



JENN

Training and Consultancy
The path to enlightened education

**LIFE SCIENCES
ENDOCRINE SYSTEM AND HOMEOSTASIS
GRADE 12
CONTENT MANUAL
TEACHER AND LEARNER
SPRING CLASSES**

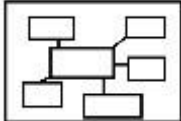





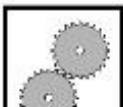

PAPER 1

TOPIC 1: ENDOCRINE SYSTEM

TOPIC 2: HOMEOSTASIS

2023

ICON DESCRIPTION

 MIND MAP	 EXAMINATION GUIDELINE	 CONTENTS	 ACTIVITIES
 BIBLIOGRAPHY	 TERMINOLOGY	 WORKED EXAMPLES	 STEPS

Topic	Mark Allocation in Paper	Study Date	Content
ENDODRINE SYSTEM AND HOMEOSTASIS P1	34 marks	Day 1	1. Pre – Test 2. Endocrine system
		Day 2	3. Homeostasis: Negative feedback mechanisms

LIFE SCIENCES PROGRAMME FOR 2023 WINTER CLASSES

GENERAL:

This paper is set according to the following types of questions:

The second row gives **SOME** examples of how questions could be stated for each question type.

Compare these examples with how questions are asked in previous papers.

Knowing Life Sciences (remembering) 40% of paper = 60 marks	Understanding Life Sciences 25% of paper = 37-38 marks	Applying Life Sciences Knowledge 20% of paper = 30 marks	Evaluating, Analyzing and Synthesizing Life Sciences Knowledge 15% of paper = 22-23 marks
State ... Name ... Give ... Label ... Describe ...	Explain ... Compare ... Draw ... Calculate (eg % of ...)	Draw a ... graph of ... Interpret ... How would you explain the phenomenon by using ... (eg natural selection)	Discuss ... Analyze ... hypothesis ... planning steps validity of ... reliability of ... conclusion... Predict ... dependent variable independent variable ...

CONTENTS**PAGES**

1. Examination guidelines	4
2. Outcomes	5
3. Revision guidelines	5 - 6
4. Terminology	6 - 7
5. Endocrine system	7 – 11
6. Homeostasis and Examination guidelines	11
7. Homeostasis and Negative feedback mechanisms	11 – 17
8. Thermoregulation	18 – 19
9. Thyroid gland disorder	20 – 21
10. Bibliography	22



1. Examination guidelines 2021 *(Learners should be provided with the official 2021 Examination Guidelines before a particular topic is taught.)*

ENDOCRINE SYSTEM AND HOMEOSTASIS

Paper 1: 34 marks

Term 2 and 3

2½ weeks

CONTENT	ELABORATION
Endocrine system	<ul style="list-style-type: none">□ Difference between an endocrine and an exocrine gland□ Definition of a hormone□ Location of each of the following glands, using a diagram, the hormones they secrete and function(s) of each hormone:<ul style="list-style-type: none">• Hypothalamus (ADH)• Pituitary/Hypophysis (GH, TSH, FSH, LH, prolactin)• Thyroid glands (thyroxin)• Islets of Langerhans in the pancreas (insulin, glucagon)• Adrenal glands (adrenalin, aldosterone)• Ovary (oestrogen, progesterone)• Testis (testosterone)
Introduction – Homeostasis	<ul style="list-style-type: none">□ Homeostasis as the process of maintaining a constant, internal environment within narrow limits, despite changes that take place internally and externally.□ The conditions within cells depend on the conditions within the internal environment (the tissue fluid)□ Factors such as carbon dioxide, glucose, salt, water concentration, temperature and pH must be kept constant in the internal environment (tissue fluid)
Homeostasis: Negative feedback mechanisms	<ul style="list-style-type: none">□ Negative feedback mechanism controlling each of the following in the body:□ Thyroxin levels<ul style="list-style-type: none">• Blood glucose levels• Blood carbon dioxide levels• Water balance (osmoregulation)• Salt□ Disorders caused by an imbalance in levels of:<ul style="list-style-type: none">• Thyroxin – Goitre• Blood glucose – Diabetes mellitus



2. Outcomes

By the end of this lesson learners should be able to:

Define a Hormone

- ✓ Differentiate between endocrine glands and exocrine glands
- ✓ Location of hormonal glands, the hormones they secrete and their functions.
- ✓ Define Homeostasis
- ✓ Define negative feedback
- ✓ Negative feedback of TSH and thyroxin, insulin and glucagon, carbon dioxide, water and salts.



3.Revision guidelines

P1	HUMAN ENDOCRINE SYSTEM & HOMEOSTASIS IN HUMANS (34 marks)	Glands and the hormones they secrete + functions	1. Location of each of the following glands, using a diagram, the hormones they secrete and function(s) of each hormone: <ul style="list-style-type: none">▪ Hypothalamus (ADH)▪ Pituitary (GH, TSH, FSH, LH, prolactin)▪ Thyroid glands (thyroxin)▪ Islets of Langerhans in the pancreas (insulin, glucagon)▪ Adrenal glands (adrenalin, aldosterone)▪ Ovary (oestrogen, progesterone)▪ Testis (testosterone)▪ Disorders: Diabetes mellitus & Goitre
		Negative feedback	2. Basic explanation of negative feedback when levels of the following are high/low and must return to normal: <ul style="list-style-type: none">▪ Glucose▪ Thyroxin▪ Carbon dioxide▪ Water▪ Salts

		Thermoregulation	<ul style="list-style-type: none"> • The role of parts of the skin on hot and cold days • Refer to the role of capillaries in the surface of the skin (vasodilation and vasoconstriction) Emphasise: • Blood moves to the skin surface and NOT veins • Heat is released by CAPILLARIES and SWEAT from sweat pores. • Sweat gland becomes more active not the sweat pores.
--	--	------------------	--

T 4. Terminology

endocrine system	a system responsible for chemical co-ordination and regulation of various activities in the body
homeostasis	a process of maintaining a constant internal environment (blood and tissue fluid) within the body.
hormones	chemical messengers in the body. they travel in the bloodstream and cause an effect elsewhere in the body
negative feedback	operate in the human body to detect changes or imbalances in the internal environment and to restore balance
osmoregulation	regulation of the water balance in the internal environment
osmotic pressure	a measure of the concentration of solutes (e.g. salt, glucose) present in a solution; this may determine whether a cell loses or gains water
antagonistically	to work in opposite ways; if one hormone causes an increase of a substance, the other hormone will cause a decrease of that substance, e.g. insulin and glucagon
thermoregulation	the control of the body temperature to keep it as close to 37°C as possible
endothermic	relates to an organism that generates heat internally through a metabolic process to maintain a constant body temperature
vasoconstriction	narrowing of blood vessels
vasodilation	widening of blood vessels
evaporation	heat loss when sweat changes into water vapor on the surface of the skin

conduction	transfer of heat between objects which are in contact
convection	as warm air rises it is replaced by cooler air
radiation	heat transfer between two objects which are not in contact



5. Endocrine system

Table 1: Exocrine and endocrine glands – the main differences

Exocrine glands	Endocrine glands
<ul style="list-style-type: none"> ➤ have ducts secretions released into a cavity or on a surface. ➤ <i>Examples:</i> salivary glands (saliva), sweat glands(sweat) 	<ul style="list-style-type: none"> ➤ ductless hormones released into the bloodstream. ➤ <i>Examples:</i> pituitary (ADH), thyroid TSH), pancreas (insulin)

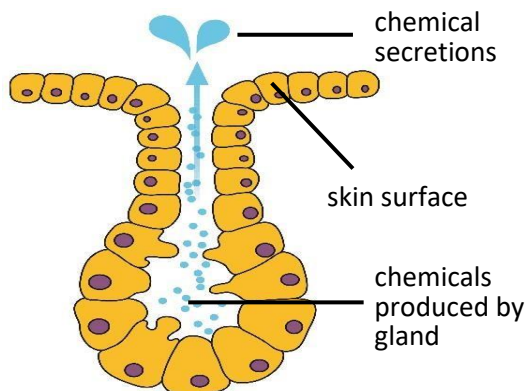


Figure 1: Exocrine gland

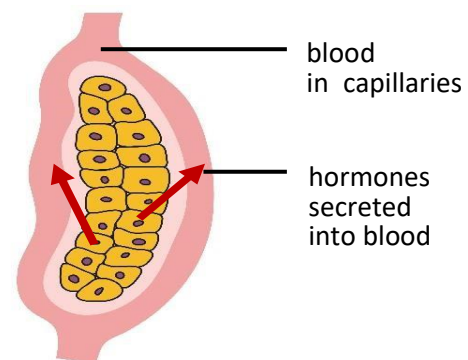


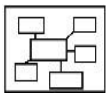
Figure 2: Endocrine gland



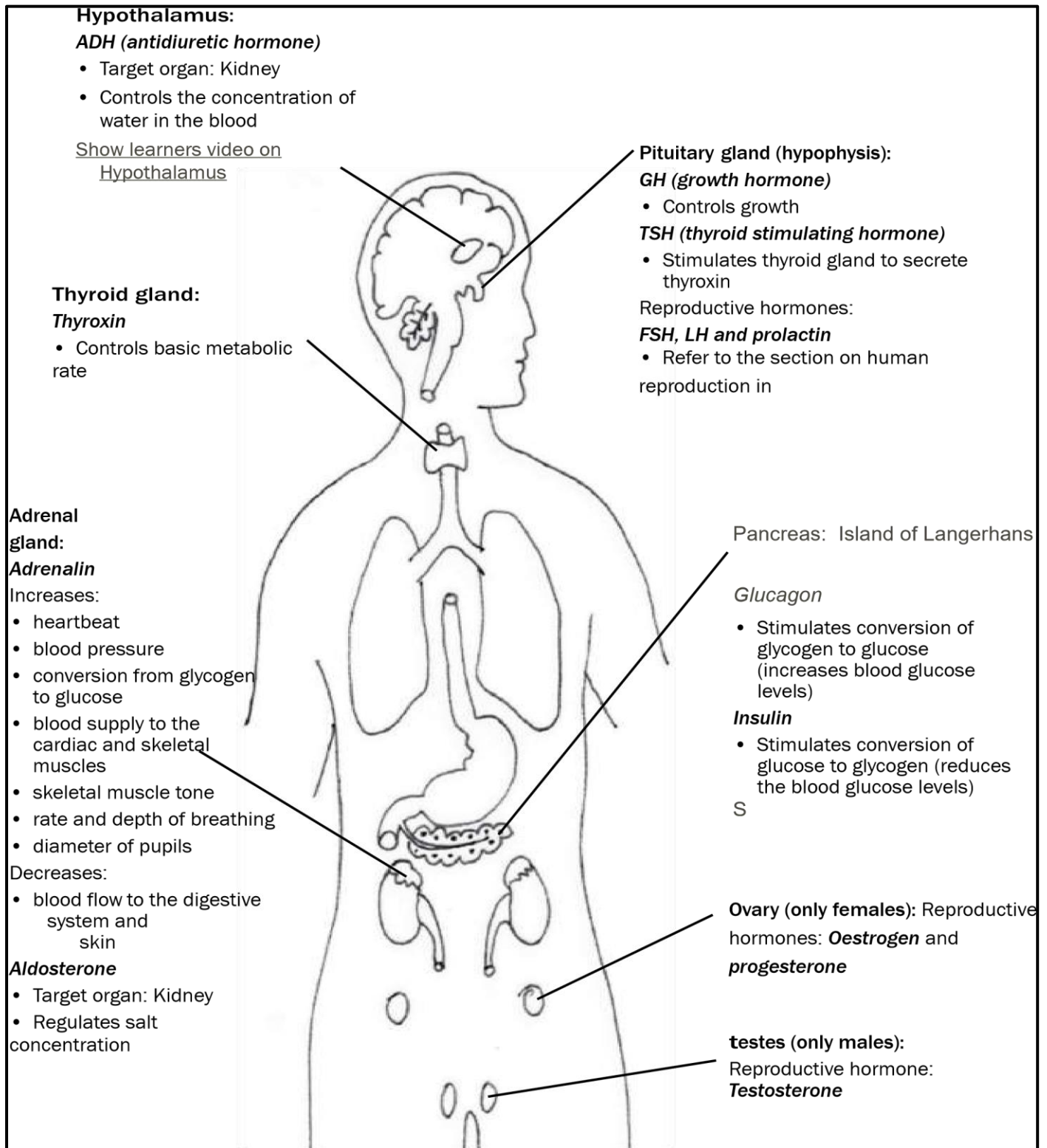
6. Definition of a hormone

Hormones are organic chemical messengers, most are proteins others are steroids

And they are secreted in small quantities.



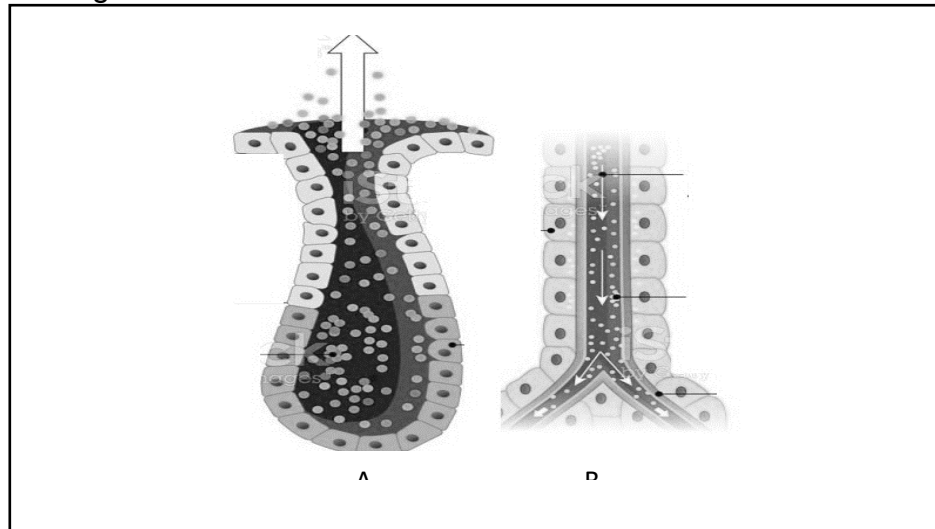
7. Mind Map: The location and functions of the different hormones.



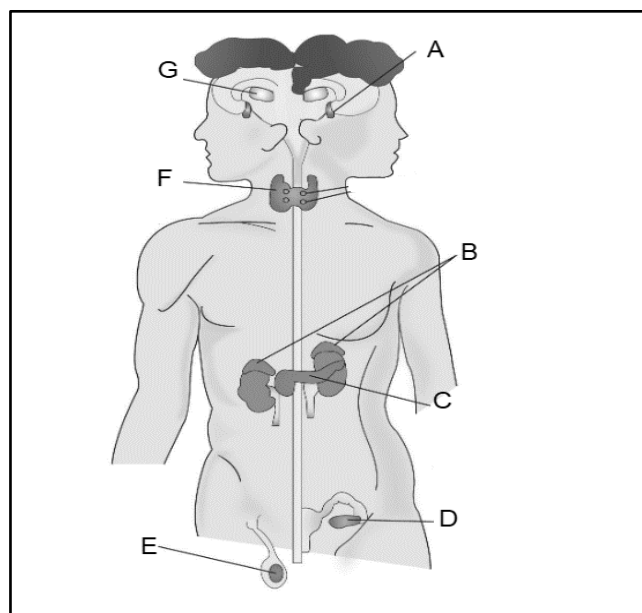


ACTIVITY 1:(Hormones)

1. Study the diagrams below



- 1.1 Explain the term hormone. (2)
 - 1.2 A is an exocrine gland and B a Endocrine gland differentiate between these two glands. (4)
 - 1.3 Tabulate 5 differences between the endocrine and nervous system. (10)
- 2 Use the diagram below, and complete the table that follows after the diagram.



Endocrine gland	Hormone	Target organ	Function of hormone
A			
B			
C			
D			
E			
F			
G			



ACTIVITY 2: (Negative feedback TSH and Thyroxin)

2.1 Study the following passage and answer the questions that follow.

Messenger substances are produced in endocrine glands of the human body and then transported to other parts of the body where they are involved in regulating the activity of particular parts. Slow, sustained or ongoing responses to these substances complement or support the other more rapid and short-lived responses of the body.

2.1.1 Write a scientific name for each of the following phrases taken from the passage:

(a) Messenger substances (1)

(b) Particular parts whose activities are regulated (1)

2.1.2 Name ONE system in the human body involved in co-ordination. (1)

2.1.3 Tabulate TWO differences between the way in which the systems named in QUESTION 2.1.2 operate. (5)

(8)



ACTIVITY 3

3.1. Answer the following questions on hormones.

3.1.1 Name the endocrine gland which secretes each of the following:

(a) TSH (1)

(b) Adrenalin (1)

(c) Thyroxin (1)

(d) Growth hormone (1)

3.1.2 It was found that the thyroxine concentration of a healthy adult remained very low for a period of three months.

- (a) Will the person gain or lose weight if he continued with his normal diet during this period? (1)
- (b) Explain your answer in QUESTION 3.1.2 (a). (3)
- (8)



8. Homeostasis: Negative feedback mechanisms

9. Examination guideline

Introduction – Homeostasis	<ul style="list-style-type: none"> ❑ Homeostasis as the process of maintaining a constant, internal environment within narrow limits, despite changes that take place internally and externally. ❑ The conditions within cells depend on the conditions within the internal environment (the tissue fluid) ❑ Factors such as carbon dioxide, glucose, salt, water concentration, temperature and pH must be kept constant in the internal environment (tissue fluid)
Homeostasis: Negative feedback mechanisms	<ul style="list-style-type: none"> ❑ Negative feedback mechanism controlling each of the following in the body: <ul style="list-style-type: none"> • Thyroxine levels • Blood glucose levels • Blood carbon dioxide levels • Water balance (osmoregulation) • Salt ❑ Disorders caused by an imbalance in levels of: <ul style="list-style-type: none"> • Thyroxine – Goitre • Blood glucose – Diabetes mellitus



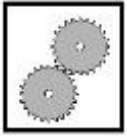
10. Negative Feedback

A negative feedback mechanism is an interaction between two hormones in which one hormone stimulates an increase in another hormone which then inhibits the first hormone, thus restoring balance.



The following is the general sequence of events in a negative feedback mechanism:

- Step 1: An imbalance is detected.**
- Step 2: A control centre is stimulated.**
- Step 3: Control centre responds.**
- Step 4: Message sent to target organ(s).**
- Step 5: The target organ responds.**
- Step 6: It opposes/reverses the imbalance.**
- Step 7: Balance is restored.**



EXAMPLE 1: Negative feedback mechanism using TSH and thyroxin

The pituitary gland is very sensitive to the thyroxin in blood.

The anterior pituitary secretes thyroid-stimulating hormone (TSH) when the level of thyroxin (hormone secreted by the thyroid) falls below optimum.

This hormone is carried to the thyroid and stimulates its cells to produce more thyroxin which is released in the blood.

As the concentration of thyroxin rises to an optimal level and still continues to rise, the thyroxin level inhibits the production of TSH.

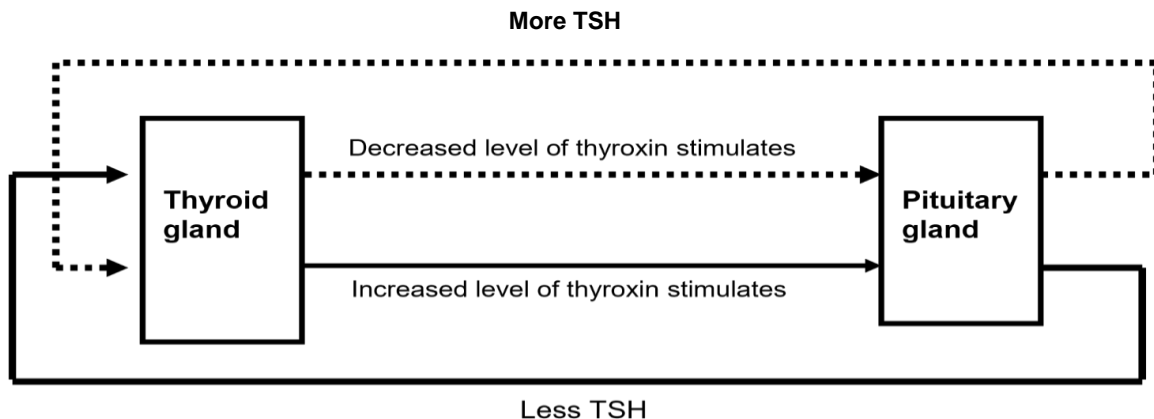
This causes reduced stimulation of the thyroid gland's cells and results in reduced production of thyroxin.

This is known as negative feedback

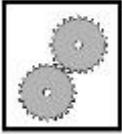


10.1. Negative feedback between TSH and Thyroxin

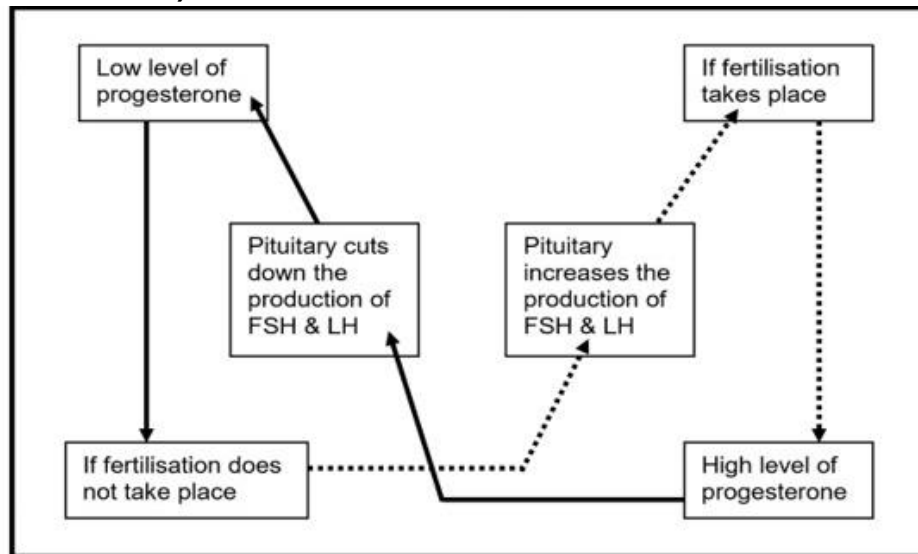
- When thyroxin levels are low
- the pituitary gland is stimulated
- to secrete more TSH
- which stimulates the Thyroid gland to secrete
- more thyroxin
- which causes an increase in metabolic rate
- to increase energy production
- When thyroxin levels are high
- the pituitary gland
- secretes less TSH
- which causes the thyroid gland to secrete
- less thyroxin



(Also learn Negative feedback between Insulin & Glucagon as well as between progesterone & FSH)



EXAMPLE 2: Negative feedback mechanism using the pituitary gland (hormones FSH and LH) and the ovaries



10.2. Control of blood glucose (Homeostasis)

□ High glucose levels

- When blood glucose levels rise **above** normal
- the pancreas / islets of Langerhans are stimulated to
- secrete more insulin into the blood
- which travels to the liver/ muscle cells
- and stimulates them to absorb more glucose from the blood
- and convert the excess glucose to glycogen
- which decreases the blood glucose levels

□ Low glucose levels

- When blood glucose levels drop below normal
- the pancreas/ islets of Langerhans are stimulated to
- secrete more glucagon into the blood
- which travels to the liver/ muscle cells
- and stimulates them to convert glycogen to glucose
- which increases the blood glucose levels



ACTIVITY4:(Disorders caused by under- and over secretion of and insulin)

Diabetes type 1 versus Diabetes type 2

The main difference between the type 1 and type 2 diabetes is that type 1 diabetes is a genetic condition that often shows up early in life, and type 2 is mainly lifestyle-related and develops over time. With type 1 diabetes, your immune system is attacking and destroying the insulin-producing cells in your pancreas.

Although type 1 and type 2 diabetes both have things in common, there are lots of differences. Like what causes them, who they affect, and how you should manage them.

For a start, type 1 affects 8% of everyone with diabetes. While type 2 diabetes affects about 90%.

The main thing to remember is that both are as serious as each other. Having high blood glucose (or sugar) levels can lead to serious health complications, no matter whether you have type 1 or type 2 diabetes. So if you have either condition, you need to take the right steps to manage it.

- 5.1. What causes Diabetes? (1)
- 5.2. Which type of Diabetes is the most common type that appear among people? (1)
- 5.3. What is insulin? (1)
- 5.4. Name the insulin- producing cells in the pancreas? (1)
- 5.5. What can lead to Diabetes type 2? (1)
- 5.6. What is the symptoms of Diabetes type 1? (4)
- 5.7. Explain why doctors can use a urine to test for Diabetes. (3)
- 5.8. Name THREE ways in which Diabetes can be treated (3)
- 5.9. Name secondary risk factors that Diabetes can experience. (3)



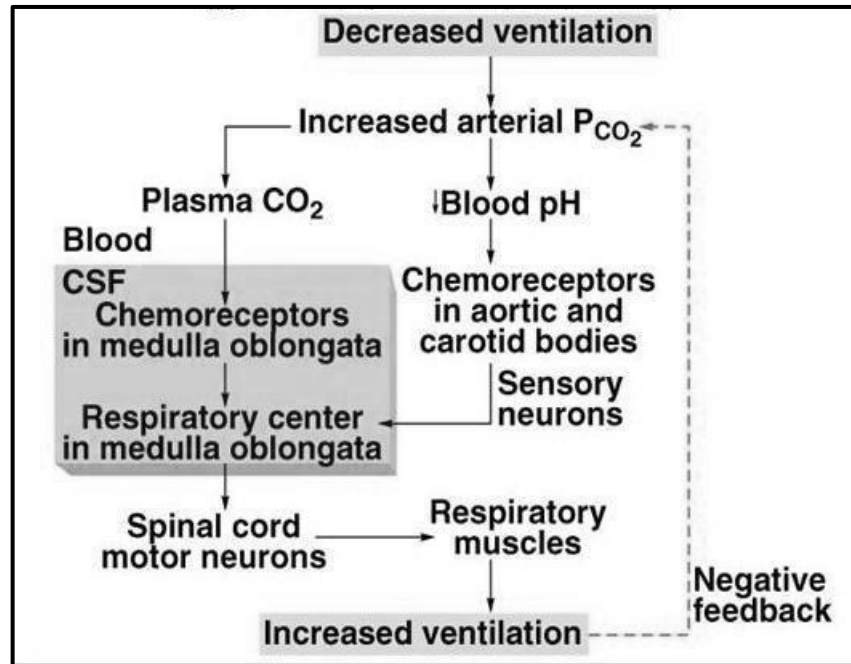
10.3.Control of CO₂ (Homeostasis)

- Receptor cells
- In the carotid artery/aorta are stimulated
- to send impulses to the medulla oblongata in the brain
- which then stimulates the heart
- to beat faster
- and the breathing muscles (diaphragm, intercostal and abdominal)
- to contract more actively
- thus, increasing the rate and depth of breathing
- More CO₂ is taken to and exhaled from the lungs
- The blood CO₂ returns to normal



ACTIVITY 5: Negative Feedback of maintaining carbon dioxide

3.1. Study the diagram



5.2 Use the information in the diagram and explain in your words negative feedback of CO_2 (14)



10.4. Osmoregulation (low water levels in blood)

- Due to dehydration/exercise/ sweating
- osmoreceptors in the hypothalamus are stimulated
- An impulse is sent to the pituitary gland
- and more ADH is secreted
- The ADH causes walls of the renal tubules
- to become more permeable to water
- More water is reabsorbed
- and the blood volume increases
- Less urine is produced
- and the urine is more concentrated



10.5. Osmoregulation for high water levels in blood - just the opposite reactions Salt balance and the role of Aldosterone

- When sodium (salt) levels are low in the blood
- the adrenal glands are stimulated
- to secrete more aldosterone
- which causes the walls of the renal tubules
- to become more permeable
- allowing for a greater reabsorption of sodium ions
- from the filtrate into the blood capillaries
- and a decreased excretion of sodium ions
- from the blood into the filtrate

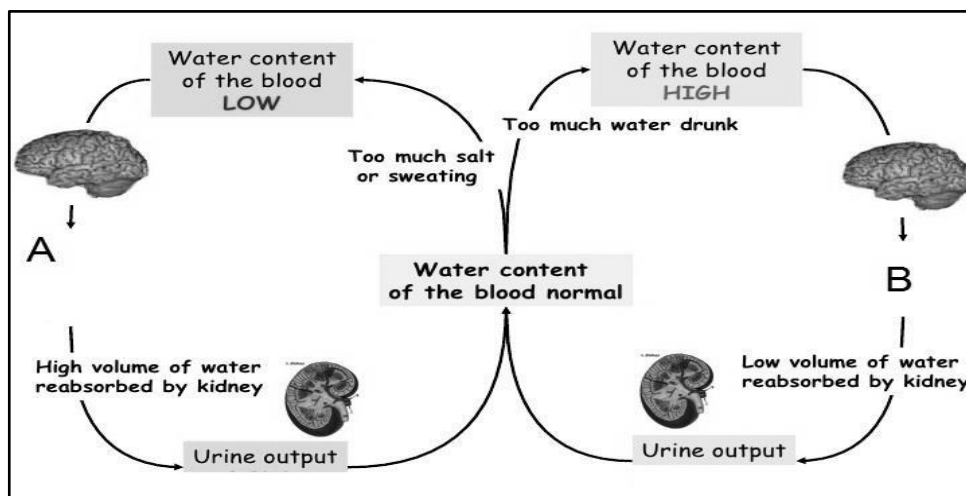


10.6. For high salt concentration - just the opposite reactions thermoregulation (during exercise or high environmental temperatures)

- Increased respiration (as a result of exercise)
- causes increased body temperature
- Hypothalamus is stimulated which
- sends impulses to the muscle layer in the walls of the skin's blood vessels
- This leads to the dilation of blood vessels/vasodilation
- and more blood flows to the skin
- More heat is lost by radiation
- More blood flows to the sweat glands
- which become more active/produce more sweat
- to lower the body temperature

? ACTIVITY 6: Negative Feedback of maintaining and water and salt concentration)

6.1. Study the diagram below and answer the questions



6.1. Process **A**

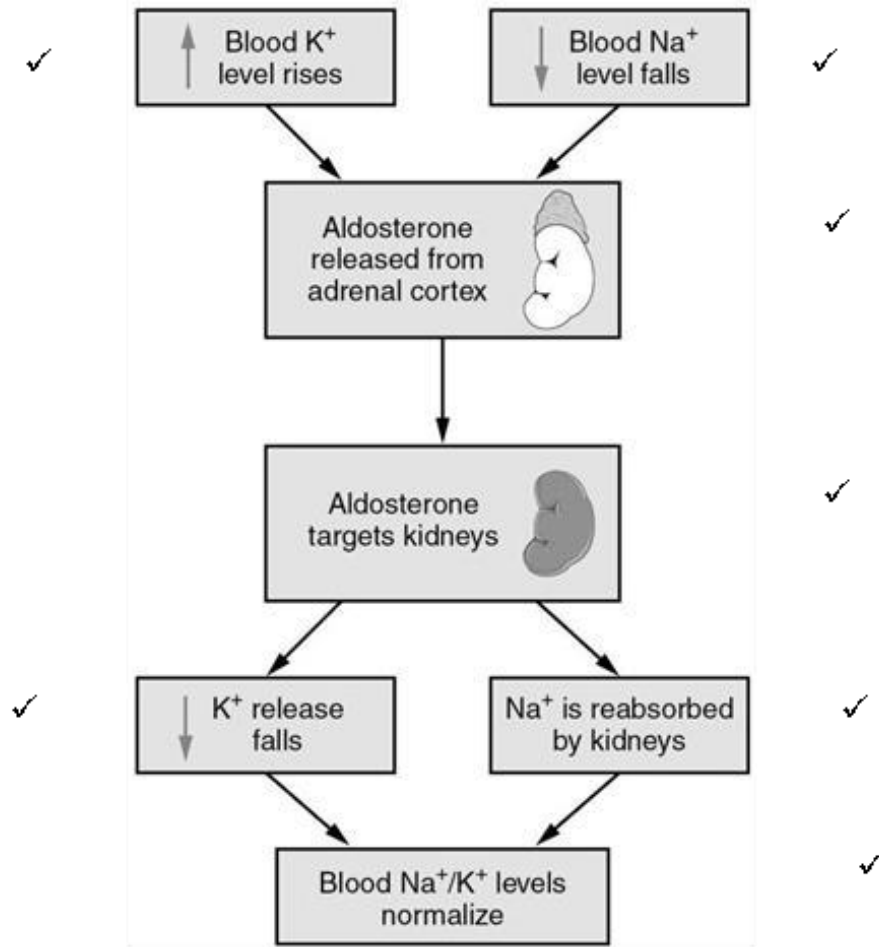
(1)

6.2. Process **B**

(1)

6.3. What is the urine output respectively at **A** and **B**? Give reasons for your answer. (4)

6.4. Describe the negative feedback of salts in the human body by means of a flow diagram: (7)





10.7. Thermoregulation (in a cold environment - opposite reactions)

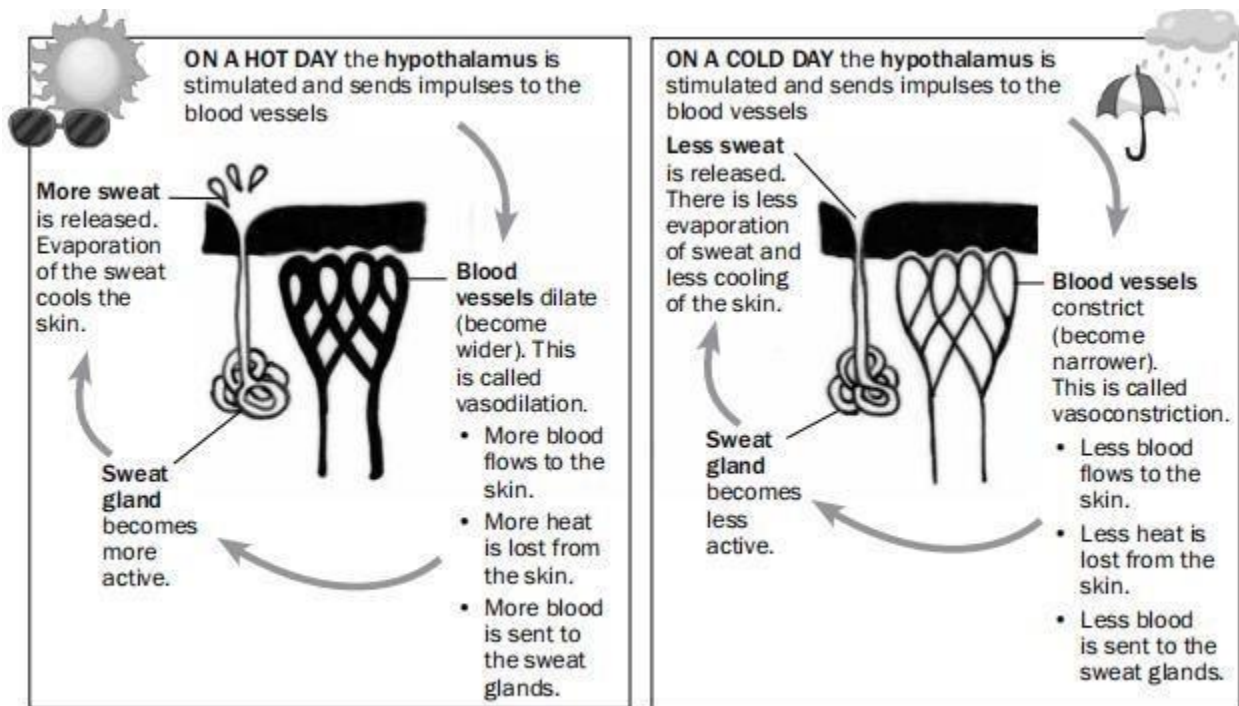
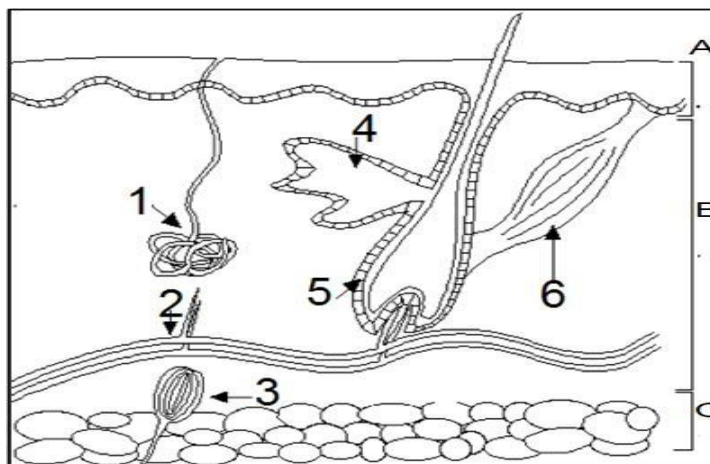


Figure 8.4 The homeostatic mechanism to regulate body temperature



ACTIVITY 7: Temperature regulation

- 7.1. Define the term *homeostasis*. (2)
- 7.2. Name SIX important matters in our bodies that must be kept constant. (6)
- 7.3. Study the diagram below and answer the questions that follow



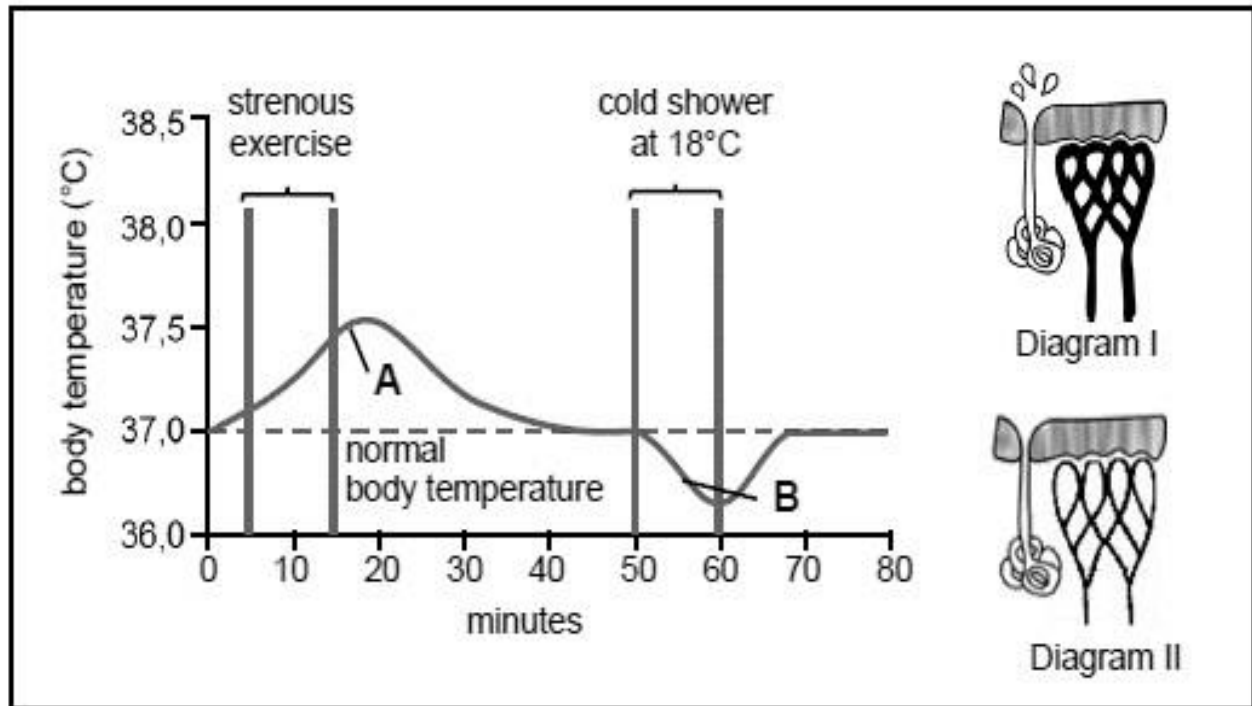
7.3.1. Identify the following labels on the diagram:

(9)

7.3.2. Name THREE adaptations of the skin for thermoregulation.

(3)

7.4. Study the diagram and answer the questions follow.



7.4.1. What is the normal body temperature for humans?

(1)

7.4.2. The term use to describe the body's ability to regulate temperature.

(1)

7.4.3. Which part of the brain react to temperature changes taking place between A and B on the graph?

(1)

7.4.4. What is the maximum temperature reached?

(1)

7.4.5. For what duration is the person exposed to strenuous excersize?

(1)

7.4.6. Differentiate between process **A** and **B**.

(8)







10.8. Thyroid gland disorders

The continued production of too much thyroxin is known as **hyperthyroidism** (hyper = high).

Continued low levels of thyroxin leads to **hypothyroidism** (hypo=low).

Thyroid gland disorders

	Hyperthyroidism	
<i>Examples</i>	Graves' disease (Figure 16A) 	Goitre (Figure 16B) 
<i>Causes</i>	autoimmune disease – which occurs when the immune system attacks the thyroid and causes it to overproduce the hormone thyroxin	goitre – condition linked to elevated thyroid activity
<i>Symptoms</i>	<ul style="list-style-type: none"> • bulging eyes • weight loss • fast metabolism 	<ul style="list-style-type: none"> • increased metabolic rate • increased cardio-vascular activity • increased anxiety • swollen thyroid gland in neck
	hypothyroidism	
<i>Examples</i>	Cretinism (Figure 16C) 	Myxoedema (Figure 16D) 
<i>Cause</i>	caused by lack of thyroxin from birth	caused by underactive thyroid gland in adulthood
<i>Symptom</i>	physical, mental retardation	<ul style="list-style-type: none"> • mental, physical tiredness • low metabolic rate • increase in dermal fat • roughening of skin

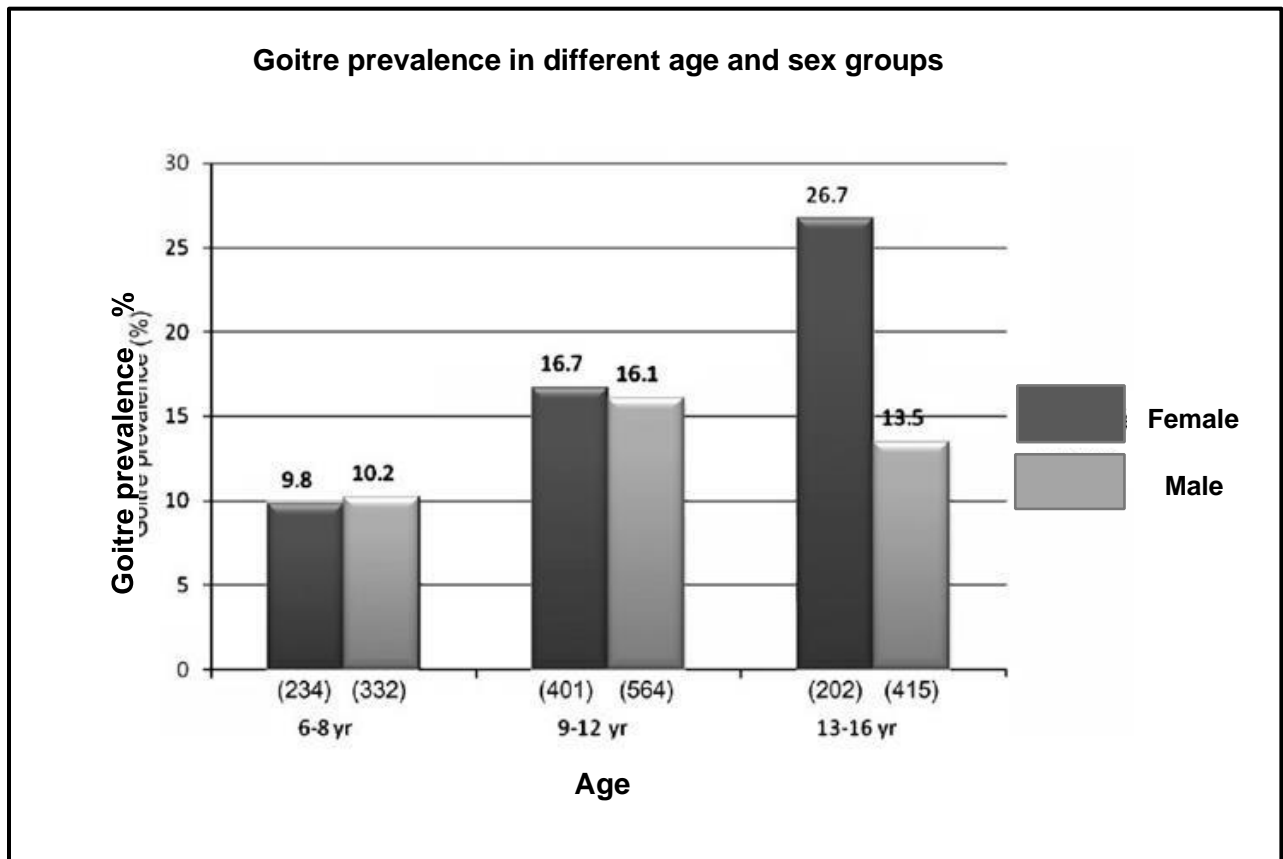


ACTIVITY 8: (Disorders caused by under- and over secretion of thyroxin)

Iodine deficiency is the most common cause of goitre. The body needs iodine to produce thyroid hormone. If you do not have enough iodine in your diet, the thyroid gets larger to try and capture all the iodine it can, so it can make the right amount of thyroid hormone.

Goitre may be associated with an irregular amount of thyroid hormone in your body (hyperthyroidism or hypothyroidism) or with normal levels of thyroid hormone.

The graph below shows the prevalence of goitre in different age groups and sex groups.



- 8.1 What is goitre? (1)
- 8.2. What is iodine? (1)
- 8.3. Why is the intake of Iodine necessary for humans? (2)
- 8.4. What is hyperthyroidism ? (1)

BIBLIOGRAPHY



Department of Basic Education – Life Sciences, Examination Guideline grade 12, 2023

Department of Basic Education, 2013 – 2023. The Curriculum Assessment and Policy Statement, National and Provincial question papers.

National Senior Certificate, 2022 diagnostic report.

How to teach Life Sciences, GRADE 12, TEACHER'S GUIDE TERM 2, MD Watson with assistance of: J Brümmer, A Esterhuizen, C van Heerden

<https://www.youtube.com/watch?v=SHgNaomqIRa>

https://www.youtube.com/watch?v=BugGCBAk_Os

Mind the Gap, Life Sciences, Grade 12, 7.1 – adapted.



JENN

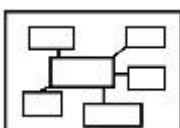





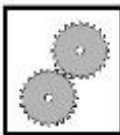

Training and Consultancy
The path to enlightened education

**LIFE SCIENCES
RESPONDING TO THE ENVIRONMENT (HUMANS)
GRADE 12
CONTENT MANUAL
TEACHER AND LEARNER
SPRING CLASSES
2023**

Nervous System

1. Type of nerves
2. Reflex Action
3. Eye and Ear

ICON DESCRIPTION

 MIND MAP	 EXAMINATION GUIDELINE	 CONTENTS	 ACTIVITIES
 BIBLIOGRAPHY	 TERMINOLOGY	 WORKED EXAMPLES	 STEPS

Topic	Mark Allocation in Paper	Study Date	Content
RESPONDING TO THE ENVIRONMENT (HUMANS) P1	54 marks	Day 3	4. Human nervous system: Cerebrum, cerebellum, corpus callosum, medulla oblongata, spinal cord, peripheral system (cranial & spinal nerves) Autonomic system (sympathetic & parasympathetic); neuron, reflex arc & reflex action; Alzheimer's disease, multiple sclerosis; injuries to nervous system; effect of drugs
		Day 4	5. Receptors: 1. Eye – structure & functions of parts; accommodation; pupil action; short- and long sightedness; astigmatism; cataracts 2. Ear – structure and functions of parts; how does the ear hear; balancing function of ear
		Day 5	Post Test

LIFE SCIENCES PROGRAMME FOR 2023 WINTER CLASSES

GENERAL:

This paper is set according to the following types of questions:

The second row gives SOME examples of how questions could be stated for each question type.

Compare these examples with how questions are asked in previous papers.

Knowing Life Sciences (remembering) 40% of paper = 60 marks	Understanding Life Sciences 25% of paper = 37-38 marks	Applying Life Sciences Knowledge 20% of paper = 30 marks	Evaluating, Analyzing and Synthesizing Life Sciences Knowledge 15% of paper = 22-23 marks
State ... Name ... Give ... Label ... Describe ...	Explain ... Compare ... Draw ... Calculate (eg % of ...)	Draw a ... graph of ... Interpret ... How would you explain the phenomenon by using ... (eg natural selection)	Discuss ... Analyze ... hypothesis ... planning steps validity of ... reliability of ... conclusion... Predict ... dependent variable independent variable ...



CONTENTS

PAGES

1. Examination guidelines	26 - 27
2. Out comes	28
3. Terminology	28 - 31
4. Human nervous system	31 - 33
5. Peripheral nervous system	33 - 37
6. Structure and functioning of a nerve	34 - 36
7. The simple reflex arc	38 - 41
8. Disorders of the CNS	41 - 42
9. Human eye	44 - 50
10. Human ear	50 - 55
11. Bibliography	56



JENN

Training and Consultancy
The path to enlightened education



1. EXAMINATION GUIDELINES

RESPONDING TO THE ENVIRONMENT (HUMANS) Paper 1: 54 marks	Term 2	4 weeks
--	---------------	----------------

CONTENT		ELABORATION
Introduction	<input type="checkbox"/>	The nervous system (involving nerves) and endocrine system (involving hormones) are two components that help humans respond to the environment
Human nervous system	<input type="checkbox"/>	The need for a nervous system in humans: <ul style="list-style-type: none"> • Reaction to stimuli (stimuli can be external and internal) • Coordination of the various activities of the body
Central nervous system	<input type="checkbox"/> <input type="checkbox"/>	The brain and spinal cord are protected by meninges. Location and functions of the following parts: <ul style="list-style-type: none"> • Brain • Cerebrum • Cerebellum • Corpus callosum o Medulla oblongata • Spinal cord
Peripheral nervous system	<input type="checkbox"/>	Location and functions of the peripheral nervous system (cranial and spinal nerves)
Autonomic nervous system	<input type="checkbox"/>	Location and functions of the autonomic nervous system (sympathetic and parasympathetic sections)
Structure and functioning of a nerve	<input type="checkbox"/> <input type="checkbox"/>	Nerves send and carry signals to and from all parts of the body and are made up of neurons (sensory or motor) Functions of sensory and motor neurons
	<input type="checkbox"/>	Structure and functions of parts of sensory and motor neurons, using diagrams: nucleus, cell body, cytoplasm, myelin sheath, axon and dendrites
The simple reflex arc	<input type="checkbox"/>	Definition of a reflex action and a reflex arc
	<input type="checkbox"/>	Structure of a reflex arc and functions of each part, using a diagram: receptor, sensory neuron, dorsal root of spinal nerve, spinal cord, interneuron, motor neuron, ventral root of spinal nerve, effector
	<input type="checkbox"/>	Functioning of a simple reflex action, using an example
	<input type="checkbox"/>	Significance of a reflex action
	<input type="checkbox"/>	Significance of synapses

Disorders of the CNS	<input type="checkbox"/>	Causes and symptoms of the following disorders of the nervous system: <ul style="list-style-type: none"> • Alzheimer's disease • Multiple sclerosis
Receptors	<input type="checkbox"/>	Functions of receptors, neurons, and effectors in responding to the environment
	<input type="checkbox"/>	The body responds to a variety of different stimuli, such as light, sound, touch, temperature, pressure, pain and chemicals (taste and smell). (No structure and names necessary except for names of the receptors in the eye and ear.)

CONTENT		ELABORATION
Human eye	<input type="checkbox"/>	Structure and functions of the parts of the human eye, using a diagram.
	<input type="checkbox"/>	Binocular vision and its importance
	<input type="checkbox"/>	The changes that occur in the human eye for each of the following, using diagrams: <ul style="list-style-type: none"> • Accommodation • Pupillary mechanism
	<input type="checkbox"/>	The nature and treatment of the following visual defects, using diagrams: <ul style="list-style-type: none"> • Short-sightedness • Long-sightedness • Astigmatism • Cataracts
Human ear	<input type="checkbox"/>	Structure of the human ear and the functions of the different parts, using a diagram
	<input type="checkbox"/>	Functioning of the human ear in: <ul style="list-style-type: none"> • Hearing (include the role of the organ of Corti, without details of its structure) • Balance (include the role of maculae and cristae, without details of their structure)
	<input type="checkbox"/>	Cause and treatment of the following hearing defects: <ul style="list-style-type: none"> • Middle ear infection (the use of grommets) • Deafness (the use of hearing aids and cochlear implants)



2. Outcomes:

At the end of the session learners/ teachers must:

- ✓ Know that the central nervous system consists of the brain and spinal cord
- ✓ Know the structure and function of the different parts of the brain
- ✓ Understand what the Peripheral nervous system is and its functions
- ✓ Understand what the Autonomic system is with its function
- ✓ Differentiate between the different types of nerves



3. TERMINOLOGY

Term	1.1.1 Definition
Accommodation	The ability of the lens of the eye to alter its shape for clear vision
Alzheimer's disease	Disease caused by nerve defects usually in older people and characterized by memory loss and confusion
Astigmatism	Eye defect caused by an uneven corneal surface
Auditory nerve	Nerve transmitting impulses from the ear to the brain
Autonomic nervous system	Nervous system containing a sympathetic and parasympathetic section
Binocular vision	The use of two eyes to form an image, giving a wider field of vision
Blind spot	Area in the retina that does not contain photoreceptors and therefore cannot form an image
Cataract	Cloudy, opaque portion in the lens of the eye
Central nervous system	Nervous system made up of the brain and the spinal cord
Cerebellum	The part of the brain which co-ordinates voluntary actions and which is responsible for balance
Cerebrum	The region of the brain associated with problem-solving
Choroid	A pigmented layer in the eye which absorbs light and prevents its reflection.
Ciliary muscles	Muscles that contract or relax to change the shape of the lens in the eye
Cones	Receptor cells, sensitive to colour, found in the eye
Conjunctiva	Protective membrane situated over the cornea of the eye
Cornea	Transparent part of the sclera in front of the eye
Cristae	Receptors in the semi-circular canals of the ear that are sensitive to speed and direction
Dendrites	Fibers that transmit impulses to a cell body in a neuron
Effector	Structure that responds to a stimulus received by a receptor / sense organ
Eustachian tube	The tube which connects the middle ear to the pharynx
Grommet	Structure inserted into the tympanic membrane to allow air to pass into the middle ear
Interneuron	Neuron that transmits impulses from the sensory neuron to the motor neuron
Iris	The part of the eye, which is coloured black, brown, green, grey or blue
Long-sightedness	The ability to see objects far away clearly, but not objects close by
Maculae	Receptors in the sacculus and utricle of the ear that are sensitive to the position of the body

Medulla Oblongata	A part of the brain responsible for involuntary actions such as breathing and dilation and constriction of blood vessels.
Meninges	Protective membranes surrounding the central nervous system
Motor neuron	Neuron that transmits impulses from the central nervous system to the effectors
Multiple sclerosis	Disease caused by damage to the myelin sheath of neurons and characterized by physical and mental disabilities
Myelin sheath	Structure that insulates a neuron in order to speed up the transmission of impulses
Neuron	The structural unit of the nervous system
Optic nerve	Nerve transmitting impulses from the eye to the brain
Organ of Corti	The structure, within the cochlea, responsible for picking up the stimulus of sound
Peripheral nerves	Nerves linking receptor and effector organs with the brain and spinal cord
Pupillary mechanism	Changes that occur in the diameter of the pupil under different light conditions
Radial muscles	The iris muscles that contract in dim light and relax in bright light
Receptor	Structure that receives a stimulus and converts it into an impulse for transmission
Reflex action	A rapid, automatic (involuntary) response to an external stimulus
Reflex arc	Path taken by an impulse during a reflex action
Retina	Layer of the eye containing photoreceptors and where images are formed
Rods	Photoreceptors in the retina that are stimulated under dim light conditions
Sensory neuron	Neuron that transmits impulses from the sense organs to the central nervous system
Short-sightedness	The ability to see objects close by clearly, but not objects far away
Suspensory ligaments	Structures that hold the lens of the eye in position
Synapse	The physiological connection between the axon of one neuron and the dendrites of another
Yellow spot	Area in the retina that contains the highest amount of cones and therefore forms the clearest image



ACTIVITY 1

1.1.4 What was the independent variable in the investigation?

- A The drug in the body
- B Time after taking the drug
- C Reaction time
- D Number of volunteers

1.1.5 The following factors were considered during the investigation:

- (i) Number of volunteers
- (ii) Time of day
- (iii) Age of volunteers
- (iv) Tools used to measure reaction time

Which ONE of the following combinations of factors will affect the validity of the investigation?

- A (i) and (ii) only
- B (i), (iii) and (iv) only
- C (i), (ii), (iii) and (iv)
- D (ii), (iii) and (iv) only

1.1.6 The part of the brain that regulates breathing is the ...

- A medulla oblongata.
- B cerebrum.
- C corpus callosum.
- D cerebellum.

6 x 2 (12)

1.2. Give the correct **biological term** for each of the following descriptions. Write only the term next to the question number (1.2.1 to 1.2.7) in the ANSWER BOOK.

- 1.2.1 The part of the brain that coordinates voluntary muscle movement
- 1.2.2 A disease characterized by a loss of the myelin sheaths of neurons, affecting their ability to transmit impulses to the central nervous system
- 1.2.3 A rapid, automatic response to an external stimulus
- 1.2.4 A collective name for the membranes that protect the brain
- 1.2.5 The part of the brain that controls the heart rate
- 1.2.6 The structure that connects the left and right hemispheres of the brain, allowing communication between them
- 1.2.7 The part of the brain that controls body temperature

(7)

- 1.3. Indicate whether each of the descriptions in COLUMN I applies to **A ONLY**, **B ONLY**, **BOTH A AND B** or **NONE** of the items in COLUMN II. Write **A only**, **B only**, **both A and B** or **none** next to the question number (1.3.1 to 1.3.3) in the ANSWER BOOK.

COLUMN I		COLUMN II
1.3.1	The part of the brain that connects the left to the right hemisphere	A: Corpus callosum B: Medulla oblongata
1.3.2	A part of the neuron that degenerates to cause multiple sclerosis	A: Axon B: Myelin sheath
1.3.3	The structure that receives a stimulus and converts it into an impulse	A: Motor neuron B: Receptor

3 x 2 (6)
TOTAL: 25



4. Central nervous system

- * Organisms need to detect and respond to stimuli to adapt and survive in a continuously changing environment.
- * Two coordinating systems
 - **Nervous system** (rapid responses involving nerves)
 - **Endocrine system** (slower responses involving hormones that is chemical)
- * Work together for communication and homeostasis in the body
 - By responding to external and internal environment changes (**stimuli**)



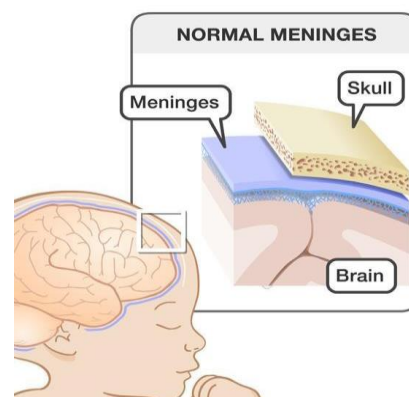
5. Human nervous system

- * A nervous system in humans is important so that the body can:
 - React to a stimulus (changes in environment)
 - Regulates body temperature on hot or cold days
 - Reflex action
 - Coordinate the various activities of the body
 - Walking, hearing seeing

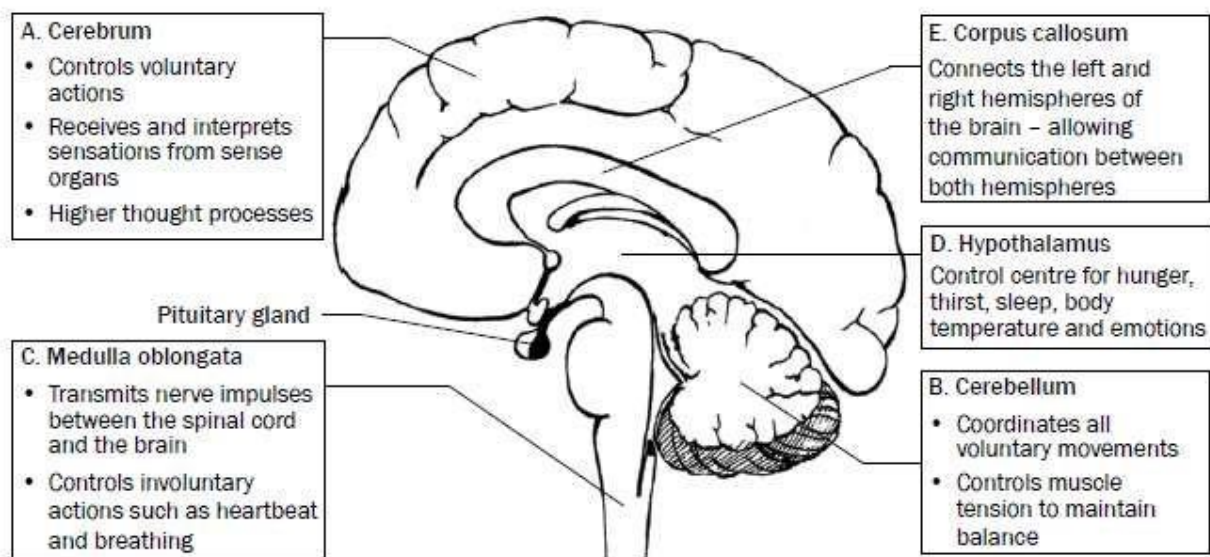


6. Central nervous system and functions

- * Consist of the brain and the spinal cord
- * Meninges
 - Membrane lining inside of skull and vertebrae.
 - To protect brain and spinal cord

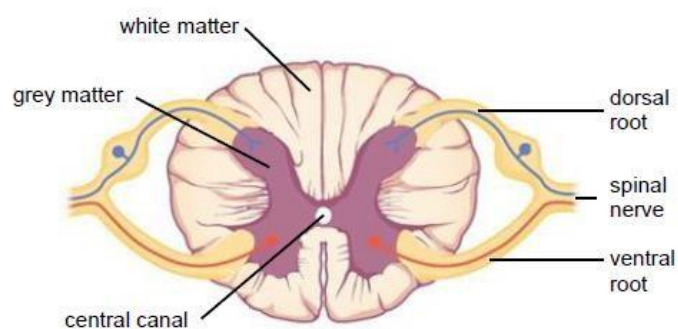


7. Parts of the brain and its functions



The structure and functions of the brain

8. Spinal cord

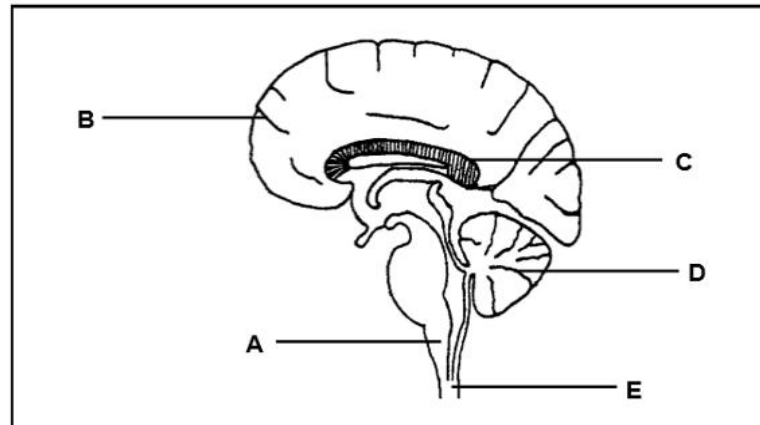


- * Long thin tubular structure
- * Extends from medulla oblongata
- * Connects most of peripheral nervous system (PNS) to the brain
- * Part of the reflex action



ACTIVITY 2

2.1 The diagram below represents the central nervous system in a human.



- 2.1.1 Identify part: (1)
 (a) A
 (b) D (1)
 2.1.2 State THREE functions of part **B**. (3)
 2.1.3 Name the part that joins the two hemispheres. (1)
 2.1.4 Name the system of membranes that surround the brain. (1)
 (7)

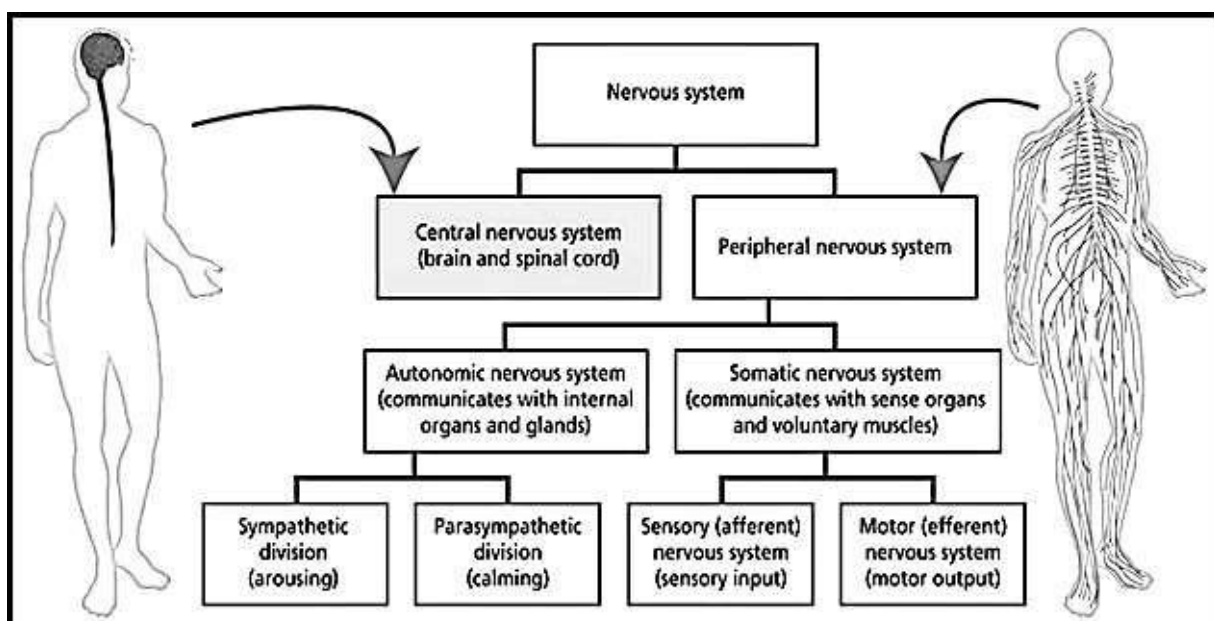


9. Peripheral nervous system

- The peripheral nervous system consists of the cranial and spinal nerve.
- The autonomic nervous system consists of the sympathetic and parasympathetic.



10. The following diagram represents the different parts of the nervous system.



11. Different parts of the nervous system.

The autonomic nervous system is the part of the nervous system that supplies the internal organs, including the blood vessels, stomach, intestine, liver, kidneys, bladder, genitals, lungs, pupils, heart, and sweat, salivary, and digestive glands.

The autonomic nervous system has two main divisions:

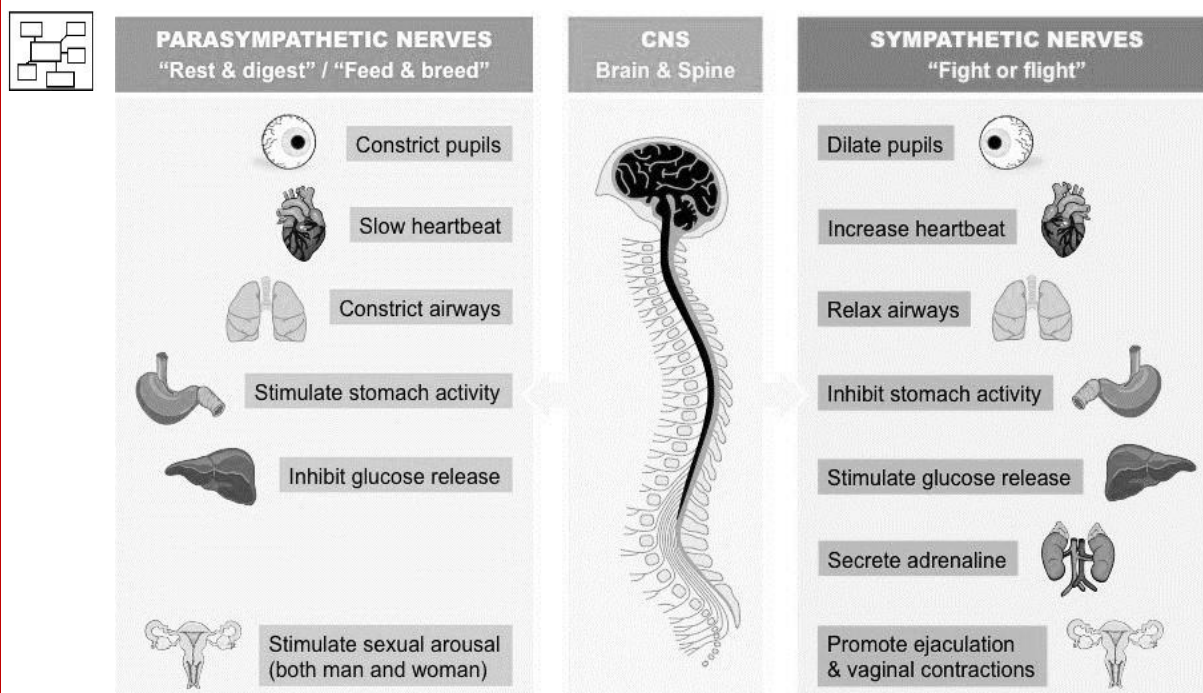
- Sympathetic
- Parasympathetic

After the autonomic nervous system receives information about the body and external environment, it responds by stimulating body processes, usually through the sympathetic division, or inhibiting them, usually through the parasympathetic division. An autonomic nerve pathway involves two nerve cells. One cell is located in the brain stem or spinal cord. It is connected by nerve fibers to the other cell, which is located in a cluster of nerve cells (called an autonomic ganglion). Nerve fibers from these ganglia connect with internal organs. Most of the ganglia for the sympathetic division are located just outside the spinal cord on both sides of it. The ganglia for the parasympathetic division are located near or in the organs they connect with.

12. Autonomic nervous system (ANS)

*Part of the PNS and is found outside the brain and spinal cord.

- * Controls internal environment that is regulated by hypothalamus and medulla oblongata
- * Carry nerve impulses from the CNS to sites of action (Effectors) in muscles or glands
- * Divided into:





13. Function of the autonomic nervous system

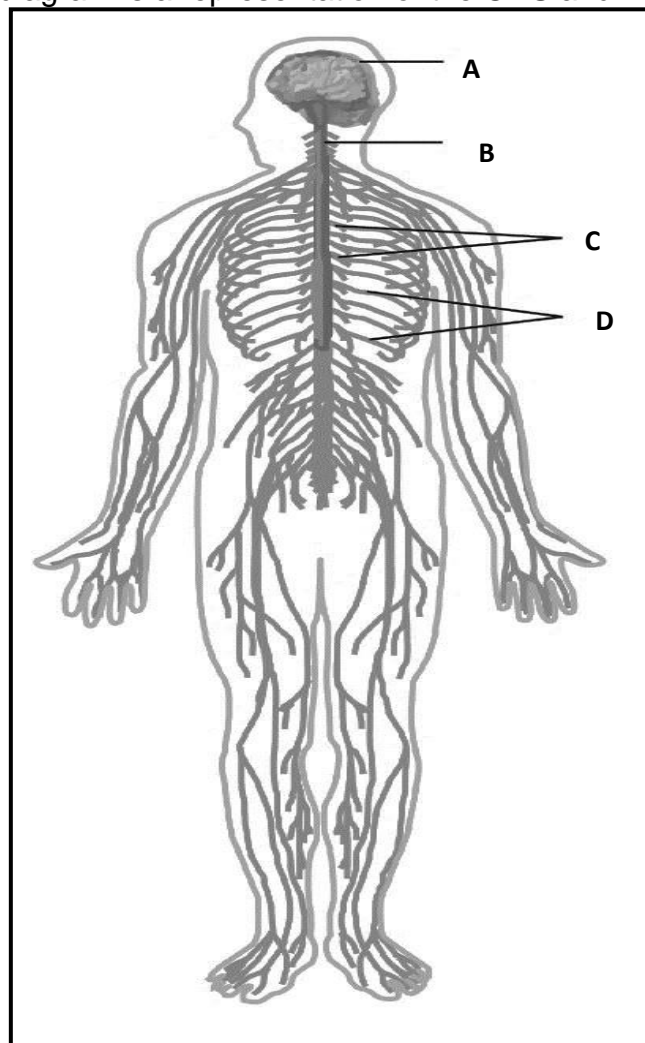
The autonomic nervous system controls internal body processes such as the following:

- Blood pressure
- Heart and breathing rate
- Body temperature
- Digestion
- Metabolism (thus affecting body weight)
- The balance of water and electrolytes (such as sodium and calcium)
- The production of body fluids (saliva, sweat, and tears)
- Urination
- Defecation
- Sexual response



ACTIVITY 3:

3.1. The following diagram is a representation of the CNS and PNS.



3.1.1 State the term that the following abbreviations represent:

- a) CNS
- b) PNS

(2)

3.1.2. Give the LETTERS represent the: (4)

a) CNS

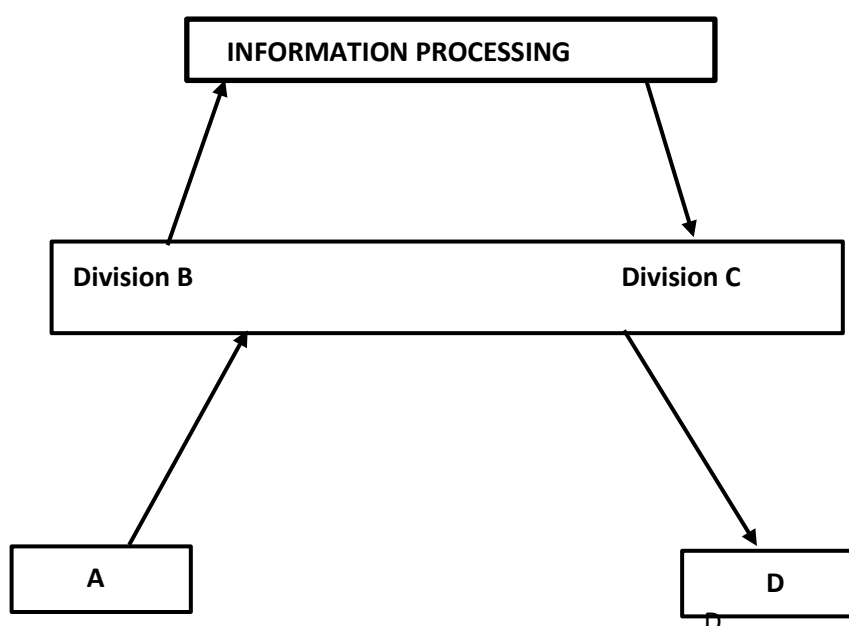
b) PNS

3.1.3. Tabulate FIVE differences between these two nervous systems mentioned above (11)

3.1.4. Name the TWO divisions that we get with the PNS. (2)

3.1.5. Name ONE function of each of these divisions. (2)

3.2. Study the diagram below.



3.2.1. A is a type of input that must go to the CNS give one word for this input. (1)

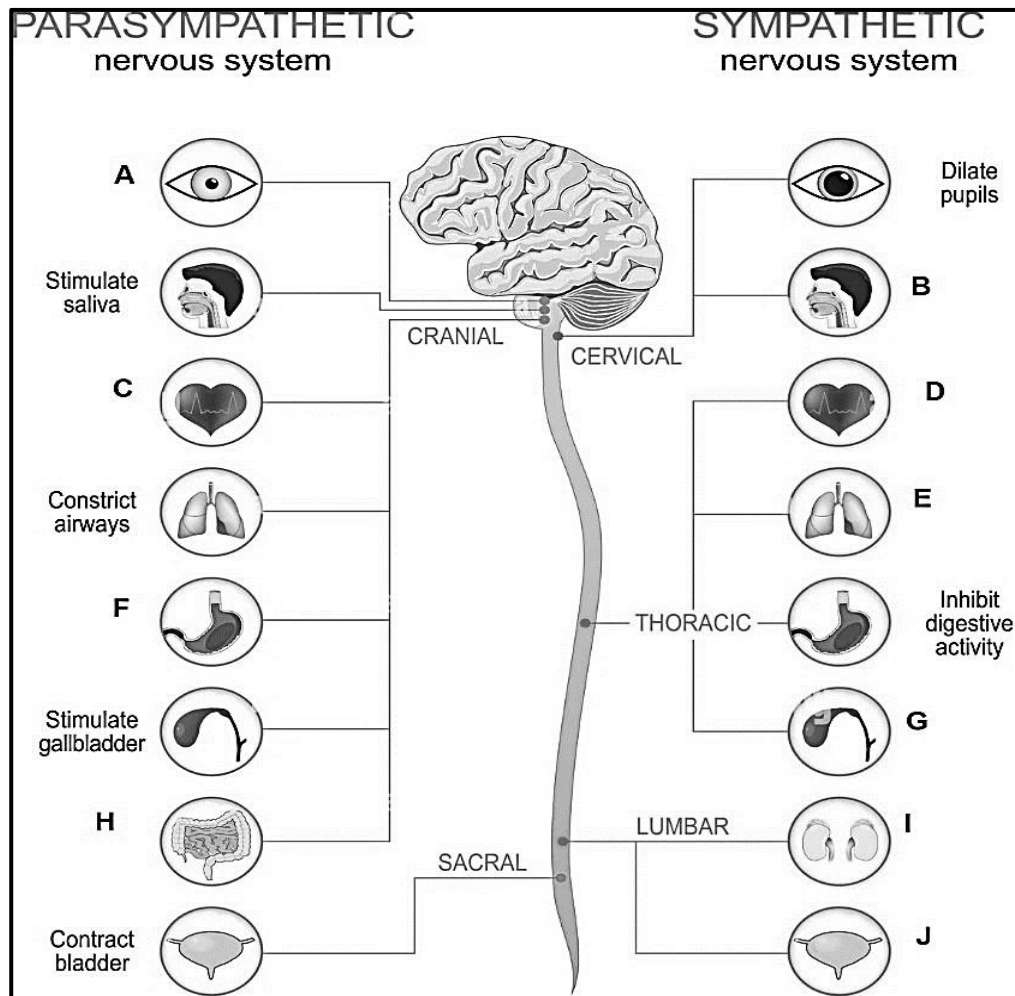
3.2.2. D is a type of output that received a message from the CNS, give one word for this output. (1)

3.2.3. Identify divisions B and C. (2)

3.2.4. What does the label information processing represent? (1)

- 3.3. The diagram below shows the two sections of the autonomic nervous system namely parasympathetic and sympathetic. Write down the appropriate labels of the following symbols.

(10)

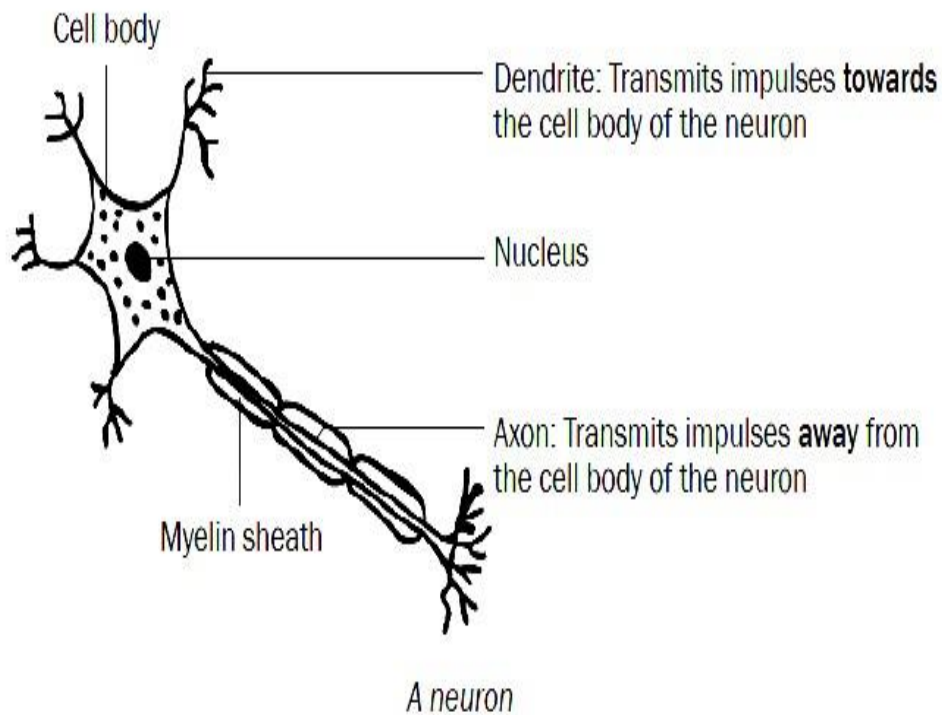


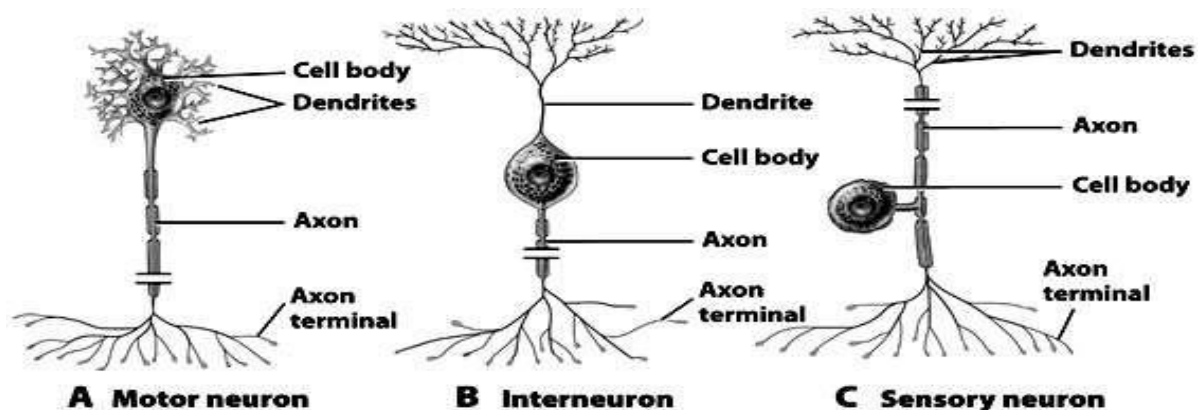


14. Structure and functioning of a nerve. (Neurons)

There are three types of neurons, namely sensory (afferent) neurons, motor (efferent) neurons and interneurons (or connectors). The Table below shows the structure and function of these neurons.

Neurons are specialised cells which connect the brain and spinal cord to all other parts of the body.



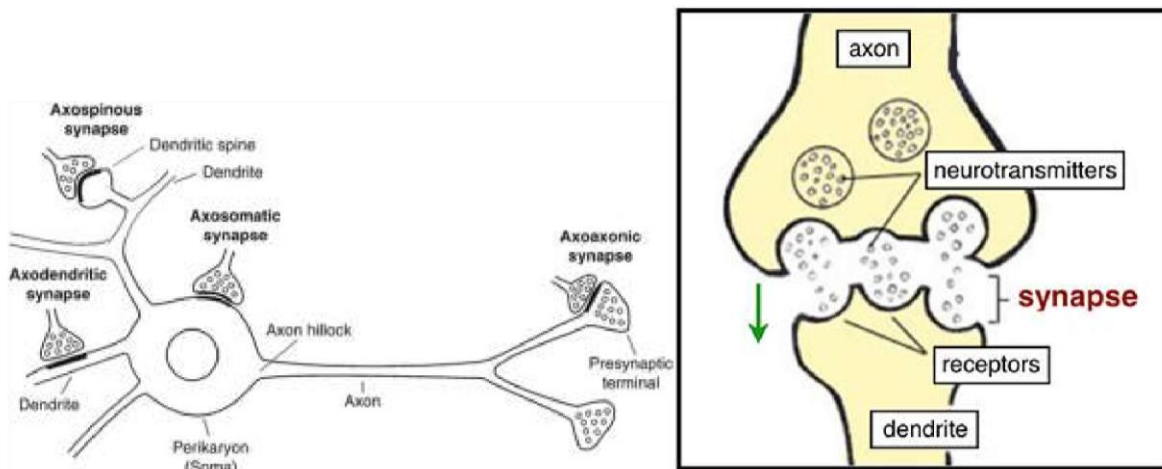


Type of neuron	Function	Structure
<p>Sensory (afferent) neuron</p> <p>Senses the stimulus</p>	Transmits impulses from the sense organs or receptors to the spinal cord and brain.	<p>Sensory neuron</p>
<p>Motor (efferent) neuron</p> <p>Response to the stimulus</p>	Transmits impulses from the brain and spinal cord to the effectors (muscles and glands). The effectors bring about the response.	<p>Motor neuron</p>
<p>Interneuron (connector)</p> <p>Found in the brain and spinal cord</p>	Links the sensory neuron to the motor neuron.	<p>Interneuron</p>

Sensory, motor and interneurons

15. Synapse

Synapse, also called neuron junction, is the site of transmission of electric nerve impulses between two nerve cells (neurons) or between a neuron and a gland or muscle cell (effector)



The function of the synapse is to transfer electric activity (information) from one cell to another.

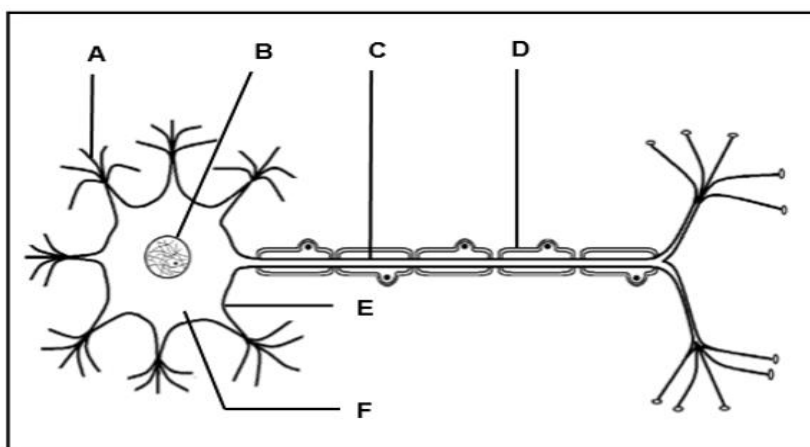
The transfer can be from nerve to nerve (neuro-neuro), or nerve to muscle (neuromy). **The** region between **the** pre- and postsynaptic membrane is very narrow, only 30-50 nm.

Synapses are the gaps between neurons. These gaps allow neurotransmitters to travel from one neuron to another. **Synapses** are the gaps in between neurons. These gaps allow neurotransmitters to travel from one neuron to another.



ACTIVITY 4

4.1. The diagram below represents the structure of a neuron.



4.1.1 Name the type of neuron in the diagram above. (1)

4.1.2 Identify part (1)

(a) B (1)

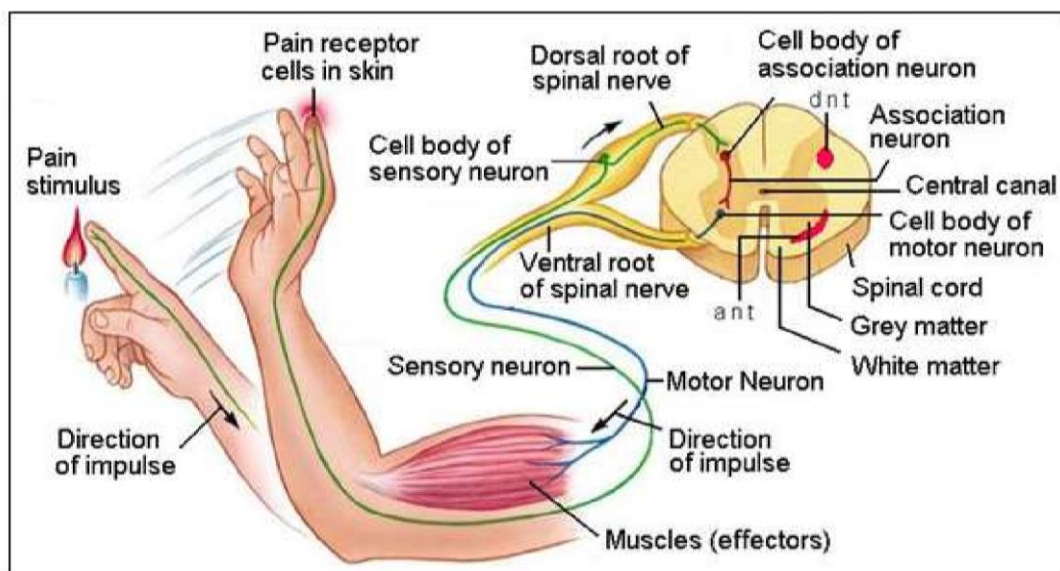
(b) F (1)

(c) A (1)

- 4.1.3 Give the LETTER and NAME of the part that:
- (a) Transmits impulses away from the cell body (2)
 - (b) Insulates and speeds up the transmission of impulses (2)
- 4.1.4 Name the condition caused by the progressive degradation of part D (1)
- (9)



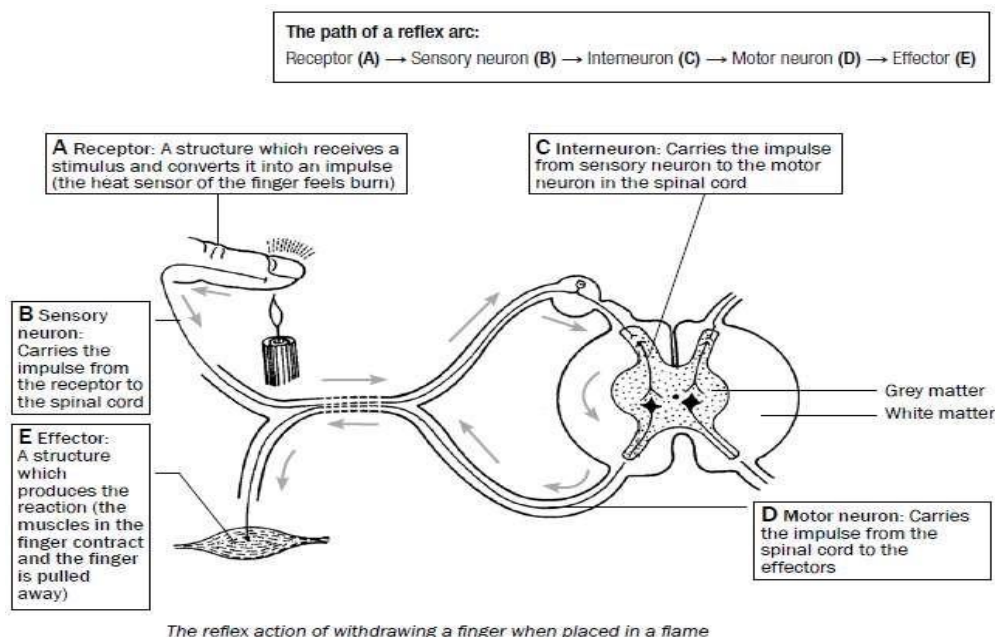
16. The simple reflex arch.



From :learnwise.co/labelled-diagram-of-a-reflex-arc/labelled-diagram-of-a-reflex-arc



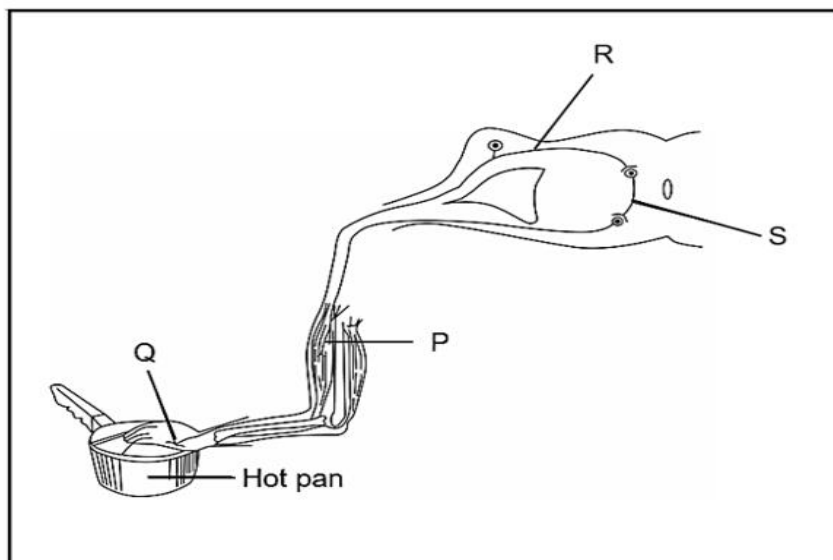
17. Follow the arrows in the following diagram to get the sequence: the impulse is transmitted from the receptor through in the sensory neuron to the interneuron from there it goes through the motor neuron to the receptor (effector muscle)





ACTIVITY 5

5.1. The diagram below shows a reflex arc.



- 5.1.1 What is a *reflex action*? (2)
- 5.1.2 Name the following:
- (a) The functional connection between **R** and **S** (1)
 - (b) Neuron **S** (1)
- 5.1.3 State the significance of the functional connection between **R** and **S** (1)
- 5.1.4 Explain the movement of the impulse from **Q** until it reaches **P**,
Ensure the correct order of LETTERs in your explanation. (8)
- 5.1.5 Explain the consequences for a reflex action if the neuron that leads to **P** is damaged. (2)
- 5.1.6 Explain how neuron **R** differs in structure from the one that transmits the impulse to **P**. (3)
- (18)**



18. Disorders of the Nervous system

Most disorders of the CNS is due to an injury or damaging of the brain or neurons.

1. Alzheimer's Disease:

Symptoms:

- a) Memory loss that disrupts daily life
- b) Challenges in planning or solving problems.
- c) Difficulty completing familiar tasks at home, at work or at leisure.
- d) Confusion with time or place
- e) Trouble understanding visual images and spatial relationships.
- f) New problems with words in speaking or writing.
- g) Misplacing things and losing the ability to retrace steps.
- h) Decreased or poor judgment
- i) Withdrawal from work or social activities
- j) Changes in mood and personality



19. Multiple sclerosis:

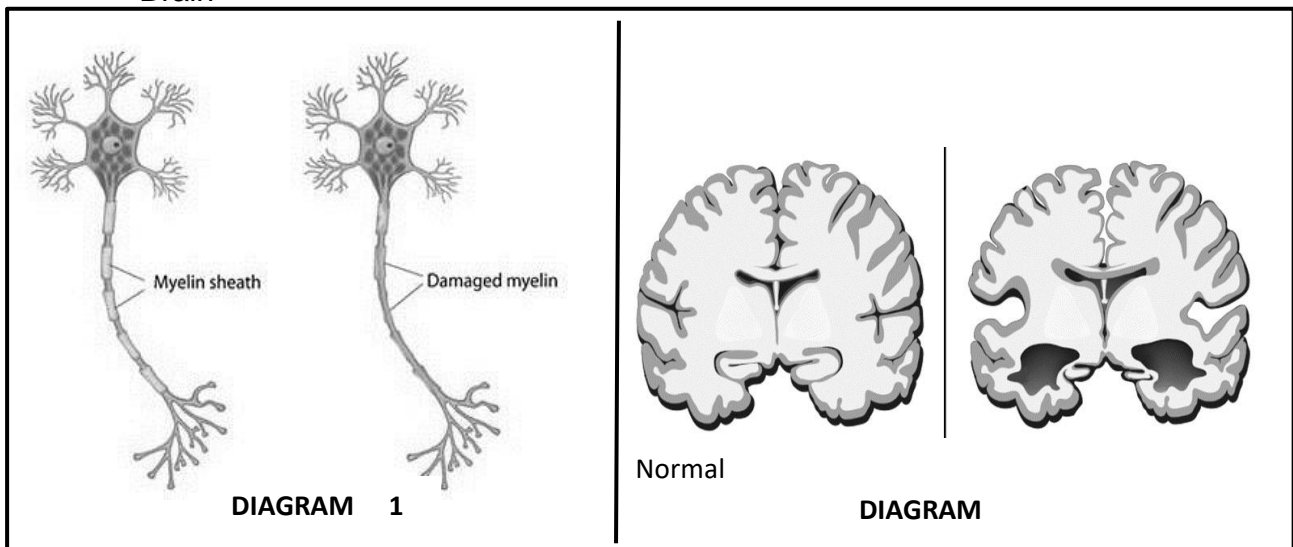
Symptoms:

- a) Muscle spasms, stiffness.
- b) Weak muscle control.
- c) Fatigue.
- d) Vision problems.
- e) Numbness and tingling.
- f) Mobility problems.
- g) Pain.
- h) Depression and anxiety.



ACTIVITY 5

5.1. Study the diagrams below that shows structural damages in neurons and the Brain



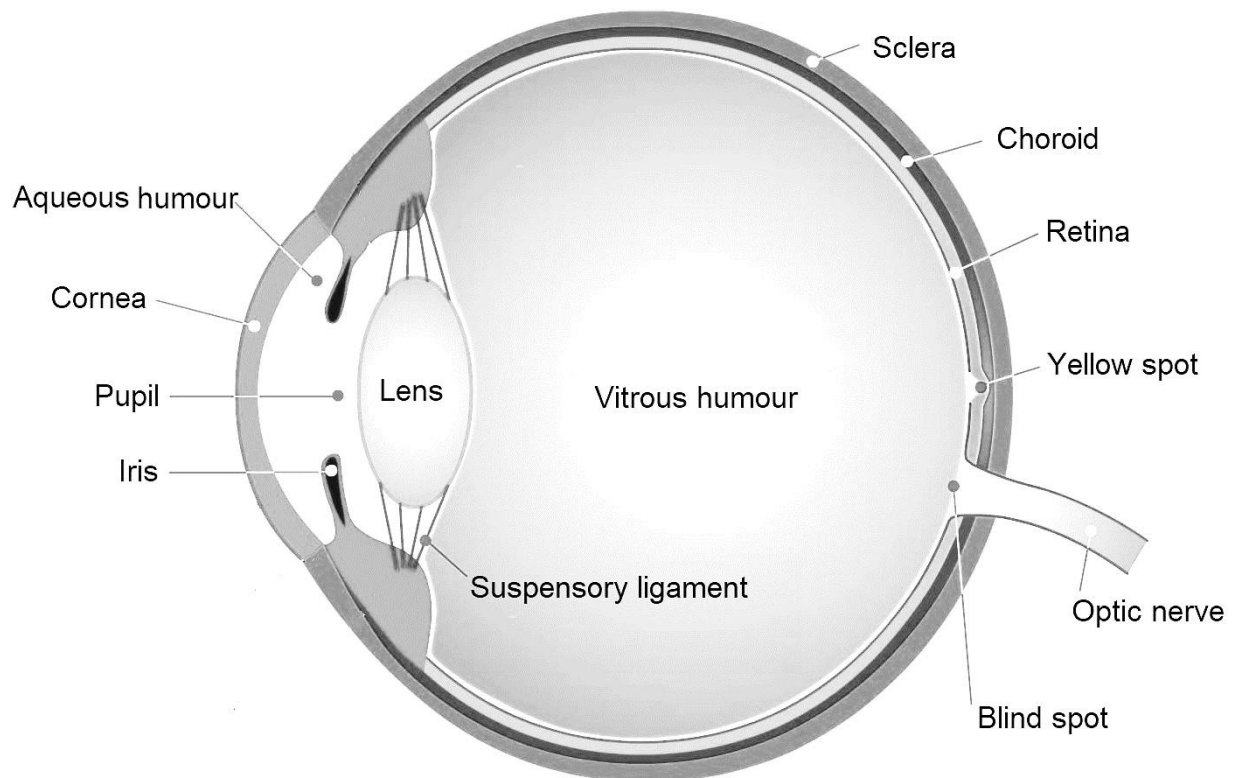
- 5.1.1. Identify the disorder illustrated by the structural damages in:
- a) Diagram 1 (1)
 - b) Diagram 2 (1)
- 5.1.2. Explain how a myelin sheath gets damaged that causes this disorder in diagram 1. (2)
- 5.1.3. What are the symptoms of Multiple sclerosis? (5)
- 5.1.4. Diagram 2 indicates progressive brain cell death overtime and causes Alzheimers. Explain other conditions that can contribute to this disorder. (3)
- 5.1.5. Give two symptoms of Alzheimer's. (2)



20. RECEPTORS

20.1. The EYE:(The Structure and functions)

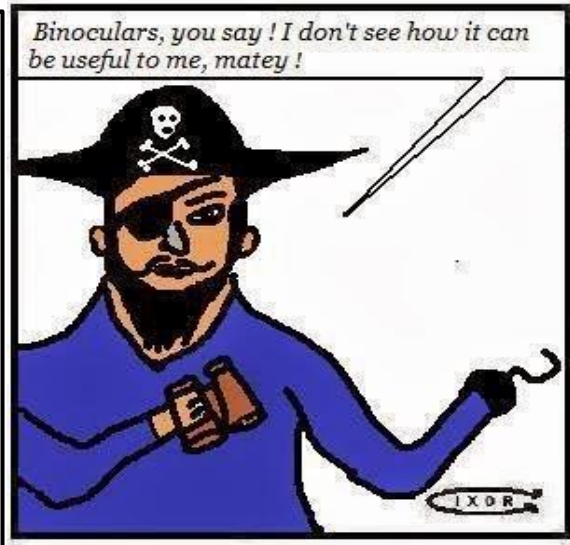
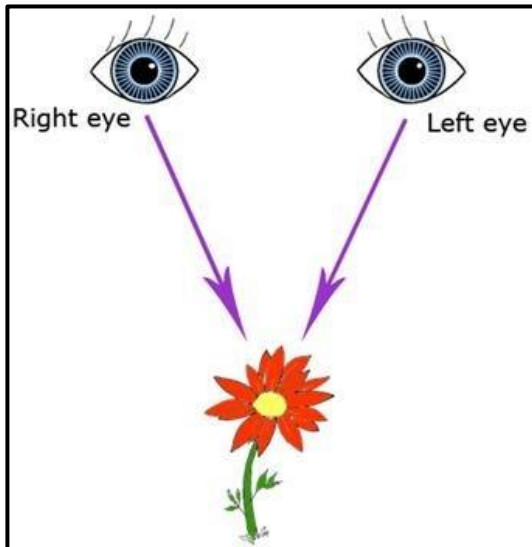
The anatomy of the human eye



Part	Function
Conjunctiva	Protection, refraction
Cornea	Refracts light - bends it as it enters the eye
Iris	Controls how much light enters the pupil
Pupil	Allows light to pass through
Lens	Focuses light onto the retina
Suspensory Ligaments	Holds lens in position/accommodation
Ciliary muscle and body	Accommodation
Retina	Contains the light receptors
Choroid	Prevents reflection of light/nourishment of the eye
Sclera	Protection/attachment of muscles
Optic nerve	carries impulses from the eye to the brain

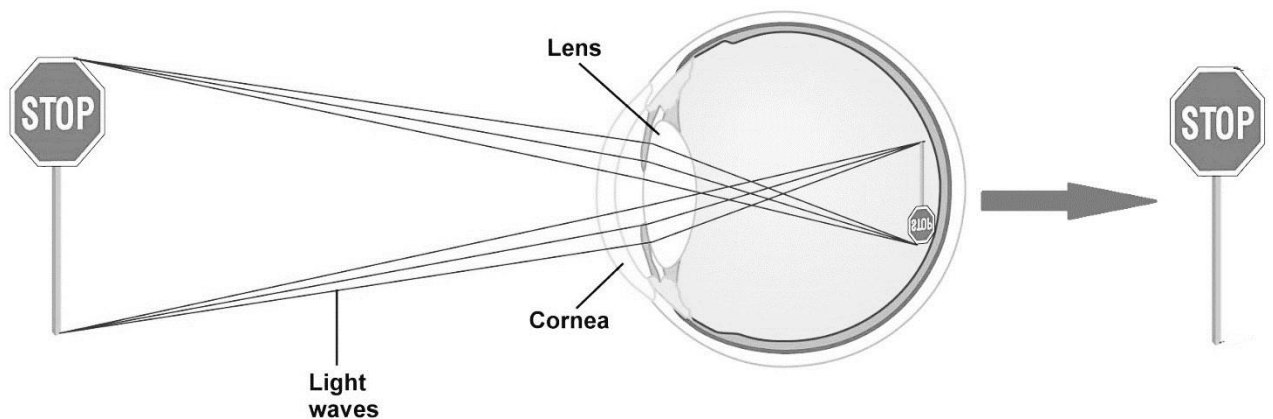


20.2. Binocular Vision

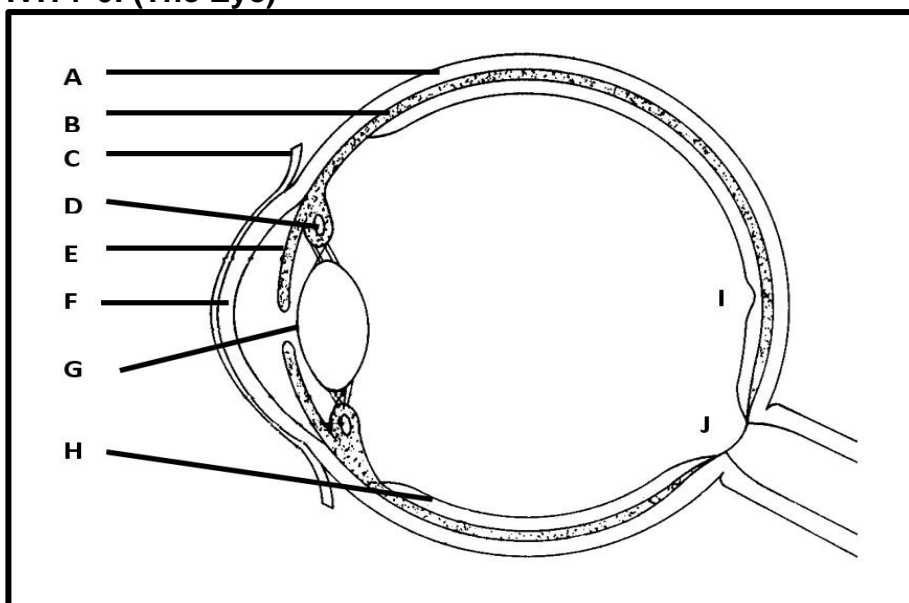


* Binocular vision (two eyes in humans)

- Light rays enter eye and becomes focuses on retina
- Eyes are used together
- Wider field of view



ACTIVITY 6: (The Eye)

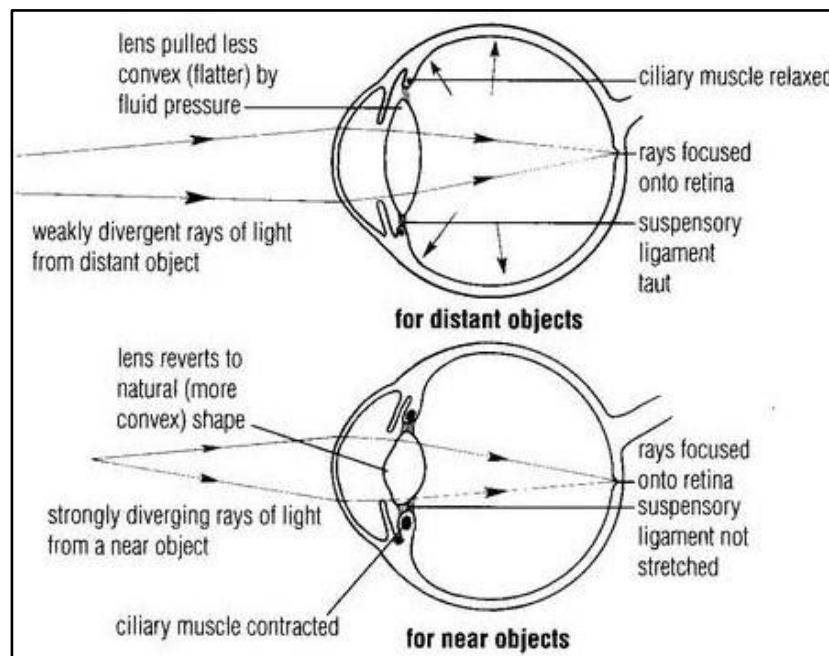


- 6.1. Identify parts **A** to **J**. (10)
- 6.2. Give the LETTER for the part that:
- a) Protects the inner structures of the eye (1)
 - b) Contract or relax to alter the tension on the suspensory ligaments (1)
- 6.2.1. Supply nutrients and oxygen to the cells of the retina (1)
- 6.2.2. Gives the clearest vision (1)
- 6.2.3. Changes shape to allow the eye to focus on near and distant objects (1)
- 6.2.4. Contain rods and Cones (1)
- 6.3. Explain the function of:
- a) The iris (2)
 - b) Cornea (2)
 - c) Choroid (2)
 - d) Aqueous humour (2)
- 6.4. Describe how the following structures are adapted for their function.
- a) The lens (4)
 - b) Sclera (2)
 - c) Iris (2)
 - d) Choroid (4)



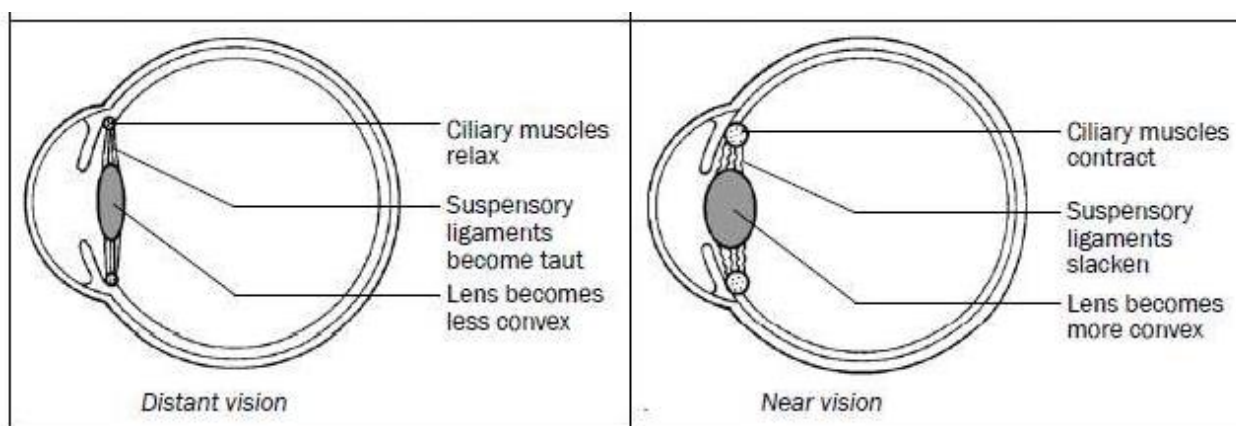
20.3. Accommodation

Accommodation is the adjustment of the shape of the lens to see objects clearly whether they are away or close by.





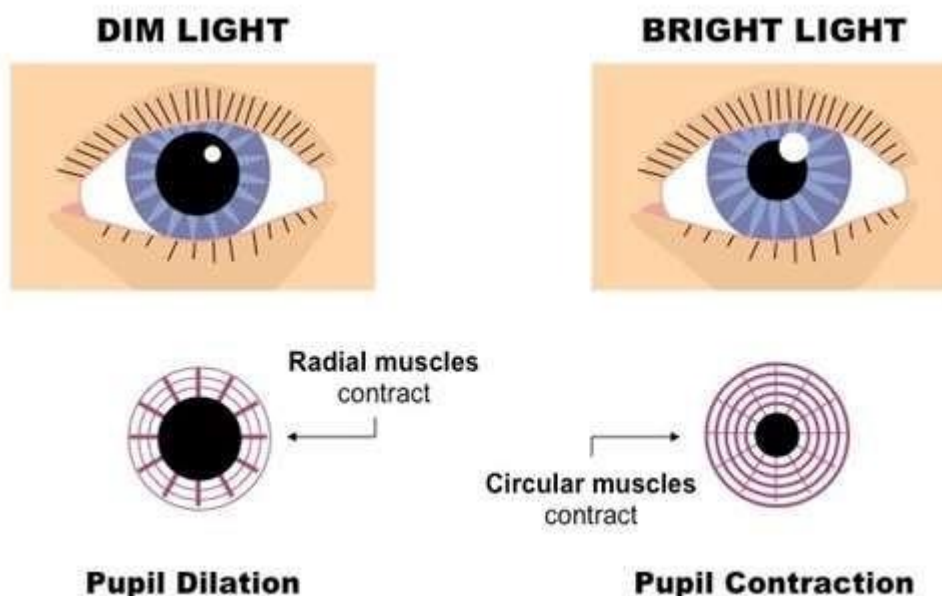
Distant vision (object further than 6m)	Near vision (object closer than 6m)
1. Ciliary muscles relax	Ciliary muscles contract
2. Suspensory ligaments tighten (become taut)	Suspensory ligaments slacken
3. Tension on lens increases	Tension on lens decreases
4. Lens is less convex(flatter)	Lens is more convex (more rounded)
5. Light rays are reflected (bent) less	Light rays are refracted (bent) more
6. Light rays are focused onto the retina	Light rays are focused onto the retina



Accommodation of the eye for distant and near vision



20.4. Pupillary mechanisms



DIM LIGHT		BRIGHT LIGHT	
Circular muscles relax	CR	Circular muscles contract	CC
Radial muscles contracts	RC	Radial muscle relaxes	RR
Pupils dilates (enlarges)		Pupil constrict (smaller)	
More light enters		Less light enters	



ACTIVITY 7: (Eye accommodation)

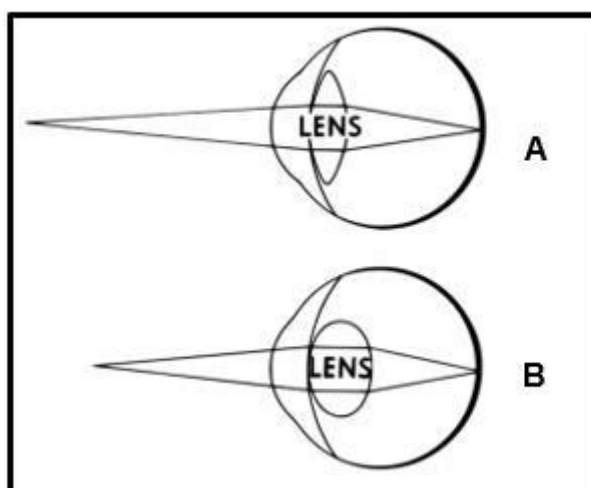
7.1. Complete the table below on eye accommodation.

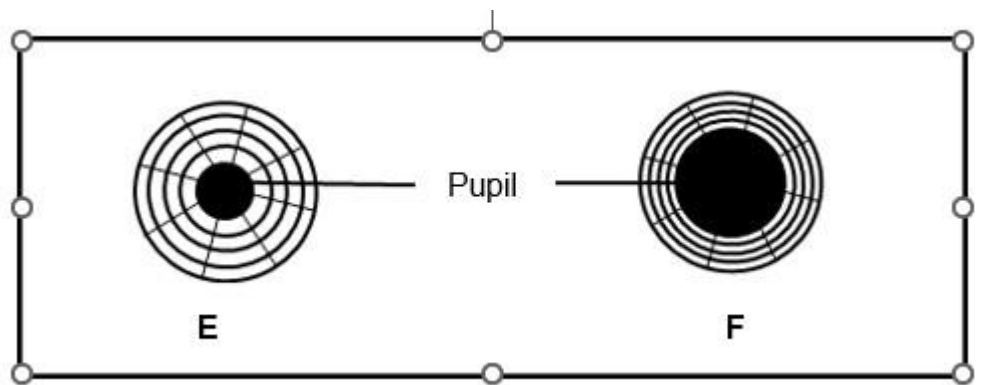
	Near vision (<i>less</i> than 6 m from the object)	Distant vision (<i>more</i> than 6 m from the object)
Ciliary muscles	Contract	7.1.1
Suspensory ligaments	7.1.2	Tighten/ become taut (Not contract)
Tension on the lens	Decreases	7.1.3
Shape of the lens	Become more convex	7.1.4
Light rays	7.1.5.	Bend less
Image	A clear image is focused on the retina	A clear image is focused on the retina

7.2. Complete the table below on pupil mechanism.

	Bright light conditions	Dim light conditions
Radial muscles	Relax	7.2.1.
Circular muscles	7.2.2.	Relax
The pupil	Constricts/get smaller	7.2.3
The amount of light entering the eye	7.2.4.	Increased

7.3. The diagram below shows structures in the human eye.



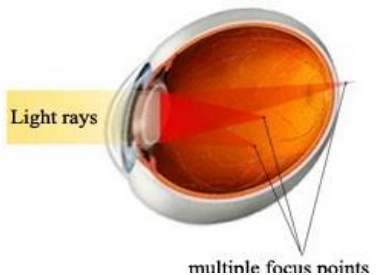



- 7.4. Give the LETTER only of the diagram that represents the eye in: (1)
 a) conditions of bright light (1)
 b) looking at an object less than six metres away
- 7.5. Name the muscle that: (1)
 a) Contract in E (1)
 b) Became taut in A
- 7.6. Describe the changes that take place in the eye in diagram B. (6)
- 7.7. Describe the changes that take place in the eye in diagram E. (4)

20.5. Visual defects

Visual defect	Nature of the defect	Corrective measures
Short – sightedness Near objects can be seen clearly(myopia)	<ul style="list-style-type: none"> Inability of the lens to become more flatter/eyeball is longer than normal. Lens bend the light rays too much. As a result, it falls in front of the retina Causing the image to be blurred Cannot see distant objects clearly. 	Wearing glasses with converging (biconcave)

Visual defect	Nature of the defect	Corrective measures
Long sightedness Objects far away can be seen clearly(hyperopia)	<ul style="list-style-type: none"> The inability of the lens to become more convex/eyeball is shorter than normal. The lens does not bend the light rays enough. As a result, it falls behind the retina. Causing the image to be blurred 	Wearing glasses with converging (biconvex) Long sightedness

	<ul style="list-style-type: none"> Cannot see distant objects clearly. 	
Astigmatism	<ul style="list-style-type: none"> The curvature of the lens or cornea is uneven resulting in distorted image 	<p>Wearing glasses with lenses shaped to correct the distortion</p> 
Cataracts	<ul style="list-style-type: none"> The lens become cloudy and opaque 	<p>Surgery to replace the lens with a synthetic lens</p> 



ACTIVITY 8:

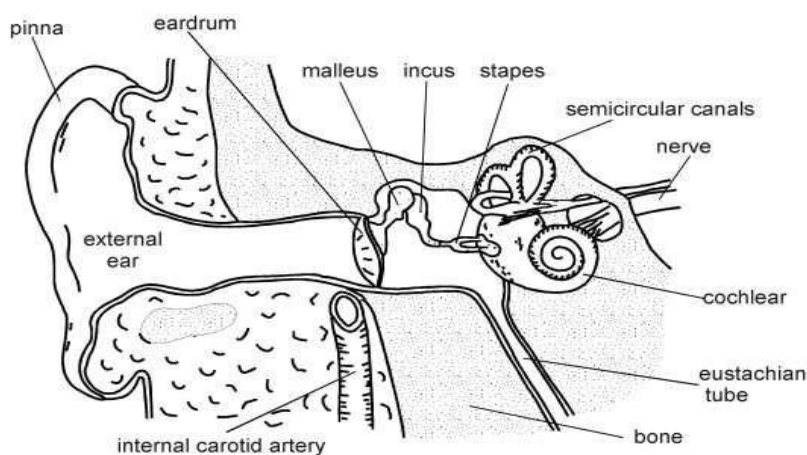


21.THE EAR

21.1. Structure and Function

The ear consists out of 3 parts:

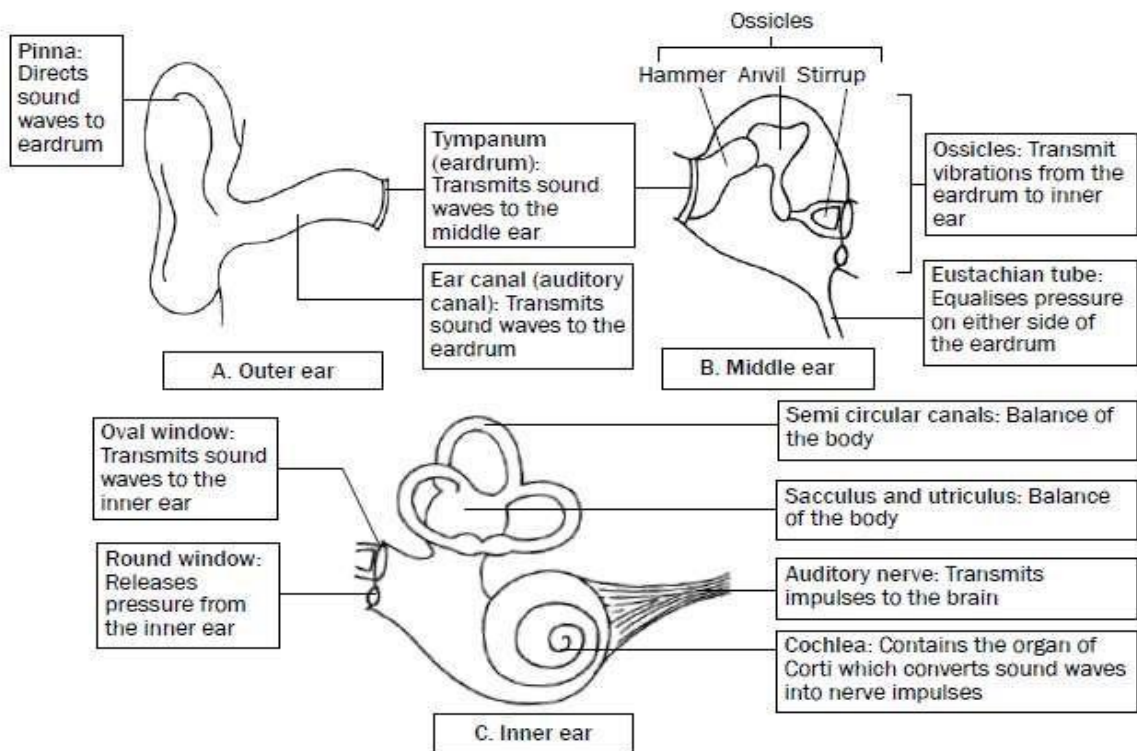
Outer ear
Middle ear
Inner ear



CROSS SECTION OF THE EAR



21.2. Functions of the different parts

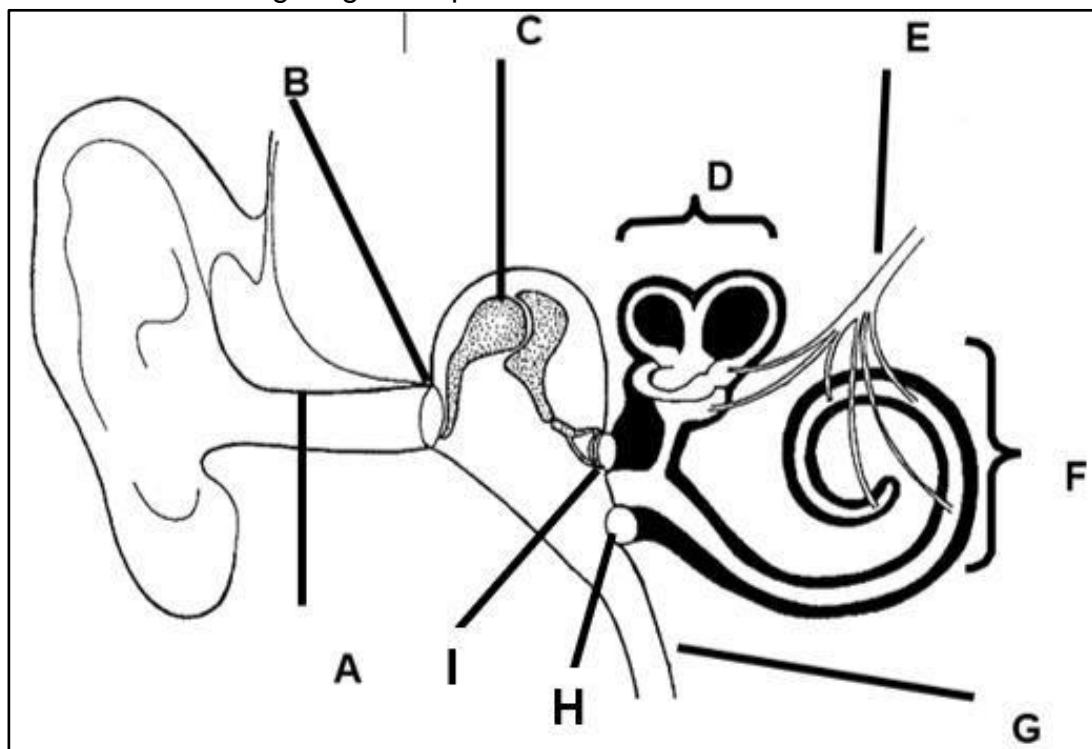


The structure of the ear

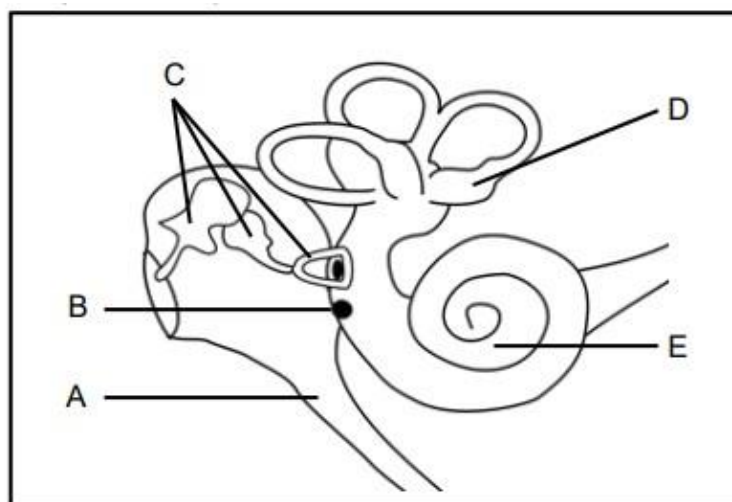


ACTIVITY 8:(The Ear)

10.1. The following diagram represents the human ear.



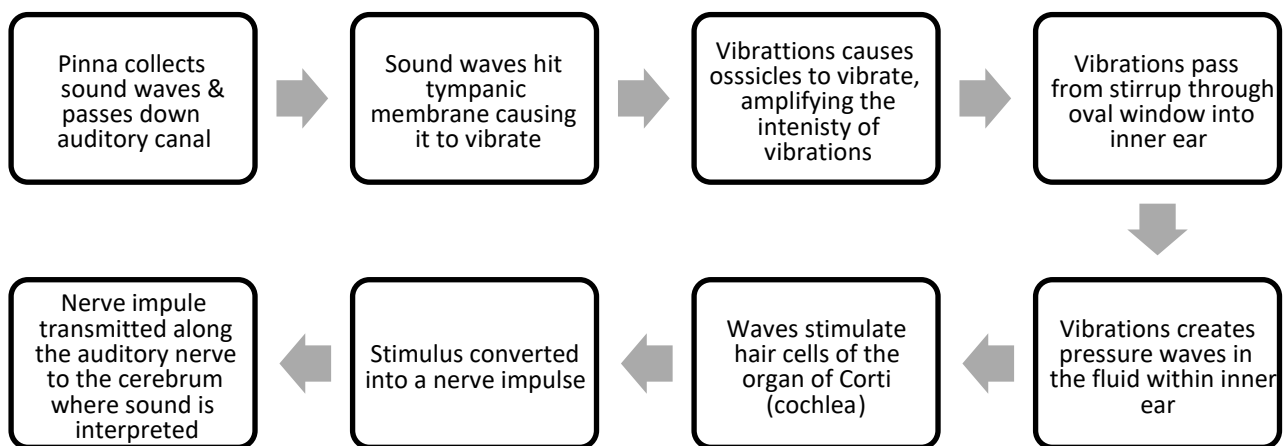
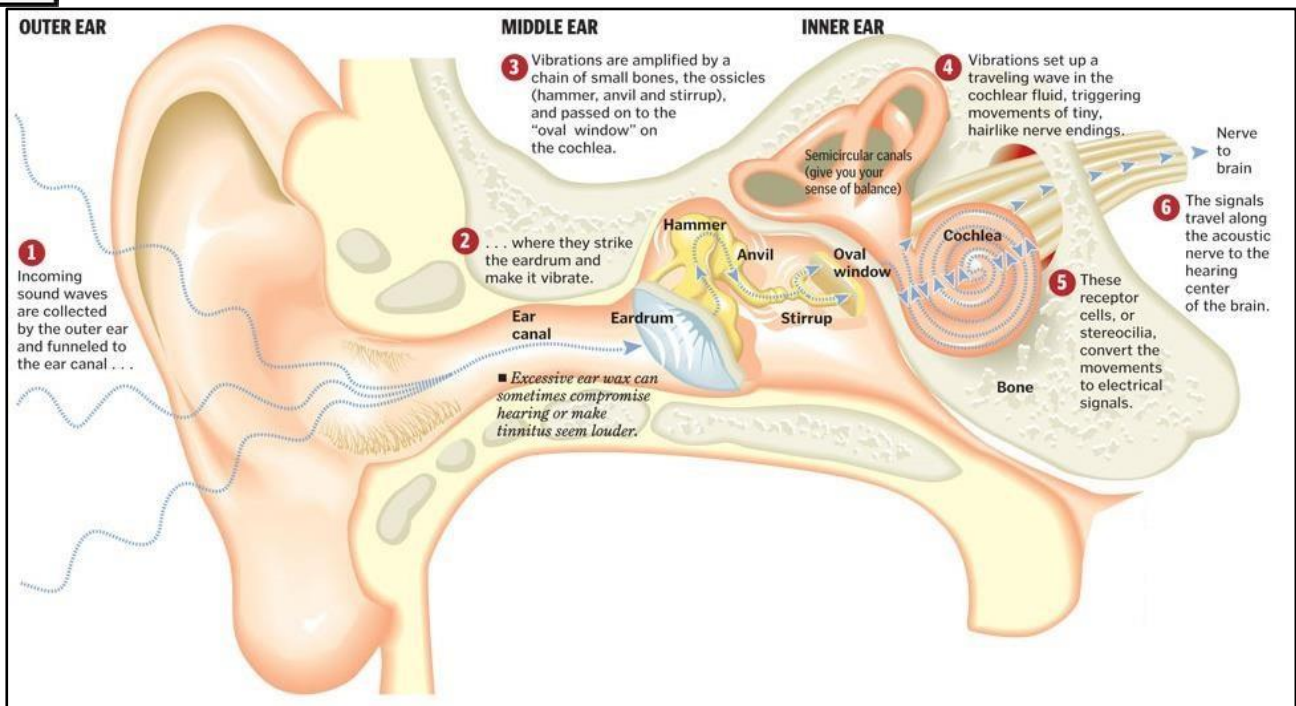
- 8.1.1 Give the LETTER and the NAME of the part that ...
- a) transmits sound waves to the tympanic membrane. (2)
 - b) amplifies the vibrations. (2)
 - c) equalises the pressure on both sides of the tympanic membrane. (2)
 - d) transmits the vibrations from the middle ear to the inner ear. (2)
 - e) has cristae to detect changes in the speed and direction of the head. (2)
 - f) transmits sound waves to the middle ear. (2)
 - g) absorbs excess pressure waves from the inner ear. (2)
 - h) Converts the stimulus of sound into an impulse. (2)
- 8.1.2. Distinguish between the three different membranes in the middle ear. (6)
- 8.1.3. Explain the function of the pinna. (2)
- 8.1.3. Name the three regions of the ear (3)
- 8.1.4. Name the receptor/s found in part:
- a) D (2)
 - b) F (1)
- 8.2. Study the diagram below. .



- 8.2.1. Identify **A** to **E**. (5)
- 8.2.2. Identify the **THREE** different irregular shaped bones in **C**. (3)
- 8.2.3. Name the parts of the inner ear. (3)



21.3. Hearing

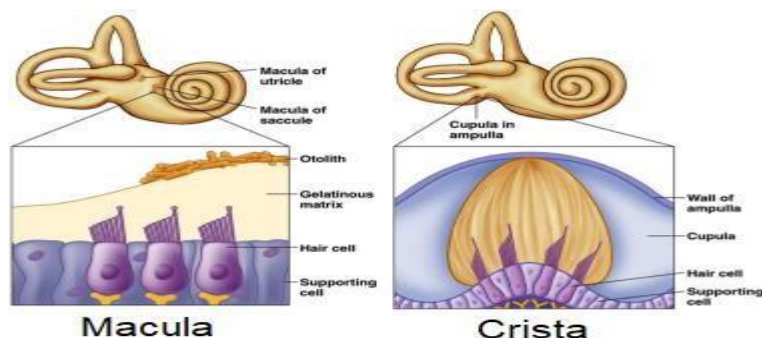


The sound vibrations are transmitted from the **large tympanic membrane** to the **smaller oval window** through the ossicles which are arranged from **largest to smallest**. This concentrates the vibrations, amplifying them.



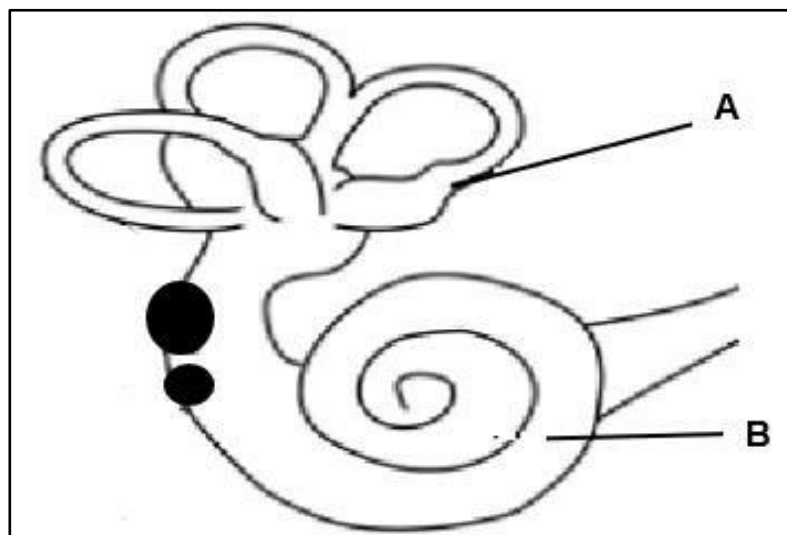
21.4. Balance

- * Controlled by three semi-circular canals in inner ear that lie at right angles with one another
 - * **Cristae** in semi-circular canals stimulated by changes in direction and speed of movement
 - As head turns in one direction the liquid in the canal will move
 - This moves the jelly-like cupula of **crista**
 - Pulling force exerted on sensory hair cells (hair cells are stimulated).
 - * **Maculae** in sacculus and utricle stimulated by changes in position of head
 - Responds to gravity
 - As head changes position pressure increases on the hair cells
 - * When stimulated
 - **Cristae** and **maculae** convert stimuli received into nerve impulses
 - Transported along auditory nerve to cerebellum
 - Cerebellum sends impulses to muscle to restore balance
- Balance can be combined with a reflex.**



ACTIVITY 9:(Hearing and Balance)

9.1. Study the following diagram and answer the questions that follow



- 9.1.1. Identify parts labelled **A** and **B**. (2)
- 9.1.2 Give the name/s of the receptors in ...
- a) **A** (1)
 - b) **B** (1)
- 9.2.1. Give the LETTER of the part that is responsible for:
- a) Hearing (1)
 - b) Balance (1)
- 9.2.2. Explain how the sound is intensified in the middle ear. (4)
- 9.2.3. Explain the role that the semi-circular canals play in balance. (12)



Department of Basic Education – Life Sciences, Examination Guideline grade 12, 2023
Department of Basic Education, 2013 – 2023. The Curriculum Assessment and Policy
Statement, National and Provincial question papers.

National Senior Certificate, 2022 diagnostic report.

How to teach Life Sciences, GRADE 12, TEACHER'S GUIDE TERM 2, MD Watson
with assistance of: J Brümmer , A Esterhuizen, C van Heerden

Learn extra by MINDSET

Hoërskool Birchleigh – A Laas

<http://www.sightmatters.com.au/F>