S.5 BIOLOGY NOTES 2020.

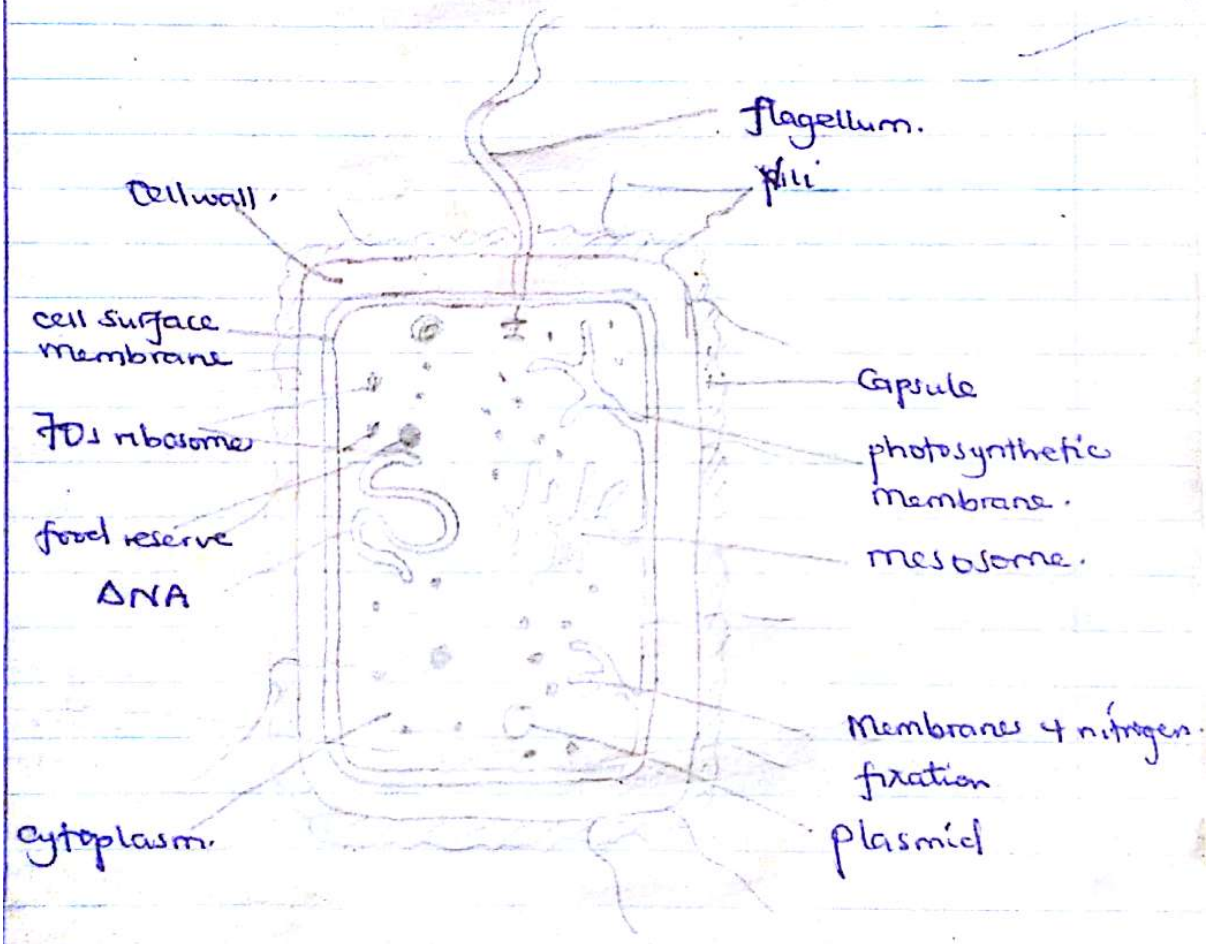
PROKARYOTIC AND EUKARYOTIC CELLS

PROKARYOTIC CELL

Prokaryotic cells are cells wh lack anuclear Membrane and Membrane bound organelle eg: bacteria cell blue-green algae.

These cells are the Most ~~per~~ ascient group of organisms with ~~simpler~~ ~~cell~~ simpler cell structure lacking an organell nucleas and hence their DNA ~~stru~~ material is not enclosed by a cell Membrane.

ATYPICAL PROKARYOTIC CELL.



EUKARYOTIC CELLS

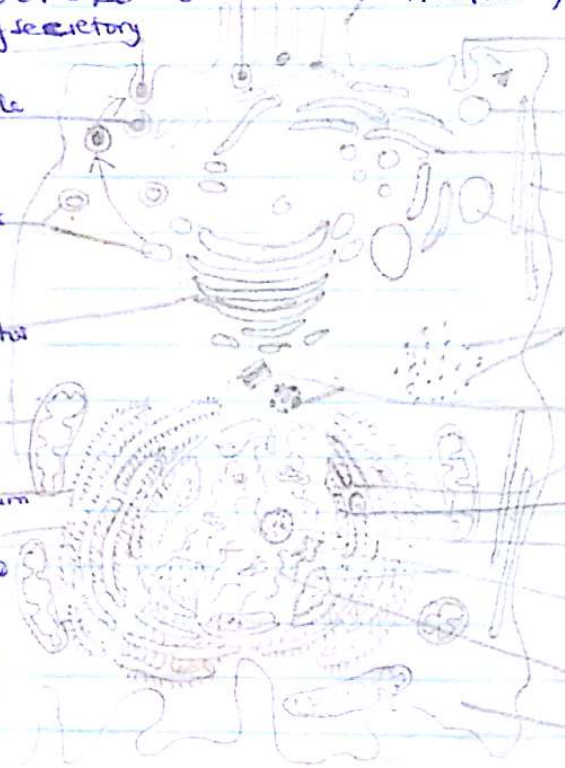
Are cells which have a nucleus enclosed with a nuclear Membrane and also have Membrane bound Organells eg Mitochondria, Cytoplasm, Chloroplast.

absorption or secretion at base of microvilli

Micro villus - increased surface for absorption or secretion

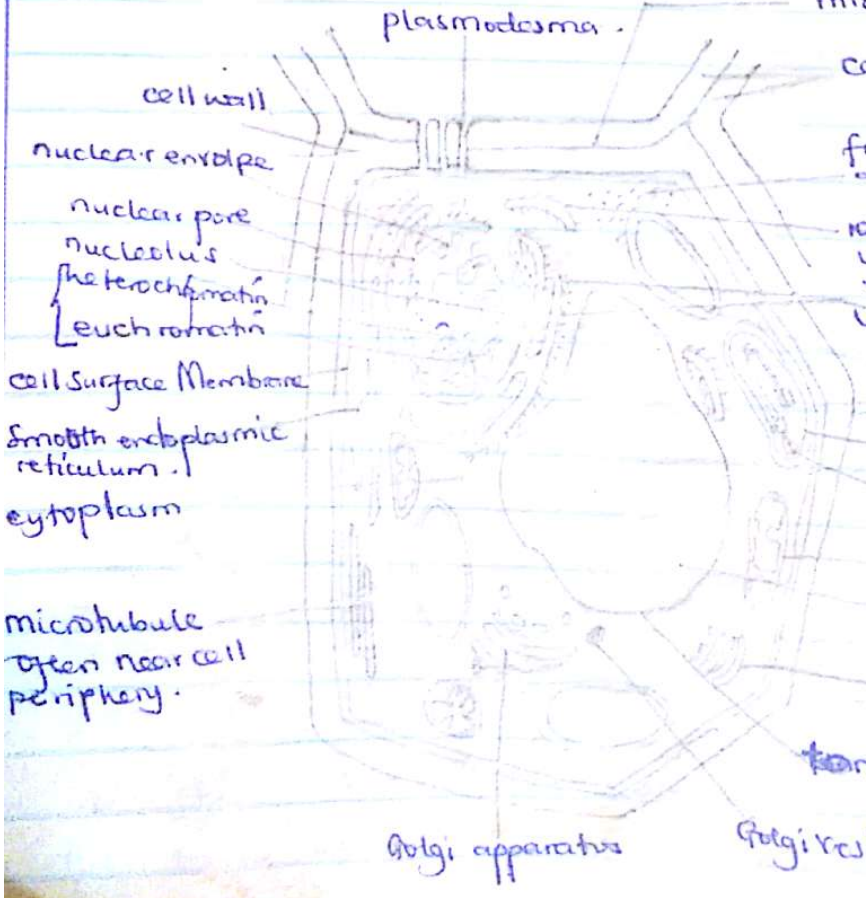
The best examples are cells of high plants and animals.

THE STRUCTURE OF AN ANIMAL CELL -



exocytosis of secretory product.
secretory vesicle
Golgi vesicles
Golgi apparatus
mitochondria
rough endoplasmic reticulum
endoplasmic reticulum bound ribosomes.
cell surface Membrane
pinocytotic vesicle forming
Pinocytotic vesicle
smooth endoplasmic reticulum.
Microtubules - often nearly cell pripheny
lysosome.
free ribosomes scattered throughout cytoplasm
two centrioles at right angles to each other and close to nucleus.
nuclear pore.
nuclear envelope (two membranes)
nucleolus
heterochromatin
euchromatin
cytoplasm

THE STRUCTURE OF A PLANT CELL



plasmodesma.
middle lamella.
cell walls of adjacent cells.
cell wall
nuclear envelope
nuclear pore
nucleolus
heterochromatin
euchromatin
free ribosomes scattered throughout cytoplasm
rough endoplasmic reticulum.
endoplasmic reticulum bound ribosomes
cell surface Membrane
Smooth endoplasmic reticulum.
cytoplasm
Chloroplasts
chloroplast envelope (two membranes)
granum.
microtubule often near cell periphery.
mitochondria
cell sap
Golgi apparatus.
tonoplast.
Golgi apparatus
Golgi vesicle

COMPARISION BTN EUKARYOTIC AND PROKARYOTIC CELL.

Similarities

→ In both cells the protoplasm is surrounded with a selectively permeable Membrane.

→ The Membrane binding the protoplasm consists of Lipids and proteins.

→ Both contain the cytoplasm.

→ A cell wall is present in some eukaryotic cell and prokaryotic cells.

→ Both contain DNA Material.

→ Both cells have the ability to replicate.

Differences.

Prokaryotic cells	Eukaryotic cells.
→ Don't have the true nucleus. and so has no nuclear Membrane.	→ Have a nucleus bound in a nuclear Membrane.
→ Contain Single stranded DNA which lies in the cytoplasm.	→ DNA is double stranded.
→ Energy yielding reactions occur in mesosome	→ Energy yielding reactions occur in Mitochondria.
→ Contain small amount of DNA	→ contain large amount of DNA
→ DNA & RNA is not associated with proteins & RNA to form chromosomes	→ DNA & RNA is associated with protein and RNA to form chromosomes.
→ They lack Membrane bound Organells	→ They contain Membrane bound Organelles such as protoplasm mitochondria and nucleus
→ They contain small ribosomes (70s)	→ Have large ribosomes (80s)
→ flagella if present lacks "9+2" of Microtubules arrangement	→ flagella if present has "9+2" microtubules arrangement.
→ They do not have a system of interconnected channels	— They have an Intercellular System of connected Membrane channel.

- The cell walls contains polysaccrides with amino acid and is strengthened by murein (polysaccrides).
- The cell wall (in plants) contain polysaccharide cellulose role is the strengthening Material.
- photosynthesis occurs on the photo synthetic Membrane
- It takes place in chloroplasts.

DIFFERENCES BTN PLANTS AND ANIMAL CELLS.

Plant cell	Animal cell.
→ contain a tough rigid cellulose in the cell wall.	→ They lack a cell wall
→ pits and plasmodesmata in	→ pits and plasmodesmata.
→ Have a middle lamella joining the cell wall and adjacent cells.	→ Do not have a middle lamella.
→ plastids (chloroplasts and leucoplasts) are present in large number.	→ plastids are absent
→ Contain a nucleus at the edge of the cell.	→ The nucleus occupies the central position of the cytoplasm.
→ chloroplast is present around the vacuole.	→ Tonoplast is absent.
→ Lysosomes not normally present.	→ Lysosome normally present.
→ Centrioles absent in Other plants absent.	→ Centrioles present.
→ Cili and flagella are absent in higher plants.	→ Cili and flangella are present.
→ Starch grains present as storage Material	→ Glycogen grains present as storage Materials.

Hypothesis

Daniel & davison model
- The protein molecules are not static
- protein molecule float off the whole membrane

Singer & Nicolson.
- protein molecules are static
- Protein Molecules are attatched on the layers of the phospholipid

Start

THE PLASMA MEMBRANE.

The plasma Membrane acts as a boundary between the cell and the environment. It permits different substances to pass through them, while other substances are not able to pass through it hence it is described as a partially permeable Membrane or Semi-permeable membrane.

The cell Membrane is also known as the plasma Membrane since it binds the protoplasm which is the living part of the cell. All cell Membranes have a basic structure.

The Molecular structure of the cell Membrane was first studied by Daniel and Davision The third scientist who put the theory to explain the structure of the cell Membrane.

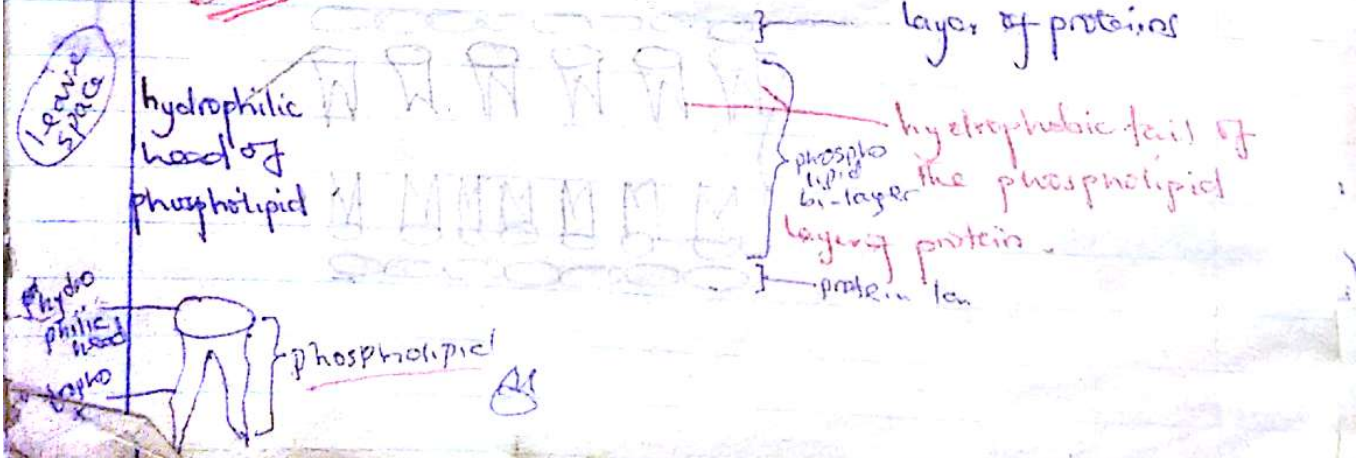
The Daniel-Davison Model of plasma Membrane

According to this Model, the plasma Membrane consist of a double layer of phospholipids, sandwitched between two layers of protein Molecules.

The lipid Molecules are positioned at right angles so that their hydrophilic heads face on the opposite side of the Membrane while the hydrophobic tails are directed towards the centre.

Phospholipids sandwitched

Draw



THE FLUID MOSAIC ~~STRUCTURE~~ MODEL OF PLASMA MEMBRANE

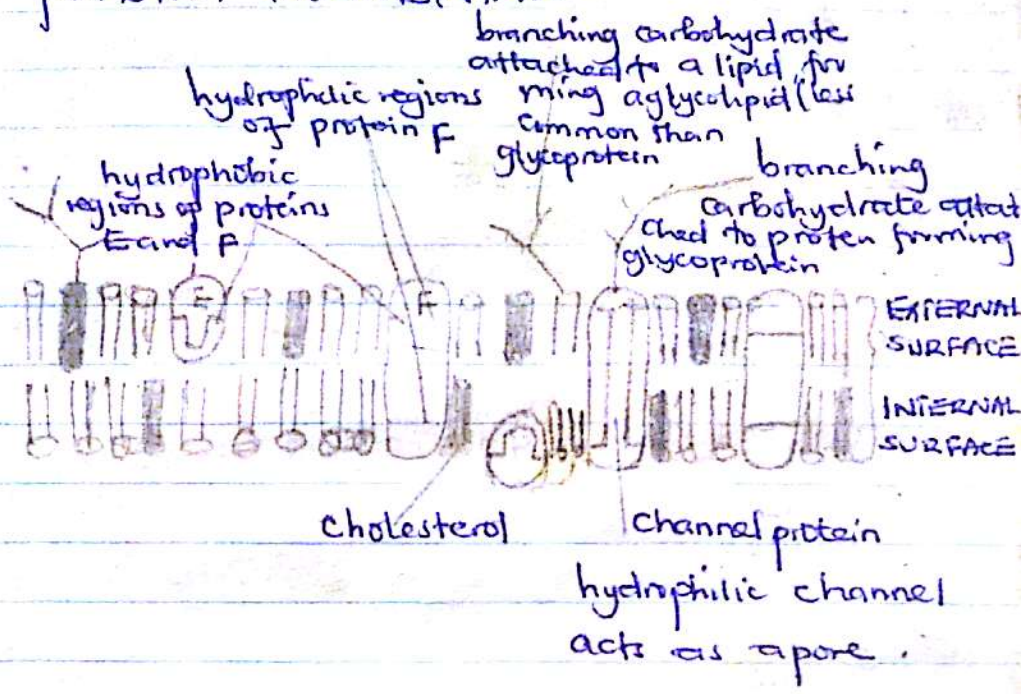
Singer and Nicolson studied the Ultra-structure of cell membrane and put out the fluid Mosaic Model.

According to this Model the plasma Membrane consist of a bi-layer of ~~phosphotic~~ phospholipids with hydrophitic heads of phospholipid Molecules facing outwards into ~~out~~ aqueous environment; and ~~the inside~~ hydrophobic tail and outside the cell. While the ~~phosphotic~~ tails face each other towards the centre of the Membrane.

The protein Molecules are scattered with in the phospholipid layer and the phospholipid Molecules move about themselves in a fluid layer. The ~~fluid~~ protein interact with the fluid phospholipid bi layer to form a fluid Mosaic pattern. Some protein Molecules penetrate into the phospholipid layer and these are known as Intrinsic protein while some protein Molecules attach on the surface of the phosphotic Molecules and these are called extrinsic proteins. Some Intrinsic proteins penetrate through both layer of phospholipids and these are called transMembrane proteins. Some protein and lipid Molecules interact with carbohydrates forming glycoprotein and glycolipid respectively. The plasma membrane also contains cholesterol which increases flexibility and stability of plasma Membrane.

Cholesterol

THE DIAGRAM SHOWING THE FLUID MOSAIC MODE OF PLASMA MEMBRANE.



TRANSPORT ACROSS THE PLASMA MEMBRANE.

Ions and larger polar Molecules, sugars, aminoacids fatty acids and glycerol are repeled by the hydrophobic region of the cell Membrane.

These substances Mayorily diffuse through the protein channels and carrier protein into or out of the cell.

Minerals ... through ion gated channels in the ... out of the cell. Water Molecules are ... and hence would be repeled by phospholipids. ... water Molecules are smaller and hence ... to the enter the cell through phospholipid ... les. Non polar substances are transported ... the phospholipid layer.

cell ...
polar ...
However ...
able ...
molec ...
across ...

functions of proteins in the plasma membrane protein

→ Some proteins are carrier proteins which are involved in selective transport of polar Molecules and ions through the cell Membrane. the process facilitated by diffusion or active transport.

→ Some protein Molecules act as enzymes which catalyses various chemical reactions.

→ Some proteins in the Membrane act as receptor Molecules eg hormonal receptors, receptor for neural transmiters and hence these proteins are in born in chemical signalling between cells.

→ Some proteins act as identity Markers (antigens) so that they can be recorganised by the body's Immune system.

→ This property is very pro Important in the body's defence against diseases

→ Some proteins in the plasma Membrane form protein channels through which ions and polar Molecules diffuse in and out of the cell.

CELL ORGANELLES

The nucleus:

Nucleus is found in the eukaryotic cells except Mature phloem, ~~Hiove~~ tube elements and Mature red blood cells.

The nucleus is the largest of cell organelles it is a double Membrane organelle (it is enclosed by an envelope ie (nuclear envelope).

The outer Membrane of an envelope is continuous with endoplasmic reticulum which May be covering ribosomes (rough endoplasmic reticulum or May be a smooth endo plasmic reticulum (lacking ribosomes)

The nuclear envelope is prerforated with nuclear pores which provide passage for Material in and out of the nuclear plasma hence facilitates the exchange of Materials btn the cytoplasms and the nuclear plasm.

The nuclear plasm also contain chromatins wlc extend into chromosomes during cell division

The nuclear also contains DNA (genetic material) and a nucleolus where ribosomes are ~~*~~ synthesised. In the nucleolus also ribosomal RNA is manufactured

In the nucleolous also ribosomal RNA is manufactured

FUNCTIONS OF THE CELL NUCLEUS.

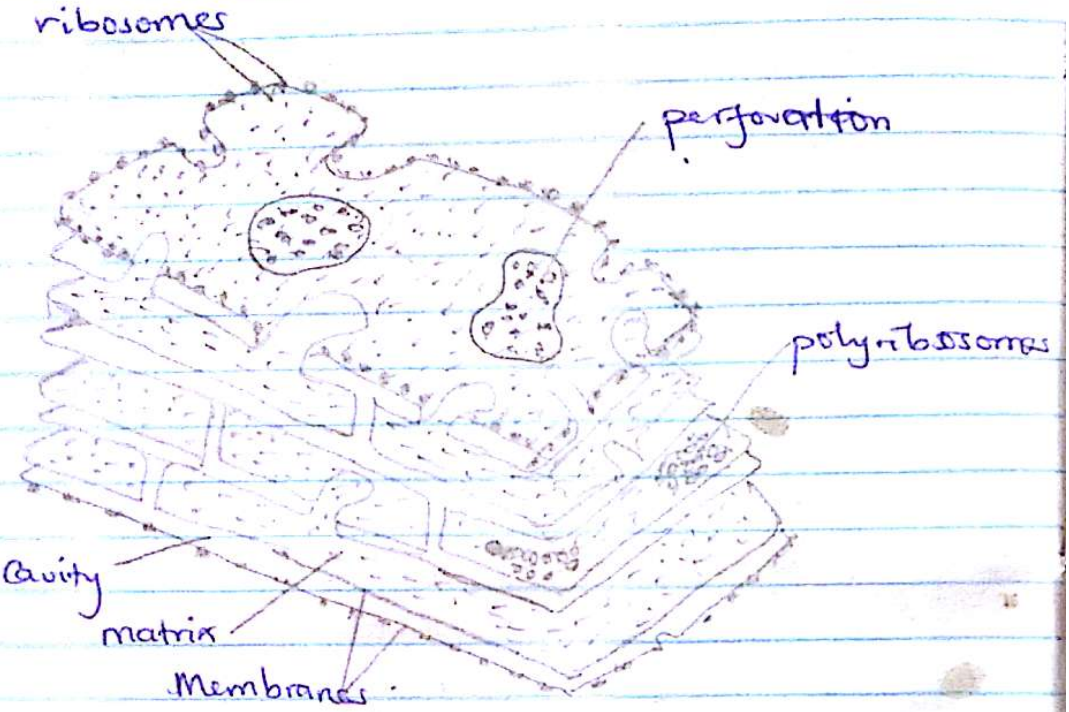
- It controlls the activities of the cell.
- It is the site ~~for protein~~ synthesis of Messanger RNA
- Ribosomes are Manufactured in the nucleolus.
- It contains DNA
- It controlls cell division in the cell.

ENDO PLASMIC RETICULUM

This is a net work of system of flattened Membrane channels called Cisternate. It is continuous to the outer Membrane of the nucleus to form a series of sheets to which its ribosomes are attatched. Then it forms rough endoplasmic reticulum and if no ribosomes then it is Smooth endoplasmic reticulum.

(responsible for transportation of materials in a cell

A DIAGRAM SHOWING FLATTENED MEMBRANES OF ROUGH ENDOPLASMIC RETICULUM.



Functions of rough endoplasmic reticulum.

→ Having extensive system of Membranes. It provides large surface are for transportation of materials in the cell.

→ It isolates and transports proteins after Manufacture.

→ It provides the structure skeleton to the cell which enables a cell to mentain its shell.

→ Its responsible for collection and storage of Manufactured Materials in the cell bey they are shade out of the cell.

Functions of smooth endo plasmic reticulum.

→ Responsible for systatheris of lipid and steroids and their transport to bee the same.

→ It synthesises polysaccharides

→ It is roponsible for mat formation of lysosomes.

→ provides vesicles wic lead to formation of Golgi body.

- Provides surface area for detoxification
- It also synthesises cellulose
- It contributes on the structural skeleton of the cell.

GOLGI BODY

- This structurely similar to smooth endoplasmic reticulum. It consist of Membrane bound channel known as Cisternae. The golgi apparatus is well developed in secretory cells where it is essential for processing and transportation of substances that are yet to be transported across the cell Membrane for secretion.

The Golgi apparatus Modified synthesised carbohydrates and proteins in the cells where by it forms glycoproteins and glycolipids which are hormone cell secretion.

Proteins from the endoplasmic reticulum form vesicles of Materials being transported which are budded off are fuse with the Membranes on the golgi apparatus from which vesicles pitch off and fuse with the cell Membrane to discharge secretions

How is the golgi apparatus formed?
Vesicles pinch off from the smooth or rough endoplasmic reticulum and fuse to form a system of Membrane sacs (Cisternae). The Membranes formed become extensive to form a system of interconnected Membranes we are now at their stage of maturation called Golgi body.

⇒ processing and transportation of substances for secretion by the Golgi body.

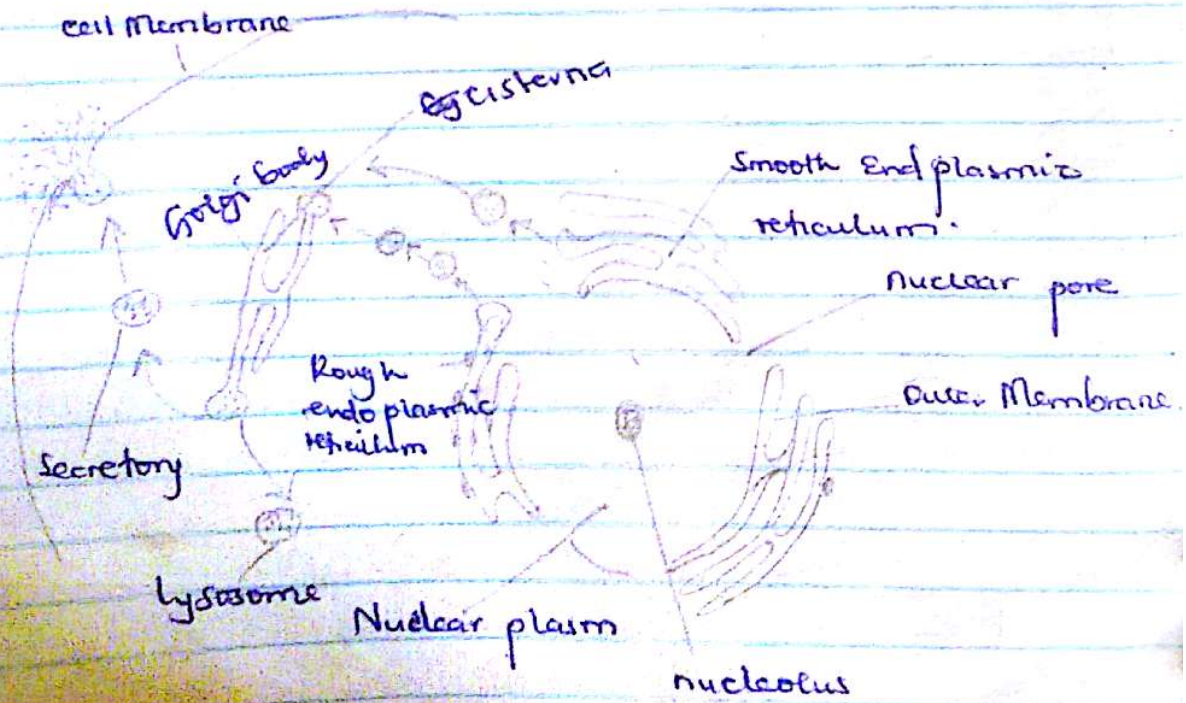
5. Co manufacture lipids and steroid.

The proteins formed from ribosomes of rough endoplasmic reticulum and the lipids and steriods formed from the smooth endoplasmic reticulum are not at their final stage of being secreted from the cell.

These substances have to be channeled through the golgi apparatus in which they are Modified and processed into useful secretory materials.

Vesicles containing carbohydrates, lipids proteins from the endo plasmic reticulum pinch off from the flattened Membranes to form vesicles who move towards the golgi body and fuse with the System of Membrane to empty their content into

~~The Membranes~~ While inside the golgi body substances are sorted, Modified and processed into useful secretory substances. Later alone the processed substances are transported through the Membrane channels of the golgi apparatus and form vesicle which budd off to form secretory vesicles or fuse with the cell Membrane to release their content and discharge ~~the content~~ outside the cell.



GENERAL FUNCTIONS OF GOLGI BODY.

- processing and transportation of secretory substances eg glycolipids, glycoprotein and enzymes.
- Responsible for formation of lysosome.
- Involved in prodn of secretory enzymes like digestive enzymes found in pancreatic juice.
- Responsible for formation of cell wall in plant cells by synthesis of cellulose.

CHLOROPLASTS.

Belongs to a large group of organelles known as plastids. Chloroplasts have a chloroplast envelope (double Membrane) ie the inner and outer Membra

They are oval in shape. Inside the chloroplast envelope there are two distinct regions ie a matrix known as stroma and stacked Membranes called grana.

Each granum consist of 2–100 closed flattened stacks called thylakoids in which photosynthetic pigments such as chlorophyll are situated.

With in the stroma are also series of starch grains wch act as temporaly stores of carbohydrates and there are small amounts of DNA. Oil droplets also occur in stroma and ribosomes (polysomes) wch May be in groups or they May be individually scattered in the stroma.

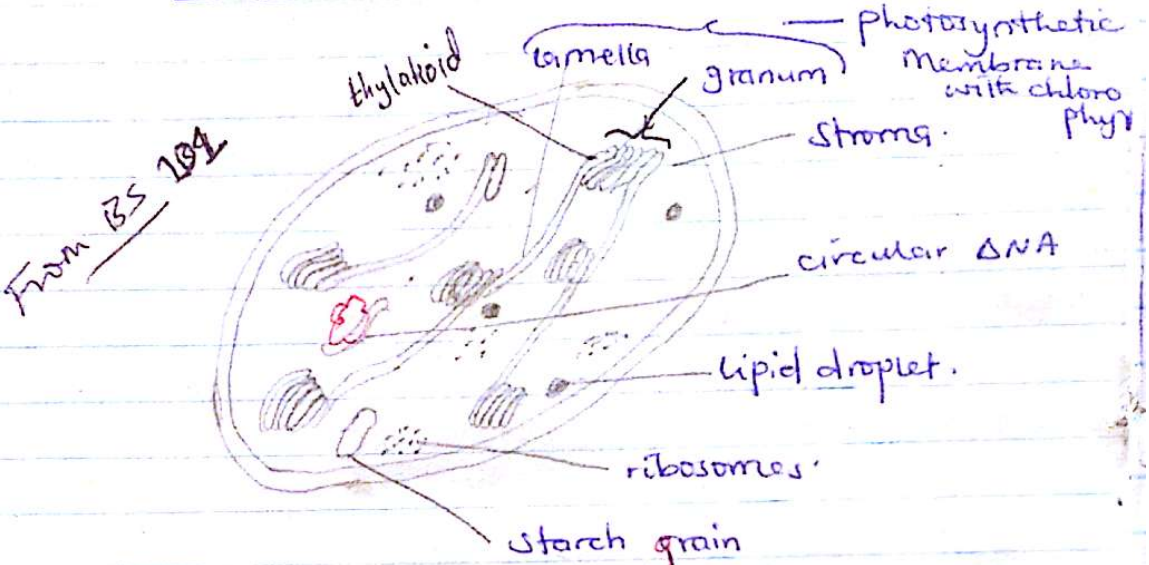
The stroma contains a variety of enzymes in involved in the light independent stage of photosynthesis.

The chloroplast is a photosynthetic organell ie where photosynthesis take place producing sugars from water and CO_2 using sunlight.

= chloroplast is photosynthetic organelle.

energy. Infact the light dependant stage (light stage) occurs in the thylakoid Membrane while the light independent stage (dark stage) takes place in the stroma.

THE STRUCTURE OF THE CHLOROPLAST.



From BS 104

How chloroplasts are adapted to their function

→ They are bounded by double Membrane (envelope) to isolate photosynthetic reactions from other cellular activities.

→ They contain numerous thylakoids to hold chrolophyll in suitable position of trapping maximum light.

→ Thylakoids are stacked on top of each other to form grana to provide a large surface area for light dependant reactions to take place with in the little space.

→ Also contain enzymes in the stroma, for photosynthetic reactions

PLASTIDS

They are small bodies of various shapes found in the ~~chloroplast~~ cytoplasm of plant cells but absent in fungi.

They contain their DNA and food reserve materials. Some plastids are pigmented where as some lack pigments.

- Both of them have DNA
- Both of them have an envelope (double membrane organell).
- Both of them have ribosome
- Both of them have a matrix

Those that are pigmented are called chromoplasts. We include chloroplasts. and those we are non pigmented are called leukoplasts.

All plastids contain a fluid matrix called stroma.

CHROMOPLASTS

The most common ~~plasts~~ Chromoplast in cells in green plants are the chloroplasts we give the leaf a green - colour.

Other chromoplasts in plants occur in variety of colours like Orange, yellow, red etc due to presence of pigments in them such as carotenes and Xanthophylls. Xanthophylls. Carotenes

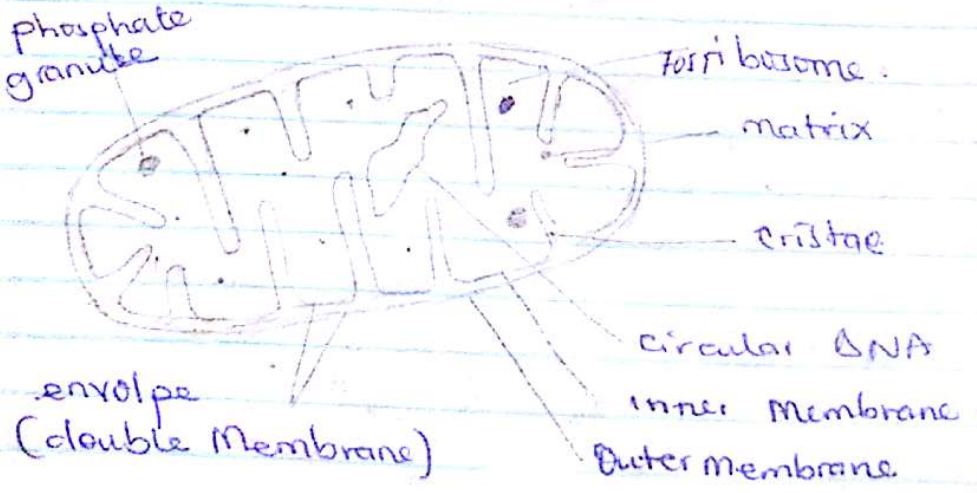
Some other chromoplasts also occur in pericarps of fruits and petals of flowers. pericarp

LEUKOPLASTS

These plastids lack pigments. They are arfound in cells of those plants tissues we are not - normally exposed to light eg roots and underground stems. Majority they are responsible for food storage in the cells.

MITOCHONDRIA

THE STRUCTURE OF A MITOCHONDRIA.



Krebs

It is a rod shaped double Membrane bound-organelle in wlc energy is produced ~~in cells~~ in Eukaryotic cells.

The inner Membrane is highly folded to give rise to partitions known as Cristae wlc are ~~Aerobic respiration~~ sites of energy production through ~~by~~ Oxidative phosphorylation and electron transport. Also - contain a matrix wlc is a site of Krebs cycle leading to energy production. In the matrix also are ribosomes and coiled strand of DNA.

The presence of ribosomes in the matrix suggests that Mitochondria carries out its own protein Synthesis ~~enzymes~~ while the presence of DNA suggests that the Mitochondria is capable of self replication (division).

~~In the wlc~~ Cells which require alot of energy eg cells of epithelial lining where materials are absorbed by active transport contain numerous mitochondria

Comparision both chloroplasts and Mitochondria

Similarities

- They both contain their own nucleic acids (DNA & RNA).
- Both have ~~a~~ fluid matrix.
- Both are bound by a double Membrane (envelopes)
- Both contain their own ribosomes.
- Their Membranes consist of lipoproteins.
- Both contain inter Membranal spaces.

Differences

Mitochondria	chloroplast.
The inner Membrane is highly folded to form cristae.	The inner Membrane ~~is~~ when folded form lamella. (Unfolded)

→ Lacks Internal Membrane sstm System

→ lacks pigments.

→ Rod shaped

→ functionally releases energy in rollula

→ The lacks Membrane when

→ Contain Internal Membrane sstm eg lamella and Thylakoid.

→ Contains pigments eg chlorophyll.

→ Oval shaped.

→ functionally release they

rains are absent.

→ starch grains are scarked with in matrix.

→ Starched

LYSOSOMES.

re found in most eukaryotic cells, and are d by a single membrane and are simple sac- ntain digestive enzymes such as lipases , proteases. enzymes are normally collectively refered Lysozymes.

lysozymes are produced by budding off body and some times the endoplasmic n.

enzymes contained in the lysosomes are from attacking the content of the m of the cell by their binding Memb

hen lysosomes lyse / rapture, they release wle carry out self digestion of the cell le they are found in the process known alysis and for this reason lysosomes are as Suicides bags in the cell.

UNCTIONS OF THE LYSOSOMES.

are responsible for digestion of worn out with in the cell. Any resulting nutrients are then absorbed / dissolved back into the sm while the indigestive material from Vesicle wle fuse with cell Membrane to

They

surround that c nuclease These as The the gol reticulu The prevente protopla rane.

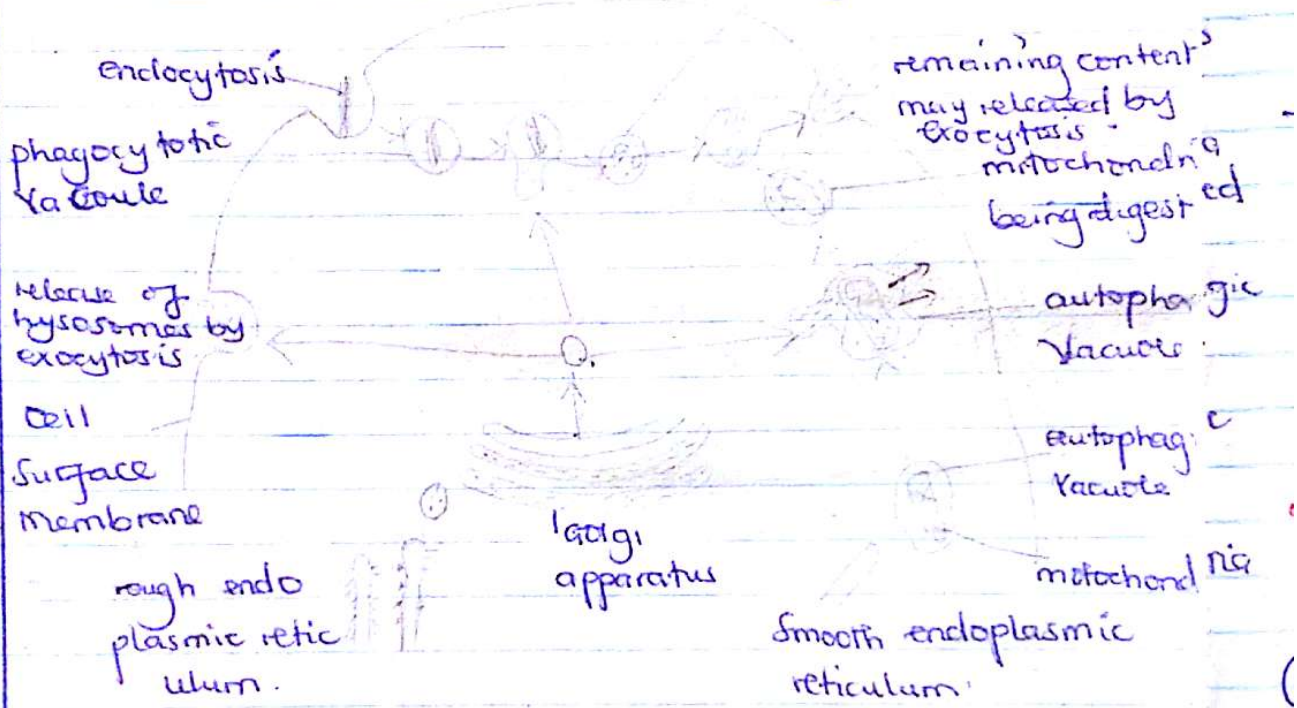
enzymes in as aut regarded

They organel useful cytopla exocytic exocytic

phagocytic

eliminate its content outside the cell.

2. Digestion of food materials taken into the cell by phagocytosis. lysosomes usually secrete their enzymes into phagocytotic vesicle after wic the useful products of digestion, are observed into the cytoplasm.



3. Autolysis: It is a process by wic cells that are old, dead, worn out or damaged are destroyed by lysosomal enzymes. for this reasons this process is also known as self digestion

Autolysis is also important in the developmental stages of animals like Tadpoles for reabsorption of the tail. Autolysis clears cells & new cell growth.

CELL VACUOLES

This is a fluid filled sac bounded by a single membrane called the Tonoplast.

Mature plant cells have a large Centralised centre vacuole wic contains a solution of sugars, Mineralsalts organic amino acids, pigments like anthocyanin and organic acids plus some hydrolytic enzymes called cell sap.

Volute??

Major functions of the vacuole.

→ The sugars and amino acids act as temporaly food - stored in the cell hence a vacuole is a storage organelle.

→ The anthocyanin contained in the vacuole is a ~~storage~~ a pigment of various colours in leaves and petals ~~of~~ of flowers for attracking pollinators and in fruits to attract animals for dispersal.

→ Contains hydrolytic enzymes wic perform functions similar to those of lysosomes.

→ The vacuole enhances turgidity in non. woody plants and leaves by contributing to the osmotic properties of the cell attributed to the ~~Volute~~ Solute accumulated in it.

step

NON MEMBRANE BOUND STRUCTURE IN THE CELL.

granules

① Ribosomes (function is manufacturing proteins)

Are small cytoplasmic granule found inside the cell. They may be free in the cytoplasm or bind to membrane system like endoplasmic reticulum.

In eukaryotic cells, they are bigger and regarded so as 80's type while in the prokaryotic cells are 70's type.

A group of ribosomes may occur in the cytoplasm making a chain and this is called polysomes / polyribosomes

Function of ribosomes

② STORAGE ~~OF~~ GRANULES.

Every cell contains a limited store of food ~~energy~~ wic may be in form of soluble materials such as sugar found in vacuoles of plant cells or insoluble material inform of glycogen, the cell

granules
~~grains~~ in animals cells, starch grains in plant cell, fat droplets in animals cells and oil droplets in plants cells.

~~Major functions of the vacuole~~;

The

FUNCTIONS OF RIBOSOMES.

They are responsible for protein synthesis in the cell.

③ MICROTUBULES.

These occur widely throughout the Eukaryotic cells but ~~absent~~ in prokaryotic cells.

They are composed of two similar proteins ie alpha (α) and Beta(β) tubulin.

They are distributed with in the cytoplasm but also may occur in bandles.

Proteins contained are called tubulins & Microtubules

FUNCTION OF MICROTUBULES

- They form a framework on wic cellulose wall is built for the case of plant cell.
- They are used in transportation of Materials especially in plant cell for instance, translocation by cytoplasmic streaming
- They form spindle fibres wic are important in cell division
- They are involved in formation of centrioles, flagella and cilia.

MICRO ~~FILAMENTS~~ FILAMENTS

Long thin Solid fibres Smaller than Microtubules. They are Made up of proteins of different types and themselves are of two types.

Thin filament - contain a protein called actin.

Thick filament - Contain a protein called Myosin

Myocin

FUNCTIONS OF THE MICRO ~~FILAMENTS~~ FILAMENTS

1. They are used for cell Mov'ts
~~involved in the formation of vesicles ie the contractility~~
2. enable the cell Membrane to form in folding's wh lead to formation of vesicles.
3. Together with Microtubule, they contribute to ~~cytoskeleton~~ Cytoskeleton of the cell.

CILIA AND FLAGELLA.

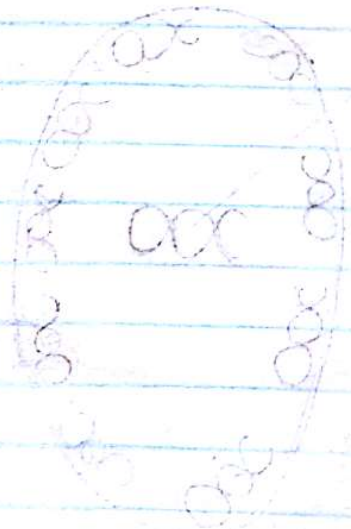
Cilia and flagella are found in some cells wh are usually motile or concerned with absorption of substances.

Cillia and flagella are almost similar ~~expect~~ except

Cillia	Flagella
1. Are usually Many	– One in most cases
2. shorter	– longer than cillia.

In Eukaryotic cells they both consist of pairs of peripheral microtubules surrounding central pair of microtubule and this arrangement is refered to as the "9+2" pattern.

THE CROSS SECTION OF FLAGELLA SHOWING "9+2" PATERN OF MICROTUBULES.



One of the two central Microtubules.

One of the 9 pairs of peripheral Microtubule

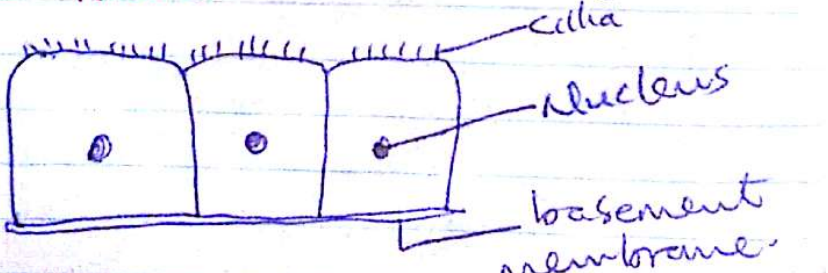
The "9+2" pattern of Microtubules, is lacking in the cillia and flagella of prokaryotic cells.

The arm like structure on one microtubule of one of the 9 pairs are sites of ATP hydrolysis to release energy required for movt of cillia or flagellam since they contain the necessary enzyme ATPase for ATP hydrolysis.

Functions of cillia to an Organism.

- Important for locomotion of low organism particularly protozoa such as paramecium.
- In some invertebrates like Molluscs, cillia maintain circulation of body's fluid in the body spaces.
- Cilia are used for Immobilising food eg in paramecium, cillia bring food to the site of ingestion by creating a wave of H_2O current.
- They are important in clearing debris like dust particles from the air in air passages.
- Responsible for movt of Ova in the Oviduct in the mammalian female reproductive sstm.
- In some parts of the body, cillia are associated with cells that form ciliated tissues wlc perform the role of increasing surface area for absorption eg. In human small intestines and in the kidney tubule.

DIAGRAM SHOWING THE CILIA CELLS OF CILIATED EPITHELIAL TISSUES.



Prolifera.

functions of the flagella.

They are also related to movt or locomotion to some ~~Cell~~ organisms

- Important for movt of whole organism eg in protozoa like Euglena, Trypanosoma ~~etc~~.
- in higher animals like mammals they are responsible for movt of sperm cells with in the reproductive tract.
- Important in feeding mechanisms of some organisms like sponges of phyllum ~~porifera~~ Porifera. by creating water current we aid movt of food particles.

CENTRIOLES

In the cell, the centrioles are located in specialised areas especially near the nucleus. Centrioles are found only in animal cells but they are generally absent in high plant cells.

Centrioles are hollow group of cylindrical structures whose wall consist of parallel groups of Microtubules arranged in rings, each ring consisting of three Microtubules.

Centrioles are important in cell division, where they assemble and organise the spindle fibres.

CELL WALL

cell walls are found in plant cells of higher plants and fungi. It consist of a rigid wall of cellulose wle is secreted by protoplast of the cell.

cell walls also occur in prokaryotic cells however plant cells walls differ in chemical composition from those of prokaryotic cell wall and fungi.

Briefly,

The primary wall of the plant cell consists consisting of cellulose fibrils running through a matrix of other polysaccharides like pectins. Pectin

Cellulose fibres consists of cross-linkages making some fluid filled spaces wle makes the cell

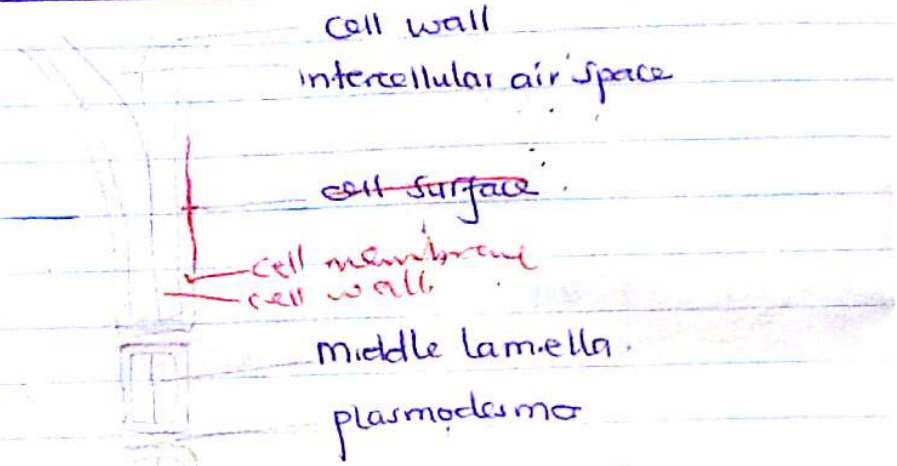
unthickened

wall permeable to H_2O and dissolved solutes.

During the deposition of the cell wall, some areas of the cell wall remain unthickened to form pits, through wic thin cytoplasmic strands pass to the neighbouring cells and offering means of movt of materials.

These areas of perforations are called plasmodesma.

DIAGRAM SHOWING THE STRUCTURE OF A CELL WALL



Btn adjacent cells of plants is a thin layer of pectic substances such as calcium and Magnesium pectates called the middle lamella. wic joins the cell walls of the two neighbouring cells.

This offer extra strengths to the cell wall.

Extra strength of the cell wall is achieved by:

(i) Lignification: Here the cell wall undergoes extensive addition of lignin which is a complex polymer of non-carbohydrates substances deposited in the cellulose. Lignin anchors cellulose fibres together rendering the cellulose wall rigid by but impermeable to water and dissolve solutes. This is necessary in cells of conducting tissues such as xylem where the protoplasmic content dies to form hollow conducting vessels.

(ii) Addition of Suberin. Also a tough substance especially in cork cells wic renders the cell impermeable to H_2O.

When not lignified allows entry of water into cell by osmosis.
Increases surface area for active transport in some cells.
Maintains & determines shape of plant cell due to big rigid.
It controls turgidity when water enters the cell.
provides mechanical support.

Functions of the cell wall

The cell wall of the root endodermal cells are impregnated with suberin that forms a barrier to water movt.

Some cells walls are modified as food reserves as in storage of hemicelluloses in some seeds.

The cell walls of ~~transfer cells~~ some plant cells develope an increased surface area of the cell surface area of ~~the cell~~ membrane ~~and the consequent increase in~~ surface area of the cell.

~~Surface~~ cuticle Membrane increases the efficiency of transfer of materials by active transports.

The walls of xylems vessels and sieve tubes ~~by~~ are adapted for long distance translocation of materials through the cells.

cell walls develope a coating of waxy ~~cutin~~ the cuticle on exposed epidermal surfaces reducing water loss and risks of infection ~~cort~~ cell walls undergo impregnation with suberin wch serves a supportive ~~similar~~ function after secondary growth.

Mechanical strength and skeletal support is produced by the cell wall. ~~Extensive~~ lignification increases in some cell walls in some plants and is particulary important in trees and shrubs.

Orientation of cellulose microfibrils limits ~~ability~~ and helps to control cell growth and shape bcz the cell's ability to stretch is determined by their arrangement.

cell walls are fairly rigid and resistant to expansion and thereby controls ~~allow~~ of turgidity when the water enters the cell by osmosis. This contributes to support - mostly in non woody or herbaceous plants, and ~~organs~~

The system of interconnected cell walls ~~(the apoplast)~~ is a major path way of movement of H_2O and mineral salts within the plant roots.

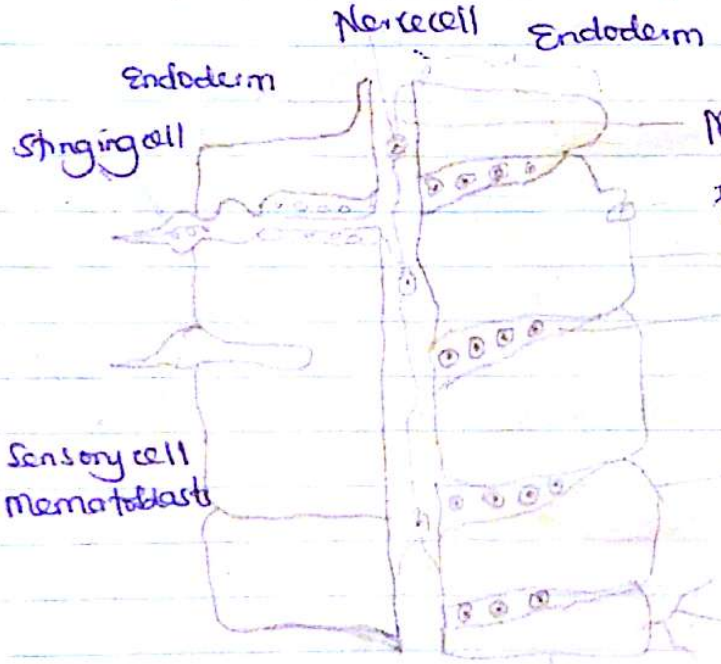
DIVERSITY OF CELLS

Cells that serves the same functions are Identical in shape and composition eg they contain the same type and number of cell organelles. However in multicellular Organisms, there are different level of cell organisation.

There is cell specialisation to form tissues and organs for instance some organisms like the hydra and sponges.

They are a tissue level of organisation where cells are specialised to perform specific functions.

THE DIAGRAM SHOWING THE LONGITUDINAL SECTION THROUGH THE BODY WALL OF THE HYDRA

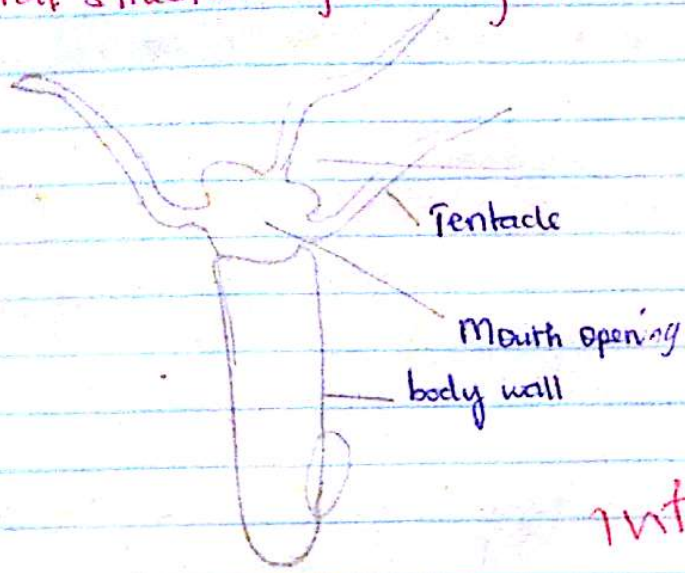


muscular epithelial cell with flagellum.

Cells show cell specialisation that is:-

(i) stringing cells: These immobilise food from external environmental eg water towards the tentacles and then the tentacles push food into the mouth opening.

External structure of the hydra.



enterons!!
enteron??
interstitial

(i) Granular cells: These secrete the digestive enzyme to the enteron where digestion takes place.
(ii) Musculo-epithelial cells: These also are involved in feeding where by they take up food particles by phagocytosis.
Some muscular epithelial cells have flagella wlc circulate the semi-fluid content of the enteron.
(iii) Nerve cells: These are of sensitizing Sensitivity of the cell
(iv) Interstitial cells: They bridge the gap btn the cells They actually act as packing cells.
(v) Sensory cells: They are for sensitivity (detecting changes in environment)

ADVANTAGES OF A MULTICELLULAR STATE

→ Insures increase in size of the organism.
→ There is cell specialisations of cells (division of labour) wlc permits greater Efficiency of the organism to exploit its environment.

DISADVANTAGES OF A MULTICELLULAR STATE.

Increases in cells.
Increase in size and it leads to a small surface area to volume ratio, which decreases diffusion rate of substances into cells.

Multicellular organisms organelles exprience difficult in finding food and air by simple diffusion. This can be over come by development of transport systems eg. Blood circulatory system.

Division of labour thereq requires diversification cells in multicellular organisms. Specialised cells exist in different organisms forexample.

Epilterial cells.

These make up epithelial tissues. They are of several types depending on the types of epithelial tissue where they are found.

Glanclular cells.

These secrete useful substances in the body eg digestive juice, hormones etc.

Fibroblasts.

Are found in higher animals. They secrete proteins fibres like collagen fibres found in - connecting tissues as their function.

Chondroblasts:

They are found in the cartilage. where they secrete the matrix of cartilage.

Osteoblasts: Osteoblast

found in bones and secrete matrix of bones.

Red blood cells: which are useful in transportation of O_2 & CO_2 with in the body and white blood cells which defend the body against diseases

Spermatozoa: There an male garmetes involved in re production.

Chromatiphores: found in amphibians and reptiles and are pigmented cells. Stinging cells These immobile Mobilizing food and also release toxic substances for killing prey.

Epidermal cells: Form

from epidermis of stems & roots of plants.

Root hair cells: for absorption of H_2O and mineral salts from soil.
Photosynthetic cells present in palisade layer of leaves, its where photosynthesis takes place.

How are challanges of multicellular state overcome?

→ By developing a transport system by which gases and nutrients are transported from one part of the body to the other.
→ Developing flattened body eg in flat worms: This increases on the surface area by which nutrients are absorbed by the body.
→ By developing thin layer of the body wall. This reduces on the diffusion distance over which molecules eg gases diffuse into or out of the cell.
→ Some organisms have their body external organs highly folded eg external gills of fish poles to increase on the surface area for gaseous exchange.
→ By bringing the external medium of exchange, close to the body tissues. eg tracheoles systems in insects where oxygen is brought near to the body tissues by a system of tubes called tracheoles.
→ They have folded membranes to provide a large short surface area for diffusion of gases.
→ Some organisms have moist respiratory surfaces to facilitate easy diffusion of gases in solution form.
→ Some organisms have pigments in their blood that have high affinity for oxygen and these aid oxygen transportation in the body.

11/03/2015.

LEVELS OF ORGANISATION

In the course of evolution there are ~~three~~ four levels of organisation of cells.

- **Unicellular level of Organisation** This is where an organism exists as a single cell which plays all the functions of life at this level of organisation the organelles in the cell are so specialized to perform specific functions equivalent to those functions performed by different tissues and organisms in higher organisms (multicellular organisms) The best example of this is the amoeba, paramecium etc.

Multicellular: Tissue level of organisation: Here the functions of life are not so readily played by a single cell but rather by a group of cells that are coordinated to perform a specific function; such organisms include coelentrates eg the hydra

The organisation of cells to form tissues exist in the hydra. this organism has its body divided into ie ectoderm (outside layer of cells) and endoderm (inside layer of cells which face the body cavity called the enteron In the middle of the two layers of cells there is a mesogloea which consists of the nerve tissues. the animals has specialised cells which are coordinated to perform specific functions as follows.

Glandular cells: These are found in the endoderm where they play a role of secreting proteolytic enzymes into the enteron which begin intracellular digestion.

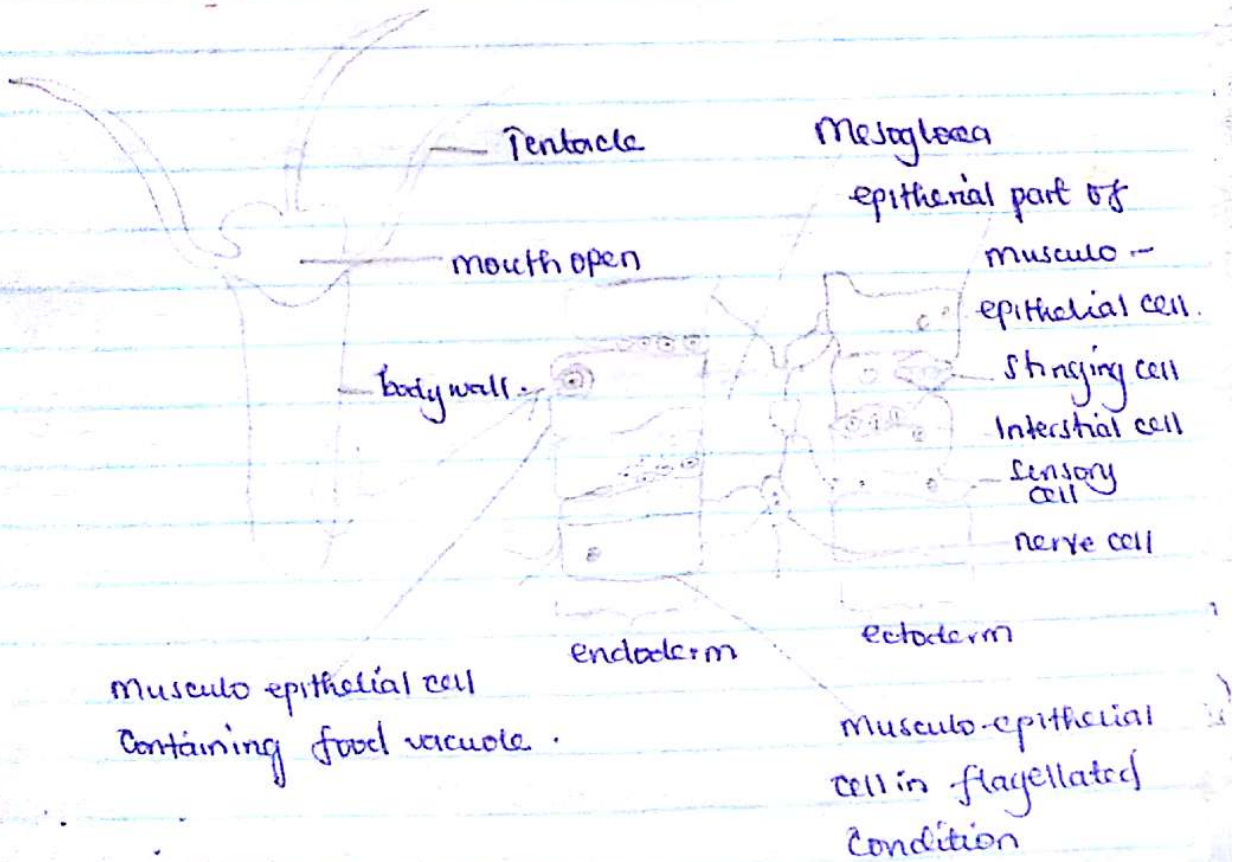
Stinging cells (nematoblasts) These are found in the ectoderm and these Immobilise food from the external environment ie water and the food (prey) is pulled towards the mouth opening by tentacles. These cells Immobilize the prey by injecting poisonous chemical which paralise the prey.

Muscular epithelial cells : found both in the endoderm and ectoderm. in the endoderm musculo epithelial cells take up particles from the enteron that are partially digested and form food vacuoles in which digestion of food is completed. These cells take up food materials by **phagocytosis**. Some musculo epithelial cells are flagellated and these found in the endoderm circulated food particles and the fluid with in the enteron for easy digestion of food.

Sensory cells : These are mainly found in the ectoderm and they play arole of sensitivity where by they enable the animal to detect changes with in the environment

Nerve cells : These are also for sensitivity. The nerve cells (damaged) sensory cells and musculo epithelial cells are intergrated to form a tissue.

Interstitial cells : These bridge the gaps btn the other cells with in the endoderm and the ectoderm.



ORGAN LEVEL OF ORGANISATION.

In this level of organisation the tissues are co-orchinated to perform aspecific function. In doing so tissues form Organs forexample a mammalian kidney is an Organ consisting tissues such as blood, smooth muscle whose sole function is to eliminate unwanted substances from the body.

COLONIAL LEVEL OF ORGANISATION

At this level of organisations cells are functionally much more isolated from one another unlike in the hydra where cells are intergrated to some degree. In colonial organisation the organisms exists as colonies of single cells which are functionally independent of one another unlike in multicellular state where there is a degree of dependency. The best examples where these organisms are the spongy.

→ **Advantages of multicellular state of life;**

Insures increase in the size of an organism

There is cell specialisation of cell (division of labour) which permits greater Efficiency of the organism to exploit its environment.

Disadvantages of multicellular state of life

- Increases in cells.
- There is cell specialisation
- Increase in size it leads to a small surface area to volume ratio which decreases diffusion rate of substance into cells.

Stop

HISTOLOGY.

Although in some organisms the functions of life are played by a single cells, in multicellular organisms group up to form tissues which play specific functions. The tissues then form organs which result in formation of organ systems.

Histology is the study of tissues

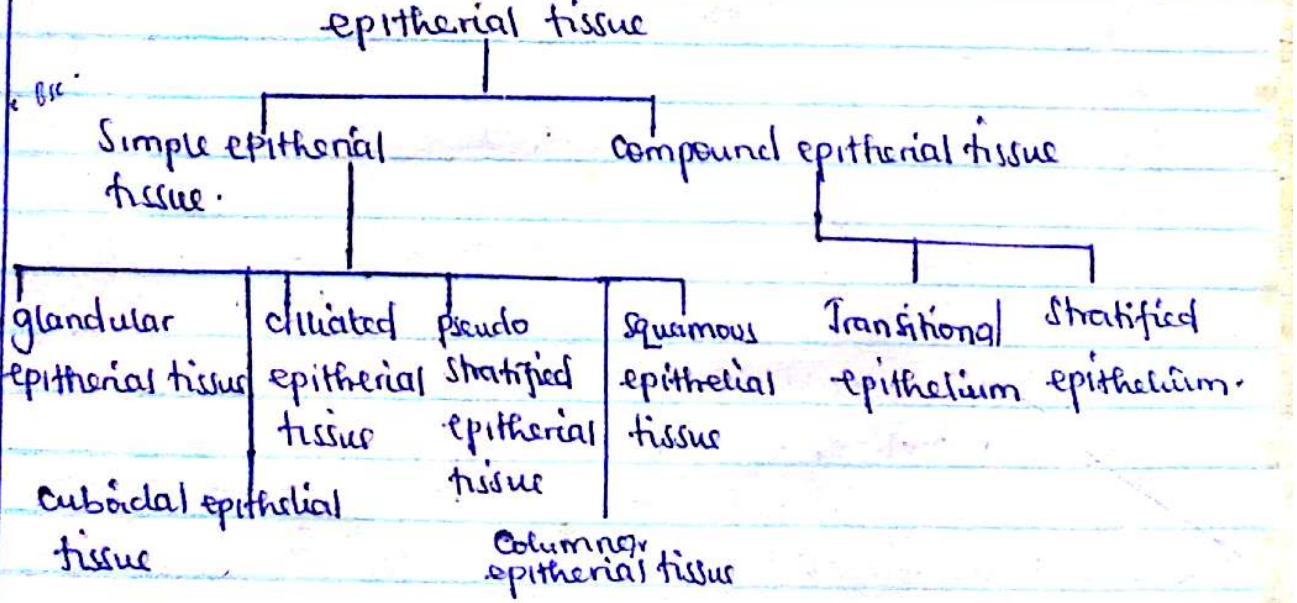
ANIMAL TISSUES.

Animal tissues can be categorised into: epithelial tissues, Glandular tissues, connective tissues, Nervous tissues.

EPITHERIAL TISSUES

An epithelium is a lining covering the body surface or a body cavity. Epithelial tissues therefore form the epithelia and cover either the external surface or the internal surface of a body part.

CLASSIFICATION OF EPITHERIAL ANIMAL TISSUES



CLASSIFICATION

Classification of epithelium tissue consist of.

(1) **Number of cell layers**: It is a simple epithelium if it is made up of a single layer of cells and it is a compound if it is made up many layers of cells.

* selectively absorption occurs in kidney tubes.

(ii) shape of cells: eg cuboid, columnar.
(iii) cell surface specialisation eg presence of cilia one cell surface hence ciliated epithelial.

SIMPLE EPITHELIUM

The are always one cell thick (single layers each). They include.

(a) Squamous (pavement) epithelium).

This consists of flat scale like cell with ridges on the surface making the boundary btn cells. cells rest on a base ment membrane. The cells have a thin nucleus and irregular surface. they are found in areas where permeability is the property of epithelium eg in the kidney tubules where selectively absorption occurs, endothelium of blood vessels especially capillaries, the alveolar surface in the lungs.

It also provides smooth lining of hollow structures such as chambers of the heart, where it allows the relatively friction free passages of fluid through them.

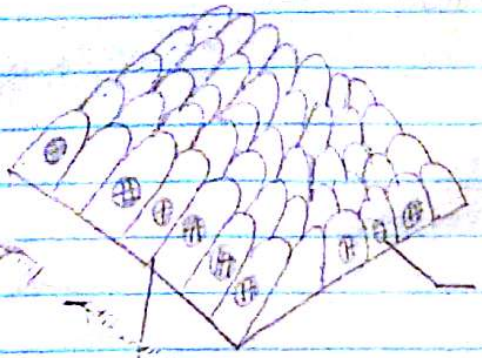
cells rest on the basement membrane
cells have thin nucleus and irregular surface
it is found in areas where permeability is high eg
* Kidney tubules
* endothelium of blood vessels, epithelium of alveolar sacs in lungs

(b) Cuboid epithelium

This consist of cells which are cube shaped possessing a central spherical nucleus. It is found in lining of ducts and tubules which may have secretory and absorptive function eg lining of salivary and pancreatic ducts, lining of proximal and distal convulated tubules of the kidney, collecting duct and in many glands with secretory functions like salivary glands, pancreas, mucus glands in the stomach and thyroid glands.

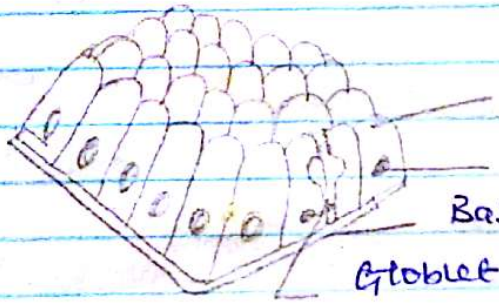
lining of ducts & tubules

* Globulet cells secrete mucous.



(C) Columnar epithelium -

This consists of arectangular cells resting on a basement membrane. They are relatively tall and narrow compared to those of cuboicled epithelium. Each cell consists of the nucleus which is situated at its basal end and goblet cells which secrete mucus are interspersed among the epithelial cells and the epithelia may be secretory or absorptive in function.



It is also found in the lining of intestinal where mucus secreted by globlet cells protects the lining of intestine from self digestion and also lubricates food.

(D) Ciliated epithelium:

Cells of this tissues are Usually columnar in shape & bear numerous cilia at the free surface hence it is simple columnar ciliated epithelium. They are always associated with Mucus secreting cells (globlet cells) producing fluid in which the cilia set up currents.

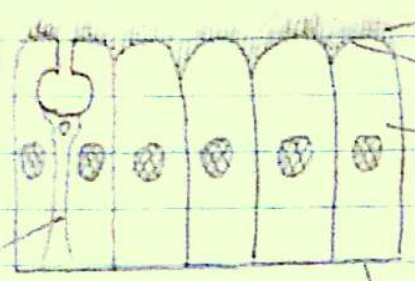
It is found in tubule structures and cavities where it helps to move particles over the duct substances eg in the fallopian tube where the cilia move the ovum (female egg cells). Respiratory passages eg trachea, Bronchi and bronchioles where cilia tra

dust so that the delicate gaseous tracts aren't damaged. Also found in mucusa of nasal passages Ventricles of the brain. and the spinal canal.

Pseudostratified epithelium

This is a simple epithelium consisting of cell resting on the basal surface/basement of cell membrane but some times don't reach apex surface thus giving ~~numerous~~ that the epithelium consist of more than ~~than~~ one layer of cells it may be ciliated in this case pseudopodastratified ciliated.

~~It is~~ Excellently found in large ducts of excretory system such as Urinary tract and respiratory passages like the tracheai & Bronchi where it is ciliated and colum



Ciliated epithelium:

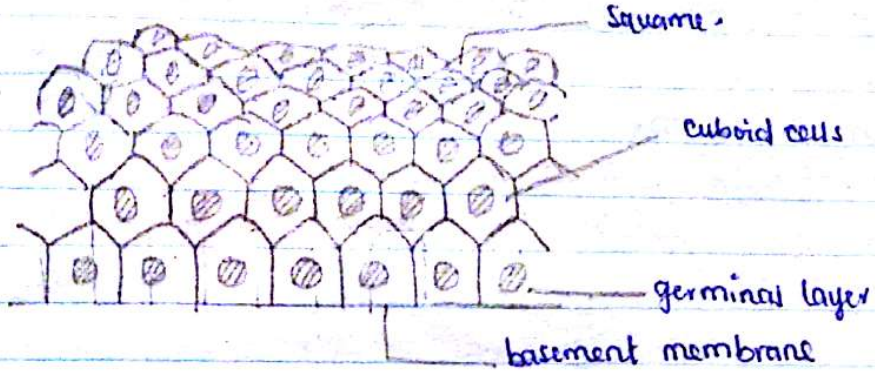
COMPOUND EPITHELIUM.

(1) Stratified epithelium:

This has more than one layer of cells with only one layer resting on the basement membrane, cells at the lower beneath the others continue to divide by mitosis and are pushed outwards towards the free surface of the tissue where they become flattened. There it may be squamous stratified epithelium, or stratified epithelium cuboidal epithelium. The first formed cells are cuboid in shape. The cells may remain un Stratified cornified eg in the lining of the oesphagus where the epithelium protects the underlying tissue against mechanical damage by friction with food being swallowed. In other areas of the body, the epithelium may be transformed into dead horny layer of keratin eg the upper layer of the skin cells keeps peeling and is replaced by new cells.

location lining of mouth, vagina

Stratified epithelium is also found in areas where lining is reliable abrasion eg in the lining of the mouth and the vagina where it protects the surface against abrasion.



protection against mech damage by abrasion

Transitional epithelia

This is the form of stratified epithelia named so because it has some characteristics that are intermediate btn stratified cuboided (when relaxed) and stratified squamous (when compressed). It consists of 3 to 4 layers of cells of similar shape and size except at the free surface where the cell appear more flattened. Cells near the surface don't peel off but are able to modify their shape when subjected to different conditions. This property is important in parts of the body where structures are subjected to considerable stretching eg lining of the bladder, urethra ureter of kidney and pelvis of the kidney.

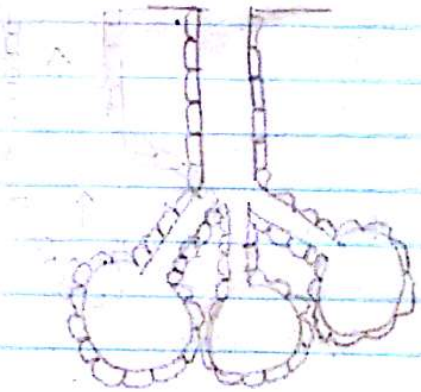
Glandular epithelium → F/A Page 35.

This consist of cells with secretory functions, such as Goblet cells or it can be an aggregate of glandular cells containing many cells to form multicellular glands. Glandular epithelium is a component of many types of glands of different shapes as follows

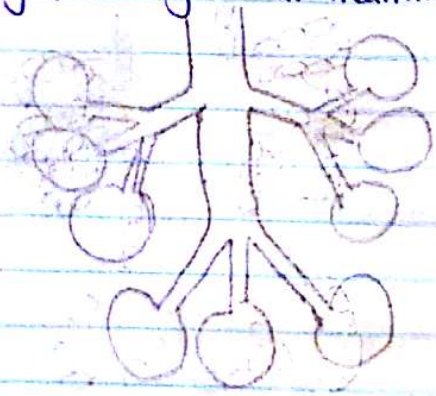
i) **Simple saccular glands:** eg mucus glands in the skin of frogs. It consists of round shaped cavity in wic glandular cells ~~forming a fringe of cells~~ to produce their secretion.

forming the frog's mucus glands

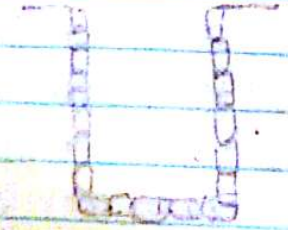
(ii) Simple ~~spaced~~ branched and saccular glands · eg sebaceous - glands in mammalian ~~gland~~ skin



(iii) Compound saccular glands : eg Exocrine part of the pancreas which secretes digestive enzymes in mammalian ~~gland~~ digestive system

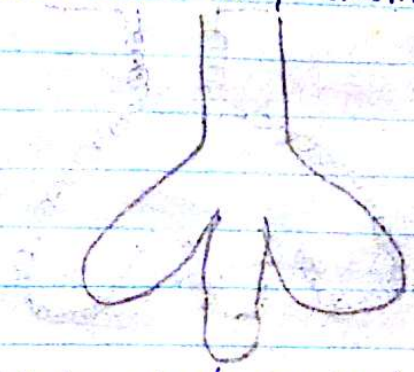


(iv) Simple tubular glands : eg crypts of lie to Kuhn in the mammalian intestinal wall.

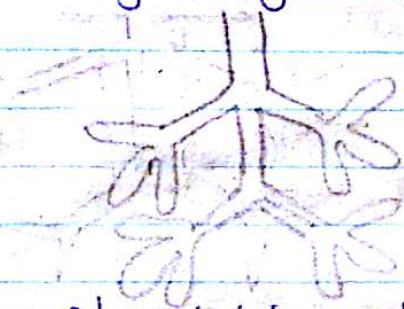


(v) Simple coiled tubular gland : eg sweat gland.

(vi) Simple ~~tubular~~ branched tubular glands eg Brunners gland found in the wall of mammalian small intestines, Gastric gland in the stomach walls.



(vii) compound tubular glands eg salivary glands.



Glands are ~~secreted~~ classified according to the mode of secretion into two.

(a) Exocrine glands:

These are glands wch produce their secretion into a duct through which the secretion is taken away. All the above examples of glands are the exocrine glands.

(b) Endocrine glands (ductless)

These are glands whose secretion is passed out directly into the blood stream. Such glands form close connections with blood capillaries.

Endocrine glands are further classified according to the mode of secretion by their cells. ie.

merocrine apocrine

(i) **Merocrine glands**; In these glands, the secretion produced by the cells are discharged without loosing any part of its cytoplasm ie the cell remains intact.

(ii) **Apocrine glands**; Here secretion from the cells occur in such away that part of the cell cytoplasm is released along with the secretion.

(iii) **Holocrine glands**; In this gland the ~~hollow~~ whole cells breaks down to release secretory parts.

holocrine

Leave out this page

Leave

Qn Explain how the epithelial tissues adapted to its functions -

Leave out

Epithelial tissue is the lining covering the body surface or surface of the duct or surface of the cavity. Its classified into simple (one cell thick) or compound (more than one cell thick) each having adaptations for its functions as follows:

① squamous epithelium is thin and this enables it to permit - diffusion of materials through it. It also provides a smooth - lining to hollow structures such as blood vessels and chambers - of the heart where it allows relatively friction free passage of fluids through them.

② cuboidal epithelium: consists of numerous micro villi projecting from the free surface of cells wic use surface area for reabsorptio n of materials from the fluid in the tubules.

③ Columnar epithelium consist of tall and quite narrow cells which provide more cytoplasm per unit area of the epithelium; for Chemical reactions

④ There is also frequently a conspicuous striated boarder of micro villi at the surface and of each cell wic increases surface area 4 absorption and secretion.

⑤ It also lines the stomach where mucus secreted by the goblet cell protects the stomach lining from the acidic contents of the stomach. mucus also lubricates the passage of food in the intestines:

⑥ Columnar epithelium lining the intestines also plays - an important part in supporting other types of cells.

⑦ ciliated epithelium bears numerous cilia at their free surfaces eg in the respiratory passages like in trachea where it serves to move materials from one location to another - Cilia wafts mucus in the respiratory tract up to the throat. for swallowing.

The mucus traps bacteria, dust and other small - particles penetrating them from reaching the lungs.

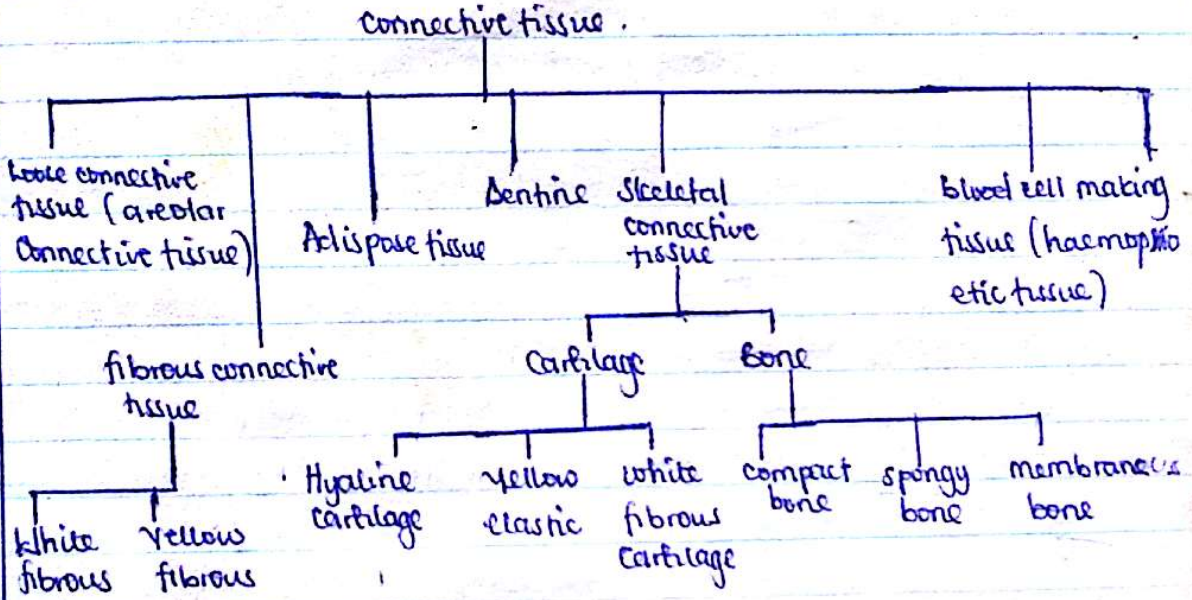
In some organisms like flattened worm, cilia on the body outside body play an important role in locomotion. The thickness of transitional epithelial tissue prevents urine from escaping into the surrounding.

(v) squamous stratified in the parts of oesophagus protects the underlying tissues against mechanical damages by friction with food just swallowed.

Start

CONNECTIVE TISSUES

Connective tissues serves the purpose of binding other tissues or organs of the body together. Atypical connective tissue consists of cells embedded in a ground substance (matrix). In some cases, the tissues may consist of fibres.
connective tissues are classified according to composition and strength as follows.



Loose connective tissue (Areolar connective tissue.

This is a simple tm of connective tissue consisting of thin fibres and thick bundles of collagen fibres embedded in a matrix. The fibres form a net work and improve on the strength of the tissue. It consists of a fluid matrix in which several types of cells are embedded. These cells include:-

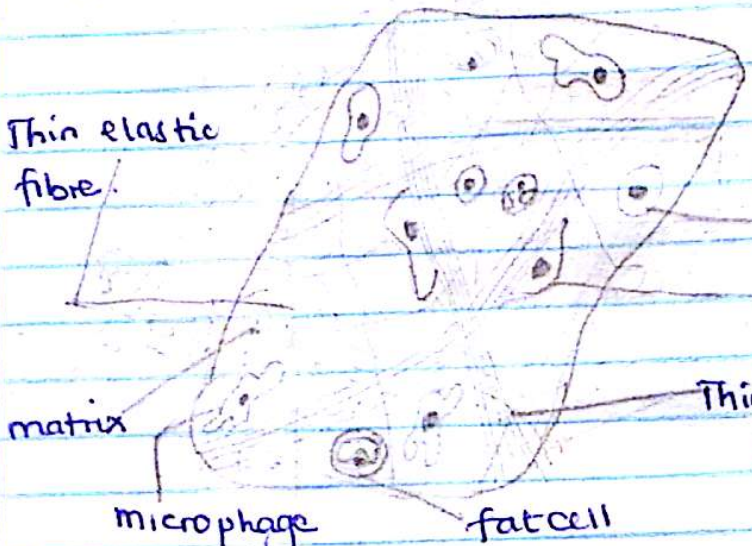
(i) **Macrophages:** These are phagocytotic cells ie they engulf bacteria and foreign particles and hence they are defensive cells (defend the body) against pathogens

(ii) **Mast cells:** These secrete an anti coagulant substance into the matrix which maintains the fluid nature of the matrix.

(iii) Fibro blasts: These play a role of producing protected fibres.
(iv) Fat cells. These store fats.

The thick collagen fibres are flexible but inelastic which provides strength to the tissue while the thin fibres made of the proteins known as elastin are elastic in nature and this ensures elasticity of the tissues.

Diagram showing a areolar connective tissue.



Make connection from functional approach pg 36.

collagen fibres.

Areolar connective tissue is found around all organs of the body where it performs an important role of supporting separating tissues so that they don't interfere with each other's activities. However other than acting as packing and binding, this is missing structures in the body, it also protects against invasion of harmful bacteria in the body it's also protects against invasion a function performed by macrophages.

Fibrous connective tissues:
This contains more fibres randomly scattered into the matrix. is they There are More fibres than cells wic makes it more stronger than the loose connective tissue.
Fibrous connective tissues are found around delicate organs of the body such as the kidneys and the heart where they provide strength and support to the organs.
Fibrous connective tissue are divided into two.
White fibrous connective tissue: This is composed of mainly parallel bundles of collagen fibres strong and flexible but inelastic eg Tendons are most pure white fibrous.

Chondroblasts

tissues we exert a pull on. Other examples are:- muscles connected to the bones. Other examples are:-

- Ligaments
- Sclerotic coat of the eye and the cornea.

(ii) **Yellow elastic tissue:**

This contains mainly a network of fibres made up of a protein known as **elastin** w/c is more ~~este~~ 'elastic'. It is commonly found in elastic structures of the body such as walls of the arteries and alveoli of the lungs.

*(iii) **Skeletal Connective tissues :**

These are responsible for support and body frame-work. They include the bones and cartillage.

(a) **Cartilage:** This is a connective tissues consisting of cells called Chondroblasts embended in a matrix known as **Condrin**. The Matrix is produced by the condroblasts themselves.

In some form of simple cartilage, no fibres in the matrix whereas in Others forms the matrix contains fibres mainly **collagens** fibres. The cells eventually become enclosed by a membrane in space called **Lacunae** and in this condition the cells are now termed as **Condrocytes**.

The magin (periphery of the cartilage) consists of a dense layer of cells embedded in fibrils and this layer is called the **perichondrium**. from here which new cells are formed and are constantly added to the Internal matrix.

Types of cartilage

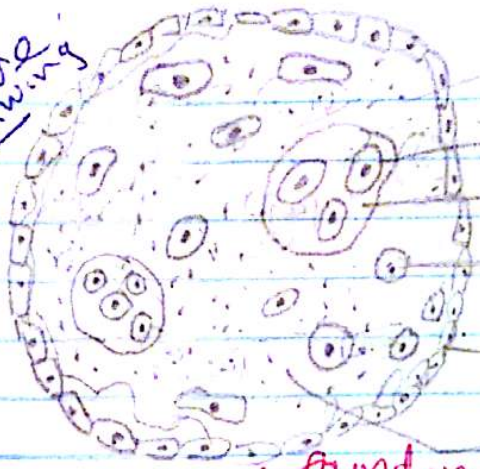
Chondroblasts ✓
condroblasts ✗

1 Hyaline cartilage.

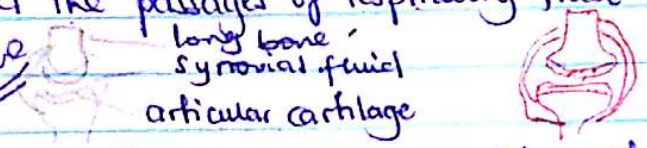
This is a simple form of cartilage consisting of a semi-transparent matrix in which cells are embedded but with no fibres. Some Chondroblast Condroblasts are freely-scattered in the matrix, while others are enclosed in Lacunae as chondrocytes. The chondrocytes near the periphery are flat shaped where as those in the centre are angular in shape.

Cartilagenous fish

leave the drawing



Hyaline cartilage is found in cartilagenous fish and in embryonic skeleton of vertebrates. Hyaline cartilage is elastic compressible also located at the end of bones forming a joint and also in the nose and the passages of respiratory tract and also in the ears.



Elastic Cartilage: This consists of a matrix which is semi-opaque. It contains a network of elastic fibres which gives it a greater elasticity and flexibility and permit the tissues to quickly retain their shape after distortion.

Fibrous cartilage: This consists of a large no of bundles of densely packed collagen fibres that run parallel to each other. These fibres provide greater tensile strength as well as a small degree of flexibility but inelastic

It is located between the adjacent vertebra (inter vertebral discs) where it provides a cushioning effect. This type of cartilage is also found in the symphysis pubis (region btn two pubic bones of the pelvis) and in the ligamentous capsules of joints.

Functions of cartilages

- Cushions both bones where it acts as a shock absorber eg in the intervertebral discs.
- It reduces friction at the articular surface of bones and thereby it acts as a lubricant.
- cartilage is a precursor of bones and thereby responsible for growth and devlt of bones.

BONES

Structure: A bone consists of a solid matrix containing amuco-polysaccharide. The matrix of a bone is deposited with calcium and phosphate salts wic makes it harder compared to that of cartilage. Some times, Calcium Carbonate and Calcium chloride may be part of the bone matrix.

The matrix of a bone is produced by bone-cells called **Osteoblasts** which are enclosed in specific spaces called **lacunae**.

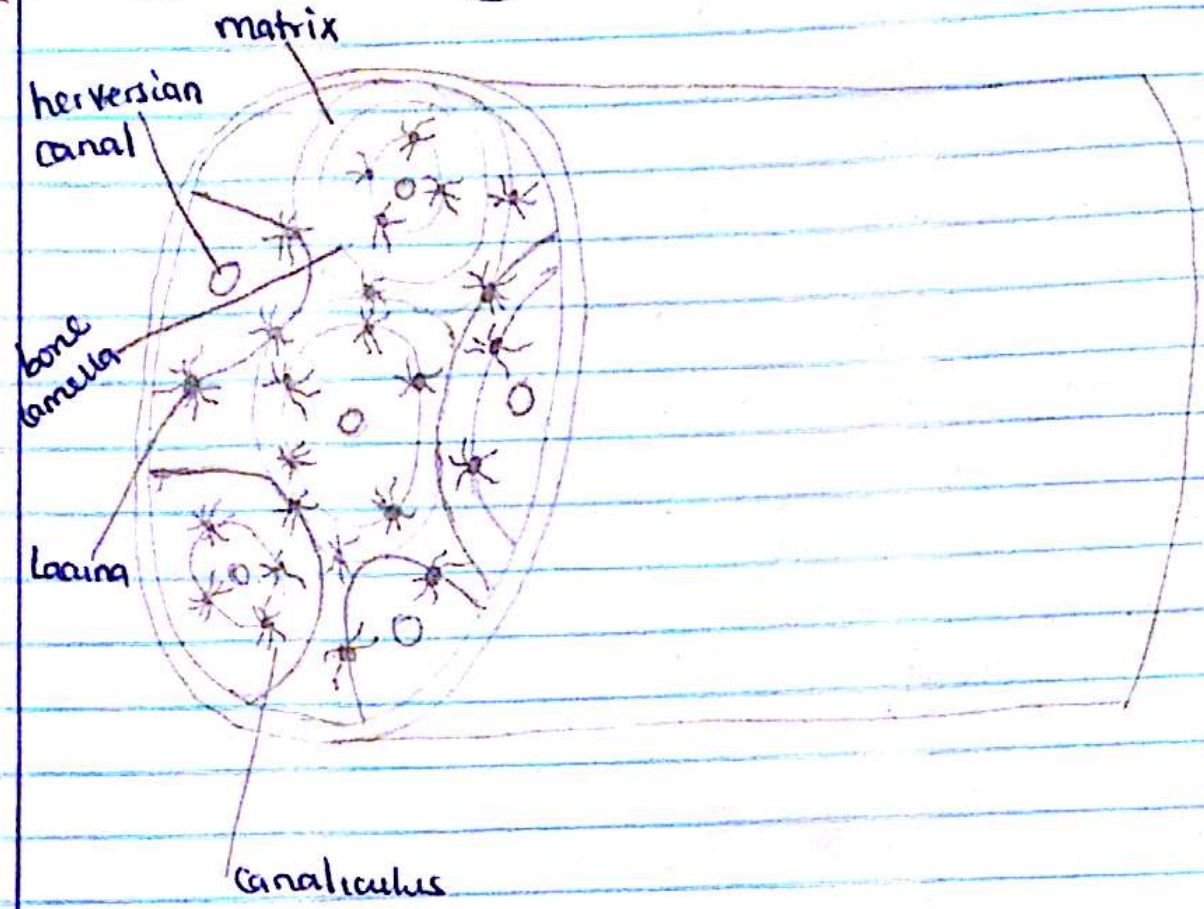
The bone matrix is laid in layers called bone **lamellae** which are concentric and in the centre of the lamella is a, haversian canal which provide passage of nerve fibres and blood vessels. **periosteum**.

Usually, the osteoblasts move about the bone matrix, as they utilise nutrients in it, forming fibrous channels called **canaliculi** in the matrix.

As the bone matures, the osteoblasts become less active and contain less organelles. At this stage, they are called **Osteocytes**. When structural changes in the bone are required, depending on the function the bone is to serve, the osteocytes are activated and quickly regain the original structure of osteoblasts.

The bone cell which actively erode the matrix in the effort of obtaining nutrients are called **Osteoclasts**.

Diagram showing a transverse section of a bone.



Types of bones.

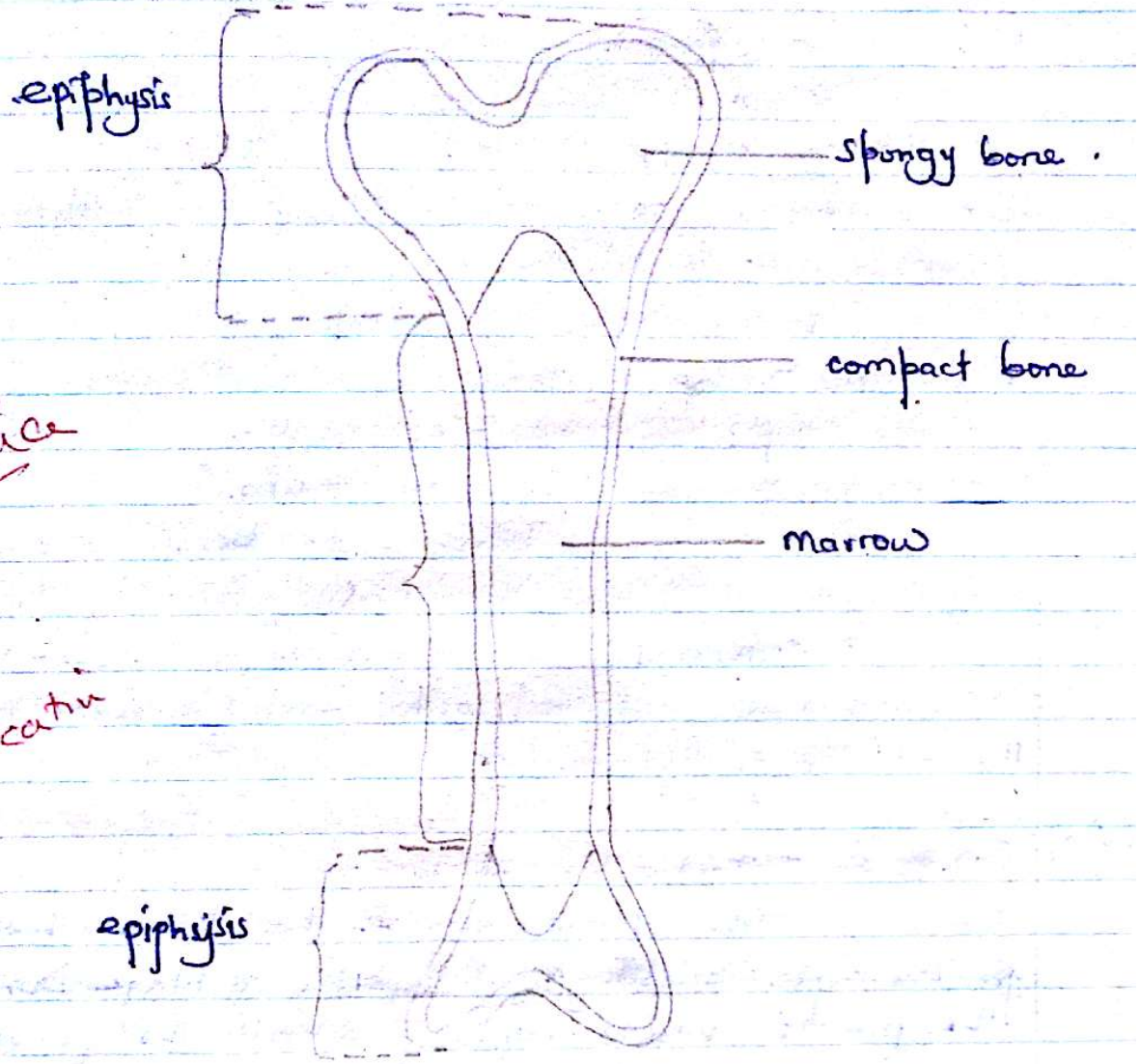
1. **Compact bones.** (hard bone)

Compact bones is harder and is responsible for offering strength to the body part where it is found. Compact bones are long bones of skeleton eg femur, Tibia, Radius etc. but also bones like those of Vertebrate column and skull are also compact bones.

The matrix of a compact bone is laid in concetric rings of lamellae with a series of haversian ~~canals~~ Canals.

The osteoblasts, lamellae and the canals together form what is called the haversian System.

Fig: structure of long bone eg femur.



leave space

ossification

vascular sys

Process of bone formation:

The process by which a bone is formed is called **Ossification**: There are two processes of ossification

a) Intramembranous Ossification

In this process of ossification, the cells of connective tissue proliferate to form the osteoblasts which forms clusters in the central plane of a connective tissue from which a bone is to be formed.

The clusters of osteoblasts arise as a result of rapid cell division by mitosis.

The osteoblasts then secrete the bone matrix and they arrange themselves in the longitudinal axis of the future bone.

As development continues, the matrix becomes arranged in concentric rings of bone lamellae whose centre is perforated by haversian canals, which allow passage of blood vessels supplying nutrients to the matrix.

A dense layer of connective tissue forms around the bone to form the periosteum.

When a spongy bone is to be formed, fibrous stripes are formed in the matrix, making the matrix less compact, but in case of a compact bone, the matrix is deposited with inorganic salts especially calcium phosphates to make it compact and harder.

(b) Endochondral ossification.

This is a process where the bone develops from simple cartilage (ie hyaline cartilage). During the process, blood vessels penetrate the perichondrium of the cartilage along its longitudinal axis (shaft). This stimulates some cells of the perichondrium (chondroblasts) to undergo active cell division and proliferate to form osteoblasts.

A primary ossification centre forms inside the shaft and this is progressively invaded by blood vessels and osteoblasts.

The osteoblasts now secrete the bone matrix which replaces chondrin of cartilage.

The matrix now becomes calcified by deposition of calcium salts.

The osteoblasts are arranged to form concentric rings with in the bone lamella with a series of haversian

Canaliculi

canals in the centre.

The bones cells erode the matrix to form a series of canaliculi. The periphery of the cartilage proliferate to form the periosteum.

Functions of bones in body

- They act as a frame work on which the body is supported.
- provide attachment to muscles.
- protect vital and delicate body organs eg the skull. protects the brain
- They act as store for calcium and other inorganic salts.
- They are a site of blood cell formation.

Bones differe from cartilage in the following ways.

Bone	cartilage.
consist of solid matrix (osteum)	Has a soft matrix
matrix is screted by osteoblasts.	matrix is screted by chondroblasts.
Highly supplied with blood vessels	lacks both vessels.
contain blood nerve fibres	No Nerve fibres.
cells are arranged in concentric rings	Cells are randomly distributed in the matrix
Has a marrow cavity	lacks a cavity.

STOP

Muscle tissue

Muscle tissues makes about 40% of the Mammalian body weight.

Muscles are classified as follow:

(a) Smooth muscles.

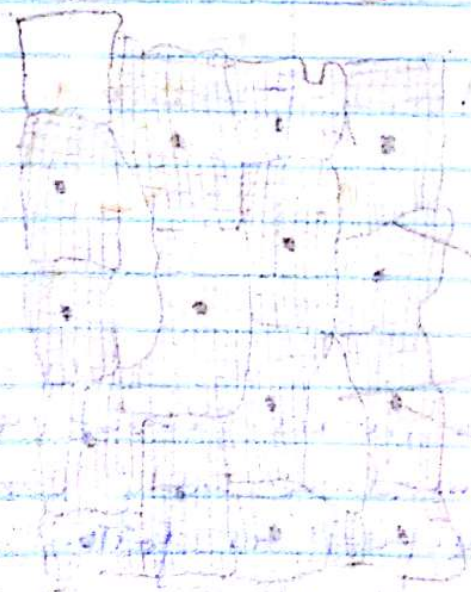
These muscles do not contain strips of fibres ie they are not striated. Smooth muscles are controlled by automatic nervous system. For this reason, they are also called Involuntary muscle. Examples are the muscle in the abdominal wall, Intestinal wall and urinary bladder. These muscles contract slowly and fatigue slowly (slow twitch muscles).

(b) Cardiac muscles.

These make up the wall of the heart This muscle tissue consists of muscle cells (myocytes) interconnected by Intercalated discs, which offer them ability to conduct a wave of contraction (action potential) continuously.

cardiac muscles are striated (ie have cross bands of fibrils) This muscle tissue has a unique property in that it is myogenic (ie contraction begins with in the muscle its self) and they contract without fatigue, for the whole of life.

Diagram showing structure of cardiac muscle



Intercalated disc (connection btn myocytes)

Space btn myocytes

Nucleus

Striations (cross bands of fibrils)

How are cardiac muscle tissue adapted to its' function?

- Myocytes are joined to form intercalated discs, for continuous excitation and rapid transmission of a wave of contraction from cell to cell.

- Each myocyte has a net work of striations which also enhance rapid transmission of a way of excitation throughout the heart.

- The tissues has a rich blood supply to deliver oxygen to myocytes to meet the high demand for oxygen which ensures rapid contraction

- The muscles contain a pigment myoglobin - which has a high affinity for oxygen which ensures that oxygen is not easily depleted in the muscles.

(c) Skeletal muscles.

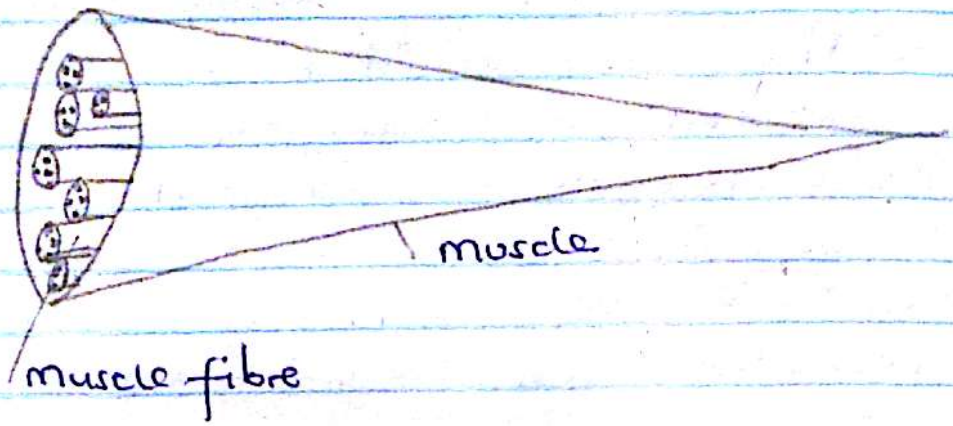
This type of muscle is responsible for skeletal movement in the body, and its - contraction is controlled by the voluntary part of the nervous system, for which reason it is also called voluntary muscle.

This skeletal muscle is striated hence they are also called striped muscle.

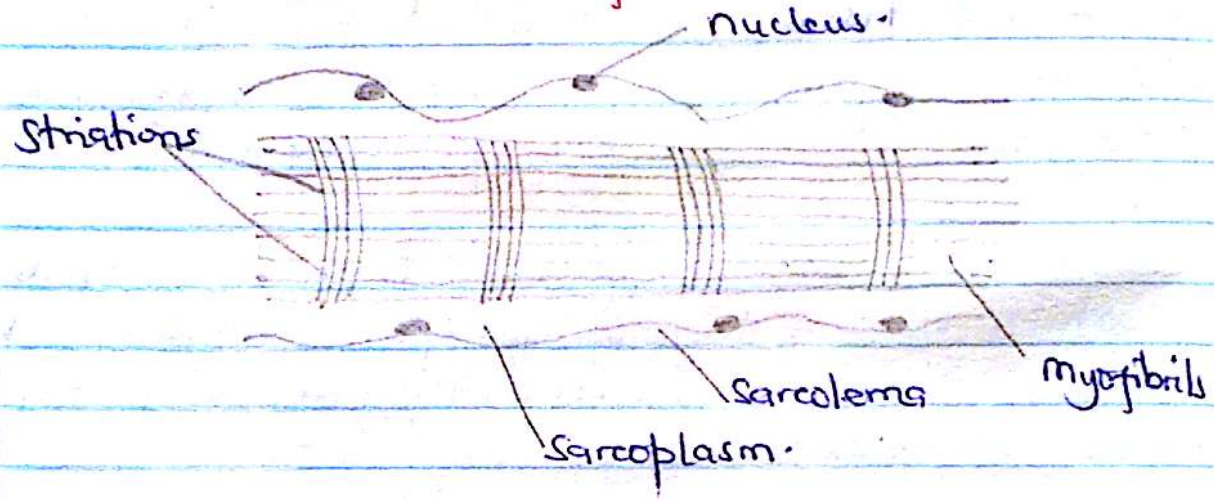
Structure

Askeletal muscle tissue consists of bundles of muscles fibres that run parallel to each - other, the whole length of the muscle tissue Each muscle fibres again consists of several strands of myofibrils which also run parallel to each other. The myofibrils are transverse d by cross bands hence striations.

Diagram showing a skeletal muscle tissue.



Internal structure of a muscle fibre

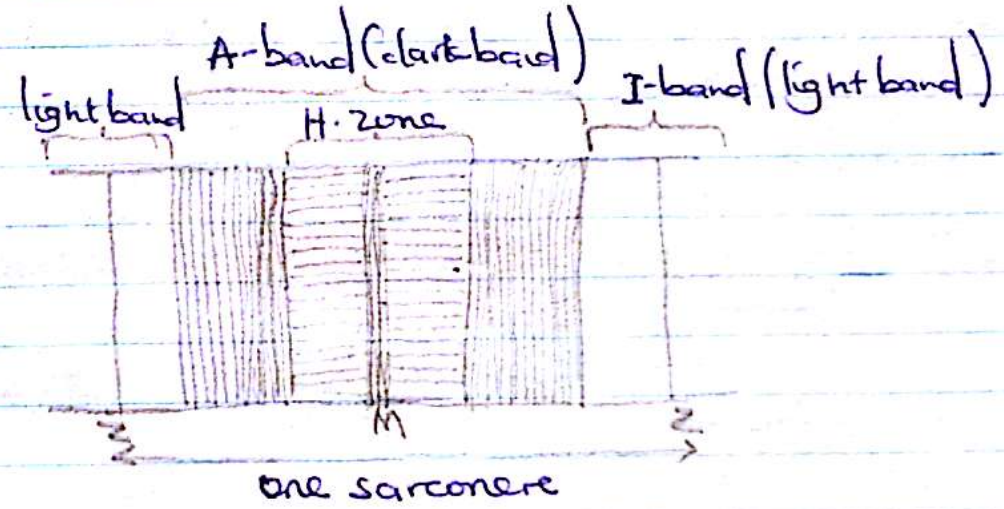


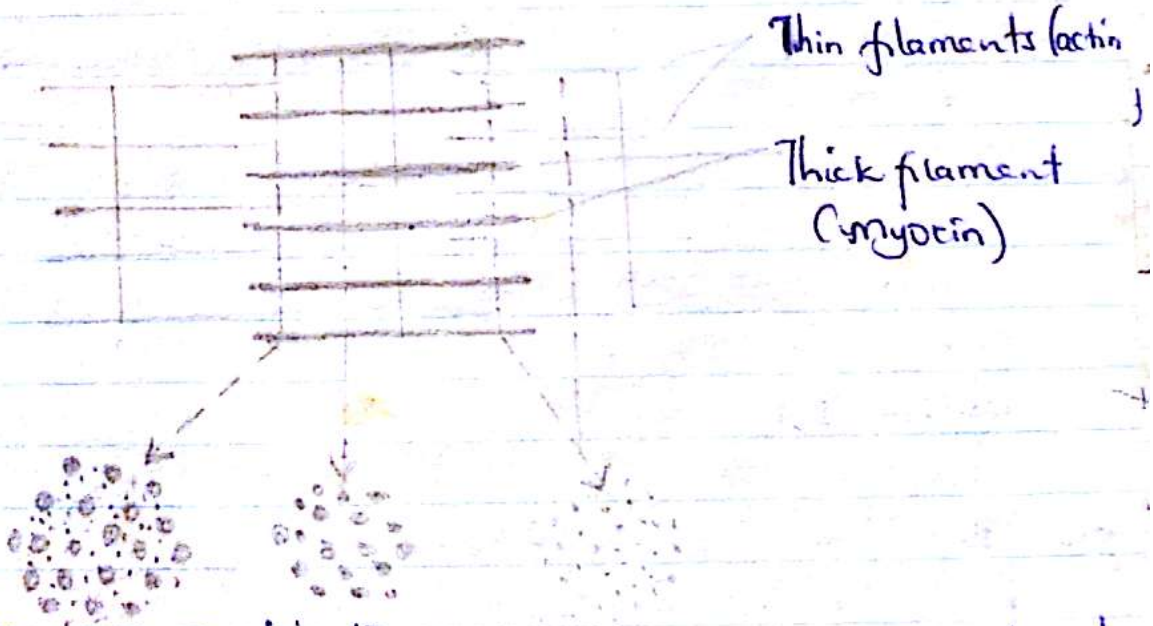
Each myofibrils consist of two protein filament;-
- Thin filament made up of a protein called actin.
- Thick filament made up of a protein called myosin.

In some parts of the myofibril, myosin and actin overlap just like interlocking fingers. When observed under electrons microscope, the whole length of the myofibril has light and dark bands. The myosin filaments form the dark band, also called A-band and actin forms the lighter band also called the I-band.

In the region where the myosin and actin overlap it appears more darker, forming a more darker part of the dark band (A-band) while the centre of the dark band (where there is myosin only) appears lighter, forming the H-zone.

The I-band (light band) consist of actin filaments only and these are joined by a z-line. The distance from one z-line to another, is a sarconere, which is a fundamental functional unit of of the myofibil
The myosin fillaments are joined by an m-line. The band pattern and the corresponding arrangement of actin and myosin filaments in a myofibril is shown in the diagram below.





Section through end of dark band (thick and thin filaments together)

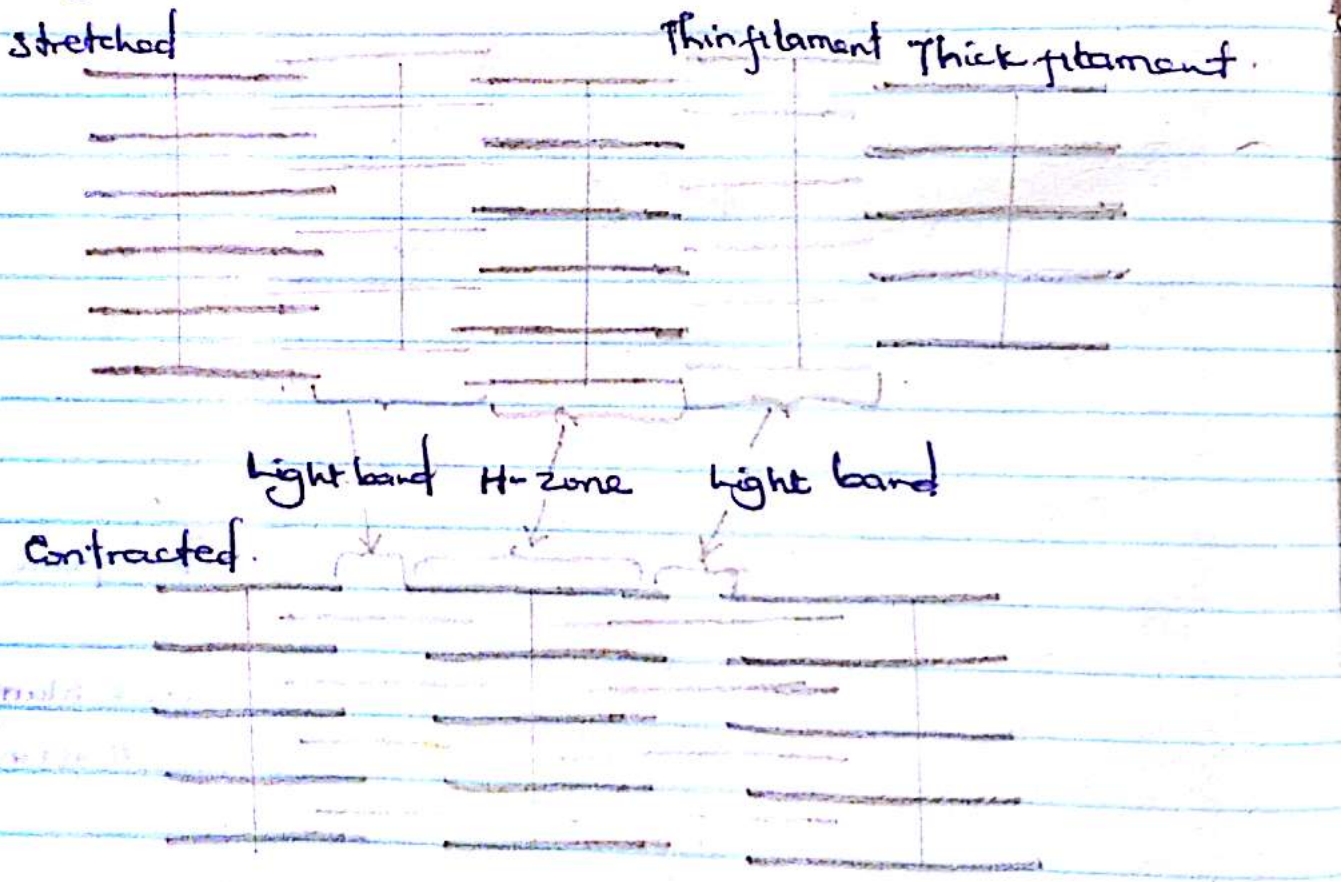
Section thru H. zone (thick filament only)

Section through light band (thin filament only)

During contraction, the actin filaments extend further into myosin. This causes the I-band (light band) to shorten and the H-zone also to become small while the more darker part of the A-band becomes bigger.

Eventually the whole ~~sarconere~~ Sarcomere (distance btn the z-lines) becomes ~~shorter~~ shorter

In a relaxed muscle, the actin filament are slightly interlocked with myosin, hence the darker part of the A-band is small while the light band (I-band) is bigger. The sarconere becomes longer as a result.



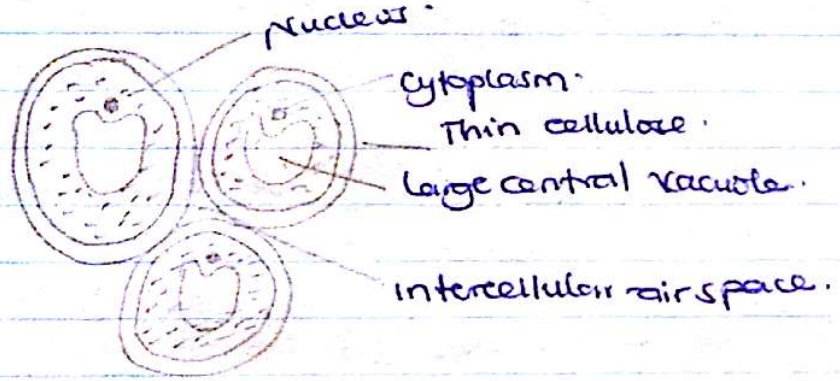
PLANT TISSUES

Plant tissues are divided into Ground tissue Ground tissues, mechanical tissues, Vascular tissues, meristematic tissues and photosynthetic tissues.

PARENCHYMA TISSUE (Ground/packing tissue).

It is a packing tissue found in the cortex. This tissue serves a function as packing tissue, i.e fills spaces in between other tissues of the plant. It consists of cells which are spherical with thin cellulose walls, and large intercellular spaces btn them

PQ 160 Br. Pg 6-3



Parenchyma tissues are distributed in the cortex, the pith, medullary rays and fill in space as packing tissue in the xylem and phloem. The main function of parenchyma are:-

(i) To fill spaces btn other tissues and hence they provide support to the plant.
- They maintain shapes and offer support to plants parts especially leaves, when the cells are turged.
- They allow gaseous exchange to take place due to intercellular air spaces.
- They are storage tissues for the plant ie they store water, lipids and a carbohydrate in form of starch, in their sytoplasm.

Parenchyma doesn't only form part of the cortex of roots and stems but also it is found in the mesophyll of leaves where they maintain the normal shape of the leaves enabling it to absorb

maximum sun light

- Made of living cells
- have walls with additional cellulose deposited in corners.
- These provides Mechanical strength

COLLENCHYMA TISSUE

Collenchyma tissue are made of living cells and they have walls with additional cellulose deposited in their corners which provides Cells in this region with extra mechanical strength. ~~cellulose~~ in these tissues are elongated with polygonal - tapering ends. They are distributed in the outer regions of the cortex of the stems and the root but also found in the midrib of leaves.

Made up of
- Living cells
- cell walls of cellulose
- deposited in their corners
- provides Mechanical strength
- cellulose are elongated
- polygonal tapering ends
- Distributed in outer regions of cortex of stem & root
- also found in midrib of leaves

Transverse section of collenchyma tissue

Longitudinal section of collenchyma tissue

QN: How is the collenchyma tissue adapted to its function

+ cell walls have additional cellulose deposited around their corners for extra-Mechanical support.

- cells have uniformly lignified cell walls

Lignified

SCLERENCHYMA TISSUES.

This tissue consists of cells with uniformly lignified cell walls. In the cellulose cell walls there is a strengthening substance called **lignin**, pectin and sometimes hemicellulose. Because lignin is a tough and impermeable substance, the protoplasm protoplasm of the cell die leaving an open lumen - and hence the sclerenchyma are conducting tissues in plants.

The main functions of sclerenchyma are;

- They provide mechanical support for plants due to lignified walls.
- permit movt of materials eg water & mineral salts between the adjacent cells.

* **Sclerenchyma tissue is of 2 types**

(I) Fibres
(II) Sclereid

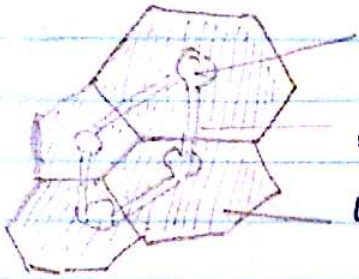
The fibres are long and narrow cells with - tapering ends while sclereids are short and - Branched cells.

Distribution in the plant.

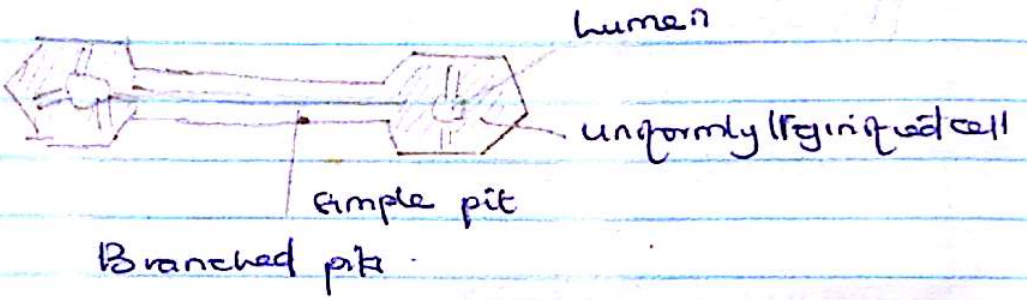
Fibres are found in the outer region of the cortex, pericycle of stems and in phloem and xylem conducting tissues. Schlereids are found in the cortex, pericarp of fruits and in seed testa.

Diagram showing a longitudinal section of a fibre cell.

Cross section of fibre tissue



Transverse section of asclereid.



How is sclerenchyma tissue adapted to its function

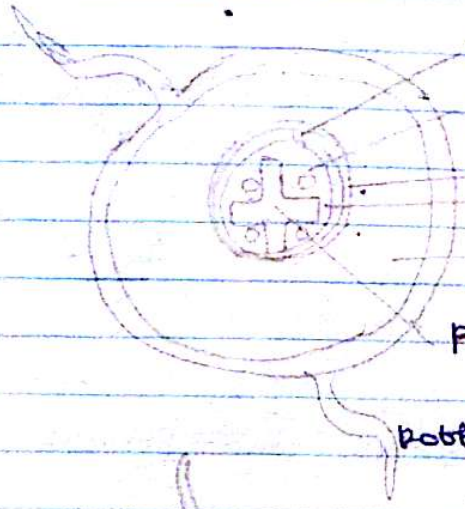
- The cellwall of sclerenchyma fibres and the sclereids are uniformly heavily thickened with lignin, a hard substance wlc provides tensile strength.
- The ends of sclerenchyma fibres interlock with one another which increases their combined strength
- The fibres are arranged into sheets of tissues that extend for a long distance in a longitudinal axis wlc also provide strength for the tissue.
- In between the cells of the sclerenchyma are simple pits which aid distribution of or transport of substances such as nutrients and water from cell to cell.

VASCULAR TISSUES

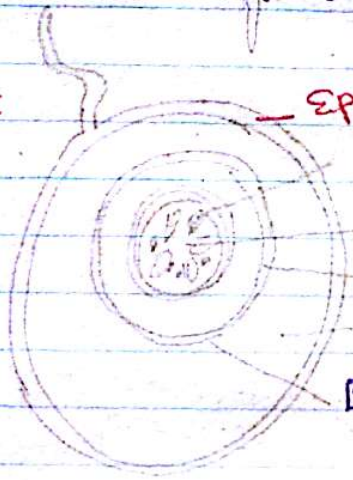
These are conducting tissues in plants consisting of xylem and phloem in roots and stems. These tissues form the vascular cylinder of higher plants together with the pericycle.

Cross section

Dicot root



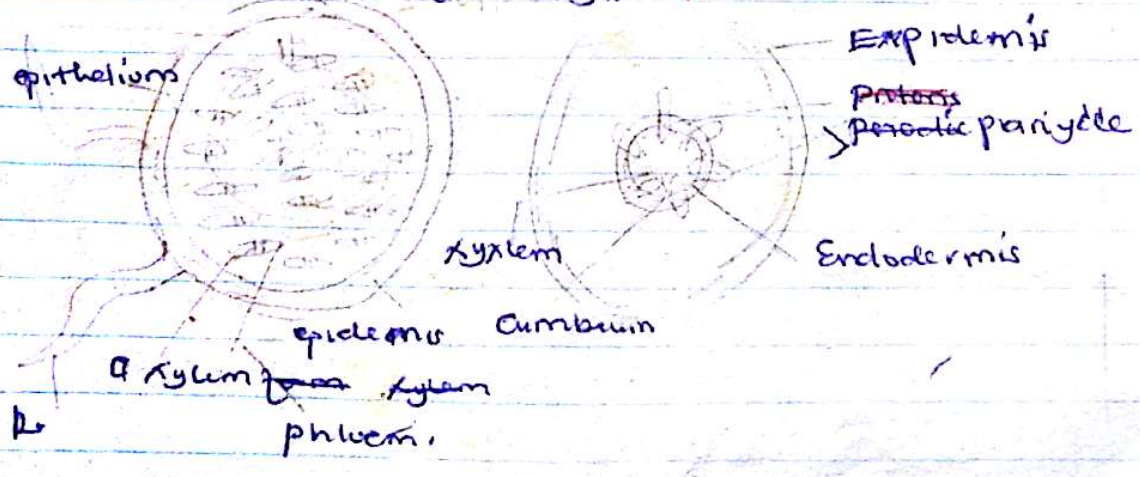
Monocot



Control, cross section

Dicot root.

Monocot ~~and dicot stem~~ Cross weigh Dicot stem



The pericycle is the outer most layer of the vascular cylinder consisting of a single layer of parenchyma cells which retain the power of cell division to enlarge the vascular cylinder.

The xylem:

Xylem consists of various types of cells wic are non living. ~~and some are living cells~~. The cell wall material is usually deposited with lignin, cellulose, pectins and hemicellulose.

The major function of xylem is to conduct water and mineral salts in plants. However it also provide mechanical support to plants. Xylem consists of 4 types of cells namely.

- Tracheids
- Vessel Elements.
- ~~Parenchyma and~~ Xylem parenchyma
- Xylem fibres.

Tracheids

A tracheid is an elongated cell with tapering ends and with thick ~~lignified~~ lignified walls. Tracheids are non-living cells because after lignin is laid into the cellulose wall, the protoplasm dies living an empty lumen that runs a long the axis of the plant organ in wic they are found, Tracheids overlap and communicate with adjacent tracheids by means of bordered pits through wic substances such as water are distributed.

Vessel Elements.

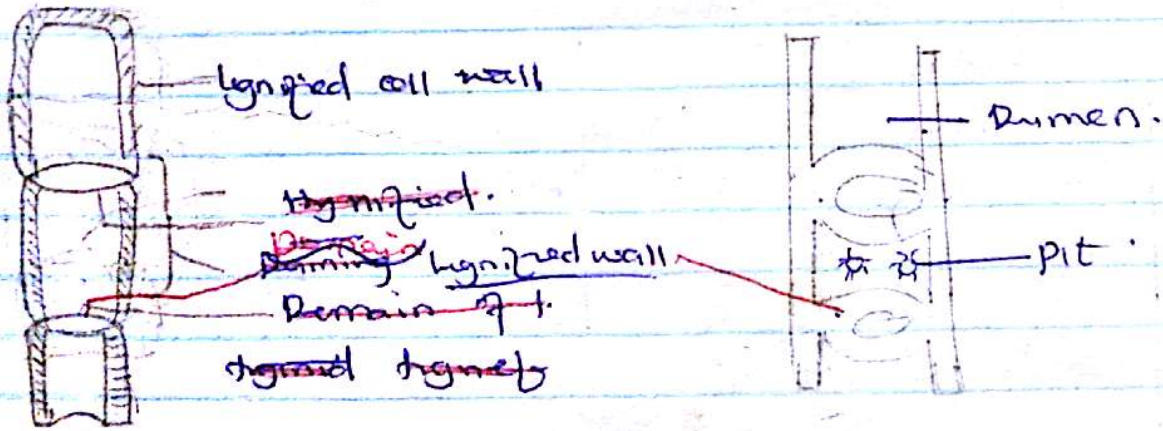
A xylem vessel element is cylindrical, opening ended non-living, tubular with lignified cell wall. A vessel is formed when cells (vessel Elements) arrange end to end so that their end wall touch wic after lignification disintergrate to form a continuous lumen thru wic H_2O is conducted.

In mature vessel, lignin is not deposited over the entire cellulose wall but only in rings or in spirals hence cereal patterns of lignification include, pitted Reticulate ~~Reticulum~~, spiral, Annular, ~~scalariform~~ and Scalariform

In spiral and annular patterns of lignification lignin is deposited in rings with cellulose wall around the whole length of xylem vessel.

In pitted lignification the whole wall of xylem is uniformly lignified except in certain areas where pits are formed as rims of lignin is deposited in form of interconnecting bars. This pattern can be modified into Scalariform lignification where the bars elongate to form rings.

Diagram showing fusion of vessel elements to xylem vessel.



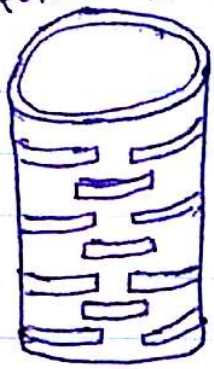
~~Location of lignification~~

Annular.

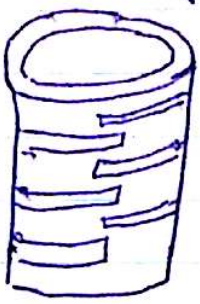
lactose

(c) ~~Annular~~

Reticulate.



Scalariform.



~~Pit~~ pitted

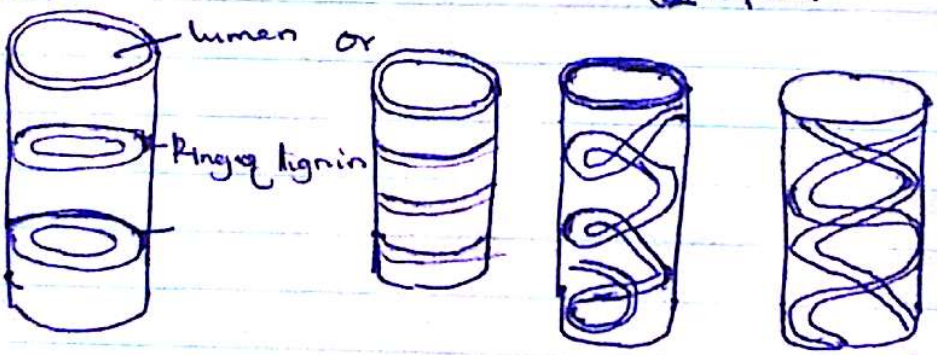
bordered pit.

4 forms of Lignification

(a) Annular

(b). Spiral

(d)



Xylem fibres

Xylem fibre like xylem vessel are associated by tracheids. They are mainly supporting tissues in function and they have much thicker walls than those of tracheids but also with bordered pits like those of vessels. However they have a narrower lumen compared to the xylem vessels and they are stronger and offer additional mechanical strength to the xylem.

Xylem parenchyma.

These consist of piles of elongated cells wlc are of parenchyma origin. They are living cells wlc serve the function of storing food.

Adaptations of xylem tissue to its functions

- Mature cells on both vessels and tracheids lack a living protoplasm to form an empty lumen wlc removes resistance a water flow through them.

- The vessel elements are placed end to end with their end walls degenerated to form a continuous lumen for distribution of water up the plant.

- The walls of tracheids and vessels are lignified which offer greater strength to withstand pressure during transportation of water.

- Vessels and tracheids lumens have a narrow / fine lumen which maintain high capillarity for water transport with in the plant.

- The lignin in the cellulose wall increase adhesion of water molecules which enable water to rise / move through the xylem vessels by capillarity.

- Vessels and tracheids have boardered pits for lateral distribution of water to the neighbouring cells.

- Has spiral and annular thickening wlc gives rise to high tensile strength and prevents the vessel from collapsing.

The phloem:

A phloem is completely a living tissue role performs a role of translocation (translocation) of organic substances eg sugars, amino acids etc in plants. It consists of sieve tube elements, companion cells, phloem fibres, parenchyma and the sclereids.

The sieve tubes:

Sieve tubes are formed by end to end fussion of cells known as sieve tube elements whose endwalls are made of cellulose and pectin substances just like parenchyma cells.
Their nuclei degenerate and get lost as the sieve elements mature and the cytoplasm become confined to the thin layer around the periphery layer of the cell.

The endwalls of the sieve elements become perforated to form sieve pores in the sieve plates through wic cytoplasmic fillaments run from one sieve element to another and these aid translocation of organic substances through the phlem.

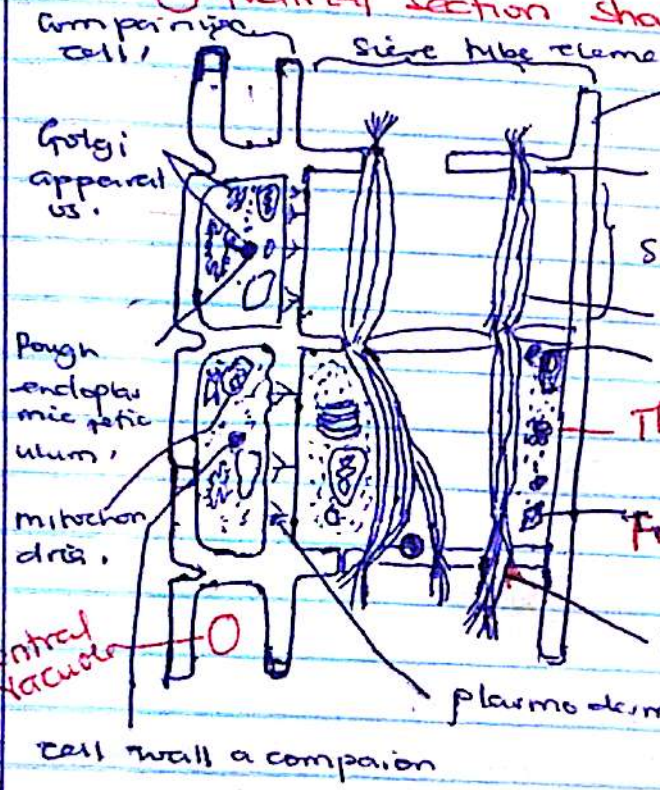
Although they lack anucleus the sieve elements remain living but are dependant on adjacent companion cells for energy required during translocation of organic substances.

The companion cells

Each companion cell is in close association with a sieve element. It contains dense cytoplasm containing numerous organelles including mitochondria, ribosomes, a prominent nucleus and endoplasmic reticulum companion don't play adirect role in translocation of organic materials but are metabolically active and supply the phloem with enough energy for translocation.

The two companion cells and sieve elements are in direct communication through small cytoplasmic ~~strands~~ strands known as Plasmodesmata plural Plasmodesma singular. that runs through the end walls of the sieve tube from the adjacent companion cells.

Longitudinal section showing a phloem tissue.



Cell structure fitting function is the distribution of organelles of a cell in an organ or tissue in intensities that suit their function.

(Starch as good store)

Starch can easily be hydrolysed by hydrolytic enzymes like amylase in times of need.

Starch is insoluble in water hence exerting a low osmotic pressure in solution.

PHLOEM PARENCHYMA:

These are elongated and sometimes tapering. They are also living cells and their main - function is to store organic food materials. They are absent in the phloem of monocot.

found in dicot but not monocot

Phloem fibres

These are also found in Dicots plants but not monocots. They are exactly similar to sclerenchyma fibres. They occassionally occur in primary phloem but more frequently in secondary phloem of dicots. In secondary phloem, they form vertically running bars of cells where they strengthen the phloem and enable it to with stand Pressure.

Adaptations of phloem to its function.

Sieve tube element

possess sieve elements wic are elongated and connected end to end to form a continuous hollow structure for continuous flow of organic substances.

end walls are perforated

The end walls of the sieve elements are perforated to form sieve pores wic allow passage of organic materials.

cytoplasmic filaments

The phloem consist of cytoplasmic filaments - that run from one sieve element to the other for continuous translocation of organic substances with in the plant by cytoplasmic streaming.

Companion cells

Each sieve element is associated with companion cells which provide the necessary energy for active transport of materials through the phloem.

Presence small amount phloem fibres

The sieve contains a small amount of phloem fibres wic provides mechanical support and ~~longitudinal~~ lignicity to plant organs.

- The phloem parenchyma aids in storage and controlling cytoplasmic components on the periphery of each sieve element and this provides free space for passage of organic substances.

Compare the structure of xylem and phloem.

Xylem	phloem.
- Has boardered pits	- No boardered pits except it has sieve pores.
- Has no nucleus	- consist of a prominent nucleus in the companion cells
- No ~~manufacturing~~ production of the energy	- It can manufacture the energy through the mitochondria in the companion cells
- It has a hollow lumen wic permits water and other substances	- It is sealed with a sieve plate.
- Companion cells absent	- companion cells present.
- Cell are dead	- cells are living

Other tissues in plants.

Epidermal tissues.

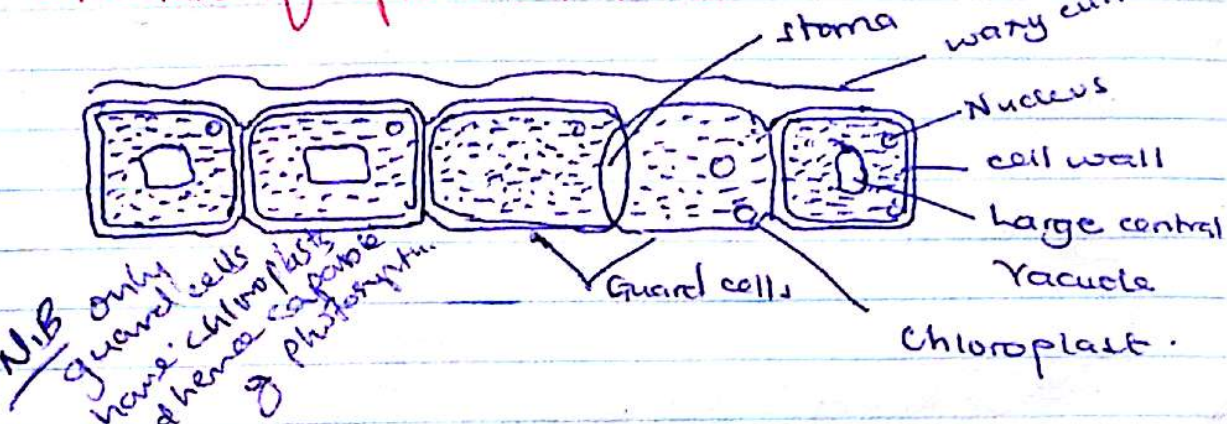
The epidermis arise from the outer most layer of the epical meristematic cells known as the Protoderm. The epidermis consist of a single layer of closely packed cells usually lacking intercellular air spaces. It consists of living cells, Some specialized eg ✿ Guard cells wic contain chloroplasts for photosynthesis unlike the rest of the epidermal cells of the leaf.

Functions of epidermal tissues.

- They offer protection of internal tissues against mechanical injury, excess heat, water loss and the infection by micro organisms like the Bacteria and fungi

- Epidermal tissue offer passage for light to the internal photosynthetic tissues of the leaves.
- In leaves the specialised epidermal cells (Guard cells) control the opening and closure of stomata.

Structure of epidermal tissue.



PHOTOSYNTHETIC TISSUES

These are tissues responsible for synthesing of organic cpds in the plant. They contain chloroplasts where photosynthesis takes place and are more abundant in leaves.

MERISTEMATIC TISSUES

These are the simplest plant tissue located at the growing point of the plant ie the apex of the root, at the apex of the shoot.

Meristematic tissues are small, thin walled and lack sap vacuoles and chloroplasts. Their important features is that they have ability to divide and subsequently differentiate into specialised cells.

Adaptations of voluntary muscles to their functions;

Consists of numerous fibres containing numerous long, cylindrical, unbranched and elastic myofibrils which allows the muscle to extend a wide range. The elasticity allows it to regain its original length after stretching.

- The myofibrils are arranged parallel to one another which allows sliding over one another during contraction and relaxation.

- Each muscle fibre has connection with motor portions of the voluntary nervous system. This enables to respond to actions of this section of the nervous system in response to changes in the envt.

- The muscles has a dense network of blood capillaries. This ensures efficient supply of oxygen and materials and removal of wastes.

- The muscles contain myoglobin instead of haemoglobin in blood. myoglobin has a higher affinity for O_2 than haemoglobin.

- The fluid bathing the myofibrils contains numerous glycogen granules and Mitochondria This ensures that enough energy is in form of ATP is available to the muscle for use in contraction.

END