETTER e.g. ‘Give only the LETTER of the molecule that carries the amino acid’. Other questions might require you to write down both the LETTER and a NAME, for example of a part from a diagram.
- Use the correct spelling when you use biological terminology in your answers. Use scientific names in terminology and avoid using common names e.g. .
- You need to do all your drawings and graphs in pencil and labels should be in blue or black ink. You may not use graph paper when drawing graphs.
- Make sure that you have all the necessary stationery for your examination e.g. blue or black pens, a pencil, an eraser, a ruler, a non-programmable calculator, protractor and a compass.

SCIENTIFIC INVESTIGATIONS:

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.

A hypothesis must:

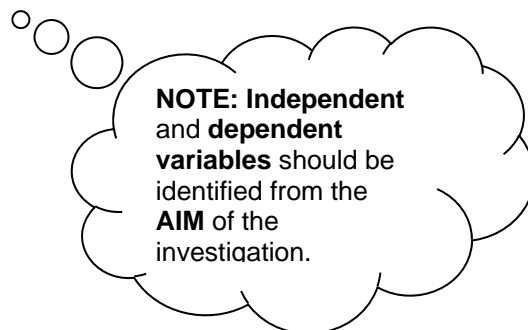
- (a) have two variables (dependent and independent variables);
- (b) state the relationship between the two variables;
- (c) be testable; and
- (d) state the independent variable first (cause) and then the dependent variable (effect).

Variables:

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.
- 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.
- 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.

Question:

1. Scientists conducted a survey to establish the relationship between the age of the mother and the risk of her having a baby with Down syndrome. They recorded the number of babies born with Down syndrome (per 5 000 births) over a one-year period and recorded the age of the mother. Their findings are summarised in the table below.

Age of mother (years)	Number of babies born with Down syndrome (per 5 000 births)
25	10
35	15
45	300

- 1.1 State FOUR planning steps that need to be considered for this survey. (4)
 1.2 State the independent variable (1)
 1.3 State the dependent variable (1)
 1.4 State ONE way of improving the reliability of the results. (1)
 1.5 State a conclusion that can be made of the results of this survey. (2)

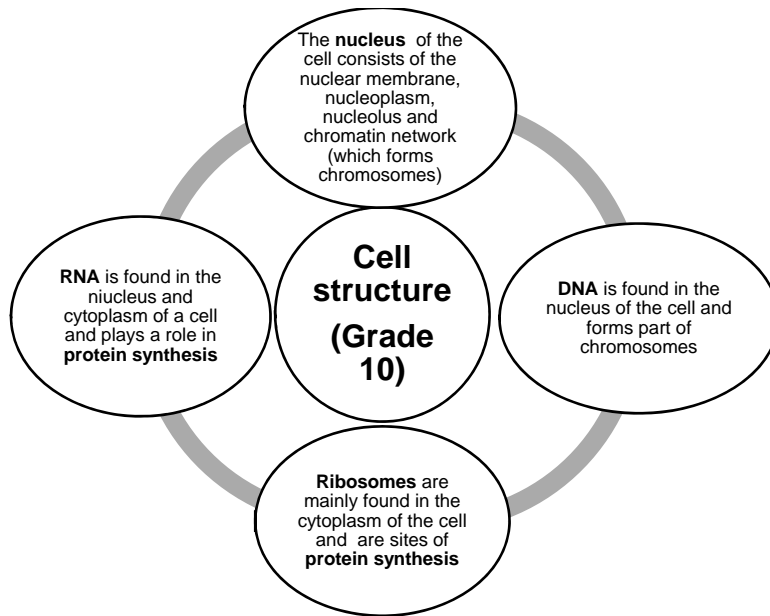
Answers:

- 1.1 Consult with various hospitals / maternity homes to gather and use the data they can provide ✓ /
 get permission from hospitals / maternity homes
 Get permission from the mothers to use the data ✓
 Decide how large the sample should be / sample size ✓
 Make sure the sample includes expectant mothers of various ages ✓
 Decide on how they will record the data ✓
 Decide on the time period they will use to gather data ✓
- 1.2 Age of the mother ✓
- 1.3 Number of babies born with Down syndrome ✓
- 1.4 Conduct the survey over more than one year ✓ / repeat the survey
 Use more than 5 000 births ✓ / increase the sample size
- 1.5 The older the mother, the higher the risk of having a baby with Down syndrome ✓ ✓

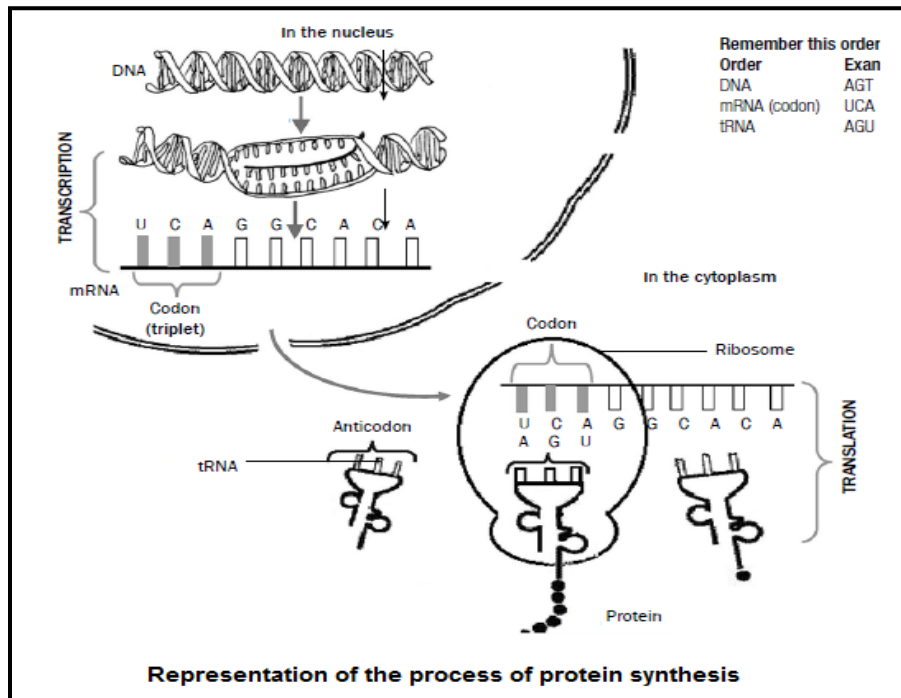
Type the following link <http://wcedportal.co.za/eresource/75361> in your browser OR scan the QR code below for more practice questions on scientific investigations:



PROTEIN SYNTHESIS



Protein synthesis is the process whereby proteins are made in living cells of an organism to form enzymes, hormones and new structures for cells. **Amino acids** are the basic building blocks of proteins. The nucleic acids DNA and RNA are involved in protein synthesis. The main steps of protein synthesis are **transcription** and **translation**.



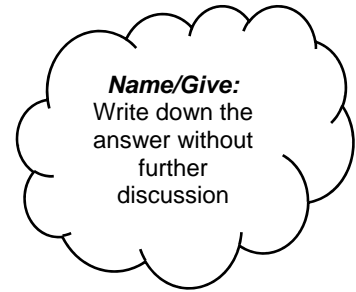
Question:

Name and **describe** the process occurring in the nucleus which results in the formation of an mRNA molecule.

Alternative question: **Describe** the process of *transcription*.

Answer:

The process is transcription✓
 The double helix DNA molecule unwinds✓
 When the hydrogen bonds break✓
 the DNA molecule unzips✓/2 DNA strands separate
 One strand is used as the template ✓to form mRNA
 using free RNA nucleotides✓from the nucleoplasm
 The mRNA is complementary to DNA✓/A-U, C-G
 This process is controlled by enzymes✓

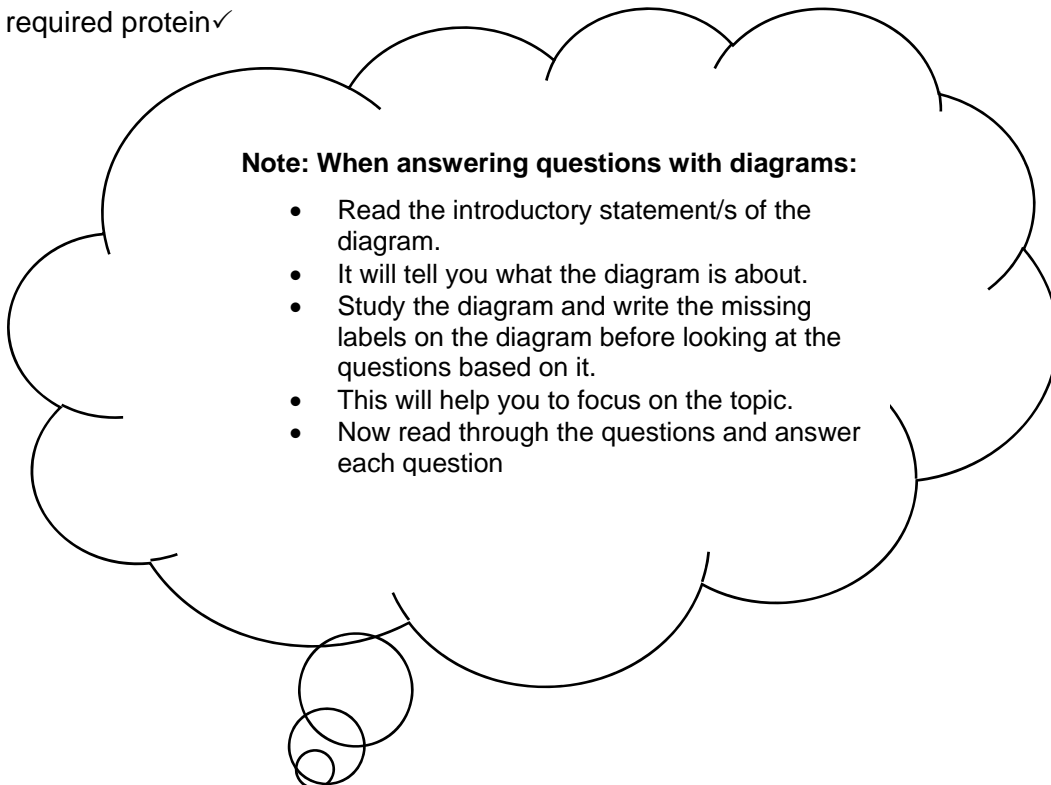
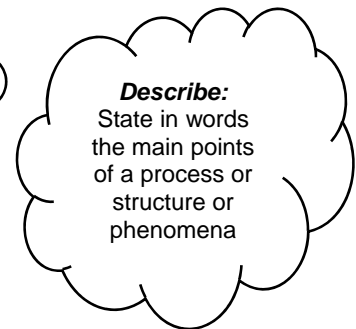


Question:

Describe the process of *translation*.

Answer:

Each tRNA carries a specific amino acid✓
 tRNA carries the amino acid to the ribosome✓
 When the anticodon on the tRNA✓
 matches the codon on the mRNA✓
 Amino acids become attached✓ in the sequence determined by the mRNA
 by peptide bonds✓
 to form the required protein✓



Question:

A species of bacteria contains a type of protein, called protein 1. A mutation occurred which resulted in the formation of a second type of protein called protein 2, instead of protein 1.

Scientists determined the amino acid sequence of each protein. They then used the amino acid sequence to find the DNA base sequences that coded for portions of these proteins.

The results are shown in the tables below.

PORTION OF PROTEIN 1				
AMINO ACID SEQUENCE	Lysine	Serine	Proline	Cysteine
DNA BASE SEQUENCE	TTT	TCA	GGT	ACG

PORTION OF PROTEIN 2				
AMINO ACID SEQUENCE	Lysine	Serine	Proline	Tryptophan
DNA BASE SEQUENCE	TTT	TCA	GGT	ACC

1. **Give** the DNA triplet for the third amino acid from the left in the sequence for protein 2. (1)
2. **Give** the codon for lysine. (1)
3. **Give** the anticodon for serine (1)
4. **Describe** how the mutation caused a change in the structure of the protein. (4)

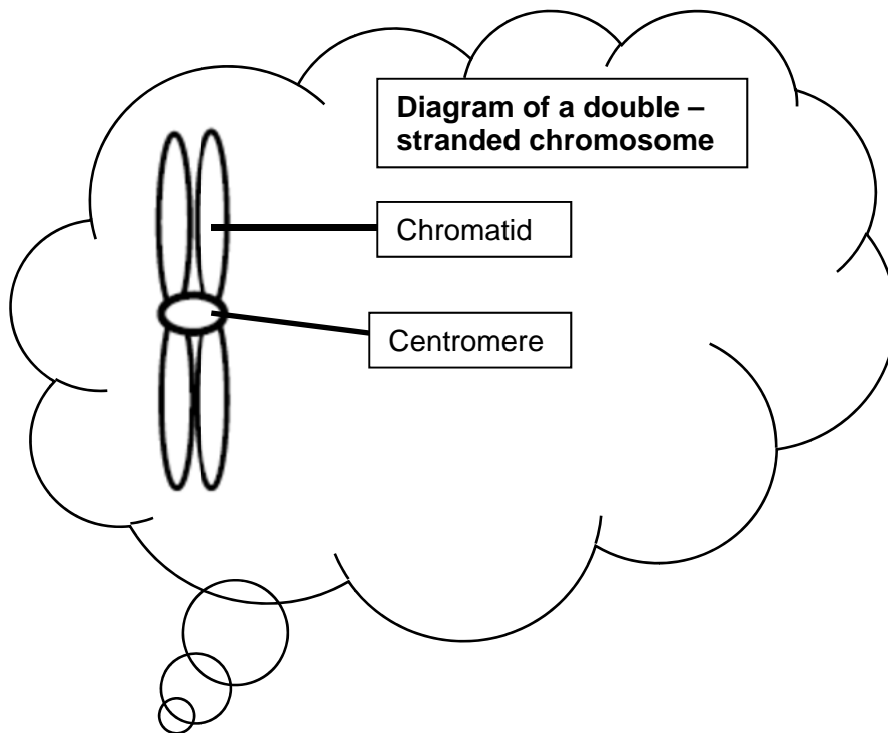
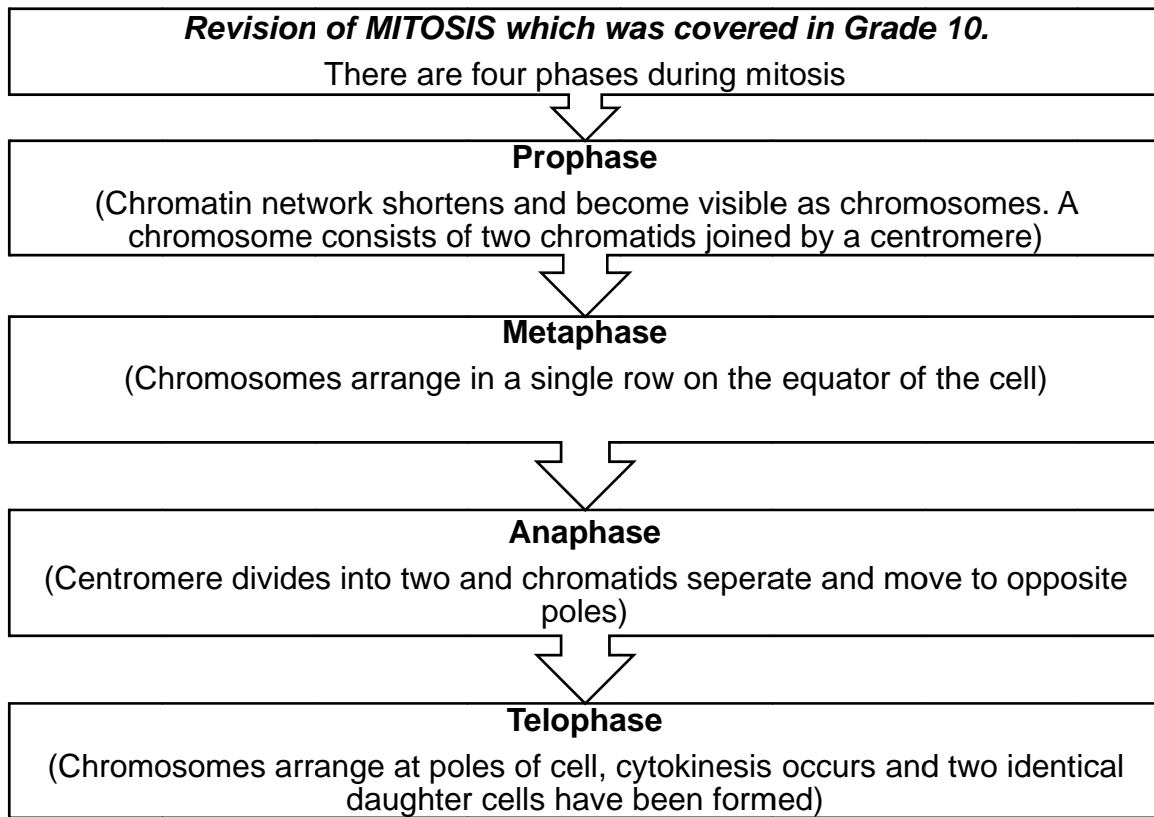
Answers:

1. GGT✓
2. AAA✓
3. UCA✓
4. One of the base triplets on the DNA has changed✓
From ACG to ACC✓
The triplet ACG codes for the amino acid cysteine✓
The triplet ACC codes for the amino acid tryptophan✓
This result in a change in the sequence✓ of amino acid

Copy the following link in your internet browser <http://wcedportal.co.za/eresource/75296> OR scan the QR code below and download more practice questions on protein synthesis:



MITOSIS AND MEIOSIS

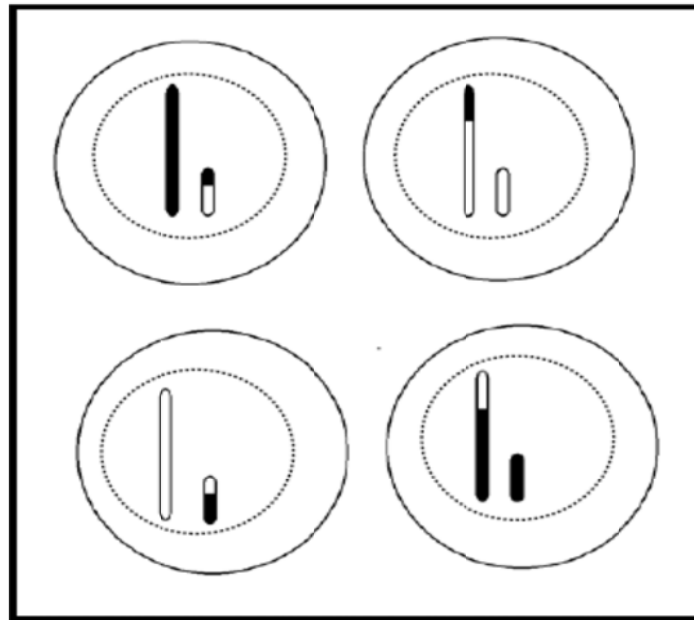


MEIOSIS:

Meiosis is a type of cell division whereby a diploid cell (somatic cell) undergoes divisions to form haploid cells (gametes or sex cells). It is a continuous process which is divided into the first meiotic division (Meiosis I) and the second meiotic division (meiosis II)

Questions:

1. Study the diagram of a phase during meiosis below.



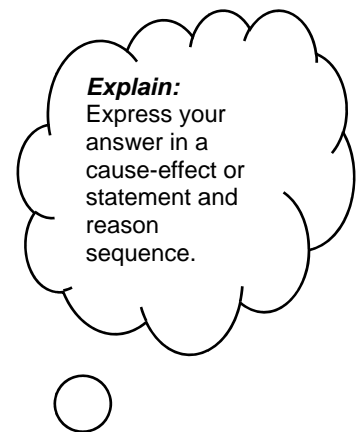
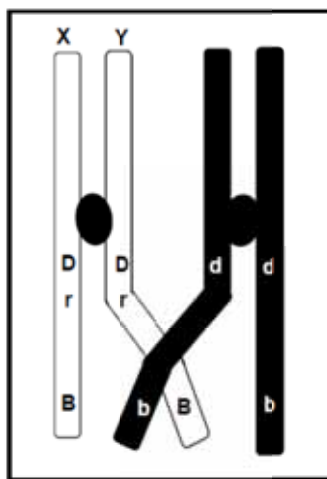
- 1.1 **Identify** the phase in the diagram above. (1)
- 1.2 **Give** TWO visible reasons for your answer to QUESTION 1.1. (2)
- 1.3 How many chromosomes:
- (a) are present in EACH cell in the diagram (1)
- (b) were present in the original cell at the start of meiosis (1)
- 1.4 The cells in the diagram are NOT identical.
- (a) **Name** TWO processes during meiosis that lead to the cells being different from one another. (2)
- (b) **Explain** the significance to a species of the cells being different from one another. (3)

Answers:

- 1.1 Telophase II ✓
- 1.2 There are 4 cells ✓
Each cell contains only a single set of un-replicated ✓ / single stranded chromosomes

- 1.3 (a) Two/2✓
 (b) Four✓/4/2 pairs
- 1.4 (a) Crossing over✓
 Random arrangement✓ of chromosomes on the equator
- (b) The gametes that form will be genetically different✓
 leading to variation in the offspring✓/increasing the gene pool
 This increases a species chances of survival✓

2. The diagram below shows crossing over during meiosis.

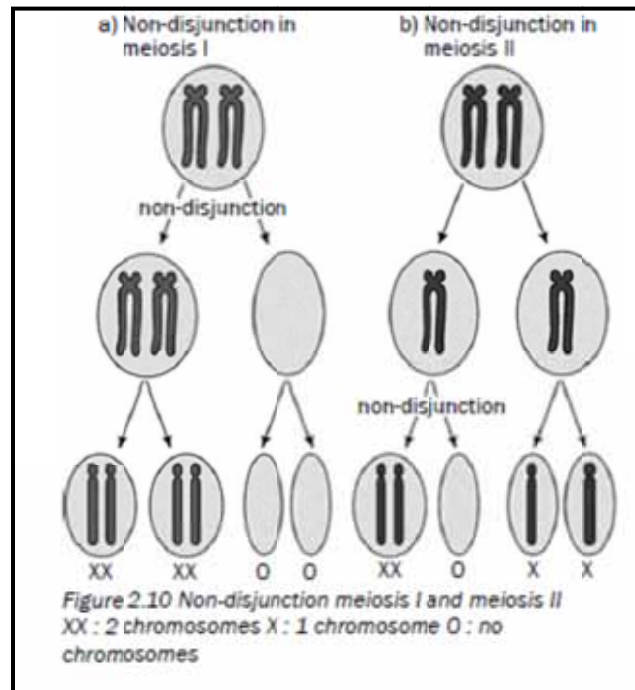


- 2.1 **Name** the phase of meiosis during which the process represented above takes place.
- 2.2 **Describe** the process of *crossing over*.
- 2.3 **Explain** the importance of crossing over.

(1)
 (3)
 (2)

Answers:

- 2.1 Prophase I ✓
- 2.2 Homologous chromosomes lie next to each other✓
 Chromatids overlap✓/touch at points called chiasmata✓
 and genetic information is exchanged✓/swapped
- 2.3 Crossing over introduces genetic variation✓ in gametes
 It may lead to new characteristics which are favourable✓
 or new characteristics which are unfavourable✓
 therefore affecting the chances of survival of the organism✓/ natural selection.

ABNORMAL MEIOSIS:

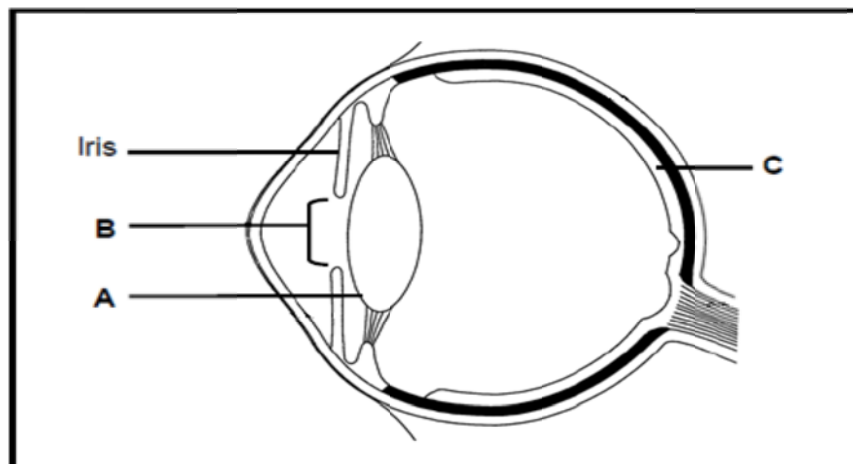
- Mistakes can occur during meiosis
- During Anaphase I one or more homologous pairs of chromosomes may not separate. Also called non-disjunction
- During Anaphase II sister chromatids of one or more chromosomes may not separate
- If there is non-disjunction of chromosome pair 21 in humans it leads to the formation of an abnormal gamete with an extra copy of chromosome 21
- If a normal gamete fuses with a gamete with an extra copy of chromosome 21 the resulting zygote will have 3 copies of chromosome 21 (47 chromosomes instead of 46)
- This leads to Down syndrome

Copy the following link in your internet browser <http://wcedportal.co.za/eresource/75301> OR scan the QR code below and download more practice questions on meiosis:

**SENSES (EYE AND EAR):**

Question:

1. The diagram below represents the structure of the human eye.



- 1.1 **State** ONE function of part:

- (a) A (1)
 (b) C (1)

- 1.2 Nocturnal animals sleep during the day and are active at night.

Explain how part:

- (a) **B** of nocturnal animals will differ from that found in animals that are active during the day (2)
 (b) **C** of nocturnal animals will differ from that found in animals that are active during the day (2)

- 1.3 **Describe** how the iris controls the amount of light entering the eye when a person is exposed to bright light. (4)

Answers:

- 1.1 (a) A Refraction of light✓ OR
 Focus light rays on the retina✓
 (b) C Converts light stimuli to impulses✓ OR
 Forms images✓

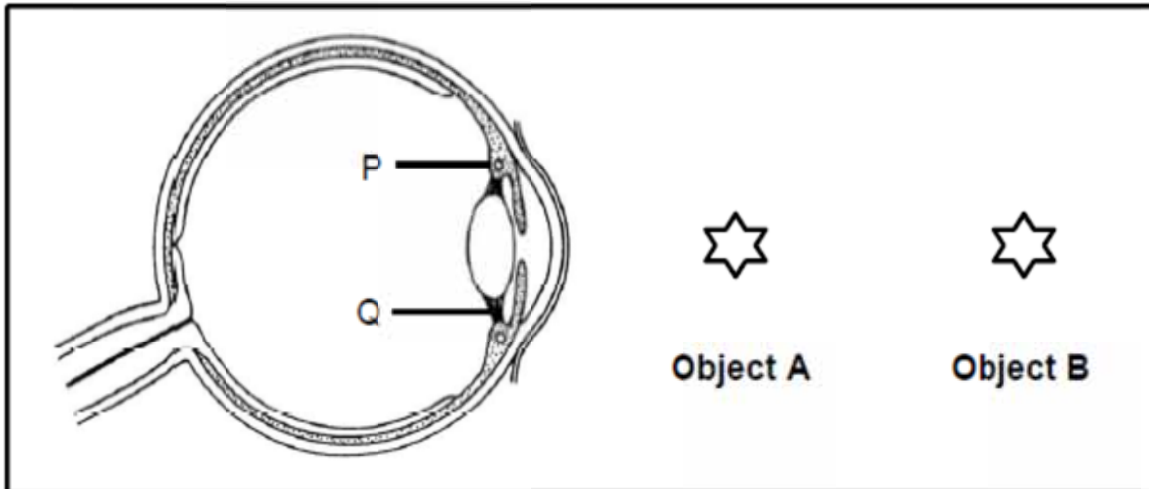
- 1.2 (a) The pupil/part B can dilate more✓
 to allow more light to enter the eye✓
 (b) The retina/part C has more rods✓
 enabling them to see in dim light✓

- 1.3 The radial muscles of the iris relax✓

Circular muscle of the iris contract✓
 The pupil constricts✓
 and less light enters the eye✓

Question:

2. The diagram below represents a human eye when the person is looking at an object that is 6 meters away. Object **A** is placed 3 meters away and Object **B** is placed 8 meters away.



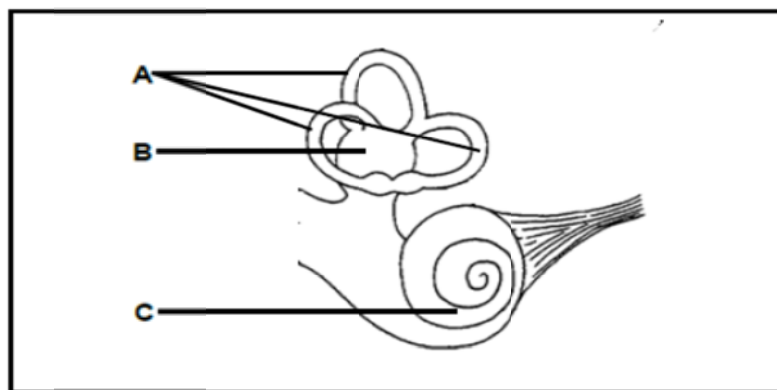
- 2.1 **Explain** the role of structures **P** and **Q** to ensure a clear image if the person moves his focus from object **B** to object **A**. (6)

Answer:

- 2.1 **P**/Ciliary muscles contract✓
 Ciliary body moves closer to lens✓
Q/Suspensory ligaments slacken✓
 Tension on the lens decreases✓
 Convexity of lens increases/lens become more convex✓
 Incoming light rays are refracted more✓

Question:

3. The diagram below represents a part of the human ear.



- 3.1 **Name** the part of the brain that receives impulses from:

- (a) Parts A and B (1)
 (b) Part C (1)
 3.2 **Name** the receptor found in part **C**. (1)
 3.3 **Explain** TWO ways in which part **A** in the diagram is structurally suited to maintain balance. (4)

Answers:

- 3.1 (a) Cerebellum✓
 (b) Cerebrum✓
 3.2 Organ of Corti✓
 3.3 The semi-circular canals/part **A** contain fluid✓/endolymph which moves when the person moves✓
 There are cristae✓ present which convert the stimulus to an impulse✓/are sensitive to the movement of the fluid
 The canals lie on three different planes✓ to detect movement in any direction✓

Question:

4. While walking in the bush a boy hears a sound which he thinks is the roar of a lion. He immediately runs to safety. Describe how he hears the sound.

Answer:

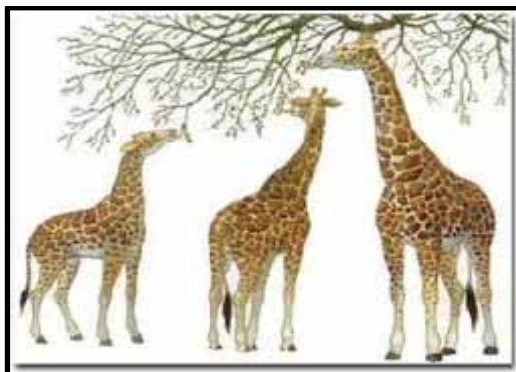
4. The pinna traps/directs the **sound waves**✓ into the ear canal✓/meatus
 This causes the tympanic membrane to **vibrate**✓
 The **vibration** is transmitted to the auditory ossicles✓
 The ossicles amplify the **vibration**✓ and transmit it to the oval window✓
 The oval window **vibrates**✓ creating **waves**✓ in the fluid/endolymph of the cochlea✓ which stimulates the Organ of Corti✓ to convert the wave into an impulse✓
 The impulse travels along the auditory nerve✓ to the cerebrum✓ where sound is interpreted

NATURAL SELECTION, PUNCTUATED EQUILIBRIUM AND SPECIATION

Copy the following link in your internet browser <http://wcedportal.co.za/eresource/75306> OR scan the QR code below and download more practice questions on natural selection and speciation:

Jean-Baptiste de Lamarck used two 'laws' to explain evolution

- **'Law' of use and disuse** – the more an organism uses a muscle or an organ the stronger the muscle or organ will developed. Muscle and organ that were not used would simply disappear after several generations.
- **'Law' of the inheritance of acquired characteristics** – the stronger muscle acquired in the organism's life time will be passed on to the next generation.



Lamarck's approach using the giraffe as an example:

- All giraffes had short necks originally
- Giraffes frequently stretched/used their necks to reach for leaves of tall trees
- causing their necks to become longer
- The characteristics of long necks acquired in this way
- was then passed on to the next generation
- forming offspring with longer necks than the generation before

Why Lamarck's theory is not acceptable?

- Acquired characteristics cannot be passed from one generation to the next.
- Organisms do not evolve because they want to evolve/Lamarck's theory is deterministic

Charles Darwin's theory of evolution by natural selection using the giraffe as an example

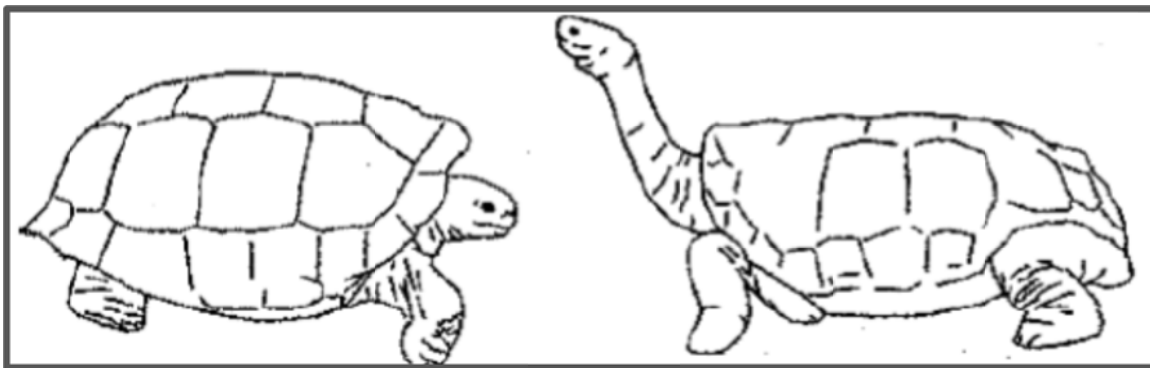
- There is a great deal of genetic variation in the giraffe population
- some giraffes have longer necks than others
- When there is a change in the environment/competition for resources
- the giraffes with shorter necks will die
- and those with longer necks will survive since they could reach the leaves of tall trees
- The giraffes with longer necks will pass on the allele for longer necks to their offspring
- In this way each the next generation of giraffes have a higher proportion of individuals with long necks.

Punctuated Equilibrium explains the speed at which evolution takes place:

- Evolution involves long periods of time where species do not change or change gradually through natural selection (known as equilibrium).
- This alternates with (is punctuated by) short periods of time where rapid changes occur through natural selection
- during which new species may form in a short period of time.

SPECIATION THROUGH GEOGRAPHIC ISOLATION

There was variation in neck length in a population of Galapagos tortoises. The original population from the mainland was separated onto two islands with different environmental conditions. Many years later it was established that speciation of the tortoises had occurred.



Question:

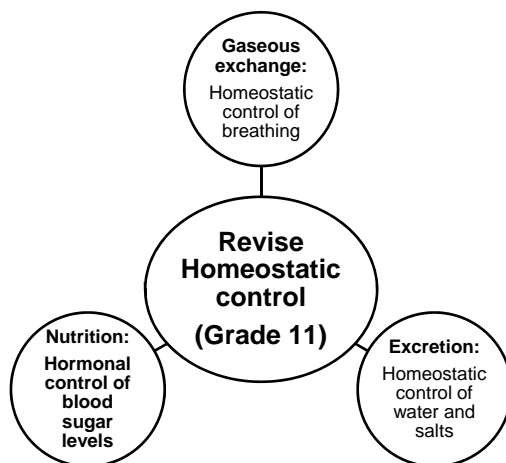
Describe the role of variation in the speciation of the Galapagos tortoises.

(8)

Answer:

Speciation occurred through geographical isolation ✓. The original population was separated by the sea ✓/a body of water and there was no gene flow ✓ between the two populations. There was variation in neck length within each population ✓. Each population was exposed to different environmental conditions ✓ and underwent natural selection independently ✓. Over a long period of time the two populations became different ✓ genotypically and phenotypically ✓.

When the two populations were mixed again ✓ they were unable to interbreed to produce **fertile offspring** ✓ thus indicating the formation of a new species ✓

HOMEOSTASIS

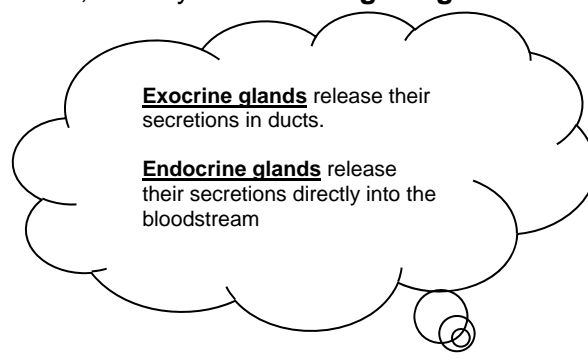
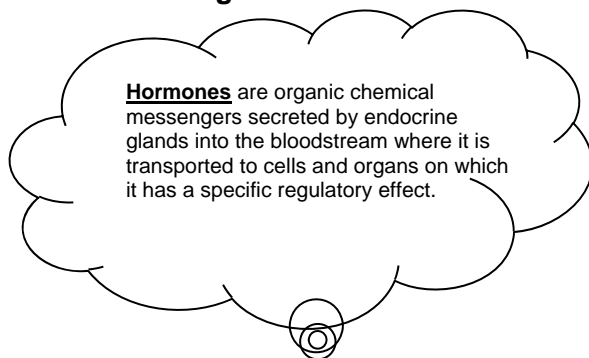
Homeostasis is the process of maintaining a constant internal environment within the body. The internal environment refers to the blood and tissue fluid that surrounds the cells of the body. Homeostasis enables the body to function efficiently, despite changes that might occur in the external or internal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

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**.

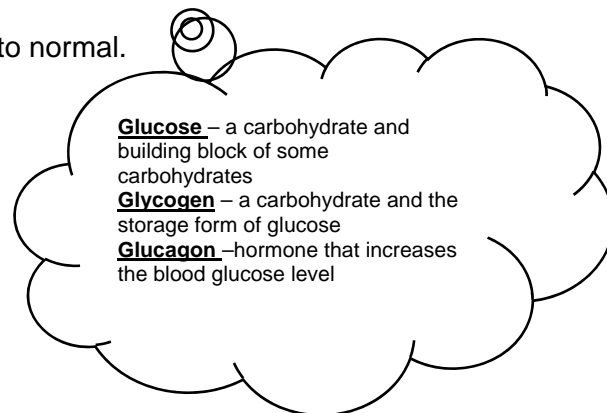


The pancreas is both an **exocrine** gland (secretes pancreatic juice into a pancreatic duct which opens in the duodenum) and **endocrine** gland (secretes the hormones namely, insulin and glucagon directly into the bloodstream).

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.

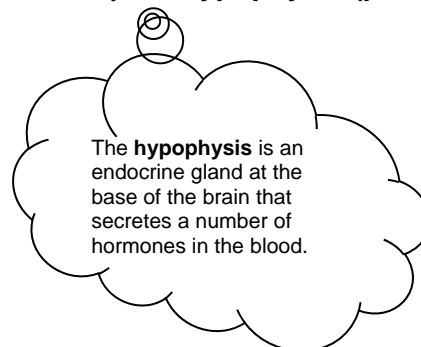
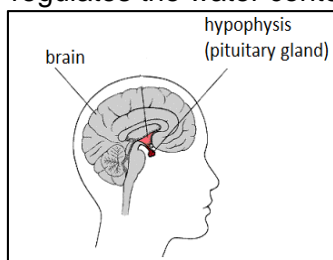


Homeostatic control of breathing

- 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

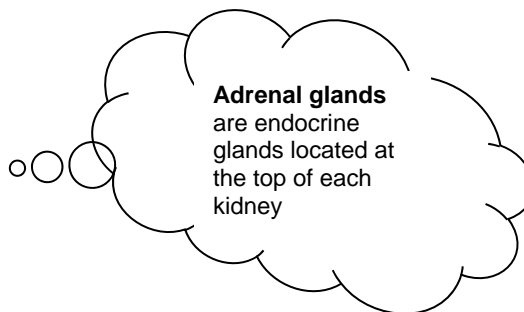
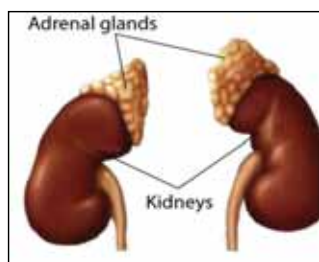
- The hypothalamus is stimulated and sends impulses to the hypophysis to secrete more ADH
- ADH travels in the blood to the kidneys and makes the walls of the distal convoluted tubules and collecting ducts more permeable to water
- More water is re-absorbed from the tubules and is passed to the surrounding 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**

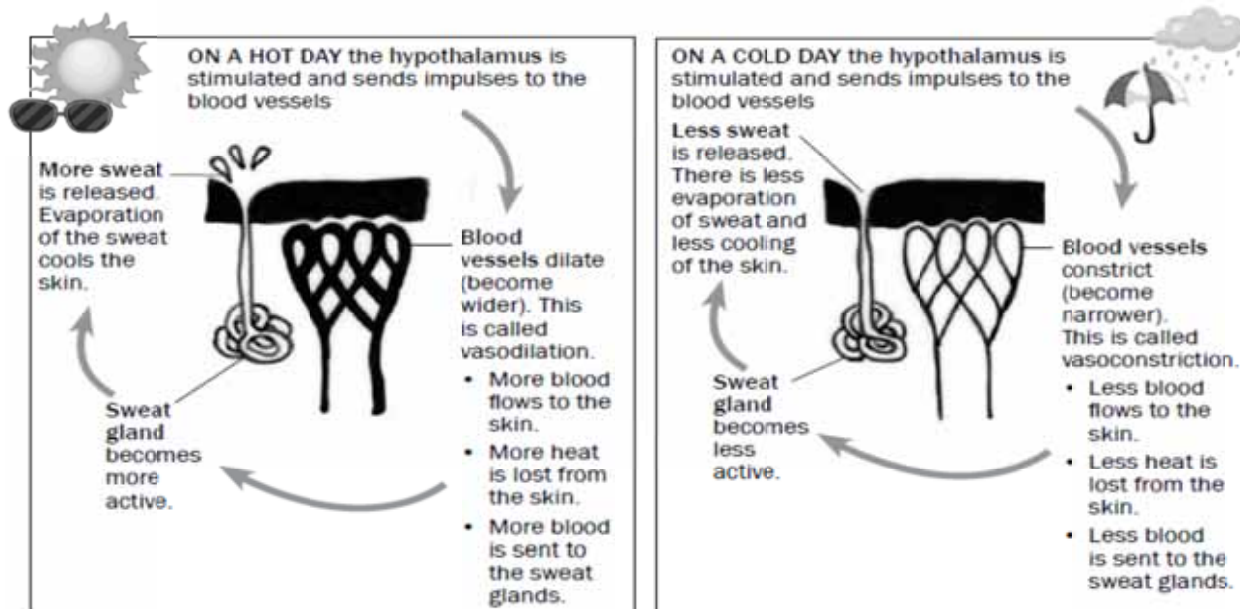
- The adrenal gland is stimulated to secrete more aldosterone
- Aldosterone increases the re-absorption of sodium ions from the distal convoluted tubules and collecting duct into the surrounding blood vessels
- The concentration of sodium ions in the blood vessels increases and returns to normal.

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.

The process of temperature regulation:

Role of **sweating**, **vasodilation** and **vasoconstriction** in negative feedback mechanism for controlling temperature/thermoregulation:

**Question:**

A man was accidentally locked in a cool room in which the temperature was 8 °C. He was only released after six hours when a co-worker heard his cries for help. Describe how his body maintained his temperature at 37 °C. (8)

Answer:

Body temperature is regulated by the hypothalamus ✓ of the brain
 The hypothalamus sends impulses to the blood vessels ✓ of the skin
 Blood vessels constrict ✓ (become narrow)/vasoconstriction occurs
 Less blood flows to the skin ✓
 Less heat is lost ✓ from the skin
 Less blood is sent to the sweat glands ✓
 Sweat glands become less active ✓/Less sweat is released
 There is less evaporation of sweat ✓ and less cooling of the skin ✓

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