

## Unit 3: Cells & Subcellular Organelles

### Short Questions

#### SHORT ANSWER QUESTIONS (EXERCISE)

**Q1. Compare the resolution and magnification of light microscope and electron microscope.**

**Ans.** (a) Resolution of light microscope is 0.2 nm/ while its magnification is 1500X

(b) Resolution of electron microscope is 0.2 nm / while it can magnify objects upto 250,000 times.

**Q2. State the cell theory. How we can validate it? What are the exceptions to cell theory?**

**Ans. 1. Cell theory:** All living organisms are made of cell and cell products.

Three essential points of cell theory.

2. Cell theory can be validated by

(i) visualizing cell structure under microscope.

(ii) having live cell imaging and genetic studies.

(iii) By studying DNA sequencing and metabolic pathways.

(iv) By experiments such as cell culture studies and tissue engineering.

**3. Exception to cell theory are**

a) viruses because they are not made of cells and cannot carry out life processes independently.

b) prions and viroids, because they show properties of living organisms but are not composed of cells.

c) Muscle cells in vertebrates.

d) Multinucleated organisms like certain fungi and algae.

e) Self replication of organelles like mitochondria and chloroplast.

**Q3. The table below compares the process of diffusion, facilitated diffusion and active transport. Fill in the blank cells, using the words "YES" or "NO".**

| Description                                                          | Process          |                       |                  |
|----------------------------------------------------------------------|------------------|-----------------------|------------------|
|                                                                      | Simple Diffusion | Facilitated Diffusion | Active Transport |
| Is ATP required?                                                     |                  |                       |                  |
| Are carrier proteins involved?                                       |                  |                       |                  |
| Is direction of transport always from higher to lower concentration? |                  |                       |                  |

**Ans.**

| Description                                                          | Process          |                       |                  |
|----------------------------------------------------------------------|------------------|-----------------------|------------------|
|                                                                      | Simple Diffusion | Facilitated Diffusion | Active Transport |
| Is ATP required?                                                     | NO               | NO                    | YES              |
| Are carrier proteins involved?                                       | NO               | YES                   | YES              |
| Is direction of transport always from higher to lower concentration? | YES              | YES                   | NO               |

**Q4. Categorize the organelles as**

(i) single membrane bounded,

(ii) double membrane bounded and

(iii) lacking any membrane.

**Ans. (i)** Single membrane bound organelles include Lysosomes, Peroxisomes, Glyoxisomes, Endoplasmic reticulum, Golgi apparatus.

(ii) Double membrane bound organelles include Mitochondria, Chloroplast, nucleus  
 (iii) organelles lacking any membrane are Ribosomes, centrioles, cytoskeleton, Nucleolus.

**Q5. State two functions of the proteins in the plasma membrane.**

**Ans. (i) Transport:** Some protein act as channels or carriers to transport substances like glucose or amino acids across membrane.

**(ii) Cell signaling:** Receptor proteins in membrane receive chemical signals from outside the cell and transmit into the cell for a response.

**Q6. State two features that mitochondria have in common with prokaryotes.**

**Ans. Mitochondria have two features common with prokaryotes:**

**(i) Presence of circular DNA:** Like prokaryotes, mitochondria contain their own circular DNA.

**(ii) Self-replication:** Mitochondria can self-replicate independent of the nucleus, similar to prokaryotes.

**Q7. List three ways in which prokaryotic cells differ from eukaryotic cells.**

**Ans. 1.** In Eukaryotic cells distinct nucleus is present, while absent in prokaryotes.

**2.** In Eukaryotic cells ribosomes are of 80S while in prokaryotic cells it is of 70S.

**3.** Mitosis and Meiosis are present in eukaryotic cells while absent in prokaryotic cells.

**Q8. List the structures and molecules, which can cross the nuclear envelope.**

**Ans. a)** Nuclear pores are permeable to small molecules.

**b)** Some large proteins like histones can also pass the nuclear membrane.

**c)** Ribosomal sub-units can also pass out through the nuclear membrane.

**Q9. Distinguish each of the following pairs.**

- Exocytosis and endocytosis
- Phagocytosis and pinocytosis
- Peroxisome and glyoxysomes

**Ans. a) Exocytosis and Endocytosis**

| Exocytosis                                                                                                                                                                           | Endocytosis                                                                                                    |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|
| (i) In this process bulky material is exported out of cell.                                                                                                                          | (i) In this process bulky material, is moved into cell across plasma membrane.                                 |
| (ii) In exocytosis, the bulky material is packed inside a membrane and vesicle is formed. This vesicle fuses with plasma membrane to release content to extra cellular environments. | (ii) Here, the plasma membrane engulfs the material forming a vesicle which detaches and moves into cytoplasm. |

**b) Phagocytosis:** In this cell takes in solid material.

**Pinocytosis**

| Phagocytosis                                                           | Pinocytosis                                                                              |
|------------------------------------------------------------------------|------------------------------------------------------------------------------------------|
| (i) It is a type of endocytosis in which cell takes in solid material. | (i) It is a types of endocytosis in which cell takes in liquids in the form of droplets. |
| (ii) It is also called as cell eating.                                 | (ii) It is also called as cell drinking.                                                 |

**c) Peroxisomes and Glyoxisomes:**

| Peroxisomes                                                                              | Glyoxisomes                                                                                                       |
|------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|
| (i) They are involved in break down fatty acids and detoxification of hydrogen peroxide. | (i) They convert stored lipids into carbohydrates during seed germination they are found only in plants cells and |

|                                                           |                                                                   |
|-----------------------------------------------------------|-------------------------------------------------------------------|
| (ii) They are found in most eukaryotic cells.             | are abundant in lipid rich seeds.                                 |
| (iii) Catalases and oxidases enzymes are present in them. | (ii) They contain enzymes that convert lipids into carbohydrates. |

**Q10. What are the main functions of lysosomes?**

**Ans.** Lysosomes are membrane bound organelles that contain digestive enzymes to breakdown macromolecules, damaged organelles and foreign particles. They play key role in intra cellular digestion and recycling of cellular components, often called as autophagy.

**Q11. Describe the role of the Golgi body.**

**Ans.**

(i) The Golgi body is involved in production of cell secretions.

(ii) It converts protein and lipids into glycoproteins and glycolipids.

(iii) In plant cells they produce pectin and other polysaccharides needed for plant structure and metabolism.

**Q12. What are histones? Where are these found in eukaryotic cells?**

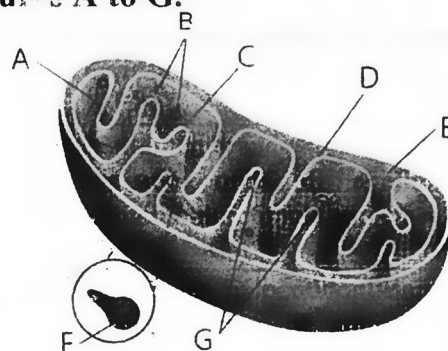
**Ans.** Histones are group of small proteins DNA strand wraps around there histone protein to form a structure called nucleosome, which is part of chromatin.

**Q13. What do you mean by "stem cell"? What are the main usages of stem cells?**

**Ans.** Stem cells are unique cells with remarkable ability to develop into many different cell types, such on muscle cell, red blood cell or brain cell.

**Usage:** Stem cells can be used in regeneration medicine, drug testing and development of personalized medicine.

**Q14. The following diagram shows the structure of a mitochondrion. Name structures A to G.**



**Ans.**

A – DNA

B – Ribosomes

C – Matrix

D – Inner membrane

E – Outer membrane

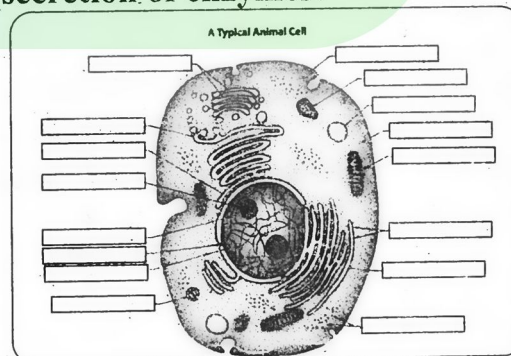
F –  $F_1$  particle

G – Cristae

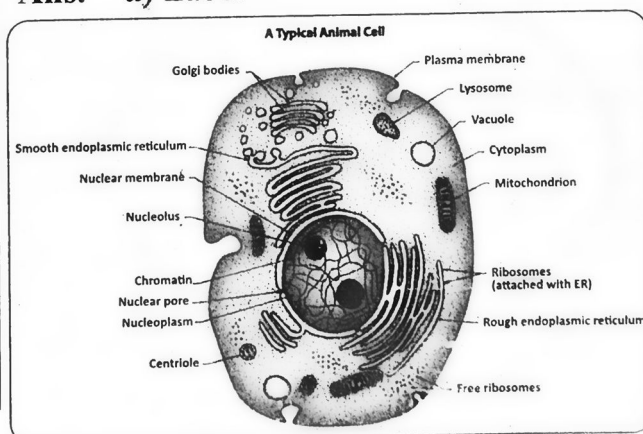
**Q15. The diagram below shows an electron micrograph of a cell.**

**a. Label the parts of the cell.**

**b. What evidence can be seen in the diagram that suggests that the cell is metabolically active and involved in secretion of enzymes?**



**Ans. a) Label**



- b) (i) Mitochondria are present  
 (ii) Secretory vesicles are coming out of endoplasmic reticulum and forming Golgi

apparatus. From Golgi apparatus Golgi vessels are formed, have various enzymes secretions.

## SLO BASED SHORT ANSWER QUESTIONS

### Cells Basic Unit of Life

**Q16. Enlist the fundamental activities performed by cell?**

- Ans.** 1. Movement 2. Nutrition  
 3. Respiration 4. Excretion  
 5. Homeostasis 6. Growth  
 7. Reproduction

### Cell theory

**Q17. What do you know about the discovery of cell.**

**Ans.** In 1665 Robert Hooke examined thin cilia of cork of oak tree under microscope. He observed that cork was made of many little boxes. He named these as cellulae (cell).

**Q18. Give three essential points of cell theory.?**

- Ans.** (i) All living organisms are composed of one or more cells.  
 (ii) Cells are the basic units of structure and function in an organism.  
 (iii) Cells come only from the division of pre-existing cells.

### Microscopy

**Q19. What is main difference between light microscope and electron microscope?**

**Ans.** In light microscope, light is used to make the image of object while in electron microscope beam of electrons passes through, the object. Image is formed on a screen.

**★Q20. What is meant by magnification of microscope?**

**Ans.** This refers to a microscope's ability to enlarge the image of an object. Different lenses within a microscope offer varying levels of magnification. It is denoted by the symbol 'X', indicating how many times larger the image appears compared to the

actual size. For example, a 10X lens can enlarge a 1  $\mu\text{m}$  object to 10  $\mu\text{m}$ . Total magnification in a microscope is determined by multiplying the magnification of all lenses.

**★Q21. Write about resolution of microscope?**

**Ans. Resolution:** This refers to a microscope's ability to distinguish between two points that are close together on an object. The greater the resolution, the finer the detail that can be observed. The naked human eye has a resolution of about 0.1 mm. In contrast, a light microscope can resolve details down to approximately 250 nm (nanometres).

**Q22. What is difference between transmission electron microscope (TEM) and scanning electron microscope (SEM)?**

**Ans.**

| TEM                                                                                                                                                                                                                                                                   | SEM                                                                                                                                                                                                                                                                                                                                     |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>• Transmission electron microscope is used to view the internal structure of cell.</li> <li>• TEM transmits a beam of electrons through a very thin specimen.</li> <li>• It can magnify objects upto 250,000 times.</li> </ul> | <ul style="list-style-type: none"> <li>• Scanning electron microscope is used to study the details of surfaces of cells or other objects.</li> <li>• The surfaces are coated with metal. When electron beam hits the metal, it is reflected and makes enlarged image.</li> <li>• SEM can magnify objects upto 100,000 times.</li> </ul> |

### Structure of Cell

#### Q23. What is protoplast?

**Ans.** When cell wall is removed, using cell wall degrading enzymes the remaining components of the cell are called a protoplast.

### Cell Wall

#### Q24. What is primary wall. Give its chemical composition?

**Ans.** Primary wall is the actual cell wall of the cell. It is composed of polysaccharides i.e. cellulose, hemicellulose and pectin.

The cellulose microfibrils are aligned at angles and are held together by hydrogen bonds. Many proteins are also present in primary walls.

#### Q25. What is secondary wall? Give its chemical composition.

**Ans.** In some plant cells, after maturation a secondary wall is made between protoplast and primary wall. Secondary wall is composed of lignin, cellulose and hemicellulose. Due to presence of lignin, secondary wall is more rigid than the primary wall.

#### Q26. What are plasmodesmata?

**Ans.** Plasmodesmata are small channels that directly connect the cytoplasm of neighbouring plant cells to each other. Plasmodesmata penetrate both the primary and secondary walls. They allow movement of materials between cells and so important in cellular communication.

#### ★Q27. How plasmodesmata are exception to cell theory?

**Ans.** Plasmodesmata have caused debate among scientists regarding cell theory. Some scientists suggest that the cells of higher plants are not really cells since they are not physically separated or independent from one another.

#### ★Q28. What are diatoms? Write about their cell walls.

**Ans.** The group of algae called diatoms synthesize their cell walls from silicic acid. The acid is polymerized inside cells, then the wall is extruded to protect the cell. The synthesis of Silica cell walls requires less energy. That is why there are higher growth rates in diatoms.

#### ★Q29. Compare the cell wall composition of algae, Fungi, Prokaryotes and archaeobacteria?

**Ans.** The cell wall of algae contains cellulose and a variety of glycoproteins.

The cell wall of fungi is composed of chitin, the same carbohydrate that gives strength to the exoskeletons of insects.

The cell walls of prokaryotes (bacteria and cyanobacteria) is composed of peptidoglycan, that is a single large polymer of amino acids and sugar.

The cell wall of archaeobacteria is composed of different polysaccharides and proteins, with no peptidoglycan.

### Plasma Membrane

#### Q30. What is fluid mosaic model?

**Ans.** Fluid mosaic model is widely accepted concept that describes the dynamics of plasma membrane. According to this model, the basic foundation of plasma membrane is a lipid bilayer. This bilayer is made of phospholipids. A collection of proteins floats within the lipid bilayer. In lipid bilayer the hydrophobic lipid tails are oriented inwards and the hydrophilic phosphate groups are aligned outwards, either towards the cytoplasm of cell or the extracellular environment.

#### ★Q31. What is significance of proteins in the lipid bilayer of plasma membrane?

**Ans.** The interior of lipid bilayer sheet is hydrophobic. It repels water-soluble

molecules that attempt to pass through it. If a cell was fully encased in pure lipid bilayer, it would be completely impermeable to water-soluble molecules e.g., sugars, polar amino acids etc. That is why, in addition to phospholipids molecules the membranes also contain proteins that provide passageways across the membrane.

**Q32. Mention various types of proteins in plasma membrane and write their functions?**

**Ans.** Following are few types of proteins in plasma membrane.

1. **Transporters:** These proteins play role in selective transport of certain substances across the lipid bilayer.
2. **Anchors:** These proteins help in attachment of plasma membrane to cytoskeleton and external fibers.
3. **Receptors:** These proteins attached with sugar and make identification marks. Some bind with messenger molecules and transmit signals to interior.
4. **Enzymes:** These proteins exhibit enzymatic activity.

**★Q33. What is significance of identification of cells in the body?**

**Ans.** The ability to distinguish among different cells is crucial to life. It allows cells in an embryo to sort themselves into tissues and organs. It also helps cells of the immune system to recognize and reject foreign cells, e.g., infectious bacteria.

**Q34. How transmission and scanning electron microscopy helped to study structure of plasma membranes?**

**Ans.**

- i. Transmission electron microscopy can reveal detailed structures of the lipid bilayer and associated proteins.
- ii. Scanning electron microscopy is useful for examining the surface topology of cells and membranes.

**Q35. Write benefits of confocal microscopy and total internal reflection fluorescence microscopy to study structure of plasma membrane.**

**Ans.**

- i. Confocal microscopy uses laser scanning and fluorescence to create sharp, detailed images of the cell membrane.
- ii. Total internal reflection fluorescence microscopy is used for high resolution images of the membrane and its interactions with the cytoskeleton and other cellular components.

**Q36. How atomic force microscopy and X-ray crystallography is useful to study structure of plasma membrane?**

**Ans.**

- i. Atomic force microscopy provides topographical images of cell membrane at high resolution.
- ii. X-ray crystallography is used to determine the atomic structure of membranes proteins.

**Q37. What is Lipidomics and Fluorescence recovery after photobleaching?**

**Ans.**

- i. Lipidomics involves the comprehensive analysis of lipids in the cell membrane using techniques like mass spectrometry.
- ii. Fluorescence recovery after photobleaching is used to study the mobility and dynamics of membrane proteins and lipids. It involves bleaching a fluorescently labelled region of membrane with a laser and observing the recovery of fluorescence as unbleached molecules move into the area.

**Q38. What is glycocalyx?**

**Ans.** The glycolipids and glycoprotein on outside surface of plasma membrane is called glycocalyx. It functions as cell identification marks that are recognized by other cell.

**Q39. What is cytosol?****Ans.**

- i. Cytosol is aqueous ground substance of cytoplasm, which contain various organelles and other inclusions.
- ii. Cytosol contains water in which many organic (proteins, carbohydrates, lipids) and inorganic salts are completely or partially dissolved.

**Q40. Name major components of cell?****Ans.** Following are the major components of cell.

1. Plasma membrane
2. Cytoplasm
3. Nucleus

**Nucleus****Q41. What is nuclear lamina?****Ans.** On the inner side of nucleus envelope, there is a protein lining called nuclear lamina. It binds to chromatin to give it structural support.**Q42. What are nuclear pores? Give their composition.****Ans.** Nuclear pores are tiny holes in the nuclear envelope. A nuclear pore is made of nuclear pore complex. It has several subunits i.e., annular subunit, Column subunit, ring subunit, luminal subunit.**★Q43. Describe types of chromatin?****Ans.** There are two types of chromatin. **Euchromatin** is the genetically active chromatin involved in transcribing RNA to produce proteins. The other kind of chromatin is termed **heterochromatin**. Its DNA is genetically inactive.**Q44. What is NOR – (Nucleolus organizer region)?****Ans.** These are certain sites of chromosomes that form Nucleoli. DNA found as NORs encodes the ribosomal RNA.**★Q45. Why single nucleus undergo division to give NORs?****Ans.** In cells that produce large amounts of protein, and thus require significant numbers of ribosomes, the size of the nucleolus is considerable.

At the onset of mitosis, the single nucleolus present in cell disappears, and after division new nucleus is formed from the NORs.

**Q46. Give components of Nucleolus?****Ans.** Nucleolus consists of granular and fibrillar components and DNA. The granular part consists of ribosomal subunits. Fibrillar part is composed of raw materials of ribosome subunits.**★Q47. What is length of DNA in human cell?****Ans.** Inside the nucleus of every human cell, there is a 6 feet long DNA. It is subdivided into 46 individual molecules (each 1.5 inches long), one for each chromosome.**Q48. What is nucleus? Mention its two major functions.****Ans.** A prominent nucleus is present in all eukaryotic cells (at centre in animal cells while pushed to side in plant cells). It performs two major functions:

- It stores the cells hereditary material (DNA).
- Coordinates the cell's activities e.g., growth, protein synthesis and cell division.

**★Q49. Which materials can pass into and out of nucleus.****Ans.** Building blocks of DNA and RNA and ATPs are allowed to enter into the nucleus. Ribosomal subunits which are build in nucleoli are the examples of materials that are allowed to leave the nucleus and enter the cytoplasm.**Q50. What is nucleoplasm?****Ans.** Nucleoplasm is the semifluid matrix found inside the nucleus. Within the

nucleoplasm most of the nuclear material consists of chromatin that organizes to form chromosomes during cell division.

### **Endoplasmic Reticulum**

★Q51. What is the significance of membranous physical connection of nucleus with ER?

Ans. Due to their physical membranous connection, the lumen of the endoplasmic reticulum and the space between the layers of the nuclear envelope comprise a single compartment. This close association enables the endoplasmic reticulum and the nucleus to share information in a very efficient manner.

Q52. Give functions of rough and smooth endoplasmic reticulum.

Ans.

#### **1. Rough endoplasmic reticulum**

Its function is production and processing of protein.

#### **★2. Smooth endoplasmic reticulum**

It has following functions

- i. Production of lipids
- ii. Detoxification of drugs
- iii. Store calcium and do calcium and carbohydrate metabolism

### **Ribosomes**

Q53. What are ribosomes? Where they are found?

Ans. **Definition:** Ribosomes are granular structures not bound by membrane.

**Occurrence:** These are found in all organisms. In eukaryotes they may be found attached with rough endoplasmic reticulum or scattered free in cytoplasm.

★Q54. Where ribosomes are found other than cytoplasm?

Ans. In addition to the most familiar cellular locations of ribosomes, they can also be found inside mitochondria and the chloroplasts of plants. These ribosomes notably differ in size and makeup than the

ribosomes found in cytoplasm, and are more like those present in prokaryotes.

★Q55. Mention usage of proteins synthesized by ribosomes?

Ans. The proteins that are synthesized by free ribosomes are for the cell's own internal use. While the proteins produced by the ribosomes bound to RER are transported outside of the cell.

★Q56. What is Svedberg value of complete ribosome?

Ans. The Svedberg values are not additive i.e. the values of the two subunits of a ribosome do not add up to the Svedberg value of the complete ribosome. This is because the rate of sedimentation of a molecule depends upon its size and shape, rather than simply its molecular weight.

Q57. What is Svedberg unit?

Ans. The sub unit of a ribosome are described by their Svedberg values, which are based upon their rate of sedimentation in a centrifuge. The complete ribosome in a eukaryotic cell has a Svedberg value of 80S. Prokaryotic cells on the other hand contains 70S ribosomes.

### **Mitochondria**

★Q58. What do you know about origin of mitochondria?

Ans. Scientists hypothesize about the origin of mitochondria. According to them, millions of years ago small, free-living prokaryotes were engulfed, but not consumed, by larger prokaryotes. The two organisms developed a symbiotic relationship over time, the larger organism providing the smaller with ample nutrients and the smaller organism providing ATP molecules to the larger one.

★Q59. Write about occurrence of mitochondria?

Ans. The number of mitochondria present in a cell depends upon the metabolic

requirements of that cell, and may range from one to thousands. Mitochondria are found in nearly all eukaryotes, including plants, animals, fungi, and protists, and are large enough to be observed with a light microscope.

**Q60. Why mitochondria are important for cell?**

**Ans.** Mitochondria are the sites of cellular respiration. They generate adenosine triphosphate (ATP) from oxygen and nutrients. ATP is chemical energy “currency” of the cell that powers the metabolic activities.

**Q61. What are F-1 particles?**

**Ans.** In mitochondria the inner surface of cristae has knob like extensions into matrix, known as F1-particles. These particles are actually the enzymes called ATP-synthase. Here ATPs are synthesized.

**Chloroplast**

**★Q62. Mention types of plastids?**

**Ans.** Cells of plants and many protists have three types of plastids i.e., chloroplasts, chromoplasts and leucoplasts. The colourless leucoplasts are involved in the storage and yellow-to-red coloured chromoplasts give colours to plant parts while chloroplasts are green and involved in photosynthesis.

**★Q63. Write the similarities and differences between mitochondria and chloroplast.**

**Ans.** Mitochondria are similar and different to chloroplasts in following ways.

- Both organelles convert energy for the cell.
- Mitochondria perform aerobic respiration. They generate chemical energy in the form of ATP by metabolizing sugars, fats and other chemical fuels with the assistance of oxygen.
- Chloroplasts perform photosynthesis. They convert energy from the sun into the biosynthesis of organic nutrients using

carbon dioxide and water. Like mitochondria, chloroplasts also contain their own DNA and are able to grow and reproduce independently of the cell.

**Q64. What are chloroplasts?**

**Ans.** Chloroplasts are specialized organelles to perform function of photosynthesis, in which light energy is converted into chemical energy. All of the green structures in plants including stems and unripened fruit contain chloroplast, but majority of the photosynthesis occurs in leaves.

**Q65. What are thylakoids, grana and lamellae?**

**Ans. Thylakoids:** The inner membranes of chloroplast lie in close association with one another and fuse along with their periphery. In this way, two adjacent membranes form a disc shape compartment called thylakoid.

**Grana:** Many thylakoids form stacks called grana (singular granum). Thylakoids are green due to the pigment chlorophyll.

**Lamellae:** These are non-green compartments that connect two grana.

**Q66. What is stroma? How glucose is formed in it?**

**Ans.** Stroma is a semi-fluid present inside the inner membrane of chloroplast. It contains dissolved enzymes and comprises most of the chloroplast volume.

**Process:** ATPs produced during light reaction are used in stroma to transform low energy carbon dioxide into high energy compound like glucose.

**Golgi Apparatus**

**Q67. What do you know about composition and occurrence of Golgi apparatus?**

**Ans.** Golgi apparatus consists of five to eight cup-shaped membrane covered sacs called cisternae that are stacked over each

other. It is found in cells of plants, animal and unicellular eukaryotes.

**Q68. How many cisternae are present in Golgi apparatus? Also give its location.**

**Ans.** Golgi apparatus may consist of 60 cisternae. Animal cells generally contains between ten and twenty Golgi stacks. This complex is usually located close to the nucleus.

**Q69. What are cis and trans faces of Golgi apparatus?**

**Ans.** Each Golgi stack has two distinct faces. The cis face is found near the endoplasmic reticulum and the trans face is positioned near the plasma membrane.

**★Q70. What do you know about the discovery of Golgi apparatus?**

**Ans.** Golgi apparatus was discovered by Camillo Golgi in 1898. He discovered this organelle during his research on nervous system by using a new staining technique known as 'Golgi staining'.

**Q71. What is main function of Golgi apparatus?**

**Ans.** Golgi apparatus is the distribution and shipping department for the cell's chemical products.

It modifies proteins and lipids that have been built in the endoplasmic reticulum and prepare for export outside the cell or for transport to other locations in the cell.

**Q72. How the compounds synthesized in ER are processed in Golgi apparatus?**

**Ans.** Small vesicles that contain proteins, carbohydrates, phospholipids and other molecules bud off from ER. These molecules reach to cis face of Golgi apparatus, and fuse with it, releasing molecules into it. Here the compounds are further processed. Enzymes present in the Golgi lumen convert them into glycoproteins and glycolipids.

**Q73. What happens to the processed products in Golgi apparatus?**

**Ans.** The processed products are released from 'trans' face of Golgi apparatus in a vesicle and directed to its final destination inside or outside the cell. The exported products are known as secretions while other products are returned to the endoplasmic reticulum or may become lysosomes.

**Q74. Which additional substances are produced by Golgi apparatus in plant cells?**

**Ans.** In plant cells, the Golgi apparatus also produce pectin and other polysaccharides that are essential for plant structure and metabolism.

### **Lysosome**

**Q75. What are lysosomes? Give their primary function.**

**Ans.** Lysosomes are spherical organelles bounded by single membrane. They serve as digestive compartments of the cell. They breakdown cellular waste products, fats, carbohydrates, proteins and other macromolecules into simple compounds for re-use by cell.

**Q76. In which type of cells are lysosomes most abundant and why?**

**Ans.** In animals, lysosomes are most numerous in disease fighting cells e.g., white blood cells. This is because white blood cells must digest materials like bacteria, viruses and other foreign invaders.

**Q77. How lysosomes help in autophagy?**

**Ans.** Lysosomes are involved in breaking the cellular material that have exceeded their life time or are no longer needed by the cell.

**Q78. How the cell remains safe from the digestive enzymes of a ruptured lysosomes?**

**Ans.** As the lysosomal matrix is acidic and cytosol is neutral environment, so even if a lysosome is ruptured, its digestive enzymes

become inactive and the cell remains uninjured.

**Q79. How many enzymes are present in lysosomes and where they are made?**

**Ans.** Lysosomes have 40 different hydrolytic enzymes. All of these enzymes are manufactured in endoplasmic reticulum and modified in Golgi apparatus. The membrane covering of lysosomes protect the rest of cell from there possible damage.

**Q80. Define lysosomal storage diseases. Give examples.**

**Ans.** In lysosomal storage diseases the patient lacks one of the hydrolytic enzymes of lysosomes. Due to this the abnormal lysosomes gets filled with the indigestible substances, which interfere with cellular functions e.g., Pompe's disease and Tay sacks disease.

**Q81. What is Pompe's disease?**

**Ans.** This is type of lysosomal storage disease. In this lysosome lack glycogen – digesting enzyme. So, harmful amounts of glycogen accumulate in liver cells.

**Q82. What is Tay Sach's disease.**

**Ans.** In this essential lipid digesting enzyme is missing. So accumulation of lipids in nerve cells of brain damages the nervous system causing mental retardation and death in early childhood.

**Q83. What role lysosomes play in development process?**

**Ans.** Selective cell death is done by lysosomes during development e.g., when tadpole develops into a frog the cells of tail are destroyed by the enzymes of lysosomes.

**★Q84. How cell is not affected by enzymes of lysosomes?**

**Ans.** The cell is safe from the enzymes of lysosomes. These enzymes require acidic environment (of pH of about 4.8). The lysosomal matrix is acidic but cytosol is a neutral environment. So, even if a lysosome

is ruptured, its digestive enzymes become inactive and the cell remains uninjured.

**★Q85. How lysosomes were discovered?**

**Ans.** In the mid-18<sup>th</sup> century, Belgian scientist Christian Rene de Duve was investigating carbohydrate metabolism in liver cells. He observed that when cells are damaged in the centrifuge, they release acid phosphatase. He suggested that this digestive enzyme was encased in some membrane bounded organelle within the cell, which he named as lysosome.

**★Q86. What role is played by lysosomes during brain development?**

**Ans.** Many cells in your brain die during development. This directed suicide is accomplished by the rupture of the lysosomes within the cells that are being eliminated.

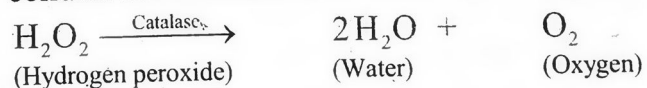
### Peroxisomes and Glyoxisome

**Q87. What are peroxisomes? Give their primary function?**

**Ans.** Peroxisomes are single membrane bound organelles found in all eukaryotic cells. They contain variety of enzymes whose function is to get rid the cell of toxic substances. E.g., Hydrogen peroxide, a common toxic by product of cellular metabolism is broken down to water and oxygen.

**Q88. What is function of catalase enzyme in peroxisome?**

**Ans.** The catalase enzymes break down hydrogen peroxide, a common by-product of cellular metabolism into water and oxygen.



**Q89. What is Zellweger Syndrome?**

**Ans.** Zellweger syndrome is one of the metabolic disorder caused due to defect in peroxisome. In this syndrome number of peroxisomes in a cell is less or absent. This is

congenital disorder (present at birth) and has no cure or effective treatment hence causing early death.

**Q90. What are Glyoxisomes? Give their function.**

**Ans.** Glyoxisomes are similar to peroxisomes but found only in plant cells. These contain enzymes that convert lipids into carbohydrates in the cells of lipid-rich seeds e.g. castor bean. This provides energy to germinating seeds.

### **Vacuoles**

**Q91. What are vacuoles? Give their important functions.**

**Ans.** Vacuoles are membrane-bound sacs in cytoplasm; their functions are

1. In mature plant cells, they provide structural support.
2. It serves as storage, waste disposal etc.

**Q92. How large vacuole is formed in plant cells?**

**Ans.** Many plant cells have a large, single central vacuole. This large vacuole slowly develops by fusion of smaller vacuoles. It takes up 80% or more space in the cell.

**Q93. Give role of central vacuole in plant cells.**

**Ans.** The central vacuole in plant cells plays an important structural role for the plant. This role of vacuole is related to its ability to control turgor pressure. Turgor pressure makes the rigidity of the cell. This also helps maintain the structural integrity of the plant along with the support from the cell wall.

**★Q94. How is single large vacuole is formed?**

**Ans.** Vacuoles are fluid-filled single-membrane bounded organelles. Cells have many small vacuoles in their cytoplasm. However, when a plant cell matures its small vacuoles fuse to form a single large vacuole.

**★Q95. What is importance of materials stored in vacuoles for humans?**

**Ans.** Several materials commonly stored in plant vacuoles have been found to be useful for humans, such as opium, rubber, and garlic flavouring.

**Q96. Write role of vacuole other than turgor pressure.**

**Ans.** 1. Vacuoles also often store the pigments that give certain flowers their colors, which aid them in attraction of bees and other pollinators.

2. Vacuoles also release molecules that are poisonous to various insects and animals thus discouraging them from consuming the plant.

### **Centrioles**

**★Q97. What are centrioles. Give their composition and location in eukaryotic cells.**

**Ans.** Centrioles are hollow and cylindrical organelles associated with assembly and organization of fibres of cytoskeleton i.e. microtubules. A centriole is made of nine triplets of microtubules.

**Location:** In eukaryotic cells centrioles occur in pairs located at right angle to one another near the nuclear envelope.

**Q98. What is basal body?**

**Ans.** Each cilium and flagellum is anchored by a modified centriole known as basal body.

**Q99. How spindle fibres are formed in plants and fungi?**

**Ans.** The cells of plants and fungi lack centrioles and basal bodies. Their microtubules and spindle fibres are organized from the structures of cytoplasm like MTOCs, microtubule organizing centres.

**Q100. Write function of centrioles?**

**Ans.** In animal and protist cells centrioles are organelles associated.

1. With the assembly and organization of fibres of cytoskeleton i.e. microtubules.
2. They are also involved in the formation of cilia and flagella.

**Q101. What is cytoskeleton? Give names of its types.**

**Ans.** It is a network of protein fibres present in cytoplasm. It has following types

- Microfilaments
- Microtubules
- Intermediate filaments

**Q102. What are microfilaments? Give their functions.**

**Ans.** Microfilaments are solid rods made of globular protein called actin. Function: They help dividing cell to pinch off into two cells. In association with myosin, microfilaments help in cellular contraction.

**Q103. What are microtubules? Give their function.**

**Ans.** These are straight, hollow cylinders composed of subunits made of tubulin proteins

**Function:-**

1. Microtubules are major components of cilia and flagella.
2. They participate in the formation of spindle fibres during cell division.

**Q104. What are intermediate filaments? Give their functions.**

**Ans.** These are made of different proteins made of vimentin subunit.

**Functions**

1. They maintain cell shape and rigidity.
2. They also anchor (fix) several organelles in the cell.

**Q105. What are cilia and flagella? Give their function and difference.**

**Ans.** Cilium and flagellum are thin, tail like projections extending from cell body.

**Difference:** Cilia are short in length and usually many in number, while flagella are longer but less in number

**Function:** Their function is locomotory organs.

**Q106. What is axoneme? Give its structure.**

**Ans.** Axoneme is the core of eukaryotic cilia and flagella.

**Structure:** It contains two central microtubules that are surrounded by an outer ring of nine doublet microtubules. Dynein molecules bridge the gap between adjacent microtubule doublets. This organization is also called as "9+2" structure.

**Q107. Where cilia are present in humans? Write their function.**

**Ans.** In humans cilia are found in the lining of the trachea where they sweep mucus and dirt out of the breathing tube.

### Prokaryotic and Eukaryotic Cells

**Q108. What is nucleoid?**

**Ans.** A prokaryotic cell lacks a nucleus. The DNA of prokaryotic cell is present in the more or less central region known as Nucleoid (Nucleus like).

**Q109. What is composition of cell wall of prokaryotic cell? Also write its location.**

**Ans.** Surrounding the plasma membrane of most of prokaryotic cells is a cell wall but it does not contain cellulose. It is composed of peptidoglycan, which is a single large polymer of amino acids and sugar.

**Q110. Compare size and cell division in eukaryotic and prokaryotic cells.**

**Ans.** Cell size: It is 10 – 100µm in eukaryotic cells and 1 – 10 µm in prokaryotic cells.

**Cell division:** In eukaryotes mitosis and meiosis occurs while in prokaryotic cells mitosis and meiosis are missing. Here cell divides by direct division called as binary fission.

**Q111. Give similarities between Prokaryotic and Eukaryotic cells.**

**Ans. Prokaryotic and Eukaryotic cells**

1. Bacteria and archaea are made of prokaryotic cells whereas all other forms are composed of eukaryotic cells.
2. Both prokaryotic and eukaryotic cells have DNA as their genetic material.
3. Both have plasma membranes as their coverings; and both have ribosomes for protein synthesis.

### **Cell Signalling**

**Q112. What is meant by cell signalling?**

**Ans.** Cell signalling is the ability of cells to respond to stimuli from their environment producing cellular responses. It involves the transmission of signals between cells through a series of molecular events leading to a cellular response.

**Q113. Differentiate between cell signalling and signal transduction?**

**Ans.** In cell signalling, signal molecule bind to a receptor on the membrane of a target cell while in signal transduction, the intracellular signalling pathway is activated as result of this binding.

**Q114. What is effect of signal transduction pathway?**

**Ans.** The signal transduction pathway leads to changes in gene expression i.e. turning specific genes on or off. This results in various cellular responses like cell growth, division, differentiation or apoptosis.

**Q115. What is difference between protein/peptide signalling and steroid signalling?**

**Ans.** Protein/peptide signalling molecules are water soluble. They can't pass through plasma membrane they bind to its specific receptor on plasma membrane. Hence intracellular signal pathway is activated. In steroid signalling, the signalling molecule e.g. steroid hormone can diffuse through

plasma membrane of the target cell, hence affecting the protein production.

### **Membrane Transport Mechanism**

**Q116. Differentiate between diffusion and facilitated diffusion?**

**Ans. Diffusion:** It is the net movement of a substance from an area of high concentration to area of low concentration, without using energy.

**Facilitated diffusion:** In this molecules are taken in or out of cells with the help of transport proteins present in plasma membranes. In this no energy is used.

**Q117. What are main types of transport proteins?**

**Ans. 1. Channel proteins:** These proteins from hydrophilia channels across the membrane that allow specific molecules to pass through e.g., ion channels.

**2. Carrier proteins:** These proteins bind to the specific molecule they transport undergo a conformational change and move molecule across the membrane e.g. glucose transporters.

**Q118. What is reverse osmosis?**

**Ans.** It is a process in which external pressure is applied to push water through a semi permeable membrane from high solute concentration to low solute concentration.

**Q119. What is  $\text{Na}^+$  -  $\text{K}^+$  pump? Where it is located?**

**Ans. 1.  $\text{Na}^+$  -  $\text{K}^+$  pump** is composed of carrier proteins for active transport.

**2.** This pump actively moves  $\text{Na}^+$  to the outside of cell and  $\text{K}^+$  to inside of cell.

**3.** It is located in the membranes of nerve cells.

**Q120. Differentiate between phagocytosis and pinocytosis?**

**Ans. Phagocytosis:** It is intake of solid material during endocytosis.

**Pinocytosis:** It is intake of liquids during endocytosis.

**Q121. Differentiate between endocytosis and exocytosis?**

**Ans. Endocytosis:** In this bulky materials are moved into the cell by invagination of plasma membrane forming a vesicle.

**Exocytosis:** In this process bulky material is exported out of the cell, here the vesicle fuses with the plasma membrane from inside and release the contents into the extracellular environment.

**★Q122. What is role of plasma membrane during exchange of matter?**

**Ans.** While exchanging matter with cells' environment, plasma membranes maintain equilibrium inside the cell as well as outside.

**Q123. What is membrane transport mechanism, its importance and types?**

**Ans.** Movement of substances in and out of cells is crucial for cellular functions.

These movements are done for nutrient uptake, waste elimination, gas exchange, and signal transduction.

Cells rely on the plasma membrane for regulating the movement of substances in and out of the cell.

Membrane transport mechanisms are essential processes that enable the cell to maintain homeostasis, acquire nutrients, remove waste products, and communicate with its environment.

There are two types of transport mechanisms i.e., passive transport (which requires no energy input) and active transport (which utilizes energy).

**★Q124. What is meant by tonicity?**

**Ans.** The term **tonicity** refers to the relative concentration of solutes in the solutions.

**Hypertonic** solutions are those in which more solute is present.

**Hypotonic** solutions are those with less solute.

**Isotonic** solutions have equal concentrations of solutes

**★Q125. What is receptor-mediated endocytosis?**

**Ans.** Specific receptor proteins of plasma membrane pick up material from outside and pinch inside to form a vesicle. For example, the cells of liver have receptor proteins for cholesterol. Cholesterol circulates in our blood in the form of low-density-lipoproteins (LDLs). The receptor proteins of plasma membrane of liver cells, recognize and take up LDLs from the blood by receptor-mediated endocytosis.

**Stem Cells****Q126. What are stem cells?**

**Ans.** Stem cells are unique cells with remarkable ability to divide develop into many different cell types in the body.

**Q127. Difference between totipotent and pluripotent stem cells?**

**Ans. Totipotent Cell:** They can differentiate into all possible cell types e.g., zygote.

**Pluripotent cell:** These cells can turn into almost any cell into almost any cell e.g., cells of early embryo.

**Q128. Differentiate between Multipotent and oligopotent. Stem cells?**

**Ans. Multipotent cells:** These cells can differentiate into closely related family of cell e.g., hematopoietic stem cell can become RBCs, WBCs or platelets.

**Oligopotent Cells:** These can differentiate into few different cell types e.g., adult lymphoid or myeloid stem cells.

**Q129. What are unipotent stem cells?**

**Ans.** These can produce cells of one kind, which is their own type e.g., adult muscle stem cells.

**Q130. Describe the uses of stem cells.**

**Ans.** Stem cells can be used in

1. Regenerative medicine
2. Drug Testing and development
3. Personalized medicine

**Q131. What are Embryonic stem cell?**

**Ans.** They are derived from the inner cell mass of blastocysts (early-stage embryo). These cells are pluripotent.

**Q132. What are Adult stem cells?**

**Ans.** These stem cells are found in various throughout the body such as bone marrow, fat and blood.

**Q133. What are induced pluripotent stem cells?**

**Ans.** They are generated in lab by reprogramming adult somatic cells to a pluripotent state. They are similar to embryonic stem cells.

**Q134. Give advantage and disadvantage of induced pluripotent stem cells?**

**Ans. Advantage:** Advantage of using these cells is that they do not have any ethical issues linked to the embryonic stem cells.

**Disadvantage:** Disadvantage of these cells is that reprogramming process can introduce genetic changes in them forming tumours.

**Q135. What are plasmodesmata?**

**Ans. Plasmodesmata:** These are small channels that directly connect the cytoplasm of neighbouring plant cells to each other. Plasmodesmata penetrate both the primary

and secondary cell walls. They allow certain molecules to pass directly from one cell to another. So, they are important in cellular communication.

**Q136. Discuss various uses of stem cells?**

**Ans. Use of Stem Cells**

**1. Regenerative Medicine:** Stem cells have the potential to repair or replace damaged tissues and organs. Therefore, they are used for treating conditions such as spinal cord injuries, type 1 diabetes, Parkinson's disease, and heart disease.

**2. Drug Testing and Development:** By differentiating stem cells into specific cell types, researchers can create models of human diseases, allowing for more accurate testing of drug effects and reducing the reliance on animal models.

**3. Personalized Medicine:** Stem cells can be derived from a patient's own cells, reducing the risk of immune rejection when used in treatments. This personalized approach can lead to more effective and safer therapies.

**Q137. What is importance of ability to distinguish among different cells?**

**Ans.** The ability to distinguish among different cells is crucial to life. It allows cells in an embryo to sort themselves into tissues and organs. It also helps cells of the immune system to recognize and reject foreign cells, e.g., infectious bacteria.

**Q138. Compare protein, lipid and carbohydrate content of different membranes.**

**Ans.**

| Membrane                      | Percent by weight |       |              |
|-------------------------------|-------------------|-------|--------------|
|                               | Protein           | Lipid | Carbohydrate |
| Human red blood cell          | 49                | 43    | 8            |
| Mitochondria (outer membrane) | 52                | 48    | 0            |
| Mitochondria (inner membrane) | 76                | 24    | 0            |
| Bacteria                      | 75                | 25    | 0            |

## LONG QUESTIONS (EXERCISE)

**Q1.** Write details of the structure and the chemical composition of cell walls of eukaryotes and prokaryotes.

**Ans.** See Q6. and Q8. of theory.

**Q2.** Explain the chemical composition and the functions of plasma membrane.

**Ans.** See Q9. of theory.

**Q3.** Identify the role of glycolipids and glycoproteins as the cell surface makers.

**Ans.** See Q9. of theory.

**Q4.** Explain the structure, chemical composition and function of ribosomes.

**Ans.** See Q13. of theory.

**Q5.** Explain the structure, and functions of Golgi complex.

**Ans.** See Q16. of theory.

**Q6.** Describe the structure, chemical composition and function of chromosome.

**Ans.** See Q11. of theory. 11403263

**Q7.** Discuss nuclear envelope and nuclear pore complex in detail.

**Ans.** See Q11. of theory.

**Q8.** Explain how Golgi apparatus is involved in making cell secretions.

**Ans.** See Q16. of theory.

**Q9.** Describe the structure and functions of smooth and rough endoplasmic reticulum.

**Ans.** See Q12. of theory.

**Q10.** Explain the role of lysosomes and peroxisomes in regulating the amounts of cellular contents.

**Ans.** See Q17. and Q18. of theory.

**Q11.** Describe the structures of the three fibres that make the cytoskeleton.

**Ans.** See Q21. of theory.

**Q12.** Describe the formation and functions of lysosomes.

**Ans.** See Q17. of theory.

**Q13.** Compare mitochondria and chloroplasts as the organelles that are involved in cellular energetics.

**Ans.** See Q14. and Q15. of theory.

**Q14.** Describe the basic structure of mitochondrion, from outside inward.

**Ans.** See Q14. of theory.

**Q15.** Describe the pathway of protein signal and steroid signal from outside of a cell to inside.

**Ans.** See Q26. of theory.

**Q16.** Categorize and explain different types of stem cells.

**Ans.** See Q31. of theory.

**Q17.** What are the advantages and disadvantages of using induced Pluripotent Stem Cells?

**Ans.** See Q32. of theory.

## INQUISITIVE QUESTIONS

**Q1.** If a researcher observes that a certain cell type has an exceptionally large Golgi apparatus, what can be inferred about the function of this cell?

**Ans.** If a cell type has an exceptionally large Golgi apparatus, it means that this cell is physiologically very active e.g., pancreatic cells that produce digestive enzymes have large Golgi apparatus.

**Q2.** If a signalling molecule is lipid-soluble, like a steroid hormone, what is the most likely mechanism for its action within the target cell?

**Ans.** After entering into the target cell it binds to the specific intracellular receptors. This binding results in the formation of active receptor – hormone complex which moves into the nucleus and binds to specific DNA sequence to regulate the transcription of genes.

**Q3. Why do we categorize endocytosis and exocytosis as active transport?**

**Ans.** Because in endocytosis as the bulky material moves into the cell, this requires energy to form vesicle and to pinch off from the cell membrane. Similarly, in exocytosis the material moves out of the cell. This also requires energy for the fusion of vesicle with the membrane.

**Q4. Justify why the membrane may be described as fluid?**

**Ans.** The membrane is described as fluid because of the ability of the molecules making up the plasma membrane to move around each other freely. This makes the structure of plasma membrane flexible and constantly changing in shape.



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