XI
8

CELL :THE UNIT OF LIFE

SYLLABUS

Cell theory and cell as the basic unit of life; Structure of prokaryotic and eukaryotic cell; Plant cell and animal cell; Cell envelope, cell membrane, cell wall; Cell organelles-structure and function; Endomembrane system-endoplasmic reticulum, Golgi bodies, lysosomes, vacuoles; mitochondria, ribosomes, plastids, micro bodies; Cytoskeleton, cilia, flagella, centrioles (ultra structure & function); Nucleus-nuclear membrane, chromatin, nucleolus.

KEY CONCEPTS

INTRODUCTION

* Cell is the fundamental structural and functional unit of all living organisms.
* First cell discovered by Robert Hooke in Cork.
* Anton Von Leeuwenhoek first saw and described a live cell. Robert Brown later discovered the nucleus. The invention of the microscope and its improvement leading to the electron microscope revealed all the structural details of the cell.
* The organization of cells and their small size allow them to maintain **homeostasis**, an appropriate internal environment.
* In order for the cell to maintain homeostasis, its contents must be separated from the external environment. The **plasma membrane** is a structurally distinctive surface membrane that surrounds all cells.
* The sizes and shapes of cells are adapted to the particular functions they perform. Some cells, such as amoebas and white blood cells, change their shape as they move about.
* Sperm cells have long, whiplike tails, called *flagella*, for locomotion.
* Nerve cells have long, thin extensions that enable them to transmit messages over great distances. Certain epithelial cells are almost rectangular and are stacked much like building blocks to form sheet like tissues. (Epithelial tissue covers the body and lines body cavities.)
* The surface area of a cell must be large enough relative to its volume to allow adequate exchange of materials with the environment.
* Surface to volume ratio of a cell decreases with increasing size.

CELL THEORY

* In 1838, **Malthias Schleiden**, a German botanist, 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.
* **Theodore Schwann** (1839), a British Zoologist, studied different types of animal cells and reported that cells had a thin outer layer which is today known as the 'plasma membrane'. He also concluded, based on his studies on plant tissues, that the presence of cell wall is a unique character of the plant cells. On the basis of this, Schwann proposed the hypothesis that the bodies of animals and plants are composed of cells and products of cells.
* Schleiden and Schwann together formulated the cell theory.

* This theory however, did not explain as to how new cells were formed.
* **Rudolf Virchow** (1855) 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 as understood today is: (i) All living organisms are composed of cells and products of cells. (ii) All cells arise from pre-existing cells.

AN OVERVIEW OF CELL

* Inside each cell is a dense membrane bound structure called nucleus. This nucleus contains the chromosomes which in turn contain the genetic material, DNA.
* Cells that have membrane bound nuclei are called **eukaryotic** whereas cells that lack a membrane bound nucleus are **prokaryotic**. In both prokaryotic and eukaryotic cells, a semi-fluid matrix called cytoplasm occupies the volume of the cell. The cytoplasm is the main arena of cellular activities in both the plant and animal cells. Various chemical reactions occur in it to keep the cell in the 'living state'.
* Besides the nucleus, the eukaryotic cells have other membrane bound distinct structures called organelles like the endoplasmic reticulum (ER), the golgi complex, lysosomes, mitochondria, microbodies and vacuoles. The prokaryotic cells lack such membrane bound organelles.
* Ribosomes are non-membrane bound organelles found in all cells – both eukaryotic as well as prokaryotic. Within the cell, ribosomes are found not only in the cytoplasm but also within the two organelles–chloroplasts (in plants) and mitochondria and on rough ER.
* Animal cells contain another non-membrane bound organelle called centriole which helps in cell division.
* Cells differ greatly in size, shape and activities. For example, Mycoplasmas, the smallest cells, are only 0.3 µm in length while bacteria could be 3 to 5 µm. The largest isolated single cell is the egg of an ostrich.

  Among multicellular organisms, human red blood cells are about 7.0 µm in diameter. Nerve cells are some of the longest cells. Cells also vary greatly in their shape. They may be disc-like, polygonal, columnar, cuboid, thread like, or even irregular. The shape of the cell may vary with the function they perform.

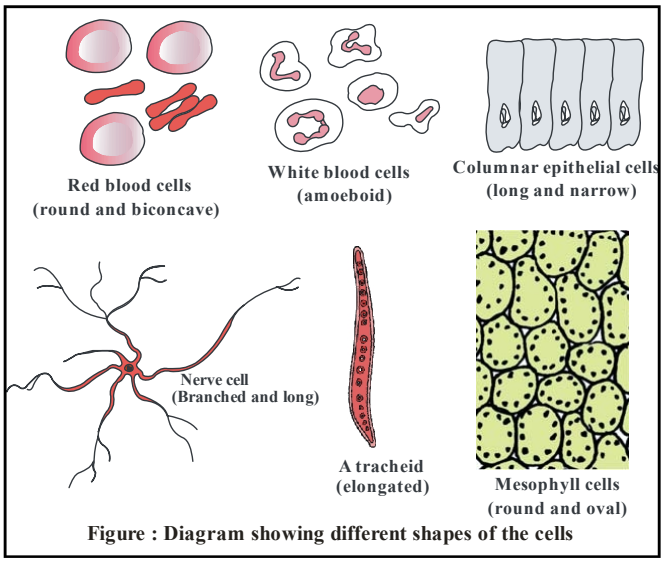


Figure : Diagram showing different shapes of the cells

PROKARYOTIC CELLS

* The prokaryotic cells are represented by bacteria, blue-green algae, mycoplasma and PPLO (Pleuro Pneumonia Like Organisms).

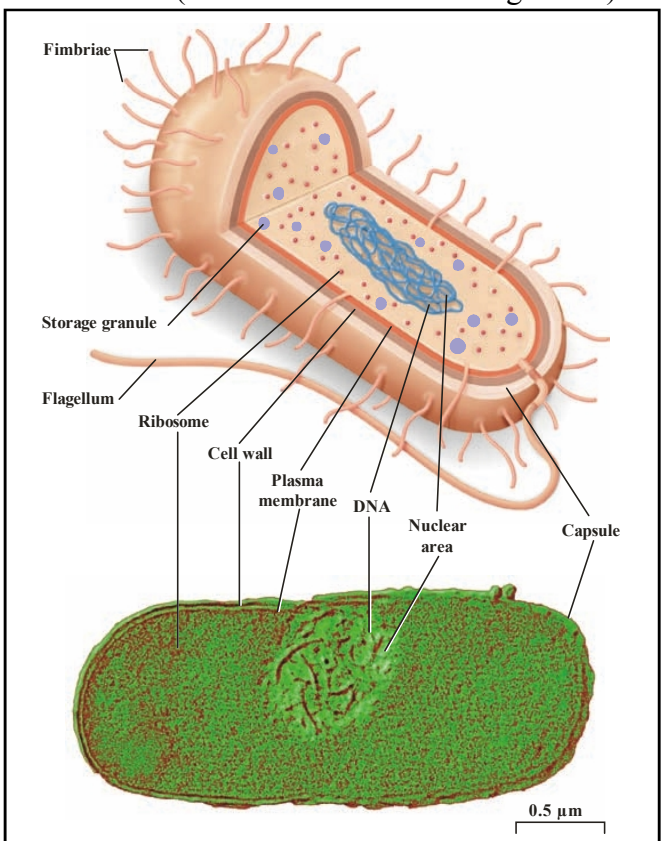


Figure : Structure of a prokaryotic cell

* They are generally smaller and multiply more rapidly than the eukaryotic cells.

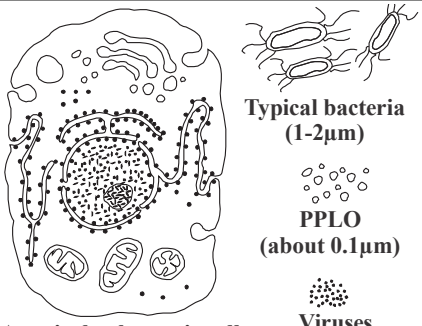


Figure : Diagram showing comparison of eukaryotic cell with other organisms

* The four basic shapes of bacteria are bacillus (rod like), coccus (spherical), vibrio (comma shaped) and spirillum (spiral).
* All prokaryotes have a cell wall surrounding the cell membrane. The fluid matrix filling the cell is the cytoplasm. There is no well-defined nucleus.
* The genetic material is basically naked, not enveloped by a nuclear membrane.
* In addition to the genomic DNA (the single chromosome/circular DNA), many bacteria have small circular DNA outside the genomic DNA. These smaller DNA are called plasmids. The plasmid DNA confers certain unique phenotypic characters to such bacteria. One such character is resistance to antibiotics.
* Plasmid DNA is used to monitor bacterial transformation with foreign DNA.
* Nuclear membrane is found in eukaryotes. No organelles, like the ones in eukaryotes, are found in prokaryotic cells except for ribosomes.
* A specialised differentiated form of cell membrane called mesosome is the characteristic of prokaryotes. They are essentially infoldings of cell membrane.

Cell Envelope and its Modifications

* The cell envelope consists of a tightly bound three layered structure i.e., the outermost glycocalyx followed by the cell wall and then the plasma membrane. Although each layer of the envelope performs distinct function, they act together as a single protective unit.
* Bacteria can be classified into two groups on the basis of the differences in the cell envelopes and the manner in which they respond to the staining procedure developed by Gram viz., those that take up the gram stain are Gram positive and the others that do not are called Gram negative bacteria.
* Glycocalyx differs in composition and thickness among different bacteria. It could be a loose sheath called the slime layer in some, while in others it may be thick and tough, called the capsule. The cell wall determines the shape of the cell and provides a strong structural support to prevent the bacterium from bursting or collapsing.
* The plasma membrane is semi-permeable in nature and interacts with the outside world. This membrane is similar structurally to that of the eukaryotes.
* A special membranous structure is the mesosome which is formed by the extensions of plasma membrane into the cell. These extensions are in the form of vesicles, tubules and lamellae. They help in cell wall formation, DNA replication and distribution to daughter cells. They also help in respiration, secretion processes, to increase the surface area of the plasma membrane and enzymatic content. In some prokaryotes like cyanobacteria, there are other membranous extensions into the cytoplasm called chromatophores which contain pigments.
* Bacterial cells may be motile or non-motile. If motile, they have thin filamentous extensions from their cell wall called flagella. Bacteria show a range in the number and arrangement of flagella. Bacterial flagellum is composed of three parts – filament, hook and basal body. The filament is the longest portion and extends from the cell surface to the outside.
* Besides flagella, Pili and Fimbriae are also surface structures of the bacteria but do not play a role in motility. The pili are elongated tubular structures made of a special protein. The fimbriae are small bristle like fibres sprouting out of the cell. In some bacteria, they are known to help attach the bacteria to rocks in streams and also to the host tissues.

Ribosomes and inclusion bodies

* In prokaryotes ribosomes are associated with the plasma membrane of the cell. They are about 15 nm by 20 nm in size and are made of two subunits - 50S and 30S units which when present

together form 70S prokaryotic ribosomes.

* Ribosomes are the site of protein synthesis.
* Several ribosomes may attach to a single mRNA and form a chain called polyribosomes or polysome. The ribosomes of a polysome translate the mRNA into proteins.
* Reserve material in prokaryotic cells are stored in the cytoplasm in the form of inclusion bodies. These are not bounded by any membrane system and lie free in the cytoplasm, e.g., phosphate granules, cyanophycean granules and glycogen granules. Gas vacuoles are found in blue green and purple and green photosynthetic bacteria.

EUKARYOTIC CELLS

* The eukaryotes include all the protists, plants, animals and fungi.
* Eukaryotic cells possess an organised nucleus with a nuclear envelope. In addition, eukaryotic cells have a variety of complex locomotory and cytoskeletal structures. Their genetic material is organised into chromosomes.
* **Differences between Prokaryotic cells and Eukaryotic cells**

S.N.	Prokaryotic cells	Eukaryotic cells
1.	Non cellulosic cell wall is present (bacteria) or absent (*Mycoplasma*)	Cellulosic cell wall (Plants) is present or absent (Animals).
2.	A prokaryotic cell is a single membrane system.	A eukaryotic cell is a double membrane system.
3.	Cell membrane bears respiratory enzymes.	Cell membrane lacks respiratory enzymes.
4.	Mesosomes are formed by infolding of cell membrane.	Mesosomes are absent.
5.	Cytoplasm lacks membrane bound organelles	Cytoplasm contains membrane bound organelles, (endoplasmic reticulum, mitochondria, golgi apparatus, lysosomes, glyoxisomes, peroxisomes etc.).
6.	Ribosomes (non membrane bound organelle) are 70 S, lie free in cytoplasm.	Ribosomes are 80 S, may lie free or bound to ER. and nuclear envelope. (70 S ribosomes are found within mitochondria and chloroplast)
7.	There are no streaming movements of cytoplasm.	Cytoplasm shows streaming movements (cyclosis).
8.	Photosynthetic lamellae i.e., thylakoids (if present) occur free in the cytoplasm.	Photosynthetic lamellae if present, occur within the chloroplasts.
9.	Sap vacuoles are lacking. Gas vacuoles may occur.	Sap vacuoles are common.
10.	Transcription and translation occur in the cytoplasm.	Transcription and translation occur in nucleus and cytoplasm respectively.
11.	Protein synthesis takes place in cytoplasm only.	Protein synthesis occurs in the cytoplasm, mitochondria and plastids.
12.	Cytoskeleton absent.	Cytoskeleton (microtubules, microfilaments and intermediate filaments) present.
13.	Nuclear material is not enclosed by nuclear envelope and lies directly in cytoplasm. It is called nucleoid.	Nuclear material is enclosed by nuclear envelope to form a nucleus distinct from cytoplasm.
14.	There is no nucleolus.	One or more nucleoli occur within the nucleus.
15.	DNA is closed and circular and without histone core (Polyamines may be present in place of histones)	Nuclear DNA is linear with a histone protein core.
16.	DNA occurs in the cytoplasm only.	DNA occurs in the nucleus as well as in mitochondria and chloroplasts.
17.	The ratio of A + T / G + C is low, <1.	The ratio of A + T / G + C is high, > 1.
18.	Plasmids and pili occur in many prokaryotic cells.	There are no plasmids and pili in eukaryotic cells.
19.	Flagella, if present, are singlet fibres and are formed of a protein flagellin.	Flagella, if present, are complex, have 9+2 pattern of microtubules formed of a protein tubulin.
20.	Mitotic spindle is not formed in cell division (Amitotic).	Mitotic spindle is formed in cell division.
21.	Sexual reproduction absent (recombination is present in bacteria).	Sexual reproduction occurs.
22.	e.g., Bacteria, blue-green algae and *Mycoplasma.*	e.g., Algae other than blue-green algae, protists, fungi, plants and animals.

* All eukaryotic cells are not identical. Plant and animal cells are different as the former possess cell walls, plastids and a large central vacuole which are absent in animal cells. On the other hand, animal cells have centrioles which are absent in almost all plant cells.

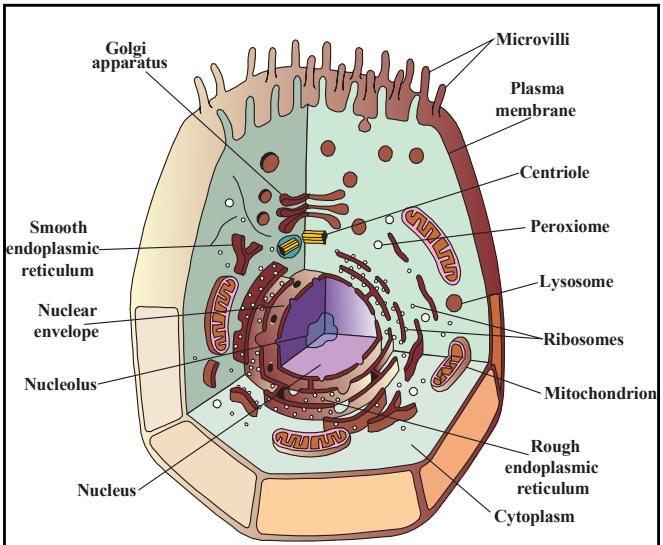


Figure : Animal cell

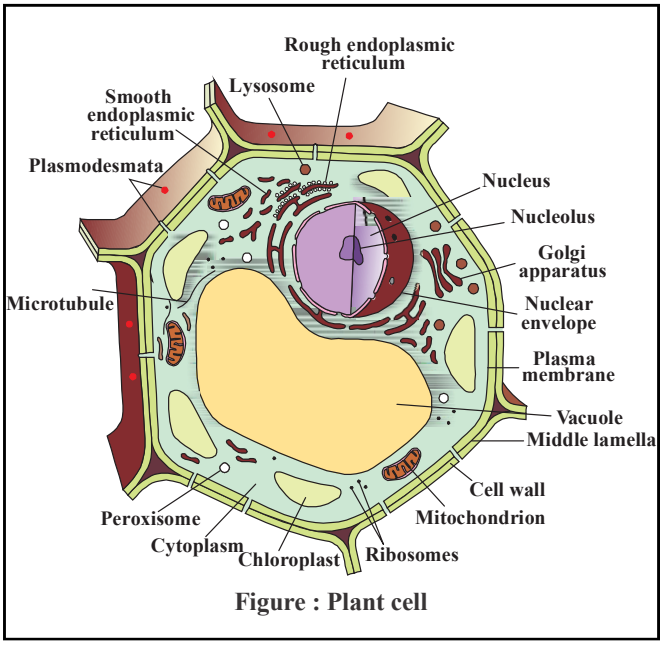


Figure : Plant cell

* Differences between plant and animal cell

Plant cell	Animal cell
Cell wall present.	Cell wall absent.
Nucleus usually lies near periphery due to vacuole.	Nucleus present near the centre.
Centrosome is usually absent from higher plant cells, except lower motile cells.	Usually centrosome is present that helps in formation of spindle fibres.
Plastids are present, except fungi.	Plastids are absent.
Mitochondria is generally spherical or oval in shape.	Generally tubular in shape.
Single large central vacuole is present.	Many vacuoles occurs, which are smaller in size.
Cytoplasm during cell division usually divides by cell plate method.	Cytoplasm divides by furrowing or cleavage method.
Plant cells are capable of forming all the amino acids coenzymes and vitamins.	Animal cells cannot form all the amino acids, coenzymes and vitamins.
There is no contractile vacuole.	Contractile vacuole may occur to pump excess water.
Spindle formed during cell division is anastral.	Spindle formed during cell division are amphiastral.
Lysosomes present in less number.	Lysosomes present in more number.

Cell Membrane

* The cell membrane is composed of lipids that are arranged in a bilayer. Also, the lipids are arranged within the membrane with the polar head towards the outer sides and the hydrophobic tails towards the inner part.This ensures that the nonpolar tail of saturated hydrocarbons is protected from the aqueous environment. The lipid component of the membrane mainly consists of phosphoglycerides.
* The cell membranes also possess protein and carbohydrate. The ratio of protein and lipid varies considerably in different cell types. In human beings, the membrane of the erythrocyte has approximately 52 per cent protein and 40 per cent lipids.
* Depending on the ease of extraction, membrane proteins can be classified as integral or peripheral. Peripheral proteins lie on the surface of membrane while the integral proteins are partially or totally buried in the membrane.
* An improved model of the structure of cell membrane was proposed by Singer and Nicolson (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. This ability to move within the membrane is measured as its fluidity.

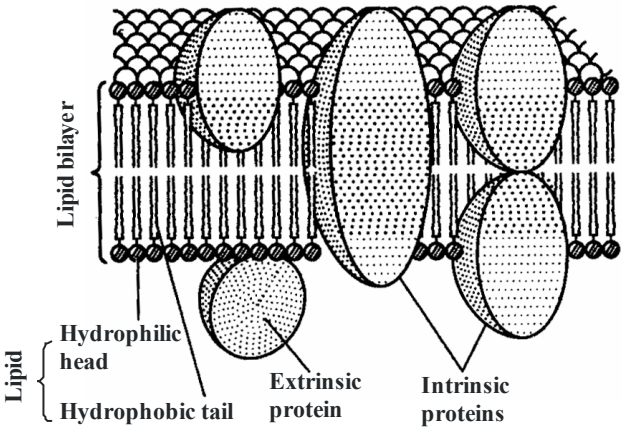


Fig : Fluid-mosaic model of the plasma membrane structure

* The fluid nature of the membrane is also important from the point of view of functions like cell growth, formation of intercellular junctions, secretion, endocytosis, cell division etc.
* One of the most important functions of the plasma membrane is the transport of the molecules across it. The membrane is selectively permeable to some molecules present on either side of it.
* Many molecules can move briefly across the membrane without any requirement of energy and this is called the **passive transport**.
* Neutral solutes may move across the membrane by the process of simple diffusion along the concentration gradient, i.e., from higher concentration to the lower.
* Water may also move across this membrane from higher to lower concentration.
* Movement of water by diffusion is called **osmosis**. As the polar molecules cannot pass through the nonpolar lipid bilayer, they require a carrier protein of the membrane to facilitate their transport across the membrane.
* A few ions or molecules are transported across the membrane against their concentration gradient, i.e., from lower to the higher concentration. Such a transport is an energy dependent process, in which ATP is utilised and is called **active transport**, e.g., Na^+/K^+ Pump.
* **Bulk transport :** It is transport of large quantities of micromolecules, macromolecules and food particles through the membrane.
* It is accompanied by formation of transport or carrier vesicles. The latter are endocytotic and perform bulk transport inwardly. The phenomenon is called **endocytosis**.

Cell Wall

* A non-living rigid structure called the cell wall forms an outer covering for the plasma membrane of fungi and plants.
* Cell wall not only gives shape to the cell and protects the cell from mechanical damage and infection, it also helps in cell-to-cell interaction and provides barrier to undesirable macromolecules.
* Algae have cell wall, made of cellulose, galactans, mannans and minerals like calcium carbonate, while in other plants it consists of cellulose, hemicellulose, pectins and proteins.
* The cell wall of a young plant cell, the primary wall is capable of growth, which gradually diminishes as the cell matures and the secondary wall is formed on the inner (towards membrane) side of the cell.
* The middle lamella is a layer mainly of calcium pectate which holds or glues the different neighbouring cells together. The cell wall and middle lamellae may be traversed by plasmodesmata which connect the cytoplasm of neighbouring cells.
* Pits are formed in lignified cell wall.
* Pits occurs in sclerenchyma, vessels and tracheids. Tracheids in gymnosperms have maximum number of bordered pits.

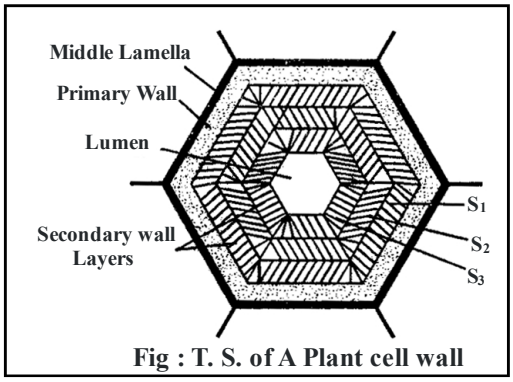


Fig : T. S. of A Plant cell wall

* In many secondary walls specially those of xylem the cell wall becomes hard and thick due to the deposition of lignin. With the increasing amount of lignin, deposition protoplasm is lost. First the lignin is deposited in middle lamella and primary wall and later on in secondary wall.

* **Growth of cell wall**

(i) **By intussuception :** As the cell wall stretches in one or more directions, new cell wall material secreted by protoplasm gets embedded within the original wall.

(ii) **By apposition :** In this method new cell wall material secreted by protoplasm is deposited by definite thin plates one after the other.

Endomembrane System

* The endomembrane system include endoplasmic reticulum (ER), golgi complex, lysosomes and vacuoles. Since the functions of the mitochondria, chloroplast and peroxisomes are not coordinated with the above components, these are not considered as part of the endomembrane system.

1. The Endoplasmic Reticulum (ER) :

* A network or reticulum of tiny tubular structures scattered in the cytoplasm that is called the endoplasmic reticulum.

* Garnier (1897) was first to observe the ergastoplasm in a cell. The ER was first noted by Porter, Claude, and Fullman in 1945 as a network. It was named by Porter in 1953.

* The ER is present in almost all eukaryotic cells. A few cells such as ova, embryonic cells, and mature RBCs, however, lack ER. It is also absent in prokaryotic cell. In rapidly dividing cells endoplasmic reticulum is poorly developed.

* The ER is made up of three components. All the three structures are bound by a single unit membrane.

(i) **Cisternae :** These are flattened, unbranched, sac like structures. They lie in stacks (piles) parallel to one another. They bear ribosomes. They contain glycoproteins named ribophorin-I and ribophorin-II that bind the ribosomes. Found in protein forming cells.

(ii) **Vesicles :** These are oval or rounded, vacuole like elements, scattered in cytoplasm. These are also studded with ribosomes.

(iii) **Tubules :** Wider, tubular, branched elements mainly present near the cell membrane. They are free from ribosomes. These are more in lipid forming cells.

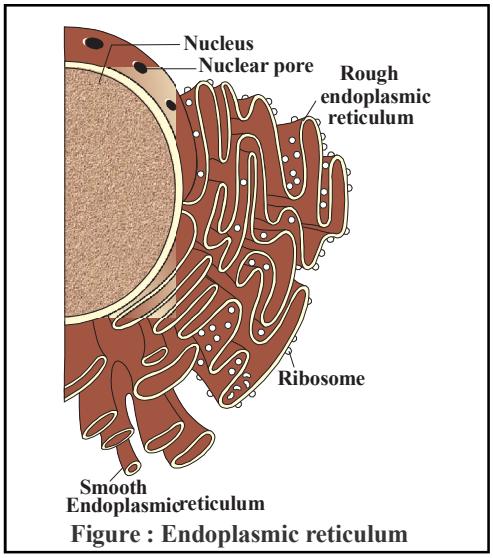


Figure : Endoplasmic reticulum

* The ER often shows ribosomes attached to their outer surface. The endoplasmic reticulun bearing ribosomes on their surface is called rough endoplasmic reticulum (RER).

* In the absence of ribosomes they appear smooth and are called smooth endoplasmic reticulum (SER).

* RER is frequently observed in the cells actively involved in protein synthesis and secretion. They are extensive and continuous with the outer membrane of the nucleus.

* The smooth endoplasmic reticulum is the major site for synthesis of lipid. In animal cells lipid-like steroidal hormones are synthesised in SER.

2. Golgi apparatus :

* Camillo Golgi (1898) first observed densely stained reticular structures near the nucleus. These were later named Golgi bodies after him. They consist of many flat, disc-shaped sacs or cisternae of 0.5µm to 1.µm diameter. These are stacked parallel to each other. Varied number of cisternae are present in a Golgi complex.

* ..... *In plants*, these are scattered irregularly in the cytoplasm and called as "*dictyosomes*". These are absent in bacteria and blue green algae, RBCs, spermatozoa of bryophytes and pteridophytes, and sieve tube cells of phloem of angiosperm. The number of golgi body increased during cell division. Average number 10 – 20 per cell. Golgi body surrounded by a zone of protoplasm which is devoid of cell organelles called zone of exclusion (Morre, 1977).

* Under transmission electron microscope the structure of golgibodies was study by Dalton and Felix (1954), golgi body is made of 4 parts.

(i) **Cisternae :** Golgi apparatus is made up of stack of flat. Sac like structure called cisternae. The margins of each cisterna are gently curved so that the entire golgi body takes on a cup like appearance.

(ii) **Tubules :** These arise due to fenestration of cisternae and it forms a complex of network.

(iii) **Secretory vesicles :** These are small sized components each about 40 Å in diameter present along convex surface of edges of cisternae. These are smooth and coated type of vesicles.

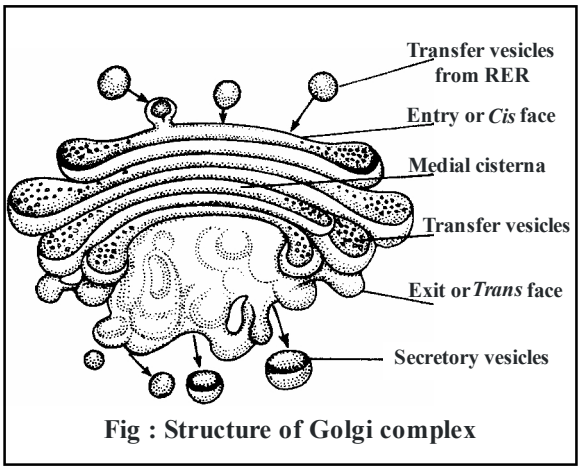


Fig : Structure of Golgi complex

(iv) **Golgian vacuoles :** They are expanded part of the cisternae which have become modified to form vacuoles. The vacuoles develop from the concave or maturing face. Golgian vacuoles contain amorphous or granular substance. Some of the golgian vacuoles function as lysosomes.

* The Golgi cisternae are concentrically arranged near the nucleus with distinct convex cis or the forming face and concave trans or the maturing face. The cis and the trans faces of the organelle are entirely different, but interconnected.
* The golgi apparatus principally performs the function of packaging materials, to be delivered either to the intra-cellular targets or secreted outside the cell. Materials to be packaged in the form of vesicles from the ER fuse with the cis face of the golgi apparatus and move towards the maturing face.
* A number of proteins synthesised by ribosomes on the endoplasmic reticulum are modified in the cisternae of the golgi apparatus before they are released from its trans face. Golgi apparatus is the important site of formation of glycoproteins and glycolipids.
* A typical sequence followed by a glycoprotein destined for secretion from the cell:
Polypeptides synthesized on ribosomes
→ protein assembled and carbohydrate component added in lumen of ER
→ transport vesicles move glycoprotein to Golgi (*cis* face) → glycoprotein further modified in Golgi → in *trans* face, glycoproteins packaged in transport vesicles → glycoproteins transported to plasma membrane → contents released from cell.

3. Lysosomes :

* Lysosomes are electron microscopic, vesicular structures of the cytoplasm, bounded by a single membrane (lipoproteinous) which are involved in intracellular digestive activities, contains hydrolytic enzymes, so called lysosomes.
* These are membrane bound vesicular structures formed by the process of packaging in the golgi apparatus. The isolated lysosomal vesicles have been found to be very rich in almost all types of hydrolytic enzymes (hydrolases – lipases, proteases, carbohydrases) optimally active at the acidic pH. These enzymes are capable of digesting carbohydrates, proteins, lipids and nucleic acids.

4. Vacuoles :

* The vacuole is the membrane-bound space found in the cytoplasm. It contains water, sap, excretory product and other materials not useful for the cell. The vacuole is bound by a single membrane called tonoplast. In plant cells the vacuoles can occupy up to 90 per cent of the volume of the cell.
* In plants, the tonoplast facilitates the transport of a number of ions and other materials against concentration gradients into the vacuole, hence their concentration is significantly higher in the vacuole than in the cytoplasm.

* In Amoeba the contractile vacuole is important for excretion. In many cells, as in protists, food vacuoles are formed by engulfing the food particles.

Mitochondria

* Mitochondria (sing.: mitochondrion), unless specifically stained, are not easily visible under the microscope.
* Mitochondria are also called chondriosome, chondrioplast, plasmosomes, plastosomes and plastochondriane.
* These were first observed in striated muscles (Voluntary) of insects as granules by Kolliker (1880), he called them "sarcosomes.
* *Michaelis* (1898) demonstrated that mitochondria play a significant role in respiration.
* *Bensley* and *Hoerr* (1934) isolated mitochondria from liver cells.
* *Seekevitz* called them "Power house of the cell".
* *Nass* and *Afzelius* (1965) observed first DNA in mitochondria.
* Minimum number of mitochondria is one in Microasterias, *Trypanosoma, Chlorella, Chlamydomonas* (green alga) and *Micromonas*. Maximum numbers are found (up to 500000) in flight muscle cell, (up to 50000) in giant *Amoeba* called *Chaos – Chaos*. These are 25 in human sperm, 300 – 400 in kidney cells and 1000 – 1600 in liver cells.
* Each mitochondrion is a double membrane-bound structure with the outer membrane and the inner membrane dividing its lumen distinctly into two aqueous compartments, i.e., the outer compartment and the inner compartment. 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 (sing.: crista) towards the matrix. The cristae increase the surface area. The two membranes have their own specific enzymes associated with the mitochondrial function.

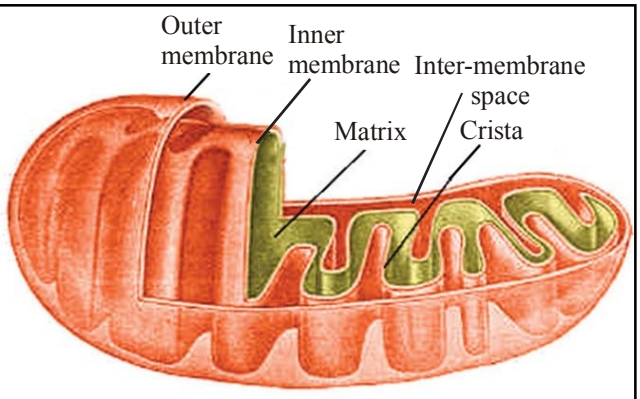


Figure : Structure of mitochondrion (Longitudinal section)

* 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 single circular DNA molecule, a few RNA molecules, ribosomes (70S) and the components required for the synthesis of proteins. The mitochondria divide by fission.
* **Enzymes of Mitochondria**

(i) **Outer membrane :** Monoamine oxidase, glycero phosphatase, acyltransferase, phospholipase A.

(ii) **Inner membrane :** Cytochrome b,c_1,c,a, (cyt.b, cyt.c_1, cyt.c, cyt.a, cyt.a_3) NADH, dehydrogenase, succinate dehydrogenase, ubiquinone, flavoprotein, ATPase.

(iii) **Perimitochondrial space :** Adenylate kinase, nucleoside diphosphokinase.

(iv) **Inner matrix :** Pyruvate dehydrogenase, citrate synthase, aconitase, isocitrate dehydrogenase, fumarase, α-Ketoglutarate dehydrogenase, malate dehydrogenase.

Plastids

* Plastids are semiautonomous organelles having DNA, RNA, Ribosomes and double membrane envelope. These are largest cell organelles in plant cell.
* Haeckel (1865) discovered plastid, but the term was first time used by Schimper (1883).
* A well organised system of grana and stroma in plastid of normal barley plant was reported by de Von Wettstein.

* Park and Biggins (1964) gave the concept of quantasomes.
* The term chlorophyll was given by Pelletier and Caventou, and structural details were given by Willstatter and Stall.
* Ris and Plaut (1962) reported DNA in chloroplast and was called plastidome.
* Plastids are found in all plant cells and in euglenoides. These are easily observed under the microscope as they are large. They bear some specific pigments, thus imparting specific colours to the plants. Based on the type of pigments plastids can be classified into chloroplasts, chromoplasts and leucoplasts.
* The chloroplasts contain chlorophyll and carotenoid pigments which are responsible for trapping light energy essential for photosynthesis. In the chromoplasts fat soluble carotenoid pigments like carotene, xanthophylls and others are present. This gives the part of the plant a yellow, orange or red colour. The leucoplasts are the colourless plastids of varied shapes and sizes with stored nutrients: Amyloplasts store carbohydrates (starch), e.g., potato; elaioplasts store oils and fats whereas the aleuroplasts store proteins.
* **Pigments of chloroplast**

  Chlorophyll a : $C_{55}\ H_{72}\ O_5 N_4 Mg$ (with methyl group)

  Chlorophyll b : $C_{55}\ H_{70} O_6 N_4 Mg$ (with aldehyde group)

  Chlorophyll c : $C_{35} H_{32} O_5\ N_4 Mg$

  Chlorophyll d : $C_{54}\ H_{70}\ O_6 N_4 Mg$

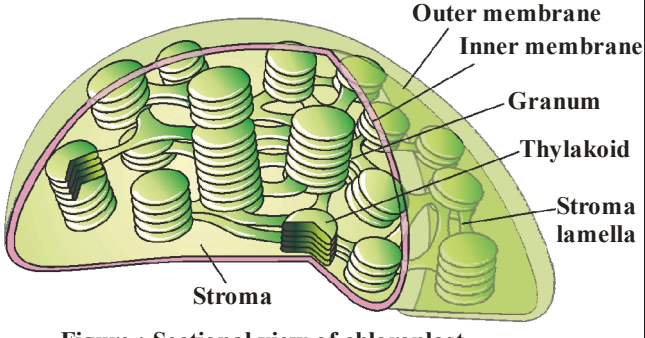


Figure : Sectional view of chloroplast

* Majority of the chloroplasts of the green plants are found in the mesophyll cells of the leaves. These are lens-shaped, oval, spherical, discoid or even ribbon-like organelles having variable length (5-10mm) and width (2-4mm). Their number varies from 1 per cell of the Chlamydomonas, a green alga to 20-40 per cell in the mesophyll.
* Like mitochondria, the chloroplasts are also double membrane bound. Of the two, the inner chloroplast membrane is relatively less permeable.
* The space limited by the inner membrane of the chloroplast is called the stroma.
* A number of organised flattened membranous sacs called the thylakoids, are present in the stroma.
* Thylakoids are arranged in stacks like the piles of coins called grana (singular: granum) or the intergranal thylakoids.
* In addition, there are flat membranous tubules called the stroma lamellae connecting the thylakoids of the different grana.
* The membrane of the thylakoids enclose a space called a lumen.
* The stroma of the chloroplast contains enzymes required for the synthesis of carbohydrates and proteins. It also contains small, double-stranded circular DNA molecules and ribosomes.
* Chlorophyll pigments are present in the thylakoids. The ribosomes of the chloroplasts are smaller (70S) than the cytoplasmic ribosomes (80S).

Ribosomes

* Ribosomes are the granular structures first observed under the electron microscope as dense particles by George Palade (1953). They are composed of ribonucleic acid (RNA) and proteins and are not surrounded by any membrane.
* The eukaryotic ribosomes are 80S while the prokaryotic ribosomes are 70S. Each ribosome has two subunits, larger and smaller subunits.
* The two subunits of 80S ribosomes are 60S and 40S while that of 70S ribosomes are 50S and 30S. Here 'S' (Svedberg's Unit) stands for the sedimentation coefficient; it is indirectly a measure of density and size. Both 70S and 80S ribosomes are composed of two subunits.

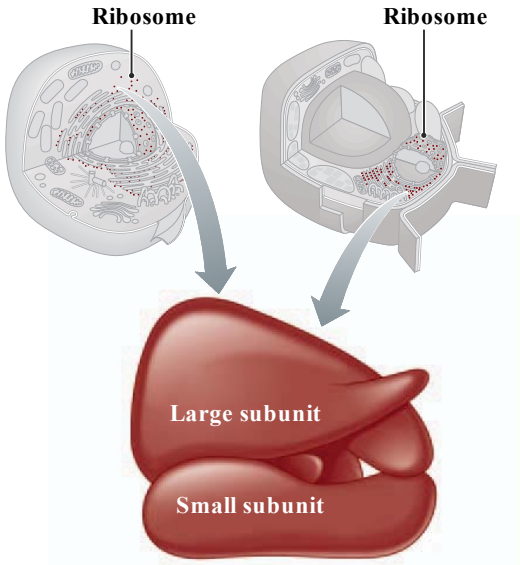


Figure : A ribosome. The diagram shows the structures of the two ribosomal subunits of mammalian ribosomes and how they come together to form the whole ribosome.

* Chemical composition of ribosomes :
  70S - 60% r-RNA + 40% proteins
  80S - 40% r-RNA + 60% proteins
  60S - r-RNA 28S, 5.8S, 5S
  40S - r-RNA 18S
  50S - r-RNA 23S, 5S
  30S - r-RNA 16S
* Ribosomes are also called protein factories of the cell or work branch of proteins.
* Free ribosomes synthesize structural proteins and bounded ribosomes synthesize proteins for transport.
* Ribosomes are essential for protein synthesis.
* Help in the process of photosynthesis.

Cytoskeleton

* An elaborate network of filamentous proteinaceous structures present in the cytoplasm is collectively referred to as the cytoskeleton.
* The cytoskeleton in a cell are involved in many functions such as mechanical support, motility, maintenance of the shape of the cell.

Cilia and Flagella

* Cilia (sing.: cilium) and flagella (sing.: flagellum) are hair-like outgrowths of the cell membrane. Cilia are small structures which work like oars, causing the movement of either the cell or the surrounding fluid. Flagella are comparatively longer and responsible for cell movement. The prokaryotic bacteria also possess flagella but these are structurally different from that of the eukaryotic flagella.
* A cilium or the flagellum are covered with plasma membrane. Their core called the axoneme, possesses a number of microtubules running parallel to the long axis. The axoneme usually has nine pairs of doublets of radially arranged peripheral microtubules, and a pair of centrally located microtubules. Such an arrangement of axonemal microtubules is referred to as the 9+2 array.
* The central tubules are connected by bridges and is also enclosed by a central sheath, which is connected to one of the tubules of each peripheral doublets by a radial spoke. Thus, there are nine radial spokes. The peripheral doublets are also interconnected by linkers. Both the cilium and flagellum emerge from centriole-like structure called the basal bodies.

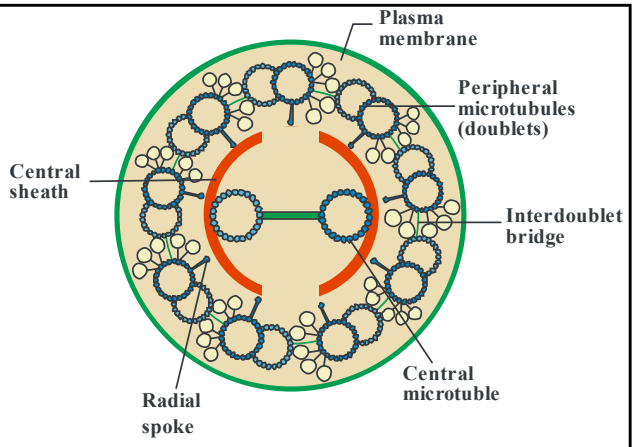


Figure : Section of cilia/flagella showing different parts

Centrosome and Centrioles

* Centrosome was first discovered by Van Benden (1887) and structure was given by T. Boweri.
* It is found in all the animal cell except mature mammalian RBC's. It is also found in most of protists and motile plant cells like antherozoids of ferns, zoospores of algae and motile algal forms *e.g.*, Chlamydomonas but is absent in prokaryotes, fungi, gymnosperms and angiosperms.

* 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 organisation like the 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 or flagella, and spindle fibres that give rise to spindle apparatus during cell division in animal cells.
* Centrosome is lipoproteinaceous structure. The microtubules of centriole are composed of protein tubulin and some lipids. They are rich in ATPase enzyme.
* The daughter centriole is formed from the pre-existing centriole in G_2 of interphase so called self-replicating organelle.

Nucleus

* Nucleus as a cell organelle was first described by Robert Brown as early as 1831.
* The material of the nucleus stained by the basic dyes was given the name chromatin by Flemming.
* The interphase nucleus (nucleus of a cell when it is not dividing) has highly extended and elaborate nucleoprotein fibres called chromatin, nuclear matrix and one or more spherical bodies called **nucleoli** (sing.: nucleolus).

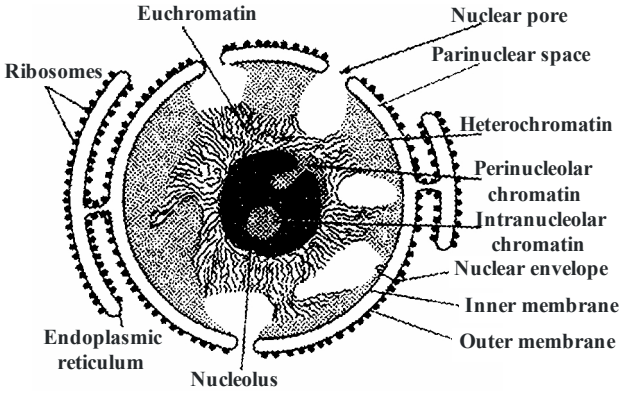


Figure : Electron microscopic structure of nucleus

* Nuclear envelope, consists of two parallel membranes with a space between (10 to 50 nm) called the **perinuclear space**, forms a barrier between the materials present inside the nucleus and that of the cytoplasm.
* The outer membrane usually remains continuous with the endoplasmic reticulum and also bears ribosomes on it.
* At a number of places the nuclear envelope is interrupted by minute pores, which are formed by the fusion of its two membranes. These nuclear pores are the passages through which movement of RNA and protein molecules takes place in both directions between the nucleus and the cytoplasm. Normally, there is only one nucleus per cell, variations in the number of nuclei are also frequently observed.
* Some mature cells even lack nucleus, e.g., erythrocytes of many mammals and sieve tube cells of vascular plants.
* The nuclear matrix or the nucleoplasm contains nucleolus and chromatin. The nucleoli are spherical structures present in the nucleoplasm. The content of nucleolus is continuous with the rest of the nucleoplasm as it is not a membrane bound structure. It is a site for active ribosomal RNA synthesis. Larger and more numerous nucleoli are present in cells actively carrying out protein synthesis.

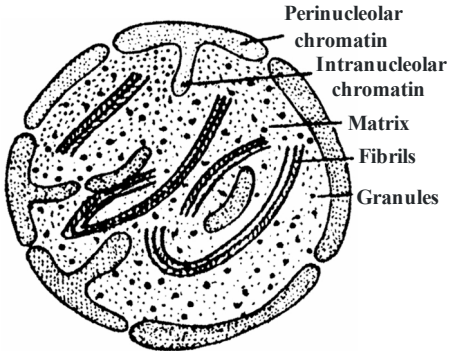


Figure : Ultra-structure of a Nucleolus

* The interphase nucleus has a loose and indistinct network of nucleoprotein fibres called chromatin. But during different stages of cell division, cells show structured **chromosomes** in place of the nucleus. Chromatin contains DNA and some basic proteins called **histones**, some non-histone proteins and also RNA. A single human cell has

approximately two metre long thread of DNA distributed among its forty six (twenty three pairs) chromosomes.

* Every chromosome essentially has a primary constriction or the **centromere** on the sides of which disc shaped structures called **kinetochores** are present. Based on the position of the centromere, the chromosomes can be classified into four types.

Figure : Chromosome with kinetochore

The **metacentric** chromosome has middle centromere forming two equal arms of the chromosome. The **sub-metacentric** chromosome has centromere nearer to one end of the chromosome resulting into one shorter arm and one longer arm.

In case of **acrocentric** chromosome the centromere is situated close to its end forming one extremely short and one very long arm, whereas the **telocentric** chromosome has a terminal centromere.

* Sometimes a few chromosomes have non-staining secondary constrictions at a constant location. This gives the appearance of a small fragment called the **satellite.**

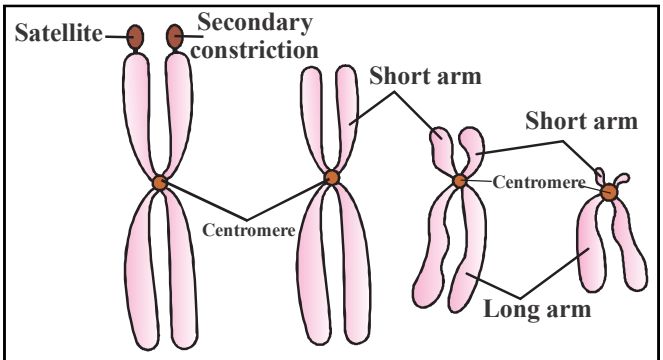


Figure : Types of chromosomes based on the position of centromere

Microbodies

Many membrane bound minute vesicles called microbodies that contain various enzymes, are present in both plant and animal cells.

CONCEPT REVIEW

* **Prokaryotic cells** are bounded by a plasma membrane but have little or no internal membrane organization. They have a nuclear area rather than a membrane-enclosed nucleus. Prokaryotes typically have a **cell wall** and **ribosomes** and may have propeller-like flagella.
* **Eukaryotic cells** have a membrane-enclosed **nucleus** and **cytoplasm**, which contains a variety of organelles; the fluid component of the cytoplasm is the **cytosol**.
* Plant cells differ from animal cells in that they have rigid cell walls, **plastids**, and large **vacuoles**; cells of most plants lack centrioles. Vacuoles are important in plant growth and development.
* Membranes divide the cell into compartments, allowing it to conduct specialized activities within small areas of the cytoplasm, concentrate molecules, and organize metabolic reactions. Membranes are also important in energy storage and conversion.
* A system of interacting membranes forms the endomembrane system.
* Small membrane-bounded sacs, called **vesicles**, transport materials between compartments.
* The nucleus, the control center of the cell, contains genetic information coded in DNA.
* The nucleus is bounded by a **nuclear envelope** consisting of a double membrane perforated with **nuclear pores** that communicate with the cytoplasm.
* DNA in the nucleus associates with protein to form **chromatin** which is organized into chromosomes. During cell division, the chromosomes condense and become visible as thread-like structures.
* The **nucleolus** is a region in the nucleus that is the site of ribosomal RNA synthesis and ribosome assembly.
* **The endoplasmic reticulum (ER)** is a network of folded internal membranes in the cytosol. **Smooth ER** is the site of lipid synthesis and detoxifying enzymes.

* **Rough ER** is studded along its outer surface with ribosomes that manufacture proteins. Proteins synthesized on rough ER may be moved into the **ER lumen**, where they are modified by the addition of a carbohydrate or lipid.
* The **Golgi complex** consists of stacks of flattened membranous sacs called **cisternae** that process, sort, and modify proteins synthesized on the ER. The Golgi complex also manufactures lysosomes.
* Glycoproteins are transported from the ER to the cis face of the Golgi complex by **transport vesicles**, formed by membrane budding.
* The Golgi modifies carbohydrates and lipids that were added to proteins by the ER, and packages them in vesicles. Glycoproteins exit the Golgi at its trans face. The Golgi routes some proteins to the plasma membrane for export from the cell. Others are transported to lysosomes or other organelles within the cytoplasm.
* **Lysosomes** contain enzymes that break down worn-out cell structures, bacteria, and other substances taken into cells.
* **Peroxisomes** contain enzymes that produce and degrade hydrogen peroxide. They are involved in lipid metabolism and detoxify harmful compounds.
* **Mitochondria**, the sites of aerobic respiration, are organelles enclosed by a double-membrane. The inner membrane is folded, forming **cristae** that increase its surface area. Mitochondria contain DNA that codes for some of its proteins.
* Mitochondria play an important role in **apoptosis**, or programmed cell death.
* The cristae and the compartment enclosed by the inner membrane, the **matrix**, contain enzymes for the reactions of aerobic respiration. During aerobic respiration, nutrients are broken down in the presence of oxygen. Energy captured from nutrients is packaged in ATP, and carbon dioxide and water are produced as by-products.
* **Chloroplasts** are plastids that carry out **photosynthesis**.
* The inner membrane of the chloroplast encloses a fluid-filled space, the **stroma. Grana,** stacks of disclike membranous sacs called **thylakoids**, are suspended in the stroma.
* The **cytoskeleton** is a dynamic internal framework made of microtubules, microfilaments, and intermediate filaments. The cytoskeleton provides structural support and functions in various types of cell movement, including transport of materials in the cell.
* **Microtubules** are hollow cylinders assembled from subunits of the protein **tubulin**. In cells that are not dividing, the minus ends of microtubules appear to be anchored in **microtubule organizing centers (MTOCs).**
* The main MTOC of animal cells is the **centrosome**, which usually contains two centrioles. Each centriole has a 9 × 3 arrangement of microtubules.
* **Microtubule-associated proteins (MAPs)** include structural MAPs and motor MAPs. Two motor MAPs are kinesin and dynein.
* **Microfilaments**, or actin filaments, formed from subunits of the protein **actin**, are important in cell movement.
* **Intermediate filaments** strengthen the cytoskeleton and stabilize cell shape.
* **Cilia** and **flagella** are thin, movable structures that project from the cell surface and function in movement. Each consists of a 9 + 2 arrangement of microtubules, and each is anchored in the cell by a **basal body** that has a 9 × 3 organization of microtubules. Cilia are short and flagella are long.
* Most cells are surrounded by a **glycocalyx**, or **cell coat**, formed by polysaccharides extending from the plasma membrane.
* Many animal cells are also surrounded by an **extracellular matrix (ECM)** consisting of carbohydrates and protein.
Fibronectins are glycoproteins of the ECM that bind to **integrins**, receptor proteins in the plasma membrane.
* Most bacteria, fungi, and plant cells are surrounded by a cell wall made of carbohydrates. Plant cells secrete cellulose and other polysaccharides that form rigid cell walls.
* According to the **fluid mosaic model**, membranes consist of a fluid phospholipid bilayer in which a variety of proteins are embedded.
* The phospholipid molecules are **amphipathic**: They have hydrophobic and hydrophilic regions. The hydrophilic heads of the phospholipids are

at the two surfaces of the bilayer, and their hydrophobic fatty acid chains are in the interior.

* In almost all biological membranes, the lipids of the bilayer are in a fluid or liquid-crystalline state, which allows the molecules to move rapidly in the plane of the membrane. Proteins move within the membrane.
* Lipid bilayers are flexible and self-sealing, and can fuse with other membranes. These properties are the basis for transport of materials from one part of the cell to another in vesicles that bud from various cell membranes and then fuse with some other membrane.
* **Integral membrane proteins** are embedded in the bilayer with their hydrophilic surfaces exposed to the aqueous environment and their hydrophobic surfaces in contact with the hydrophobic interior of the bilayer.
  Transmembrane proteins are integral proteins that extend completely through the membrane.
* **Peripheral membrane proteins** are associated with the surface of the bilayer, usually bound to exposed regions of integral proteins, and are easily removed without disrupting the structure of the membrane.
* Membrane proteins, lipids, and carbohydrates are asymmetrically positioned with respect to the bilayer so that one side of the membrane has a different composition and structure from the other.
* Membrane proteins have many functions, including transport of materials, acting as enzymes or receptors, cell recognition, and structurally linking cells together.
* Biological membranes are selectively permeable membranes; that is, they allow the passage of some substances but not others. **Diffusion** is the net movement of a substance down its **concentration gradient** from a region of greater concentration to one of lower concentration.
* Osmosis is a kind of diffusion in which molecules of water pass through a selectively permeable membrane from a region where water has a higher effective concentration to a region where its effective concentration is lower.
* Diffusion and osmosis are physical processes that do not require the cell to directly expend metabolic energy.
* **transport proteins** facilitate the passage of certain ions and molecules through biological membranes. **Channel proteins** are transport proteins that form passageways through which water and certain ions travel through the membrane. **Carrier proteins** are transport proteins that undergo a series of conformational changes as they bind and transport a specific solute.

IMPORTANT POINTS

* Schleiden and Schwann proposed cell theory in 1838-39.
* Living beings are made up of cells. This was first stated by Lamarck.
* Oxysomes or $F_0 - F_1$ particles occur on inner mitochondrial membrane.
* The functional unit of Golgi apparatus is Cisternae.
* Water soluble pigment present in cell vacuole is Anthocyanin.
* Fluid mosaic model of cell membrane was put forward by Singer and Nicolson.
* Chloroplasts is absent in animal cell.
* Foldings of inner mitochondria membrane are called cristae.
* Filaments present in flagella/cilia are microtubules.
* Ribosomes of bacteria mitochondria and chloroplasts are of 70S type.
* Lysosomes are so called as they have digestive enzymes.
* Ribosomes are made up of RNA and proteins.
* Thylakoids occur inside chloroplasts.
* Export house/firm of cell is golgi body.
* Prokaryotes differ from eukaryotes in absence of histone.
* Lysosome enzymes are active at pH 5.
* F_1 particles occur in mitochondria.
* Endoplasmic reticulum = Synthesis of lipids.
  Free ribosome = Synthesis of non-secretory proteins. Mitochondrion = Cellular respiration
  Contractile = Osmoregulation and excretion.
* In *Ulothrox*, the shape of chloroplast is girdle-shaped.
* Permease increases membrane permeability.
* Plasmodesmata is an effective transport pathway between two adjacent cells.
* TCA enzymes mostly occur in mitochondrial matrix.

* Table : Eukaryotic Cell structures and their functions :

Structure	Description	Function
Cell Nucleus		
Nucleus	Large structure surrounded by double membrane; contains nucleous and chromosomes.	Information in DNA is transcribed in RNA synthesis; specifies cell proteins
Nucleous	Granular body within nucleus; consists of RNA and protein.	Site of ribosomal RNA synthesis; ribosome subunit assembly.
Chromosomes	Composed of a complex DNA and protein known as *chromatin;* condense during cell division, becoming visible as rod-like structures.	Contain genes (units of hereditary information) that govern structure and activity of cell.
Cytoplasmic Organelles		
Plasma membrane	Membrane boundary of cell	Encloses cell contents; regulates movement of materials in and out of cell; helps maintain cell shape; communicates with other cells (also present in prokaryotes)
Endoplasmic reticulum(ER)	Network of internal membranes extending through cytoplasm.	Synthesizes lipids and modifies many proteins; origin of intracellular transport vesicles that carry proteins.
Smooth	Lacks ribosomes on outer surface	Lipid biosynthesis; drug detoxification
Rough	Ribosomes stud outer surface	Manufacture of many proteins destined for secretion or for incorporation into membranes.
Ribosomes	Granules composed of RNA and protein; some attached to ER, some free in cytosol	Synthesize polypeptides in both prokaryotes and eulcaryotes.
Golgi complex	Stacks of flattened membrane sacs	Modifies proteins; packages secreted proteins; sorts other proteins to vacuoles and other organelles.
Lysosomes	Membranous sacs (in animals)	Contain enzymes to break down ingested materials, secretions, wastes
Vacuoles	Membranous sacs (mostly in plants, fungi, algae)	Store materials, wastes, water; maintain hydrostatic pressure.
Peroxisomes	Membranous sacs containing a variety of enzymes.	Site of many diverse metabolic reactions.
Mitochondria	Sacs consisting of two membranes; inner membrane is folded to form cristae and encloses matrix.	Site of most reactions of cellular respiration; transformation of energy originating from glucose or lipids into ATP energy
Plastids (e.g., chloroplasts)	Double-membrane structure enclosing internal thylakoid membranes; chloroplasts contain chlorophyll in thylakoid membranes.	Chloroplasts are site of photosynthesis; chlorophyll captures light energy; ATP and other energy-rich compounds are formed and then used to convert CO_2 to carbohydrate.
Cytoskeleton		
Microtubules	Hollow tubes made of subunits of tubulin protein.	Provide structural support; have role in cell and organelle movement and cell division; components of cilia, flagella, centrioles, basal bodies.
Microfilaments	Solid, rodlike structures consisting of actin protein.	Provide structural support; play role in cell and organelle movement and cell division.
Intermediate filaments	Tough fibers made of protein.	Help strengthen cytoskeleton; stabilize cell shape.
Centriole	Pair of hollow cylinders located near nucleus; each centriole consists of nine microtubule triplets (9 X 3 structure).	Mitotic spindle forms between centrioles during animal cell division; may anchor and organize microtubule formation in animal cells; absent in most plants.
Cilia	Relatively short projections extending from surface of cell; covered by plasma membrane; made of two central and nine pairs of peripheral microtubules (9 + 2 structure).	Movement of some unicellular organisms; used to move materials on surface of some tissues.
Flagella	Long projections made of 2 central and nine pairs of peripheral microtubules (9+2 structure); extend from surface of cell; covered by plasma membrane.	Cell locomotion by sperm cells and some unicellular eukaryotes.

QUESTION BANK

EXERCISE - 1 (LEVEL-1) [NCERT EXTRACT]

SECTION - 1 (VOCABULARY BUILDER)

Choose one correct response for each question.
For Q.1-Q.5
Match the column I with column II.

Q.1

	Column I	Column II
a.	Leeuwenhoek	i. Described a living cell
b.	Robert Hooke	ii. Unicellular
c.	*Chlamydomonas*	iii. Discovered cell membrane
d.	Robert Brown	iv. Wrote '*Micrographia*'
e.	Schwann	v. Discovered the nucleus

Codes
(A) a-i, b-iv, c-ii, d-v, e-iii
(B) a-iii, b-ii, c-v, d-iv, e-i
(C) a-iv, b-i, c-v, d-iii, e-ii
(D) a-v, b-iii, c-i, d-iv, e-ii

Q.2

	Column I (Cell Organelle)	Column II (Function)
a.	Endoplasmic reticulum	i. Take part in cellular respiration
b.	Free ribosome	ii. Take part in osmoregulation and excretion
c.	Mitochondrion	iii. Synthesis of lipids
d.	Contractile vacuole	iv. Synthesise non-secretory proteins

Codes
(A) a-iii, b-iv, c-i, d-ii (B) a-i, b-ii, c-iv, d-iii
(C) a-iii, b-ii, c-i, d-iv (D) a-iii, b-ii, c-iv, d-i

Q.3

	Column I	Column II
a.	Cristae	i. Fat membranous sacs in stroma
b.	Cisternae	ii. Infoldings in mitochondria
c.	Thylakoids	iii. Disc-shaped sacs in Golgi apparatus
d.	Secondary constriction	iv. Satellite

Codes
(A) a-i, b-iii, c-iv, d-ii
(B) a-ii, b-iii, c-i, d-iv
(C) a-iii, b-i, c-iv, d-ii
(D) a-i, b-iv, c-ii, d-iii

Q.4

	Column I (sub-structures)		Column II (functions)
a.	Nucleosome	(i)	Cell adhering junctions
b.	Tubulin	(ii)	Battery of degradative enzymes.
c.	Desmosomes	(iii)	Structural units of chromatin
d.	Lysosomes	(iv)	Protein units on microtubules
		(v)	Oxidative phosphorylation

Codes
(A) a-i, b-iii, c-iv, d-ii (B) a-ii, b-iii, c-i, d-iv
(C) a-iii, b-iv, c-i, d-ii (D) a-i, b-iv, c-ii, d-iii

Q.5

Column I	Column II
(a) Smooth endoplasmic reticulum	(i) Consists of microtubules
(b) Centrioles	(ii) Digests damaged cells
(c) Peroxisome	(iii) Synthesizes ribosomes
(d) Nucleolus	(iv) Detoxifies alcohol in liver cells
(e) Lysosome	(v) Breaks down the by-product of cell respiration

Codes
(A) a-iv, b-i, c-v, d-iii, e-ii
(B) a-iii, b-ii, c-v, d-iv, e-i
(C) a-iv, b-i, c-v, d-iii, e-ii
(D) a-v, b-iii, c-i, d-iv, e-ii

SECTION - 2 (BASIC CONCEPTS BUILDER)

For Q.6 to Q.25 :

Choose one word for the given statement from the list.

Prokaryotes, Plasmids, Nuclear pores, Heterochromatin, tightly, 'J' shaped, Kinetochore, Tonoplast, Slime layer; Capsule, Viruses, Mitochondria, Protoplast, Centriole, Cuticle, Transmembrane protein (tunnel protein), Lipid

Q.6 ____ are an exception to cell theory.

Q.7 Protoplasm of a eukaryotic cell is called _____.

Q.8 _____ are self-replicating, extra chromosomal segments of double-stranded circular and naked DNA, present in a bacterial cell.

Q.9 The 'power house' of cell is _____.

Q.10 Membrane that covers the vacuole in a plant cells is called _____.

Q.11 Many bacteria have small circular DNA outside the genomic DNA. These smaller DNA are called _____.

Q.12 Glycocalyx (mucilage sheath) of a bacterial cell may occur in the form of a loose sheath called ____ or it may be thick and tough called ____.

Q.13 Naked DNA without histones is found in _____.

Q.14 Animal cell contains non-membrane bound organelles called ___ which helps in cell division.

Q.15 Deposition of wax-like fatty substances over epidermis forms ____.

Q.16 The integral proteins which run throughout the lipid bilayer in plasma membrane is called _____.

Q.17 The SER is abundant in those cells which are active in _____ synthesis.

Q.18 _____ maintain continuity between nucleo-cytoplasmic regions.

Q.19 ____ region gets dark stain during interphase and has condensed region with ___ packed DNA.

Q.20 Acrocentric chromosomes appear ____

Q.21 Disc-shaped protein structure attached to the centromeric portion is called ___.

Q.22 Lysosomes are double membrane vesicles budded off from Golgi apparatus and contains digestive enzymes. **[True / False]**

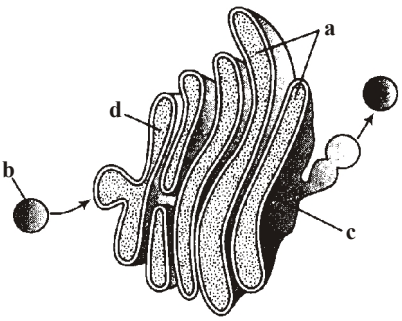
Q.23 Endoplasmic reticulum consists of a network of membranous tubule and helps in transport, synthesis and secretion. **[True / False]**

Q.24 Leucoplasts are bound by two membranes, lack pigments but contains their own DNA and protein synthesising machinery. **[True / False]**

Q.25 Sphaerosomes are single membrane bound and are associated with the synthesis and storage of lipids. **[True / False]**

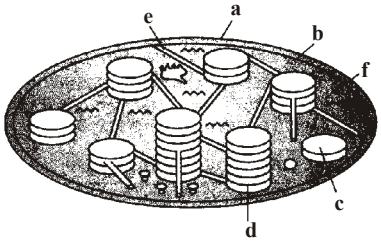
SECTION - 3 (ENHANCE DIAGRAM SKILLS)

Q.26 Which one of the following is the correct labelling of given structure of Golgi apparatus?



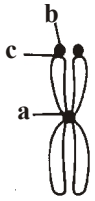
(A) a-Cisternae, b-Vesicle, c-cis face, d-trans face
(B) a-Cisternae, b-Vesicle, c-trans face, d-cis face
(C) a-Tubules, b-Vesicle, c-trans face, d-cis face
(D) a-Vesicle, b-Cisternae, c-cis face, d-trans face

Q.27 Identify a to f in the sectional view of a chloroplast showing the different parts.



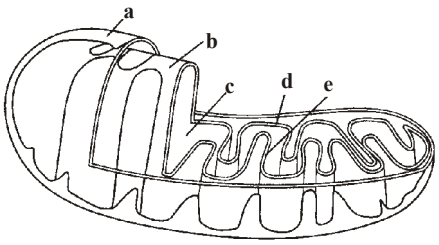
(A) a-Inner membrane, b-Granum, c-Outer membrane, d-Stroma lamella, e-Stroma, f-Thylakoid
(B) a-Outer membrane, b-Inner membrane, c-Granum, d-Thylakoid, e-Stroma lamella, f-Stroma
(C) a-Thylakoid, b-Outer membrane, c-Stroma, d-Stroma lamella, e-Granum, f-Inner membrane
(D) a-Outer membrane, b-Stroma, c-Inner membrane, d-Granum, e-Thylakoid, f-Stroma lamella

Q.28 Which of the following is the correct representation of a, b, and c in the given figure of a chromosome?



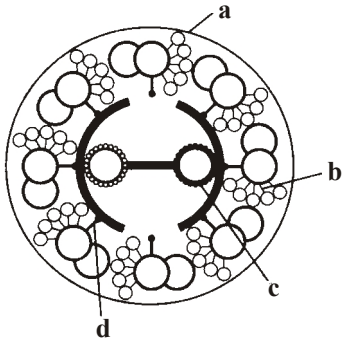
(A) a-Centromere, b-Satellite, c-Secondary constriction
(B) a-Centromere, b-Satellite, c-Primary constriction
(C) a-Centriole, b-Satellite, c-Primary constriction
(d) a-Centriole, b-Satellite, c-Secondary constriction

Q.29 Identify structures a to e in the sectional view of a mitochondrion.



(A) a-Outer membrane, b-Inner membrane, c-Matrix, d-Inter membrane space, e-Cristae
(B) a-Outer membrane, b-Inner membrane, c-Inter membrane space,d-Matrix,e-Cristae
(C) a-Outer membrane, b-Inner membrane, c-Matrix, d-Cristae, e-Inter membrane space
(D) a-Outer membrane, b-Inner membrane, c-Cristae, d-Matrix. e-Inter membrane space

Q.30 Identify a to d in the diagrammatic representation of internal structure of centrioles.



(A) a-Interdoublet bridge, b-Central microtubule, c-Plasma membrane, d-Radial spoke
(B) a-Plasma membrane, b-Central microtubule, c-Interdoublet bridge, d-Radial spoke
(C) a-Plasma membrane, n-Interdoublet bridge, c-Central microtubule, d-Radial spoke
(D) a-Plasma membrane, b-Interdoublet bridge, c-Radial spoke, d-Central microtubule

SECTION - 4 (ENHANCE PROBLEM SOLVING SKILLS)

Choose one correct response for each question.

PART - 1 : CELL THEORY

Q.31 *Omnis cellula-e-cellula* (all cells arises from pre-existing cells). This concept was given by
(A) Schleiden and Schwann (B) Virchow
(C) Robert Brown (D) Leeuwenhoek

Q.32 Who observed few living cells capable of moving, such as bacteria, protozoa, spermatozoa and red blood corpuscles under his own designed microscope?
(A) Aristotle (B) Robert Hooke
(C) Leeuwenhoek (D) Dutrochet

Q.33 Nobody can have life if its constituent parts are not formed of cells. It was observed by
(A) Robert Hooke (B) Mathias Schleiden
(C) Lamarck (D) Louis Pasteur

Q.34 Cell membrane was discovered by Schwann (1838) but it was named by –
(A) Nageli and Cramer
(B) Schwann and Schleiden
(C) Robert Brown
(D) Rudolf Virchow

Q.35 One of the following is an exception to cell theory
(A) Bacteria (B) Prokaryotes
(C) Blue green algae (D) Bacteriophage

Q.36 Cell theory was formulated by
(A) Schleiden and Schwann (B) Rudolf Virchow
(C) Robert Brown (D) Robert Hooke

PART - 2 : AN OVERVIEW OF CELL

Q.37 Comparing small and large cells, which statement is correct?
(A) Small cells have a small surface area per volume ratio.
(B) Exchange rate of nutrients is fast with large cells.
(C) Small cells have a large surface area per volume ratio.
(D) Exchange rate of nutrients is slow with small cells.

Q.38 Within the cell, ribosomes are found in –
(A) cytoplasm
(B) chloroplasts (in plants) and mitochondria
(C) rough ER
(D) All of the above

Q.39 The longest cell in the human body is
(A) Liver cell (B) Muscle cell
(C) Neuroglia cell (D) Nerve cell

Q.40 Which of the following are properties of reserved cells?
(A) They are differentiated and they have capacity of cell division.
(B) They are undifferentiated and they do not have capacity of cell division.
(C) They are differentiated and they do not have capacity of cell division.
(D) They are undifferentiated and they have capacity of cell division.

Q.41 Surface to volume ratio of a cell
(A) Remains constant
(B) Decreases with increasing size
(C) Increases with increasing size
(D) Both (B) & (C)

Q.42 The factors which set the limit of cell size or volume are –
I. nucleo-cytoplasmic or kern-plasma ratio.
II. rate of metabolic activity.
III. ability of oxygen and other materials to reach every part of the cell.
IV. ability of waste products to pass outside.
V. ratio of surface area to the volume of the cell.
Identify the correct set of statements.
(A) III and IV (B) I and II
(C) Only V (D) I, II, III and IV

PART - 3 : PROKARYOTIC CELLS

Q.43 Which of the following represents prokaryotic cells?
(A) PPLO (B) Mycoplasma
(C) Bacteria (D) All of these

Q.44 Long flattened, usually unbranched units arranged in parallel stacks in endoplasmic reticulum are called
(A) cisternae (B) cristae
(C) vesicles (D) tubules

Q.45 Polyribosomes are aggregation of
(A) peroxisomes
(B) ribosomes and rRNA
(C) several ribosomes held together by a string of mRNA.
(D) rRNA and mRNA

Q.46 The prokaryotic cells are characterised by
(A) Distinct chromosome
(B) Absence of chromatin material
(C) Absence of nuclear membrane
(D) Distinct nuclear membrane

Q.47 The term 'cytoplasm' and 'nucleoplasm' were given by –
(A) Purkinje (B) Strasburger
(C) Brown (D) Flemming

Q.48 Which of the following is not a characteristic of prokaryotic cells?
(A) Circular DNA
(B) Mesosome
(C) Photosynthetic membrane system
(D) Membrane bound organelles

Q.49 What is a genophore?
(A) DNA in prokaryotes.
(B) DNA and RNA in prokaryotes.
(C) DNA and protein in prokaryotes.
(D) RNA in prokaryotes.

Q.50 Which of the following is present in the prokaryotes?
(A) Nuclear envelope (B) Golgi apparatus
(C) Mitochondria (D) Ribosomes

Q.51 Most of the bacterial cell envelope consists of
(A) only glycocalyx
(B) a tightly bound three layered structure
(C) the cell membrane
(D) cell wall and cell membrane

Q.52 In prokaryotic cells, an organelle like the one in eukaryotic cells is
(A) lysosomes (B) Golgi apparatus
(C) ribosomes (D) plastids

Q.53 Which of the following is present in a prokaryote cell?
(A) mitochondria (B) ribosomes
(C) endoplasmic reticulum (D) chloroplasts

Q.54 Gram negative bacteria differ from gram positive bacteria in having
(A) Thick cell wall and is primarily made up of peptidoglycan.
(B) Complex cell envelope made up of three layers.
(C) The cell wall is 20-80 nm in thickness and also contains tightly bound techoic acids.
(D) Absence of cell wall lipids

Q.55 Bacterial flagellum consists of all of the following components except
(A) microtubule (B) filament
(C) basal body (D) hook

Q.56 *E. coli* about to replicate was placed in a medium containing radioactive thymidine for five minutes, then it was made to replicate in a normal medium. Which of the following observation will be correct?
(A) Both the strands of DNA will be radioactive.
(B) One strand will be radioactive.
(C) Each half strand will be radioactive.
(D) None of the strand will be radioactive.

Q.57 Which statement is not true about prokaryotes?
(A) DNA is completed with histones
(B) Well-developed nucleus is absent
(C) Mesosome is present
(D) Mitochondria is absent

Q.58 Cell wall consists of –
(A) lignin, hemicellulose, protein and lipid
(B) hemicellulose, cellulose, tubulin and lignin
(C) lignin, hemicellulose, pectin and lipid
(D) lignin, hemicellulose, pectin and cellulose

Q.59 Cell membrane is made up of
(A) protein
(B) cellulose
(C) lipids
(D) lipids, carbohydrates and protein

Q.60 Which of the following statement is incorrect about plasmids?
(A) They are extrachromosomal DNA.
(B) They are used in genetic engineering.
(C) They help in the replication of nucleoid.
(D) They are small, circular and confer certain unique phenotypic characters to some bacteria like resistance to antibiotics.

PART - 4 : EUKARYOTIC CELL

Q.61 Structural lipids of cell membrane are –
(A) simple lipid (B) chromolipids
(C) steroid (D) phospholipids

Q.62 The chromosome in which centromere lies slightly away from the middle of the chromosome resulting in one shorter arm and one longer arm, is called –
(A) metacentric (B) submetacentric
(C) acrocentric (D) telocentric

Q.63 Eukaryotic cell differs from a prokaryotic cell in having
(A) No cytoskeleton (B) Circular DNA
(C) Mesosomes (D) Sap vacuoles

Q.64 In eukaryotic cell, thylakoids, if present,
(A) are grouped inside the chloroplasts
(B) lies freely in the cytoplasm
(C) lies freely outside the cytoplasm
(D) grouped outside the cytoplasm

Q.65 Organelles important in spindle formation during nuclear division is –
(A) Golgi body (B) chloroplast
(C) centriole (D) mitochondrion

Q.66 Assembly of two subunits, 40S and 60S of the ribosome is –
(A) 100S (B) 80S
(C) 70S (D) 50S

Q.67 The term mitochondria was given by –
(A) Benda (B) Altmann
(C) Palade (D) de Duve

Q.68 RER is well developed in cells engaged in the synthesis of
(A) Nucleotides (B) Proteins
(C) Lipids (D) Secretory products

Q.69 Which of the following differentiate plant cells from animal cells?
(A) Large vacuole, plastid and cell wall.
(B) Cell wall, plastid and centriole.
(C) Cell wall, plastid and mitochondria.
(D) Cell membrane, plastid and cell wall.

Q.70 Difference between rough and smooth endoplasmic reticulum is that –
(A) rough ER has ribosomes
(B) smooth ER has ribosomes
(C) smooth ER takes part in protein synthesis
(D) both has F_1-particles

Q.71 Synthesis of ATP in mitochondria takes place
(A) In the matrix
(B) In the intracristal space
(C) At the cristae
(D) At the outer membrane

Q.72 Which of the following is the filler substance of the matrix of eukaryotic cell?
(A) Pectin (B) Cutin
(C) Lignin (D) Suberin

Q.73 An organelle with an internal cross section showing characteristic 9 + 2 morphology is the
(A) microtubule (B) microfilament
(C) cilium or flagellum (D) cytoskeleton

Q.74 F_1-particles present in mitochondria are
(A) episomes (B) spherosomes
(C) oxysomes (D) microsomes

Q.75 Fluidmosaic model was given by –
(A) Beadle and Tatum
(B) Jacob and Monod
(C) Singer and Nicholson
(D) Watson and Crick

Q.76 Chromosome with centromere at one End –
(A) Metacentric (B) Submetacentric
(C) Telocentric (D) Acrocentric

Q.77 Nucleolus is –
(A) Dense acidophilic body
(B) Present in cytoplasm
(C) Spherical, colloidal and basophilic body
(D) Is a membrane bound structure

Q.78 Cell organelles common in Monera & Protista is
(A) lysosome (B) chloroplast
(C) ribosome (D) vacuole

Q.79 Which one is a single membrane cell organelle ?
(A) Endoplasmic reticulum (B) Mitochondria
(C) Lysosomes (D) Chloroplast

Q.80 The main site for ribosomal RNA synthesis is
(A) Nucleus (B) Nucleolus
(C) Endoplasmic reticulum (D) Golgi apparatus

Q.81 In eukaryotic cells, genetic material or DNA is organised into
(A) chromosomes
(B) chromatin
(C) chromosomes and chromatin
(D) None of the above

Q.82 Which of the following is not true for a eukaryotic cell?
(A) It has 80S type of ribosome present in the mitochondria.
(B) It has 80S type of ribosome present in the cytoplasm.
(C) Mitochondria contains circular DNA.
(D) Membrane bound organelles are present.

Q.83 According to the fluid mosaic model, membranes consist
(A) a lipid-protein sandwich.
(B) mainly phospholipids with scattered nucleic acids.
(C) a fluid phospholipid bilayer in which proteins are embedded.
(D) a fluid phospholipid bilayer in which carbohydrates are embedded.

Q.84 Three morphological forms of golgi complex are
(A) Lamellae, tubules and vesicles
(B) Cisternae, tubules and vesicles
(C) Cisternae, tubules and lamellae
(D) Granum, thalykoids and vesicles

Q.85 The endoplasmic reticulum is present in –
(A) Nucleus (B) Chromosomes
(C) Nucleolus (D) Cytoplasm

Q.86 A single unit membrane organelle is –
(A) Ribosomes (B) Mitochondria
(C) Chloroplast (D) Lysosomes

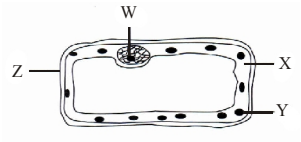
Q.87 Which structure is present in Chromosomes –
(A) Nucleus (B) Centromere
(C) Centrosome (D) Golgi body

EXERCISE - 2 (LEVEL-2)

Choose one correct response for each question.

For questions 1 and 2

Refer to the diagram below which shows a cell.



Q.1 Which of the following are the correct identities of W, X, Y and Z?
(A) W-Cell wall, X-Chloroplast, Y-Cytoplasm, Z-Nucleus
(B) W-Chloroplast, X-Cytoplasm, Y-Nucleus, Z-Cell wall
(C) W-Nucleus, X-Cytoplasm, Y-Chloroplast, Z-Cell membrane
(D) W-Nucleus, X-Cytoplasm, Y- Chloroplast, Z-Cell wall

Q.2 Which of the following is the correct function of X?
(A) Controls cellular function
(B) Glucose production
(C) Stores all hereditary materials
(D) Where most of the chemical reactions take place

Q.3 Lysosomes are filled with –
(A) oxidising enzymes (B) glycolytic enzymes
(C) hydrolytic enzymes (D) lipase enzymes

Q.4 What are those structures that appear as 'beads-on-string' in the chromosomes when viewed under electron microscope?
(A) Nucleotides (B) Nucleosomes
(C) Base pairs (D) Genes

Q.5 The telomeres of eukaryotic chromosomes consist of short sequences of –
(A) adenine rich repeats
(B) guanine rich repeats
(C) uracil rich repeats
(D) cytosine rich repeats.

Q.6 Keeping in view the fluid mosaic model for the structure of cell membrane, which one of the following statements is correct with respect to the movement of lipids and proteins from one mono layer to the other (described as flip-flop movement)?
(A) While proteins can flip-flop, lipids can not.
(B) Neither lipids, nor proteins can flip-flop.
(C) Both lipids and proteins can flip-flop.
(D) While lipids can rarely flip-flop, proteins cannot.

Q.7 Which of the following pairs is mismatched?
(A) Pili – Involved in locomotion.
(B) Cell wall – Protective, determines shape, prevents from bursting.
(C) Glycocalyx - May be capsule or slime layer.
(D) Flagella, pili and fimbriae–Surface structures of bacterial cell.

Q.8 Most of the water in turgid plant cells occurs chiefly in
(A) nucleus (B) vacuoles
(C) cell wall (D) cytoplasm.

Q.9 Which of the following is the respiratory centre of a plant cell?
(A) Chloroplasts (B) Mitochondria
(C) Ribosomes (D) Nucleus

Q.10 Which of the following is **not** a membrane system in a cell?
(A) Golgi body
(B) Smooth endoplasmic reticulum
(C) Mitochondrion
(D) Glycogen granules

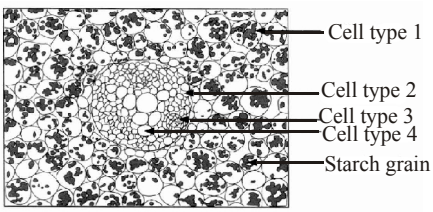
Q.11 Which of the following is not normally found in a plant cell?
(A) mitochondria (B) endoplasmic reticulum
(C) plastids (D) centrioles

Q.12 Which of the following pairs is mismatched?
(A) Pilli – involved in locomotion
(B) Cell wall – protective, determines shape, prevents from bursting.
(C) Glycocalyx – may be capsule or slime layer
(D) Flagella, pilli and fimbriae – surface structures of bacterial cell.

Q.13 Membranes are components of all of the following except
(A) microtubule (B) nucleus
(C) Golgi apparatus (D) mitochondrion

Q.14 Which of the following cells has a haploid chromosome number?
(A) Sperm cell (B) Kidney cell
(C) Muscle cell (D) Cheek cell

Q.15 The photomicrograph below shows part of a section of a young root.



Which type of cells cannot break down food to release energy?
(A) Cell type 1 (B) Cell type 2
(C) Cell type 3 (D) Cell type 4

Q.16 Zone of exclusion surrounds –
(A) Golgi apparatus (B) centriole
(C) nucleus (D) lysosome

Q.17 In chloroplasts, chlorophyll is present in the
(A) outer membrane (B) inner membrane
(C) thylakoids (D) stroma

Q.18 House-keeping proteins occur in
(A) endoplasmic reticulum (B) Golgi complex
(C) cytoskeleton (D) all of the above

Q.19 The cell theory states that __
(i) new cells arise from preexisting cells.
(ii) cells contain genetic material.
(iii) all cells divide.
(iv) living things are composed of cells
Choose the correct option –
(A) (i), (ii) (B) (ii), (iii)
(C) (i), (iv) (D) (iii), (iv)

Q.20 Which of the following statements is not true? Biological membranes –
(A) are composed partly of amphipathic lipids.
(B) have hydrophobic and hydrophilic regions.
(C) are typically in a fluid state.
(D) are made mainly of lipids and of proteins that lie like thin sheets on the membrane surface.

Q.21 Cells are small because, in part, as size increases, the surface area to volume __
(i) increases (ii) doubles (iii) decreases
(iv) reduces adequate nutrient-waste exchange
Choose the correct option –
(A) (i), (ii) (B) (ii), (iii)
(C) (i), (iv) (D) (iii), (iv)

Q.22 Which part of the cell is partially permeable?
(A) Cell membrane (B) Cell wall
(C) Cytoplasm (D) Vacuole

Q.23 Which of the following activities cannot be performed by the human red blood cell?
(A) Release of energy (B) Release of oxygen
(C) Replication of DNA (D) Uptake of glucose

Q.24 The Golgi complex __.
(i) modifies proteins
(ii) produces carbohydrates
(iii) digests organelles
(iv) assembles proteins using mRNA template
Choose the correct option –
(A) (i), (ii) (B) (ii), (iii)
(C) (i), (iv) (D) (iii), (iv)

Q.25 Which of the following function(s) in cell movement?
(A) microtubules (B) cristae
(C) grana (D) smooth ER

Q.26 Which of the following represents the storage polysaccharide in animal cells?
(A) Starch grains
(B) Smooth endoplasmic reticulum
(C) Mitochondrion
(D) Glycogen granules

Q.27 All members of the Tan family have attached ear lobes. Which of the following determines this genetic expression?
(A) Rough endoplasmic reticulum
(B) Chromosomes
(C) Golgi apparatus
(D) Glycogen granules

Q.28 Which is/are not associated with mitochondria?
(A) cristae (B) aerobic respiration
(C) apoptosis (D) thylakoids

Q.29 The cell theory states that
(A) new cells come from preexisting cells.
(B) all cells are descended from ancient cells.
(C) cells divide.
(D) cells contains genetic material.

Q.30 Choose the incorrect option.
(A) Centriole – Composed of tubulin
(B) Centrosome – Serves as microtubule organising centre
(C) Centriole – Present in all plants and animals
(D) Centrosome Associated with nuclear membrane during interphase.

Q.31 The extracellular matrix –
(A) consists mainly of myosin and RNA.
(B) projects to form microvilli.
(C) houses the centrioles.
(D) contains fibronectins that bind to integrins.

Q.32 The endomembrane system includes
(i) endoplasmic reticulum
(ii) the nuclear envelope
(iii) the plasma membrane
(iv) secretory vesicles
Choose the correct option –
(A) (i), (ii), (iii), (iv) (B) (i), (ii), (iii)
(C) (ii), (iv) (D) (iii), (iv)

Q.33 Phospholipids can assemble into a bilayer because of their
(A) ability to dissolve in water
(B) dual solubility properties
(C) inability to associate with other phospholipids
(D) lack of fatty acids

Q.34 In a phospholipid bilayer, __ fatty acids align end-to-end within the bilayer and form a region that excludes water.
(A) hydrophobic (B) hygroscopic
(C) hydrophilic (D) hypertonic

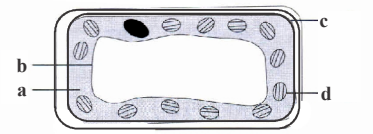
Q.35 The Golgi complex functions to –
(A) modify proteins (B) process proteins
(C) modify glycoproteins (D) all of the above

Q.36 The membranes that partition the cytoplasm of eukaryotic cells (endomembrane system) include
(A) Golgi complex (B) lysosomes
(C) endoplasmic reticulum (D) all of the above

Q.37 Which of the following is NOT a function of membrane proteins?
(A) transport (B) recognition/adhesion
(C) receptor (D) none of the above

Q.38 Which of the following functions of the cellular structures is not correct?
(A) Cellular structures-Chloroplast
Functions - Site where photosynthesis takes place.
(B) Cellular structures-Cytoplasm
Functions- Site where most metabolic reactions take place/
(C) Cellular structures-Mitochondrion
Functions-Site where glucose is produced
(D) Cellular structures-Nucleus
Functions-Contains the heredity information of the cell

Q.39 In which of the following labelled structures are starch grains found?



(A) a (B) b
(C) c (D) d

Q.40 Lysosomes __ .
(i) contain digestive enzymes
(ii) break down complex molecules
(iii) break down organelles
(iv) can fuse with endocytotic vesicles
Choose the correct option –
(A) (i), (ii), (iii), (iv) (B) (i), (ii), (iii)
(C) (ii), (iv) (D) (iii), (iv)

Q.41 Transmembrane proteins –
(A) are peripheral proteins.
(B) are receptor proteins.
(C) extend completely through the membrane.
(D) extend along the surface of the membrane.

Q.42 What is the approximate size of a human red blood cell?
(A) 0.01 micrometer (B) 8 micrometers
(C) 80 micrometers (D) 8 nanometers

Q.43 Smooth E.R. carries out all of the following activities except
(A) lipid production
(B) detoxification
(C) connects rough E.R. to the Golgi
(D) produces RNA

Q.44 Which of the following is not a function of the plasma membrane?
(A) transports materials
(B) helps to structurally link cells together
(C) manufactures proteins
(D) anchors the cell to the extracellular matrix

Q.45 Mitochondria and chloroplasts both ____
(i) are found in plant cells
(ii) are found in animal cells
(iii) contain DNA
(iv) originated from ancient prokaryotes
Choose the correct option –
(A) (i), (ii), (iii), (iv) (B) (i), (ii), (iii)
(C) (ii), (iv) (D) (i), (iii), (iv)

Q.46 In eukaryotic cells, DNA is found in –
(A) chromosomes (B) chromatin
(C) mitochondria (D) A, B and C are correct

Q.47 Cell walls __
(i) occur in plants (ii) occur in fungi
(iii) occur in algal protistins (iv) contain cellulose
Choose the correct option –
(A) (i), (ii), (iii), (iv) (B) (i), (ii), (iii)
(C) (ii), (iv) (D) (i), (iii), (iv)

Q.48 Which is true for both xylem and red blood cells?
(A) Large surface area to volume ratio
(B) No nucleus
(C) No cytoplasm
(D) Thickened cell wall

Q.49 Which of the following best characterizes the structure of the plasma membrane?
(A) rigid and unchanging
(B) rigid but varying from cell to cell
(C) fluid but unorganized
(D) very active

Q.50 Which of the following would not normally diffuse through the lipid bilayer of a plasma membrane?
(A) CO_2 (B) amino acid
(C) starch (D) water

Q.51 Which of the following is a similarity between a red blood cell and a plant root hair cell?
(A) Cellulose cell wall (B) Chloroplasts
(C) Large surface area (D) A nucleus

Q.52 Which of the following is LEAST likely to cross a plasma membrane by simple diffusion?
(A) O_2 (B) H_2O
(C) CO_2 (D) H^+

Q.53 Which of the following statement is not correct for prokaryotic cell?
(A) Prokaryotes have no chromosomes and therefore, lack DNA.
(B) Prokaryotic flagella are similar in structure to eukaryotic flagella.
(C) Because prokaryotes do not contain organelles, they cannot perform photosynthesis or carry out cellular respiration
(D) All of the above

Q.54 The cytoskeleton __ .
(i) changes constantly
(ii) is composed of protein
(iii) includes microtubules
(iv) extends into the nucleus
Choose the correct option –
(A) (i), (ii), (iii), (iv) (B) (i), (ii), (iii)
(C) (ii), (iv) (D) (i), (iii), (iv)

Q.55 Which of the following is/are most closely associated with the breakdown of ingested material?
(A) ribosomes (B) smooth ER
(C) mitochondria (D) lysosomes

Q.56 An amoeba had its nucleus removed. For several days it continued to move and feed, but did not reproduce. A normal amoeba reproduced twice in that time. What conclusion can be drawn about the role of the nucleus in the amoeba?
(A) The nucleus is necessary for cell growth.
(B) The nucleus is necessary for reproduction.
(C) The nucleus is the only place that contains DNA.
(D) The nucleus regulates the activity of the cell.

Q.57 Which of the following chemicals represents a somatic cell's basic defense against foreign bodies?
(A) Lysozymes (B) Myosin
(C) Insulin (D) Lipase

Q.58 Which of the following organelles may produce vacuoles which isolate proteins that may cause intracellular damage in mammalian cells?
(A) Golgi body
(B) Smooth endoplasmic reticulum
(C) Rough endoplasmic reticulum
(D) Ribosomes

Q.59 Which of the following groups is arranged in descending order of complexity in a multicellular organism?
(A) Cell, tissue, organ, system
(B) Tissue, cell, system, organ
(C) System, organ, tissue, cell
(D) Organ, system, tissue, cell

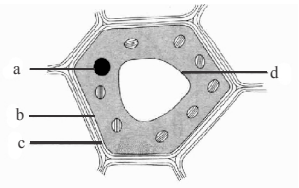
Q.60 Plasma membranes of eukaryotic cells have a large amount of –
(A) cholesterols (B) phospholipid
(C) fluidity (D) all of the above

Q.61 A slide of an unknown specimen is observed under the microscope. Which of the following structures would be helpful in determining whether the specimen is a plant or an animal tissue?
(a) Cellulose cell wall (b) Chloroplasts
(c) Mitochondria (d) Plasma membrane
(A) (a) only (B) (a) and (b) only
(C) (a), (b) & (d) only (D) (a), (b), (c) & (d)

Q.62 In signal transduction –
(A) an extracellular signal is converted to an intracellular signal.
(B) a signal is relayed through a series of molecules in the membrane.
(C) signal molecules are destroyed before target cells can respond to the signal.
(D) only answers A and B are correct.

Q.63 Which of the following are most closely associated with photosynthesis?
(A) basal bodies (B) smooth ER
(C) cristae (D) thylakoids

Q.64 The diagram below shows a plant cell. Which structure is an inelastic barrier?



(A) a (B) b
(C) c (D) d

Q.65 A 9+2 arrangement of microtubules best describes
(A) cilia (B) centrosomes
(C) basal bodies (D) microfilaments

Q.66 Tight junctions __ .
(A) allow exchange of material directly between adjacent cells.
(B) are attached to microfilaments that anchor junction to the cytoplasm.
(C) seal spaces between cells to prevent passage of material.
(D) are glycoproteins that attach adjacent cells.

Q.67 The middle lamella is composed of –
(A) Pectates (B) Cellulose
(C) Lignin (D) Proteins

Q.68 Cell wall is present in –
(A) Plant cells (B) Procaryotic cell
(C) Algal cell (D) All the above

Q.69 Plasma membrane is –
(A) Selectively permeable (B) Permeable
(C) Impermeable (D) Semipermeable

Q.70 Amphipathic molecule in plasma membrane is –
(A) Protein (B) Carbohydrates
(C) Phospholipids (D) All the above

Q.71 Which of the following statements are correct?
I. Mycoplasmas are the smallest cells.
II. Nerve cells are some of the longest cells.
III. Ribosomes are non-membrane bound organelles found only in eukaryotic cells.
IV. The cytoplasm is the main arena of cellular activities only in plant cells.
(A) I, II and III (B) I and II
(C) II and III (D) I, II, III and IV

Q.72 Which of the following features are correct regarding ribosomes?
I. Non-membrane bound.
II. Absent in plastids and mitochondria.
III. Present in the cytoplasm and RER.
IV. Take part in protein synthesis.
The correct option is
(A) Only II (B) I and II
(C) I, II, III and IV (D) I, III and IV

Q.73 Selective permeability occurs in –
(A) Cell wall (B) Plasma membrane
(C) Cytoplasm (D) None of these

Q.74 Cell membrane is selective permeable. This means that it
(A) allows all materials to pass through
(B) allows only water to pass through
(C) allows only certain materials to pass through
(D) allows only ions to pass through.

Q.75 Ingestion of solid food by plasma membranes is called
(A) Endosmosis (B) Pinocytosis
(C) Cytokinesis (D) Phagocytosis

Q.76 Ingestion of large molecules by animal cell is called
(A) Diffusion (B) Osmosis
(C) Exocytosis (D) Endocytosis

Q.77 Plasma membrane exhibits for external substances
(A) Impermeability
(B) Semi permeability
(C) Permeability
(D) Selective Semipermeability

Q.78 Which of these is not a function of Golgi apparatus?
(A) Site of synthesis of glycoproteins and glycolipids
(B) Secretion
(C) Membrane transformation
(D) Site of protein synthesis

Q.79 In fluid mosaic model of plasma membrane –
(A) Upper layer is non-polar and hydrophilic.
(B) Polar layer is hydrophobic.
(C) Phospholipids form a bimolecular layer in middle part.
(D) Proteins form a middle layer.

Q.80 Plasmodesmata connections help in –
(A) Cytoplasmic streaming.
(B) Synchronous mitotic divisions.
(C) Locomotion of unicellular organisms.
(D) Movement of substances between cells.

Q.81 According to widely accepted "fluid mosaic model" cell membranes are semi-fluid, where lipids and integral proteins can diffuse randomly. In recent years, this model has been modified in several respects. In this regard, which of the following statements is incorrect
(A) Proteins can also undergo flip-flop movements in the lipid bilayer.
(B) Many proteins remain completely embeded within the lipid bilayer.
(C) Proteins in cell membranes can travel within the lipid bilayer
(D) Proteins can remain confined within certain domains of the membranes.

Q.82 Which one of the following is not a constituent of cell membrane –
(A) Cholesterol (B) Glycolipids
(C) Proline (D) Phospholipids

Q.83 F_1 subunit of oxysome is called –
(A) Head (B) Stalk
(C) Base (D) Filament

Q.84 Plant cells differ from animal cells in having
(A) cell wall (B) plastids
(C) a large central vacuole (D) all of these

Q.85 The stored food and secretory substances found in the cytoplasm makes –
(A) Cytoplasm (C) Protoplasm
(B) Hyaloplasm (D) Deutoplasm

Q.86 During germination which cell organelle converts fatty acid into soluble carbohydrate –
(A) Peroxisome (B) Glyoxysome
(C) Sphaerosomes (D) Lysosome

Q.87 Labilisers found on membrane of lysosome are
(A) Cortisone and cortisol
(B) Cholesterol and heparin
(C) Testosterone and progesterone
(D) Cholesterol and progesterone

Q.88 How many components present in fully developed golgi apparatus –
(A) 2 (B) 3
(C) 4 (D) 5

Q.89 Cell recognition & adhesion are facilitated by components of plasma membrane. These components are generally
(A) protein molecules alone
(B) lipids alone
(C) both lipids and proteins
(D) glycolipids and glycoproteins

Q.90 Cellular furnaces of cells are –
(A) Chloroplast (B) Mitochondria
(C) Ribosome (D) Nucleus

Q.91 Autodissolution and osteogenesis are function of
(A) Golgibodies (B) Ribosome
(C) Lysosomes (D) Mitochondria

Q.92 Semi autonomous cell organelles of cell are –
(A) Nucleus and chloroplast
(B) Chloroplast and mitochondria
(C) Vacuoles and golgi complex
(D) Ribosome and lysosome

Q.93 The name mitochondria was first given by :
(A) Robert Brown (B) Benda
(C) Altmann (D) L.S. Jorge

Q.94 Cristae are found in –
(A) Surface of grana
(B) Surface of plasma membrane.
(C) Wall of Mitochondria
(D) Nuclear Membrane.

Q.95 Mechanical support, enzyme circulation/protein synthesis and detoxification of drugs are function of
(A) dictyosomes (B) chloroplast
(C) ribosomes (D) ER

Q.96 Which of the following plastids are helpful in starch formation and storage –
(A) Chromoplast (B) Leucoplasts
(C) Chloroplast (D) Lycopene

Q.97 Lamellae of chloroplast are known as :
(A) Granum (B) Frets
(C) Thylakoids (D) Stroma lamellae

Q.98 Which of the following enzymes are found in matrix of peroxisomes –
(A) NADH cytochrome reductase
(B) Glyoxidases and malate dehydrogenase
(C) Acid phosphatases and isocitric lysase
(D) Catalases and oxidases

Q.99 70S type of ribosomes found in –
(A) Prokaryotic cells
(B) Prokaryotic cells, chloroplasts and mitochondria
(C) Mitochondria
(D) Nucleus, mitochondria

Q.100 Mitoplast is :
(A) Outer membrane less chloroplast
(B) Outer membrane less mitochondria
(C) Granum less chloroplast
(D) Well developed nucleus

Q.101 Grana and stroma lamellae are the parts of –
(A) Mitochondria (B) Chloroplast
(C) Endoplasmic reticulum (D) Vacuoles

Q.102 Sedimentation coefficient of mitoribosomes of higher plants
(A) 80s (B) 70s
(C) 65s (D) 55s

Q.103 Which of the following substances are stored in Aleuroplast
(A) Starch (B) Oil and Lipids
(C) Proteins (D) Water and Oil

Q.104 Smallest cell organelle which called cell engine is
(A) Ribosome (B) Lysosome
(C) Vacuoles (D) Endoplasmic reticulum

Q.105 The Ribosomes are made up of –
(A) DNA + Protein (B) RNA + Protein
(C) DNA + RNA (D) None of these

Q.106 Functional unit of Chloroplast is –
(A) Stroma (B) Quantasome
(C) Oxysomes (D) Peroxysomes

Q.107 Cilia and flagella both have –
(A) 9 + 2 arrangement of microtubule
(B) Protective structure of cells
(C) Only present in protozoa Animals
(D) Only outgrowth structure of cytoplasm

Q.108 Centrioles and centrosomes are present in cells of –
(A) Animals (B) Bacteria
(C) Green cells (D) Cyanobacteria

Q.109 Similarity between plant and animal flagella microtubules
(A) 9 + 3 (B) 9 + 2
(C) 9 + 6 (D) 9 + 1

Q.110 Ribosomes are produced in –
(A) Nucleolus (B) Cytoplasm
(C) Mitochondria (D) Golgibody

Q.111 Which of the following pair lack the unit membrane –
(A) Nucleus & E.R.
(B) Mitochondria & chloroplast
(C) Ribosome & nucleolus
(D) Golgi body & lysosome

Q.112 Golgibody is concerned with –
(A) Respiration (B) Secretion
(C) Excretion (D) Degradation

Q.113 Three of the following statements regarding cell organelles are correct while one is wrong. Which one is wrong –
(A) Lysosomes are double membraned vesicles budded off form golgi apparatus and contain digestive enzymes.
(B) Endoplasmic reticulum consists of a network of membranous tubules and helps in transport, synthesis and secretion.
(C) Leucoplasts are bound by two membranes lack pigment but contain their own DNA and protein synthesizing machinery.
(D) Spharosomes are single membrane bound and are associated with synthesis and storage of lipids.

Q.114 In which one of the following would you expect to find glyoxysomes –
(A) Endosperm of wheat
(B) Endosperm of castor
(C) Palisade cells in leaf
(D) Root hairs

Q.115 Which of the following statements regarding cilia is not correct –
(A) Cilia contain an outer of nine doublet microtubules surrounding two single microtubules.
(B) The organized beating of cilia is controlled by fluxes Ca^{2+} across the membrane.
(C) Cilia are hair-like cellular appendages.
(D) Microtubules of cilia are composed of tubulin.

Q.116 Lysosomes are _____ vesicular structures formed by the process of packaging in the __
(A) membrane bound, Golgi apparatus
(B) non-membrane bound, Golgi apparatus
(C) membrane bound, ER
(D) non-membrane bound, ER

Q.117 Hereditary characters are due to –
(A) Chromosomes (B) Gene
(C) Blood (D) Placenta

Q.118 Which one is synonymous to gene –
(A) Recon (B) Muton
(C) Cistron (D) Genome

Q.119 One genome is which type of set of Chromosomes
(A) Haploid (B) Diploid
(C) Triploid (D) Polyploid

Q.120 Correct sequence of layers of bacterial cell envelope from outward to inward is
(A) Cell wall → Glycocalyx → Cell membrane
(B) Cell membrane → Glycocalyx → Cell wall
(C) Glycocalyx → Cell wall → Cell membrane
(D) Glycocalyx → Cell membrane → Cell wall.

Q.121 Part of Chromosome which joins with spindle fibres is
(A) Chromatid (B) Chromonema
(C) Chromomere (D) Centromere

Q.122 The type of ribosomes found in prokaryotes is
(A) 80 S type (B) 70 S type
(C) 30 S type (D) 50 S type

Q.123 Which of the following occurs more than one and less than five in a chromosome :
(A) Chromatid (B) Chromomere
(C) Centromere (D) Telomere

Q.124 The cells without nuclei are present in –
(A) Vascular cambium
(B) Root hair
(C) Companion cell
(D) Members of sieve tube

Q.125 Protein synthesis in an animal cell occurs
(A) On ribosomes present in cytoplasm as well as in mitochondria.
(B) On ribosomes present in the nucleolus as well as in cytoplasm.
(C) Only on ribosomes attached to the nuclear envelope and endoplasmic reticulum.
(D) Only on the ribosomes present in cytosol.

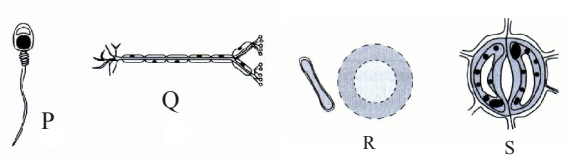
Q.126 The average thickness of plasma membrane is –
(A) 75 Å (B) 75 -100 Å
(C) 100 - 150 Å (D) 200 Å

EXERCISE - 3 (LEVEL-3)

Choose one correct response for each question.

For questions 1 and 2

Refer to the diagram which shows four types of cells.



Q.1 Which of the following are the correct functions for the cells?

(A) P-Reproduction, Q-Sensing, R-Transport, S-Regulation

(B) P-Reproduction, Q-Regulation, R-Transport, S-Sensing

(C) P-Transport, Q-Reproduction, R-Sensing, S-Regulation

(D) P-Transport, Q-Regulation, R-Reproduction, S-Sensing

Q.2 Which of the above cells can carry out photosynthesis and respiration?

(A) Photosynthesis-S; Respiration-P, Q, R

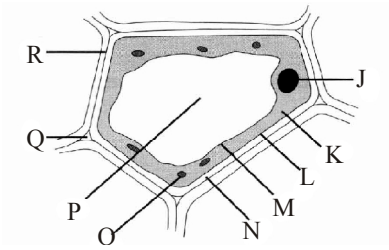
(B) Photosynthesis-S; Respiration-P, Q, R, S

(C) Photosynthesis-Q, S; Respiration-P, R

(D) Photosynthesis-Q, S; Respiration-P,Q,R, S

For questions 3 and 4

Refer to the diagram below which shows a cell.



Q.3 Which of the following describes parts J, K, M and N?

(A) J-Contains hereditary materials
K-Made up of mainly sugar molecules
M-Most chemical reactions occur
N-Partially permeable

(B) J-Contains hereditary materials
K-Most chemical reactions occur
M-Partially permeable
N-Made up of mainly sugar molecules

(C) J-Contains hereditary materials
K-Most chemical reactions occur
M-Made up of mainly sugar molecules
N-Partially permeable

(D) J-Most chemical reactions occur
K-Contains hereditary materials
M-Partially permeable
N-Made up of mainly sugar molecules

Q.4 Which of the following parts are absent in a matured xylem cell?

(A) J and K only

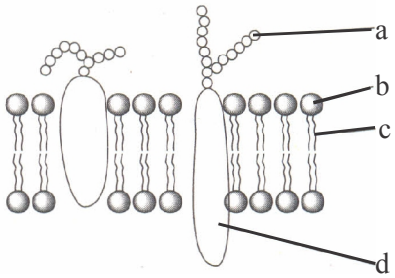
(B) J, K and O only

(C) J, K, L, M and O only

(D) J, K, L, N and O only

Questions 5-7

The following questions refer to the figure below, which shows the plasma membrane.



Q.5 Identify the hydrophilic portion of a lipid molecule.

(A) a (B) b
(C) c (D) d

Q.6 Identify the proteins involved in transport.

(A) a (B) b
(C) c (D) d

Q.7 Identify the glycocalyx.

(A) a (B) b
(C) c (D) d

Q.8 Consider the following statements.

a. Plant cells have centrioles which are absent in almost all animal cells.
b. Ribosomes are the site of protein synthesis.
c. The middle lamella is a layer mainly of calcium carbonate which holds the different neighbouring cells together.
d. In animal cell steroidal hormones are synthesized by smooth endoplasmic reticulum.

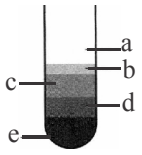
Of the above statements –
(A) (a) and (b) only are correct.
(B) (c) and (d) only are correct.
(C) (b) and (d) only are correct.
(D) (a) and (d) only are correct.

Q.9 Which of the following sequences represents a possible pathway in the production of a secretory protein?
(A) Rough ER → Secretory vesicle → Ribosomes → Golgi apparatus
(B) Ribosomes → Rough ER → Golgi apparatus → Secretory vesicle
(C) Secretory vesicle → Golgi apparatus → Ribosomes → Rough ER
(D) Rough ER → Ribosomes → Secretory vesicles → Golgi apparatus.

Q.10 Which sequence most accurately describes glycoprotein processing in the eukaryotic cell?
(A) smooth ER→ transport vesicle → cis region of Golgi → trans region of Golgi → plasma membrane or other organelle
(B) rough ER → transport vesicle → cis region of Golgi → trans region of Golgi → plasma membrane or other organelle
(C) rough ER→ transport vesicle → trans region of Golgi → cis region of Golgi → plasma membrane or other organelle
(D) rough ER → nucleus → cis region of Golgi → trans region of Golgi → plasma membrane or other organelle

Q.11 Which of the following contain plastids?
(i) plants (ii) animals
(iii) algae (iv) some eukaryotes
(v) some prokaryotes.
Choose the correct option –
(A) (i), (ii), (iii), (iv) (B) (i), (ii), (iii)
(C) (ii), (iv) (D) (i), (iii), (iv)

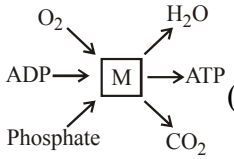
Q.12 A scientist has made a homogenate of human liver cells in a blender and then spun that mixture in an ultracentrifuge, as shown. Which layer would include the most mitochondria?
(A) a
(B) b or e
(C) c
(D) d

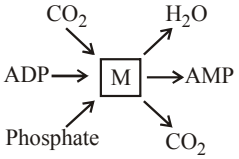


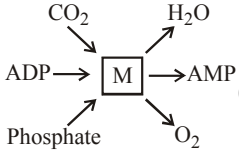
Q.13 The ATP-generating reactions of the mitochondria occur in/on the _
(i) cristae of inner mitochondrial membrane
(ii) outer mitochondrial membrane
(iii) intermembrane space
(iv) matrix
Choose the correct option –
(A) (i), (ii) (B) (ii), (iii)
(C) (i), (iv) (D) (iii), (iv)

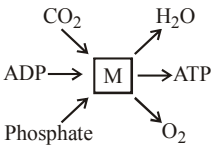
Q.14 Extracellular matrix __ .
(A) functions in protection and support
(B) is secreted by the cell
(C) composed of protein and polysaccharide
(D) occurs in plants
Choose the correct option –
(A) (i), (ii), (iii), (iv) (B) (i), (ii), (iii)
(C) (ii), (iv) (D) (i), (iii), (iv)

Q.15 Which of the following representation correctly explains the function of mitochondrion?

(A)


(B)


(C)


(D)


Q.16 Consider the following statements.

a. In prokaryotic cells, a special membranous structure formed by the extension of the plasma membrane into the cell is known as polysome.

b. The smooth endoplasmic reticulum is the major site for synthesis of glycoproteins.

c. RuBisCO is the most abundant protein in the whole of biosphere.

d. Mitochondria, chloroplasts and peroxisomes are not considered as part of endomembrane system.

Of the above statements

(A) c and d alone are correct
(B) a and b alone are correct
(C) b and c alone are correct
(D) a and d alone are correct

Q.17 Match List I and List II and select the correct option using the codes given below the lists.

	List I		**List II**
a.	Lysosome	(i)	Bacteria without cell walls
b.	Mycoplasma	(ii)	A virus that infects bacterial cells.
c.	Thylakoid	(iii)	Flattened sacs in a chloroplast
d.	Bacteriophage	(iv)	A vesicle in which hydrolytic enzymes are stored

(A) a-(iii), b-(i), c-(ii), d-(iv)
(B) a-(iv), b-(i), c-(iii), d-(ii)
(C) a-(ii), b-(iii), c-(iv), d-(i)
(D) a-(i), b-(iv), c-(ii), d-(iii)

Q.18 Which sequence most accurately describes information flow in the eukaryotic cell?

(A) DNA in nucleus → messenger RNA → ribosomes → protein synthesis
(B) DNA in nucleus → ribosomal RNA → mitochondria → protein synthesis
(C) RNA in nucleus→ messenger DNA → ribosomes → protein synthesis
(D) DNA in nucleus → messenger RNA → Golgi complex → protein synthesis

Q.19 Which of the following statements are correct about prokaryotic genetic material (DNA)?

I. DNA is naked, that is without histones.
II. DNA is usually circular/single chromosome.
III. Outside the genomic DNA, small circular DNA is also present in many bacteria.
IV. The extra genomic DNA is/are called plasmids.

(A) I and II (B) I and III
(C) I only (D) I, II, III and IV

Q.20 Proteins are transported around the cell in membranous vesicles. These vesicles

I. form when a section of membrane protrudes and buds off.
II. give a layer of coat protein around the inside of the vesicle.
III. use their protein coat to find their target membrane.
IV. are uncoated after they reach their target.

Select the correct options of their transport.

(A) I, II (B) I, III
(C) I, III, IV (D) I, II, III and IV

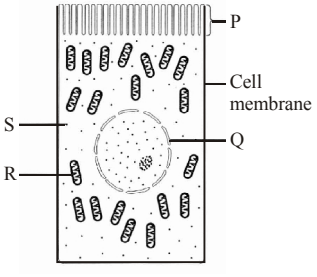
Q.21 Identify the correct match between types of chromosomes and their descriptions.

	Column I (Chromosomes)	**Column II (Position of centromere)**
a.	Metacentric	(i) At the tip
b.	Submetacentric	(ii) Almost near the tip
c.	Acrocentric	(iii) At the middle
d.	Telocentric	(iv) Slightly away from the middle

(A) a-(i), b-(iii), c-(ii), d-(iv)
(B) a-(iv), b-(iii), c-(ii), d-(i)
(C) a-(i), b-(ii), c-(iii), d-(iv)
(D) a-(iii), b-(iv), c-(ii), d-(i)

For questions 22 and 23

Refer to the diagram which shows an epithelial cell found in certain parts of the alimentary canal.



Q.22 Which of the following correctly identifies Q, R and S?
(A) Q-Cytoplasm, R-Mitochondrion, S-Nuclear envelope
(B) Q-Mitochondrion, R-Chloroplast, S-Cytoplasm
(C) Q-Nuclear envelope, R-Mitochondrion, S-Cytoplasm
(D) Q-Nuclear envelope, R-Chloroplast, S-Mitochondrion

Q.23 In which of the following parts of the alimentary canal is this cell most likely to be found?
(A) Oesophagus (B) Pancreas
(C) Rectum (D) Small intestine

Note (Q.24-Q.31) :
(A) Statement- 1 is True, Statement-2 is True, Statement-2 is a correct explanation for Statement -1
(B) Statement-1 is True, Statement-2 is True ; Statement-2 is NOT a correct explanation for Statement - 1
(C) Statement - 1 is True, Statement- 2 is False
(D) Statement -1 is False, Statement -2 is False.

Q.24 **Statement 1 :** Cell membrane is semipermeable.
Statement 2 : The constituent molecules can freely move in the membrane.

Q.25 **Statement 1 :** Plasmids are double-stranded extra chromosomal DNA.
Statement 2 : Plasmids are possessed by eukaryotic cells.

Q.26 **Statement 1 :** Living organisms possess specific individuality with the definite shape and size.
Statement 2 : Both living and non living entities resemble each other at the lower level of organisation.

Q.27 **Statement 1 :** Mitochondria is known as power house of cell.
Statement 2 : ATP production takes place here.

Q.28 **Statement 1 :** Cell wall is not found in animal cell.
Statement 2 : Animal cells are covered by cell membrane.

Q.29 **Statement 1 :** It is important that the organisms should have cell.
Statement 2 : A cell keeps its chemical composition steady within its boundary.

Q.30 **Statement 1 :** A cell membrane shows fluid behaviour.
Statement 2 : A membrane is a mosaic or composite of diverse lipids and proteins.

Q.31 **Statement 1 :** Mitochondria and chloroplast are semiautonomous organelles.
Statement 2 : They are formed by the division of pre-existing organelles as well as they contain DNA but lack protein synthesising machinery.

Q.32 Ribosomes are synthesized in
(A) nucleolus (B) cytoplasm
(C) mitochondria (D) Golgi complex

Q.33 Ribosomes are composed of
(A) RNA only (B) Proteins only
(C) RNA and proteins
(D) RNA, proteins & DNA

Q.34 Which of these is not correct regarding ribosomes?
(A) Non-membrane bound
(B) Present in the cytoplasm and on RER
(C) Absent in chloroplast and mitochondria
(D) Take part in protein synthesis

Q.35 Centrioles arise from
(A) pre-existing centrioles (B) *de novo*
(C) nuclear envelope (D) sphaerosome

Q.36 The chromosome in which centromere lies slightly away from the middle of the chromosome resulting into one shorter arm and one longer arm, is called as –
(A) metacentric (B) submetacentric
(C) acrocentric (D) telocentric

Q.37 Choose the correct statements.
I. Passive cells are larger in size.
II. Larger cells have lower surface volume ratio.
III. To remain active, larger cells are either cylindrical in shape or possess several extensions of the cell membrane, like microvilli.
IV. Microvilli are found in all those cells, which are active in absorption.
V. Microvilli (membrane infoldings) occurs in transfer cells found in plants in the region of absorption or secretion of nutrients.
Option containing all correct statements is
(A) I and IV (B) I, II, III and IV
(C) I, III and II (D) I, II, III, IV and V

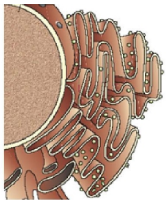
EXERCISE - 4 (PREVIOUS YEARS AIPMT/NEET EXAM QUESTIONS)

Choose one correct response for each question.

Q.1 The Golgi complex plays a major role : **[NEET 2013]**

(A) in post translational modification of proteins and glycosidation of lipids.
(B) in trapping the light and transforming it into chemical energy.
(C) in digesting proteins and carbohydrates.
(D) as energy transferring organelles.

Q.2 Which one of the following organelle in the figure correctly matches with ts function?



[NEET 2013]

(A) Rough endoplasmic reticulum, protein synthesis
(B) Rough endoplasmic reticulum, formation of glycoproteins.
(C) Golgi apparatus, protein synthesis
(D) Golgi apparatus, formation of glycolipids.

Q.3 Archaebacteria differ from eubacteria in **[NEET 2013]**

(A) Cell membrane structure
(B) Mode of nutrition
(C) Cell shape
(D) Mode of reproduction

Q.4 Which structures perform the function of mitochondria in bacteria? **[NEET 2013]**

(A) Nucleoid (B) Ribosomes
(C) Cell wall (D) Mesosomes

Q.5 The solid linear cytoskeletal elements having a diameter of 6 nm and made up of a single type of monomer are known **[AIPMT 2014]**

(A) Microtubules (B) Microfilaments
(C) Intermediate filaments (D) Lamins

Q.6 The osmotic expansion of a cell kept in water is chiefly regulated by – **[AIPMT 2014]**

(A) Mitochondria (B) Vacuoles
(C) Plastids (D) Ribosomes

Q.7 Match the following and select the correct answer **[AIPMT 2014]**

a. Centriole	(i) Infoldings in mitochondria
b. Chlorophyll	(ii) Thylakoids
c. Cristae	(iii) Nucleic acids
d. Ribozymes	(iv) Basal body cilia or flagella

(A) a-(iv), b-(ii), c-(i), d-(iii)
(B) a-(i), b-(ii), c-(iv), d-(iii)
(C) a-(i), b-(iii), c-(ii), d-(iv)
(D) a-(iv), b-(iii), c-(i), d-(ii)

Q.8 Cytochromes are found in : **[AIPMT 2015]**

(A) Outer wall of mitochondria
(B) Cristae of mitochondria
(C) Lysosomes
(D) Matrix of mitochondria

Q.9 DNA is not present in : **[AIPMT 2015]**

(A) Ribosomes (B) Nucleus
(C) Mitochondria (D) Chloroplast

Q.10 Nuclear envelope is a derivative of : **[AIPMT 2015]**

(A) Membrane of Golgi complex.
(B) Microtubules.
(C) Rough endoplasmic reticulum.
(D) Smooth endoplasmic reticulum.

Q.11 The chromosomes in which centromere is situated close to one end are : **[AIPMT 2015]**

(A) Acrocentric (B) Telocentric
(C) Sub-metacentric (D) Metacentric

Q.12 Select the correct matching in the following pairs **[AIPMT 2015]**

(A) Smooth ER . Synthesis of lipids
(B) Rough ER. Synthesis of glycogen
(C) Rough ER. Oxidation of fatty acids
(D) Smooth ER. Oxidation of phospholipids

Q.13 Mitochondria and chloroplast are **[NEET 2016 PHASE 1]**

(a) semi-autonomous organelles

(b) formed by division of pre-existing organelles and they contain DNA but lack protein synthesizing machinery

Which one of the following options is correct?

(A) Both (a) and (b) are correct

(B) (b) is true but (a) is false

(C) (a) is true but (b) is false

(D) Both (a) and (b) are false

Q.14 Microtubules are the constituents of **[NEET 2016 PHASE 1]**

(A) Cilia, Flagella and Peroxisomes

(B) Spindle fibres, Centrioles and Cilia

(C) Centrioles, Spindle fibres and Chromatin

(D) Centrosome, Nucleosome and Centrioles

Q.15 A complex of ribosomes attached to a single strand of RNA is known **[NEET 2016 PHASE 1]**

(A) Polysome (B) Polymer

(C) Polypeptide (D) Okazaki fragment

Q.16 Which one of the following cell organelles is enclosed by a single membrane? **[NEET 2016 PHASE 1]**

(A) Mitochondria (B) Chloroplasts

(C) Lysosomes (D) Nuclei

Q.17 Select the mismatch. **[NEET 2016 PHASE 2]**

(A) Gas vacuoles – Green bacteria

(B) Large central vacuoles – Animal cells

(C) Protists – Eukaryotes

(D) Methanogens – Prokaryotes

Q.18 Select the wrong statement **[NEET 2016 PHASE 2]**

(A) Bacterial cell wall is made up of peptidoglycan.

(B) Pili and fimbriae are mainly involved in motility of bacterial cells.

(C) Cyanobacteria lack flagellated cells

(D) Mycoplasma is a wall-less microorganism

Q.19 A cell organelle containing hydrolytic enzymes is **[NEET 2016 PHASE 2]**

(A) Lysosome (B) Microsome

(C) Ribosome (D) Mesosome

Q.20 Which of the following cell organelles is responsible for extracting energy from carbohydrates to form ATP ? **[NEET 2017]**

(A) Lysosome (B) Ribosome

(C) Chloroplast (D) Mitochondrion

Q.21 Spliceosomes are **not** found in cells of : **[NEET 2017]**

(A) Plants (B) Fungi

(C) Animals (D) Bacteria

Q.22 The Golgi complex participates in **[NEET 2018]**

(A) Respiration in bacteria

(B) Formation of secretory vesicles

(C) Fatty acid breakdown

(D) Activation of amino acid

Q.23 Which of the following is true for nucleolus? **[NEET 2018]**

(A) It takes part in spindle formation.

(B) It is a membrane-bound structure.

(C) Larger nucleoli are present in dividing cells.

(D) It is a site for active ribosomal RNA synthesis

Q.24 Which of the following events does not occur in rough endoplasmic reticulum? **[NEET 2018]**

(A) Cleavage of signal peptide

(B) Protein glycosylation

(C) Protein folding

(D) Phospholipid synthesis

Q.25 Many ribosomes may associate with a single mRNA to form multiple copies of a polypeptide simultaneously. Such strings of ribosomes are termed as **[NEET 2018]**

(A) Plastidome (B) Polyhedral bodies

(C) Polysome (D) Nucleosome

Q.26 The shorter and longer arms of a submetacentric chromosome are referred to as **[NEET 2019]**

(A) s-arm and l-arm respectively

(B) p-arm and q-arm respectively

(C) q-arm and p-arm respectively

(D) m-arm and n-arm respectively

Q.27 Which of the following statements is **not correct**? **[NEET 2019]**

(A) Lysosomes have numerous hydrolytic enzymes.

(B) The hydrolytic enzymes of lysosomes are active under acidic pH.

(C) Lysosomes are membrane bound structures.

(D) Lysosomes are formed by the process of packaging in the endoplasmic reticulum.

Q.28 Which of the following pair of organelles does not contain DNA? **[NEET 2019]**

(A) Mitochondria and Lysosomes

(B) Chloroplast and Vacuoles

(C) Lysosomes and Vacuoles

(D) Nuclear envelope and Mitochondria

Q.29 The concept of "*Omnis cellula-e cellula*" regarding cell division was first proposed by **[NEET 2019]**

(A) Rudolf Virchow (B) Theodor Schwann

(C) Schleiden (D) Aristotle

ANSWER KEY

EXERCISE-1 (SECTION-1&2)

(1) (A) **(2)** (A) **(3)** (B)
(4) (C) **(5)** (A) **(6)** Viruses
(7) Protoplast **(8)** Plasmids
(9) Mitochondria **(10)** Tonoplast
(11) Plasmids **(12)** Slime layer; capsule
(13) Prokaryotes **(14)** Centriole
(15) Cuticle
(16) Transmembrane protein (tunnel protein)
(17) Lipid **(18)** Nuclear pores
(19) Heterochromatin, tightly **(20)** 'J' shaped
(21) Kinetochore **(22)** False **(23)** True
(24) True **(25)** True

EXERCISE - 1 [SECTION-3 & 4]

Q	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
A	B	B	A	A	C	B	B	C	A	D	A	C	D	D	D	B	D	D	A	C	C	B	D	A	D
Q	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
A	B	C	B	B	A	D	A	D	D	C	D	B	D	A	C	B	A	A	A	A	C	A	C	C	C
Q	76	77	78	79	80	81	82	83	84	85	86	87													
A	C	A	C	C	B	C	A	C	B	D	D	B													

EXERCISE - 2

Q	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
A	D	D	C	B	B	D	A	B	B	D	D	A	A	A	D	A	C	D	C	D	D	A	C	A	A
Q	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
A	D	B	D	A	C	D	A	B	A	D	D	C	C	A	A	C	B	D	C	D	D	A	B	D	C
Q	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
A	C	D	D	B	D	B	A	A	C	D	B	D	D	C	A	C	A	D	A	C	B	D	B	C	D
Q	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
A	D	D	D	C	D	A	C	A	D	D	B	C	C	D	B	C	B	B	C	D	B	C	D	B	B
Q	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125
A	B	B	C	A	B	B	A	A	B	A	C	B	A	B	B	A	B	C	A	C	D	B	D	D	A
Q	126																								
A	B																								

EXERCISE - 3

Q	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
A	A	B	B	C	B	D	A	C	B	B	D	D	C	B	A	A	B	A	D	C	D	C	D	B	C
Q	26	27	28	29	30	31	32	33	34	35	36	37													
A	B	A	A	A	A	C	A	C	C	A	B	D													

EXERCISE - 4

Q	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
A	A	A	A	D	B	B	A	B	A	C	A	A	C	B	A	C	B	B	A	D	D	B	D	D	C	B	D	C	A

SOLUTIONS

EXERCISE-1

(1) (A) **(2)** (A) **(3)** (B) **(4)** (C)

(5) **(A).**

(i) The smooth endoplasmic reticulum detoxifies the cell, produces steroids like cholesterol and connects the rough endoplasmic reticulum to the Golgi.

(ii) Centrioles consist of microtubules in a 9 triplet configuration.

(iii) Peroxisomes break down peroxide, which is a poisonous by-product of cell respiration.

(iv) The nucleolus is responsible for synthesizing ribosomal RNA, one of the main components of ribosomes.

(v) Lysosomes contain hydrolytic enzymes that break down nutrients, waste products, and cell debris.

(6) **Viruses** are an exception to cell theory. Viruses are acellular and do not have a cellular machinery. Even then they are considered to be organisms.

(7) **Protoplast**

(8) **Plasmids**

(9) **Mitochondria.** The power house of cell is mitochondria, because it is associated with cellular respiration and energy generations of the cell.

(10) **Tonoplast** is the membrane that bounds the vacuoles of the plant cells.

(11) **Plasmids**

(12) **Slime layer; capsule.**

(13) **Prokaryotes.** Naked DNA, without histones are found in prokaryotes like BGA, bacteria, etc. DNA is not associated with histone proteins and that's why it is called naked DNA.

(14) **Centriole**

(15) Cuticle

(16) Transmembrane protein (tunnel protein)

(17) Lipid **(18)** Nuclear pores

(19) Heterochromatin, tightly **(20)** 'J' shaped

(21) Kinetochore

(22) **False.** Double membranes are absent in lysosomes. They are enclosed by single lipoproteinaceous unit membrane. Lysosomes are called suicidal bags of the cell due to presence of hydrolytic enzyme.

(23) True **(24)** True **(25)** True **(26)** (B)

(27) (B) **(28)** (A) **(29)** (A) **(30)** (C)

(31) **(B).** Rudolf Virchow (1855) first explained that the cells gets divided and new cells are formed from pre-existing cells (*omnis cellula-e-cellula*).

(32) (B)

(33) **(C).** Lamarck observed, that nobody can have life if its constituent parts are not formed of cells.

(34) **(A).** Cell membrane was discovered by Schwann (1838) but it was named by Nageli and Cramer (1855).

(35) (D)

(36) **(A).** Cell theory was formulated by Schleiden and Schwann in 1839 in their paper Microscope investigations on the similarity of structure and growth in animals and plants.

(37) **(C).** Small cells have a large surface area per volume ratio as compared to large cells.

(38) **(D).** In eukaryotes, ribosomes are found in chloroplasts and mitochondria. In prokaryotes, ribosomes occur freely in the cytoplasmic matrix.

In eukaryotic cells, RER possesses ribosomes attached to its membranes.

Ribosomes occur in all living cells with the exception of mammalian erythrocytes or red blood corpuscles.

(39) (D)

(40) **(D).** Reserved cells (quiescent cells) are undifferentiated cells and they have the capacity of cell division.

(41) (B) **(42)** (D)

(43) **(D).** The prokaryotic cells are represented by bacteria, blue-green algae, mycoplasma and PPLO.

(44) **(A).** Long flattened, usually unbranched units arranged in parallel stacks in endoplasmic reticulum are called cisternae.

(45) **(C).**

(46) (C)

(47) **(B).**

(48) **(D).** The prokaryotes lack membrane bound organelles such as mitochondria, endoplasmic reticulum, Golgi apparatus, lysosomes, microtubules, microfilaments and centrioles.

(49) **(A).** The characteristic feature of bacterial nucleus is the absence of nuclear membrane, nucleolus and nuclear sap and such a nucleus is called nucleoid or genophore. It contains DNA.

(50) (D) **(51)** (B) **(52)** (C)

(53) **(B).** Prokaryotes have NO internal membranes. Therefore, they lack mitochondria, E.R., chloroplasts, and nuclear membrane. They do have small ribosomes.

(54) (B)

(55) **(A).** Bacterial flagella are unistranded, equivalent to a single microtubular fibre. It consists or three parts i.e., basal body, hook and filament.

(56) **(D).** None of the strand will be radioactive as *E.coli* was in normal medium during replication.

(57) **(A).** In prokaryotic cells, the genetic material is not organised into nucleus and all the membrane bound organelles are absent. The histone proteins are absent and therefore, the genetic material is not organised into chromatin.

(58) **(D).** Cell wall consists of lignin, hemicellulose, pectin and cellulose.

(59) **(D).** Cell membrane is made up of 60% protein and 40% lipids, chemically. The percentage of carbohydrates ranges from 1-10, which are in the form of glycoproteins or glycolipids.

(60) **(C).** In prokaryotes, additional small circular DNA entities called plasmids are present. Plasmids carry additional specific factors like nitrogen fixation, resistance, fertility, etc. DNA present as genetic material is naked and often called genophore, nuclear body or nucleoid.

(61) **(D).** Cell membrane (plasmalemma) is composed of protein, lipids & some amount of carbohydrate. Membrane lipid is primarily phospholipid. It contains both polar and non-polar portion.

(62) **(B).** The submetacentric chromosome has centromere nearer to one end of the chromosome resulting in one shorter arm and one longer arm.

(63) (D)

(64) **(A).** In eukaryotic cells, thylakoids, it present, are grouped inside the chloroplasts instead of floating freely in cytoplasm.

(65) **(C).** The centrioles appears as two cylindrical structures.They are formed of microtubules. In higher animals, they forms the mitotic poles, i.e., they are involved in the formation of spindles.

(66) **(B).** The actual values of sedimentation coefficients of eukaryotic ribosomes is 79-80S in fungi and 80S in mammals. The sedimentation coefficient of two subunits are 40S (small) and 60S (large).

(67) **(A).** Benda (1897) gave the term 'mitochondria' after Richard Altmann (1894) who described them as bioplasts.

(68) (A)

(69) **(A).** All eukaryotic cells are not identical. Plant and animal cells are different as plant cells possess cell wall, plastids and a large vacuole which are absent in animal cells. On the other hand, animals cells have centrioles which are absent in almost all plant cells.

(70) **(A).** On rough endoplasmic reticulum, the ribosomes are attached to the surface by ribophorin-I and ribophorin-II. The ribosomes are meant for protein synthesis.

(71) (C)

(72) **(A).** Pectin is the filler substance of the matrix of eukaryotic cells.

(73) **(C).** A eukaryotic flagellum is a bundle of 9 fused pairs of microtubule doublets, surrounding two central single microtubules. The so called 9+ 2 structure is the characteristic of core of eukaryotic flagellum called an axoneme.

(74) **(C).** F_1-particies or oxysomes are present on the cristae of mitochondria. Oxysomes are involved in oxidative phosphoryation.

(75) (C) **(76)** (C) **(77)** (A)

(78) **(C).** Ribosomes are present in both Protista and Monera. These are concerned with protein synthesis.

(79) **(C).** Single membrane cell organelles are known as microbodies,e.g., lysosomes, peroxisomes,glyoxysomes & spherosomes.

(80) (B)

(81) **(C).** In eukaryotic cells, genetic material is organised into chromosomes. DNA is bounded with histone proteins to form chromatin.

(82) **(A).** In eukaryotic cell, ribosomes are of 80S type. 70S ribosomes however, occurs in plastids and mitochondria.

(83) (C) **(84)** (B) **(85)** (D)

(86) (D) **(87)** (B)

EXERCISE-2

(1) (D) **(2)** (D) **(3)** (C) **(4)** (B)

(5) (B) **(6)** (D) **(7)** (A) **(8)** (B)

(9) (B) **(10)** (D)

(11) **(D).** Plant cells lack centrioles. Instead they have microtubule organizing regions. They also have mitochondria, ribosomes, plastids, and endoplasmic reticulum.

(12) **(A).** Pilli are not involved in locomotion. Actually, pilli are longer, fewer and thicker tubular outgrowths, which develop in response to F^+ or fertility factor in gram negative bacteria.

(13) **(A).** Microtubules are part of the cytoskeletal structure and are made of the protein tubulin. The others all consist of selectively permeable plasma membranes.

(14) (A) **(15)** (D) **(16)** (A)

(17) **(C).** The thylakoid membrane contains photosynthetic pigments, namely, chlorophyll a, chlorophyll b, carotenoids (carotene, xanthophylls) & plastoquinone.

(18) (D) **(19)** (C) **(20)** (D)

(21) **(D).** (iii) is correct because surface area increases with the square of a dimension, whereas volume increases with the cube of a dimension; therefore, as the dimension increases, volume increases more rapidly than surface area; (iv) is correct because the ability of a cell to take up nutrients and to eliminates wastes depends on diffusion, which is limited by surface area.

(22) (A) **(23)** (C) **(24)** (A) **(25)** (A)

(26) (D) **(27)** (B) **(28)** (D) **(29)** (A)

(30) **(C).** Centrioles are present in animals, but absent in plants.

(31) (D) **(32)** (A) **(33)** (B)

(34) (A) **(35)** (D) **(36)** (D) **(37)** (C)

(38) (C) **(39)** (A) **(40)** (A) **(41)** (C)

(42) **(B).** Human red blood cells are small, 8 micrometers (μm) or 80nm. An average cell is about 80 micrometers.

(43) **(D).** Smooth ER connects the rough E.R. to the Golgi, carries out detoxification, and produces lipids like steroids. The nucleolus produces RNA.

(44) (C) **(45)** (D) **(46)** (D) **(47)** (A)

(48) (B)

(49) **(D).** The plasma membrane is organized and made of many small particles that move about readily. Hence the name, fluid mosaic. A membrane is a very active structure. A cell's activity is limited by how fast plasma membranes can take in and get rid of materials.

(50) **(C).** Starch, a polysaccharide, is too large to diffuse through the plasma membrane.

(51) (C)

(52) **(D).** The passage of charged/polar molecules is generally impeded because of the membrane's hydrophobic core.

(53) **(D).** Prokaryotic cells have DNA (circular) without histones. Generally flagella, if present, are single-stranded and without differentiation of axoneme and sheath.

(54) **(B).** (i) is correct because the cytoskeleton is constantly be built up and broken down in various regions of the cell; (ii) is correct because protein are what make up microfilaments, intermediate filaments, and microtubules; (iii) is correct because microtubles are one of the three types of cytoskeletal elements.

(55) (D) **(56)** (B) **(57)** (A) **(58)** (A)

(59) (C) **(60)** (D) **(61)** (B) **(62)** (D)

(63) (D) **(64)** (C) **(65)** (A) **(66)** (C)

(67) (A) **(68)** (D) **(69)** (A) **(70)** (C)

(71) **(B).** Cytoplasm is the crystallo-colloidal complex that forms the protoplasm excluding its nucleoid.
Cytoplasm is granular due to presence of large number of ribosomes. Membrane bound cell organelles as found in eukaryotes are absent in prokaryotes.
Cytoplasm is present in prokaryotic as well as in eukaryotic cells. Ribosomes are also present in both, prokaryotic as well as eukaryotic cells.
In prokaryotes, it is of 70S in nature, while in eukaryotes it is of 80S.

(72) **(D).** Ribosomes are naked ribonucleoprotein protoplasmic particles in which a covering membrane is absent. The ribosomes are of two types, i.e., cytoplasmic and organelle. The organelle ribosomes are found in plastids and mitochondria. The cytoplasmic ribosomes may remain free in the cytoplasmic matrix or attached to the cytosolic surface of ER with the help of SRP protein.
The bound ribosomes, generally transfer their proteins to cisternae of the ER for their transport to other parts, both inside and outside the cell.

(73) (B)

(74) **(C).** Selectively / differentially permeable membranes are the membranes, which allow some substances to pass through them more readily than others. All living biological membranes are selectively permeable.

(75) (D) **(76)** (D) **(77)** (D)

(78) **(D).** The Golgi apparatus links carbohydrates with proteins coming from ER to form glycoproteins. This process is called glycosylation. Golgi complex brings about membrane transformation, that is, converting one type of membrane (e.g., that of ER) into other types (e.g., selectively permeable plasma membrane, differentiated membrane of lysosome). This complex also takes part in the recycling of plama membrane. The Golgi complex modifies, sorts and packages proteins and lipids coming from the ER. Chemical labels are added to send the products to other specific parts of the cell or out of the cell.
Packaging involves wrapping the material by a membrane, forming secretory vesicles.The secretory vesicles pinch off from the ends of the cisternae and appear as dense secretory or zymogen granules in the cytoplasm. Later, these vesicles release their secretions by exocytosis or reverse pinocytosis. Site of protein synthesis is ribosomes.

(79) (C) **(80)** (D) **(81)** (A) **(82)** (C)

(83) (A)

(84) **(D).** A plant cell has rigid wall on the outside. It has plastids and a centrally located large vacuole. All of these are absent in an animal cell.

(85) (D) **(86)** (B) **(87)** (C) **(88)** (C)

(89) **(D).** Proteins have very specific shapes which make them ideal as receptor molecules for chemical signalling between cells. Branching side chain glycolipids on the outer surface of cell membranes are also involved in cell-cell recognition.

(90) (B) **(91)** (C) **(92)** (B) **(93)** (B)

(94) (C)

(95) **(D).** ER functions as cytoskeleton or skeletal framework by providing mechanical support to colloidal cytoplasmic matrix. It conducts information from cell to cell. RER helps in protein synthesis. SER takes part in detoxification of toxic chemicals in liver.

(96) (B) **(97)** (C) **(98)** (D)

(99) (B) **(100)** (B) **(101)** (B) **(102)** (B)

(103) (C) **(104)** (A) **(105)** (B) **(106)** (B)

(107) (A) **(108)** (A) **(109)** (B) **(110)** (A)

(111) (C) **(112)** (B) **(113)** (A) **(114)** (B)

(115) (B)

(116) **(A).** Lysosomes are single membrane bound vesicles which contain hydrolytic enzymes. They are believed to be formed by the joint activity of ER and Golgi complex. Precursors of hydrolytic enzymes are synthesized at RER and are transferred to the forming face of Golgi complex. These precursors are then changed to enzymes.

Enzymes are then packed in larger vesicles and are pinched off at maturing face. These vesicles combine with endosomes to produce lysosomes.

(117) (B) **(118)** (C) **(119)** (A)

(120) **(C).** Glycocalyx is the outermost layer of the cell envelope. Cell wall lies between plasma membrane and glycocalyx.

(121) (D)

(122) **(B).** The cytoplasmic ribosomes of prokaryotes (blue green algae, bacteria and PPLOs) are 70S. They have two subunits 50 S and 30S.

(123) (D) **(124)** (D) **(125)** (A)

(126) (B)

EXERCISE-3

(1) (A) **(2)** (B) **(3)** (B) **(4)** (C)

(5) **(B).** The phospholipid head is polar and hydrophilic.

(6) **(D).** This is a protein channel.

(7) **(A).** The glycocalyx is involved in cell-to-cell communication.

(8) (C) **(9)** (B) **(10)** (B)

(11) **(D).** (i), (ii) and (iv) are correct because plastids are found in plants (which are eukayotes), fungi (which is a eukaryote), and protoctistins, including algae (which also are eukaryotes), but not in animals (which also are eukaryotes), which means that some but not all eukaryotes contain plastids; (v) is incorrect because no prokaryotes have membrane-bound organelles, including plastids.

(12) **(D).** Centrifugation causes the densest structures to sink to the bottom and the lightest to remain on top. Nuclei are the densest, and mitochondria are the next most dense. The least dense layer would consist of ribosomes.

(13) (C) **(14)** (B) **(15)** (A) **(16)** (A)

(17) (B) **(18)** (A) **(19)** (D) **(20)** (C)

(21) (D) **(22)** (C) **(23)** (D)

(24) **(B).** Cell membrane is semipermeable as it allows continuous flow of selected materials across it as required from time to time.
On the other hand, constituent molecules of cell membrane are free to move inside membrane.

(25) **(C).** Plasmid is extra-chromosomal DNA. Also called fertility factor and is possessed by prokaryotic cells.

(26) **(B).** All living organisms have definite shape and size and all show specific individuality with a orderly mannered organisation whereas at the lower level of organisation, both the living and non living made up of atoms.

(27) (A) **(28)** (A) **(29)** (A) **(30)** (A)

(31) **(C).** Mitochondria and chloroplast are semi-autonomous cell organelles, which contains their own DNA and protein synthesising machinery. They arises from pre-existing organelles and their functions are partially controlled by nucleus of cell and partially themselves.

(32) **(A).** Nucleolus is a dense, rounded, dark-staining, granular structure without a limiting membrane. It consists largely of RNAs and proteins. Nucleolus synthesizes and stores RNA. It also receives ribosomal proteins from the cytoplasm for storage. It forms ribosomal subunits by wrapping the rRNAs with ribosomal proteins. The ribosomal subunits later leave the nucleus through the nuclear pores.

(33) **(C).** Chemically, ribosomes consist of two parts, proteins and rRNA. Proteins are both structural and enzymatic.

(34) **(C).** Ribosomes are naked ribonucleoprotein protoplasmic particles (RNP) which function as a site for protein synthesis.
Depending upon the location of their occurrence, ribosomes are of two types, cytoplasmic and organelle. The organelle ribosomes are found in plastids (plastidoribosomes) & mitochondria (mitoribosomes) which are 70S in nature. The cytoplasmic ribosomes (cytoribosomes) may remain free in the cytoplasmic matrix or are attached to the cytosolic surface of endoplasmic reticulum.

(35) **(A).** Cytoplasm of eukaryotic animal cells contains two cylindrical, rod-shaped, microtubular structures, called centrioles,

near the nucleus. Centrioles lack limiting membrane and DNA or RNA and form a spindle of microtubules. Though centrioles have not been found to contain DNA, yet they are capable of forming new centrioles with the help of massules or pericentriolar satellites which function as nucleating centres.

(36) **(B).** In submetacentric type of chromosome, the centromere lies at some distance away from the midpoint, dividing the chromosome into two unequal arms.

(37) **(D).** All passive cells like eggs are larger in size. Larger cells have lower surface volume ratio. All active cells are smaller. If larger cells has to remain active, they are either cylindrical in shape or possess several extensions of the cell membrane. Microvilli are one of such developments. They are found in all those cells, which are active in absorption. These also occur in transfer cells found in plants.

EXERCISE-4

(1) **(A).** Golgi apparatus is the important site of formation of glycoproteins and glycolipid.

(2) **(A).** ER→ (i) RER : Ribosomes, Protein synthesis

(ii) SER : Ribosome-absent, Lipid synthesis

(3) **(A).** In archaebacteria cell membrane is made up of single layer of branched chain lipid molecule, while in eubacteria it is made up of unbranched phospholipids bilayer.

(4) **(D).** Mesosomes help in respiration, secretion processes, to increase the surface area of the plasma membrane and enzymatic contact.

(5) **(B).** Microfilament are made up of 2 molecules of 6 nm actin protein. Microtubule are 25 nm hollow tube like structure while intermidiate filament are 10 nm and lamins are nuclear proteins.

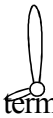
(6) **(B).** Vacoule is involved in osmoregulation in plant cell.

(7) **(A).** Ribozyme is catalytic RNA.

(8) **(B).** Cytochromes proceed electron transport system in cristae of mitochondria.

(9) **(A).** Except Ribosome,Mitochondria, Chloroplast and Nucleus have DNA.

(10) **(C).**

(11) **(A).**  Acrocentric chromosome has sub-terminal position of centromere.

(12) **(A).**

(13) **(C).** Mitochondria and chloroplast are semi-autonomous organelles which contains DNA, RNA, ribosomes (705) etc.

(14) **(B).** Microtubules are structures present in cilia, flagella, centrioles and spindle fibres.

(15) **(A).** In prokaryotes, several ribosomes may attach to single mRNA and form a chain called polyribosomes or polysomes.

(16) **(C).** Nuclei, mitochondria and chloroplasts are double membrane bound organelles. Lysosomes are single membrane bound organelle.

(17) **(B).** Large central vacuole is present in plant cells.

(18) **(B).** Pili and fimbriae are surface structures of the bacteria that do not play a role in motility.

(19) **(A).** The isolated lysosomal vesicles have been found to be very rich in almost all types of hydrolytic enzymes.

(20) **(D).** Mitochondria are the site of aerobic oxidation of carbohydrates to generate ATP.

(21) **(D).** Spliceosomes are used in removal of introns during post-transcriptional processing of hnRNA in eukaryotes only as split genes are absent as prokaryotes.

(22) **(B).** Golgi complex, after processing releases secretory vesicles from their trans-face.

(23) **(D).** Nucleolus is a non membranous structure and is a site of r-RNA synthesis.

(24) **(D).** Phospholipid synthesis does not take place in RER. Smooth endoplasmic reticulum are involved in lipid synthesis.

(25) **(C).** The phenomenon of association of many ribosomes with single m-RNA leads to formation of polyribosomes or polysomes or ergasomes.

(26) **(B).** Sub metacentric chromosome is Heterobrachial.

Short arm designated as 'p' arm (p = petite i.e. short)

Long arm designated as 'q' arm.

(27) **(D).** Lysosomes bud off from trans face of Golgi bodies.

Precursor of lysosomal enzymes are synthesised by RER and then send to Golgi bodies for further processing.

(28) **(C).** Lysosomes and Vacuoles do not have DNA.

(29) **(A).** Concept of "Omnis cellula-e cellula" regarding cell division was proposed by Rudolph Virchow.