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Class	9th	Chapter	03
Subject	Biology	Board	Punjab

CHAPTER 3: THE CELL

TEXTBOOK EXERCISE SOLUTION

A. Select the Correct Answers for the Following Questions

1. The process of cellular respiration occurs in:

(a) Nucleus (b) Mitochondria (c) Ribosomes (d) Golgi apparatus

Answer: (b) Mitochondria

2. The smooth endoplasmic reticulum (SER) is primarily involved in the synthesis of:

(a) Proteins (b) Lipids (c) Carbohydrates (d) Nucleic acids

Answer: (b) Lipids

3. Ribosomes are composed of:

(a) RNA and protein (b) DNA and protein (c) Carbohydrates and lipids (d) RNA and carbohydrates

Answer: (a) RNA and protein

4. What is the primary function of ribosomes?

(a) Energy production (b) Protein synthesis (c) Lipid synthesis (d) DNA synthesis

Answer: (b) Protein synthesis

5. Which cell organelle is involved in packaging and modifying proteins?

(a) Nucleus (b) Mitochondria (c) Golgi apparatus (d) Endoplasmic reticulum

Answer: (c) Golgi apparatus

6. Which cell organelle is responsible for breaking down waste materials?

(a) Golgi apparatus (b) Nucleus (c) Mitochondria (d) Lysosome

Answer: (d) Lysosome

7. Which of the following cell structures is involved in maintaining cell shape?

(a) Cytoskeleton (b) Centrioles (c) Nucleus (d) Lysosome

Answer: (a) Cytoskeleton

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8. Which specialized region of the nucleus is responsible for ribosome assembly?

(a) Nucleoplasm (b) Nucleolus (c) Chromatin (d) Chromosomes

Answer: (b) Nucleolus

9. What is the main function of nuclear pores?

(a) Regulation of cell division (b) Control of cell pH (c) Protein synthesis (d) Control of the transport of molecules

Answer: (d) Control of the transport of molecules

10. Which of the following cellular structures is found in animal cells and helps in cell division?

(a) Cell membrane (b) Centriole (c) Plasmodesma (d) Vacuole

Answer: (b) Centriole

11. Which subcellular organelle plays a crucial role in energy production within the cell?

(a) Endoplasmic reticulum (b) Golgi apparatus (c) Mitochondria (d) Lysosomes

Answer: (c) Mitochondria

12. In a multicellular plant, which cell type is responsible for the production of glucose?

(a) Xylem (b) Phloem (c) Epidermal cells (d) Mesophyll cells

Answer: (d) Mesophyll cells

13. Which organelle can increase its number by dividing independently?

(a) Ribosomes (b) Lysosomes (c) Mitochondria (d) Golgi apparatus

Answer: (c) Mitochondria

14. Which of the following structures are present on the surface of rough endoplasmic reticulum?

(a) Ribosomes (b) Lysosomes (c) Mitochondria (d) Vacuoles

Answer: (a) Ribosomes

B. Write Short Answers

1. What are the main functions of the cell membrane?

Answer: The cell membrane regulates the entry and exit of materials because it is selectively permeable. It protects cellular contents, helps maintain the cell's shape, provides a boundary around the cell, and facilitates cell-to-cell communication and recognition.

2. What key role does the Golgi apparatus play in eukaryotic cells?

Answer: The Golgi apparatus modifies, sorts, packages, and transports proteins and lipids received from the endoplasmic reticulum to their correct destinations inside or outside the cell. It also helps form lysosomes.

3. How do lysosomes contribute to the cell's functioning?

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Answer: Lysosomes contain hydrolytic enzymes that break down worn-out cell organelles, foreign particles, food molecules, and cellular debris through intracellular digestion. They also participate in the recycling of cellular components.

4. Which organelle detoxifies harmful substances and breaks down lipids?

Answer: The **Smooth Endoplasmic Reticulum (SER)** helps detoxify harmful substances, including certain drugs, and synthesizes lipids. Peroxisomes also contribute to detoxification and the breakdown of fatty acids.

5. What is the smooth endoplasmic reticulum responsible for?

Answer: The smooth endoplasmic reticulum is responsible for lipid synthesis, including the production of phospholipids and cholesterol. It also participates in carbohydrate metabolism, detoxification of drugs and toxins, and calcium ion storage in muscle cells.

6. How do the vacuoles in plant cells differ from vacuoles in animal cells?

Answer: Plant cells typically possess a single, large, central vacuole that stores water and nutrients and maintains turgor pressure. Animal cells may contain several smaller vacuoles that are mainly involved in storage and transport.

7. What could happen if lysosomal enzymes stop working properly?

Answer: If lysosomal enzymes stop working properly, undigested cellular waste and debris may accumulate inside the cell. This can cause cellular dysfunction and toxicity. Certain inherited disorders caused by the accumulation of substances inside lysosomes are known as lysosomal storage diseases.

8. Why are cristae important for cellular respiration?

Answer: Cristae are inward folds of the inner mitochondrial membrane. They increase the surface area available for respiratory enzymes, electron transport chain proteins, and ATP synthase, which are essential for ATP production during aerobic respiration.

9. How are chromatin and chromosomes related?

Answer: Chromatin and chromosomes are different structural forms of the same genetic material, consisting of DNA and proteins. Chromatin is generally less condensed during interphase, whereas chromosomes become highly condensed and visible during cell division.

10. Which type of cell is responsible for sending nerve signals?

Answer: Neurons, also called nerve cells, are responsible for receiving and transmitting nerve signals.

11. What do mesophyll cells do in plant leaves?

Answer: Mesophyll cells contain numerous chloroplasts and are the main sites of photosynthesis in plant leaves. They use light energy to produce glucose from carbon dioxide and water, releasing oxygen as a by-product.

12. How would you define a stem cell?

Answer: A stem cell is an unspecialized cell that can divide to produce more stem cells and differentiate into specialized cell types, such as blood cells, muscle cells, or nerve cells.

13. Name the chemical compounds that make up the following structures.

(a) Cell Membrane: Phospholipids and proteins, along with carbohydrates and cholesterol.

(b) Fungal Cell Wall: Chitin.

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(c) Plant Cell Wall: Cellulose, along with hemicellulose and pectin.

(d) Bacterial Cell Wall: Peptidoglycan (murein).

(e) Ribosomes: Ribosomal RNA (rRNA) and proteins.

(f) Chromosomes: DNA and proteins, including histone proteins in eukaryotic chromosomes.

14. Label the parts of these cell diagrams.

Answer: The following are common structures labelled in standard plant and animal cell diagrams.

Animal Cell:

- Cell membrane
- Cytoplasm
- Nucleus
- Nucleolus
- Mitochondria
- Rough endoplasmic reticulum
- Smooth endoplasmic reticulum
- Golgi apparatus
- Ribosomes
- Centrioles
- Cytoskeleton

Plant Cell:

- Cell wall
- Cell membrane
- Cytoplasm
- Nucleus
- Large central vacuole
- Chloroplasts
- Mitochondria
- Golgi apparatus
- Endoplasmic reticulum
- Ribosomes

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C. Write Answers in Detail

1. Explain the fluid mosaic model of the cell membrane.

Answer: The fluid mosaic model was proposed by S. J. Singer and G. L. Nicolson in 1972. It describes the structure and organization of the plasma membrane.

Fluid Nature: The membrane consists of a phospholipid bilayer. Phospholipid molecules and many membrane proteins can move laterally within the membrane, giving it flexibility.

Mosaic Nature: Different protein molecules are embedded in or attached to the lipid bilayer, forming a mosaic-like arrangement.

Components: The membrane contains phospholipids, integral and peripheral proteins, cholesterol in many eukaryotic membranes, and carbohydrate chains attached to proteins or lipids. These carbohydrates help in cell recognition and communication.

2. Describe the structure and functions of the cell wall.

Answer:

Structure: The cell wall is a rigid protective layer located outside the cell membrane. It is present in plants, fungi, and bacteria, although its chemical composition differs among these groups. Plant cell walls consist mainly of cellulose microfibrils embedded in a matrix containing substances such as pectin and hemicellulose. Some plant cells also develop secondary walls containing lignin.

Functions:

- Provides structural strength and mechanical support.
- Maintains the shape of the cell.
- Protects the cell against mechanical injury and some pathogens.
- Helps prevent osmotic bursting when water enters the cell.
- Supports plant tissues and helps maintain their rigidity.

3. Discuss the components of the nucleus.

Answer: The nucleus is a membrane-bound organelle that contains most of the genetic material in eukaryotic cells. Its main components are:

Nuclear Envelope: A double-membrane structure surrounding the nucleus. It contains nuclear pores that regulate the movement of molecules between the nucleus and cytoplasm.

Nucleoplasm: A jelly-like fluid that fills the interior of the nucleus and contains various substances involved in nuclear activities.

Nucleolus: A dense, non-membrane-bound structure composed mainly of RNA and proteins. It is involved in ribosomal RNA production and ribosome assembly.

Chromatin/Chromosomes: The hereditary material consisting of DNA and proteins. It contains genetic instructions that control cellular activities, growth, and reproduction.

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4. Describe the structure and function of lysosomes and the endoplasmic reticulum.

Answer:

Lysosomes

Structure: Lysosomes are small, single-membrane-bound organelles containing hydrolytic digestive enzymes.

Functions:

- Digest large biological molecules.
- Break down worn-out cell organelles.
- Recycle cellular components.
- Help destroy certain foreign particles and cellular debris.
- Participate in cellular processes associated with the removal of damaged components.

Endoplasmic Reticulum (ER)

Structure: The endoplasmic reticulum is an interconnected network of membrane-bound sacs and tubules extending through the cytoplasm and connected to the nuclear envelope. It is divided into rough and smooth endoplasmic reticulum.

Rough Endoplasmic Reticulum (RER): It has ribosomes attached to its surface and is involved in the synthesis and initial processing of many proteins.

Smooth Endoplasmic Reticulum (SER): It lacks attached ribosomes and is involved in lipid synthesis, carbohydrate metabolism, detoxification, and calcium storage in certain cells.

5. Describe the formation and function of the Golgi complex.

Answer:

Formation: The Golgi complex, also called the Golgi body or Golgi apparatus, consists of stacks of flattened, membrane-bound sacs called cisternae. It receives transport vesicles carrying proteins and lipids from the endoplasmic reticulum.

Functions:

- Receives newly synthesized proteins and lipids from the endoplasmic reticulum.
- Chemically modifies proteins and lipids, including the addition of carbohydrate groups.
- Sorts and packages materials into transport vesicles.
- Sends materials to specific destinations inside or outside the cell.
- Helps form lysosomes and contributes to secretion.

6. Describe the structure and functions of the chloroplast.

Answer:

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Structure: A chloroplast is a double-membrane-bound organelle found in plant cells and many algae. It contains a fluid-filled matrix called the stroma. Inside the stroma are flattened membrane sacs called thylakoids, which are arranged in stacks known as grana. Chloroplasts contain chlorophyll, the green pigment that absorbs light energy. They also contain their own DNA and ribosomes.

Functions:

- Chloroplasts are the main sites of photosynthesis in plants.
- Chlorophyll absorbs light energy.
- Light-dependent reactions take place in the thylakoid membranes.
- The Calvin cycle takes place in the stroma, where carbon dioxide is used to produce carbohydrates.
- Oxygen is released during the light-dependent reactions as water is split.

7. How does turgor pressure develop in a plant cell?

Answer: When a plant cell is placed in a hypotonic environment, water enters the cell by osmosis. Water accumulates in the large central vacuole, causing it to expand. The contents of the cell press against the rigid cell wall, producing outward pressure. This pressure is called **turgor pressure**.

Turgor pressure helps maintain the firmness of plant cells and provides support to non-woody plant tissues. When plant cells lose water, their turgor pressure decreases, causing the plant to wilt.

8. Write any four differences between a plant cell and an animal cell.

Answer:

1. Cell Wall: Plant cells have a rigid cell wall made mainly of cellulose, whereas animal cells lack a cell wall.

2. Vacuoles: Plant cells typically have one large central vacuole, whereas animal cells may contain several smaller vacuoles.

3. Plastids: Plant cells contain plastids, such as chloroplasts, for photosynthesis. Animal cells do not contain plastids.

4. Centrioles: Animal cells commonly possess centrioles involved in cell division. Most higher plant cells lack centrioles.

9. Describe the concept of division of labour and how it applies in multicellular organisms. Give at least three examples.

Answer:

Concept: Division of labour means that different tasks are performed by specialized cells, tissues, and organs rather than by a single cell or structure. This arrangement increases the efficiency of an organism.

Application in Multicellular Organisms: In multicellular organisms, cells become specialized for particular functions. Similar specialized cells form tissues, and tissues work together in organs and organ systems.

Examples:

1. **Red Blood Cells:** Specialized for transporting oxygen throughout the body.

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2. **Xylem Vessels:** Specialized for conducting water and mineral salts from roots to other parts of a plant.
3. **Muscle Cells:** Specialized for contraction and movement.

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10. Write a note on cell specialization.

Answer: Cell specialization, also known as cell differentiation, is the process through which unspecialized cells develop specific structures and functions. During differentiation, the regulation of gene activity allows cells to develop features suited to particular roles.

For example, neurons are specialized for transmitting signals, root hair cells are adapted for absorbing water and minerals, and epithelial cells provide protection and form coverings. Cell specialization enables multicellular organisms to carry out complex functions efficiently.

D. Inquisitive Questions

1. What impact might mitochondrial dysfunction or absence have on other organelles' ability to operate in a cell?

Answer: Mitochondria produce much of the ATP used by eukaryotic cells through cellular respiration. If mitochondria malfunction or are absent, ATP production may decrease significantly, depending on the cell type and its ability to produce ATP through other pathways.

Without sufficient ATP, energy-dependent cellular processes become impaired. Active transport across cell membranes may become less efficient, protein processing and transport may be disrupted, and the maintenance of ion balance may fail. Lysosomes and other organelles may also be affected indirectly by changes in cellular energy and internal conditions.

Severe mitochondrial dysfunction can lead to cellular damage and, in some cases, cell death. This demonstrates the importance of mitochondria in maintaining normal cellular activities.

2. What may happen if the coordination between ribosomes and the nucleus were to fail, and why is it so important?

Answer: The nucleus contains the cell's genetic material (DNA). It uses this information to produce messenger RNA (mRNA), which carries instructions to ribosomes for protein synthesis.

If communication between the nucleus and ribosomes fails, the production of proteins may become disrupted or inaccurate. As a result, the cell may not produce sufficient structural proteins, enzymes, and other essential molecules.

This disruption can interfere with cellular metabolism, growth, repair, and cell division. Therefore, coordination between the nucleus and ribosomes is essential for normal cell function and survival.

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