NCERT Exemplar Solutions of Class 11 Biology – Chapter 8: Cell: The Unit of Life

VERY SHORT ANSWER TYPE QUESTIONS

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

Solution:

A vacuole is a membrane-bound space found in the cytoplasm. It is found in both plant and animal cells but is much larger in plants (occupies 90% of the space in plant cells). Its significance includes:

- **Storage**: Stores water, ions, and various organic molecules
- **Waste disposal**: Accumulates waste products for degradation
- **Cell elongation**: Helps in cell growth by taking up water
- **Cell protection**: Acts as a barrier against harmful substances
- **Turgor pressure maintenance**: Maintains cell rigidity and plant structure

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2. What does 'S' refer in the 70S & 80S ribosome?

Solution:

The 'S' refers to **Svedberg's unit** or **sedimentation coefficient**. It is indirectly a measure of density and size, representing how fast a particle sediments in an ultracentrifuge. The higher the S value, the larger and denser the particle. 70S ribosomes are found in prokaryotes, while 80S ribosomes are found in eukaryotic cytoplasm.

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

Solution:

Lysosomes are single membrane-bound organelles rich in hydrolytic enzymes. These enzymes include proteases, lipases, nucleases, and other digestive enzymes that break down cellular waste, worn-out organelles, and materials taken up by endocytosis. Lysosomes are often called "suicide bags" of the cell.

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4. What are gas vacuoles? State their functions.

Solution:

Gas vacuoles are aggregates of hollow cylindrical structures called gas vesicles. They are found primarily in aquatic prokaryotes (cyanobacteria and some bacteria).

Functions:

- **Gas storage**: Store metabolic gases (mainly nitrogen)
- **Buoyancy control**: Help organisms regulate their position in water column
- **Depth regulation**: Allow vertical migration in response to light and nutrient availability

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5. What is the function of a polysome?

Solution:

The function of a **polysome** (polyribosome) is to **translate mRNA into proteins**. A polysome

consists of multiple ribosomes attached to a single mRNA molecule, allowing simultaneous translation and increased protein production efficiency. This arrangement is particularly important in cells with high protein synthesis requirements.

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6. What is the feature of a metacentric chromosome?

Solution:

The **metacentric chromosome** has a **centromere located in the middle**, forming two equal arms of the chromosome. This creates an X-shaped structure during cell division. The two arms are called "p" (short) and "q" (long) arms, but in metacentric chromosomes, they are approximately equal in length.

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7. What is referred to as satellite chromosome?

Solution:

A **satellite chromosome** is a chromosome that has **non-staining secondary constrictions** at a constant location. This secondary constriction creates the appearance of a small fragment called the **satellite** attached to the main chromosome body. These constrictions often contain genes for ribosomal RNA and are sites of nucleolus formation.

SHORT ANSWER TYPE QUESTIONS

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

Solution:

The **nucleolus** plays a crucial role in protein synthesis:

- **Structure**: Contains small spherical bodies and is not membrane-bound
- **rRNA synthesis**: It is the primary site for active ribosomal RNA (rRNA) synthesis
- **Ribosome assembly**: Receives and stores ribosomal proteins formed in the cytoplasm
- **Ribosome biogenesis**: Assembles ribosomal subunits from rRNA and ribosomal proteins
- **Size correlation**: Larger nucleoli are found in cells with high protein synthesis activity
- **Multiple nucleoli**: Highly active cells may have multiple nucleoli

The nucleolus essentially serves as the "ribosome factory" of the cell, directly supporting protein synthesis by producing the cellular machinery required for translation.

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

Solution:

Association of carbohydrates with plasma membrane:

- Carbohydrates attach to membrane proteins and lipids through **glycosylation**
- Forms **glycoproteins** (carbohydrate + protein) and **glycolipids** (carbohydrate + lipid)
- Primarily located on the **outer surface** of the membrane (extracellular side)

Significance:

- **Cell recognition**: Act as identification markers for cell-to-cell recognition
- **Cell adhesion**: Help cells stick together to form tissues
- **Signal transduction**: Participate in cell signaling pathways
- **Immune recognition**: Help immune system distinguish self from non-self
- **Blood group determination**: ABO blood groups are determined by membrane carbohydrates

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3. Comment on the cartwheel structure of centriole.

Solution:

Cartwheel structure of centriole:

- **Organization**: Each centriole has a cylindrical structure with **9 triplets of microtubules**
- **Arrangement**: The triplets are arranged in a circular pattern resembling a cartwheel
- **Perpendicular orientation**: Two centrioles in a centrosome lie perpendicular to each other
- **Linking**: Adjacent triplets are linked by connecting proteins
- **Central hub**: Has a central cartwheel structure with spokes radiating outward

Significance:

- This unique arrangement is essential for centriole function in organizing the cytoskeleton
- Provides structural stability and proper spatial organization
- Critical for spindle fiber formation during cell division

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4. Briefly describe the cell theory.

Solution:

Classical Cell Theory (Schleiden and Schwann, 1839):

1. **All living organisms** are composed of cells and cell products
2. **Cell is the structural and functional unit** of life
3. **All cells arise from pre-existing cells** (added by Rudolf Virchow, 1855)

Modern Cell Theory includes additional principles:

- Cells contain hereditary information (DNA) passed from cell to cell
- All cells have the same basic chemical composition and metabolic processes
- Energy flow (metabolism and biochemistry) occurs within cells

Significance:

- Unified understanding of life's organization
- Foundation for biology and medicine
- Basis for understanding growth, reproduction, and heredity

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

Solution:

Rough Endoplasmic Reticulum (RER)	Smooth Endoplasmic Reticulum (SER)
Ribosomes attached to the surface	**No ribosomes** attached
Protein synthesis and enzyme production	**Lipid synthesis** and steroid hormone production
Mainly composed of **cisternae** and few tubules	Mainly composed of **vesicles and tubules**
Found in cells with **high secretory activity**	Abundant in cells involved in **lipid metabolism**
Rough appearance due to ribosomes	**Smooth appearance** without ribosomes
Connected to **nuclear membrane**	May be continuous with RER
Examples: Pancreatic cells, plasma cells	Examples: Liver cells, steroid-producing cells

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

Solution:

Biochemical composition of plasma membrane:

Components:

- **Lipids (40-50%)**: Phospholipids, cholesterol, glycolipids
- **Proteins (50-60%)**: Integral and peripheral proteins
- **Carbohydrates (5-10%)**: Attached to proteins and lipids
- **Water**: Associated with hydrophilic regions

Lipid arrangement:

- **Bilayer structure**: Lipids arranged in two layers
- **Hydrophilic heads**: Face outward toward aqueous environments
- **Hydrophobic tails**: Point inward, away from water
- **Asymmetric distribution**: Different lipid compositions on inner and outer layers
- **Fluid nature**: Lipids can move laterally within the layer
- **Cholesterol**: Intercalated between phospholipids, modulating fluidity

This arrangement creates a **selective barrier** that maintains cell integrity while allowing controlled transport.

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

Solution:

Plasmids are small, circular DNA molecules present in bacteria **outside the genomic DNA** (chromosomal DNA).

Characteristics:

- **Autonomous replication**: Can replicate independently of chromosomal DNA

- **Variable size**: Range from a few thousand to several hundred thousand base pairs
- **Double-stranded**: Circular, double-stranded DNA molecules
- **Not essential**: Not required for basic cellular survival

Roles in bacteria:

- **Antibiotic resistance**: Carry genes conferring resistance to antibiotics
- **Metabolic advantages**: Encode enzymes for utilizing unusual nutrients
- **Virulence factors**: Contain genes for toxin production
- **Conjugation**: Enable horizontal gene transfer between bacteria
- **Biotechnology applications**: Used as vectors for genetic engineering
- **Adaptation**: Help bacteria survive in specific environments

Significance: Plasmids are crucial tools in molecular biology and genetic engineering.

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8. What are histones? What are their functions?

Solution:

Histones are highly alkaline (basic) proteins found in the nuclei of eukaryotic cells.

Characteristics:

- **Rich in lysine and arginine**: Positively charged amino acids
- **Highly conserved**: Similar across different species
- **Small proteins**: Molecular weight around 11,000-21,000 Da
- **Five main types**: H1, H2A, H2B, H3, and H4

Functions:

1. **DNA packaging**: Package long DNA molecules into compact, organized structures
2. **Nucleosome formation**: Form the core around which DNA wraps (8 histone octamer)
3. **Gene regulation**: Control gene expression through chromatin remodeling
4. **Chromatin structure**: Maintain higher-order chromatin organization
5. **DNA protection**: Protect DNA from damage and degradation
6. **Epigenetic regulation**: Chemical modifications affect gene expression without changing DNA sequence

Significance: Essential for organizing the large amount of DNA in eukaryotic cells and regulating gene expression.