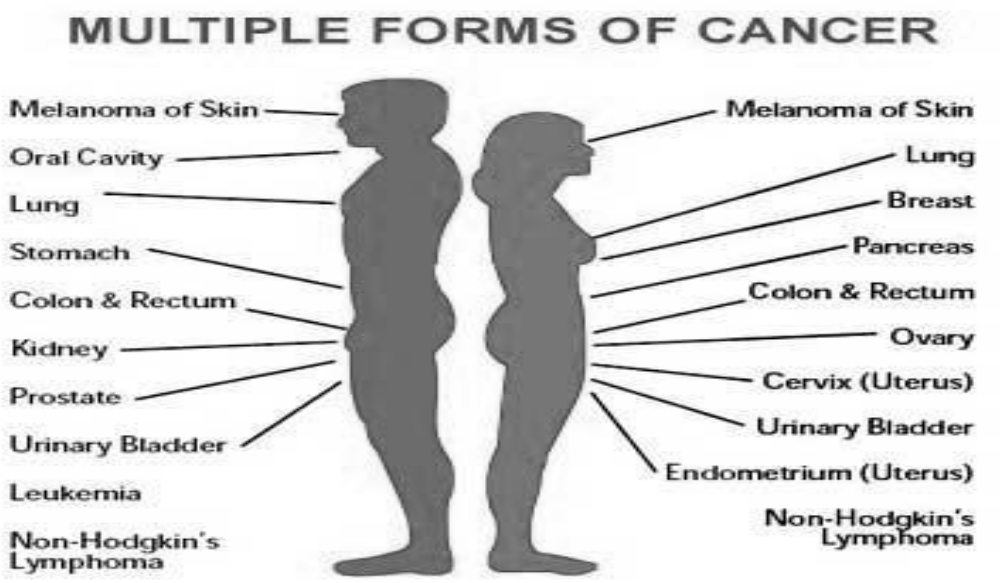
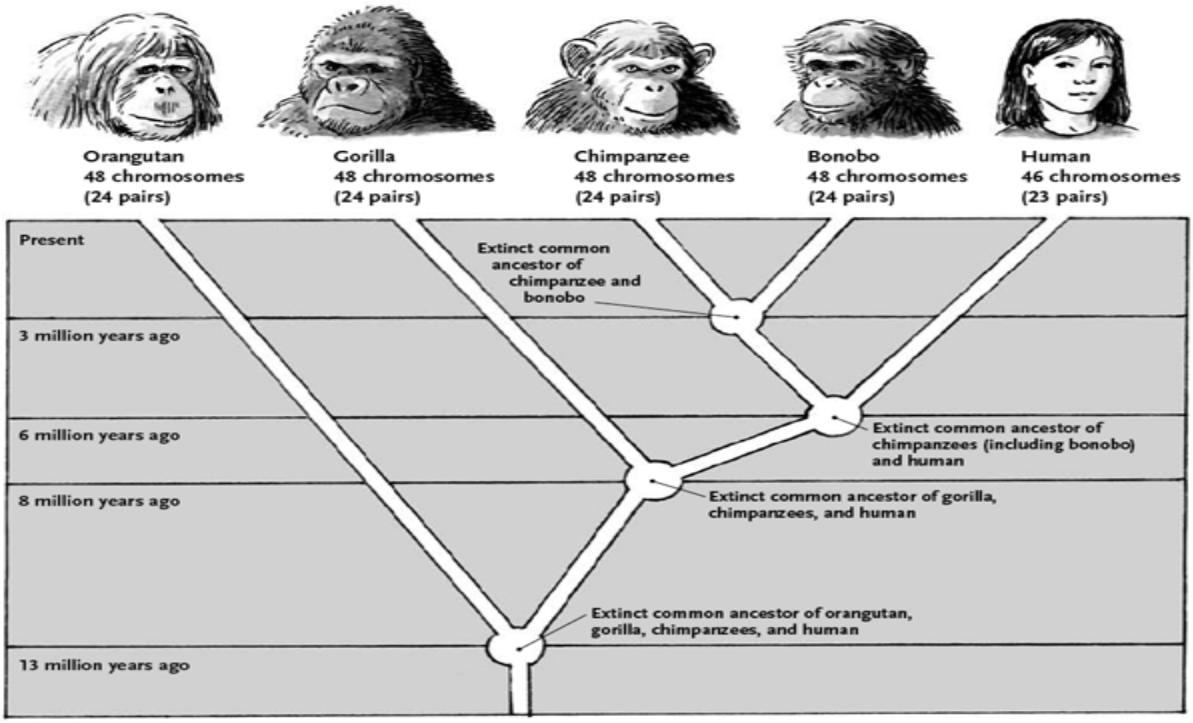
SENIOR SECONDARY BIOLOGY

FORM FOUR NOTES





CHRISTOPHER Z.M. KANYIMBO

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TROPISMS

Tropisms are growth movements made by plants in response to external stimuli that is coming from one direction. The growth movement can be towards or away from the stimuli. The common stimuli in plants are light, gravity and water.

Types of Tropisms

1. **Phototropism**

This is the plant growth movement in response to direction of source of light. The response involving growth towards direction of light is called **positive phototropism**. The response involving growth away from direction of light is called **negative phototropism**.

2. **Geotropism**

This is the plant growth movement in response to gravity. Growth movements towards gravity are called positive geotropism. Growth movements away from gravity are called negative geotropism.

3. **Hydrotropism**

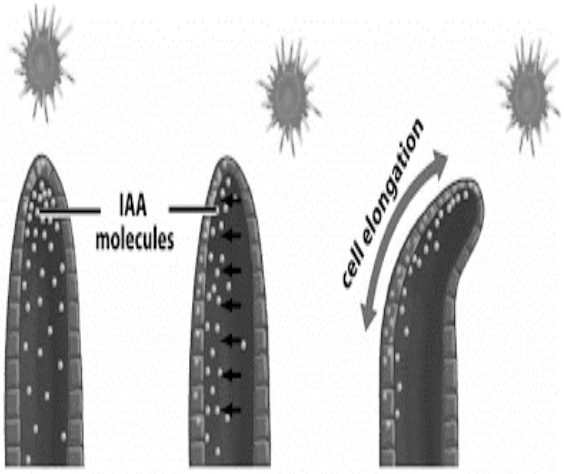
This is a growth response by roots towards water in the soil.

AUXINS

Auxins are plant growth hormones. Auxins control growth of cells in small quantities. The auxins are produced at tips of shoots and roots. Auxins stimulate or induce cell elongation and growth in shoots while in roots they inhibit or slow down cell elongation and growth.

External stimuli (light, gravity and water) affect the distribution of these auxins in plants. They accumulate more in regions close to gravity and water and accumulate away from light.

Auxins and Phototropism



(a) When sunlight is overhead, the IAA molecules produced by the apical meristem are distributed evenly in the shoot.

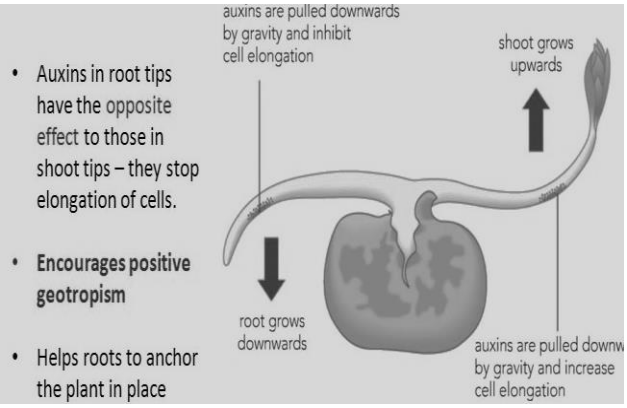
(b) Once the sunlight shines on the shoot at an angle, the IAA molecules move to the far side and induce the elongation of cells on that side.

(c) Cell elongation results in the bending of the shoot toward the light.

In phototropism the stimulus is light. Auxins produced in shoot tips migrate from the illuminated side towards the darker side. This means the darker or shaded side contains more auxins. This results in cells on the shaded side growing faster than those on the illuminated side. This causes the shoot to

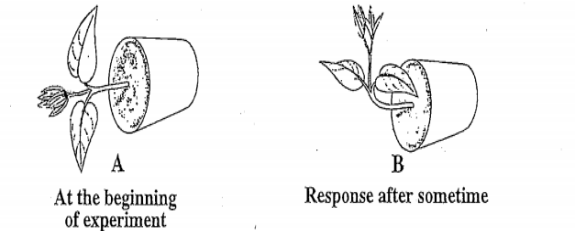
bend towards light to show positive phototropism.

Auxins and Geotropism in Shoots and Roots



In geotropism the stimulus is gravity.

a. In shoots

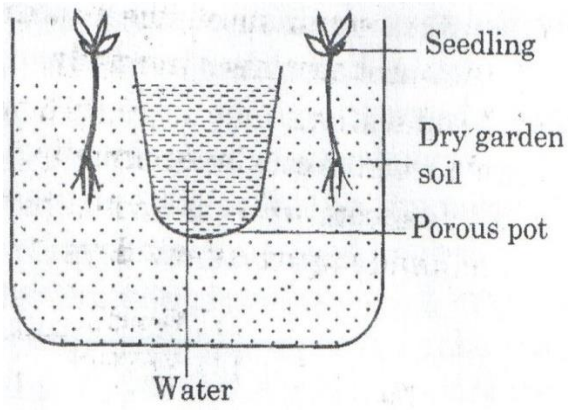


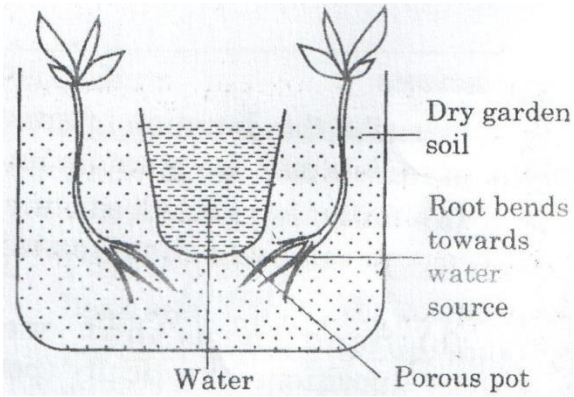
When a potted plant is placed horizontally gravity pulls at auxins produced at the shoot tips and accumulate in the lower side of the shoot. This results in higher concentration of auxins in the lower side hence cells elongate faster than those on the upper side. This causes the shoot to bend upwards away from gravity (B) to show negative geotropism.

b. In roots

When a seedling is placed horizontally, gravity pulls at auxins produced by a radicle tip. Auxins accumulate more on the lower side of the radicle. Since auxins in the radicle inhibit cell growth then the upper side of the radicle grows faster than the lower side causing the radicle to bend downwards to show **positive geotropism**.

Auxins and Hydrotropism





When there is unequal distribution of water in the soil, auxins produced by root tips migrate and accumulate more close to the moist side (the side with high water content). Cell growth is inhibited in the side with high auxins concentration causing the root to bend towards an area of high water content

INVESTIGATIONS ON TROPISMS

HYDROTROPISM

Activity: To investigate hydrotropism in radicles of germinating seeds.

Materials

- Porous clay pot
- Wide and shallow basin
- Dry sand or fine saw dust
- 8-10 soaked seeds
- Match sticks or tooth picks

Procedure

1. Place the porous pot at the centre of the basin or trough.
2. Pour the sand or saw dust into the basin so that it surrounds the clay pot.
3. Sow the seeds about 3cm deep into the dry sand or saw dust and 5cm around the pot. Do not water the dry sand or saw dust.
4. Fill the pot with water. Some of the water will drain out into the surrounding sand.
5. After 2-3 days carefully scoop out the sand from around each germinating seed and observe the direction of growth of the radicles.

Expected result

The radicles will grow towards the wet sand around the clay pot. This shows positive geotropism.

Conclusion

Roots grow towards a water source.

PHOTOTROPISM

Investigation 1: To Find the Effect Of One-Sided Lighting On Growing Shoots

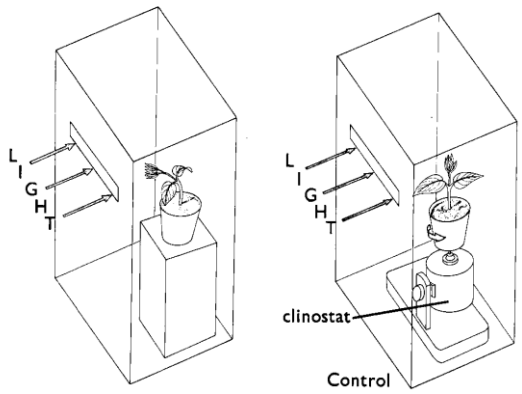
Materials

- Two potted seedlings
- Two cardboard boxes
- Clinostat

Procedure

1. Water the seedlings.
2. Place one seedling in a box with a small hole at the level of the seedling.
3. Place the other seedling in identical situation but on a slowly rotating clinostat.

Result



The shoot on the clinostat continues to grow upwards. The shoot without clinostat changes direction of growth and grows towards light.

Conclusion

One sided-lighting causes shoots to bend towards light.

NB: The shoot bends towards light in set up without clinostat because auxins accumulate on the shaded side causing cell elongation on the side than on the illuminated side. This causes the shoot to bend towards light. In the set up with clinostat, the shoot continues to grow vertically because there is even distribution of auxins due to the rotating clinostat.

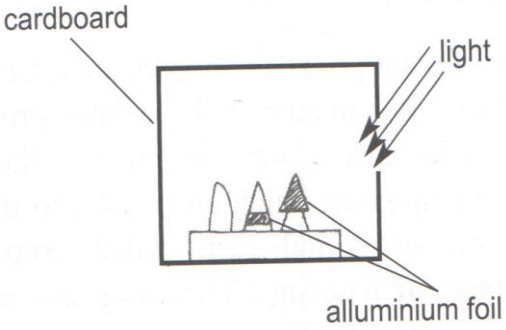
Investigation 2: To investigate the part of a shoot that responds to light

Materials

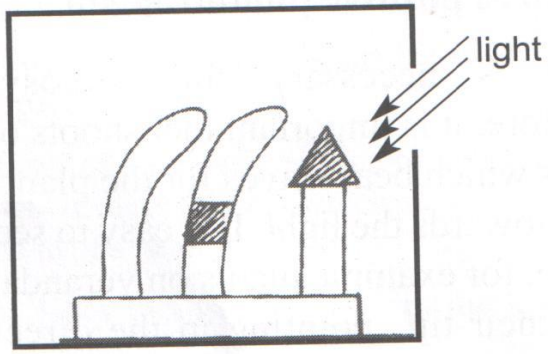
- Three potted seedlings
- Aluminium foil
- A cardboard with a small hole on one side

Procedure

1. Cover the tip of one seedling with aluminium foil.
2. Cover the middle of the seedling with aluminium foil
3. Leave the third seedling untampered with.
4. Put the seedlings in a cardboard .
5. Illuminate the seedlings from one side
6. Leave the apparatus for some days.



Result



After some days the shoot with covered tip continues to grow upright. The shoot with covered middle and the one which is not tampered with bend towards light.

Conclusion

The tip of the shoot is the part that responds to light.

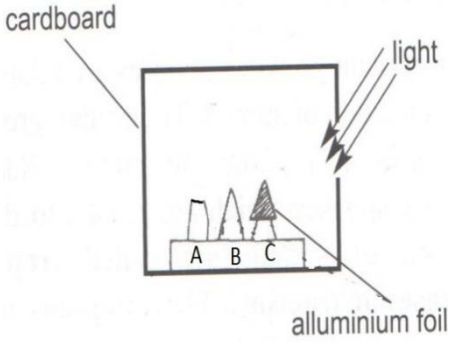
Investigations 3: To investigate how Auxins Influence Phototropism

Materials

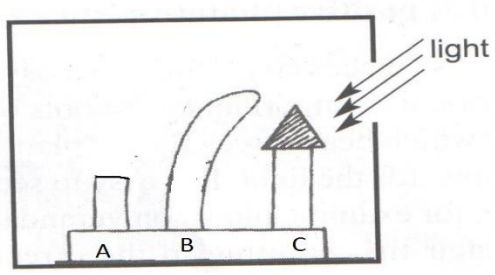
- Three seedlings in damp soil
- Aluminium foil
- Cardboard

Procedure

1. Cut the tip of one seedling and label it **A**.
2. Cover the tip of the second seedling with aluminium foil and label it **B.**
3. Leave the third seedling untampered with and label it **C.**
4. Place the seedlings in a cardboard with a hole on one side.
5. Leave the set up for few days.



Results



Seedling labelled **A** does not change in terms of growth since the auxin-producing cells are eliminated. Seedling **B** elongates and bends towards light because there is uneven distribution of auxins due to light coming from one side. Seedling **C** continues to grow upwards since the tip has uniform distribution of auxins since it is not affected by light.

GEOTROPISM

Investigation 1: To Investigate the Effect of Gravity on Shoots

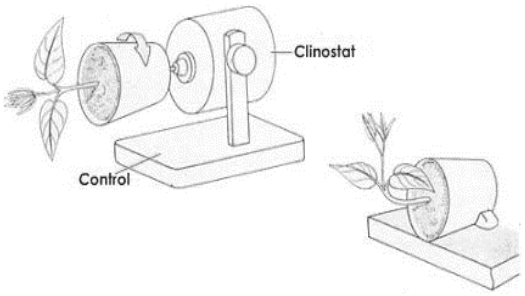
Materials

- Two potted seedlings
- Clinostat

Procedure

1. Place one seedling horizontally.
2. Place the second seedling horizontally and on a clinostat.
3. Ensure that all sides are equally exposed to pull of gravity.
4. Make sure the lighting should be the same for the shoots.

Result



The shoot on the clinostat will still be growing horizontally. The other shoot will change direction of growth and grows vertically upwards.

Conclusion

Shoots grow away from gravity to show negative geotropism.

Investigation 2: To Investigate the Effect of Gravity on Roots

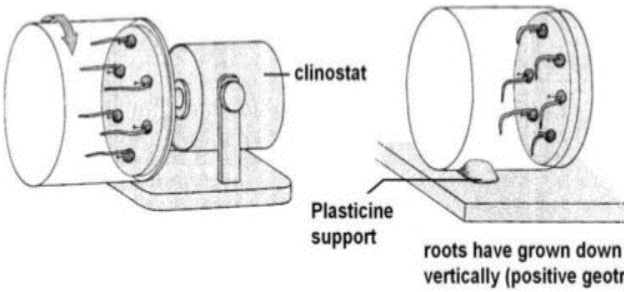
Materials

- Bean seedlings with straight radicles.
- Corks
- Jar
- Clinostat

Procedure

1. Pin the seedlings to two large corks.
2. Place the corks in the mouth of the jars.
3. Leave one set up in horizontal position so that radicles are placed horizontally.
4. Place the other set up on a clinostat.
5. Place the set up in darkness to eliminate phototropic responses.
6. Leave the set up for about two days

Results



The radicles of seedlings on the clinostat continue to grow horizontally while those in the stationary jar grow downwards.

Conclusion

Gravity causes radicles to grow downwards.

Investigation 3: To Investigate Part of the Radicle That Responds to Gravity

Materials

- Seedlings with straight radicles
- Petri dishes
- Indian ink

Procedure

1. Mark the radicles with Indian ink lines 2mm apart.
2. Place the seedlings between two strips of moist cotton wool in petri dishes.
3. Arrange the petri dishes with the seedlings placed horizontally.
4. Replace the lid and hold it in position with elastic rubber band.
5. Leave it to stand for few days

Results

The tip of the radicle bends towards gravity.

Conclusion

The tip of the radicle responds to gravity.

Importance of Tropisms

a. Enables shoots to grow towards light and expose leaves for photosynthesis.
b. Tropisms ensure that flowers are lifted in the positions where they are most likely to receive pollen through wind or insects.
c. Enable plant roots to grow into the soil for absorption of water and mineral salts and support
d. Hydrotropism enables plants to grow towards water and absorb water.

Practical uses of Auxins

1. **Weed Killers**

Auxins work by making a plant grow so fast that it quickly exhausts itself and dies. Weed killers are selective, that is, they kill certain plants but leave others unharmed. Examples of such weed killers are a group of auxins known as phenoxyacetic which destroy and kill weeds.

2. **Rooting in cuttings**

The cut end of a stem is dipped into the auxin compound and then planted. The auxins stimulate root growth so that they appear sooner than in untreated cuttings.

3. **Growth Inhibitors**

Auxins can slow or inhibit growth. They can be sprayed on potatoes to prevent sprouting during transport and storage. They can also be sprayed on hedges to slow down their growth.

4. **Fruit setting**

Auxins can cause fruits to appear without pollination a process called parthenocarpy. The fruits so produced have no seeds since there is no pollination.

NASTIC RESPONSES

These are responses that occur when plants move some parts of their body due to the presence of a particular stimulus.

The response does not depend on the direction of the stimulus.

Examples of Nastic Responses

a. Mimosa Pudica

The plant folds its leaves when touched. Under normal circumstances the leaves of the plant are well spread along the mid rib. When touched, the leaves fold rapidly as a way to prevent damage to the leaves. This is a nastic response called **haptonasty** or **thigmonasty**.

b. The Venus flytrap

Its an example of an insectivorous plant (a plant that eats insects). It has hairs which are sensitive to touch. When an insect lands on the leaf blade, it is sensed by hairs causing the leaves to rapidly fold. This encloses the insect inside the leaf and kills it. As the insect decomposes, the leaves secrete enzymes which digest the insect.

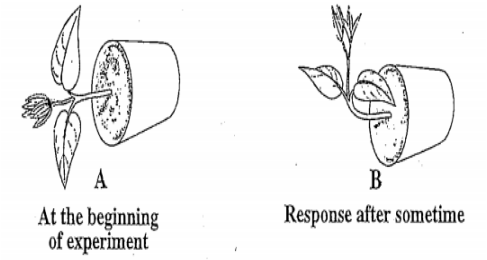
c. Sleeping movement in Plants

This is a response to changes in light intensity during day. It is common in leguminous plants. During day time the leaves open flat to make sure that the sun rays are horizontal to their surface. At night the leaves fold or close.

In hot weather, the leaves droop to minimise water loss through transpiration.

REVISION EXERCISE

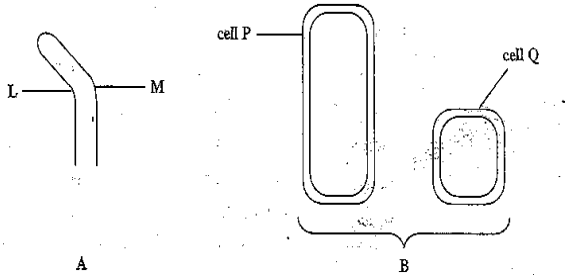
1. The figure shows a response in a plant that was placed horizontally. Use it to answer questions that follow.



a. What was the stimulus in this experiment?
b. Describe the response in B.
c. Explain how the response in B is brought about.

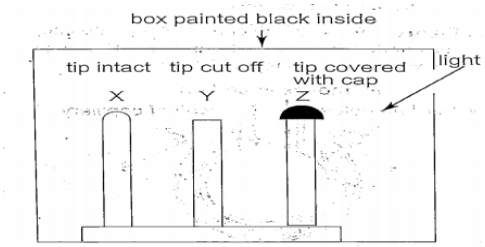
2. a. what are auxins?
   b.How do auxins affect the growth of the following parts of the plants?
   i. Shoots
   ii. Roots

3. The figure below diagrams A and B. Diagram A shows the results of what happened when a shoot was illuminated from one side for 48 hours. Diagram B shows cells P and Q which were taken from parts of the shoot in diagram A.



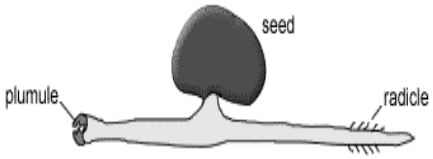
   a. Which side of the shoot in diagram A was illuminated?
   b. Which cell was taken from the part marked M? Explain your answer.

4. The figure below shows three seedlings X,Y,Z placed in a box painted black and with a hole on one side. The seedlings were treated differently. Use it to answer questions that follow.



   a. Why was the box painted black inside?
   b. Draw a diagram to show the results at the end of the experiment.

5. The diagram below shows a seedling that was placed horizontally in the dark for 48 hours. Use it to answer questions that follow.



   a. Draw a diagram of the seedling to show the results after 48 hours.
   b. Explain how the results indicated by your diagram came about.

6. Describe an experiment that you can carry out to find the effect of one sided illumination on a growing shoot.
7. Describe an experiment that you can carry out find the part of a shoot that responds to gravity
8. Describe an experiment you can carry out to find the part of a shoot that responds to light.

THE HUMAN EXCRETORY SYSTEM

Excretion is the removal of waste substances produced by metabolism from the body.

Metabolism is the sum total of chemical reactions taking place in a cell. There are two types of metabolism: catabolism which refers to chemical reactions that involve breaking down complex substances into simpler ones and anabolism which refers to chemical reactions that involve building of complex substances from smaller ones.

Secretion: release of useful substances in the body such as hormones by glands.

Egestion: the expulsion of undigested food material from the gut.

Homeostasis: the maintenance of the internal environment of the body.

Examples of Metabolic Wastes Produced by Cells

- Carbon dioxide produced by respiration
- Nitrogenous wastes produced by protein metabolism such as urea, ammonia and uric acid
- Excess water
- Wastes of chemical substances such as drugs and hormones after their function
- Bile pigments produced after breakdown of red blood cells.

Importance of Excretion

- It removes waste substances which are toxic to cell.
- It controls the p^H of blood by monitoring the levels of hydrogen ions (H^+) in the blood.
- It regulates the level of water in the body.

Main Excretory Organs in Humans

Kidneys- remove urea, uric acid, excess water and excess salts

Liver- removes drugs, excess amino acids

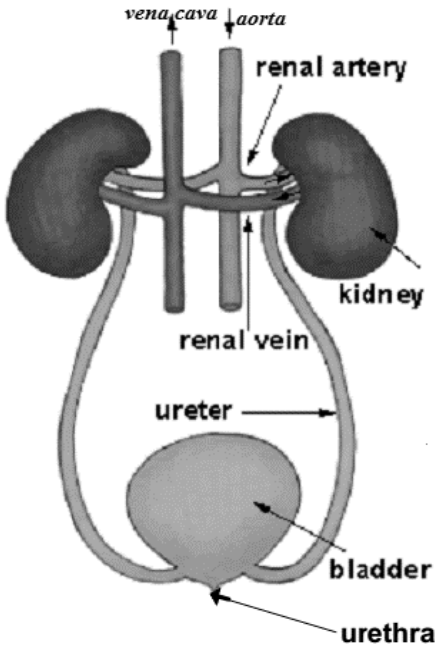
Lungs- remove carbon dioxide

Skin: removes excess water and mineral salts through sweat.

All these organs and their associated tissues form the excretory system.

The kidney is one of the main excretory organs in the body. It is part of what is called the urinary system.

The Urinary System



Aorta: carries the blood from the heart and branches into renal arteries.

Renal arteries: lead the blood from the aorta to into the kidney.

Kidney: removes waste products from blood.

Renal veins: carry blood from the kidneys to the vena cava.

Vena cava: carries blood to the heart.

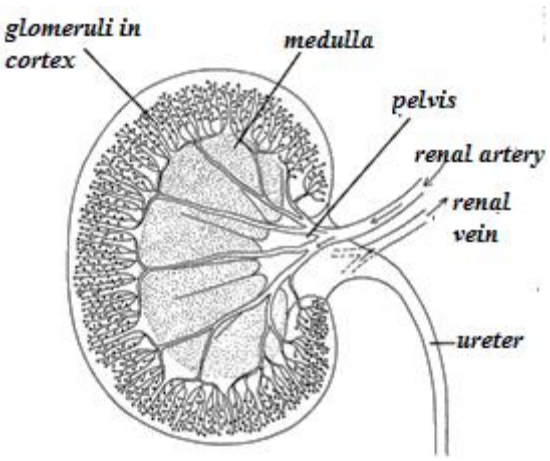
Ureter: leads urine to the urine bladder.

Urine bladder: stores urine before it is expelled from the body.

Sphincter: ring of muscles that regulate flow of urine into the urethra.

Urethra: leads urine to outside the body.

PARTS OF A KIDNEY



Cortex: This is darker outermost part of the kidney. It contains glomerulus where ultra-filtration takes place.

The Nephron

Medulla: This is the light coloured inner region of the kidney. The medulla extends into the pelvis in triangular projections called pyramids.

Pelvis: This is the widening end of the ureter which enters the kidney.

Ureter: It leads urine to the urinary bladder

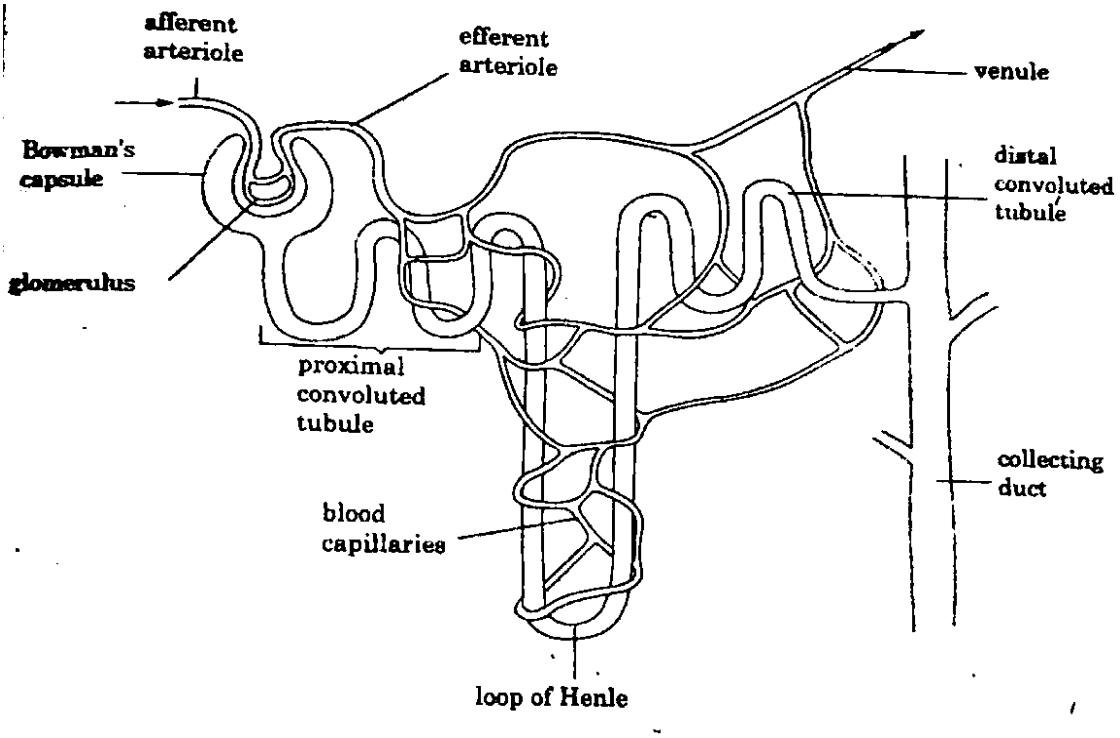
Nephron: This is the functional unit of the kidney. It performs the functions of the kidney.

Renal artery: It receives blood from the aorta. Blood in the renal artery has high concentration of metabolic wastes such as urea and uric acid. It also has high concentration of useful substances such as oxygen.

Renal Vein: It leads blood from the kidneys to the vena cava. Blood in renal vein has high concentration of carbon dioxide but low concentration of urea. The blood also contains reabsorbed substances.

How the Kidney Functions

Each kidney contains thousands of long tubes called nephrons that filter substances from blood. To explain the how the kidney functions we have to look at the working of the nephrons. This is because the nephron is the functional unit of the kidney.



Arteriole (branch from renal artery): It brings blood full of waste to the glomerulus.

Glomerulus: It is a network of blood capillaries where filtration of blood takes place.

Bowman's capsule: It's a cup where glomerular filtrate collects after being formed.

Proximal convoluted tubule: leads the glomerular filtrate down the medulla. There is selective re-absorption of glucose, amino acids and ions.

Loop of Henle: This is a U-shaped tube. It is the main site of water re-absorption.

Distal convoluted tubule: This is where hormones, vitamins and salts are re-absorbed from the glomerular filtrate.

Collecting duct: water is reabsorbed in the collecting duct. It also leads the remaining fluid (urine) to the pelvis.

Excretion in the kidney involves two processes: ultra-filtration and re-absorption

Ultra-filtration

This takes place in the glomerulus under very high pressure. The pressure forces small substances such as water, glucose, amino acids, urea, salts and vitamins into the Bowman's capsule. Larger molecules such as blood proteins, blood cells and platelets remain in the blood. The glomerular filtrate moves down the nephron.

Selective Re-absorption

As the glomerular filtrate moves down the nephron useful substances are reabsorbed into the blood capillaries.

Amino acids, glucose and salts are reabsorbed through active transport. Water is reabsorbed by osmosis. By the time the glomerular filtrate moves down the nephron it has high concentration of urea, some salts and water. The filtrate is now called **urine**.

Substances That Are Excreted By Kidneys

- Urea, uric acid, toxic substances, excess water and excess salts.

Comparison of Composition of Blood Plasma and Urine

Substances	Blood Plasma (%)	Urine (%)
Water	92	95
Proteins	7	0
Glucose	0.1	0
Urea	0.03	2

Function of Kidneys

a. They remove metabolic wastes from the body.
b. They control or regulate water levels in the body.
c. They regulate p^H levels in the body by controlling levels of hydrogen ions in the blood.
d. They also control chemical composition of the blood.

Effects of Eating and Drinking habits on Kidneys

- Excessive consumption of salt may result into disorders such kidney stones
- Excessive protein intake may lead to kidney stones. Deamination of excessive proteins form urea and uric acid. Uric acid and other chemicals are deposited in the pelvis as kidney stones
- Excessive intake of carbonated drinks and foods make some chemical substances to accumulate in the kidneys causing kidney damage
- Taking alcohol can cause damage to the liver and kidneys.

Good Habits That Promote Proper Functioning of Kidneys

- Taking adequate amount of water daily
- Minimising salt intake in food
- Reducing intake of food rich in proteins
- Taking a lot of vegetables which provide vitamins essential to the functioning of the kidneys.
- Taking fruits in diet

Effects of Water and Salts in Urine Production

Water

When a person takes a lot fluids the amount of water in the blood increases. This causes less water to be reabsorbed in the kidneys resulting into productions of large amounts of dilute urine. The urine is also light in colour.

When a person takes less fluid the amount of water in the blood decreases. This causes more water to be reabsorbed in the kidneys resulting into production of small amounts of concentrated urine. The urine is usually brown in colour.

Salts

When a person takes in food with a lot of salt the blood solute level becomes higher and this causes more water to be reabsorbed in the kidneys to maintain normal blood solute level resulting into low urine output. The urine is concentrated and brown in colour.

When the blood has low salt concentration the kidneys absorb less water resulting into production of large amounts of dilute urine. The urine is normally light coloured.

Activity: Investigating the Effects of Water on Quantity and Colour of Urine

Materials

- Measuring cylinders
- Test tubes
- clean and safe water

Procedure

1. Drink a litre of water. This increases water levels in the blood.
2. Fifteen minutes later urinate in a measuring cylinder and record the volume.
3. Fill a test tube with a sample of the urine and throw the rest away.
4. Repeat procedure 2 and 3 three times at 15 minute interval
5. Observe the results

Expected Results

In the first urination the urine quantity is large and the urine is light coloured. The urine becomes less in quantity and more brown in colour as water levels in the body decrease with time.

Conclusion

Water affects urine quantity and colour.

Osmo-regulation

This is the control of water levels in the body. This aims to maintain balance of water in the body. The control of water levels in the body is affected by a hormone called **Anti-diuretic hormone** (**ADH**). When the level of water in the body is low, the hypothalamus in the brain detects this and sends a message to the pituitary gland to produce ADH. The ADH travels to the kidney and makes the kidney tubules more permeable to water. More water is reabsorbed by blood capillaries surrounding the kidney tubules. This results in production of urine which is little, coloured and very concentrated.

When the level of water is high in the blood the hypothalamus detects this and suppresses the production of ADH by the pituitary gland. Since ADH is not produced the kidney tubules are less permeable to water and less water is reabsorbed. This results in production of large amounts of urine which is dilute and light coloured.

The role of aldosterone in osmo-regulation

Aldosterone is a hormone produced in the adrenal glands. When the blood has low salt concentration it tends to reabsorb less water. This can lower blood volume because the great part of blood is water.

In case of low salt concentration aldosterone is secreted by adrenal glands and travels to the kidneys. It stimulates the kidneys to reabsorb more salts back into the blood stream. This causes more water to be reabsorbed to the blood and the blood volume is increased.

In case of excess water less aldosterone is produced and salts are not reabsorbed and are lost through urine. This results into elimination of excess water through urine.

Problems of the Kidneys

1. **Proteinuria**

This condition is indicated by presence of protein in urine. This occurs when capillaries in the glomerulus lose ability to be selectively permeable. They allow large protein molecules to pass through and enter the kidney tubules. These protein molecules

are not reabsorbed and are passed out in urine.

2. Kidney Failure

This is decline in kidney performance due to disease or injury. It can also be failure of the kidney to function due to disease or injury. It is also called renal failure.

The kidney fails to purify or clean the blood by removing the wastes. The toxic wastes accumulate in the blood and poison body cells and this can lead to death.

Causes of Kidney failure

a. Inflammation of the Kidney

This is caused by bacterial infection or blockage of the ureter.

b. Inflammation of the Glomerulus (Glomerular nephritis)

It is caused by antibodies that are trapped in the glomerulus. It can also be caused by rupturing of the glomerulus.

c. Kidney Stones

These are small crystallised substances such as calcium. They block and cause ulcers in kidneys.

d. Birth defects

Some people are born with abnormal kidneys.

e. Physical Damage

This occurs through due to accidents.

f. Drop in blood pressure due to heart failure, haemorrhage or shock

g. Low blood pressure leading to failure to form urine and the kidney stops working.

h. Uremia

Uremia is a condition in which there is excess urea in the blood. It occurs when the kidneys are not working properly and urea accumulates in the blood.

Uremia may cause convulsions, coma, vomiting, diarrhoea and difficulty in breathing.

i. Gout

This is a disorder caused by the absorption of uric acid salts in the blood. Uric acid salts forming crystals in kidneys. It is caused by a diet that has too much organ meat such as kidneys and organ meat. Patients are given medications that break up the uric acid into harmless compound.

j. Diabetes Insipidus

This is a condition in which the kidney fails to reabsorb the water in the glomerular filtrate leading to too much water in the urine. This is caused by failure to produce anti-diuretic hormone by the pituitary gland leading to failure by the kidney to reabsorb adequate water.

k. Pyelonephritis

This is a bacterial infection of the renal pelvis. The bacteria invade the kidneys from other sites of infection in the body. The kidney becomes swollen and filled with pus. This can be treated with antibiotics.

Prevention of Kidney Failure

- Treating infections to avoid infection of kidneys
- Proper diet. Avoid excess proteins to prevent gout
- Avoid foods that contain toxic such as arsenic and carbon tetrachloride
- Avoid or reduce alcohol intake manage other diseases such as diabetes mellitus and hypertension

Treatment for Kidney Failure

- **Kidney transplants:** a healthy kidney from one person to a person who needs it.
- **Dialysis treatment**: it is used to clean the blood of a person.

3. Kidney Cancer

Kidney cancer is common in males. Nicotine in cigarettes increases chances of kidney cancer.

Symptoms of kidney cancer

- Swelling of the renal vein of the kidney. The cancerous cells may spread to the blood
- Secondary development of tumours in the lungs and bones
- In children it affects the renal vessels and spreads to the lungs.

Treatment can be through radiotherapy and chemotherapy.

4. Blockage of the Ureters

This is also called renal colic.

Causes

- It is caused by deposits of mineral salts in the ureter. The minerals may later block the ureters

Symptoms of renal colic

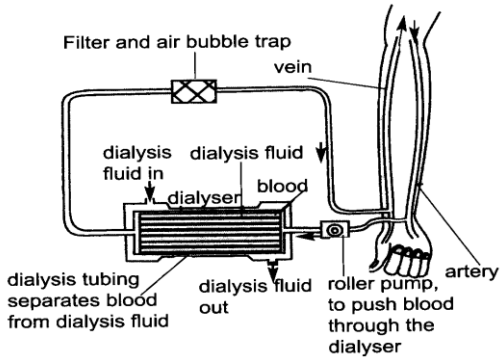
- Sudden extreme pain with vomiting when they into the ureter
- Signs of shock and patient may collapse
- Blood stains in urine
- Passing frequent small amounts of urine as the ureter is partially blocked.
- Urination may stop completely

Treatment

- Administer pain killers
- Surgery to remove to remove deposited minerals
- Exercise to dislodge the stones from the ureter as one urinates
- Control diet to reduce intake of concerned minerals
- Dialysis treatment
- Increase water intake

The Dialysis Machine

Dialysis is a process by which wastes, excess water and excess salts are removed in an artificial way from the body.



How the Dialysis Machine Works

The patient is connected to machine by inserting a catheter into an artery. This is connected to a flexible tube leading to the machine and to a vein. In the machine wastes and excess water and salts are removed. Blood flows in a tube or tubes which are semi-permeable and are surrounded by special fluid called **dialysis fluid**. The dialysis fluid and blood flow in opposite directions (counter-current system) which maximises diffusion gradient. The dialysis fluid has no concentration of wastes; therefore, wastes diffuse from blood into dialysis fluid. Excess water, excess water, excess amino acids and urea diffuse out of the blood into the dialysis fluid.. The dialysis fluid has the same concentration of useful substances such as glucose, glycerol, and ions to that of blood. This prevents loss of nutrients through diffusion. The dialysis may branch

into smaller tubes to increase surface area of diffusion.

Notes

- Heparin is added to prevent blood clotting in the dialyser.
- The pump draws blood from the artery and increases the blood pressure.
- The bubble traps trap traps or removes air bubbles from blood. This prevents gas embolism where air may get into the body of a patient. The air may block blood supply to vital organs such as brain or heart resulting into death.

Similarities between a Kidney and Dialysis Machine

- Both purify the blood of wastes
- Both use diffusion and osmosis principles

Differences between Dialysis Machine and Kidneys

- Dialysis machine is used for a short period of time while a kidney works continuously.
- Ultrafiltration does not take place in dialysis machine but occurs in kidneys
- The dialysis machine does not respond to hormones such as ADH while the kidney responds
- In kidneys selective reabsorption occurs while in dialysis machine it does not occur.

Advantages And Disadvantages Of Kidney Transplant And Dialysis

	Advantages	**Disadvantages**
Dialysis	• No major surgery needed • Sometimes there is no waiting list-it prevents people from dying	• Diet needs to be carefully controlled • Restricts normal life as the patient is treated for about 8 to 10 hours under treatment
Kidney Transplant	• No need for dialysis • The recipient can lead a relatively normal life • Diet does not need to be controlled	• Major surgery has many risks • There is possibility of organ rejection • Immunosuppressant drugs need to be taken for life

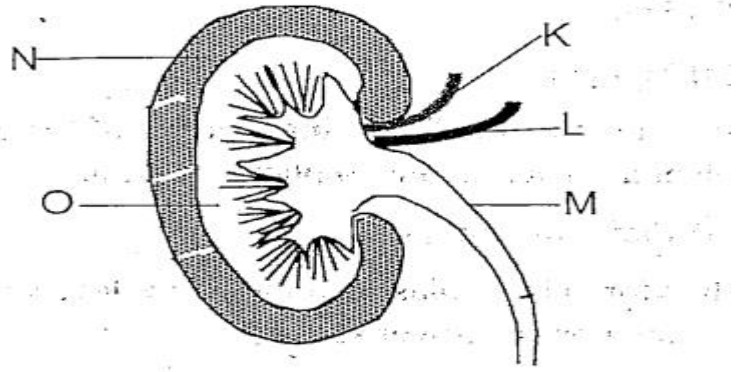
REVISION EXERCISE

1. a. What is the difference between secretion and excretion?
   b. Briefly describe the following processes involved in excretion in kidneys
      i. Ultra-filtration
      ii. Selective re-absorption
      iii. Osmo-regulation
2. The table below shows composition of blood and urine. Use it to answer questions that follow.

Substance	Blood (%)	Urine (%)
Water	90	96
Protein	9	0
Glucose	0.1	0
Urea	0.03	2
Uric acid	0.003	0.05
Creatinine	0.001	0.1
Chloride	0.37	0.6
Sodium	0.35	0.35 → 0.6
Potassium	0.02	0.15

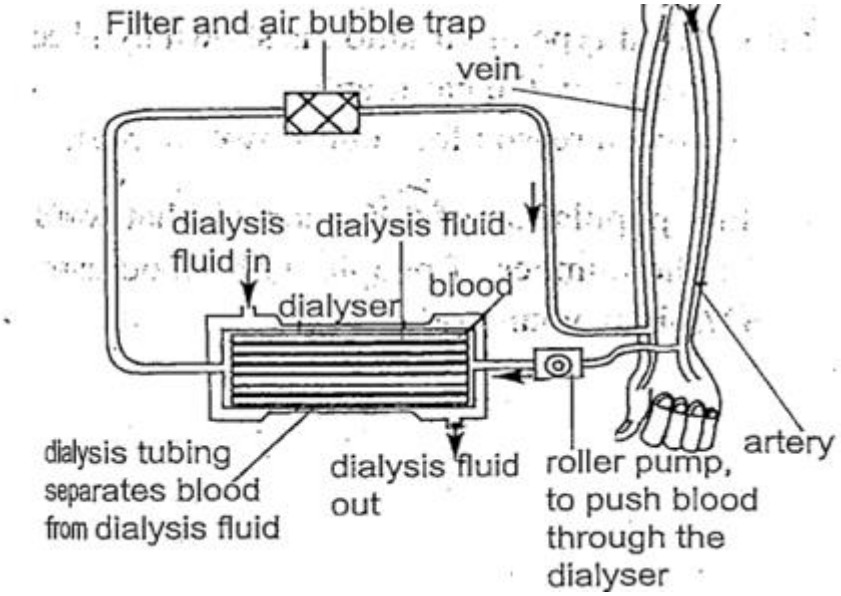
a. Give one substance that is present in blood but completely absent in urine.
b. Apart from urea and water mention other two substances that are more concentrated in urine than in blood.
c. Mention the hormone that regulates blood water levels.
d. Why is urea excreted in large quantities? Explain.

3. The figure below shows a vertical section through the human kidney. Use it to answer questions that follow.



a. Identify the parts marked O and N
b. Which of the blood vessels K and L is the renal vein? Explain your answer.
c. Describe the difference in concentration of the following substances in blood vessels L and K.
   i. Urea
   ii. Carbon dioxide
   iii. Glucose
d. State the conditions indicated by the presence of the following in urine
   i. Glucose
   ii. Proteins
e. Briefly describe the role of ADH in osmo-regulation.

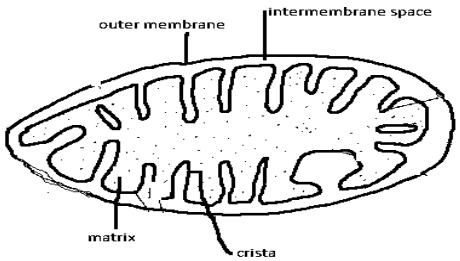
4. The figure below shows the dialysis machine. Use it to answer questions that follow.



a. Why are there many smaller tubes other one long tube in the dialyser?
b. Why are the blood and dialysis fluid moving in opposite directions in the dialyser?
c. Explain how loss of useful substances is avoided in the dialysis machine.
d. State the similarity between the tubes of the dialysis machine and kidney tubules.

THE HUMAN RESPIRATORY SYSTEM

Respiration is the breakdown of organic food substances to release energy. Respiration takes place in cell organelles called **mitochondria**.



The mitochondrion is adapted for respiration because:

a. It is highly folded which creates large surface area for respiration.
b. It contains enzymes and other special molecules required for respiration

Mitochondria are found in almost all cells but they are abundant in cells that need a lot of energy such as sperms and muscle cells.

Breathing: the taking in of oxygen and release of carbon dioxide by animals.

Gaseous exchange: the exchange of oxygen and carbon dioxide across a membrane.

There are two types of respiration

a. Aerobic respiration
b. Anaerobic respiration

AEROBIC RESPIRATION

This type of respiration takes place in the presence of oxygen. Glucose reacts with oxygen and produces carbon dioxide, water and energy. Energy is the **main product**; **water** and carbon dioxide are **by-products**.

Glucose + Oxygen ⟶ Carbon dioxide + Water + Energy

$C_6H_{12}O_6 + 6O_2 \longrightarrow 6CO_2 + 6H_2O + 2898Kj$

60% of the energy is in form of heat energy which is lost or used to warm up the body. Some energy is immediately used by the cell.

The remainder is converted to storable form of energy molecule called **Adenosine Triphosphate** (ATP). ATP is a combination of a complex organic molecule called Adenosine and three phosphate groups.

When the third phosphate group is removed the stored energy is released. Adenosine is left with two phosphate groups called **Adenosine diphosphate** (ADP).

In aerobic respiration glucose is completely broken down hence the release of energy in large quantities.

ANAEROBIC RESPIRATION

The release of energy from organic food substances in the absence of oxygen. In plants and fungi it is called **alcoholic fermentation**. Because alcohol or ethanol is produced.

Glucose ⟶ ethanol + Carbon dioxide+ Energy

$C_6H_{12}O_6 \longrightarrow 2CH_3CH_2OH + 2CO_2 + 210kJ$

Energy is the main product, and **Carbon dioxide** and **ethanol** are **by-products** of anaerobic respiration in plants.

In animals like human muscles anaerobic respiration is called **lactic fermentation** because acid is produced.

Glucose ⟶ Lactic acid + energy

$C_6H_{12}O_6$ ⟶ $2CH_3CHOHCOOH$ + 150Kj

In animals, anaerobic respiration produces **energy** as a **main product** and **lactic acid** as a **by-product**.

Lactic acid is toxic when it accumulates in animal cells. It causes **muscle fatigue**. It is usually broken down to water and carbon dioxide.

This happens when oxygen becomes available. The amount of oxygen needed to break down lactic acid is called **oxygen debt**.

Similarities between Aerobic and Anaerobic Respiration

- They both produce energy
- In both, glucose as a raw material is broken down into simpler forms.
- Both do not require oxygen in the first stages of the processes.

Differences between Aerobic and Anaerobic Respiration

- Aerobic respiration uses oxygen while anaerobic respiration does not use oxygen.
- Aerobic respiration produces a lot of energy per glucose molecule because glucose is completely broken down while anaerobic respiration produces small amount of energy because glucose is partially broken down.
- Aerobic respiration produce water and carbon dioxide as by-products while anaerobic respiration produces ethanol and carbon dioxide in plants and lactic acid in animals as by-products
- Aerobic respiration by-products are simple substances that cannot be broken down further while in anaerobic respiration the by-products are complex substances that can be broken down further.

Uses of Energy Produced by Respiration

a. Energy is used for growth e.g. in protein synthesis.
b. Heat energy is used to warm up the body- to maintain body temperature.
c. Is used in active transport to move molecules against concentration gradient.
d. Movement-contraction of muscles requires energy.

GASEOUS EXCHANGE IN LIVING THINGS

Gaseous exchange is the diffusion of oxygen and carbon dioxide across a gaseous exchange structure.

Importance of gaseous exchange

a. Organisms are able to obtain useful gases from their environment
b. Organisms are able to get rid of waste gases into their environment

Properties of Efficient Gaseous Exchange Structures

a. They are permeable to oxygen and carbon dioxide
b. They are moist-to dissolve the gases so that they are transported by blood in animals with transport systems
c. They are thin for faster diffusion due to short distance

d. They are rich in blood capillaries in animals with transport systems to transport gases.
e. They have large surface area for maximum gaseous exchange

GASEOUS EXCHANGE IN HUMANS

Gaseous exchange in lungs is between the air and blood cells. In the tissues it is between tissue fluid and cells. The fluid surrounding cells is called tissue fluid. Tissue fluid has higher concentration of oxygen than cells and oxygen diffuses from tissue fluid into the cells. On the other hand carbon dioxide is highly concentrated in cells than in surrounding tissue fluid. Carbon dioxide diffuses out of cells into tissue fluid.

Similarities between Exchange of gases in Lungs and Tissues

- In both, oxygen and carbon dioxide diffuse along their concentration gradients.
- In both hemoglobin found in red blood cells is the transport agent.

Differences between Exchange of Gases in Lungs and Tissues

- In lungs gaseous exchange is between air and the blood cells while in gaseous exchange is between tissue fluid and cells.
- In lungs oxygen diffuses into blood cells and carbon dioxide diffuses out into the air while in tissues oxygen diffuses from tissue fluid into cells and carbon dioxide diffuses from cells into the tissue fluid.
- In lungs it takes place faster while in tissues its slower.

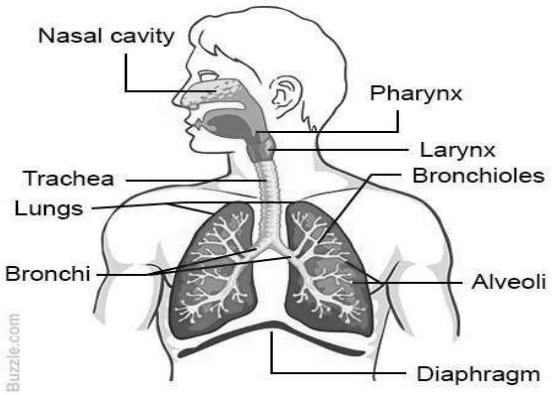
Importance of Gaseous exchange

a. Allows organisms to get oxygen for respiration in cells
b. Enables organisms to get rid of carbon dioxide produced by respiration

Structure of the Human Respiratory System

Twelve pairs of ribs surround and protect the lungs and the heart. Intercoastal muscles are attached to the ribs.

A large sheet of muscle (diaphragm) separates the thorax from the abdomen.



The nostrils/nasal cavity: have hairs that filter the air. It also warms and moistens the air.

The pharynx: it is located behind the nasal cavity and above the larynx. It is a food and air passage.

Trachea: made of rings of cartilage that keeps the trachea open. Rings of cartilage prevent the collapse of the trachea during inhalation.

Larynx/Voice box: it is a passage of air. It has two membranes called vocal cords. The vocal cords can be made to vibrate to produce speech.

Bronchi: these are branches of the trachea. They branch into bronchial tubes which

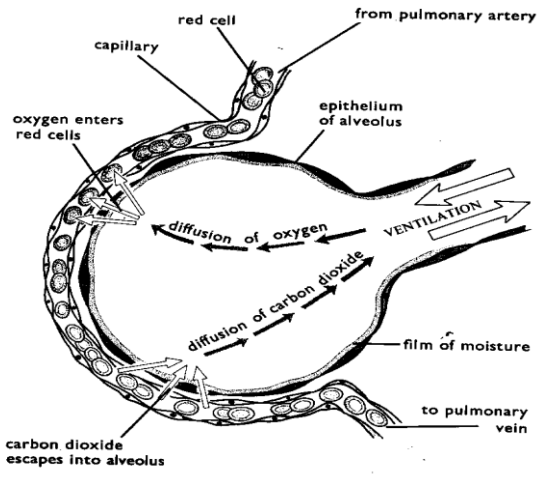
further divide into bronchioles that lead to the alveoli.

Alveoli: they are a site of gaseous exchange in lungs.

Diaphragm: a dome shaped sheet of muscles located at the bottom of the rib cage. During inhalation it contracts and moves downwards and increases volume of chest cavity and air rushes into lungs. During exhalation it relaxes and air is expelled.

Intercoastal muscles: during inhalation the external intercoastal muscles contract and pull the chest cavity upwards and outwards. This increases volume of the chest cavity and air rushes into the lungs. During exhalation internal intercoastal muscles contract pulling the chest cavity inwards and downwards and air rushes out.

The alveolus



This is the site of gaseous exchange in lungs.

Oxygen diffuses through a thin epithelium of the alveolus and the endothelium of the capillaries. It combines with haemoglobin to form **oxy-haemoglobi**n. Carbon dioxide diffuses in reverse direction.

ADAPTATION OF THE ALVEOLUS FOR GASEOUS EXCHANGE.

a. It has a network of blood capillaries that carry the gases being exchanged.
b. Thin walls in between capillaries and alveolus –gases diffuse faster.
c. It is lined with a thin film of moisture to dissolve the diffusing gases.
d. Diffusion gradient: There are differences in concentrations of gases in the blood and alveolus, more oxygen in alveolus than the blood hence oxygen diffuses into capillaries, and more carbon dioxide in blood capillaries hence oxygen diffuses into the alveolus.
e. They are numerous: increase surface area for gaseous exchange.

The lung is surrounded by **a pleural cavity.** It is a space lined by pleural membranes, membranes protect the lungs, stop them leaking air into the thoracic cavity. In between the membranes there is **pleural fluid** that reduces friction between lungs and thorax.

Adaptations of Lungs for Exchange of Gases

Lungs

a. Presence of numerous alveoli- increases surface area for gaseous exchange
b. Trachea has rings of cartilage to hold the trachea open.
c. Alveoli have thin walls for fast diffusion of gases.
d. Alveoli have dense network of blood capillaries for gas transport

The trachea has cilia and goblet cells that produce mucus-cilia and mucus help to clean the respiratory system

Breathing mechanism

Breathing is the taking of air into and outside the lungs.

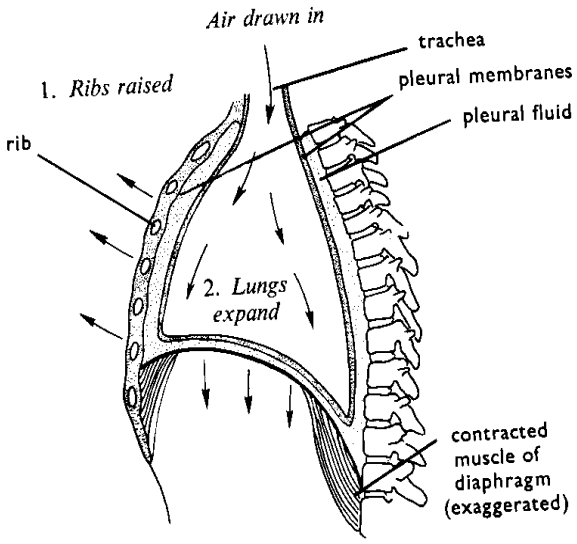
The following structures help in breathing:

i. Ribs
ii. Diaphragm
iii. Intercostals muscle (both external and internal)

Breathing takes place in two phases:

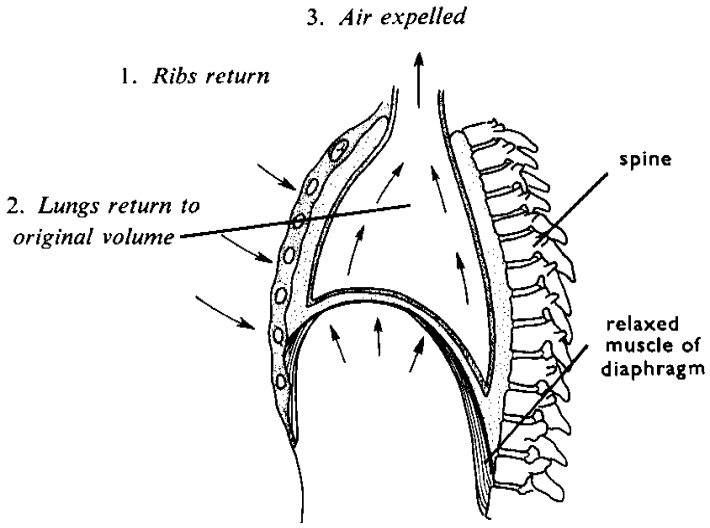
i. Breathing in (inspiration)
ii. Breathing out (expiration)

BREATHING IN (INHALATION)



Diaphragm contracts and moves downwards (flattens). External intercoastal muscles contract and pull the rib cage upwards and outwards. This increases the volume of the chest cavity. Air pressure inside the chest cavity and that of the lungs decreases compared to atmospheric air pressure. Air rushes into the lungs from the atmosphere.

BREATHING OUT (EXHALATION)



Diaphragm relaxes and returns to its dome shape. External intercoastal muscles relax but internal contract and pull rib cage downwards and inwards. Lung volume decreases and pressure increases. Air rushes out.

Adaptations of the Respiratory structures in Human Beings

- The nasal passage has hairs and mucus that trap dust particles and other foreign particles coming with inhaled air.
- The trachea is lined with ciliated cells (goblet cells). The cilia sweep the mucus with trapped particles out of the respiratory tract.
- There a tissue of cartilage called epiglottis in the larynx that closes the trachea during swallowing to prevent entry of food into the trachea.
- The trachea and nasal cavity have a dense network of blood capillaries close to the surface which warms the inhaled air.

- Lungs have numerous alveoli which provide a large surface area for exchange of gases.
- The trachea is made of rings of cartilage that keep it always open.
- The alveoli are thin to enable faster diffusion of gases.
- The alveoli are surrounded by a dense network of blood capillaries for efficient transport of the gases exchanged.

Regulation/control of Breathing.

Breathing is controlled by the Medulla oblongata. Medulla oblongata monitors the levels of carbon dioxide and oxygen in the blood stream and adjusts the breathing rate to maintain balance of the gases. In case of high carbon dioxide concentration, receptors in the medulla oblongata detect this. The oblongata sends impulses to the breathing structures to increase breathing rate for faster oxygen intake and carbon dioxide expulsion.

Factors That Influence Breathing Rate

a) Carbon dioxide concentration in the Blood

An increase in carbon dioxide concentration in the blood leads to increased rate of breathing. This increases rate of carbon dioxide expulsion and oxygen intake hence increasing oxygen concentration in the blood.

b) Haemoglobin content or Amount of Red Blood Cells in the body

When red blood cells or haemoglobin are low in the body less oxygen is transported to cells. This causes the breathing rate to increase to compensate for shortfall and meet the oxygen demands of the body.

c) Physical exercises

More oxygen is needed for respiration to provide energy for the physical exercise. Breathing rate increases to increase oxygen intake.

d) Atmospheric pressure and oxygen concentration

High pressure means more oxygen is available and breathing rate is normal. Less pressure means less oxygen is available and breathing rate increases to get more oxygen.

e) Emotional changes in the body

Emotional changes in the body may include things like panicking, fright. These cause the production of adrenaline which increases breathing and respiration rates.

f) Health condition of the body

Health people usually breathe normally. Sick people may breathe faster or slower depending on the infection.

Activity: Investigating the Effect of Exercise on Breathing Rate

Materials

- Stop watch
- Students
- Rope

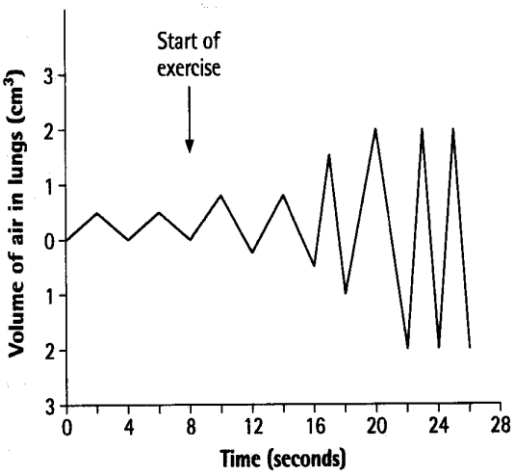
Procedure

1. Count the number of breaths for 5 minutes of a student while he or she is standing.
2. Calculate the breathing rate per minute and record.
3. Let the student skip twenty times with the rope.
4. Count the number of breaths for 5 minutes of the student after skipping.
5. Calculate the breathing rate per minute and record the breathing rate.

Result

Exercise increases breathing rate.

Effects of exercise on breathing



a. Increases the rate of breathing (number of breaths per minute) to expel carbon dioxide and get oxygen
b. Increases depth of breathing.
c. Increased concentration of carbon dioxide in the blood due to increased respiration
d. Decrease of amount of oxygen in the blood due to an increase in the amount of oxygen used for respiration.

Complete breath= **one inhalation** + **one exhalation**. During normal breathing the rate is 12-18 breaths per minute. During an exercise breathing rate may go up to 27 breaths per minute.

LUNG VOLUMES AND CAPACITIES

The average female has lung capacity of 4 litres and adult male 5 litres.

Lung capacity: is the total amount of air held by lungs when they are fully inflated (4L for females and 5L for males)

Tidal volume: the volume of air breathed in and out during one normal resting breath (0.5L)

Complementary air: when breathing deeply 2 litres of air is forced in and out of the lungs. The extra 1.5 litres on top of tidal air is called **complementary air**.

Inspiratory capacity: It is the maximum amount of air that can be inspired.

Inspiratory reserve volume: the extra volume inhaled over and above the tidal volume.

Expiratory reserve volume: the extra volume of air expelled above the tidal volume.

Functional residual capacity: is the amount of air remaining in the lungs after normal expiration.

During exercise a person takes in and expels an additional 3 litres to tidal air. 3 litres of air is exchanged during exercise. This air is called **vital lung capacity**-the maximum volume of air breathed in and out from deepest inhalation and deepest exhalation.

Residual air: the amount of air that cannot be expelled during breathing. It is about 1.5 litres.

Residual air = lung capacity−vital capacity.

The **Spirometer** is the device that is used to measure the volume of air going in and out of lungs.

Activity: Measuring lung Capacity

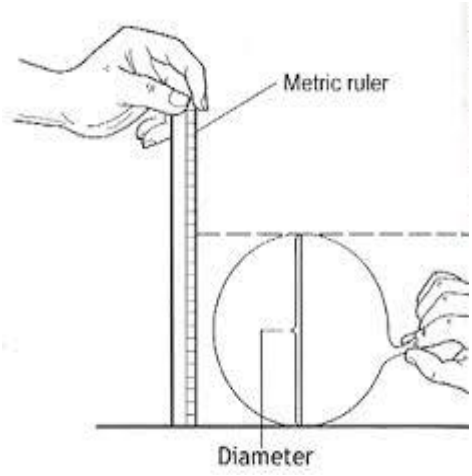
Materials

- Meter rule

- Two large balloons of equal size

Procedure

1. Inhale normally and then exhale normally into the first balloon. Do not force your breathing.
2. Hold the mouth of the balloon and measure its diameter.
3. Repeat the procedures 1 and 2 three times so that you have three measurements.
4. Take a very deep breath and exhale with maximum force into the second balloon. Measure the diameter of the balloon. Repeat this step three times with the second balloon.



Results

The volume of air in the second balloon is greater than in the first balloon.

NB: The forced breathing constitutes vital capacity of the lung. The normal breathing out represents tidal volume.

Carbon Monoxide Poisoning

Carbon monoxide poisoning occurs after inhalation of a lot of carbon monoxide. Carbon monoxide is a toxic gas. Carbon Monoxide (CO) is a product of incomplete combustion (burning) of organic materials in insufficient oxygen.

Causes of Carbon Monoxide Poisoning

a. Running generators or small engines inside buildings.
b. Burning charcoal in poorly ventilated rooms
c. Chimneys that are not working properly or are blocked

How Carbon Monoxide Occurs

The poisoning occurs after inhalation of carbon monoxide. Carbon monoxide has higher affinity for haemoglobin than oxygen in that it readily combines with haemoglobin to form **carboxyhaemoglobi**n. Unlike oxyhaemoglobin, which splits readily in cells to release oxygen, carboxyhaemoglobin is very stable and does not easily split. In this case it does not release oxygen for use by cells.

Since cells are denied oxygen, they cannot respire to produce energy. This results in fatigue (lack of energy), headache and unconsciousness or death. Due to lack of energy body processes stop taking place and a person may die due to suffocation. This is called **carbon monoxide poisoning**.

First Aid for Carbon Monoxide Poisoning

Take the person out of the room and make them lay comfortably in an open space. If air circulation is not sufficient fan the patient. If the person is having difficulties in breathing then use **mouth to mouth resuscitation** (kiss of life).

Ways of Preventing Carbon Monoxide Poisoning

a. Do not run generators or small engines inside houses or buildings.
b. Ensure that chimneys are working

c. Avoid burning charcoal in poorly ventilated rooms

Abnormal Conditions Associated with the Respiratory system.

a. Asthma

Asthma is a disorder resulting from the inflammation or swelling of the respiratory tract. The bronchi and bronchioles constrict leading to narrowing of the air passages leading to difficulties in breathing.

Asthmatic attacks are caused by allergens such as dust, pollen grains, sprays, dust mites and perfumes. Asthma can lead to stiffness of the chest, wheezing sound in the chest and exhaustion due to reduced oxygen levels.

b. Bronchitis

This is the inflammation of the bronchial tubes. The membrane in the bronchial tubes produce thick mucus that blocks or narrows the air passages leading to difficulties in breathing.

Bronchitis can be caused by infections, air pollution and cigarette smoking.

c. Pulmonary tuberculosis

It is caused by a bacterium called ***mycobacterium tuberculosis***. The bacterium destroy lung tissues making difficult for the infected person to breathe. It can lead to death if not properly treated.

d. Lung Cancer

This develops due to formation of tumours in alveoli. Cells from the tumours can spread other parts of the body. If untreated it can lead to death.

Smoking

Tobacco contains about 300 chemical compounds. Most of these are harmful to lungs.

Effects of Smoking

a. Respiratory Infections

Cigarette smoke contains substances that irritate the respiratory tract hence increasing mucus production. The cilia on the respiratory tract are destroyed and bacteria and other harmful substances are not removed. This may result in lung infections such as bronchitis and emphysema.

b. Addiction

Nicotine in tobacco is addictive leading to the person to depend on the smoking habit.

c. Cancer

Smoke from cigarettes contains tar which is a carcinogen. The carcinogen encourages cancerous cells to develop in the lungs by damaging DNA of the cells.

d. Harm to foetus

Tobacco smoke contains carbon monoxide and nicotine. Carbon monoxide may combine with foetal haemoglobin leading to retarded foetal growth, may also result into still-borns or miscarriages.

Activity: To devlop a Futures Wheel on Effects of Smoking

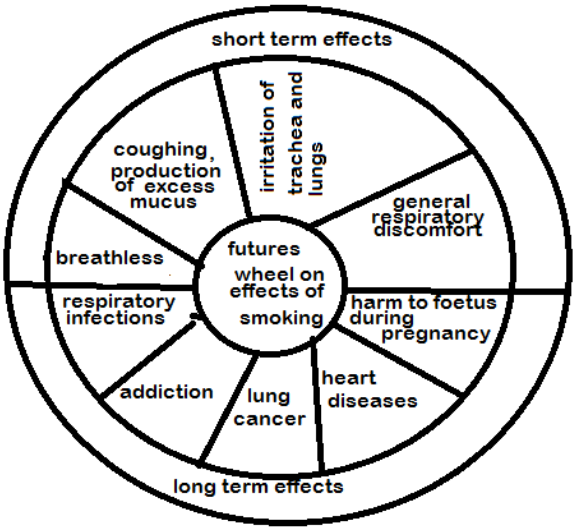
Materials

- Flip chart paper
- Marker pens
- Notebooks

Procedure

1. Work in groups of four students
2. List the effects of smoking
3. Group the effects into long term or short term effects
4. Draw a circle on paper and divide it into two halves

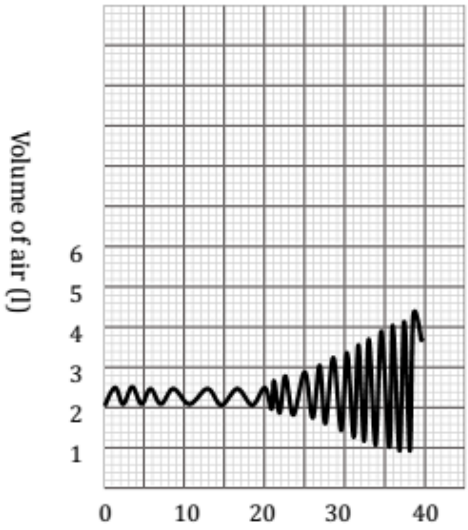
5. Divide the circle into sections depending on the number of effects.
6. Write the effects in the relevant spaces in the circle. This forms the futures wheel on effects of smoking as shown below.



REVISION EXERCISE

1. Define the following
   a. Respiration
   b. Residual air
   c. Lung capacity
2. a. state any two ways in which the alveolus is adapted to its function.
   b. Describe how exchange of gases takes place in lungs
   c. State any two properties of an efficient gaseous exchange structure
3. a. Mention any three effects of exercise on breathing
   b. Describe how carbon monoxide poisoning occurs
   c. Describe how medulla oblongata regulates breathing
   d. Describe any three adaptations of the human respiratory system.

   e. s
4. a. Describe any three effects of smoking.
   b. State any two abnormal conditions associated with the human respiratory system.
   c. Describe how you can measure lung capacity
   d. Explain how the following affect breathing rate
      i. haemoglobin content
      ii. carbon dioxide concentration
      iii. physical exercise
      iv. oxygen concentration
5. The figure below shows volume of air in lungs of a child at to the start of the exercise.



   a. At what time does the child start the exercise?
   b. What is the maximum volume of air inspired during the exercise?
   c. Calculate number of breaths per minute
      i. At rest
      ii. After exercise
   d. Explain why there is an increase in breathing rate between 20-40 second

COORDINATION

The linking together of various processes in an animal is called coordination. In humans and other mammals nervous and endocrine systems bring about coordination.

Definition of Terms

Stimulus: the change in the environment of an organism that influence the behaviour of an organism.

Irritability: the ability of an organism to respond to a stimulus.

Receptors: these are parts of the body that detect stimuli such as eyes, ears, nose and skin and tongue.

Effectors: these are parts of the body that respond to a stimulus.

Impulse: electrical message or information transmitted by nerve cells or neurones.

Neurone: a specialised cell that conducts impulses.

THE NERVOUS SYSTEM

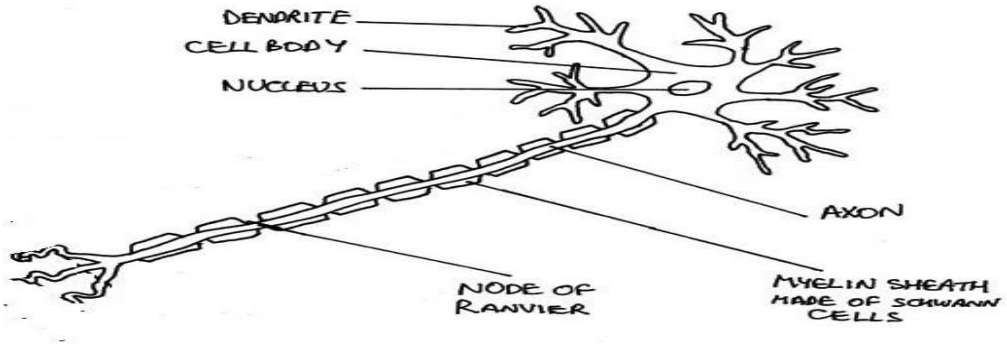
The nervous system or any mammal consists of:

i. The central nervous system (CNS): this consists of the brain and the spinal cord
ii. The peripheral nervous system: this consists of a branching system of nerves linking the brain (cranial nerves) and spinal cord (spinal nerves) with all parts of the body.

Functions of the nervous system

i. Receiving stimuli from the environment.
ii. Converting the stimuli into electrical impulses, a process called transduction.
iii. Transmitting impulses over distances.
iv. Interpretation of impulses and coordination of responses to stimuli.

STRUCTURE OF A NEURONE



Dendrites/Dendron: transmit impulses to the cell body.

Cell body: produce an appropriate impulse.

Axons: transmit impulses away from the cell body.

Myelin sheath: insulate axons hence speed up impulse transmission.

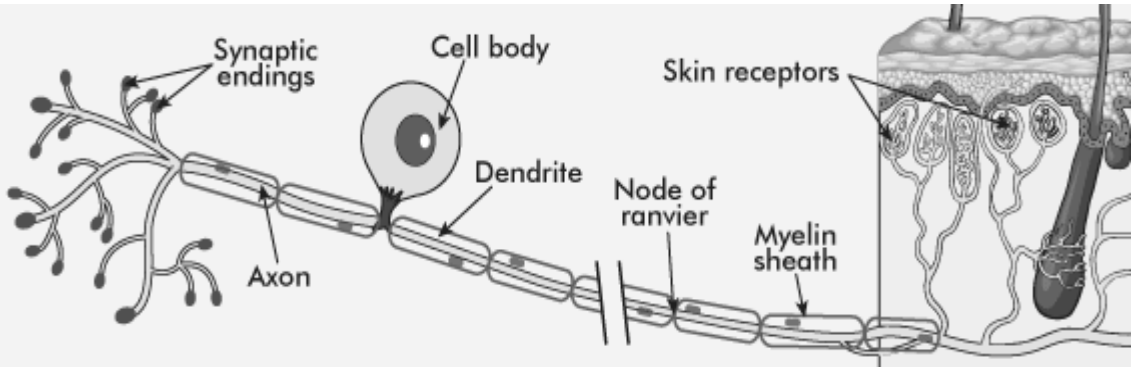
Nodes of Ranvier: speed up transmission of impulses.

Synaptic knobs: transmit impulses to other neurones.

TYPES OF NEURONES

There are three types of neurones: sensory neurones relay neurones and motor neurones.

1. **Sensory Neurone**

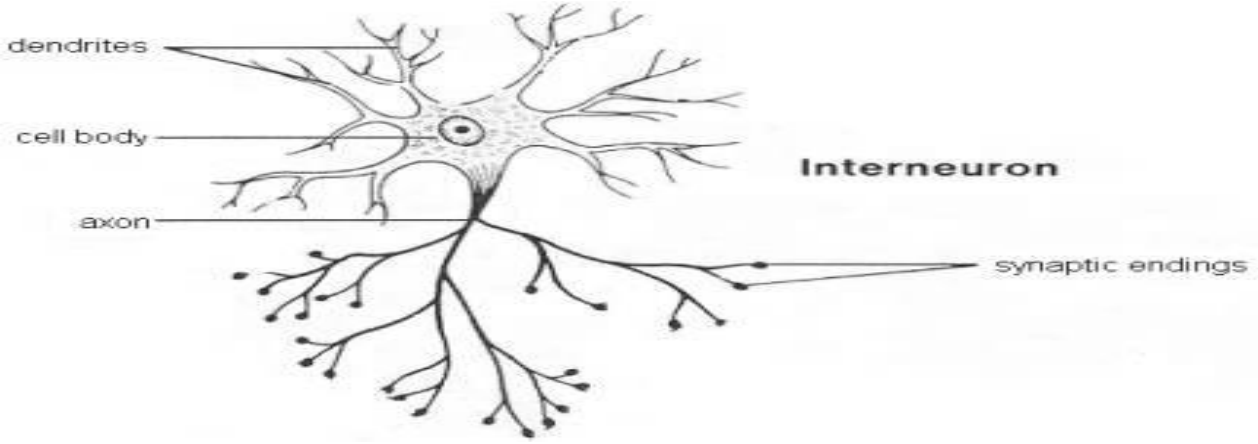


Sensory neurones are also called receptor neurones. They are connected with sense organs. The cell body is located along their length and they have myelin sheath.

Function of sensory neurone

- They transmit impulses from receptors (sense organs) to the central nervous system.

2. **Relay Neurone**

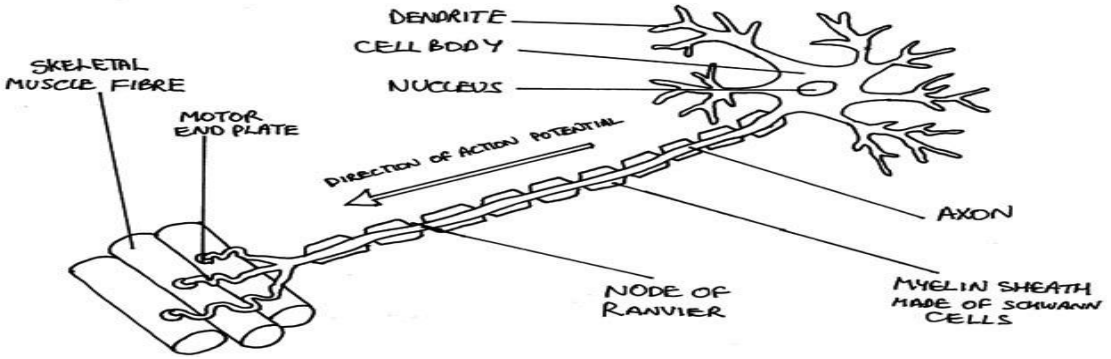


Relay neurones are also called association neurones. They do not have myelin sheath. They have short axons. They are located in the grey matter of the brain and spinal cord.

Function of Relay Neurone

- Store information.
- Link sensory and motor neurones by relaying impulses from sensory to motor neurones.

3. Motor Neurone



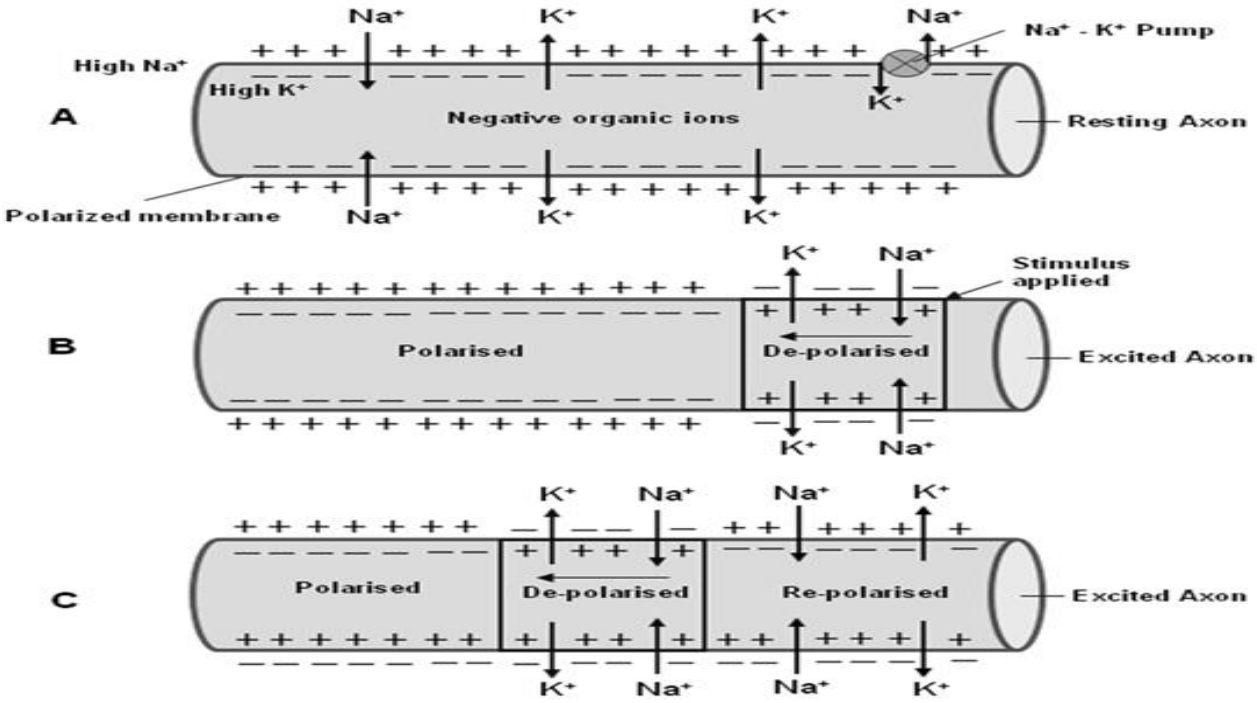
Motor neurones have myelin sheath. They have long axons. Their cell bodies are located at the end of the axons. They are connected to effectors such as glands and muscles. Cell bodies of motor neurones are located in the central nervous system.

Functions of Motor Neurones

- They carry impulses from the central nervous system (the spinal cord and the brain) to the effectors (muscles and glands).

Nerve impulse Transmission by a Neurone

An impulse involves propagation of electric charges along a neurone.



Nerve impulse transmission occurs in two stages

- Resting potential
- Action potential

Resting Potential

When a neurone is not conducting an impulse it is said to be at resting potential.

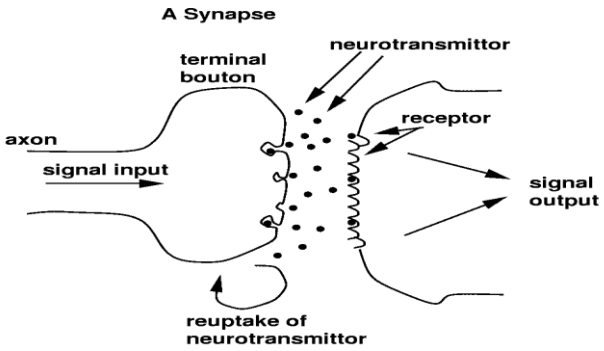
The concentration of sodium ions is more on the outside than the inside of the membrane. There are more potassium ions

and chloride ions on the inside than the outside. Due to diffusion of potassium ions from the inside to outside the net charge is negative on the inside and positive on the outside. The neurone is said to be polarised. The inside is negative due to negatively charged molecules and chloride.

Action Potential

Stimulation of the membrane reverses the flow of ions across the membrane. The membrane becomes depolarised (more permeable to ions). Sodium ions diffuse to inside. Chloride ions diffuse outside to balance the charge. The inside of the membrane becomes positively charged and the outside negatively charged. The reverse in charges is called action potential and the neurone conducts the impulse in this condition. When the impulse passes the node of ranvier there is restoration of the charge. Sodium ions diffuse to the outside using the sodium potassium pumps that use energy. Potassium ions and chloride ions diffuse to the inside. The outside becomes positively charged and the inside negatively charged. The neurone goes to resting potential ready for another impulse.

SYNAPSE



A synapse is a microscopic gap between one neurone and the next. It is the gap between the end plate of one neurone and the dendrite of the next. Impulses are carried across the synapse by chemicals called **neurotransmitters.**

Impulse Transmission across a Synapse

An impulse arrives at the synapse. The seminal vesicles in synaptic knobs release neurotransmitters into the synapse. The neurotransmitters diffuse across the gap and bind to the dendrites of other neurones and cause formation of the same impulse and the impulse restarts on the other side. Once the impulse has crossed the synapse the neurotransmitters are destroyed.

NB: Examples of neurotransmitters include acetylcholine, noradrenalin, dopamine and serotonin.

Functions of Synapses

- Ensure unidirectionality-ensures movement of impulse to one direction.
- Amplification-impulses are amplified
- Prevent overstimulation

THE CENTRAL NERVOUS SYSTEM

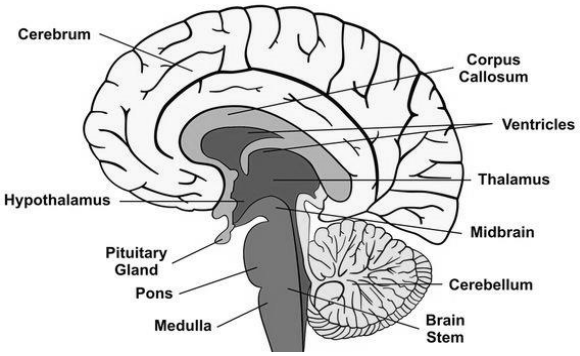
The brain is made up of two halves called hemispheres (the right and left hemispheres). The hemispheres are interconnected by a group of nerves called **corpus callosum.** The right hemisphere controls activities of the left side of the body while the left hemisphere controls activities of the right side of the body.

The outermost part of the brain is grey due to cell bodies and innermost part is white due to axons. The brain is covered by two membranes called meninges. The outer membrane is called **dura matter**. It protects the brain from mechanical damage. The inner membrane is called the **pia matter**-it has blood capillaries and lymph vessels. Between the dura matter and pia matter there is space filled with a fluid called **cerebro-spinal fluid**. The cerebro-

spinal fluid performs the following functions:

i. Distributes oxygen and nutrients to the nervous tissues.
ii. Acts as a shock absorber by cushioning it against physical/mechanical damage.
iii. The fluid contains lymphocytes which protect the brain against disease infections.

Functions of the Major Parts of the Brain



1. Cerebrum

This is the largest part of the human brain. It is divided into right and left cerebral hemispheres. Its outer layer is called cerebral cortex or grey matter. It is highly folded hence higher number of neurones. The large surface area enables humans to carry out complex activities.

Functions of the Cerebrum

i. It is the memory centre.
ii. It is involved in learning.
iii. It is the intelligence centre.
iv. It is involved in creativity and imagination.
v. Contains centres for all five senses which receive and interpret impulses from sense receptors.

2. Cerebellum

The cerebellum is located below the rear part of the cerebellum. It is smaller than the cerebrum. It is also highly folded.

Functions of the Cerebellum

i. Coordination of body movements (muscular coordination).
ii. Maintains balance and posture hence is called gyroscope.
iii. Ensures dexterity in fine movements like playing the guitar, sewing and typing.

3. Medulla Oblongata

This is the hind most and smallest part of the brain.

Functions of the Medulla Oblongata

i. It controls vital reflexes that regulate heart beat rate, breathing, blood circulation and blood pressure.
ii. It controls non-vital reflexes that coordinate swallowing, salivation, coughing and sneezing.

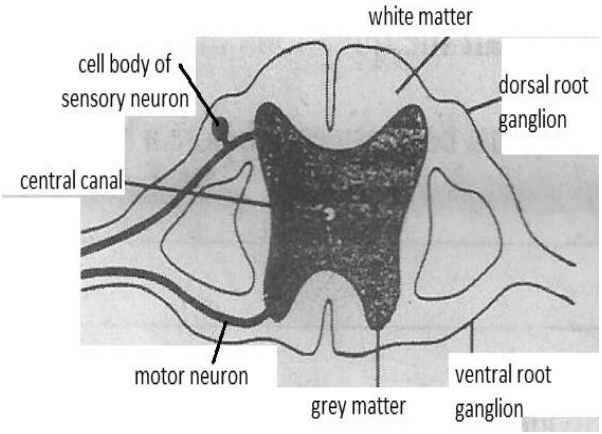
The following are the general functions of the brain

i. It receives and interprets impulses from all sensory organs of the body.
ii. It sends off impulses to glands and muscles causing them to function as effectors.
iii. It stores information so that behaviour can be modified according to past experience.

THE SPINAL CORD

The spinal cord is an extension of the brain running from the base of the brain down the back. It is protected by the vertebrae of the backbone and meninges. The outer parts of the spinal cord contain the white matter and the inner part contains the grey matter.

Cross-section of the Spinal Cord



There are 31 pairs of spinal nerves and these divide form two branches, the dorsal and ventral roots.

Dorsal root: also known as the sensory root is made of sensory neurones that bring impulses from receptors.

Ventral root: also known as motor root is made of motor neurones that carry impulses from the spinal cord to effectors.

Ganglion: is a bulge made by cell bodies sensory neurones in the dorsal root. All cell bodies apart from those of the dorsal root are concentrated in the grey matter. The white matter consists of nerve fibres.

White matter: it covers the peripheral areas of the grey matter. The white matter consists of nerve fibres that carry impulses up and down the spinal cord.

Grey matter: this is a butterfly shaped that appear grey in fresh tissue. It is grey due to presence of numerous cell bodies.

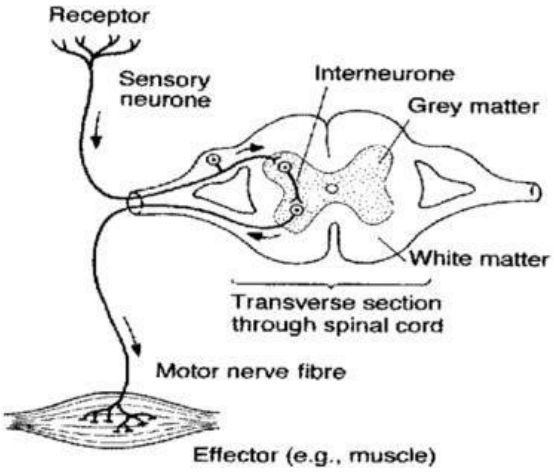
Central/spinal canal: it is a small clear space. It is filled with **cerebrospinal fluid**.

Functions of the Spinal Cord

i. It links nerves of the peripheral nervous system with the brain.
ii. Coordinates certain automatic or reflex responses.

REFLEX ACTIONS

A reflex action is a rapid automatic response to a stimulus which is not under voluntary control of the brain. The nervous pathway taken by a nerve impulse is called a **reflex arc.**



The reflex arc consists of five distinct parts:

i. Receptor to receive stimulus
ii. Sensory neurone which carry impulses from receptors to central nervous system.
iii. Multipolar neurone-relays impulses from sensory neurone to motor neurone.
iv. Motor neurone-carries impulses from central nervous to the effectors.
v. Effector to give response to stimulus.

Cranial reflexes are those reflexes controlled by the brain. The reflexes include breathing, blinking, pupil reflexes, salivation, heartbeat and swallowing. **Spinal reflexes** are controlled by the spinal cord. Examples of spinal reflexes include knee and ankle jerks. Withdrawing a hand from a hot/sharp object is controlled by both the brain and the spinal cord.

Types of Action

There are two types of reflex actions:

i. Simple reflex actions

ii. Conditioned reflex actions

Simple Reflex Actions

This is a reflex action in which a stimulus always produces a natural response. Simple reflexes are not learnt.

Examples of Simple Reflex Actions

- Knee jerk reactions
- Salivation at sight of food
- Secretion of tears when onion is peeled near you
- Sneezing
- Quick withdrawal of a hand or finger from a hot object

Practical Activities on Reflex Actions

1. **Knee Jerk**

   Materials

   - Students
   - Taylor's hammer or reflex hammer

Procedure

1. A student has to sit on a table with legs hanging loosely
2. With a taylor's hammer gently tap the student on the knee just below the knee cap
3. Observe what happens
4. Repeat the procedure

Results

The lower leg is jerked forward.

2. **Ankle Jerk**

Materials

- Students
- Reflex hammer

Procedure

1. A student must kneel on a chair and let feet lay loosely
2. Tap the back of the student's foot just above the foot
3. Observe what happens
4. Repeat the procedure

Results

The ankle is jerked.

3. **The Blink Reflex**

Materials

- Students

Procedure

1. Let a student open his or her eyes. The student should look straight ahead.
2. Another student should suddenly wave their hand in front of the first student's eyes
3. Observe what happens
4. Repeat the procedure

Results

The first student blinks

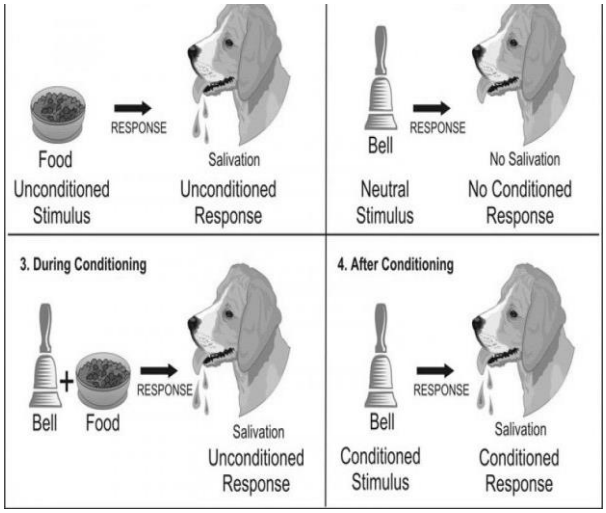
CONDITIONED REFLEXES

Conditioned reflexes are reflexes that are acquired through training and past experience.

Examples of conditioned reflexes

- Cycling, walking, driving, salivation upon hearing noon bell at boarding school and going to class when the bell rings at 7:30 am.

In an experiment a Russian scientist Ivan Pavlov rang a bell when he fed dogs.



The dogs then salivated in response to the bell even when no food was given. The natural stimulus (food) has been replaced by unnatural one (the bell). This is an example of a conditioned reflex.

Steps Involved in Conditioning an Organism

i. An organism is exposed to a natural stimulus. A response is produced.

ii. An organism is exposed to both natural and substitute stimulus. The same response is produced.

iii. An organism is exposed to the substitute stimulus only. The same response is produced.

Importance of Reflex Actions

a. They protect the body from harm. Reflexes that protect the body from harm include blinking, withdrawal of a hand from a hot or sharp object.
b. They help to in control of internal environment (homeostasis) such as heart beat, breathing and blood pressure.
c. Help in learning skills such sewing and cycling.
d. Some animals use reflex actions to catch prey and obtain food.

INVESTIGATIONS ON COORDINATION

1. To Investigate the Effect of Time of the Day on Memorising

Materials

- Two lists of words
- Stop watch

Procedure

1. Write down two lists of 20 words on two separate sheets.
2. Memorise the list of words on one sheet in the morning for 5 minutes.
3. Write down the number of words you can remember from the sheet at noon.
4. In the evening after school try to memorise the words on the second sheet for 5 minutes
5. Write down the number of words you can remember from the second sheet before going to sleep.

Results

More words memorised in the morning were recalled than those memorised in the

evening after school. In the morning are fresh after.

Conclusion

Time of the day affects our ability to memorise or record information.

1. **To Investigate Effects of Practice on Hitting a Target**

Materials

- Dart board
- Arrows/ball

Procedure

1. Make a mark on the dart board.
2. Aim the mark using arrows/ball
3. Take ten attempts (1st round) and count number of hits to target you make.
4. Continue for about ten rounds (100 attempts). Record the number of hits to the target you make in each round.

Result

At the beginning there were few hits on the target. As rounds continued hits on target increased.

Conclusion

Practice increases accuracy in hitting the target.

NB: Exposure to one stimulus for repeated times make the brain to coordinate repeated activities faster and more accurately.

DRUGS AND THE CENTRAL NERVOUS SYSTEM

A drug is a chemical substance that can alter the way in which a part of the body works. Drug abuse is the use of drugs in a way that can cause harm to the person using them or someone else. Drugs affecting the brain and spinal cord fall under the following groups:

Sedatives/depressants: these drugs act by reducing brain cell activity hence reduce anxiety and induce sleep. Examples of sedatives include valium, alcohol and opium.

Stimulants: these speed up the action of the nervous system. Stimulants make the drug user more confident and alert. Examples include caffeine and nicotine.

Pain killers (analgesics): they suppress the part of the brain or spinal cord responsible for pain or inhibit formation of impulse at the site of pain. Examples of pain killers include aspirin, morphine and ibuprofen.

Hallucinogens: these drugs cause hallucinations or illusions. Hallucinations are perceptions of somebody or something that is not there. Examples of hallucinations include cannabis, lysergic and diethylamide.

Effects Of Alcohol On The Central Nervous System

a. It slows down the transmission of impulses which slows down the speed at which a person can respond to a stimulus.
b. It damages brain cells hence affects memory and judgement.
c. It increases the feeling of aggression resulting to increased violence.
d. It interferes with body balance resulting to unconsciousness convulsions.

Alcohol taken by a pregnant woman may diffuse across the placenta to the foetus. Alcohol causes the following effects on the foetus:

i. Poor mental development by slowing down the development of brain cells in the foetus.

ii. Development of a small brain and a small head.

Effects of Marijuana on the Central Nervous System

a. Marijuana contains chemicals that damage cells in the memory centre of the brain. This leads to loss of memory.
b. High doses of marijuana lead to total breakdown of mental coordination leading to madness.
c. It also damages cells that control emotions. This results to distorted emotional reactions by an individual. This leads to slow or no emotional reactions in situations where it is needed and feelings of worry and anxiety even when there is nothing to worry about.
d. Marijuana interferes with transmission of impulses from one impulse because it affects the release of neurotransmitters at a synapse. Some chemicals in marijuana (cannabinoids) act as neurotransmitters hence disrupting mental processes.

Problems Associated with Nervous System

1. **Poliomyelitis (Infantile Paralysis)**

Poliomyelitis is a disease caused by a virus called **poliovirus**. It damages the axons of motor neurones to muscles of the legs and arms hence no response and movement of these organs and the muscles are paralysed. This result in poor development of bones and limbs wither.

2. **Meningitis**

Meningitis is a disease that affects the meninges surrounding the brain and the spinal cord. It causes the meninges to be inflamed. It is caused by viruses, bacteria, fungi or parasites. The symptoms of meningitis include headache, neck stiffness, fever, epilepsy, coma and deafness. Meningitis leads to death if untreated.

3. **Leprosy**

It is caused by bacteria called **mycobacterium leprae**. It causes permanent damage to the skin, neurones, limbs and eyes. It affects the peripheral nervous system.

4. **Tetanus**

It is caused by bacteria called **clostridium tetani**. The bacteria is present in the soil and enters the body through cuts. It causes permanent contraction of muscles by interfering with nervous transmission. This causes the jaws to lock after contraction of muscles.

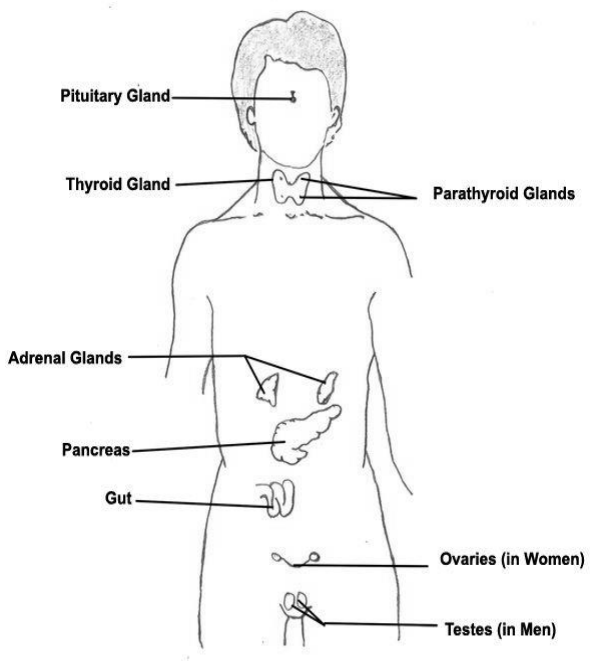
5. **Stroke**

Stroke is brain damage caused by a lack of blood flow to any part of the brain. A stroke is caused by blockage or bursting of a capillary in the brain leading to formation of blood clots that block or interfere with blood cells. Deprived of oxygen and nutrients brain cells die leading to stroke. A stroke leads to permanent brain damage and disability for patients. A person with stroke may develop paralysis on one or both sides of the body, have difficulty in walking or lose ability to speak or understand speech. It may also result to death.

CHEMICAL COORDINATION /ENDOCRINE SYSTEM

The endocrine system is a series of organs called **glands** which secrete chemicals called **hormones.** Hormones are chemical substances produced by endocrine glands to carry impulses to target organs. The

hormones may have an effect on the whole body or specific organs. An organ that is affected by a particular hormone is called a **target organ** for that particular hormone. There are two types of glands exocrine and endocrine glands. An exocrine gland secretes its products into a duct eg sweat glands.



Endocrine System

An endocrine is ductless and has the following characteristics:

1. It secretes chemicals (hormones).
2. It has no duct-hormones are secreted directly into the blood stream
3. It has rich supply of capillaries.

A hormone has the following properties:

a. It travels in the blood
b. It has its effect at a site (target) different from the site where it is made.
c. It is specific
d. It is a small soluble molecule
e. It is effective in low concentrations

Examples of endocrine glands are pituitary glands, thyroid gland, pancreas, testes, ovaries and adrenals.

THE PITUITARY GLAND

The pituitary gland is at the base of the cerebrum. It is called the **master gland** because it produces hormones that influence other glands. The pituitary gland produces the following hormones:

a. Growth hormone

The growth hormone regulates growth hence controls mitosis in meristems. Too much production of growth hormone results into giantism and too little production leads to dwarfism.

b. Follicle stimulating hormone

It regulates development of graffian follicles in the **ovaries**. It regulates formation of sperms in males.

c. Anti-diuretic hormone

It regulates water levels in the body. Failure by the pituitary gland to produce the hormone leads to a condition called diabetes mellitus.

Diabetes Insipidus

This is a condition which develops when the pituitary gland fails to secrete antidiuretic hormone. The kidney nephrons are unable to reabsorb the required amounts of water. This leads to production of large amounts of dilute urine a condition known as diuresis. The urine is tasteless or insipid. This can lead to dehydration. People with this condition drink a lot of water.

d. Leutinising hormone

It controls ovulation in females. It controls ejaculation in males.

e. Thyroid stimulating hormone

It stimulates the thyroid to produce thyroxine.

f. Oxytocin

It stimulate birth or labour in females.

g. Prolactin

It regulates milk production.

THYROID GLAND

It is located around the larynx. They produce a hormone called thyroxine. Thyroxine is responsible rate of growth and development of an organism since it controls metabolism rate. Thyroxineis a complex protein compound that contains iodine. Deficiency in iodine causes goitre (the swelling of the thyroid gland).

Under secretion of thyroxine leads to the following conditions:

a. The skin become rough and hair is lost.
b. Weight increases and movement becomes slower a condition known as **myxoedema.**
c. The tongue swells.
d. Deficiency at birth leads to poor growth and retardation, a condition known as **cretinism.**

Over secretion of thyroxine leads to increase in metabolic rate in the body which results to the following:

a. High body temperatures.
b. Increased breathing rate and heart beat.
c. Increased rate of breakdown of glucose, glycogen, and fats leading to loss of body weight.
d. Excess energy production that results to physical and mental restlessness. Some people become nervous and irritable.
e. Bulging or protruding eyes.

ADRENAL GLANDS

Adrenal glands are located on top of each kidney. They produce a hormone called **adrenaline**. Adrenaline is produced by the inner part of the adrenal gland known as the **adrenal medulla.** The hormone is involved in response to danger, anxiety, excitement and emergency. It is sometimes referred to as **fight/flight/emergencyhormone.**

Adrenaline prepares for fight or flight in the following ways:

- Increased conversion of glycogen to glucose.
- Increased rate of breathing to supply oxygen required for more energy production.
- It increases heart beat to increase transport of gases and nutrients such as glucose.
- Increased rate of muscle contraction enabling rapid movements.

Underproduction of adrenaline causes:

- Reduced activity
- Fatigue
- Stress and slow response to danger.

PANCREAS

It is both an exocrine gland and endocrine gland because it produces pancreatic juice. It is an endocrine gland because it produces insulin and glucagon. These hormones regulate sugar levels in the body. Insulin causes liver cells to change excess glucose to glycogen for storage in the liver and muscles. Glucagon changes glycogen to glucose when levels of glucose are low in the blood. Insulin and glucagon are produced by special cells inside the pancreas called **islets of Langerhans**. Deficiency in insulin results into loss of

glucose in urine, a condition known as diabetes mellitus.

Diabetes Mellitus

This is a condition that develops when the pancreas fails to produce insulin. This results into high glucose levels in the blood since it's not converted to glycogen for storage. Some glucose is passed out in urine.

Symptoms of Diabetes Mellitus

- Urinating frequently
- Frequent thirst
- Loss of weight
- Dehydration
- Poor resistance to infection
- Presence of glucose in urine.

OVARIES

They are found in female mammals. They produce two hormones, oestrogen and progesterone.

Oestrogen

Oestrogen has the following functions:

- Stimulates thickening of the uterus.
- Responsible for female secondary characteristics.
- Enlargement of vagina.
- Controls heat periods in females.

Progesterone

- This hormone maintains pregnancy by maintaining thickening of the uterine.

TESTES

Found in males. Produce hormone called**testosterone**. Testosterone is responsible for:

- Sperm production
- Male secondary characteristics (deep voice, muscularity, appearance of hairs in pubic region and arm pits, enlargement of the penis).

Functional Similarities and Differences between Endocrine and Nervous Systems

Similarities

- Both stimulate responses to stimuli. These responses are of survival value.
- Both are involved in coordination of body activities.

Differences

1. In the endocrine system responses are slow while in the nervous system responses are usually fast.
2. Hormones are transmitted through blood while in the nervous system impulses are transmitted through nerve cells.
3. Hormones reach all parts of the body while nerve impulses are transmitted through nerve cells connected to specific parts of the body.
4. Hormones stay longer in the blood and as a result, their effects last longer while in nervous system impulses are short lived and their effects last for a short time.
5. Endocrine system uses hormones to relay impulses while nervous system nervous system uses electrical charges to transmit impulses.

REVISION EXERCISE

1. What do you understand by the following terms?

   a. Coordination

   b. Hormone

   c. Impulse

   d. Neurone

   e. Target organ

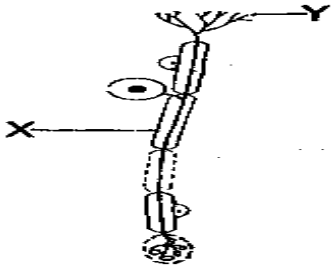
2. a. State any two differences between nervous and hormonal coordination

   b.State any two effects of the following on the nervous system

   i. marijuana

   ii. alcohol

   3a. Define a conditioned reflex action
   b.What is the difference conditioned reflex and simple reflex action
   c.Mention three steps involved in conditioning and organism
   d.The figure below is a diagram of a neurone. Use it to answer questions that follow.

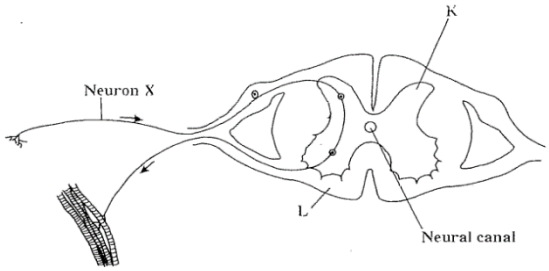


   i. Identify the type of the neurone in the diagram

8. .

   ii. Give any two features that enabled you to identify the neurone
   iii. State one function of part marked X.
   iv. Part Y helps to form synapses.
   e. What is a synapse?
   f. Explain how a nerve impulse is transmitted across a synapse

4. The figure below shows the cross-section of the spinal cord. Use it to answer questions that follow.



   a. Name the part marked L

   b. Give one function of the fluid found in the neural canal.

   c. Give the structural difference between K and L.

5. Describe how the following conditions develop in humans

   a. Diabetes mellitus

   b. Diabetes insipidus

6. Describe the path followed by an impulse during a knee jerk.

7. Describe any five abnormal conditions associated with the nervous system

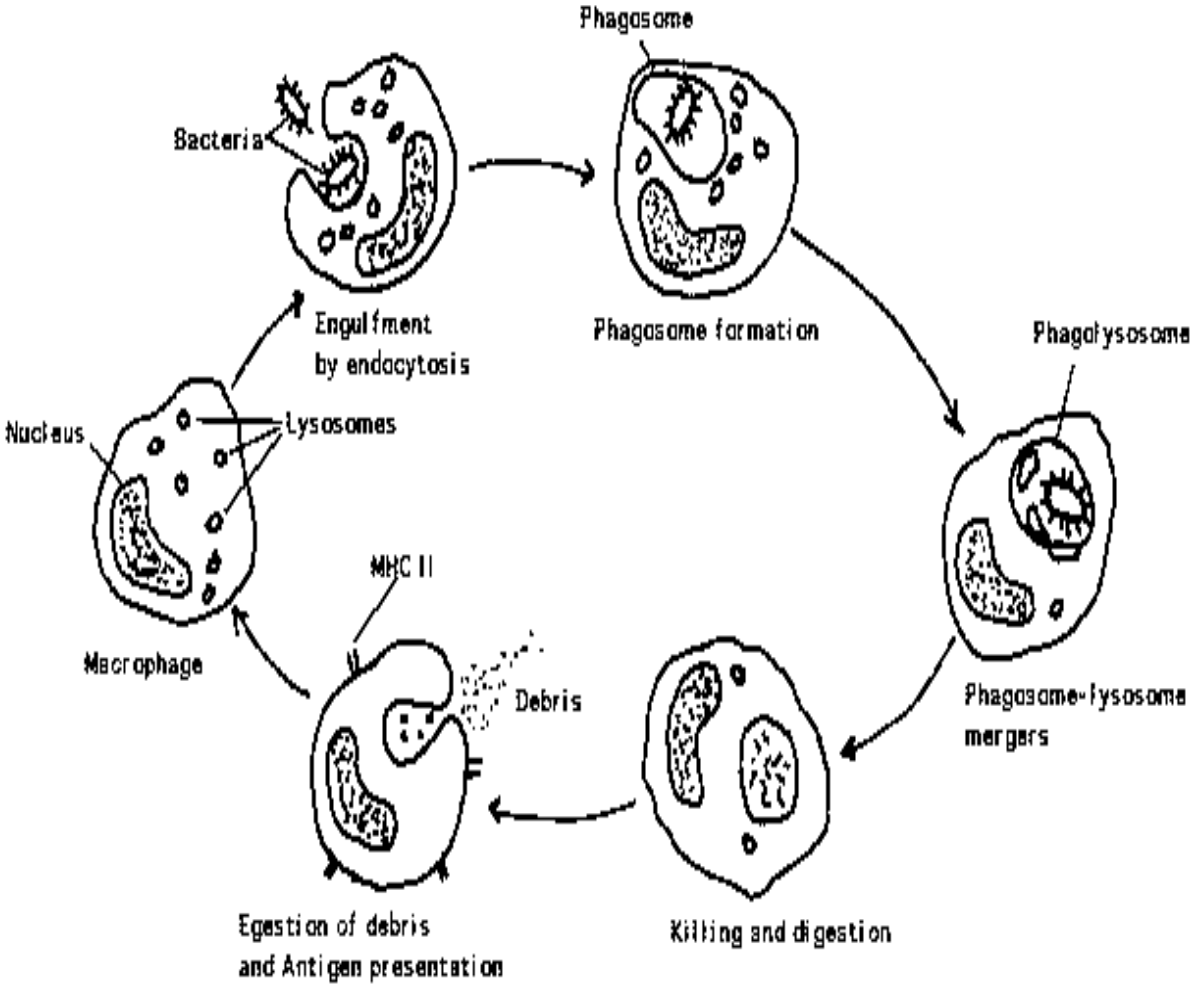
IMMUNITY

Immunity is the body's ability to resist infections or diseases. The body defends itself against pathogens in different ways. Such defence can be first line or second line.

CELLS INVOLVED IN IMMUNITY

The cells involved in immunity are phagocytes and lymphocytes.

1. **Phagocytes**



When a cut is sustained chemicals called histamines are produced by cells resulting into the area around the cut becomes inflamed red and hot. This results into an influx of phagocytes that kill germs by **phagocytosis.**

2. Lymphocytes

It involves the reaction of two types of lymphocytes to antigens: B-lymphocytes and T-lymphocytes.

Lymphocytes are divided into two:

a. T-lymphocytes or T-cells
b. B-lymphocytes or B-cells

T-LYMPHOCYTES

T-cells attack the following:

i. Cells that have been infected by microbes
ii. Transplanted organs and tissue
iii. Cancer-causing cells

When T-lymphocytes come into contact with foreign antigens they differentiate into memory cells and effector cells. There are three types of effector cells:

i. T-helper cells
ii. Killer cells
iii. Suppressor cells

T-Helper cells stimulate B-lymphocytes to function. T-Helper cells also stimulate T-killer cells to start attacking targeted pathogens or substances. T-Suppressor cells cause killer cells to stop killing pathogens or destroying targeted substances. T-Memory cells store the memory of the whole attack.

B-LYMPHOCYTES

When B-lymphoctyes come into contact with germs they differentiate into **memory cells** and **effector cells.** B-Memory cells store information about attack by disease or response to disease. B-effector cells produce antibodies that kill germs. Antibodies are specific, for example, antibodies against measles will only destroy the measles virus not other disease organisms. Antibodies work in the following ways:

i. Opsonins: these are antibodies that combine with antigen material on the outer surface of the pathogens so that phagocytes can easily destroy the germs.
ii. Lysins: these are antibodies that kill bacteria and viruses by dissolving them.
iii. Agglutinins: cause pathogens to stick together in clamps. In this condition germs cannot penetrate cells nor reproduce properly.
iv. Anti-toxins: these are antibodies that neutralise toxins produced by pathogens.

FIRST LINE DEFENCE

The first line defence prevents pathogens from entering the body. The body does this by creating entry barriers or killing pathogens. The following are the first line defences in the human body.

a. Skin

The outer layer of the skin (cornified layer) is made of dead cells and is dry hence micro-organisms cannot survive on the skin. Sweat (produced by sweat glands) and sebum (produced by sebaceous glands) contain enzymes that kill or inactivate germs. Sebum

(body oil) traps dust and germs which are removed by bathing.

b. Mucus

Mucus lining the respiratory system is produced by goblet cells. It traps dust and germs. it contains an enzyme called lysozyme that destroy certain bacteria. The mucus is expelled together with pathogens.

c. Cilia

Cilia are tiny hair-like structures that line the inside of some parts of the body. The cilia can move back and forth to trap and sweep pathogens and prevent them from entering the lungs. They usually sweep pathogens trapped in mucus.

d. Tears

Tears are produced by tear glands. Tears contain lytic enzymes called **lysozymes** that kill pathogens. This means pathogens cannot enter through the openings around the eye.

e. Blood Clotting

Blood clotting seals or closes wounds to prevent entry of germs. It also prevents anaemia by stopping further loss of blood.

f. Symbiotic Defence

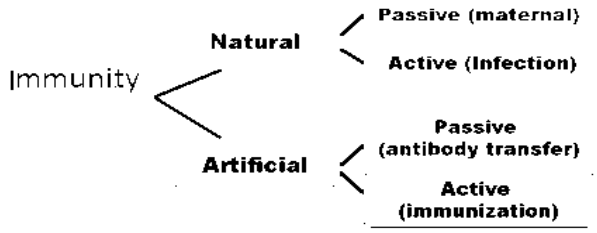
Symbiotic defence is provided by bacteria called E. Coli that habits in the small intestines especially of a baby. The bacteria attacks and kills germs that enter together with food.

g. Hydrochloric Acid In The Stomach

Hydrochloric acid contained in gastric juice kills some germs that are swallowed together with food.

NATURAL AND ARTIFICIAL IMMUNITY

There are two types of immunity: natural and artificial immunity. Natural immunity is the immunity that comes from the body itself. Artificial immunity is the immunity obtained by introducing weakened or killed germs or readymade antibodies into the body.



Both natural and artificial immunity can be active or passive. Active immunity is when the body produces its own antibodies. Passive immunity is when the body receives ready-made antibodies.

Natural Immunity

Natural immunity is divided into two:

- Active natural immunity
- Passive natural immunity

Active Natural Immunity

This is immunity obtained through infection. When the body is invaded by germs it produces antibodies against antigens of the pathogens. Once the organism recovers it can produce antibodies very quickly should the pathogens invade it again. This makes an organism immune.

Passive Natural Immunity

This is also called maternal immunity. It is acquired in two ways:

i. The foetus receives antibodies that diffuse through the placenta from the mother.
ii. Through breast milk especially colostrum that has alot of antibodies.

Artificial Immunity

Artificial immunity can be divided into two:

- Active artificial immunity
- Passive artificial immunity

Active Artificial Immunity

This is obtained by introducing weakened or killed germs in the body (vaccination). The body produces antibodies as if it is under real attack by the disease hence making the body immune. Active immunity stays longer in the body because the body learns to make antibodies through memory cells.

Passive Artificial Immunity

This is immunity obtained by introducing readymade antibodies into the body. The antibodies are usually extracted from the serum of an animal that has recovered from the disease. Passive artificial immunity does not last for long.

The effects of HIV on Helper T-cells and Killer T-cells

i. Helper T-cells

The virus attacks the Helper T-cells it starts to replicate in the cells. The Helper T-cells eventually die and the new virus infect other cells leading to reduction in Helper T-cells. This reduces the body's ability to defend itself against infections leading to opportunistic infections.

ii. Killer T-cells

These lymphocytes kill cells that have been infected by HIV. Their activity reduces with destruction of Helper T-cells by HIV.

How HIV Weakens the Immune System

The virus destroys T-helper cells. It attaches itself to special protein called cluster determinate 4 (CD4) on the surface of T-helper cells before invading and destroying the cells. As T-helper cells are destroyed more HIV is released which attack other T-helper cells. When T-helper cells are destroyed it means T-killer cells and B-lymphocytes are not stimulated to fight infection. This means the immunity of a person weakens.

VACCINATIONS

Vaccination is the introduction of vaccines into the body of an organism. Immunisation is also called immunisation or inoculation. A **vaccine** is a dosage of weakened or killed germs or toxoids.

How Vaccination Works

When the vaccine is introduced in the body, the body responds by producing antibodies and forming memory cells as if it is under actual infection. The antibodies produced make an organism immune to the disease vaccinated against. Memory cells enable a rapid response to actual infections since the body already learnt how to produce antibodies against the infection.

Diseases That Can Be Vaccinated Against

Disease	Causative agent	Nature of Vaccine	Duration
Typhoid	Bacteria	Dead bacteria	1-2 years
Cholera	Bacteria	Dead bacteria	6 years
Whooping cough	Bacteria	Dead bacteria	-
Smallpox	Virus	Cow pox virus	3 years
Tuberculosis	Bacteria	Attenuated bacteria	4 years
Measles	Virus	Attenuated virus	-
Poliomyelitis	Virus	Virus	6 months
Diphtheria	Bacteria toxin	Toxoid	3 years
Tetanus	Bacteria toxins	Toxoids	5 years
Rabies	Virus	Attenuated virus	1 year
Yellow fever	virus	Attenuated virus	10 years

Importance of vaccination

- It helps to stimulate an immune response that protects an organism from a specific infection
- It prevents spread of certain diseases hence saving lives.

The role of the Lymphatic System on HIV immune Response

The lymphatic system produces white blood cells. The white blood cells produced attack the virus directly or produce antibodies that try to kill the virus.

BLOOD TRANSFUSION

This is the transfer of blood from one person to another who needs it. One of the factors considered before transfusion is blood groups.

The ABO Blood Group System

The blood groups are determined by special proteins on surface of red blood cells. These proteins are called antigens or agglutinogens. The antigens are of two types: antigen A and antigen B.

If red blood cells have **antigen A** then the person belongs to blood **group A**. If the red cells have **antigen B** their surface then the person belongs to blood **group B**. If red blood cells have both **A** and **B** antigens then the blood group is **AB**. If the red blood cells have no antigens then the blood group is **O**.

There are two antibodies corresponding to antigens. These are **antibody a** (Anti-A antibody) and **antibody b** (Anti-B antibody). The antibodies are called agglutinins. When corresponding antibodies and antigens occur together agglutination of blood takes place.

Blood Group A

- Has A antigens
- Has anti-B antibodies

Blood Group B

- Has B antigens
- Has anti-A antibodies

Blood Group AB

- Has both A and B antigens

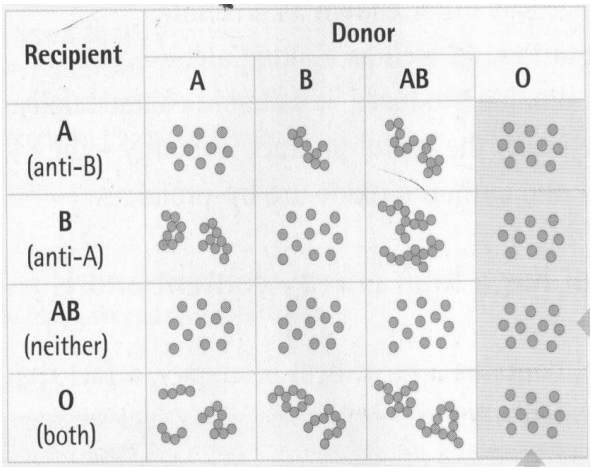
- Has no antibodies

Blood Group O

- Has no antigens
- Has both anti-B and anti-A antibodies

How to Determine the Blood Group of a Person

Anti-A serum and Anti-B serum are put into two separate Petri-dishes like containers called wells. A sample of blood is collected from an individual. Some drops of the blood are put in both sera. If blood agglutinates in anti-A serum only the blood group is A. If the blood agglutinates in anti-B serum only then the group is B. If the blood agglutinates in both sera then the blood group is AB. If there is no agglutination in both sera then blood group is O.



AB is a universal recipient because it has no antibodies to cause blood agglutination. O is a universal donor because it has no antigens that cause production of antibodies that cause agglutination.

Antigen: any foreign protein that causes production of antibodies.

Antibody: proteins produced by the body to destroy or neutralise antigens.

The Rhesus Blood System

There is another antigen found on red blood cells of some people. This antigen is called the Rhesus antigen or the Rhesus factor or antigen D. Individuals with this antigen on their red blood cells are said to be ***rhesus positive (Rh^+)***. Those without the antigen are said to be ***rhesus negative*** (Rh^-).

Examples of blood groups and Rhesus factor

Blood group	**Explanation**
B^+	Blood group is B and is rhesus positive
O^+	Blood group is O and is rhesus positive
A^-	Blood group is A and is rhesus negative
AB^-	Blood group is AB and is rhesus negative

Rhesus negative blood does not normally have antibodies against the rhesus antigen in the plasma. When the rhesus positive blood is introduced into a rhesus negative individual the production of anti-rhesus antibody (antibody D) is triggered. The first transfusion cause very little agglutination. Subsequent transfusions can lead to serious agglutination since levels of anti-rhesus antibodies are already high leading to death of an individual.

Production of rhesus antibodies can also be triggered by leakage of the rhesus positive antigen of a foetus into the blood stream of

the mother. The mother produces rhesus antibody that can cause agglutination of blood in the foetus. The baby may be born anaemic or in serious cases a miscarriage may occur.

FACTORS TO CONSIDER BEFORE BLOOD TRANSFUSION

a. Blood Groups

ABO blood groups should be considered before blood transfusion. This is done to avoid agglutination which may result in blockage of blood vessels which disturbs oxygen and nutrient supply leading to death.

b. Rhesus Factor

To avoid miscarriages which may occur after first pregnancy when the foetus is Rh^+ and mother is Rh^-. When the blood of the mother and foetus mix then the mother's body produces antibodies against antigen D. The first pregnancy survives but subsequent pregnancies are destroyed by the high levels of antibodies produced by the Rh^- mother.

c. Syphilis

To avoid infecting the blood recipient. The disease can lead to sterility, blindness in new born babies and madness.

d. Age of the Donor

The donor should not be too old or too young for faster replacement of blood (16-65 years old). In old people iron absorption is low and young ones bone marrows are not fully developed hence their blood replacement is slow.

e. Anaemia

To avoid death due to low levels of oxygen transported.

f. Hepatitis

To avoid infection of the recipient. Hepatitis is a liver disease and should be tested before blood transfusion.

g. HIV/AIDS

To avoid infecting the recipient. The blood donor should be tested for HIV before transfusion.

Agglutination

This means the sticking together of blood. This can lead to blockage of blood vessels that supply nutrients to vital organs such as the heart, lungs and the brain leading to death.

ORGAN TRANSPLANT

An organ transplant is the moving of an organ from one body to another to replace damaged or absent organs.

Example of Organs That are Transplanted

- Heart, lungs, kidney, pancreas and eyes.

Factors to Consider Before Organ Transplants

a. Tissue Matching

Tissues should match to avoid tissue rejection. Donors are usually relatives.

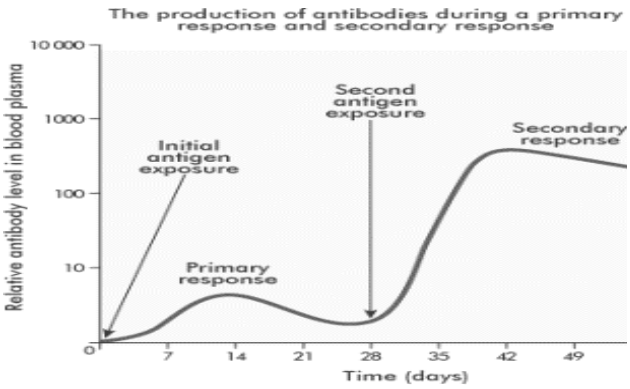
b. Health of the Donor

The health of the donor is considered to avoid infecting the recipient or putting the donor at risk. Ensure that the donor does not put themselves at health risk by donating organs.

c. Use of Immuno-Depressant Drugs

The drugs help to suppress the production of antibodies against the transplanted organ hence preventing organ rejection.

An Illustration of the Body's Response to Infection/Disease



1st response/Primary response: the response is slow as the body learns to produce antibodies that are specific to the infection. This takes time and a person may get sick.

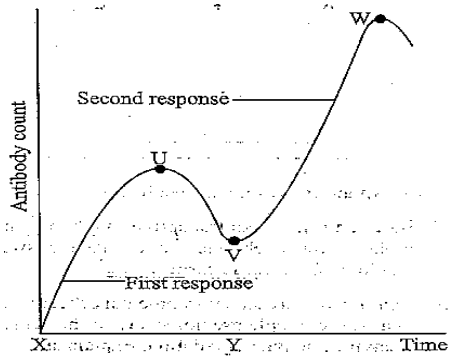
2nd response/secondary response: the second response is rapid because memory cells are present and antibodies are produced rapidly making the body immune to infection.

REVISION EXERCISE

1. Define the following terms
   a. Inoculation
   b. Primary response
   c. Antigen
   d. Antibody
   e. Immunity
   f. Agglutins
2. The table below shows the number of children who were infected by tuberculosis after being exposed to two different treatments. Use it to answer questions that follow.

Treatment	Number of Children	Number of Infected Children
vaccinated	500	20
unvaccinated	500	350

   a. Calculate the percentage of vaccinated children that was not infected.
   b. Explain how the vaccine protected some children from tuberculosis.
3. The figure below is a graph showing the response of antibodies in the human body at different times. Use it to answer questions that follow.



   a. Why does the level of antibodies decrease between U and V
   b. State what happens in the human body between X and Y
   c. Why is there a rapid change in response between V and W?
   d. How does HIV weaken the immunity of a person?
   e. Define a vaccine
   f. Children under five years are vaccinated against diseases such as tetanus and tuberculosis
      i. Why can a vaccine for tuberculosis not be used against tetanus?
4. Describe how natural and artificial immunities are acquired. Your answer should be in an essay form.
5. Explain any five factors that you would consider before a blood transfusion

VARIATION AND MUTATION

This is the difference between organisms of the same or different species. Variation between organisms of the same species is called **intra-species variation**. Variation between organisms of different species is called **interspecies variation**.

Causes of Variation

a. Age

Characteristics develop with age. Differences in age result in differences in characteristics such as size, mass and height.

b. Environment

Environment can determine the characteristics an organism possesses. Some aspects of the environment that cause variation include diet, climate, diseases and accidents.

c. Heredity

This is the passing of characteristics from parents to off springs. Off springs from different parents have different traits.

d. Mutation

Sudden changes to structure of genetic material changes the way characteristics are controlled hence variation.

e. Meiosis

Segregation of chromosomes and crossing over during gamete formation can lead to variation.

f. Sexual Reproduction

During sexual reproduction a zygote is formed by fusing of gametes from two separate parents. This results in differences in characteristics.

Types of Variation

a. Continuous Variation

These are variations that can be arranged from one extreme to another. There is a range of values due to presence of intermediates.

Examples of continuous variation

- Mass
- Height
- Age
- Skin colour
- Size

b. Discontinuous Variation

These are variations that have clear cut differences with no intermediates between them.

Examples Discontinuous Variations

- Blood groups
- Sex or gender
- Tongue rolling

USING MATHEMATICAL SKILLS TO DESCRIBE VARIATION

a. Calculating frequency

Frequency is the number of times a value or item appears.

Example

The following numbers are scores of five students in a biology test: 20, 05, 10, 70 and 20. From the figures the frequency of scores

of 20 is 2 while the frequency of scores of 10 is 1.

b. Calculating mean

Mean is the sum of all the values in a group divided by the number of values in each group.

Example

The heights of four students are as follows 70cm, 30cm, 20cm and 40cm.

Mean= $\frac{70cm+30cm+20cm+40cm}{4}$

$=160cm/4$

=<u>40cm</u>

c. Calculating Mode

Mode is the value of items that has the highest frequency.

Example

The heights of seven form four students are as follows: 1m, 1.6m, 1.1m, 1m, 2m, 1.8m, 1m.

The modal height is 1m.

d. Calculating Median

Median is the middle value when the values are arranged in ascending or descending order.

Example

The masses of five kittens are as follows, 30g, 25g, 18g, 16g, 15g. The median is 18g.

If it were like this, 16g, 30g, 25g and 15g, you add the two values in the middle and find average as shown below:

= 30g, 25g, 16g, 15g

= 25g+15g/2

=41g/2

=<u>20.5g</u>

Calculating Range

This is the difference between maximum data value and minimum data value.

Example

The following are the scores in mathematics test for some form three students: 0, 80,79,40,2,24,30 and 55.

Range = 80-0

=<u>80</u>

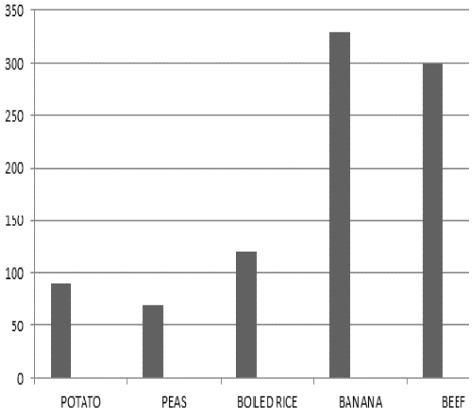
Presenting Data Using Bar Charts or Histograms

Bar Charts/Graphs

The table below shows the amount of energy in 100g of each type of food.

Food	Energy (kJ/100 g)
Potato	90
Peas	70
Boiled rice	120
Banana	330
Beef	200

Draw a Bar chart to show amount of energy against food type.



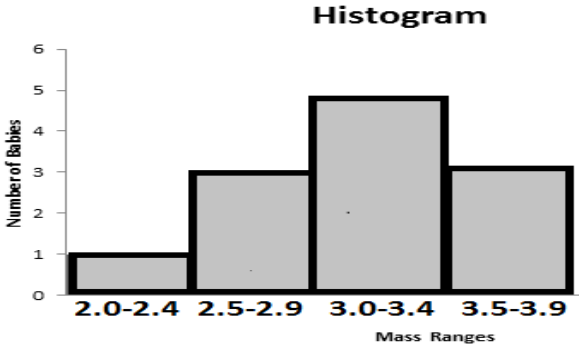
Histograms

The data below shows the birth masses of 12 babies (in Kg).

3.1	3.4	3.0
2.5	2.5	3.5
3.0	2.6	2.0
3.5	3.4	3.5

Draw a histogram Using the data above

Birth Mass (Kg)	2.0-2.4	2.5-2.9	3.0-3.4	3.5-3.9
Number of Babies	1	3	5	3



MUTATION

Mutation refers to sudden change in structure of genes or chromosomes which also changes the way they control characteristics. Most mutations are changes to a single gene that may lead to production of a defective protein that may change an individual's traits.

Types of Mutation

- Gene mutation
- Chromosome mutation

Gene Mutation

It occurs due to molecular changes to a gene on the locus. It is also called **point mutation**.

Chromosome Mutation

This occurs when changes occur in chromosomes. Part of the chromosome may break off and get lost or join another chromosome.

Causes of Mutation

a. Chemicals

Chemicals react with nucleotide bases of DNA. This changes DNA and the way it controls characteristics.

b. Exposure to Ultraviolet rays

These rays cause damage to DNA. This changes the way DNA controls the characteristics of an organism.

c. Exposure to Radiation

Radiation also leads to changes in DNA as it has a lot of energy that split DNA in cells. This causes changes in DNA hence mutation.

d. Temperature

Temperature increase results in increase in rate of mutation.

Effects of Mutation

- Some mutations are lethal (deadly) such that an organism dies before

reaching maturity such as albinism in plants and sickle cell anaemics.

- Some mutations are beneficial organisms such that the organism becomes better adapted to survive in its environment.
- Some mutations may change the phenotype of an organism but the organism is not affected in any way such a mutant with extra toe.

NB: Substances that cause mutation are called **mutagens**. The individuals or organisms that have genes that have undergone mutation are called **mutants.**

Examples of Mutation

- Haemophilia
- Sickle cell anaemia
- Colour blindness
- Albinism

Genotypes and Phenotypes Related to Sickle Cell Anaemia

GENOTYPE	TYPE OF HAEMOGLOBIN	SHAPE	PHENOTYPE
Hb^AHb^A	Normal	Biconcave	Normal
Hb^AHb^S (carrier)	Normal and sickle cell	Biconcave & sickle cell	Sickle cell anaemia trait.
Hb^SHb^S	Sickle cell	Sickle cell	Sickle cell anaemia

SICKLE CELL ANAEMIA

This is the condition whereby the body produces abnormal or defective red blood cells (haemoglobin). Normal red blood cells are biconcave discs while sickle cells are either sickle shaped or crescent shaped. Sickle cells arise due to mutation of genes for production of normal red blood cells. Sickle cells have less surface area hence less surface area for haemoglobin to carry oxygen. The person is weak and the condition is called **sickle cell anaemia.** Sickle anaemics are homozygous recessive (Hb^SHb^S). Others are heterozygotes (Hb^AHb^S) and others are homozygous dominant (Hb^AHb^A).

Sickle cell anaemics do not survive to maturity. However, they are resistant to malaria as there is little room for plasmodia to multiply.

ALBINISM

This is a condition of lacking normal skin pigmentation (melanin). Absence of melanin leads to albinism. Albinism is caused by defective gene for production of melanin. The defective gene causes failure to produce an enzyme called **tyrosinase** needed to form melanin. Melanin protects the skin and eyes from harmful ultraviolet rays from the sun. Without melanin the skin lacks protection from the sun and is subjected to premature ageing and skin cancer.

Possible Genotypes and Phenotypes in Relation to Albinism

GENOTYPE	PHENOTYPE
AA	Normal
Aa	Normal Skin (carrier)
aa	Albinism

REVISION EXERCISE

1. The diagram below shows a variety of dogs

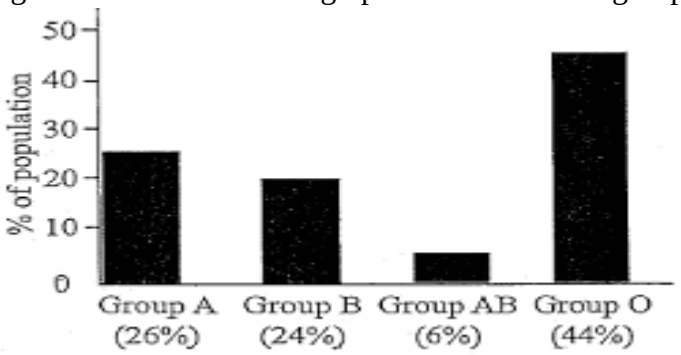
a. Identify one variation that can be observed in the dogs
b. Explain any two ways in which the variation mentioned above would have arisen in the dogs
c. To which types of variation do the following belong

i. Blood groups
ii. Tongue rolling
iii. Age
iv. Height

2. A farmer planted maize seeds. After the seeds have germinated the farmer observed that some seedlings had white leaves. All the seedlings with white leaves died five days later

a. State the genetic term used to describe the condition of seedlings with white leaves.
b. Explain why the seedlings with white leaves died five days after germination
c. State how the condition in 2a above arose in the maize seedlings

3. The figure below shows a bar graph of human blood groups

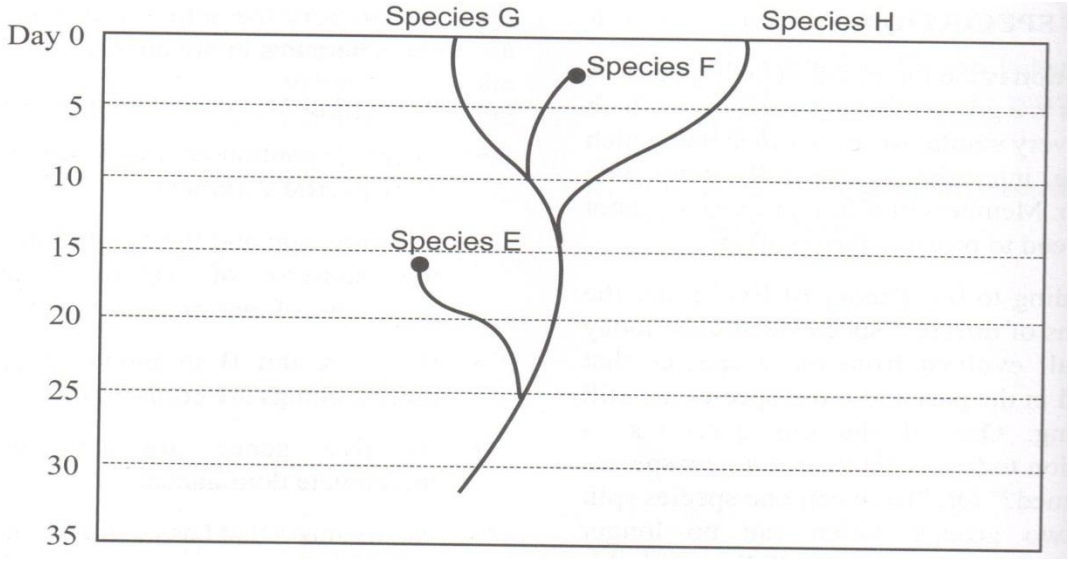


a. What type of variation is shown by blood groups in the bar graph?
b. In a population of 300 what will be the number of people with blood group AB?
c. Give two examples where mutations may be:

i. Beneficial to a person
ii. Disadvantageous to a person

EVOLUTION

This refers to gradual change in organisms. Life on earth began from simple forms which slowly evolved into present day organisms. All living things evolved from common ancestors over a long period of time. This is called the theory of evolution. It was proposed by a scientist by the name of Charles Darwin-the father of evolution.



Darwin's Theory of Evolution

Darwin's theory of evolution is based on the following ideas:

a. **Overproduction**: all organisms produce more off springs than can survive. This is due to many factors such as hunger and disease.
b. **Struggle for existence**: overproduction leads to competition for resources which are limited. The resources competed for include food, water, space and mates.
c. **Variation**: there are variations in characteristics of organisms. Some variations enable organisms to compete effectively or successfully and are called favourable/advantageous/beneficial variations. The variations that prevent an organism to compete effectively are called disadvantageous or non-beneficial variations.
d. **Survival of the fittest**: beneficial variations are called adaptations. Adaptations are inheritable characteristics that make an organism suited to survive in its environment. Those with adaptations survive and those without adaptations are eliminated.
e. **Advantageous characteristics are passed on to off springs**: organisms with adaptations pass on their adaptations to their off springs. The organisms with advantageous variations increase in number while those with disadvantageous variations decrease in number in a given population.
f. **Natural selection**: organisms with disadvantageous variations do not survive the competition. They do

not grow to maturity and reproduce. They reduce in number in a given population. It is as if nature selects some organisms to live and some to die through diseases, predators, hunger and drought.

g. **Gradual change**: the changes in organisms are very gradual. Evolution occurs slowly and continuously over millions of years. The changes occur due to accumulation of adaptations in organism which may lead to formation of new species which are totally different from the original species.

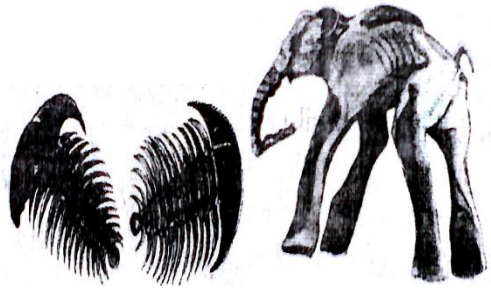
Charles Darwin's theory of evolution is a theory of evolution by natural selection.

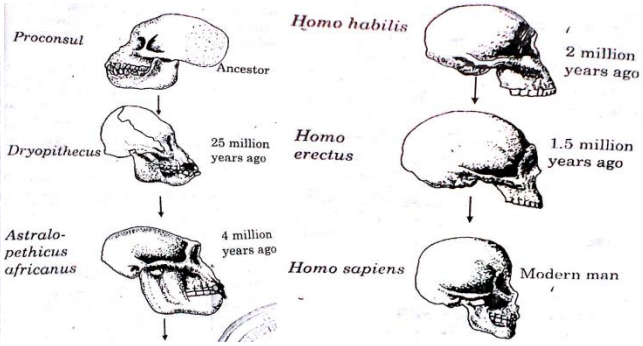
EVIDENCE FOR EVOLUTION

1. Fossil Records

Fossils are remains of plants and animals that lived millions of years ago. The fossils are studied and fossil information of related organisms is arranged in such a way that they form a series according to their age, starting from oldest to the most recent. This is called a fossil record.

***Trilobites (ancestor of insects), mammoth (ancestor of elephants) and evolution of* humans**

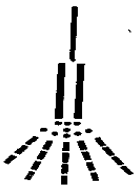




Fossil records indicate extinction of organisms due to presence of fossils of organisms that do not exist today, they show progressive change within forms of organisms and they show existence of transitional forms between organisms.

2. Comparative anatomy

Anatomy is the study of the structure of living organisms. Comparative anatomy is the study of structural differences and similarities between organisms. It involves the comparison of structural designs of certain parts organisms. For example, the limb bone pattern of all animals with four legs has the same structural designs. The design is called **pentadactyl limb design.**

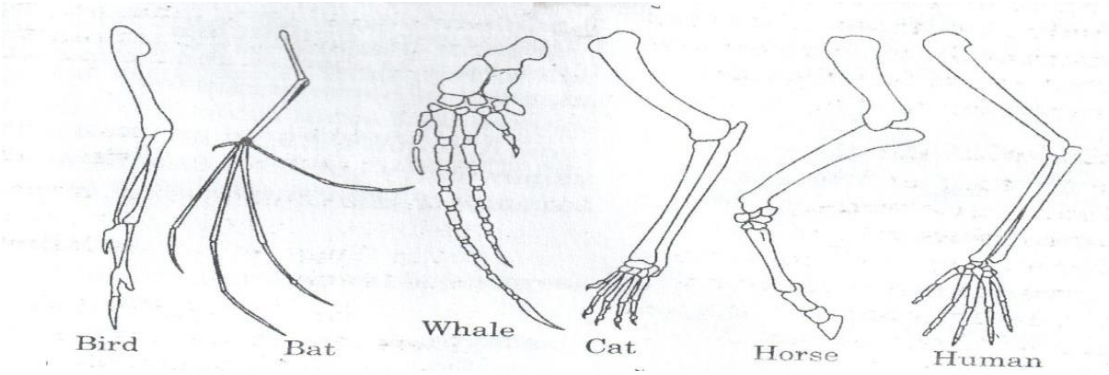


This shows that organisms having this plan arose from the same ancestral parent.

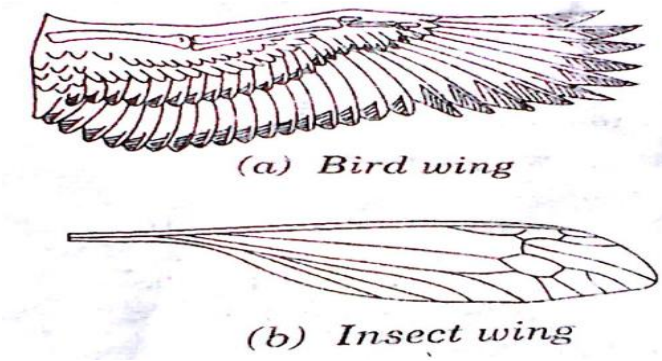
Under comparative anatomy there are the following categories of structures:

a. **Homologous structures**: these are structures having a similar pattern but used for different functions e.g. the fore limb of a monkey, human being and a dolphin. This shows divergent evolution since these

organisms have diverged from each other during evolution.

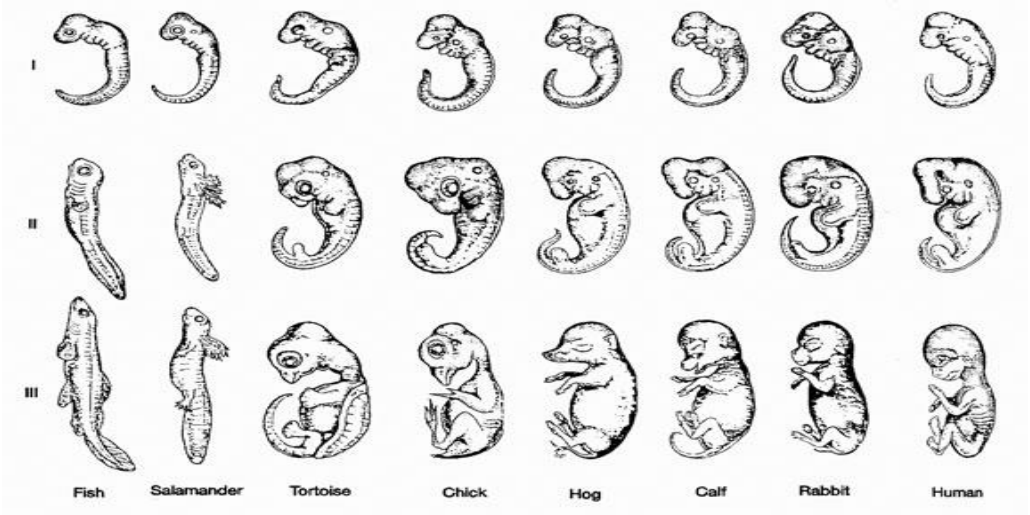


b. **Analogous structures**: these are structures having different patterns but used for the same function e.g. wings of a bird and wings of an insect, thorns in plants and spines of animals. This shows convergent evolution which suggests that the organisms evolved from different ancestors but develop similar adaptations.



c. **Vestigial structures**: these are structures present in organisms but serve no function at all e.g. appendix in humans and claw-like structures in pythons and some snakes.

3. Comparative Embryology



This is comparative study of different embryos of different animals. Many similarities are noted in the early stages of embryo development. These similarities support the idea that these

animals have a common ancestral or evolutionary origin. Embryo development can be used as evidence for evolution.

4. Geographical Distribution

Organisms living in different parts of the world have many similarities in common. For example the leopard is similar to animals like tigers, cheetahs, lions and cats. The similarities support the idea that the organisms evolved from common ancestors. Animals of the same species were separated by geographical barriers such as oceans and mountains and could not interbreed. These organisms evolved into different species as they adapted to their different environmental conditions. Geographical barriers create geographical isolation between organisms.

5. Cell Biology

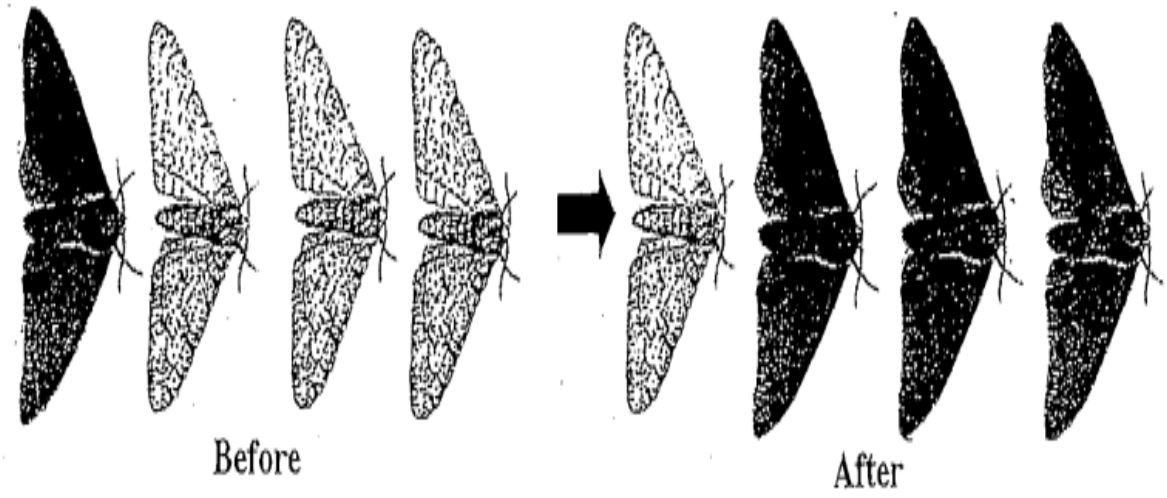
Studies of different cells from different organisms may reveal some differences and similarities between them. For example cells without true nucleus and nuclear membrane are **prokaryotic** cells and those with nucleus and nuclear membrane are **eukaryotic** cells. Organism with prokaryotic cells are more closely related such as bacteria and blue algae hence they may have evolved from the same ancestor. On the other hand organisms with eukaryotic cells may also have evolved from common ancestors such as monkeys and humans. Another example is presence of haemoglobin, DNA and other cell organelles in cells of mammals can also show evolution from common ancestor.

Natural Selection in Action

1. Sickle Cell Anaemia

Individuals with sickle cell anaemia always suffer from severe anaemia and die before reaching maturity and do not reproduce hence the gene is eliminated. Individuals with sickle cell trait survive better than normal individuals in malaria prone areas. The rate of multiplication of plasmodia in individuals with sickle cell trait is slow hence having lower chances of death due to malaria. Individuals with normal haemoglobin are easily attacked by malaria as there is enough room for plasmodia multiplication hence individuals can easily die from malaria and can be eliminated.

2. Peppered Moth (Biston Betularia)



The peppered moth is commonly found in England. There are two types of such moths; light moths and dark coloured moths. The dark coloured moths arose due to mutation in genes for body colour. The dark moth was very rare before industrial revolution but increased with industrial revolution. Before industrial revolution tree trunks were covered by light coloured lichens which grow on them. The light coloured moths were hidden by light coloured lichens from predatory birds. Dark coloured moths were easily seen and eaten by predatory birds. The number of light coloured moths increased while dark coloured moths decreased. Due to pollution after industrial revolution, the lichens population was reduced and tree trunks were darkened by soot. This results in black forms to be better hidden than light forms hence more light coloured moths are eaten by predatory birds than dark coloured moths. This results in increase in number of black coloured moths and reduction in light coloured moths.

3. Drug Resistance

Sometimes organisms that are meant to be killed by the drugs, pesticides and antibiotics do not die. This is because organisms are resistance to these drugs. Resistance to drugs arises due to mutation or natural selection. In natural selection the drugs may be selective in that they may kill some organisms while failing to kill others. Organisms such as bacteria that are not resistance to drugs die while those that are resistance to drugs survive and multiply.

SPECIATION

Speciation is the formation of new species. A species is a group of organisms that can interbreed successfully and produce viable offspring. New species can develop due to Natural selection and Isolation.

1. Natural Selection and Speciation

With time and over many generations favourable adaptations accumulate in a given group of organisms while unfavourable ones disappear. This leads to clear differences between a particular species and its ancestors. The species develops into a new species because its features do not fit into the features of its ancestors.

2. Isolation And Speciation

Speciation can also occur when a group of organisms of the same species are separated by geographical, ecological, behavioural, reproductive and genetic barriers.. If their environments are different they will adapt differently to suit their habitats. They also acquire different reproductive behaviours. Overtime the two groups may become so different that they cannot interbreed successfully.

Mechanisms of Isolation

Geographical Isolation: isolation brought about by physical barriers such as mountains, seas and oceans. Organisms of the same species are separated by these barriers. As each of the two groups adapt to their different environments they develop different characteristics leading to formation of new species.

Ecological isolation: due to occupation of different habitats from the original one organisms of the same species may be isolated. As they adapt to new habitats they

form new species due to accumulation of different adaptations.

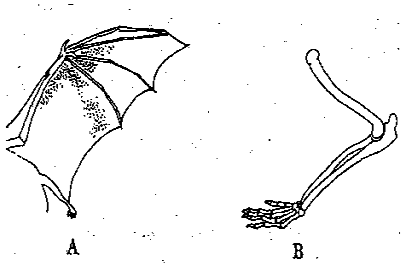
Behavioural isolation: organisms change behaviour before mating period. This seeks to attract members of the opposite sex. The behaviour can be nesting, songs or coloration which may change and fail to attract members of the opposite sex. Mating fails to take place. Each of the isolated populations may be acted upon by different environmental factors resulting in formation of new species.

Reproductive isolation: sometimes isolated populations develop structural differences in reproductive organs. Copulation is not possible between isolated individuals. This may lead to development of new species.

Genetic isolation: this is a result of mutation which result in formation of new genotype. Fertilisation may take place but may result into inferior zygotes that fail to develop properly. The new genotypes undergo natural selection and yield a new species.

REVISION EXERCISE

1. What do you understand by the following terms
   a. Speciation
   b. Evolution
   c. Vestigial structures
   d. Homologous structures
2. How do the following support the theory of evolution?
   i. Comparative anatomy
   ii. Embryology
   iii. Fossil records
3. How do the following help in formation of new species
   a. Isolation
   b. Natural selection
4. The figure below shows the wing of a bat labelled A and the front leg of a rabbit labelled B. Use it to answer questions that follow.



   a. Give two structural differences between A and B.
   b. What type of evidence of evolution is shown above? Give a reason for your answer.
   c. Describe any five evidence of evolution.

BIOTECHNOLOGY

Biotechnology is the use of living organisms and their body processes to develop new and useful products that help to improve human life.

Biotechnology aims at solving existing problems in lives of people

PLANT AND ANIMAL BREEDING

Plant and animal breeding is done to produce animals and plants that have useful qualities. This improves agricultural productivity.

Plant and animal breeding applies genetic principles to produce improved breeds of animals and varieties of plants.

1. NEW MAIZE VARITIES

This aims to produce maize varieties with good qualities and suited to various regions of Malawi.
Aims of developing new maize varieties include:

- To produce early maturing varieties for areas with short rainy seasons.
- To produce late maturing varieties for areas with longer growing seasons.
- To produce high yielding varieties.
- To produce disease resistant varieties

Ways of Improving Crops/Plants

- **Introduction**: this is the importation of crop varieties with desirable characteristics for propagation. The imported varieties may replace local varieties.
- **Selection**: the choosing of plants with desirable traits for propagation or breeding.
- **Hybridisation/cross breeding**: two varieties of plants are chosen and crossed to produce new variety that has good qualities of both parents.

2. NEW POULTRY AND DAIRY BREEDS

This aims to produce:

- Breeds that grow fast.
- Breeds suitable to the climatic conditions of Malawi.
- Breeds that produce high yields.
- Disease resistant breeds.

WAYS OF ANIMAL IMPROVEMENT

Selection: the choosing of animals with desirable characteristics for breeding.

Introduction: the importing of animals with desirable characteristics for breeding.

Cross breeding: crossing two breeds of animals to produce a new breed that possesses good qualities from both parents.

Inbreeding: mating closely related animals to preserve desirable characteristics (to prevent genetic erosion).

Progeny testing: choosing animals (male) for breeding based on the performance of their off springs (daughters).

Sib selection: choosing animals (female) for breeding based on the performance of their off springs (sons).

APPLICATION OF BIOTECHNOLOGY

The knowledge of biotechnology can be used to improve the quality of human life. Therefore biotechnology is applied in various fields.

a. In Medicine

i. Genetic engineering is applied in producing medically important proteins. For example insulin to treat diabetes mellitus can be produced using bacterium called **Escherichia coli**.
ii. Gene therapy. A defective gene can be removed and replaced by a normal gene to treat the disorder.
iii. Vaccines and blood clotting factors are produced from viruses using genetic engineering techniques

b. In Agricultre

i. Improving shelf-life of agricultural produce. This lengthens the period required for produce to go bad.
ii. Production of genetically modified organisms. Introducing genes (trangenes) that determine certain desired characteristics can change the genotype of organisms. This is aimed at improving disease resistance, resistance to drought and protein content. Crops with transgenes are called genetically modified (GM) crops.
iii. Bacteria has been used to produce a hormone called **Bovin somatrophin** which is injected into cows to increase milk production.

c. In Industry

Industrial uses of biotechnology mainly rely on enzymes and micro-organisms such as fungi and bacteria. For example:

i. In the manufacture of beer and bread certain fungi (yeast) are used for faster fermentation
ii. In the manufacturing of detergents, enzymes with better cleaning power have been used
iii. Large scale meat tendering uses enzymes
iv. In sewage treatment, plant enzymes have been used to break down the organic matter.

d. In forensic Science

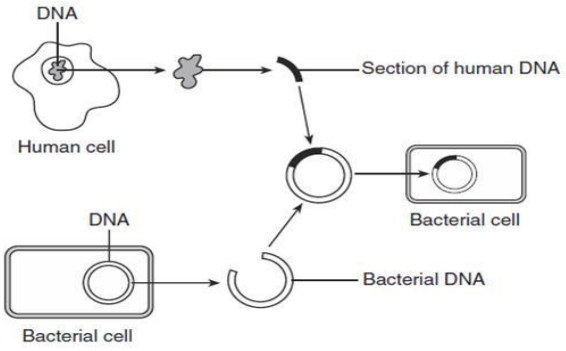
Studying the DNA of a child and of the parents in dispute of paternity resolves the disputes. Similarities in DNA structures studied indicate closeness in relationship.

GENETIC ENGINEERING

Genetic engineering is a process that involves introduction of a portion of foreign DNA into a host organism to stimulate the synthesis of a protein. It is also called recombitant DNA technology.

The process of integration or insertion of DNA from organism to another is called **cloning**. An organism whose DNA has been altered by addition of genes is called a **transgenic organism**. The production of large quantities of identical genes by genetic engineering is called **genetic cloning.**

How Genetic Engineering is done



A section of DNA extracted from an organism is translocated into a bacterium or a virus. The foreign DNA is inserted in the plasmid inside the bacterial cell to stimulate the synthesis of required proteins for various functions. Once the piece of DNA has been successfully inserted the bacteria may divide continuously to produce other bacteria which contain copies of the foreign DNA. All the new bacteria produce the required protein under control of foreign DNA.

How Insulin is produced

A gene for insulin production is extracted from the pancreas of a human being. The gene is introduced into a portion of the bacteria's DNA. The bacteria with the new insulin is cultured and allowed to multiply. The insulin gene inserted in the bacteria instructs it to produce the human insulin. The hormone is then collected from the bacteria. The insulin is then purified and packaged for sale.

NB: Insulin is used to treat diabetes mellitus.

Application of Genetic Engineering

- Production of vaccines from micro-organisms especially Hepatitis B vaccine in man and foot and mouth disease in cattle.
- Production of the Bovine somatrophin hormone using bacteria. The hormone is injected into cows to make them produce more milk
- Production of pest-resistant crops. A gene is transferred from a bacterium Bacillus thuringiesis into some crops. The gene influences the production of substances that repel the pests.
- Production of disease resistant animals such as influenza resistant pigs
- Production of insulin using bacteria or viruses
- Production of transgenic cows that produce more milk.
- Transgenic plants have been used to produce a chemical that is used as a biodegradable plastics thus reducing pollution..

Benefits of Genetic Engineering

- Production of proteins in plants and animals to treat disorders in both plants and animals such diabetes mellitus, disease resistance, etc.
- Provision of high quality hybrids of plants and animals with improved nutritional value.
- It has been used to produce drought, disease and pest resistant hybrids in plants and retaining high yields.
- It has promoted increased agricultural production such as increased milk production which can lead to food security.

- Improving shelf-life of agricultural produce. This lengthens the period required for produce to go bad.

Problems of Genetic Engineering

- Some genetically modified organisms may have negative effects on human life. For example some products like milk were found to have traces of antibiotics that may trigger cancer.
- It can lead to production of harmful organisms which can be released to the environment.
- Alteration of genetic codes of organisms may lead to undesirable mutations that may cause disorders to the organisms concerned.
- The technique is tedious and expensive
- The host micro-organism may reject the inserted DNA either by destroying it or inactivating it.

Ethical Implications on the use of Biotechnology

Ethics involves what people believe to be right and acceptable in the community. Ethical issues raised by biotechnology include:

- The probability of the survival and growth of genetically modified organisms beyond the intended environment.
- Genetically identical plants and animals lead to loss of biodiversity
- The genetically modified plants may escape into the wild and superweeds may be created by cross-breeding of wild species and transgenic species.
- Protection of human subjects during clinical trials
- Businesses control the products being produced and aim at profit which may not be in the interests of consumers of the products.
- The transgenic products may cause allergic reactions in people.
- Affordability of the technology
- The extent to which genetically modified organisms may be harmful to human beings, the environment and other organisms they come in contact with.

REVISION EXERCISE

1. Define the following terms
   i. Biotechnology
   ii. Genetic engineering
   iii. Transgenic organisms
2. Describe the process of genetic engineering
3. Describe any two ways in which genetic engineering is applied in the following areas:
   i. Agriculture
   ii. Medicine
   iii. Industry
4. Describe how insulin is produced using genetic engineering
5. What are some of the ethical issues that arise on use of biotechnology? Mention two.
6. State two ways in which genetic engineering is applied

INFECTIOUS DISEASES

A disease is a disordered state of the body of an organism.

Non-Infectious Diseases

- Nutritional diseases
- Genetic diseases
- Mental diseases
- Ageing diseases
- Human induced diseases (due to alcohol or drugs)

Infectious diseases

They are also known as parasitic diseases. They are caused by other living organisms such as viruses, bacteria, fungi, protozoa and worms. The diseases are often communicable because they can be transmitted from one person to another.

Diseases are transmitted by organisms called **vectors**. A vector is an organism that carries disease causing organisms. A person who carries pathogens but he or she is not sick is called a **carrier**.

Incubation period of a disease is the time between catching a disease and the appearance of its symptoms.

Modes of transmission of Diseases

a. **Air**-diseases spread through the air and are called **airborne diseases** such as T.B. and common cold.
b. **Water**-diseases spread by contaminated water and they are called **water-borne diseases** such as cholera and typhoid.
c. **Food** – spread by contaminated food such as cholera and dysentery.
d. **Vectors**-spread by living organisms such malaria and trypanosomiasis
e. **Direct contact**-diseases spread by direct contact with an infected person or their clothing. These are called **contagious diseases**.

DISEASES CAUSED BY BACTERIA

A. TUBERCLOSIS (T.B.)

T.B. of the lungs (pulmonary tuberculosis) is caused by bacterium called **mycobacterium tuberculosis**. T.B. of the bones is caused by bacterium called mycobacterium called **mycobacterium bovis**.

Mode of Transmission

- droplets from breathing or sneezing (airborne)
- dry infected sputum in particles of dust
- T.B. of the bones is transmitted through drinking contaminated milk.

Signs and Symptoms of T.B.

- General weight loss and fatigue
- Fever
- Persistent coughing
- Chest pains
- Sweating at night
- Sputum may contain blood

Prevention of T.B.

- Drink clean boiled milk.
- Always stay in well ventilated homes.
- Avoid overcrowding.
- Immunization of children with BCG vaccine (BCG: Bacillus Calmate Guerin).
- Isolate the patient.

Treatment of T.B.

- Use drugs such ethambutal, isoniazid streptomycin and rifampicin.

B. PNEUMONIA

It is caused by **pneumonococcus streptococcus** bacteria. It affects the respiratory tract. It causes production of fluid which collects in the alveolus. The lungs become filled and have no air hence prevents exchange of gases in lungs.

Mode of Transmission

- It is spread by inhaling contaminated air. It is an airborne disease.

Signs and symptoms

- Fever
- Headache
- Coughing
- Chest pains
- Difficulties in breathing

Prevention of Pneumonia

- Avoid overcrowding
- Live in well-ventilated homes.
- Vaccination.

Treatment of Pneumonia

- Use antibiotics such as erythromycin, penicillin, and tetracycline.

C. CHOLERA

It is caused by bacterium called **vibrio cholerae.** The bacteria can survive in areas of low oxygen like in small intestine.

Mode of transmission

- Fecal contamination
- Food contamination
- Handling of contaminated objects and putting dirty fingers in the mouth.
- Vectors like flies from human faeces to food.
- Through contaminated water

Signs and Symptoms of Cholera

- Severe diarrhoea due to toxins produced by bacteria
- Abdominal pains
- Watery rice-like stools
- Severe vomiting
- Dehydration and loss of mineral salts

Prevention of Cholera

- Correct disposal of faeces
- Wash hands after using the toilet
- Wash hands before eating
- Treating water before drinking such as boiling or chlorination.
- Education awareness campaigns on hygiene
- Covering food to prevent contact with flies
- Wash raw food with clean water before eating

Treatment of Cholera

- Use of antibiotics
- Administering of ORS to the patient

D. TYPHOID

It is caused by bacteria called **salmonella typhi**. It affects the alimentary canal, spreading to the lymph and blood, lungs, bone marrow and spleen.

Mode of Transmission

- Contaminated food and water
- Contaminated objects
- Vectors-flies or carriers

Signs and Symptoms

- Mild fever

- Slight abdominal pain
- Ulceration and rupture of the intestine
- Diarrhoea
- Constipation

Prevention of Typhoid

- Vaccination
- Proper disposal of faeces
- Treatment of water
- Thorough cooking of food to kill bacteria
- Wash fruits and vegetables before eating them

Treatment of Typhoid

- Use of antibiotics

DISEASES CAUSED BY VIRUSES

A. COMMON COLD

It is caused by a variety of viruses.

Mode of Transmission

- Transmitted by droplets through coughing, sneezing, from infected people.

Signs and Symptoms of Common Cold

- Running nose
- Sneezing
- Fever
- Sore throat

Prevention of Common Cold

- Avoid overcrowded areas
- Keeping rooms well-ventilated

Treatment

- Taking prophylactic drugs
- Taking a lot of fluids

B. INFLUEZA OR FLU

It is caused by the influenza virus

Mode of transmission

- It is spread by droplet infection through the air
- It can also be spread by touching items with the virus and touching the mouth

Signs and Symptoms

- Sudden fever and headache
- Sore throat and muscle pains
- Nausea and vomiting
- Dizziness

Prevention

- Use back of hand or cloth when sneezing
- Vaccination

Treatment of Influenza

- Use antiviral drugs in severe cases
- Drinking hot drinks
- Use cough drops
- Use drugs that lower the fever

❖ There are no drugs for most of influenza.

C. MEASLES

It is caused by measles virus.

It occurs mainly in children.

Means of transmission

- By droplets
- Through contaminated eating utensils and clothes

Signs and Symptoms of Measles

- Sore throat
- Running nose
- Coughing and fever
- Small white spots in mouth called koplik spots
- Skin rash, swollen glands, and swollen eyes.

- ❖ Complications that may happen include blindness and deafness. It may also result in sterility when it affects the testes and the ovaries.

Treatment

- There is no specific treatment for the disease

Prevention

- Immunization or vaccination.

NB: Survivors of measles get natural active immunity. They can never be affected by the disease again.

D. AIDS

Meaning of AIDS

A: Acquired-means passed from one person to another

I: Immune-means the body's defence or protection against infections

D: Deficiency-means weakening of the body's defence against diseases

S: Syndrome-a group of diseases that come when the immunity is weak

AIDS is caused by Human Immunodeficiency Virus (HIV). The virus destroys the body's immune system. The virus infects and destroys certain types of white blood cells called T-helper Lymphocytes. The T-helper cells cannot stimulate killer cells to fight infection. This breaks down the immunity of the body.

Mode of Transmission of AIDS

- Through sexual intercourse with an infected person
- From infected mother to child during birth
- Sharing of piercing objects such as needles, syringes and razor blades
- Blood transfusion with infected blood
- Through close contact between infected and non-infected person through cuts or open wounds

Signs and Symptoms of AIDS

- Sudden loss of weight
- Lymphoma (cancer of the lymphatic system)
- Chronic diarrhoea for more than a month
- Persistent cough
- Shingles
- Fever
- Swollen lymph glands or lymph nodes
- Loss of appetite

Prevention of the Disease

- Abstinence from sex before marriage
- Practicing protected sex
- Being faithful to one partner
- Screening blood for HIV before blood transfusion
- Avoid sharing piercing objects such as blades, needles and syringes.

Treatment

- Use antiretroviral drugs (ARVs) which slow down the spread of the virus in the body. AIDS has no cure.

E. CHICKEN POX

This is a skin disease caused by a virus called varicella zosta.

Mode of Transmission

- Through air droplets

- Contact with infected person and their clothes

Signs and Symptoms

- Rashes on the skin
- A lot of itching on the skin rashes
- Mild fever

Treatment

There is no specific treatment.

Prevention of Chicken Pox

- Through vaccination or immunization

A person who recovers from the disease gets natural active immunity. They can never be affected by the disease again.

DISEASES CAUSED BY PROTOZOA

A. MALARIA

Malaria means bad air as it was believed that it was caused by contaminated air.

Malaria is caused by a parasite called **plasmodium.**

Mode of Transmission

The malaria parasite is transmitted by a **female anopheles mosquito.**

When the female anopheles mosquito bites an infected person, it passes saliva down the proboscis to prevent blood clotting before it sucks up the blood. The plasmodium remains in its salivary glands. When the mosquito bites a healthy person it injects the plasmodia present in its saliva into the blood stream of a healthy person and the person becomes infected.

Effects of Plasmodia on the Host

The plasmodia multiply in the liver. Then invade red blood cells. They reproduce in red blood cells and cause the cells to burst releasing more plasmodia. The bursting of red blood cells by plasmodia may cause **anaemia**. When red blood cells burst toxins from plasmodia are also released. The toxins and damaged red blood cells cause symptoms of malaria.

Signs and Symptoms of Malaria

- High fever
- Headache
- Sweating
- Convulsions and coma if the parasite attacks the brain
- Nausea
- Anaemia
- Little deeply coloured urine

Prevention of Malaria

- Sleeping under mosquito nets
- Draining stagnant water-where mosquitoes breed
- Spraying oil on stagnant water which suffocates larvae and pupa of mosquitoes
- Clearing bushes near and around residential areas
- Introducing ducks and fish in ponds or lakes to eat mosquito larvae
- Using insecticides to kill mosquitoes
- Wearing long sleeved clothes especially at night
- Using mosquito repellants

Treatment of malaria

- Using drugs such as artemesinin, chloroquine, fansidar, lumefantrine artemether.

B. SLEEPING SICKNESS/TRYPANOSOMIASIS

- It is caused by protozoon called trypanosome rhodesience.

Mode of Transmission

It is transmitted by **tsetse flies** when they bite infected people or cattle and later bite healthy people.

Trypanosome releases chemicals which go to the brain causing a person to become unconscious hence sleeping sickness.

Signs and Symptoms

- Fever and headaches
- Enlargement of lymph nodes, spleen and liver
- Muscular spasms and frequent sleeping
- Emaciation: thinness of the body
- Fever

Treatment

- Use drugs such as pentamidine

Prevention

- clearing bushes
- spraying insecticides
- releasing sterile males

C. AMOEBIASIS (AMOEBIC DYSENTRY)

It is caused by protozoon **Entamoeba histolytica.**

Mode of Transmission

- It is transmitted by houseflies, uncooked food and unhygienic food preparation.

Signs and Symptoms

- Fever
- Nausea and vomiting
- Diarrhoea and blood in stools

Treatment

- Use drugs such as **metronidazole.**

Prevention

- Hygienic food handling and preparation
- Control of flies

D. ELEPHANTIASIS

Elephantiasis is not caused by protozoa but a type of round filarial worm ***wuchereria bancrofti.***

The worm lives in the circulatory and lymphatic system. It is transmitted by a bite from the **culex mosquito.** The worm enters the lymphatic vessels and blocks them. This causes the lymph to accumulate in that part of the body. This causes the affected part to swell to large proportions.

Signs and Symptoms

- Massive swelling on legs and arms
- It may also lead to swellings of the scrotum and breasts

Control and prevention

a. Mosquito control
b. Treatment using appropriate drugs

DISEASES CAUSED BY FUNGI

A. RINGWORM

It is caused by a fungus called **Tinea**. It is a contagious disease.

Mode of Transmission

- Direct contact with infected heads
- Using infected combs or shaving equipment
- Sharing head brushes and hats

Signs and Symptoms

- Round grey patches on the head and face
- Itching on the grey patches
- Hair loss on the patches

Treatment

- Use fungicide creams and tablets
- Drugs such as griseofulvin

Prevention of Ringworm

- Hygiene in care of hair
- Avoid sharing of combs, brushes and hats

B. THRUSH/CANDIDIASIS

It is caused by a fungus called **candida albicans**. It can occur in the mouth, vagina and intestines. It may arise due to changes in acidity in the vagina in females during pregnancy or diabetes. Newborn babies can be infected in the mouth during birth.

Mode of transmission

- It is transmitted mainly through sexual intercourse
- From mother to child during birth

Signs and Symptoms

- Fluffy white patches on infected area
- Red inflamed skin under the patches
- Severe irritation

Control and prevention

- Drugs used as lotions, creams or pessaries (for vaginal infections)
- Use drugs such clotrimazole

C. ATHLETE'S FOOT

It is a fungal disease that affects feet in human beings. It occurs due to:

- Wearing closed shoes for a long time
- Keeping the feet wet for a long time
- Excessive sweating in the feet.

It common in areas with warm wet weather.

Mode of transmission

- Contact with infected feet, floors, mats on which people walk barefoot.
- Contact with shoes of infected people

Signs and Symptoms

- Itching feet
- Pain between toes
- Swollen, peeling and craved skin between toes

Prevention

- Proper drying of feet after bathing
- Use sandals in public showers
- Change socks frequently

Control

Treatment with antifungal drugs such griseofulvin in form of powders and creams.

PREVENTION AND CONTROL OF DISEASES AT HOUSEHOLD AND COMMUNITY LEVEL

a. **Water treatment**: this is the process of removing undesirable properties of raw water to make it safe for human consumption. Water treatment kills pathogens such as bacteria and flukes hence preventing spread of diseases. There are many methods of water treatment such as filtration, boiling

and using chemicals such chlorination.

b. **Proper disposal of human and domestic wastes**: this includes using latrines, toilets and sewage treatment and rubbish pits. This helps in prevention of diseases such as cholera, typhoid and amoebiasis.
c. **Personal hygiene**: this involves observing personal cleanliness such as washing hands before eating food and after using toilet, washing the body daily, covering food. Personal hygiene reduces risk of diarrhoeal infection.
d. **Vector control**: control of vectors such as flies and cockroaches prevents the spread of diarrhoeal diseases.
e. **Food treatment and preservation**: this is the practice of processing food to prevent spoilage and food poisoning. Microbes decompose unprocessed food and when microbes are consumed together with food they can cause serious illness or death. Preserved and treated food has less risk of ill-health as microbes are unable to grow and multiply on preserved food. Some ways of food preservation and treatment include smoking, salting, drying, freezing, canning, pasteurization and radioactive preservation.
f. **Health services**: they provide treatment of diseases to prevent spread of diseases, provision of safe water and sanitary services, health education and maternity services. Health services help to prevent spread of diseases.

CANCER

Cancer refers to uncontrolled cell division that may lead to development of tumours. Breast cancer is the most common in women and lung cancer is most common in men. The common cancers are cancers for skin, stomach, colon, bladder, blood, e.tc. The type of cell division associated with cancer is mitosis. The abnormal multiplication of cells is due to mutation of genes that control cell division. The abnormal genes are called **oncogenes.** The cells undergo uncontrolled cell division and the cells form a mass of cells called **tumou**r. Cancerous cells may spread to other parts of the body a process called **metastasis**.

Causes of Cancer

Cancer is caused by mutation of genes that control cell division. Factors that can cause gene mutation includes radiation, viral infections, chemicals, etc.

Types of cancer

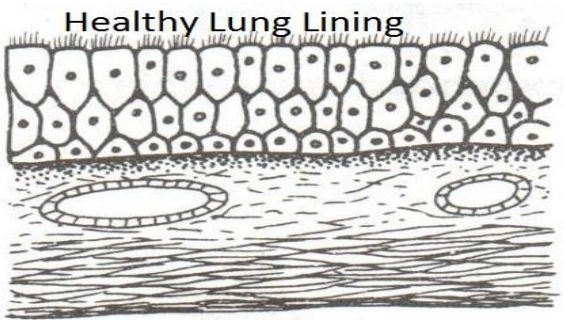
i. Malignant cancer: cancer in which tumour cells spread and invade other cells. The cells spread and attack and destroy healthy cells leading to death.
ii. Benign cancer: cancer in which tumour cells do not spread and invade other cells. The cells grow on one part of the body only.

Characteristics of Cancerous Cells

a. They are self-sufficient in growth signals-cell division is normally controlled by genes. However, cancer cells acquire autonomous drive to divide by mitosis.

b. Sustained angiogenesis-they are able to develop their own blood supply and blood vessels.
c. Tissue invasion and metastasis-cancer cells are able to migrate to other organs, invade other tissues and colonise these organs.
d. Cancerous cells suppress and inactivate genes and pathways that normally enable cells to die.
They are insensitive to growth-inhibitory signals by suppressing tumour suppressor genes.

Lung cancer



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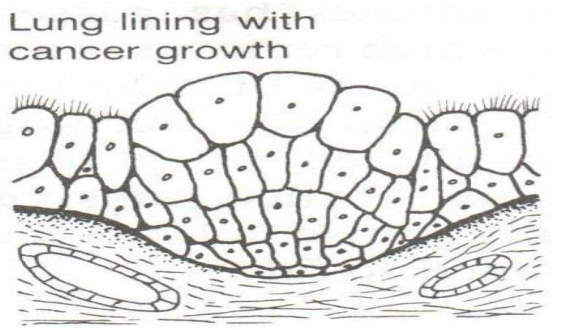

e.

Effects of Cancerous Cells in the Body

a. Cancerous cells compete for nutrients and space with normal body cells.
b. Malfunctioning of body organs-tumours can grow and interfere with various systems in the body such as digestive, circulatory and nervous systems. They can also attack organs such as the brain and lungs. This results in organs not functioning properly.
c. Death of cells, tissues and organs. This may lead to death of an individual if not treated.

Factors That Increase the Risk of Cancer

a. **Smoking**: smoke from cigarettes contains a substance called tar. Tar contains chemicals that can cause mutations of genes in the lungs, mouth and throat leading to cancer. Tar is a carcinogen. A carcinogen is any substance that increases the risk of cancer.
b. **Viral infections**: viruses contain DNA and RNA that may have oncogenes. When these DNA are injected into an individual's cells they may cause cancer.
c. **Over-exposure to radiation**: over-exposure to radiation such as x-rays, ultraviolet rays, gamma rays and beta rays increases risk of cancer. Radiations can penetrate into cells and break or damage DNA or cause mutations that can lead to cancer.
d. **Chemicals**: chemicals such mercury, artificial food sweeteners, food preservatives increase risk of cancer. These chemicals may react with DNA bases hence causing mutation that result into cancer. Chemicals in food that cause cancer are called **dietary carcinogens**.
e. **Excess alcohol consumption**: alcohol damages liver cells making them to develop cancer. It is converted to other chemicals that increase the risk of cancer.

Ways of Preventing and Controlling Cancer

a. Healthy Living

- Avoid smoking to reduce cancers of the lungs, mouth, oesophagus and larynx
- Eat plenty of plant foods such as fruits and vegetables which are rich rich in vitamins C and E, beta carotene and selenium which neutralise chemicals before they cause gene mutation.
- Avoid drinking alcohol to avoid lung and colon cancers among others.
- Protect yourself from harmful radiations that may contribute to cancer.

b. Immunisation

Get immunisation for hepatitis B to limit liver cancer and Human Papilloma Virus that leads to cervical cancer.

c. Avoid Risky Behaviour

Some sexually transmitted diseases may increase the risk of cancer. For example people with HIV have a higher risk of cancer of the anus, cervix, lungs and immune system. Human papilloma virus is associated with cervical cancer, cancer of the penis, and vagina. Avoiding risky behaviour may reduce chances of developing cancer.

Control and Management for Cancer

- **Hormone therapy**-to reduce cell activity. For example in treatment of breast cancer.
- **Surgery** to remove a tumour or organ or tissue that is affected.
- **Chemotherapy**-using medicines to stop cell division
- **Radiotherapy-using** ionising radiation to kill rapidly growing cells.
- **Gene therapy** to repair diseased cells by replacing defective genes.

NB: Cancer is not contagious because the immunity of an individual whose body is in contact with foreign cancerous cells destroys the cancerous cells since they are identified as foreign proteins.

Management of cancer

This includes palliative care which is a specialized medical care for people with serious illnesses.

It seeks to provide relief to the patients from pain, stress and discomfort by improving the quality of life for the patient.

Palliative care is done by a team of medical personnel to provide support to cancer patients and other patients with terminal illnesses.

Palliative care helps the patient to cope with the pain and other problems related to the disease.

REVISION EXERCISE

1. The figure below shows legs of a person with a skin disease

a. Name the disease

b. To which group of organisms does causative agent of the disease belong

c. Describe the life cycle of the causative agent of the disease
d. Give two ways of preventing the disease
2. Suppose you are a Health Assistant in a community where there is high prevalence of malaria what advice would you give to the community on prevention of malaria. Explain any five points in an essay.
3. The figure below shows a mode of transmission of some diseases
a. Identify the mode of transmission
b. Name any two diseases that can be transmitted by the mode shown
c. Explain any one way of preventing transmission of diseases through the mode shown above
4. At a certain school students develop a rash on the skin and high fever. A doctor diagnosed them positive for a certain disease.
a. Identify the disease
b. What is its causative agent?
c. Mention any two ways in which the disease could have been transmitted.
5. a. explain what happens during the incubation period of the disease
b. Name the cause of sleeping sickness.
c. Explain any two ways of preventing sleeping sickness.
6. a. Describe any two ways in which palliative care for cancer patients is important
b. describe how the following increase risk of cancer.
    i. Smoking
    ii. Viral infections
7. How do the following ways help in HIV prevention?
a. using condoms
b. being faithful to your partner
8. Describe the following
    i. Effects of cancerous cells in the body
    ii. Why cancer is not contagious
    iii. Window period for HIV & AIDS