COORDINATION IN PLANTS AND ANIMALS

Some common terms

- **Irritability**: ability of an organism to detect and respond to stimulus in the environment.
- **Stimulus**; refers to a change in the internal or external environment to which an organism responds.

  Stimulus can be categorized as,
  - ✓ ***Chemical stimulus*** e.g smell & taste
  - ✓ ***physical stimulus/mechanical*** e.g light, pressure, gravity, touch,& heat
  - ✓ ***External stimulus*** i.e change in the conditions in the external environment of an organism, to which an organism responds. e.g sound, light, temperature, touch , smell etc.
  - ✓ ***Internal stimulus*** i.e change in all conditions in fluids surrounding the living cells e.g. internal body temperature, salt concentration, carbon dioxide concentration and blood sugar.
- **Receptors ;** cells or organs that receive the stimulus from internal and external environments and convert it into impulses. e.g ears, nose, skin , tongue etc.
- **Effectors ;** is a cell or organ or body structure that produces a physiological response when stimulated. e.g. muscles and glands.
- **Response;** change in activity of part or whole of an organism body as a result of the presence of a stimulus.

  Can either be towards the direction of stimulus (***Positive response***) or away from the direction of stimulus (**negative stimulus**).

(a) Reception and response in plants

Plant responses include;

- ❖ Nasty / nastic response
- ❖ Tropism/ tropic response

(i). Nastic response;

- ✓ Is a non directional movement of part of a plant in response to some diffused non directional stimulus. i.e response does not depend on the direction from which stimulus is coming from. Examples include.
- ✓ Folding and droping of leaves of *Mimosa pudica* on slight touch.(thigmonastic/haptonastic)
- ✓ Closing of leaves in insectivorous plants such as venus fly trap, on landing of insects between its lobes.(haptonastic).

- ✓ Some plants fold their petals and leaves when light intensity decreases and are spread with increase in light intensity.(photonasty).
- ✓ Opening of crocus and tulip flowers in response to a rise in temperature(thermonasty)

Significance of nastic responses.

- ✓ The plant avoids losing a lot of water through transpiration.
- ✓ It enables the insectivorous plants to feed by capturing landing insects.
- ✓ Folding of leaves when light intensity decreases and spreading with increase in light intensity, allows maximum absorption of light for photosynthesis, more carbohydrate is made and faster.

(ii). **Tropism/ tropic response**

- ✓ Growth movement of parts of a plant in response to unidirectional stimuli or stimuli coming from a single direction.
- ✓ Most tropic responses are slow, and are usually caused by plant growth substance, auxins.
- ✓ Growth of plant parts can be away from the stimulus (***negative tropism***) or towards the stimulus (***positive tropism***).

Types of tropisms

- Classified according to the type of external stimulus involved i.e

External stimulus	Type of response	Examples
light	Phototropism, growth movement of part of plant in response to a unidirectional light.	▪ Plant shoots grow towards the direction of light(positively phototropic) ▪ Plant roots grow away from the direction of light. (negatively phototropic)
water	Hydrotropism , growth movement of part of a plant in response to a unidirectional source of water.	▪ Plant roots grow towards a water source (positivity hydrotropic)
Gravity	Geotropism/gravitropism, growth movement of part of a plant in response to gravity.	▪ Plant roots grow downwards towards the gravitational pull (positively geotropic). ▪ Plant shoots grows away from gravitational pull(negatively geotropic)
Chemical	Chemotropism, growth movement of part of a plant in response to a unidirectional source of chemical.	▪ Pollen tubes grow towards the micropyle, where chemicals are secreted(positively chemotropic)

		▪ Hyphae of some fungi grow away from their products of metabolism(negatively chemotropic).
Touch	Thigmotropism/haptotropism; is the growth movement part of plant in response to unidirectional touch.	▪ Tendrils of young passion fruits, and pumpkins twine around support.(positively haptotropic). ▪ Root tips grow away from stones and other obstacles.(negatively haptotropic)

IMPORTANCE OF TROPISM TO PLANTS

- ❖ Positive phototropism of shoots allows plants leaves absorb sunlight for photosynthesis
- ❖ Positive phototropism allows shoots to be spread out holding flowers and fruits in best positions, enhancing pollination and dispersal respectively.
- ❖ Positive geotropism of roots allows plants to absorb water and mineral salts.
- ❖ It also provides firm anchorage to the plant in the soil, preventing physical destruction by wind.
- ❖ Negative geotropism of plant shoots, allows for upward growth, leaves are therefore in best positions to absorb sun light for photosynthesis.
- ❖ Exposes flowers to agents of pollination
- ❖ Positive hydrotropism of roots, allows plants to absorb water and mineral salts for photosynthesis.
- ❖ Thigmotropism enables plants with weak stems to obtain support.
- ❖ Positive chemotropism allows for growth of pollen tube, enhancing the process of fertilization in flowering plants

QUESTION;

1.**(a). What is tropism?**

(b). Describe the importance of the different types of tropisms in plants.

2. Describe an experiment to show phototropism in plant shoots.

Aim of experiment. To show phototropism in plant shoots.

Requirements

- ✓ Two potted bean seedlings, 2 boxes with windows on one side, one clinostat, water.

Procedure

- ✓ Two potted bean seedlings are watered.
- ✓ One is placed in a box with a window on one side to allow light to reach the shoot from one direction only.
- ✓ The other seeding is placed in another box with the same conditions but on a clinostat rotating slowly so that all the sides of the shoot are equally exposed light.
- ✓ The two experiments are left to stand for 7 days.

Observations

- ✓ shoot of the bean seeding in box A grew bending towards light while the other seedling in B continued to grow upright.

Conclusion

- ✓ shoots grow towards the direction of light and are positively phototropic.

3. **Describe an experiment to show geotropism in plant shoots**

Aim of experiment; To show geotropism in plant shoots.

Requirements. 2 potted seedlings which have grown straight, clinostat, water, plastacine, cardboard.

Procedure

- ✓ A shoot of potted plant is laid horizontally in a jar fixed in position by pastacine.
- ✓ Second potted seedling is placed in a slowly rotating clinostat, so as to expose all the sides equally to the pull of gravity.
- ✓ Both experiments are covered with card board to cut off the effect of light, and experiment left to stand for 48hours.

Observation;

- ✓ Shoot of stationary seedling changes direction, growing upwards, while the one in the clinostat continues growing horizontally.

Explanation

- ✓ In the slowly rotating clinostat, plant shoot experiences gravity equally in on all sides ; therefore no specific direction of gravity, shoot continues to grow horizontally.
- ✓ Shoot of seedling laid horizontally experiences a specific source of gravity, causing un even distribution of auxins in plant shoot with much concentration on lower side; therefore grows faster and bends upwards.

Conclusion

- ✓ Shoots grow away from direction of gravity, therefore negatively geotropic.

4. **Describe an experiment to show geotropism in plant roots**

Aim of experiment; To show geotropism in plant roots

Requirements ; Young bean seedling with straight radicles, moist cotton wool, 2 petri dishes , one clinostat, pins.

Procedure;

- ✓ Two petri dishes are tightly packed with moist cotton wool.
- ✓ Bean seedlings with straight radicles are pinned, with one radicle vertically upwards, second with radicle horizontal, and the other radicle vertically downwards.
- ✓ Control experiment is set up , all seedlings pinned with their radicles horizontal , and petridish placed in a clinostat.
- ✓ Both experiments are left to stand for about two days in darkness to avoid the effect of light.

Observation

- ✓ Radicles of seedlings pinned in the petridish placed in slowly rotating clinostat continued growing horizontally, without bending.
- ✓ All radicles of seedling pinned in the first petri dish grew bending vertically downwards.

Conclusion

Roots grow towards the direction of gravity, therefore are positively geotropic.

5. **Describe an experiment to show hydrotropism in plant roots**

Aim of experiment; To show hydrotropism in plant roots

Requirements; porous pot, dry soil, water, glass trough, bean seeds

Procedure;

- ✓ A porous pot is placed at the centre of the trough.
- ✓ Pot is filled with water
- ✓ Dry soil is is placed all around the pot in the trough.

- ✓ Germinated seeds are placed 5cm from the porous pot.
- ✓ Set up is left to stand for 3 days.

Observation

- ✓ Radicles grow downwards towards the water source as the shoots continue growing vertically upwards.

Conclusion

- ✓ Roots grow towards water , therefore positively hydrotropic.

CHEMICAL CONTROL OF PLANT RESPONSES

- ❖ Upward growth of shoots and down ward growth of roots in plants is controlled by **plant growth substances i.e** auxins, gibberellins, abscisic acid, cytokinins, and ethene.
- ❖ Growth substances in plants are made in one part of plant, transported to another part where they cause an effect on growth.
- ❖ Movement of these growth substances from cell to cell is by **diffusion**, so it takes time for them to reach their target cell, thus response in plants is slower than in animals.

(a) **Auxins;**

- ❖ Are produced in the shoot and root tips.
- ❖ Example of auxin is Indole-acetic acid(IAA).

Control plant growth by;

- ➢ Influencing cell elongation; by increasing protein synthesis, facilitating stretching of cell walls as cells gain water by osmosis, and by stimulating formation of sap vacuoles.
- ➢ Simulating the development of adventitious roots
- ➢ Inhibiting growth of lateral buds (apical dominance)
- ➢ Inducing parthenocarpy (formation of fruits without fertilisation)
- ➢ Inhibiting abscission/ falling of fruits, young leaves and flowers before maturity.
- ➢ Promoting mature leaf fall(abscission)
- ➢ Initiating secondary growth by stimulating cell division in the cambium.
- ➢ Stimulating translocation of organic substances in the phloem.

Questions.

1. **Describe an experiment to show the effect of auxin distribution on the growth of the shoot** .

Aim: To show the effect of auxin distribution on the growth of the shoot

Requirements; seedlings with straight coleoptiles, razor blades.

Procedure;

- o Seedlings with straight coleoptiles are selected.
- o A razor blade is inserted on one side of the coleoptiles tip and the coleoptiles are left to grow in the dark 48 hours.

Observation

Coleoptiles continue to grow upwards but grows bending towards the side with a razor blade.

Conclusion

Side of coleoptiles with razor blade grows slower than the side without razor blade.

Explanation

- Auxins in the dark diffuse evenly down to all the sides of the coleoptiles.
- insertion of the razor blade on one side of the coleoptiles, prevents diffusion of auxin on that side.
- growth on the side of the razorblade is reduced and the side without the razor blade grows fast becoming longer which result in the bending of the coleoptiles towards the side of razor blade.

2. Describe an experiment to verify that uneven distribution of Auxin causes unequal growth at the tip of shoots.

Aim; To verify that uneven distribution of Auxin causes unequal growth at the tip of shoots.

Requirements. Two seedlings with straight coleoptiles, razor blade.

Procedure.

- ✓ Seedlings with straight coleoptiles are selected.
- ✓ tip of some coleoptiles are removed by cutting with a razor blade, and then put back on one side.
- ✓ tip of another coleoptile is removed, placed on agar plate for some time.
- ✓ Tip is removed from agar plate and plate placed on one side of the decapitated coleoptiles and both experiments left to stand for 48hours in the dark.

Observation

Seedling A, coleoptiles grows while bending towards the side without the tip.

Seedling B, coleoptiles grow bending towards the side without the agar plate.

Conclusion

Faster growth occurs in the coleoptiles tips with caused diffusion of auxins and slowly on the side with less auxins.

Explanation

- In seedling A, placing the tip on one side, diffusion of auxins down on one side of the coleoptiles occurs; causing to grow more rapidly than the other side with less auxin, causing it to bend.
- In seedling B, auxins from the cut tip diffused to the agar plate, and on placing the plate on one side of cut cut coleoptiles, auxins diffused down that side, increasing its growth, and causing bending.

3. **Describe an experiment to show the effect of auxins in the roots.**

Aim: To show the effects of auxins in the roots

Requirements; Seedling with straight radicals, razor blade, agar plates.

Procedure

- tip of the root is cut , removed and placed on the agar plate for some time.
- tip of the root is removed from the agar plate and agar plate placed on one side of the cut root.
- agar plate is left on the root for 3 days.

Observation

Root grows bending towards the side with agar, due to rapid growth on the side without agar.

Conclusion

Less auxins are necessary for tropic response in root

Explanation

Auxins diffused from the root tip to the gar plate, and on placing the agar on one side of the root , auxins diffused from the agar plate to one side of the root. The part with agar had more auxins hence slowing down growth on this side and side with less auxins, grows more rapidly causing the bending.

AUXIN AND PHOTOTROPISM

(a) If a plant shoot is exposed to light coming from all directions/ total darkness,

- ✓ Auxins produced at the shoot tips diffuse uniformly down the shoot,
- ✓ This causes all cells in the zone of cell elongation to elongate uniformly, therefore uniform upward growth of shoot occurs.

(b). if a plant shoot is exposed to a unidirectional light source/ light coming from one direction;

- ✓ Light causes the auxins to diffuse to and accumulate on the dark side of the shoot,
- ✓ Higher concentration of auxin on the dark side, rapid growth of cells here occurs, causes them to elongate more than cells on the side exposed to unidirectional light, therefore shoot bends towards the unidirectional light.

AUXIN AND GEOTROPISM

In a horizontally growing seedling,/ seedling with straight radicle and shoot, radicle grows bending downwards, and shoot grows bending upwards because,

- ✓ Auxins produced at the root and shoot tips diffuse to regions of growth,
- ✓ Due to gravity, more auxin accumulates in the lower areas of the root and shoots, lower regions will have high concentration of auxins.
- ✓ In the root, a high concentration of auxin slows down growth therefore the lower side grows slowly while the upper side grows faster due to more cell elongation, causing the bending of the root downwards.
- ✓ In the shoot, a high concentration of auxin stimulates faster growth on the lower side which makes it longer than the upper side and the shoot bends upwards away from gravity.

Illustration.

Questions

1. Explain the effect of

(a) light reaching the shoot of a plant from only one direction.

.

(b) gravity on shoots and roots .

Assignment

Describe an experiment that would be carried out to show that a plant shoot is negatively geotropic.(13mks)

Describe an experiment to show the region of growth in a root (7marks)

Solution

Aim – to show the region of growth in a root.

Requirements

- Freshly germinating seeds with straight radicles
- Pins
- Rulers
- Coloured ink
- Moist cotton wool
- Conical flask
- Cork

Procedure.

- Straight root or radicle is marked equal intervals using coloured ink
- Seedlings are pinned to underside of a cork with their roots hanging downwards,
- Cork is put in the neck of a flask containing moist cotton wool

- Set up is put in darkness and left to stand for 3 days.

Observation

Marked intervals behind the tip of root are longer than those above the tip.

Conclusion

Growth in the root is at region just behind the root tip.

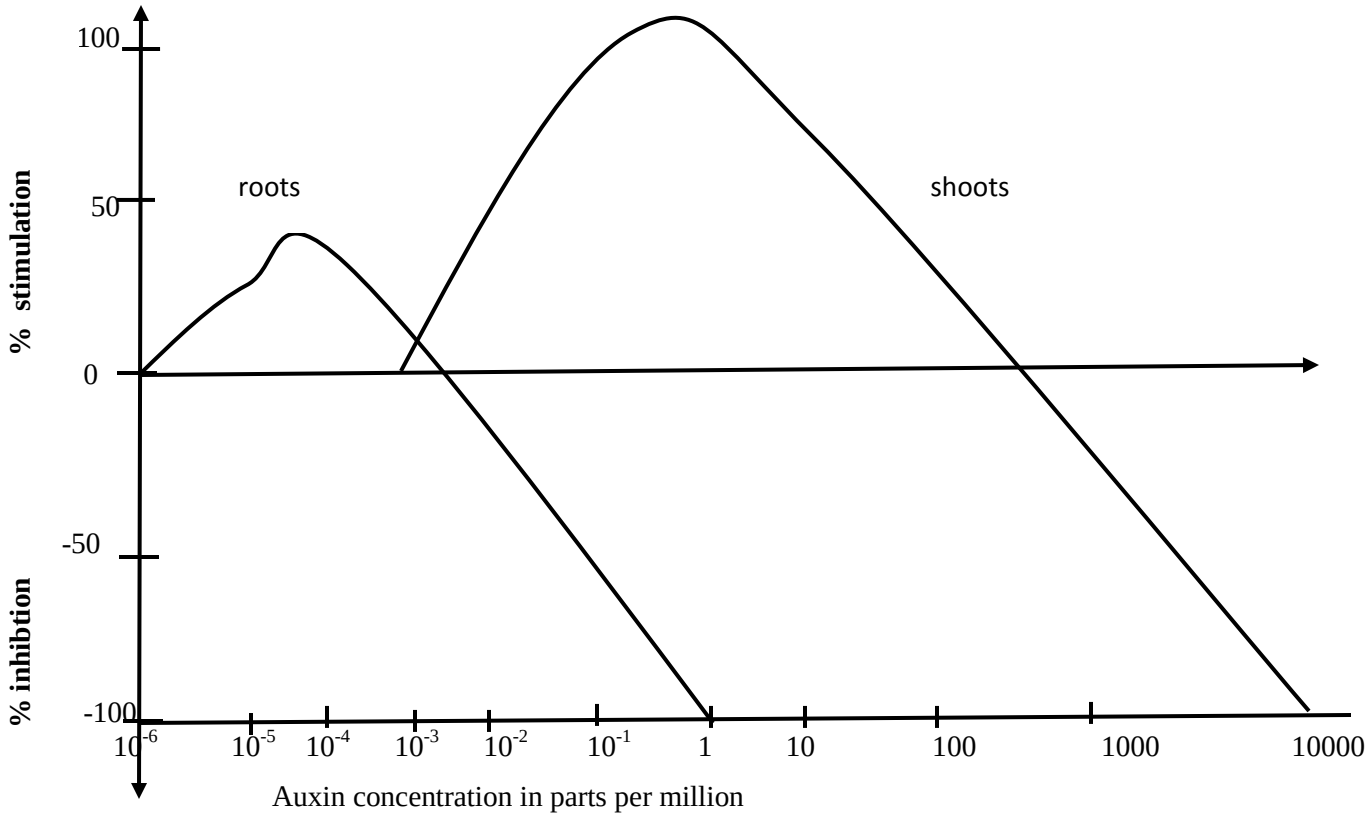
Question

How does auxin concentration affect the growth of plant roots?

Solution

Low auxin concentration stimulates root growth and high auxin concentration retards root growth.

Graph showing effect of auxin concentration on growth responses of roots and shoots.



Interpretation

(a) In roots;

- Increase in auxin concentration from 10^{-6} to 10^{-4} ppm, increases the stimulation in growth of roots
- Maximum stimulation of growth in roots is at auxin concentration, 10^{-4} ppm
- Increase in auxin concentration from 10^{-4} to 10^{-2} ppm, decreases the stimulation of growth in roots
- Auxin concentration greater than 10^{-2} ppm, does not stimulate growth of roots, but produces increasing inhibition of roots as the concentration increases.
- Concentration of auxin greater than 1ppm inhibits growth of roots.

(b) In shoots ;

- Auxin concentration from 10^{-6} to 10^{-4} ppm, produces no stimulation of growth in shoots
- Increase in auxin concentration from 10^{-4} to 1 ppm, increases stimulation of growth in shoots, reaching a maximum stimulation of growth at concentration 1ppm.
- Concentration of auxin greater than 1ppm there is decreasing stimulation in growth in shoots .
- Auxin concentration of 10000ppm produces total inhibition of growth in shoots.

ASSIGNMENT ; Compare tropic and nastic responses in plants (10marks)

(b) **other important plant growth substances, and their effects in plant growth**

Growth substance	Site of production	Effect on plant growth
Gibberelins	Young leaves, root tips, embryo seeds	▪ Breaks seed dormancy ▪ Elongation of internodes of dwarf plants ▪ Stimulates germination of seeds by synthesis of amylase which hydrolyses starch to maltose for respiration. ▪ Simulate flowering in some plants ▪ Inhibits growth of adventitious roots ▪ Promotes growth of side branches
cytokinins	Fruits, seeds, and carried to other plant parts	▪ Slows down ageing of leaves ▪ Breaks dormancy in both buds and seeds ▪ Stimulates bud development ▪ Enlargement of cotyledons ▪ Stimulate formation of callus tissue that heals damaged tissues in plants
Ethene/ethylene	Nodes of stems, ageing leaves, flowers, outer covering of fruits	▪ Promotes ripening of fruits ▪ Breaks bud dormancy ▪ Stimulates abscission of leaves ▪ Induces flowering in pineapples ▪ Inhibits root growth
Abscissic acid	Buds, base of leaves, fruits, seeds, tubers	▪ Stimulates leaf fall ▪ Inhibits germination in seeds by prolonging dormancy ▪ Stimulates closure of stomata in leaves under water stress ▪ Promotes ageing

ASSIGNMENT

Compare the effects of auxins and gibberellins (7marks)

Explain how auxins are used in agriculture (5marks)

Reception, response and behavior in animals

Tacti responses /taxis(plural, taxes)

Is the movement of a whole organism in response to a unidirectional stimulus.

Can be positive (towards the stimulus) or negative(away from stimulus)

Classified according to the nature of stimulus e.g

stimulus	**Response**	**example**s
light	Phototaxis, movement of whole organism towards a unidirectional light.	▪ Maggots move away from light(negative phototactic) ▪ Grasshoppers fly towards light at night(show positive phototaxis)
Chemical	Chemotaxis, movement of whole organism inresponse to chemical concentration.	▪ Movement of bees towards flowers following scent from them.(shows positive chemotaxis) ▪ Male moths fly towards a pheromone(shows positive chemotaxis)
water	Hydrotaxis , movement of whole organism in response to moisture.	▪ Earthworms move to moist areas of soil(shows positive hydrotaxis). ▪ Wood louse seeks moist area.(shows positive hydrotaxis)

READ ABOUT **THERMOTAXIS, GEOTAXIS, HAPTOTAXIS giving relevant examples in each case.(juma batwalla , pages 246,247,and any other relevant biology book**)

Questions .

1. Describe an experiment to demonstrate hydrotaxis in using a named invertebrate.

Aim; To demonstrate hydrotaxis in wood lice.

Requirments Glass tube, wood lice, anhydrous calcium chloride, cotton wool, water.

Procedure

- ✓ Some cotton wool is moistened by soaking in water.
- ✓ soaked cotton is plugged at the end of the glass tube
- ✓ wood lice are placed at the centre of the glass tube
- ✓ Anhydrous calcium chloride together with cotton wool is plugged at the other end of the glass tube.
- ✓ experiment is left to stand for about 3 hours.

Observation
All the woodlice moved to the moist cotton wool
Conclusion
Wood lice are positively hydrotactic

2. **Describe an experiment to demonstrate phototaxis using a named invertebrate**

Aim ; To demonstrate phototaxis in blow fly larvae/ maggot

Requirement; Glass tube, black paper, cotton wool water.

Procedure

- soaked cotton wool is spread at the base of the glass tube.
- one side of the glass is wrapped with black paper.
- blow fly larvae are introduced in the middle of the glass tube and experiment left for about 3 hours

observation

Most of the blowfly larvae move and settle on the dark side of the glass tube.
Conclusion
Blow fly larvae are negatively phototactic.

ASSIGNMENT

Describe an experiment to demonstrate chemotaxis in sugar ants.(student book 3, page 71) 7marks.

IMPORTANCE OF TACTIC RESPONSES

- Tactic response enables the organisms to move to areas with favorable conditions for their survival e.g., earthworms move to moist soils to avoid loss of water and death.
- It enable organisms to move to areas where they can hide from their predators
- It enables organisms move to areas where they can locate and obtain food.
- It enables organisms to locate mates during the breeding season, enhancing production of off springs

Nervous co-ordination in animals

Nervous system.

Is a communication system in animals consisting of specialized cells (nerve cells)/**neurons**, linked to each other and to different sensory cells (**receptors**) and **effectors.**

Divided into two main parts,

- Central nervous system, made up of brain and spinal cord
- Peripheral nervous system, made up of all nerves arising from the brain(**cranial nerves**), and spinal cord, (**spinal nerves**), connecting receptor and effector with central nervous system.

(a) Central nervous system.

Consist of brain and spinal cord.

Structure and function of the brain

Structure.

- Is an enlarged , specialized front region of the spinal cord.
- Divided into two hemispheres, left hemisphere controlling the right side of the body and right hemispheres controlling the left side of the body , interconnected by a group of nerves, **corpus callosum.**
- Consist of three main parts, **fore brain** (olfactory lobes, cerebrum, dorsal pineal body, pituitary gland), **mid brain**(optic lobes), and **hind brain** (cerebellum , medulla oblongata).

Section through head showing the brain (introduction to biology , DG mackean page 143, student book 3, page 80)

Function of major parts of the brain.

Part	**functions**
Medulla oblongata	▪ Controls involuntary activities in the body like heart beat rate, swallowing, breathing rate, salivation, vomiting, laughing etc.
Cerebrum, consisting of left cerebral and right cerebral hemispheres. Surface of cerebral hemisphere is called **cerebral cortex**	▪ Controls intelligence, reasoning, memory, learning. ▪ Coordinates all body voluntary activities such as walking , dancing, and jumping. ▪ Receives and interprets impulses from the sense organs. ▪ Responsible for emotions like joy, anger, and sorrow.
cerebellum	▪ Coordination of body movements, and body balance
hypothalamus	▪ Controls feeding, sleeping, pleasure, thirst, and aggression. ▪ Regulates body temperature ▪ Regulates water content and carbon dioxide level of blood ▪ Controls the pituitary gland secretion.
thalamus	▪ Integrates sensory information received by the brain before conveying it to cerebral cortex of the cerebrum.
Corpus callosum	▪ Connects the left and right hemispheres.
Pituitary gland	▪ Secretes various hormones which regulate a number of body processes

General functions of the brain

- ✓ Stores information for memory
- ✓ integrates information received and co-oordinates activities of the body so that all body actions work efficiently together.
- ✓ receives messages from all sensory organs of the body
- ✓ sends the messages to the glands and muscles causing to function accordingly.

Structure and function of the spinal cord.

Structure.

- Is a cylinder of nervous tissue , extending from the base of the brain and down the back of the body
- Has H-shaped central area, grey matter containing **cell bodies** of relay neurone and motor neurone, and **synapse**.
- Grey matter contains a spinal canal at its centre , and containing cerebrospinal fluid, providing nutrients to cells of the canal.
- Grey matter is surrounded by white matter, composed of nerve fibres surrounded by myelin sheath.

Spinal cord in transverse section

Functions of the spinal cord.

- ✓ Carries sensory impulses from sense organs to the brain
- ✓ Provides a pathway for transmission of impulses from the brain
- ✓ Coordination centre for simple spinal reflexes (knee jerk or hand jerk)
- ✓ Coordinates body involuntary activities like contraction of the bladder
- ✓ Provides points of origin of spinal nerves.

(b) Peripheral nervous system.

- made up of all nerves arising from the brain(**cranial nerves**), and spinal cord, (**spinal nerves**), connecting,
  - ✓ receptors in (ears, eyes, ribs, abdomen, hands, legs) with central nervous system
  - ✓ effector(muscle and glands) with central nervous system.

STRUCTURE AND FUNCTIONS OF NEURONES

The basic structural and functional units of the nervous system are called nerve cells/ neurone.

Neurone consists of two main parts,

- ✓ cell body consisting of cytoplasm, nucleus, dendrons, and dendrites.
- ✓ Axon.

Detailed description of main parts of neurone, and their functions.

Part	**Descriptive feature**	**Functions**
(i) Cell body	Consists of; ✓ Nucleus, ✓ Cytoplasm contains mitochondria and ribosomes ✓ Dendrons(extensions from cell body). ✓ Dendrites(extensions branching from the dendrons are in contact with other neurons.	✓ Controls activities of the neurone ✓ Mitochondria provides energy for transmission of nerve impulses. ✓ Ribosomes for protein synthesis ✓ Dendrons carry impulses towards the cell body ✓ Dendrites transmit impulses from different cells to the dendrons
(ii) Axon	Is a long membrane cytoplasmic extension. May be covered by a sheath of fatty substance**, myelin sheath** formed by **Schwann cells.** Myelin sheath has constrictions, form junctions, nodes of ranvier.	✓ Transmits impulses over long distances away from the cell body. Myelin sheath, ▪ Protects the axon ▪ Speeds up transmission of impulses ▪ Insulates the axon from another ✓ Nodes of ranvier speeds up transmission of nerve impulses.

Types of neurones (**introduction to Biology , DG mackean page 138)**

Type of neurone	Descriptive features	function
(i) sensory neurone/afferent neurone	▪ Has single Dendron longer than axon, covered by myelin sheath ▪ Cell body located outside the central nervous system, and gives rise to nerve fibre that divides into axon leading to CNS, and Dendron leading to cell body	✓ carry nerve impulses from the from receptors to the central nervous system
(ii) motor neurone.	▪ Cell body located in the CNS. ▪ Cell body gives rise to a long axon and many dendrons.	✓ Carry impulses from the CNS to the effectors, muscle and glands.
(iii) relay / interneurone/ intermediate neurone.	▪ have relatively short axons ▪ located in the grey matter of the spinal cord and brain.	✓ Relay impulses from the sensory neurones to the motor neurones

Comparison between motor and sensory neurones

(a) similarities

- Both transmit impulses
- Both from a network between the body tissue and CNS.
- Have similar basic structures.

(b) Differences

Sensory neurone	Motor neurone
Impulses are conducted towards the cell body.	Impulses are transmitted away from the cell body
Terminal dendrites connected to relay neurons.	terminal dendrites connect with the effectors
It has a cell body located on the branch of the Axon	It has a cell body at the end of the axon
Conduct impulses from the receptors to the CNS.	Carries impulses away from the central nervous system
Has one dendron	dendrons are more than one.
Short axon	Long axon

SYNAPSE.

- Is a junction formed between axon of one neurone and dendrite or cell body of another neurone.
- Dendrites of the two neurons do not physically touch, impulse transmission across this microscopic gap is by chemical transmitter substances e.g . acetylcholine and noradrenaline.

STRUCTURE AND FUNCTION OF A SYNAPSE.

STRUCTURE.

- ✓ Each axon of the neurone is expanded forming a swollen knob, the **axon terminal/ synaptic knob**, consisting of, **numerous mitochondria** which provide ATP to make more chemical transmitter substances, and pump calcium out of the knob, **numerous synaptic vesicles** containing chemical transmitter substances that transmit impulses from one neurone to another.
- ✓ Calcium ions present at the synaptic knob influence the movement of vesicles carrying the transmitter substance, when impulses reach the synapse.

FUNCTION.

- ✓ Transmission of nerve impulses from one neurone to another.
- ✓ Ensures unidirectional transmission of nerve impulses

DRAWING OF A SYNAPSE (long horn sec book 3, page 86, UCE revision biology by Higenyi J and Apollo.N page 122)

TRANSMISSION OF NERVE IMPULSE ACROSS A SYNAPSE

- Arrival of stimulus at the end of an axon , triggers the release of transmitter substances e.g acetyl choline into the synaptic gap.
- Acetyl choline diffuses across the gap, stimulates the dendrites of an adjacent neurone to from an impulse, and so the impulse is passed.
- After transmitting the impulse, enzyme **acetylcholinesterase** hydrolyses acetylcholine into choline and acetic acid, which diffuse across the synaptic gap into synaptic knob, later reassembled back to acetylcholine.

Question .

Describe how an impulse is transmitted through a synapse.

REFLEX ACTION (SIMPLE REFLEXES) AND CONDITIONED REFLEXES

(a) Reflex action.

- Is a rapid automatic and involuntary response to stimulus by an organ or system of organs without control of the brain.
- Same stimulus produces same response all the time.

Examples of reflex actions , their stimuli and importance to humans.

Simple reflex action	**stimulus**	**Importance**
Knee jerk	Touch on tendon of the knee	Prevents damage of the lower leg
Withdrawal of hand	Hot objects	Prevents burning of hand
Blinking	Foreign particles on the cornea	Protects the eye from physical injury
salivation	Sight or sight of food	Prepares the individual for softening and lubrication of food, easing swallowing.
Constriction of the pupil of eye.	Bright light	Prevents excess entry of light into the eye, which can damage the cells in the retina.
Sneezing	Dust getting into nose	Releases and expels dust containing germs e.g bacteria
Secretion of tears	Onion peels	Irritating chemicals that can damage the eyes are washed away by tears.

Reflex arc,

- Is a route or nervous pathway taken by the nerve impulses in a reflex action.
- Consists of **receptor** (e.g sensory cells in the eye), **sensory neurone** linking with **intermediate neurone** in the grey matter of spinal cord, **motor neurone**, **effectors**(muscle or glands) i.e
- Receptors ⟶ sensory neurone ⟶ relay neurone ⟶ motor neurone ⟶ effectors .

Drawing of a reflex arc.(DG mackean, page 140, longhorn biology book 3, page 84, UCE revision biology page 122)

Description of withdrawal of hand from a hot object/ after being pricked by a pin.

- Heat or pain receptors in the skin are stimulated, fire off impulses which travel along sensory neurons of the arm, to the spinal cord via dorsal root.
- In the grey matter of spinal cord, impulses pass from the sensory neurones to relay neurones across a synapse.
- relay neurones pass the impulses to motor neurones, which leave spinal cord through ventral root, carrying impulses to muscle, the biceps.
- bicep muscles contracts withdrawing the hand from object, preventing damage of tissues.

Importance of reflex actions to animals

- Prevents damage /injuries to bodies such as burns and cuts
- Enables homeostatic control of breathing rate, blood pressure ,to take place through reflex responses.
- Enables the body to make automatic involuntary adjustments to changes in the external environment e.g constricting of pupil in bright light.

Differences between reflex and voluntary actions

Reflex action	**Voluntary action**
• Are very fast	• May take a few seconds they are a bit slow
• response to the stimulus is always the same.	• response to the stimulus may vary depending o the circumstances.
• nervous pathways are in the brain or spinal cord	• Nervous pathways are always in cerebral cortex of brain.
• May use up to three neurones	• Involves many neurones

(b) Conditioned reflexes.

- Are learned automatic response which an organism develops after practice when ineffective stimulus/ substitute stimulus is introduced.
- Examples include; balancing on bicycle, walking, taking cover on the sound of a gun, balancing on one leg, swimming etc
- Organism learns to respond to substitute stimulus by associating it with another.

Question . Describe pavlov's experiment on conditioned reflex.

- Russian Biologist , Ivan Pavlov carried out experiments on dogs.
- Sounded a bell to dogs, no salivation response
- Presented powdered meat to dogs, measured quantity of saliva were produced.
- Presents powdered meat and sounded the bell simultaneously on several occasions, salivation occurred.
- Later he rang the bell without presenting powdered meat, and found out that the dogs salivated.
- The dogs were conditioned to associate ringing of the bell with food.
- Continuous sounding the bell, without presenting powdered meat, quantity of saliva produced reduced gradually, until finally no salivation occurred.

CHARACTERISTICS OF CONDITIONED REFLEXES.

- Involve two stimuli associated together.
- Are temporary
- Reinforced by repetition/practice
- Are involuntary/ not under conscious control of the brain.

Comparison of reflex action and conditioned reflexes

(a) Similarities.

- Both are involuntary responses
- Both are initiated by some kind of stimulus
- Messages are relayed inform of impulses
- Both are coordinated within the CNS

(b) differences

Conditioned reflex	**Reflex action**
• Co-ordinated in the brain.	• Co-ordinated either in the brain or the spinal cord
• More than one stimulus is required to cause a response.	• Only one stimulus is needed to cause a response
• It is a learnt response.	• It is inborn
• Response occurs after repetition/ practice	• Response occurs instantly after stimulus.

CHEMICAL COORDINATION IN ANIMALS

Some common terms

Target cells/ organs.; are cells/ organs in the body of animals where hormones exert their effects/ cause a response.

Hormone; is an organic substance secreted in a part of an organism and cause a response in another part of that organism.

Gland. Are specialized structures that secrete useful substances in the body.

- ❖ Are of two types i.e **endocrine glands** and **exocrine gland**.

(a) Endocrine gland.

- ❖ Are glands which donot have ducts
- ❖ Hormones secreted are released directly into blood stream, transported to the tissues they exert their effects.
- ❖ Examples include pituitary gland, pancreas, adrenal gland, ovary, thyroid gland, testis.

Location of major endocrine glands in the human body.(DG mackean page 144, long horn biology book 3, page 73,)

(b) exocrine gland.

- ❖ Have glands
- ❖ Their secretions are transported through tiny tubes of ducts
- ❖ Mostly secrete digestive juices involved in digestion
- ❖ Examples include, pancreas, salivary glands, sweat glands, gastric glands, walls of duodenum.

Hormones secreted by endocrine glands, and their effects.

Endocrine gland	Hormone secreted	Effects
Thyroid gland	✓ Thyroxine	▪ Controls growth and development in young animals ▪ Induces early metamorphosis in tadpoles ▪ Controls rate of chemical reaction, respiration in adult human
Adrenal gland	✓ Adrenaline	▪ Increases heart beat rate, increases breathing rate, causes dilation of pupils ▪ Increased metabolism, inhibits digestion and peristalsis by diverting blood to muscles. ▪ Increase in blood pressure, contraction of erector pilli muscles, causing hair to stand, increased sweating.
	✓ aldosterone	▪ Stimulates the nephrons to reabsorb salts(NaCl) from glomerular filtrate, maintaining osmotic pressure of blood.
pancreas	✓ Glucagon	▪ stimulates the liver to convert glycogen to glucose , increasing blood sugar level back to normal, decreases metabolic rate
	✓ insulin	▪ stimulates the liver to convert excess glucose to glycogen, and fats,decreasing the amount of glucose in blood .
ovary	✓ oestrogen	▪ development of female reproductive organs, secondary sexual characteristics, healing and repair of uterus wall after menstruation.
	✓ progesterone	▪ Causes thickening of uterine wall and maintains pregnancy & inhibits production of luteinizing hormone.
Testis	✓ testosterone	▪ promotes development of male sex secondary characteristics
Pituitary gland	✓ antidiuretic hormone	▪ controls the amount of water reabsorbed into blood by the kidneys
	Growth hormone(somatotrophic hormone)	▪ stimulates growth of bones and other tissues

QUESTION. Explain why the pituitary gland is referred to as a master gland.(**DG mackean page 145, long horn book 3, page 75)**

- ✓ Several of the hormones it secretes in turn controls the secretion from other endocrine glands. i.e it
- ✓ secretes Thyroid stimulating hormone(TSH) /thyrotropin that causes the thyroid glands to secrete thyroxine hormone.
- ✓ secretes Follicle stimulating hormone(FSH) that stimulates the ovary to secrete oestrogen hormone .
- ✓ secretes luteinising hormone that brings about release of the ovum by the ovary (ovulation) , development of corpus luteum in the ovary and stimulates the testis to secrete testosterone from interstitial cells.
- ✓ secretes adrenocorticotrophic hormone that simulates the adrenal cortex to secrete adrenaline
- ✓ secretes prolactin which stimulates production of milk in the females breasts.

Comparison between nervous and endocrine system/ nervous coordination and chemical (hormonal) coordination.

(a)similarities.

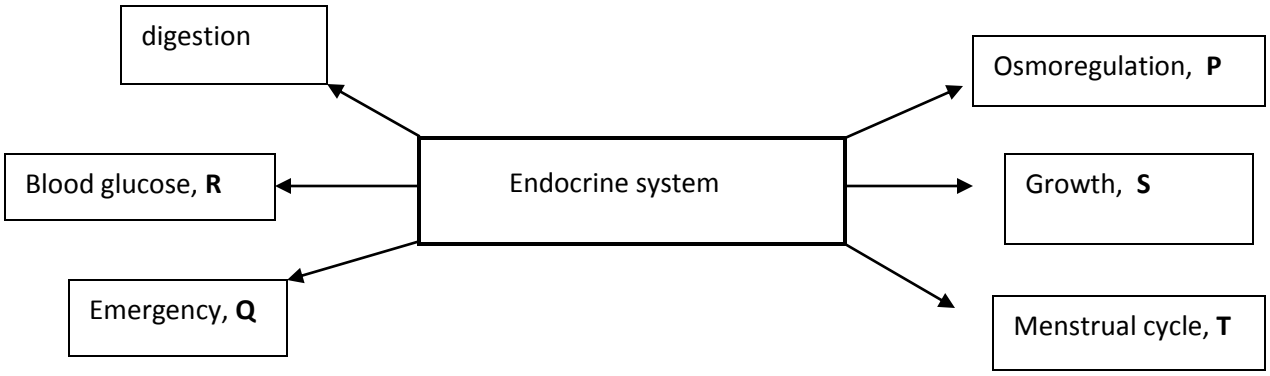
- Both systems cause responses.
- Both system produce means of coordination in the body.
- In both systems, impulses are transmitted by chemical substances
- In both systems, there is transmission of messages.

(b) differences.

Nervous System	**Endocrine (hormonal system)**
• controlled by the brain	• Most endocrine glands are controlled by the pituitary gland
• Messages travel along nerves	• Messages travel by blood
• Communication is by nerve impulses and transmitter substances.	• Communication is chemical messengers, hormones
• Responses last for a short time	• Responses last for a long time
• Response is in one part of the body	• Response is usually in many parts of the body
• There is a quick transmission of impulses	• There is a slow transmission of messages
• Effects is temporary and reversible	• Effects may be permanent and irreversible

QUESTIONS.

1. The chart below shows process controlled by the endocrine system in humans.



(a). Name the glands which secrete hormone, R
(b). Name the hormone responsible for processes, P,Q,R and S
(c). What is the effect of hypersecretion of hormone S?

Solution.

(a). pancreas
(b) P- antidiuretic hormone/vasopressin
Q-adrenaline
R-glucagon and insulin
S-thyroxine
(c) excessive growth leading to **gigantism** in children
Expthalmic goitre in adults, where state of restless and increased heart beat.

ASSIGNMENT.

1. Name the type of response exhibited where,
   a) Roots of a seedling grow towards a porous pot containing water.
   b) Maggots move towards the dark when exposed to light
   c) Sperms swim towards the ova in a female reproductive tract.
   d) A millipede coils itself and produces a stinking substance when touched.

2. Withdrawing a hand from a hot object and bending of a plant shoot towards light are examples of sensitivity by living organisms.

a) What is the importance of sensitivity to living organisms.
b) State ways in which the two actions described above differ.
c) Suggest the cause of the following defects in humans
   i. Production of large amounts of dilute urine
   ii. Overweight and sluggishness in an adult individual.

RECEPTOR ORGANS IN MAMMALS.

Receptor organs are organs responsible for detecting the presence of a stimulus.
Examples of receptor organs in mammals and their functions.

Stimulus/stimuli	**Receptor organ**	**Function(s)**
Light	eye	Detect light/vision
Sound/gravity	ear	Hearing, & balance
Chemicals in air	nose	smelling
Temperature, pressure, & touch	skin	Detects temperature, pressure and touch
Chemical	tongue	tasting

(a) MAMMALIAN EYE

Gross structure of the mammalian eye

- Is spherical shaped structure located in a spherical space, orbit/socket on the front part of the skull.
- Eyeball /spherical shaped structure is attached in position by muscles , which control the movement its movement in the orbit.

Drawing showing external features of eye **(batwalla J, 25**)

External parts of eye showing muscle attachement(**DGmackean,130**)

(b) **mammalian eye in longitudinal section**(**DG mackean , page 130**)

FUNCTION OF PARTS OF THE EYE

Part	Descriptive features	functions
sclera	• Tough , non elastic, fibrous coat round the eye ball • Forms a transparent part, cornea	✓ Protection of the eye ball. ✓ Maintains shape of the eye ball ✓ Provides surfaces for attachment of the muscles.
Eye lid	Cover , so protecting the eye ball Regularly blinks so distributing fluid round the surface of the eye and thus preventing drying the eye Protects the retina from bright light by reflex action	
Eye lashes	Trap dust particles preventing them from entering the eye	
Tear glands	Open under the top of the eyelids	Secrete tears that ✓ keeps the surface of the eye moist ✓ kills any bacteria which be present ✓ Wash away dust and other particles.
cornea	Curved transparent disc in the front part of the sclera	✓ Allows light into the eye ✓ Refracts light rays focusing them onto the retina
conjuctiva	Thin transparent layer of tissue lining the inside of the eyelids, front of the sclera, and continuous with the epithelium of the cornea.	✓ Protects the cornea
Choroid layer	Layer of tissue lining the inside of the sclera, its deeply pigmented with melanin & richly supplied with blood vessels	✓ Blood vessels supply the retina and rest of the eye with nutrients and oxygen ✓ Blood vessels also remove carbon dioxide and other metabolic wastes ✓ Melanin prevents reflection of light within the eye.
Ciliary body	Located at the junction between the sclera and cornea & contains blood vessels and ciliary muscles	✓ Produces aqueous humour
Ciliary muscles	Circular sheets of muscles forming bundles of radial and circular muscles.	✓ On contraction and relaxation, alter the shape of the lens during accommodation.
Suspensory ligament	✓ Attach ciliary body to the lens	
lens	Transparent, elastic, biconvex, in structure	✓ Separates the aqueous and vitreous humour ✓ Refracts light on to the retina
Vitreous humour	Semi solid, colourless, transparent, jelly like substance containing water, salts and proteins	✓ Refracts light rays onto the retina ✓ maintains the shape of the eye ✓ equalize pressure on both sides of the lens
Aqueous humour	Clear/colourless watery fluid of salts, secreted by the ciliary body	✓ supplies nutrients and removes wastes from the cornea and lens. ✓ Refracts light rays onto the retina ✓ Equalize pressure on both sides of the lens ✓ Maintains shape of the eyeball
Iris	Circular, muscular diaphragm containing the pigment that gives the eye its colour.	✓ Controls the amount of light entering the eye by adjusting the size of the pupil
pupil	An opening/hole at the centre of the iris	✓ Allows light to enter into the eye
retina	Innermost layer of the eye, containing light sensitive cells, photoreceptor cells(cones and rods), cellbodies, and axons of neurones supplying the optic nerve	✓ Contain photoreceptor cells that are sensitive to light of different intensity i.e cones(high light intensity) and rods (low light intensity)
Optic nerve	✓ Bundle of nerve fibres carrying impulses from the retina to the brain	
Fovea(yellow spot)	Most sensitive part of the retina, containing cones only	✓ Sensitive to colour ✓ Gives clear images
Blind spot	Has no rods and cones, thus not light sensitive ✓ Has only blood vessels	

IMAGE FORMATION AND VISION

- Light rays from an external object are reflected to the cornea of eye
- Cornea refracts these light rays to the pupil, which are then passed through the aqueous humour, lens, and vitreous humour reaching the retina by refraction.
- Image of the object, real, upside down/inverted, and smaller than the object is formed on the retina,
- Image on the retina stimulates light sensitive cells, impulses are fired off in the nerve fibres, passed along the optic nerve to the brain, upside down image is interpreted and right size , colour and distance of object determined.

Illustration (**long horn biology book 3 page 93, DG mackean , page 131**)

ACCOMMODATION OF THE EYE

- Is the ability of the eye to focus both distant and near objects .
- Occurs as a result of adjustments in the shape of the lens, brought by contraction and relaxation of the ciliary muscles.

(a).During focusing of close objects e.g letters in a book being read.

- Diverging light rays from a close object reach cornea where they are refracted
- Circular ciliary muscles contract.
- Suspensory ligament relax hence slacken/become loose(tension is reduced).
- Lens becomes thicker/more convex/more curved/assume a round shape.
- Degree of refraction of light rays increases, & are focused onto the retina where image is formed.

OR **(see page 95, long horn book 3**)

(b) During focusing of distant objectse.g a plane high in the sky.

- Parallel rays from a distant object reach the cornea where they are refracted.
- Circular ciliary muscles are relaxed
- Suspensory ligaments are stretched outwards, making them tight
- Lens is pulled outward, making it flat and thin/ less convex
- Degree of refraction of light rays decreases, & are focused onto the retina where image is formed

OR (**see DG mackean , page 132**)

CONTROL OF AMOUNT OF LIGHT ENTERING THE EYE.

- ❖ controlled by contraction and relaxation of circular and radial smooth muscles of the iris which determines the pupil size in different light intensities.

(a) **In bright light/high light intensity**;

- ✓ circular iris muscle contract, radial muscles relax
- ✓ pupil constricts
- ✓ less light enters the eye.

OR (**New class book biology, Juma Batwalla, page 259)**

(b) **In dim light/ low light intensity;**

- ✓ circular iris muscle relax, radial muscle contracts
- ✓ pupils dilates
- ✓ more light enters the eye.

OR (**New class book biology , juma B, page 259)**

COMMON EYE DEFECTS AND THEIR CORRECTIONS

Defect	cause	effects	Corrective measures
Short sightedness(myopia)	Large/elongated eyeball	✓ Light from a distant object is focused infront of the retina, image on the retina is blurred.	Wearing spectacles with concave/diverging lenses, which make parallel rays diverge, refracted onto the retina for focus**.**
Long sightedness(hyperm etropia)	Small or short eyeball	✓ Light from a close object would be brought to a focus behind the retina, so the image on the retina is blurred.	Wearing spectacles with convex lens(converging lens), which converge light rays from a nearby object onto the retina

Astigmatism	Rough and uneven corneal surface	✓ Light rays passing through corneal surface are bent at different angles, & scattered, thus not all of them are focused on the retina ✓ Image formed falls out of the retina, is thus distorted.	Wearing of spectacles with uneven/irregular /cylindrical lens, enable convergence of the light rays onto the retina irrespective of the part of the cornea that refracts them.
Old sight/presbyopia	Lens hardens losing its elasticity.	Decrease in the ability of the lens to change its thickness during accommodation, therefore cannot focus both near and distant objects readily.	Wearing spectacles with bifocal lenses
cataracts	Stiff and opaque lens	Less light enters the eye and accommodation is inefficient	Surgery to remove defective lens and replacement of lens with artificial lens

Questions.

1. (a). What is accommodation of the eye?
   (b) Describe how the eye is able to see nearby and distant objects
   c). State the cause of longsightedness and suggest how it can be corrected.
2. (a). What is astigmatism?
   (b) How does the human eye adjust itself for seeing in;
      (i). dim light
      (ii). Bright light
   (c) State the differences between shortsightedness and longsightedness.

Solution(part c)

shortsightedness	**longsightedness**
Only near objects are focused clearly	Only distant objects are focused clearly
Images of fur objects form infront of the retina	Images of near objects form behind the retina
Caused by strong lens and long eye ball	Caused by weak lensand short eye ball
Great curvature of cornea is formed	Little curvature of cornea is formed
Corrected by diverging lens	Corrected by converging lens

3. The figure below shows a section of a human eye. Study it and use it to answer the questions that follow**.(UCE revision biology, page 234)**

   (a). Name the parts labeled A and B
   (b) What is the function of part labeled B in the eye?
   (c). If a person entered a room with bright light, state the changes that would occur in each of the parts labeled A and B of the eye.
   (d). In the space below, draw the shape of the lens only when the eye is focusing on near and distant objects respectively.
   (e). Describe how the shape of the lens is brought about when the eye is focusing on a near object.
4. (a). What is long- sightedness?
   (b). State two causes of long- sightedness.
   (c). In the space below, draw and show light rays from an object gets into the eye of a person who is showing long sightedness.
   (d). What is the effect of each of the following movements of different parts of the eye?
      (i). contraction of the iris
      (ii). Relaxation of the ciliary muscle
      (iii). Shortening and thickening of the lens.

(b) MAMMALIAN EAR

- Is a complex sense organ for **hearing** and for **body balancing**.
- Balancing (movement and position of the head relative to gravity) is detected by the **vestibular apparatus; consisting of semicircular canal, Utricle and Saccule**
- Rest of the ear structure are concerned with hearing.

Structure of the mammalian ear.(**A New class book for Olevel Biology, J.Batwalla, Page261)**

Parts of the ear, their structure and Functions.

- ✓ Divided into three main parts; **outer ear**, **inner ear**, and **middle ear**.

Part	structure	Function(s)
(a) **Outer ear**, consisting of.		
(i) pinna/auricle/earlobe	Made of elastic cartilage covered with skin	✓ Collects, and directs sound waves to external auditory canal. ✓ Provides protection of the middle ear
(ii)auditory canal	Tube like structure lined with cells the secrete wax. Consist of sebaceous glands secreting sebum	✓ Directs sound waves to the ear drum ✓ Wax traps dust which gets into the ear ✓ Sebum moistens the linining making it soft
(iii) ear drum/tympanic membrane)	Membrane separating outer ear from middle ear.	✓ Vibrates sound waves to the ear ossicles.
(b) **middle ear**, consisting of,	Situated between outer and inner ear Cavity within the skull filled with air.	
(i) ear ossicles	Are the malleus(Hammer), incus(Anvil),and Stapes(Stirrup)	✓ Vibrate and transmit sound waves to the inner ear. ✓ Connect ear drum to the oval window
(ii) Eustachian tube	Short tube connecting the middle ear to the throat/ pharynx.	✓ Equalizes air pressure between the outer and the middle ear
(iii) oval window and round window	Thin flexible membrane	✓ Receives vibrations from the stapes and transmit them to the cochlea of inner ear.
c) **inner ear** consisting of,	Consists of a complex system of canals and cavities within the skull bone containing fluid, **endolymph** and is separated from skull wall by another fluid **perilymph.**	
(i) Vestibular apparatus	Consist of 3 **semicircular canals** each lying in a different plane at right angles to the other 2 , utricle(utriculus) and saccule(sacuculus)	✓ Maintaining balance and posture of the head/body
(ii) cochlea	Spiral canal filled with endolymph and perilymph.	✓ Hearing

HEARING

- ✓ pinna collects sound waves from the source, transmits through the auditory canal to the eardrum.
- ✓ eardrum vibrates transmitting the vibrations to the ossicles, which amplify them, and conduct these vibrations to the oval windows.
- ✓ vibrations of the stapes on the oval windows set the fluids of the inner cochlea to vibrate,
- ✓ sensory hair cells in the cochlea are stimulated and fire off impulse which are transmitted to the brain along auditory nerves.
- ✓ On reaching the brain, sound impulse are interpreted and sensation of sound is produced.

ASSIGNMENT

Read about **balance and posture(long horn biology , book 3 page 104, DG mackean page 135)**

DEAFNESS AND ITS CAUSES

Deafness is a condition in which an individual is unable to hear properly.

Type of deafness	causes	correction
• **Absolute/nerve**(condition in which impulses are not able to reach the brain.)	• Damaged auditory nerve by presence of tumor. • Damaged cochlea, thus unable to perceive sound. • Damaged brain cells involved in sound reception. • Heredity, child born with some parts of the ear missing / functionless	• Use of visual signs during speech • Learning skills of lip reading.
• **Conductive(** condition in which an individual can not heat due to problems of relaying sound waves to the ear drum.	• Accumulation of wax in the ear canal • Damage or rupturing of the ear drum by objects, blows on the head, and loud sounds • Ear infection leading to production of pus that reduces sound movement in the ear. • Use of drugs e.g chloroquine	• Treatment of ear infections • Use of hearing aids to enhance sound transmission in the ear • Learning lip reading skills • Use of visual signs in speech

(c) THE TONGUE

- Sense organ for taste
- Consist of receptor cells called the **taste buds**.
- taste buds chemoreceptor's are sensitive to chemicals in solution and are of four types, **sweet**(sugar solution), s**alt**(sea salt), **sour**(lemon juice, spoilt milk), **bitter**(quinine, choloroquine)

  Drawing of tongue showing different regions of taste(long horn biology book 3)

(d) NOSE

- sense organ for smell or olfaction
- consists of Olfactory cells located in its spaces/nasal cavity.
- chemicals in the air dissolve in the moist lining of the nasal cavity, stimulating chemoreceptor and generate impulses, which are sent to the brain by olfactory nerve.
- Brain interprets the impulse as smell, indicating presence of particular chemical in the air.

Question. **List the receptor cells in the skin and the stimuli they detect.**

Sensory receptor cell	Stimulus
Panician	Pressure
Hair plexus	Touch or pain
Free nerve ending	Cold
Meissners corpuscle	Touch

Outline different ways of caring for sensory organs.

- Clear dust and other substances from the ear and nose canals.
- Use goggles to protect the eyes whenever you are working in areas with strong light and dust particles.
- Clean the ears, noise, skin, tongue and eye.

SUCCESS IN COORDINATION