GRADE 10 SECTION

ORGANISMS AND LIFE PROCESSES.

1. Identify the characteristics of living organisms.

The characteristics of living organisms are:

- Feeding
-Breathing
-Respiration
- Reproducing
- Growing
-Locomotion
- Sensitivity
- Excretion

THE ABOVE CHARACTERISTICS MAY BE FURTHER EXPLAINED AS:

(A)FEEDING:This is the process by which living organisms obtain their food.All living things feed, but in different ways.There are two main types of nutrition,namely Autotrophic nutrition and Heterotrophic nutrition.Autotrophs make their own food e.g.plants photosynthesizes it own food.Heterotrophs takes in food that is already available in bodies of others.e.g.plants,fungi and protozoa.

(***B)BREATHING AND RESPIRATION:***Breathing is the taking in of air rich in oxygen and releasing air rich in carbon dioxide.The oxygen is used to release energy from food and carbon dioxide is produced as a waste product.This process is called Respiration.

(C)REPRODUCING:All living organisms produce young ones.Reproduction can either be sexual or asexual.In sexual reproduction,male and female sex cells fuse to form a zygote which develops into a new organism.In asexual reproduction,the parent organism divides to form two or more new offsprings without sex cells.

(D)GROWING:All living organisms grow.This causes the body of an organism to increase in size and become more complex.In unicellular organisms,growth mainly involves an increase in cell size while in multicellular organisms,growth is caused by an increase in the number of cells through cell division.

(E)MOVEMENT AND LOCOMOTION:Animals generally move the whole body, while in plants,movement is confined to certain parts e.g.growing tips of the shoot,the root tip,opening and closing of the stomata and flowers.The movement of an entire organism from one place to another is called locomotion.It enables organisms to move avoid unfavourable conditions and to find food.

(F)SENSITIVITY:This is the ability to detect and respond to changes in the surrounding.Sensitivity is essential to organisms as it enables them to react appropriately to stimuli for survival.

(G)EXCRETION:This is the removal of metabolic wastes from the cells of an organism.Excretion ensures that the environment in an organism is conducive for cells to continue functioning.

2. Distinguish between living organisms and non-living things.

The main differences between living and non-living organisms are tabulated below:

Living organisms	**Non Living things**
Feed	Do not feed
Reproduce	Do not reproduce
Grow	Do not grow
Excrete	Do not excrete
Are sensitive	Are not sensitive
Are capable of locomotion and movement	Are not capable of locomotion and movement
Respire	Do not respire
Have cells	Do not have a cells

3. Describe life processes of living organisms.

Life processes of living organisms are the chemical reactions that take place inside living cells. The sum total of chemical reactions that take place inside living cells are collectively called metabolism. There are two types of metabolic reactions, namely anabolic and catabolic reactions.

*(1)**ANABOLIC REACTION.(ANABOLISM).***

Anabolic reactions are metabolic reactions where large and complex molecules are synthesized from small and simple molecules e.g. photosynthesis.

(a)WORD EQUATION:

Carbon dioxide + water $\xrightarrow{\text{enzymes}}$ glucose + oxygen.

(b)CHEMICAL EQUATION:

$6CO_{2\,(g)} + 6H_2O_{(l)} \xrightarrow{\text{enzymes}} C_6H_{12}O_{6\,(S)} + 6O_{2(g).}$

(2).CATABOLIC REACTION(CATABOLISM).

Catabolic reactions are metabolic reactions where large complex molecules are broken down into smaller and simpler molecules eg Respiration.

(a)WORD EQUATION:

Glucose + Oxygen $\xrightarrow{\text{enzymes}}$ Carbon dioxide + Energy.

(b)CHEMICAL EQUATION:

$C_6H_{12}O_{6(s)} + 6O_{2(g)} \xrightarrow{\text{enzymes}} 6CO_{2(g)} + 6H_2O_{(l)}$ +Energy (2880 kj).

All metabolic reactions are catalyzed by enzymes. An enzyme is a biological catalyst inside a living organism,it is important in speeding up or slowing down life processes.

UNIT 2

ANIMAL AND PLANT CELLS.

CELL STUCTURE AND ORGANISATION.

1.MICROSCOPES.

A microscope is a device that produces a magnified image of the structure that is too small to be seen by our naked eye.

A Microscope can be simple or compound.

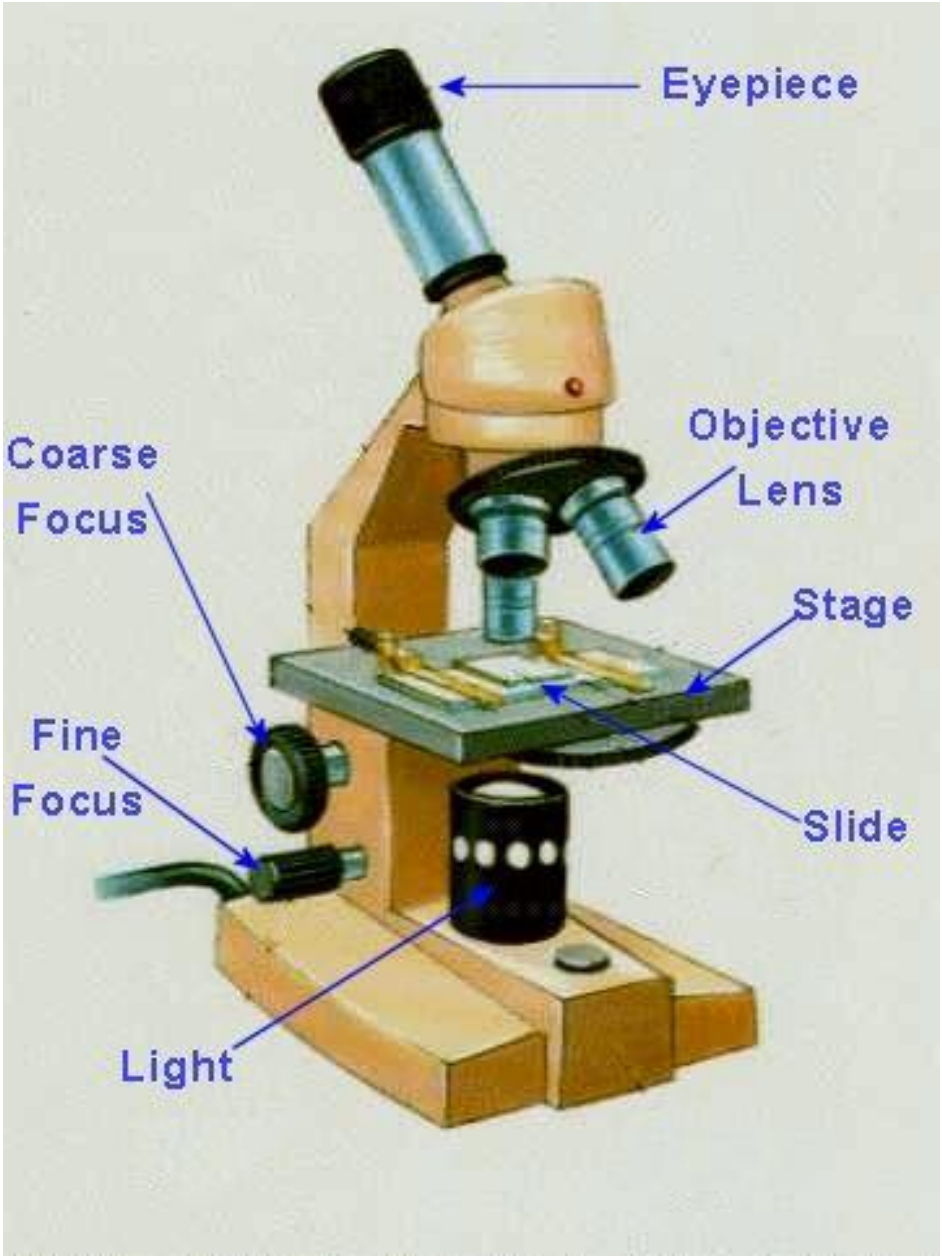
A simple microscope is a hand lens.

2.STRUCTURE OF A HAND LENS.

3.A COMPOUND MICROSCOPE.

A Compound microscope has two or more lenses.The eyepiece lens is situated on the top of the microscope,the objective lenses at the bottom of the tube on the revolving nose piece.By rotating the nose piece,you can select the objective lens through which you will view your specimen.

4.PARTS OF A COMPOUND MICROSCOPE.



FUNCTIONS OF THE PARTS OF THE COMPOUND MICROSCOPE

(a)EYEPIECE:

This is the lens through which the observer looks at the specimen under observation.

(b)OBJECTIVE LENS:

Magnifies the object under study.It is of two types:-

-**Lower power objective** provides magnification of *10 and is the shortest objective lens piece and can be rotated to change the magnification lens piece.

-**High power objective** provides a magnification of *40 and is the longest objective.

(c)NOSE PIECE:Holds and turns the objectives into a viewing position.

(d)STAGE:Holds slides with the specimen.

(e)CLIPS :Holds slides firmly on the stage.

(f)COARSE ADJUSTMENT KNOB: Lowers and raises the body tube to focus the image during general focussing.

(g)FINE ADJUSTING KNOB: Fine focussing to sharpen the image.

(h)BASE Supports the microscope on a bench.

(i)ARM: For holding a body tube.

(j)CONDENSER: Concentrates light from the mirror or source to the object on the stage.

(k)DIAPHRAGM LEVER: Opens and closes the Diaphragm, controls the amount of light that enters a microscope.

(l)OPENING OF THE STAGE: Permits light to pass up to the eye piece.

(m)MIRROR: It produces or reflects light up towards the eye piece through the object being viewed into the microscope.

4.Demonstrate The Correct Use Of A Microscope.

How to use a microscope.

Focussing,mounting and observing

- Make sure the stage is well-lit by adjusting the mirror or illuminator.
- Prepare the tissue to be studied and place it on a microscope slide.
- Ensure that the specimen is moist by adding a drop of water.
- Then cover the specimen with a cover slip making sure no air bubbles are trapped underneath.

- Place the slide on the microscope stage and secure it with with the clips on the stage.
- Using the coarse adjustment,lower the objective lens until it is about half a centimetre from the slide.As the objective is lowered,view from the side to ensure that the objective lens does not come into contact with the glass slide as this may crush the slide and smash the specimen.
- Move the objective upwards by moving the coarse adjustment in the opposite direction.This should be done while looking in the eye piece.Continue doing this until you can see the specimen through the eye piece.
- While still looking through the eye piece,use the fine adjustment to make the specimen clearer or sharp.
- Study the specimen and make drawings as required.

5. Calculate magnification of specimen

Magnification is the measure of how many times bigger or smaller the diagram or image looks, when viewed with the microscope compared to its actual size.

- Magnification = $\frac{\text{Size of Image/Drawing}}{\text{Size of Object/Specimen}}$

- The substitution must be correctly done with identical units in the numerator and denominator.The units in the numerator and denominator must be identical,if an individual measures the specimen size as 6.4cm and the corresponding measurement on the diagram is 7.2 cm, the substitution will be correct if written as:
- 7.2 cm/6.4 cm or 72 mm/64 mm but will be wrong if written as: 7.2/6.4 or 72/64 or 7.2cm/64 mm or 72 mm/6.4 cm.
- The final answer for magnification must be written to one decimal place with a multiplication sign (X) or the word ‘times’ either before or after the magnification and without units.

  e.g. the answer for the substitution given above is 1.125 but should be written as:

  X1.1 or 1.1X or times 1.1 or 1.1 times.

- In summary, the magnification for the above given situation would be calculated as follows:

Magnification = Size of Image = 7.2 cm = X 1.1

Size of Object 6.4 cm

CELL STRUCTURE AND ORGANISATION

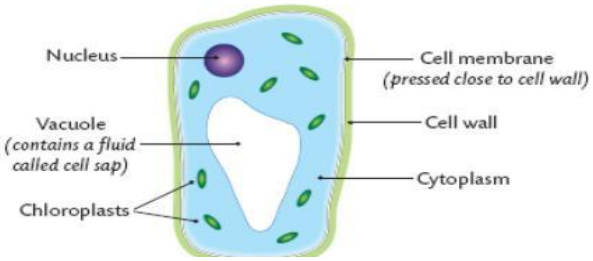
A Cell is a basic functional unit of living organisms.All chemical processes of life take place inside cells.

A cell consists of a semi-liquid material called **cytoplasm** which is enclosed or surrounded by a cell membrane or plasma membrane.The cytoplasm contains a number of dissolved substances and minute specialized structures called **organelles.**

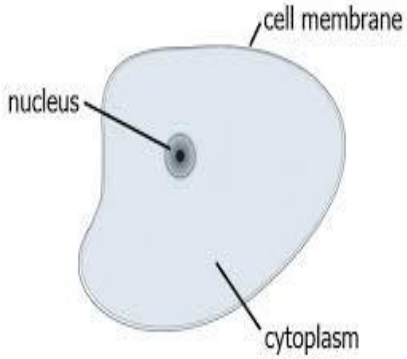
1.Investigate the structure of cells and functions of the cell organelles.

(A) STRUCTURE OF CELLS.

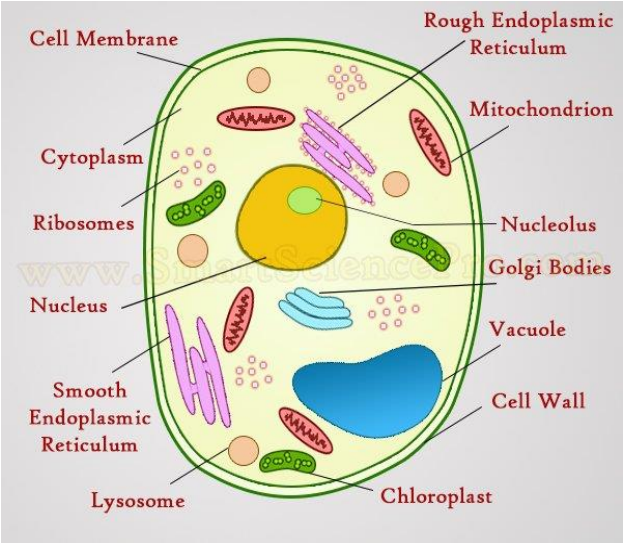
(i)A SIMPLE STRUCTURE OF A PLANT CELL.



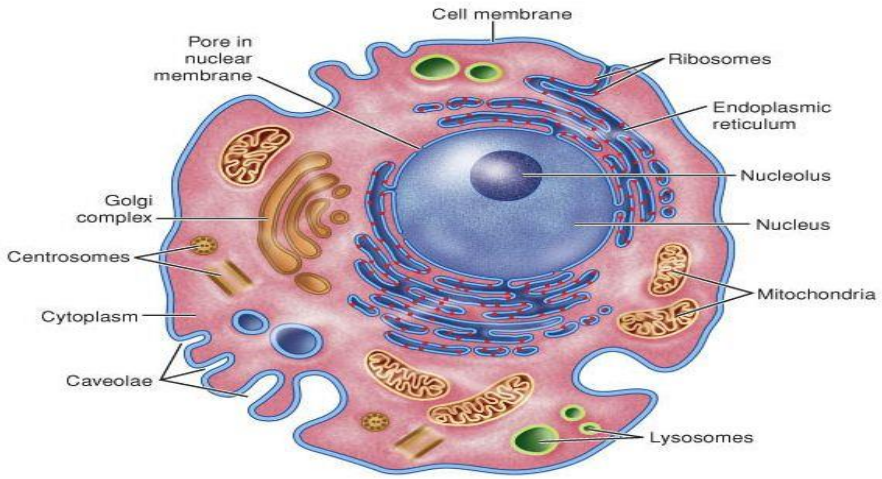
(ii)A SIMPLE STRUCTURE OF AN ANIMAL CELL.



(b)(i) A DETAILED STRUCTURE OF A PLANT CELL.



(ii) A DETAILED STRUCTURE OF AN ANIMAL CELL.



(c) functions of cell organelles.

(i) *Nucleus:* This part is responsible for controlling all cell activities and storage of genetic information on threads of DNA called chromosomes. It is surrounded by a double membrane called the nuclear membrane which has openings called nuclear pores. The inside of the nucleus contains a fluid called the nucleoplasm and a dense body of DNA called the nucleolus.

(ii)Cell membrane: This part is made of lipids and proteins and is responsible for controlling the substances that enter and leave the cells. It is adapted for this function by being selectively/partially permeable. This means it allows some substances to pass through it and prevents others from passing through. The substances that cross the cell membrane freely include gases (such as oxygen and carbon dioxide) and water because their molecules are smaller in size. On the other hand,

substances such as urea whose molecules are large do not freely cross the cell membrane but use special carrier proteins to do so.

(iii)Cytoplasm: This is a jelly-like fluid made of water and dissolved substances such as proteins, salts and sugars. It contains suspended cell structures called organelles and is the site for cell activities.

Note: The three parts (nucleus, cytoplasm and cell membrane) are collectively called the protoplasm. The protoplasm is defined as the living part of a cell.

(iv)Mitochondrion (plural: mitochondria): These are rod-shaped or sausage-shaped structures in the cell. This is where respiration takes place. For this reason mitochondria are called the power house of the cell.

(v)Ribosomes: These are small round structures in the cell where protein synthesis takes place. Some ribosomes float freely in the cytoplasm while others are attached to the rough endoplasmic reticulum.

*(vii)Endoplasmic Reticulum:*This is a network of membranes used for transportation of substances within the cytoplasm. There are two types of endoplasmic reticulum, namely smooth endoplasmic reticulum and rough endoplasmic reticulum. Rough endoplasmic reticulum has ribosomes on its surface and transports proteins. Smooth endoplasmic reticulum has no ribosomes on its surface and transports lipids.

(viii)Golgi Bodies: These are a pile of flattened vesicles which modify and carry proteins such as enzymes from the sites of synthesis to the sites of reaction. They are collectively called the Golgi apparatus.

(ix)Chloroplasts: These are oval-shaped structures found in plant cells. They carry out photosynthesis. They contain a green pigment called chlorophyll which absorbs light energy for photosynthesis.

(x)Vacuole: This is a fluid filled space inside the cytoplasm of a plant cell. It contains a fluid called cell sap (a solution of sugars and salts in water) and is surrounded by a membrane called tanoplast. The concentration of the cell sap plays a role in the movement of water into and out of the cell.

(xi)Cell wall: This is the outermost boundary of the plant cell. It is made of a substance called cellulose. It is important for protection against damage and prevention of bursting when the plant cell gains a lot of water. It also gives shape to the plant cell. It is fully permeable to all substances.

2. Distinguish between plant and animal cell structure.

Differences between animal and plant cells

Plant Cell	**Animal Cell**
Has cellulose cell wall	Does not have cellulose cell wall
Has large permanent vacuole	Does not have large permanent vacuole
Has chloroplasts	Does not have chloroplasts
Has regular shape and bigger size	Has irregular shape and smaller size

3. Relate cell structure to functions.

(a)THE RELATIONSHIP BETWEEN STRUCTURES AND FUNCTIONS OF PLANT CELLS.

(i)Root Hair cells: These are cells found near the tips of roots.

Functions.

- Absorption of water and mineral salts
- Anchor the plant in the ground

Adaptations.

- Has an elongated outgrowth (long extension) which increases the surface area for faster diffusion during absorption.
- Absence of chloroplast to create more room for absorption.
- High concentration of mitochondria to provide energy for active absorption /transport of mineral salts. In addition, root hair cells are numerous which further increase their surface area.

(ii)**Xylem Cells:**

Functions.

- Conduction of water and mineral salts
- Mechanical support of the plant.

Adaptations.

- End walls of neighbouring cells broken to form continuous tubes.
- Protoplasm is absent leaving a hollow space in the middle of the cell.
- Walls are lignified (filled with lignin) to provide mechanical support.

(iii)Phloem cells:

Function.

- To transport manufactured food from one part(leaves)to another part of the plant.

Adaptations.

- End walls between neighbouring cells are perforated to form sieve plates.
- Protoplasm is partly lost leaving behind some cytoplasm strands.
- Presence of companion cells which supply phloem cells with enzymes and ATP.

(iv)Palisade cells.

Function.

- Carrying out the process of photosynthesis.

Adaptations.

- A high concentration of chloro plasts.
- The cells are vertical and longer.This allows chloroplasts to migrate upwards or downwards as light intensity changes so that they are not damaged by excess light.

(b)THE RELATIONSHIP BETWEEN STRUCTURES AND FUNCTIONS OF ANIMAL CELLS.

(i)Muscle Cells:

Functions.

- Contraction to produce movement

Adaptations.

- Abundance of mitochondria to release energy for contraction
- Presence of actin and myosin filaments in the cytoplasm which carry out contraction

(ii)Red blood cell (Erythrocyte):

Functions.

- Transportation of oxygen and small amounts of carbon dioxide.

Adaptations.

- Biconcave disc shape to increase the surface area for diffusion of oxygen.

- Presence of a red pigment called haemoglobin which has a high affinity (attraction) for oxygen. Haemoglobin combines with oxygen to form oxy-haemoglobin when oxygen concentrations are high (e.g. in the lungs). When oxygen concentrations are low e.g. in the muscles, oxyhaemoglobin dissociates forming haemoglobin and oxygen.

(iii)Nerve Cell (neurone):
Functions.

- To conduct electrical impulses (nerve impulses) from one part of the body to another.

Adaptations.

- Presence of dendrites that collect impulses from neighbouring cells.
- Presence of axon that carries impulses from one end of the neurone to another.
- Presence of synaptic knob that forms a link with other neurones.
- Presence of nodes of Ranvier that make impulses move faster.
- Note the part of the neurone having the nucleus and cytoplasm is called the cell body.

(iv)White Blood Cells:
- These are cells that defend the body against infection (diseases). Two examples of white blood cells are phagocytes and lymphocytes.

-Phagocytes.
Functions.

- They defend the body against infection by engulfing and digesting germs (foreign bodies).

Adaptations.

- Lobed nucleus which makes engulfing of germs easy.
- Amoeboid movement which makes it possible for them to move towards germs.

- They have no fixed shape but can change their shapes, making engulfing of foreign bodies possible.

-Lymphocytes.
Functions.

- To defend the body against infection by producing antibodies and antitoxins. Antibodies are proteins that destroy germs/foreign bodies while anti-toxins are proteins that neutralize poisons from germs.

Adaptations.
Presence of a large nucleus and thin cytoplasm.

4. **Describe cell organization in multicellular organisms**

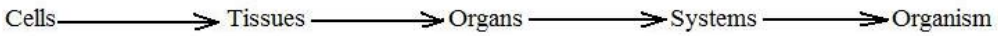
In multicellular organisms,the life processes in a single cell cannot maintain the whole organism.Groups of specialized cells form tissues,different tissues performing a particular function form a system and systems together form an organism.

(a)TISSUES.Tissues are specialized cells having the same shape/structure and function. Examples of tissues are epidermis, palisade tissue, spongy tissue, blood,epithelium and bone tissue.

(b).ORGANS.An organ is a group two or more specialised tissues performing a specific function . Examples of organs are roots, stems, leaves, liver, skin, heart, brain, eyes, ears, kidneys and lungs.

(c)SYSTEM. A System is a group of organised organs performing a particular function . Examples of systems are vascular system, digestive system, excretory system, endocrine system, nervous system, skeletal system, respiratory system and reproductive system. What organs make up each of these systems?

Levels of cell organization may be summarized as follows:



5. **Identify tissues in plants and animals**

(i) Plants:palisade, phloem, epidermis, xylem, spongy.

***(ii) Animals*.**muscle, bone, nerves, blood.

6**. Explain the general functions of each tissue**

(i)Phloem tissue.

Function.

- To transport manufactured food from one part of the plant to another

(ii)Palisade tissue.

- That's where photosynthesis mainly takes place

(iii)Xylem tissue.

- To transport water and mineral salts from the roots to all parts of the plant.

(iv)Muscle tissue.

Functions.

- To conduct electrical impulses (nerve impulses) from one part of the body to another.
- Contraction to produce movement.

(v)Nerve tissue.

- To conduct electrical impulses (nerve impulses)from one part of the body to another.

(vi)Blood tissue.

Blood is a tissue made up of liquid called plasma. Plasma is mainly water with dissolved substances like hormones, enzymes, gases and nutrients.

Functions.

- To transport materials to and from all parts of the body.
- To protect the body from diseases.
- To regulate the body temperature.

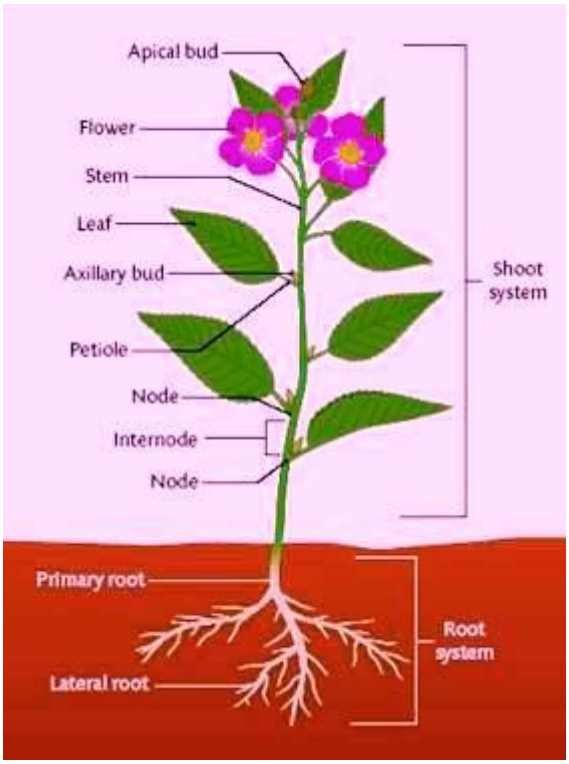
7. **Identify organs in plants and animals.**

Plant are living organisms belonging to the kingdom Plantae. They include trees, herbs, shurbs, bushes, grasses, vines, ferns, mosses, and green algae.

Vascular **plants** have two distinct organ systems: a shoot system and a root system. The shoot system consists of two portions: the vegetative (non-reproductive) parts of the **plant**, such as the leaves and the stems; and the reproductive parts of the **plant**, which include flowers and fruits. The shoot system generally grows above ground, where it absorbs the light needed for photosynthesis. The root system, which supports the plants and absorbs water and minerals, is usually underground.

- **Stems and branches**:Stems and branches hold up the leaves and space the leaves out. This helps the plant to get the light it needs.
- **Roots:**Roots help fix the plant to the soil or to other plants. Roots take in water and nutrients.
- **Leaves**:Leaves make all the food for the plant. They do this by changing light, water and gases into food. This process is called photosynthesis.

- **Flowers**:Flowers contain the male and female parts of the plants. Successful pollination of the flower can result in the production of fruit and seeds.



Parts of a Plant.

***Parts of a Plant*-roots.**

All roots are responsible for:

- Anchoring the plant to the ground
- Extracting water and minerals from the soil

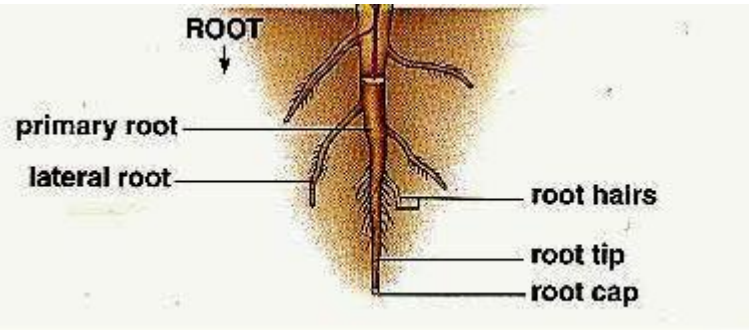
In a typical root we can distinguish the following parts:

1. Primary root - the thickest . It grows downwards.

2. Secondary roots - arise from the primary root. They are not as thick as the primary one. They go sidewards.

3. Root cap - is a kind of protection the roots end with. It is designed to drill the soil and it is able to guide the root growth by perceiving gravity.

4. Root hairs - are minute filaments roots are covered with. They absorb water and nutrients from the soil.



Parts of a Plant-stem.

Stems

All stems are responsible for:

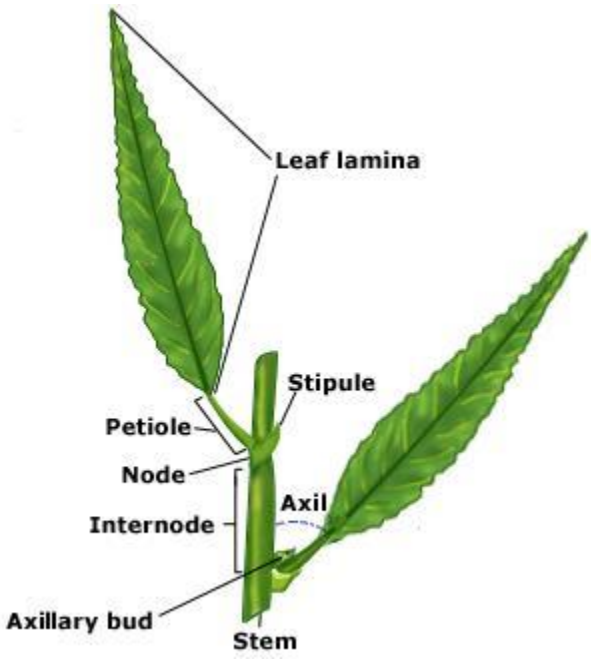
- Supporting leaves and flowers physically
- Holding the leaves and flowers in the best position for food gathering and reproduction
- Using xylem and phloem to transport materials from areas of plenty to areas of need in various parts of the plant
- Storing nutrients for future use

Stem have following structures:

- **Bud** - an underdeveloped and unelongated stem composed of a short axis with compressed internodes, a meristematic apex, and primordial leaves and/or flowers.
- **Terminal bud** - a bud at the tip of a stem responsible for terminal growth.
- **Axillary bud or lateral bud** - buds along side the axis of a stem; they were produced by the terminal bud during growth; once they grow out and form a lateral stem they become terminal buds of the lateral branch.
- **Flower bud** - a bud containing a floral meristem which develops into flowers; usually larger than vegetative buds.
- **Leaf scar** - a scar marking the former point of attachment of a leaf or petiole to the stem.
- **Internode** - the part of the stem between nodes

- **Node** - part of stem marking the point of attachment of leaves, flowers, fruits, buds and other stems.
- **Lenticel** - rough areas on stems (and some fruits, ex. apple) composed of loosely packed cells extending from the cortex through the Ruptured epidermis**;** serve as "breathing pores" for gas exchange. Only occur on young stems.

Parts of a Plant-leaves Diagram

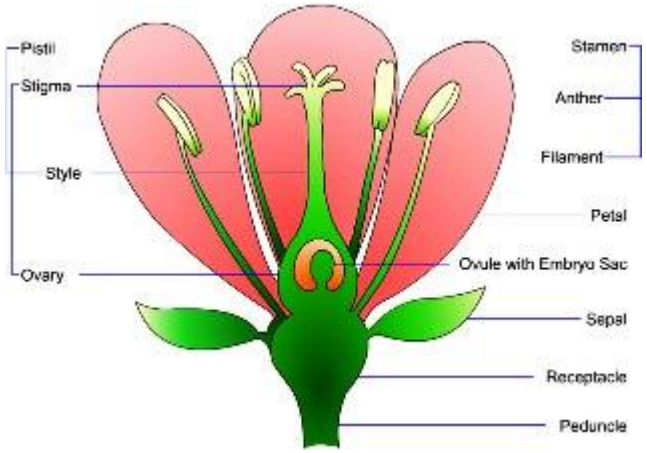


All leaves are responsible for:

- Absorbing the sun's rays for photosynthesis
- Taking in carbon dioxide and releasing oxygen and water vapor (breathing)
- Removing waste products from the plant
- Using osmotic pressure to draw water up from the roots.

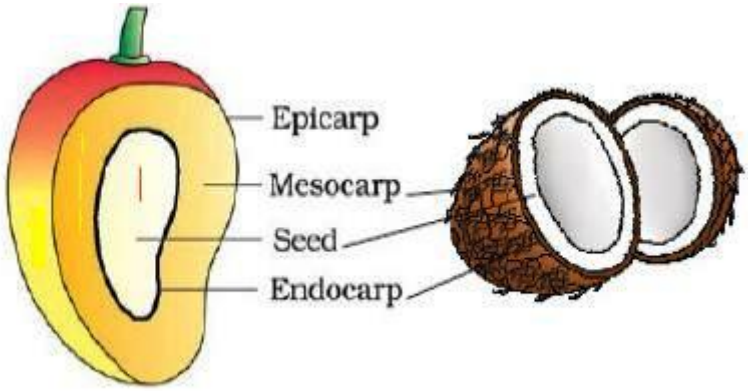
Parts of a Plant-flower ,fruits and Seeds.

The Flower:



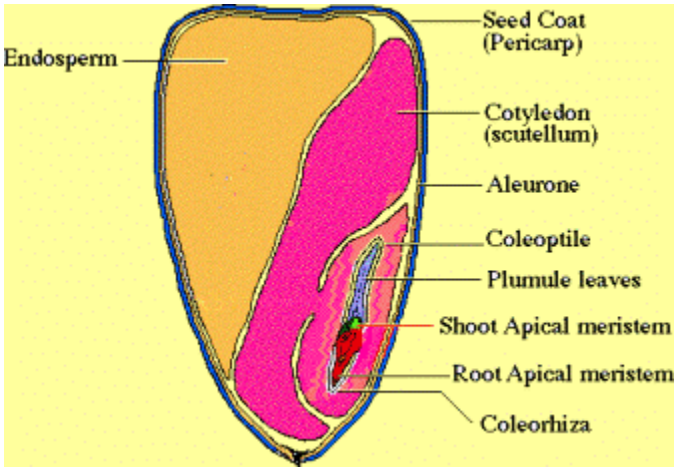
The flower is the reproductive unit of some plants . Parts of the flower include petals, sepals, one or more carpels and stamens .

Fruit



The fruit is that part of a plant which is in charge of protecting the seeds and guarantee their dispersal. It becomes as a result of the fertilization inside the carpel, which produce the ripening of the ovary walls that will create the fruit. Some fruits, however, have another origin, deriving from the flower receptacle or some other parts of the flower.

Seed



The seed is enclosed inside the endocarp.:
The radicle is the part of the embryo which emerges first. Once outside it develops into a main root, producing root hairs and secondary roots.

- The plumule is like a leaf in its early development.
- The hypocotyl is the space between the radicle and the plumule. It develops into a stem.
- The endosperm is the food supply contained in the seed. This is sometimes included in the cotyledons, which either achieve the function of primary leaves or food storage, even both of them in some cases.
- The seed coat or testa - is the outer layer of the seed.
- The micropyle is a litle pore on the seed coat , through which, apart from entering the sperm, the seed absorbs water to begin germination.

(ii) Animals:

The organs of the body

An organ is a complex structure with a special job or a number of jobs to do. For example:

- The eye is the organ of sight.
- The kidneys are organs which get rid of water and poisonous materials from the body as urine.
- The liver has many jobs and is involved in more than one system.

Various organs are grouped together to form a body system which carries out a special job.

	Organs in the Body	Job or function
	muscle (meat) bones	Support and move the body
	stomach, liver, intestine, pancreas	Digest and absorb food
	heart, blood vessels	The brood carries substances around the body
	muzzle, windpipe, lungs	Breathing
	kidneys, bladder	Get rid of poisons and waste (urine)
	brain, nerves spinal cord	Pass messages around the body, control the body
	eyes, ears, nose skin	Sense and detect things outside the body
	testes, penis ovaries, uterus, vagina, vulva, udder	Reproduction
	lymph nodes, spleen	Defence against infections

DIFFUSION AND OSMOSIS

8. **Describe the processes of diffusion and osmosis**

(i) Diffusion: This is movement of solutes into and out of the cell down the concentration gradient. (The difference in concentration between a region with a high concentration of molecules and region of low concentration of molecules).

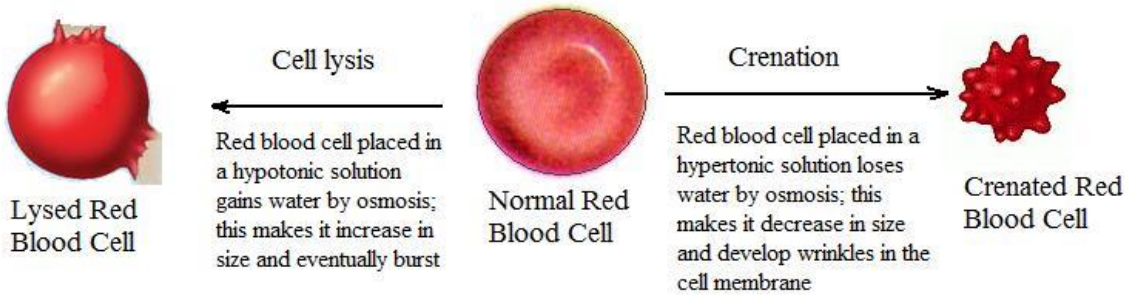
(ii) Osmosis: is the movement of water molecules from a region of high water potential to a region of low water potential through a selectively permeable membrane. Osmosis is a special type of diffusion.

9. **Explain the effects and importance of diffusion and osmosis in living organisms**

Effects of Osmosis in Animals

When an animal cell such as a red blood cell is placed in a hypotonic solution, it gains water by osmosis. This is as a result of the water potential of the hypotonic solution being higher inside the cell than outside the cell. Eventually the cell swells up and bursts. The bursting of an animal cell due to osmotic gain of water is called cell lysis. An animal cell which is placed in a hypertonic solution loses water by osmosis because the water potential inside the cell is higher than the water potential of the hypertonic solution. This leads to shrinking and crinkling/wrinkling of an animal cell. This is a condition called crenation. Osmotic loss of water by animal tissues leads to dehydration of the animal. The following diagrams illustrate cell lysis and crenation.

Cell lysis and crenation in a red blood cell



b) Effects of Osmosis in Plants

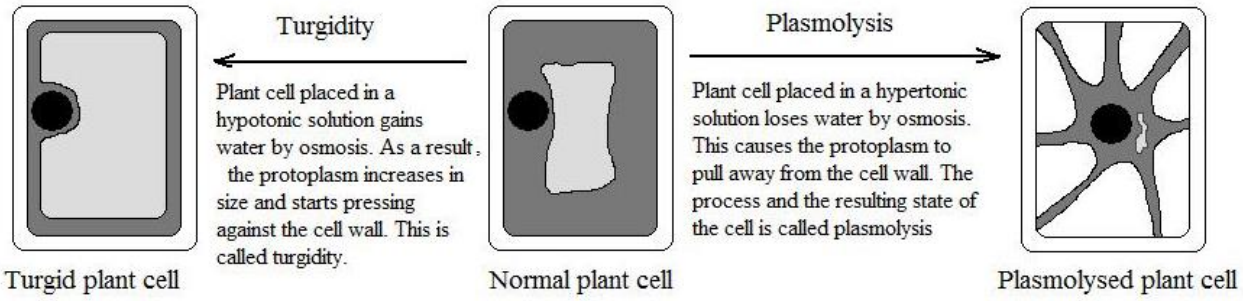
(i)Turgidity

When a plant cell is placed in a hypotonic solution, it gains water by osmosis because the water potential of the hypotonic solution is higher than the water potential inside the plant cell. The protoplasm swells and eventually starts pressing against the cell wall. The condition where the protoplasm of a plant cell presses against the cell wall due to osmotic gain of water is called turgidity.

A plant cell that is undergoing turgidity is said to be turgid. The plant cell does not burst because it has a cellulose cell wall which protects it from bursting.

(ii)Plasmolysis.

When a plant cell is placed in a hypertonic solution, it loses water by osmosis because the water potential inside the cell is higher than the water potential of the hypertonic solution. The protoplasm shrinks and pulls away from the cell wall due to osmotic loss of water . This is a condition refered to as plasmolysis. A plant cell that is undergoing plasmolysis is said to be plasmolysed. The following diagrams illustrate turgidity and plasmolysis.



Flaccid

When a plant tissue such as a peeled potato tuber is placed in a hypotonic solution, it gains water by osmosis and becomes bigger and more firm. The presence of water in plant tissues forms a hydrostatic skeleton which renders mechanical support to the entire plant When a plant tissue such as a peeled potato tuber is placed in a hypertonic solution, it loses water by osmosis and becomes flaccid/flabby (smaller and weaker). In a living plant, this leads to a condition called wilting. Wilting is the sagging of delicate plant parts such as leaves, flowers and young stems due loss of water. Temporary wilting is one which can be reversed by supplying a plant with water. Permanent wilting can not be reversed even if a plant is supplied with water the plant tissues have already died. Suggest why it is not advisable to apply too much fertilizer on plants.

Importance of Diffusion

Diffusion is important in living organisms in the following ways:

- Movement of Oxygen from the lungs to the blood and from the blood to the tissue cells.
- Carbon dioxide moves from the tissue cells to the blood and from the blood to the lungs.
- Dissolved food moves from the blood into the tissue cells.
- Metabolic wastes such as urea move from the tissue cells into the blood.
- Carbon dioxide needed for photosynthesis by plants moves from the atmosphere into the leaves by diffussion.
- Oxygen produced during photosynthesis moves out of the leaves to the atmosphere by diffusion.

Water vapour moves out of the air spaces of leaves to the atmosphere during transpiration by diffusion

Osmosis is important in living organisms mainly in movement of water into and out of cells (absorption of water by plants, movement of water from cell to cell e.t.c)

Effects of Osmosis in Living Organisms

The cells, tissues, organs and systems of living organisms are always exposed to body fluids or solutions of different concentrations. There are three types of solutions an organism may be exposed to, namely hypotonic, isotonic and hypertonic solutions.

Hypotonic

A hypotonic solution is one whose concentration is lower than the concentration inside a living cell.

Isotonic

An isotonic solution is one whose concentration is equal to the concentration inside a living cell. Isotonic solutions have no net osmotic effects in living organisms because a dynamic equilibrium exists between them and the living cells.

Hypertonic

A hypertonic solution is one whose concentration is higher than the concentration inside a living cell.

10. Describe what active transport is.

The movement of particles against a concentration gradient using energy from ATP. It is the main process by which mineral ions move into and out of living cells e.g. ion uptake by root hairs,uptake of glucose by epithelial cells of the villi and transportation of glucose to storage organs in plants

ENZYMES

1. **Describe the characteristics of Enzymes.**

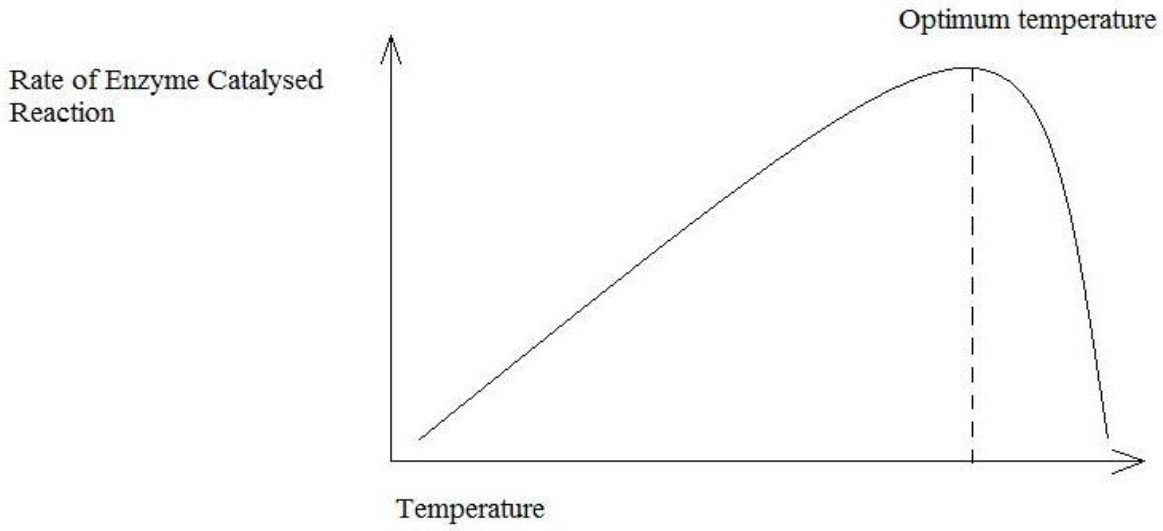
- Most of them are protein in nature.
- They are catalysts.
- They catalyze both forward and reverse reactions.
- They are specific. This means each enzyme acts on only one substrate or a narrow range of related substrates.
- Their activity is affected by temperature, PH, substrate concentration, enzyme concentration, inhibitors and cofactors (coenzymes and activators).Memory aid: SEPTIC

2. Explain the effects of temperature and pH on enzyme action)

(i)Temperature

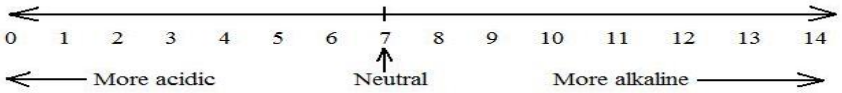
Enzyme activity increases with increase in temperature up to the optimum temperature. Optimum temperature is the temperature at which an enzyme works best. This occurs because an increase in temperature results in increase in the kinetic energy of both the enzyme and the substrate. every increase of 10 ^{o} C. The optimum temperature is the temperature at which an enzyme works best. The activity reduces after the optimum temperature because the enzyme gets denatured and loses

its catalytic function. Enzyme denaturation is the disturbance of the shape of an enzyme and its active site such that the substrate no longer fits in the active site. Hence the enzyme can no longer carry out its catalytic function. The following graph shows how enzyme activity is affected by temperature.

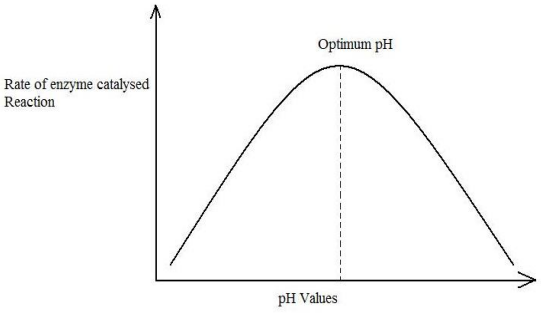


(i)pH

pH is a measure of how acidic or alkaline a substance is. pH values range from 1 to 14.As shown in the diagram below**.**



The pH value at which a given enzyme works best is called the optimum pH. Values lower or higher than the optimum pH lower enzyme activity. The optimum pH varies from enzyme to enzyme, depending on the enzyme's natural occurrence. For instance, the digestive enzymes of the stomach work best at acidic pH values while those of the duodenum work best at alkaline pH values. A graph of enzyme activity against pH is always symmetrical and has its peak **at the optimum pH, as illustrated by the following diagram**



3. Explain industrial application of enzymes.

(i)Making of Biological Detergents.

Enzymes are included in biological detergents so that they can hydrolyze stains of biological origin. The most commonly used enzymes are proteases which breakdown protein stains such as blood and chlorophyll stains, forming colourless amino acids as products. Lipases and carbohydrases may be used to get rid of lipid and carbohydrate stains, respectively, but these are easy to wash even with ordinary detergents.

(ii)Baking.

When baking, flour, water, sugar and yeast are mixed to make dough. Yeast secretes zymase which breaks down sugars to form alcohol and carbon dioxide. The carbon dioxide forms bubbles which cause the dough to rise.

(iii)Brewing.

When brewing cereal seeds are soaked until they start germinating. During the process of germination, starch is broken down to maltose by the enzyme amylase. Maltose is broken down to glucose by maltase. The seeds are dried and ground to form a powder. The powder is boiled in hot water to form a paste. After the past cools, yeast is added. The enzyme zymase from yeast acts on sugars to form alcohol and carbon dioxide. The alcohol is removed from the mixture by distillation. Baking and brewing both make use of the enzyme zymase which is found in yeast.

(iv) Making Sweeteners for Food and Drinks.

In sweetening of confectioneries, glucose is converted into fructose by the enzyme glucose isomerase because fructose is sweeter than glucose.

(v)In the Dairy Industry.

In the dairy industry, the enzyme rennin is used to coagulate milk during the making of yoghurt and cheese.

(vi)Tanning of Leather.

Tanning is a process by which leather is made soft and pliable. Trypsin is utilized to digest proteins in the leather during tanning.

(vi) Extraction and Processing of Fruit Juice.

When extracting juices from fruits enzymes known as cellulases and pectinases are used to increase the juice yield and prevent jellying of the juices, respectively.

(vii) Tenderizing of Meat.

The meat industry makes use of Trypsin to tenderize meat and predigest baby food.

NUTRIENTS

A nutrient is a chemical or substance that provides what is needed for plants or animals to live and grow.

CLASSES OF NUTRIENTS

There are seven different nutrients:

- carbohydrates.
- proteins.
- fats.
- minerals.
- vitamins.
- fibre.
- water.

Different foods contain different combination of these nutrients.

1.Carbohydrates are referred to as energy-giving foods. They provide energy in the form of calories that the body needs to be able to work, and to support other functions.

Carbohydrates are needed in large amounts by the body. They are the body's main source of fuel because they are easily converted into energy. This energy is usually in the form of glucose, which all tissues and cells in our bodies readily use.

The main sources of carbohydrates are bread, wheat, potatoes of all kinds, maize, rice, cassava, pasta, macaroni, banana, sweets, sugar cane, sweet fruits, and honey. Other foods like vegetables, beans, nuts and seeds contain carbohydrates, but in lesser amounts.

Classification of carbohydrates

Based on the number of sugar units**, carbohydrates are classified into three groups; these are monosaccharides, disaccharides and polysaccharides.**

(i)Monosaccharides and disaccharides are referred to as **simple sugars** or **simple carbohydrates** that our body can easily utilise. Examples include sugar, honey, sweet fruits and sugar cane.

(ii) Polysaccharides are called **complex carbohydrates** and they need to be broken down into simple sugars to be used by our body Examples include starch and cellulose.

2. Proteins

Proteins are needed in our diets for growth (especially important for children, teens and pregnant women) and to improve immune functions. They also play an important role in making essential hormones and enzymes, in tissue repair, preserving lean muscle mass, and supplying energy in times when carbohydrates are not available.Pregnant women need protein to build their bodies and that of the babies and placentas, to make extra blood and for fat storage. Breastfeeding mothers need protein to make breast milk.

Sources of protein.

The main sources of proteins are meats, chicken, eggs, beans, ground nuts, lentils, fish, cheese and milk.

All animal foods contain more protein than plants and are therefore usually better sources of body building foods. However, even though plant proteins are usually not as good for body-building as animal proteins, they can become more effective nutritionally when both are mixed with each other.

3. Fats and oils

Fats and oils are concentrated sources of energy and so are important nutrients for young children who need a lot of energy-rich food. Fats can also make meals more tasty and satisfying. Fat is found in meat, chicken, milk products, butters, creams, avocado, cooking oils and fats, cheese, fish and ground nuts.

2.4.1 Classification of fats

Fats are classified into saturated and unsaturated fats.**Saturated fats** are usually solid at cool temperatures. Eating too much saturated fat is not good for a person's health, as it can cause heart and blood vessel problems.**Unsaturated fats** are usually liquid at room temperature. These types of fats are healthy fats. Examples include fats from fish, oil seeds (sesame and sunflower), maize oil and ground nut oil. Plant sources of fats are better for a person's health than the animal sources, because animal fats contain more saturated fats.

2.5 WATER

You get water through liquid foods and beverages, such as soup, milk, tea, coffee, soda, drinking water, and juices. Alcohol is not a good source of water because it is a diuretic. It causes the body to release water.

Water is essential for life. We need water for a number of reasons:

- For the body to make cells and fluids such as tears, digestive juices and breast milk
- For the body to make sweat for cooling itself.
- For essential body processes — most take place in water.
- For keeping the lining of the mouth, intestine, eyelids and lungs wet and healthy.
- For the production of urine, which carries waste from the body.

2.6 Fibre

Fibre is a mixture of different carbohydrates which are not digested like other nutrients but pass through the gut nearly unchanged. Foods rich in fibre are vegetables like cabbage, carrots, cassava; fruits like banana and avocado; peas and beans; whole-grain cereals like wheat flour and refined maize or sorghum.

2.6 Including fibre in the diet.

Fibre should be included in the diet for the following reasons:

- Fibre makes food bulky or bigger — this can help a person who is overweight to eat less food
- Fibre makes the faeces soft and bulky; this can help prevent constipation
- Fibre slows the absorption of nutrients, so it helps nutrients to enter the blood stream slowly. This is important for patients with diabetes mellitus.

In this section you have learned about the macronutrients: carbohydrates, fats, proteins, water and fibre, and how they nourish the body. You are now going to learn more about vitamins and minerals, the important micronutrients.

2.7 Micronutrients in detail

2.7.1 Vitamins

Vitamins are groups of related substances present in small amounts in foodstuffs and are necessary for the body to function normally. Vitamins are also called protective foods. They are grouped together because, as their name implies, they are a vital factor in the diet.

Classifications of vitamins

Vitamins are classified into two groups:

Fat soluble vitamins (vitamins A, D, E and K) are soluble in fats and fat solvents. They are insoluble in water. So these are utilised only if there is enough fat in the body.

Water soluble vitamins (vitamins B and C, and folic acid) are soluble in water and so they cannot be stored in the body.

The best sources of micronutrients in our diets are fruits and vegetables. These two food groups contain essential vitamins and minerals. Animal sources of foods are also both good sources of micronutrients. However, an adequate micronutrient intake can only be achieved through sufficient intake of a balanced diet that includes plenty of fruits and vegetables. Table 2.1 overleaf sets out the functions of some of the important vitamins and examples of sources of food for each of these.

Table 2.1 Functions and sources of vitamins.

Vitamins	Function	Food sources	
Vitamin A	Night vision	Breastmilk, tomatoes, cabbage, lettuce, pumpkins Mangoes, papaya, carrots	

	Healing **epithelial** cells Normal development of teeth and bones	Liver, kidney, egg yolk, milk, butter, cheese cream	
Vitamin D	Needed for absorption of calcium from small intestines **Calcification** of the skeleton	Ultra violet light from the sun Eggs, butter, fish Fortified oils, fats and cereals	
Vitamin K	For blood clotting	Green leafy vegetables Fruits, cereals, meat, dairy products	
B complex	Metabolism of carbohydrates, proteins and fats	Milk, egg yolk, liver, kidney and heart Whole grain cereals, meat, whole bread, fish, bananas	
Vitamin C	Prevention of **scurvy** Aiding wound healing Assisting absorption of iron	Fresh fruits (oranges, banana, mango, grapefruits, lemons, potatoes) and vegetables (cabbage, carrots, pepper, tomatoes) Breastmilk	

Epithelial cells form the thin layer of tissue lining the gut, respiratory and genitourinary systems.
Calcification refers to the hardening of bones by calcium deposits.
Scurvy is a disease caused by vitamin C deficiency which leads to sore skin, bleeding gums and internal bleeding.

2.7.2 Minerals

Minerals are the substances that people need to ensure the health and correct working of their soft tissues, fluids and their skeleton. Examples of minerals include calcium, iron, iodine, fluorine, phosphorus, potassium, zinc, selenium, and sodium. Table 2.2 outlines the functions of some of these important minerals and examples of sources of food for each of these.

Table 2.2 Functions and sources of common minerals.

Minerals	Function	Food sources
Calcium	Gives bones and teeth rigidity and strength	Milk, cheese and dairy products Foods fortified with calcium, e.g. flour, cereals. eggs, fish cabbage
Iron	Formation of haemoglobin	Meat and meat products Eggs, bread, green leafy vegetables, pulses, fruits
Iodine	For normal metabolism of cells	Iodised salt, sea vegetables, yogurt, cow's milk, eggs, and cheese Fish; plants grown in iodine-rich soil
Zinc	For children to grow and develop normally; for wound healing	Maize, fish, breastmilk, meat, beans
Fluorine	Helps to keep teeth strong	Water

NUTRITIONAL RELATED DISORDERS/CONDITIONS.

Deficiencies, excesses and imbalances in diet can produce negative impacts on health, which may lead to diseases.These disorders can be rectified when a person is given the right nutrients in their right amounts.

DISEASES DUE TO NUTRITIONAL DEFICIENCY.

1.KWASHIORKOR.

This disease is caused by lack of proteins in the diet.It is common in children who mainly feed on carbohydrates.

TREATMENT

Feed the child with food rich in proteins like meat,milk, fish and beans.

2.MARASMUS.

It is caused by lack of proteins and carbohydrates in the body,mainly in infants.

PREVENTION AND TREATMENT.

Supply of food rich in proteins and carbohydrates.

Balanced diet.

Educate mothers on the need for a balanced diet for their children.

3.GOITRE.

It is caused by lack of iodine in the diet.

Supply of iodine in the diet.

PREVENTION AND TREATMENT.

Surgical removal of thyroid gland especially in adults.

4.SCURVY.

It is caused by lack of water soluble vitamin C that is essential for healthy gums and teeth.

PREVENTION /TREATMENT

Supply food rich in vitamin C,e.g citrus fruits,green vegetables ,sweet and irish potatoes.

Use of vitamin C suppliments to supply the required vitamin C.

5.RICKETS.

It is caused by the following:

Lack of vitamin D.(calciferol) in the diet.

Inability for the skin to synthesize vitamin D using ultra-violet radiations from the sun.

Poor absorption of calcium and phosphorous in the body .

Reduced calcification and bone formation.

PREVENTION

Supply of food rich in vitamin D like fish,liver and code liver oils.

Exposure of oneself to sunlight /ultra-violet radiations to allow the skin to synthesize vitamin D (Calciferol).

6.ANEAMIA.

Aneamia is caused by lack of iron ,vitamin B_{12} and worms that compete for food with the host.

PREVENTION.

-Supply of food rich in iron and B_{12} eg liver,lean meat,fish,milk and eggs.
-Take supplements of vitamin B_{12} and iron.
-Deworm periodically.
7.OBESITY.
This is a medical condition in which the body accumulates fats beyond a certain limit.It is caused by the following:
-Eating bulky food.too much carbohydrates.
-Psychological disturbances that slows down metabolism which leads to the build up of fats.Anxiety may result in over-eating.
-Lack of exercises to keep the weight within accepted limit by burning excess calories.
MANAGEMENT AND CONTROL OF OBESITY.
-Control energy giving foods intake.
-Use drugs that reduce appetite and stimulate lipid metabolism.
-Doing physical exercises.
DIETARY NEEDS
Different conditions in different people require different diets ,consisting of all food nutrients in their right proportions.
1.DIET FOR THE AGED
An aged person requires a diety that consists of mainly fluids,should comprise of several small meals per day which helps in the efficient digestion of the food.
-Little carbohydrates should be given due to the reduced ability to do work.
-A lot of vitamins must be given to prevent infections as their immune system has reduced.Mineral elements must also be given to prevent diseases like goiter and have strong bones.
-Fats should be given so that they act as shock absorbers around organs.
2.DIET FOR A PREGNANT WOMAN.
A pregnant woman requires a balanced diet for herself and the developing baby in her womb.
She must have a diet rich in:
-proteins because new cells for growth are made.
-Vitamin C to prevent infections.
-Mineral ions like calcium and phosphorus for strong and proper formation of bones and teeth,if she takes less calcium,her teeth would ache.
-Iron for the formation of red blood cells,if little is taken ,much of it is used by the foetus alone and the mother becomes aneamic.
-A lot of fluids because many chemical reactions take place in fluid medium and the water is also required for buoyancy in the amniotic cavity.
-A lot of carbohydrates in order to be energetic.
3.DIET FOR A SICK PERSON.
The diet for the sick person should provide nutrients that will address the following factors:
-The sick maybe weak and may lose weight during the illness.
-The immune system may be weakened.
The person may lose a lot of water especially if they have a fever,diarrhea or vomiting.

-The person may have reduced or no appetite.
The following are the components that should be contained in a sick person's diet:
-Adquate protein for repair of damaged cells and the replacement of dead cells.
-Adquate carbohydrates and fats to help the sick gain weight and energy.
-Adquate safe water to replace that which was lost due to sickness.
-Mineral salts and vitamins that the body needs.

4-DIET FOR A LACTATING WOMAN.

Alactating mother requires a balanced diet so that the the baby receives sufficient milk.She must eat a lot of food containing:
-Proteins so that more milk is made for her baby.
-Fluids to increase the amount of milk in the mammary glands.
-Carbohydrates so that she gets enough to her child.
-Vitamins and Mineral salts to prevent deficiency diseases and keep her look young and healthy.

5.DIET FOR THE PRE-SCHOOL CHILDREN.

Children in this group use a lot of energy because they are very active.They require a balanced diet that will provide all nutrients they need,because they eat in small portions,they ought to at least five meals a day.Their diet should comprise:
-Energy giving foods.
-proteins.
-Fruits and vegetables for the supply of minerals and vitamins.
-Milk should also be given.

6.DIET FOR A SPORTSMAN.

A sportsman is involved in intense physical activity.Sportsmen need:
-A lot of carbohydrates for energy.
-Mineral salts for the muscles.
-Adquate proteins for muscular development and healing of injuries.
-Enough water to replace that which is lost during sweating in order to maintain the cellular fluids at the right concentration.

7.DIET FOR THE YOUTH.

The youth require many different types of nutrients in the body.They are so energetic and vulnerable to diseases.It is important to reduce sugar intake as this may cause obesity,heart disease and diabetes.The youth need:
-Proteins for body growth and repair.
-Carbohydrates for energy.
-Fats for energy and warmth.
-Vitamins such as B_{12} and B_{6}.
-Minerals such as Zinc.

1. **Investigate the presence of nutrients in food samples**.

(a). The Iodine Test for Starch.

(i)If the sample is in solid /powder form

- Place a small amount of sample on a white tile
- Add 2 drops of iodine solution to the sample; then observe and record what happens.

((ii)) If the sample is in solution/suspension form

- Place 2 cm^3 of sample solution into a clean and dry test tube.
- Add 2 drops of iodine solution to the test tube and shake;

Then observe and record what happens.

The possible observations and corresponding conclusions are given in the table below:

Observation	Conclusion
Solution remains yellowish-brown	Starch absent
Solution turns blue-black	Starch present

(b). The Benedict's test for Reducing Sugars.

This test requires the sample to be in solution form and may be performed on suspensions. If the sample is in solid form, it will first need to be ground /crushed/cut into very small pieces and to be shaken with distilled water for extraction of reducing sugars if they are present. Filter and then proceed with the following test method on the filtrate:

- Place 2 cm^3 of sample solution into a clean and dry test tube.
- Add 2 cm^3/an equal volume of Benedict's solution to the sample solution and shake.
- Gently heat the mixture using a water bath; then observe and record what happens.

The possible observations and corresponding conclusions are given in the following table:

Observation	Conclusion
Solution remains blue	Reducing sugars absent
*Solution turns green/yellow/orange/brick red	Reducing sugars present

*Only state the final colour observed and not all the colours mentioned in the table. The extent of the colour change indicates the quantity of reducing sugars present i.e. green and yellow colours

indicate that little/traces/small amounts of reducing sugars are present, orange indicates that reducing sugars are present and brick red indicates high concentrations of reducing sugars present.

(c). The Benedict's test for Non-reducing Sugars.

- First carry out the Benedict's test for reducing sugars. If the colour of the solution remains blue, proceed with the next steps.
- Place another 2 cm^3 of sample solution into a clean and dry test tube.
- Add 1 cm^3 of dilute hydrochloric, heat in water bath for 3 minutes and cool.
- Add sodium hydrogen carbonate solution or sodium hydroxide solution to the mixture, a little at a time until fizzing stops.
- Add an equal volume of Benedict's solution to the mixture.
- Gently heat the mixture using a water bath; then observe and record what happens.

The possible observations and corresponding conclusions are given in the following table:

Observation	Conclusion
Solution remains blue	Non-reducing sugars absent
Solution turns green/yellow/ orange/brick red	Non-reducing sugar present

(d). The Biuret Test for Proteins.

This test also works best for solutions and suspensions. Extraction by grinding and shaking with distilled water is therefore necessary where samples are in solid form. The filtrate will then be tested as follows:

- Place 2 cm^3 of sample solution into a clean and dry test tube.
- Either add 5 drops of sodium hydroxide solution to the sample solution followed by a 2 drops of copper (II) sulphate solution, drop by drop, shaking and observing after each drop.
- Or add an equal volume of Biuret solution; then observe and record what happens.

The possible observations and corresponding conclusions are given in following table:

Observation	Conclusion
Solution remains blue	Proteins absent
*Solution turns purple/violet/lilac/mauve	Proteins present

Only one of these options needs to be mentioned. Candidates are advised to use colour names which are commonly used e.g. it is better to use the name purple or violet instead of mauve or lilac.

(e). Testing for Lipids (Fats and Oils).

(i) The Emulsion Test

- Shake a small sample/a drop of sample solution with 2 cm^3absolute ethanol in a test tube.
- Add a few drops of distilled water to the test tube; then observe and record what happens.

The possible observations and corresponding conclusions are given in the following table:

Observation	Conclusion
Solution remains clear	Fats/oils absent
Emulsion formed/solution turns cloudy	Fats/oils present

(ii) The Grease Spot Test.

- Place a drop of sample/sample solution on filter paper or brown paper.
- Place a drop of distilled water next to the drop of the sample.
- Hold the paper against light until the drop of water disappears; then observe and record what happens to the sample spot.

The possible observations and corresponding conclusions are given in the following table:

Observation	Conclusion
Sample spot disappears	Fats/oils absent
Permanent translucent/oily/greasy spot formed	Fats/oils present

2. Identify good sources of nutrients

- ***Carbohydrates***: rice, potatoes, bread ,inshima,cassava.
- ***Proteins:*** fish, meat, chicken, beans,eggs.
- ***Lipids:*** fats and oils.
- ***Vitamins:***Mango, orange, pineapple ,apple ,banana and vegetables.

3. **Describe the importance of nutrients, salts, vitamins and roughage to the body.**

Nutrients:

- Supply of energy to the body
- Repair worn out tissues.
- Protects us from diseases.

(i)Salts:

- Strengthen the body and teeth e.g. calcium
- Supply blood (haemoglobin) e.g. iron.

(ii)Water:

- Its needed for chemical reactions.

(iii)Roughage:

- Prevents constipation.

1. **Investigate the presence of nutrients in food samples**.

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5. Describe the micro and macro plant nutrients and their deficiency.

There are two groups of elements needed by plants for proper growth namely major elements and minor elements. Major elements are required by plants in large quantities. Three examples of major elements are nitrogen, phosphorous and potassium (NPK). Minor elements are needed by the plant in small quantities. Examples of mineral ions needed by plants are magnesium and nitrates.

(i)Magnesium.

This forms part of the chlorophyll molecule. Deficiency causes chlorosis which is characterised by yellowing of leaves beginning from the bottom of the plant.

(ii)Nitrogen.

This is absorbed from the soil in the form of nitrate ions (NO^-_3) or ammonium ions (NH^+_4). It is important for synthesis of proteins. Deficiency leads to stunted growth, weak stems and yellowing of leaves.

(iii)Potassium.

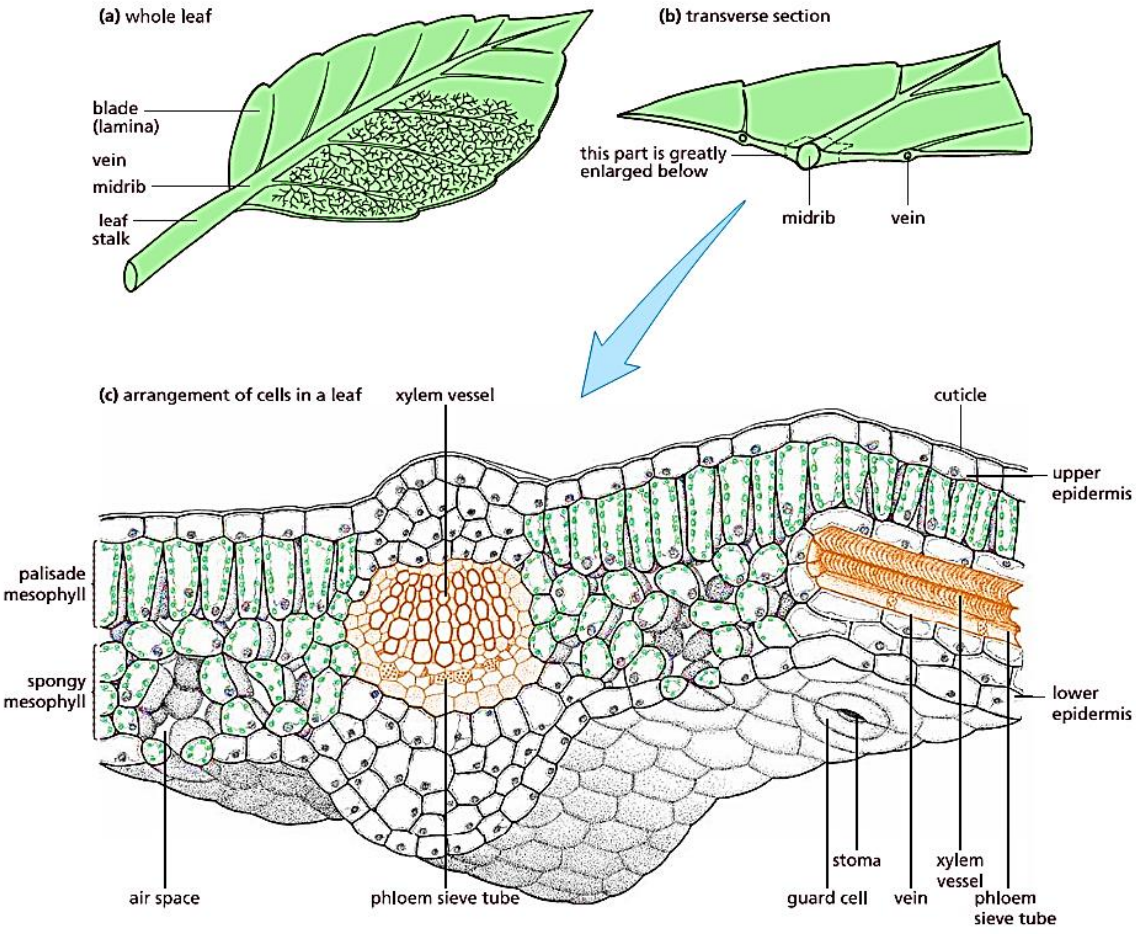
Potassium is important for flowering and fruit formation and is absorbed in the form of potassium ions (K^+). Deficiency of potassium causes poor flowering and fruit formation.

(iv)Phosphorous.

It is absorbed in the form of phosphate ions (PO^{3-}_4). It is important for the formation of Nucleic acids and ATP. Deficiency leads to purple leaves and poorly developed roots.

NUTRITION IN PLANTS

1. **Describe the external and internal structure of a leaf.**



2. External parts of the leaf and their functions:

- Leaf Blade (lamina): Wide flattened area of leaf for concentrating sunlight on photosynthetic cells.
- Petiole: Short stem that attaches leaf to main stem or branch.
- Veins: Vascular bundles within leaf for transport. The veins deliver water and salts to the leaf cells and carry away the food made by them. The **veins** also act as skeletons that supports the softer tissues of the leaf blade
-
- Node: Growth region of stem where leaves or new branches arise.
- **Leaf stalk** it attaches the leaf to the stem. **Leaf stalk** continues into the leaf as a
- **Midrib** is the point where the vein of the leaf are attached in some plants

3. Internal parts of the leaf and their functions:

Part of leaf	Details
Cuticle	Made of wax, waterproof ng the leaf. It is secreted by cells of the upper epidermis.
palisade mesophyll	These cells are thin and transparent to allow light to pass through. No chloroplasts are present. They act as a barrier to disease organisms.
spongy mesophyll	These cells are more spherical and loosely packed. They contain chloroplasts, but not as many as in palisade cells. Air spaces between cells allow gaseous exchange – carbon dioxide to the cells, oxygen from the cells during photosynthesis.
vascular bundle	This is a leaf vein, made up of xylem and phloem. Xylem vessels bring water and minerals to the leaf. Phloem vessels transport sugars and amino acids away (this is called translocation).
lower epidermis	This acts as a protective layer. Stomata are present to regulate the loss of water vapour (this is called transpiration). It is the site of gaseous exchange into and out of the leaf.
Stomata	Each stoma is surrounded by a pair of guard cells. These can control whether the stoma is open or closed. Water vapour passes out during transpiration. Carbon dioxide diffuses in and oxygen diffuses out during photosynthesis.

4. Investigate factors necessary for photosynthesis

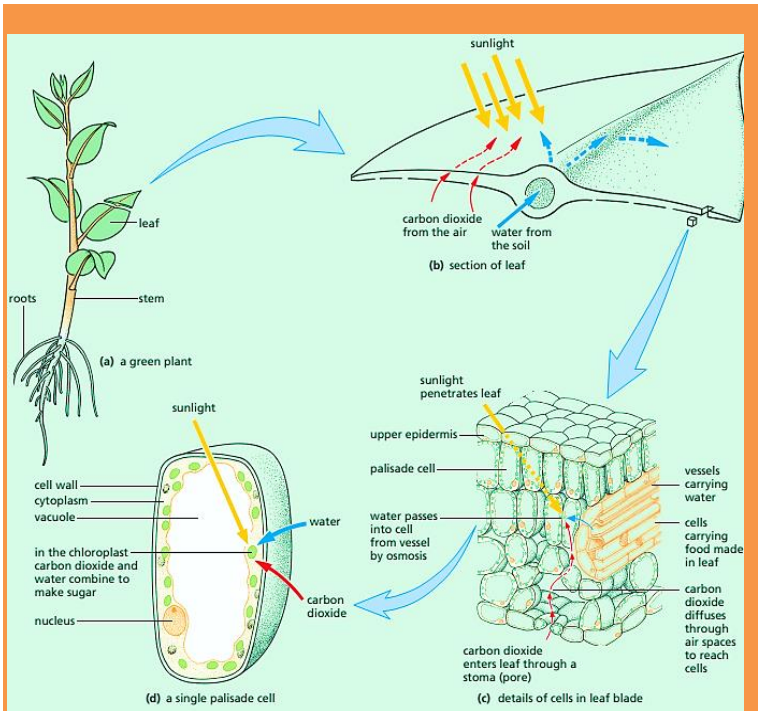
Sunlight: The rate of the light reaction will depend on the light intensity. The brighter the light, the faster will water molecules be split in the chloroplasts.

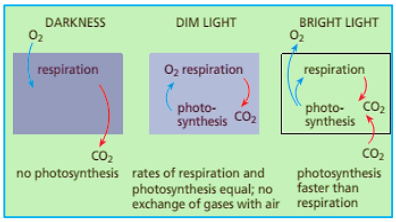
The 'dark' reaction will be affected by temperature. A rise in temperature will increase the rate at which carbon dioxide is combined with hydrogen to make carbohydrate.

- **Carbon dioxide concentration**: Manufacture of carbohydrate is not possible without carbon dioxide. Thus if the amount of CO_2 reduces in air (in air there is 0.03% of CO_2) the rate of photosynthesis reduces.
- **Water:** Water makes the guard cells turgid and the stomata opens. On the other hand water is utilized as a raw material in dark phase of the process.
- **Temperature:** Photosynthesis seizes near 0℃ and above 45℃ of temperature. Optimum temperature for photosynthesis is 22℃- 35℃. Below 22℃ and above 35℃ rate of photosynthesis decreases.
- **Oxygen:** If density of oxygen increases in atmosphere the rat of photosynthesis will decrease.

5. Describe the light and dark reactions of photosynthesis.

- **Light Reaction:** Light is essential for this phage. In this process water breaks down to O_2, e- (electron) and Hydrogen (proton = H+) by the help of energy obtained from sunlight. Such break down is called **Photolysis** or **Photolysis of water.** Large amount of light energy is assimilated in chemical compound named ATP (Adenosine Tri-Phosphate) and NADPH2 (Nicotinamide Adenosine Dinucleotide Hydrogen Phosphate) as chemical energy. ATP and NADPH2 are called assimilatory Power. This process of formation of ATP by using light energy is *called* Photophosphorylation.





- **Dark Reaction**: Light is not required in this process. ATP a $NADPH_2$ produced in light phase, are utilized in this process to manufacture carbohydrates. The process of manufacture of carbohydrate is as follows: - CO_2, from atmosphere enters inside the leaf thus in the cell, through stomata. CO_2 combined with Ribulose 1, 5 Diphosphate, present in the cell, produces an unstable compound named Keto acid. This Keto acid later on break down into
two molecules named a 3 -Carbon compound named 3-Phosphoglyceric acid (first stable compound). This Phosphoglyceric acid then converted to 3-Phosphoglyceraldehyde and Dihydroxy Acetone Phosphate utilising ATP and NADPH2, produced earlier in light phase. By several successive reactions these 3-Phosphoglyceric acid and Dihydroxy Acetone Phosphate ultimately produce Carbohydrate (Sucrose-Sugar) in one side and Ribulose 1,5,

6. **Describe the chemical reactions for photosynthesis**: Photosynthesis is a biochemical reaction by which chloroplast, in the plant cell, uses the energy, received from the photon of sunlight, manufactures carbohydrate food by CO_2 of the atmosphere and water.

$$6CO_2 + 6H_2O \xrightarrow[\text{chlorophyll}]{\text{sunlight}} C_6H_{12}O_6 + 6O_2$$

uptake of carbon dioxide; uptake of water; production of sugar (or starch); release of oxygen

7. **Describe the fate of glucose in plants**.

The glucose formed is metabolically active and takes part in the following reactions:

- Some of it is used for respiration
- Some of it is converted to cellulose and becomes part of cell walls
- Some of it is combined with nitrogen and used to synthesise amino acids
- Some of it is converted to sucrose in order to be transported
- Some of it is converted to fats and oils
- Some of it is converted to nucleic acids

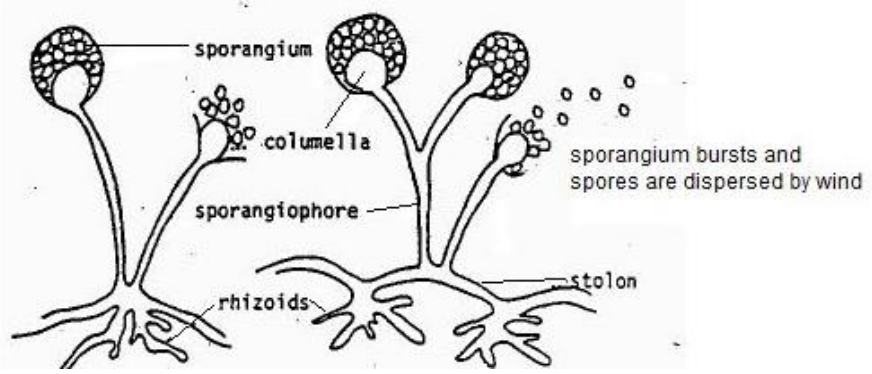
- The excess is converted to starch for storage

8. **Describe the importance of nutrients in plant.**
   Magnesium
   This forms part of the chlorophyll molecule. Deficiency causes chlorosis which is characterised by yellowing of leaves beginning from the bottom of the plant.
   Nitrogen
   This is absorbed from the soil in the form of nitrate ions (NO^-_3) or ammonium ions (NH^+_4). It is important for synthesis of proteins. Deficiency leads to stunted growth, weak stems and yellowing of leaves.
   Potassium
   Potassium is important for flowering and fruit formation and is absorbed in the form of potassium ions (K^+). Deficiency of potassium causes poor flowering and fruit formation. **Phosphorous**
   It is absorbed in the form of phosphate ions (PO^{3-}_4). It is important for the formation of Nucleic acids and ATP. Deficiency leads to purple leaves and poorly developed roots.
9. **Identify storage organs of plants.**
   The food manufactured by plants is normally converted to starch and oils for storage. Oils are mainly stored in seeds e.g. in groundnuts and sunflower. Starch is stored in a range of modified plant organs, some of which are discussed below.

I. **Root tuber:** This a fibrous root swollen with stored food e.g. sweet potato (*Ipomeabatatas*) tuber
II. **Stem tuber**: This is an underground stem swollen with stored food e.g. Irish potato (*Solanumtuberosum*)
III. **Bulb**: A bulb is made of underground fleshy leaves growing from a short stem e.g. onion (*Allium sp*)
IV. **Rhizome**: This is a swollen underground horizontal stem e.g. ginger
V. **Corm**: This is swollen underground and vertical short stem e.g. *Crocus sp*.
VI. **Seed:** A sexually produced structure containing a plant embryo and its food store protected by a testa.

SAPROPHYTIC NUTRITION

10. **Investigate the structure of Rhizopus or Mucor.**



11. **State the functions of the parts of Rhizopus**.

- The bodies of *Mucor* and *Rhizopus*are made of threads called hyphae. A mass of hyphae is called a mycelium. Horizontal hyphae are called stolons; root like hyphae are called rhizoids while those that bear spore cases (sporangia) are called sporangiophores. Each spore case contains numerous spores. Spores are microscopic structures produced asexually which are capable of germinating under favourable conditions.

12. **Describe what saprophytic nutrition is**.
    Saprophytic nutrition is a type of nutrition where an organism called the saprophyte feeds on dead and decaying organic matter known as the substrate. The saprophyte feeds by secreting extracellular digestive enzymes from its hyphae. These enzymes hydrolyze the substrate and the saprophyte absorbs the end products. Examples of saprophytic organisms are mould fungi such as *Mucor* and *Rhizopus.*
13. **Explain the importance of saprophytic nutrition**.
    Saprophytes are important in the following ways:

- They decompose dead organic matter, thereby preventing accumulation of dead bodies

- They play a role in the recycling of nutrients such as carbon and nitrogen
- Some saprophytes are used as food e.g. mushrooms.
- Some saprophytes such as yeast are important in brewing and baking

14. **Identify the external structure and function of the human teeth.**

Types of Teeth

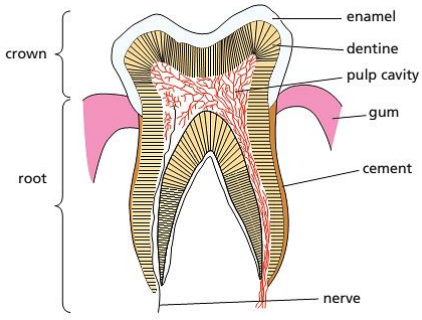
There are four types of teeth namely incisors, canines, premolars and molars.

- Incisors: These are chisel-shaped teeth used for cutting and biting. Each incisor only has one root.
- Canine: These are dagger-shaped (pointed) teeth used for tearing flesh, suffocating prey and carrying young ones. Each canine only has one root. In carnivorous animals, the canines are very long and pointed.
- **Premolars**: these are broad and ridged teeth used for grinding or crushing food. Each usually has two roots.
- **Molars**: these are broad and ridged teeth used for grinding or crushing food. Each molar has from two to four roots. The projections on top of the crowns of premolars and molars are called cusps or ridges

NUTRITION IN ANIMALS

15. **Describe the internal structure and function of the human tooth**.

Internal Structure of a Tooth



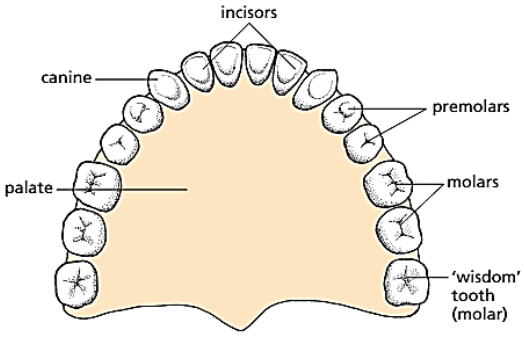
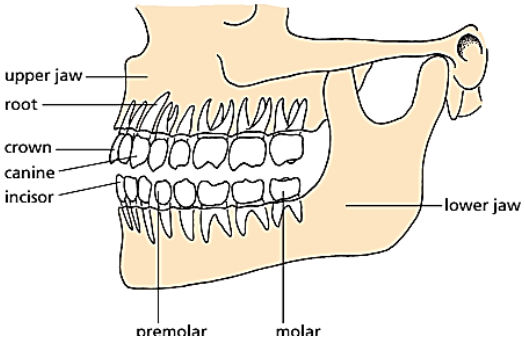


Figure 7.15 Teeth in human upper jaw



Internal structure of a molar

Functions of tooth parts:

Enamel

This is the hardest substance in the body of an animal. It's made of Calcium and Phosphate salts and its functions are:

- Preventing wearing away of the tooth
- Protecting the tooth from damage
- It is used as a biting and grinding surface

However the enamel can be corroded (dissolved) by acids.

Dentine

This is a bone-like tissue below the enamel which is made of calcium and phosphate salts, collagen fibres and cytoplasmic strands. It contains fine canals which link the pulp cavity to the enamel.

Pulp Cavity

This is a space within the dentine which is made of tooth-producing cells, nerves and blood vessels. The nerves make the tooth sensitive to stimuli such as temperature, pH and pressure. The blood vessels supply the tooth with food and oxygen

Cement

This is a bone-like tissue with fibres that anchor the tooth to the jawbone

16. **Describe the dental formulae of a dog and human being.**

Dental Formula (Plural: Dental Formulae)

The dental formula is the number and arrangement of teeth according to type on the upper and lower jaw in one half of the mouth of an animal. Examples of dental formulae are:
Human being

Man

$$i=\frac{2}{2}c=\frac{1}{1}\,pm=\frac{2}{2}m=\frac{3}{3}$$

Cat

$$i=\frac{3}{3}c=\frac{1}{1}\,pm=\frac{3}{2}m=\frac{1}{1}$$

Cow

$$i=\frac{0}{3}c=\frac{0}{1}\,pm=\frac{3}{3}m=\frac{3}{3}$$

Rat

$$i=\frac{1}{1}c=\frac{0}{0}\,pm=\frac{0}{0}m=\frac{3}{3}$$

Where i=incisors, c=canines, pm=premolars and m=molars
Note that the dental formulae only show the number of teeth present in one half of the mouth. To get the total number of teeth, the numbers in the dental formula must be multiplied by two.

Examples
Determine the total number of teeth in the following for Man

$$i = upper\ jaw : 2\ x\ 2 + lower\ jaw\ 2\ x\ 2 = 8$$
$$c = upper\ jaw: 1\ x\ 2 + lower\ jaw: 1x2 = 4$$
$$pm = \ upper\ jaw : 2\ x\ 2 + lower\ jaw: 2x2 = 8$$
$$m = upper\ jaw : 2x\ 3 + lower\ jaw: 2x3 = 12$$
$$\text{Total} = 8 + 4 + 8 + 12 = 32$$

17. **Identify the differences in dentition of carnivores, herbivores and omnivores.**
    Relationship between Dentition and Type of Diet
    a) Dentition in Carnivore
    Carnivores are animals that feed predominantly on flesh e.g. lions. Their dentition is specialised in the following ways:
    - Canines are very long and pointed to enable them to tear flesh and suffocate their prey.
    - Presence of carnassial teeth (the last upper premolar and first lower molar) which work like the blades of a scissors to slice meat and shear flesh away from bones.

    b) Dentition in a Herbivore
    Herbivores are animals that feed predominantly on vegetation e.g. sheep. Their dentition is specialised in the following ways:
    - Upper incisors are absent and replaced by a horny pad which works in conjunction with lower incisors to grip vegetation and wrench it.
    - There is a space between the incisors and premolars called the diastema. It is used to manipulate food by separating the freshly eaten food from the one that is already being chewed.

    c) Dentition in an Omnivore
    Omnivores are animals that feed on both flesh and vegetation e.g. human beings. Their dentition is not specialised for any kind of diet.

18. **Describe causes, signs and symptoms of gum disease and tooth decay**
    Tooth Decay
    Also called dental decay or dental caries, this is a condition where the enamel of teeth is dissolved (corroded) by organic acids produced by fermentation of sugars by bacteria in the mouth forming cavities in the teeth. When cavity reaches the dentine, the tooth starts getting painful. The pain increases further when the cavity reaches the pulp cavity. At this stage, the tooth pains each time the patient takes very hot

or very cold foods, becomes infected and may even start having a bad smell due to accumulation of abscess (pus). The condition may be treated by filling the tooth in with cement or having a tooth extraction.

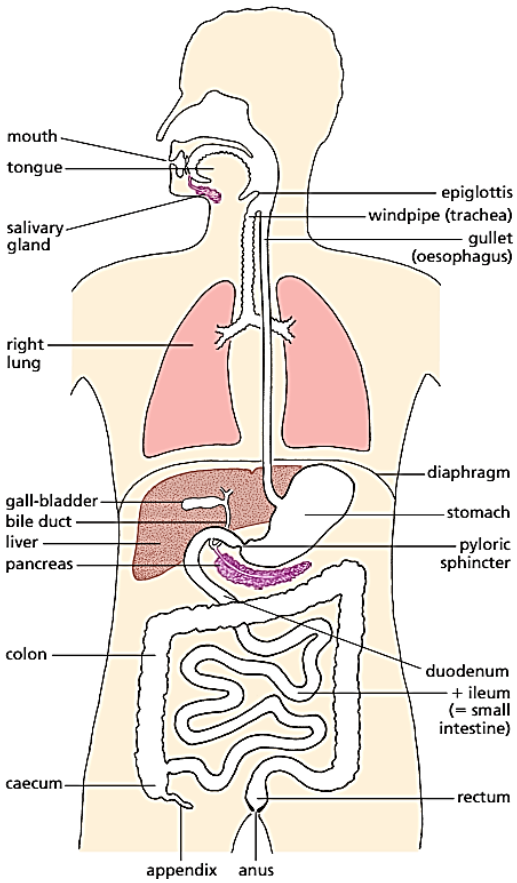
Prevention of Tooth Decay

- Brushing teeth with fluoride toothpaste after every meal
- Avoiding intake of sugary foods
- Regular visits to the dentist i.e. at least twice every year (once every six months)
- Taking foods that are rich in calcium, phosphorus and vitamins C and D
- Using dental floss to remove food particles from teeth
- Using teeth properly by avoiding using them for opening bottle tops and the like as this may crack the enamel.

19. **State the main processes in holozoic nutrition.**

in a specialized tube called the alimentary canal or digestive system and involves five stages namely ingestion, digestion, absorption, assimilation and egestion.
Ingestion is the intake of food into the mouth.
Digestion is the breaking down of food. There are two types of digestion, namely *physical digestion* and *chemical digestion*
Mechanical digestion is the breakdown of food into smaller pieces without chemical change to the food molecules.
Chemical digestion is the breakdown of large insoluble molecules into small soluble molecules.
Absorption is the movement of small food molecules and ions through the wall of the intestine into the blood.
Assimilation the movement of digested food molecules into the cells of the body where they are used, becoming part of the cells.
Egestion is the removal of undigested food from the body through the anus**.**

20. **Identify the main regions of the alimentary canal and associated organs.**



21. Describe the processes of digestion, absorption and assimilation of nutrients.

Digestion of Carbohydrates, Lipids and Proteins

Digestion of food substances occurs in the mouth, stomach, duodenum and jejunum.

Digestion in the Mouth

The following events occur after food has been ingested into the mouth:

(i) Chewing: Also called mastication, this is the break down of *large pieces of food* into smaller ones by teeth. It increases the surface area of the food for more efficient enzyme activity and makes food easy to swallow.

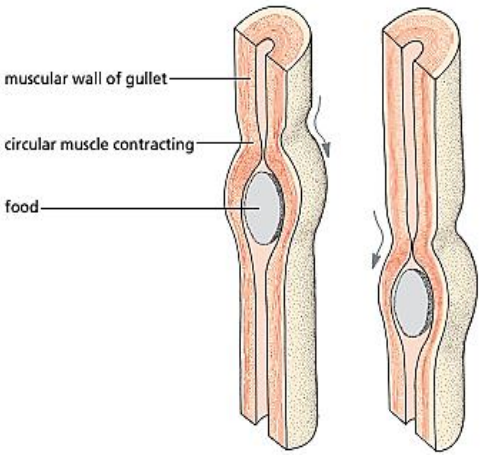
(ii) Secretion of Saliva: This is carried out by salivary glands. Saliva is a mixture of water, mucus, the enzymes salivary amylase and lysozyme in a slightly alkaline medium. The water helps in cooling food that is too hot and warming up food that is too cold so that its temperature is favourable for enzyme action. It also softens food for easy chewing e.g. it is easier to chew biscuits after they have been moistened by saliva. The mucus lubricates food for easier swallowing. The slightly alkaline pH is favourable or optimum for the activity of salivary amylase. Salivary amylase starts the digestion of cooked starch to produce maltose. However, only small amounts of starch are converted to maltose in the mouth because food stays for a short time in the mouth. Amylase does not work in the stomach because the pH there is acidic.

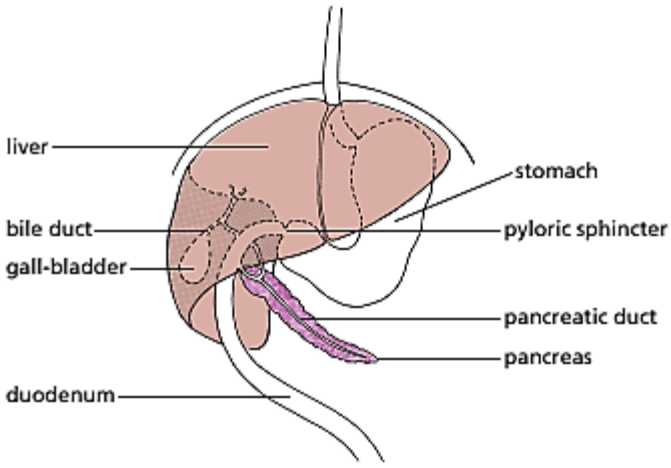
(iii) Mixing Food with Saliva and formation of Bolus

While food is being chewed, the tongue mixes it with saliva. Later, the tongue works with the palate (top of the mouth) to roll the chewed food up into a round semi solid mass called abolus, in readiness for swallowing.

Swallowing and Peristalsis

Swallowing is the passage of food or liquids from the mouth to the stomach through the oesophagus. During swallowing, the food bolus moves by a process known as peristalsis. Peristalsis is the alternate contraction and relaxation of circular and longitudinal muscles in a wave-like manner in order to move food along the alimentary canal. Peristalsis is illustrated in the following diagram:





Behind the bolus, circular muscles contract while longitudinal muscles relax. Ahead of the bolus, circular muscles relax while longitudinal muscles contract.

Digestion in the Stomach

The stomach is an elastic bag with a muscular wall and a glandular lining. The entrance of the stomach is guarded by the cardiac sphincter. The exit is guarded by the pyloric sphincter. The following events take place in the stomach;

Secretion of gastric juice: Gastric juice is a mixture of pepsin, rennin, hydrochloric acid and mucus. Pepsin breaks down proteins to form peptides. Rennin coagulates milk by converting the soluble protein caesinogen into an insoluble form called casein. This delays the passage of milk to the duodenum giving chance for pepsin to digest milk protein. Both pepsin and rennin are secreted in inactive forms called pepsinogen and prorennin, respectively. Hydrochloric acid activates them into active enzymes and sets an acidic pH which is optimum. It also kills some bacteria and hydrolyses sucrose to glucose and fructose. Mucus protects the lining of the stomach against the acid and pepsin.

Churning: This is the mixing of food by rhythmic contraction of the muscles in the wall of the stomach to form a paste called **chyme**.

Temporal Storage of Food: Liquids can stay in the stomach for up to 30 minutes; carbohydrates are kept for about one hour; proteins and lipids stay up to 2 hours.

Digestion in the Duodenum

The duodenum receives digestive juices from the liver and the pancreas. The liver secretes bile which is temporarily stored in the gall bladder and carried to the duodenum by the bile duct. Bile contains sodium hydrogen carbonate, bile salts and bile pigments. Sodium hydrogen carbonate neutralizes the acidic chyme and then sets an optimum alkaline pH for the enzymes of the duodenum. The bile salts emulsify fats thereby increasing the surface area for the action of lipase. Emulsification is the break down of large drops of fats into small droplets. Bile pigments have no digestive function but add colour to the faeces.

The pancreas secretes pancreatic juice which contains sodium hydrogen carbonate, trypsin, lipase and pancreatic amylase. Sodium hydrogen carbonate neutralizes the acidic chyme and then sets an optimum alkaline pH for the enzymes of the duodenum. Trypsin breaks down proteins to form peptides. Lipase breaks down fat molecules to fatty acid and glycerol. Pancreatic amylase breaks down starch to form maltose.

Digestion in the Jejunum

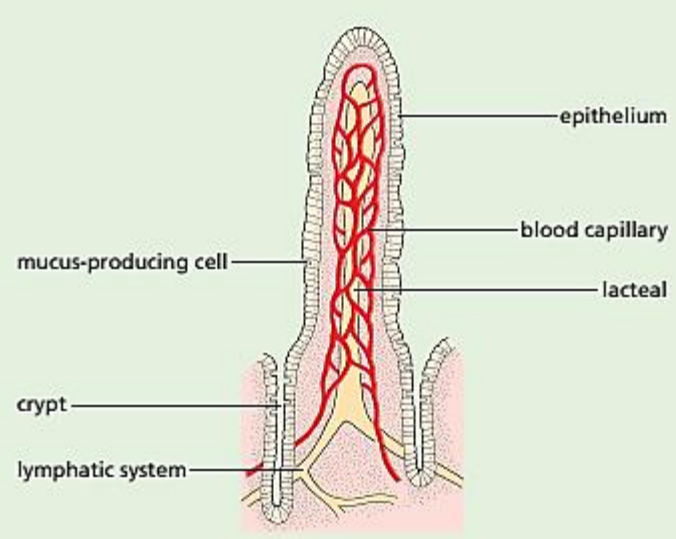
This secretes Intestinal Juice (succusentericus) which contains Lactase, maltase, sucrase and peptidase. Lactase breaks down lactose to glucose and galactose. Maltase breaks down maltose to glucose. Sucrase breaks down sucrose to glucose and fructose. Peptidase breaks down peptides to amino acids. Digestion is completed in the jejunum.

The ileum and Absorption

The ileum carries out absorption of digestive end products and is adapted for this function in the following ways:

- The ileum is very long thereby providing a large surface area for absorption.
- It has a thin epithelium for more efficient diffusion of food.
- It has finger like projections called villi (singular: villus) and microvilli which further increase the surface area for absorption.
- Each villus has a network of capillaries for absorption and transportation of monosaccharides and amino acids
- Each villus has a lacteal which absorbs and transports fatty acids and glycerol.

Diagram of a Villus



Assimilation of Digestive end Products
After absorption, the digestive end products are transported in the blood to the liver by the hepatic portal vein. The food is then assimilated as follows
a) Assimilation of Monosaccharides (Glucose, Fructose and Galactose)
Glucose is mainly used as a substrate for tissue (cellular) respiration. If it is in excess, the excess is converted to glycogen which is stored in the muscles and the liver. However the human body stores limited amounts of glycogen i.e. about 400g (300g in the muscles and 100g in the liver). If there is still some excess glucose, it is converted to fat and stored in the adipose tissue under the skin and around delicate body organs such as the brain, heart, liver, kidneys and intestine. These processes are influenced by a hormone called insulin which is secreted by the pancreas. Fructose and galactose are assimilated in the same way as glucose.

b) Assimilation of Amino Acids

Amino acids are assembled to make the proteins required by the body. Excess amino acids are deaminated by the liver. Deamination is the process by which the amino group of an amino acid is removed and eventually converted to urea by the liver. Ammonia is an intermediate during deamination and is highly toxic. It is quickly converted to urea which less toxic. The remaining part of the amino acid known as the carbon- skeleton may be converted to glucose by a process called gluconeogenesis. Urea is toxic if allowed to accumulate in the body. It is carried from the liver by blood and is removed from the body by the kidneys by the process of excretion.

c) **Assimilation of Glycerol and Fatty Acids**

Glycerol and fatty acids are chemically combined to make fats which have the following uses in the body:

- Insulation- animals have a layer of fat under their skins which prevents heat loss from the body
- Formation of cell membrane- the cell membrane is made of lipids called phospholipids which can be synthesized from fats and oils
- Energy source-lipids store a lot of energy which is made available when the supply of carbohydrates in the body is low. In fact lipids store twice as much energy as an equal amount of carbohydrates.

Excess fats are stored in the adipose tissue under the skin and around delicate body organs such as the brain, heart, liver, kidneys and intestine. The fat under the skin is responsible for insulation while the fat around delicate organs cushions the organs against shocks.

8. Investigate the common ailments of the alimentary canal.

Diarrhoea: The passage of watery stool, resulting in dehydration and loss of mineral ions from the body. It is caused by intake of food or drinks that are contaminated with pathogens. The pathogens cause inflammation of the intestinal lining leading to diarrhoea.

Constipation: Difficult defaecation due to hardness and dryness of faeces, resulting from insufficient roughage and water in diet. It may also result from keeping the faeces in the rectum for too long which causes the rectum to absorb too much water, making the faeces hard and dry.
Stomach Ulcers: An ulcer is defined as an open sore that produces toxic matter. Stomach ulcers may result from over-production of pepsin and hydrochloric acid or when the mucus layer in the stomach is not sufficiently thin. This causes the lining of the stomach to be destroyed by the action of pepsin or hydrochloric acid.
Piles (haemorrhoids): This is a condition where the veins in the rectum become swollen and eventually burst causing pain and blood-stained stool. It may be caused by frequent constipation.

9. Describe the metabolic functions of the liver.

The liver is the largest *internalorgan* in the human body and performs a wide range of functions including the following:

- Destruction of old red blood cells resulting in formation of bile which is important in emulsification of fats.
- Deamination of excess amino acids resulting in formation of urea.
- Detoxification of poisons and alcohol by converting them to less toxic substances e.g. hydrogen peroxide is broken down to water and oxygen by the enzyme catalase in the liver. Excess intake of alcohol frequently can lead to a condition called cirrhosis (hardening liver tissue, leading to loss of function)
- Conversion of excess glucose to glycogen and storage of glycogen, thereby regulating the levels of blood sugar.
- Manufacture of red blood cells in babies
- Transamination (the conversion some amino acids to others)
- Synthesis of plasma proteins such as prothrombin, fibrinogen, globulins and albumin.
- Storage of some vitamins (e.g. vitamin A) and some mineral ions (e.g. iron)
- Production of heat through a wide range of exothermic/exergonic reactions.

10. Describe the effects of common ailments of the liver.

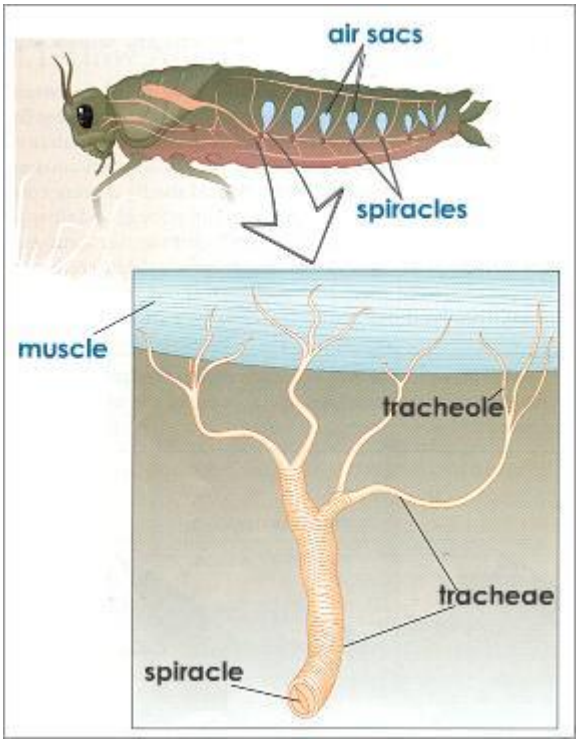
- Hepatitis: Inflammation of the liver which may result from infection hepatitis viruses.
- Hepatomegaly: Enlargement of the liver.
- Cirrhosis: Hardening of liver tissue resulting from poisoning or excessive intake of alcohol.

RESPIRATORY SYSTEM

1 Describe the respiratory organs of animals.

(a) Respiratory organs of an insect

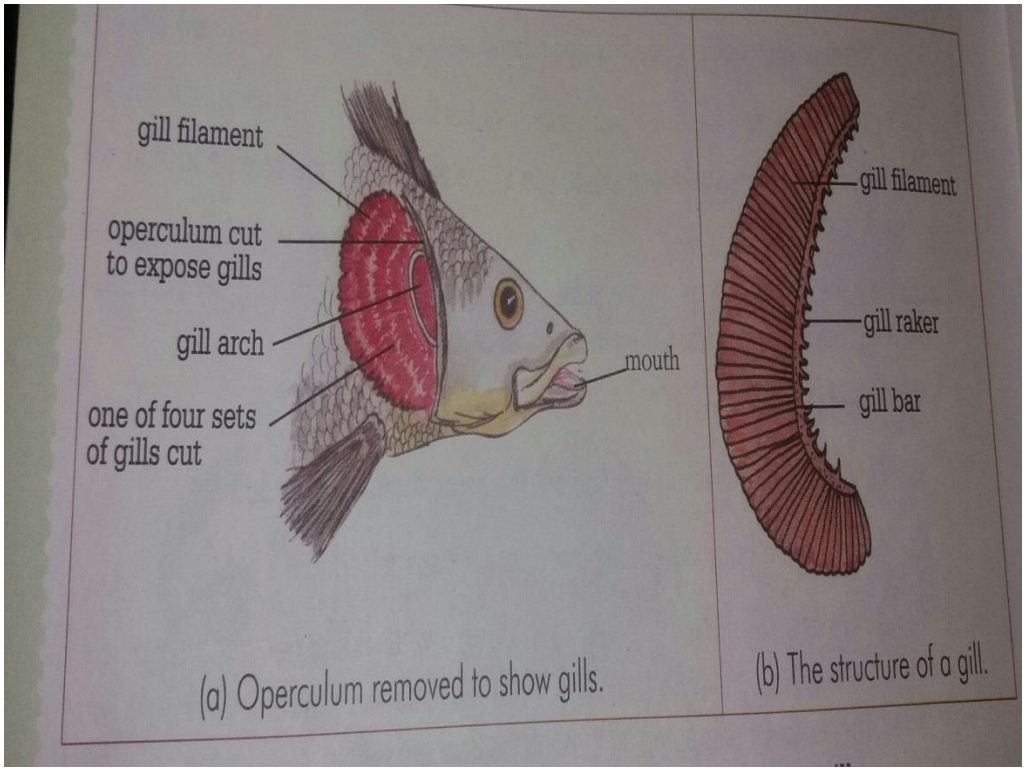
Insects carry out gaseous exchange through a network of air tubes called tracheal system which penetrate all over the body. The system consists of a pair of spiracles on the surface of each abdominal segments and in between the thoracic segments and a network of tubes all over the body .Each spiracle has muscular control valve to regulate its opening. The spiracles lead to a large network of air tubes called trachea. The tubes are kept open by spiral folds of chitin. The trachea finally divide into very fine branches called tracheoles which are closely connected with respiring tissues .The tracheoles contain a fluid to dissolve the gases.



Tracheal system of an insect

(b) Respiratory organ of a fish

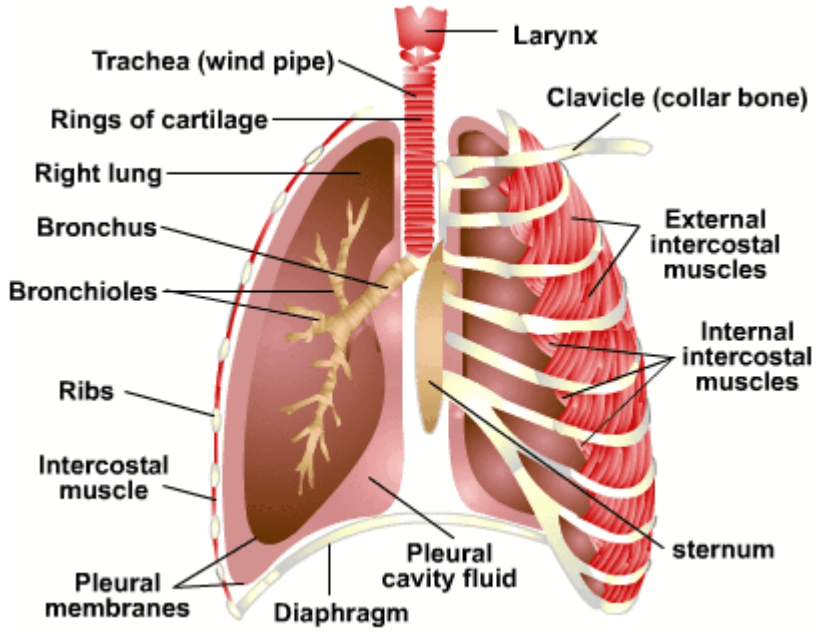
Fish carry out gaseous exchange through specialized structures called gills. The gills consists of a long curved bone called the gill bar and a double row of filaments attached to the bar. Each filament has numerous vertical plates called lamellae which contains a network of capillaries. The gills also have structures called gill rakers. Gill rakers trap solid particles and prevent them from reaching the delicate gill filaments .On the outside, the gill is protected by a bony plate called operculum .The operculum also controls in and out movement of water.



Structure of gills

(c) Respiratory organs of man

The organ for gaseous exchange in man is the lung located in the chest cavity. Hence the need for a breathing system in man. It is made up of the nostrils which leads to a mucus and cilia lined nasal cavity. The nasal cavity in turn leads to the larynx and then to the trachea. The epiglottis located at the junction of the trachea and the larynx closes the tracheal opening when swallowing .Incomplete rings of cartilage keep the trachea open .Inside the chest cavity, the trachea divide into two branches referred to as bronchi. Inside the lungs the bronchi divide into fine air bags called air sacs. Each air sac is folded like pockets called alveolus. The lungs are enclosed by a double membrane called the pleural membrane. Enclosed between the membranes is a fluid called pleural fluid whose function is to cushion the lungs against friction and shock. The chest cavity is supported by the ribs which articulate with the thoracic vertebrae at the back and the sternum at the front .At the floor of the cavity is a dome shaped muscular sheet called the diaphragm. The inside of the ribs are covered by internal intercostal muscles while the outside is covered by external intercostal muscles. The muscles contract antagonistically to cause movement of the ribs.



Breathing system in man

2 Describe the mechanism of gaseous exchange in animals

(a) Mechanism of gaseous exchange in an insect

When the spiracle valve opens, air rich in oxygen is drawn inside due to the expansion of the abdomen. At the tissues, oxygen diffuses from tracheole

Fluid into tissues and carbon dioxide diffuses from the tissues into the tracheole fluid. Compression of the abdomen forces air out of the tracheole system.

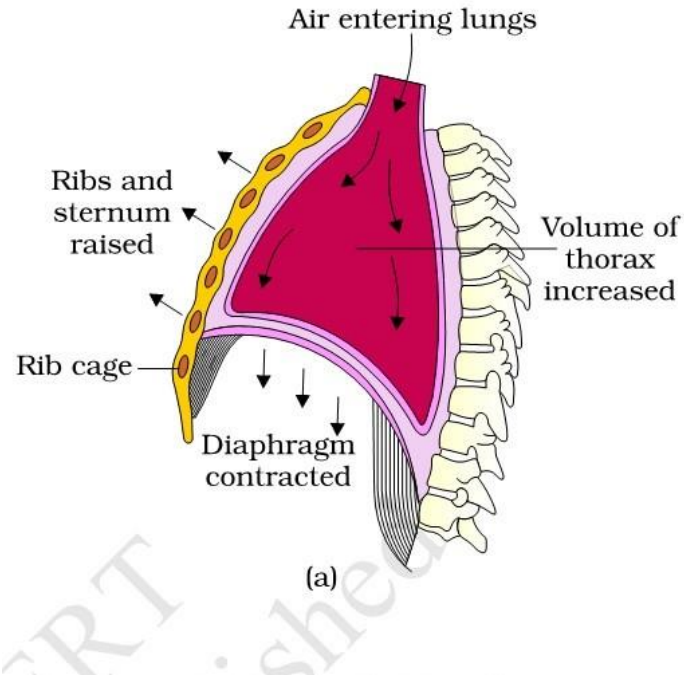
(b)Mechanism of gaseous exchange in the fish

The exchange of gases in the gills exhibit counter flow system. In such a system, two fluids flow in opposite directions. In fish, blood and water flow in opposite directions. During inspiration the floor of the mouth lowers, the gill chambers expand laterally, pressure falls. The operculum valves close, the mouth opens and water enters and flows to the gill chambers. Exchange of gases takes place. The floor of the mouth raise, pressure increases, operculum valves opens, the mouth closes and water flows out.

(c)Gaseous exchange in man

Inspiration or inhalation

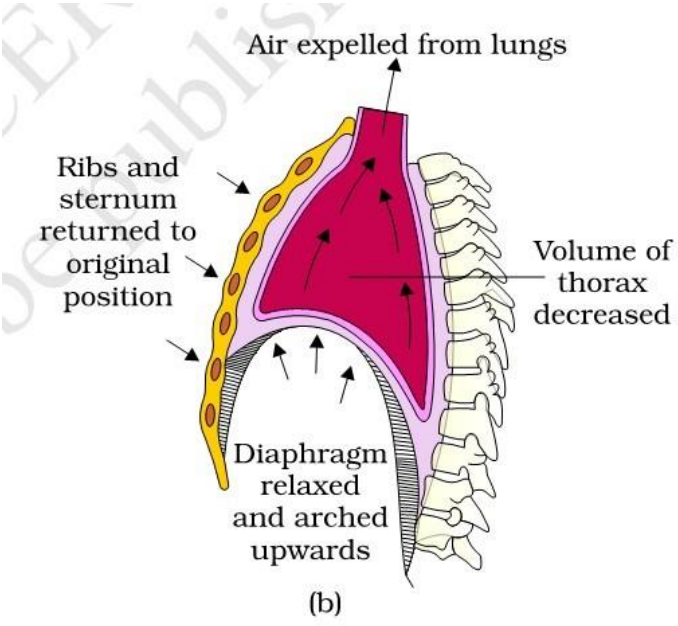
In inspiration, external intercostal muscles contract, internal intercostal muscles relax, the ribs are pulled upwards and outwards, the diaphragm muscles contract, pulling the diaphragm down thus causing it to flatten. The volume of the chest cavity increases and pressure reduces .Air is then forced in to the lungs from the outside .Exchange of gases takes place along a diffusion gradient i.e. oxygen diffuses into the blood and carbon dioxide out of the blood capillaries into the alveolus.



Inspiration

Expiration or inhalation

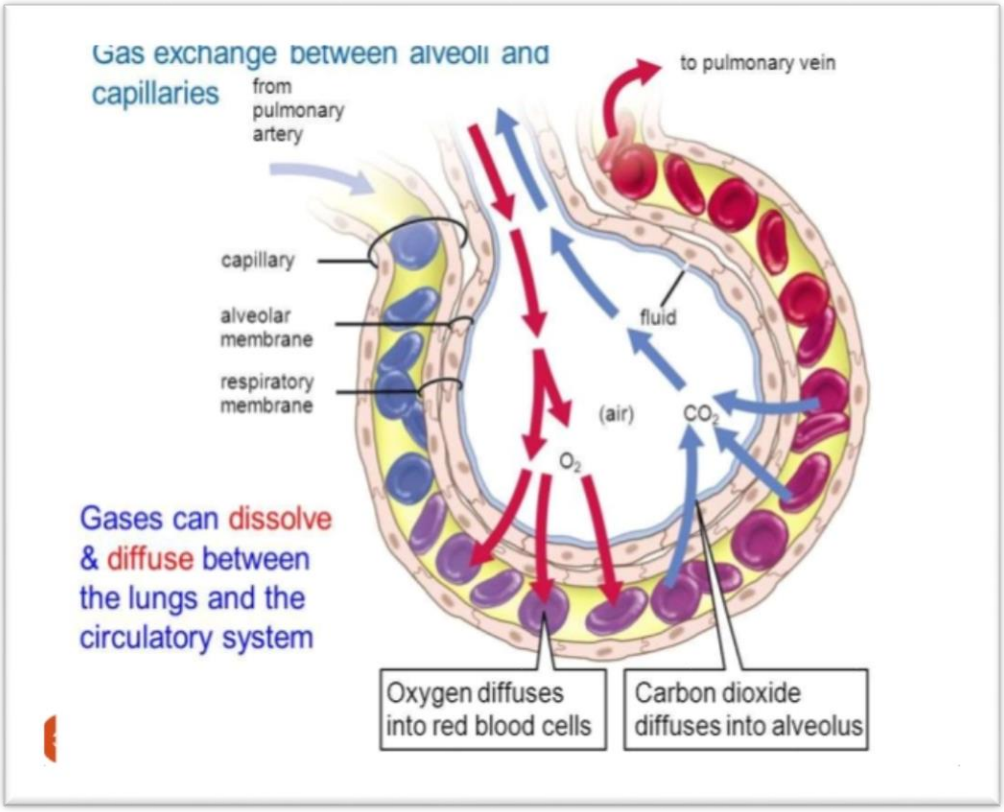
During expiration the external intercostal muscles relax, the internal intercostal muscles contract while the ribs are pulled downwards and inwards. The diaphragm muscles relax and assume a dome shape. The volume of the chest cavity decreases and pressure is increased. The air is forced out of the lungs through the air passages and into the atmosphere.



Expiration

Exchange of gases in the alveolus

In the lungs exchange take place between the blood in the capillaries and air contained in the alveoli. The blood capillaries and the alveolus are made of one cell thick wall and are in intimate contact. The inner wall of the alveolus is lined with a thin film of moisture.



MECHANISM OF GASEOUS EXCHANGE IN THE ALVEOLUS

Blood richer in carbon dioxide and with low concentration of oxygen enters through the afferent vessel (pulmonary artery).Carbon dioxide diffuses across the capillary and alveolus wall due to high partial pressure in blood and then dissolves in the film of moisture which lines the alveolus. Once inside the alveolus space, the CO_2 is released out through the ventilation system. Oxygen on the other hand diffuses into the blood from the alveolus where it is at a higher concentration due to high partial pressure. Once inside the blood capillary, the oxygen combines with haemoglobin for transport.

3 Describe the composition of inspired and expired air.

Gases	Inspired air	Expired air
Oxygen	21%	16%

Carbon dioxide	0.003%	4%
Nitrogen	78%	78%
Water vapour	variable	Saturated
Other gases	Traces	Saturated

4 Describe the effects of air pollutants on health of human beings

Cigarette smoke (nicotine and tar)

The short- term effect of smoking cause the bronchiole to constrict and the cilia lining the air passage to stop beating. The smoke also makes the lining to produce more mucus. Nicotine the addictive component of tobacco smoke, produces an increase in the rate of the heart beat and a rise in blood pressure.

The short term effect of smoking may take many years to develop but they are severe ,disabling and often lethal. They include

Lung cancer-carcinogen causes un controlled cell division leading to lung cancer.

Emphysema-the weakening and breakdown of the walls of the alveoli. The irritant substance(tar) in the smoke cause a smoker cough and the coughing bursts some of the weakened alveoli .In time, the absorbing surface of the lungs is greatly reduced. Then the smoker cannot oxygenate his or her blood properly and the least exertion makes a person breathless.

Sulphur dioxide

Sulphur increases respiratory infection rates and irritates eyes and respiratory tract.

Carbon monoxide

Oxygen combines with hemoglobin to form oxyhemoglobin in red blood cells. Carbon monoxide (C0) reduces the oxyhemoglobin formation because it binds very tightly to hemoglobin ,and the effect is permanent since carboxyhemoglobin is very stable. This reduces aerobic respiration and transportation of oxygen.

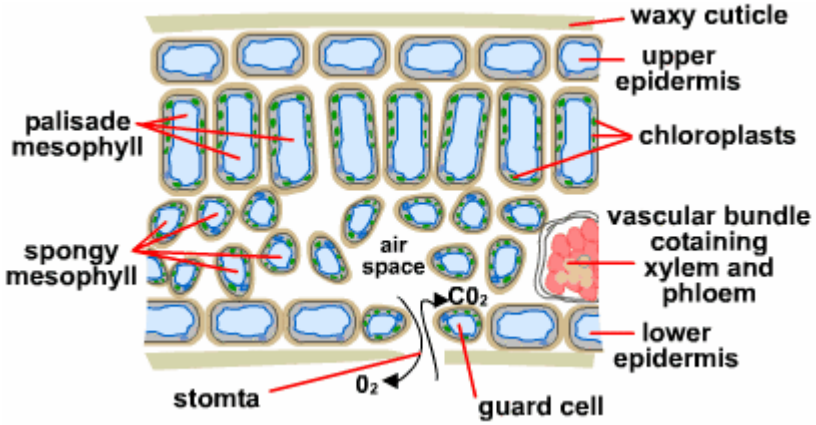
5 Explain gaseous exchange in green plants

Gaseous exchange in plants may take place through the leaf, stem or roots. This happens by diffusion of gases through the openings found on the mentioned parts

(a) Gaseous exchange through the leaves.

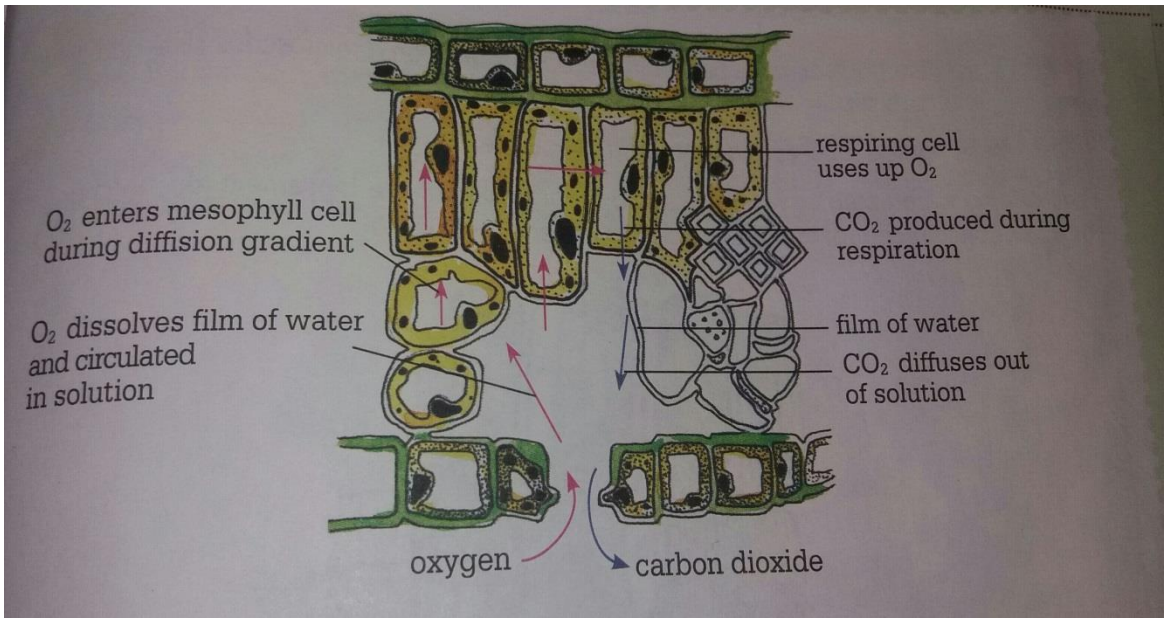
During the day

Photosynthesis takes place. Carbon dioxide diffuses into the leaf while oxygen diffuses out of the leaf. This makes carbon dioxide to be at low concentration in the air spaces around the cells. Carbon dioxide diffuses into the leaf through the stomata where it is at a low concentration. It then diffuses into the moist spongy mesophyll and into the adjacent cells. Since the rate of photosynthesis is higher than the rate of respiration, more oxygen is produced than can be used in respiration so the rest of the free oxygen diffuses out into the atmosphere.



During the night

No photosynthesis occur, only respiration takes place which uses oxygen and produces carbon dioxide. Therefore, oxygen is in low concentration in the cells and carbon dioxide is in high concentration. This causes oxygen to diffuse from the atmosphere where it is in higher concentration into the spongy mesophyll where it is at low concentration. In turn, carbon dioxide diffuses from the spongy mesophyll where it is at high concentration to a lower concentration in the atmosphere.



(b) Gaseous exchange through the stem.

Gaseous exchange in stems take place through the lenticels .Lenticels are tiny openings on the barks within stems of plants through which gaseous exchange takes occurs. Due to the difference in concentration gradient, gases diffuse in and out of the stem through the lenticels.

(c) Gaseous exchange through the roots.

Plant roots exchange gases dissolved within their surroundings. Water plants use oxygen dissolved in the water. Carbon dioxide is released to the surrounding .Terrestrial plants exchange gases from both air dissolved in soil and in air spaces.

Describe types of respiration

Respiration is the release of energy from food in cells of living organisms.

Types of tissue respiration

Aerobic respiration

This is a form of tissue respiration that involves utilization of oxygen. The food substance mainly glucose is broken down into carbon dioxide water releasing energy in the process. Therefore, aerobic respiration is the oxidation of glucose to release energy.

Word equation

Glucose + oxygen →carbon dioxide +water + energy

Chemical equation

$C_6H_{12}O_6 + 6\ O_2 \rightarrow 6\ CO_2 + 6\ H_2O$ + Energy

Anaerobic respiration

This is a form of tissue respiration wereby oxygen is not utilized.

Anaerobic respiration in plant is referred to as fermentation. It also occurs in yeast and some bacteria. The process can be summarized as

$C_6H_{12}O_6 \rightarrow 2C_2H_5\ 0H + 2C0_2$ + Energy

Glucose Ethanol Carbon dioxide

In animals, glucose is converted to lactic acid and energy is produced. The overall reaction in anaerobic respiration in animals can be summarized as:

$C_6H_{12}O_6 \rightarrow 2C_3\ H_6\ 0_3$ + Energy

Glucose Lactic acid

Differences between aerobic and anaerobic respiration

Aerobic respiration	Anaerobic respiration
1.More energy is produced per glucose Molecule (i.e. 32 ATP)	1.Little glucose produced per glucose molecule (only 2ATP)

2.Glucose is completely oxidized to all energy	2.Glucose is only partially broken down and most of the energy remains locked up in ethanol or lactic acid.
3.Oxygen is used	3.Oygen is not used
4.Water is produced	4.Water is not produced
5.Is carried out in the mitochondria	Is carried out in the cytoplasm
6 .In animals, lactic acid and ATP are produced. CO_2 is not produced.	6. In plants, CO_2 ethanol and energy is produced.

Describe the production of adenosine triphosphate

The energy released from the breakdown of glucose is used to synthesise molecules called ATP (Adenosine Triphosphate) by adding inorganic phosphate (P) to ADP (Adenosine diphosphate) as shown in the equation below

Chemical equation

$$ADP + P \xrightarrow{Energy} ATP$$

Word equation

Adenosine diphosphate + inorganic phosphate →Adenosine triphosphate

Importance of ATP

-it is an Instant source of energy to the cells.

-it is the storage form of energy in cells.

Investigate the production of carbon dioxide during respiration

State ways in which respiration is important

-Muscle contraction, e.g, laughing, walking, eating, blinking and playing.

-Active transport of substances across the plasma membranes.

-Transmission of nerve impulses, e.g, hearing, seeing and feeling

-Cell division, e.g, new cells used for growth and repair of worn out tissues.

-Synthesis and secretion of substances such as enzymes, hormones, etc

-provision of heat to the body: optimum temperature is important for enzymes that control activities in the cell.

Explain the industrial application of respiration

Brewing industry- for example in the production of alcohol where glucose is broken down anaerobically by yeast to produce ethanol. The resulting ethanol can further be processed into beer by addition of hops which acts as stabilisers. Spirits are produced by distillation of the ethanol water mixture.

Bread baking industry-The glucose in wheat flour is broken down by yeast is broken into ethanol, a little energy and carbon dioxide. Carbon dioxide gas makes the dough to rise as it leaves the mixture, making the bread to become spongy.

Production of fermented milk products- fermentation of milk leads to formation of products like yoghurt , cheese and butter.

Sewage treatment- Sewage from commercial and domestic use is piped to sewage treatment plant. When sewage reaches the treatment plant it is rich in organic matter. During the secondary stage of treatment, sewage is treated by aerobic and anaerobic micro –organisms .This removes organic wastes and harmful substances

Production of sour milk through fermentation of fresh milk under anaerobic respiration.

Production of fermented porridge by fermentation of maize flour under anaerobic respiration.

Production of compost manure.

HEALTH

1. **Describe what good health is?**
   Good health is the physical, mental and social well-being .It is dependent on receiving a balanced diet and an appropriate physical and mental activity.
2. **Define disease.**
   Disease is the loss of health resulting from disturbances of the normal processes of the body.
3. **Describe the various types of diseases.**
   Deficiency diseases-these are diseases caused by lack of nutrients in the diet e.g. kwashiorkor due to lack of proteins, goitre due to lack of iodine and marasmus due to lack of carbohydrates in the diet.
   Genetic diseases-these are diseases that are caused by changes in the gene or DNA structure. Genetic diseases can be inherited from parent to offspring e.g. sickle cell anemia and downs syndrome
   Pathogenic diseases-these are diseases that are caused by pathogens such as bacteria ,virus, protozoa and fungi .The pathogens enter and reproduce inside the host and attack the human body immune system causing different diseases e.g. polio, malaria ,yellow fever, cholera tuberculosis etc.
   Social diseases-these are diseases transmitted through sexual contact, either through vaginal or oral intercourse .They are also known as venereal or sexually transmitted diseases .Social diseases are wholly dependent on behavioral patterns such as gonorrhea, syphilis and HIV and AIDS.
   Mental illness-mental illness is a disease of the mind. It is characterized by emotions and behavior that is not considered normal in the person's culture .A mental disorder is a combination of how a person feels or acts.
   Ageing and Degenerative diseases-these are diseases that affects the structure or function of tissues or organs. These increasingly deteriorate over time.
4. **Describe causative agents, signs and symptoms, methods of transmission and control.**

Disease	Causative agent	Signs and symptoms	Method of transmission	Control
Cholera	Bacterium of the strain vibrio cholerae	.severe diarrhoea .abdominal pain .vomiting .Dehydration .intestinal rupture hence irritations of the intestines	.Through ingestion of contaminated food and water. .Through vectors such as houseflies .Handling of contaminated material.	.Use of clean drinking water. .proper sewage disposal. .Washing hands after using toilets. .Covering foods so that flies do not contaminate it. .Isolation of infected people.
Malaria	Protozoa plasmodium	.High fever and shaking chills due to rupture of red blood cells. .Sweating .Headache	Bite by an infected female anopheles mosquito	.Vector control by draining stagnant waters .Spraying breeding sites using insecticides

		.aches and pains in joints .Anaemia .Enlarged liver and spleen		.Sleeping under insecticide treated mosquito nets .cut down vegetation around homes to destroy Breeding places of mosquito. .Spraying exposed Water surfaces with oil to destroy mosquito larvae .use of mosquito coils and repellents .Using fish to eat mosquito larvae .fumigation of rooms .Fixing of wire mesh screens on windows and ventilators
Bilharzia (schistosemiasis)	Flat worm (schistosoma mansoni)	.Blood in urine .pain in lower abdomen .Coughing, fever .Enlargement of spleen and liver .skin itching	.Exposure to cercaria larvae in water .Schistosoma eggs pass from patient into water and hatch into larvae .larvae bore into snail and produce other larvae .These bore into the skin of humans and become adults	.Avoid contact with infected water .Destroying snail habitat .Drain stagnant water .Using latrines .Drinking boiled water .Avoid urinating in or near water bodies.

5. **Describe ways of HIV transmission.**
   -transmission can occur through sexual intercourse in semen or vaginal secretions.
   -sharing needles during intravenous drug use
   -in hospitals when carrying out blood transfusion, in some cases the blood is infected with the virus or blood products that contained HIV, though this is much reduced now because of knowledge of transmission.
   -the HIV virus can be transmitted from the blood of an infected female to foetus during pregnancy or delivery (mother to child transmission).
   -organ transplants from an infected donor.
   -sharing toothbrushes, shaving blades or nail cutters with infected person.
6. **Explain the dangers of having multiple sexual partners.**
   -risk of contracting STI'S such as HIV
   -disintegration of families due to the death of parents.
   -unplanned pregnancies
7. **Describe ways of safe sexual practices.**
   -abstinence
   -consistent and correct use of condoms
   - VCT services
   -Be faithful to one partner

8. **Identify the causes of stigma to people living with HIV and AIDS.**
   -fear, myth, lack of support groups, lack of information on the available services.
9. **Describe ways of reducing discrimination to people living with HIV and AIDS.**
   -Giving them a well-balanced diet.
   -giving medical treatment as soon as they develop signs and symptoms of illness
   -providing them with ARVs which help to slow down the advancement of the condition.
   -loving them and responding to their needs
   .-counselling them to stop behavior that could worsen their conditions
   -not discriminating them. Avoid branding them as walking corpses, denying them education and health services, chasing them away from home, hiding them from public and refusing to share rooms or utensils with them.
10. **Explain the term of immunity to disease.**
    Immunity is the ability to resist attack by disease causing microorganisms. Immunity can either be active or passive. Active immunity is whereby the body of an animal is induced to produce its own antibodies. Passive immunity involves introduction of already prepared antibodies to the body of the animal in order to make it immune from a particular disease.
11. **Investigate the importance of the immune system.**
    It builds the body's defence against infections and diseases making the body to remain healthy. It recognize foreign substances (antigens) that enter the body. The immune system of the body, in response to the antigens produce antibodies. Antibodies fight and destroy the antigens. Antigens are chemicals produced by pathogens.
12. **Describe the factors that reduce immunity to pathogenic diseases**
    The immune system is reduced by poor diet, repeated invasions by pathogens and the development of resistant strains of the pathogens.
13. **Explain the importance of immunization.**
    -immunization protects children (and adults) against harmful infections before they come into contact with them in the community.
    -immunization uses the body's natural defence mechanism the immune response to build resistance to specific infections. Disease like measles, mumps, tetanus, polio, hepatitis B etc can be prevented by routine childhood immunization.
    -immunizations helps children to stay healthy by preventing serious infections.
    -immunization is the safest and most effective way of giving protection against the disease. After immunization, your child is far less likely to catch the disease if there are cases in the community, the benefit of protection against the disease far outweighs the very small risks of immunizations.
    -if enough people in the community are immunized, the infections can no longer be spread from person to person and the disease dies out altogether.
14. **Describe the life cycle of a housefly.**
    The life cycle of a housefly starts with the female laying eggs. The eggs develop into larvae, then pupa. Lastly the adult emerges.
15. **Explain the role of the housefly in the spreading of diseases.** Houseflies spread disease because pathogens cling to their hairy legs. Their saliva also contains pathogens. Houseflies feed themselves by spreading saliva over food to dissolve it then sucking it up. Diseases like cholera, typhoid and dysentery are spread in this way.
16. **Relate the control of water borne diseases to the life cycle of the house fly.** Improving hygiene by providing sanitation such as toilets, washing and bathing facilities. Disinfecting water to ensure that supply of drinking water is safe. Hygienic food preparation and delivery.
17. **Describe the life cycle of a mosquito.** Mosquitoes lay eggs on the surface of water. Eggs hatch into larvae after 48 hours. Larvae live in water. They shed their skin four times growing larger after each molting. Larvae commonly called wrigglers, feed on small microorganisms in the water. On the fourth molt, a larva changes into pupa. The pupal stage is a non-feeding stage. During this stage the mosquito turns into an adult.
18. **Explain the role of mosquitoes in the spreading of diseases**. Malaria is transmitted by the female anopheles mosquito. During a mosquito bite, the mosquito releases the anticoagulant into the victim's blood system to prevent the sucked blood from clotting. In the process, it

injects the plasmodium parasite present within its salivary glands into the victim's body. The person therefore becomes infected.

19. **Relate the control of malaria to the life cycle of the mosquito**
    Malaria can be controlled chemically by targeting the pupa and larvae in the water with insecticides and oil on the water or biologically by introducing fish and parasites that eat the pupa and larvae. Draining grounds and filling ponds can eliminate larvae by reducing the number of adult mosquitoes able to transmit the disease .Cut down vegetation around homes to destroy breeding places of mosquitoes.

GRADE 11: SECTION

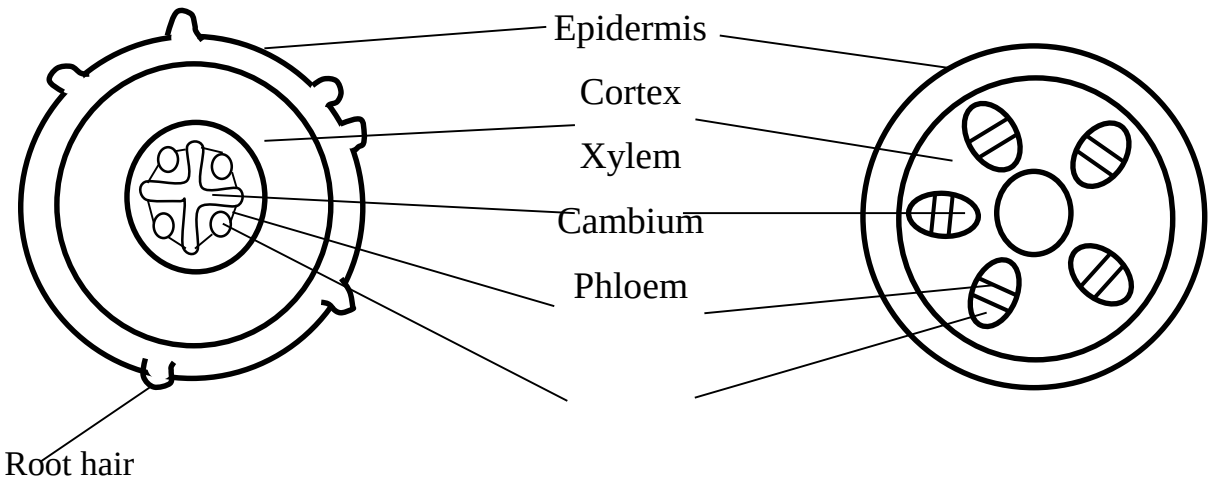
TRANSPORT AND STORAGE IN PLANTS

1. **Describe the external and internal structure of roots and stems.**

External structure of the root

The apical meristem located next to the root cap consists of undifferentiated cells which are continually dividing to give rise to new cells. The root cap protects the meristem from mechanical damage as the root penetrates through the soil particles.

Internal structure of the dicot root and a cross section of a dicotyledonous stem

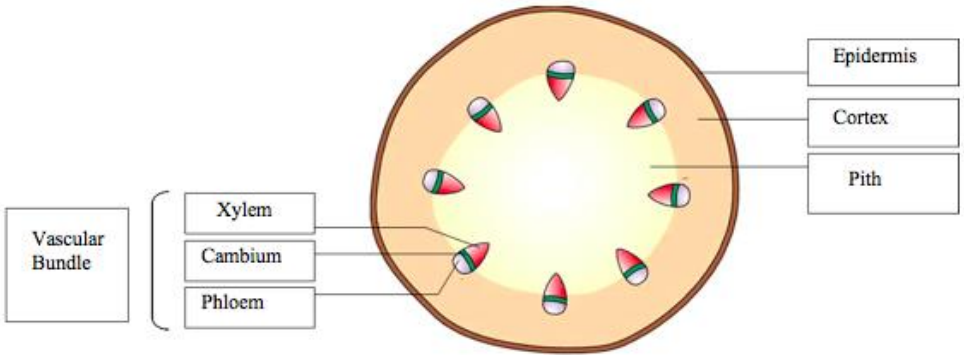


Cross section of a dicotyledonous root

Cross section of a dicotyledonous stem

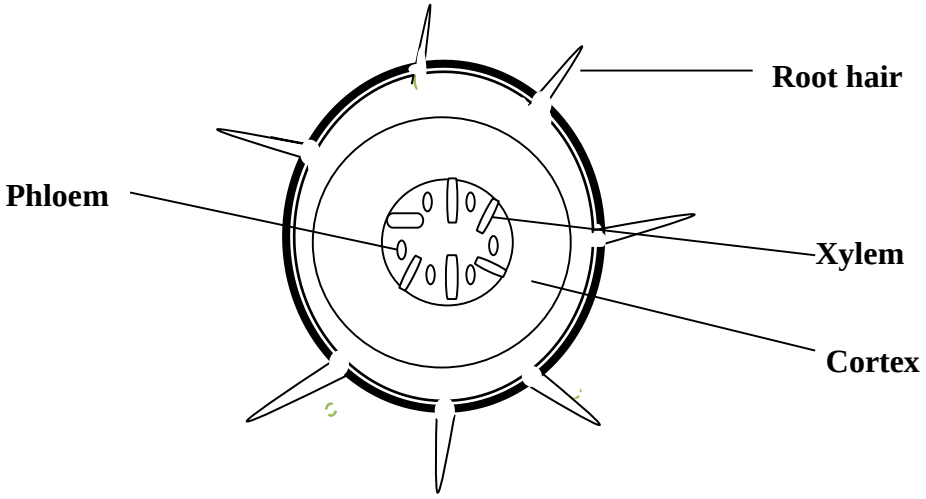
The internal structure of the root consists of the epidermis, root hairs, cortex, endodermis, pericycle and vascular bundles. The epidermis protects the stem. Root hairs absorb water and mineral salts. The cortex is made up of vascular bundles and cells that give the plant mechanical strength. The endodermis contains water Casparian strips that control water flow into the vascular tissue. The vascular bundles consist of the xylem and phloem. The xylem transports water and

mineral salts. The phloem transports manufactured food. The cambium is an actively dividing layer of cells.



Internal structure of monocot root

The epidermis on the outside of the root consists of a single layer of cells. Some of the epidermal cells have root hairs. The cortex forms the layer below the epidermis and is made up of thin-walled parenchyma cells. It contains water proof casparian strips that control water flow into the vascular tissue. The endodermis forms the innermost layer of the cortex. Xylem and phloem vessels are found in the central part of the root.



External structure of the stem

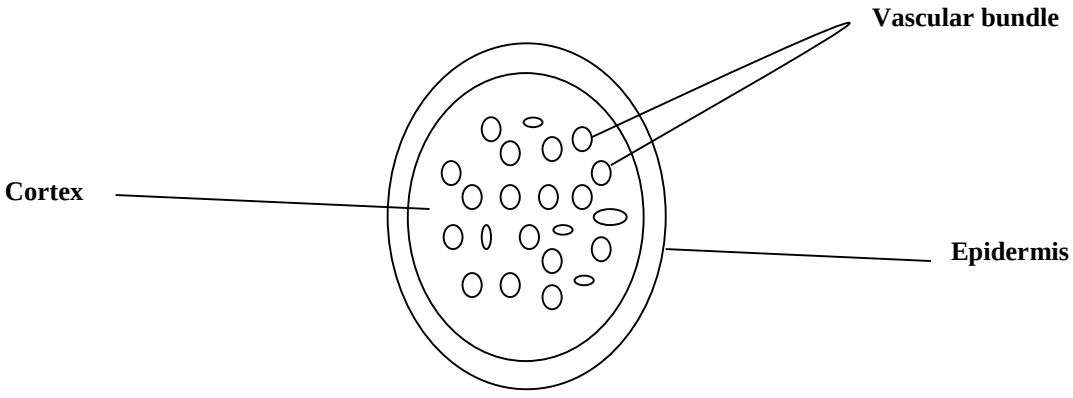
The apical bud consisting of meristematic cells is found at the tip of the stem. Leaves, branches, flowers, fruits and seeds are borne on the stem. The leaves receive sunlight to photosynthesize. Flowers get pollinated. The fruits are held on the stem in such a way that the ripe fruit and seeds can be scattered easily. The stem also stores food, transports water from the roots to the leaves, and transports carbohydrates to the roots and some stems.

Internal structure of the dicot stem

The epidermis is the outer layer of cells that covers the stem. The cortex is made up of collenchymas cells that provide support. The parenchyma cells in the cortex store food. The vascular tissue forms the ring around the pith. The vascular bundles consist of phloem and xylem tissue, separated by the vascular cambium. The xylem is inside while phloem is outside.

Internal structure of monocot stem

The epidermis is the outer layer of cells that covers the stem. The cortex is made up of collenchyma cells that provide support and parenchyma cells that store food. Vascular bundles are scattered throughout the cortex tissue. Each vascular bundle is oval in shape. Phloem tissue is located at one end of the oval, with xylem tissue making up the rest.



2. **Describe the absorption of water and the uptake of mineral salts by roots.**

The cell sap in the vacuole of root hair cells has a high concentration of dissolved mineral salts and sugars. The presence of these solutes makes the cell sap hypertonic to the water found between soil particles. Because of this concentration gradient, water molecules move from the soil through the selectively permeable membrane of root hair cells by osmosis.

Mineral salt are absorbed as mineral ions from the surrounding soil for land plants; or water for aquatic plants. The concentration of salts in the cell sap of the root hair cells is higher than that in the soil or water. Mineral salts are taken up by active transport against their concentration gradient. This process requires energy. Once the mineral ions are absorbed into the xylem, they are transported in dissolved form to other parts of the plant.

3. **Describe the movement of water and transport of mineral salts from the roots to the leaves.**

   From the roots, water moves up the stem in the xylem vessels and then into the leaves. Most water escapes into the atmosphere through the stomata in form of water Vapour by transpiration. The continuous column of water in the xylem flowing from roots, up the stem and into the leaves is called the transpiration stream. The column of water is maintained by root pressure, capillarity and transpiration stream. Root pressure is the force created by active transport of mineral ions into the xylem vessels by cells of the endodermis. The mineral ions create a region of high solute concentration in the xylem.

   Due to the osmotic gradient created, water is drawn from the cortex into the xylem vessels. The movement of water through the xylem vessels by capillarity occurs due to cohesion and adhesion forces. Cohesion causes water molecules in the xylem vessels to attract each other and stick together as they move upwards. Adhesion causes water molecules to be attracted to the xylem causing them to move upwards in the xylem. During transpiration, water evaporates from the leaves of the plant. More water from the xylem is drawn to offset the osmotic imbalance. This creates a suction pressure that maintains continuous movement of water.

4. **Describe the movement of organic solutes in phloem**.

   The transport of dissolved products of photosynthesis and other solutes is called **Translocation.**

Organic solutes include sucrose and amino acids dissolved in water. Food materials from photosynthetic cells move into adjacent sieve tube elements by active transport. Once in sieve tubes the food substances move by diffusion, active transport and cytoplasmic streaming.

More soluble food substances such as sugars move from one sieve tube to the next by diffusion. The food substances diffuse from a region of high concentration in the leaves to a region of lower concentration such as the roots.

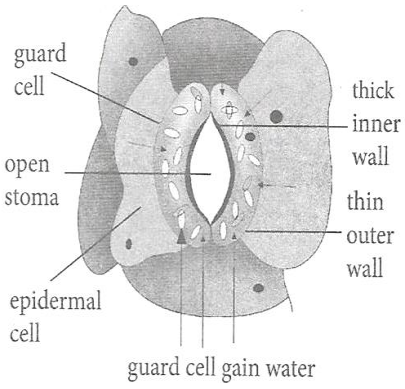
Some food substances move against concentration by active transport. Some of the organic food substances move along the cytoplasmic filaments which are continuous from one sieve element to the next.

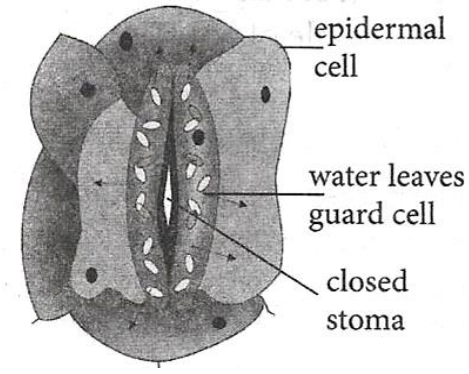
5. **Demonstrate the process of transpiration.**

Opening and closing of stomata

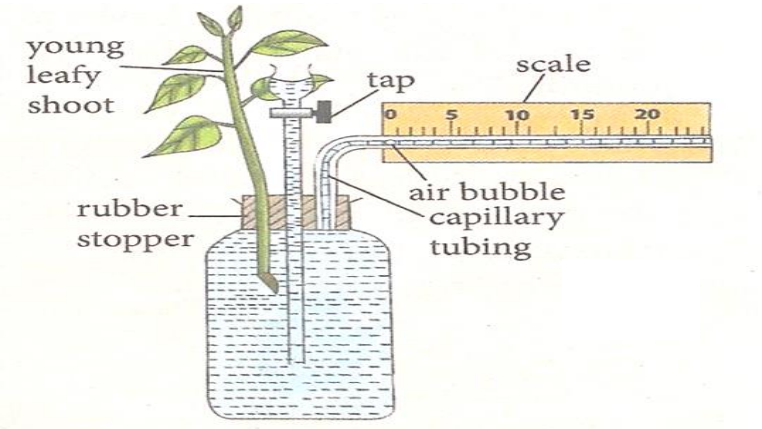
The water evaporates from cells into the air spaces in the leaf and then diffuses out through the stomata. Water evaporates from a high concentration in the plant to a low concentration in the atmosphere outside the leaf. The size of stomata is controlled by guard cells. Each stoma is surrounded by a pair of bean shaped guard cells. The guard cells absorb water, swell and pull open the stomata. When the guard cells lose water they shrink and close the stomata. Stomata open during daylight hours while light is available. This enables carbon dioxide to diffuse in, so that photosynthesis can take place. Stomata close when it is dark, when carbon dioxide is not required. This reduces the amount of water lost by the plant at a time when it not needed for photosynthesis. If plants lose water faster than it is replaced by the roots, the stomata can close to prevent wilting and further water loss. There are more stomata on the ventral side of a leaf (underneath). This is to prevent the guard cells from opening too wide during the day. This prevents water loss in the plant.

Use of





When using the Potometer it is assumed that water uptake is equal to water loss through transpiration.



6. **Investigate th**

-Humidity: the higher the humidity, the lower the transpiration rate because high humidity lowers the concentration gradient between the leaf and the atmosphere. High humidity causes the air in the leaves and the outside to contain about the same amount of water vapor. The rate of transpiration is thus decreased.

- Light intensity: the higher the light intensity, the higher the transpiration because high light -intensity causes opening of the stomata.

-Wind: the higher the wind speed, the greater the rate of transpiration. When the air is still, a layer of water vapor forms over leaf and reduces transpiration rate. But when there is wind, a layer of vapor is blown away thereby increasing diffusion rate.

-Temperature: an increase in environment temperature results into increased rate of transpiration. This because increased temperature leads to increased kinetic energy of water vapor molecules which therefore escape faster from the leaves hence increasing transpiration rate.

7. **Describe the adaptive features of a leaf to reduce excess loss of water**.

- Shedding of leaves in severe conditions (summer) reducing the number stomata so that no water loss can occur.

- Reduced size of leaves (needle- shaped leaves) - minimizes surface area over which transpiration takes place in the leaf.

- Reduces number of stomata- most terrestrial plants have very few or no stomata on the upper surfaces of leaves to reduce the rate of transpiration. Some plants have sunken stomata.

DESCRIBE THE PROCESS OF GUTTATION

At night roots some plants continue to activate transport ions and water into the xylem. This causes water pressure in the roots to increase. This root pressure is strong enough to force water and mineral salts completely out of the tips of the leaves, this is called **guttation.**

8. **Explain the significance of transpiration in plants.**

   It creates transpiration pull that facilitates absorption of water by the plant. Evaporation of water from a leaf has a cooling effect which helps prevent hot direct sunlight from damaging the cells in plants, provides water one of the main raw materials of photosynthesis and facilitates absorption of mineral ions from the soil. When water evaporates from the leaf it condenses and forms clouds in the water cycle.

TRANSPORT IN MAN

1. Identify the composition of blood.

   The solid part of blood is made of red blood cells, white blood cells and platelets. Plasma which is the liquid portion of blood consists of water and contains many important dissolved substances, including the products of digestion, such as glucose, fatty acids, glycerol, amino acids, vitamins, and minerals, plasma proteins such as fibrinogen and antibodies, hormones and waste materials, such as urea and carbon dioxide.

2. **Explain the functions of blood.**

   - **<u>The main functions of blood</u>**

     These are, transport, defense, and blood clotting.

Transport functions:

Soluble products of digestion and absorption such as glucose, amino acids, fatty acids, vitamins and minerals are transported from the gut to the liver and then to the general circulation.

Waste products of metabolism such as urea are transported from sites of production to sites of removal, such as the liver and kidneys.

Respiratory gases, oxygen and carbon dioxide are transported from sites of uptake or production to their site of use or removal.

Hormones such as insulin are transported from their sites of production in the glands to the target organs where they have their effects.

Regulatory function:

Water plays a part in distribution of heat between heat producing areas such as the liver and areas of heat loss such as the skin

Protective functions:

Platelets, plasma proteins like fibrinogen and many other plasma factors such as calcium ions protect against loss of blood and entry of pathogens by clotting mechanisms.

White blood cells protect against disease- causing micro-organisms. Phagocytes engulf the bacteria while lymphocytes produce and secrete specific antibodies against them.

3. **Distinguish between red and white blood cells.**

Red blood cells are biconcave in shape while white blood cells have no definite shape. Red blood cells contain hemoglobin while white blood cells do not contain hemoglobin. Red blood cells lack the nucleus while white blood cells have the nucleus. Red blood cells transport oxygen and small amounts of carbon dioxide while white blood cells defend the body against disease- causing micro-organisms.

4. **Identify the sites where the blood cells are produced.**

White blood cells are made in the bone marrow, lymph nodes, tonsils, thymus and spleen. Red blood cells are in the bone marrow, particularly at the ends of the long arm and leg bones, in the ribs, and in vertebrae in adults but can also be made by the liver in babies

5. **Explain the process of blood clotting.**

When platelets are exposed to injured body tissue, they release an enzyme called Thromboplastin. Thromboplastin acts on a plasma protein called Prothrombin changing it to an active form called thrombin. Thrombin acts on another plasma protein called fibrinogen changing it into an insoluble form called fibrin. This reaction occurs in the presence of calcium ions. The fibrin forms a mesh over the wound. This mesh traps red and white blood cells, leading to the formation of a clot over the wound.

6. **Describe the ABO blood groups**

There are four main blood groups namely blood groups A, B, AB and O. Two types of antigens found on the surface of red blood cells are antigen A and antigen B. The antigens determine the blood groups as shown in the table below.

BLOOD GROUP	ANTIGEN

A	Have antigen A
B	Have antigen B
AB	Have both antigen A and antigen B
O	Lack both antigen A and antigen B

Antibodies found in blood plasma interact with antigens on the red blood cells. The two antibodies are antibody a and antibody b. a person with a specific antigen does not possess the complimentary antibody.

BLOOD GROUP	ANTIBGENS ON RED BLOOD CELL	ANTIBODIES IN PLASMA
A	A	B
B	B	A
AB	A and B	None
O	None	a and b

7. Explain the importance of determining the blood groups and Rhesus factors.

Safe blood transfusion is only important if blood groups and Rhesus factor are determined. This reduces the chances of agglutination in the event of blood transfusion. Transplant of tissues and organs require determination of blood groups and Rhesus factor. Some tissues may be rejected by the recipient because they would act like antigen causing antibody-antigen reaction. Determination of Rhesus factor prevents disorders, such as hemolytic disease of the fetus.

Define Rhesus factor

It is an antigen occurring on the red blood cells of human beings.

Importance Of Rhesus Factor

It is important because it causes hemolytic diseases of new born and incompatibility blood transfusions.

Red blood cells with the antigen are said to be RH positive (**Rh^+**) while those without the surface antigen are said to be rhesus negative (**Rh^-**)

8. Explain the donor-recipient compatibility of blood groups.

An antigen reacts with a corresponding antibody making the blood cells to clump together. The antibody- antigen reaction is called agglutination. Antigen A and antibody a will cause

agglutination. Antigen B and antibody b will also cause agglutination. A person with blood group AB does not have antibodies in the blood plasma. Therefore blood group AB is a universal recipient. A person with blood group O lacks antigens and he is a universal donor. Blood group A can only receive blood from blood groups A and O. Blood group B can only receive blood from blood groups B and O. Blood group A can only donate blood to blood groups A and AB. Blood group B can only donate blood to blood groups B and AB. Blood group AB can only donate blood to blood group AB. Blood group O can only receive blood from blood group O.

9. **Explain the importance of screening the blood for the purpose of transfusion.**

   Screening is important to ensure blood is safe and no disease causing micro- organisms are present that could cause disease in the recipient. Screening would minimize transmission of diseases such as HIV and AIDS, syphilis and hepatitis B.

10. **Investigate common blood disorders.**

    Sickle cell anaemia: this is an inherited disease where a person has abnormal haemoglobin. As a result red blood cells become sickle- shaped, especially when oxygen levels are low in the body.

    Haemophilia: this is an inherited disease where a person bleeds for longer periods than normal due to poor clotting of blood due to absence of blood clotting proteins.

    Leukemia: it is the cancer of white blood cells. The patient makes an abnormally high number of immature white blood cells.

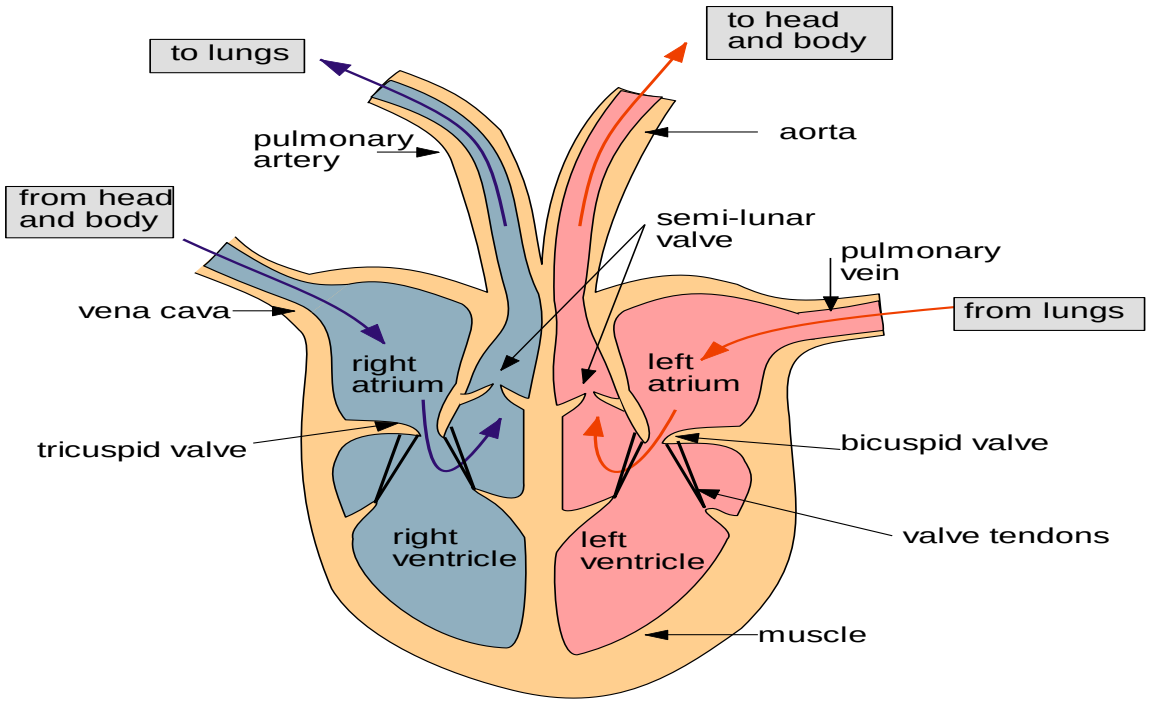
    Anaemia: an inability to transport enough oxygen can be detected by noting a lower normal number of red blood cells. Describe the structure of the human heart.

11. **Describe the structure of the human heart**

    The heart is made up of cardiac muscles which contract and relax without getting tired. The heart is enclosed in a pericardium membrane which secretes a fluid that lubricates the heart when it is in pumping action. The coronary artery supplies the heart with blood.

The four chambers of the heart are: the right atrium and left atrium the right ventricle and left ventricle. The atria receive blood. The right atrium receives deoxygenated blood from the body through the vena cava. The left atrium receives oxygenated blood through the pulmonary vein.

The ventricles pump blood out of the heart. The right ventricle pumps deoxygenated blood to the lungs through the pulmonary artery. The left ventricle pumps oxygenated blood to the rest of the body through the aorta. The left ventricle is much thicker than the right ventricle because the left ventricle pumps blood with a high pressure to all parts of the body. The right ventricle pumps blood to the lungs which is a shorter distance away. The valves in the heart that prevent back flow of blood include: the semi-lunar valves found at the base of pulmonary artery and aorta, the bicuspid and tricuspid valves found between the atria and ventricles.



12. Describe how the heart functions.

During atrial systole, the atria contract squeezing blood into the ventricles. The bicuspid and tricuspid valves are opened while semi lunar valves remain closed. During atrial systole, the ventricles are relaxed and fill up with blood. When the ventricles are full, the

bicuspid and tricuspid valves close while the semi lunar valves open. The ventricles contract thereby pumping blood into arteries. The contraction of the ventricles is called ventricular systole. When the atria contract, the ventricles relax to receive blood from the atria. The relaxation of the ventricles is called ventricular diastole. This short phase is followed by the relaxation of the atria. The relaxation of the atria is called atrial diastole. The relaxed atria draw blood from the veins. Blood from the right ventricle flows to the lungs through the pulmonary artery where it is supplied with oxygen and becomes oxygenated. The oxygenated blood the flows to the heart through the pulmonary vein. From the left ventricle, blood is pumped to the whole body leaving the heart through the aorta.

The heart beat is made up of one systole and one diastole. The contraction of the muscles of the ventricles arises from within the heart muscle in a small area in the right atrium called the pacemaker.

DESCIBE HEART RATE AND PULSE RATE

The term heart rate refers to the number of heart beats per minute. It can be measured using an instrument called the stethoscope. The heart rate of a normal adult human being at rest is about72 beats/minute.

A pulse is a wave of pressure created in the arteries by a heartbeat. The number pulses per minute is called the **pulse rate**.

The pulse is the thumping sensation in the blood vessels. It is as a result of blood flowing in wave-like movement as pumped by the heart. The pulse rate is the same as heart beat.

13. Explain the causes of the coronary heart diseases.

Excessive intake of fatty foods causes coronary heart diseases. Fatty foods are easily converted to cholesterol which in turn blocks the coronary arteries. Cigarette smoke contains a stimulant called nicotine which tends to promote the accumulation of cholesterol in the blood. When you are emotionally stressed, the body secretes high levels of adrenaline which tends to promote accumulation of cholesterol in the blood stream. Inhalation of harmful gaseous compounds, for example carbon monoxide when the environment is polluted increases the chances of suffering from a coronary disease.

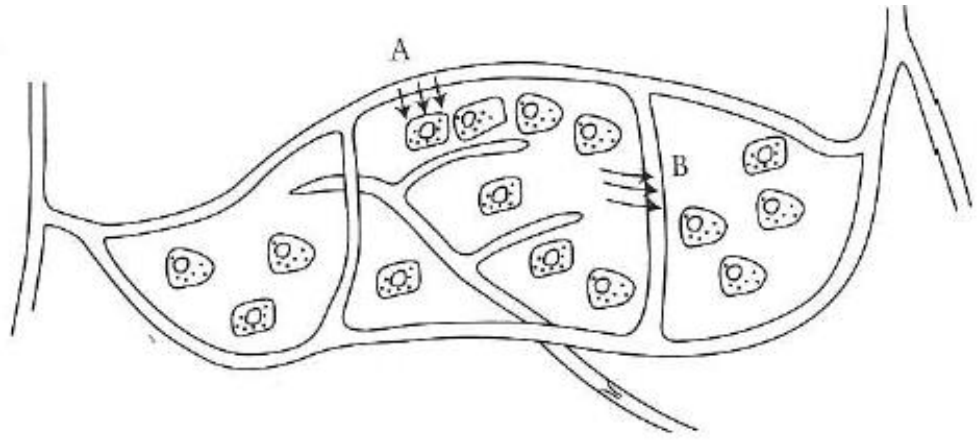
14. Describe the ways of preventing coronary heart diseases.

Avoid excessive intake of fatty foods. Regular exercise improves blood circulation and reduces chances of accumulation of cholesterol in arteries.

15. Describe the structure of the lymphatic system in relation to blood circulatory system.

The lymphatic system is made up of lymphatic capillaries that join to form larger lymphatic vessels. The vessels finally drain into the blood system at the vena cava just before it enters the heart. The lymph move along the vessels by contraction of muscles surrounding them. The vessels have valves at intervals to prevent back flow of lymph.

Lymphocytes produced in the lymph nodes defend the body against diseases by producing antibodies and antitoxins. Lymph nodes have a network of fibres that trap bacteria which are then destroyed by the lymphocytes.



16. Compare tissue fluid and lymph to blood.

Blood contains blood cells while tissue fluid and lymph lack blood cells. Blood contains plasma proteins such as fibrinogen while tissue fluid and lymph lack plasma proteins.

17. Describe the flow of lymph.

Lymph drains into the lymphatic vessels. The lymph vessels bring the lymph back to the heart through the vena cava. Lymphatic vessels have valves to prevent back flow of lymph. Because the fluid in the lymphatic vessels is at very low pressure, the contraction and relaxation of muscles help to squeeze the lymph back to the heart. In addition, inhalation causes the negative pressure in the chest cavity which helps the lymph to drain towards the heart.

18. Describe the structure of lymph vessels.

Lymphatic vessels are vessels that transport tissue fluid away from the tissues. The smallest lymphatic vessels are the lymph capillaries. The lymph capillaries have closed ends and thin walls to allow tissue fluid to easily enter the lymphatic vessels. Lymphatic capillaries join to form larger vessels called lymphatic vessels.

19. Describe the functions of lymph nodes in disease prevention.

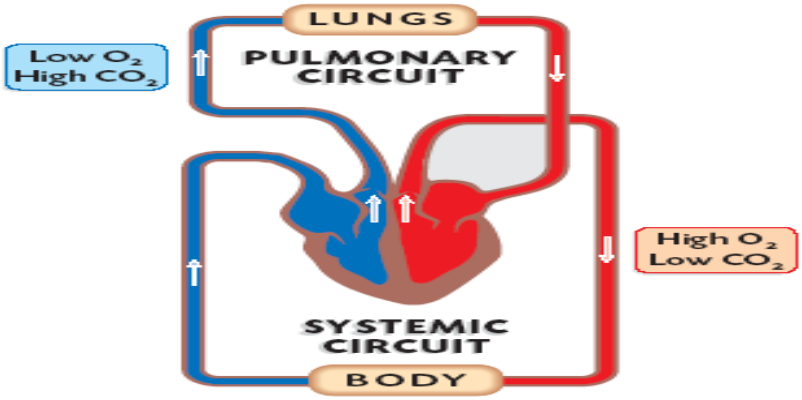
White blood cells called lymphocytes are produced in the lymph nodes. Lymphocytes produce antibodies that destroy bacteria.

20. Describe types of blood circulatory systems.

The two types of circulatory systems are closed and open circulatory systems. In closed circulatory system, the circulating fluid or blood is always enclosed within tubes called blood vessels which transports towards and away from the heart. This can be single or double circulation. In open circulatory system, blood is pumped by the heart into the body cavity which is a series of body spaces collectively known as haemocoel.

21. Describe double circulation.

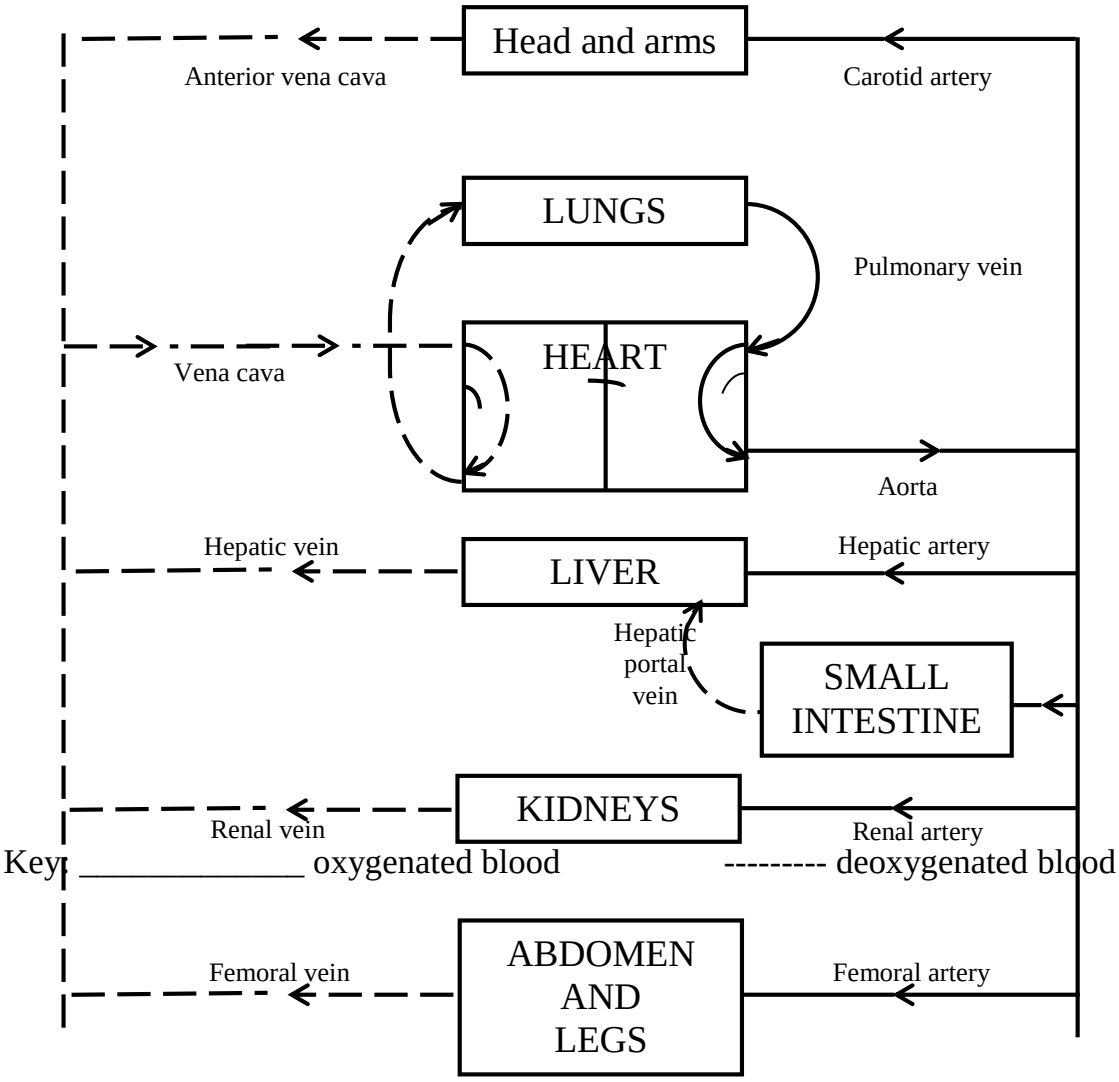
Blood passes through the heart twice during one complete circulation around the body. It involves pulmonary circulation and systemic circulation. In pulmonary circulation, blood flows from the right ventricle to the lungs through the pulmonary artery and from the lungs to the left atrium through the pulmonary vein. The main purpose of this circulation is to oxygenate the blood and remove carbon dioxide from the blood through the lungs. In systemic circulation, blood flows from the left ventricle to the rest of the body through the aorta and from the rest of the body to the right atrium through the venacava. The purpose of this circulation is to distribute oxygen around the body and to collect carbon dioxide from body tissues.



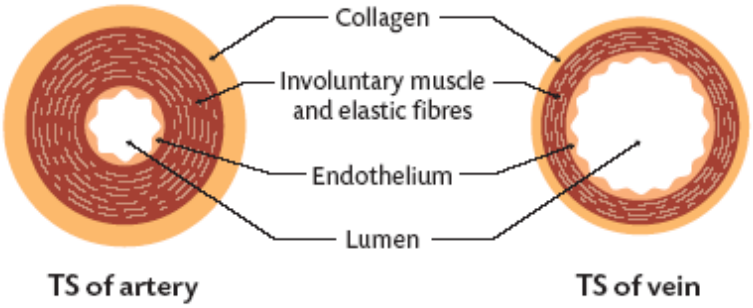
22. **Distinguish between the single and double circulation**.

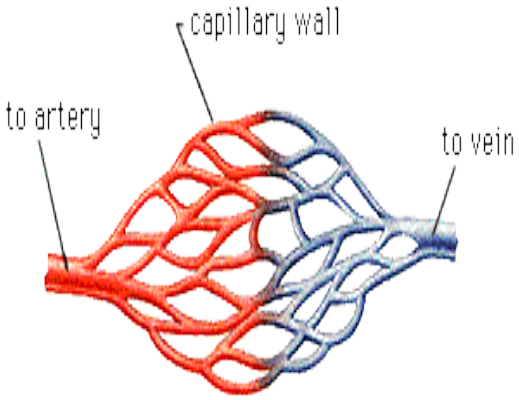
In single circulation, blood flows through the heart once to make a complete circulation while in double circulation, blood flows through the heart twice to make a complete circulation.

23. Identify the main blood vessels in the double circulation.



24. **Compare the structure and functions of arteries, veins and capillaries**.





Arteries have thick and muscular walls to withstand high pressure which cause rupture. The inner layer has elastic fibers to allow them dilate so as to accommodate blood that flows in pulses. Arteries have a narrow lumen. They have no valves except at the base of the aorta and pulmonary artery. They carry oxygenated blood except the pulmonary artery away from the heart.

Veins have thin and less muscular walls since they carry blood under low pressure. Blood flows steadily in veins. They have a wider lumen and have valves at intervals. They carry deoxygenated blood except the pulmonary vein towards the heart

Capillaries are thin walled minute blood vessels which run through the tissues. They have walls that are one cell thick to allow substances to move in and out of them by diffusion.

EXCRETION

1. **Describe the process of excretion.**

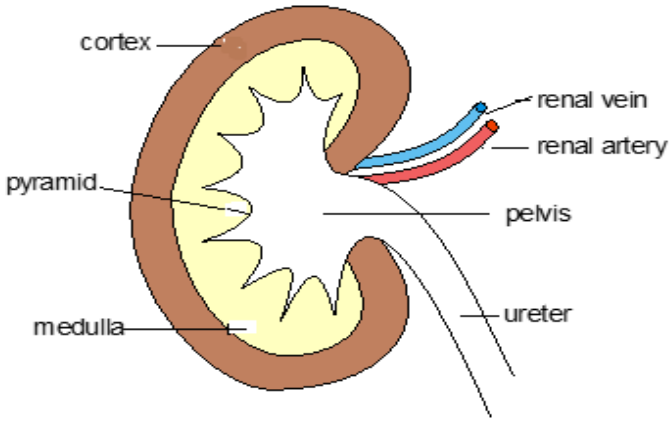
   This is the removal of toxic metabolic waste products from the bodies of living organisms. The products of excretion are called excretory products while the organs used to remove them are called excretory organs.

2. **Explain the significance of excretion in animals.**

   Unwanted toxic substances of metabolism and by-products are removed from the body of an animal. If left to accumulate, these waste products become poisonous and harm the organism`s normal body functions. Removal of waste products from the body of the animal results in maintenance of a constant internal environment that is required for normal

physiological processes to occur. These include regulation of osmotic potential of body fluids, regulation of pH and blood sugar levels.

3. **Identify the internal structure of the kidneys.**



4. **Explain the mechanism of excretion in the kidneys.**

   During ultra-filtration, small molecules such as water, mineral salts, glucose and urea from the glomerulus are filtered into the Bowman`s capsule of a nephron. It is caused by a build up of pressure in the glomerulus. The pressure builds up due to the following reasons: the afferent end of the glomerulus is wider than the efferent end and blood from arteries is under high pressure. During ultra-filtration, the red blood cells and large molecules such as plasma proteins remain inside the glomerulus. The liquid that collects in the Bowmn`s capsule is called the glomerular filtrate. The glomerular filtrate drains from the Bowman`s capsule by the renal tubule.

   During selective reabsorption useful substances are reabsorbed from the glomerular filtrate in the renal tubule into the blood stream. The first (proximal) convolution reabsorbs all glucose, some water and some salt. The second (distal) convolution reabsorbs salts and water. Water is reabsorbed by osmosis while mineral ions, glucose and mineral salts are reabsorbed by active transport.

   Osmoregulation takes place in the loop of Henle. If the body has very little water in it, the anti diuretic hormone is secreted by the pituitary gland in the brain. It causes water to be reabsorbed from the glomerulus into the surrounding cells. This results in the production of small volumes of concentrated urine. But if the body has enough water, anti diuretic hormone is not secreted and huge volumes of dilute urine are produced.

5. **Identify the common disorders and diseases associated with the kidney.**

Common disorders and diseases include kidney failure and acute renal failure. The malfunctioning of the kidneys as a result of partial or complete damage of the nephron caused by bacterial or viral infection leads to kidney failure. The infections result in inflammation of the nephron leading to a variety of kidney diseases known as nephritis.

Glomerular nephritis originates from the infection of other body parts like throat causing an antibody- antigen complex that blocks the glomeruli. The blockage hinders normal functioning of the kidney such that urea is not excreted from the blood. This can result in mental disorientation, vomiting and confusion. Remedies of kidney failure include: use of a broad spectrum of antibiotics, controlled diet, for example adequate intake of salt and intake of fluids that can be used to rectify kidney failure.

Acute renal failure is a sudden decline in renal functioning caused by a drop in pressure due to excessive blood loss, kidney infections and stones, trauma and shock.

High blood pressure can also lead to kidney failure. Arteries in the kidneys are damaged by high pressure resulting in low blood supply to the kidneys. Kidneys are unable to regulate blood pressure hence more arteries are blocked and stop functioning.

Kidney failure may be treated using two ways: kidney transplant and using a dialysis (kidney) machine. Kidney plant involves a surgical operation during which a normal kidney from a donor is added to an individual experiencing kidney failure. The transplanted kidney must be compatible with the recipient; otherwise there will be tissue rejection.

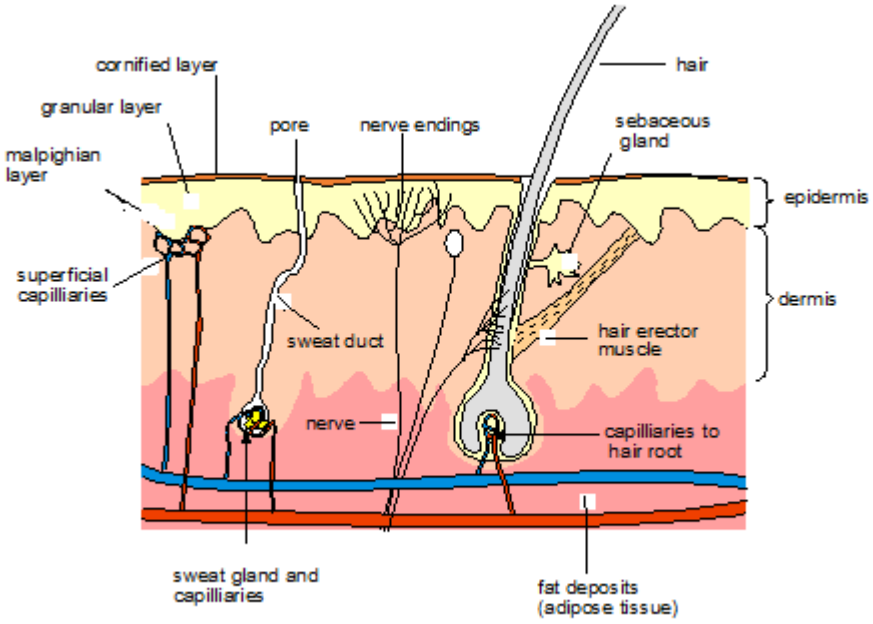
A kidney machine is made of a dialysis tubule through the patient's blood passes. The tubule is long and coiled in order to increase the surface area for diffusion. The tubule is also thin and selectively permeable to allow small molecules such as glucose, urea, salt and water to pass through but prevent large ones from doing so.

The dialysis machine also contains dialysis fluid which is a solution of salts and glucose in water and its concentration equal to the normal concentration of the blood to prevent loss of glucose or any other essential mineral salt from the patient's blood. The patient's blood is led from the vein in the arm and pumped through the dialysis tubule, as blood flows through the dialysis tubule molecules of small size such as urea and salts diffuse out of the blood into the dialysis fluid.

6. **Investigate the role of the lungs in excretion.**

   Lungs excrete carbon dioxide. Carbon dioxide is excreted during the process of gaseous exchange in the alveoli. Carbon dioxide diffuses from the blood into the alveoli across the alveolar walls.

7. **Identify the structure of the human skin.**



8. **Describe the role of the human skin in excretion.**

   The skin plays a role in excretion of excess water, mineral salts and traces of urea through sweat.

HOMEOSTASIS AND OSMOREGULATION

1. **Describe what homeostasis is.**

   Homeostasis is the maintenance of a constant internal environment. The conditions in the internal environment which need to be kept constant include temperature, blood sugar, contents of tissue fluid, salt and water.

2. **Identify important organs in homeostasis**.

   Important organs in homeostasis include the kidney, the skin and the liver.

3. **Describe the role of the kidney in maintaining the balance of water and salt ions.**

   When the osmotic pressure of the body rises due to low amount of water caused by dehydration and reduced water intake the pituitary gland is stimulated by the hypothalamus to secrete ant diuretic hormone. Anti diuretic hormone causes kidney tubules in the nephron to be more permeable to water, more water is reabsorbed into the bloodstream, restoring osmotic pressure of body fluids.

When the amount of sodium ions in the blood is low, the adrenal glands secrete aldosterone hormone which causes the distal convoluted tubule to reabsorb more sodium ions into the blood stream. When the concentration of sodium ions in the blood is adequate, adrenal glands are less stimulated; hence less sodium ions are reabsorbed.

4. **Describe the mechanism of thermoregulation by the skin.**

In cold temperature the skin reduces loss of heat in the following ways:

-Erector muscles contract causing the hairs on the surface of the skin to stand upright. Air which is a bad conductor of heat is trapped between the hairs preventing heat loss from the body.

-Vasoconstriction (narrowing of skin arterioles) occurs to reduce the amount of blood passing through the skin. This reduces heat loss.

-Shivering that is the rapid muscular contraction of skeletal muscles in the limbs. Heat is released due to respiration that takes place in the muscles. Body temperature is hence brought back to normal levels.

In hot temperature the skin promote heat loss in the following ways:

-Erector muscles relax causing the hair to lie flat on the skin. This increases heat loss from the body by conduction since no layer of still air forms.

-Vasodilation (widening of skin arterioles) occurs increasing the amount of blood passing through the skin. This allows more heat to be lost from the body by conduction.

-Sweating-sweat glands become more active and produce more sweat. The water in sweat absorbs heat from the body in order to evaporate, thereby cooling the body.

5. **Describe the role of the liver in the regulation of blood sugar and body temperature.**

When the glucose level is above normal in the blood, the pancreas is stimulated to produce insulin which lowers the level of glucose in the following ways: stimulates cells of the liver and muscles to convert excess glucose to glycogen which is stored in the liver and muscles and causes the cells of the adipose tissue to convert excess glucose to fats. It also stimulates liver cells to oxidize glucose to release energy.

When glucose levels are too low in the blood, the pancreas secretes glucagon which increases glucose levels in the blood in the following ways: causes the cells of the liver and muscles to convert glycogen to glucose and causes fats (glycerol) and amino acids to be changed into glucose.

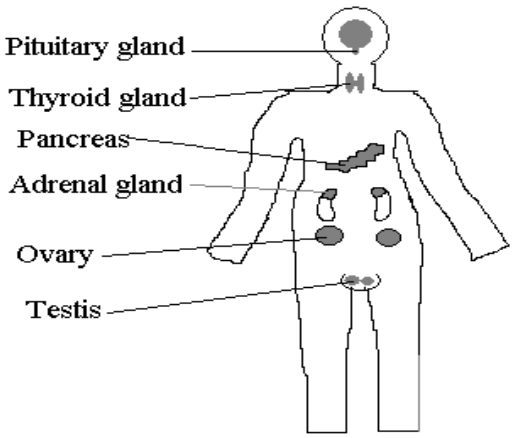
The liver produces and distributes heat because of many metabolic reactions that take place in it and the network of blood vessels.

THE ENDOCRINE SYSTEM

1. **Describe what a hormone is.**

   A hormone is a chemical secreted by a ductless gland, transported by blood and has effects on one or more target organs before being destroyed by the liver.

2. **Identify the endocrine glands in a human being.**



3. **Identify the hormones produced by the pancreas, adrenal, thyroid and pituitary glands.**

- Pancreas: Insulin and glucagon:
- Adrenal gland: adrenaline ,
- Thyroid gland: Thyroxine ,
- Pituitary gland: (1) Hormones produced by the pituitary gland and stimulates other endocrine glands - thyroid stimulating hormone, follicle stimulating hormone, interstitial stimulating hormone,**Adrenocorticotrophic Hormone**

  Luteinising Hormone.

  (2) Hormones produced by the pituitary glands but are not involved in stimulating other endocrine glands - Antidiuretic hormone,Growthhormone,Oxytocin, prolactin.

4. **Describe the functions of thyroxine, insulin, glucagon and adrenaline**.

Thyroxine hormone

It controls the basal metabolic rate of the body, normal development of the skeleton and the brain .It also **stimulates respiration of glucose and fats as well as controlling the growth and differentiation of cells.**

Insulin

It's secreted when the sugar levels are high in the blood and causes the cells of the liver and muscles to convert excess glucose to glycogen which is stored in the liver and muscles. It causes the cells of the adipose tissue to convert excess glucose to fats. The fats are stored under the skin and around delicate body organs such as the heart, liver, kidneys, intestines and brain. Insulin enables body cells to absorb glucose from the blood and use it, promotes convection of carbohydrates to fats and Slows down the conversion of protein to carbohydrates.

Glucagon

When glucose levels are too low in blood, the pancreas detects and secretes glucagon which increases glucose levels in blood by causing the cells of the liver and muscles to convert glycogen to glucose.

It also causes fat to be changed into glucose and may cause proteins to be modified so that they are utilised for energy production.

Adrenaline

This hormone is called the "*fight or flight hormone*" and is produced when an individual is angry, scared, emotionally excited or under stress. It prepares the body for action in various ways such as, boosting the respiration, increasing the breathing rate so that more oxygen is taken in to be used for energy production, increasing the heart rate so that more blood containing glucose and oxygen can be carried to the muscles.

Adrenaline diverts blood from the changing of glycogen to glucose, thereby increasing glucose levels in the blood to be used for gut to the muscles by constricting the blood vessels of the gut and dilating the blood vessels of the muscles. It dilates the pupils in the eyes for increased alertness .It dilates the bronchi and increases the volume of the thorax so that more air containing oxygen may be taken in .It increases the sensitivity of the nervous system for faster response to stimuli .It raises hair in furry animals and causes the appearance of 'goose bumps' as well as shivering.

Effects of over secretion of adrenaline

Muscles become tense and painful, headaches or even migraines, high blood pressure leading to hypertension **which can cause stroke or heart failure, pain in the stomach and intestines, diarrhoea,** excessive sweating and exhaustion.

Effects of under secretion of adrenaline

Improved muscular performance, mental alertness, extra blood flows to muscles and brain carrying more oxygen and glucose, decreased rate of digestion waste products egested faster and more energy available for body activity. Reduction in blood sugar level and rapid weight loss.

Effects of over secretion of thyroxine

Over production of thyroxine causes hyperactivity which is characterised by an increased metabolic and heart rate, loss of body mass and extreme irritability

Effects of under secretion of thyroxine.

Under production of thyroxine causes myxoedema and cretinism. Myxoedema is a condition where the basal metabolic rate and mental development are slow. Cretinism is a condition where

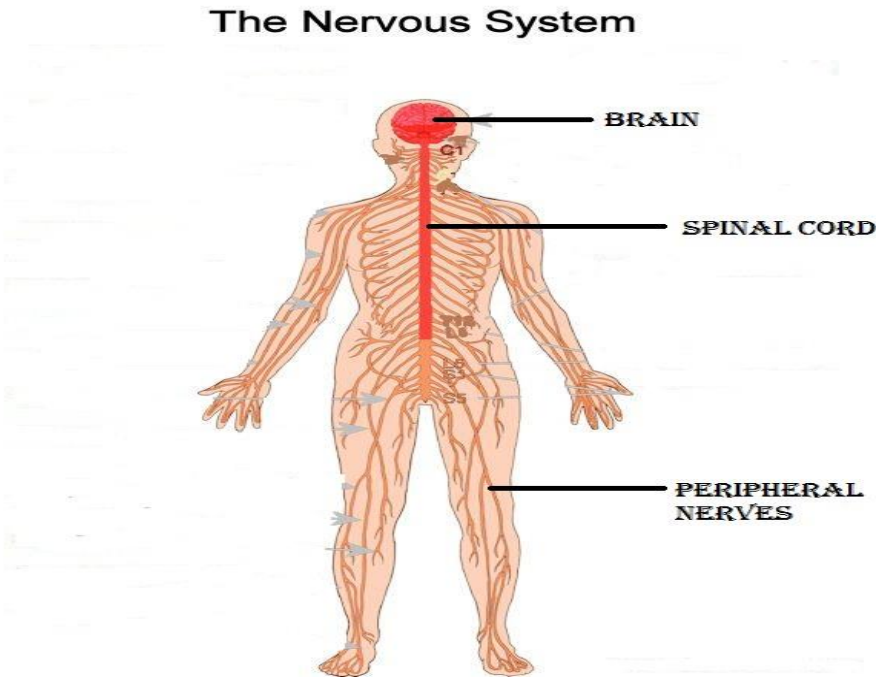
the physical, mental and sexual developments of a child are retarded. A person who suffers from cretinism is called a cretin. Iodine deficiency causes swelling of the thyroid gland, a condition known as goitre which is -swelling of the neck due to enlargement of the thyroid gland.

The nervous system and sense organs

Identify main parts of the nervous system in a human being.

The Nervous System is made up of the brain, spinal cord and nerves. The brain and the spinal cord together make up the central nervous system (CNS) while the nerves make up the peripheral nervous system (PNS).

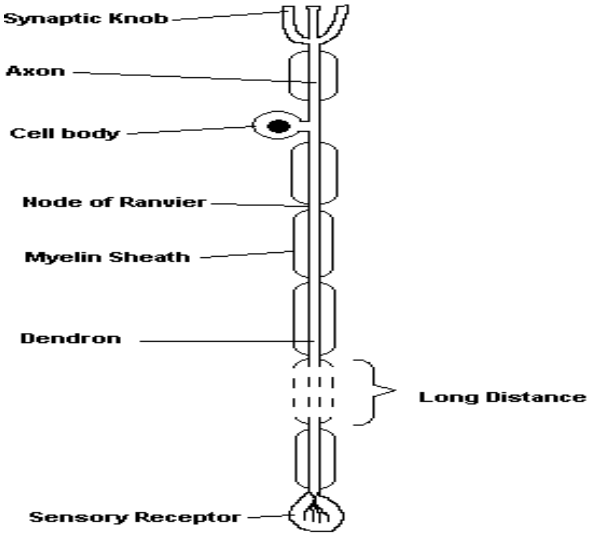
The Figure below shows the main parts of the nervous system in a human being



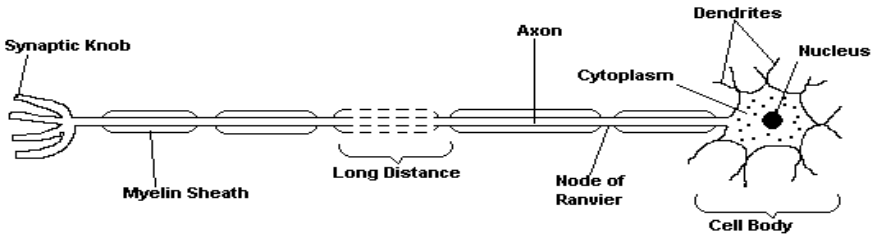
1. **Describe what neurones are.**

Neurones or nerve cells are specialised cells through which information is carried in the nervous system.**Types of neurones include sensory, relay (connector, intermediate, multipolar, pyramidal) and motor neurones**

Sensory neurones, also known as afferent neurones, transmit impulses from receptor to the central nervous system and are characterized by having long dendrons and short axons. Their cell bodies are located on one side of the axon. See diagram below:

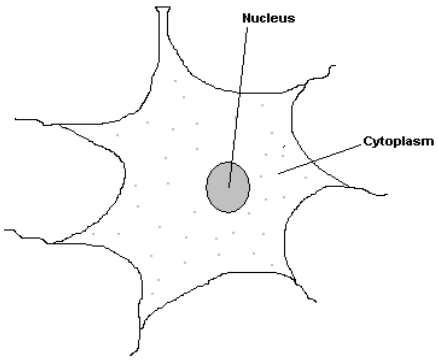


Motor neurones transmit impulses from the central nervous system to the effectors. An effector is any part of the body that carries out a response to a nervous impulse.**They Motor neurones are characterised by having long axons and short dendrites.**
Their cell bodies are terminally located (located at the end) and they also carry impulses from the central nervous system to the effectors.



Motor neuron

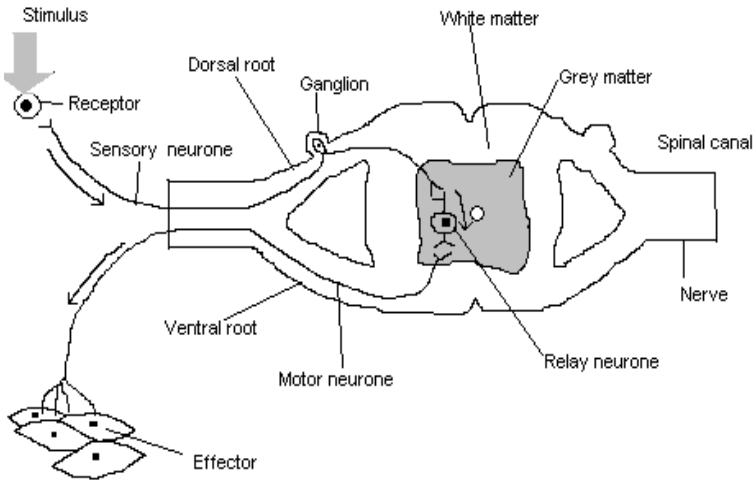
Relay neurones connects sensory and motor neurones. Relay information from sensory to motor neurones.**They are located in the central nervous system and are multipolar so as to provide many alternative paths for impulses.**



Relay Neuron

2. **Explain the path taken by an impulse through a spinal reflex arc**

- A receptor detects a change in a condition (stimulus).A message is carried in form of an electrical impulse from the receptor to the central nervous system by a sensory neurone.A relay neurone will then carry the electrical impulse from the sensory neurone to the motor neurone which will in turn carry the impulse to the effector. The relay neurone acts as the link between the sensory and the motor neurone. The figure below illustrates the path taken by an impulse through a spinal reflex arc.



Receptor → Sensory Neuron → Relay Neuron → Motor Neuron → Effector

3. **Describe what the spinal, cranial and the conditioned reflex actions are**

- **Spinal reflex action**

Spinal reflex actions are inherited or inborn responses which produce the same response for a given stimulus e.g. knee jerking and bulging of the biceps of the hand when struck. **During a spinal reflex, impulses pass through the spinal cord**

- **Cranial reflex action**

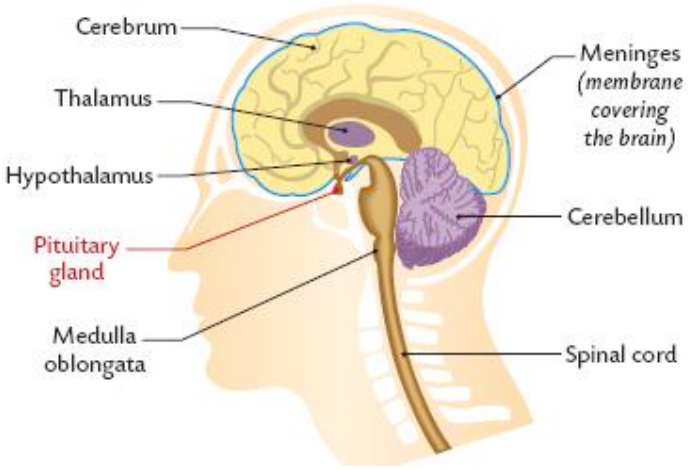
Cranial reflexes are mediated by the brain and pass along the cranial nerves.
Examples are constriction and dilation of the eye pupil, blinking of the eye, salivation in response to sight or thought of food.

- **Conditioned reflex action**

Conditioned reflexes are learned or trained reflexes in which the final response has no natural relationship to the stimulus but the animal associates it with a related stimulus after being trained to do so. In an experiment, a Russian scientist Ivan Pavlov observed that dogs always salivated when they saw, smelled or tasted food. Pavlov then started ringing a bell whenever he would present food to the dogs. Eventually the dogs started salivating at the sound of the bell alone. The dogs could respond to the bell as if it were food. The bell had become a stimulus though completely unrelated to food. The natural stimulus the food had been replaced by an unnatural one (the sound of the bell). Conditioned reflexes can be unlearned__ if the unnatural stimulus is not repeated with the natural one __ if the food was produced without a bell over a period of time, the dogs would no longer salivate at the sound of the bell.

4. **Identify the main parts of the brain of a human being.**

34.10 Structure of the brain



5. **Explain the functions of the forebrain and the hindbrain.**

   The fore brain (cerebrum and hypothalamus).

   Cerebrum

   It determines the level of intelligence, thinking, memory and imagination. It also Controls voluntary movements such as movement of limbs, mouth, lips, tongue, neck, abdomen. It is responsible for the sensation of pain, temperature, touch, sight and hearing.

   Hypothalamus

   It Controls temperature and water, Controls feeding, talking and eating. It stimulates the pituitary to secrete hormone.

The hindbrain (cerebellum and medulla oblongata).

Cerebellum

It helps to maintain a balance or equilibrium through coordinated muscle movements as well as maintenance of normal body posture.

Medulla oblongata

Controls the unconscious body actions such as swallowing, salivation, vomiting, sneezing, coughing, heart rate, respiration, breathing rate, contraction and dilation of blood vessels.

6. **Describe the effects of abuse of drugs on the nervous system**

   The term drug refers to useful substances such as medicine as well as harmful substances. Harmful substances are classified into **stimulants, depressants, hallucinogens, narcotics and inhalants/solvents.**

Stimulants: These are drugs that accelerate/increase the rate of impulse transmission in the nervous system. Examples of stimulants are cocaine, caffeine, nicotine and amphetamines. Their effects include; increasing alertness, heart rate and breathing rate. They also reduce the desire for food (lack of appetite) and to sleep. Stimulants make someone feel energetic bring about euphoria (feeling of well being).
However, stimulants increase the risk of cardiovascular diseases such as hypertension and coronary heart disease. Prolonged use can lead to dependency and liver damage. Overdoses can cause death.

Depressants: These are drugs that slow down the rate of impulse transmission in the nervous system. Examples of depressants are alcohol and heroin. Their effects include; reduced anxiety and tension, increased desire for sleep and drowsiness. In small amounts, some cause an increased desire for food, euphoria, numbing of pain by inhibiting pain and emotion centres. Note: Depressants affect the breathing centre of the brain.

Hallucinogens: These are drugs that distort the perception of an individual e.g marijuana and LSD (lysergic acid diethylamide).
Abuse of drugs destroys neurons, induces relief from pain, fatigue, alleviates depression and reduces sexual urge.

7. **Explain the effects of tetanus infection**

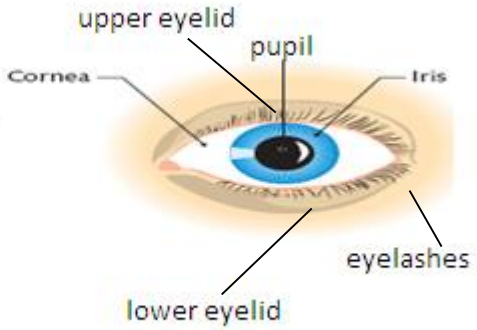
Tetanus toxin is a neurotoxin which inhibits transmission of impulses in the nervous system leading to muscular tenseness. The tetanus toxin exerts its effect on the brain cells resulting in the formation of lesions especially in the cortical region hence inhibiting brain functions. The tetanus toxin inhibits interneurone communication by hindering synthesis and release of a neurotransmitter substance called acetylcholine. The tetanus toxin induces muscular contractions leading to severe muscle spasms that are powerful enough to tear the muscles. This could result in

paralysis. The toxin also affects muscles that control breathing resulting in difficulty in breathing and subsequent suffocation.

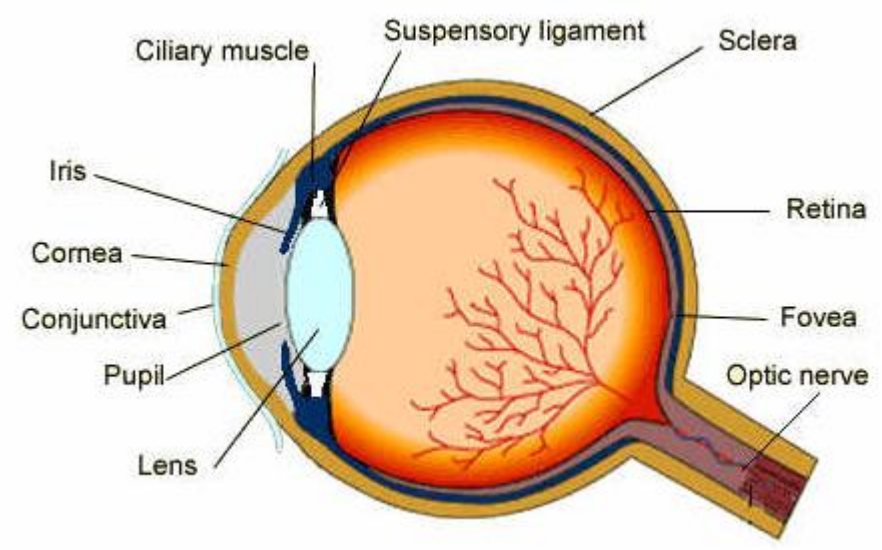
Sense organs

1. **Identify the external and internal structures of the human eye.**

   EXTERNAL STRUCTURE OF THE EYE



   INTERNAL STRUCTURE OF EYE



2. **Explain the functions of the parts of eye.**

Part of eye	Function
Pupil	allows light to enter the eye
Iris	expands and contracts to control the amount of light entering the eye
Sclera	protects the eye against damage
Retina	contains light sensitive cells, the rods and cones/this is where images are formed
cornea	transparent layer responsible for most of the refraction of light
tear gland	Secretes antiseptic, salty tears which remove dust and destroy some bacteria hence protecting the eye.
Conjunctiva	It protects the cornea. It's transparent and protective membrane that covers the exposed part of the eyeball.

3. **Describe the accommodation of the eye**.

- Accommodation is the automatic change in shape of the lens to ensure that a clear image is formed on the retina.

Accommodation of near objects

- To bring the image of the near objet to focus, the lens should be made thicker or more convex. This is achieved through the contraction of ciliary muscles and relaxation of suspensory ligaments.

Accommodation of distant objects

- To bring the image of distant object to focus, the lens should be made thinner or less convex. This is brought about by the cilliary muscles relaxing while the suspensory ligaments becoming tight (contract) thereby pulling the edge of the elastic lens.

4. **Describe the causes of short and long sightedness**.

Causes of long- sightedness:

This is an eye defect caused either due to the eyeball being too short or the lens being too thin. The shortness of the eyeball leads to focusing the rays behind the retina. The thinness of the lens

makes it not able to converge the light rays on the retina. Instead the image is formed behind the retina.

Causes of short- sightedness:

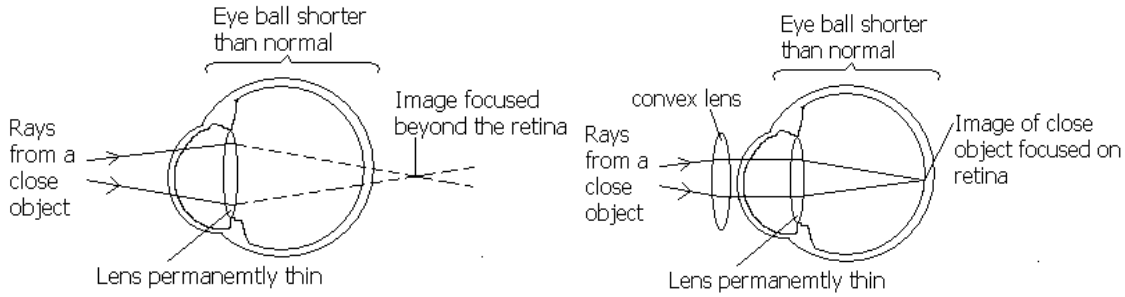
This is an eye defect in which either the eyeball is longer than normal such that the parallel rays from distant objects are brought to focus in front of the retina or the lens is too thick that it bends the parallel rays of light from an object converging them to focus in front of the retina. This leads to formation of blurred image.

5. **Explain the correction of short and long sight.**

Correction of long – sightedness:

Long a sightedness can be corrected by wearing spectacles with convex lens which bends the light rays inward the process called convergence. The rays are now focused on the retina hence the image is clear.

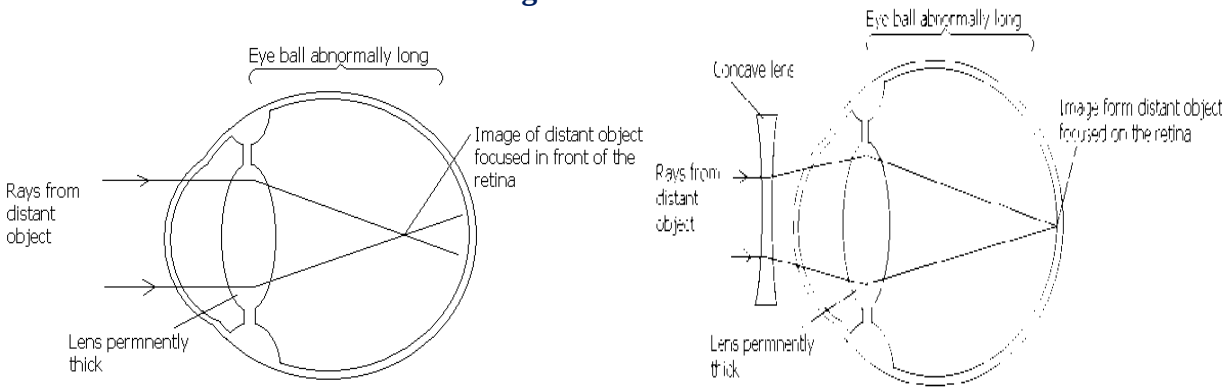
Long Sight and its Correction



Correction of short sightedness:

This is done by wearing spectacles with concave lenses, also referred to as diverging lens. Concave lenses diverge the light rays ensuring that they are focused on the retina hence the image becomes clear.

Short Sight and its Correction



6. **Investigate the common causes and methods of preventing blindness.**

Causes of blindness

Blindness has several causes but the most common causes in Zambia are discussed below:

Vitamin A deficiency

Vitamin A deficiency is the leading cause of preventative blindness in children and pregnant women. It affects the rods (which are sensitive to low light intensity) leading to less synthesis of retinal; a photo chemical substance. The rods eventually get damaged.

Vitamin A deficiency can be prevented by eating foods rich in Vitamin A such as carrots and pumpkins. Breast-feeding infants also prevents Vitamin A deficiency as breast milk contains Vitamin A.

Filarial worm infection

The adult filarial worm migrates through the subconjunctival tissues in the eyes of humans and may eventually find their way to the retina. This could result in a damaged retina. When rods are affected, it could result in night blindness.

Treatment involves killing the adult filarial worms with anti-worm medication supplied by the local clinics as well as conducting surgery to remove adult worms from the eye.

Diabetes mellitus

Diabetes mellitus can result in night blindness due to excess levels of sugar in the blood and high blood pressure that damages blood vessels in the eye.

Treatment with insulin and a healthy, low sugar diet can prevent blindness in a diabetic person.

Physical injury

This can cause blindness in babies, children and adults. Eye infection, objects in the eye, burn wounds and looking at very sharp objects can cause permanent blindness.

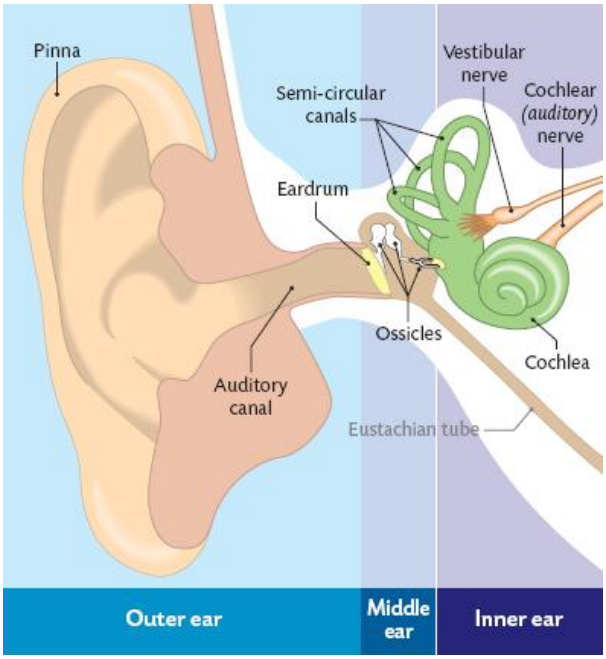
Immediate treatment at a clinic or hospital can save a person's eyesight.

Cataracts

Cataracts can cause blindness. A cataract is the clouding over and hardening of the lens of the eye due to old age, diabetes, strong sunlight and heavy smoking. Cataracts lead to hazy vision and eventually cause blindness.

Normal cataracts are cured by surgically removing the lens and replacing it with an artificial lens. Normal vision is then restored.

7. **Describe the structure of the human ears.**



The human ear is made up of outer, middle and inner ears.

Outer ear

The pinna directs sound waves into the external auditory canal. The external auditory canal has hairs and some cells that secrete wax which trap dust and micro-organisms preventing from reaching the inner part of the ear.

Middle ear

The ear drum vibrates under the impact of sound waves. The ear ossicles namely hammer (malleus), the incus (anvil) and stirrup (stapes) amplify the vibrations. The Eustachian tube balances pressure on both sides of the ear drum.

Inner ear

The cochlea is fluid filled, coiled tube that transmits vibrations from the middle ear to the sensitive nerve cells, where they are converted into a nerve signal.

Semi- circular canals are fluid –filled canals that play an important role in balance and orientation in human body.

The auditory nerve carries impulses from the ear to the brain

8. **Explain the functions of the parts of the ear.**

Part of ear	Function
Ear drum	Vibrates under the impact of sound. Forms the boundary between the outer ear and the middle ear.
Ear ossicles	The ear ossicles amplify the vibrations and form a sound transmitting bridge from the ear drum across the middle ear cavity to the inner ear. It connect the eardrum to the oval window.
Eustachian tube	Connects the middle ear to the pharynx. It allows entry or exit of air into or out of the middle, which balances the air pressure on both sides of the eardrum.
Cochlea	The cochlea is fluid filled, coiled tube that transmits vibrations from the middle ear to the sensitive nerve cells, where they are converted into a nerve signal.
semi circular canals	Contains hairs which detect changes in the position of the head relative to gravity, It is specialized in maintaining balance and posture.

9. **Describe causes and methods of preventing deafness.**

Deafness refers to the loss of hearing due to defective ears.

Causes of deafness

- infection of the ear
- Injury to the hearing centre in the brain, cochlea, and auditory canal.
- damage to the ear drum or cochlea due to very loud music loud music or quarry blasts
- Hereditary abnormality of the ear ossicles which cause non-conduction of the sound from the outer ear.

Preventing of deafness

- avoid loud noise
- use of good cleaning method

Describe the role of the skin as a sense organ

- The skin contains sensory cells which can be stimulated by changes in temperature and pressure. Some are sensitive to touch and pain. When stimulated the sensory cells send nerve impulses to the brain. The brain then gives the response either in the form of the reflex action or record an impression by which an animal is aware of the stimulus.

The skeleton and locomotion

1. **Identify various types of skeleton.**

- Types of skeleton:

Endoskeleton

Exoskeleton

Hydrostatic skeletons.

2. **Describe the functions of the skeleton.**

- Functions of skeleton:

The skeleton **support the body** by providing a rigid frame work against such forces as compression, tension and gravitational force.

It **gives shape** to the body and provides points of attachment to for muscles.

The skeleton **protects delicate internal organs** against physical injury. eg the heart and lungs protected by the rib cage, the brain protected by the skull, spinal cord by the vertebral column etc.

Structure and locomotion-muscles which contract to cause movement are attached to the skeleton.

The skeleton of an insect

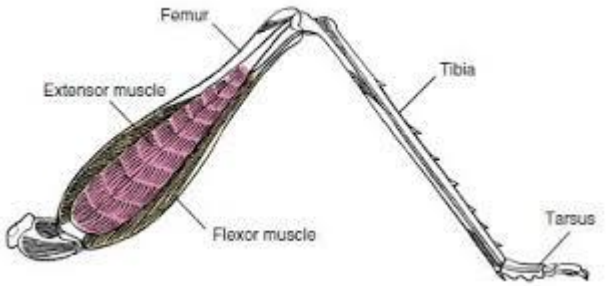
1. **Investigate the structure and composition of an exoskeleton**.

The exoskeleton of an insect is completely external to the body. Covering the body surface is a layer called a cuticle. This is a non-living structure secreted by the layers of the epidermis .The cuticle is divided into two main layers, the epicuticle (outer layer) and procuticle (inner layer).The epicuticle is a very thin layer and is covered with wax. Theprocuticle is further divided into two sub-layers, called the exocuticle and endocuticle. Both contain chitin, which strengthens the exoskeleton. Beneath the procuticle is a single layer of cells called the epidermis. The epidermis

produces cells for the upper layers of the cuticle. The epidermis enables the insect to form a new exoskeleton when it has shed the old one.

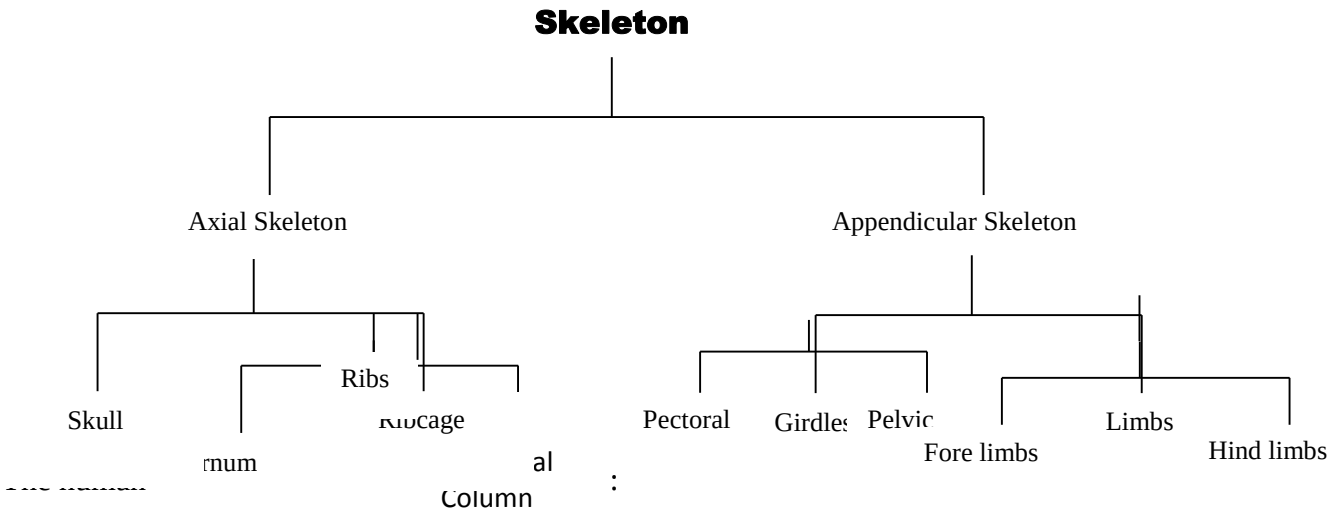
2. **Identify joints and muscles in the limbs of a grasshopper**.

- Joints and attachment of muscle (flexors and extensors) in the limbs of a grasshopper



The mammalian skeleton

1. **Identify the bones of the axial and the appendicular skeletons**.



Column :

a. Axial skeleton

b. Appendicular skeleton.

The **axial skeleton** consists of the skull and ribcage. The ribcage is made up of the sternum (breast bone), ribs and vertebral column (spine).

The **appendicular skeleton** consists of the girdles and limbs. They are two types of girdles which are the pectoral and pelvic girdles. The limbs include the fore limbs (arms) and hind limbs (legs).

2.Explain a bone as a living tissue

A bone is considered a living tissue because it consists of living cells and fibres and penetrated by blood vessels which keep the cells alive and allows growth and repair.

The spongy bone is filled with red bone marrow that forms red blood cells. The central cavity is filled with yellow bone marrow which makes white blood cells.

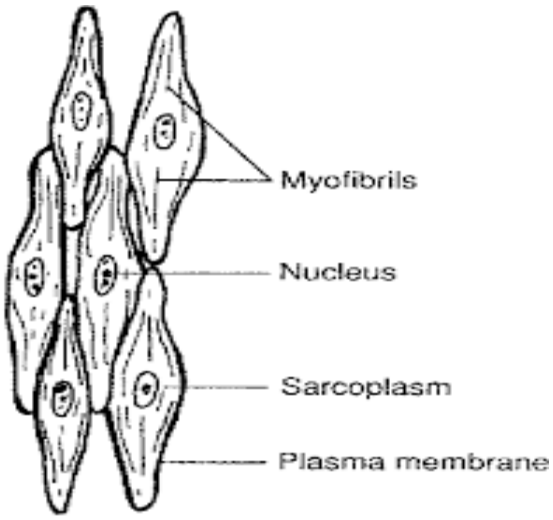
Abnormal division of cells in the bone marrow leads to cancer or leukemia. The tuberculosis bacteria can enter an infected person`s bone marrow and stay dormant even after they have been treated with antibiotics for the disease. TB bacteria are particularly likely to attack the vertebrae of the spine and the ends of long bones. If not treated, the vertebrae may collapse and cause paralysis in the limbs.

Muscles and joints

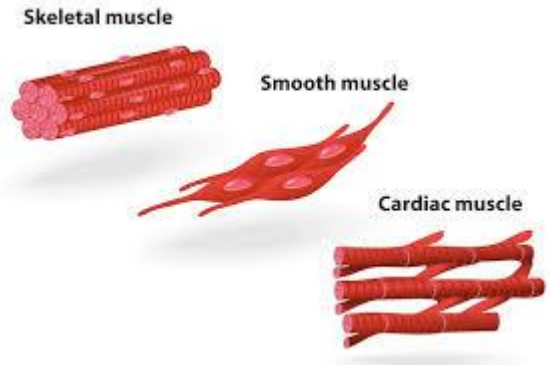
2. **Describe the structure of a skeletal muscle**.

A skeletal muscle, also known as striated/striped or voluntary muscle is spindle shaped i.e. tapers at both ends. Each muscle has long fibres. When seen under a microscope its fibres are seen to have stripes running over them. They are striped as such they are striated hence the name striated muscles.

Skeletal muscles are attached to the bones and are concerned with locomotion. They are multinucleated (each cell has several nuclei) For a muscle fibre to contract it requires energy. Each muscle fibre contains many and larger mitochondria that supply energy to the muscle through cellular respiration.



Types of Muscles



3. **Demonstrate the action of antagonistic muscles**.

Skeletal muscles occur in pairs known as **antagonistic** muscles. Antagonistic muscles are pairs of muscles which produce movement in opposite directions at the same joint.

The muscle which causes bending of the joint when it contracts is called a **flexor muscle** while the one that causes extending of the joint when it contracts is called the **extensor muscle**.

An example of antagonistic muscles are the **biceps** (extensor) and **triceps** (extensor) which act on the elbow.

The iris of the eye consists of circular and radial involuntary muscles that are antagonistic. When light intensity is high the circular muscles of the iris contract causing the radial muscles to relax. The pupil constricts (becomes smaller) and less light enters the eye. When light intensity is low, the radial muscles of the iris contract causing the circular muscles to relax. The pupil dilates (becomes wider) and more light enters the eye to enable you to see in less light.

4. **Compare the ball and socket joint and the hinge joint.**

A ball and socket joint is one which allows movement in all planes (directions) including rotational movement. The rounded head of one bone fits into a cavity in which the head of the other bone moves freely while a hinge joint is a joint which permits movement in one plane only. The depression in one bone allows the smooth condyles of another bone to fit and articulate.

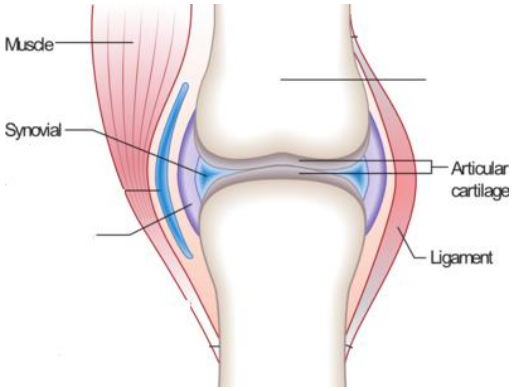
Joint Disorders

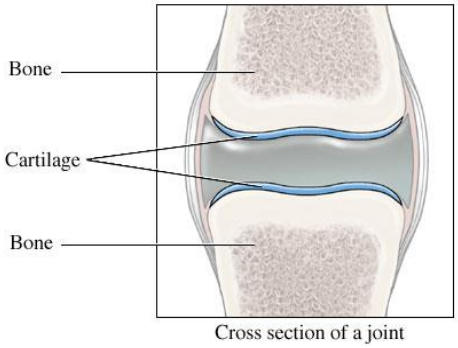
Gout- is a condition characterized by formation of uric acid crystals at the joints. It leads to swelling and paining of the joints. Uric acid is made when the body breaks down certain foods e.g

mushroom, meat, alcohol and converts some of the amino acids into uric acid. Gout attacks are more common in cooler parts of the body and also in areas that experience more use of joints such as the foot.

Arthritis- is inflammation of joints characterized by painful and swollen joints. The inflammation initially affects the synovial membrane but eventually causes damage to the cartilage and bone, making movement difficult.

5. **Identify the parts and functions of the synovial joint**





Cross section of a joint

Need study bl

Functions of the parts of a synovial joint:

- **Cartilage** prevents friction and the grinding of bone against bone. It acts as a shock absorber.
- **Ligament** connects bone to bone and prevent dislocation of the joint. They keep the joint stable.
- **Synovial fluid** is a lubricating fluid that reduces friction in the joint and allow free movement. It also supplies nutrients and oxygen to the parts of the joint and removes waste products.
- **Synovial membrane** secretes the synovial fluid.
- **Joint capsule** encloses the joint membrane.
- **Tendons** joins muscles to bone and translate muscle contraction into movement of bone.

6. **Compare the joints, muscle attachment and movement in endoskeletons with those of exoskeletons**

In endoskeletons synovial joints allow free movement in all directions. Antagonistic muscles are attached by tendons to the living bones. The relatively light, hollow bones allow efficient movement. Movement takes place in several directions and in different environments, such as water, land and the air.

In exoskeletons joints allow movement in one direction only. Antagonistic muscles are attached to special parts on the inside of the cuticle of the exoskeleton. Small insects with exoskeleton can move fast on land, in water and in the air. Large animals with exoskeletons will move slowly because a bigger exoskeleton is heavy.

Tropic and taxic responses

Tropic responses

1. **Describe what tropic response is.**

Tropic response or tropism refers to a growth movement by a plant in response to environmental stimulus,egwater,light gravity and chemicals. The direction of growth is dictated by the direction of the stimulus.This means that,a plant organ grows either towards or away from the source of stimulus.

2. Demonstrate growth responses exhibited by plants.

(a) Phototropism

This is the growth movement or bending of a plant in response to light coming from one direction. The direction or orientation of a curvature is dependent on the direction from which light originates. If the plant bends towards the direction of light, it is referred to as positive phototropism while if the curvature is away from the light it is referred to as negative phototropism.

(b) Geotropism

This is a growth response towards the force of gravity. Roots are positively geotropic while stems are negatively geotropic.

(c) Hydrotropism

This is the growth of the plant in response to water. Roots are positively hydrotropic because they grow into the soil, which provide the constant water and mineral ions.

(d) Chemotropism refers to growth movement in response to chemical substances. If the substances are not distributed uniformly in a given medium, growth curvature occurs in the direction of the concentration gradient. If the curvature is towards the higher concentration the growth response is said to be positively chemotropic while if it is towards the lower concentration, the growth response is said to be negatively chemotropic

3. Explain the effects of light energy and gravity on the growth of plants.

If a plant is exposed to light from one source the auxins migrate to the darker areas away from light. The bending of the shoot tip is caused by differential growth rates of the shoot on the different sides. There is reduced growth on the illuminated side and an increased growth on the shaded side. This is because the shaded side has higher concentration of auxin which stimulates higher growth by encouraging cell division and cell elongation. The illuminated side has a lower concentration of auxin hence a relatively lower growth rate.

In a horizontally oriented root, there is lateral displacement of auxin due to force of gravity leading to the accumulation on the lower half of the root. The high concentration of auxin inhibits cell division and cell elongation so the upper has a higher rate of cell division and elongation leading to a growth curvature of the root downwards.

Taxic Responses

1. **Describe what taxic response is.**

   This is the movement of the whole organism in response to the direction of an external stimulus. A taxis involves orientation and movement directly to or away from one or stimuli such as light

2. **Explain responses exhibited by invertebrates.**

Woodlice and cockroaches move away from light to avoid exposure and desiccation. Cockroaches and wood lice show negative phototaxis by moving away from light.

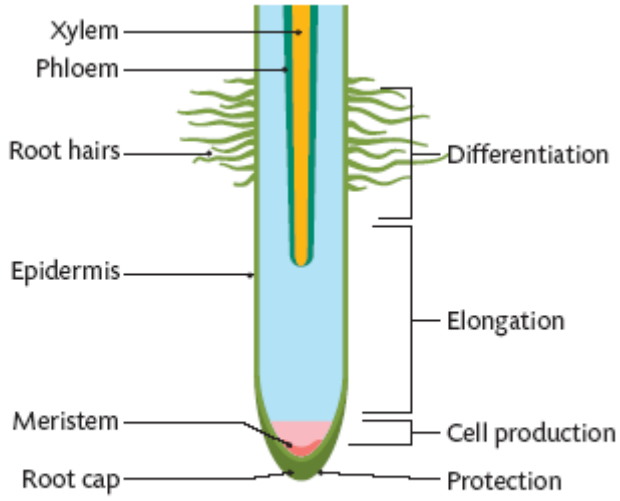
Growth and development

Growth in Plants

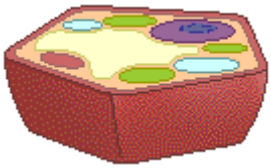
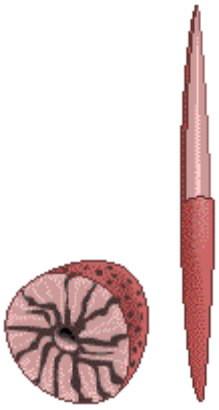
1. **Explain the meaning of growth.**

- Growth: Increase in number of cells, dry mass, complexity and size

2. **Identify the regions of growth in stems and roots.**



3. **Identify differentiated cells in plants.**

Ground Tissue	**Parenchyma Tissue**	**Collenchyma Tissue**	**Sclerenchyma Tissue ***
Function	• Photosynthesis • Food storage • Healing and tissue regeneration	• Support in young stems, roots, and petioles	• Rigid support • Protection
Cell Types in This Tissue	Parenchyma cells 	Collenchyma cells 	Sclereid cells &fibre cells 

4. **Explain the differentiation of primary and secondary tissues in plants.**

Collenchyma

Differentiation: cell walls are unevenly thickened with cellulose and cells are tightly packed together

Function in the plant: provides strength and flexibility for stems and leaves

Parenchyma

Differentiation: cells have thin walls and large vacuoles

Function in the plant: used for storage of sugar, water and starches; some contain chloroplast for photosynthesis

Cambium

Differentiation: vascular cambium is found between the xylem and phloem in vascular bundles and contains meristematic cells.

Function in the plant: responsible for the growth of xylem secondary growth and can be seen as annual rings in older stems.

Sclerenchyma

Differentiation: cells are usually dead and hollow the cells walls contain lignin to make the cells strong

Function in the plant: provides the stems of plants with strength and support

Phloem

Differentiation: consist of long columns of sieve tube cells (with no nuclei) and companion cells (other living cells)

Function in the plant: Transport of sugars

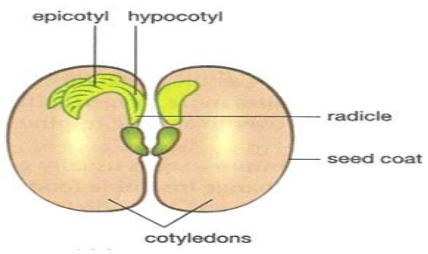
Xylem vessels

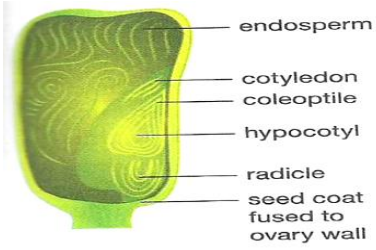
Differentiation: Develop into long hollow tubes (dead cells with no nuclei or cytoplasm) and strengthened with lignin

Function in the plant: Transport of water and strengthening of the organs

Germination and development

1. **Distinguish the structure of a dicotyledonous and a monocotyledonous seed.**





- Structure of a dicot and a monocot seed.

2. **Investigate conditions necessary for germination.**

   A water supply- germination starts with seed take up water. The seed swells up as water moves through it the increase in water increases the metabolism inside the seed.

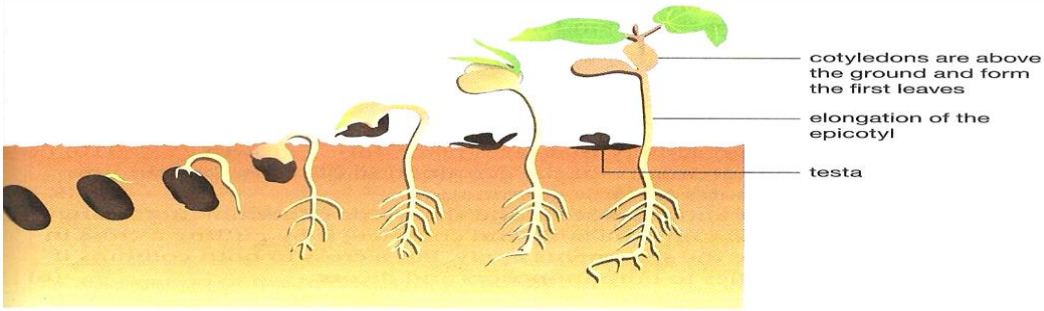
   Presence of oxygen- as the metabolism of the seed increases, respiration increase. This requires more oxygen. Although the seed respires anaerobically at first, it switches over to aerobic respiration as more energy is used by the growing seed.

   Favourable temperature-seed usually germinate in the warmer spring months. Enzymes change insoluble food stores in the cotyledons to soluble, usable food. Enzymes need a favourable temperature to work efficiently

3. **Demonstrate hypogeal and Epigeal germination.**

Hypogeal germination refers to the elongation of the hypocotyls in monocots. As the shoot develops, the cotyledons the seed remain underground.

Epigeal germination refers to the elongation of epicotyls in dicots. In seed, such as the bean seed, the cotyledons grow above the ground during germination, and they become the first photosynthetic leaves



UNIT 1.0 ASEXUAL REPRODUCTION

Reproduction in Fungi, Amoeba and Bacteria

1. **Describe the different types of reproduction.**

Ans:

Asexual Reproduction

- produce offspring from a single parent without fusion of gametes
- produce offspring by **mitosis**
- new organism exactly like its parent

Sexual Reproduction

- provides a mean of survival of the species under unfavourable conditions
- have a different genetic make-up from their parents
- a good chance for some of the offspring to adapt to the new environment
- sex cells & gametes are produced by **meiosis**
- sometimes an organism can produce both male & female gametes (hermaphrodite)
- fertilization (male gamete + female gamete) takes place which produce a zygote

2. **Describe asexual reproduction in unicellular organisms**

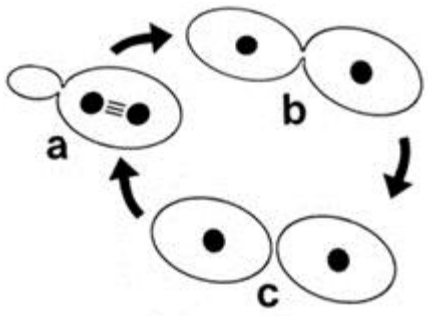
Ans:

Binary Fission (e.g. Amoeba)

1. Pseudopodia withdrawn
2. Nucleus divided into two
3. Two daughter Amoebas formed

Budding (eg. Yeast)

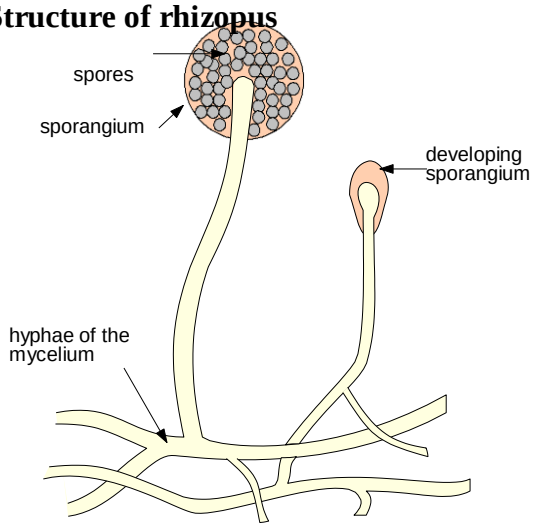
1. Parent cell produces small outgrowth
2. Outgrowth detaches from parent cell
3. A new cell formed

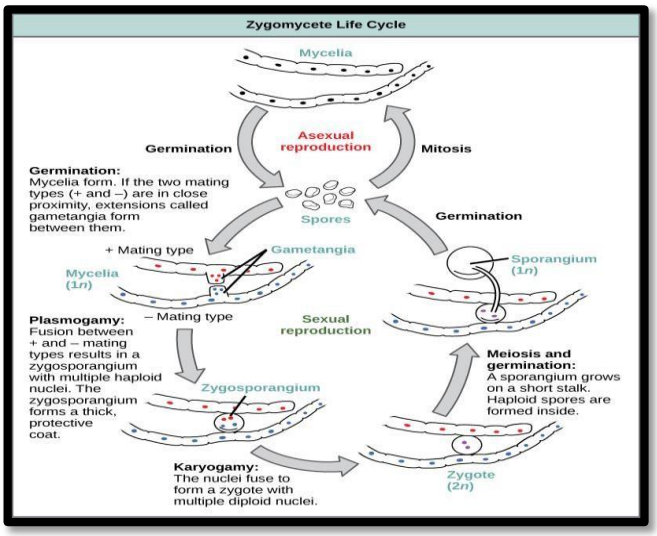


3. **Describe the sexual and asexual reproduction in fungus**.

ANS: Asexually fungi reproduce by means of spores. Once the spores are dispersed from the parents they germinate, if conditions are suitable. Sexually fungi reproduce by means of haploid cells from two different mycelia. The nuclei of the two different mycelia fuse to form a diploid zygote then meiosis occurs to form haploid spores.

Structure of rhizopus





4. **Explain the importance of fungi and bacteria**

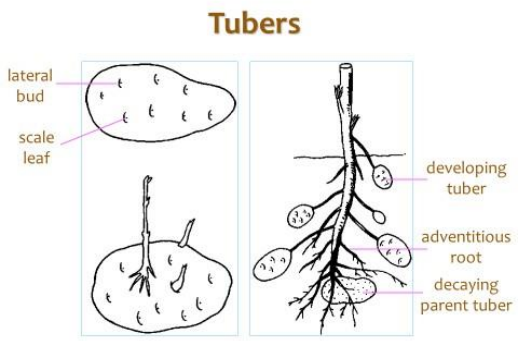
Ans: Decomposition of organic matter and nutrient recycling
Disease causing effects e.g. Ringworm and Bacillary dysentery. Production of a food and

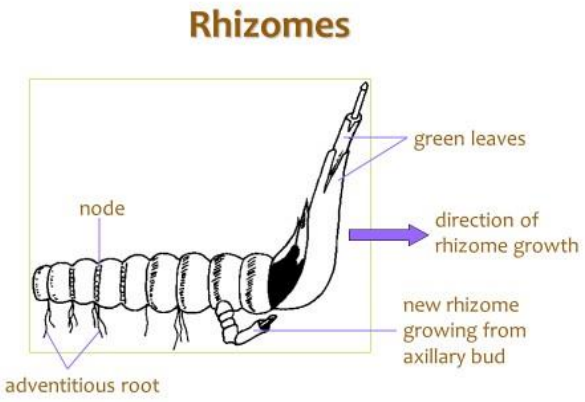
alcohol, source of food (mushroom)

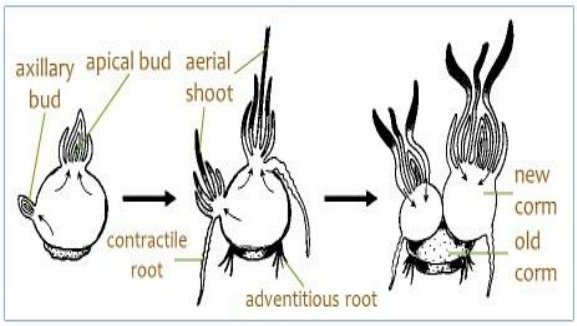
Vegetative Reproduction

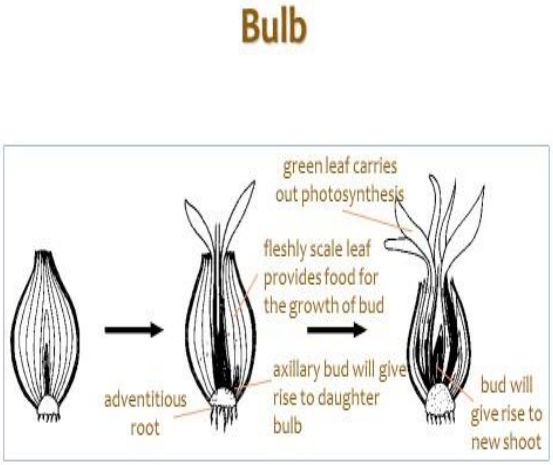
Ans: Different methods of natural propagation: Runners, rhizomes, corms, buds, suckers, stem tubers, root tubers, bulbs

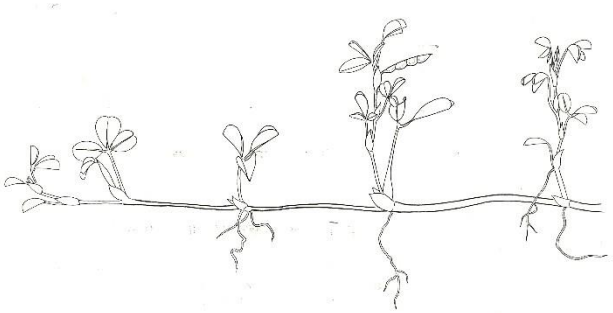
Runner











Root tubers.
This is a root that has become swollen with stored food and is able to grow into a new plant.eg sweet potatoes and carrots.

Stem tubers.
It is an underground stem that has become swollen with stored food(starch).it has buds that grow into new plants.eg Irish potatoes.

Runners (stolons)
They are horizontal stems growing above the ground. It has adventitious roots and buds at the nodes.eg lawn grass, sweet potatoes and strawberries.

Rhizomes.
It is a swollen horizontal stem found above or below the ground. It has buds that can grow into a new plant.eg ginger.

Corms.
It is a swollen base of a stem enclosed by dry, scale-like leaves.

Bulbs.
It is an underground stem, surrounded by thick fleshy leaves. It is attached to a short, fleshy stem.eg onion and garlic.

6. Investigate different methods of artificial propagation

ANS: Budding, cuttings, grafting, layering

Budding

. A new bud is developed on parent plant
2. Adventitious roots formed & absorbed water and mineral salts for young plant
3. Parent plant develops green leaves for photosynthesis
4. Food stored in a specialized underground storage organ (not transport to parent plant)
5. Bud formed for growth in next growing season
6. Aerial shoot dies down in dry season
7. Underground storage organ remains dormant till next year

Cuttings.

A process by which a piece of branch, stem, root or leaf when planted grows into a new individual plants.eg cassava,sweet potatoes,sugar canes.

Explain the advantages and disadvantages of vegetative propagation.

Advantages	Disadvantages
rapid rate of reproduction	overcrowding may occur which leads to competition for water, space & light
can retain desirable characters as offspring are genetically identical to parent	no genetic variation occurs which decreases the ability to adapt to changes in the surroundings
large food reserves are provided for daughter plants	diseases of the parent plant are rapidly transmitted to the offspring
does not involve external agents or another plant	Plants do not colonise new areas because they are not widely dispersed.

UNIT 2: SEXUAL REPRODUCTION IN FLOWERING PLANTS

2. **Describe the functions of various parts of a flower**

ANS:

Although flowers come in different shapes, forms and sizes, they have the same basic parts. The basic parts of a flower include:

Stigma, filament, style, petals, anther, ovary, sepal, receptacle and stalk.

The stigma, style and the ovary are collectively called the **Gynoecium**. The male parts are the filament and the anthers. The male parts of a flower are collectively called the **Androecium.**

The following are the functions of the parts of a flower;

ANTHERS: produce pollen grains which are the male reproductive cells of a flower,

FILAMENT: hold the anthers in the right position for pollen distribution during pollination. Filaments also contain vascular bundles which supply the neede nutrients.

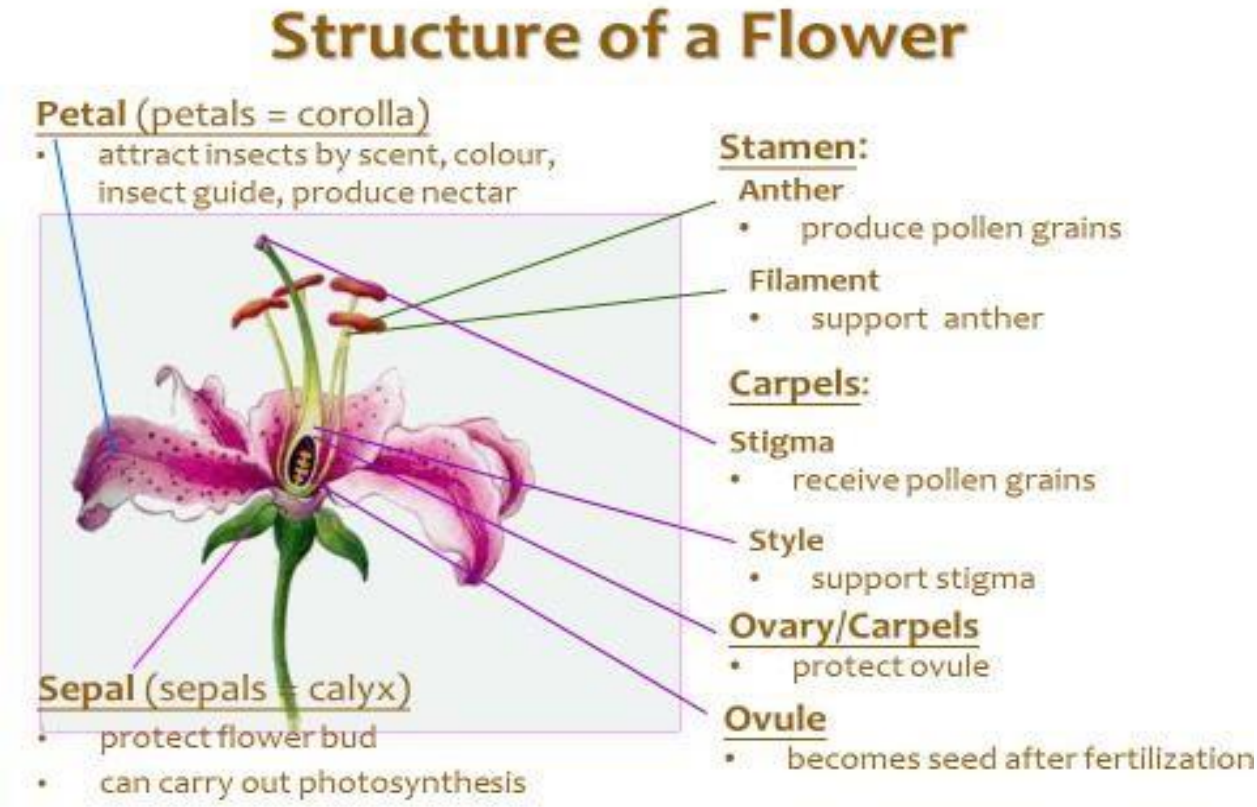
PETALS: they attract insect for pollination. They are usually bright coloured in insect pollinated flowers

SEPALS: They protect the young flower when it is still in the bud. They also contain chlorophyll hence synthesize carbohydrates for the flowers.

STIGMA: it receives the pollen grains and induce their germination into pollen tubes

STYLE: it is a tube-like structure through which the pollen tube grows down to the ovary

OVARY: it contains ovules and fertilasation takes place in their. The ovary develops into the fruit after fertilization and the ovules develop into seeds



3. **Distinguish between two different types of pollination.**

Ans : **Self-pollination** this is the transfer of pollen grains from the anthers to the stigma of the same flower or different flower of the same plant species while **cross pollination** is the transfer of pollen grains from the anthers to the stigma of another plant of the same species.

Note self-pollinated flowers have the following characteristics

Bisexual, hermaphrodite flowers, for example marigold
Anthers and stigmas ripen at the same time e.g. tomatoes
Flowers remain closed until fertilisation has taken place e.g. garden peas
The flowers are buried in the ground e.g. groundnuts

4. **Distinguish between wind and insect pollination**

Wind-Pollinated Flower	**Insect-Pollinated Flower**
• generally small & inconspicuous • green or dull coloured, or no petals at all • no nectar • no scent • anthers hanging out of the flower • stigma is large & feathery, exposed for catching pollen grains • having large number of pollen grains which are lighter & with smooth surface • flowers sometimes appear in colder & drier season	• generally larger & conspicuous • brightly coloured, often with insect-guide • nectaries often present at the base of flower which produces nectar • often strongly scented • anthers found inside the flower • stigma found inside the flower • having small number of pollen grains which are rougher & heavier with spikes • flowers appear in warmer season

5. **Describe the process of fertilization in flowers.**

Ans: Fertilization

- fusion of male gamete & female gamete to form a zygote

Process

pollen grain lands on a stigma and then secretes sugary solution

- stimulates the development of pollen tube which grows down the style & ovary
- secretes enzyme to digest a pathway through style
- liberates male gamete in ovary & fuse with egg cell

6. **Investigate ways in which seeds and fruits are dispersed**.

Seed and fruit- dispersal is mainly by water, wind, animals and self-mechanism.

7. **Explain the adaptation of fruits and seeds to mode of dispersal**.

Ans: Different types of dispersal:

By animal

Possess spines & hooks which cling to animals' fur protected by hard seed coat which resists the action of animals' digestive juice after eaten

By wind

Some fruits are light & have large surface area to catch wind.

Others: by explosion, by water

Explain the importance of fruit and seed dispersal.

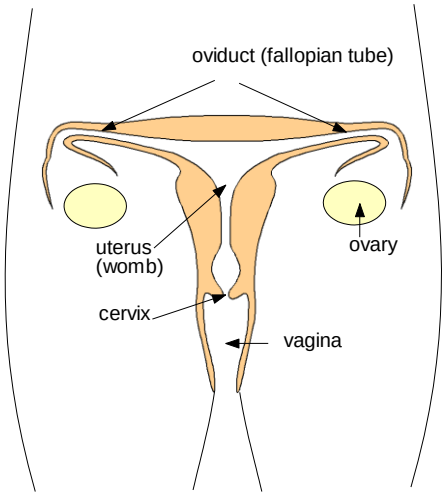
Importance of dispersal: For plant propagation, plant preservation and survival

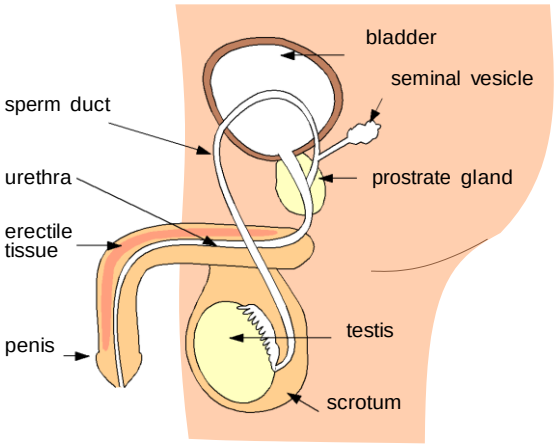
UNIT 3: REPRODUCTION IN ANIMALS
Sexual Reproduction in Animals

1. **Describe the process of reproduction in a frog**

Frogs reproduce in water, male frogs call to attract females. It induces the female to release her eggs in water and the male frog releases the sperms over the eggs. This is called external fertilisation because it takes place outside the females' body. There is no parental care once the eggs have been laid. Each egg contains egg York rich in food needed in for development of the embryo. The egg hatches into a tadpole. It has external gills and eat planktons small plant particles.

2 **Identify male and female reproductive organs in human beings.**
Ans:





2. **Explain the functions of the different organs of the human reproductive system**

Ans:

FALLOPIAN TUBES (OVIDUCT) The fallopian tubes are about 12 cm long and have ends that are funnel shaped. These ends collect the egg after ovulation. Cilia and peristalsis move the egg along the tube. The egg will die in the tube if it is not **fertilised**.

UTERUS: The uterus, also known as the **womb**, is made of involuntary muscle. It is lines with the **endometrium**. This lining thickens with cells and blood every month. This happens in order to nourish the embryo (if present).

CERVIX: The opening of the uterus is called the **cervix**. The cervix separates the vagina from the uterus

VAGINA: The vagina is a muscular tube which allows the sperm to enter the female as well as the baby to exit. It is lined with **mucous** secreting cells.

URETHRA The **urethra** opens near the vagina. The vagina is protected by folds of skin called the **vulva**. The **hymen** partially blocks the entrance of the vagina. It is broken by **sexual intercourse** or with the use of **tampons**

MALE REPRODUCTIVE SYSTEM

Testes (Singular-Testis)

- **Pair of structures that produce sperms (Spermatozoa) and testosterone hormone.**

- **The scrotum hold the testicles outside the body to keep them at a temperature slightly lower than that of the body for effective production of sperms.**

- **Each testis is made up of seminiterous tubules which is the actual site for sperm production.**

Sperm Duct (Vas deferens)

It is a mascular tube that carries sperms from the epididymis to the urethra.

Urethra

It is a tube that carries semen from the sperm duct and urine from the bladder.

Prostate Gland

It secretes an alkaline fluid that enables the sperms to swim in as it moves. The fluid contains an enzyme that makes the sperm more active and neutralize the acid in the urethra.

Cowper's Gland

Produces thick, clear mucus that forms part of the fluid part of semen.

Seminal Vesicle

It secretes a thick, clear fluid that contains nutrients that nourishes the sperm.

Penis

- **The penis deposit semen into the vagina during sexual intercourse.**

Describe the biological changes associated with sexual development in human beings

At puberty, oestrogen causes the primary female sexual characteristics of the growth of the sex organs.

At puberty both oestrogen and progesterone cause the secondary female characteristics. They include:

a. The enlargement of the breasts b. Widening of the hips
c. Increased body fat
d. Growth of public and underarm hair
e. General growth spurt in height

3. **Describe the menstrual cycle**.

Ans: The **menstrual cycle** occurs every 28 days from puberty to **menopause** (the end of the female's reproductive life). It occurs only if fertilisation of the egg has not taken place.

The typical events of the **menstrual cycle** are:

Day 1 to day 5-

a. The **endometrium** breaks down and is shed from the body. This is called **menstruation.**
b. **Meiosis** occurs in the ovary to produce a new egg surrounded by the **Graafian follicle**.

Day 6 to day 13-

a. **Oestrogen** is produced by the **Graafian follicle**. Oestrogen also stimulates the endometrium to thicken again. One Graafian follicle with one egg develops.
b. Oestrogen stimulates the **production of LH** (leuteinising hormone

Day 14-

a. The surge of **LH** stimulates **ovulation.**
b. The egg enters the funnel of the Fallopian tube. It can be fertilised for the next 48 hours.

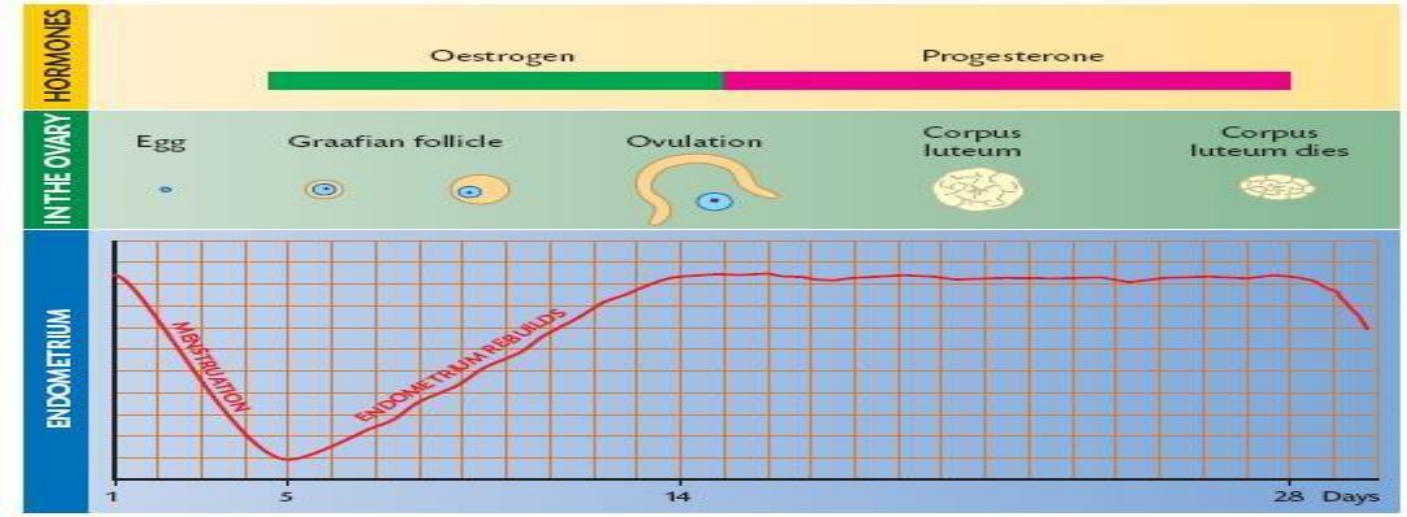
Day 15 to day 26-

b. The **corpus luteum** (yellow body) develops from the remains of the Graafian follicle. This produced **progesterone** and some **oestrogen**. The progesterone causes the endometrium to continue to thicken. It also prevents new eggs from forming.

c. The egg that was released at day 14 will die if it is not fertilised.
d. If fertilisation did not take place the corpus luteum begins to degenerate.

Day 26 to day 28-

a. Oestrogen and progesterone levels decline. b. The endometrium begins to break down.
c. **Day one** of the cycle begins.



4. **Explain the processes of fertilisation and implantation in human beings**.

Ans: Copulation is also called **coitus** or **sexual intercourse**. During this process the **penis** moves into the **vagina** in order to deposit **semen** which contains **sperm cells**. The depositing of the semen is called **insemination**.

FERTILISATION (EVENTS OF FERTILISATION)

a) After **insemination** the sperm will move up the **Fallopian tubes**.
b) If **ovulation** has occurred and an egg is present the egg will release a chemical that attracts the sperm. This is called **chemotaxis**.
c) The sperm that reaches the egg will use an **enzyme** in its **acrosomes** to make an opening in the membrane of the egg.
d) Once **one sperm** enters the egg (only the head enters) the egg forms a **membrane** that prevents other sperm from entering.
e) The nucleus of the egg fuses with the nucleus of the egg. A **diploid zygote** forms.
f) Fertilisation may take place during days 11-16 of the menstrual cycle.

IMPLANTATION

About 6-9 days after fertilisation the fertilised egg becomes **embedded** into the lining of the **uterus**. The zygote has now become an **embryo**. A membrane called the **amnion** develops around the embryo. This membrane will secrete **amnion fluid** which surrounds and protects the embryo

5. **Identify causes of infertility in human beings**

Ans:

MALE INFERTILITY

The most common cause of male infertility is the low production of sperm. There are many causes of low sperm production. Stress, alcohol and drug abuse, high temperature of the testes, and low testosterone production are all causes

FEMALE INFERTILITY

Female infertility is the inability to conceive either by fertilisation failure or implantation failure. Egg cell formation or ovulation may not occur due to a **hormone imbalance**. The egg cell may not be able pass to the uterus due to **blockage of the Fallopian tubes**. Treatment with **hormones** may be successful. **In-vitro fertilisation** and **implantation** is often used to treat female infertility.

Describe development of the embryo in the uterus.

EARLY DEVELOPMET OF THE ZYGOTE

1. The zygote divides many times by **cleavage** (increase in the number of cells by division but no overall increase in size) to double its cell number. A solid clump of about 100 cells called the **morula** is formed.

2. About 5 days after fertilisation the morula develops into a hollow ball called a **blastocyst**. The outer cells of the blastocyst form the **trophoplast.** This will become the membranes around the embryo. The inner cells, called the **inner mass** will become the **embryo**.

3. The blastocyst is pushed down the fallopian tube and into the uterus for implantation.

The **Gestation period** is the length of time from fertilisation to birth. In humans it is generally 266 days (38 weeks/9months)

6. **Describe health risks associated with foetal development**

Ans Health Risks: Poor nutrition, smoking, alcohol and drugs/ herbal medicines during pregnancy

Describe healthy pregnancy and safe child birth

Healthy pregnancy: Antenatal services, good nutrition, exercise, giving birth at a health facility and birth Control.

7. Explain some methods of birth control

Method of birth control: Refer to mechanical (Condoms, IUDs) surgical, hormonal and natural

Methods	
Natural Methods	**(i) <u>Abstinence</u>** - Not having sex - Protects against sexually transmitted diseases. - 100% effective or reliable **(ii) <u>Rhythm Methods (knowing the calendar)</u>** - Couples not having sex in the days before, during and after ovulation. - Not reliable because the menstrual cycle is not consistent. **(iii) <u>Withdrawal Methods</u>** - The man pulls out the penis out of the vagina just before ejaculation. - Not reliable because the fluid the man releases before ejaculation contains traces of spermatozoa. **(iv) <u>Douching</u>** - Water used to wash the semen out of vagina - Not reliable
Mechanical Methods (Barrier)	**(i) <u>Condoms</u>** - A thin latex sheath fitted around the erect penis or inserted into the vagina. - Condoms prevent sperms from being deposited into the female's vagina. - It protects against sexually transmitted diseases. It is very reliable if properly used. (ii) Diaphragm (Cap) - A thin latex fitted over the cervix to prevent sperms entering uterus. - Must be fitted by a doctor - More reliable when used with spermicides **(iii) <u>Intrauterine Device (IUD)</u>** - It is a device made with copper coated with plastic - It is usually coilled or T-shaped. - Must be fitted by a health professional inside the uterus.

	- It affects the lining of the uterus so that implantation does not take place. - It can remain in the body up to 10 years - Can cause discomfort if wrongly placed. - It is reliable
Hormonal Methods (Chemical)	**(i) <u>Contraceptive Pills</u>** - Contains oestrogen and progesterone which prevent ovulation. - They are reliable if taken according to prescription. - May have side effects eg Nausea menstrual cycle, weight gain. **(ii) <u>Contraceptive Injection</u>** - It contains oestrogen and progesterone and given in form of an injection. **(iii) <u>Spermcides</u>** - They are inform of creams, that are applied in the vagina to kill sperms - They are reliable if used with the diaphragm
Surgical Methods	**(i) <u>Vasectomy In Males</u>** - It involves cutting and tying the sperm ducts. - Semen is produced but does not contain sperms - Sexual characteristics not affected since testosterone is released in the blood stream. - It is permanent - It is very reliable **(ii) <u>Tubal Ligation In Females</u>** - The oviduct is cut and tied to prevent sperm cells from reaching the eggs - Sexual characteristics not affected - It is permanent - It is very reliable.

Describe the benefits and possible risks of using contraceptives

Benefits and Risks of Contraceptives: Benefits: Planned families, Risks: side effects (Disturbed menstrual cycle, weight gain, and hormonal imbalance)

UNIT 4: GENETICS

Genetics: the study of how characters are transferred or inherited from one generation to the next

Variation in Plant and Animal Species

1. **Describe terms used in the study of genetics**

Terms used in the study of genetics:

Gene: A gene is a short length of DNA on a chromosome which is a unit determining an inherited character

Alleles: Alternative forms of genes on the same position of the homologous chromosomes which control the same character but have different expressions

Chromosome: Genetic materials found inside the nucleus of a cell

Genotype - the genetic composition

Phenotype - the external appearance

Homozygous (pure-breeding)with the same alleles in the same character

Heterozygous (hybrid) with different alleles

Dominant gene (or character)
which expresses its effect even in heterozygous condition

Recessive gene (or character)
which expresses its effect only in homozygous condition

- **Pedigree**
  - it shows the inheritance of one or more characters in different generations

Test cross
cross the organism with dominant character to an organism with homozygous recessive character
to test whether the organism with the dominant character is homozygous or heterozygous

- **Back cross**
  - cross an organism with one of its parent

2. **Describe the variations in human beings**.

Variation: the differences between individuals of the same species

Variation in human being: Eye colour, skin colour, finger print, tongue rolling, height

Observe variations in flowering plants

Variations in flowering plant: Fruit structure and scent, height (tall, dwarf. Include leaf size, shape, and weight).

3. **Distinguish between continuous and discontinuous variations.**

continuous variation

- with a continuous range of intermediate values
- eg. height, weight, intelligence quotient, heart beat

discontinuous variation

- the character is clear-cut & not showing intermediates
- eg. tongue rolling, ear lobes and colour of corn

4. **Describe the factors that cause variations among plant and animals of the same species.**

Meiosis

homologous chromosomes separate independently from each other and pass into a different gamete (INDEPENDENT ASSORTMENT). As a result, a great variety of gametes are produced

- **Random Fertilization**
  - since fertilization is a random process, there are many possible different combinations of genes in a zygote

Mutation

genetic make-up may suddenly change
sometimes occur naturally
rate may greatly increase if the organism is exposed to radiation, certain chemicals or neutron bombardment
most mutation are harmful

- **Environmental Factors**

cause variation in characters with continuous variation Factors that cause variations include climatic factors, nutrition and soils.

Cell Division and Chromosomes

5. **Describe the stages of cell division.**

The stages of cell division

(i) Mitosis – Number of cells increase, chromosome number remain constant.

- The cell undergoes repair
- Chromosome are invisible

(ii) Prophase - Chromosome are thick and short
-Chromosome are visible under a microscope
-The nuclear membrane is present

(ii) Metaphase - Nuclear membrane disappear

- Chromosomes lie along the equator
- Spindle fibre are formed

(iv) Anaphase -Chromatids are separated and pulled at the opposite poles
-No nuclear membrane

(V) Telophase – The cell membrane divide
-Nuclear membrane surrounds the chromosome at the opposite poles.

(i) Prophase- Homologous chromo song pair up to form Bivalents. Bivalents form cross-over of chromatid. During cross-over, genes are exchange resulting in different semes.

(ii) Metaphase -Homologous pairs of chromo song lie along the equator
-Nuclear membrane disappears
-spindle fibres appear

(iii) Anaphase - Homologous chromosomes separate and pulled to the opposite poles
Points of gene exchange are shared. It is a source of variation in organisms.

(v) Telophase -The nuclear membrane develops around the chromosomes at each end
-the cell membrane divides into two daughters.
The two daughters then under so second meiotic division to produce four daughter cells three of the four degenerate

Interphase
The nucleolus and the nuclear envelope are distinct and the chromosomes are in the form of threadlike chromatin.

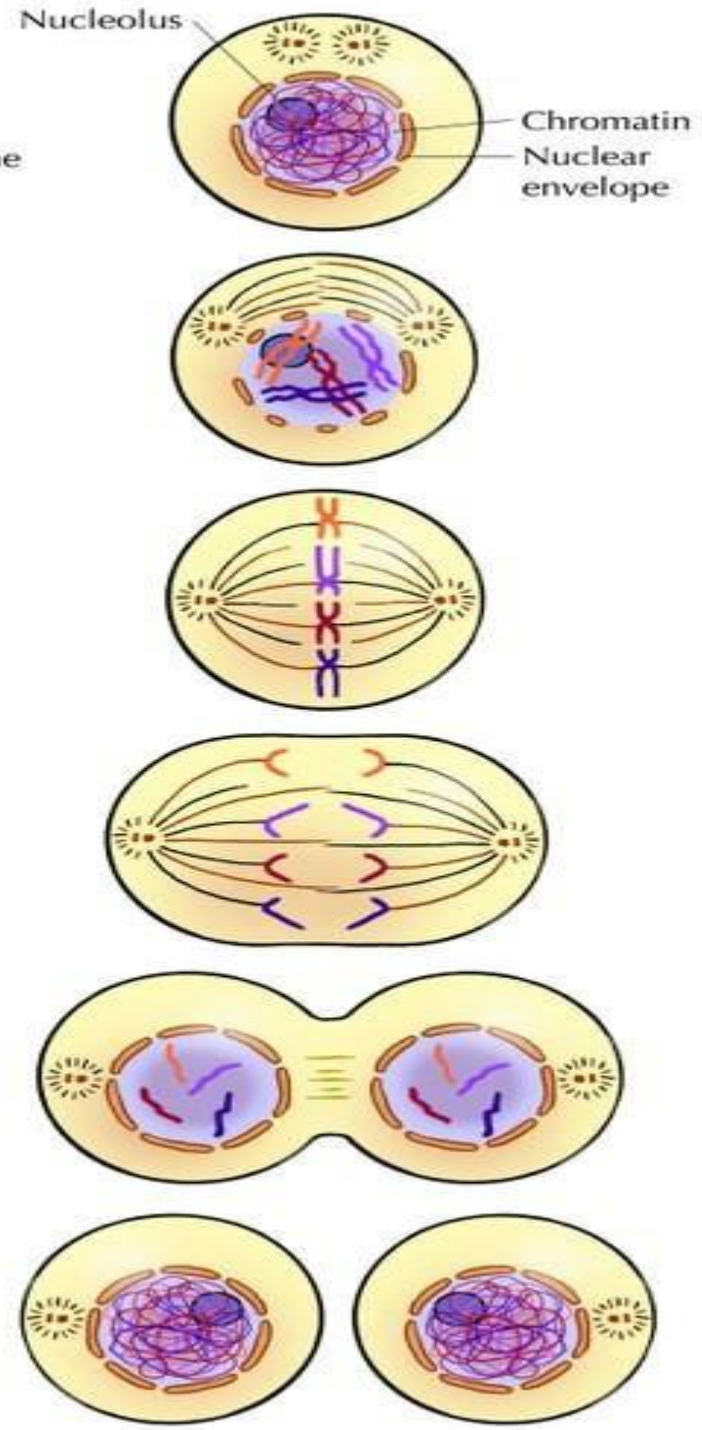
Prophase
The chromosomes appear condensed, and the nuclear envelope in not apparent.

Metaphase
Thick, coiled chromosomes, each with two chromatids, are lined up on the metaphase plate.

Anaphase
The chromatids of each chromosome have separated and are moving toward the poles.

Telophase
The chromosomes are at the poles, and are becoming more diffuse. The nuclear envelope is reforming. The cytoplasm may be dividing.

Cytokinesis (part of telophase)
Division into two daughter cells is completed.



1. **Explain the importance of mitosis and meiosis**.

Mitosis

Maintains the gene constituent, this leads to having pure breeds. It brings about growing of new tissues and replacement of cells. It brings about the increase in size of an organism, growing. Mitosis causes asexual reproduction in single called organisms such as amoeba.

Meiosis

It brings about the formation of six cells it brings about the development of new varieties of organisms due to Gross-over and random pairing of chromosomes.

Distinguish between mitosis and meiosis.

In mitosis there is only one cycle of division while in mitosis there are two cycles.

In mitosis two daughter cells are produced at the end while in meiosis there are four daughter cells.

Mitosis takes place in somatie cells while meiosis takes place in reproductive organs such as ovary and treverdes

In mitosis pure breeds are produced while in meiosis new hybrids are produce

6. Explain the importance of mitosis and meiosis

	Mitosis	**Meiosis**
Number of division	1	2
No. of daughter cells produced	2	4
Type of cells produced	Somatic (body) cells	Gametes (sex cells)
Chromosome number of daughter cells	Same as parent cell (diploid)	Half of parent cell (haploid)
Pairing of homologous chromosomes	No	Yes
Occurrence	Growing tissues	Reproductive tissues (gonads)
Role	For growth and replacement	For gamete formation

Produce haploid gametes which, after fertilization, can restore normal diploid conditions

Produce genetic variations

Inheritance

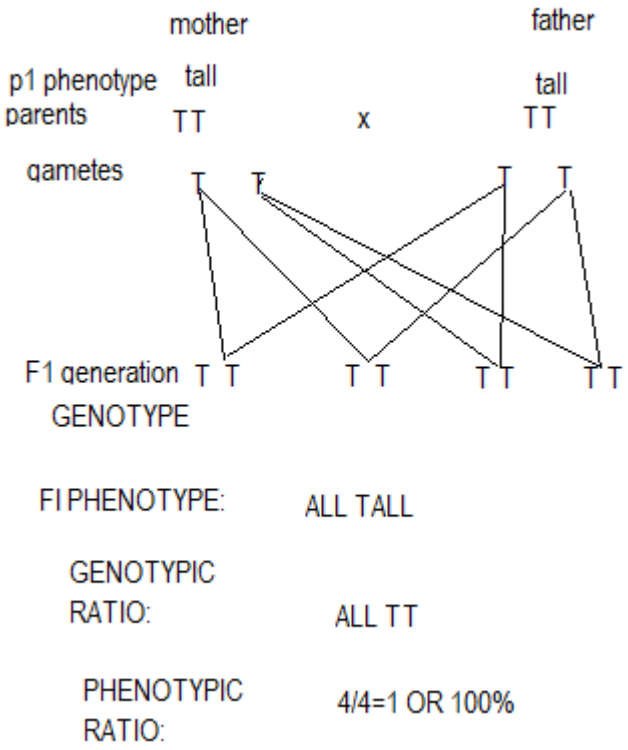
7. **Explain what a monohybrid inheritance is**.

Monohybrid Inheritance:

- The inheritance of just one pair of contrasting characters
- Cross 2 pure breeding parents with contrasting characters

Demonstrate the inheritance of characteristics using the crossings

If a homozygous tall female mates with a homozygous tall male, all the offsprings will be tall. The genetic diagram below illustrates this;



8. **Explain the factors that determine the sex of a human being.**

in humans, sex is determined by sex chromosomes

male : XY chromosomes

female : XX chromosomes

- chromosomes other than sex chromosomes somatic chromosomes which control normal body characters
- 22 pairs are identical in both sexes (human)
    - autosomes
- The 23rd pair is different in male and female
    - sex chromosomes

9. **Explain the inheritance of sex linked characteristics.**

Ans:All the genes carried on the sex chromosomes are transmitted along with those determining the sex of an organism- a characteristics is sex linked if the gene that controls it is found on the X or Y chromosome. Examples of sex linked characteristics in humans include red-green colour blindness, haemophilia and hairy ears

10. Describe the mechanism of ABO blood groups inheritance

Ans: The A, B, AB or O phenotype is determined by three alleles designated I^A, I^B and I^O. I^A and I^B are both dominant to I^O, but I^A and I^B are co-dominant. Therefore individuals with alleles I^A and I^B will have AB blood group.

11. Describe what mutation is

permanent changes in structure of chromosomes and genes
Identify the causes of mutation.

12. Explain effects of mutation

Causes of mutation: Natural radiation (nuclear emission, and x-rays, ultra-violet light.

Describe the uses of mutations

Uses of mutations: Induced mutation in Agriculture. (Polyploidy plan

UNIT 5: CLASSIFICATION OF PLANTS AND ANIMALS

Classification:

Classification is the grouping of living organisms according to similar structures and functions.

Taxonomy: the science of describing, naming, and classifying organisms

1. **Identify various types of plants**.

Ans: Types of plants: **Chlorophytes** (Algae), they are autotrophies, convert nitrogen from waste into usable form. **Bryophytes** (mosses, ferns), are multicellular, autotrophies, shade loving and water loving, reproduce by spore formation, have no vascular system, anchored by rhizoids. **Coniferous** plants (pine trees) have needle like shaped leaves with a thick waxy cuticle, seeds enclosed in cones and not fruits and **flowering plants** (bougainvillea) seeds found in fruits, have flowers.

2. **Identify various types of animals.**

Ans; Types of mammals.eg giraffes, human beings. **Athropods** eg crabs cockroaches, locusts, ticks and spiders. Have an exoskeleton made of chitin, segmented body with jointed legs and wings, have compound eyes. **Amphibians** eg frogs, toads and salamanders. Live on water and land and limited to damp areas. Need water to reproduce. **Reptiles** eg snakes, lizards, crocodiles, turtles and tortoises. Lay eggs, their bodies covered with dry scales. **Birds**, internal fertilization, lay eggs, have a strong, light skeleton that allows flight with wings. Bodies covered with feathers and scales feet. **Protozoans** differ in shape, size, how they feed and move. They are classified in four groups. Amoeba, ciliates, flagellates and sporozoans.

3. **Formulate a simple key for classification of plants and animals.**

Ans: Simple key for classification is known as Dichotomous keys. It involves a series of linked steps involving a choice between two features. It is a tool used by biologists to **identify** an unknown organism

It is simply a series of **paired** statements of anatomical description that leads to an **identification**

4. **Use a simple classification key to identify plants and animals**.

Dichotomous key for identification of animals

1. a) animal has a spine……..go to 2
   b) animal has no spine……..…invertebrate
2. a) animal has no gills and fins……..…. go to 3
   b) animal has gills and fins…….. Fish
3. a) animal has no scales…….....go to 4
   b) animal has scales……..….reptile
4. a) animal has feathers ……..bird

b) animal has no feathers ……..go to 5
5. a) animal has hair…….mammal
b) animal has no hair……..amphibian

Dichotomous key for identification of plants

1a Fruits occur singly ..... Go to 3
1b Fruits occur in clusters of two or more ..... Go to 2
2a Fruits are round ..... Grapes
2b Fruits are elongate ..... Bananas
3a Thick skin that separates easily from flesh .....Oranges
3b Thin skin that adheres to flesh ..... Go to 4
4a More than one seed per fruit ..... Apples
4b One seed per fruit ..... Go to 5
5a Skin covered with velvety hairs ..... Peaches
5b Skin smooth, without hairs ..... Plums

UNIT 6: THE SOIL

1. **Demonstrate soil composition.**

Ans: Soil composition: a typical soil comprises two main constituents
(i) Organic materials: these are soil organisms and humus which is formed from plant and animal remains.
(ii) Inorganic materials: these include mineral particles, water, air and dissolved mineral salts.

2. **Describe the types of soil and their properties.**

Ans:Types and Properties of soil: types; Clay, Loam and sand soils
A soil sample is classified in terms of the size of its mineral particles. The size of these particles determine the contents and properties of a soil sample.
The main types of soil include;

I. **Sandy soil**; this is a soil that contyains mopre tghan 70% sand and less than 20% clay. It is course in texture with particles between 0.002 mm and 2mm in diameter

Properties

- ❖ It forms large air spaces which make water to drain fast
- ❖ It has poor capillarity
- ❖ It was poor water retention
- ❖ It is alkaline in nature.

II. **clay soil;** the soil contains more than 30% clay and less than 40% sand. Clay particles are 0.002mm or smaller.

Properties

- ❖ It has very small spaces between them and holds very little air.
- ❖ In clay soil, water drains slowly
- ❖ It has good capillarity and retains moisture
- ❖ It is acidic in nature

III. **Loamy soil;** it contains 40-70% sandy and 20-40% clay soils. The particles in loamy soil are smaller than sandy soil.

Properties

- ❖ It has good aeration and drainage
- ❖ It has good mineral and water retention
- ❖ It has high humus content giving it a good crumb structure
- ❖ The PH of loamy soil is around neutral.
- ❖ It is good for agriculture.

3. **Describe factors that make soil fertile.**

Ans: Factors that make soil fertile: Air, micro organisms, moisture, mineral elements, organic matter, pH

4. **Investigate causes of loss of fertility in soil**.

Ans:Causes of loss of fertility in soil: Deforestation, poor farming methods, late burning, overgrazing, leaching, harvesting

5. **Explain methods of improving and retaining soil fertility**.

Ans:Methods of improving and retaining soil fertility: Suitable pH, weeding, application of fertiliser, crop rotation, conservation farming

UNIT 7: ECOLOGY

Biotic and Abiotic Interactions

1. **Explain the term ecology**.

Ans: Ecology: is the study of relationships that organisms have with each other and their environment.

2. Explain the terms used in ecology

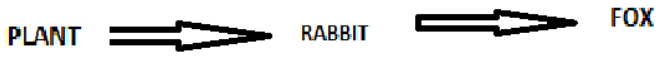
Ans:

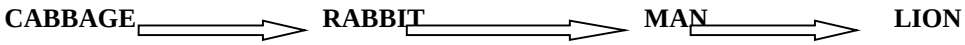
- **Habitat**: the place where an organism lives. An **organism** in any habitat is never an independent unit.
- **Ecological niche**: the function of an organism or the role it plays in the habitat.
- **Population**: a group of individuals of the same species occupying a given area at a given time.
- **Community:** when different populations of plants and animals live together and interact within the same environment
- **Ecosystem**: an ecological system formed by the interaction of living organisms and their non-living environment (both biotic and abiotic factors)
    - A functioning ecosystem uses both energy and materials (inorganic nutrients)

Feeding Relationships and Energy Flow

3. **Design a food chain**.

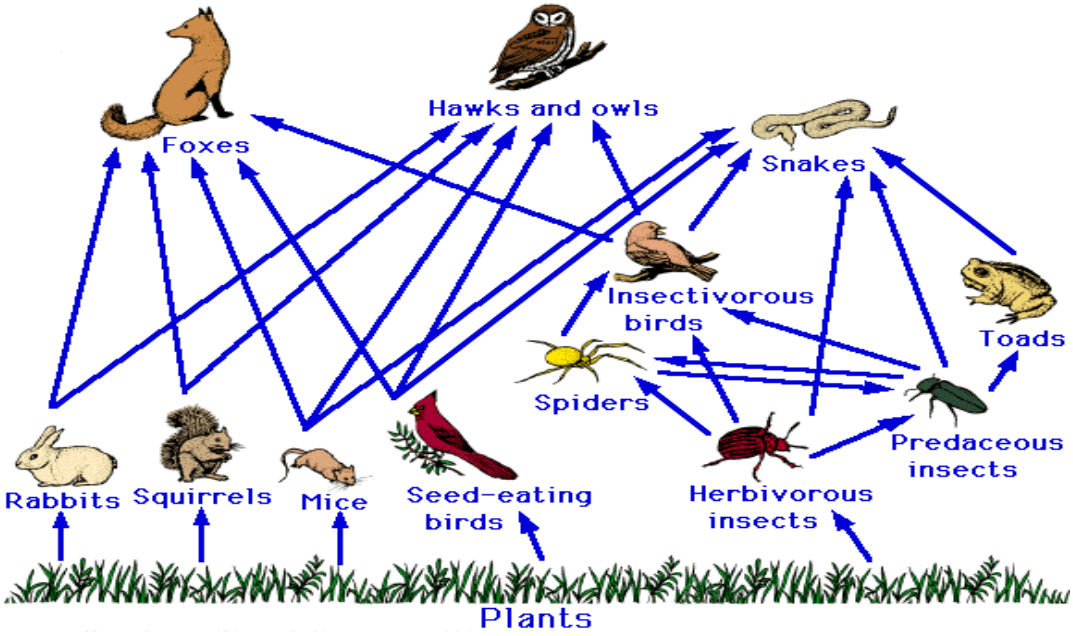
b. **Ans:**





A food chain is a sequence of feeding relationships that begins with producers and involves at least three organisms. In every food chain the producers occupy the first trophic level, the primary consumers occupy the second trophic level, and the secondary consumers occupy the third trophic level and so on.

4. Design a food web.



Ans:

5. Describe the way energy flows along food chains and food webs.

Ans:

A food chain is a sequence of feeding relationships that begins with producers and involves at least three organisms. Energy from the sun is converted into chemical energy that other organisms can eat as food. This means that it is transferred through the entire food chain until it reaches the top most consumers .In every food chain the producers occupy the first trophic level, the primary consumers occupy the second trophic level, and the secondary consumers occupy the third trophic level and so on.

6. **Describe the efficiency of energy transfer between trophic levels**.

Ans:

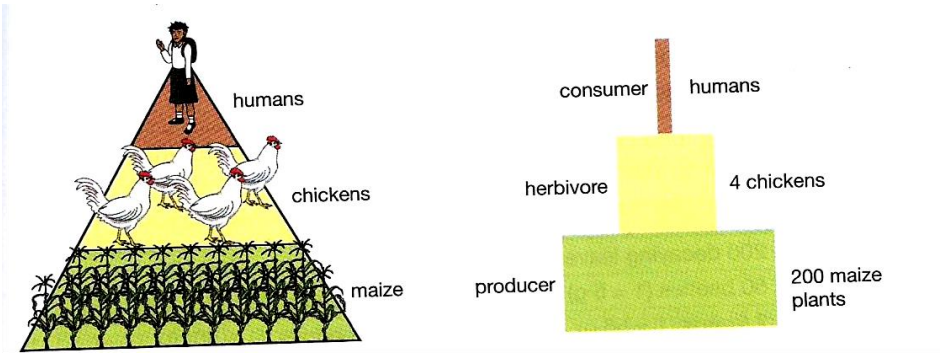
In the process of being transferred from trophic level to another, 10% of energy is passed on to the next while 90% of the energy is lost through respiration, egestion and excretion. By the time a food chain reaches the fourth trophic level there is very little energy available for any higher level.

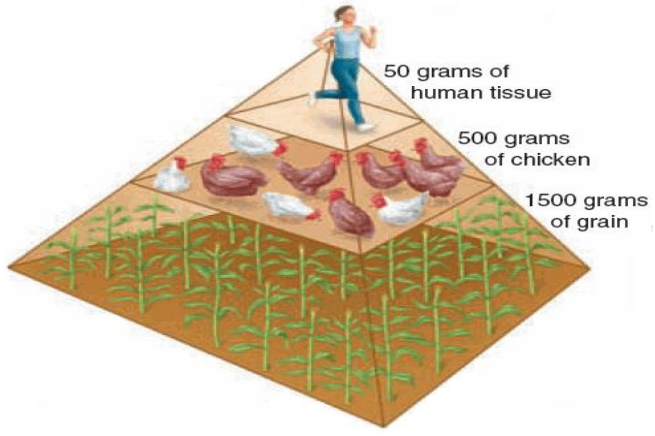
7. What are the differences between a food chain and a food web?
   A food chain consists of one sequence of feeding relationships while a food web consists of several interlinked sequences of feeding relationships. Each organism occupies only one trophic level in a food chain while in a food web an organism may occupy more than one trophic level except the producers. A food chain usually involves fewer organisms than a food web.
8. **Construct pyramids of numbers, bio-mass and energy**

Ans:

Pyramids are graphic representations of the relative amounts of energy or matter at each trophic level. May be: Energy Pyramid, Biomass Pyramid OR Pyramid of Numbers

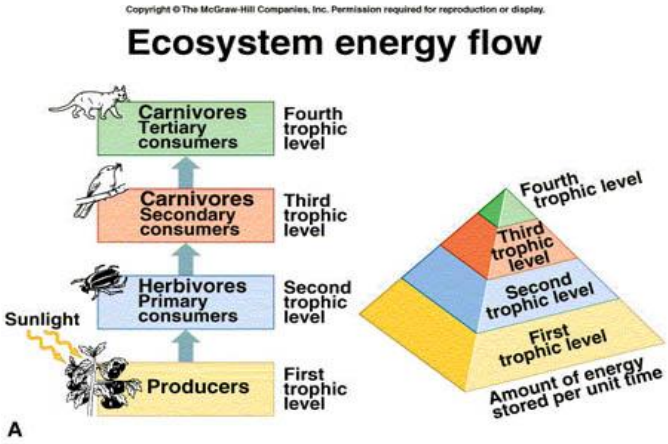
Pyramid of Numbers: These allow you to compare the number of organisms present in each trophic level at a particular time. They are usually upright but may be upside down.





Energy Pyramid

Pyramid of energy allows us to compare the amount of energy passing through each trophic level. They are always upright.



Population

i. **Explain the term population.**

Ans: A group of organisms of the same species living in the same area at the same time.

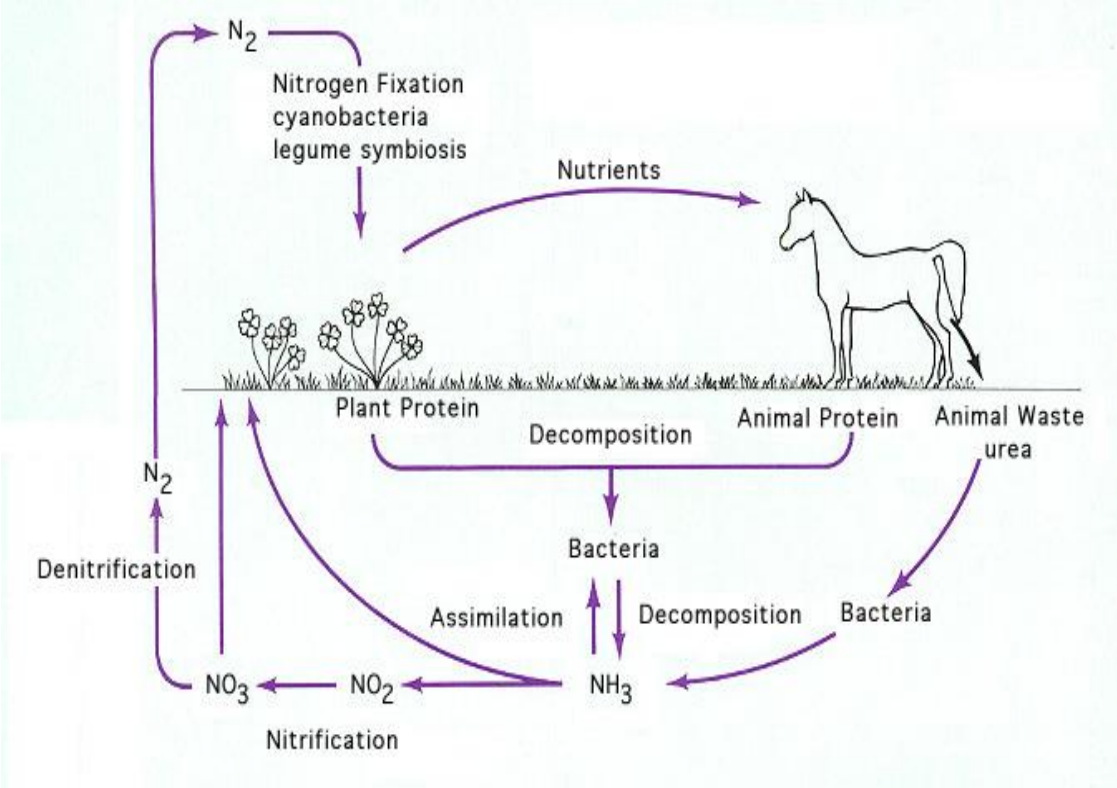
ii. **Investigate factors that cause change in population size**.

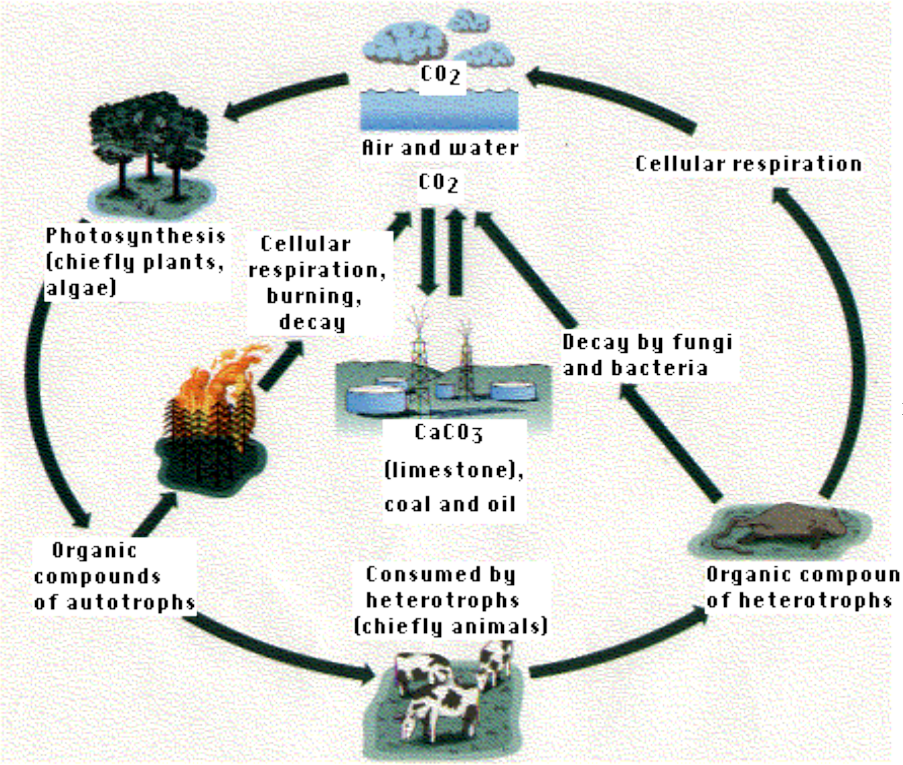
Ans: Factors that cause change in population size include birth rate, immigration, death rate and emigration. A high birth rate and high rate of immigration leads to an increase in the size of a population. A high death rate and a high rate of emigration lead to a decrease in the size of the population.

Carbon and Nitrogen, Water Cycles

Describe how carbon and nitrogen are cycled within an ecosystem.

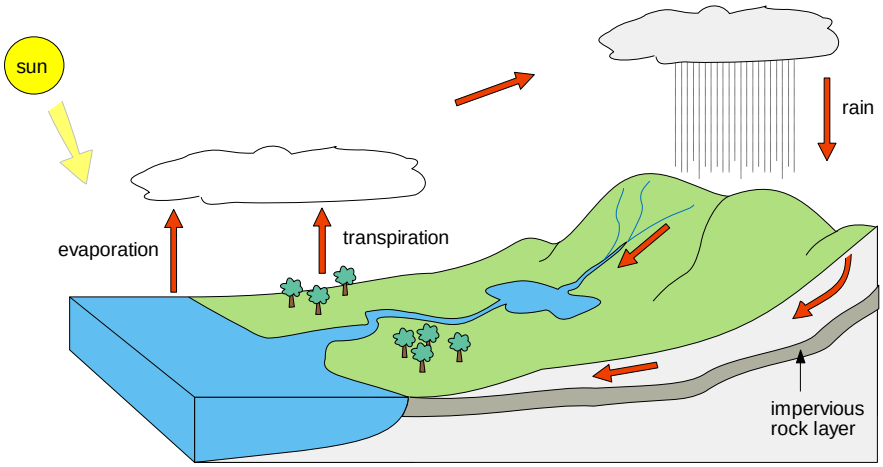
Ans:





The carbon cycle

iii. Describe what the water cycle is.
Ans:



iv. Investigate key features of an ecosystem.

Ans: An ecosystem consists of biotic factors (living organisms) and abiotic factors (non-living components). Biotic and abiotic factors interact with one another, especially through feeding relationships. In pond producers include reeds and water lilies. Herbivores such as such as snails eat plants. Pond skaters feed on dead insects. Carnivores such as frogs feed on herbivores. Decomposers include worms and larvae.

v. **Explain the effects of Agriculture on an ecosystem**.

Ans: Fertilizers and pesticides disturb the ecosystems by killing innocent organisms and increasing soil acidity. This leads to water, soil and air pollution. The clearance of forest for agriculture leads to reduction in biodiversity.

vi. Describe the effects of deforestation on soil stability and climate

Ans: The removal of natural vegetation and trees exposes soil to erosion. It contributes to green house effect that is it slows down the escape of heat from the atmosphere into space. This has leads to an effect known as global warming resulting in droughts and floods.

Pollution

vii. Describe the undesirable effects of pollution.

Ans: Water pollution-Some microorganisms in sewage may cause diseases like cholera, decomposition of organic components of sewage leads to high levels of phosphates and nitrates. This is called eutrophication and leads to rapid multiplication of algae which suspended particles reduce penetration of light, slowing down photosynthesis for aquatic plants.

Air pollution-sulphur dioxide forms acid rain when dissolved in rainy water. This destroys plants. Carbon dioxide contributes to global warming.

Land pollution—garbage is the bleeding site for pathogens and produce unpleasant smell.

viii. Determine measures to prevent pollution

Ans: Measures to prevent pollution: Conversion of sulphur dioxide to sulphuric acid by passing it through a tank of water, treating sewage before releasing it into streams, filters should be fitted in chimneys so that toxic gases like sulphur dioxide can be absorbed before being emitted into the atmosphere.

<u>Conservation</u>

ix. Identify the importance of conserving plant and animal species.

Ans: Importance of conserving plant and animal species is that it helps to maintain biodiversity and also helps to prevent endangered species from going into extinction

x. Explain how to reuse, reduce and recycle materials.

Ans: Reduction involves using less material in design and manufacture, trying to keep products for longer, and using less hazardous materials, such as plastic. Waste products are used again for the same purpose of which they were intended. Recycle materials such as plastics to make conduit pipes used in the construction of house.

xi. Investigate the importance of sustainable use of resources

Ans: Sustainable use of resources: Avoid deforestation, over fishing, over hunting; encourage game keeping

BIO-DIVERSITY.

1. **Investigate the importance of diversity of organisms in given locality**

Ans: Diversity of organisms contributes to equilibrium of organisms in the ecosystem. Species lost past a certain point will have a negative influence on the functioning of the ecosystem.

2. **Explain how some organisms are adapted to the environment**

Ans:

Fish-have endoskeleton and are found in water, bodies covered with scales and swim with fins, breathe with gills and gaseous exchange takes place in water and reproduce sexually and lay eggs.

Insects-are invertebrates have exoskeleton made of chitin which prevents them from drying out, reproduce sexually by laying eggs and grow in stages after moulting, segmented bodies and jointed appendages.

Mammals- Are vertebrates with hair or fair on skin, born after internal fertilization, have mammary glands which produce milk and have different sense organs.

Plants- Are multicellular and are photosynthetic, have cellulose cell wall, reproduce sexually using seeds while some asexually through spores.

3. **Investigate the impact of human activity on organisms**

Ans: Trophy hunting is allowed in hunting season prevents loss of biodiversity. Over fishing is prevented in the bleeding season and small fish is released to allow them to grow and bleed. Houses are supplied with electricity in suburbs to decrease the demand for charcoal in order to slow down deforestation.

4. **Describe the economic reasons for maintaining bio-diversity.**

Ans:

Tourism provides people with the means to explore the natural world and provides income for the country. Medicinal plants provide herbs used to treat diseases like malaria. Animals are hunted for food and skins.