HUMAN ANATOMY AND PHYSIOLOGY - I

[HAP-I]

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UNIT-I

Ch-1 → Introduction to Human Body.
Ch-2 → Cellular level of Organizers.
Ch-3 → Tissue level of organization.

Introduction to Human body.

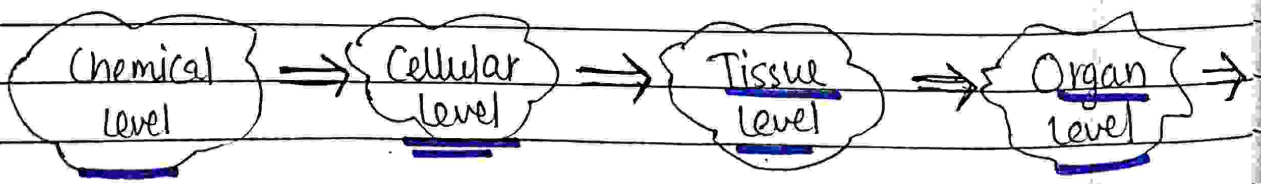
The study of human body involves two major principles :-

i) Anatomy
ii) Physiology.

i) **Anatomy** → The branch of science which deal with the study of **structure** of different organs of human Body.
examples → Histology [study about tissue] etc.

ii) **Physiology** → The branch of science which deal with the study of **functions** of different organs of human body.
ex → Neurophysiology [study about function of neuron]
Immunology etc..

- Levels of structural organization and body Systems.



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Mine
Date : / /20
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System Level → Organism Level → Complete Body

i) Chemical level → Most basic level, two or more atoms joins together to form molecules like CO, O, N etc.

ii) Cellular level → It is the basic structural and functional level of body i.e. cell.

iii) Tissue level → These are the group of cell which works together to perform a particular function.

iv) Organ level → Different types of tissue combine together to form organs which do proper functioning of body. ex → lungs, heart etc.

v) System level → A group of organ combine together to form system.
ex → Digestive system, Respiratory system etc.

vi) Organism level → It is the highest level and a complete body made up with combined of all system.
ex → Human Body.

Body System →
There are 11 system in human body.

1) Nervous System
2) Integumentary system / Exocrine System
3) Respiratory System

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4) Cardiovascular System / Circulatory System.
5) Digestive System / Excretory system
6) Urinary System / Renal System
7) Reproductive System
8) Muscular System
9) Skeletal System
10) Immune System / Lymphatic System
11) Endocrine System.

i) Nervous System → Its coordinate voluntary and involuntary action and transmit signal (information) by different parts of body.

ii) Integumentary System → Skin, Hair, nails, sweat and other exocrine glands.

iii) Respiratory System → It brings air into and out of the lungs to absorb oxygen and remove carbon dioxide.

iv) Cardiovascular system → Organs → Heart, Blood vessels. It circulates blood around the body via the heart, arteries and veins, delivering oxygen and nutrients to organs and cells.

v) Digestive System → Organs → Mouth, pharynx, stomach, intestine. To absorb nutrients and remove waste via the gastrointestinal tract.

vi) Urinary System → Organs → kidney, Urethra, Urinary bladder. The system where the kidney filter blood to produce urine, and get rid of waste.

vii) Reproductive System → The reproductive organ required for the production of offspring.

viii) Muscular System → It enables the body to move using muscles.

ix) Skeletal system → Bones maintain the structure of the body and its organs and give protection.

x) Immune System / Lymphatic system →
- It defends the body against pathogens that may harm the body.
- The system consist of network of lymphatic vessels that carry a clear fluid called lymph.

xi) Endocrine System → A system consists of different types of harmones which help in functioning in body. ex → T_3 & T_4 harmons (help in growth).

- **Basic Life Process**

i) Metabolism ← Catabolism, Anabolism
ii) Responsiveness
iii) Movement
iv) Growth
v) Differentiation
vi) Reproduction
vii) Respiration

i) **Responsiveness** → It is the ability of the body to detect and respond to changes.
eg. decreass in body temp. represents respond to changes

ii) **Metabolism** → It is the sum of all the chemical process that occurs in the body.

Metabolism → Catabolism
→ Anabolism.

- **Catabolism** → Breakdown of complex chemical substance into the simple compounds
- **Anabolism** → Building up of complex chemical substance from small components.

iii) **Movement** → It include motion of the whole body individual organs etc.

iv) **Growth** → It is an increase in body size that result from an increase in the size of existing cells.

v) **Differentiation** → It is the development of cell from an unspecialized to a specialised state.
eg. RBCs, WBCs and several types of cell rise

Mine
Date : / /20
Page :

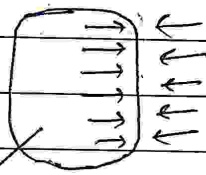
from the same unspecialized cell in Red bone marrow.

vi) Reproduction → It refers to the formation of new cells and also produce new offsprings.
eg → Old cells produce two new cells or parents cell produce fetus.

vii) Respiration → It involves the exchange of O_2 and ↑ (+) CO_2 b/w the cells and the external ↓ environment.
eg → Human body do respiration etc.

HOMEOSTASIS

Homeo + Stasis
↓ ↓
[constant] [state]



eg →
Body temp. → 37°C → it will be constant

- When Internal environment is constant with respect to external environment.

Or

Internal environment = External environment

feedback System →

If there are any changes take place in internal environment then feedback system is take back into its constant state or in Homeostasis.

→ It is of two types:-

i) Positive feedback System. (+) ↑
ii) Negative feedback System. (-) ↓

i) Positive feedback System → When anything is decrease in our internal environment, then it is try to back into normal situation by increasing it.

eg →

- In blood clotting, when any part of body injured, this system release chemical that activate blood platelets. Platelets are responsible for formation of blood clot and stop bleeding.

- During childbirth, it stimulate oxytocin, release through endocrine system. it stimulus the contraction of the uterus to help in childbirth.

Mine
Date : / /20
Page :

ii) Negative feedback system → When anything is increase in our body (internal environment), then this system is try to back into its normal condition by decreasing it.

eg → Temp ↑ → Skin heat ↑ —signal→ Hypothalamus

↓

TRC (Temperature Regulation centre)

↓

Sweat gland stimulus ↑

↓

Sweating ↑

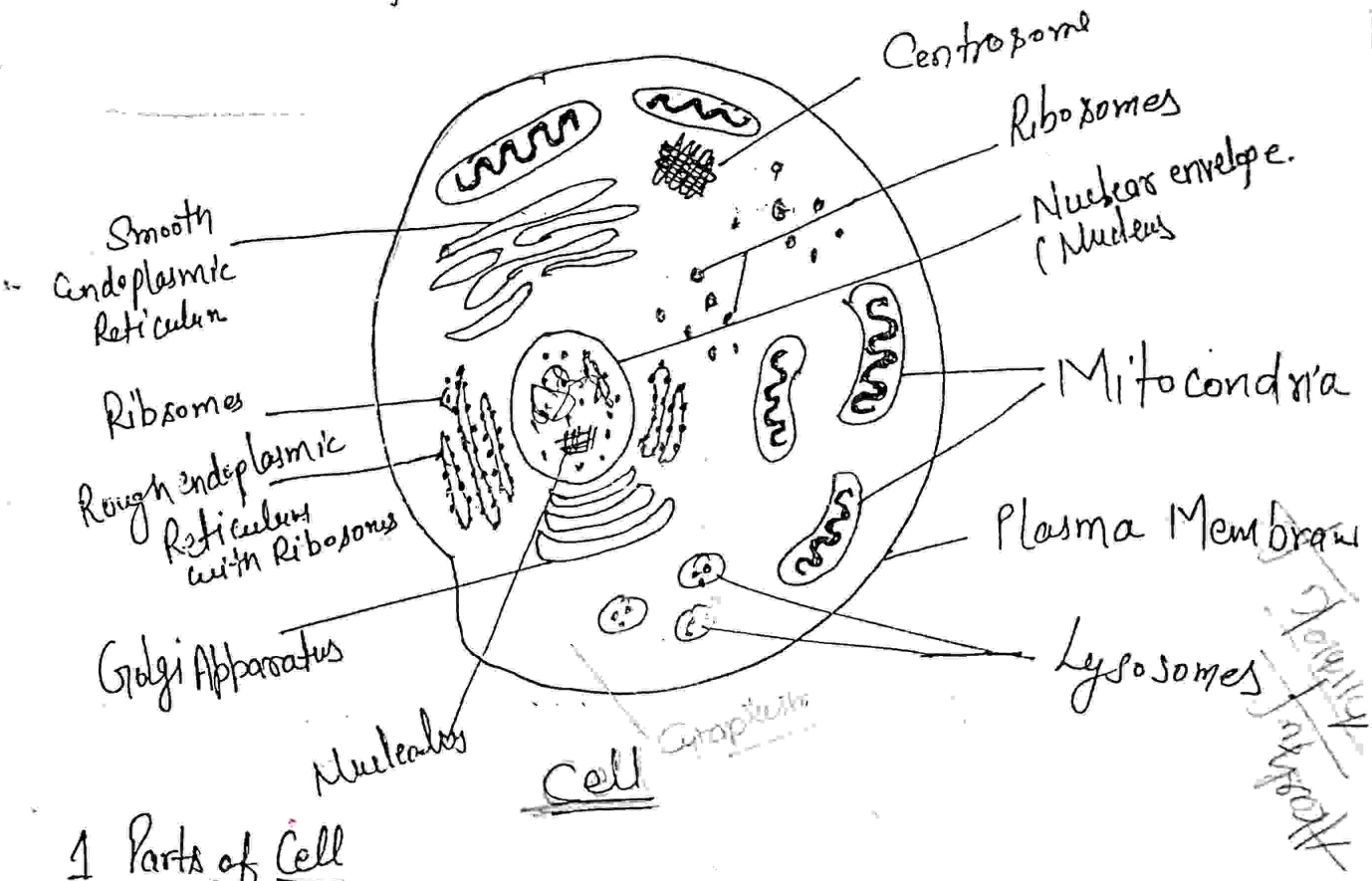
↓

Temperature ↓ and back to its homeostasis.

Cell

Cell is the basic living, ~~structural~~ functional unit of body enclosed a membrane. There are about 200 different types of cells in our body. All cell arise from existing cell by the process of cell division, in which one cell divides into two identical cell.

Cell biology is the study of cellular structure & functions. Structure of the cell is intimately related to its function.



Cell

1 Parts of Cell

1. Plasma membrane:- It forms outer flexible surface of the cell that separates its internal environment from the external environment. This selative barrier regulates the flow of materials into the & out of a cell It plays keyrole in communication among cells & between cells & their external environment.

2. Cytoplasm:- It consists of all cellular contents between the plasma membrane & the nucleus. Cytoplasm has two components: Cytosol & Organel

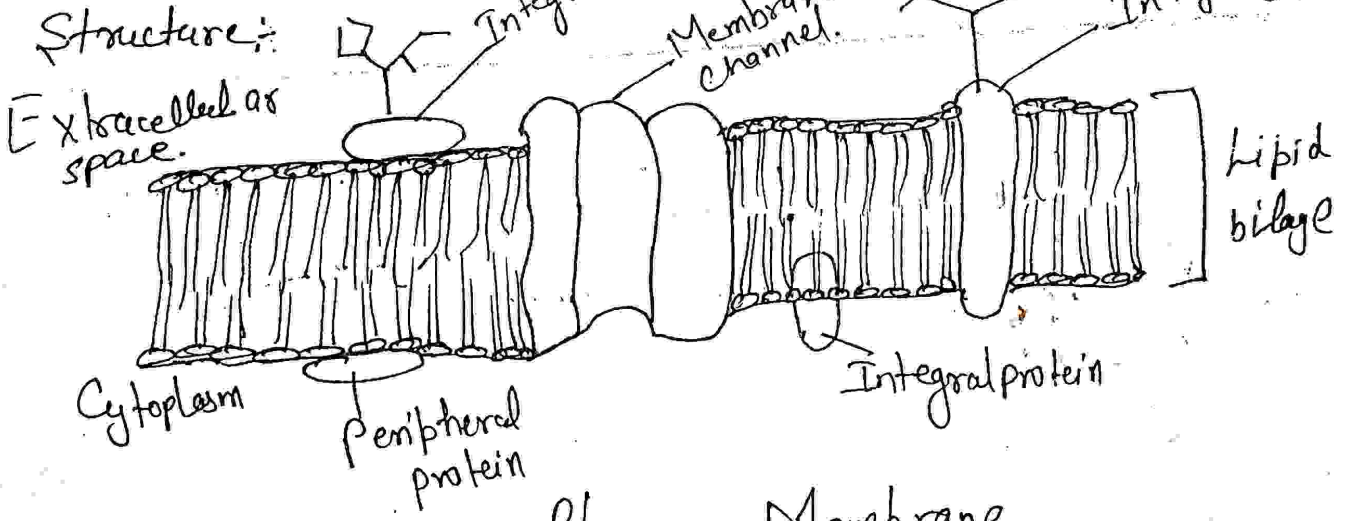
④ Cytosol:- It is the fluid portion of cytoplasm, contains water, dissolved salts & suspended particals.

⑤ Organelles:- They are surrounded by cytosol. Each type of organelles has a characteristic and specific functions. Ex- Include endoplasmic reticulum, Golgi complex, lysosomes, peroxisomes, ribosomes, mitochondria & Cytoskeleton.

⑤ Nucleus:- This large organelle contains most of cellular DNA. A single molecule of DNA is associated with several proteins to form a chromosome. Whole Contains thousands of hereditary units called genes. The genes control most aspects of cellular structure and functions.

1 The Plasma Membrane:- Plasma membrane surrounds and contains the cytoplasm of a cell. It is a flexible yet sturdy barrier between the cell's environment and the extracellular enviroment.

Structure:-



Plasma Membrane

The membrane is composed of proteins and lipids that are held togeth by non covalent forces.

According to fluid mosaic model, the membrane is mosaic of prot floating like icebergs in a lipid bilayer.

The lipid bilayer consists of two back to back layers of phospholipids Cholesterol and glycolipids. The bi-layer arrangement occurs because of amphipathic (both polar & Non-polar parts) nature of the lipids.

Integral proteins extend into or through the lipid bi-layer Peripheral Proteins associate with membrane lipids or integral proteins at the inner or outer surface of the membrane.

Many integral proteins are glycoproteins with sugar groups attached to the ends that face the extracellular fluid. Together with glycolipids & glycoproteins forms a glycocalyx on the extra cellular surface of cells

Functions:-

1. Protection: It protects cell from injury.
2. Barrier: It hold or bound cell contents and maintains individuality of the cell
3. Shape of the cell - It anchors structural elements of the cytoskelon which provide distinct shape to specific cells.
4. Cell Recognition: Glycoproteins and glycolipids function as receptors for specific chemical signals from out side and trigger specific processes with in the cell, eg: immune response rejection of a sub. and signal transduction.
5. Cell junction: Membrane protein helps adjacent cells to form various types of junctions for keeping the cells together during formation of tissues
6. Microvilli: These are membrane ~~protein help~~ evaginations specialized for increasing surface area for absorption.
7. Cell movements:- Movements like undulations (eg- Fibroblasts) & pseudopodia (eg macrophages) are formed by cell membrane. They also form sheaths around flagella

8. Enzymes:- Some membrane proteins catalyze biochemical reactions.
9. Transport proteins:- Many membrane proteins form channels that facilitate the transport of water, ions & nutrients like sugar and amino acids.
10. Selective permeability:- It allows entry to only selected substances and impereables to others.
11. Bulk transport. Bulk intake of materials from outside by invagination of plasma membrane to form vesicles is called endocytosis. Throwing out of waste products & secretory materials by the reverse process is called exocytosis
12. Impulse transmission:- Nerve impulses travel through the plasma membrane of nerve cells.

2 Cytoplasm

It has two Components < Cytosol
Organelles.

- Cytosol & Organelles are the main Components of Cytoplasm
- The gel like substance enclosed with in the plasma membrane & is present external to the nucleus is called Cytoplasm.
- The semifluid portion of Cytoplasm in which organelles and inclusions are suspended is called cytosol or intracellular fluid.

Cytosol is transparent, viscous gel like fluid containing 75 to 90% of water, suspended & dissolved Components such as proteins, lipids & Carbohydrate, different inorganic substance & salts.
The cell organelles are embedded in Cytosol.

- Endoplasmic Reticulum
- Ribosomes
- Golgi Complex
- Mitochondria
- Cytoskeleton
- Centrosome
- lysosomes
- Peroxisomes

Endoplasmic Reticulum (ER)

The endoplasmic reticulum is a pattern of membrane enclosed chann called as cisterns of varying shapes. It is an interconnected network of internal membrane. It extends from the nuclear envelope throughout the cytoplasm.

Based on its association with ribosomes the ER is of two types.

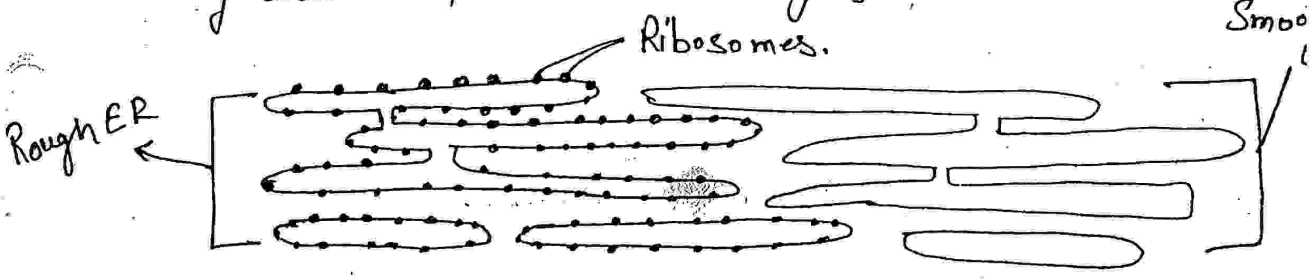
i) Rough Endoplasmic Reticulum (RER)
ii) Smooth Endoplasmic Reticulum (SMR)

i) Rough Endoplasmic Reticulum (RER):-

The ribosomes are attached on the surface. Hence they are granular in apperance & rough. It is responsible for synt of many secretory proteins & membranes. The proteins then enter the SF within ER for processing & sorting.

ii) Smooth Endoplasmic Reticulum (SER):-

The ribosomes are not attached to the surface; hence smooth in nature. Smooth ER is the site of fatty acid, phospholipids & steroid synthesis. It can inactivate or detoxify a verity of chemicals including alcohol pesticides & carcinogens.

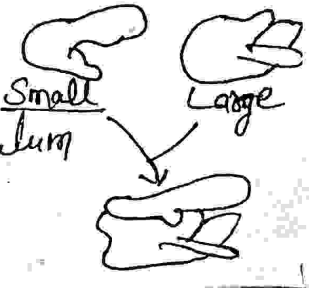


Ribosomes.

These are tiny spheres that contains ribosomal RNA & several ribo proteins; These are the site for protein synthesis. These are made up of two subunits; Smaller sub unit (40S): RNA of smaller size and the Larger sub unit (60S): RNA of larger size.

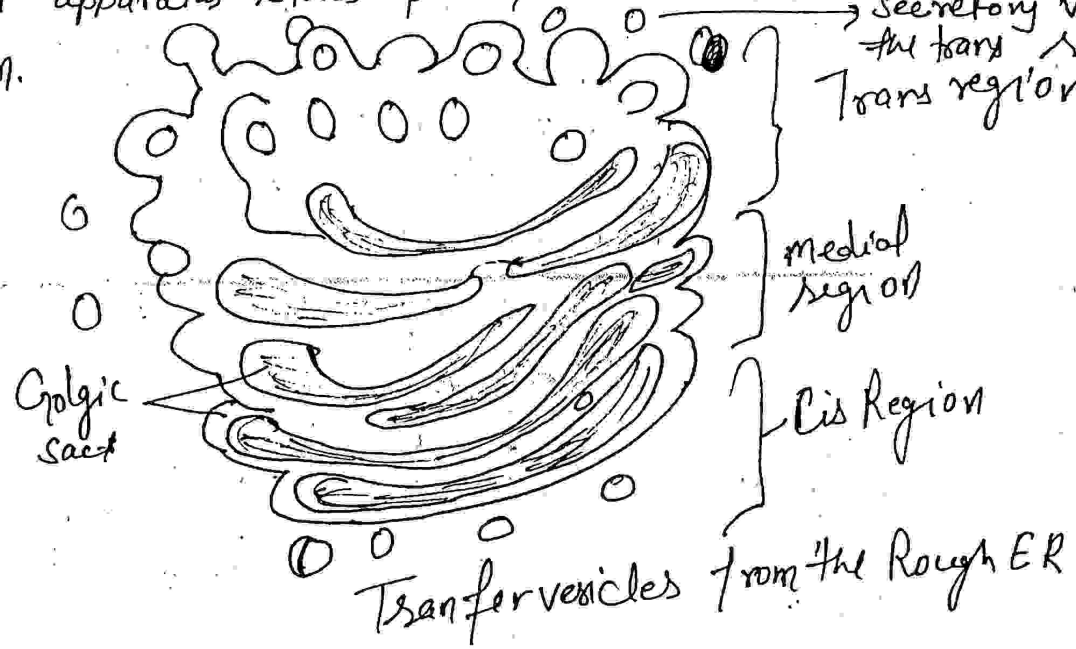
Ribosomes are of two types

i) Membrane bound :- Attached to endoplasmic reticulum
ii) Free Ribosomes :- These are free in Cytosol

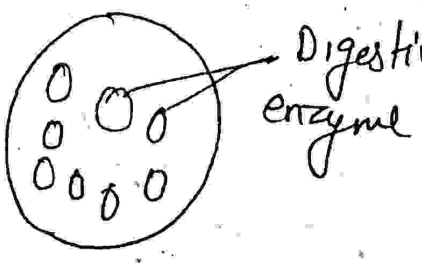


Golgi Complex:- Golgi apparatus or Complex is present near the nucleus.

- It consists of four to six flattened sacs called as Cisterns placed upon each other like a pile of plates with expanded bulges at their ends. The stack of Golgi sacs has two defined regions i.e Cis & Trans.
- Proteins synthesized by the ribosomes are brought to the lumen of endoplasmic reticulum & then to golgi apparatus through transfer vesicales. The vesicles fuse with the Cis region of the Golgi Complex releasing their Contents into the internal portion.
- These proteins are modified and secreted vesi outside the cell when needed through the secretory vesicles on the trans end.
- Golgi apparatus stores proteins and is also responsible for modifying them.

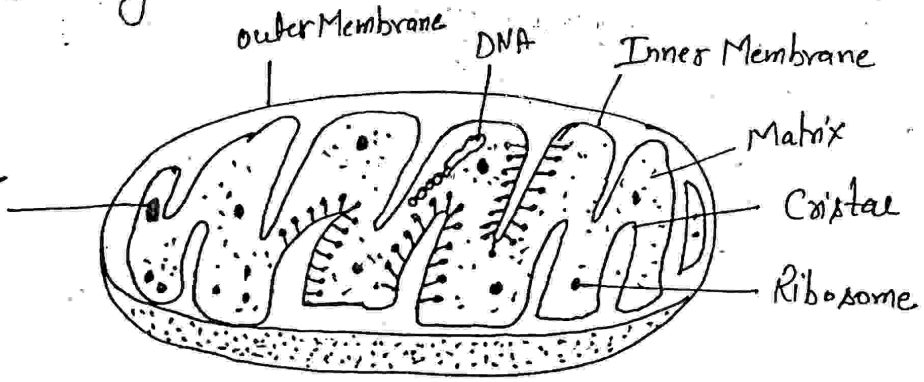


Lysosomes:- Lysosomes are secretory formed from the golgi complex These are membrane bound spherical vacuoles which function as the digestive system of the cell. It contains 60 kinds of powerful digestive & hydrolytic enzymes that can hydrolyse large molecules such as RNA & DNA or proteins & lipids. Lysosomal enzymes work best at acidic pH=5 and inactivated at natural pH value.



Mitochodria :- Mitochodria generate ATP & are therefore called as powerhouse of cells. The numbers of mitochondria vary from cell cell depending on their energy requirement.

- A mitochondria consists of two lipoprotein membranes.
  - Outer mitochondrial: It is intact & covers the whole structure
  - Inner mitochondrial: It contains a series of fold called as cristal
- The region between two membranes is called as the intermembrane space
- The inner fold of the mitochondrial membrane increase the surface area thereby increasing the out put of cellular respiration. Large central fluid filled cavity enclosed by the inner mitochondrial membrane is called mitocondrial matrix. Oxidative enzymes of mitochondria cause oxidation of nutrients, Co_2 & H_2O release energy which utilized in formation of adenosine triphosphate. Mitochondria also plays a critical role in apoptosis, cell signalling cellgrowth & control of cell cycle.



Mitochondria

~~Peroxisomes~~ :

Peroxisomes : These orgnelles are similar in structure to lysosomes but comparatively smaller in structure. It contains many oxidases enzyme that can oxidize (remove of H) various organic substances such as fatty acids, amino acid & uric acid. In order to protect the cell from the toxic effects of H_2O_2, peroxisomes also contain the enzyme Catalase

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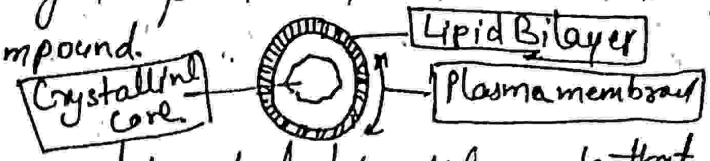
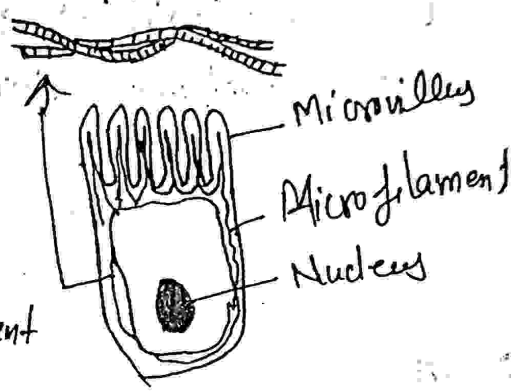
· Catalase decompose hydrogen peroxide or utilizes it to oxidise another organic compound.



Cytoskeleton.

It is a network of three types of protein filaments that extend through out the cytosol:

- Microfilaments
- Intermediate filaments
- Microtubules.

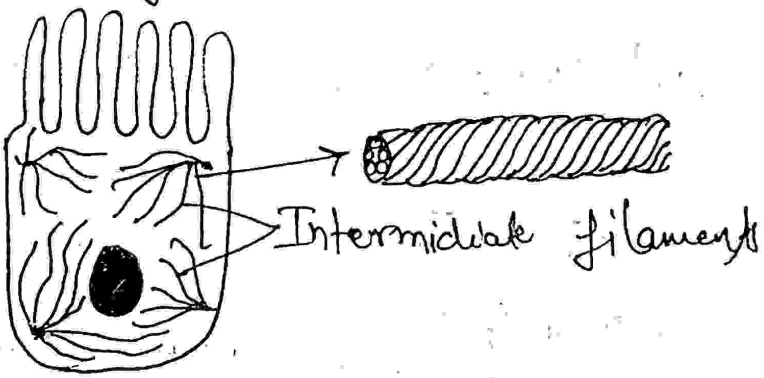


Microfilaments: Microfilaments are thin, composed of protein actin & are most prevelent at the periphery of the cell.

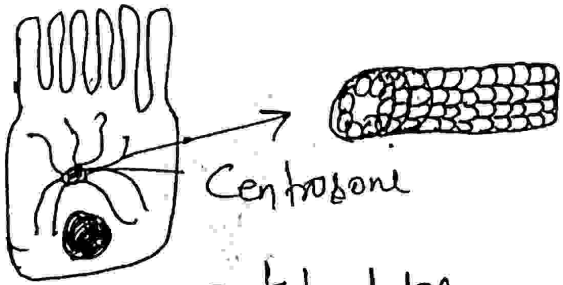
Intermediate: It is thicker then microfilaments. Several different proteins compose these exceptionally strong filaments

Microtubules: Largest cytoskeletal components are long unbranched how tubes composed mainly of the protein tubulin. Centrosom grow outward toward the periphery of the cell

Intermidiate ⇒



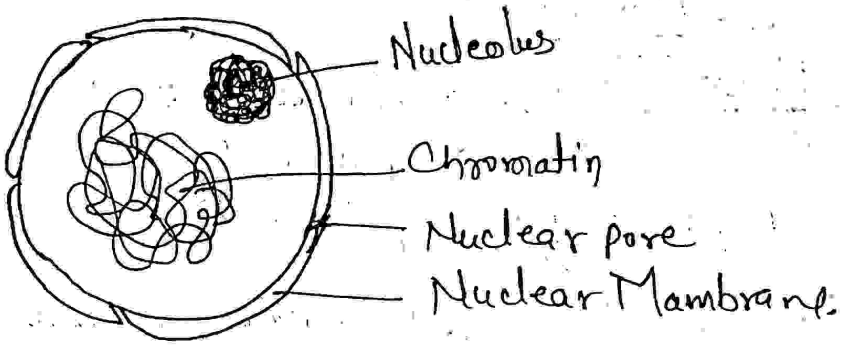
Microtubules



Cytoskeleton

3 Nucleus

The nucleus is usually a spherical or oval in shape & largest structure in th cell. The nuclear membrane is a double membrane which separates nucleus from the cytoplasm. Both the inner & outer membrane is phospholipid bilayer. Nuclear membrane is externally continuous with endoplasmic reticulum. The nuclear mambrane contains nuclear por in the membrane where inner and outer part of mambrane is fuses.



Nucleus

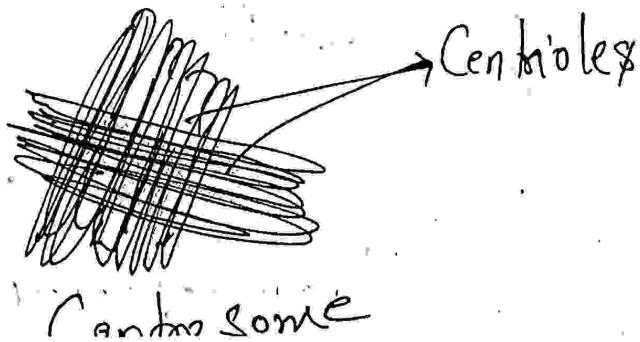
Theses pores act as channel for transfer of ions and water solut molecules b/w the nucleus & the cytoplasm.

→ Nucleus contain a sperical structure called nucleolus & ~~structure~~

→ Nucleolus contains aggregations of protein DNA & RNA

Centrosome

This is directs organisation of microtubules within the cell. It consists of a pair of centroles & plays an important role in during cell division.



Centrosome

Process of Transport Across the Plasma Membrane

Material transport processes can be classified as active & passive. depending on whether they require cellular energy.

Passive Processes

Passive processes do not require input of cellular energy. A substance moves down its concentration gradient across membrane due to its kinetic energy.

Active Processes

Active processes use cellular energy of ATP to drive a substance "uphill" against its concentration or electrical gradient.

① Movement of Small Molecules across the Membrane:-

A) Diffusion
- Simple
- Facilitated
- Osmosis

B) Active transport
- Primary
- Secondary.

② Movement of large molecule across the membrane:-

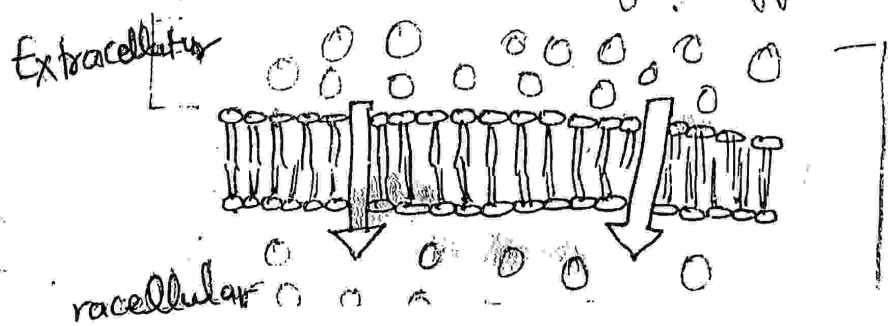
i) Endocytosis.

ii) Exocytosis.

(1)

i) Simple diffusion / Passive transport:

- It is a passive processes where the solute molecules in a solution are carried in the direction of their concentration gradient i.e from higher Concentration to lower Concentration without utilization of energy.



Passive transport

Substances move across the cell membrane by the 3 basic Mechanisms:-

1.) Molecules remains in the aqueous phase & diffuse through aqueous channels or pores in the membrane.

2.) The molecules leaves the aqueous phase on one side of the membrane, dissolve in lipid bi-layer & cross it & and again enters the aqueous phase on opposite side of membrane.

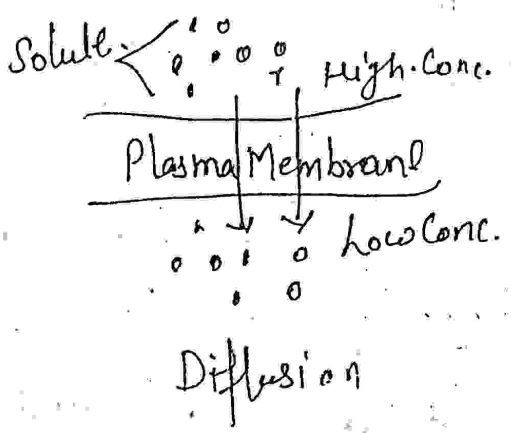
3.) The molecules combine with carrier molecule & help them across the cell membrane.

ii) Facilitated Diffusion:-

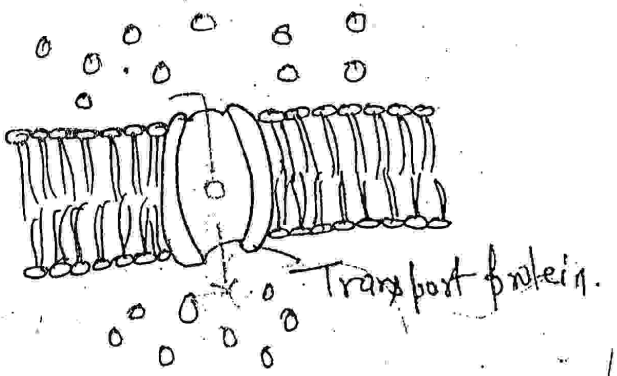
It also called as carrier-mediated diffusion. The carrier protein facilitates the diffusion of the substance to the other of membrane. Energy is not required for such transfer.

- Many lipid insoluble substances like Vitamins, Glucose, urea cr the membrane by this process.
- The transfer is in the direction of concentration gradie from higher concentration to lower concentration.

This transfer achived through the structural changes in the protein when it bind with the material to be transferred.



Diffusion

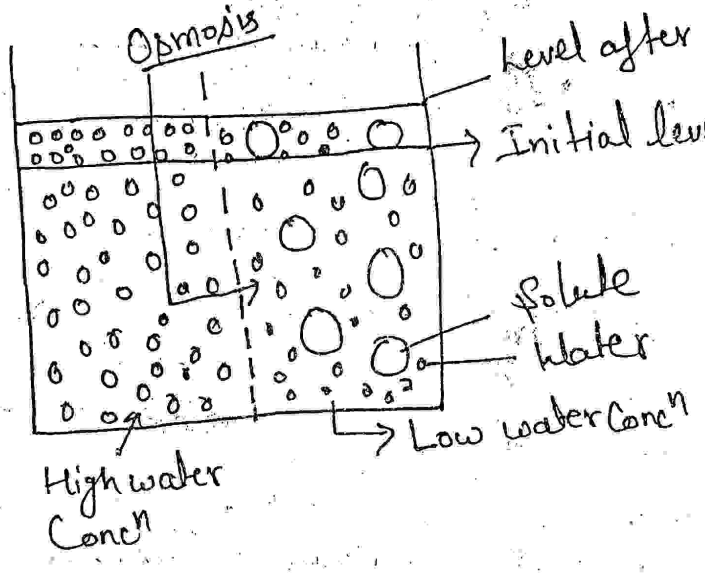


[Facilitated Diffusion]

Osmosis:

It is defined as movement of solvent molecule across a semi-permiab membrane from an area of higher concentration to an area of lower concen-tration. It occurs only when a membrane is permeable to water bu it is not permeable to certain solutes.

⇒ When the water moves into a body or cell by osmosis (called end-osmosis) it creates a hydrostatic pressure inside the body or cell (cell may burst). When water moves out of the cell due to osmosis (called exosmosis) the cell shrinks called crenation.



- The osmotic pressure of a solution is proportional to the conc.^n of the solute particles that can not cross membrane. Higher the solute concentration, higher is the solution's osmotic pressure.

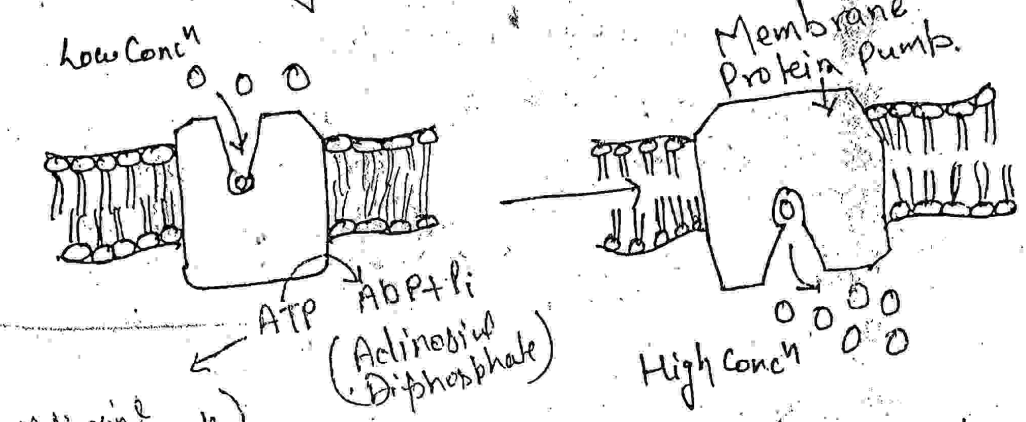
B. Active Transport

When the material is transported out against the conc gradient ie from lower concentration to higher Concentratic with utilization of energy then the process is called active transport.

- Energy is obtained from hydrolysis ATP
- Active transporte is of two types

Primary Active Transport:- (4)

The energy is obtained from hydrolysis of ATP to pump the ions or a substance across a plasma membrane against concentration gradient.



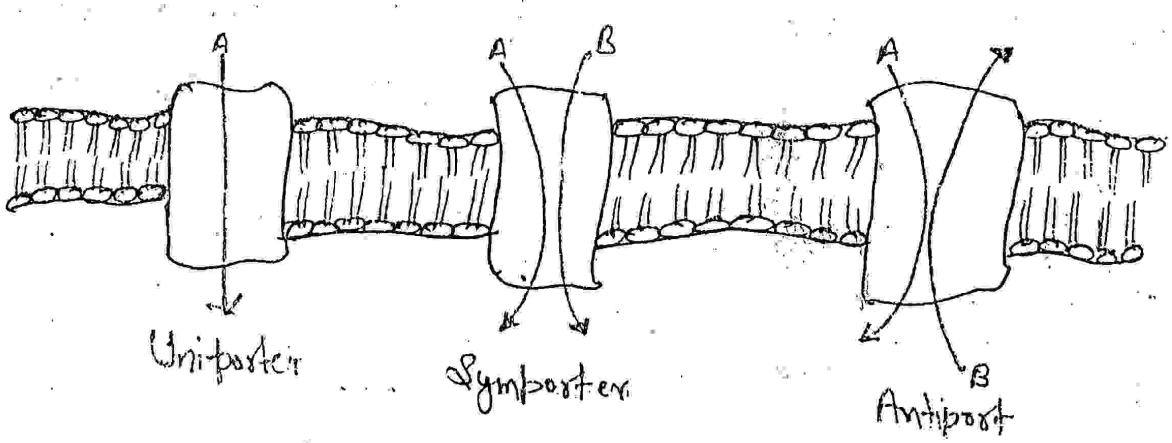
Primary Active Transport

ii) Secondary Active Transport:-

The energy stored in a Na^+ or H^+ concentration gradient is used transport other ions or solutes (Coupled transport)

Antiport move Na^+ or H^+ & other substance in opposite direction eg Ca^{2+}, H^+ out of cells.

Symporters Move Na^+ (or H^+) & another substance in the same direction across the membrane eg glucose amino acid into cells.



Secondary Active Transport

(2) i) Endo Cytosis :-

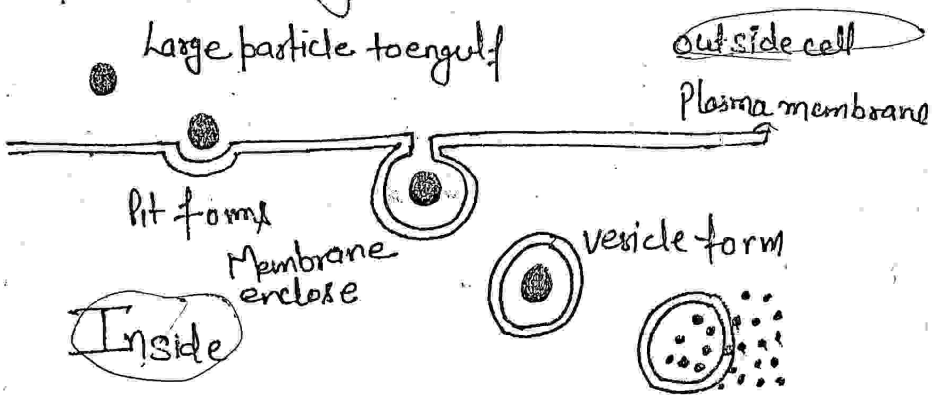
It is movement of substances into a cell in vesicles.

It is a transport mechanism which involves engulfing extracellular materials with in segment of the cell membrane to form a vesicle called as corpuscular or vesicular transport.

Types :- (a) Phagocytosis
(b) Pinocytosis

(a) Phagocytosis :- It is a form of endocytosis in which the cell engulfs large solid particles, such as worn out cells, whole bacteria & viruses.

(b) Pinocytosis :- It is form of endocytosis in which tiny droplets of extracellular fluid taken up



ii) Exocytosis

It is movement of substances out of a cell in secretory vesicle that fuse with the plasma membrane & release their contents into the extracellular fluid.

eg Neurotransmitters
Hormones
Digestive enzymes.

Cell Junctions

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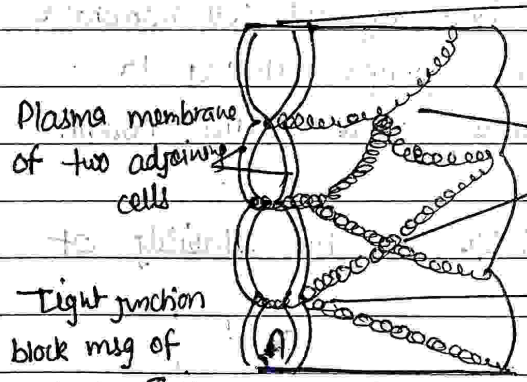
Cell junctions are contact point b/w the plasma membrane. It consist of multi-protein complexes that provide contact b/w a cell & the extracellular matrix. It is also called intracellular bridge.

Types of cell junction →

i) Tight junction
ii) Adherens junction
iii) Desmosomes
iv) Hemidesmosomes
v) Gap junction.

1) Tight Junction →

Tight junction consist of fused ridges of tightly packed transmembrane junctional proteins. They regulate formation of barriers by modulating cell proliferation, differentiations polarization & control barrier function by restricting paracellular diffusion. The above mechanism may pave way for new therapeutic strategies in drug delivery across epithelial barriers.



Functions:- Hold the cell together.

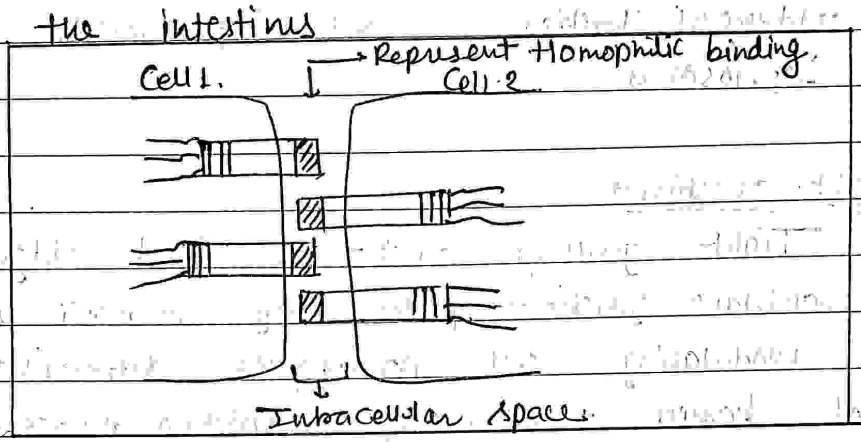
- Help to maintain the polarity of cell by preventing the lateral diffusion of protein b/w the apical & lateral/basal surfaces.
- Tight junction prevents the passage of molecules & ions through the space b/w plasma membrane of adjacent cells.

2) Adherens junctions → These are those protein complexes that occurs at cell-cell junctions in epithelial and endothelial

DATE

tissue. Adherens junction contains plaque layer of proteins on the inside of the plasma membrane that attaches both to membrane proteins & microfilaments of the cytoskeleton. Also called as intermediate junction or belt desmosome.

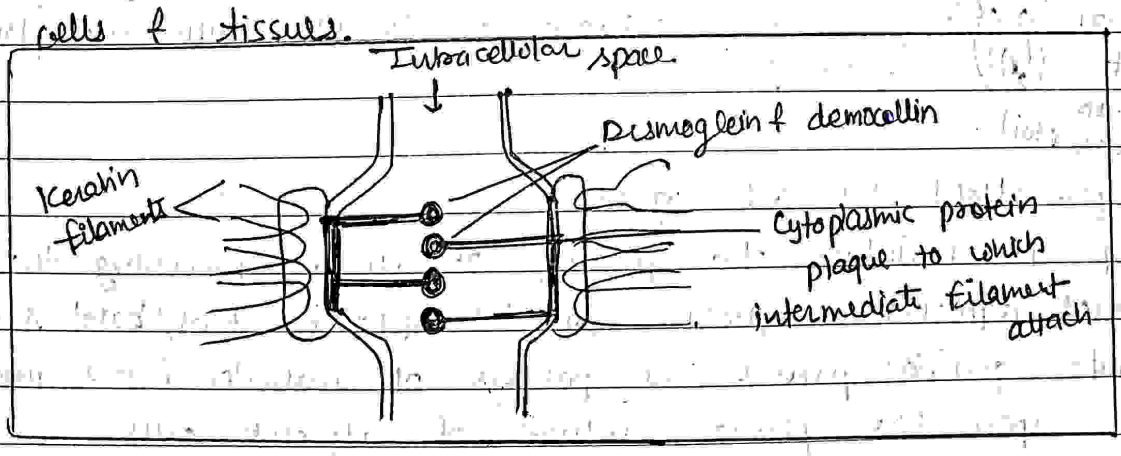
Adherens junction helps to epithelial surface to resist separation during various contractile activity such as movement of food through the intestines.



(3) Desmosomes

It contain plaque & trans-membrane glycoproteins such as cadherins that extend into intracellular space b/w adjacent cell membrane and attach cells to another. A desmosome plaque attached to cytoskeleton known as intermediate filaments that consist keratin protein.

Such type of structural arrangement helps in the stability of cells & tissues.



(4) Hemidesmosomes → It resemble like desmosomes but they do not link the adjacent cell, the structure of hemidesmosome

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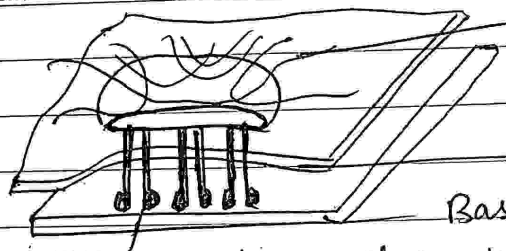
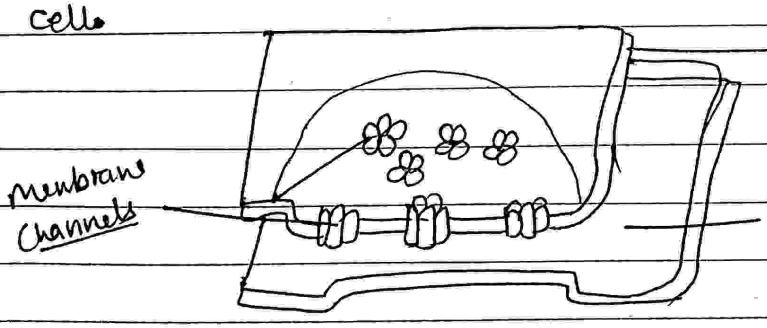
In half of desmosms the inner side of plasma membrane, integrins attached to the intermediated filaments made up of keratin protein. The outer side of plasma membrane the integrins attached to the protein laminin present in the basment membrane.



(4) Gap Junction →

Membrane proteins present in gap junction are called as connexins form ting fluid-filled tunnels called connexn that connect neighboring cells. The plasma membrane of gap junctions are separated by a very narrow intracellular gap. A gap junctions allow the communicatios of cells with one another. Gap junction enable nerve or muscle impulses to spread rapidly among nervas cells.



V-IST

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Tissue

- The tissue of the body consist of large number of cells & they are classified according to the size, shape and functions of those cells.
- Tissue are classified into four major groups.

Tissue
- Epithelial tissue
- Connective tissue
- Muscular tissue
- Nervous tissue

- Histology → It is the branch of science that deals with the study of tissue.

① Epithelial tissue :- Epithelial tissue form the covering or lining to the free surface of the body. They perform vital function like protection, excretion, glandular secretion & absorption.

- The epithelial tissue/cells contain minimal extracellular material But they are arranged on basement membrane

- Classification of epithelial tissue
  - Simple
    - Squamous
    - Cuboidal
    - Columnar
    - Ciliated
    - Glandular
  - Stratified
    - Transitional
    - Columnar
    - Cuboidal
    - Squamous

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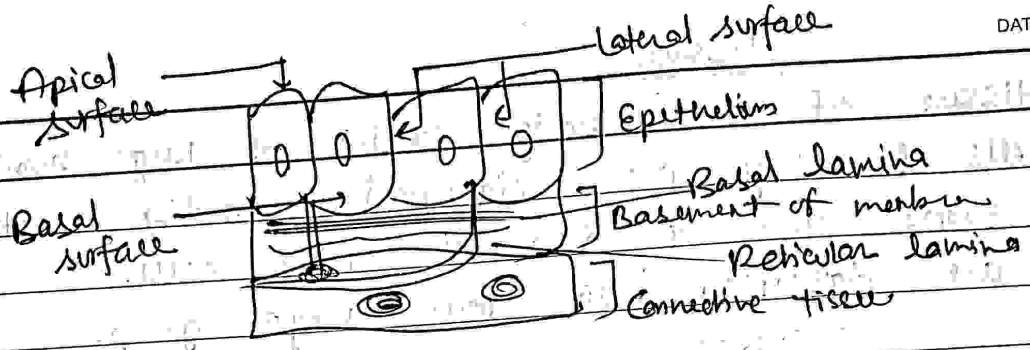


Surface of Epithelial

① Apical surface :- It faces the body surface, a body cavity, the lumen of an internal organ that receives cell secretion. It may contain cilia & microvilli.

② Lateral surface :- It faces the adjacent cell on either sides. It may contain tight junction, adherens junction, desmosomes & gap junctions.

③ Basal surface :- It present opposite to that of apical surface. In multiple layer epithelial cells the apical layer is the most superficial layer of cell & the basal layer is the deepest layer of cells.

Basement membrane :-

It is a thin extracellular layer that consist of two layer i.e Basal & Reticular lamina.

- Basal lamina → It is closer to & secreted by the epithelial cells It contain protein such as laminin & collagen as well as glycoproteins & proteoglycans.
- Reticular lamina → It is closer to the underlying connective tissue & contain protein such as collagen but produced by connective tissue.

Simple Epithelium :- It consists of single layer of cells.

↓

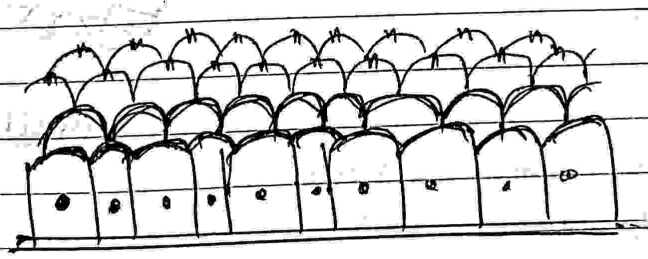
Squamous | Columnar | Ciliated | Cuboidal | Glandular.

DATE

① Simple squamous epithelium →
It consist of single layer of flat cells arranged on basement membrane. The nucleus of each cell is oval or spherical.
- Locations → Heart, blood vessels, lymphatic vessels, airsacs of lungs, & glomerular capsules of kidney.
- Functions → • Blood filtration in the kidney.
• Diffusion of O_2 to blod vessels of the lungs.

② Cuboidal epithelium →
It consist of single layer of cube-shaped cells having centrally located nucleus.
Location → It covers surface of ovary, lines kidney tubules & smaller duct of many gland, also in thyroid glands & duct of some glands eg. Pancreas.
function → It performs the function of secretion and absorption.

③ Simple Columnar →
It consist of single layer of rectangular cell arranged on basement membrane. It contain goblet cell & cells with microvilli in some locations.
Location → It lines the GIT, duct of many glands & gall bladder.
function → Secretion & absorption.



Columnar

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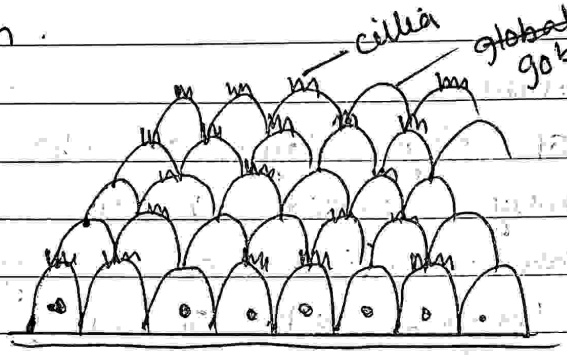
④ Simple cuboi cilliated epithelium →

Consist of single layer of celiated column like cell with nucleus near the base of cells. goble cell in some location.

location → few portion of upper respiratory tract ureus, citerine tube, central canal of spinal cord, ventricles of the brain

fnction → Moves mucus & other substances by cilliary action.

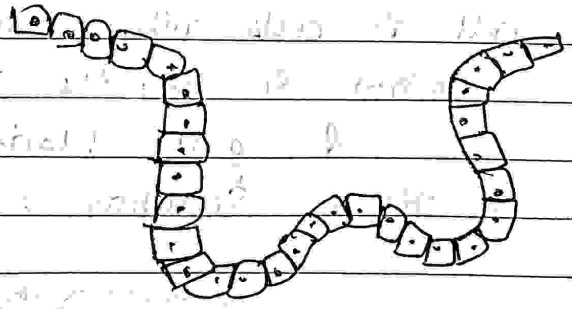


Celliated

⑤ Glandular epithelium

It consist of cylindrical or columnar cells. It is present in the secretory gland like slivery gland & breast. It is of two type. Unicellular & multicellular.

Unicellular



multicellular

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- Stratified epithelium → It consists of several layer of cells.

Types

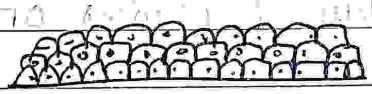
- Squamous
- Cuboidal
- Columnar
- Transitional

(i) Stratified squamous epithelium → Squamous cells from the apical layer of several layers deep to it cells from the basal layer replace surface cells as they are lost regularly.

location → Keratinized → skin.

Non-keratinized → Lining of mouth, oesophagus, pharynx, tongue, vegina

function → Protection, limited secretion.

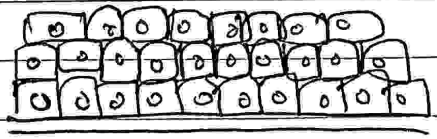


Squamous.

(ii) Stratified Cuboidal Epithelium → Consists of two or more layers of cells in which cells in the apical layers are cube shaped.

location → Duct of adult sweat glands & oesophageal glands & part of male urethra.

function → • Protection • Limited seretion • Absorption.



Cuboidal.

(iii) Stratified Columnar epithelium →

It consist of several layers or irregular shaped cells: only the apical layers has columnar cells.

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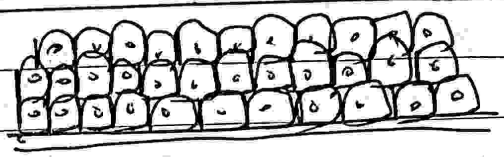
location →
— Urethra
— Conjunctiva dorsa
— Oesophageal gland
→ Small area of anal mucous membrane



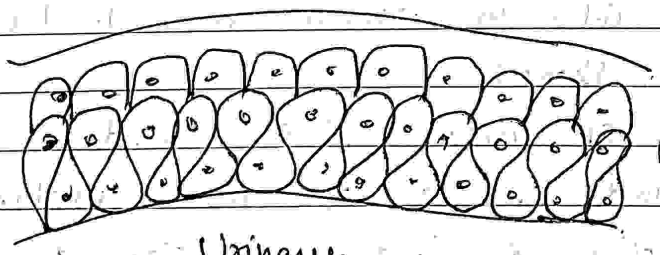
Columnar

function → Protection & secretion.

(iv) Transitional epithelium → Its appearance is variable shape of cells in apical layer ranges from squamous to (when stretched) to cuboidal (when relaxed).

location →
lines urinary bladder & portions of ureters & urethra.

functions → Permits distention.



Relaxed

Urinary bladder

DATE

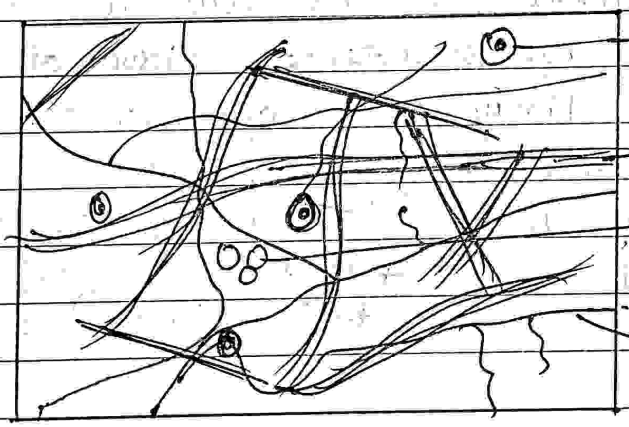
(2) Connective tissue

Connective tissue serves to connect or bind together different organs or different parts of an organ. They contain an intracellular substance matrix. It helps in binding & supporting the cells.

Classification

- Loose Connective tissue
- Dense fibrous tissue
- Elastic tissue
- Adipose tissue
- Cartilage
- Bone

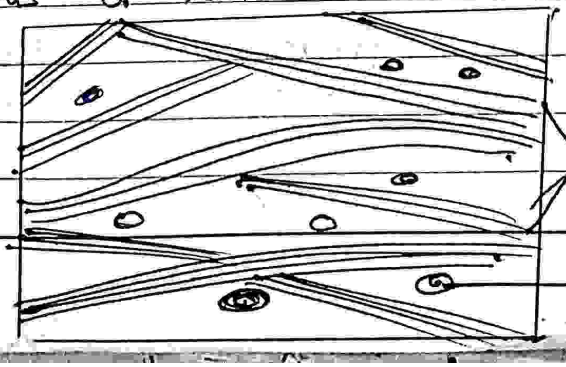
1) Loose connective tissue (Areolar tissue) → It is the most widely distributed tissue in the body. It is loose irregular connective tissue. It connects the skin to the underlying structures. Also it fills unoccupied spaces b/w organs. It is found b/w muscles, blood vessels & nerves.



functions → Strength, Elasticity, Support

ii) Dense fibrous tissue → The tissue has compactly arranged fibres with greatly reduced interspaces. The cells are less no. than areolar tissue. This type tissue is present in dermis of skin.

- provide strong attachement with various structure.



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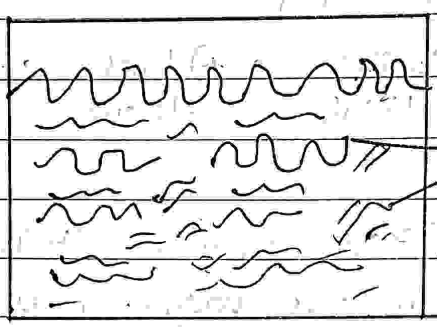
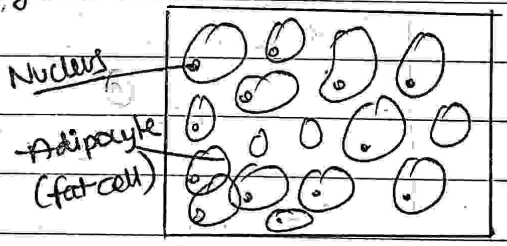
iii) Elastic tissue → This tissue is yellow in colour & contains more no. of elastic fibers. It is present in tissue where strength is required with elasticity.
eg. trachea & Bronchi, lung
→ Allows stretching of various organs.

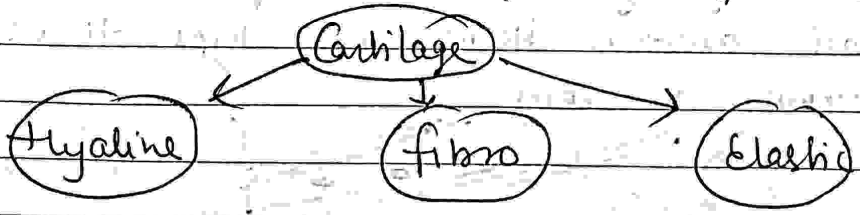


iv) Adipose tissue :- (fatty tissue) ⇒
It contain large surrounded cells & cytoplasm is loaded with fat. The nucleus of the cells is pushed towards the periphery eg. subcutaneous tissue of skin.
— around heart kidney, yellow bone marrow

- Reduce heat loss through skin.
- Serves as an energy reserve.
- Supports & protects



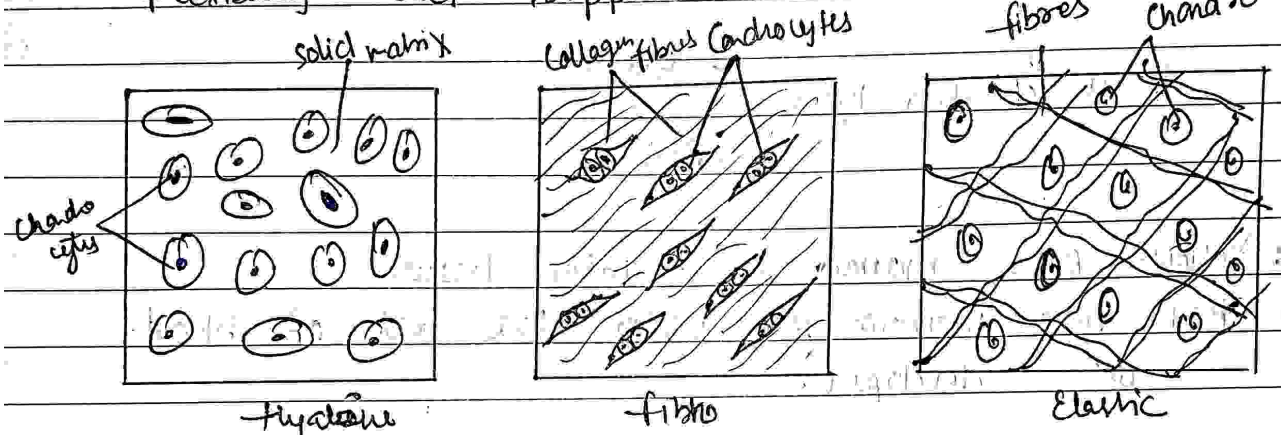
v) Cartilage : It has a tough, gelatinous and elastic rode matrix formed of chondrin. The cells are more or less round and lie in groups of four embedded in the matrix.



DATE _____

(a) Hyaline Cartilage → Matrix is free from fibres and is transparent also the cells are arranged in small groups.
→ Located in end of bones, Nose, larynx, trachea, bronchi.

- Provide smooth surface for movement at joints as well as flexibility and support.



(b) fibrocartilage → The grand substance contain thick bundles of collagen fibres. It is found in the inter-vertebral discs public symphysis (hippone join anteriorly).
- support & fission.

(c) Elastic Cartilage → It contain a network of branching and rejoining collagenous fibres Located in parts of external ear & lid on the top of larynx.
- Give support and maintain shape.

- Bone → It is the hard connective tissue. Bones contain a high conch of salts like calcium phosphate & calcium carbonate.
A bone consists of generally ⇒ :

DATE

(a) Periosteum → Membrane of fibrous tissue covering surface of bones.

(b) Compact bone → Hard dense substance found below periosteum

(c) Spongy bone → Porous tissue. It forms the interior of mature bond.

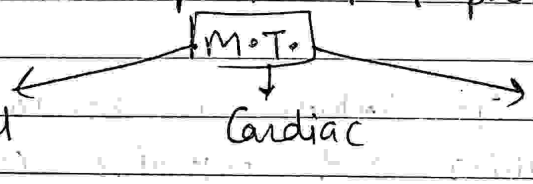
(d) Bone marrow → Soft material which fills the hollow of interior of a mature bone

It is of two types { yellow, Red

- Yellow Bone marrow is a fatty tissue
- Red bone marrow from which the cell of blood are developed.

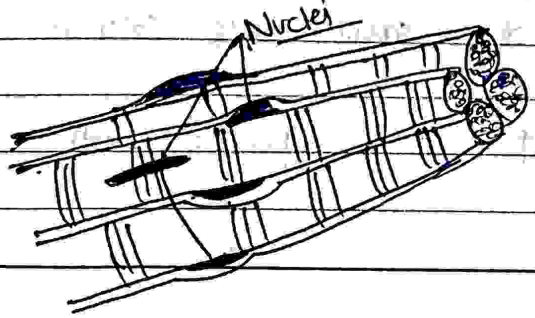
(3) Muscular Tissue

Muscular tissue consists of fibres that are specialized for contraction. It provide motion, maintanance of posture, heat production & protection.



(A) Skeletal muscle tissue → It consist of long, cylindrical, striated fibres with many peripherally located nuclei. usually attached to bones by tendons; voluntary control.

- motion, posture, heat production & protection.



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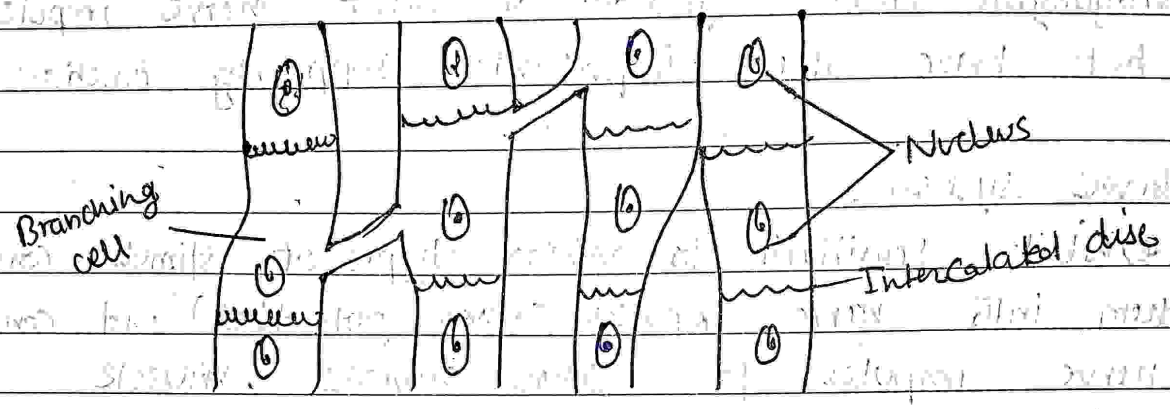
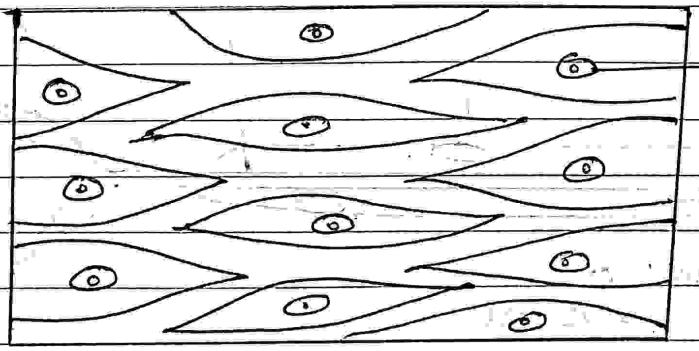
(B) Cardiac Muscle tissue → It consist of branched striated fibres with one or two centrally located nuclei; Involuntary control.

- Heart wall
- Pumps blood to all parts of the body.



(C) Smooth Muscle tissue → It consist of spindle shape, thickest in centre or tapering at both ends, non striated fibres with one centrally located Nucleus; Involuntary Control

- In iris of the eye, Blood vessels, lungs, stomach, gall bladder, intestine, urinary bladder
- Moving → [constriction of blood vessels & airways, propulsion of food through GI tract, contraction of urinary bladder and gall bladder].



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(4) Nervous Tissue

Nervous system is composed of neurons (nerve cells) & neuroglia (protective & supporting cells)

Neurons consist of a cell body process extending from the cell body (multiple dendrites & single axon).

Neurogangliá do not generate or conduct nerve impulses but have other important supporting functions.

- Nervous system.

⇒ exhibit sensitivity to various types of stimuli, converts them into nerve impulses (action potentials) and conducts nerve impulses to other neurons, muscle fibres or glands.