KUSOMA REVISION MATERIALS

BIOLOGY FORM 1 NOTES

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1. **a) Define biology**

   a. the study of life/living things b.

b) **List the branches of biology**

- Zoology (study of animals)
- Botany (study of plants)
- Microbiology (study of microorganisms)

c) **Explain the importance of biology**

- helps to solve environmental problems
- Helps to learn scientific skills
- For entry into other professions/careers
- To apply knowledge to everyday life situations
- To classify organisms into their right groups
- understanding living organisms

d) **State the characteristics of living organisms**

- feeding/nutrition
- Growth and development
- respiration (to produce energy)
- sensitivity/irritation/response
- excretion (getting rid of metabolic waste material)
- movement/locomotion
- reproduction

e) State the main differences between plants and animals

Animals	**Plants**
Specialized excretory organs	No specialized excretory organs
Respond to stimulus quickly	Slow respond to stimulus
All body parts grow equally(intercalary)	Grow at shoot tip and root tip only
Move around to look for food	Stationery
Heterotrophic	Autotrophic
Cells have no cell walls	Cells have cell wall made of cellulose

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No chlorophyll	Contain chlorophyll
Give parental care to young	Plants don't care for their young

2. a) i) What is a hand lens?

- Convex lens mounted on a frame and used to magnify small objects for viewing.
-

ii) How is a hand lens used?

- place the lens a short distance from the eye
- Bring the object to be viewed near the lens until an enlarged and clear image can be seen.
-

ii) When is a hand lens used?

- For reasonably sized objects such as insect wing, leg, flower parts.
- Cannot be used for small objects such as cells, stomata.
-

iv) Explain how to calculate drawing magnification

- drawing magnification equals to length of drawing divided by length of object or image length divided by actual length i.e. $\frac{\text{length of drawing}}{\text{Length of object}}$ or $\frac{\text{image length}}{\text{actual length}}$

b) i) what is classification?

- Orderly arrangement of living organisms into various groups according to their similarities.

ii) List the external features used to classify plants

- rhizoids(e.g. mosses)
- frond (e.g. ferns)
- roots e.g. taproot, fibrous roots, modified roots
- flowers
- leaves
- buds
- seeds
-

iii) List the external features used to classify animals

- horns e.g. cattle, goat, sheep, deer, gazelle etc
- hooves e.g. cattle, sheep, donkey
- mammary glands e.g. cattle, dog, sheep, cat
- hair e.g. human, cat
- Shell e.g. snail, Tortoise
- spines e.g. hedge hog, porcupine

c) Give the reasons why classification is important

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- Placing/grouping living organisms into correct groups called taxa
- Identification
- arrange information about living organisms into orderly and sequential manner i.e. it is easy to study organisms in groups
-helps in understanding evolutionary relationships
- monitoring disappearance and appearance of organisms i.e. predict characteristics of organisms

d) i) Name the taxonomic units of classification in descending order

- Kingdom (largest unit)
- Phylum (animals)/division (plants)
- Class
- Order
    - Family
    - Genus
    - Species(smallest unit)
    -

ii) What is a species?

- all organisms which can interbreed and give rise to fertile (viable) offspring

iii) Name the major kingdoms used in classification

-monera
-protoctista/protista
-fungi
-plantae
-animalia

e) i) Define the term binomial nomenclature

- a scientific system of naming organisms using the generic/genus and specific/species names
- e.g. for humans, Homo sapiens

ii) State the principles followed during binomial nomenclature

- the first (generic) name should begin with a capital letter while the rest are small letters
- the two names are printed in italics and if handwritten should be underlined each separately
-

iii) Give the advantages of using binomial nomenclature

- no confusion about which organism is referred to
- names are internationally accepted regardless of language
- shows evolutionary relationship hence easy to understand
- useful in naming many species unlike use of common names

iv) Name the types of classification

- traditional (using common names)

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- scientific(using binomial nomenclature)

3. **a) i) Define the term cell**

What is cell biology?

- it is the basic unit of organization of an organism i.e. the basic functional and structural unit of an organism

study of structure and functioning of a cell
also called cytology

b)i) What is a microscope?

- an instrument used to magnify objects and make them appear bigger.

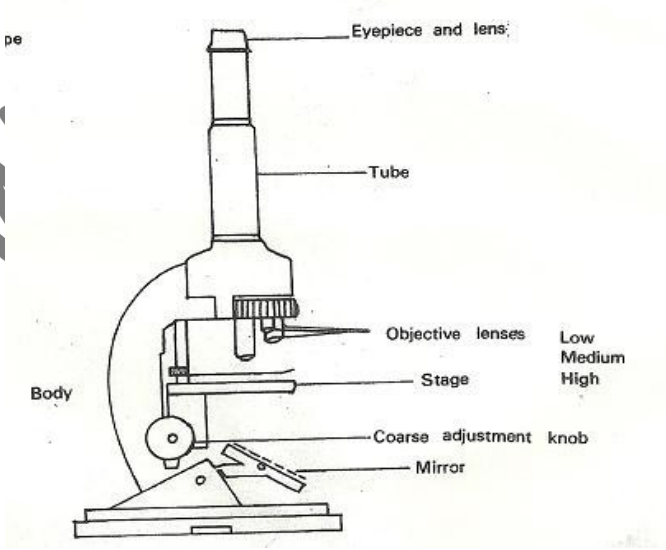
Name the types of microscope

the light microscope
the electron microscope
-

iii) **State the purpose of using a light microscope**

-it magnifies and reveals the structure details of tiny objects such as the cell, that cannot be seen by the human eye dir
-

iv) Draw a labeled sketch of a light microscope



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v) State the functions of the labeled parts

a.) **Eyepiece** used to look through and to magnify the object
b.) **Course adjustment knob** raises or lowers body tube and focuses object roughly
c.) **Fine adjustment knob raises** or lowers body tube by small distances to bring image into fine focus
d.) **objective lens** brings image into focus and also magnifies object/image

- **stage** is a platform where object or specimen on slide is placed
- **mirror** reflects light through condenser and directs it to objective lens
- **clips** hold glass slide in position
- **body tube** holds eyepiece and revolving nose piece which has objective lenses
- **limb** or base support whole instrument

- **arm** for holding when carrying instrument
- **revolving nose piece** holds objective lens in place enabling change from one objective lens to another

e) i) Explain the procedure followed when using a microscope

- put the microscope on the bench with the stage facing away from you (viewer)
- turn the lower power objective to click in line with the eyepiece
- Ensure that the diaphragm/iris is fully open
- Adjust the mirror until the stage is illuminated with enough light
- Place the slide containing the specimen on the stage for magnification
- Draw the image and indicate magnification of the drawing.

ii) State the precautions that are necessary when handling a microscope

- always use two hands when carrying it
- never place a microscope too close to the edge of the bench or table
- do not touch the mirror and lens with wet or dirty hands
- clean dirty lenses using a special lens cleaning cloth
- clean other parts using a soft cloth or tissue paper
- low power objective must click into position before and after use.
- Do not wet any part of the microscope
- Clean and store well after use

d) i) What is magnification?

- The power of making an image larger

ii) Give the formula used to calculate magnification in a light microscope

- eyepiece lens magnification x objective lens magnification

iii) Give the reasons for each of the following steps when preparing a cross-section of a stem or leaf for examination under the microscope

cutting very thin sections

- thin sections allow light to pass through making it easy to observe the tissue

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- to maintain turgidity hence maintain shape of cell

Using a sharp razor blade during the cutting

- [illegible]

Staining the sections with iodine before observing

- [illegible]
- it makes thin sections

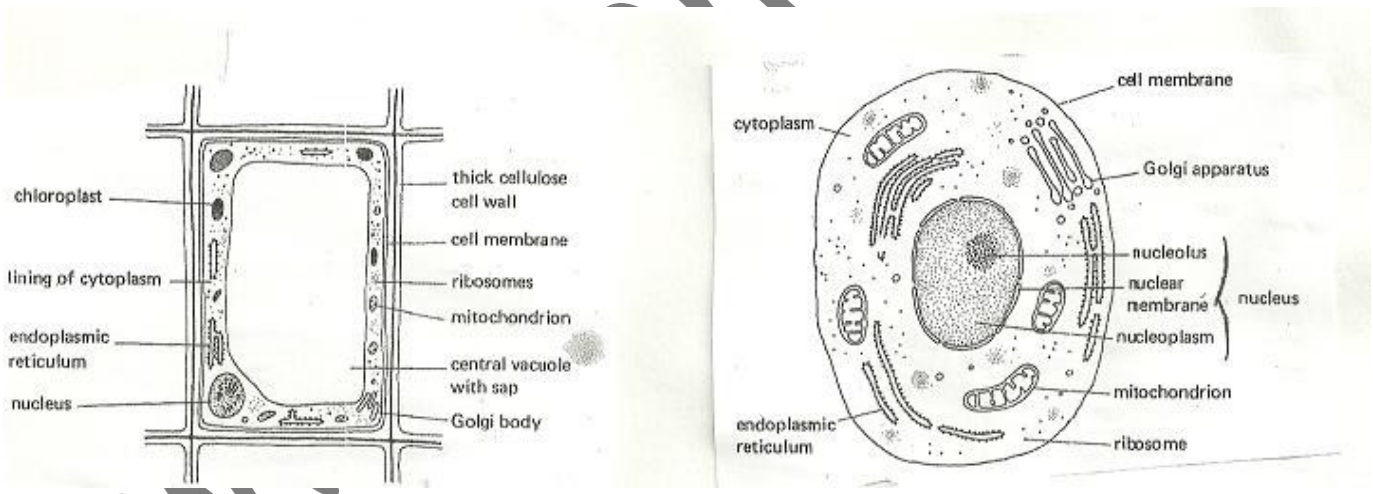
To make chloroplasts, starch containing structures, granules or plastids distinct.

Placing sections in water

e) i) List the parts of a cell that can be seen under a light microscope

a cell membrane b cytoplasm
ccell wall e nucleus d vacuole

ii) Draw the general structure of a plant and animal cell



iii) List the parts of a cell that can be seen under an electronic microscope and state the functions of each part.

Cell wall

- found in plant cells in addition to cell membrane
- made of cellulose which makes the plant tough
- allows gases, water and other substances to pass through

Cell membrane

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- permeable/selective to control movement of materials in and out of cells
- bound/encloses the cell contents
- also called plasma membrane or plasmallema

Cytoplasm
- fluid medium where chemical reactions occur
- also where cell organelles are suspended

Nucleus
- controls cell activities

Nucleolus
- synthesizes DNA

Vacuole
- sacs filled with fluid called cell sap
- large in plants but small in animals
- act as reservoirs for food and harmful wastes which would otherwise interfere with the metabolism in cytoplasm

Lysosomes
- store hydrolytic enzymes
- destroy worn out cell organelles, cells, pathogens
- digestion of food in unicellular organisms
- autolysis

Golgi apparatus
- processing/packaging of synthesized materials
- transporting/secretion of packaged materials/cell materials e.g. glycoproteins and mucus
- production of lysosomes

Ribosomes
- where protein synthesis takes place

Mitochondrion
- synthesis of ATP/energy

Chloroplasts
- where photosynthesis takes place

Endoplasmic reticulum
- transport of cell secretions

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- can be rough or smooth

iv) State the functions of cell sap

stores chemical substances, sugar, salts
- maintains shape of the cell/provides mechanical strength
- plays a role in osmoregulation by creating an osmotic gradient that brings about movement of water
-

e) Compare plant and animal cells
- plant cells have chloroplasts lacking in animals
- animal cells have many small vacuoles while plant cells have a large central vacuole
- plant cell have cellulose cell walls lacking in animal cells
- cytoplasm in plant cell is in the periphery but in animal cell it is centrally placed
- plants store starch, oil and protein while animals store gats and glycogen
- animal cells have centrioles which plant cells do not have

f) Explain the meaning of each of the following

i) Cell

- Basic unit of organization in an organism
- Specialized animal cells include sperm, ovum muscle
Specialized plant cells include epidermal, guard cell and palisade cell

ii) Tissue
- these are cells of a particular type grouped together to perform a certain function
- animal tissues include epithelium, blood, nerves, muscle, skeletal and connective tissues
- plant tissues include epidermal, photosynthetic, vascular, strengthening tissues

iii) Organ
- tissues combine together to form organs
- an organ is a complex structure with a particular function
- animal examples include heart, liver, kidney, lungs, brain, blood vessels, muscles, skeleton
- Plant organs include leaves, roots, flowers, and stem.

iv) Organ system
- organs are grouped together to form systems also called organ systems
- animal systems include excretory, digestive, respiratory, nervous, circulatory, endocrine(hormones/glands), skeletal systems
- plant systems include transport system

g) i) Name the structures which are present in plant cells but absent in animal cells
- Chloroplast
- Cell wall

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ii) Name the structures which are present in animal cells but absent in plant cells

- Lysosomes
- Centrioles
- Pinocytic vesicles
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h) Explain how to estimate cell size

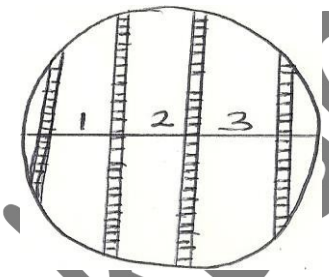
i) Materials

- cell sizes are measured in units known as micrometers (my)
- required is a transparent ruler marked in millimeters
- 1mμ = $\frac{1\ mm}{1000}$

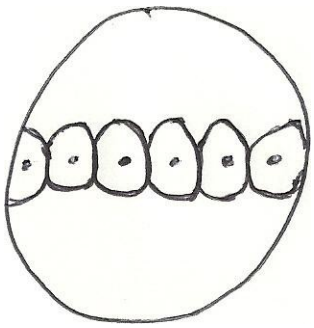
ii) Procedure

- Click to low power

- place transparent ruler with its millimeter marks on the stage
- focus so that the millimeter marks can be seen as thick dark lines
- estimate the diameter of field of view by counting the one millimeter spaces between the first mark and the last one across the field of view as shown below



- the diameter of the field of view above is estimated as 3.2 mm
- convert the diameter of the field of view from millimeters to micrometers i.e. 3.2/1000
- Estimate the fraction of the field of view occupied by the cell. This is done by estimating the number of cells places end to end that would fill the diameter of the field of view as shown below



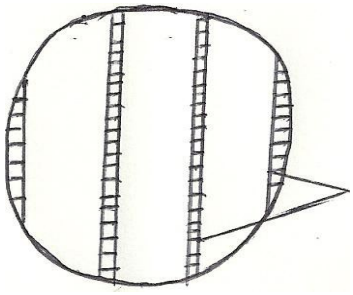
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- in the figure above, it is estimated that approximately six cells will occupy the diameter of the field of view
- therefore, one cell will occupy 1/6 of the field of view
- its diameter is calculated as 1/6 times the diameter of the field of view

i) **i) In a drawing of a giraffe, the height of the head from the ground was recorded as 10cm. the drawing also showed a magnification of 0.02. calculate the actual height of the giraffe**

Drawing height = 10cm = 500cm
Magnification 0.02

ii) **In a class experiment to estimate sizes of cells a student observed and obtained millimeter marks on the field of view of a microscope as shown in the diagram below**.



- If the student counted 40 cells on the diameter of the field of view, what was the approximate size of the each cell in micrometers?

Diameter of field of view = 3 x 1000 = 75 mμ
Number of cells 40

iii) **Under which of the following light microscope magnifications would one see a larger part of the specimen? X40 or x400? Give a reason**

- x40
- Smaller magnification gives a wider field of view hence a larger part seen.

e.) a) i) Define cell physiology

- the study of the functions of a cell in relation to their structure

ii) State the functions of the cell

- exchange of materials between the cell and the external environment
- physiological reactions e.g. photosynthesis
- production of energy through mitochondria

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b) i) Describe the structure of cell membrane

- made up of three layers
- Lipid portion sandwiched between two protein layers
- Lipid portion enhances penetration of oil soluble substances

Pores present to facilitate inward and outward movement of water soluble substances

iii) Give the properties of cell membrane

- semi-permeable
- sensitive to changes in temperature and pH
- Possesses electric charges.

c) i) What is diffusion?

- movement of substances/molecules/particles/ions from a region of high concentration to a region of low concentration (until equilibrium is reached)

ii) State the factors affecting diffusion

- diffusion gradient/concentration gradient
- surface area to volume ratio
- temperature
- size of molecules
- state of the diffusing substance
- thickness of membrane and tissues

iii) Explain the roles of diffusion in living organisms

- gaseous exchange
- absorption of digested food in intestines
- movement of salts in plants
- movement of materials between blood capillaries and tissues
- removal of waste materials from bodies of small organisms
- air movement in intercellular spaces in plants

iv) Suggest an experiment to demonstrate diffusion

- to a beaker of water, drop crystals of potassium permanganate or copper sulphate
- leave to stand in a place without disturbing
- observe the spreading of molecules
- liquid is coloured uniformly due to diffusion

d) i) What is osmosis?

- Movement of water or solvent molecules from a dilute/hypotonic solution to a more concentrated/hypertonic solution across a semi-permeable membrane.

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- movement of solvent molecules from a region of their higher concentration to a region of their lower concentration through a semi-permeable membrane

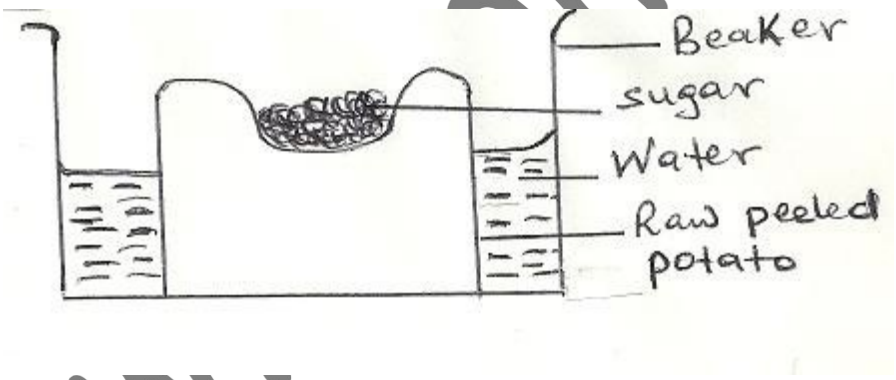
ii) State the factors affecting osmosis

- concentration of the solution
- concentration gradient
- temperature

iv) Explain the roles of osmosis in living organisms

- helps to draw water into roots of plants
- helps in the passage of water from one living cell to another in the plant
- helps to keep plant cells turgid increasing support
- Helps in opening and closing of stomata.
- Folding of leaves in ***Mimosa pudica*** when touched
- Feeding in insectivorous plants

v) A group of students set up an experiment to investigate a certain physiological process. The set up is as shown in the diagram below.



After some time they observed that the level of sugar had risen.

What was the physiological process under investigation?

- Osmosis

Why was there a rise in the level of sugar solution?

- sugar solution is more concentrated than cell sap osmosis
- those cells become more concentrated and therefore draw water from neighbouring cells
- this process continues until the cells in contact with the water in the container draw it up causing a rise in the level of the sugar solution

Suggest the results that the students would obtain if they repeated the experiment using cooked potato

- The level of sugar solution will not rise.

What is the reason for your suggestion?

- boiling kills/destroys cells making them osmotically inactive

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vi) Explain the following terms

Hypnotic

- a solution whose concentration is lower than that of the cell

Isotonic

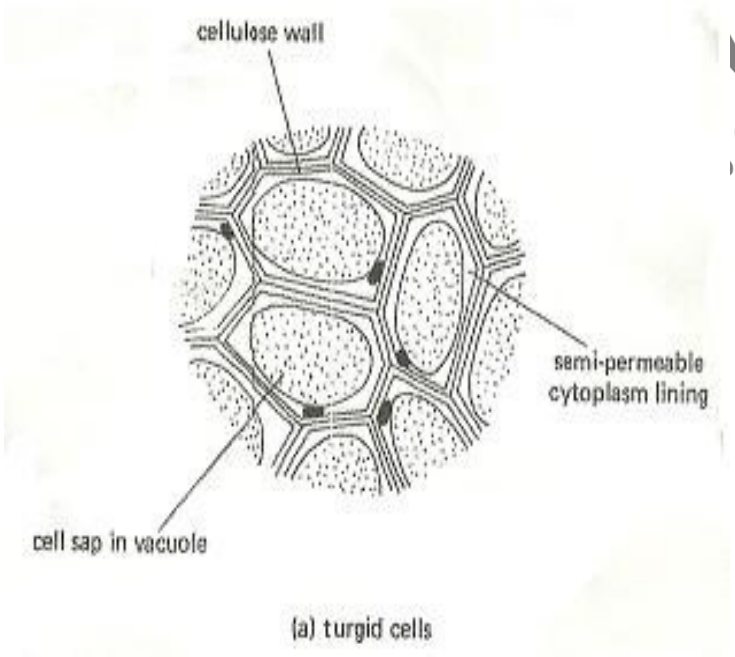
- a solution whose concentration is the same as that of the cell

Hypertonic

- a solution whose concentration is higher than that of the cell

Turgor pressure

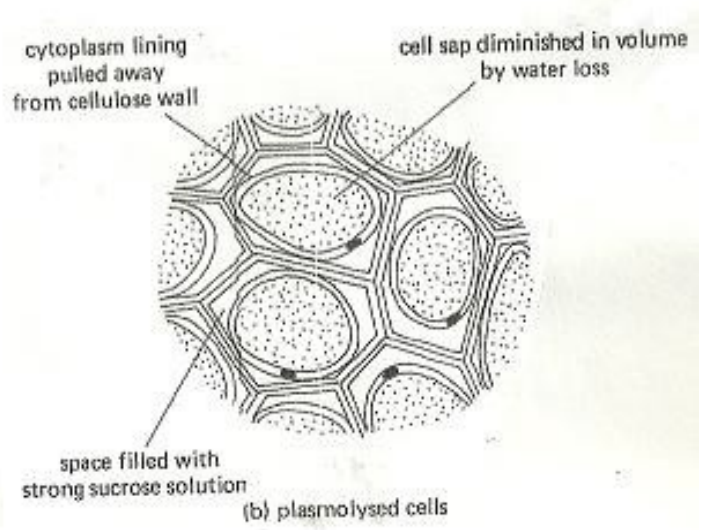
- As a cell gains water, its vacuole enlarges and exerts an outward pressure called turgor pressure.



(a) turgid cells

Plasmolysis

- if a plant is placed in a hypotonic solution if loses water
- the protoplasm shrinks to an extent that it pulls away from the cellulose cell wall



(b) plasmolysed cells

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Wilting

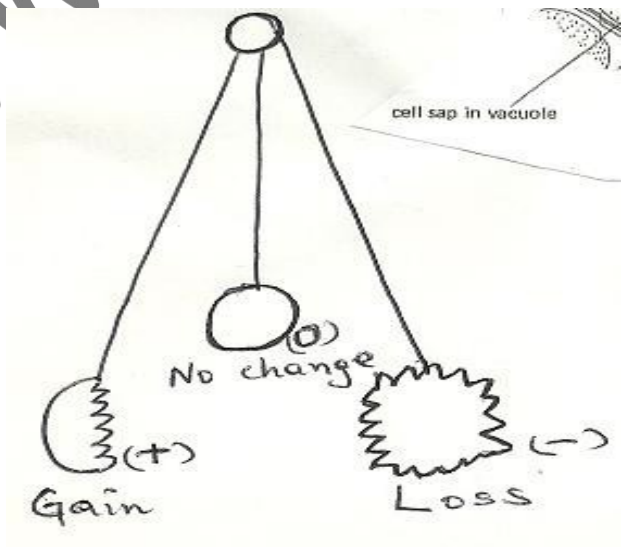
- when a plant is turgid it can stand upright
- however, if the cells lose a lot of water, turgidity is reduced
- the plant then droops because the cells are flaccid
- the plant is said to wilt

Haemolysis

- if red blood cells are placed in distilled water, the cells take up water by osmosis, swell and burst
- this is because it does not have any mechanism like the cellulose cell wall to prevent overstretching nor any means of removing excess water
- this is called haemolysis

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e) A form one student placed red blood cells in different salt concentrations and obtained the following results:-



There was a gain (+) no change (0 zero) and a loss (-) in the volume of the cells as show below:-

Briefly explain the results of the experiment

- in the first solution , red blood cell absorbed water by osmosis, swell and burst (haemolysis) hence the solution is hypotonic
- in the second solution, there was no change in size or structure as it was isotonic hence no osmotic gradient
- in the third solution the red blood cell lost water to shrink hence became crenated as the solution was hypotonic to the cell cytoplasm.

f) i) What is active transport?

- movement of molecules and ions against a concentration gradient
- the substances move from a lower to a higher concentration gradient by use of energy

ii) State the factors affecting active transport

- oxygen concentration
- temperature
- change in pH
- glucose concentration
- enzyme inhibitors

iii) Why is oxygen important in the process of active transport?

- Oxygen is required for respiration, which produces energy necessary for the process to occur.

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2.1) the factors that affect the rates of the following process in living organisms.

a.) **<u>DIFFUSION.</u>**

- **Diffusion gradient** which refers to the difference in concentration of molecules between the region of high concentration and the region of low concentration. Increasing the concentration gradient causes an increase in rate of diffusion and vice versa.

-Surface area to volume ratio .is the ratio of total surface area exposed by an organism compared to its body volume. Small sized living organisms have a large surface area to volume ratio. The larger the surface area to volume ratio ,the high the rate of diffusion and vice versa. Small organisms like amoeba and paramecium can hence rely on diffusion for transport of substances into and within its body and removal of waste products

-thickness of membranes. Molecules take longer to diffuse across thick membranes than across thin membranes hence the thin the membrane the higher the rate of diffusion.

-Temperature. Increasing temperature increases the kinetic energy of diffusing molecules making them to spread faster. Increasing temperature increases the rate of diffusion and vice versa

-size of molecules/molecular weight. Small sized molecules/molecules of low molecular weight move/diffuse faster hence the rate of diffusion is high where the molecules involved are small or have low molecular weight and vice versa**.**

B.)OSMOSIS

-Temperature. Increasing temperature increases the kinetic energy of water molecules making them to spread faster. Increasing temperature increases the rate of osmosis and vice versa

-concentration gradient/diffusion pressure deficit. Refers to the difference in concentration on either side of a semi-permeable membrane. The higher the osmotic pressure difference the higher the rate of osmosis.

C.) ACTIVE TRANSPORT

OXYGEN CONCENTRATION. It is required for respiration/to oxidize respiratory substrates to release energy required for active transport. an increase in oxygen concentration causes a simultaneous increase to the rate of active transport upto a certain level.

P^H Enzymes being protein in nature are P^H specific. Extreme change in P^H affect the rate of respiration which is controlled by enzymes and may denature the enzymes reducing the rate of active transport.

-GLUCOSE CONCENTRATION. is the main respiratory substrate for energy production. An increase in glucose concentration in cells increase the rate of respiration and hence the rate of active transport is increased upto a certain optimum level beyond which any additional increase in glucose concentration has no effect.

TEMPERATURE. The process of respiration by which energy for active transport is generated is controlled by enzymes. Enzymes work best at temperatures of between 35^0c-40^0c,usually called optimum temperature ranges. At very low temperatures enzymes are inactive lowering the rate of respiration hence low rates of active transport . increase in temperature above optimum (above 40^0c)denatures enzymes slowing down respiration and ac tive transport until it finally stops.

ENZYMES INHIBITORS. They are substances which slow down (by competing with the enzyme for the active sites in the substrate) or stop (by blocking the active sites of the enzyme) the activity/funtioning of enzymes .this slows down or stops respiration and so is active transport.

CONCENTRATION OF CARRIER MOLECULES IN THE CELL MEMBRANE. They are substances that bind to the ions being transported actively and carrying them across the membrane . increase in concentration of carrier molecules increases the rate of active transport upto a certain level and vise versa.

4.) explain briefly the role of osmosis in living tissues.

In plants:

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Osmosis facilitates the absorption of water from the soil by plant roots, water is required for the process of photosynthesis.
Turgidity of cells contributes to support in herbaceous plants and helps plant to maintain shape.
Helps in closing and opening of stomata regulating the process of gaseous exchange and transpiration.
It facilitates feeding in insectivorous plants like venus fly trap.
In animals:
Enables reabsorption of water from the kidney tubules back to blood stream facilitating the process of osmoregulation.
It enables organisms in fresh water bodies like amoeba to absorb water.
it is applied in food preservation.

5.) explain what happens when plant and animal cells are put in hypotonic and hypertonic solutions.

a. i)**plant cells in hypotonic solution.**

The concentration of the plant cell sap is hypertonic to the solution/water medium. the cell draws in water by osmosis through the cell wall, cell membrane into the cell cytoplasm. Water enters the cell vacuole by osmosis; it enlarges and exerts an outward pressure on the cell wall called turgor pressure. Increased turgor pressure pushes the cell cytoplasm against the cell wall until the cell wall cannot stretch any further. The cell becomes firm or rigid and is said to be turgid. As the cell wall is being stretched outwards, it develops a resistant inwards pressure that is equal and opposite to the turgor pressure and this is called wall pressure.

ii.) **Plant cells in hypertonic solution.**

The plant cell sap is hypotonic to the solution medium. Water molecules are drawn out of the plant cells by osmosis into the hypertonic solution through the semi-permiable membrane of the plant cells. As a result the plant cell will start to shrink/less rigid and become flabby. The cell membrane/plasma membrane is pulled away from the cell wall and the cell is said to be flaccid. this process by which a plant cell lose water, shrink and become flaccid is called plasmolysis. However the shape of the plant cell is maintained by the tough rigid cellulose cell wall which prevents crenation in plant cells.

b.i) **Animal cells in hypotonic solution.**

The concentration of water in the cytoplasm of the plant cells is hypertonic to the solution medium in the test. Water molecules are then drawn into the animal cell cytoplasm from the surrounding medium by osmosis through the semipermiable membrane. the cell swells as water is drawn into them by osmosis .as water continues to enter into the cell,the weak animal cell membrane bursts a process called lysis. in red blood cells this process is called haemolysis. However in unicellular organisms like amoeba and paramecium,bursting of their cells does not take place because they have specialized organelles called contractile vacuoles for removal of exces water out of their bodies/cells.

ii.) animal cells in hypertonic solution.

The concentration of the animal cells cell cytoplasm is hypotonic to the solution medium in the test. the surrounding hypertonic solution will draw water out of the animal cells by osmosis through the semi-

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permeable membrane. Continued loss of water causes the cells to be smaller in size and their membranes become wrinkled. This process will continue until the concentration of the cell sap and the surrounding medium is equal i.e isotonic.the process by which animal cells lose water and shrink is called crenation.

6.) **Explain briefly the role of active transport in living organisms.**

It is involved in active reabsorption of glucose and mineral salts in kidney tubules during formation of urine. it enables the absorption of digested food from the alimentary canal/small intestines into the blood stream. Excretion of waste products from body cells for eventual removal. Involved in transmission of nerve impulses within the nerve cells through the sodium pump which maintains a balance between sodium and potassium ions. It facilitates accumulation of substances in the body cells to offset osmotic pressure of organisms in dry and marine environment allowing them to absorb water by osmosis and avoid desiccation. In plants it enables plant roots to absorb water from the soil against the concentration gradient. It's involved in translocation of manufactured food in the phloem tissue within the plant body. It's involved in the opening and closing of the stomata through the sodium-potassium pump mechanism.

iv) Outline the roles of active transport in living organisms

- mineral salt intake by plants
- selective reabsorption of glucose and some salts by kidney tubules
- absorption of digested good by small intestines
- excretion of waste products from body cells
- reabsorption of useful materials in the blood stream or at the tissue fluid
- sodium pump mechanism in the nerve cells/neurons

f.) a) i) Define nutrition

- the process by which living organisms obtain and assimilate nutrients
-

ii) State the importance of nutrition

- for respiration to get energy
- for growth
- for development
- to repair and replace worn out and damaged parts and tissues

b) Differentiate the various modes of feeding

i) Autotrophism

- manufacturing food from simple organic substances
- types are photosynthesis and chemosynthesis

ii) Heterotrophism

- obtaining food from autotrophes and other organic substances
- types are holozoic, saprophytic and parasitic

g.) a) i) Define photosynthesis

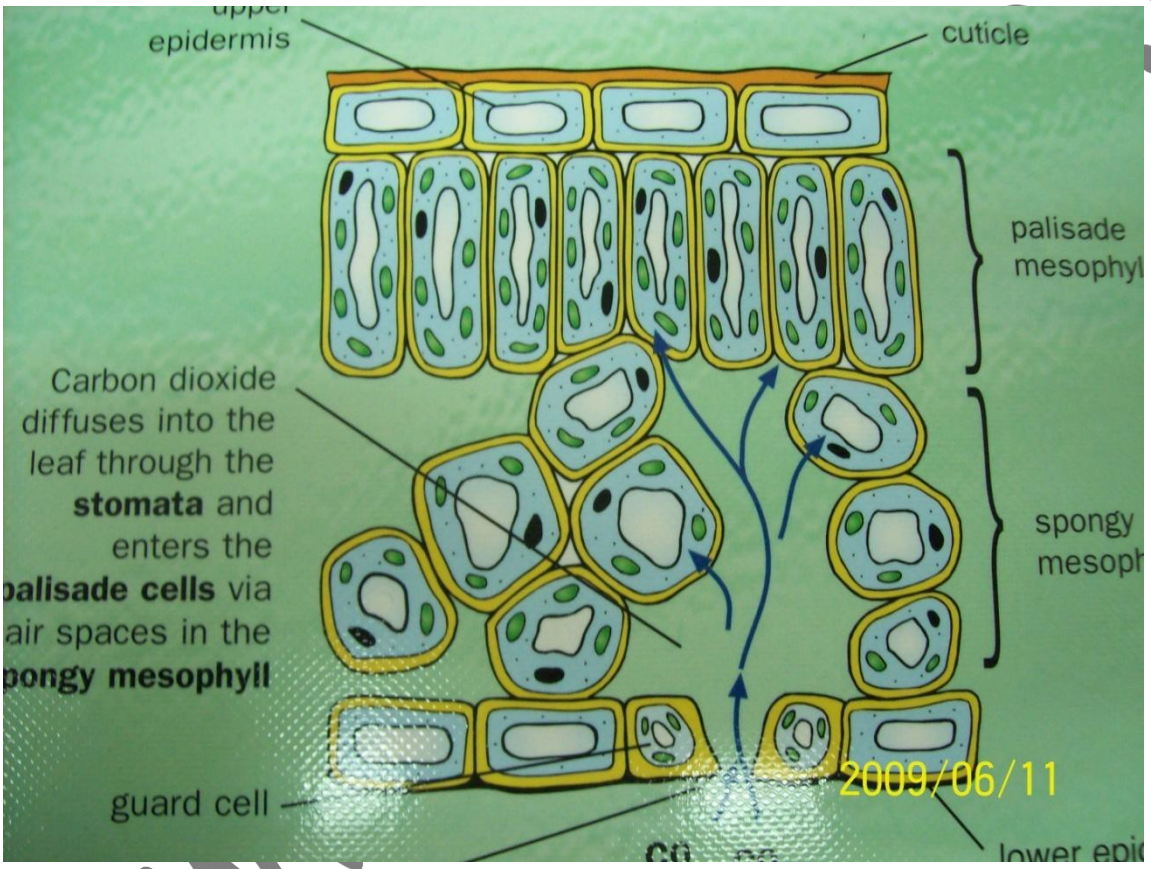
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formation of sugars/glucose which is a source of energy purification of air(CO2 is used, O2 is released)
storage of energy to be used later in respiration
stores energy in wood, coal, oil to be used later to run industries

- the process by which green plants build up organic compounds from carbon IV oxide and water in the presence of sunlight

Structural adaptation of the leaf to its function

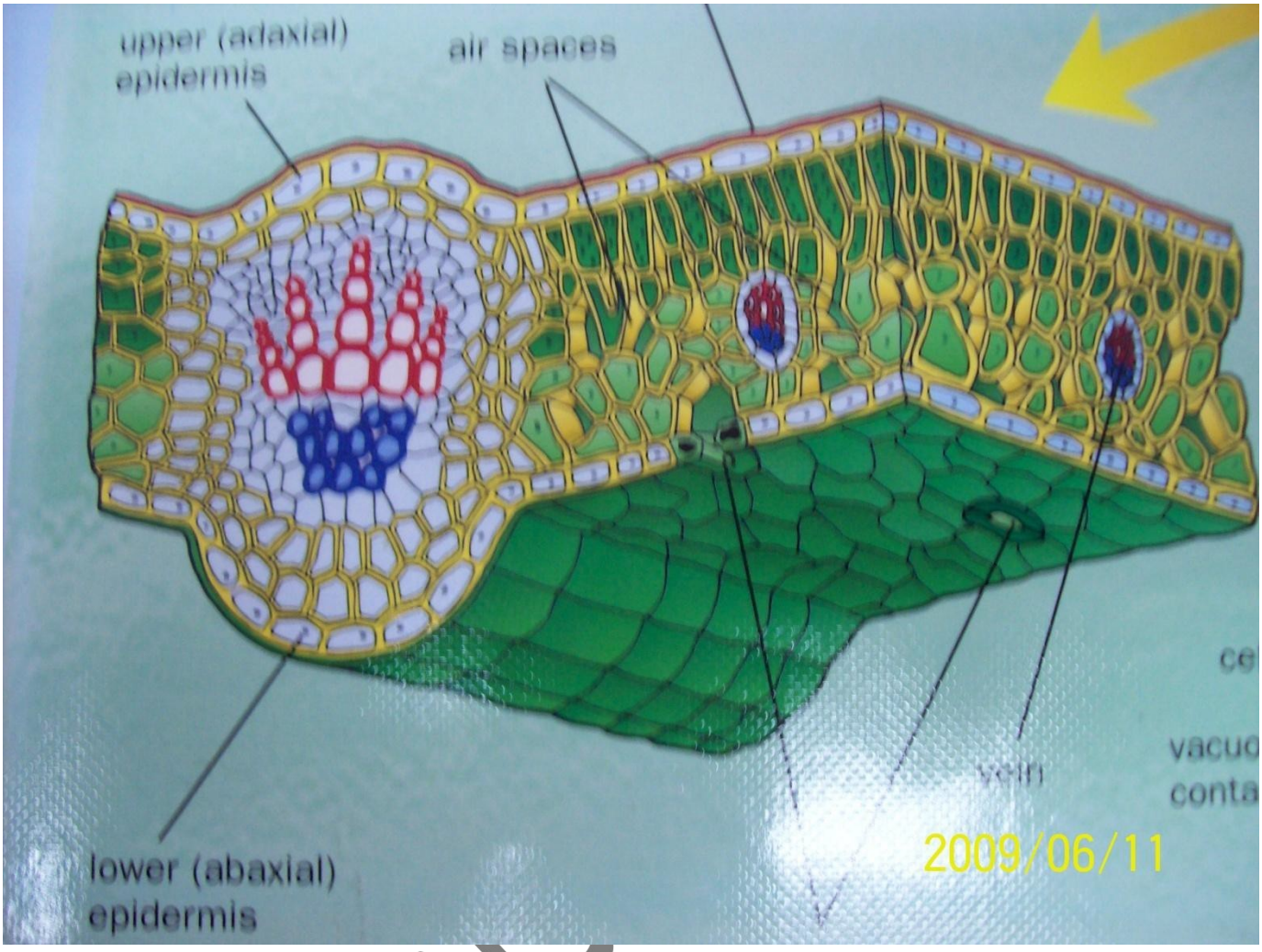
ii. State the importance of photosynthesis



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The leaf has a broad and flattened lamina to provide a large surface area for trapping optimum light for photosynthesis and allow maximum gaseous exchange.
The leaf epidermis is thin (one cell thick) to reduce the distance across which diffusion of carbon (iv) oxide gas to palisade cells and oxygen gas from palisade cells takes place.
The leaf has numerous stomata that allows easy diffusion of gases into and out of the palisade tissue.
The leaf cuticle and epidermis are transparent to allow easy penetration of light to the photosynthetic tissue.
The palisade cells are numerous,elongated and contain numerous chloroplasts to trapping optimum light for photosynthesis.
The palisade tissue is just beneath the upper epidermis exposing them to trap optimum light for photosynthesis.
The leaf has numerous leaf veins consisting of a.) xylem vessels and tracheids for transporting water and dissolved mineral salts from the soil to the photosynthetic tissue
b.) phloem tissue for translocation of of manufactured food from the leaf to storage organs and other parts of the plant .
Numerous and large air spaces in the spongy mesopyl layer for optimum gaseous exchange with the photosynthetic tissue.
Phylotaxy which is regular arrangement of leaves on the stem minimizes overshadowing and overlapping exposing all leaves to light for photosynthesis.
The prominent midrib and leaf veins reduces chances of rolling of leaves maintaining a large surface area for trapping optimum light for photosynthesis.

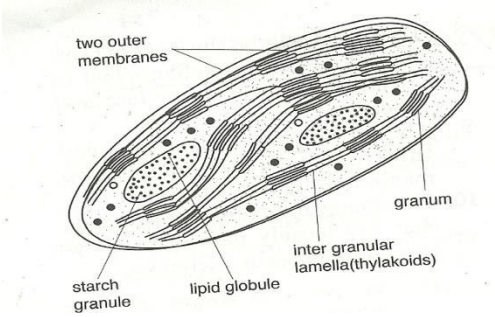
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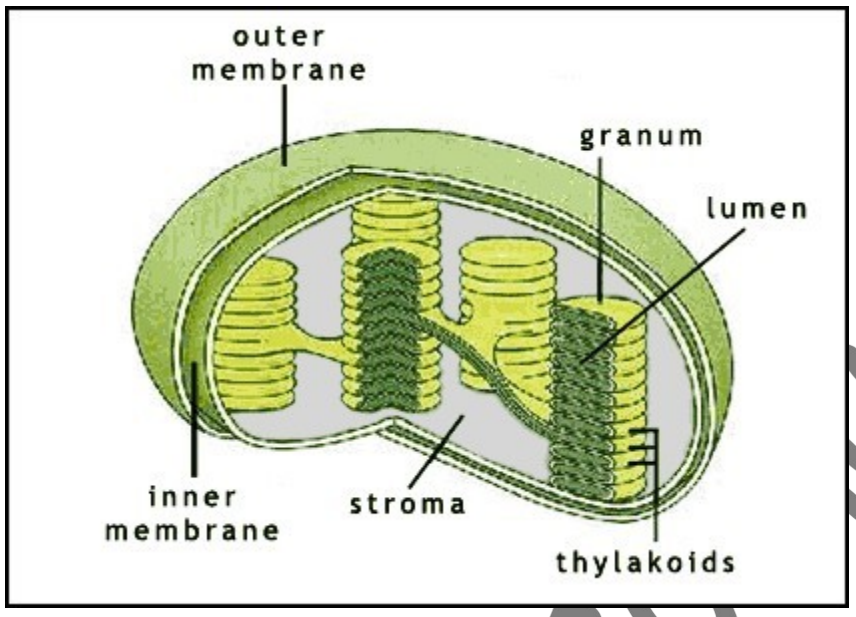


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C) Describe the structure and function of chloroplast

i) Structure





Function

- structure in which photosynthesis takes place

Adaptations

- has numerous/many grana to provide large surface area for packing many chlorophyll pigments have numerous chloro
- has stroma/third matrix which contain certain enzymes that catalyze photosynthetic reactions
-

d) i) Give a word equation for photosynthesis

Carbon (iv)Oxide + watersunlight ▬▬▬ sugar + oxygen

Chlorophyll

NB $6CO_2 + 6H_2O$ ▬ $C_6H_{12}0_6 + 6O_2$

.) describe briefly the process of photosynthesis in plants.

The process of photosynthesis takes place in green plants allowing them to make their own food. The process is controlled by enzymes and involves a series of reactions that take place in chloroplasts. The raw materials required are water and carbon (iv) oxide.the process takes place in two consecutive stages i.e

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Light reaction stage.

It's also called the light dependent stage as it requires light energy . the reactions take place in the granna of the chloroplast. light energy from the sun is trapped by chlorophyll in the chloroplast and converted into chemical energy. This energy splits water molecules into hydrogen ions and oxygen atoms a process is called photolysis. The oxygen atoms are released as aby product or used up in the process of respiration. The hydrogen ions formed are used in the dark stage of photosynthesis.

Water ——————→ hydrogen ions + oxygen atoms

$2H_2O$ ——————→ $4H^+$ + $o_{2\,g}$

Some of the light enrgy is used to combine a molecule called adenosine diphosphate(ADP) with a phosphate group to form the rich energy molecules called adenosine Tri-Phosphate(ATP)

ADP + P ——————→ ATP

Dark reaction stage.

It's also called the light independent stage of photosynthesis since light is not required because it can take place both in presence and absence of light. the reactions are controlled by enzymes. the hydrogen atoms released in the light stage are combined with carbon(iv)oxide to form simple sugars mainly glucose. The process uses energy from ATP. This is reffered to as carbon (iv) oxide fixation. The reactions take place in the stroma of chloroplast. The excess glucose is converted into starch or lipids for storage.

The general process of photosynthesis can be summarized by the following word and chemical equitions.

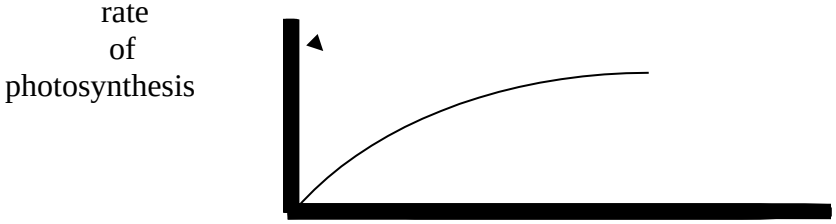
Water + carbon (iv) oxide ——light & chlorophyll——→ glucose + oxygen

$6H_2o$ + 6co ——————→ $C_6H_{12}O_6$ + $6O_2$

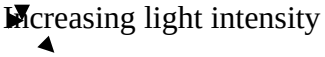
9.) factors that cause high rate of photosynthesis.

<u>High water availability in the soil</u>. Water a raw material for photosynthesis is split in presence of light to provide the hydrogen ions required in carbon (iv) fixation. When water is readily available more hydrogen ions are produced hence high rate of photosynthesis.

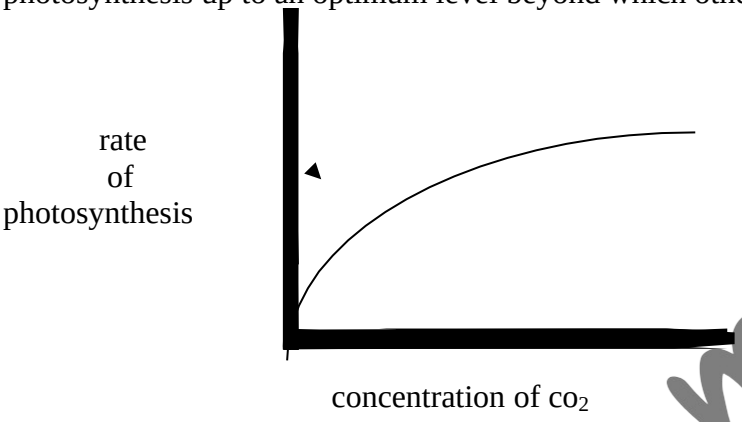
High light intensity. Light splits water molecules to hydrogen ions and oxygen atoms. Increasing light intensity increases the rate of photosynthesis up to a certain level beyond which other factors become limiting and rate of photosynthesis becomes constant.



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Day length. Long day length especially at high latitudes (temperate regions) provides more light for photosynthesis causing an increase in the rate of photosynthesis.
Light quality. The preferred wavelengths for photosynthesis range between 400nm-700nm. the rate of photosynthesis is higher in red and blue light and lower in all other types of light.
Concentration of carbon (iv) oxide. It's a raw material required to combine with hydrogen ions to form simple carbohydrate molecules. Increasing the concentration of carbon (iv) oxide increases the rate of photosynthesis up to an optimum level beyond which other factors limit the rate of photosynthesis.



f) Give the differences between the light and dark reactions during photosynthesis

Light reactions	**Dark reactions**
• occurs in grana	• occurs in stroma

h.) a) i) What are chemicals of life?
- substances which make up cells, tissues and organs of the living system
- they combine to form organic compounds

ii) What are organic compounds?
- compounds that contain the element carbon

iii) List the organic compounds

- proteins

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- carbohydrates
- lipids(fats and oils)
- vitamins
- enzymes
- nucleic acids(DNA and RNA)

b) i) What are carbohydrates?

- Compounds of carbon, hydrogen and oxygen
- The elements are in the ratio of I carbon: 2 hydrogen: 1 oxygen

ii) Name the groups of carbohydrates

- monosaccharides (simple carbohydrates) e.g. glucose, fructose and galactose
- disaccharides (formed when two monosaccharides combine) e.g. maltose, sucrose, lactose
- polysaccharides (composed of many monosaccharides and disaccharides) e.g. starch, glycogen, cellulose

iv) State the general functions of carbohydrates

- production of chemical energy
- storage of starch(plants) and glycogen (animals)
- commercial uses e.g. manufacture of paper, textiles

c) i) what are proteins?

- compounds of carbon, hydrogen and oxygen and in addition nitrogen, and sometimes sulphur and or phosphorus
- building blocks are called amino acids

ii) Name the types of amino acids

- essential amino acids which must be supplied in food since they body cannot synthesize them
- Non-essential amino acids which body can synthesize.

iv) State the classes of proteins

- first class proteins which supply all the essential amino acids
- second class proteins which lack at least one amino acid

v) Give the functions of proteins

- structural compounds e.g. muscles, hair, hooves, and feathers

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- as enzymes e.g. pepsin, trypsin
- hormones e.g. insulin and glucagons
- antibodies
- part of haemoglobin molecule
- actin and myosin in muscles
- collagen in bones and cartilage
- pigments in rods and cones for coordination
- components of blood i.e. plasma proteins

d) i) What are lipids

- Fats and oils
- They contain carbon, hydrogen and oxygen
- However, they contain a higher proportion of carbon and hydrogen but less oxygen that in carbohydrates

ii) Name the types of lipids

- oils(liquid under room temperature)
- fats (solid under room temperature)

iii) What are the building blocks of lipids?

- fatty acids and glycerol

v) State the functions of lipids

- production of energy
- source of metabolic water
- structural compound

e) i) What are enzymes?

- a chemical compound, protein in nature, which acts as a biological catalyst

ii) State the properties of enzymes

- are highly specific in nature
- they are not used up during chemical reactions
- work within specific range of temperature
- work within specific range of pH
- enzyme controlled reactions are reversible

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iii) State the factors that affect enzyme action

- temperature
- substrate concentration
- pH of the medium
- enzyme concentration
- presence of inhibitors and co-factors

v) Name the types of enzyme inhibitors

- competitive inhibitors
- non- competitive inhibitors

vi) What are the functions of enzymes?

- enable cellular reactions to take place at a reasonably faster rate
- Control cell reactions therefore no violent incidences occur in cells that might burn them.

i.) a) Explain the various types of heterotrophic nutrition

i) Holozoic

- Mode of feeding by animals where solid complex food substances are ingested, digested and egested.

ii) Saprophytism

- feeding on dead organic matter

iii) Parasitism

- feeding from another organism but not killing it

iv) Symbiosis

- an association in which organisms of different species derive mutual benefit from one another

b) Differentiate between omnivorous, carnivorous and herbivorous modes of nutrition

i) Herbivorous

- herbivores feed exclusively on vegetation

ii) Omnivorous

- omnivores are animals which feed partially on plant materials and partially on flesh e.g pigs

iii) Carnivorous

- Carnivores feed on flesh alone e.g. lion

c) i) What is dentition?

- Refers to the number, arrangement and kind of teeth in an animal

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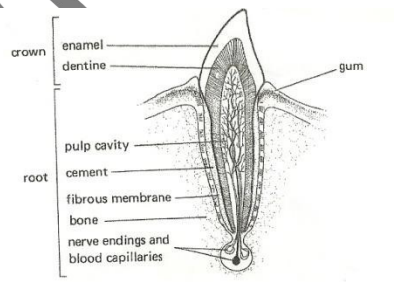
ii) Distinguish between the terms homodont and heterodont

- homodont have same kind , type, shape and size of teeth which perform similar function e.g. fish, reptiles and amphibians
- Heterodont have different kind, type, shape and size of teeth which perform different functions as those found in mammals.

iv) Name the types of teeth found in mammals

- Incisors
- Canines
- Pre-molars
- Molars

d) Describe the adaptations and functions of various types of mammalian

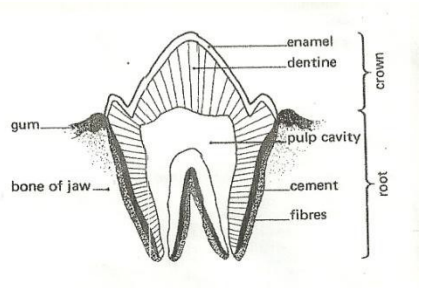


teeth Incisors

- chisel shaped/wedge shaped
- found in the front of the buccal cavity
- used for cutting

i) Canines

- next to incisors
- very sharp and pointed
- located at the sides of jaws
- used for tearing food



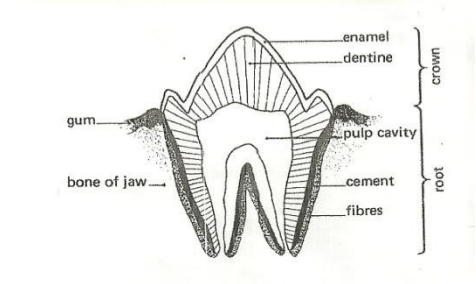
ii) Premolars

- next to canines but before molars
- have cusps and ridges on their surface
- used for crushing and grinding

iii) Molars

- found at the back of the jaw
- have cusps and ridges on their surface
- absent in young mammals but appear later when permanent teeth grow
- used for grinding and crushing
-

e) i)Draw a labeled diagram to represent internal structure of a mammalian tooth.



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ii) State the functions of the labeled structures labeled

Dentine

- main constituent of teeth
- like bone in structure but contains no cells

Enamel

- protects tooth from mechanical/physical injury
- the hard covering of the exposed part of teeth

Crown

- portion of tooth above the
- gum covered with dentine

Root

- part imbedded in the jaw below the gum
- covered by substances called cement
- cement is hard and bone-like

Cement

- bone-like substance covering root and enamel of mammalian tooth

Neck

- region at the same level with the gum
- forms a junction between the crown and root
- covered by enamel

Pulp cavity

- at centre of tooth within dentine
- has blood vessels for transporting nutrients/food and gases
- has nerves for sensitivity

f) i) What is dental formula?

- formula indicating the number of each kind of teeth for a given species of mammal
- only half the jaw is included
- the number in the upper jaw of one side is written above that in the lower jaw of one side
- the categories of teeth are given in the order incisors, canines, pre-molars, molars

ii) Give examples of dentition in named mammals

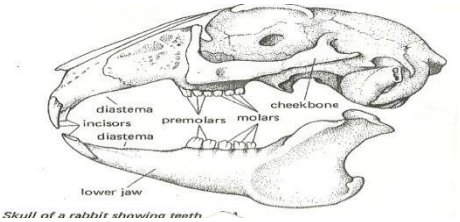
- carnivore e.g. dog $i^{2}/_{3}$, $c\ ^{1}/_{1}$, $pm\ ^{2}/_{3}$, $m^{2}/_{3} = 42$
- herbivore e.g. sheep $I\ ^{0}/_{3}$, $c\ ^{0}/_{1}$, $pm\ ^{2}/_{3}$, $m^{3}/_{3} = 30$

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- Omnivore e.g. human $I^{2}/_{2}$. $c^{1}/_{1}$, $pm^{2}/_{2}$, $m^{3}/_{3}$ = 32

iii) How would one use dental formula to identify the following?
Herbivores

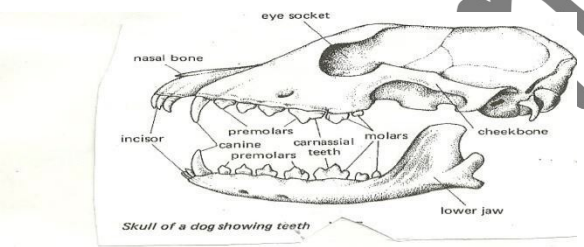
- presence of diastema/gap between incisors and premolars
- free movement of tongue
- absence of incisors in upper jaw
- absence of canines
- presence of hard pad
- closely packed molars



Skull of a rabbit showing teeth

Carnivore

- presence of canines
- presence of carnassial teeth
- presence of incisors in upper jaw/absence of diastema/gap between incisor and premolar



Skull of a dog showing teeth

iv) State the functions of the following structures in mammals

Carnassials

- tearing flesh from bones

Pad of gum

- provides grasping surface for lower incisors

g) Name the common dental diseases

- dental caries
- periodontal (pyorrhea and gingivitis)

j.) a) i) What is digestion?

- breakdown of complex food particles by enzymes to simple substances which can be absorbed

ii) Explain the types of digestion
Intercellular

- Digestion that takes place in food vacuoles inside cells.

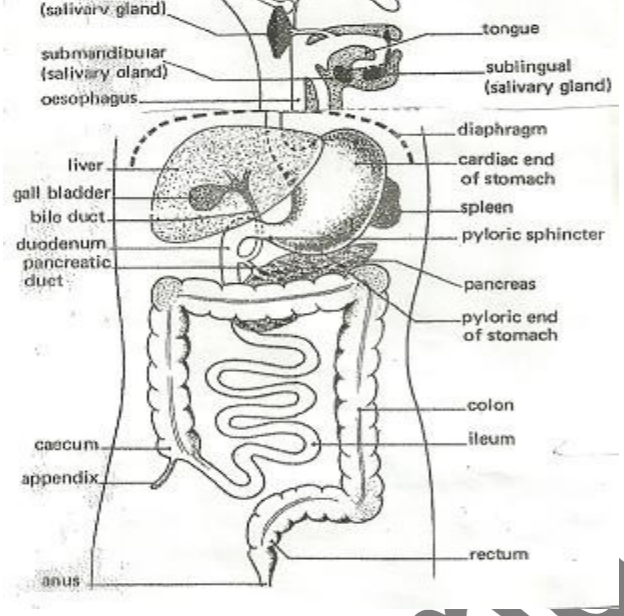
Extra cellular

- digestion that takes place outside cells e.g. in the digestive tract

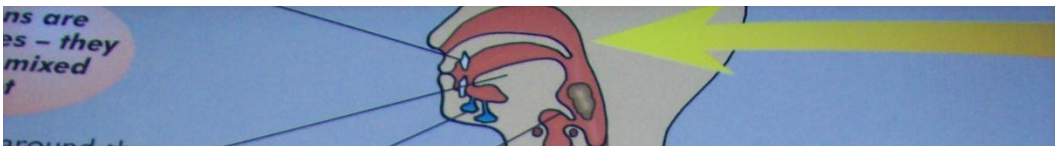
b) i) Draw human digestive system

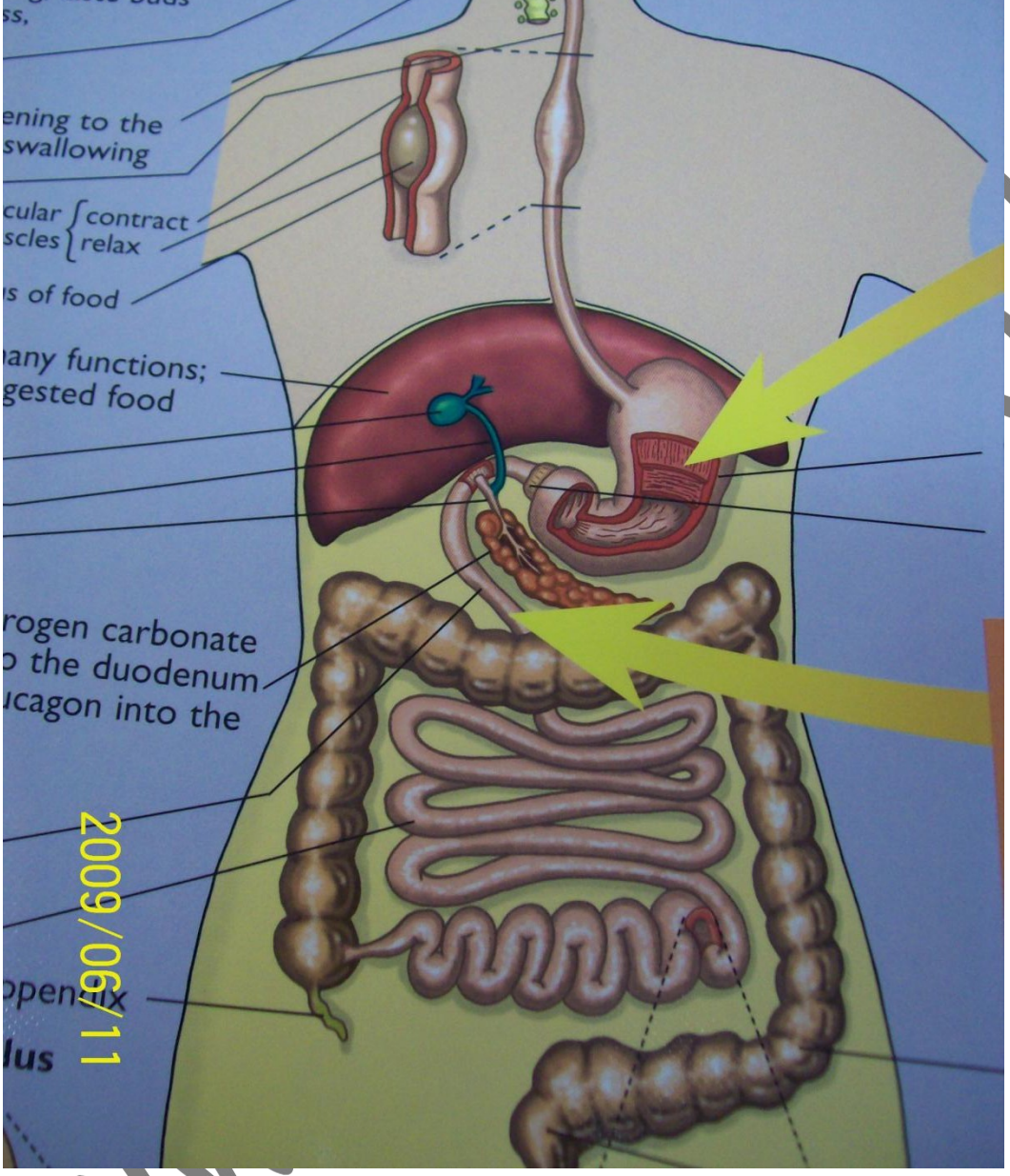


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ii) Describe the process of digestion in the various parts of the human digestive system

Mout
h

- contains teeth for chewing
- has tongue for mixing food with saliva
- has salivary glands for chemical digestion, secretion of enzymes and mucus secretion
- starch is acted on by salivary amylase enzymes to produce maltose
- the tongue rolls food into a bolus which is carried into the stomach by peristalsis
- peristalsis is movement of food along the gut by waves of contraction

- it facilitates rapid digestion due to its mixing action

Oesophagus

- also called gullet
- forms a passage for food by peristalsis
- connects the mouth to the stomach

Stomach

- has gastric glands which secrete gastric juices
- these juices contain hydrochloric acid(HCL), mucus, and the enzymes pepsin, rennin and lipase
- HCL produces an acidic medium for enzyme action
- Proteins are acted upon by pepsin to produce peptides
- Caseinogen is acted upon by rennin to produce casein
- Fats are acted upon by lipase to produce fatty acids and glycerol
- Mucus lubricates the stomach and prevents autolysis of stomach (mucus protects stomach)

Duodenum

- the first u-shaped part of the small intestine
- food in the stomach is now in a semi-liquid form called chime
- chime leaves the stomach by peristalsis into the duodenum
- there, the liver produces bile pigments, bile salts and sodium hydrogen carbonate
- the stomach is usually alkaline to neutralize chime which is acidic
- bile salts emulsify fats
- bile comes from the gall bladder through the bile duct
- sodium hydrogen carbonate provides the correct pH/alkaline
- pancreatic juices are released by pancreas into the
- duodenum
- the juices contain trypsin, chemotrypsin, amylase, lipase and protease
- proteins are acted upon by trypsin to form polypeptides and amino acids
  starch is broken down to maltose by amylase

Ileum

- produces intestinal juices
- Intestinal juice contains maltase, sucrase, lactase, erepsin, lipase, and several other peptidases
- Maltose is broken down to glucose and galactose by lactase
- Sucrose is acted upon by sucrase to glucose

Polypeptides are broken down into amino acids by
erepsin

- Mucus secretion is to protect the ileum wall from digestion/autolysis

Colon

- Commonly called the large intestine
- Wider than the ileum
- has several mucus-producing cells

Highly folded for water absorption

- Also prepares food for egestion
- egestion is the process by which the insoluble parts of food are discharged from the body in form

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of faeces.

Rectum
- Muscular and enlarged
- it produces mucus
- used for storage and removal of faeces

Anus

- found at the exterior end of the
rectum The rectum opens into the anus
- The anus has anal sphincter to control egestion
- Anus is used for egestion of faeces

c) Explain how mammalian intestines are adapted to perform their function
-
The mammalian intestines are relatively long and coiled. This allows food enough time and increases surface area for digestion and absorption of products of digestion
- The intestinal lumen (inner wall) has projections called villi to increase surface area for absorption
- The villi have projections called micro-villi which lead to further increase of surface area for absorption
- The walls have glands which secrete enzymes for digestion e.g. maltase, sucrase, lactase, peptidase and enterokinase.
- Goblet cells (mucus secreting cells or glands) produce mucus which protects the intestinal wall from being digested and reduces friction.
- Intestines have openings of ducts which allow bile, a pancreatic juice into the lumen
- The intestines have circular and longitudinal muscles whose contraction and relaxation (peristalsis) leads to mixing of food with enzymes (juices) helps push food along the gut.
- The intestines are well supplied with blood vessels that supply oxygen and remove digested food.
- Intestines have lacteal vessels for transport of lipids (fats and oils)
- Intestines have thin epithelium to facilitate fast/rapid absorption/diffusion

d) What is the function of hydrochloric acid in digestion?
- kills bacteria
- activates trypsinogen to trypsin which digests proteins to peptones and peptones to soluble amino acids
- provides acidic medium for gastric enzymes

e) i) What is assimilation?
- The process by which digested food is taken up by cells and used in the body for various purposes.

ii) State the uses of digested food in the bodies of animals
- Protection
- Repair
- Growth
- Energy production

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f) Name the types of food substances in the food that do not undergo digestion in human digestive system

- mineral salts
- water
- roughage
- vitamins

k.) Explain the importance of the following food substances in human nutrition

Vitamins

- are organic chemical compounds essential for a healthy body
- are obtained from fresh fruits and vegetables
- some are synthesized in the body e.g. vitamin K
- they are destroyed by overcooking food
- they protect the body against diseases, play regulatory mechanisms in the body and act as co-enzymes
- insufficient amounts lead to deficiency diseases e.g. rickets, scurvy, beriberi

a) Mineral salts

- are important in organic compounds containing elements which are essential for normal body metabolism
- those required in large quantities are called macro-nutrients while those required in small quantities are called micro-nutrients or trace elements
- They are used in bone and teeth formation. In osmotic balance and neurotransmission
- insufficient amounts lead to anaemia, rickets, goiter
- Excess amounts lead to high blood pressure, and dental disorders.

b) Roughage

- composed of cellulose and plant fibers
- digested by cellulose contained by gut microorganisms
- provides grip essential for peristalsis
- lack of roughage leads to slow movement of food leading to constipation
- roughage adds bulk to food for peristalsis to take place

c) Water

- used in transport in the body, universal solvent, hydrolysis
- insufficient leads to dehydration

l.) Explain the factors that determine energy requirements in humans

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a) Basal Metabolic Rate (BMR)

- this is the energy required when the body is completely at rest
- used to carry out breathing, heartbeat, circulation of blood and other basic reactions
- also used in maintaining body temperature at constant
- all movements or physical work e.g. walking, eating required more energy.

b) Occupation

- means activity occurring everyday
- everyday activity determines energy requirement
- People doing heavy work like digging require more energy than office workers.

c) Age

- children carry out many activities and also have more cell division than adults
- their BMR is therefore higher than for adults
- as they grow older, they become less active and their energy requirements decrease

d) Body size

- small bodied people have a large surface area to volume ratio
- their bodies lose more heat energy to the surrounding
- they therefore require more energy-giving foods
- this is the opposite for big bodied people

e) Sex

- most males are more muscular than females
- they also do heavier work than females hence require more energy
- females do lighter work hence require less energy

f) Climate

- in warm climate the body requires less energy
- in low temperatures the body requires more energy to maintain body temperature

m.) Explain various tests carried out on food

Test	Procedure	Observation	Conclusion
Starch	- add iodine solution	- colour changes to blue black/dark	Present
Reducing sugar	Benedicts solution heat/boil/warm in hot water bath	- colour changes to Green to yellow to orange to brown to red	Present
Non-reducing sugar	Dilute HCL, $NaHCO_3$, heat/boil, warm in hot water bath	- colour changes to Green to yellow to orange to brown to red	Present

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Proteins	1% $CuSO_4$, 5% NaOH	-- colour changes to purple/violet	Present
Ascorbic acid (Vitamin C)	DCPIP drop wise	DCPIP decolorized	Present
Fats/oils (lipids)	- rub on filter paper - ethanol	- translucent mark - white emulsions	present

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