Veda International School

Kusugal Road, Hubballi

(Proposed ICSE Board)

Exercise

1, Define the following terms:

i), Cell: The smallest unit of structure and functional unit of living organisms.

ii) Vitellogenesis: Formation of yolk in the egg

iii) Cell organelle: it is a part of cell that performs specific function in the cell

iv) Nucleus: a spherical structure in cell which controls all the activities of the cell

2. Differentiate between

i) organ and organelle

Feature	Organ	Organelle
Definition	A group of tissues that work together to perform a specific function in a living organism.	A specialized structure within a cell that performs a specific function.
Level of Organization	Part of an organ system in multicellular organisms.	Part of a cell, either prokaryotic or eukaryotic.
Size	Larger, visible to the naked eye.	Microscopic, visible only under a microscope.
Composition	Made up of different types of tissues.	Made up of molecules, proteins, lipids, and sometimes membranes.
Examples	Heart, lungs, liver, kidney (in animals); roots, stems, leaves (in plants).	Nucleus, mitochondria, ribosomes, chloroplasts (in plant cells), Golgi apparatus.
Function	Supports life processes by working together with other organs.	Supports cell function by carrying out specific intracellular processes.

ii) Cell membrane and cell wall

Feature	Cell Membrane	Cell Wall
Definition	A thin, flexible barrier that surrounds the cell, controlling the movement of substances in and out.	A rigid, protective layer outside the cell membrane that provides structure and support.

Feature	Cell Membrane	Cell Wall
Composition	Made of a **phospholipid bilayer** with embedded proteins.	Made of **cellulose (plants), chitin (fungi), or peptidoglycan (bacteria).**
Flexibility	Flexible and dynamic.	Rigid and firm.
Function	Regulates transport of materials, protects the cell, and enables communication.	Provides mechanical support, protection, and shape to the cell.
Permeability	Selectively permeable, allowing controlled exchange of substances.	More permeable than the membrane, allowing many substances to pass through.
Presence in Organisms	Found in **all** cells (both prokaryotic and eukaryotic).	Found in **plants, fungi, bacteria, and some protists** (not in animal cells).
Location	The outermost layer in animal cells; inside the cell wall in plant, fungal, and bacterial cells.	External to the cell membrane in organisms that have it.

iii) Nucleus and Nucleolus

Feature	Nucleus	Nucleolus
Definition	A large, membrane-bound organelle that contains genetic material (DNA) and controls cell activities.	A dense, spherical structure inside the nucleus responsible for ribosome production.
Presence	Found in **eukaryotic cells** only.	Found inside the nucleus of eukaryotic cells.
Structure	Surrounded by a **nuclear envelope** with pores, containing chromatin (DNA + proteins) and the nucleolus.	A **dense, dark-staining** region inside the nucleus, without a membrane.
Function	Controls cell activities, stores genetic information, and regulates gene expression.	Produces and assembles ribosomal RNA (rRNA) and ribosome subunits.
Components	Contains chromatin (DNA), nucleoplasm, nucleolus, and nuclear membrane.	Rich in RNA, proteins, and ribosome precursors.

iv) Leucoplast and chloroplast

Feature	Leucoplast	Chloroplast
Function	Stores nutrients like starch, lipids, and proteins	Conducts photosynthesis by converting sunlight into energy
Color	Colorless (due to lack of pigments)	Green (due to chlorophyll)

Feature	Leucoplast	Chloroplast
Pigments	Absent	Contains chlorophyll and other pigments (carotenoids)
Location	Found in non-photosynthetic tissues (e.g., roots, tubers, seeds)	Found in green parts of plants (e.g., leaves, stems)
Types	Amyloplast (stores starch), Elaioplast (stores lipids), Proteinoplast (stores proteins)	No subtypes; all chloroplasts function in photosynthesis
Role in Metabolism	Stores and synthesizes essential compounds	Produces glucose and oxygen via photosynthesis
Internal Structure	Simple internal structure without thylakoids	Contains thylakoids, grana, and stroma for photosynthesis

v) protoplasm and cytoplasm

Feature	Protoplasm	Cytoplasm
Definition	The entire living content of a cell, including the cytoplasm and nucleus	The fluid content inside the cell membrane, excluding the nucleus
Components	Includes cytoplasm, nucleus, and organelles	Includes cytosol, organelles (except the nucleus), and inclusions
Presence	Found in all living cells	Found only in the cell's interior (outside the nucleus)
Function	Responsible for all life processes in the cell	Provides a medium for organelle movement and biochemical reactions
Location	Inside the cell membrane	Between the cell membrane and nucleus

3. List various parts of cell which are seen when studied under electron microscope

1. Cell Surface Structures

- **Plasma membrane** – The outer boundary of the cell, appearing as a bilayer.
- **Cell wall (in plants, bacteria, fungi)** – A rigid structure outside the plasma membrane.
- **Cilia and flagella** – Hair-like structures involved in movement.

2. Cytoplasmic Components

- **Cytoskeleton** – Includes **microtubules, microfilaments, and intermediate filaments**, which provide support and shape.
- **Ribosomes** – Small protein-synthesizing structures (both free and attached to rough ER).

3. Membranous Organelles

- **Endoplasmic Reticulum (ER)**
- **Rough ER (RER)** – Studded with ribosomes; involved in protein synthesis.
- **Smooth ER (SER)** – Lacks ribosomes; involved in lipid synthesis and detoxification.
- **Golgi apparatus** – Stacks of membrane-bound sacs for protein modification and packaging.
- **Mitochondria** – Double-membraned structures with internal folds (cristae) for energy production.
- **Lysosomes** – Contain digestive enzymes to break down cellular waste.
- **Peroxisomes** – Involved in breaking down fatty acids and detoxification.

4. Nuclear Structures

- **Nuclear membrane** – A double membrane surrounding the nucleus with nuclear pores.
- **Chromatin** – DNA and protein complex visible as a dense network.
- **Nucleolus** – A dense region inside the nucleus involved in ribosome production.

5. Special Organelles (in Plant Cells)

- **Chloroplasts** – Contain thylakoids and grana for photosynthesis.
- **Plasmodesmata** – Channels between plant cells for communication.

4. Tabulate difference between animal cell and plant cell

Feature	Animal Cell	Plant Cell
Cell Wall	Absent	Present (made of cellulose)
Shape	Usually round or irregular	Usually rectangular or rigid
Chloroplasts	Absent	Present (for photosynthesis)
Vacuole	Small and temporary (if present)	Large central vacuole
Plastids	Absent	Present (e.g., chloroplasts, leucoplasts)
Centrioles	Present	Absent in most plant cells
Lysosomes	Present	Rare or absent
Energy Storage	Glycogen	Starch
Mode of Nutrition	Heterotrophic (consumes food)	Autotrophic (produces food via photosynthesis)
Cytokinesis	Cleavage furrow formation	Cell plate formation

5. 'A cell without nucleus is with no future', comment

While some cells can survive temporarily without a nucleus, they generally cannot sustain themselves long-term. Thus, the statement is mostly accurate, emphasizing the nucleus's role in ensuring a cell's functionality and future.

6. Justify the statement that " mitochondria are power house of a cell"

Ans: Mitochondria are called the **"powerhouse of the cell"** because they are the primary site of **cellular respiration** and **energy (ATP) production**. Here's why this statement is justified:

1. **ATP Production** – Mitochondria generate **adenosine triphosphate (ATP)**, the energy currency of the cell, through a process called **oxidative phosphorylation**. ATP is essential for various cellular activities.
2. **Cellular Respiration** – Mitochondria break down glucose and oxygen through **aerobic respiration**, producing energy in the form of ATP
3. **Self-Sufficiency** – Mitochondria have their own **DNA and ribosomes**, enabling them to produce some of their own proteins required for energy generation.

Since mitochondria generate and supply energy crucial for cellular activities, they are rightly termed the **"powerhouse of the cell."**

7. Give three importants functions of each of the following ER, Lysosomes, golgi bodies, plastids, nucleus, mitochondria

Endoplasmic Reticulum (ER)

1. **Protein Synthesis (Rough ER)** – Provides a site for ribosomes to synthesize proteins.
2. **Lipid Synthesis (Smooth ER)** – Produces lipids, including phospholipids and steroids.
3. **Transport of Materials** – Acts as a transport system for proteins and other molecules within the cell.

Lysosomes

1. **Digestion of Cellular Waste** – Breaks down worn-out organelles, food particles, and foreign invaders.
2. **Autophagy** – Helps recycle cellular components through self-digestion.
3. **Defense Mechanism** – Destroys harmful pathogens that enter the cell.

Golgi Bodies (Golgi Apparatus)

1. **Modification of Proteins** – Modifies, processes, and folds proteins received from the ER.
2. **Packaging and Transport** – Packages proteins and lipids into vesicles for transport.
3. **Production of Lysosomes** – Helps in the formation of lysosomes.

Plastids (in plant cells)

1. **Photosynthesis (Chloroplasts)** – Convert sunlight into energy (glucose) through photosynthesis.
2. **Storage of Starch (Leucoplasts)** – Store starch, oils, and proteins.
3. **Pigment Synthesis (Chromoplasts)** – Contain pigments that give color to fruits and flowers.

Nucleus

1. **Genetic Information Storage** – Houses DNA, which carries genetic instructions.

2. **Control Center** – Regulates all cellular activities, including growth and metabolism.
3. **RNA Synthesis** – Produces RNA for protein synthesis.

Mitochondria

1. **ATP Production** – Generates energy (ATP) through cellular respiration.
2. **Regulation of Cell Metabolism** – Helps in the metabolism of carbohydrates and fats.
3. **Cell Death Regulation** – Plays a role in apoptosis (programmed cell death).

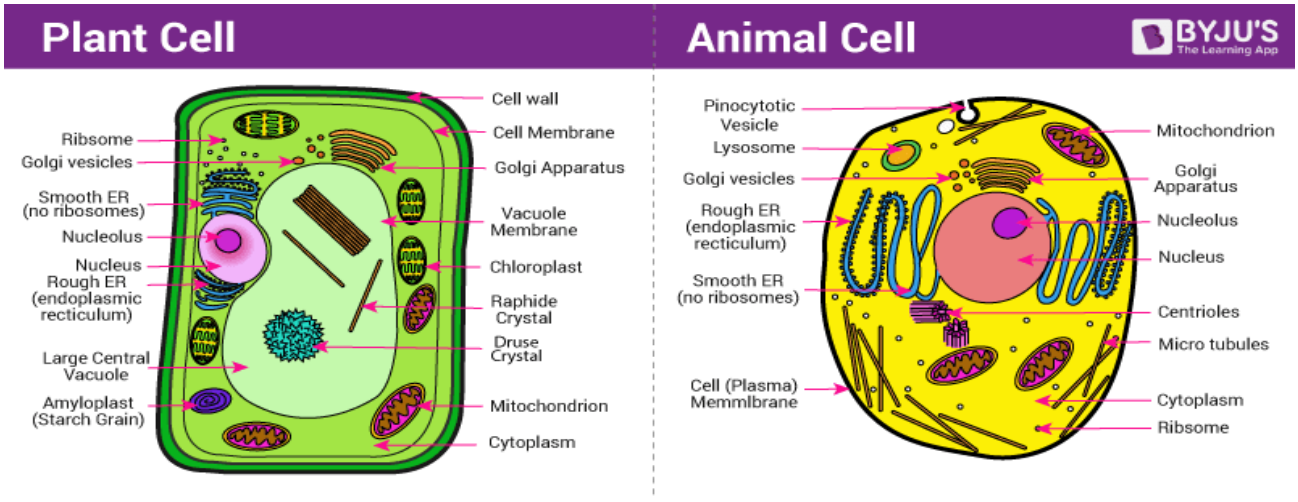
8.Cell organelles associated with the given functions:

1. Liberation of energy → Mitochondria (site of ATP production through cellular respiration)
2. Cytoskeleton → Microtubules, Microfilaments, Intermediate filaments (provide structural support and shape to the cell)
3. Protein synthesis → Ribosomes (synthesize proteins), Rough Endoplasmic Reticulum (RER) (modifies and transports proteins)
4. Photosynthesis → Chloroplasts (convert solar energy into chemical energy in plant cells)
5. Vitellogenesis (yolk formation) → Golgi apparatus (modifies, packages, and secretes proteins and lipids, including yolk in egg cells)
6. Formation of cell wall → Golgi apparatus (Dictyosomes in plants) (synthesizes and secretes polysaccharides for cell wall formation)
7. Intracellular digestion → Lysosomes (contain hydrolytic enzymes to break down waste and foreign substances)
8. Formation of other organelles → Endoplasmic Reticulum (ER) and Golgi apparatus (help in membrane synthesis and vesicle formation, which contribute to the development of other organelles)

9. Give one word for each of yhe following

1. Organelle – Part of a cell performing a specific function.
2. Tissue – A group of cells performing a specific function.
3. Nucleus – Controlling center of a cell.
4. Mitochondria – Powerhouse of a cell
5. Lysosome – Suicide bag of a cell.
6. Vacuole – Fluid-filled membrane-bound spaces in the cell.
7. Ribosome – Protein factories of a cell.

10. Draw a labelled diagram of plant cell and animal cell



11. Tabulate the difference between prokaryotic cell and eukaryotic cell.

Feature	**Prokaryotic Cell**	**Eukaryotic Cell**
Nucleus	Absent (nucleoid region present)	Present (membrane-bound nucleus)
Size	Small (0.1–5 µm)	Larger (10–100 µm)
Cell Type	Unicellular	Unicellular or multicellular
Membrane-bound Organelles	Absent	Present (e.g., mitochondria, ER, Golgi)
Genetic Material	Circular, single-stranded DNA	Linear, multiple chromosomes with histones
Cell Division	Binary fission	Mitosis and meiosis
Ribosomes	70S (smaller)	80S (larger)
Cell Wall	Present (peptidoglycan in bacteria)	Present in plants and fungi (cellulose or chitin)
Examples	Bacteria, Archaea	Animals, Plants, Fungi, Protists

12. Explain briefly
i) The ultimate chemical nature of protoplasm cannot be determined

Ans: The ultimate chemical nature of protoplasm cannot be determined because it is a highly complex and dynamic mixture of biomolecules, including proteins, lipids, carbohydrates, nucleic acids, and various inorganic compounds. Its composition varies depending on the type of cell, its function, and environmental conditions. Additionally, protoplasm is in a constant state of metabolic activity, making it difficult to isolate and analyze without altering its properties. These factors make it impossible to define a single, fixed chemical formula for protoplasm.

ii) Plant cell contain fewer mitochondria

Plant cells contain fewer mitochondria compared to animal cells because they primarily generate energy through **photosynthesis** in chloroplasts. During daylight, chloroplasts produce ATP and glucose, reducing the need for mitochondria to generate ATP through cellular respiration. However, mitochondria are still present in plant cells to produce energy, especially in non-photosynthetic tissues (e.g., roots) and during the night when photosynthesis is not active.

iii) When cut pieces of beet root are boiled in water, the water turns red but when the pieces of carrot are boiled the water remains colourless

The difference in color change when boiling beetroot and carrot in water is due to the presence and properties of pigments in these vegetables:

1. **Beetroot** contains a pigment called **betalain**, which is water-soluble. When beetroot pieces are boiled, the heat damages the cell membranes, allowing the red pigment to leak out into the water, turning it red.

2. **Carrots** contain **carotenoids**, which are fat-soluble pigments rather than water-soluble. Since carotenoids do not dissolve in water, boiling carrot pieces does not cause the water to change color, keeping it clear.

Thus, the solubility of the pigments in water determines whether or not the boiling water changes color.

13. Describe the structure of mitochondrion.

Ans: The mitochondrion has a **double-membrane structure**:

1. **Outer membrane** – A smooth layer that encloses the organelle and contains pores for molecule exchange.
2. **Inner membrane** – Highly folded into **cristae**, which increase the surface area for ATP production.
3. **Intermembrane space** – The region between the inner and outer membranes, important for proton accumulation in ATP synthesis.
4. **Matrix** – The innermost space containing enzymes, mitochondrial DNA, and ribosomes, where the Krebs cycle occurs.

This structure allows mitochondria to efficiently produce energy (ATP) through cellular respiration.

14. Why protoplasm cannot be analysed chemically?

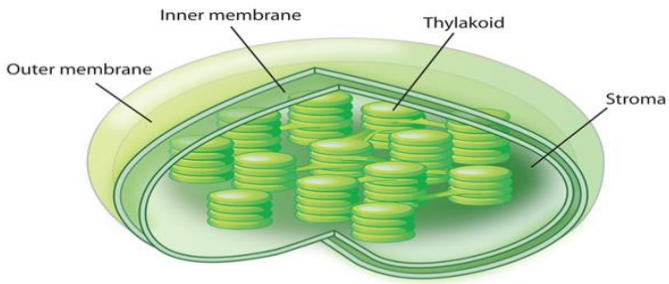
Ans: Protoplasm cannot be easily analyzed chemically due to its complex and dynamic nature. It is a highly organized mixture of various organic and inorganic substances, including proteins, lipids, nucleic acids, carbohydrates, and ions, all of which are constantly interacting. These components are in a fluid, gel-like state, making it difficult to isolate or study them separately without disrupting the overall function.

Additionally, protoplasm's composition varies from cell to cell and can change depending on the cell's metabolic state, which complicates chemical analysis. Moreover, the protoplasm includes many enzymes and organelles that are involved in continuous biochemical reactions, which makes it challenging to pinpoint specific chemical interactions without altering the structure or function of the cell.

15. Why are cells generally of a small sized?

Ans: Cells are generally small in size to maintain efficient exchange of materials (like oxygen, nutrients, and waste) across their membrane. As cells get larger, the surface area-to-volume ratio decreases, meaning there’s less membrane area available for these exchanges relative to the cell's volume. Smaller cells have a higher surface area relative to their volume, making it easier to transport materials in and out quickly. This helps maintain proper cellular function and survival.

16. Draw a neat labelled diagram of chloroplast



i), Function of stroma and thylakoid
Ans: The stroma is the fluid-filled space inside the chloroplast that surrounds the thylakoids. It plays a crucial role in photosynthesis by:
1. Calvin Cycle (Light-Independent Reactions) – The stroma contains enzymes required for the Calvin cycle, where carbon dioxide is fixed into glucose using ATP and NADPH.
2. Storage of Enzymes and Molecules – It stores enzymes, sugars, starch, and other molecules needed for photosynthesis.
3. Synthesis of Organic Molecules – The stroma helps in the synthesis of fatty acids, amino acids, and other organic compounds.
4. DNA and Ribosome Containment – Chloroplast DNA and ribosomes in the stroma help in protein synthesis necessary for chloroplast function.

In a chloroplast, the **thylakoid** has several key functions related to photosynthesis:

1. **Light Absorption**: Thylakoid membranes contain chlorophyll, which absorbs sunlight, the primary energy source for photosynthesis.
2. **Production of ATP and NADPH**: During the light-dependent reactions, light energy is used to produce ATP and NADPH, which are energy carriers for the next phase of photosynthesis.
3. **Oxygen Release**: The splitting of water molecules in the thylakoid space (photolysis) releases oxygen as a byproduct.
4. **Proton Gradient Formation**: The thylakoid membranes help create a proton gradient, essential for ATP production via chemiosmosis.

ii) Photosynthetic Pigments Present in Chloroplast:
The key pigments responsible for capturing light energy are:
1. Chlorophyll a – Primary pigment involved in photosynthesis.
2. Chlorophyll b – Accessory pigment that helps in light absorption.
3. Carotenoids (Carotenes & Xanthophylls) – Help in light absorption and provide photoprotection.
4. Phycobilins (found in cyanobacteria and red algae, but not in higher plants).
These pigments are primarily found in the thylakoid membranes rather than the stroma, but the products of their activity (ATP and NADPH) are utilized in the stroma for the Calvin cycle.

iii) Is Chloroplast Present in Animal Cells?

No, chloroplasts are not present in animal cells. Chloroplasts are unique to plant cells and some protists, where they carry out photosynthesis. Animal cells lack chloroplasts because they do not perform photosynthesis and obtain energy from consumed food instead.

iv) Name Two Other Types of Plastids:
Apart from chloroplasts, the two other major types of plastids are:
1. Leucoplasts – Colorless plastids primarily involved in storage.
Types of Leucoplasts:
Amyloplasts – Store starch.
Elaioplasts – Store lipids.
Proteinoplasts – Store proteins.
2. Chromoplasts – Colored plastids responsible for pigment synthesis and storage.
Contain carotenoids (yellow, orange, or red pigments), found in fruits, flowers, and aging leaves.

17. Name the following
1. Kitchen of the cell – Chloroplast
2. Structure that surrounds centrioles – Pericentriolar material
3. Part of the cell which helps in the formation of the acrosome of human sperm – Golgi apparatus
4. Two animals having 19 pairs of chromosomes – Horse (Equus ferus caballus) and Indian Muntjac (Muntiacus muntjak vaginalis)
5. Photosynthetically active plastid having brown-colored pigments – Phaeoplast (found in brown algae)
6. The type of leucoplast that stores starch – Amyloplast

18. Fill in the blanks
1. Cell is the smallest unit of structure and function.
2. The first microscope was constructed by Zacharias Janssen.
3. Name "cell" was given by Robert Hooke.
4. Schleiden and Schwann postulated the cell theory.
5. Vacuoles are bounded by a membrane called tonoplast.
6. Cyclosis are the streaming movements of cell cytoplasm.

19. Given below are figures of three cell organelle identidy these organelles and write their function
a) Rough endoplasmic reticulum- Primary function is protein synthesis and processing
b) Nucleus: primary function is control centre of the cell which controls functions of all cell organelles
c) Mitochondrion: Primary function is to produces ATP(adenosine triphosphate) for the body.

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20. Who put forward the cell theory? what are its silent features?

Ans: The **Cell Theory** was put forward by **Matthias Schleiden** (a German botanist) and **Theodor Schwann** (a German zoologist) in **1839**. Later, **Rudolf Virchow** (1855) expanded the theory by stating that all cells arise from pre-existing cells.

Salient Features of Cell Theory:

1. **All living organisms are composed of one or more cells.**
    - Cells are the basic units of structure and function in all organisms.
2. **The cell is the basic unit of life.**
    - It is the smallest unit capable of performing all life processes.
3. **All cells arise from pre-existing cells.**
    - This was added by **Rudolf Virchow** in 1855 as **"Omnis cellula e cellula"**, meaning new cells originate only from existing cells.
4. **Cells contain hereditary material.**
    - Genetic information (DNA/RNA) is passed from one generation to another.
5. **All metabolic activities occur within cells.**
    - Essential life processes like respiration, protein synthesis, and energy production take place inside cells.

21. What is the contribution of following scientists?

- **Thomas Huxley**
    - Proposed that **protoplasm** is the physical basis of life, highlighting its importance in cellular function.
- **Jan Evangelista Purkinje**
    - Coined the term **"protoplasm"** in 1839 to describe the jelly-like substance inside cells, which is now known as the cytoplasm.
- **Antonie van Leeuwenhoek**
    - First to observe **living cells** (bacteria, protozoa, sperm cells, and red blood cells) using a simple microscope.
    - His discoveries laid the foundation for **cell theory**.
- **Max Knoll & Ernst Ruska**
    - Invented the **electron microscope**, which enabled scientists to study cell structures like organelles (mitochondria, ribosomes) in much greater detail.