

Cell: The Unit of Life

Very Short answer type Questions

1. What is the significance of vacuole in a plant cell?

A: In plant cells the vacuoles act as repositories for metabolic by-products, excretions and other waste materials. It plays important role in osmoregulation. It imparts colour to certain plant parts due to the presence of anthocyanins.

2. What does 'S' refers in a 70S & 80S ribosome?

A: 'S' stands for the sedimentation coefficient expressed in Svedberg unit. It is indirectly a measure of density and size.

3. Mention a single membrane bound organelle which is rich in hydrolytic enzymes?

A: Lysosome.

4. What are gas vacuoles? State their functions?

A: Gas vacuoles are aggregates of number of small vesicles in certain aquatic bacteria. They hold atmospheric gases and help bacteria afloat in water at particular depths.

5. What is the function of a polysome?

A: The ribosomes of a polysome translate the mRNA into protein.

6. What is the feature of a metacentric chromosome?

A: The metacentric chromosome has middle centromere forming two equal arms of the chromosome.

7. What is referred to as satellite chromosome?

A: Portion of chromosome beyond secondary constriction is called as satellite. Satellites show repetitive nucleotides. Chromosomes with satellites are called as satellite chromosomes.

8. What are microbodies? What do they contain?

A. Peroxisomes and Glyoxysomes are often called as microbodies.

Peroxisomes contain enzymes for phospholipid synthesis and catabolism of long chain fatty acids.

Glyoxysomes contain enzymes of glyoxylate cycle that convert lipids into carbohydrates.

9. What is middle lamella made of? What is its functional significance?

A: Middle lamella is made up of calcium pectates. It glues (cements) different neighbouring cells. It interconnects neighbouring cells through their plasmodesmata.

10. **What is osmosis?**

A: Movement of water (solvent) by diffusion across the membrane is called as osmosis.

11. **Which part of the bacterial cell is targeted in Gram's staining?**

A: Chemical composition of cell envelope (cell wall) is targeted in Gram's staining.

12. **Which of the following is not correct?**

(a) Robert Brown discovered the cell.

(b) Schleiden and Schwann formulated the cell theory.

(c) Virchow explained that cells are formed from pre-existing cells.

(d) A unicellular organism carries out its life activities within a single cell.

A: (a) Robert Brown discovered the cell.

13. **New cells generate from?**

(a) Bacterial fermentation.

(b) Regeneration of old cells.

(c) Pre-existing cells.

(d) Abiotic materials.

A: (c) Pre-existing cells.

14. **Match the following:**

(a) Cristae

(i) Flat membranous sacs in stroma

(b) Cisternae

(ii) Infoldings in mitochondria

(c) Thylakoids

(iii) Disc-shaped sacs in Golgi apparatus.

A: a — ii ; b — iii ; c — i.

15. **Which of the following is correct?**

(a) Cells of all living organisms have nucleus.

(b) Both animal and plant cells have a well defined cell wall.

(c) In prokaryotes, there are no membrane bound organelles.

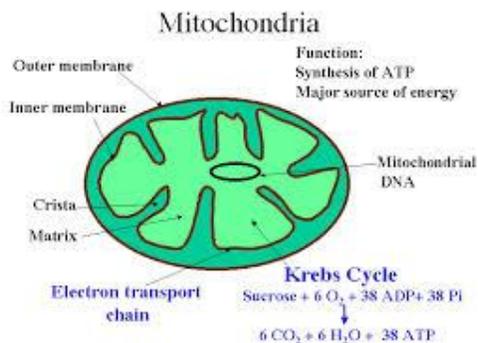
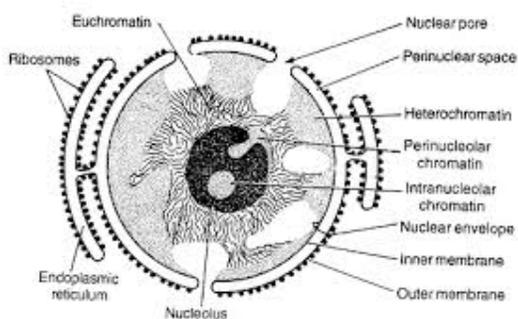
(d) Cells are formed from *de novo* from abiotic materials.

A: (c) In prokaryotes, there are no membrane bound organelles.

Short Answer type Questions

1. Describe structure and function of mitochondria?

A.

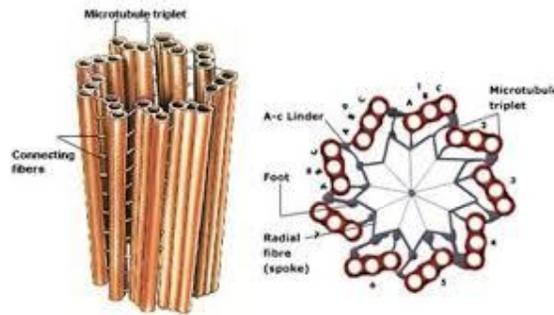


Mitochondria are double membraned cell organelle. Mitochondria is a rod shaped cell organelle or sausage shaped or cylindrical having a diameter of 0.2 to $1.0\ \mu\text{m}$ and length of 1.0 to $4\ \mu\text{m}$. Outer wall is smooth and inner wall folds into finger like projections inwards called cristae. Opposite cristae do not fuse. They are present only in eukaryotic cells. Central liquid portion is called matrix. In the matrix circular form of DNA is present. 70S type ribosomes are also present in the matrix.

They are the sites of aerobic respiration and produce cellular energy in the form of ATP hence they are called “Power houses of the cell”.

2. Describe the structure of the nucleus?

A: Nucleus is discovered by Robert Brown. In the interphase cells it is clearly seen as a round globose structure. It is enclosed by a double membrane. In between two membranes intermembranous space is present called perinuclear space. Outer membrane shows pores in it called nuclear pores. The liquid portion inside is called as nucleoplasm consisting on proteins water, enzymes, etc. One or two dense portions are present and they are called nucleolus. The nuclear matrix shows thread like structure called chromatin. The chromatin during cell division condenses to form chromosomes. Chromosomes are made of DNA and basic histone proteins. Normally there is one nucleus but the number may vary from one to many. In ascomycotina and basidiomycotina two nuclei are present in dikaryotic condition. In Zygomycotina many nuclei are present.



3. Comment on the cartwheel Structure of centriole?

Ans: Centrosome is an organelle usually containing two cylindrical structure called centrioles. They are surrounded by amorphous pericentriolar materials. Both the centrioles in a centrosome lie perpendicular to each other in which each has an organization like “cartwheel”. They are made up of nine evenly spaced peripheral fibrils of tubulin. Each of the peripheral fibril is a triplet. The adjacent triplets are also linked. The central part of the centriole is also proteinaceous and called the ‘Hub’, which is connected with tubules of the peripheral triplets by radial spokes made of protein. The centrioles form the basal body of cilia and flagella and spindle fibres that give rise to spindle apparatus during cell division in animal cells.

4. Briefly describe the cell theory?

A. Schwann proposed the hypothesis that the bodies of animals and plants are composed of cells and produces of cells. Schleiden, examined a large number of plants and observed that all plants are composed of different kinds of cells which form the tissues of the plant. Schleiden and Schwann together formulated cell theory. But this theory did not explain as to how new cells were formed. Rudolf Virchow first explained that cells divided and new cells are formed from pre-existing cells. He modified the hypothesis of Schleiden and Schwann and gives a definite shape to cell theory which states that:

- 1) All living organisms are composed of cells and products of cells.
- 2) All cells arise from the pre-existing cells.

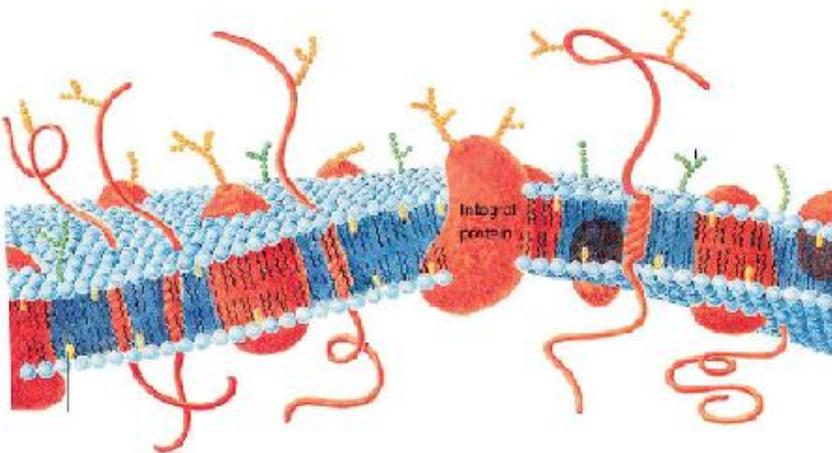
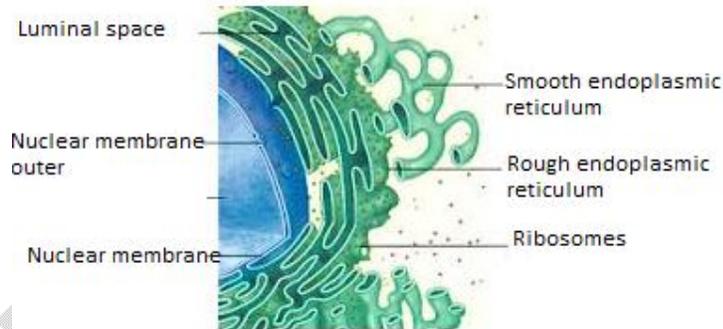
5. Differentiate between Rough Endoplasmic Reticulum (RER) and smooth Endoplasmic Reticulum (SER)?

Ans.

Rough ER	Smooth ER
i) Rough ER is studded with ribosomes ii) These are mainly composed of cisternae iii) Generally associated with nuclear membrane iv) Main function of protein synthesis	i) Smooth ER is not associated with ribosomes ii) These are mainly composed of tubules iii) Generally associated with plasma membrane. iv) Main function is lipid synthesis.

6. Give the biochemical composition of plasma membrane. How are lipid molecules arranged in the membrane?

Ans:



Plasma membrane is made up of lipids that are arranged in fila. Later biochemical investigations clearly revealed that the cell membrane also posses protein and Carbohydrate. The lipids are arranged with in the membrane, with the polar (hydrophilic) head towards the outer sides and the tail (hydrophobic) towards the inner part. Within the lipids, proteins are classified into integral or peripheral proteins.

An improved model Nicholson (1972) widely accepted as “Fluid Mosaic Model” According to this, the quasi fluid nature of lipid enables lateral movement of proteins within the overall bilayer.

7. What is cytoskeleton? What functions is it involved in?

A. An elaborate network of filamentous proteinaceous structures present in the cytoplasm is called cytoskeleton. Eukaryotic cells contain three major components of cytoskeleton, microfilaments, intermediate filaments and microtubules. Cytoskeleton is involved in mechanical support, maintenance of cell shape, cell motility, intracellular transport signaling across the cell and Karyokinesis.

8. What is the endomembrane system? What cell organelles are not included in it? Why?

A. A group of cell organelle with coordinate functions is called endomembrane system. Mitochondrial, chloroplast and peroxisomes are not associated with endomembrane system because their functions are not coordinated with the ER, Golgi complex, lysosomes and vacuoles.

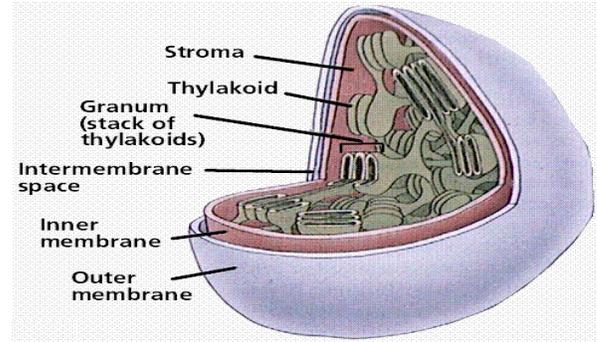
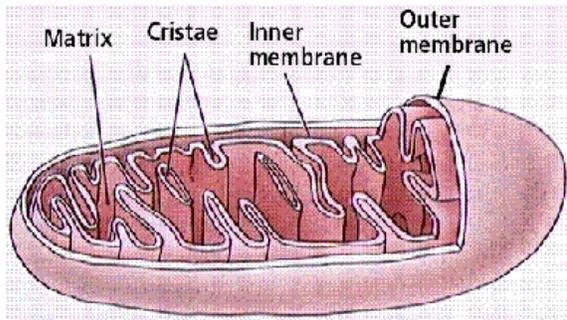
9. Distinguish between Active transport and passive transport?

A.

Active transport	Passive transport
1. Movement of molecules or ions across the plasma membrane by utilizing ATP is called Active transport. 2. It is carried out against the concentration gradient. Ex: Uptake of salt by cells through solution pump.	1. Movement of molecules across the plasma membrane without utilizing metabolic energy is called concentration gradient. 2. It is carried out along the concentration gradient. Ex: If the concentration of water is more outside the cell than inside, water will flow. into the cell, called diffusion.

10. What are nucleosomes? What are they made of?

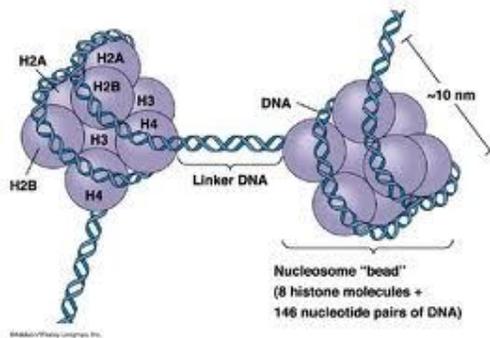
A.



1) Under electron Microscope, chromatin appears as “beads on string”. These beads are known as Nucleosomes. A typical nucleosomes contains 200 bp of DNA double helix wrapped around a core of histone octamer having two copies of each of four types of histone proteins viz H2A, H2B, H3 and H4, H1 histone lines outside the nucleosome core and seals the two turns of DNA by binding at the point where DNA enters and leaves the core. The DNA continues between two nucleosomes is called linker DNA.

11. Name two cell-organelles that are double membrane bound. What are the characteristics of these two organelles? State their functions and draw labelled diagrams of both?

A.

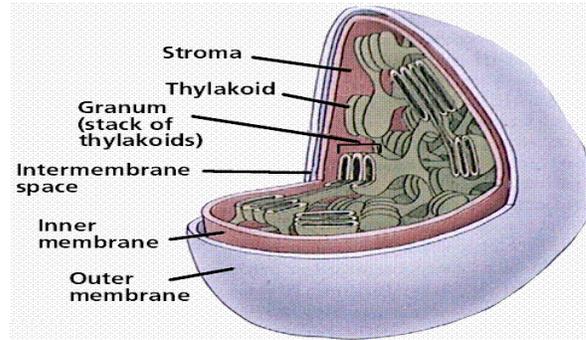


Mitochondria and chloroplasts are double membrane found cell organelles Mitochondria is a rod shaped cell organelle or sausage shaped or cylindrical having a diameter of 0.2 to 1.0 $m\mu$ and length of 1.0 to 4 $m\mu$. They are the sites of aerobic respiration and produce cellular energy in the form of ATP hence they are called “Power houses of the cell”.

Chloroplasts are lens shaped, oval, spherical or ribbon like bodies having 5-10 $m\mu$ length and 2.4 $m\mu$ width. They contain enzymes, required for the synthesis of carbohydrates and proteins.

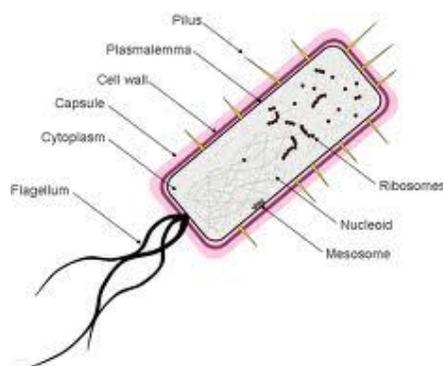
12. What are the characteristics of a prokaryotic cell?

A.



- i) Nuclear envelope is absent; cell shows a single circular, super coiled naked DNA called nucleoid.
- ii) Nucleolus is absent
- iii) Endomembrane system is absent
- iv) Mitochondria, plastids, lysosomes, peroxisomes and cytoskeleton are absent
- v) Respiratory enzymes are located in cell membrane
- vi) 70 s type of ribosomes are present
- vii) Cell is surrounded by a cell wall, made up of polysaccharides, lipids and proteins.
- viii) Cells divide amitotically

13. Describe the cell organelle which contains chlorophyll?



Cell organelle which contains chlorophyll is chloroplast. Chloroplasts are the sites of photosynthesis in eukaryotes. They are double walled. It has an outer membrane and an inner membrane. In between membranes periplastidial space is present. They contain chlorophyll, the green pigment necessary for photosynthesis to occur, and associated accessory pigments (carotenes and xanthophylls) in photosystems embedded in membranous sacs, thylakoids (collectively a stack of thylakoids are a granum [plural = grana]) floating in a fluid termed the stroma. Chloroplasts contain many different types of accessory pigments, depending on the taxonomic group of the organism being observed. Like mitochondria, chloroplasts have their own DNA, and ribosomes.

14. Give a brief account of type of chromosomes based on their position of centromere

A: **Metacentric:** These are X-shaped chromosomes, with the centromere in the middle so that the two arms of the chromosomes are almost equal. A chromosome is metacentric if its two arms are roughly equal in length.

Submetacentric: If arms' lengths are unequal, the chromosome is said to be submetacentric.

Acrocentric: If the one of the arm is so short that it is hard to observe, but still present, then the chromosome is Acrocentric.

Telocentric: A **telocentric** chromosome's centromere is located at the terminal end of the chromosome.

15. Briefly give the contribution of the following scientists in formulating the cell theory?

a) **Rudolf Virchow** b) **Schleiden and Schwann.**

A. A) **Rudolf Virchow:** He first explained that cells divided and new cells are formed from pre-existing cells (Omnis cellula –e cellula) He modified the hypothesis of Schleiden and Schwann to give the cell theory a final shape cell theory states that all living organisms are



composed of cells and products of cells. All cells arise from pre-existing cells.

b) **Schleiden and Schwann:** In 1838, Mathias Schleiden, examined a large number of plants and observed that cell plants are composed of different kinds of cells which form the tissues of the plant. Theodoe Schwann (1839), a British Zoologist, studied different types of animal cells and reported that cells had a thin outer layer which is called plasma membrane. He also concluded, based on his studies on plant tissues, the presence of cell wall is a unique character of the plant cells. Based on this, Schwann proposed the hypothesis that the bodies of animals and plants are composed of cells and products of cells.

LONG ANSWER TYPE QUESTIONS

1. What structural and functional attributes must a cell have to be called a living cell?

A. All living organisms are made up of cells and product of cells. Cell is the basic structural and functional unit of living organisms. Each cell has different organelles and performs different functions.

- 1) Cells obey laws of energetic ie. They transform energy.
- 2) Cells highly structural with emergent properties.
- 3) Cells have an evolutionary origin.
- 4) Cells metabolize means possess metabolic pathways, process nutrients, self adjust to environment.
- 5) Cells self replicate-nucleic acids, ribosomes.
- 6) Cell osmoregulate – vacuoles, vesicles.
- 7) Cells communicate – Glycoproteins.
- 8) Cells show animation cyclosis.
- 9) Cell grows, divide and differentiate.
10. Cells die.

2. Ekaryotic cells have organelles which may?

- a) Not be bound by a membrane.
- b) Bound by a single membrane.
- c) Bound by a double membrane.

Give the various sub-cellular organelles into these three categories.

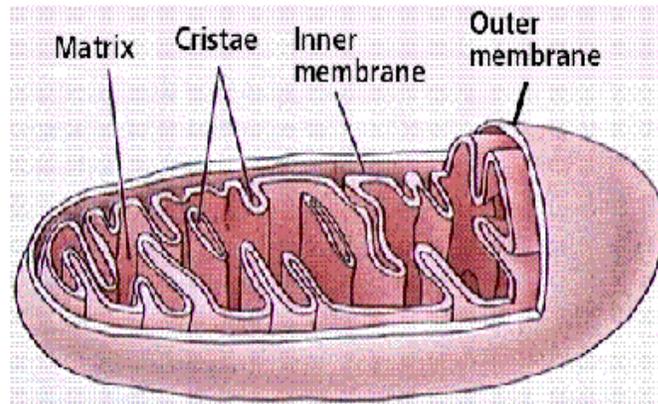
- A.**
- a) Not be bound by a membrane: Nucleolus.
 - b) Bound by a single membrane: Lysosomes, vacuoles.

c) Bound by a double membrane: Mitochondria, chloroplast, nucleus.

3. **The genomic content of the nucleus is constant for a given species where as the extra chromosomal DNA is found to be variable among the members of a population.**

Explain?

A.



In Prokaryotes (Bacteria) in addition to the genomic DNA, small circular DNA molecules are present in the cytoplasm. These small DNA molecules are called plasmids. They confer unique phenotypic character to such bacteria (ie.) resistance to antibiotics. It is also used to monitor bacterial transformation with foreign DNA.

In eukaryotes, extra DNA molecules are present both in chloroplast (stroma) and mitochondria (matrix) Because of the presence of this DNA molecule; they are treated as self –autonomous cell organelles.

4. **Justify the statement. “Mitochondria are power houses of the cell”?**

A. Mitochondria is sausage-shaped or cylindrical structure having a diameter of 0.2 to 1.0 μm and length 1.0 to 4.1 μm . Each mitochondrion is a double membrane bound structure with outer membrane and inner membrane dividing its lumen distinctly into two aqueous compartments. The inner compartment is called the matrix. The outer membrane forms the continuous limiting boundary of the organelle. The inner membrane forms a number of infoldings called the cristae towards the matrix. The cristae increase the surface area. The mitochondria are the sites of aerobic respiration. They produce cellular energy in the form of ATP; hence they are called “power houses” of the cell. The matrix also possesses a single circular DNA molecules, a few RNA molecules, ribosomes (70S) and the compartments required for the synthesis of proteins.

5. Is there a species specific or region specific type of plastid? How does no distinguish one from the other?

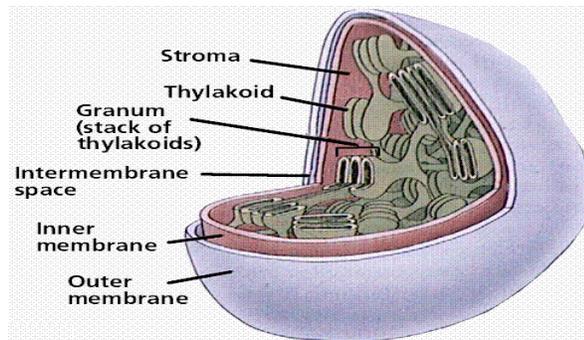
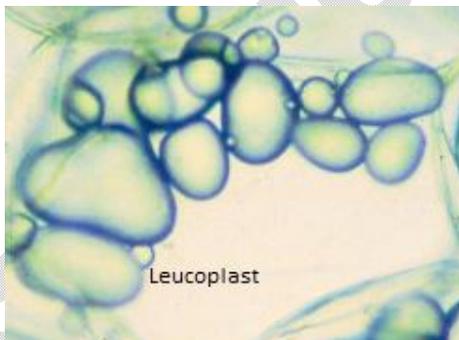
A.

Plastids are species specific and are found in all plant cells and in euglenoids. They bear some specific pigments thus imparting specific colours to the part of the plant which possess them. Based on the type of pigments, plastids are classified into three types. They are Leucoplasts, Chromoplasts, and Chloroplasts.

Leucoplasts: They are the colourless plastids which store food materials. Based on the storage product, they are of 3 types of namely Amyloplasts (store starch) elaioplasts (store oils) and aleuroplasts (store proteins).

Chromoplasts : They are coloured pigments which were in yellow, orange or red in colour, In these plastids, fat soluble carotenoids like carotene and xanthophylls are present which imparts orange, red or yellow colour.

Chloroplasts: These are green coloured plastids which help in synthesis of food materials by photosynthesis. They contain chlorophyll and carotenoid pigments which trap light energy. Each chloroplast is oval or spherical, double membrane bound cell organelle. The space present inner to inner membrane is called stroma. A number of organized flattened membranes sacs called thylakoids and present in the stroma. Thylakoids are arranged in stacks like the piles of coins called grana. The thylakoids of the different grana are connected by membranous tubules called the stroma lamellae. The stroma of the chloroplast contains

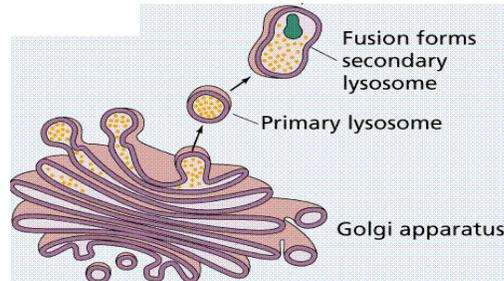
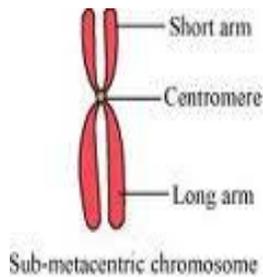


enzymes required for the synthesis of carbohydrates and proteins.

6. Write the functions of the following?

- a) Centromere b) Cell wall c) Smooth ER d) Golgi complex e) Centrioles

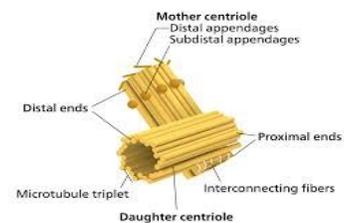
A.

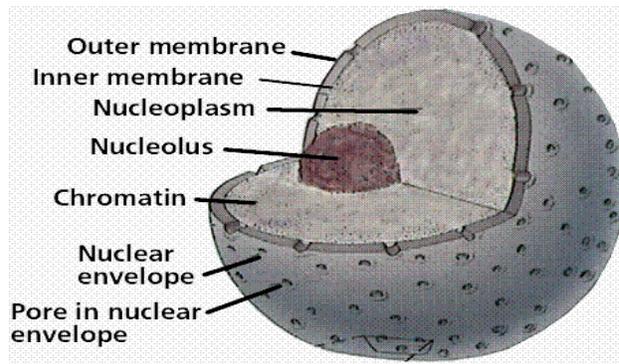


- a) **Centromere** : It is required for proper chromosome segregation. The centromere keeps the two sister chromatids together. It is also where the chromosome attaches to the spindle apparatus during mitosis and meiosis.
- b) **Cell wall**: It gives a definite shape to the cell and protects the cell from mechanical damage and infection. It also helps in cell-to-cell interaction and acts as a barrier to undesirable macromolecules.
- c) **Smooth ER**: It helps in synthesis of lipids, metabolism of carbohydrates and calcium concentration, drug detoxification and attachment of receptors on cell membrane proteins. The smooth ER also contains the enzyme Glucose – 6 – Phosphatase which converts Glucose – 6 – Phosphate to glucose.
- d) **Golgi complex**: It is the important site for the formation of glycoproteins and glycolipids. It is also involved in the synthesis of cell wall materials and also plays a main role in the formation of cell plate during cell division.
- e) **Centrioles** : They form the basal body of cilia and flagella and spindle fibres that give rise to spindle apparatus during cell division in animal cells.

7. Are the different types of plastids interchangeable? If yes, give examples where they are getting converted from one type to another?

- A. Yes, plastids are interchangeable in form. Generally three types of plastids are present in plant cells namely, leucoplasts (storage), chromoplasts (coloured, attraction) and chloroplasts (synthesis of food). Chromoplasts are coloured plastids (orange, yellow or red), occurs in the cell of petals, fruits, etc. They contain less chlorophyll and more carotenes (orange) or (red) and xanthophylls (yellow). The red colour of tomato is due to the presence of lycopene in the chromoplasts. The chromoplasts of red algae contain phycoyanin and phycoerythrin. The chromoplasts of brown algae contain fucoxanthin.





Depending upon circumstances, one type of plastid may be converted into another type.

For Ex:

- 1) The leucoplasts in stem tubers of potato, on exposure to sunlight transform into chloroplasts.
- 2) In capsicum, the cells of ovary consist of leucoplasts. When ovary changes into fruit, leucoplasts are transformed into chloroplasts. When the fruit ripens chloroplasts are changed into chromoplasts.

8. Describe the structure of the following with the help of labelled diagrams.

(i) Nucleus (ii) Centrosome

A.

i) Nucleus: It was first discovered by Robert Brown. Later the material of the nucleus stained by the basic dyes was given the name chromatin by Flemming. The interphase nucleus are highly extended and elaborate nucleoprotein fibres called chromatin, nuclear matrix and one or two nucleoli. Electron microscopy has revealed that the nucleus is covered by double layered nuclear envelope, with a space between called perinuclear spaces, forms a barrier between materials present inside the nucleus and the cytoplasm.

The outer nuclear envelope remains continuous with the endoplasmic reticulum and also bears ribosomes. At a number of places, the nuclear envelope is interrupted by nuclear pores, which allows the passage of RNA and protein molecules in both directions between the nucleus and cytoplasm. The nucleoplasm contains nucleolus and chromatin. The nucleoli and spherical structures involved in active ribosomal RNA synthesis. The chromatin in different stages of cell division, become chromosomes. They contain DNA and some basic proteins

called histones and also RNA. Nucleus plays an important role in biogenesis of ribosomes. It plays a significant role in mitosis.

ii) **Centrosome** : Centrosome is an organelle usually containing two cylindrical structures called centrioles. They are surrounded by amorphous pericentriolar materials. Both the centrioles in a centrosome lie perpendicular to each other in which each has an organization like cartwheel. They are made up of nine evenly spaced peripheral fibrils of tubulin. Each of the peripheral fibril is a triplet. The adjacent triplets are also linked. The central part of the centriole is also proteinaceous and called the 'hub', which is connected with tubules of the peripheral triplets by radial spokes made of protein. The centrioles form the basal body of cilia and flagella and spindle fibres that give rise to spindle apparatus during cell division in animal cells.

9. **What is a centromere ? How does the position of centromere form the basis of classification of chromosomes? Support your answer with a diagram showing the position of centromere on different types of chromosomes.**

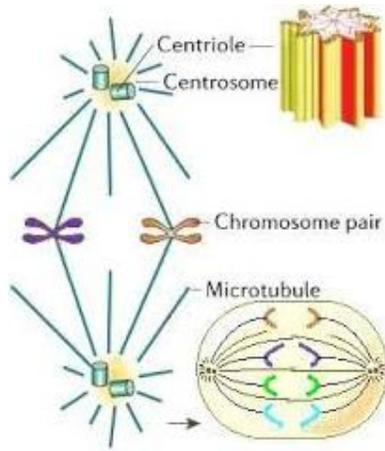
A.



Centromere is the region of chromosome that becomes attached to spindle fibres. Special proteins surrounded the centromere. They form a disc shaped structures called kinetochores.

Each chromosome shows centromere at a specific position. Basing on the position of centromere, four types of chromosomes are recognized. They are:

- 1) Metacentric : “If the centromere is situated at midpoint of a chromosome”. It is “V” shaped and consists of two equal arms.
- 2) Sub – metacentric : “If the centromere is situated slightly away from midpoint of a chromosome”. It is ‘L’ shaped. It consists of two unequal arms.
- 3) Acrocentric : If the centromere is situated at the sub terminal position of a chromosome. It is rod shaped or”J” shaped. It consists of very long arm and a very small arm.
- 4) Telocentric : “If the centromere is situated at the terminal position of a chromosome”. It is “i” shaped and has only one arm.



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