1. Which cell organelle is responsible for protein synthesis?

A) Endoplasmic reticulum

B) Lysosome

C) Ribosome

D) Golgi apparatus

Answer: C) Ribosome

Explanation: Ribosomes are the cellular structures responsible for protein synthesis. They are either found freely floating in the cytoplasm or attached to the endoplasmic reticulum.

2. Which of the following is not a function of the cell membrane?

A) Regulating the passage of substances into and out of the cell

B) Providing structural support to the cell

C) Recognizing signals from other cells

D) Controlling the movement of organelles within the cell

Answer: B) Providing structural support to the cell

Explanation: While the cell membrane plays crucial roles in maintaining the cell's internal environment and regulating transport, providing structural support is primarily the function of the cell wall in plant cells and some other organisms.

3. Which type of cell lacks a nucleus?

A) Plant cell

B) Animal cell

C) Bacterial cell

D) Fungal cell

Answer: C) Bacterial cell

Explanation: Bacterial cells are prokaryotic cells and do not have a nucleus. Instead, their genetic material is present in the form of a single circular chromosome in the cytoplasm.

4. Which organelle is responsible for packaging and distributing proteins within the cell?

A) Endoplasmic reticulum

B) Lysosome

C) Ribosome

D) Golgi apparatus

Answer: D) Golgi apparatus

Explanation: The Golgi apparatus processes, packages, and distributes proteins and lipids received from the endoplasmic reticulum throughout the cell or for secretion outside the cell.

5. Which organelle is responsible for cellular respiration, converting glucose into ATP (energy)?

A) Nucleus

B) Ribosome

C) Mitochondria

D) Golgi apparatus

Answer: C) Mitochondria

Explanation: Mitochondria are known as the powerhouses of the cell because they produce ATP through cellular respiration, using glucose and oxygen.

6. Which of the following is a characteristic feature of prokaryotic cells?

A) Presence of a nucleus

B) Presence of membrane-bound organelles

C) Presence of cell wall

D) Presence of chloroplasts

Answer: C) Presence of cell wall

Explanation: Prokaryotic cells, like bacteria, lack a nucleus and membrane-bound organelles but have a cell wall, which provides structure and protection.

7. Which structure in the cell is responsible for storing water, nutrients, and waste products?

A) Nucleus

B) Mitochondria

C) Vacuole

D) Chloroplast

Answer: C) Vacuole

Explanation: Vacuoles are membrane-bound sacs within cells that store water, nutrients, and waste products. They are larger and more prominent in plant cells.

8. Which organelle is responsible for synthesizing lipids and detoxifying drugs in the cell?

A) Ribosome

B) Golgi apparatus

C) Smooth endoplasmic reticulum

D) Lysosome

Answer: C) Smooth endoplasmic reticulum

Explanation: The smooth endoplasmic reticulum (ER) lacks ribosomes on its surface and is involved in lipid synthesis, detoxification of drugs, and metabolism of carbohydrates.

9. Which organelle is responsible for breaking down complex molecules and recycling cellular components?

A) Ribosome

B) Golgi apparatus

C) Lysosome

D) Nucleus

Answer: C) Lysosome

Explanation: Lysosomes contain digestive enzymes that break down complex molecules, old organelles, and cellular debris, helping in recycling within the cell.

10. Which organelle is responsible for modifying, sorting, and packaging proteins for secretion or for use within the cell?

A) Nucleus

B) Ribosome

C) Golgi apparatus

D) Endoplasmic reticulum

Answer: C) Golgi apparatus

Explanation: The Golgi apparatus processes, modifies, sorts, and packages proteins and lipids received from the endoplasmic reticulum for storage or secretion.

11. Which organelle is responsible for maintaining turgor pressure in plant cells?

A) Mitochondria

B) Vacuole

C) Chloroplast

D) Ribosome

Answer: B) Vacuole

Explanation: The vacuole in plant cells helps maintain turgor pressure by storing water and other substances, providing structural support to the cell.

12. Which type of cells lack membrane-bound organelles?

A) Eukaryotic cells

B) Prokaryotic cells

C) Animal cells

D) Plant cells

Answer: B) Prokaryotic cells

Explanation: Prokaryotic cells, such as bacteria, lack membrane-bound organelles like nuclei, mitochondria, and endoplasmic reticulum, which are characteristic of eukaryotic cells.

13. Which structure is responsible for maintaining cell-to-cell communication and cell recognition?

A) Cell membrane

B) Nucleus

C) Ribosome

D) Golgi apparatus

Answer: A) Cell membrane

Explanation: The cell membrane regulates communication between cells and the external environment, and also plays a role in cell recognition and signaling.

14. Which of the following organelles contains its own genetic material and is thought to have originated from an endosymbiotic event?

A) Mitochondria

B) Golgi apparatus

C) Endoplasmic reticulum

D) Lysosome

Answer: A) Mitochondria

Explanation: Mitochondria are organelles with their own DNA and are believed to have originated from a symbiotic relationship between ancient eukaryotic cells and bacteria.

15. Which organelle contains enzymes that break down damaged or old organelles and recycle their components?

A) Nucleus

B) Ribosome

C) Lysosome

D) Golgi apparatus

Answer: C) Lysosome

Explanation: Lysosomes contain digestive enzymes that break down cellular waste, damaged organelles, and foreign substances, facilitating recycling within the cell.

16. Which organelle is responsible for producing and assembling ribosomal subunits?

A) Nucleus

B) Golgi apparatus

C) Endoplasmic reticulum

D) Nucleolus

Answer: D) Nucleolus

Explanation: The nucleolus is a structure within the nucleus where ribosomal RNA (rRNA) is synthesized and ribosomal subunits are assembled.

17. Which type of cell division is responsible for growth and repair in multicellular organisms?

A) Mitosis

B) Meiosis

C) Binary fission

D) Budding

Answer: A) Mitosis

Explanation: Mitosis is a type of cell division in which a single cell divides to produce two identical daughter cells, used for growth, repair, and asexual reproduction in multicellular organisms.

18. Which type of cell division is responsible for producing gametes (sperm and egg cells) in sexually reproducing organisms?

A) Mitosis

B) Meiosis

C) Binary fission

D) Budding

Answer: B) Meiosis

Explanation: Meiosis is a type of cell division that produces haploid gametes (sperm and egg cells) with half the number of chromosomes of the parent cell, necessary for sexual reproduction.

19. Which structure is responsible for the movement of chromosomes during cell division?

A) Centrosome

B) Nucleolus

C) Chloroplast

D) Vacuole

Answer: A) Centrosome

Explanation: The centrosome is an organelle involved in organizing microtubules during cell division, facilitating the movement and separation of chromosomes to opposite poles of the dividing cell.

20. Which organelle is responsible for breaking down carbohydrates, lipids, and proteins into smaller molecules that can be used by the cell?

A) Ribosome

B) Lysosome

C) Golgi apparatus

D) Endoplasmic reticulum

Answer: B) Lysosome

Explanation: Lysosomes contain digestive enzymes that break down carbohydrates, lipids, proteins, and other molecules into smaller components that can be recycled or used by the cell.

21. Which type of cell division results in the formation of two identical daughter cells with the same number of chromosomes as the parent cell?

A) Mitosis

B) Meiosis

C) Binary fission

D) Budding

Answer: A) Mitosis

Explanation: Mitosis is a type of cell division in which a single cell divides to produce two genetically identical daughter cells, each with the same number of chromosomes as the parent cell.

22. Which organelle is responsible for modifying and sorting proteins before they are sent to their final destination within or outside the cell?

A) Endoplasmic reticulum

B) Golgi apparatus

C) Nucleus

D) Vacuole

Answer: B) Golgi apparatus

Explanation: The Golgi apparatus processes, modifies, sorts, and packages proteins and lipids received from the endoplasmic reticulum, preparing them for storage or secretion.

23. Which organelle is responsible for the synthesis of lipids, including phospholipids for cell membranes?

A) Nucleus

B) Ribosome

C) Smooth endoplasmic reticulum

D) Golgi apparatus

Answer: C) Smooth endoplasmic reticulum*

Explanation: The smooth endoplasmic reticulum (ER) is involved in lipid synthesis, including the production of phospholipids for cell membranes, as well as the metabolism of carbohydrates and detoxification.

24. Which process involves the engulfing of large particles or other cells by cells, forming a vesicle that fuses with a lysosome for digestion?

A) Pinocytosis

B) Exocytosis

C) Phagocytosis

D) Endocytosis

Answer: C) Phagocytosis

Explanation: Phagocytosis is the process by which cells engulf large particles or other cells into vesicles, which then fuse with lysosomes for digestion and recycling of materials.

25. Which process involves the engulfing of large particles or other cells by cells, forming a vesicle that fuses with a lysosome for digestion?

A) Pinocytosis

B) Exocytosis

C) Phagocytosis

D) Endocytosis

Answer: C) Phagocytosis

Explanation: Phagocytosis is the process by which cells engulf large particles or other cells into vesicles, which then fuse with lysosomes for digestion and recycling of materials.

26. Which organelle is responsible for converting glucose into ATP through glycolysis and cellular respiration?

A) Nucleus

B) Mitochondria

C) Golgi apparatus

D) Endoplasmic reticulum

Answer: B) Mitochondria

Explanation: Mitochondria are organelles responsible for cellular respiration, where glucose is converted into ATP (energy) through glycolysis and oxidative phosphorylation.

II. Fill in the blanks:

1. The _____ is a network of membrane-bound tubules involved in protein and lipid synthesis.

Answer: endoplasmic reticulum (ER)

Explanation: The endoplasmic reticulum (ER) plays a crucial role in protein synthesis, folding, and transport. It also synthesizes lipids and participates in detoxification processes.

2. _____ are specialized structures within the nucleus that contain genetic information in the form of DNA.

Answer: Chromosomes

Explanation: Chromosomes are thread-like structures made of DNA and proteins. They carry genes, which encode instructions for synthesizing proteins and controlling cell functions.

3._____ is the diffusion of water molecules across a selectively permeable membrane from an area of higher water concentration to lower water concentration.

Answer: Osmosis

Explanation: Osmosis is essential for maintaining water balance and regulating the internal environment of cells. It is crucial in processes like nutrient uptake in plants and kidney function in animals.

4. _____ are small, non-membrane-bound structures in the cytoplasm that synthesize proteins based on instructions from the nucleus.

Answer: Ribosomes

Explanation: Ribosomes are the sites of protein synthesis in cells. They translate mRNA into polypeptide chains, which fold into functional proteins that carry out various cellular functions.

5. The _____ is a rigid structure outside the cell membrane that provides support and protection for plant cells.

Answer: Cell wall

Explanation: The cell wall is made of cellulose and provides structural support and protection to plant cells. It maintains cell shape and prevents excessive uptake of water.

6. _____ are organelles found in plant cells and some protists that contain green pigments and carry out photosynthesis.

Answer: Chloroplasts

Explanation: Chloroplasts are specialized organelles in plant cells responsible for photosynthesis. They convert light energy into chemical energy (glucose) using chlorophyll pigments.

7. _____ is the process by which cells selectively engulf large particles, such as food, into vesicles for digestion.

Answer: Phagocytosis

Explanation: A phagocytosis is a form of endocytosis where cells engulf large particles or even other cells into vesicles called phagosomes for digestion.

8. _____ are the building blocks of proteins, synthesized in the cytoplasm by ribosomes.

Answer: Amino acids

Explanation: Amino acids are organic compounds that serve as the monomers (building blocks) of proteins. They are assembled into polypeptide chains by ribosomes during protein synthesis.

9. _____ is the semi-fluid matrix that fills the interior of cells and surrounds organelles.

Answer: Cytoplasm

Explanation: Cytoplasm is the gel-like substance inside cells where organelles are suspended. It contains water, salts, and organic molecules needed for cellular processes.

10. _____ is the process by which cells release energy from glucose and other organic molecules with the help of oxygen, producing carbon dioxide and water as by-products.

Answer: Cellular respiration

Explanation: Cellular respiration is the metabolic process in which cells break down glucose and other organic molecules in the presence of oxygen to produce ATP (energy), carbon dioxide, and water.

11. _____ are small membrane-bound sacs that transport and store materials within the cell.

Answer: Vesicles

Explanation: Vesicles are small, membrane-bound sacs within cells that transport, store, or digest cellular products and wastes. They play a role in intracellular transport and communication.

12. _____ are the structural and functional units of heredity that carry genetic information from one generation to the next.

Answer: Genes

Explanation: Genes are segments of DNA that encode instructions for making proteins and controlling cellular activities. They are passed from parents to offspring and determine traits.

13. _____ are the building blocks of nucleic acids (DNA and RNA), consisting of a phosphate group, a sugar molecule, and a nitrogenous base.

Answer: Nucleotides

Explanation: Nucleotides are monomers that make up nucleic acids (DNA and RNA). Each nucleotide consists of a phosphate group, a sugar molecule (deoxyribose in DNA and ribose in RNA), and a nitrogenous base (adenine, thymine/uracil, cytosine, or guanine).

14. _____ are structures within the nucleus where ribosomal RNA (rRNA) combines with proteins to form ribosome subunits.

Answer: Nucleoli (singular: nucleolus

Explanation: Nucleoli are dense structures within the nucleus where ribosomal RNA (rRNA) is transcribed, processed, and combined with proteins to form ribosome subunits.

Section B

Short Answer Questions

Q1. Why are cells considered the basic structural and functional units of living organisms?

Answer: Cells are considered the basic units of living organisms because they are capable of performing all necessary functions for life. Each cell is able to carry out metabolism, respond to stimuli, grow, reproduce, and maintain homeostasis independently. These functions are essential for the survival and functioning of an organism as a whole.

Explanation: Cells are the smallest structural and functional units of living organisms. They are capable of performing all the activities necessary for life, such as obtaining nutrients, eliminating waste, and carrying out metabolic processes. Each cell contains all the necessary organelles and biomolecules to maintain its functions and contribute to the overall functioning of the organism.

Q2. Compare and contrast prokaryotic and eukaryotic cells.

Answer: Prokaryotic cells are simpler in structure, lack a nucleus and membrane-bound organelles, and their genetic material is in the form of a single circular chromosome. Eukaryotic cells are more complex, have a nucleus and membrane-bound organelles, and their genetic material is organized into multiple linear chromosomes within the nucleus.

Explanation:

- Prokaryotic cells: They are typically smaller and simpler in structure. Their genetic material (DNA) is not enclosed within a nucleus but floats freely in the cytoplasm. They lack membrane-bound organelles like mitochondria, endoplasmic reticulum, and Golgi apparatus.

- Eukaryotic cells: They are larger and more complex. Their genetic material is enclosed within a membrane-bound nucleus. Eukaryotic cells contain various membrane-bound organelles that perform specific functions, such as mitochondria for energy production, endoplasmic reticulum for protein synthesis, and Golgi apparatus for processing and packaging of proteins.

Q3. Why are mitochondria often referred to as the powerhouse of the cell?

Answer: Mitochondria are referred to as the powerhouse of the cell because they are the sites of cellular respiration, where energy (in the form of ATP) is produced from the breakdown of glucose and other organic molecules. ATP is the primary energy currency of cells, used for various cellular processes.

Explanation

- Cellular respiration: Mitochondria contain enzymes and electron transport chains involved in aerobic respiration, which generates ATP through the oxidation of glucose and other nutrients.

- ATP production: ATP molecules store energy that is released and utilized by the cell for activities such as muscle contraction, protein synthesis, active transport, and maintaining cell membrane potential.

- Abundance in energy-demanding cells: Cells with high energy demands, such as muscle cells and neurons, have a large number of mitochondria to meet their energy requirements, emphasizing their role as the powerhouse of the cell.

Q4. Discuss the significance of the endoplasmic reticulum (ER) in protein synthesis and lipid metabolism.

Answer: The endoplasmic reticulum (ER) is a network of membrane-bound sacs and tubules that plays a crucial role in protein synthesis and lipid metabolism. The rough ER synthesizes proteins, which are then transported to the Golgi apparatus for further processing and secretion. The smooth ER is involved in lipid synthesis, detoxification of drugs and toxins, and calcium storage.

Explanation:

- Rough ER: Studded with ribosomes on its surface, the rough ER synthesizes proteins that are destined for secretion from the cell or for insertion into cell membranes. These proteins undergo folding and modification within the ER lumen.

- Smooth ER: Lacks ribosomes and is involved in lipid metabolism, synthesizing phospholipids and steroids. It also detoxifies drugs and toxins by modifying them into more water-soluble forms that can be excreted from the cell. Additionally, the smooth ER stores calcium ions necessary for muscle contraction and other cellular processes.

- Coordination with Golgi apparatus: The ER works in coordination with the Golgi apparatus to ensure proper processing, modification, and packaging of proteins and lipids before they are transported to their final destinations within the cell or outside the cell.

Q5: Discuss the role of the nucleus in cellular function and inheritance.

Answer: The nucleus plays a critical role in cellular function and inheritance. It houses the cell's genetic material (DNA), which contains instructions for protein synthesis and cellular activities. The nucleus regulates gene expression, controls cellular processes, and passes genetic information from one generation to the next during cell division.

Explanation:

- Genetic material: DNA molecules in the nucleus contain genes that encode proteins and RNA molecules essential for cellular structure and function. These genes determine an organism's traits and characteristics.

- Gene expression: The nucleus regulates gene expression by controlling the transcription of DNA into messenger RNA (mRNA), which is then translated into proteins by ribosomes.

- Cell division: During cell division, the nucleus undergoes processes such as mitosis (in eukaryotic cells) or binary fission (in prokaryotic cells) to ensure that genetic information is accurately replicated and distributed to daughter cells.

- Inheritance: Genetic information stored in the nucleus is passed from parent cells to daughter cells during cell division, maintaining continuity of traits across generations.

Q6. Discuss the role of lysosomes in cellular digestion and recycling.

Answer: Lysosomes are membrane-bound organelles filled with digestive enzymes. They play a key role in cellular digestion by breaking down macromolecules, old organelles, and foreign materials engulfed by the cell through processes like phagocytosis and autophagy. Lysosomes also facilitate the recycling of cellular components and contribute to maintaining cellular homeostasis.

Explanation:

- Digestive enzymes: Lysosomal enzymes, such as proteases, lipases, and nucleases, break down proteins, lipids, nucleic acids, and carbohydrates into smaller molecules that can be reused by the cell.

- Phagocytosis and autophagy: Lysosomes fuse with vesicles containing engulfed materials or damaged organelles, forming digestive vesicles. Enzymes within lysosomes digest these contents, releasing nutrients and building blocks for cellular metabolism.

Q7. Discuss the importance of cell division in growth, repair, and reproduction of organisms.

Answer: Cell division is crucial for the growth, repair, and reproduction of organisms. During growth, cells divide to increase the number of cells in tissues and organs. In repair, cell division replaces damaged or dead cells with new ones. In reproduction, cell division ensures the transmission of genetic information to offspring, maintaining the continuity of species.

Explanation:

- Growth: Cell division allows multicellular organisms to increase in size by producing more cells. This process is essential for development from a single fertilized egg to a complex organism composed of trillions of cells.

- Repair: Cell division replaces damaged or worn-out cells through processes like mitosis (in eukaryotes) or binary fission (in prokaryotes). It facilitates tissue regeneration and wound healing in response to injuries or diseases.

- Reproduction: Cell division plays a central role in reproduction by producing gametes (sperm and egg cells) through meiosis and facilitating fertilization to create new individuals with unique genetic combinations.

Q8. Explain the importance of the Golgi apparatus in cellular function.

Answer: The Golgi apparatus is involved in modifying, sorting, and packaging proteins and lipids for secretion or delivery to other organelles. It receives newly synthesized proteins from the endoplasmic reticulum (ER), modifies them through processes like glycosylation, and packages them into vesicles for transport to their final destinations. The Golgi apparatus also synthesizes complex polysaccharides for cell membranes and forms lysosomes by packaging enzymes.

Explanation:

- Protein modification: The Golgi apparatus modifies proteins by adding carbohydrates (glycosylation) and other molecules, which are necessary for protein function and stability.

- Sorting and packaging: Proteins and lipids processed in the Golgi apparatus are sorted into vesicles that transport them to specific destinations, such as the cell membrane for secretion or incorporation into other organelles.

- Formation of lysosomes: The Golgi apparatus synthesizes digestive enzymes and packages them into vesicles, which fuse with endosomes to form lysosomes responsible for cellular digestion.

- Secretion and cell membrane maintenance: The Golgi apparatus plays a crucial role in the secretion of proteins, hormones, and enzymes from cells, as well as in maintaining and renewing the cell membrane through lipid synthesis and modification.

Section D

III. Large Answer Question:

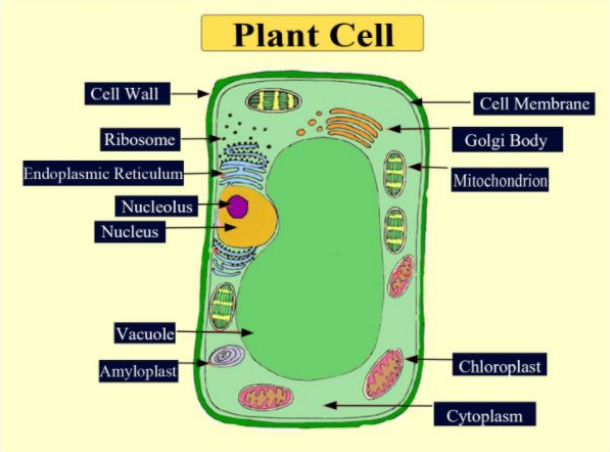
Q1. How does a plant cell differ from an animal cell?

Answer: The differences between plant cells and animal cells are listed below:

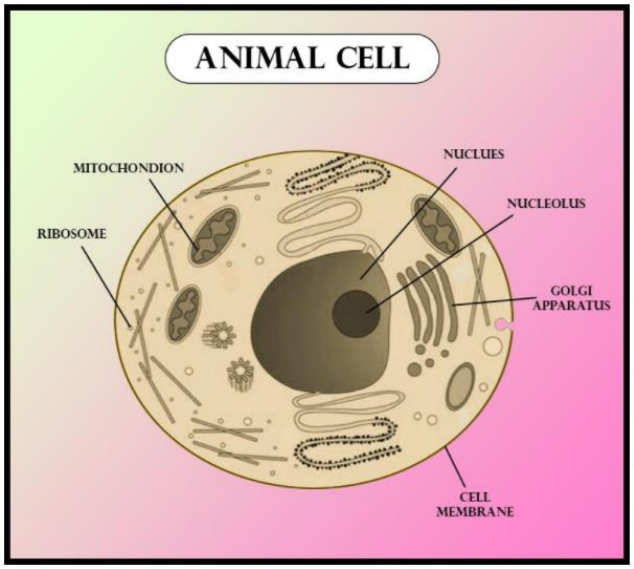
Plant cell	Animal cell
1. A plant cell is surrounded by a rigid cell wall.	1. An animal cell does not have a cell wall.
2. Presence of a large vacuole is seen in plant cells.	2. Whereas there are very small vacuoles as compared to plant cells are seen in animal cells.
3. Larger in size.	3. Smaller in size.

4. Plant cells have plastids.	4. Animal cells do not have plastids.
5. Centrosomes are absent in plant cells	5. Animal cells have centrosomes.
6. Plant cells do not have cilia.	6. Animal cells have cilia.
7. Lysosomes are very rare in plant cells.	7. Animal cells have lysosomes.

Plant Cell:



Animal Cell:



Q2. Differentiate between rough and smooth endoplasmic reticulum. How is the endoplasmic reticulum important for membrane biogenesis?

Answer:

Rough Endoplasmic reticulum	Smooth Endoplasmic reticulum
It possesses ribosomes attached to the membrane.	It does not possess ribosomes attached to its membrane.
Involved in protein synthesis	Involved in lipid synthesis
Found deep inside the cytoplasm.	Found on the periphery.
May develop from the nucleus.	May develop from the rough endoplasmic reticulum.

1. Structure and Appearance:

- Rough Endoplasmic Reticulum (RER):

  - Appears rough under a microscope due to ribosomes attached to its outer surface.

  - Ribosomes are tiny structures involved in protein synthesis.

- Smooth Endoplasmic Reticulum (SER):

  - Appears smooth under a microscope because it lacks ribosomes on its surface.

  - Has a tubular structure.

2. Function:

- **Rough Endoplasmic Reticulum (RER):

  - Main function is protein synthesis.

  - Ribosomes on the RER synthesize proteins that are then transported into the RER's interior (lumen) for processing.

  - Involved in the synthesis of proteins that are either secreted from the cell or inserted into cell membranes.

- Smooth Endoplasmic Reticulum (SER):

  - Main functions include lipid metabolism and detoxification.

  - Synthesizes lipids (fats), such as phospholipids and cholesterol.

  - Detoxifies drugs and harmful substances in the liver.

  - Stores calcium ions in muscle cells, which are important for muscle contraction.

3. Location and Distribution:

- Both SER and RER are interconnected networks of membranes that extend throughout the cytoplasm of eukaryotic cells.

- RER is more abundant in cells that are active in protein synthesis, such as pancreatic cells and cells that produce antibodies.

- SER is more abundant in cells involved in lipid metabolism and detoxification, such as liver cells.

4. Specialization:

RER: Specializes in protein synthesis and processing.

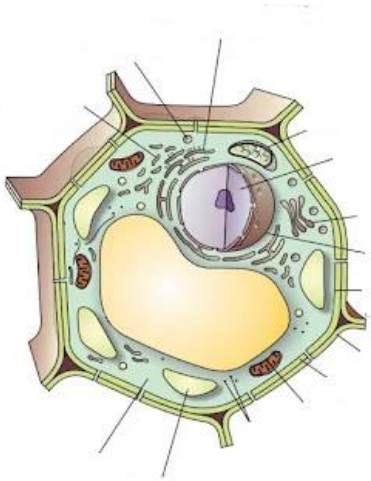
SER: Specializes in lipid metabolism, detoxification, and calcium ion storage.

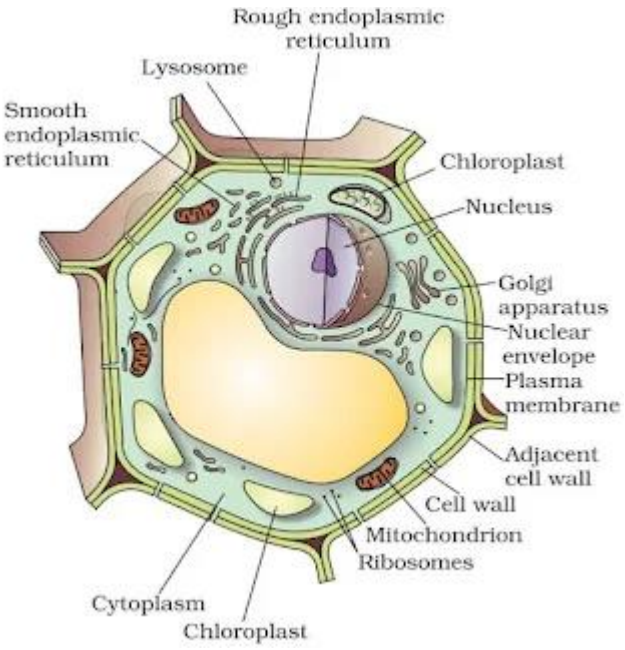
Rough Endoplasmic reticulum	Smooth Endoplasmic reticulum
It possesses ribosomes attached to the membrane.	It does not possess ribosomes attached to its membrane.
Involved in protein synthesis	Involved in lipid synthesis
Found deep inside the cytoplasm.	Found on the periphery.
May develop from the nucleus.	May develop from the rough endoplasmic reticulum.

Section E

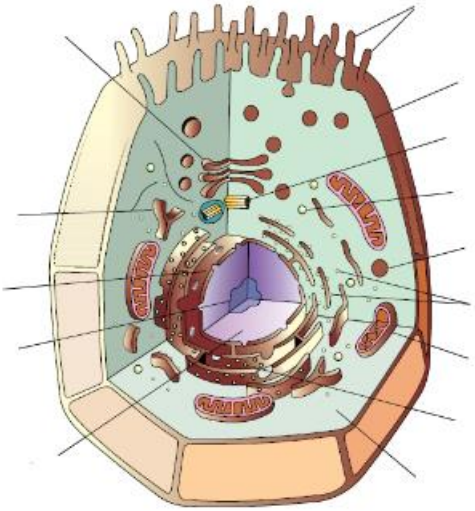
IV. Picture Study:

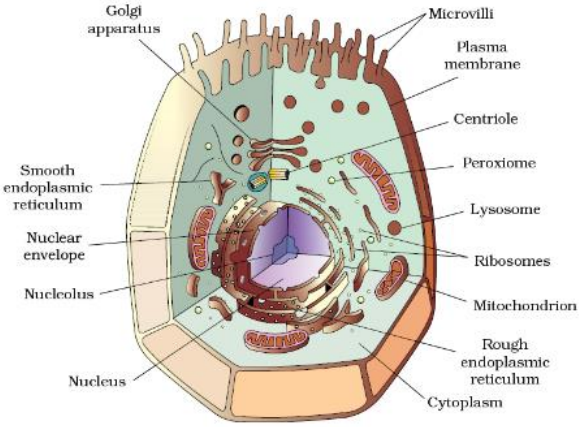
A. Label the parts of plant cells:



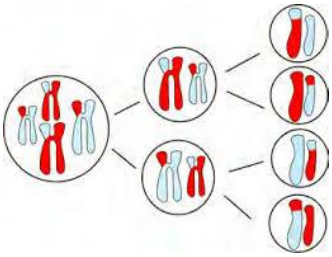


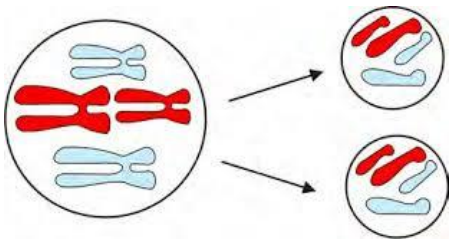
B. Label the parts of Animal cell





C. Identify Mitosis and Meiosis in the diagram below





Meiosis

Mitosis