8

Cell: The Unit of Life

Multiple Choice Questions (MCQs)

Q. 1 A common characteristic feature of plant sieve tube cells and most of mammalian erythrocytes is

(a) absence of mitochondria
(b) presence of cell wall
(c) presence of haemoglobin
(d) absence of nucleus

Thinking Process

In prokaryotes the genetic material is scattered and irregular and is not membrane bound. In eukaryotes the nucleus is well defined and enclosed in a membrane called, nuclear envelope.

Ans. *(d)* The common characteristic feature of plant sieve tube and mammalian erythrocyte is the absence of nucleus. Sieve tubes are the component of phloem and do not contain nucleus. Similarly, erythrocytes in mammalian cell also do not posses nucleus. Erythrocytes are the RBCs which helps in gaseous exchange.

Mitochondria is absent in sieve tube cells. Pigment haemoglobin is present in mammalian erythrocytes but not in sieve tube cells. Cell wall is made of cellulose and is present in all plant cells, and thus absent in erythrocytes.

Q. 2 Select one which is not true for ribosome

(a) Made up of two sub-units
(b) Form polysome
(c) May attach to *m*RNA
(d) Have no role in protein synthesis

Ans. *(d)* **Ribosomes** are truly called as **protein factory** and they play a vital role in protein synthesis. Thus, the statement that ribosomes have no role in protein synthesis is not true.

Other statements are true for ribosome

Ribosomes are made up of two subunits, *i.e.,* large and small.
In prokaryotes it is 70S (50S and 30S).
In eukaryotes it is 80S (60S and 40S).

Polyribosomes
Several ribosomes attach to a single *m*RNA and form a chain like structrue.

Polysomes
They are formed by the attachment of ribosomes with *m*RNA.

Q. 3 Which one of these is not a eukaryote?

(a) *Euglena* (b) *Anabaena* (c) *Spirogyra* (d) *Agaricus*

Thinking Process

Cells are categorised into prokaryotes and eukaryotes on the basis of certain structural differences among them. There is no well defined nucleus, genetic material is naked due to the absence of nuclear membrane and the cells do not have membrane bound cell organelles. In eukaryotes, the presence of membrane bound cell organelles and well defined nucleus are the determining features.

Ans. ***(b)*** In above question, *Anabaena* is the only organism that is not an eukaryote and only possess prokaryotic characteristic features. *i.e.,* absence of membrane bound organelles and undefined nucleus.

Whereas, *Euglena*, *Spirogyra* and *Agaricus* are eukaryotes, possessing membrane bound organelles as mitochondria and nucleus (well defined).

Q. 4 Which of the following stain is not used for staining chromosomes?

(a) Basic fuschsin (b) Safranin

(c) Methylene blue (d) Carmine

Thinking Process

Staining is an auxillary technique that is used in microscopy to enhance contrast of the microscopic images. Stains and dyes are frequently used in biology and medical science for observing structural differentiation of biological tissue, microbes, blood cells and other different organelles within cells.

Ans. ***(b)*** **Safranin** It is used as a counterstain in gram staining and endospore staining. It can also be used for detection of cartilage, mucin and mast cell granule.

Carmine The basic dye, is used to stain nucleic acid and chromosomes, which possess negative charge on them. It gives chromosomes a pink colour thus, differentiating from other cellular organelles.

Basic Fuschin It involves in staining of human chromosomes elastic fibres, cardiac or skeletal muscle tissue.

Methylene blue It used to stain nuclei, Golgi bodies and pectic substances.

Q. 5 Different cells have different sizes. Arrange the following cells in an ascending order of their size. Choose the correct option among the followings.

I. Mycoplasma II. Ostrich eggs

III. Human RBC IV. Bacteria

(a) I, IV, III, II (b) I, II, III, IV

(c) II, I, III, IV (d) III, II, I, IV

Ans. ***(a)*** Represents the correct ascending order of cell's size.

Cells in organism vary greatly in their size, shapes and activities.

I. Mycoplasmas are the smallest cell with size only 0.3 mm.
II. Bacterial cell are of size 30 – 5 μm.
III. In human red blood cells are of about 7.0 μm in diameter.
IV. Ostrich eggs are among the largest cells with size (15 × 13) cm.

Mycoplasma Like Organisms (MLOs) or mycoplasma are the smallest cell followed by the size of bacterial cell, then RBCs and ostrich egg cell is the largest known cell.

Q. 6 Which of the following features is common to prokaryotes and many eukaryotes?

(a) Chromatin material present

(b) Cell wall present

(c) Nuclear membrane present

(d) Membrane bound sub-cellular organelles present

Ans. ***(b)*** Presence of cell wall is the common feature that is observed in both prokaryotic and some eukaryotic cells.

Cell wall is present in bacteria (prokaryotes) and in plants (eukaryotes) however cell wall is absent in animal cells. Cell wall acts as protection unit for cell and also provides shape to the cell. Cell wall is made up of cellular, hemicellulose or pectins.

The genetic material in prokaryotes is naked and not enveloped by nuclear membrane. Chromatin material is present in eukaryotes only.

Sub-cellular organelles in prokaryotes are not well defined and are not membrane bound while eukaryotes have membranous organelles which are complex structures with multifunctions.

Q. 7 Who proposed the fluid mosaic model of plasma membrane?

(a) Camillo Golgi

(b) Schleiden and Schwann

(c) Singer and Nicolson

(d) Robert Brown

Ans. ***(c)*** **Singer** and **Nicolson** (1972) proposed the structure of cell membrane that was widely accepted and called as fluid mosaic model which states that fluid, native of lipids helps in the movement of protein within the membrane.

Schleiden and **Schwann** (1839) Observed thin outer layer in cells called plasma membrane and proposed cell theory.

Camillo Golgi (1898) discovered the Golgi apparatus.

Robert Brown (1831) discovered the nucleus in the cell which was later termed as chromatin by Flemming.

Q. 8 Which of the following statement is true for a secretory cell?

(a) Golgi apparatus is absent

(b) Rough Endoplasmic Reticulum (RER) is easily observed in the cell.

(c) Only Smooth Endoplasmic Reticulum (SER) is present.

(d) Secretory granules are formed in nucleus.

Ans. ***(b)*** Rough Endoplasmic Reticulum (RER) is observed in the cells that are actively involved in the protein synthesis and secretin.

Other options are in correct as

Golgi apparatus is present insecretary cells.

Secretary cell has both SER and RER. SER in the major site for the synthesis of lipids.

No secretary granules are found in nucleus.

Q. 9 What is a tonoplast?

(a) Outer membrane of mitochondria

(b) Inner membrane of chloroplast

(c) Membrane boundary of the vacuole of plant cells

(d) Cell membrane of a plant cell

Ans. *(c)* **Tonoplast** In plant cell the vacuole in bound by a single membrane called tonoplast. The tonoplast facilitates the transport of ions and other material against the concentration gradient into the vacuole. Hence, their concentration is higher in the vacuole than in the cytoplasm.

The outer membrane of mitochondria is formed of porin proteins and inner membrane bounds of chloroplast the stroma

The cell membrane of the plant cell is not a tonoplast. It is simple biological/unit membrane present in every cellular organism.

Q. 10 Which of the following is not true of a eukaryotic cell?

(a) Cell wall is made up of peptidoglycans

(b) It has 80S type of ribosome present in the cytoplasm

(c) Mitochondria contain circular DNA

(d) Membrane bound organelles are present

Thinking Process

Ribosomes in prokaryotic and eukaryotic organisms are the site of protein synthesis. Several ribosomes may attach to single mRNA and form a chain called polysome that translates mRNA into proteins.

Ans. *(a)* A cell wall made up of peptidoglycan is found in bacteria and not in eukaryotes. Eukaryotic cell wall is made up of cellulose hemicellulose, pectin chitin etc. Thus, is not true for eukaryotic cell.

In eukaryotes ribosomes present in cytoplasm is of 80S type but the ribosome in mitochondria is of 70S type, which represents the type present in prokaryotic cell.

In eukaryotes cell organelles are highly complex and membrane bound and the mitochondria in eukaryotes bear a separate circular DNA.

Q. 11 Which of the following statement is not true for plasma membrane?

(a) It is present in both plant and animal cell

(b) Lipid is present as a bilayer in it

(c) Proteins are present integrated as well as loosely associated with the lipid bilayer

(d) Carbohydrate is never found in it

Ans. *(d)* Statement is false.

Carbohydrates are never found in plasma membrane is not true. The biochemical investigation done on cell membrane clearly demonstrate that the cell membrane possess protein and carbohydrates as biochemical components.

The other options stand true for plasma membrane

Plasma membrane is present in both plant and animal cells. Lipid is present as a bilayer and lipid component is made of phosphoglycerides (fluid mosaic model by Singer and Nicolson).

Proteins are present integrated as well as loosely associated with the lipid bilayer. The ratio of protein and lipid varies considerably in different cell types.

Q. 12 Plastid differs from mitochondria on the basis of one of the following features. Mark the right answer.

(a) Presence of two layers of membrane

(b) Presence of ribosome

(c) Presence of thylakoids

(d) Presence of DNA

Ans. *(c)* Presence of thylakoids, the structural elements of chloroplast, differs then (plastids) from mitochondria. Thylakoids are flattened sacs stocked one above the other to form grana. They help in photosynthesis

Rest of the features- presence of two layers of membrane, ribosome and presence of DNA are common to both plastids and mitochondria.

Q. 13 Which of the following is not a function of cytoskeleton in a cell?

(a) Intracellular transport

(b) Maintenance of cell shape and structure

(c) Support of the organelle

(d) Cell motility

Thinking Process

An elaborate network of filamentous proteinaceous structure present in cytoplasm is referred to as cytoskeleton.

Ans. *(a)* Cytoskeleton is not associated with the intracellular transport. The microtubules and microfilaments, are the components of cytoskeleton and are responsible for cellular and intercellular movements Rest of the options are functions of cytoskeleton is a cell.

Cytoskeleton provides mechanical support to the cell that helps in maintaining cell shape and structure.

The cytoskeleton also keeps other organelles such as mitochandria and ribosomes separated from one another to avoid interference in one another's activities. It also helps in supporting the cell organelles.

Q. 14 The stain used to visualise mitochondria is

(a) fast green (b) safranin (c) acetocarmine (d) janus green

Ans. *(d)* **Janus** green is used to stain mitochondria. Janus green act as an indicator and changes colour according to the amount of oxygen present. It oxidizes to blue colour in presence of oxygen and in its absence changes its colour to pink.

Safranin is used to stain nuclei and lignified walls of cell.

Acetocarmine is used for staining nucleic acid and chromosomes.

Fast green It is used for staining histones at alkaline pH after acid extraction from DNA.

Very Short Answer Type Questions

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

Ans. The vacuole is a membrane bound space found in the cytoplasm. It contain water, sap, excretory product and other materials that are not seful for the cell. In plants osmosis vacuoles occupy 90% of the volume of the cell. They help in maintaining cell fluid balance, and shape of the cell by maintaining turger pressure against the cell well.

Q. 2 What does 'S' refer in a 70S and 80S ribosome?

Ans. 'S' refers to Svedbergs unit for sedimentation coefficient. Sedimentation coefficient depicts that how fast a cell organelle sediments during the ultracentrifugation.

In cells heavier the structure, higher is the sedimentation coefficient.

The value of S is equal to 10^{-13} seconds (1 s $= 1 \times 1 = ^{-13}$ seconds).

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

Thinking Process

The different parts of the cell preforming different functions are known as the organelles. Some of these organelles are nucleus, Golgi apparatus, endoplasmic reticulum and mitochondria.

Ans. Lysosomes are the membrane bound vesicular structures formed by Golgi apparatus.

These vesicles on isolation have been found to be rich in all types of hydrolytic enzymes *i.e.,* hydrolase, lipases, proteases and carbohydrases which digest carbohydrates proteins, lipids and nucleic acid at acidic pH.

Q. 4 What are gas vacuoles? State their functions.

Ans. Gas vacuoles are also known as pseudovacuoles or air vacuoles. Gas vacuoles are the characteristic feature of prokaryotes reported only in prokaryotes. Each gas vesicles are made of sub-microscopic hexagonal vesicles and are surrounded by a thin protein membrane. Gas vacuoles store metabolic gases and take part in buoyancy regulation.

Q. 5 What is the function of a polysome? (*Gk. Poly* = many, *Soma* = body).

Ans. A polysome consist of a cluster of ribosomes that are held, simultaneously by a strand of messenger RNA (*m*RNA) in rosette or helical group.They contain a portion of the genetic code that each ribosome is translating and are used in formation of multiple copies of same polypeptide. They are found in the cytoplasm during the process of active protein synthesis.

Q. 6 What is the feature of a metacentric chromosome?

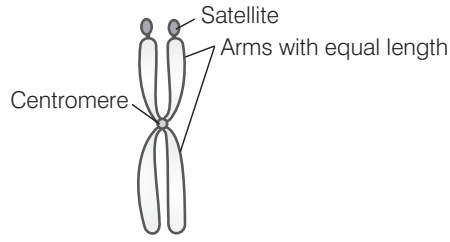
Thinking Process

During cell division, a short thick rod-like organelle is formed, known as chromosomes. These are formed by the condensing and tight coiling of the chromatin fibres. The chromosomes are divided into different types on the basis their arms and location of centromere.

(i) Telocentric *(ii) Acrocentric*

(iii) Submetacentric *(iv) Metacentric*

Ans. In metacentric chromosome centromere is median, *i.e.,* centromere lie in the middle portion. Thus, forming two equal arms of chromosome.



Metacentric chromosome

Q. 7 What is referred to as satellite chromosome?

Ans. The chromosomes may have additional constriction or secondary constriction at their ends as distal part of the arm formed by chromatin thread are known satellite chromosome. These constriction gives appearance of an out growth or small fragment.

These are also known as (sat) chromosomes or marker chromosome number. Chromosome 13, 14, 15, 16, 21 and 22 are satellite chromosomes.

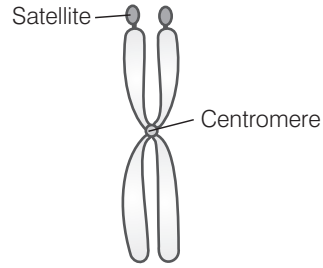


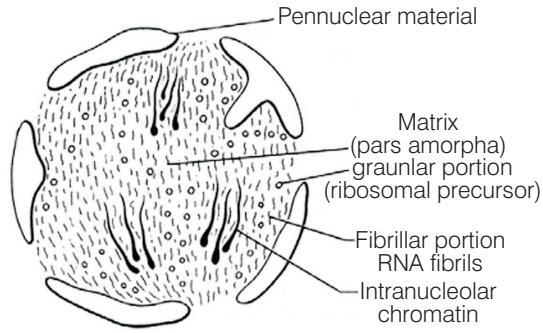
Diagram representing satellite chromosomes

Short Answer Type Questions

Q. 1 Discuss briefly the role of nucleolus in the cells actively involved in protein synthesis.

Ans. **Nucleolus** is the round, naked and a slightly irregular structure, which is attached to the chromatin at a specific region called as **Nucleolar Organizer Region** (NOR)

Nucleolus was first discovered by Fontana (1781).



Ultrastructure of nucleolus

(i) Nucleolus is the chief site for the ribosomal RNA synthesis.

(ii) It is the centre for the formation of ribosome components.

(iii) It is the colloidal complex that fills the nucleus.

(iv) It combines *r*RNA with proteins to produce ribosomal sub-units. After their formation, the ribosomes sub-units pass out and get established in the cytoplasm.

(v) It also receive and store ribosomal proteins formed in the cytoplasm.

(vi) These ribosomal proteins formed are the sites for protein synthesis in the cell.

(vii) Nucleolus is essential for spindle formation during nuclear division.

Q. 2 Explain the association of carbohydrate to the plasma membrane and its significance.

Thinking Process

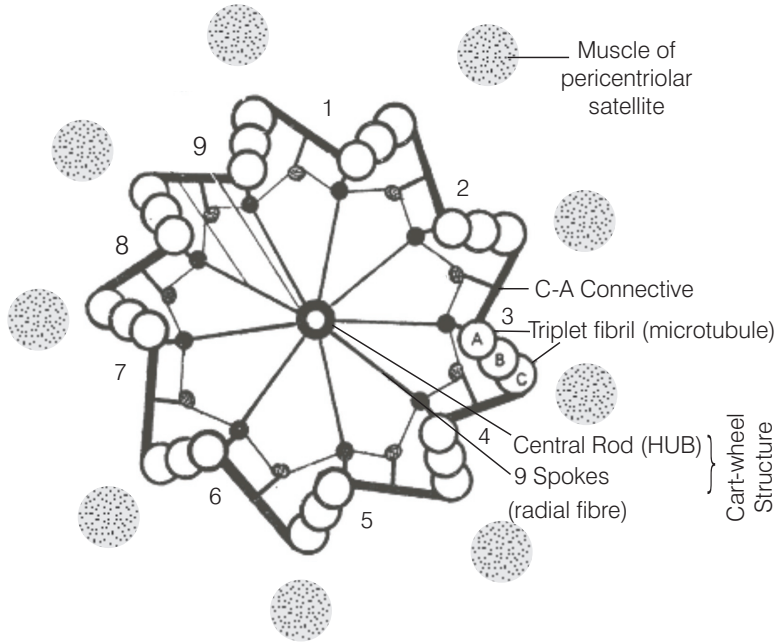
The plasma membrane also known as cell membrane, i.e., surrounds the cell. It consists of lipids, proteins and carbohydrates that are imperative in both structure and function of the cell.

Ans. Sugar residues or carbohydrates attaches either with proteins or lipids usually making up less than 10% of the membrane weight, they can give rise to a wide variety of structures in relatively short chains. They give individual cell types a distinguishing features. Therefore, they may be involved in.

Cell Recognition *e.g.,* surface of RBC have carbohydrates arranged in branched chains: differences in the arrangement give rise to different blood group antigens (*i.e.,* AB and O).

Cell surface differences are also responsible for the specificity of action of cells with hormones, drugs, viruses or bacteria. The cause of cell surface differences is related to characteristic surface due to carbohydrate component.

Q. 3 Comment on the cartwheel structure of centriole.



Ans. ***(d)*** Centrosome is an organelle usually containing two cylindrical structures called centrioles. They are surrounded by amorphous pericentriolar materials both the centriole in centrosome lie perpendicular to each other in which each has an organisation like that of an 'cartwheel'.

A centriole possess a whorl of 9 peripheral fibrils. There fibrils are absent in the centre, hence the arrangement is called 9 + 0. Each fibrils is made of 3 sub-fibres. Therefore, called triplet fibril.

The centrioles form the basal body of cilia and flagella. It also forms spindle fibres that gives rise to spindle apparatus during cell division in animals.

Q. 4 Briefly describe the cell theory.

Ans. Schleiden and Schwann in 1838-39, formulated the cell theory, *which originally contained following two statements*

(i) All living beings are made up of cells and products formed by the cells.

(ii) Cells are the structural and functional units of life.

The cell theory stated by **Schleiden** and **Schwann** failed to explain the question of origin of cells. A major expansion of the cell theory was expressed by **Virchow** in 1855, in his statement '*Omnis cellula e cellula*' (all cells arise from pre-existing cells).This concept, was the actual idea of Nagelli (1846), which later on was elaborated by Virchow, along with considerable evidences in its support. The work of Nagelli and Virchow established cell division as the central phenomenon in the continuity of life.

Thus, the modern cell theory is based on two facts

(i) all living organisms are composed of cells and products of cell.

(ii) cells are the bosic structural and functional unites of life.

(iii) all cells arise from pre-existing cells.

Viruses are exception to cell theory as they are not composed of cell. They consist of a nucleic acid (DNA or RNA) surrounded by a protein sheath and are incapable of independent existence, self regulation and self reproduction.

Q. 5 Differentiate between Rough Endoplasmic Reticulum (RER) and Smooth Endoplasmic Reticulum (SER).

Thinking Process

Endoplasmic reticulum is an 3-dimensional, complicated and inter connected system of membrane like channels that run through the cytoplasm. ER was discovered by Porter and Thompson. Porter named it as endoplasmic reticulum. ER are of two types- SER and RER.

Ans. *Difference between Rough Endoplasmic Reticulum (RER) and Smooth Endoplasmic Reticulum (SER) are as below*

	RER (Rough Endoplasmic Reticulum)	**SER** (Smooth Endoplasmic Reticulum)
1.	RER possesses ribosomes attached to its surface.	SER does not bear ribosomes attach to their surface.
2.	Mainly formed of cisternae and few tubules.	Mainly formed of vesicles and the tubules.
3.	RER takes part in the synthesis of proteins and enzymes.	SER takes part in the synthesis of glycogen, lipids and steroids.
4.	RER is internal and connected with nuclear envelope.	SER is peripheral. It may be connected with plasmalemma.
5.	It may develop from the nuclear envelope.	It may develop from RER.
6.	Enzymes for detoxification are absent in RER	It has the enzymes for detoxification.
7.	It forms lysosomes through the agency of Golgi apparatus.	SER gives rise to sphaerosomes.

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

Thinking Process

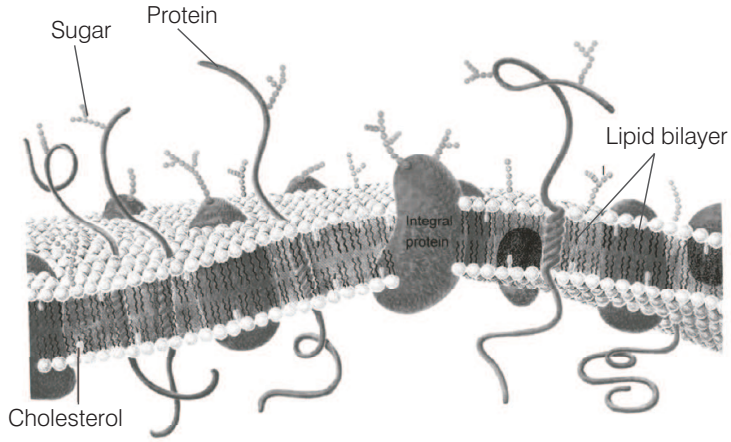
To stay alive all living things need membranes. Membranes are the barrier which gives cells their outer boundaries (plasma membrane) and their inner compartments (organelle).

Being selectively permeable, plasma membranes control the movement of substances into and out of the cell, regulating fluid composition, control flow of information and finally involve in capture and release of energy.

Ans. Chemical composition of plasma membrane

Component	Composition
Lipids	(20-79%)
Proteins	(20-70%)
Carbohydrates	(1-5%)
Water	20%

Lipids are the major components of the cell membrane as they form the continuous structural frame of the cell membrane. Lipids such as phospholipids, glycolipids, and steroids are found in membranes.



Fluid mosaic model of plasma membrane

The lipid molecule possess both polar hydrophilic (water loving) and non-polar hydrophobic (water repelling) ends. The hydrophilic region is in the form of a head, while the hydrophobic part contains two tails of fatty acid.

Hydrophobic tail is present towards the centre of the membrane. This structures results is the formation of lipid bilayer known as unit membrane/biological membrane/cell membrane.

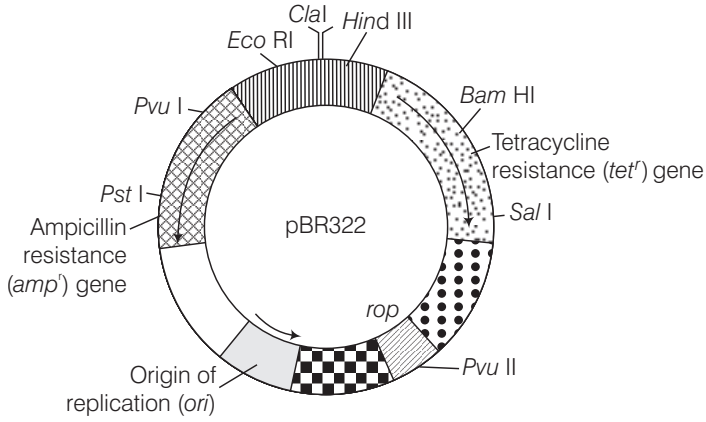
Q. 7 What are plasmids? Describe their role in bacteria.

Ans. A plasmid is usually a circular (sometime linear), double strandad DNA, that can replicate itself autonomously. These are found in the cytoplasm of the bacterial cell, plasmids normally remain separated from the chromosome, but sometimes may integrate into it temporarily and replicate with it incidentally.

Role of Plasmids in Bacteria

Plasmids are the extrachromosomal circular, independently replicating unit besides nucleoid in the bacterial cell.

Plasmids are used to transfer the information from one cell to another, *i.e.,* transfer of important genes (*e.g.,* they may confer resistance of particular, antibiotics to their bacterial cells), enabl to metabolise a nutrient, which normally a bacteria is unable to. It also helps in conjugation of bacteria. These days, plasmids are used in a variety of recombination experiments, as cloning vectors. A such example of plasmid vector is given below in figure.



Structure of plasmid showing antibiotic resistant genes

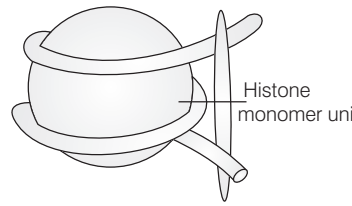
Q. 8 What are histones? What are their functions?

Thinking Process

DNA is a polynucleotide and one segment of DNA is called as gene. Thousands of genes are found in an organism. All parts of DNA are not functional and the DNA due to its large size that has to be packed within tiny nucleus, contain certain proteins, i.e., helps in DNA packaging.

Ans. **Histones** are the basic group of globular proteins that have a high content of basic amino acis, *i.e.,* arginine and lysine. Histones forms the part of the chromosomal material in eukaryotic cells.

There are five types of histone proteins H_1, H_2A, H_2B, H_3 and H_4. Four of them (H_2A, H_2B, H_3 and H_4) occur in pairs to produce histone octamer called Nubody or core of nucleosome.



Core of histone molecules

Functions Histones bear positively charged ends, that attaract negetively charged strands of DNA.

Histones provides a medium around which DNA winds, and they play a vital role in gene regulation, as they act as gene repressor. They form the chromatin material and provide stability as are not coagulated by heat.

Long Answer Type Questions

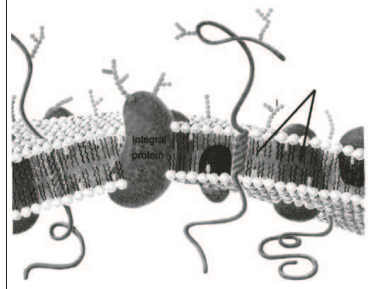
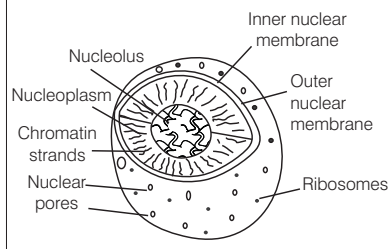
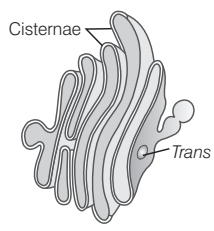
Q. 1 What structural and functional attributes must a cell have to be called a living cell?

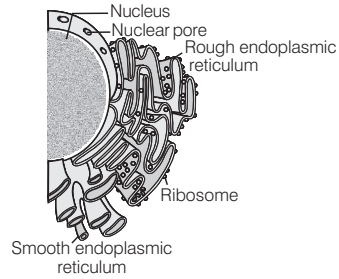
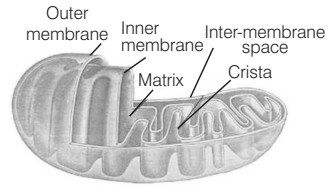
Thinking Process

Cell is the structural and functional unit of all living organism. A single cell is capable of independent existence and also performs the essential functions of life. All cells have certain functions in common so as to carry out basic life processes, but the differential distribution of organelles gives cell a distinct characteristic.

Ans. All organisms are made up of cells, which further organises themselves into tissues, organs and organ systems. Thus, forming the building blocks of organisms cells also the property of totipotency, capable of developing into a new organism.

Besides, forming the structural unit they perform different specialised functions in the same way as each organ or system carries out in an organism. Thus, exhibiting division of labour *i.e.,* cell organelles are specific in their functions.

	Structure	Function	Diagram
1.	**Cell membrane** all cell possess a phospholipid based cell membrane.	The cell membrane is selectively permeable, *i.e.,* only selected material can pass through it.	
2.	**Cytoplasm** It is a watery solution containing controlled concentration of organic and inorganic compounds.	It functions as a site for metabolism and provide energy and material for growth and reproduction.	
3.	**Nucleus** It essentially consists of DNA, the nuclear matrix or the nucleoplasm containing nucleolus and chromatin.	It serves to store and transmit information to direct the synthetic activities of the entire cell. In also transfers the genetic information required for growth and reproduction.	
4.	**Golgi apparatus** (Golgi complex) They constitute of many flat disc shaped sacs or cistermae of 0.5 μm – 1.0 μm diameter. These stacks are arranged parallel to each other.	These are mainly involved in packaging the materials to be delivered either to intracellular targets or secreted outside the cells.	

	Structure	Function	Diagram
5.	**The Endoplasmic Reticulum** (ER) ER is often an extensive 3– dimensional network of intra cellular membranes formed by three elements– cisternae, tubules and vesicles	The ER bearing ribosomes on it surface is called rough endoplasmic reticulum (CRER). These are involved in protein synthesis and secretion. The ER without ribosomes are called smooth endoplasmic reticulum involved in synthesis of lipids like steroidal hormones.	
6.	**Mitochondria** Mitochondria is a double membrane bound structure with outer and inner membrane dividing its lumen into two compartments, i.e., outer membrane forming of organelle and inner membrane forming number of infoldings called the cristae.	Mitochondria are the sites for aerobic respiration. It is known as power house of the cell since producing cellular energy in the form of ATP.	
7.	**Lysosomes** These are membrane bound vesicular structures, formed by the process of packaging in the Golgi apparatus.	These are rich in many types of hydrolytic enzymes (hydrolases lipases, proteases, carbohydrates).	
8.	**Vacuoles** The vacuole is the membrane bound space found in the cytoplasm, it contain water, sap, excretory product and other material not useful for the cell. The vacuole is bound by single membrane called tonoplast.	In plants the tonoplast facililates the transport of a number of ions and other materials against concentration gradients into the vacuole.	.

All these factors, *i.e.,* structural and functional attributes it to be called a living cell.

Q. 2 Briefly give the contributions of the following scientists in formulating the cell theory

(a) Rudolf Virchow

(b) Schleiden and Schwann

Ans. (a) **Rudolf Virchow** (1855) first explained that the cells divide and new cells are formed from the pre-existing cells (*omnis cellula e cellula*).

Virchow was the first to demonstrate that the cell theory applies to diseased tissue as well as to healthy tissue. He also engaged his research in the fields of archeology and anthropology.

(b) **Schleiden** and **Schwann** observed the cells and cell membranes for the first time. They proposed the **cell theroy** which explains that the animal and plant cells are composed of cells and product of cells.

Theodore Schwann (1839) studied different types of animal cells and reported that cells had a thin outer layer which is called as plasma membrane. Schleiden also concluded on plant studies, *i.e.,* the presence of cell wall is a unique character of plant cells. Thus, they proposed that plants and animals are composed of cells and their products.

Q. 3 Is extragenomic DNA present in prokaryotes and eukaryotes? If yes, indicate their location in both the types of organisms.

Ans. *Yes*, extragenomic DNA is present in both prokaryotes and eukaryotes. In case of eukaryotes, extragenomic DNA is present in two organelles, *e.g.,* plastids and mitochondria.

Extrachromosomal DNA in Prokaryotes In case of prokaryotic cells, the extragenomic DNA is present in the form of plasmids. The plasmid are circular DNA molecules, which confer certain unique phenotypic characters to the bacteria.

One such character is antibiotic resistance to bacteria. The plasmid DNA is also used to monitor bacterial transformation with foreign DNA. Bacteria transformation is the method of sexual reproduction in bacteria.

Extrachromosomal DNA in Eukaryotes

Mitochondrial DNA (*mt*DNA) is usually circular. Mitochondrial DNA spans about 16,500 DNA building blocks (base pairs) representing a small fraction of the total DNA in cells.

*mt*DNA contains 37 genes, all of which are essential for normal mitochondrial functions. Thirteen of these genes provides instruction for making enzymes involved in oxidative phosporylation.

Mitochondrial genes are among the estimated 20000-25000 total genes in the human genome.

Plastids These are small bodies found free in most plant cells and are of three types leucoplast, chromoplast and chloroplast. These are double membrane bound structures for trapping radiation and storage purpose.

It contains small, double stranded circular DNA molecules and ribosomes essential in synthesising certain proteins. As they both can synthesise proteins and replicate on their own they are known as semi-autonomous organelles.

Q. 4 Structure and function are correlatable in living organisms. Can you justify this by taking plasma membrane as an example?

Ans. In animals and plants, plasma membrane structure and function are correlated. A cell membrane consists of protein, lipid and carbohydrates.

The protein component present in membrane acts as a solute channels allowing the flow of minerals, hormones and cellular information from one organelle to another or from one cell to another.

In case of plants where minerals are absorbed actively from the soil. The plasma membrane possess proteinaceous carrier.

The oligosaccharides attached to membrane serve as recognition centres and help in recognising foreign entities before allowing them entry into the cell.

The lipid content of plasma membrane in plant and animal cells are arranged with their hydrophilic polar head directed outwards and non-polar hydrophobic tails directed inwards providing fluidity to the membrane. Glycocalyx present in cell membrane also helps in cellular attachment.

Q. 5 Eukaryotic cells have organelles which may

(a) not be bound by a membrane

(b) bound by a single membrane

(c) bound by a double membrane

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

Thinking Process

In eukaryotic cells, there is an extensive compartmentalisation of cytoplasm through the presence of membrane bound organelles serving for specific functions.

Ans. (a) **Cell organelles with no membrane** In eukaryotic cell, ribosomes occur freely in the cytoplasmic matrix and are attached to the outer cytoplasmic surface of the rough endoplasmic reticulum and nuclear envelope. The ribosomes are also found in the matrix of mitochondria and stroma of plastids called as mitoribosomes and plastidoribosomes, respectively.

(b) **Cell organelles with single membrane** A lysosome is a tiny sac bounded by a single unit membrane of lipoprotein. The lysosomes occurs in all animal cells and protozoans. Prokaryotic cell lack lysosomes.

Number of lysosomes varies with the cell type. Lysosome contain a dense, finely granular fluid consisting of glycoproteinaceous hydrolytic (digestive) enzymes called acid hydrolases. Cell organelles like sphaerosomes and microbodies also possess single membranes.

(c) **Cell organelles with double membrane** Mitochondria are double membrane bound structures with the outer membrane and inner membrane dividing its lumen distinctly into two aqueous compartments.

The inner compartment is called the matrix whereas the outer membrane forms the continuous limiting boundary of the organelle. Chloroplast and nucleus are also double membrane bound organelles.

Q. 6 The genomic content of the nucleus is constant for a given species where as the extrachromosomal DNA is found to be variable among the members of a population. Explain.

Ans. In bacteria, additional to the genomic DNA, small circular DNA molecules are present in cytoplasm. These small molecules are called plasmids. They confer unique phenotypic character to bacteria, *i.e.,* resistance to antibiotics. It is also used to monitor bacterial transformation with foreign DNA.

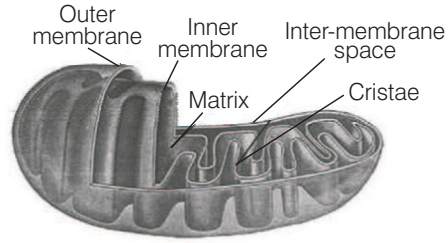
In eukaryotes, the extra DNA molecules are present in chloroplast (stroma) and mitochondria (matrix). Because of the presence of this DNA molecule, they are treated as self autonomous organelles. In case of highly active organism, the DNA extrachromosomal is found to be more as compared to the less active ones.

Q. 7 Justify the statement, 'Mitochondria are power houses of the cell'.

Ans. Mitochondria is a sausage shaped or cylindrical structure having a diameter of 0.2 to 1.0 μm and length 1.0 - 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 matrix and outer one forming infoldings is called cristae towards the matrix. These cristae are associated with an increase in surface area.

The mitochondria are the actual sites of aerobic respiration. They produce cellular energy in the form of ATP, hence are called as **power house of the cell**.



Structure of mitochondria

This ATP generated is used in performing vital functions by the organism. The matrix of mitochondria also possess a single circular DNA molecule of itself and a few RNA molecules, ribosomes (70S) and the compartments required for the protein synthesis.

Q. 8 Is there a species specific or region specific type of plastids? How does one distinguish one from the other?

Ans. 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 main types, *i.e.,* leucoplasts, chromoplasts and chloroplasts.

Leucoplasts They are colourless plastids which store food material based on there storage products, *they are of three types*

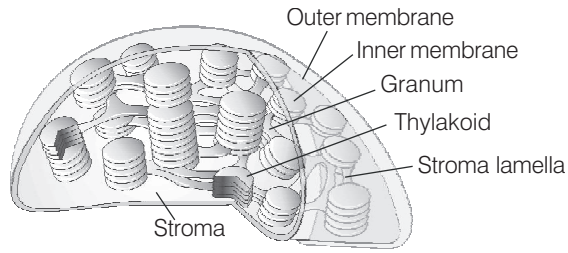
(a) **Amyloplasts** Stores starch, *e.g.,* tuber of potato, grain of rice, grain of wheat.
(b) **Elaioplasts** These store fats, *e.g.,* rose
(c) **Aleuroplasts** They are protein storing plastids, e.g., castor endosperm

Chromoplast These are non photosynthetic coloured plastids which synthesise and store carotenoid pigments. They appear orange, red or yellow. These mostly occur in ripe fruits (tomato and chilles) carrot roots, etc.

Chloroplasts These are green colour plastids which help in synthesising food material by photosynthesis. They contain chorophyll and carotenoid pigments which trap light energy. Each chloroplast is oval or spherical, double membrane bound cell organelle.

The space present inside inner membrane is called stroma. A number of organised flattened membranous sacs called thylakoids are present in the stroma. Thylakoids are arranged in stacks are called grana.

The thylakoids of different grana are connected by membranous tubules called the stroma lamellae. The stroma of the lamellae contain the enzymes that are required for the synthesis of carbohydrates and proteins.

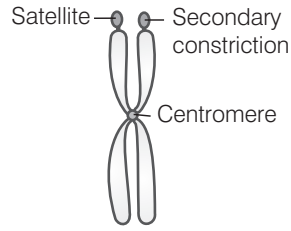


Structure of chloroplast

Q. 9 Write the functions of the following

(a) Centromere
(b) Cell wall
(c) Smooth ER
(d) Golgi apparatus
(e) Centrioles

Ans. (a) **Centromere** It is required for proper chromosome segregation. The centromere consists of two sister chromatids. It is also necessary at the point chromosome attaches to the spindle apparatus during mitosis and meiosis.

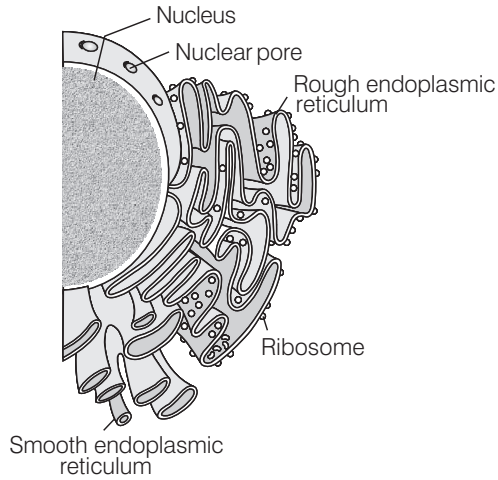


Centromeres

(b) **Cell wall** It gives a definite shape to the cell and protects the cell from mechanical injury and infections. It also helps in cell to cell interaction and act as a barrier for undesirable macromolecules.

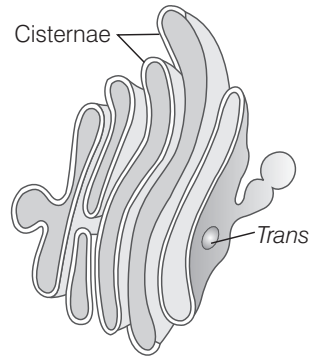
(c) **Smooth ER** It helps in synthesis of lipids, metabolism of carbohydrates, regulation of calcium concentration, drug detoxification and attachment of receptor on cell membrane proteins.

The smooth ER also contain enzymes-glucose 6 phosphatase, which converts glucose 6 phosphate to glycogen, essential in glucose metabolism.



Structure of endoplasmic reticulum

(d) **Golgi apparatus** It is the important site for the formation of glycoprotein and glycolipids. It is also involved in the synthesis of cell wall materials and also play an important role in formation of cell plate during cell division.



Structure of Golgi body

(e) **Centrioles** They form the base body of cilia and flagella and spindle fibres that gives rise to spindle apparatus during cell division in animal cells. They help in formation of microtubules and sperm tail. They also help in cell division by forming asters, which acts as spindle pole.

Q. 10 Are the different types of plastids interchangeable? If yes, give examples where they are getting converted from one type to another.

Thinking Process

Plastids are semiautonomous organelles having DNA and double membrane envelope which stores or synthesise various types of organic compounds.

Ans. *Yes*, plastids are interchangeable in their form. Generally, three types of plastids are present in plant cells, *i.e.,* leucoplasts (storage), chromoplast (coloured) and chloroplasts (synthesis of food green pigment).

Depending upon the circumstances, one type of plasmid may be converted into another type. *e.g.*,

(i) In *Capsicum*, the cells of ovary consist of leucoplasts. When ovary changes into fruit, leucoplasts are transformed into chloroplasts. When the fruit ripens chloroplast are converted into chromoplast.

(ii) The leucoplast in stem tubers of potato, on exposure to sunlight transform to chloroplasts.

In some cases the chloroplasts gets converted during ripening of fruits, *e.g.,* tomato chilli when they change colour from green to red. In occurs because of chlorophyll and degeneration of lamella.