SECTION-I

CELL BIOLOGY

CHAPTER-1
CELL STRUCTURE AND FUNCTIONS

Science Titbits

During centrifugation the bigger particles sediment faster and have higher sedimentation coefficients (Svedberg, or S values) Sedimentation coefficients are, however, not additive Sedimentation rate does not depend only on the mass or volume of a particle, and when two particles bind together there is inevitably a loss of surface area Thus when measured separately they will have Svedberg values that may not add up to that of the bound particle This is notably the case With the ribosome. Ribosomes are most often identified by their sedimentation coefficient .For instance, the 70 S ribosome that comes from bacteria has actually a sedimentation coefficient of 70 Svedberg, although it is composed of a 50 S subunit and a 30 S subunit

Teacher's Point

Teachers would demonstrate all the techniques used in cell biology or show fiims/slldeshow on screen or monitor of computer.

QI- What are the major differences between animal cell and plant cell?

Ans.' Differences between Animal Cell and Plant Cell:

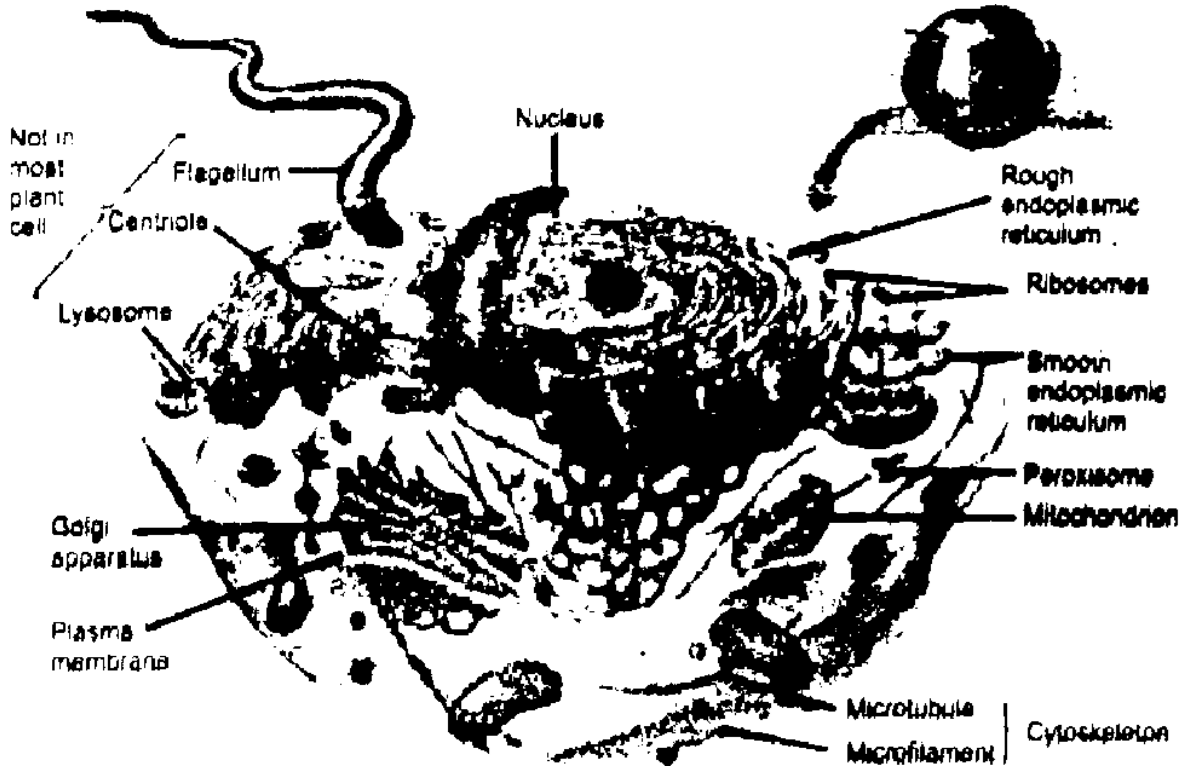
	Animal Cell	Plant Cell

cell wall	A cell membrane is the outer most boundary of an annal cell Ceil wall is absent	A cell wall IS the outer most boundary & a plant cell.
Centrioles	Centnoles are present In annal and lower plant cells	Centrioles are absent In higher plant cells
Vacuoles	An animal cell may contain numerous small srzed vacuoles	A plant cell has one or few large sized vacuole
Position of Nucleus	The position of nucleus IS usually central	Due to a large vacuole nucleus is pressed aside towards the cell membrane
Plastids	There are no plastids In ansmal cet! and hence they cannot manufacture their own food material	Plastids are present In plant cells and hence they can manufacture their own food material.

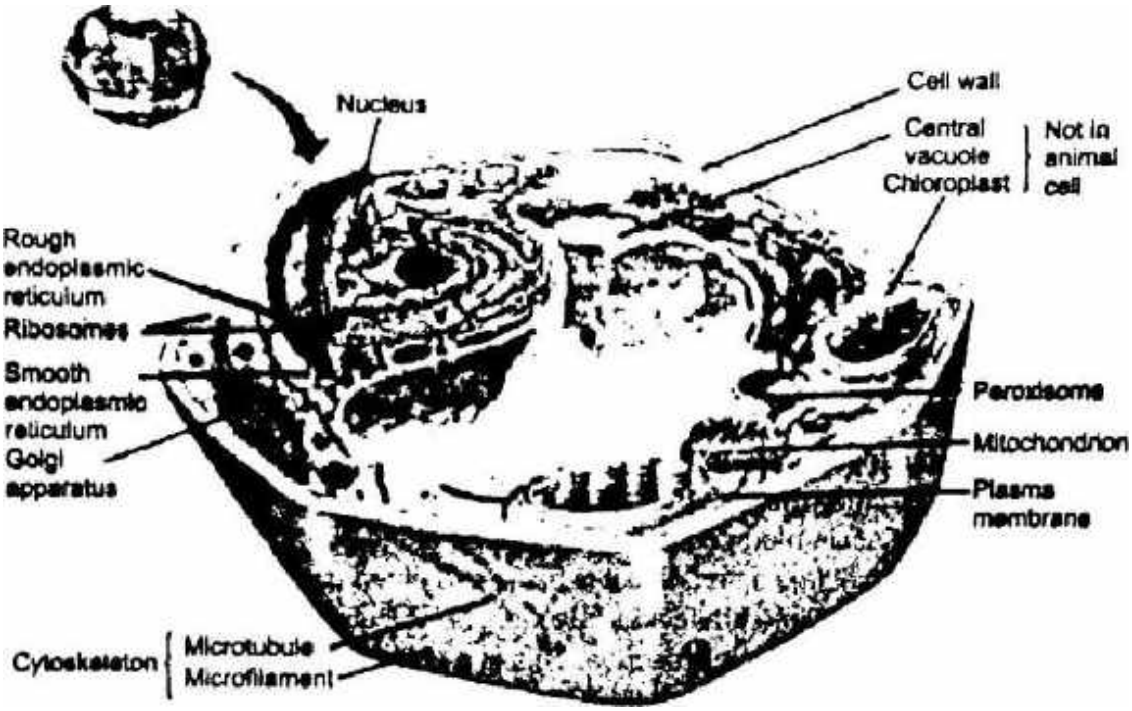
OR Second Answer

Plant Cell	Animal Cell
1. The are iar er In size	I. The are smaller in size.
2. Cell wail 's present	2. Cell wall is absent
3. Lysosomes are absent or very few in number	3. Lysosomes are larger in number
4. Plastids are present	4. Plasttds are absent
5. Subunits of Golgl bodes known as dict osomes are present	5- Prominent Golg' bodies are present
6. Vacuoles are lar er In size	6 Vacuoles are smaller in Size

Q2. Draw the electron microscopic structure of both animal and plant cells. Ans:



Electron microscopic structure of an animal cell



Electron microscopic structure of a plant cell

Q3. What is the difference between cell wall and plasma membrane?

Ans: Difference between cell wall and plasma membrane:

1. Cell membrane is also known as plasma membrane or plasma lemma cell wall IS not.
2. Cell membrane IS found In annal cells and cell wall In plant cells
3. Cell wall covers the cell membrane and forms the outer covering.
4. Cell membrane IS partially permeable but cell wall IS completely permeable.
5. Cell membrane do not contain cellulose cell wall does.
6. Cell wall is elastic, cell membrane IS not
7. Cell wall controls turgidity of a cell, plasma membrane does not.
8. Cell wall made up of peptidoglygan is present tn bacteria.
9. Celi wall made up of chitin is present in fungi.
10. Cell wall is metabolically inactive but cell membrane is metabolically active
11. Cell wall protects the shape of the cell ang maintains it while cell membrane protects the cytoplasm and osmotic balance In a cell.

OR Second Answer)

Basis for Com arison	Plasma Membrane	Cell Wall
Meaning	Plasma Membrane IS a delicate. thin structure of around 5-1 Onm Wide and ts vtslble under electron microscope and it IS present In all types of cell helps In the passage of molecules and rotects the roto lasm	Cell Wall is a thick r191d structure of around 4-20um Wide and ES VISIble under light microscope, it IS present In plant cell bacterial and fungal cell helps in providing sha e and rl Idit to the cell
Presence	Plasma Membrane IS present In all types of ceils	Cell Wall IS present In the plant cell, bactena, fungi and al ae
Composition	Made up of lipids and proteins and carbohydrates	Made up of cellulose (plant cell) chitin (fungi) and e tido I can bacterta

Structure	Thin layers and IS visible only through the electron microsco e	Thick layers which are visible through the light mtcrosco e.
Permeabili	Semi-permeabie	Completely permeable
Receptors	Plasma membrane have receptors helps in cell-cell communication	Cell wall does not have receptors
Metabolic Function	MetabolicaHy active and living	Inactive and non-ltwng
Thickness	Same thickness throughout Its life	Thickness grows with life
Nutrition	Need proper nutrition to survive	Doesn't need any nutrition from cell but deposition instead
Functions	1. protects protoplasm 2. It separates the components present Inside to outside enwronrnent 3. Helps cell-cell communication 4. It allows the passage of molecules.	Ii Cell wall provides rigidity to the cell, protect the cell from external shock and other mechanical forces 2.. It is responsible for cell morphology 3. It prevents large molecule to enter into the cell. 4. Also, prevent the cell from being toxic 5. Helps lh maintaining the osmotic environment of the cell

Q4. What is cell wall?

Ans: cell Wall:



The plasma membrane is the outer living boundary of the cell Many cells have an extracellular component that ts formed extertor to tne membrane which IS called cell wall.

The cell wall is present in plant cells prokaryotes and fungi but antmat Crisscross arrangement of microfibrils cells do not have cell wall This is probably due to their iocomotor mode of life Plant cell walls differ tn chemical composition from (hose of the prokaryotes (tnaae up ot peptidoglycan or muretn) and fungi (made up of chitin).

We will dISCUSS here only plant cell wall The cell wall ts secreted by the cell The plant cell wall conststs of three main layers, primary cell wall middle lamella and secondary cell wall

Critical Thinking

Is plant cell wall permeable, semipermeable or impermeable boundary? Ans: Cell Walls (in plants fungi and prokaryotic cells) are permeable, and surround the Cell Membrane (which is selectively (or semi-) permeable).

OR (Second Answer)

An example of a permeablp membrane in nature is the cell wall in plant cells Cell walls provide support and protection for plant cells They are fully permeable to water. molecules. and protetns This allows water and nutrients to be freely exchanged between the plant cells.

Science Titbits

Pectin is a polymer of around 200 galacturomc acid molecules Majority of Its carboxyl groups are methylated (COOCH3) It IS less hydrophilic then pectic acid but soluble in hot water It IS another major component of middle iameåa but a so founa In •primary walls.

Science Titbits

Pectic acids are polymer of around 100 galacturontc acid molecules These are very hydrophilic and form salts with Ca^{t*} and Mg^{tt} that are Insoluble gels These are mapr components of middle lamella but also found in primary walls.

Critical Thinking

Why the cell surface membrane is described as fluid mosaic?

Ans: The Fluid Mosaic Model states' that membranes are composed of a Phospholipid Bilayer with various protein molecules floating around within it. The 'Fluid part represents how some parts of the membranecan move around freely, if they are not attached to other parts of the cell.

OR (Second Answer)

It IS sometimes referred to as a fluid mosaic because it has many types of molecules which float along the lipids due to the many types of molecules that make up the cell membrane The laqwd part IS the lipid bilayer which floats along the lipids due to the many types ot molecules that make up the cell

Teacher's Point

Teachers would cut a section of stem to show the components of plant cell wall under high power of a microscope.

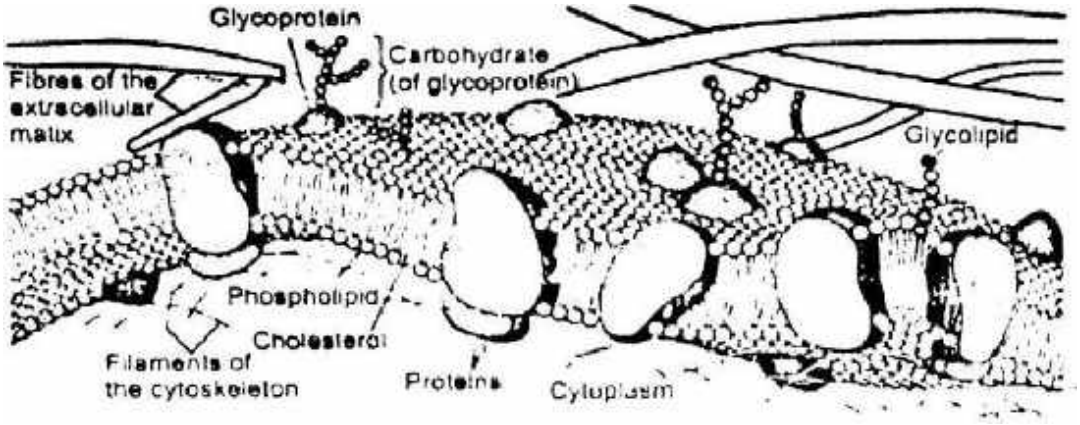
Science Titbits

The fluidity of membrane dependent on Its lipid components Including phospholipids, glycohptds and cholesterol

Skills: Analyzing, Interpreting and Communication

Draw and label fluid mosaic model of plasma membrane.

Solution:



Fluid mosaic model of plasma membrane

Teacher's Point

Teachers would demonstrate the structure of plasma membrane With the help of a model.

Q5. Define protoplasm.

Ans: Protoplasm:

The tiVlng matter of a cell IS called protoplasm In eukaryotic cells It can be dtvided Into two parts I.e cytoplasm and nucleus .Q6. Define cell organelles.

Ans: Cell Organelles:

In a eukaryotic cell, the cytoplasm contains highly organized discrete structures which are specific for various cellular functions are called cell organelles. The cell organelles are generally enclosed by the membrane except few such as ribosome.

The organelles in the cytoplasmic matrix of a cell are: endoplasmic reticulum, ribosomes, Golgi complex. peroxysomes glyoxysomes, lysosomes mitochondria. and chloroplasts etc .Q6. Define cytoplasmic inclusions.

Ans: Cytoplasmic Inclusions:

The nonlivtng granules of storage or waste compounds of the cell that do not possess metabolic activity and are not bounded by membranes are called cytoplasmic inclusions

.The most common inclusions are glycogen, lipid droplets crystals and pigments.

Q7. Write a note on vacuoles,

What is the role of the vacuole in a cell?

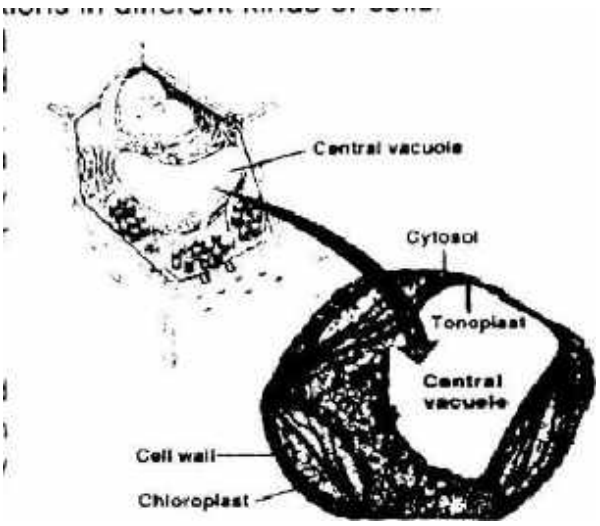
What is the main function of the vacuole in a cell?

Ans: Vacuoles:

Vacuoles are large vesicles on§inate from the endoplasmic rettculum and Golgi complex and plasma membrane.

Role Of the vacuole/ Function of the vacuole:

Vacuoles perform a variety of functions in different kinds of cells In young plant cells, many small vacuoles are present which can hold reserves of important organic compounds These vacuoles may also help in protection of plant against herbivores by storing compounds that are poisonous or unpleasant in animals.



Vacuole of a mature plant cell

Food Vacuoles:

The Ingested food of cell IS stored In vesicles, called food vacuoles In annal cells food vacuoles. formed by phagocytosis.

Contractile Vacuoles:

Many freshwater protlsts have contractile vacuoles that pump excess water out of the cell, thereby maintaining a suitable concentration of ions and molecules inside the cell .Central Vacuole:

Mature plani cells generally contan a large central vacuole develops by the coalescence of smaller vacuole Cell Sap:

The solution inside the central vacuole called cell sap is plant cell s matn reservoir of inorganic ions, including potassium and chloride .Tonoplast:

The membrane separating the vacuole from cytoplasm is called tonopiast.

The central vacuole plays a major role in mechanical suppoct by maintaining turgor and also acts a store house of the cell.

Science Titbits

Mitochondrta and chloroplasts display similarities with bacteria like both are self-replicating organelles, both have their own genetic system and metabolic machinery i.e , both has small circular DNA, all kinds of RNA and ribosomes (70S) . An Interesting fact about them is that they are capable to survive outstde the cell In artificial medium if carefully fractionated Based upon these observations evolutionists believe that they were Independent organism and the early ancestor of eukaryotic cells engulfed them Eventually, the engulfed cells formed a relationship with the host cell in which they were enclosed, becoming an

endosymbiont (a cell living within another cell) Therefore they are supposed as organisms within organism.

Science Titbits

Mitochondria divide and In this way their number doubles before cell division Lysosomes regulate the number of mitochondrta Excess of mitochondria are digested by Lysosomes. Because mitochondria are •contaned within ova (egg cells) but not within the heads Of the sperm cells. the mitochondria in a fertilized egg are denved from mother.

Q8. What are plastids? Explain the types of plastids.

What are the different types of plastids? Ans:

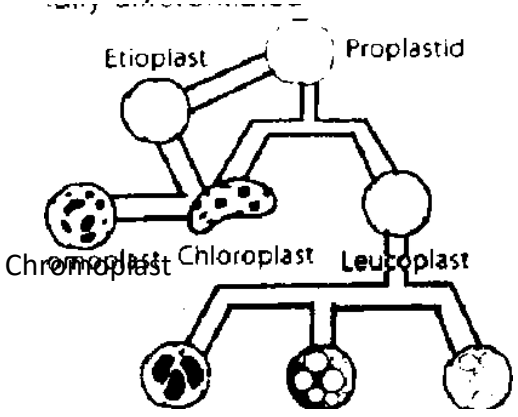
Plastids:

Plastids are found in plant and algal cells. and they are necessary for essential life processes. like photosynthesis and food storage Classification of Plastids:

On the basis of presence or absence and type of pigments, and the stage of development, plastids have been classified Into proplastids leucoplasts. chromop'asts and chloroplasts .Proplastids:

Proplastids are young, Immature and developing plastíds They are self — replicating organelles They divide and re-divide in menstematic cells and are distributed to different cell types Depending upon the structures In which they found, the intracellular factors and on exposure to light. they may develop into leucoplast (colourless plastids) or chloroplast (green plastids) .Etioplast:

Etioplast IS a type of leucoplasts which on exposure to light develop Into chloroplast Similarly chloroplasts may become leucoplasts, but coloured•plastIds as in petals are mostly terminally differentiated



Amyloplast Elaiopiast Proteinoplast Types of plastids

Leucoplasts:

Leucoplasts are found In parenchyma cells of root stem and seeds They act as storage organelles. Based on the kind of substance they store they are further classified Into amyloplasts (store starch), elaioptast (store lipids) and proteinoplast (store protein).

Chromoplasts:

Chromoplasts synthesize and store different coloured pigments other than green Therefore, they are found in coloured parts of plant such as flower petals and fruit wall where they attract Insects and thus help In pollination Chloroplasts:

Chloroplasts are found in green parts of the plants and act as Site of photosynthesis.

Teacher's Point

Teachers would demonstrate thylakoids with the help of a model.

Science Titbits

In muscle cells the microfilaments are called myofilaments which are of twc different types i.e , thin and thick myofilaments The thin filaments are actin filaments while the thick filaments (16pm thick) are composed of another protern. the myosin; therefore, they are also called myosin filaments.

Teacher's Point

Teachers would demonstrate the three types of cytoskeleton by making model, using string and beads of different colours .Q9. What is nucleus?

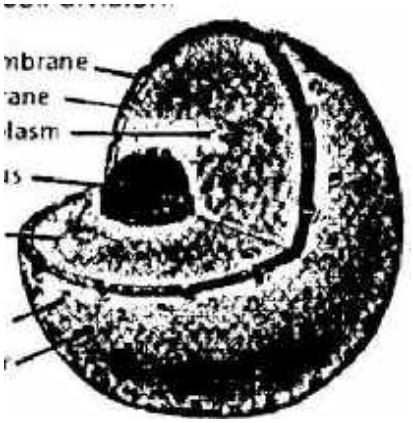
Ans: Nucleus:

Nucleus IS the most prominent and the most important part of a cell. In animal cells it is found jn the centre (With exception of muscle fibre cells) but In adult piant cell it is slightly away from the centre due to the presence of a large central vacuole A typical eukaryotic nucleus consists of nuclear envelope, nucleoplasm. nucleoli and chromatin.

QIO. Write a note on Nucleolus.

Ans: Nucleolus:

Nucleolus, (plural: nucleoli) is a non-membrane bound structure in the nucleoplasm, A cell may have one or more nucleoli Nucleolus appears during interphase and disappears during cell division



Nucleolus

A nucleolus consists Of a peripheral granular area (contains ribosomal subunits) and a central flbrller area (contains rRNA and rDNA) Therefore nucleolus IS Involved in the construction of ribosomes

Science Titbits

Seve tube cells tn plants and red blood cells in human are exceptional living

- cells that do not possess nucleus, On the other hand some cells have more than one nuctei i e.. binucleate or dikaryottc cells (cells having two nuclei) and multinucleate or coenocytic cells (cells having many nuclei).

Science Titbits

Plasmids are Important vectors In modern genetic engineering techntques Plasmids also occur In lower eukaryotes eg . yeast Several different types Of plasmids can exist In one cell Transmissible plasmids can be transferred from ceil to cell by conjugation Nontransrnsslble plasmids are small; they are frequently present In many copies per ceil

QII. How bacterial cell division occurs?

What do you know about binary fission?

Ans: Bacterial Cell Division:

Bacteria are rapidly growing organisms They divide by a specialized kind of cell dtvlSlOn known as binary fission This IS a direct cell division in which no spindle fibres are formed In order to distribute nuclear contents between the daughter cells This is very much different from eukaryotic cell divisions i.e , mitosis and meiosis.

Skills: Analyzing, Interpreting and Communication

- Compare and contrast the structure and function of mitochondria with those of chloroplasts.

Solution: See Q#41 from (Extensive Questions)

- Compare in tabular form, the functions of organettes with the processes occurring in animals and plants.

Solution: Organelles of Eukaryotic Cells:

Below is a list of or anelles that are commont found In eukar otic cells

O anelle	Function
Nucleus	The "brains" of the cell, the nucleus directs cell activities and contains genetic material called chromosomes made of DNA
Mitochondria	Make ener y out of food
Ribosomes	Make protein
Gol i A aratus	Make process and package proteins
L sosome	Contains digestive enzymes to help break food down.

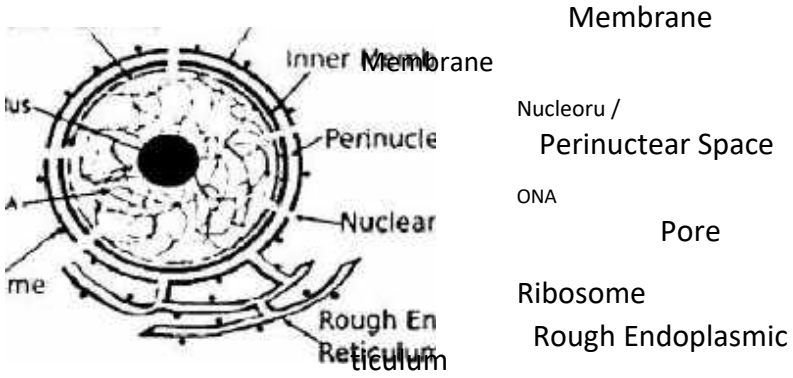
Endoplasmic Reticulum	Called the "Intracellular highway" because It IS for transporting all sorts of Items around the cell.
Vacuole	Used for storage, vacuoles usually contain water or food
Plant cells also have:	
Chloro lasts	Use sunlight to create food b photos nthesis
Cell Wall	For sup ort

- List the structure and molecules, which can cross the nuclear envelope.

Solution:

Nuclear pores are large protein complexes that cross the nuclear envelope.

There are numerous pores in nuclear envelope called nuclear pores which are composed of a specialized transport protetn called nucleoporin.



Nuclear envelope

At the pont of nuclear pore both the membranes are Interconnected These pores regulate the nucleo-cytoptasmic exchange of materials This exchange Includes RNA and ribosomal proteins moving from nucleus to the cytoplasm and proteins (such as DNA poiymerase) carbohydrates signaffing and lipids moving Into the nucleus Although smaller molecules simply diffuse through the pores, larger molecules may be recognized by specific Signal sequences and then be diffused With the help of nucleoporin Into or out of the nucleus.

Activity

1. Measure the size of paramecwm pollen grains, hair etc by micrometry
2. Prepare and examine the Slides of annal and plant cells using diftele:žnttal staining

EXERCISE

MCQs

1. Select the correct answer.

(i) Which of the following is the major advantage of using a light microscope instead of an electron microscope?

(A) superior resolving power (C) constant depth of focus

(ii) So observation of hvjng matter (D) use of very thin sections Some cellular organelles are bound by a single membrane, while other organelles have two membranes (envelopes) around them. Which one of the followin is correct?

	Sin le membrane	Double membranes
	erox somes. I sosome	nucleus, chloro tast
B)	chloroplast, I sosome	nucleus, erox somes
(C)	nucleus chloroplast	I sosome, perox somes
(D)	nucleus sosome	chloro last, erox somes

(iii) Which of the following cell structures contains the highest concentration of RNA?

(A) centnole (B) lysosome
(C) chromosome (D) nucleolus

(iv) A tadpole's tail is gradually broken down during metamorphosis into an adult frog. Which organelle increases in number in the cells of the tail at this time?

(A) centriole (B) endoplasmic reticulum (C) Golgi complex (D) lysosomes

(v) Whlch of the followlng organelles always contalns DNA?

(A) centriole (B) Golgi complex (C) lysosome (D) mitochondria

vi Which distinguishes a prokaryotic cell from a eukaryotic cell? (A) prokaryotic ceit have a cell wall and a nucleus

(B) prokaryotic cells have no membrane bound organelles

(C) prokaryotic cells have a centrtole

(D) prokaryotic cells have no ribosomes

(vii) The elasticity of the plasma membrane demonstrates that it is made up in part of

(A) lipids (B) nucleic acids
(C) carbohydrates (D) proteins

(viii) Filaments present in flagella and cilia are

(A) microflbrlls B microtubules
(C) microfilaments (D) microvillt

(ix) wrncn ot the following structure is found in all living organisms:

(A) cell membrane (B) nucleus (C) lysosome (D) vacuole

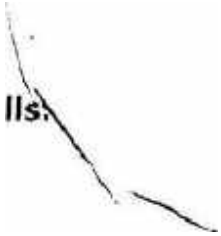
(x) The cell wall of plant cell is different from that of pr&aryotes in:

(A) both structure and chemical compositton

(B) structure only (C) chemical composition only

(D) number of layers only

(xi) Which of the following are present in prokaryotic cells



(A) chloropÎast. DNA, nuclear envelope

(B) chromosomes, mitochondria, nuclear envelope (C) cytoplasm, DNA, mitochondria (D)cytoplasm, DNA. ribosome

(xii) Which of the following is present in alh eukaryotic cells:

A cell wall (B)diptord nucleus (C)flagellum

(D) membrane bounded organelles

(xiii) Which of the following would be more prominent in a secretory cell than nonsecretory cell:

(A)lysosome (B) Golgl compiex

(C) mitochondrion fibosome

(xiv) When a glycoprotein is being synthesized for secretion from a cell, which route is it most likely to take? (A) Golgi complex RE-R—SER

(B) RER—Colgl complex—SER

(C) RER→SER→Golgi complex

(D) SER—Colgi compiex—RER

(xv) Which one of the following is responsible for cyclosis?

(A) microtubule (B) microfilament

(C) Intermediate filament (D) - none of them

Answers

(i) C	(ii) A	(iii) D	(iv) D	(v) D
(vi) B	(vii) A	(viii) B	(ix) A	(x) C
(xi) D	(xii) D	(xiii) B	(xiv) C	(xv) B

—E9UEST10NS

2. Name three organelles reveaed by an electron microscope.

Ans: The organelles In the cytoplasmic matrix of a cell are endoplasmic reticulum, ribosomes, Colgt complex, Peroxysomes, glyoxysomes lysosornes mitochondria, and chloroplasts etc

3. Why cell wall is not present in animal cells?

Ans: The cell wall is present in plant cells, prokaryotes and fungi but annal ceils

do not have cell wall This is probably dL•e to their locomotor mode of life

(ix) wrncn ot the following structure is found in all living organisms:

(A) cell membrane (B) nucleus (C) lysosome (D) vacuole

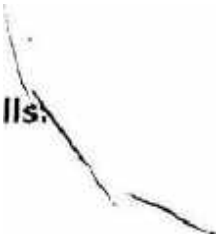
(x) The cell wall of plant cell is different from that of pr&aryotes in:

(A) both structure and chemical compositton

(B) structure only (C) chemical composition only

(D) number of layers only

(xi) Which of the following are present in prokaryotic cells



(A) chloropÎast. DNA, nuclear envelope

(B) chromosomes, mitochondria, nuclear envelope (C) cytoplasm, DNA, mitochondria (D) cytoplasm, DNA. ribosome

(xii) Which of the following is present in alh eukaryotic cells:

A cell wall (B) diptord nucleus (C) flagellum

(D) membrane bounded organelles

(xiii) Which of the following would be more prominent in a secretory cell than nonsecretory cell:

(A) lysosome (B) Golgl compiex

(C) mitochondrion fibosome

(xiv) When a glycoprotein is being synthesized for secretion from a cell, which route is it most likely to take? (A) Golgi complex RE-R—SER

(B) RER—Colgl complex—SER

(C) RER→SER→Golgi complex

(D) SER—Colgi compiex—RER

(xv) Which one of the following is responsible for cyclosis?

(A) microtubule (B) microfilament

(C) Intermediate filament (D) - none of them

Answers

(i) C	(ii) A	(iii) D	(iv) D	(v) D
(vi) B	(vii) A	(viii) B	(ix) A	(x) C
(xi) D	(xii) D	(xiii) B	(xiv) C	(xv) B

—E9UEST10NS

2. Name three organelles reveaed by an electron microscope.

Ans: The organelles In the cytoplasmic matrix of a cell are endoplasmic reticulum, ribosomes, Colgt complex, Peroxysomes, glyoxysomes lysosornes mitochondria, and chloroplasts etc.

3. Why cell wall is not present in animal cells?

Ans: The cell wall is present in plant cells, prokaryotes and fungi but annal ceils

do not have cell wall This is probably dL•e to their locomotor mode of life.

4. What nølds the ribosomes together in a polysome?

Ans: The attachment IS controlled by presence of magnestum ions concentration or forming salt bRnds between phosphate group of RNA and amano group of amino acid or both by hagnesium Ions and sa\t bonds Both ribosomal subunits are generally attachec together at the time of thetr function (translation) The ribosomes are Involved in ne events of protein synthesis (translation), Sometimes during prote.n synthesis, several ribosomes are attached to one mRNA molecule Such a chan of many rùosomes is called polysome or polyribosomes In this way several copies of same polypeptide can be produced in very less time.

So. q)RNA holds together the ribosomes In a polysome.

5. HOW and where lysosomes are formed in the cell?

Ans: The hysosomal enzymes are manufactured on the RER Then these Z enzymes are transported to Golg, complex through SER. After modificatlon, these enzymes are released from Cola, complex in the form of vesicles Such vesicles are called lysosomes.

6. What are lysosomal storage diseases? Give example.

Ans: Lysosomal Storage Diseases:

Lysosomes contan various digestive enzymes if a particular lysosomal enzyme IS missgng In an individual. the digestion of that particu'ar substance (for whtch enzyme was spec:fic) Will be affected As a result, the substance begins to accumulate In the cell and cause different problems. Such complications which are caused by the accumulation of various substances in the cell due to lack of certain lysosomal enzymes are called lysosomal storage diseases.

These diseases are hereditary and congenital therefore run in particular farnhes and exlSt 5y birth In an individual Most of these diseases are fatal in early childhood About more than 20 such diseases have been discovered so far Example:

One of the common examples Tay-Sachs disease in which a lipid digesting enzyme is missjng or Inactive and the brain becomes impaired by an accumulation of lipids in the cell.

7. What would happen if there are no lysosomes in human cells? Ans: Lysosomes are the membrane-bQund vesicles, which contan digestive (hydrolytic). enzymes like acid hydrolase ihey digest a variety Of substances Including worn out organelles, food particles, Viruses, ana Dactena. If there were no lysosomes in the human cell, it will not be æle to digest food and there would be accumulation of wastes like worn out parts irstde the human cell. Thus, human cell will not be able to survlve.

OR (Second knswer)

If Lysosomes weren't present In the human cell wore out organelles and proteins would go wasted, the Lysoscrnes are there to reprocess wore out organelles and such, without them human would eventually die.

8. Why lysosomes are called suicide bags?

Ans: Because lysosomes contain large number of enzymes which can digest forežgn particles that enter the celi This process IS called autolysis This occurs while enzymes are released. Killing Itself s called suicide, so they are called suicidal bags of cell

9. Name the structures and organelles which are cc..mmon in plant cell, animal cell and a prokarytic cell.

Ans: There are three structures and organelles whlch are C6frrnon in plant cell anmai celi and a prokarytlc cell.

- Cell Membrane Cytop'asm Ribosome

10. How is a chloroplast similar to a bacterium?

Ans: Mitochondria and chloroplasts display similarities W'th bakierta like both are self-replicating organelles, both have ther own genefic syste and metabolic machinery both has small circular DNA, all kinds of RNA and rib omes (70$frx

An interesting fact about them that they are capable to survi tsd<he cell in artificial medium rf carefully fractionated

Based upon these observations evolutionists believe that they independent organism and the early ancestor of eukaryotic cells engtdfed them.

Eventually, the engulfed cells formed a relationship With th host cetl In which they were enclosed becoming an endosymbtont (a cell living w In another cell) Therefore, they are supposed as organisms '"thin organism.

OR (Second Answer)

Mitochondria and chloroplasts have striking Fim'larlties to bacteria cells.
They have their own DNA, which js separate from the DNA found 'n the nucleus of the ceil And both organelles use thetr DNA to produce many proteins and enzymes required for their function.

11. Name the organelles of eukaryotic cell and write their specific functions.

Ans: Organelles of Eukaryotic Cells:

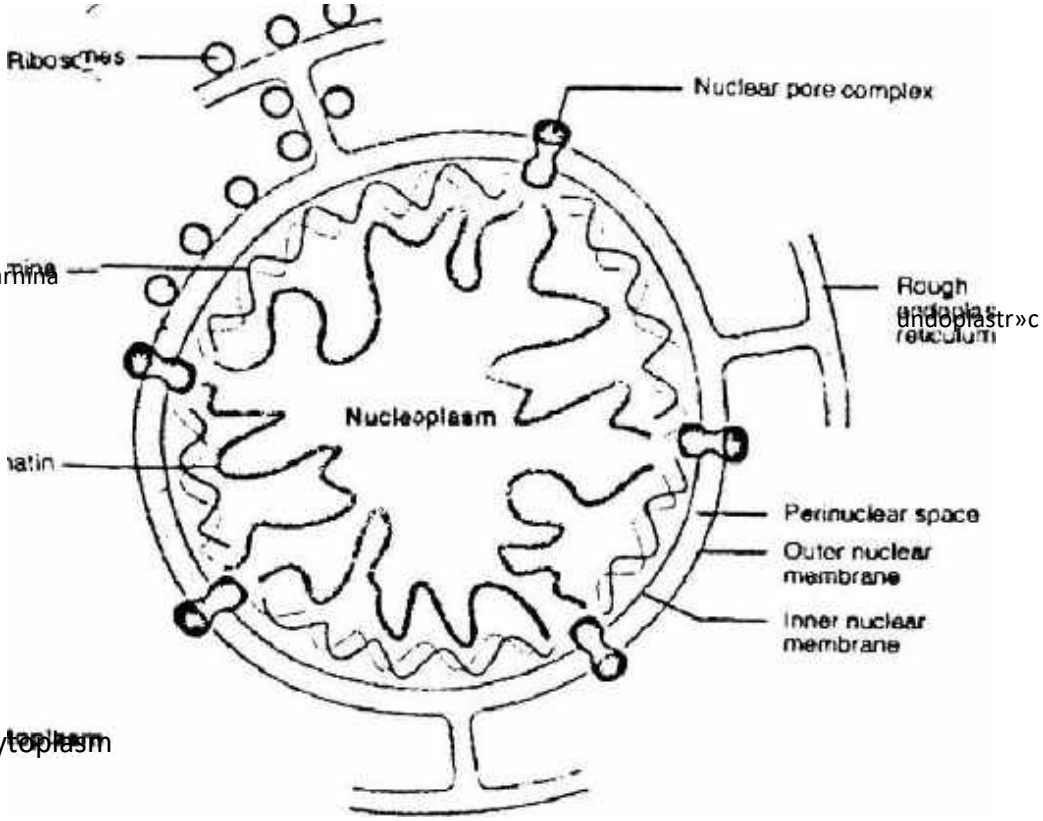
Below is a list of or anelles that are commonl found in rygzzells.

O anelle	Function
Nucleus	The "brains" of the cell, the nucleus directs celi activities and contains genetic materia! chromosomes made of DNA
Mitochondria	Make energy out of food
Ribosomes	Make protan
Gol i A aratuS	Make, process and package proteins
L sosome	Contains digestive enzymes to help break food down
EndnoJasmic Reticulum	Called the "intracellular highway" because It is for transporting all sorts of Items around the cell
Vacuole	Used for storage, vacuoles. usually contain water or food
Plant cells also have:	
Chloro lasts	Use sunlight t create food by photosynthesis
cell Wall	For support

12. List the structure and molecules, which can cross the nuclear envelope.

Ans: Nuclear pores are large protan complexes that cross the nuclear envelope

There are numerous pores in nuclear envelope called nuclear pores which are composed of a specialized transport protein called nucleoporin



Ni.øear

C nromatin

N uclear envelope

At the point of nuclear pore both the membranes are interconnected These pores regulate the nucieo-cytoplasmc exchange of materials This exchange includes RNA and ribosomal proteins moving from nucleus to the cytoplasm and proteins (such as RNA polymerase), carbohydrates, stgnalhng and lipids moving into the tnucéus ÀÏtfrough smaller molecules Simply diffuse through the pores, larger molecules may be recognized by specific signal sequences and then be diffused With the help of nucleopertn into or out of the nucleus.

13. Why do eukaryotic cells need both membranous organelles and fibrous cytoskeleton ççmponents?

Ans.'

- Eukaryotic cells are cells With a memtrane bound nucleus These cells have Intricate transport system to carry food a-td Information between otganetles ♦ Prokaryotes do not have membrane b01nd nuclei and therefore do not have intricate transport systems Rather nutrients just slush around at the whim of Brownian motion.
- Eukaryotes need membranous organees in order to compartmentalize the various functions of the cell
- Eukaryotes also need fibrous cytoskeletal components to hold the cell in place By holding the organelles in .)lace the eukaryotic cell IS able to facilitate transpon.

OR (Second Answer)

Eukaryotes need membranous organelles 'in order to compartmentalize tne various functions of the cell Eukaryotes also reed fibrous cytoskeletal components to hold the cell In place By nolding the organeles in pace the eunar yollC ceti IS able to facilitate transpon.

14. What are prokaryotic cells? List the structures missing in prokaryotic cells.

Ans: Prokaryotic Cells:

Prokaryotic cells include archaea, bacteria and cyanobacteria whereas all other forms of life are composed of eukaryotic cells.

Prokaryotic cells are cells that do not have a true nucleus or most other cell organelles. Organisms that have prokaryotic cells are unicellular and called prokaryotes.

Structures Missing in Prokaryotic Cells:

A prokaryotic cell lacks definite membrane bounded nucleus and other organelles Its DNA IS dispersed In cytoplasm.

Nucleus, endoplasmic retjculum, Coly complex mitochondrion, lysosomes nucleolus chloroplast cytoskeleton. 80S ribosomes (larger) and flagella or Cllga which are made up of microtubules All these structures are misstng In prokaryotes.

15. Differentiate between the patterns of cell division in p+okaryotic and eukaryotic cells.

Ans: Cell division simpler in prokaryotes than eukaryotes because prokaryotic cells themsewes are simpler.

- Prokaryotic cells have a stngle circular chromosome no nucleus. and few other organelles
- Eukaryotic cells. tn contrast, have muftiple chromosomes contaqned within a nucleus, and many other organelles

16. Compare microfilaments and microtubules. Ans:

	Microfilaments	Microtubules
Structure	Double Helix	Helical lattice
Size	7 nm In diameter	20-25 nm in diameter
Composition	Predominantly composed of contractile protein called actin.	Composed of subunits of protein tubulin These subunits are termed as alpha and beta
Strength	Flexible and relatively strong Resist buckling due to compressive forces and filament fracture by tensile forces	Stiff and resist bending forces.
Function	Micro-filaments are smaller and thinner and mostly help cells move	Microtubules are shaped stmilarly but are larger. and help with cell functions such as mitosis •and various cell transport functions

17. Why ER is present in all eukaryotic cells but not in prokaryotic cells?

Ans: Eukaryotic cells are large tn size Therefore they develop endoplasmic reticulum for transportation and support.

Unlike eukaryotic cells prokaryotic cells do not have a cell nucleus or any membrane-bound organeiles such as mitochondria Therefore neither the DNA of prokaryotic cells nor any of the Sites of metaboirc activity within a prokaryotic cel' are enclosed by a separate membrane.

18. What organelles are single membrane bound, double membrane bound and lacking any membrane?

Ans: Celi O:ganelles are organ like each performing specific function/s but formed of mclecules and membranes only (sub- cellular) .Double Membrane bound Organelles:

Mitochondria, Ch!oroplasts, Endoplasmtc Reticulurn. Golgi Body, and Nucleus .Single Membrane bound Organelles:

Vysosomes Peroxisomes, Vacuoles Organelles

lacking any membrane:

Ribosomes, Centroles, Nucleolus

19. How cytoskeletons are important to eukaryotic cells?

Ans: The eukaryotic cytoskeleton is made up of a network of long, thin protan fibers and has many functions It helps to matntan cell shape it holds organelles in place and for some ceils, it enables cel! movement.

The cytoskeleton also plays important roles in both the Intracellular movement of substances and In cell davislon Certain proteins act like a path that vesicles and organelies move a!ong within the ceil The tnreadllKe proteins tnat make up the cytoskeleton continuaily rebuild to adapt to the cell's constantly changing needs Three main kinds of cytoskeleton fibers are microtubules , intermediate filaments, and microfilaments.

OR (Second Answer)

It forms a framework for the movement of organelles around the cytoplasm most of the organelles are attacned to the cytoskeleton The network consists of protein microfilaments Intermediate filaments, and microtubules'.

The cytoskeleton provides an important structural framework for Cell shape.

20. Compare the chemical composition of nucleoplasm 4k'ith that of cytoplasm.

Ans: Nucleoplasm is the transparent semifluid ground substance formed of a mixture Of proteins, enzymes (DNA and RNA polymerase) free nucleotide and some metal ions (Mg) for the synthesis of DNA and RNAs. It also contains histone and non-histone protein. So the nucleoplasm is slightly different from cytoplasm .21. Explain that nucleoli are the areas where ribosomes are assembled. Ans.' The genes that encode ribosomal proteins are transcrlbed outside of the nucleolus by RNA polymerase Il Yielding mRNAs that are translated on cytoplasmic ribosomes The ribosomal proteins are then transported from the cytoplasm to the nucleolus where they are assembled With rRNAs to form preriboscmal particles

22. Define/ Desèribe/ Explain briefly:

cell theory, homogenization, centrifugation, density gradient centrifugation, differentiat centrifugation, pellet, supernatant, differential staining, microdissection, chromosomal microdissection, laser microdissection, tissue culture, chromatography, paper chromatography, ch romatog ram, chromatography chamber, electrophoresis, spectrophotometry, absorption spectrum, resolution, magnification, microscopy, micrometry, fluid mosaic model, antigen, cell surface maker, endoplasmic reticulum, rough ERF smooth ER, ribosomes, polysome, Golgi complex, lysosomes, primary tysosomes, secondary lysosomes, autophagy, autophagosomes, autolysis, lysosomal storage disease, peroxisomes, glyoxisomes, vacuoles, food vacuole, contractile vacuole, cell sap, tonoplast,

mitochondria, porins, ATP synthase, plastids, etioplast, leucoplast, amyloplast, elaioplast, proteinoplast, chromoplast, chloroplast, stroma, grana, thylakoid, inter grana, centriole, centrospheres, centrosome, mitotic apparatus, basal bodies, troponinr tropomyosin, myofibril, microfilament, nuclear envelope, nuclear lamina, nucleoplasm, nucleolus, chromosome, chromatin, centromere, nuclear organizer, satellite, junk DNA, telomeres, glycocalyx, slime layer, mesosomes, nucleoid, plasmid.

Ans: Cell Theory:

We are quite familiar With the word cell' I e , a basic unit of life. By the middle of the nineteenth century biologists had formulated cell theory which IS a fundamental concept in biology According to cell theory are as follows.

(1) The cell is the fundamental unit of structure and function in living thngs.

(2) All organisms are made up of one or more cells.

(3) Cells arise from other cells through cellular diwston.

(4) Cells carry genetic material passed to daughter cells during cellular division.

(5) All cells are essentially the same In chemical composition (6) Energy flow (metabolism and biochemistry) occurs within cells .Homogenization:

In cell bi6žpgy or molecular biology research homogenization is a process whereby a biological sample IS brought to a state such that all fractions of the sample are equal in composition.

It is the formation of a homogenous mass of ceils (cell homogenate or ceil suspension), It involves the grinding of cells In a suitable medium With correct pH .IGnlC composition, temperature and In the presence of certain enzymes that can break the cementing substance of cells.

For example pectinase which digest middle lamella among plant cells This can be done in a cell homogenizer (food mixer/blender) This procedure gives rise a uniform mixture of cells i e. , cert homogenate. The resulting mixture IS then centrifuged.

Centrifugation:

Centrifugation is the process to separate substances on the basis of their size and densities under the Influence of centrifugal force Et vs done by the machine called centrifuge

Density Gradient Centrifugation:

In density gradient centrifugation the components of different Sizes and densities are separated tn different layers (sediments) in the tube contanng

tonic medium according to the'r Size and densities The upper sediments have smaller and less dense components than lower sediments . Differential Centrifugation:

In differential centrifugation the sedimentation rate for a particle of a given size and shape measure how fast the particle "settles" or sedlments The faster the rotation of the centrifuge, the smaller the partjcles Will sediment .Pellet:

A series of increasing speeds can be used At each step, the content which make sediment in the bottom of the tube are called pellet. Supernatant:

Sediment that remains suspended above the tube In the form of liquid are catted supernatant.

OR

The soluble liquid fraction of a sample after centrifugation or precipitation of Insoluble solids.

Differential Staining:

Most biological structures are transparent In order to differentiate between these structures vartous colour dyes are apphed Such techniques are called staining techniques.

When only one stain. such as borax carmine (that stains nucleus) IS used it IS called single staining When two stans one that statn nucleus e g haematoxylin and other that Will stain cytoplasm e.g. eosin are used, the process IS called double staining or differential staining.

OR

Differential Staining is a staining process which uses more than one chemical stain.

Microdissection:

Microdlssectton refers to the variety of techniques where a microscope IS used to assist in dissection It is done to remove turnour or granules from delicate tissue or cells like, brain, heart and nerve cells In this techniqud. the image IS seen on large TV screen or monitor while dissecting Different kinds of techniques involve mtcrodlssection I.e..

Chromosomal Microdissection:

It Involves the use of fine glass needle under a microscope to remove a portion from a complete chromosome .Laser Microdissection;

It Involves the use of a laser through a microscope to dissect selected cells .Tissue Culture:

Growth of a cell or a tissue on chemically defined nutrient medium under sterile conditions IS called tissue culture. This technique can be employed for both plants and animals.

Chromatography:

Chromatography is a technique which IS used to separate different chemical compounds from a mixtures It is generally used for the separation of mixtures of proteins amino acids or photosynthetic pigments.

Paper Chromatography:

Paper chromatography IS a simple and most widely used technique It Involves two phases I e stationary phase and mobile phase.

The mobile phase consists of a solvent in which mixture sample IS dissolved It IS passed through the stationary phase which consists of a filter paper Chromatogram:

When mobile phase travels through the stationary phase the molecules mixture sample begin to separate as dots at different places on stationary phase according to their Individual affinity Then the paper sprayed With-a liquid locating agent (staining dye) that shows up the dots as colours that can be seen- This paper IS called chromatogram and the apparatus IS called chromatography chamber

OR

A chromatogram essentially the output of a chromatography run It is an electronic file or hardcopy containing the Information generated during the chromatography run.

Chromatography Chamber:

When mobile phase travels through the stationary phase the molecules mixture sample begin to separate as dots at different places on stationary phase according to their Individual affinity. Then the paper IS sprayed With a hquld locating agent (staining dye) that shows up the dots as colours that can be seen This paper IS called chromatogram and the apparatus IS called chromatography chamber Electrophoresis:

Electrophoresis IS a technique used In laboratories In order to separate macromolecules based on stze The techntque applies a negative charge so protens move towards a positive charge This is used for both DNA and RNA analysis.

Spectrophotometry:

Spectrophotometry IS a technique which IS used to deterrnne the absorption of different wavelength of light by a particular chemical compound or a photosynthetic pigment.

Absorption Spectrum:

The amount of light absorbed at each wavelength is plotted tn a graph and the result is what we call the absorption spectrum In other words, absorption spectrum is a graph which shows the absorption of different wavelength of light by a

particular pigment .Resolution:

Our naked eye is capable to distinguish two points which have at least 0 1 mm distance This min mum capacity of a tens to d(Ìferentiate between two adjacent points IS called resolution power of the lens- Therefore. resolution of naked eye IS 0 mm.

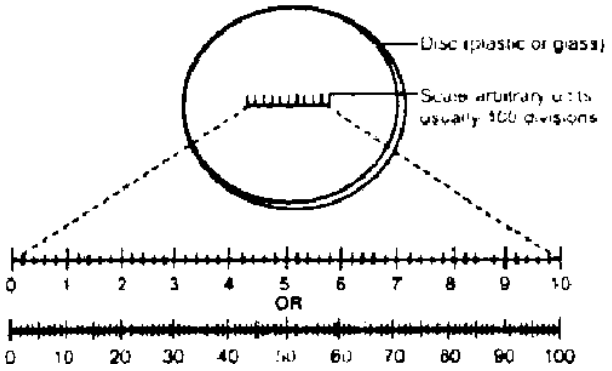
Magnification:

The magnification is the capacity of an optical instrument to increase the Size of an obJect than Its ortgtnal stze The objects which cannot be seen by nakea eye can also be Observed by increasing magnification. Different lenses have different magnification powers which are represented by letter "X" that means the number of times than original size Therefore, a lens of magnification powel can increase the size of an object of t gm to 10 gm.

Microscopy:

Microscopy is the technique used to view objects that cannot be seen by the naked eye. The range can be anything between mm and nm Most animal cells and plant cells are between 10 gm and 30 gm A common compound microscope consists of ocular lens and objective lens, The overall magnification power of such a microscope is equal to the product of magnification powers of both lenses. The resolving power of light microscope 0.25 gm or 250 nm (25000 angstrom) and Its magnification is up to 4000, The resolving power of electron microscope is 0 5-5.0 angstrom and its magnification is up to 300,000 .Micrometry:

Objects can be measured under the microscope by means of an eye piece graticule or ocular micrometre This IS a transparent scale mounted in the focal plane of the eye piece, so it can be seen in the field of view at the same time as an object IS being examined under the microscope Obviously, to be of any use the eye ptece gratlcule scale must be calculated This can be done by placing a stage micrometre under the microscope This is a glass slide on which IS etched a senes of vertical lines separated by distances of 1 0 mm,0 1 mm and 0.01 mm — rather like a miniature transparent ruler By superimposing the images of the eye piece graticule and stage micrometer scales, It IS possible to calibrate the graticule so that the size of a given object vtewed under the microscope can be estimated You Will study micrometry in detail and measure the Size of microscopic objects in the practical class.



90 100

Ocular micrometre or graticule

Fluid Mosaic Model:

The Fluid Mosaic Model states that membranes are composed of a Phospholipid Bilayer with various protein molecules floating around within it The Fluid' part represents how some parts of the membrane can move around freely, if• they are not attached to other parts of the cell .Antigen:

Some protetns are antigens which enable the cells to recognize other cells for example the foreign antigens can be recognized and attacked by immune system.

Cell Surface Marker:

Cell surface markers are the molecules present on outer surface of plasma membrane which provsde the recognition of particular cell type so each type ot ceil can have Its own specific markers Mostly glycolipids and glycoprotetns act as cell surface markers. They act as cell Identity markers or name tags just like the signboard of shops They are involved In cell to cell recognition i e , they are Involved In sticking the correct cells together in tissues .Endoplasmic Reticulum:

An Interconnecting network of asternae (elongated closed sacs) which IS generally extended from nuclear membrane to the plasma membrane throughout the cytoplasm of all eukaryotic cells is called endoplasmic reticulum (ER) .Rough ER:

Rough ER has rtbosomes attached to the sides facing the cytoplasm and has rough appearance under electron microscope Rough ER is mainly concerned With the events of protein synthesis (translation) due to the association of ribosomes, however their presence In the cell also provides a mechanical support to the cell.

Smooth ER:

Smooth ER is continuous With the RER Since, ribosomes are not attached to It, therefore, It has smooth appearance under electron microscope, The smooth ER functions in various metabolic processes. eg . metabolism of carbohydrates The detoxificatlon of drugs and po'son espectally In the hver cells and synthesis of lipids including oils, phospholipids and steroid take place In smooth ER It also stores calcium ions, when released calcium ions trigger contraction of the muscle .Smooth ER also transports various cellular products within the cell or out of the cell e.g., proteins from rough ER are also transported to the Golgl complex through smooth ER Like rough ER the presence smooth ER in the cell also provides a mechanical support to the cell .Ribosomes:

Ribosomes were first observed using electron microscope as dense granules Ribosomes are roughly spherical granular non membranous bodtes found in both eukaryotic as well as prokaryotic celts However eukaryotic ribosomes are lager i.e., are about 20 to 24 nm in diameter and characterized as 80S ribosomes while the prokaryotic ribosomes are slightly smaller and are characterized as 70S ribosomes. They can be seen only under the electron microscope They are made pf almost an equal amount of RNA and protein so

they are ribonucleoprotein Ribosomes are formed in the nucleolus. Then these are transported to the cytoplasm through •the nuclear pore.

OR

The ribosome is a complex molecular machine, found within all living cells

that serves as the site of biological protein synthesis Ribosomes link amino acids together In the order specified by messenger RNA molecules Polysome:

Sometimes, during protein synthesis, several ribosomes are attached to one mRNA molecule. Such a chain of many ribosomes is called polysome or polyribosomes.

Golgi Complex:

It was discovered by Italian biologist Camillo Gotgi in 1898 for which he was awarded Nobel Pnze Its structure was revealed by electron microscope It is found in all eukaryotic cells.

Golgi complex consists of a stack of flattened, membrane bound sacs called cisternae together with system of associated vestcles (small sacs) called Golgi vesicles It is belteved that a complex system of Interconnected tubules IS formed around the central stack At one end of the stack a new ctsternae are constantly beng formed by the fusion of vesicles from the smooth ER This outer or forming face (CIS face) is convex, while the inner end is concave and is called maturing face (trans face) where the cisternae break up Into vesicles again.

The most important function of Golgl complex IS the processing of ce l secretions .Lysosomes:

Lyso means splttting and soma means body These are Single membranous, sphencal sacs (vestcles) They contan digestive or hydrolytic enzymes The lysosomal enzymes are manufactured on the RER Then these enzymes are transported to Golgl complex through SER After modification these enzymes are released from Golgi complex in the form of vesicles. Such vesicles are called lysosomes.

Primary Lysosomes:

The newly formed lysosomes before the start of their functions are usually called primary lysosomes They vary in size, and usually 0 2-0 5 prn in diameter .In plant and fungi. certain vacuoles carryout enzymatic hydrolysis a function shared by lysosomes in annal cells .Secondary Lysosomes:

Secondary Lysosome:

.Once a lysosome has fused with food vacuole, the resulting structure is called secondary lysosome In which food begins to digest .Autophagy:

The process by which unwanted structures within the cell are engulfed and digested within the lysosomes is called autophagy .Autophagosomes:

This js self-eating process of a cell In which a lysosome begins to digest cell s own organelles Such lysosomes are also called autophagosomes

Thts process either takes place In starvation period in order to obtain energy or It occurs In routine In order to control number of specific organelle .For example:

If someone starts to perform heavy muscular exercise the numbe{ of mitochondria begins to Increase in his muscle cells but if he leaves exercise, the number of mitochondrta are again decreased by the process of autophagy .

Autolysis:

Sometimes, especially during developmental phase, when a particular cell IS reqwred to be disintegrated, a type of cell death is committed, called autolysis.

Lysosomal Storage Disease:

Since, lysosomes contain various digestive enzymes If a particular lysosomal enzyme IS missing In are Individual, the digestion of that particular substance (for which enzyme was specific) will be affected As a result, the substance begins to accumulate in the cell and cause different problems Such complications which are caused by the accumulation of various substances In the cell due to lack of certain lysosomal enzymes are called lysosomal storage diseases

Peroxisomes:

Peroxisomes were discovered In 1965 tn hver cells Peroxisomes are approximately 0 5 to 1 micrometer In diameter. Peroxisomes contain some oxidatçve enzymes tike peroxidases catalases and glycolic acid oxidases They are abundant In liver cells where they are specificaliy Involved tn the formation and decomposition of hydrogen peroxide so they are named peroxisomes They are mainly concerned with the detoxification of alcohol. In this activity alcohol IS oxidized into hydrogen peroxide (H202) With the help of peroxidase enzyme .

Glyoxisomes:

Peroxisomes and glyoxysomes are collectively called microbodies. These are similar to lysosomes In the sense that they are single membranous, vesicular structures They contain enzymes (although different than iysosome) and originate from Colgi complex but they are smaller than lysosome .Vacuoles:

Vacuoles are large vestcles ortgtnate from the endoplasmic reticulum and Golgi complex and plasma membrane Vacuoles perform a variety of functions in different kinds of cells .Food Vacuole:

The ingested food of cell IS stored 'n vesicles, called food vacuoles .

Contractile Vacuole:

The digested products are absorbed by the cytoplasm while the remaining wastes containing vesicle now called contractile vacuole

OR

A contractiie vacuole (CV) is a sub-cellular structure (organelle) involved in osmoregulatlon It IS found predominantly jn protlsts and in unicellular algae It was previously known as pulsatile or pulsatingvacuole.

Cell sap: The solution Inside the central vacuolet called cell sap.

OR

The solution that fills the vacuoles of plant cells, called cell sap It contains sugars, amino acids, waste substañces (such as tannins), and mineral salts . Tonoplast:

The membrane separating the vacuole from cytoplasm IS called tonoplast.

OR

The cytoplasrmc membrane surrounding the vacuole, separating the vacuolar contents from the cytoplasm in a cell Mitochondria :

Mitochondria (stngular• mttochondrion) are present in all eukaryotic cells .Some cells have a single large mitochondrion, but more often a cell has hundreds or even thousands of mitochondria, the number correlates with the cell's level of metabohc activity. OR

The mitochondrion is a double membrane-bound organelle found In all eukaryotic organisms Some cells In some mult•cellular organtsms may however lack them .Porins:

Each membrane IS a phosphohpid bilayer With a unique collection of embedded proteins The outer membrane IS smooth and somewhat like a sieve The outer memorane has special proteins embedded Into the membrane called porins

ATP Synthase:

The inner surface of cristae is furnished with granular structures called stalk particles or FO-FI particles These particles are actually ATP synthase enzymes . Plastids:

Plastids are found in plant and algal cells and they are necessary for essential life processes. like photosynthesvs and food storage On the of presence or absence and type of pigments, and the stage of development plastids have been classified Into proplastids leucoplasts, chromoplasts and chlorop'asts .Etioplast:

Etioplast is a type of leucoplasts which on exposure to light develop into chloroplast Similarly chloroplasts may become }eucoplasts; but coloured plastids as in petals are mostly terminally differentiated Leucoplast:

Leucoplasts are found in parenchyma ceils of root stem and seeds They act as storage organelles.

OR

Leucoplasts are found In parenchyma cells of root stem and seeds They act as storage organelles Based on •the kind of substance they store they are further classified Into amyloplasts (store starch), elaioplast (store lipids) and proteinoplast (store protetn) Amyloplast:

Amyloplasts are non-pigmented organelles found in some plant cells They are responsible for the synthesis and storage of starch granules, through the polymerization of glucose, Amyloplasts åtso convert this starch back into sugar when the plant needs energy .Elaioplast:

Etioplast is a type of leucoplasts which on exposure to light develop Into chloroplast_ Similarly chloroplasts may become leucoplasts: but coloured plastids as in petals are mostly terminally differentiated.

OR

Elaioplasts are a type of leucoplast that is specialized for the storage of lipids In plants Elaioplasts house Oil body deposits as rounded plastoglobuli, which are essentially fat droplets .Proteinoplast:

Proteinoplasts (sometimes called proteoplasts, aheuroplasts. and aleuronaplasts) are specialized organelles found onåy tn plant cells. Proteinoplasts belong to a broad category of organelles known as plastids. Because they lack pigment proteinoplasts are more specifically a kind of leucoplast Chromoplast:

Chromoplasts synthesize and store different coloured pigments other than green Therefore, they are found In coloured pans of plant such as flower petals and fruit wall where they attract insects and thus help in pollination.

Chloroplast:

Chloroplasts are found in green pans of the plants and act as site of photosynthesis.

Stroma:

The ground mass ot Chloroplast IS called stroma It ts the colourless proternaceous substance which like mitochondrial matrix also contains a small circular DNA, alt kinds of RNA ribosomes (70S) ana various enzymes .Grana:

Smaller thylakoids (grana lamellae) are disc like sacs which are piled over one another like stack of cons Each stack of smaller thylakoids is called granum (plural grana). Each granum consists of 25-50 thylaK01ds and there are about 40 60 grana found in each chloroplast Photosynthetic pigments are also found In the membranes of smaller thylakoids .Thylakoid:

The stroma contains a system of chlorophyll bearing doubte membrane lamellae that form flattened sac-like structures called thylakoids There are two types of thylakoids: smaller thytakoids and the larger thylak01ds.

Inter Grana:

Larger thylakoids (stroma lamellae) connect the grana With each other and are also called intergrana These membranes are colourless as they do not have pigments Chloroplast IS the Site of photosynthesis In a plant cell The first phase of photosynthesis IS tight dependent reaction in which sunlight IS captured and transformed into ATP This phase takes place tn grana region of chloroplast .The second phase of photosynthesis is light independent reaction (dark reaction) In which C02 IS reduced to make carbohydrates The enzymes for this activity are found In stroma region of chloroplast.

Centriole:

Centnoles are non-membranous cell organelles touna many sn ammai cells.

They are also found in fungi like protists such as slime molds and water molds. Centrioles are rod shaped structures and usually occur in pairs These' occur at rtght angle to each other near one pole of the nucleus Centrioles are about 0_15-0 25 gm In diameter and 0 3-2 gm In length. Centrospheres:

Ceñtrioles lie in a distinctly, staining region of the cytoplasm known as centrosphere. Centrosome:

The centrioles and centrosphere are together called centrosome. Each centroe is composed of nine triplets of microtubule which are circularly arranged around a central axis. Mitotic Apparatus:

Just before the celt diviston. the pair of centrioles duplicates and becomes two pairs wh.ch later on migrate to the opposite Sides of the nucleus Both centriole pairs give rise microtubules (spindle fibres) dunng cell division The whole structure of spindle ftbres is known as mitotic apparatus which helps jn the distribution of chromosomes between the daughter cells during ceil division Basal Bodies:

In addition, centroles also gtve r•se to basal bodies or kinetosome of Cilia and flagella.

Troponin:

Troporun. or the troponn complex IS a complex of three regulatory proteins that is Integral to muscle contractton In skeletal muscle and cardiac muscle. but not smooth muscle

Tropomyosin:

Tropomyostn IS a two-stranded alpha-helical coiled coil protein found in cell cytoskeletons Myofibril:

Generally. these filaments are found just under the piasma membrane where they ensure the circular streaming movement of cytoplasm due to their contractile activity In some cells (muscles), they are very abundant and found as bundles called myofibrils. Microfilament:

Microfilaments also called actin filamènts are filaments In the cytoplasm of eukaryotic cells that form part of the cytoskeleton. Nuclear envelope:

Nuclear envelope (also called nuclear membrane) is a double membrane covering which makes the ooundary of nucteus Both membranes of nuclear envelope are separated by a fluid-filled perinuclear space The membranes are composed of lipid bilayer and proteins The outer membrane of nuclear envelope is covered with ribosomes and connected with the membranes of ER There are numerous pores in nuclear envelope called nuclear pores which are composed of a specialized transport protetn called nucleoporin. Nuclear lamina:

Except at the pores the nuclear side of the envelope is lined by the nuclear iamtna. a net like array of protan filaments tnat maintains tne snape ot tne nucleus by mechanically supporting the nuclear envelope. Nucleoplasm:

Nucleoplasrn the transparent semiflutd ground substance formed of a mixture of proteins enzymes (DNA and RNA polymerase), free nucleotide and some metal Ions (Mg) for the synthesis of DNA and RNAs. It also contains histone

and non-histone protein. So the nucleoplasm is slightly different from cytoplasm.

Nucleolus:

Nucleolus, (plural' nucleoli) is a non-membrane bound structure ih the nucleoplasm A cell may have one or more nucleoli Nucleolus appears during tnterphase and disappears dunng cell division.

A nucleolus consists of a peripheral granular area (contains ribosomal subunits) and a central fibriler area (contains rRNA and rDNA) Therefore nucleolus IS involved In the construction of ribosomes Chromosome:

Dunng cell dtvtsion chromatin fibres begin to condense and coli up into separate structures called chromosomes which are thick enough to be seen Witn a light microscope. Chromatin:

Chromatin IS a network of thin thread like structures made up of DNA and associated protein molecules.

Centromere:

A typical chrombsome consists of two strands called chromatids which are attached With each other at a point known as centromere.

Nuclear Organizer:

Some chromosomes may have another potnt of union along the length of chromatids called secondary constriction or nucleolar organizer It gives rtse to nucleoli during Interphase At least one pair of homologous chromosomes possesses nucleolar organzer region. Satellite:

Beside secondary constriction the end becomes a knob like structure calied satellite.

Junk DNA:

In genetics, the term junk DNA refers to regions of DNA that are noncodlng Some of this noncodtng DNA IS used to produce noncodlng RNA components such as transfer RNA, regulatory RNA and ribosomal RNA. Telomeres:

The terminal ends of chromosomes are called telomeres which prevent the two chromosomes to attach with each other from their ends.

OR

A telomere is a region of repetitve nucleotide sequences at each end of a chromosome, which protects the end of the chromosome from deterioration or from fusion with neighboring chromosomes. Glycocalyx:

The glycocalyx is a glycoprotein-polysaccharide covering that surrounds the cell wall of some bacteria There are two types of glycocalyx of bacteria i.e , capsule and slime layer. Slime Layer:

Slime layer is a more loosely attached glycocalyx that can be removed flum the cell more easily It makes the cell slippery and thus prevents them to be phagocytosed by the host cells. Almost all bacteria have cell wall outside the cell membrane except mycoplasma which lacks cell wall. Unlike eukaryofic cell wall (plant and fungi), the bacterial cell wall gs mainly composed of peptidoglycan or

mure•ln Further composition and stryctural features of cell wall differ greatly in different groups of bacteria which Will be discussed In chapter SIX .Mesosomes:

The cell membrane or plasma membrane lies beneath the cell wall which lacks cholesterols In lipid bilayer unlike eukaryotic plasma membrane At certain points this membrane Invaginates into the cytoplasm to form infolding, these are known as mesosomes .Nucleoid:

The nucleoid is the nuclear region of bacteria which is not separated from the cytoplasm by nuclear membrane. It IS seen in the electron microscope as an area lighter than the cytoplasmic contents. it consists of a large circular double stranded DNA molecule which is also known as bacterial chromosome.

OR

The nucleoid (meaning nucleus-like) IS an irregularly shaped reglon within the cell of a prokaryote that contains all or most of the genetic matergal called

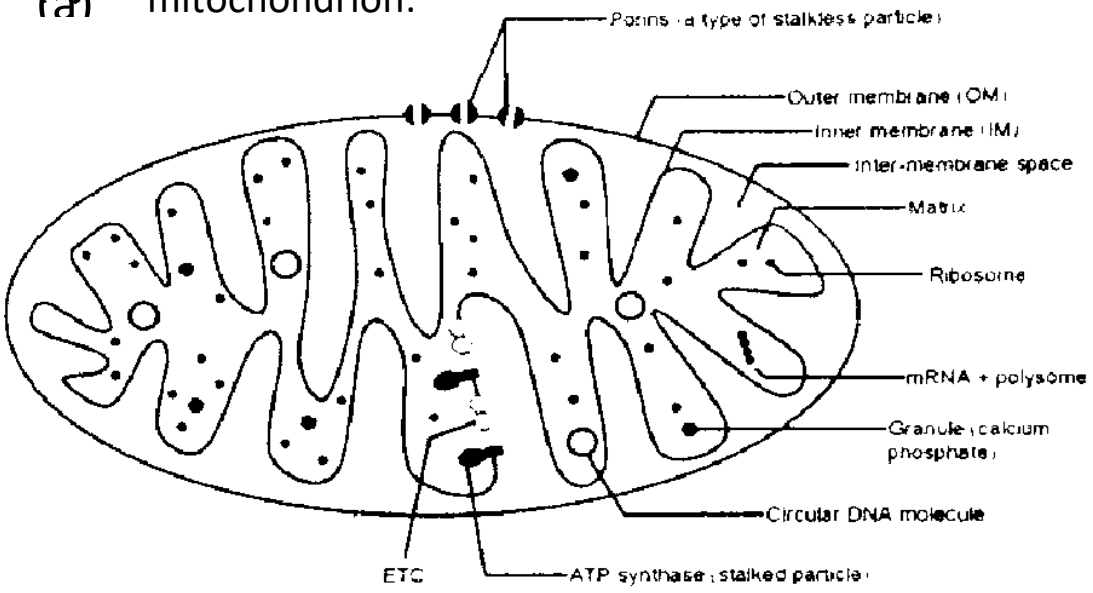
genophore In contrast to the nucleus of a eukaryotic cell. it not surrounded by a nuclear membrane Plasmid:

Plasmids ara Important vectors In modern genetic engineering tèchntques Plasmids also occur In lower eukaryotes e g. yeast Several different types of plasmids can exist tn one cell Transmissible plasmids can be transferred from cell to ceil by conjugation Nontransmlsslble plasmids are small they are frequently present tn many coples per cell

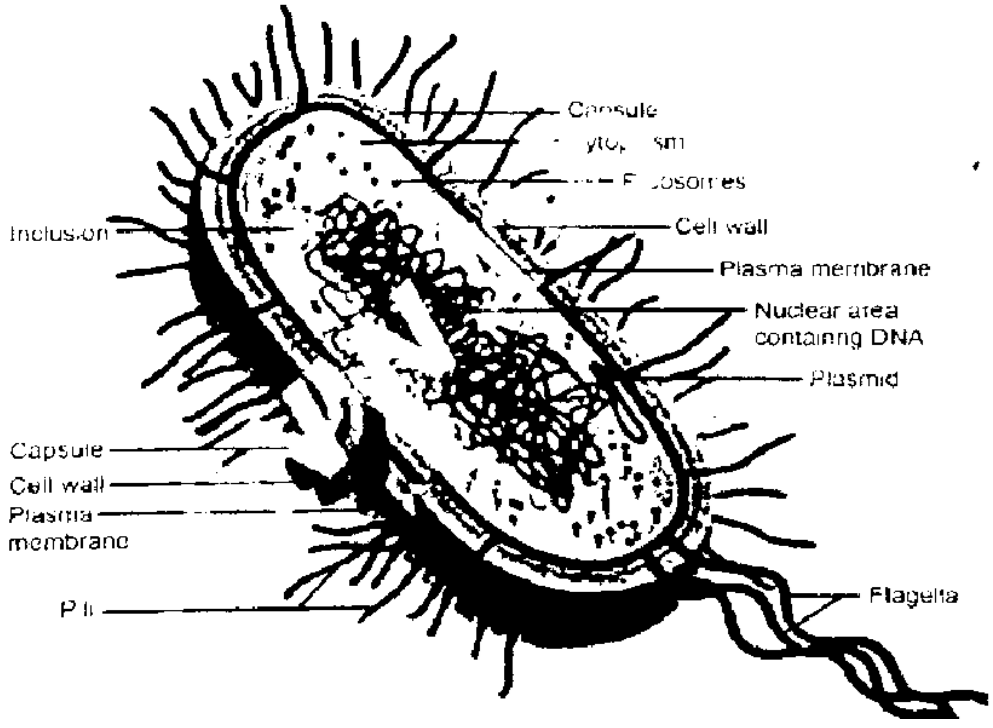
23. Draw a labelled diagram of a section through:

(a) mitochondrion (b) bacterium (c) chloroplast

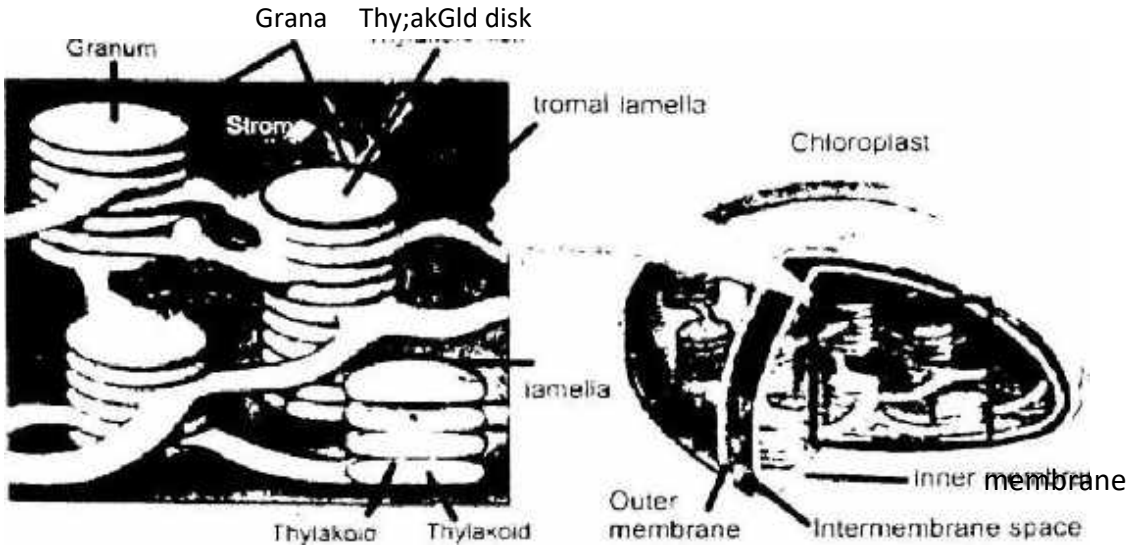
Ans: (a) mitochondrion:



(b) **bacterium:**



(c) chloroplast:



25. Write the difference between:

(a) resolution and magnification

(b) plant cell wall and bacterial cell wall

(c) cytoplasm of eukaryotic and prokaryotic cell

(d) ftagella of eukaryotic and prokaryotic cell (e) rough ER and smooth ER f chromatin and chromosome

(g) euchromatin and heterochromatin (h) nuclear lamina and chromatin

Ans: a resolution and ma nification:

Resolution	Ma nification
Our naked eye IS capable to disttngutsh two points which have at least 1 mm distance This mnmum capacity of a lens to differentiate between two adjacent points IS called resolution power of the lens	The magnification is the capacity of an optical instrument to Increase the size of an object than Its original Size The objects which cannot be seen by naked eye can also be observed by Increasing magnification. Different lenses have different magnificatlon powers which are represented by letter •X that means the number of times than ori Inal Size

Therefore, resolution of naked eye js 0 1 mm This resolution can be increased b Increasin ma niflcation	Therefore, a tens of IOX magnification power can increase the Size of an 0b ect of 1 gm to 10 gm

OR (Second Answer)

Difference between Magnification and Resolution:

- Magnification gives how many times the image has been magnified by the Instrument Resolution gives the ability to separate between two closely placed objects on an mage
- The resolution IS the quality or the sharpness of the image This IS why SLR cameras which have large apertures produce very sharp Images whereas pont and Shoot cameras lack In sharpness
- For Instruments such as telescopes and microscopes the resolution also determines the maxmurn magnification the instrument can obtain

b lant cell wall and bacterial cell wall:

Plant cell wall	Bacteria Cell Wall
Plant cell wails are mostly made up of chitin, cellulose and hemi cellulose which are both alpha and beta linked poly scchandes these not only are significantly stronger but also render lant cell walls that stren th	Bacterial cell walls mostly contan types of glucosarnnes called N acetyl glucose amine and N acetyl muramlc acid, both are cross lenked by a penta glycne Interbridge this crosslinkng ca ability gives it niflcant stren th

OR (Second Answer)

We can differentiate Bacteria cell wail from Plant cell wall on the basis of

Plant Cell Wall	Bacteria Cell Wall
Structure	
One main difference between plant and bacterial cell walls is thetr structure Plant cell walls are made up of cellulose hemicellulose, pectin and lignin Plant cells have both a primary and a secondary cell wall Primary walls surround growing and dividing plant cells. The secondary cell walls are Important because they facilitate the transport of water and nutrients and allow for upnght growth such as the . rowth of plants' stems	Bacteria cell walls are made up of peptidoglycan they do not contan cellulose like Plant cell walls rne bacteria ceil wall IS rigid The cell wall IS crucial to cell survival as It plays a Vital role in the interaction of the bactenal cell and the enVlronment
Function	
The cell walls In plant cells serve many functions For example, they determine and maintain' cell shape provide structural support; control dlrectton and speed of growth store carbohydrates protect the cell against outside elements; regulate the flow of materials In and out of the cell; and ald in cell-to-cell communication	The cell wall of bactena serves several functions. such as maintanng the shape of the cell servtng as an anchor for flagella, and providing protection Bacterta have three different shapes •sprai (spiflllum), spherical (coccus) and rodshaped (bacillus) Some bacteria, such as mycoplasma, have no ceil wall and no specific shape Bacteria have two different types of cell walls gram-positive and gram-negative Gram- positive bacteria have a cell wall that can be penetrated Gram-negative bacteria have an outer membrane . for protection, meaning gram-negative bacterta are more likely to fend off harm to the cell from outside environmental forces

•

(c) cytoplasm of eukaryotic and prokaryotic cell:

In a eukaryotic cell. the cytoplasm contains highly organized discrete structures which are specific for various cellular functions are called cell organelles The cell organelles are generally enclosed by the membrane except few such as ribosome.

On the other hand the nonliving granules of storage or waste compounds of the cell that do not possess metabolic activity and are not bounded by membranes are called cytoplasmic inclusions The most common inclusions are glycogen, lipid droplets. crystals and pigments The organelles In the cytoplasmic matrix of a cell are endoplasmic rettculum ribosomes Golg complex peroxysomes glyoxysomes lysosom£ mitocnondna, and chloroplasts etc.

OR (Second Answer)

- In eukaryotic cells (which are nucleated), the cytoplasm IS everything between the plasma membrane and tne nuclear envelope.
- In prokaryotes cytoplasm encompasses everything within the plasma membrane.
- The cytosol IS one mapr component of the cytoplasm In both prokaryotes and eukaryotes — this solution contains numerous Ions molecules and organelles Therefore it is aiso the Site of many metabolic reactions. such as proten synthesis
- In eukaryotes the cytoskeleton is also part of the cytoplasm .(d) flagella of eukaryotic and prokaryotic cell:

Flagella are long thread like structures which are used for locomotion .Bacterial flagella are composed of flagellin protein and lack microtubules In this way they differ from eukaryotic flagella.

OR (Second Answer)

A Flagellum IS a whip-like structure found in various micro-organisms But the eukaryotic and prokaryotic (bacterial) versions are utterly different In thetr mechanisms and proteins Almost certatnly two separate developments - convergent evolution. Eukaryotic flagella resemble Cilia and may have a common crigln .OR (Second Answer)

Difference between Prokaryotic and Eukaryotic Flagella:

- Prokaryotic flagella are smaller and simple In structure. whereas eukaryotic flagella are larger and complex in structure.
- Prokaryotic flagella are made up of flagellin protein whlle eukaryotic flagella are made up of tubulin.
- The movement of prokaryotic flagella IS proton driven, whereas the movement of eukaryotic flagella is ATP driven
- Prokaryotic flagella have rotator movement, whereas eukaryotic flagella have blending movement.
- Unlike the prokaryotic flagella eukaryotic flagella have 9+2 arrangement of microtubules.
- Prokaryotic flagella are located outside of the plasma membrane whereas the flagella in eukaryotes are covered with the plasma membrane.

OR Second Answer)

Proka otic Fla ella	Euka otic Fla ella
The are sin te stranded	The are 1 1 stranded
A covering membraneous sheath 's absent	Flagella are covered by sheath derived from lasmalemma
The stze IS smaller	The size IS lar er

They are narrower	They are thicker
Each fiagellum has three parts basal body. hook and filament	There are two parts basal body and shaft
Basal body bears nn s	Basal body bears rootlets
They are formed of protein fia ellin	The strands are formed of protein tubulin
They perform rotatory movements	They perform lashing or undulätory movements

(e) rough ER and smooth ER:

Rough ER has ribosomes attached to the sides facing the cytoplasm and has rough appearance under eiectron microscope Rough ER IS mainly concerned With the events of protein synthesis (translation) due to the assoctation of ribosomes however, their presence in the cell also provides a mechanical support to the cell.

Smooth ER IS continuous WFth the RER Since ribosomes are not attached to It, therefore. it has smooth appearance under electron microscope. The smooth ER functions tn various metabolic processes. e g., metabolism of carbohydrates. The detoxification of drugs and poison especially in the liver cells and synthesis of lipids including oils. phospholipids and steroid take place in smooth ER It also stores calcum tons when released calcium Ions trigger contraction of the muscle. Smooth ER also transports various cellular products within the cell or out of the cell e g proteins from rough ER are also transported to the Golgi complex through smooth ER Like rough ER the presence smooth ER in the cell also provides a mechanical support to the cell.

OR (Second Answer)

ifference between Smooth and ɔu

Smooth ER	Rough ER
Ribosomes	
Ribosomes are absent in smooth ER	Ribosomes aré present In rough ER
Location	
Smooth ER IS manly found near the cell membrane	Rough ER is manly found near the c to lasm
Ori in	
Smooth ER originates from rough ER b sheddin the ribosomes	Rough ER originates from nuclear membranes

Com osition	
Smooth ER IS manly composed of tubules	Rough ER is mainly composed of cisternae
Function	
Major function IS to synthesis lipids The also store li ids and roteins	Major function IS to synthesize and store roteins
Localization	
Smooth ER is mainly present In llPld forming celis such as adipocytes Interstitial cells of the testis. glycogen storing cells In the liver, adrenal cortex cells muscle cells leukocytes etc	Rough ER ts manly present in protein forming cells such as pancreatic accnal cells, goblet cells antibody producing plasma cells Nissl's granules of nerve cells etc
Conclusion ER IS considered as an interconnected system consist'ng of membranebound channels in the cytoplasm Both smooth and rough ER play a rote In the synthesis and storage of macromolecules Smooth ER produces lipids They also store lipids and proteins On the contrary, rough ER synthestzes proteins and stores them. The presence of ribosomes bound on the surface of the rough ER lets them synthescze proteins Therefore, the man difference between smooth and rough ER IS in the presence or absence of ribosomes on the;r surfaces	

OR Second Answer

Difference between Rou h ER and Smooth ER	
Rou h Endo lasmic Reticulum	SmoQth Endo lasmic Reticulum
1. Membrane covered With Ribosomes	1. Membrane not covered With Ribosomes
2. Found in cells which actively synthesize proteins Eg. Enzyme cells	2. Found in cells which are involved in the synthesis of non protein molecules Steroids. hos holi ids
3. Involved In roten s nthesls	3. Involved In other functions
4. More stable	4. Less stable

5. Found In Pancreatic Exocrine cells	5. Found in Epithelial cells, Intestinal cells Sarco lasmtc Reticulum

chromatin and chromosome:

	Chromatin	Chromosome
Definition	In the nucleus, the DNA double helix IS packaged by spec:al proteins (hlStones) to form a complex called chromatin The chromatin undergoes further condensation to form the chromosome.	A compact structure of nucleic acids and protein found in the nucleus of most living cells carrying genettc Information In the form of genes
Structure	Composed of leosomes- complex of a DNA and ptoteins (called histones). Represent DNA folded on nucleoproteins by a magnitude of 50 The	Chromosomes are condensed Chromatin Fibers They are a higher order of DNA organization, where DNA is condensed at least b. 10 000 times
	chromatin fiber is app 10 nm in diameter	onto Itself
Appearance	Chromatin Fibers are Long and thin They are uncoiled structures found Inside the nucleus	Chromosomes are compact thick and ribbon-like These are coiled structures seen prominently durtng cell division
Pairs	Chromatin IS unpaired.	Chromosome IS paired
Metabolic activity	Permisstve to DNA replication RNA synthesis (transcription) and recombination events.	Refractory to these processes
Presence	Found throughout the cell cycle.	Distinctly vtsible during cell divtston (metaphase, anaphase) as highly condensed structures

		upto several thousand nrn.
Conformation	May nave open (eucnromattn) or compact (heterochromatin) conformations which IS dynamically regulated Curing the cell-cycle stages	Predomnantty heterochromatic state With a predetermined position In the nucleus and a specific shape such as metacentric submetacentnc acrocentnc, telocentnc
Visualization	Electron microscope (beads on string appearance)	Light microscope (classic four-arm structure when duplicated)

euchromatin and heterochromatin:

	Euchromatin	Heterochromatin
Definition	A chromosome matertai which does not stan strongly except during cell division	Chromosome material of different density from standard or usually greater. in which the activity of the genes gets modified or su ressed
Packages	Loosely packed regions of chromatin that help them in erformin various tasks	Tightly packed particles that assist in performtng them various tasks
Color	Lighter colors due to the loose acka in	Darer coor aue to the aensely packed chromatin regions
Task	Protection of the integrity of gene to the handling or processes like regulation of t he ene	The transcription of the DNA to the mRNA products
State	Transcnpttonally Inactive	Transcriptionally active

(g OR Second Answer

Heterochromatin	Euchromatin
1. It IS darkly stained region of the chromatin chromosome	1. It IS lightly stained region

2. It is compactly coiled regions and With more DNA	2. It IS loosely coiled region and with less DNA
3. It is genetically inert as cannot transcribe mRNA due to ti ht coilin	3. It IS genetically active
4. It IS late re lacative	4. it IS earl re Itcatlve

nuclear lamina and chromatin

Nuclear Lamina	Chromatin
Except at the pores the nuclear side of the envelope is lined by the nuclear lamina, a net like array of protein filaments that maintains. the shape of the nucieus by mechanically supporting the nuclear envelo e.	Chromatin is a network of thin thread like structures made up of DNA and associated protein molecules

(h

EXTENSIVE QUESTIONS

26. Describe the principles and uses/applications of the apparatus used in the techniques of:

(a) Fractionation
(b) Microdissection
(c) Tissue culture
(d) Differential staining
(e) Centrifugation
(f) Chromatography
(g) Electrophoresis
(h) Spectrophotometry

Ans: (a) Fractionation

Cell Fractionation:

Use:

Cell fractionation IS the combination of various methods used to separate a cell organelle and components based upon size and density It is very useful for electron microscopy of cell components Principle:

The principle of cell fractionation conststs of two steps i.e homogenization and centrifugation.

i. Homogenization:

It is the formation of a homogenous mass of cells (cell homogenate or cell suspension) It involves the grinding of cells in a suitable medium with correct pH ionic composition, temperature and in the presence of certain enzymes that can break the cementing substance of cetls

For example pectinase which digest middle lamella among plant cells. This can be done in a cell homogenizer (food mixertblender). This procedure gives rese a OR Second Answer

Heterochromatin	Euchromatin
1. It IS darkly stained region of the chromatin chromosome	1. It IS lightly stained region
2. It is compactly coiled regions and With more DNA	2. It IS loosely coiled region and with less DNA
3. It is genetically inert as cannot transcribe mRNA due to ti ht coilin	3. It IS genetically active
4. It IS late re lacative	4. it IS earl re Itcatlve

nuclear lamina and chromatin

Nuclear Lamina	Chromatin
Except at the pores the nuclear side of the envelope is lined by the nuclear lamina, a net like array of protein filaments that maintains. the shape of the nucieus by mechanically supporting the nuclear envelo e.	Chromatin is a network of thin thread like structures made up of DNA and associated protein molecules

(h

EXTENSIVE QUESTIONS

26. Describe the principles and uses/applications of the apparatus used in the techniques of:

(a)	Fractionation	(b)	Microdissection
(c)	Tissue culture	(d)	Differential staining
(e)	Centrifugation	(f)	Chromatography
(g)	Electrophoresis	(h)	Spectrophotometry

Ans: (a) Fractionation

Cell Fractionation:

Use:

Cell fractionation IS the combination of various methods used to separate a cell organelle and components based upon size and density It is very useful for electron microscopy of cell components Principle:

The principle of cell fractionation conststs of two steps i.e homogenization and centrifugation.

i. Homogenization:

It is the formation of a homogenous mass of cells (cell homogenate or cell suspension) It involves the grinding of cells in a suitable medium with correct pH ionic composition, temperature and in the presence of certain enzymes that can break the cementing substance of cetls

For example pectinase which digest middle lamella among plant cells. This can be done in a cell homogenizer (food mixertblender). This procedure gives rese a uniform mixture of cells e cell homogenate The resulting mixture IS then centrifuged ii. Centrifugation:

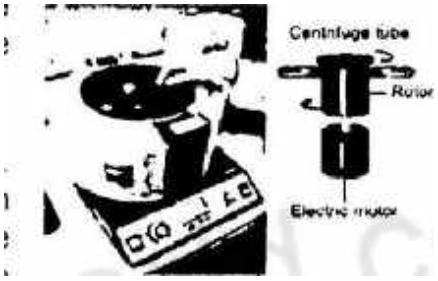
Centrifugation is the process to separate substances on the basis of their Size and densities under the Influence of centrifugal force It IS done by the machine called centrifuge Use:

This machine can spin the tubes Contents are kept in tubes that are much like the test tubes, Spinning the tubes exerts a centrifugal force on the contents Types of Centrifugation:

There are two major ways of centrifugation I.e density gradient centrifugation and differential centrifugation Density Gradient Centrifugation:

In density gradient centrifugation the cell components of different Sizes and densities are separated in different layers (sediments) in the tube containing lonlC medium according to their Size and densities The upper sediments have smaller and less dense components than lower sediments Differential Centrifugation:

In differential centrifugation the sedimentation rate for a particle of a given size and Shape measure how fast the particle •settles" or sediments The faster the rotation of the centnfuge. the smaller the particles Will sediment.



Pellet and Supernatant:

A series of increasing speeds can be used At each step, the content which make sediment in the bottom of the tube are called pellet and those that remain suspended above the sediment In the A centrifuge form of liquid are called supernatant. After each speed the supernatant can be drawn off and centrifuge again A seres Of pellets containing cell organelles of smaller and smaller Size can therefore be obtatned (b) Microdissection:

Microdissectton refers to the variety of techniques where a microscope IS used to assist in dissection Use:

It is done to remove tumour or granules from delicate tissue or cells like brain, heart and nerve cells Technique/ Principle:

In this technique, the image is seen on large TV screen or monitor while dissecting Different kinds of techniques involve microdissectlon I.e

(1) Chromosomal microdissection:

It involves the use of fine glass needle under a microscope to remove a portion from a complete chromosome

(2) Laser microdissection:

It Involves the use of a laser through a microscope to dissect selected ceils (c) Tissue culture:

Growth of a cell or a tissue on chemically defined nutrient medium under sterile conditions IS called tissue culture

Technique/ Use/ Principle:

This technique can be employed for both plants and animals.

Plant tissue culturing is mainly used for plant cloning I e , production of genetically identical plants (clones) Animal tissue culture is usually set up by growtng individual cells to form a single layer of cells over the surface of a glass container. Animal tissue cultures are used to see any abnormality in the cell, e g , cancer chromosomal disorder etc .(d) Differential staining:

Most biological structures are transparent In order to differentiate between these structures various colour dyes are applied.

Such techniques are called staining

Fhniques Technique/Use/Principle:

When only one statn, such as borax carmine (tnat stains nucleus) IS used It IS called single Staining When two stains, one that Will stain nucleus eg , haematoxylin



Differential staining

and other that Will stain cytoplasm e g eosin are used ,the process is called double staining or differential staining.

(e) Centrifugation:

Centrifugation is the process to separate substances on the basis of their size and densities under the Influence of centrifugal force It is done by the machine -called centrifuge .Use:

This machine can spin the tubes. Contents are kept in tubes that are much like the test tubes Splming the tubes exerts a centrifugal force on the contents .Types of Centrifugation:

There are two major. ways of centrifugation i.e., density gradient centrifugation and differential centrifugation.

Density Gradient Centrifugation:

In density gradient centrifugation the cell components of different sizes and densities are separated in different layers (sediments) in the tube containing tonic medium according to their size and densities. The upper sediments have smaller and less dense components than lower sediments . Differential Centrifugation:

In differential centrifugation the sedimentation rate for a particle of a given Size and shape measure how fast the particle "settles" or sediments The faster the rotation of the centrifuge the smallerThe particles Will sediment .Pellet and Supernatant:

A series of Increasing speeds can be used At each step, the content which make sediment in the bottom of the tube are called pellet and those that remain suspended above the sediment in the form of liquid are called supernatant. After each speed, the supernatant can be drawn off and centrifuge again A series of

pellets containing cell organelles of smaller and smaller Size can therefore be obtajned.

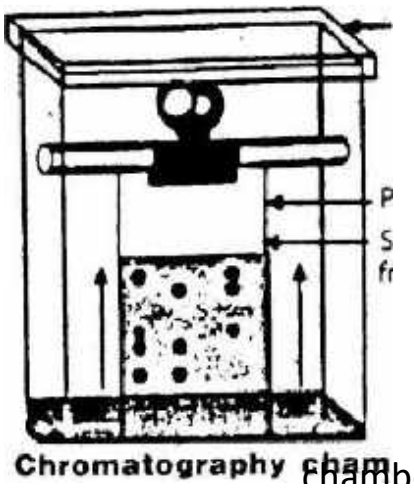
(f) Chromatography:

Chromatography IS a technique which is used to separate different chemical compounds from a mixtures It is generally used for the separation of mixtures of proteins, armno acids or photosynthetic pigments.

Use/ Techniques:

There are different types of chromatographic technlques Paper chromatography IS a simple and most Wdely used tecnnvque It Involves twc phases t e : stationary phase and mobile Lid phase

The mobile phase consists of a solvent In which mixture sample IS dissolved. It is passed through the stationary phase whach consists of a filter paper . Paper



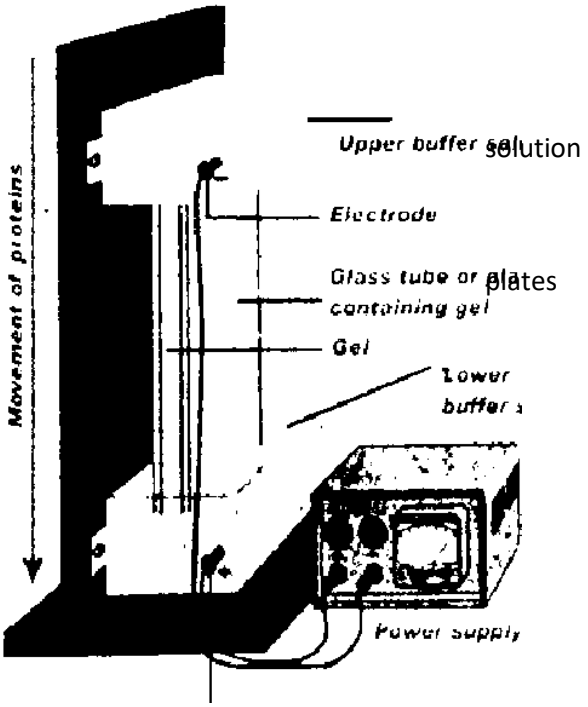
Chromatography cham chamber

When mobile phase travels through the stationary phase the molecules mixture sample begin to separate as dots at different places on stationary phase according to therr individual affinity Then the paper IS. sprayed With a liquid locating agent (staining dye) that shows up the dots as colours that can be seen This paper IS called chromatogram and the apparatus as canea chromatography cnamber (g) Electrophoresis:

It is a technique which IS used to separate fragments of a charge bearing polymer molecule according to their Size, shape, molecular weight and surface charge whether (+) or (—) Such charge bearing polymer molecules are DNA, RNA . protein etc.

Use/Technique:

This technique utilizes a gel medium (composed of agarose or polyacrylamide) for separation of fragments which is done under the Influence of an electric field Often the gel is sandwiched between glass or plastic plates to form a Viscous slab The two ends of the slabs are suspended In two salt solutions that buffer solution are connected by electrodes to a power source, When voltage is applied to the apparatus the molecules present in the gel migrate through the electric field according to ther Individual charge and tney move away from one another tn the gel.

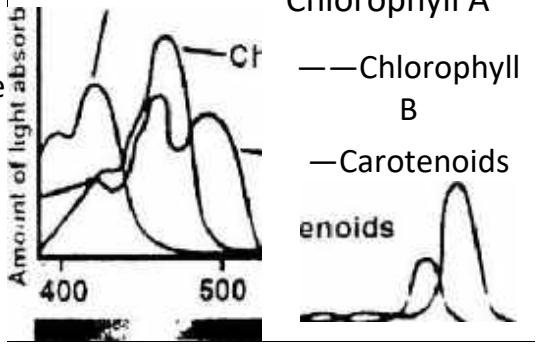


The negative charged Electrode molecule wilt move towards the Gel Electrophoresis positive pole and the molecule having ppsitlve charge will move towards the negative pole. The velocity of movement of fragments is inversely proportional to the size Therefore smaller fragments move faster than larger In this way all the fragments are separated in the gel after some time Later on the molecules can be pin pointed by stanng the gel.

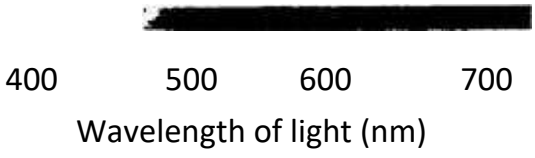
(h) Spectrophotometry:

Spectrophotometry IS a technique which ts used to determne the absorption of different wavelength of light by a particular chemical compound or a photosynthetic pigment



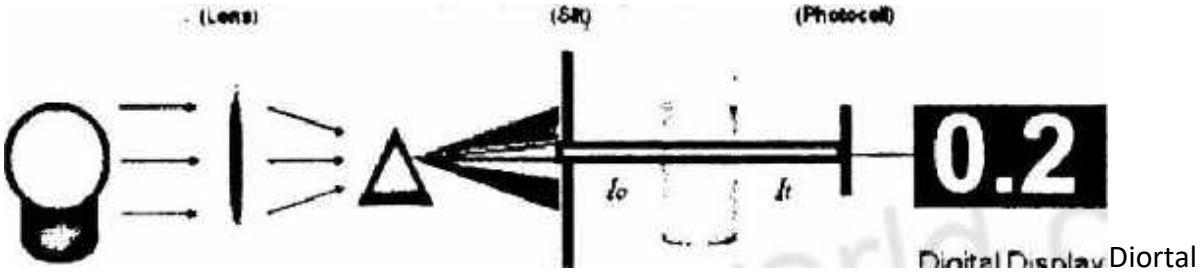


The spectrophotometer IS an Instrument that measures the amount of light that passes through the sarìple and from this It can be calculated how much light was absorbed.



Spectrophotometer Absorption spectrum

Collimator Vávelength Selector Detector



Diortal Display

Light source Monochromator (Prism or Grating) Sample Solution or Meter

Principle of spectrophotometry

Absorption Spectrum:

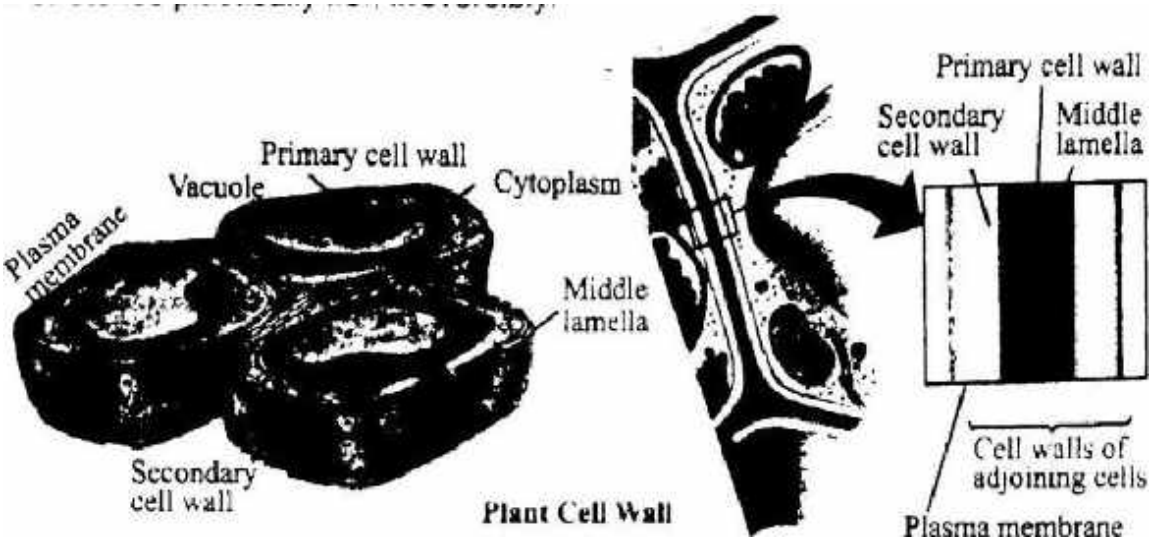
The amount of light absorbed at each wavelength is plotted in a graph and the result IS what we call the absorption spectrum In other words, absorption spectrum IS a graph which shows the absorption of different wavelength of light by a particular Pigment Use:

Spectrophotometry can be used to determine the wavelengths of light that take part in photosynthesis It can also be used to determine the very minute quantity of a substance (such as DNA) ln.a sample.

27. What are the locations, chemical compositions and significance of the following in a plant cell wall? (a) Primary cell walt (b) Secondary cell wall (c) Middle lamella.

Ans: (a) Primary cell wall:

Primary cell wall IS a true wali and develops In newly growing cell I e . during cell divasion Each cell produces a primary cell wall The primary cell wali IS present Inner to the middle lamella The primary cell wali IS thin and shghtly flexible The primary cell wall is composed of cellulose microfjbrils (bundles of cetlulose chains) running through the matrix of other polysaccharides like hemicelluloses and pectin The mcrofibrlls show a crisscross arrangement In layers one above the others Tnrs feature gives the cell great strength The primary cell wall is adapted to growth The wall stretches plastically i e , irreversibly



(b) Secondary cell wall:

Secondary cell wall is formed between the primary cell wall and plasma membrane only in sclerenchyma cells The plant cells possessing secondary cell wall are generally dead and provide support for the plant. The secondary cell wall develops only when the cell has reached maximum Size 1 e. , completes its growth because It IS very much thick and rigid therefore it does not allow fulther growth .The secondary cell wall consists of cellulose, hemicelluloses, lignin Inorganic salts and waxes Its cellulose mjcrofibrils also show crisscross arrangement Lignin cements and anchors cellulose mcrofjbrlls together and It mainly responsible for rigidness.

(c) Middle la mella:

Middle lamella IS present between adjacent primary cell walls of two cells It is composed of sticky, gel-like magnesium and calcium salts (pectic acids) and pectin The middle lamella holds neighbounng cell walls together The cell wall IS porous (the pores are called .pjts) and allows free passage of water and dissolved material. The secondary cell wall provides definite shape and mechanical support to the cell.

28. Explain the (a) Chemical composition of plasma membrane (b) Role of plasma membrane in regulating cell's interactions with environment

Ans.' (a) Chemical composition Of plasma membrane:

Plasma Membrane:

Plasma membrane is the boundary of protoplasm. It is found in all living prokaryotic and eukaryotic cells Plasma membrane is also called cell membrane or plasmalemma or ceJl surface membrane. It gives shape and mechanical support to the cells.

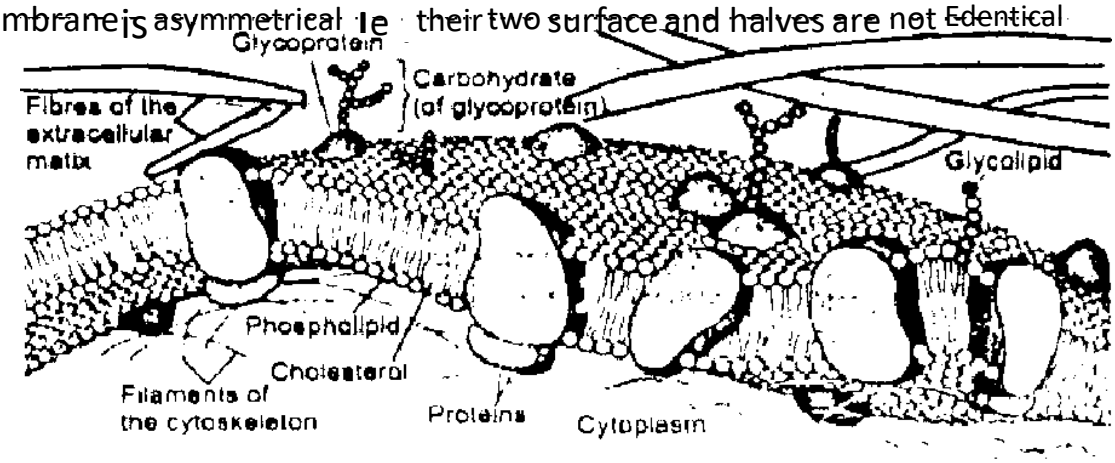
Composition of plasma membrane:

Chemically cell membrane consists of proteins 60-80% lipids 20-40% and small quantity of carbohydrates The lipid contents include phospholipids and cholesterols (absent In prokaryotic cell membrane) The protein contents Include various structural and functional proteins The carbohydrates are generally found in conjugated form like glycohptds and glycoproteins . Structure of plasma membrane:

Fluid mosaic model of plasma membrane.

The model proposes that the membrane IS a phospholipids bilayer tn which protetn molecules are either partially or wholly embedded The protetns are scattered throughout the membrane In an Irregular pattern just like large ice bergs float in the sea The pattern of distribution of proteins can vary from membrane to membrane and also vary on both surfaces of membrane The membrane is about 7 nm thick.

The lipid part of plasma membrane consists Of two layers (bilayer) of phospholipids which are arranged in such a way that their hýdrophobic ends face each other while hydrophilic ends are appeared on the surface The steroids . cholesterols are wedged Into the phospholipid bilåyer at some Intervals The plasma membrane is asymmetrical Ie their two surface and halves are not Edentical



Fluid mosaic model of plasma membrane

In general most membrane proteins are observed to drift sideways in the fluid bilayer The proteins within a membrane determine most of the functions Many plasma membrane protetns are glycoproteins, which have an attached carbohydrate chain Carbohydrates in the form of branched or unbranched oligosaccharides are either attached to protetns (glycoproteins) or lipids (glycolipids) generally on the outer side of membrane.

(b) Role of plasma membrane in regulating cell's interactrons with envimnment:

Plasma membrane regulates cell's interaction With rts ermronment by the controlling transport of material across the cell.

Transport across plasma membrane occurs to: (1) obtain nutrtent (2) excrete waste substances (3) secrete useful substancés (4) generate ionic

gradients essential for nervous and muscular activity (5) rnarntaån a suitabie pH and ionic concentration within the cell for enzyme activity.

Plasma membrane acts as semipermeable membrane:

Plasma membrane acts as semipermeable membrane I e It allows some dissolved substances to move across while it Inhibits the others The substances which are lipid soluble cross It more easily than others Many small gas molecules (02 and C02), water, glucose etc , being neutral can easily cross while tons beng charged particles have some difficulty In crossing For movement across the cel' surface membrane there are four basic mechanssms Diffusion and osmosis are passive processes Active transport and bulk transport (endocytoss and exocytoslsþ are energy consuming processes.

29. Describe the lipid foundation and variety of proteins of the plasma membrane.

Ans: Functions of plasma membrane lipids:

The lipid part of plasma membrane controls the fluidity Of the membrane. When the concentration of unsaturated fatty acid In phospholipids becomes greater the bilayer becomes more fluid that makes cell membrane more pliable i e flexible. The cholesterol also helps stabilize the phospholipids at a body temperature but helps keep the membrane fluid at lower temperature. The overall lipid bilayer provides the basic structure of membrane It also restricts entry and exit of polar molecules and ions The conjugated liptds (glycolipids) work as cell surface markers, their detailed role Will be discussed later in this chapter. Functions of plasma membrane proteins:.

A great variety of proteins are found in plasma membrane which may act as transport channel or carrier enzyme, receptors or as antigens.

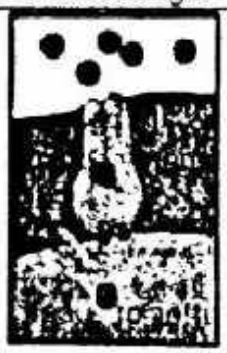
1. Channel proteins and Carrier proteins:

Certain plasma membrane proteins are involved in the passage of molecules through the membrane. Some of those have a channel through which a substance simply can move across the membrane, other are carriers that combine With a substance and help It to move across the membrane.

2. Enzymes:

Some plasma membrane proteins have enzymatic functions. They perform metabolic reactions directly for example the membrane protein, adenylate •cyclase catal

catalyzes the transformation of ATP to cyclic AMP (cAMP), a second messenger

Channel Protein: Allows a **particular** molecule **or ion to** cross the plasma membrane freely.		**Carrier Protein:** Selectively Interacts a specific molecule or **ion** so that it can cross the plasma **membrane.**	

Functions performed by protein in the plasma membrane

zes the transformation of ATP to c clic AMP (cAMP a second messen er

3. Receptor molecules:

Some proteins in the plasma membrane are receptors that receive signals from other cells Each type of receptor has a shape that allows a specific charge to bind It The binding of a molecule can cause the proteins to change its shape and brjng about an intracellular response

For example, hormones ctrculate in the blood but bind to specific target cells, which have the correct receptor Sites Some receptors are glycolipid In nature

4. Antigens:

Some proteins are anttgens which enable the to recognize other cells for example the foreign antigens can be recognized and attacked by immune system.

30. What are the functions of the plasma membrane proteins?

Ans: Functions of plasma membrane proteins:

A great variety of proteins are found in plasma membrane which may act as transport channel or carrier enzyme receptors or as antigens

1. Channel proteins and Carrier proteins:

Certain plasma membrane proteins are Involved in the passage of molecules through the membrane Some of those have a channel through which a substance simply can move across the membrane other are carreers that combine With a substance and help It to move across the membrane

2. Enzymes:

Some plasma membrane proteins have enzymatic functions They perform metabolic reactions directly, for example the membrane protein, adenylate cyclase, catal zes the transformation of ATP to c clic AMP cAMP a second messen er

Channel Protein: Carrier Protein:

Selectivety

Allows a particular molecule or ion to cross the plasma membrane freely

Interacts a specific molecule or ion so that It can crosS the plasma membrane.

Functions performed b rotein in the lasma membrane

3. Receptor molecules:

Some proteins In the plasma membrane are receptors that receive signals from other cells Each type of receptor has a shape that allows a specific charge to bind it. The binding of a molecule can cause the proteins to change its shape and bring about an intracellular response. For example. hormones circulate tn the blood but bind to specific target cells, which have the correct receptor Sites Some receptors are glycolipid in nature

4. Antigens:

Some proteins are antigens which enable the cells to recognize other cells for example the foreign antigens can be recognized and attacked •by immune system.

31. What is the role of glycolipids and glycoproteins as the cell surface markers?

Ans: Roles of.glycolipids and glycoptt)teins as cell surface markers:

Cell surface markers are the molecules present on outer surface of plasma membrane which provide the recognition Of particular cell type so each type of cell can have its own specific markers Mostly glycolipld= and glycoproteins act as cell surface' markers.

They act as cell identity markers or name tags just like the signboard of shops They are involved in cell to cell recognition I e they are involved In sticking the correct cells together in tissues.

32. What is the chemical nature of cytoplasm? Explain the metabolic roles of cytoplasm. Ans: Cytoplasm:

Cytoplasm IS the region between nuclear membrane and plasma membrane This IS also a common component of both prokaryotic and eukaryotic cells The major difference between the cytoplasm of these two kinds of cells is the presence or absence of cytoskeleton and membrane bounded organeltes. These structures are absent in prokaryotic cells.

Physico•chemical nature of cytoplasm:

It IS about 90% water and forms a solution that contains all the fundamental biochemtcals of life Some of these are ions and small molecules In true solution such as salts, sugars, amino acids, fatty acids, nucleotides vitamins and dissolved gases Others are large molecules, such as proteins which form the colloidal solutions.

Cytosol and Cytogel:

The inner portion of cytoplasm i.e., towards the nucleus is less viscous and IS called cytosol whlle the peripheral part of cytoplasm i e , towards the plasma membrane is more Viscous and is called cytogel .Cyclosis:

A circular streaming movement can also be observed in cytoplasm due to the contractile activity of microfilaments. This movement is called cyclosis which IS •responsible for distribution of cell contents In cytoplasm .

Metabolic and storage role of cytoplasm:

The cytoplasm acts as a site of metabolism and store house of a cell The metabolic pathways generally occur in the cytosol which includes protein biosynthesis. glycolysis, glycogenolysis gluconeogenesis etc. The cytogel is usually concerned With storage of useful compounds which are subsequently used In various cellular activities and waste compounds which are eliminated from the cell time to time.

33. Describe the structures and functions of smooth and rough endoplasmic reticulum.

Ans: Endoplasmic reticulum:

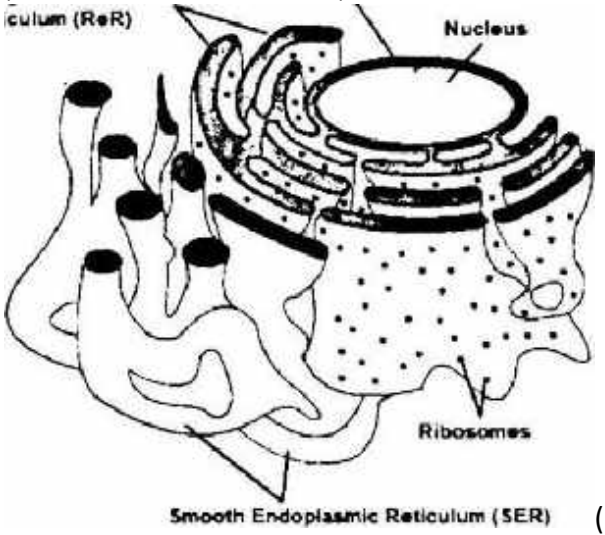
An interconnecting network Of cisternae (elongated closed sacs) whièh is generally extended from nuclear membrane to the plasma membrane throughout the cytoplasm of all eukaryotic cells IS called endoplasmic reticulum (ER) .Types of Endoplasmic reticulum:

There are two types of ER rough ER and smooth ER Most cells contain both types of ER However, some cells (skeletal muscle cells) have smooth ER more, where these are called sarcoplasmic reticulum .Rough Endoplasmic Reticulum:

Rough ER has ribosomes attached to the sides facing the cytoplasm and has rough appearance under electron microscope .Functions:

Rough ER is mainly concerned with the events of protein synthesis (translation) due to the association of ribosomes, however, their presence in the cell also provides a mechanical support to the cell.

Rwgh Endopl&M1ic Nuct•ar Env•iop•



Reticul• (R.R)

Endoptasmic reticulum

Smooth Endoplasmic Reticulum:

Smooth ER is continuous with the RER Since, ribosomes are not attached to it, therefore, it has smooth appearance under electron microscope .Functions:

The smooth ER functions in vartous metabolic processes, e.g., metabolism of carbohydrates. The detoxification of drugs and poison especially in the liver cells and synthesis of lipids including Oils, phospholipids and steroid take place in smooth ER. It also stores calcium Ions, when released calcium tons trigger contraction of the muscle. Smooth ER also transports various cellular products within the cell or out of the cell e g. , proteins from rough ER are also transported to the Gotgi complex through smooth ER Like rough ER the presence smooth ER In the cell also provides a mechanical support to the cell.

34. Explain the structure, chemical composition and function of ribosomes.

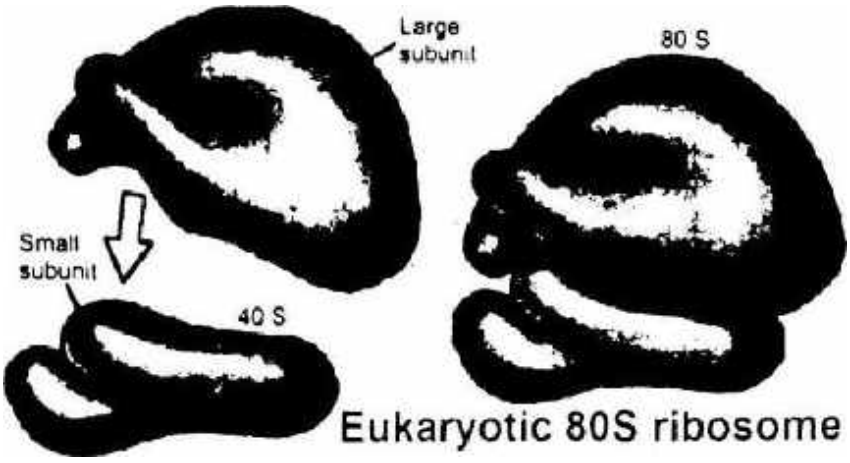
Ans: Ribosomes:

Ribosomes were first observed using electron microscope as dense granules, Ribosomes are roughly sphencal granular non membranous bodies found in both eukaryotic as well as prokaryotic cells .Structure:

However, eukaryotic ribosomes are lager i.e., are about 20 to 24 nm in diameter and characterized as 80S ribosomes while the prokaryotic ribosomes are -slightly smaller and are charactenzed as 70S ribosomes. They can be seen only under the electron microscope .Chemical Composition:

They are made Of almost an equal amount of RNA and protein so they are ribonucleoprotein Ribosomes are formed in the nucteolus Then these are transported to the cytoplasm through the nuclear pore.

60 s



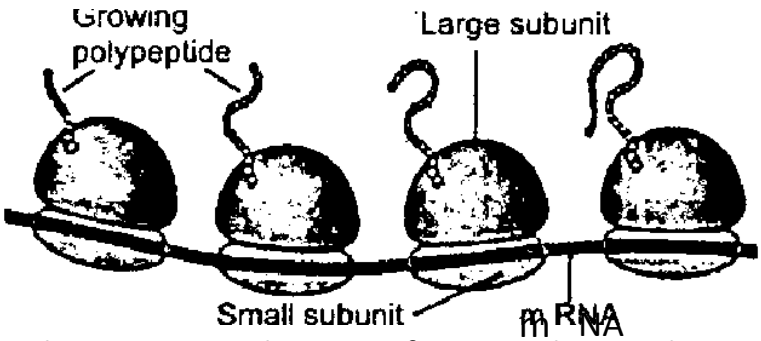
Eukaryotic 80S ribosome

In a eukaryotic cell, the ribosomes may be found as attached With RER or freely dispersed In the cytoplasm Ribosomes are also found in matrix of

mitochondria and stroma of chloroplast but these ribosomes are prokaryotic (70S) in nature The eukaryotic ribosomes are composed Of two subunits (particles) Of different Sizes The larger one is 60S particles and the smaller one is 40S particles. The two subunits on attachment form 80S particles.

The attachment IS controlled by presence of magnesium ions concentration or forming salt bonds between phosphate group of RNA and amtno group of amino acid or both by magnesium ions and salt bonds Both rlbosomal subunits are generally attached together at the time of their function (translation). Functions:

The ribosomes are Involved in the events of protein synthesis (translation). Sometimes, during protein synthesis, several ribosomes are attached to one mRNA molecule Such a chan of many ribosomes is called polysome or



polyribosomes. In this way several copies of same polypeptide can be produced In very less time. Growing

Small subunit

Polysome

35. Explain the structure, and functions of Golgi complex.

Ans: Golgi complex:

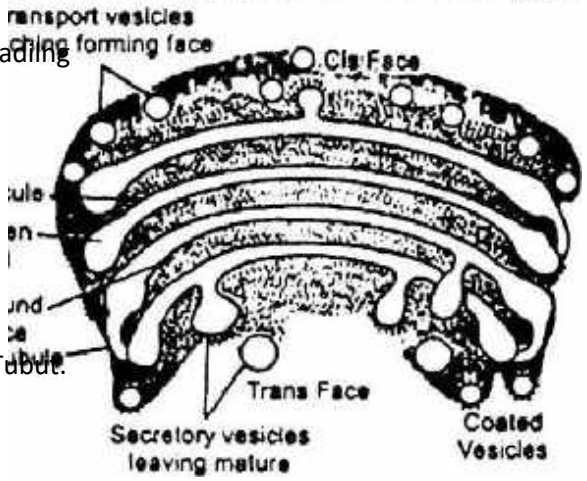
It was discovered by Italian biologist Camillo GoEgi in 1898 for which he was awarded Nobel Prtze. Its structure was revealed by electron microscope. It IS found in all eukaryotic cells.

Structure of Golgi Complex:

Golgi complex consists of a stack of flattened, membrane bound sacs called cisternae, together With system of associated vesicles (small sacs) called Golgi vesicles It IS believed that a complex system of interconnected tubules is formed

around the central stack At one end of the stack a new asternae are constantly beng formed by the fusion of ves©es from the smooth ER This outer or forming face (CIS face) is convex, while the inner end is concave and es catied maturing face (trans face) where the cisternae break up into vesicles again

reading



Tubut.

Saççule

Swollen End

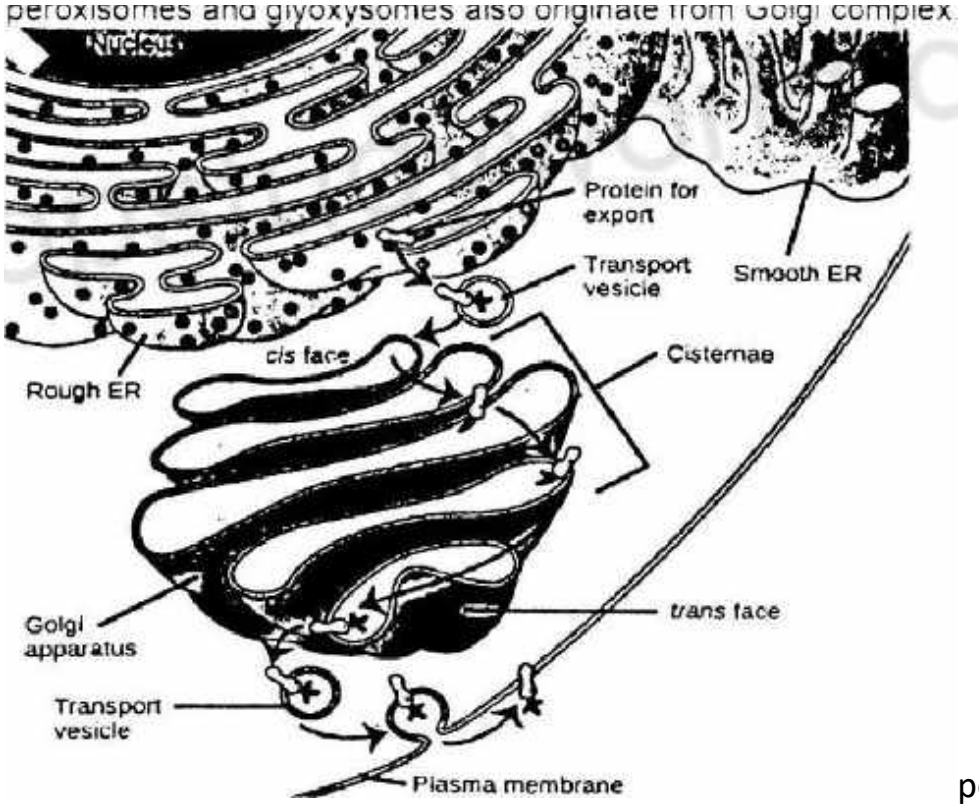
Golgi Ground Substance

face

Golgi complex

Functions of Golgi Complex:

The most irngffiant function of Golgi complex is the processang of cell secretions Therefore these organelles are abundant In secretory (glandular) cells In many cases the CSI secretions consist Of proteins Golgl complex collects these proteins from RER through SER modifies them to perform specific function and then exports these modified products in the form of vesicle Certain organelles, such as lysosomes



peroxisomes and I oxysomes also on tnate from Col I complex

Role of Golgi complex in a glandular cell

Golg! complex IS also Involved In the formation of corougated molecules like glycoprotein, lipoprotein etc In plant cell during cell diwston G0191 complex also gwes rise vesicles which contan cell wall synthesizing materials At the time Qf cytoplasmic division (cytokinesis), these Golgi vesicles are arranged on the cell equator fuse together and form a structure, called phragmoplast. Later on new cell wall IS derived from this structure.

36. Explain the structure and functions of the peroxysomes and glyoxisomes in animal and plant cells.

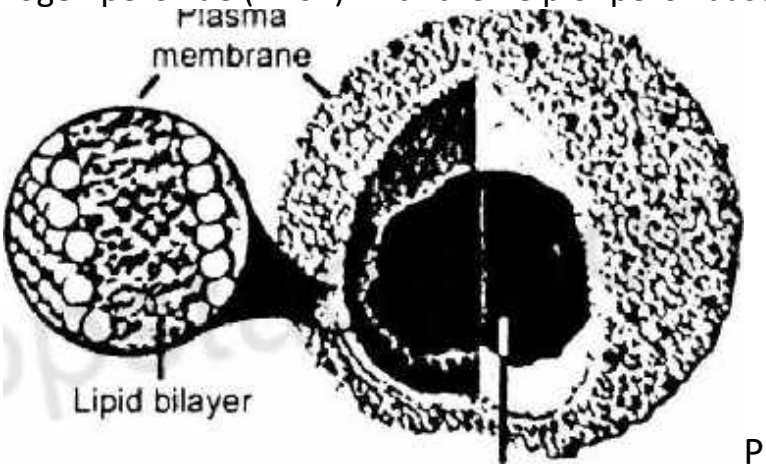
Ans: Peroxisomes and Glyoxysomes:

Peroxisomes and glyoxysomes are collectively called microbodies. These are similar to lysosomes in the sense that they are single membranous, vesicular structures They contain enzymes (although different than lysosome) and originate from Golgi complex but they are smaller than lysosome

Structure and Functions of Peroxysomes in animal and plant cells:

Peroxisomes were discovered In 1965 in liver cells Peroxisomes are approximately 0 5 to 1 micrometer in diameter Peroxisomes contain some oxidative enzymes like peroxidases. catalases and glycolic acid oxidases They are abundant In liver cells where they are specifically involved in the formation and decomposition of hydrogen peroxide so they are named peroxisomes They are

mainly concerned with the detoxification of alcohol In this activity alcohol is oxidized into hydrogen peroxide (H202) With the help of peroxidase enzyme.



Plasma

U rate oxidase

-Peroxisomes crystalline core

Hydrogen peroxide is Itself a toxjc molecule, which is immediately broken down to water and oxygen by another enzyme called catalase In plant cell peroxisomes are Involved tn photorespiration. A step of photorespiration takes place in peroxisomes in which glycolate is converted into glycine with the help of an enzyme called glycolic acid oxidase.

Structure and Functions of the Glyoxisomes in animal and plant cells:

Glyoxysomes are found only at seedling stage in oil seed plants These organelles have a number of enzymes for plant lipid metabolism that are not found tn animal cells The germinating seedlings convert stored fatty acids to carbohydrates This IS achieved through a metabolic pathway called glyoxylate cycle the enzymes of which are located in the glyoxysomes.

37.Explain the formation, structure and functions of the lysosomes. Ans:

Lysosomes:

Formation:

Lyso means splitting and soma means body These are single membranous spherical sacs (vesicles). They contain digestive or hydrolytic enzymes The tysosomal enzymes are manufactured on the RER Then these enzymes are transported to Golgi complex through SER After modification these enzymes are released from Golgi complex in the form of vesicles Such vesicles are called lysosomes.

Primary lysosomes:

The newly formed lysosomes before the start of their functions are usually called primary lysosomes They vary in size, and usually 0 2-0 5 pm in diameter .In plant and fungi, certain vacuoles carryout enzymatic hydrolysis a function shared by tysosomes in animal cells .Structure:

Lysosomes contain about 40 different digestive enzymes These enzymes can breakdown every mapr macromolecule of the cell The contents Of the lysosome are acidic (With pH around 4-4 5).

Its main function IS the breakdown and removng of old parts of the cell or microorgantsm The lysosomes fuses With membrane bound vesicle that artses from ahy of these pathways - endocytosis, phagocytosis or autophagocytosls, These vesicles are referred to as endosomes, phagosomes and autophagosomes respectively These endosomes fuses with lysosomes (primary lysosomes) and forms secondary lysosomes (sometimes referred to as endolysosomes). The bromolecules are further brokendown into smaller forms like amino acids monosaccharides, nucleotides and fatty acids which are then recycled In the cell.

Functions:

Major functions of lysosomes include intracellular digestion, autophagy, autolysis.

Food Vacuoles:

The Ingested food of cell is stored in vesicles, called food vacuoles.

Secondary Lysosome:

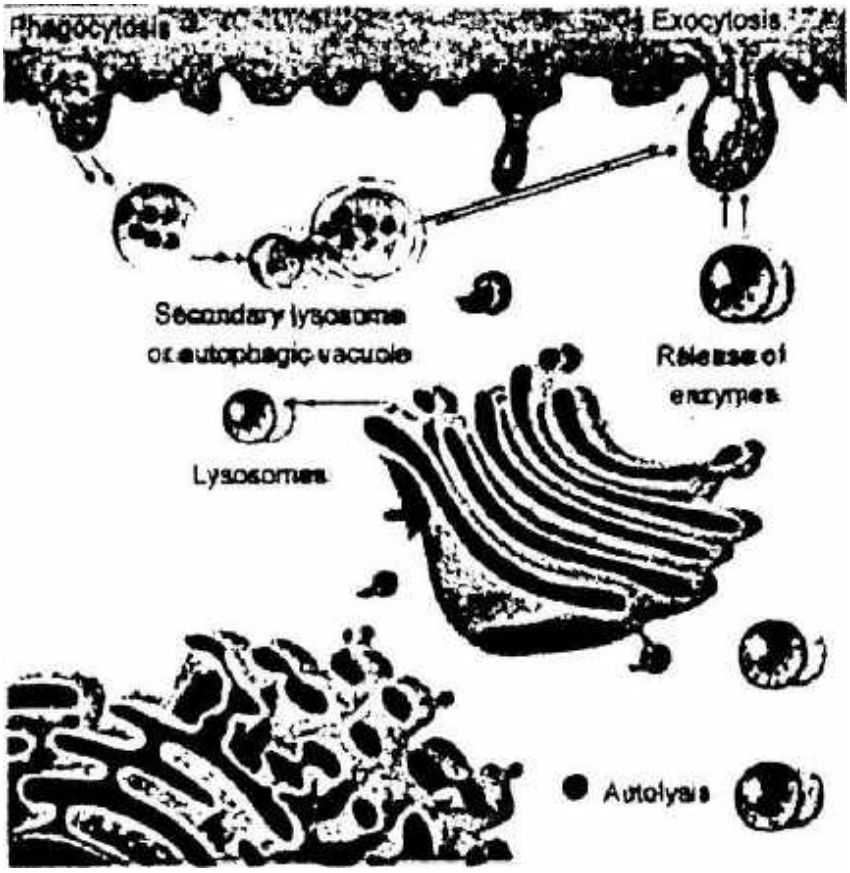
Once a lysosome has fused With food vacuole, the resulting structure is càlled secondary lysosome In which food begins to digest, Contractile Vacuole:

The digested products are absorbed by the cytoplasm while the remanng wastes containing vesicle is now called contractile vacuole. Intracellular Digestion:

Later on these vacuoles fuse with cell membrane (exocytosis) to eliminate undigested wastes, This whole process is known as intracellular digestion.

Autophagy:

The process by unwanted structures within the cell are engulfed and digested within the lysosomes IS called autophagy.



Lysosomes: form and functions

Autophagosomes:

This IS self-eating process of a cell In which a lysosome begtns to digest cell's own organelles Such tysosomes are also called autophagosomes.

This process either takes place in starvation period in order to obtain energy or it occurs In routine In order to control number of specific organelle .For example:

If someone starts to perform heavy muscular exercise, the number of mitochondria begins to increase in his muscle cells, but if he leaves exercise, the number of mitochondria are again decreased by the process of autophagy .

Autolysis:

Sometimes, especially during developmental phase, when a particular cell is required to be disintegrated, a type of cell death is committed called autolysis.

Suicidal Bags:

This IS a programmed cell death in which lysosomes burst and their enzyme contents are quickly dispersed throughout the cytoplasm. In this way the cell IS disintegrated Into fragments which are phagocytosed by other cells. Due to this function lysosomes are also called suicidal bags.

38. What are the storage diseases? Explain with reference to the malfunctioning of lysosomes.

Ans: Lysosomal. Storage Diseases:

Lysosomes contain various digestive enzymes if a particular lysosomal enzyme is missing in an individual, the digestion of that particular substance (for which enzyme was specific) Will be affected As a result the substance begins to accumulate in the cell and cause different problems. Such complications which are caused by the accumulation of various substances in the due to lack of certain lysosomal enzymes are called tysosomal storage diseases.

These diseases are hereditary and congenital therefore run in particular families and exist by birth in an individualL Most of these diseases are fatal in early childhood About more than 20 such diseases nave been discovered so far. Example:

One of the common examples IS Tay-Sachs disease in which a lipid digestng enzyme is missing or inactive and the brain becomes Impaired by an accumulation of lipids in the cell,

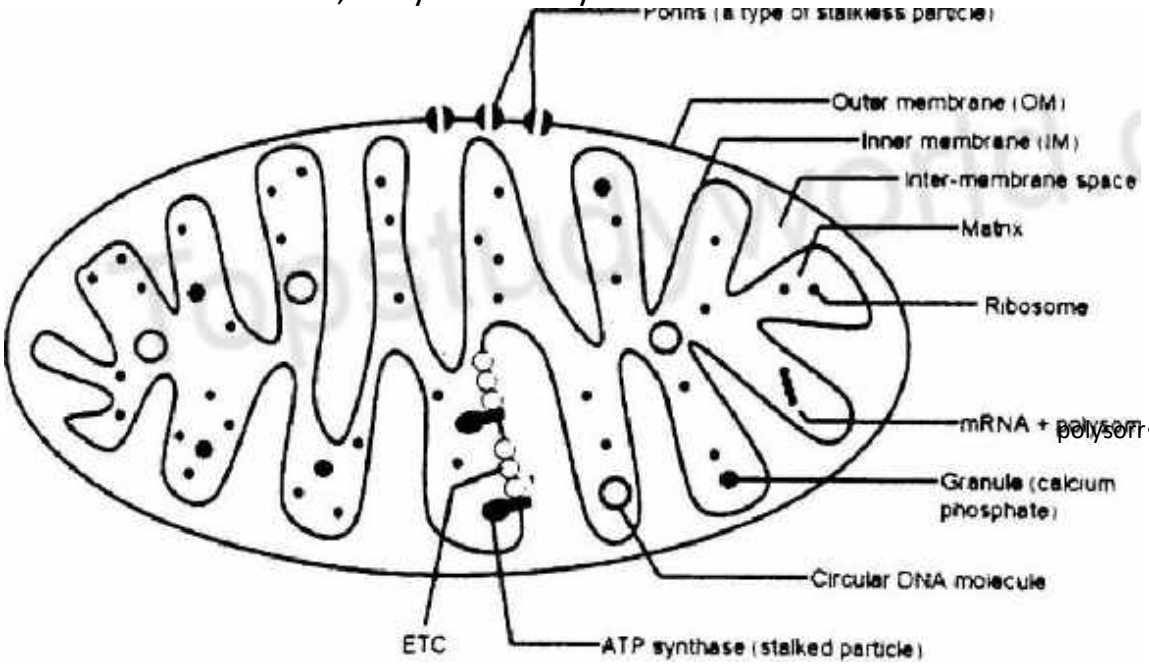
39. Describe the external and internal structure of mitochondrion? What are the functions of these structures present in mitochondria?

Ans: Mitochondria:

Mitochondria (singu\ar• mitochondrion) are present jn all eukaryotic cells .Some cells have a single large mitochondrion, but more often a cell has hundreds or even thousands of mitochondria, the number correlates with the ceil's levei of metabolic activity For example ceils that move or contract have proportionally more mitochondria per volume than less active cells.

External and Internal Structure of Mitochondrion:

Mitochondna are capable to divide themselves (self-replicating) in order to increase their number, They divided by fission.



Pcõns (a type of st81khss partcb)

Mitochondrion with FI particles

Mitochondria are cylindrical or rod shaped structures Its length ranges from 2 to 5 gm and are to 1.0 pm diameters.

They are enclosed by double membrane, the outer membrane and the inner membrane. Each membrane is a phospholipid bilayer with a unique collection of embedded proteins: The outer membrane is smooth and somewhat like a sieve.

Porins:

The outer membrane has speaat proteins embedded into the membrane called porins These are responsible for the transport of molecules across the membrane Prions allow free passage of various molecules Into the Inner membrane space.

Cristae:

The inner membrane is selectively permeable and folded inwards The folds are called cristae (singular crista) which serve to Increase the surface area Stalk Particles or FO-FI Particles:

The Inner surface of cristae is furnished with granular structures called stalk Particles or FO-FI Particles.

These particles are actually ATP synthase enzymes. In addition, several other complexes are also found in Inner mitochondrial membrane, which serve as electron carriers in electron transport chain The inner membrane divides the mitochondrion into two internal compartments. The first is the intermembrane space the narrow region between the inner and outer membranes. The second compartment, the mitochondrial matrix, enclosed by the inner membrane.

Mitochondrial matrix IS a jelly like material that contains a small circular DNA, all kinds of RNA. ribosomes (70S) and enzymes The presence of these components indicates that mitochondria have their own genetic system It means. the protejn, which are required by mitochondria are synthesized by their own metabolic machinery.

Mitochondria are the sites of cellular respiration, the metabolic process that uses oxygen to generate ATP by extracting energy from sugars fats, and other organic compounds Enzymes in the matrix catalyze some of the steps of cellular respiration like Krebs cycle Other proteins that function in ATP generation through electron transport chan are found into the Inner membrane.

40. Describe the external and Internal structure of chloroplast? What are the functions of these structures present in chloroplast?

Ans: Chloroplasts:

Chromoplasts synthesize and store different coloured pigments other than green. Therefore, they are found in coloured parts of plant such as flower petals and fruit wall where they attract Insects and thus help in pollination.

Chloroplasts are found in green parts of the plants and act as Site of photosynthesis.

External and Internal Structure and Functions of Chloroplast:

Chloroplast is a discoid structure which consists of three parts i e envelope, stroma and thylakoids. Each chloroplast is bounded by a smooth double membrane (envelope) The outer membrane tike mitochondria contans ponns and therefore freely permeable to smalt molecules The inner membrane is semtpermeable and rich in protein. Between the two intermembrane space IS 25 -75 angstrom (Å) wide Stroma:

The ground mass of chloroplast is called stroma It is the colourless proteinaceous substance which .11ke mitochondrtal matrjx also contains a small circular DNA, all kinds of RNA, ribosomes (70S) and various enzymes

Thylakoids:

The stroma contains a system of chlorophyll bearing double membrane lamellae that form flattened sac-like structures called thylakoids.

There are two types of thylakoids smaller thylak01ds and the larger thylakoids.

Smaller thylakoids (grana lamellae):

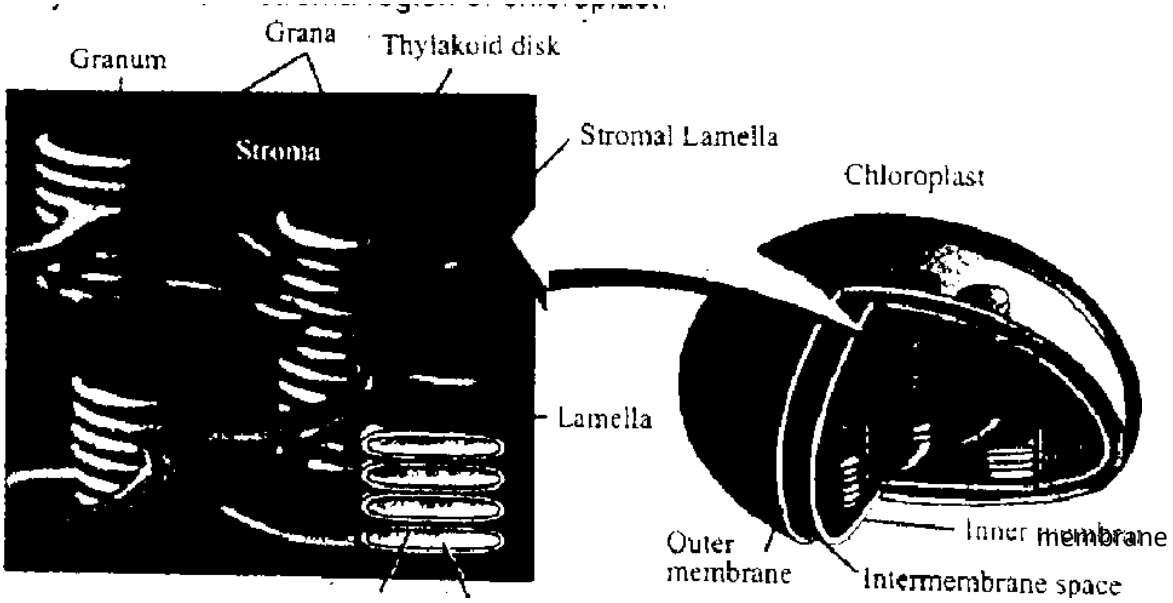
Smaller thylakoids (grana lamellae) are disc like sacs which are piled over one another like stack of coins Each stack of smaller thylakoids is called granum (plurat: grana) Each granum consists of 25-50 thylakoids and there are about 40 60 grana found in each chloroplast, Photosynthetic pigments are also found in the membranes of smaller thylakoids.

Larger thylakoids (stroma lamellae):

Larger thylakoids (stroma lamellae) connect the grana with each other and are also called intergrana These membranes are colourless as they do not have pigments Chloroplast is the site of photosynthesis in a plant cell.

The first phase of photosynthesis IS light dependent reaction In which sunlight is captured and transformed into ATP. This phase takes place in grana region of chloroplast.

The second phase of photosynthesis is light independent reaction (dark reaction) In which C02 is reduced to make carbohydrates. The enzymes for thIS activity are found in stroma region of chloroplast



Thylakoid disk

Thylakoid Thylakoid membrane space

Chloroplast

41. Compare and contrast the structure and functions of mitochondria and chloroplasts.

Ans: Similarities:

Mitochondria and chloroplast both have:

A double membrane surrounding the organelles.

- Purportedly prokaryotic origins according to the endosymbiotic theory which suggests that mitochondria and chloroplast were once prokaryotic bacteria engulfed by endocytosis in early eukaryotes
- Their own circular DNA which codes for certain enzymes reqwred for the chemtcal reactions that take place in these organelles.
- Their own 70S ribosomes made up of 50S and 30S subunits to translate proteins.
- The enzyme ATP synthase which utihzes the energy released from the movement of protons across it (proton-motive force) to phosphorylate ADP to ATP (Thus, another similarity would be that they both produce ATP) ♦ Electron transport chains, which are embedded in the inner mitochondrial membrane and thylakoid membrane in mitochondria and chloroplasts respectively.
- Both organelles have chemical cycles in which the initial acceptor IS regenerated at the end of the cycle In mitochondria the Krebs cycle occurs after which oxaloacetate is regenerated at the end Of the reaction. In chloroplasts, the Calvin cycle occurs in which ribulose bisphosphate (RuBP) is regenerated at the end of the reaction.

Differences:

- Obvious structural and naming differences that you should be able to figure out from the diagram above.
- Mitochondria are Involved In cellular respiration whereas chloroplasts are involved In photosynthesis. Thus, the overall chemical reactions for the processes occurring 'n them are different and reversed - Respiration: $C_6H_{12}O_6$ + 602 scoa+ 6Hao + ATP
- Photosynthesis: 6C02 + 6Hao + 602
- Mitochondria are found in all animal and plant celis Chloroplasts, however, are found in only specific types of plant cells such as the palisade mesophyll and spongy mesophyll cells of leaves. These cells are the ones Involved In carrying out photosynthesis. Other types of plant cells, such as root cells do not contain chloroplasts.
- Chloroplasts contain pigments such as chlorophyll a, chlorophyll b and carotehoids. Mitochondria do not contain any such pigments.
- The ATP synthase In mitochondria and chloroplast are orientated differently. ATP synthase In mitochondria points into the matrix, With protons flowing from the intermembrane space to the matrix. In chloroplasts however, ATP synthase points towards the stroma, and protons flow from the thylakoid space into the stroma.
- The types of electron acceptors present in mitochondria and chloroplast vary. While mitochondria contain NAD and FAD, Chloroplasts contain NADP ♦ The sources of energy used to synthesize ATP in mitochondria and chloroplasts are different. In mitochondria, this energy comes from the oxidation of glucose, and IS hence termed oxidative phosphorylatton In chloroplast this energy comes from light so it IS called photophosphorylatlon.
- Mitochondria function under both light and dark conditions Chloroplasts on the other-hand do need light to function.
- Electron transpon chans The final electron acceptor jn mitochondria IS oxygen whereas the final electron acceptor in chloroplasts IS NADP.
- In mitochondria, the root source of electrons IS generally glucose (it could be other substrates depending on what was utilized) In chloroplasts however the root source of electrons is the photolysis of water occurring at photosystem Il, Water (H20) is• broken down to release 2 protons, 2 e}ectrons and a molecule of oxygen.
- Mitochondria give out carbon dioxide from the decarboxylation (removal of carbon) reactiqns that occur during the link reaction and Krebs cycle but chloroplasts give out oxygen due to photolysis as explained above.

OR Second Answer

	Mitochondria	Chloro last

Meaning	A large, membrane-bound bean-shaped organelle found in almost all kind of eukaryotic organism also known as •powerhouse of the cell' Mitochondria are responsible for cellular respiration and ene metabolism	The chloroplast IS found only in green plants and in few algae they are the Sites of photosynthesis This organelle of the cell is much more complex and larger than the mitochondria
Found in	Mitochondria are present in the cells of all types of aerobic organisms, like plants and annals	Chloroplast is present in green plants and green algae, protists like Euglena
Colour	Mitochondria are the co!ourless or anelles	The chloroplast IS green tn colours.
Sha	Bean shape	Disc shape
Chamber	Mitochondria have two chambers: matrix and the cristae	Chloroplast also has two chambers stroma and th lakoid
Inner membrane	The Inner membrane of mitochondna is folded into cristae	The inner membrane of the chloroplast rises Into flattened sacs called as th lakoids
Pigments	Mitochondria do not possess any pigments.	The thylakoid membrane in chloroplast co nta ns carotenolds, chlorophyll and hotos nthetlc 1 ments
Other characteristics	Mitochondria convert sugar (glucose) into chemical called as ATP adenosine tri hos hate	In the chemicai bonds of glucose, the solar energy is stored
	It consumes oxygen	It liberates or releases ox en
	M'tochondna release energy by the breakdown of the organic food and produce carbon dioxide and water.	Chloroplast helps In storing the energy and uses carbon dioxide and water to make lucose (ene

	Mitochondna are the Site of beta oxidative, photorespiration oxidative hos hor lation, ETC	The chloroplast IS the Site of the photorespiration and photosynthests

OR (Second Answer)

Difference bebueen Mitochondria and Chloroplast:

Mitochondria:

1. They are colourless cell organelles.
2. Mitochondria are found In all types of cells of aerobic organisms, both plants and animals.
3. They are generally cylindrical in outline.
4. Their inner membrane IS folded Into cnstae
5, Cnstae do not form grana.
6. Pigments do not occur in mitochondria.
7. Mitochondria do not take part in the conversion of light energy into chemicàl energy.
8. They liberate energy by breaking down of organic food to produce carbon dioxide and water.
9. Mitochondria consume oxygen.
10. Site of electron transport chain, Beta oxidation, Oxidative phosphorylation . Photorespiration .Chloroplast:

1. Chloroplast are green organelles
2. They are restricted to only some protists {Euglena) and in plants.
3. Chloroplasts are generally disc shaped
4. The inner membrane gives rise to flattened sacs called thylakoids.
5. At places, thyfak01ds produce stacks of disc called grana.
6. The membranes of thylak01ds possess photosynthetic pigments, chlorophylls and carotenoids.
7. Chloroplasts are the centers of conversion of solar energy into chemical energy.
8. They store energy by building up organic food for which carbon dioxide and water are used as raw materials in the process-of photosynthesas.

9. Chloroplasts liberate oxygen.

10. Site of Photosynthesis, Photorespiration

42. What are centrioles? Describe the structure, composition and functions of centriole.

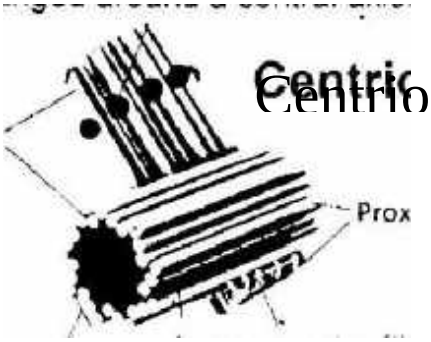
Ans: Centrioles:

Centnoles are non-membranous cell organelles found mainly in animal cells .They are also found In fungi like protists such as slime molds and water molds .Structure of Centrioles:

Centnoles are rod shaped structures and usually occur in pairs These occur at right angle to each other near one pole of the nucleus, Centnoles are about 0 150 25 gm in diameter and 0 3-2 pm in length, Centrioles he In a distinctly, statning region of the cytoplasm known as centrosphere The centrioees and centrosphere are together called centrosome.

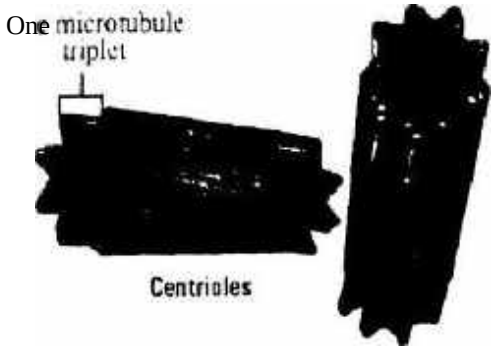
Composition of Centrioles:

Each centriole IS composed of nine triplets of microtubule which are circularly arranged around a central axis



Distal ends

Proximal ends



Microtubule triplet Interconnecting fibers Functions of Centriole:

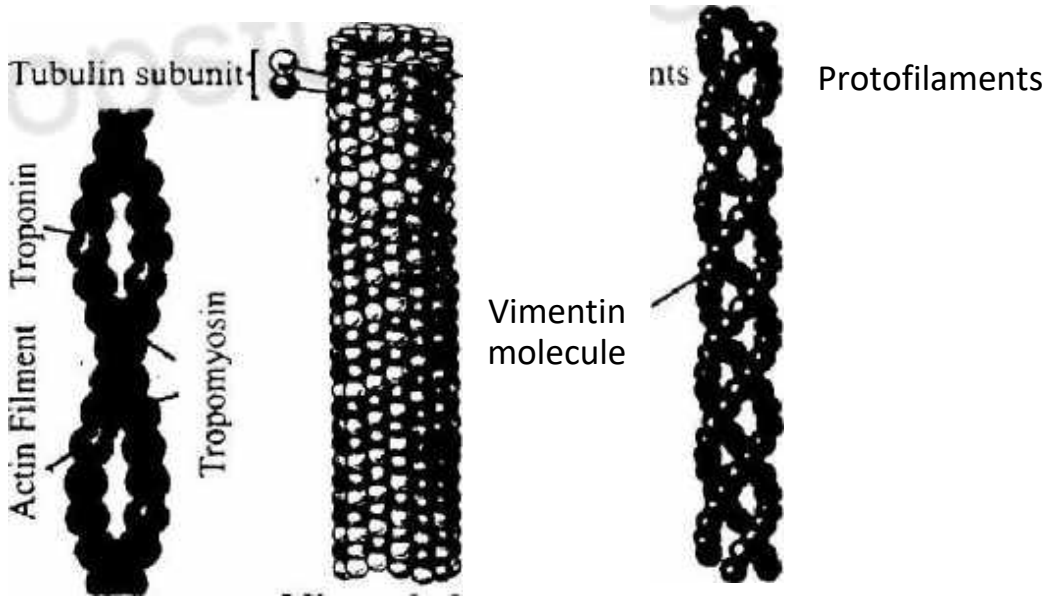
Just before the cell division the par of centrioles duplicates and becomes two pars which later on migrate to the opposite Sides of the nucleus Both centrtole pairs give rise microtubules (spindle fibres) during cell division The whole structure of spindle fibres is known as mitotic apparatus which helps in the distribution of chromosomes between the daughter cells during cell division. In addition centrioles also give rise to basal bodies or kinetosome of Cilia and flagella

43. What are cytoskeletons? Describe the types, structure, composition and functions of cytoskeleton.

Ans: Cytoskeleton:

The term cytoskeleton is generàlly applied to three different kinds of fibrous structures which are distributed from nucleus to the plasma membrane throughout the cytoplasm of a eukaryotic cell .Types of Cytoskeleton:

These fibres Include microfilaments, microtubules, and intermediate filaments.



Microfilament Microtubule Intermediate filament

Cytoskeleton

Three types of cytoskeleton

Microfilaments:

Microfilaments are also known as actin filaments .

Structure:

These are extremely thin contractile fibres about 7 nm In diameter that occur In bundles or mesh like networks, The actin filament contains two chaans of globular actin (G-actin) monomers twisted about each other In a helical manner Each chain IS calied fibrous or filamentous actin (F-actin) Composition:

Two chains of tropomyosin also twist around an actin filament and another protein troponin occurs in the form of triplets at Intervals along the length of filament

Function:

Generally, these filaments are found just under the plasma membrane where they ensure the circular streaming movement of cytoplasm due to their contractile activity In some cells (muscles), they are very abundant and found as bundles called myofibrils In this form they enable the cells for contraction and relaxation .

Microtubules:

Structure:

Microtubules are small hollow cylinders about 25nm in diameter and 0.2 - 25 pm in length .Composition:

They are composed of a protein, the tubulin. Each tubulin is a dimer i e consists of two subunits which are known as alpha and beta subunits. These tubulin dimers form paired filaments by their linear arrangements Such paired filaments are coiled or twisted to form tubular structures, the microtubules Function:

In plant cells, the microtubules are freely dispersed in cytoplasm At the time of cell division these freely dispersed microtubules organize themselves in the form of spindle shaped structure called mitotic apparatus which ensures the distribution of chromosomes between the daughter cells.

In annal cells the microtubutes are involved in the formation of centrgoles cilia flagella and basal body .IntermediateFilam

Structure:

Intermediate filaments are 8 to 10 nm In diameter i.e., intermediate In Size between actin filaments and microtubules, this is why they are called intermediate filaments. The basic protein subunit of the filament is vimentin The vimentin subunits also form chains or strings by linear arrangement .Composition:

Each intermediate filament is composed of three chains of vimentin which •are twisted about each other in such a way that no hollow space is left between them.

Function:

They usually form a network in the cytoplasm which provide a mechanical support to nuclear envelope and plasma membrane.

44. Describe the structure of cilia and flagella. Explain the mechanism of movement of cilia and flagella.

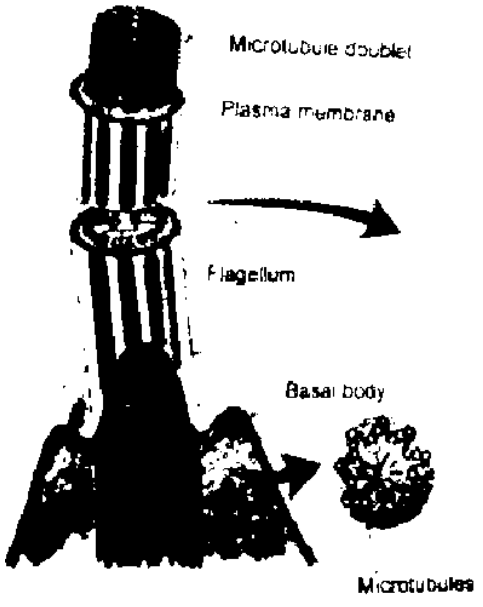
Ans: Cilia and Flagella:

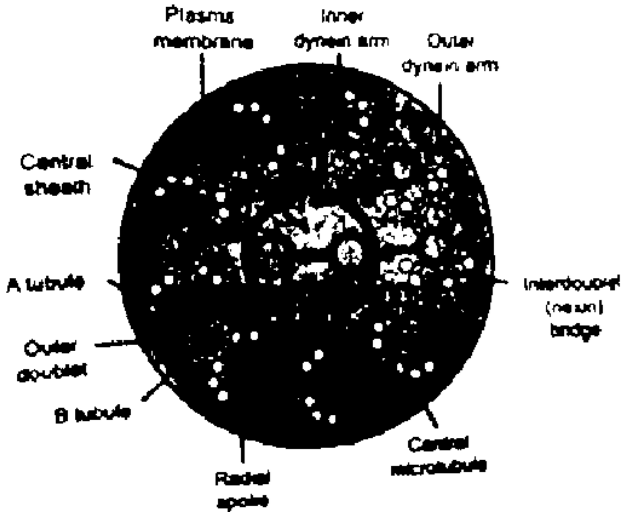
Cilia (L. cilium eyelash, hair) and flagella (L. flagella, whip) are hair like projection on the surface of the cells The internal structure of both Cilia and flagella is quite same but they may differ In size, number and pattern of movement. The flagella are longer, few in number i.e , 1 2 or 4. exhibit undulating motion and beat independently Whereas cilia are numerous and relatively short and beat perpendicularly in metachronous (cilia of a row beating one after the other) or In synchronous rhythm (all cilia of a row beating simultaneously) Structure of cilia and flagella:

Cilia and flagella onginate from their basal bodies embedded in the cytoplasm Each cilium and flagellum consists of a longitudinal axoneme enclosed in a spiral sheath of cytoplasm and a plasma membrane continuous With the cell membrane. Axoneme IS made up of a bundle of eleven longitudinal microfibrils or bundles of microtubules Nine are peripheral and arranged in a ring. In the centre of the rtng are two microtubules This arrangement IS called "9 + 2'[Y] pattern There IS a bridge connecting the two central microtubules.

Each peripheral microflbnls IS composed of two subfibres formtng a doublet .The Inner subfibre of the is complete (A tubule) and the outer sub fibre is Cshaped (B tubule). Each inner subfibre has two -arms, the outer dynein arm and inner dynern arm The arms are composed of dynein protein A radial spoke extends from a tubule to the Inner sheath Nexln IS a protetnous Inter-doublet linkage The axoneme 's held together by three sets of protein crosshnks: I.e (1) Bridge connecting the two central tubules (2) Radial spokes (3) Nexln

Cilia and flagel'a originate from their basa\ bodies embedded in the cytoplasm Each cilium and a flagellum have a basat body lying in the cytoplasm at its base. Basaf bodies have the same circular arrangement of mtcrotubule triplets as centnoles





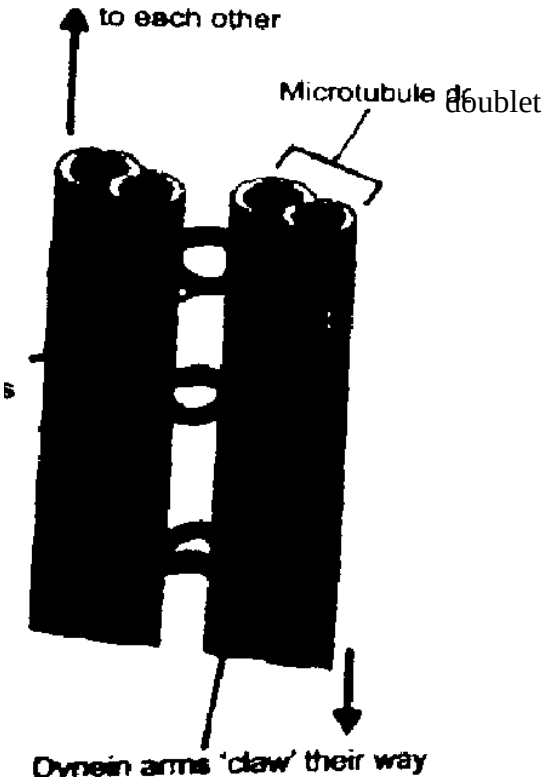
Structure of a eukaryotic flagellum or cilium

Mechanism of movement of cilia and flagella:

The mechanics of dyneln "walking" are remtmscent of dat climbing a tree by attaching Its Claw moving its legs releasing its front claws. and grabbing again farther up the tree.

Similarly, the dyneln arms of one doublet attach to an adjacent doublet and pull so that the doublets slide past each other in opposite direction The arms then release from the other doublet and reattach a little farther along its length As a result the cilia or flagellum elongates rather than bending

For lateral movement of a cllium or flageilum, the dynein "walking" must have something to pull against The dynetn arms are responsible for the bending movement of cilia and flagella Dyneln in the axoneme forms bridges between nei9hbouring microtubule doublets The dynetn hydrotyses ATP to provide energy. When ATP activates the motor domain of dynetnt it attempts to walk along the adjonng microtubule doublet This would force the adJacent doublets to slide over one another The sliding over IS prevented by the connecting]cross links" I e (1) Badge connecting the two central tubules. (2) Radial spokes (3) Nexn Thus, neighbounng doublets cannot slide past each other very far. Instead, the forces exerted by dyneln arms cause the doublets to curve, bending cilium or flagellum





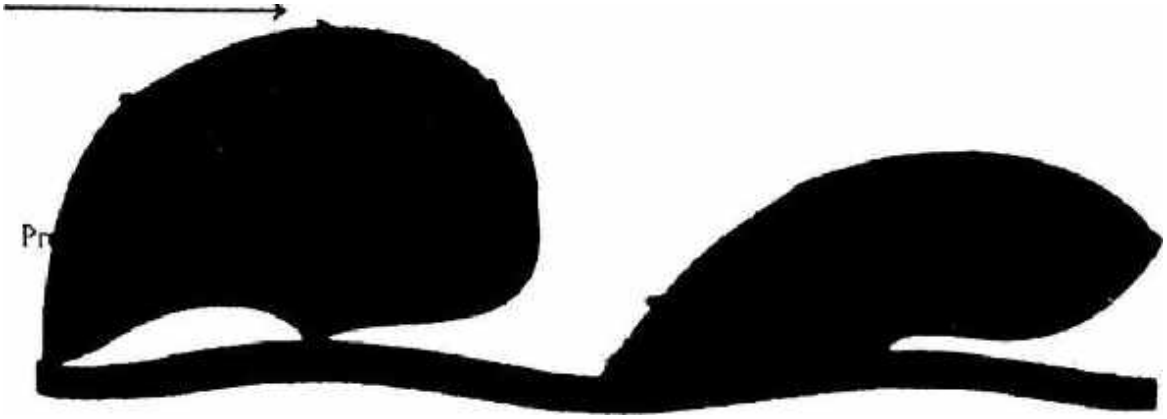
Doublets ùløe relative

Dynein
8 ide arms

Mechanism of microtubules bending in cilia and flagella

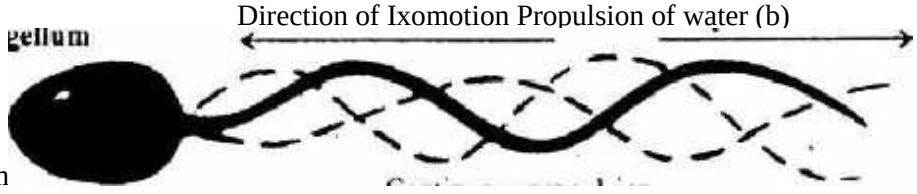
(a) Cilium

Direction of locomotion



Power stroke Return stroke or EfT(Xtivc stroke Plasma membrane or Recovery stroke

Direction of Ixomotion Propulsion of water (b)



Flagellum

Continuous propulsion Cilium

Fig: Characteristic movement patterns of cilia.and flagella. (a) Cilia usually "row" along. providing a force of movement parallel to the plasma membrane, just as oars provide movement parallel to sides ot a rowboat(b} Flagella often move in a wave like motion with a continuous bending that starts at the base and move up to the tip, This motion provides a force Of movemet$ perpendicular to the plasma membrane, In this way a flagellum attached to a sperm can move the sperm straight ahead .Movement of cilia:

(1) In 1955 It was suggested that the movement of cilia is due to sliding of double fibrils In two groups one after the other.

(2) Five out of nine double frbrils contract simultaneously.

(3) As a result clhum bends or shortens.

(4) It IS called effective Stroke.

(5) Four out of nine double fibrils contract and cilium becomes straight. It is called recovery stroke Movement of flagellum:

A flagellum causes movement by the passage of rapid successive waves of bending from the attached to the free end, as it can be seen in flagellar movement of human sperms, which propel them forward within the fluid medium of the female reproductive tract.

45. What is nuclear envelope? Describe the chemical composition and structure of nuclear envelope.

Ans: Nuclear envelope:

Nuclear envelope (also called nuclear membrane) is a double membrane covering which makes •the boundary of nucleus Both membranes of nuclear envelope are separated by a fluid-filled perinuclear space .Chemical Composition of Nuclear Envelope:

The membranes are composed of lipid bilayer and proteins.

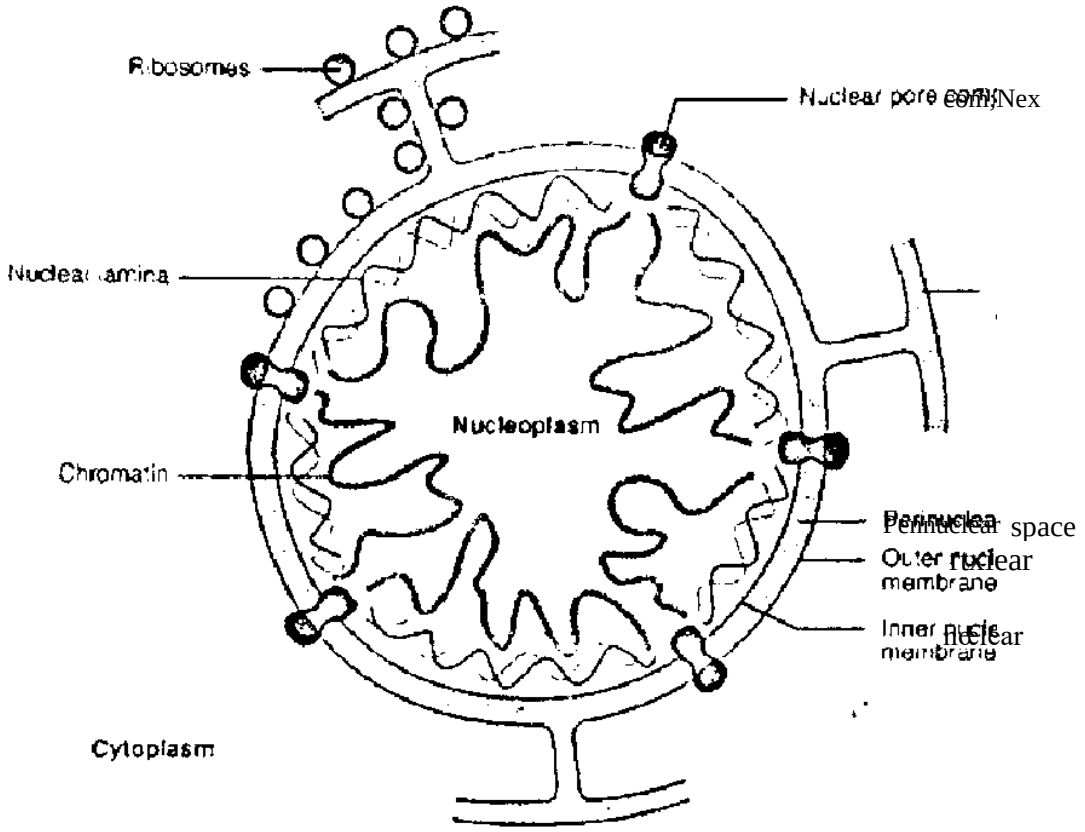
Structure of Nuclear Envelope:

The membranes are composed of lipid bilayer and proteins The outer membrane of nuclear envelope IS covered With ribosomes and is connected W'th the membranes of ER.

Nuclear pores and Nucleoporin:

There are numerous pores in nuclear envelope called nuclear pores which are composed of a specialized transport protein called nucleoporin

Rough



endoplasmc retoulurn

Nuclear envelope

At the point of nuclear pore both the membranes are interconnected These pores regulate the nucleo-cytoplasmic exchange of materials This exchange Includes RNA and ribosomal proteins moving from nucleus to the cytoplasm and proteins (such as DNA polymerase), carbohydrates Signalhng and hPlds moving Into the nucleus Although smaller molecules simply diffuse through the pores. larger molecules may be recognized by signal sequences and then be diffused With the help of nucleoponn•lnto or out of the nucleus.

Nuclear lamina:

Except at the pores, the nuclear Side of the envelope lined by the nuclear lamina, a net like array of protein filaments that maintains the shape of the nucleus by mechanically supporting the nuclear envelope.

46. What are chromosomes? Describe the structure, chemical composition and function Of chromosome.

Ans: Chromosomes:

Chromatin IS a network of thin thread like structures made up of DNA and associated protein molecules. During. cell division chromatin fibres begln to condense and coil up into separate structures called chromosomes which are thick enough to be seen With a light microscope. Chemical Composition Of Chromosome:

The major chemical components of the chromosome are DNA RNA (nucleic acids), and proteins (histones and nonhistones).

Structure of Chromosome:

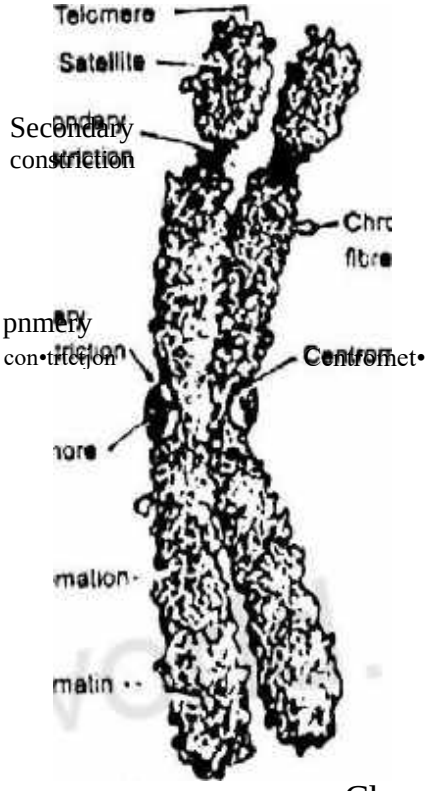
Chromatids and Centromere:

A typecal chromosome consists of two strands called chromatids which are attached With each other at a point known as centromere.

Primary Constriction:

The centromere lies within a thinner segment of-the chromosome called primary constriction.

The centromere is a constriction functionally related to the movement of



Chromatin chromosomes during cell division. Kinetochores:

Each centromere has two plaques of protecn called kinetochores that are oriented on the opposite sides of the constriction Each kinetochore forms the Klnetochor• site of attachment for a single microtubule durtng cell dlVlSlOn.

Secondary Constriction or Nucleolar

Organizer: HeterochromatvonSome chromosomes may have another pont of union along the length of chromatids called secondary Euchromatin constriction or nucleolar organizer. It gives rise to nucleoli during interphase.

Satellite and junk DNA: A pair of chromosome

At least, one pair of homologous chromosomes possesses nucleolar organizer region Beside secondary constriction, the end becomes a knob like structure called satellite This regton has a useless sequence of DNA called junk DNA.

Telomeres:

The terminal ends of chromosomes are called telomeres which prevent the two chromosomes to attach With each other from their ends Chromosomes are stained with acetocarmtne or acetoorcin.

Euchromatin:

Some parts of the chromosome take less stan and appear lighter in colour . These areas are called euchromatin Heterochromatin:

Some parts of the chromosomes take more stain and appear darker These areas are called heterochromatin Individual chromosomes can be identified by ther Size and shape.

Function of Chromosome:

Functions of Chromosomes are as follows:

i. Genetic Code Storage:

Chromosome contains the genetic material that is required by the organism to develop and grow. DNA molecules are made of chain of units called genes .Genes are those sections of the DNA which code for specific proteins required by the cell for its proper functioning .ii. Sex Determination:

Humans have 23 pairs of chromosomes out of which one pair IS the sex chromosome Females have two X chromosomes and males have one X and one Y chromosome The sex of the child IS determined by the chromosome passed down by the male If X chromosome is passed out of XY chromosome, the child Will be a female and If a Y chromosome is passed, a male child develops .iii. Control of Cell Division:

Chromosomes check successful division of cells during the process of mitosis. The chromosomes of the parent cells insure that the correct information IS passed on to the daughter cells required by the cell to grow and develop correctly . iv. Formation of Proteins and Storage:

Protetns are essential for the activity of a cell. The chromosomes direct the sequences of proteins formed in our body and also maintain the order of DNA The proteins are also stored in the coded structure of the chromosomes These proteins bound to the DNA help in proper packaging of the DNA .47. Describe the cell envelope in a bacterial cell.

Ans: The bacterial cell consists of cell envelope (glycocatyx and cell wall), cell membrane, cytoplasm, nucleoid and cell appendages (flagella and pilli). Cell

envelope IS outer wrapping of a bacterial cell which consists of glycocalyx and cell wall.

48. Describe the structure of bacteria as a model prokaryotic cell.

Ans: Prokaryotic and Eukaryotic Cells:

Two kinds of structurally different cells have been evolved overtme . Prokaryotic cells Include archaea, bacteria and Cyanobacteria whereas all other forms of life are composed of eukaryotic cells. A prokaryotic cell lacks definite membrane bounded nucleus and other organelles Its DNA is dispersed In cytoplasm. On the other hand, a eukaryotic cell contains a nucleus, endoplasmic reticulum, Golgi complex, mitochondrion, lysosomes nucleolus, chloroplast . cytoskeleton, 80S ribosomes. (larger), and flagella or Cilia · which are made up of microtubules. All these structures are missing in prokaryotes .Structure of Bacteria as a Model Prokaryotic Cell:

The bacterial ceil consists of cell envelope (glycocalyx and cell wall), cell membrane. cytoplasm, nucleoid and cell appendages (flagella and pilli) .Cell envelope:

Cell envelope is outer wrapping of a bacterial cell which consists of glycocalyx and cell wall .Glycocalyx;

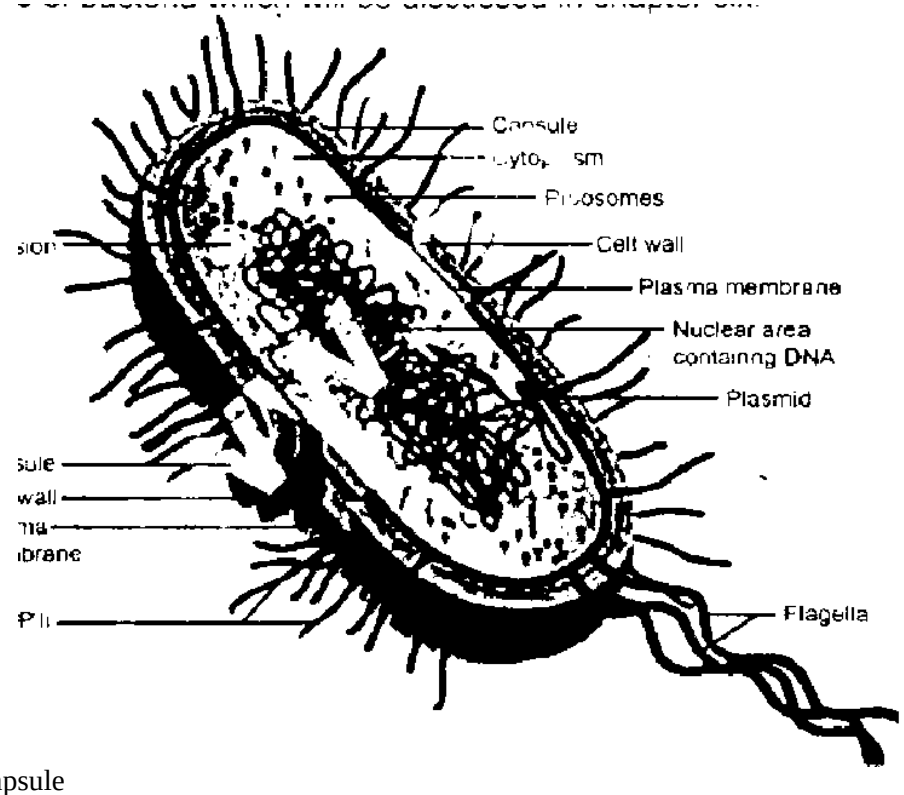
The glycocalyx IS a glycoprotein-polysaccharide covering that surrounds the cell wall of some bacteria There are two types of glycocalyx of bacteria i.e , capsule and slime layer.

Capsule:

The capsule is highly condensed form that IS relatively tightly associated with the underlying cell wall It provides sticky or gummy nature to the bacteria and helps them to attach With the surface of host tissues .Slime layer:

Slime layer is a more loosely attached glycocalyx that can be removed from the cell more easily It makes the cell slippery and thus. prevents them to be phagocytosed by the host cells. Almost all bacteria have cell watl outside the cell membrane except mycoplasma which lacks cell wall, Unlike eukaryotlc cell wall (plant and fungi), the bacterial cell wall mainly composed of peptidoglycan or mureln Further composition and structural features of cell wall differ greatly in different groups of bacteria which Will be discussed In chapter six

Incluston



Capsule
cell wall
Plasma
memorane

A bacterium

Cell membrane or Plasma membrane:

The cell membrane or plasma membrane lies beneath the cell wall which lacks cholesterols in lipid bilayer unlike eukaryotic membrane .Mesosomes:

At certain points cell membrane invaginates into the cytoplasm to form infoldlng, these are known as mesosomes In addition to the control of transport of materials across the cell, bacterial plasma membrane also involves in cellular respiration, photosynthesis and DNA replication.

Bacterial Cytoplasm:

The bacterial cytoplasm IS also a jelly like dense mass which lacks cytoskeleton and cellular organelles except ribosomes .Ribosomes:

The ribosomes are large in number and freely dispersed in the cytoplasm. These are smaller than eukaryotic ribosomes and characterized as 70S Bacterial