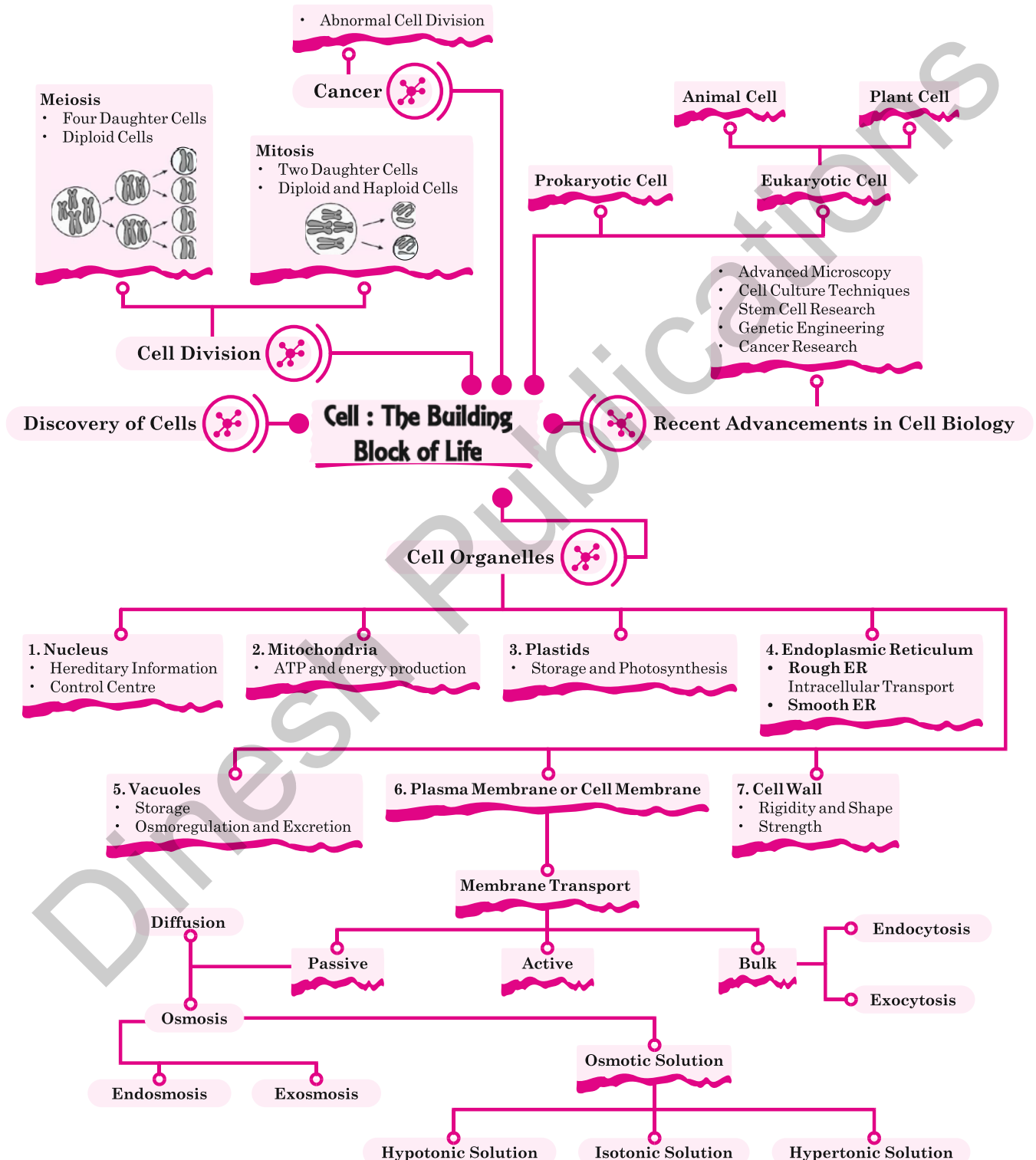


Memory Map

2. Cell : The Building Block of Life



Cell : The Building Block of Life

2



Introduction

All living organisms are made of cells, the basic unit of life. Some are unicellular, while others are multicellular. Cells form tissues, tissues form organs, and organs form organ systems. Despite this complexity, the cell remains the fundamental unit of structure and function in all living organisms.



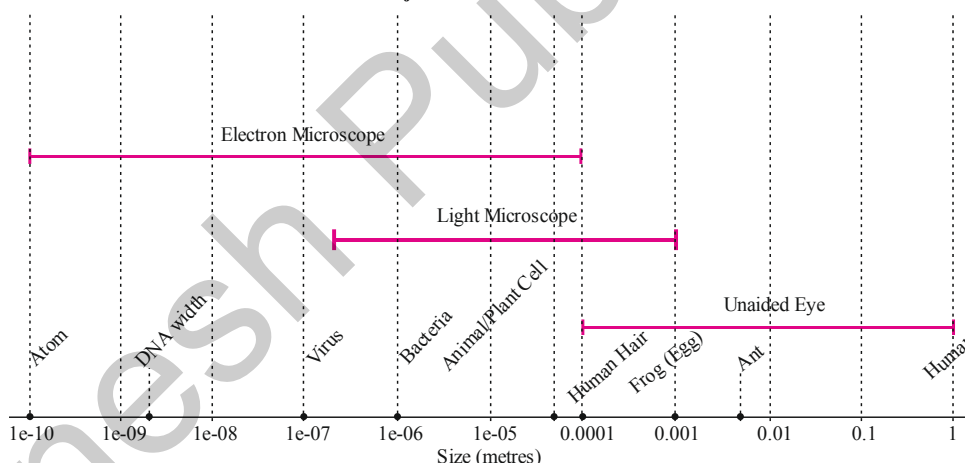
2.1 How to Study Cells?

[NCERT Pg No 9-11]

The human eye can distinguish two close objects only if they are at least 0.1 mm apart. This is called the limit of resolution. Since cells are much smaller than this, they cannot be seen with the naked eye.

To study cells, scientists use a microscope. A microscope uses lenses, such as an objective lens and an eyepiece, to magnify tiny objects and make them visible.

Scale of Objects : From Atoms to Humans



Here is the exact rewritten content from your image :

Microscopes

To study cells, scientists use microscopes :

- **Light Microscope :**

Uses visible light and lenses to magnify objects. It is commonly used in school laboratories. It can magnify objects upto several hundred times.

- **Electron Microscope :**

Uses a beam of electrons instead of light.

It provides much higher magnification and resolution, allowing scientists to observe very fine details of the cell structure.

Microscopes have improved over time in terms of :

- **Magnification** (how large the image appears).
- **Resolution** (clarity of the image).
- **Contrast** (difference between parts of the image).

Thus, microscopes are essential tools for understanding the structure and function of cells.



A microscope magnifies objects using lenses. If both the eyepiece and objective lens are 10X, the total magnification is 100X. This means that, the cell appears 100 times larger than its actual size.

Microscopes help us to study very small structures by improving clarity, contrast, and magnification.

$$\text{Estimated size of the onion peel cell} = \frac{\text{Diameter of the visible field in micrometer}}{\text{Number of cells along the diameter}}$$

An **electron microscope** is a powerful instrument used by scientists to study the detailed structure of cells. Unlike light microscopes, which use a light to form images, electron microscopes use a beam of electrons.

Because electrons have much shorter wavelengths than light, these microscopes can produce images with very high magnification and clarity. This allows scientists to observe extremely small structures inside cells at the **nanometre scale** (a nanometre is one-billionth of a metre).

Thus, electron microscopes help us to see the fine details of cell structures that cannot be seen with ordinary light microscopes.

2.2 Structure of a Cell

[NCERT Pg No 11-14]

The cell is the basic structural and functional unit of life. Every living organism is made up of cells. A cell performs all vital activities necessary for survival.

Basic Components of a Cell

A typical cell consists of :

1. **Cell membrane** – outer boundary
2. **Cytoplasm** – inner fluid
3. **Nucleus** – control centre

These parts work together to ensure proper functioning of the cell.

2.2.1 Cell Membrane : The Universal Feature of a Cell

The **cell membrane**, also called the **plasma membrane**, is a thin layer that surrounds the cell.

Functions :

- Protects the cell.
- Maintains its shape.
- Controls the entry and exit of substances.

The cell membrane is selectively permeable, which means :

- It allows certain substances to pass through.
- It restricts others.

Structure :

- Made up of lipids and proteins.
- Arranged in a fluid mosaic pattern.
- Flexible and dynamic in nature.

Transport Processes :

Diffusion

Movement of the particles from higher concentration to the lower concentration.

Osmosis

Movement of water across a selectively permeable membrane from a region of higher water concentration to the lower water concentration.

Example :

- Potato swells in water (water enters cell).
- Potato shrinks in salt solution (water leaves cell).



What If

Q. What if mung bean seeds are kept in a concentrated solution after soaking in water for 12 hours ? What will happen to them ?

[NCERT Pg No 12]

Ans. The seeds will shrink (become flaccid). When soaked in water for 12 hours, the seeds swell due to absorbing water (endosmosis). When these swollen seeds are transferred to a highly concentrated (hypertonic) solution, the concentration of water is higher inside the seed than outside. Because of osmosis, water will naturally move from the inside of the seed out into the concentrated solution. This outward movement of water is called exosmosis, and it causes the seeds to lose water and shrink.

Ever Wonder If

A cell is placed in solutions of the different concentrations ?

- **Isotonic solution :**

The solute concentration inside and outside the cell is equal.

→ No net movement of water; the cell remains unchanged.

- **Hypotonic solution :**

The outside solution has lower solute concentration than inside the cell.

→ Water enters the cell; the cell swells.

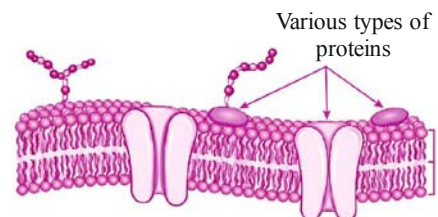
- **Hypertonic solution :**

The outside solution has higher solute concentration than inside the cell.

→ Water leaves the cell; the cell shrinks.

The cell membrane is extremely thin (7-10 nm) and it is made of lipids and proteins. Its structure is explained by the fluid mosaic model.

- It consists of a lipid bilayer with water-attracting heads outward and water-repelling tails inward.
- The molecules can move freely, making the membrane fluid.
- Proteins are embedded in the membrane and act as gatekeepers, controlling the movement of substances.
- The arrangement of the molecules gives it a mosaic-like appearance.



Cells communicate with their surroundings through the cell membrane. In plants, fungi, and bacteria, an extra outer layer called the **cell wall** provides protection, support, and maintains shape.

2.2.2 Cell Wall : The Outer Covering of Cells

Plant cells have an extra outer layer is called the **cell wall**, which provides strength, protection, and support. It helps plants maintain shape and stay upright.

- The cell wall is rigid but permeable, allowing water and minerals to pass through.
- It works alongwith the cell membrane to help roots absorb water and nutrients.

Osmosis Effect :

- In a concentrated sugar solution, plant cells lose water, but do not shrink in size because the rigid cell wall maintains their shape.
- The inner contents shrink and pull away from the cell wall (plasmolysis).

Animal Cells :

- Animal cells (like cheek cells) do not have a cell wall.
- When placed in a concentrated solution, they shrink due to water loss.

Composition :

- The plant cell wall is mainly made of cellulose, a carbohydrate that also acts as roughage in our diet.
- Some microorganisms like fungi and bacteria also have a cell wall for protection.



Pause and Ponder

1. What argument would you give for the necessity of a cell wall in plants usually fixed in one place versus in animals usually moving from one place to the other ? [NCERT Pg No 14]

Ans. Because plants are rooted in one place, they cannot move to seek shelter from harsh environmental changes like high winds, heavy rain, or temperature extremes. The rigid cell wall provides them with the necessary structural support, shape, and physical protection to withstand these external stresses. Animals, however, can move to avoid danger and find shelter. Furthermore, animal cells need to be flexible to allow for muscle contraction and bodily movement, which a rigid cell wall would prevent.

2. What consequences would you predict for a plant cell if its cell wall were to become as flexible as a cell membrane ? [NCERT Pg No 14]

Ans. Loss of Structural Integrity: Plants rely on the rigidity of their cell walls to stand upright. If the walls became flexible, the plant would lose its structural support and immediately wilt.

Risk of Bursting (Lysis) : Plant cells frequently absorb water to remain firm (turgid). The rigid cell wall provides back-pressure to prevent the cell from expanding too much. If the wall were flexible, a plant cell taking in too much water would simply expand until it bursts.

3. Why is it important to cut the two potato pieces in roughly equal size and measure their initial weight before placing them in different liquids ? [NCERT Pg No 14]

Ans. Equal Size : Cutting them to the same size ensures they have a similar surface area. This guarantees a “fair test,” so the rate of osmosis is comparable between the two samples.

Initial Weight : Measuring the starting weight establishes a baseline. To calculate the exact amount of water the potato gained or lost during the experiment, you must subtract the initial weight from the final weight. Without the starting weight, the results cannot be quantified.



Practice Questions



Very Short Answer Type Questions

1. Where do new cells come from?

Ans. New cells come from the pre-existing cells through the cell division.

2. What is the basic unit of life ?

Ans. The cell.

3. What is the limit of resolution of the human eye ?

Ans. 0.1 mm.

4. What is a unicellular organism ?

Ans. An organism made of a single cell.

5. What is the cell membrane also called ?

Ans. Plasma membrane.



Short Answer Type Questions

6. Why can't cells be seen with the naked eye ?

Ans. Cells cannot be seen with the naked eye because they are extremely small in size. Most cells are much smaller than 0.1 mm, which is the resolving limit of the human eye. Therefore, they can only be observed with the help of a microscope.

7. How do microscopes help in studying cells ?

Ans. Microscopes help in studying cells by magnifying very small objects so that they become visible to the human eye. They increase the magnification and resolution, enabling us to observe the structure and details of cells and their organelles clearly.

8. What is selective permeability ?

Ans. Selective permeability is the property of the cell membrane by which it allows certain substances to pass through it while preventing the passage of others.

9. Differentiate between the diffusion and osmosis.

Ans. Diffusion : It is the movement of particles from a region of higher concentration to a region of lower concentration.

Osmosis : It is the movement of water molecules through a selectively permeable membrane from a region of higher water concentration to a region of lower water concentration.

10. What happens to a potato piece in salt solution ? Why ?

Ans. When a potato piece is placed in a salt solution, it **shrinks**. This is because water moves out of the potato cells into the surrounding solution through the process of **osmosis**, as the salt solution has a higher concentration.



Long Answer Type Questions

11. Why is the cell called the structural and functional unit of life ?

Ans. The cell is called the structural and functional unit of life because it forms the basic building block of



all living organisms and performs all the essential functions required for life.

All living organisms, whether unicellular or multicellular, are made up of cells. In multicellular organisms, cells combine to form tissues, tissues form organs, and organs form organ systems. Thus, cells provide the structural organization of the body.

In addition to structure, cells also perform various vital life processes. All metabolic activities such as respiration, digestion, excretion, growth, and reproduction take place within the cell. Even in unicellular organisms like Amoeba, a single cell carries out all life functions.

Each cell contains specialized structures called organelles, which perform specific functions necessary for the survival of the organism. Therefore, the cell is considered the smallest unit capable of carrying out all activities of life.

Hence, since the cell forms the structure of organisms and carries out all essential functions, it is rightly called the structural and functional unit of life.

12. Explain the structure and functions of the cell membrane.

Ans. The cell membrane, also known as the plasma membrane, is a thin, flexible, and selectively permeable membrane that surrounds the cell and separates its contents from the external environment.

Structure :

The cell membrane is mainly composed of lipids (phospholipids) and proteins. These components are arranged in a special pattern known as the fluid mosaic model. In this model, the lipid molecules form a bilayer, while proteins are embedded within it. This arrangement makes the membrane flexible and dynamic in nature.

The membrane has very small pores that allow certain substances to pass through it. Due to its structure, the membrane shows the property of selective permeability.

Functions :

- 1. Protection :** It encloses and protects the internal contents of the cell from the external environment.
- 2. Shape and support :** It helps in maintaining the shape and integrity of the cell.

3. Selective permeability : It controls the movement of substances into and out of the cell, allowing only specific molecules to pass.

4. Exchange of materials : It facilitates the intake of nutrients and the removal of waste products.

5. Cell communication : It helps the cell interact with its surroundings and other cells.

Thus, the cell membrane plays a vital role in maintaining the internal balance of the cell and ensuring its proper functioning.

13. Explain the role of microscopes in cell study.

Ans. Microscopes play a very important role in the study of cells because most cells are too small to be seen with the naked eye. They help in observing and studying the detailed structure of cells and their components.

Microscopes work by magnifying small objects and increasing their visibility. They also improve the resolution, which helps in distinguishing fine details clearly.

Types of Microscopes :

- 1. Light Microscope :** This microscope uses visible light to illuminate the specimen. It provides moderate magnification and allows us to observe the general structure of cells, such as the nucleus, cytoplasm, and cell membrane. It is commonly used in schools and laboratories.
- 2. Electron Microscope :** This microscope uses a beam of electrons instead of light. It provides very high magnification and resolution, allowing scientists to observe very small structures inside the cell, such as mitochondria, ribosomes, and other organelles.

Importance :

Microscopes have made it possible to :

- Discover cells and their internal structures.
- Study the differences between plant and animal cells.
- Understand cell functions and processes.
- Advance research in biology and medicine.

Thus, microscopes are essential tools that have greatly contributed to the development of modern biology by enabling the detailed study of cells.



Numerical / Application Type Question

- 14. If the diameter of the field of view is 5000 μm and 25 cells are seen. Find the size of one cell.**

Ans. Size of one cell = $5000 \div 25 = 200 \mu\text{m}$

2.3 The Cell Interior : A Coordinated Working System

[NCERT Pg No 14]

Most cells have three main parts :

- **Cell membrane** – selectively permeable outer boundary.
- **Cytoplasm** – semi-fluid, jelly-like substance.
- **Nucleus** – control centre of the cell.

The cytoplasm contains small structures called **organelles**, which perform specific functions (mostly visible under an electron microscope).

**Types of Cells :****Prokaryotic cells (e.g., bacteria) :**

- No well-defined nucleus.
- No membrane-bound organelles.
- Cell activities occur in the cytoplasm.

Eukaryotic cells (e.g., plant and animal cells) :

- Well-defined nucleus.
- Presence of membrane-bound organelles.
- More complex structure and functions.

Table 2.1 : Comparison of Different Types of Cells Based on Structure

S. No.	Cell Structure	Bacterial Cell	Plant Cell	Animal Cell
1	Cell membrane	Present	Present	Present
2	Cell wall	Present	Present	Absent
3	Cytoplasm	Present	Present	Present
4	Well-defined nucleus (membrane-bound)	Absent	Present	Present
5	Primitive nucleus (nucleoid)	Present	Absent	Absent
6	Membrane-bound organelles	Absent	Present	Present

Table 2.2 : Comparison Between Prokaryotic and Eukaryotic Cells

Characteristic	Prokaryotic Cell	Eukaryotic Cell
Primitive nucleus	Present	Absent
Cell size	1-10 μm	10-100 μm
Number of cells in organism	Usually unicellular	Unicellular or multicellular
Membrane-bound organelles	Absent	Present
Membrane-bound nucleus	Absent	Present

Additional Note (Curiosity)

- Viruses, viroids, and prions are a cellular (non-cellular) infectious agents.
- Viruses contain genetic material enclosed in a protein coat.
- Viroids consist only of the genetic material without a protein coat.
- Prions are infectious proteins and do not contain genetic material.
- In eukaryotic cells, a network of fine fibres called the cytoskeleton provides support, maintains cell shape, and helps in movement and internal transport. It can be seen only under an electron microscope.
- The cytoplasm may also contain stored materials like starch (in plant cells) and crystals of calcium oxalate or silica. These stored substances are called cell inclusions.

2.3.1 Why do Eukaryotic Cells need these Organelles ?

[NCERT Pg No 16]

Cells contain specialised structures called organelles, each performing a specific function.

1. Nucleus – Control Centre

- Controls all cell activities
- Contains DNA and chromosomes
- Responsible for inheritance

Chromosomes contain genetic material (DNA), which carries information from parents to offspring.

Curiosity Corner

Some cells are specialised for specific functions. For example, mature red blood cells (RBCs) in humans do not have a nucleus. This allows more space for haemoglobin, enabling them to carry more oxygen.

However, without a nucleus, they cannot repair or divide, so their lifespan is short—about 120 days.

Example of another cell without a nucleus :

- **Sieve tube cells** in plants (they lose their nucleus at maturity).

2. Ribosomes – Protein Factories

- Sites of protein synthesis
- Can be free or attached to ER



3. Endoplasmic Reticulum (ER) – Transport System

A network of membranes inside the cell.

Types :

- **Rough ER (RER):**

Has ribosomes → makes proteins

- **Smooth ER (SER):**

No ribosomes → makes fats and lipids

4. Golgi Apparatus – Packaging Centre

- Modifies, packages and transports substances
- Works closely with ER

5. Lysosomes – Cleaning Units

- Contain digestive enzymes
- Breakdown waste materials
- Remove damaged organelles

Curiosity Corner

Human sperm cells contain enzymes in structures like lysosomes. These enzymes help breakdown the outer layer of the egg during fertilisation, allowing the sperm to enter.

6. Mitochondria – Powerhouse of the Cell

- Produces energy through respiration
- Stores energy as ATP
- Has double membrane

7. Plastids – Special Organelles in Plants

Types :

- **Chloroplast :**
Contains chlorophyll → photosynthesis
- **Chromoplast :**
Gives colour to fruits and flowers
- **Leucoplast :**
Stores food

Note : How do flowers, fruits, and vegetables acquire varied colours ?

Flowers, fruits, and vegetables get their colours from special plastids called chromoplasts, which contain pigments other than chlorophyll. These pigments (yellow, orange or red) give bright colours that attract pollinators and animals, helping in pollination and seed dispersal.

Some plastids are colourless and are called leucoplasts. They store food materials like starch, oils, and proteins. For example, leucoplasts in potato and taro store starch.

8. Vacuole – Storage Unit

- Stores water, food and waste
- Large in plant cells
- Maintains pressure and shape



NCERT Intext Questions



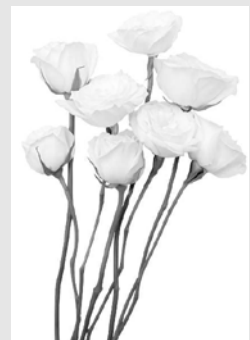
Pause and Ponder

4. Do white flowers contain any pigment? Give reasons.

[NCERT Pg No 19]

Ans. Yes, they do, but generally not the types of pigments that produce visible colour to the human eye.

First, the “white” appearance is largely structural; tiny air pockets between the petal cells reflect and scatter all visible wavelengths of sunlight, making it look white. However, white flowers often contain colourless pigments called flavonols. While invisible to humans, flavonols absorb ultraviolet (UV) light. This creates UV patterns on the petals that attract pollinating insects like bees, which can see in the UV spectrum.





5. Draw a well-labelled schematic diagram of a plant or an animal cell using these clue.

- (i) Nucleus appears as a dark and round body inside the cell.
- (ii) ER spreads like a network of extended nuclear envelope.
- (iii) Mitochondria and chloroplasts are rod shaped.

[NCERT Pg No 19]

Ans. (Instructions for drawing based on the clues: Nucleus, ER, Mitochondria and chloroplasts).

Based on clue (iii) which mentions chloroplasts, you must draw a Plant Cell, as animal cells do not contain chloroplasts.

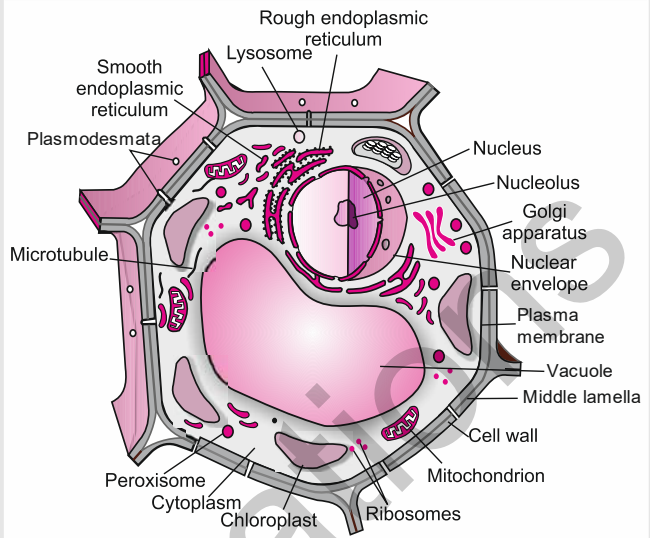
Boundaries : Draw a double outer layer. Label the thick outer layer "Cell Wall" and the inner layer "Cell Membrane."

Nucleus (Clue i) : Draw a large, dark, round body pushed slightly to the side of the cell (to make room for a central vacuole) and label it "Nucleus."

Endoplasmic Reticulum (Clue ii) : Draw a network of folded, tubular structures extending outward from the nuclear envelope and label it "Endoplasmic Reticulum."

Mitochondria and Chloroplasts (Clue iii) : Draw a few rod-shaped structures with zig-zag inner folds and label them "Mitochondria." Draw other rod-shaped structures containing little stacks of discs inside and label them "Chloroplasts."

Finishing touches : Draw a large empty sac in the centre labeled "Large Central Vacuole" and label the jelly-like substance filling the rest of the cell "Cytoplasm."



Practice Questions



Very Short Answer Type Questions

1. What are the three main parts of a cell ?

Ans. Cell membrane, cytoplasm, and nucleus.

2. What is cytoplasm ?

Ans. A jelly-like substance where cell activities occur.

3. What is a prokaryotic cell ?

Ans. A cell without a well-defined nucleus.

4. Give one example of a eukaryotic cell.

Ans. Plant cell / Animal cell.

5. What are organelles ?

Ans. Specialised structures that perform specific functions.

6. Which organelle is called the powerhouse of the cell ?

Ans. Mitochondria.

7. What is the function of ribosomes ?

Ans. Protein synthesis.

8. Which organelle controls cell activities ?

Ans. Nucleus.

9. What is ATP ?

Ans. Energy currency of the cell.

10. Name one cell without a nucleus.

Ans. Red blood cell (RBC).



Short Answer Type Questions

11. Differentiate between the prokaryotic and eukaryotic cells.

Ans.	Feature	Prokaryotic Cells	Eukaryotic Cells
	Nucleus	No well-defined nucleus	Well-defined nucleus present
	Organelles	Membrane-bound organelles absent	Membrane-bound organelles present
	Size	Small (1–10 μm)	Larger (10–100 μm)
	Complexity	Simple structure	Complex structure
	Example	Bacteria, Cyanobacteria	Plant and animal cells

12. What are the functions of the nucleus ?

Ans. The nucleus is an important organelle that performs the following functions:

- It controls all activities of the cell.
- It contains genetic material (DNA).
- It is responsible for inheritance of characters from parents to offspring.



13. Explain the function of the endoplasmic reticulum.

Ans. The endoplasmic reticulum (ER) is a network of membranes that functions as a transport system in the cell.

Rough ER (RER) : Synthesizes proteins (has ribosomes attached)

Smooth ER (SER) : Synthesizes fats and lipids
It also helps in detoxification and intracellular transport.

14. What is the role of Golgi apparatus ?

Ans. The Golgi apparatus modifies, packages, and transports substances such as proteins and lipids within the cell or outside it. It also helps in the formation of secretory vesicles.

15. What are lysosomes ? Why are they called cleaning units ?

Ans. Lysosomes are small sac-like organelles that contain digestive enzymes. They break down waste materials, foreign particles, and damaged organelles. They are called “cleaning units” because they keep the cell clean by removing unwanted substances.

16. What is the function of a mitochondria ?

Ans. Mitochondria are responsible for **producing energy** in the form of ATP through the process of respiration. This energy is used for all cellular activities.

17. Write the types and functions of plastids.

Ans. **Chloroplast :** Performs photosynthesis.
Chromoplast : Provides colour to fruits and flowers.
Leucoplast : Stores food (starch, oil, proteins).

18. What is a vacuole ?

Ans. A vacuole is a membrane-bound storage organelle that stores water, food, waste materials, and other substances. In plant cells, it is large and helps maintain turgidity.



Long Answer Type Questions

19. Explain the structure and functions of cell organelles.

Ans. A cell contains several specialized structures called cell organelles, each of which performs a specific function necessary for the proper functioning of the cell.

Nucleus : Controls all activities of the cell and contains genetic material (DNA).

Mitochondria : Produce energy in the form of ATP through respiration.

Endoplasmic Reticulum (ER) : Acts as a transport system within the cell; RER synthesizes proteins, and SER synthesizes lipids.

Golgi Apparatus : Modifies, packages, and transports proteins and lipids.

Ribosomes : Synthesize proteins and are known as the “protein factories” of the cell.

Lysosomes : Contain digestive enzymes and break down waste materials and damaged organelles.

Plastids : Found in plant cells; help in photosynthesis, storage, and colouring.

Vacuole : Stores water, food, and waste materials and helps maintain cell pressure.

Thus, each organelle performs a specific function, and together they ensure the efficient working of the cell.

20. Why do eukaryotic cells need organelles ?

Ans. Eukaryotic cells are complex and perform a large number of functions. Therefore, they require specialized structures called organelles to carry out these functions efficiently.

Each organelle performs a specific function. This is known as the division of labour within the cell. For example, mitochondria produce energy, the nucleus controls activities, and ribosomes synthesize proteins.

Due to this division of labour, different processes can occur simultaneously without interfering with each other. This increases the efficiency and coordination of cellular activities.

Hence, organelles are essential for the proper functioning, survival, and organization of eukaryotic cells.

21. Explain why RBCs do not have a nucleus.

Ans. Red Blood Cells (RBCs) do not have a nucleus in their mature form. This is because the absence of a nucleus provides more space for haemoglobin, the pigment responsible for carrying oxygen.

With more haemoglobin, RBCs can transport a larger amount of oxygen to different parts of the body. This increases their efficiency in oxygen transport.

However, due to the absence of a nucleus, RBCs cannot divide or repair themselves. As a result, they have a short lifespan of about 120 days.

Thus, the absence of a nucleus is an adaptation that helps RBCs perform their function more effectively.

22. Differentiate between the plant cell and animal cell.

Feature	Plant Cell	Animal Cell
Cell wall	Present	Absent
Plastids	Present	Absent
Vacuole	Large central vacuole	Small or absent
Shape	Usually fixed (rectangular)	Usually irregular (round/oval)

23. Explain the role of mitochondria as the powerhouse of the cell.

Ans. Mitochondria are known as the powerhouse of the cell because they produce energy required for various cellular activities.

They carry out the process of cellular respiration, in which food molecules are broken down in the presence of oxygen to release energy. This energy is stored in the form of ATP (Adenosine Triphosphate). ATP acts as an energy currency of the cell and is used for activities such as movement, growth, synthesis of substances, and active transport.

Since mitochondria supply energy for all life processes, they are rightly called the powerhouse of the cell.



2.4 How do Normal Cells Grow and Divide ?

Cells grow and divide to :

- Increase size of organism
- Repair damaged tissues
- Replace old cells

2.4.1 Cell Division

Cell division is the process by which new cells are formed.

Types of Cell Division :

(a) Mitosis

- Produces two identical daughter cells.
- Maintains same chromosome number.
- Important for growth and repair.

(b) Meiosis

- Produces four daughter cells.
- Chromosome number is halved.
- Important for reproduction.
- Creates variation among organisms.



NCERT Intext Questions

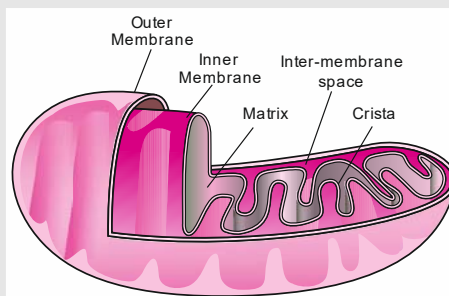


Pause and Ponder

6. Instead of many small ones, why does a cell not have a single giant mitochondrion? How does this relate to the concept of surface area ?

[NCERT Pg No 22]

Ans. This is due to the Surface Area to Volume Ratio. Mitochondria generate energy (ATP) for the cell along their inner membranes. If a cell had only one giant mitochondrion, its internal volume would be large, but its surface area relative to that volume would be quite small. By having many small mitochondria instead, the total combined surface area is drastically increased. A larger surface area provides more space for the chemical reactions of cellular respiration to occur, making energy production much faster and more efficient.

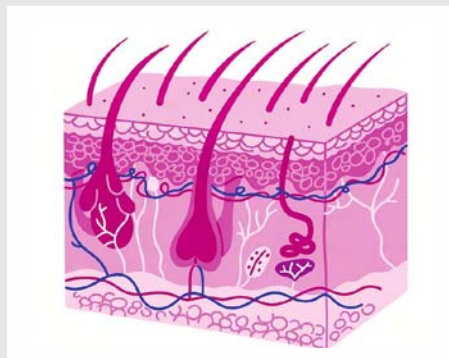


7. If the skin cells start dividing by meiosis instead of mitosis, what do you think will happen to a cut on the skin? [NCERT Pg No 22]

Ans. The cut would fail to heal properly, resulting in severe tissue damage.

Incorrect Chromosome Count : Mitosis creates identical diploid cells (46 chromosomes in humans) needed to replace damaged skin. Meiosis is designed to create sex cells, reducing the chromosome count by half (haploid, 23 chromosomes). These haploid cells cannot function as normal skin cells.

Genetic Variation : Healing requires genetically identical cells to rebuild the exact tissue that was lost. Meiosis introduces genetic variation, so the new cells would not match the surrounding tissue. Ultimately, these abnormal cells would die off, and the wound would remain open.



2.5 Cell Theory : The Unifying Principle of Biology

[NCERT Pg No 23]

Cell theory states :

1. All living organisms are made up of cells
2. Cell is the basic unit of life
3. All cells arise from pre-existing cells

This theory explains the unity and continuity of life.



2.5.1 Do Cell Grow and Reproduce Forever ?

Cells have a definite life cycle :

- Growth
- Function
- Death

Controlled Division :

Cells divide in a controlled manner.

Uncontrolled Division :

If control is lost → leads to tumors (cancer)

Special Concepts

Contact Inhibition

Cells stop dividing when they come in contact with neighbouring cells.

Totipotency (in plants)

Plant cells can develop into a complete plant under suitable conditions.



Ready to Go Beyond

1. How do cells monitor their growth to maintain a balance?

[NCERT Pg No 23]

Ans. Cells have a highly sophisticated internal and external monitoring system to ensure they only grow and divide when it is safe and necessary.

Cell Cycle Checkpoints : The life of a cell (the cell cycle) has specific “checkpoints” (primarily G_1 , G_2 , and M checkpoints). Think of these as quality control stations. The cell pauses at these stations to check if its DNA is intact, if it has enough nutrients, and if it is large enough to divide. If something is wrong, the cell stops dividing until the issue is fixed.

External Signals (Growth Factors) : Cells don't just decide to divide on their own; they rely on chemical signals (growth factors) from neighboring cells or the body. Without these “go” signals, a cell will not divide.

Contact Inhibition : Normal cells have a built-in sensor for crowding. When cells grow and touch each other, they send signals to stop dividing. This prevents them from piling up and forming tumors.

2. Explore different ways by which cells maintain themselves.

[NCERT Pg No 23]

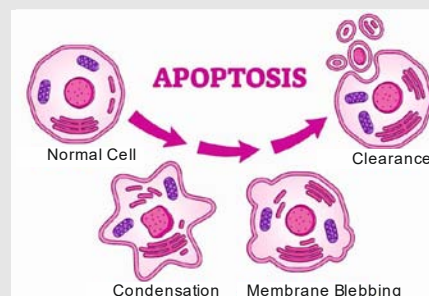
Ans. Apart from Programmed Cell Death (Apoptosis) mentioned in your book, cells use several other mechanisms to maintain their health, quality, and internal balance (homeostasis).

Autophagy (Cellular Recycling) : This literally means “self-eating.” When parts of the cell (like mitochondria or proteins) become old or damaged, the cell packages them up and breaks them down using special enzymes. The broken-down parts are, then recycled to build new cellular structures.

DNA Repair Mechanisms : Every time a cell divides, or when it is exposed to things like UV light, its DNA can get damaged. Cells have a team of special enzymes that constantly scan the DNA for errors and repair them, preventing harmful mutations.

Selective Membrane Transport : To maintain internal balance, the cell membrane strictly controls what enters and exits the cell. It actively pumps out waste products and toxins while bringing in essential nutrients, maintaining the perfect balance of water and ions.

Programmed Cell Death (Apoptosis) : If a cell is damaged beyond repair, infected by a virus or simply no longer needed (like the tissue between an embryo's fingers), it safely dismantles itself without harming surrounding cells.



Curiosity Corner

How do cancer cells grow and spread ?

Normal cells grow, age, and die in a controlled way. Sometimes this control fails, causing cells to grow and divide uncontrollably. This leads to the formation of **tumors**, which can be **benign** (non-cancerous) or **malignant** (cancerous). Cancerous tumors can invade nearby tissues and spread to other parts of the body, forming new tumors.



Real Life Connect

Cell organelles can be compared to parts of a factory, where each has a specific role. The mitochondria act as the powerhouse, generating energy like an electricity unit. Ribosomes function as production machines, making proteins. The Golgi apparatus serves as the packaging and distribution centre, while lysosomes act as waste disposal units, breaking down unwanted materials. Together, these organelles work in coordination to ensure the smooth functioning of the cell.

Key Points

- The cell forms the smallest unit that builds up the structure of organisms and carries out all essential life activities.
- Prokaryotic cells are simple in organisation. They do not possess a true nucleus; instead, their genetic material lies in a region known as the nucleoid. They also lack membrane-bound organelles.
- Eukaryotic cells are comparatively larger and more advanced. They contain a clearly defined nucleus and various specialised, membrane-bound organelles.
- Every cell is enclosed by a cell membrane. Additionally, plant, fungal, and bacterial cells have a cell wall outside the membrane, providing extra support and protection.
- In eukaryotic cells, the nucleus contains chromosomes, which are made up of DNA and proteins and are responsible for storing hereditary information.
- The interior of the cell is filled with cytoplasm, where various cellular activities take place. In eukaryotes, this region houses different organelles, each with a specific role.
- Key organelles found in cells include the nucleus, endoplasmic reticulum, mitochondria, Golgi apparatus, ribosomes, and lysosomes, all of which contribute to the functioning of the cell.
- Plant cells have additional structures called plastids, such as chloroplasts (for photosynthesis), leucoplasts (for storage), and chromoplasts (for pigments).
- During mitosis, a single cell divides to produce two identical daughter cells.
- Meiosis involves two stages of division and results in four daughter cells, each containing half the number of chromosomes of the parent cell.
- Under normal conditions, cells grow, perform their functions, and die in a regulated manner. However, cancer cells lose this control and divide continuously, leading to the formation of abnormal masses known as tumours.

Practice Questions



Very Short Answer Type Questions

1. What is cell theory ?

Ans. It states that all living organisms are made of cells, and cells arise from pre-existing cells.

2. Who proposed that all cells come from pre-existing cells ?

Ans. Rudolf Virchow.

3. What is the basic unit of life ?

Ans. The cell.

4. What is contact inhibition ?

Ans. Cells stop dividing when they touch neighbouring cells.

5. What is totipotency ?

Ans. The ability of plant cells to form a complete plant.



Short Answer Type Questions

6. State the three main points of a cell theory.

Ans. The three main points of cell theory are:

- All living organisms are composed of one or more cells.

- The cell is the basic structural and functional unit of life.
- All cells arise from pre-existing cells.

7. Explain the life cycle of a cell.

Ans. The life cycle of a cell consists of a series of events through which a cell grows, performs its functions, and eventually divides to form new cells. After its formation, the cell increases in size, carries out metabolic activities, and then undergoes cell division. Finally, the cell may age and die.

8. What happens when cell division becomes uncontrolled ?

Ans. When cell division becomes uncontrolled, cells begin to divide rapidly without regulation. This leads to the formation of abnormal masses of cells called **tumours**, which may develop into cancer.

9. Differentiate between the controlled and uncontrolled cell division.

Ans. Controlled cell division : It is a regulated process in which cells divide in a proper and orderly manner to support growth, repair, and maintenance of the body.



Uncontrolled cell division : It is an unregulated and rapid division of cells, which leads to the formation of tumours and may cause cancer. .

10. Explain totipotency with an example.

Ans. Totipotency is the ability of a single cell to develop into a complete organism. In plants, certain cells have this ability. For example, in **tissue culture**, a single plant cell can grow and develop into a whole plant under suitable conditions.



Long Answer Type Questions

11. Explain cell theory and its importance.

Ans. Cell theory is a fundamental concept in biology that explains the basic structure and functioning of all living organisms. It was proposed by scientists Schleiden and Schwann, and later modified by Virchow.

Cell Theory States :

- All living organisms are made up of one or more cells.
- The cell is the basic structural and functional unit of life.
- All new cells arise from pre-existing cells.

Importance of Cell Theory :

- 1. Explains unity of life :** It shows that all living organisms, from simple to complex, are composed of cells.
- 2. Basis of biological study :** It forms the foundation for understanding structure, growth, and functioning of organisms.
- 3. Explains continuity of life :** The idea that cells arise from pre-existing cells explains how life continues through generations.
- 4. Helps in medical science :** Understanding cells helps in studying diseases and developing treatments.

Thus, cell theory is essential for understanding the organization, functioning, and continuity of life.

12. Describe how cancer develops in the body.

Ans. In a normal body, cells divide in a controlled and regulated manner to maintain growth and repair. This process is regulated by various mechanisms such as cell cycle control and contact inhibition.

However, sometimes due to genetic mutations or external factors, this control is lost. As a result, cells begin to divide rapidly and uncontrollably.

This leads to the formation of a mass of abnormal cells called a tumour.

Types of Tumours :

Benign tumours : Non-cancerous and do not spread to other parts of the body.

Malignant tumours : Cancerous and capable of spreading to other parts of the body through blood or lymph. This process is called **metastasis**.

As malignant cells spread, they damage normal tissues and organs, leading to serious health problems.

Thus, cancer develops due to **loss of control over cell division**, resulting in abnormal growth of cells.

13. Explain special concepts : Contact inhibition and totipotency.

Ans. Contact Inhibition : Contact inhibition is a property of normal cells in which they stop dividing when they come into contact with neighbouring cells. This prevents overcrowding and ensures proper organization of tissues.

In cancer cells, this property is lost, leading to uncontrolled growth.

Totipotency : Totipotency is the ability of a cell to develop into a complete organism under suitable conditions.

This property is mainly seen in plant cells, where even a single cell can regenerate into a whole plant. This principle is widely used in tissue culture techniques for plant propagation.

Both contact inhibition and totipotency are important concepts that explain cell growth regulation and developmental potential in living organisms.

THINK IT OVER

[NCERT Pg No 8]

• **Where do cells come from?**

Cells arise from pre-existing cells through the process of cell division.

• **How have technological interventions helped us understand the world beyond the naked eye?**

Technological advancements, such as microscopes, have enabled scientists to observe tiny structures like cells and microorganisms. These tools have expanded our knowledge of life at the microscopic level, which cannot be seen with the naked eye.

• **Why is the cell considered the structural and functional unit of life?**

A cell is called the structural and functional unit of life because all living organisms are made up of cells, and all vital processes necessary for life occur within them.

• **How does a cell multiply?**

A cell multiplies through a process called cell division, where one cell divides to form two or more new cells.

Life is believed to have started in water, possibly in small pools or hot springs like those in Puga Valley, Ladakh, which resemble early Earth conditions. These springs contain thermophiles—heat-loving unicellular organisms. Calcium carbonate deposits there may have protected early molecules and helped form the first cell membrane.



NCERT Exercise

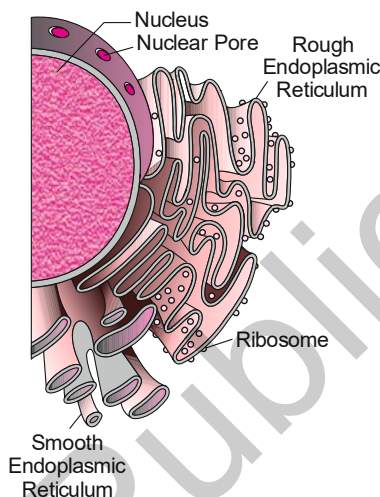


Revise, Reflect, Refine

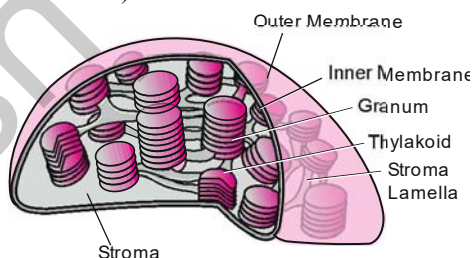
1. Differentiate between the following pairs of terms based on the clues given in parentheses : (i) Cell membrane and cell wall (permeability) (ii) RER and SER (structure) (iii) Chloroplasts and chromoplasts (pigments).

[NCERT Pg No 24]

- Ans. (i) Cell membrane and cell wall :** The cell membrane is selectively permeable (allows only certain substances to pass), whereas the plant cell wall is freely permeable (allows most substances to pass through easily).
- (ii) RER and SER :** Rough Endoplasmic Reticulum (RER) has ribosomes attached to its surface, giving it a rough microscopic structure. Smooth Endoplasmic Reticulum (SER) lacks ribosomes, giving it a smooth tubular structure.



- (iii) Chloroplasts and chromoplasts :** Chloroplasts contain the green pigment chlorophyll (essential for photosynthesis), while chromoplasts contain other coloured pigments like carotenoids (which give red, orange, or yellow colours to flowers and fruits).



2. Two similar animal cells are placed in two different solutions : Cell X is placed in pure water. Cell Y is placed in a concentrated salt solution. Cells are observed after sometime. Cell X swells, and Cell Y shrinks. Which statement provides the correct explanation for the above observations?

[NCERT Pg No 24-25]

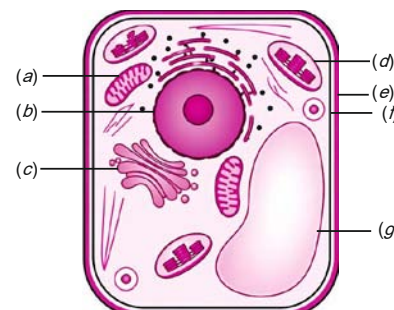
- Ans.** Water moved into Cell X and moved out of Cell Y through the cell membrane.

Explanation : Cell X swelled due to endosmosis as water entered it from the hypotonic pure water. Cell Y shrink due to exosmosis as water left the cell into the hypertonic salt solution.

3. Look at the diagram of a cell in the Fig. Identify the parts labelled from (a) to (g) and correctly match them with their functions given below.

[NCERT Pg No 25]

- Ans. (a) Mitochondria :** (ii) Site of cellular respiration.
(b) Cell Wall : (v) Provides structural rigidity to the cell.
(c) Cell Membrane : (iv) Separates the cell contents from surroundings.
(d) Nucleus : (i) Controlling all the activities of a cell.





- (e) **Vacuole** : (iii) Storage organelle that also provides rigidity to the cell.
 (f) **Golgi apparatus** : (vi) Packs and stores materials received from ER.
 (g) **Chloroplast** : (vii) Helps in manufacturing food.

4. Which of the following option(s) of the pairs of cell organelles are correctly placed under the given categories ?

[NCERT Pg No 25]

Ans. Explanation : Leucoplasts are plastids present only in plant cells, and the cell wall is a structure completely absent in animal cells. Both fit their respective columns perfectly.

Option	Present in the plant cells	Absent in the animal cells
(i)	Leucoplast	Cell wall
(ii)	Mitochondria	Ribosome
(iii)	Cell wall	Golgi apparatus
(iv)	Lysosome	Endoplasmic reticulum

5. Two students, Renu and Rohit, were having a discussion on the plastids. Renu emphasised that all parts of the plants, even roots, contain plastids. However, Rohit did not agree with the statement and told her that plastids are absent in plant roots since the roots are underground and do not need to perform photosynthesis. Who is correct? Justify your answer.

[NCERT Pg No 25]

Ans. Renu is correct. While it is true that plant roots are underground and do not perform photosynthesis (meaning they lack the green plastids called the chloroplasts), they still contain other vital types of plastids. Specifically, roots contain leucoplasts, which are colourless plastids that act as bulk storage organelles for starch, oils, and protein granules.

6. Mitochondria and chloroplasts are two important organelles in a plant cell. Discuss how these two organelles are structurally and functionally similar to each other, and different from each other.

[NCERT Pg No 25]

Ans. Structural Similarities : Both are double-membrane-bound organelles and both are semi-autonomous (meaning they contain their own circular DNA and ribosomes).

Functional Similarities : Both are primarily involved in the energy metabolism of the cell.

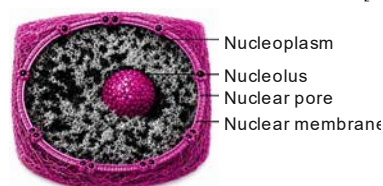
Structural Differences : Mitochondria have an inner membrane folded into finger-like structures called cristae, while chloroplasts contain flat, disc-like sacs called thylakoids stacked into grana. Also, chloroplasts contain chlorophyll, whereas mitochondria do not.

Functional Differences : Mitochondria perform cellular respiration (breaking down glucose to release energy as ATP), whereas chloroplasts perform photosynthesis (capturing solar energy to synthesise glucose).

7. Which of the following pairs of cell organelles contains DNA ?

[NCERT Pg No 25]

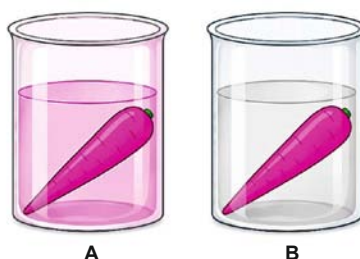
- (i) Chloroplasts, Ribosomes
 (ii) Mitochondria, Nucleus
 (iii) Golgi bodies, Ribosomes
 (iv) Nucleus, Lysosomes



Ans. (ii) Mitochondria, Nucleus.

8. A researcher carried out an experiment in which she took two carrots of similar size. She placed one carrot in plain water and the other carrot in concentrated salt solution (Fig.). After 24 hours she recorded her observations.

[NCERT Pg No 26]



Experimental set-up having carrot (a) in plain water, and (b) in salt solution

- Ans.** (i) The researcher wants to test the hypothesis of how plant cells (carrot) react when placed in hypotonic (plain water) and hypertonic (concentrated salt) solutions, basically observing the process of osmosis.
 (ii) To improve the experiment, she should measure the initial weight and length of the carrot pieces before putting them in the solutions, and then measure them again after 24 hours to get exact quantitative data on the changes.



(iii) The carrot in plain water stays stiff because of endosmosis; water enters the cells, making them turgid. The carrot in salt water becomes rubbery and limp due to exosmosis; water leaves the cells, causing them to shrink (plasmolysis).

9. Indicate the presence or absence of the following structures in bacterial and animal cells. [NCERT Pg No 26]

Structures in a cell	Bacterial cell	Animal cell
Chromosome		
Nucleus		
Mitochondria		
Golgi complex		
Chromoplasts		

Ans. **Chromosome** : Bacterial cell (Present, as a nucleoid region), Animal cell (Present).

Nucleus : Bacterial cell (Absent), Animal cell (Present).

Mitochondria : Bacterial cell (Absent), Animal cell (Present).

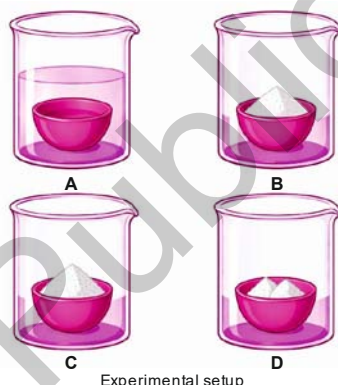
Golgi complex : Bacterial cell (Absent), Animal cell (Present).

Chromoplasts : Bacterial cell (Absent), Animal cell (Absent) (**Note** : Chromoplasts are only found in plant cells).

10. Carry out the following experiment :

[NCERT Pg No 26]

Take four peeled potato halves and scoop each one out to make potato cups. One of these potato cups should be made from a boiled potato. Place each of the potato cups in a beaker containing water (Fig.).



Experimental setup

Now, setup the experiment as follows :

(a) Keep Cup A empty.

(b) Add one teaspoon sugar in Cup B.

(c) Add one teaspoon salt in Cup C.

(d) Add one teaspoon sugar in the boiled potato in Cup D.

Observe the four potato cups at least two hours and answer the following questions :

(i) Explain why water gathers in the hollowed portion of Cup B and Cup C.

(ii) Why is Cup A necessary for this experiment?

(iii) Explain why water does not gather in the hollowed portions of Cup A and D.

Ans. (i) Cup A is necessary as a control setup. It helps to show that without a solute (like sugar or salt), water will not move into the hollowed portion, proving that osmosis is responsible for the changes in Cups B and C.

(ii) Water does not gather in Cup A because it lacks a higher concentration solute to draw water in. Water does not gather in Cup D because boiling the potato kills its cells, destroying the selectively permeable nature of the cell membrane, which completely stops osmosis.

11. Identify the pair that incorrectly matches the cell organelle with its function.

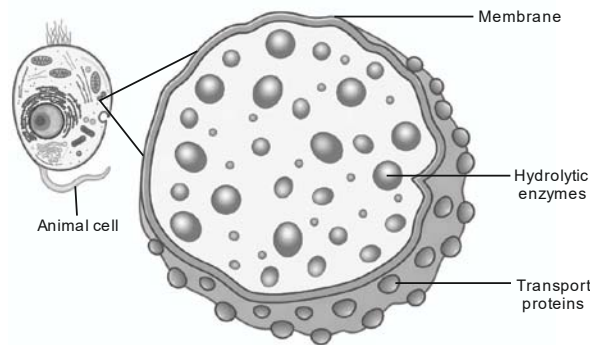
[NCERT Pg No 26]

(i) Ribosome - Protein synthesis

(ii) SER - Lipid and cellulose synthesis

(iii) Lysosome - Digestion of foreign agents

Ans. (ii) **SER** : Lipid and cellulose synthesis. (**Explanation** : While Smooth Endoplasmic Reticulum does synthesise lipids, cellulose is synthesised by enzyme complexes located on the cell membrane, not by the SER).

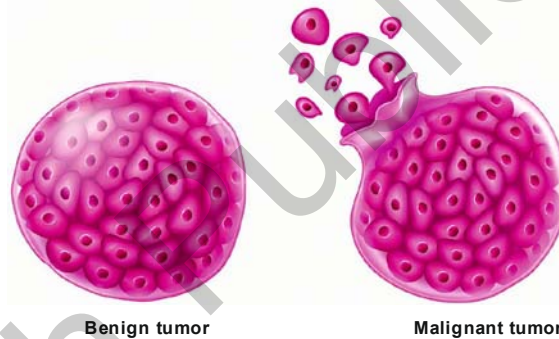


12. What outcome do you expect, if all the mitochondria are removed from a eukaryotic cell ? [NCERT Pg No 26]

Ans. Mitochondria are the powerhouses of the cell. If they are removed, the cell will not be able to perform aerobic cellular respiration to produce ATP (energy). Without this energy, all metabolic activities will stop, and the cell will quickly die.

13. Which phenomenon inhibits the formation of tumors in the human body? Can plants also develop tumors? Explain. [NCERT Pg No 26]

Ans. The phenomenon that inhibits tumor formation is called Contact Inhibition (normal cells stop dividing when they come into physical contact with each other). Yes, plants can also develop tumors. When plant cells lose control over their division (often due to bacterial infections like *Agrobacterium tumefaciens*), they form unorganised, continuously dividing cell masses called galls or plant tumors.



14. The cell membrane of a cell is made up of proteins and lipids. Which cell organelles help in the synthesis of cell membrane ? Write the path of these compounds from their site of synthesis to the cell membrane and show this through a labelled diagram. [NCERT Pg No 27]

Ans. The Rough Endoplasmic Reticulum (RER) synthesises proteins, and the Smooth Endoplasmic Reticulum (SER) synthesises lipids.

Path : Proteins and Lipids synthesised in the ER $\rightarrow$ Transported via vesicles to the Golgi apparatus for modification and packaging $\rightarrow$ Secretory vesicles carry them to the Cell membrane where they are integrated into it (a process called membrane biogenesis). (For the diagram, you will need to draw the Endomembrane System showing the nucleus, ER, vesicles moving to the Golgi, and then vesicles fusing with the outer cell membrane).

15. What would happen if gametes are formed by mitotic divisions ? [NCERT Pg No 27]

Ans. If gametes (sperm and egg cells) were formed by mitosis, they would be diploid (having the full set of 46 chromosomes in humans) instead of haploid. When fertilisation occurs, the resulting zygote would have double the normal chromosome number (92). This doubling would continue in every generation, leading to massive genetic abnormalities, and the offspring would not survive.

16. A farmer, Deepa, was very happy with the harvest of amla (Indian Gooseberry) and lemons on her farm. However, she could sell only one-fourth of the produce in the local market. Recognising that a significant amount of produce may be lost post-harvest, she employed a traditional yet scientifically sound method to extend the shelf life of amla and lemons. She turned perishable produce into profitable products, such as pickles and sharbat. She used the excess produce to prepare pickles, murabbas, and sharbat by adding appropriate amounts of salt, sugar or jaggery to small pieces of fruit and their juices. These were then stored in small glass bottles for sale, helping her prevent the wastage of post-harvest produce. This shift from



farming to agro-processing would strengthen food security and boost the local economy, creating a sustainable model that cuts waste while increasing her income.

Based on the above passage answer the following questions:

- (i) Which scientific concept has the farmer applied in the preservation of the farm produce ?
- (ii) How does the addition of high concentrations of salt and sugar create an environment that prevents the growth of spoilage-causing bacteria and fungi ?
- (iii) Suggest a healthy recipe of this kind for food preservation.
- (iv) What are the scientific values addressed in this case ?

- Ans.** (i) The scientific concept applied here is Osmosis (specifically Exosmosis) and the creation of a hypertonic environment to prevent microbial growth.
- (ii) High concentrations of salt and sugar create a hypertonic solution. If bacteria or fungi land on the food, water is rapidly drawn out of their cells via exosmosis. This dehydrates and kills the microbes, preventing food spoilage.
- (iii) Another healthy recipe for preservation is Sun-drying (removing moisture directly from fruits/vegetables) or fermenting them using beneficial bacteria.
- (iv) The scientific values of addressed include critical thinking, applying scientific knowledge for sustainable living, reducing food waste and boosting the local economy.



The Quest Continues...

Q. What is the future of the development of synthetic cells using non-living chemicals ? If a synthetic cell is developed, what may be the related ethical issues ?

[NCERT Pg No 27]

- Ans.** The future of synthetic cells holds massive potential for fields like medicine and environmental science. They could be custom-designed to clean up oil spills, digest plastic waste or act as targeted drug delivery systems inside the human body. However, the ethical issues are significant. Concerns include the morality of “playing God” by creating artificial life, the massive risk of these synthetic cells mutating or escaping into nature and disrupting existing ecosystems, and the potential for them to be weaponized as dangerous bioterrorism agents.

Competency Based Questions



Multiple Choice Questions

1. The basic unit of life is :
(a) Tissue (b) Organ
(c) Cell (d) Atom
2. Cells arise from :
(a) Air (b) Water
(c) Pre-existing cells (d) Soil
3. The limit of resolution of the human eye is :
(a) 1 mm (b) 0.1 mm
(c) 0.01 mm (d) 10 mm
4. Which of the following microscope uses electrons ?
(a) Light microscope
(b) Electron microscope
(c) Compound microscope
(d) Simple microscope
5. The cell membrane is :
(a) Impermeable
(b) Freely permeable
(c) Selectively permeable
(d) Rigid
6. Movement of water through a membrane is called :
(a) Diffusion (b) Osmosis
(c) Respiration (d) Transpiration
7. Plant cell wall is made of :
(a) Protein (b) Lipid
(c) Cellulose (d) DNA
8. Which of the following organelle controls cell activities ?
(a) Cytoplasm (b) Nucleus
(c) Ribosome (d) ER
9. Powerhouse of the cell is :
(a) Golgi body (b) Ribosome
(c) Mitochondria (d) Lysosome
10. Protein synthesis occurs in :
(a) Lysosome (b) Ribosome
(c) Golgi (d) Nucleus
11. Rough ER has :
(a) Lipids (b) DNA
(c) Ribosomes (d) Vacuole



12. Smooth ER synthesises :
(a) Protein (b) Lipid
(c) DNA (d) Enzymes
13. Golgi apparatus helps in :
(a) Digestion (b) Packaging
(c) Respiration (d) Storage
14. Lysosomes are called :
(a) Powerhouse (b) Suicide bags
(c) Control centre (d) Storage
15. Chromoplasts give :
(a) Shape (b) Energy
(c) Colour (d) Support
16. Leucoplasts store :
(a) Energy (b) Pigments
(c) Food (d) Oxygen
17. Vacuole stores :
(a) DNA (b) Water and waste
(c) Protein (d) Lipid
18. Bacteria are :
(a) Eukaryotic (b) Prokaryotic
(c) Multicellular (d) Complex
19. Eukaryotic cells have :
(a) No nucleus
(b) Primitive nucleus
(c) Well-defined nucleus
(d) No organelles
20. RBCs lack :
(a) Cytoplasm (b) Nucleus
(c) Membrane (d) Protein
21. Cell wall is absent in :
(a) Plant cell (b) Bacteria
(c) Animal cell (d) Fungi
22. Diffusion occurs due to :
(a) Gravity
(b) Pressure
(c) Concentration gradient
(d) Temperature
23. Hypotonic solution causes cell to :
(a) Shrink (b) Burst
(c) Swell (d) Die
24. Hypertonic solution causes :
(a) Swelling (b) Shrinking
(c) Division (d) Growth
25. Cell theory was given by :
(a) Darwin (b) Schleiden and Schwann
(c) Newton (d) Mendel



Fill in the Blanks

26. The is the basic unit of life.
27. Cells arise from cells.
28. The limit of resolution of the human eye is mm.
29. Cells are studied using a
30. The cell membrane is permeable.
31. Movement of particles from high to low concentration is called
32. Movement of water across a membrane is called
33. The plant cell wall is made of
34. The controls all cell activities.
35. The cytoplasm is a substance.
36. are the sites of protein synthesis.
37. The is called the powerhouse of the cell.
38. Smooth ER synthesises
39. Golgi apparatus helps in substances.
40. Lysosomes contain enzymes.
41. Chromoplasts give to fruits and flowers.
42. Leucoplasts store
43. Vacuole stores and waste materials.
44. Prokaryotic cells lack a nucleus.
45. is the ability of plant cells to form a complete plant.



True or False

46. Cells can be seen with the naked eye.
47. Cell membrane is selectively permeable.
48. Diffusion requires a membrane.
49. Osmosis involves movement of water.
50. Plant cells have a cell wall.
51. Animal cells have a cell wall.
52. Mitochondria produce energy.
53. Ribosomes synthesise proteins.
54. Golgi apparatus helps in packaging substances.
55. Lysosomes contain enzymes.
56. Prokaryotic cells have a well-defined nucleus.
57. Eukaryotic cells have membrane-bound organelles.
58. RBCs have a nucleus.
59. Chromoplasts give colour to fruits.
60. Leucoplasts store food.
61. Vacuole is large in plant cells.
62. Diffusion occurs from low to high concentration.
63. Hypertonic solution causes cells to shrink.
64. Cell theory states that all cells arise from pre-existing cells.
65. Uncontrolled cell division can lead to cancer.



Match the Columns

66. Match the columns :

Column-A	Column-B
(A) Mitochondria	(i) Protein synthesis
(B) Ribosome	(ii) Energy production
(C) Golgi apparatus	(iii) Packaging
(D) Lysosome	(iv) Digestion

(a) (A)-(ii), (B)-(i), (C)-(iii), (D)-(iv)

(b) (A)-(i), (B)-(iii), (C)-(iv), (D)-(ii)

(c) (A)-(iv), (B)-(iii), (C)-(ii), (D)-(i)

(d) (A)-(iii), (B)-(ii), (C)-(iv), (D)-(i)

67. Match the columns :

Column-A	Column-B
(A) Diffusion	(i) Movement of water
(B) Osmosis	(ii) Movement of particles
(C) Hypertonic solution	(iii) Cell shrinks
(D) Hypotonic solution	(iv) Cell swells

(a) (A)-(i), (B)-(iii), (C)-(iv), (D)-(ii)

(b) (A)-(ii), (B)-(i), (C)-(iii), (D)-(iv)

(c) (A)-(iv), (B)-(iii), (C)-(ii), (D)-(i)

(d) (A)-(iii), (B)-(ii), (C)-(iv), (D)-(i)

68. Match the columns :

Column-A	Column-B
(A) Chloroplast	(i) Colour
(B) Chromoplast	(ii) Photosynthesis
(C) Leucoplast	(iii) Storage
(D) Vacuole	(iv) Storage of water

(a) (A)-(iii), (B)-(ii), (C)-(iv), (D)-(i)

(b) (A)-(i), (B)-(iii), (C)-(iv), (D)-(ii)

(c) (A)-(iv), (B)-(iii), (C)-(ii), (D)-(i)

(d) (A)-(ii), (B)-(i), (C)-(iii), (D)-(iv)

69. Match the columns :

Column-A	Column-B
(A) Prokaryotic cell	(i) Well-defined nucleus
(B) Eukaryotic cell	(ii) No nucleus
(C) Bacteria	(iii) Prokaryotic
(D) Animal cell	(iv) No cell wall

(a) (A)-(ii), (B)-(i), (C)-(iii), (D)-(iv)

(b) (A)-(i), (B)-(iii), (C)-(iv), (D)-(ii)

(c) (A)-(iv), (B)-(iii), (C)-(ii), (D)-(i)

(d) (A)-(iii), (B)-(ii), (C)-(iv), (D)-(i)

70. Match the columns :

Column-A	Column-B
(A) Cell membrane	(i) Rigid support
(B) Cell wall	(ii) Selective permeability
(C) Cytoplasm	(iii) Jelly-like substance
(D) Nucleus	(iv) Control centre

(a) (A)-(i), (B)-(iii), (C)-(iv), (D)-(ii)

(b) (A)-(ii), (B)-(i), (C)-(iii), (D)-(iv)

(c) (A)-(iv), (B)-(iii), (C)-(ii), (D)-(i)

(d) (A)-(iii), (B)-(ii), (C)-(iv), (D)-(i)



Assertion-Reason Type Questions

Instructions : Each question has an Assertion (A) followed by Reason (R). Mark the correct choice.

- (a) Both (A) and (R) are true and (R) is the correct explanation of (A).
 (b) Both (A) and (R) are true but (R) is not the correct explanation of (A).
 (c) (A) is true but (R) is false.
 (d) (A) is false but (R) is true.

71. **Assertion (A) :** Cell is the basic unit of life.**Reason (R) :** All life processes occur within cells.72. **Assertion (A) :** Cells cannot be seen with the naked eye.**Reason (R) :** Cells are smaller than the limit of resolution of the human eye.73. **Assertion (A) :** The cell membrane is selectively permeable.**Reason (R) :** It allows all substances to pass freely.74. **Assertion (A) :** Diffusion does not require a membrane.**Reason (R) :** It occurs due to concentration gradient.75. **Assertion (A) :** Osmosis requires a selectively permeable membrane.**Reason (R) :** Water moves across the membrane from high to low concentration.76. **Assertion (A) :** Plant cells do not burst in hypotonic solution.**Reason (R) :** They have a rigid cell wall.77. **Assertion (A) :** Animal cells shrink in concentrated solutions.**Reason (R) :** Water moves out of the cell.78. **Assertion (A) :** Prokaryotic cells lack a nucleus.**Reason (R) :** They have a nucleoid region instead.79. **Assertion (A) :** Eukaryotic cells are more complex than prokaryotic cells.**Reason (R) :** They contain membrane-bound organelles.



- 80. Assertion (A) :** Mitochondria are called the powerhouse of the cell.
Reason (R) : They produce ATP during respiration.
- 81. Assertion (A) :** Ribosomes are called protein factories.
Reason (R) : They synthesise lipids.
- 82. Assertion (A) :** Lysosomes are known as suicidal bags.
Reason (R) : They contain digestive enzymes.
- 83. Assertion (A) :** Chromoplasts give colour to fruits and

flowers.

Reason (R) : They contain pigments other than chlorophyll.

- 84. Assertion (A) :** RBCs do not have a nucleus.
Reason (R) : It provides more space for haemoglobin.
- 85. Assertion (A) :** Uncontrolled cell division leads to cancer.
Reason (R) : Cells lose control over growth and division.



Case Study Based Questions

86. Osmosis in Plant Cells

A student conducted an experiment using potato pieces. One piece was placed in plain water, while the other was placed in a concentrated salt solution. After a few hours, the potato in water became swollen and firm, whereas the potato in the salt solution became soft and shrunken. The student concluded that water moved across the cell membrane depending on the concentration of the surrounding solution. This experiment demonstrates how plant cells behave differently in hypotonic and hypertonic solutions. The presence of a rigid cell wall also prevents plant cells from bursting even when excess water enters them.

Questions :

- (a) The swelling of potato in water is due to :
 (i) Diffusion (ii) Osmosis
 (iii) Respiration (iv) Transpiration
- (b) The salt solution is :
 (i) Hypotonic (ii) Isotonic
 (iii) Hypertonic (iv) Neutral
- (c) Why does the plant cell not burst in water ?
 (i) Cell membrane (ii) Cytoplasm
 (iii) Cell wall (iv) Nucleus
- (d) Movement of water out of the potato is called :
 (i) Endosmosis (ii) Exosmosis
 (iii) Diffusion (iv) Active transport

87. Role of Cell Organelles

A researcher studied a cell under an electron microscope and observed several organelles performing different functions. The mitochondria were actively producing energy, ribosomes were synthesising proteins, and the Golgi apparatus was modifying and packaging substances. The endoplasmic reticulum formed a network for transport within the cell. This division of labour ensures that the cell functions efficiently. Without these organelles, the cell would not be able to survive or perform essential life processes.

Questions :

- (a) The organelle producing energy is :
 (i) Golgi (ii) Ribosome
 (iii) Mitochondria (iv) Lysosome
- (b) Protein synthesis occurs in :
 (i) ER (ii) Golgi
 (iii) Ribosome (iv) Nucleus

(c) Golgi apparatus helps in :

- (i) Respiration (ii) Packaging
 (iii) Storage (iv) Digestion

(d) ER mainly helps in:

- (i) Transport (ii) Storage
 (iii) Digestion (iv) Movement

88. Prokaryotic vs Eukaryotic Cells

A biology student compared bacterial cells with plant and animal cells. He observed that bacterial cells were smaller and lacked a well-defined nucleus and membrane-bound organelles. In contrast, plant and animal cells had a distinct nucleus and various organelles such as mitochondria, ER, and Golgi bodies. This difference makes eukaryotic cells more complex and capable of performing specialised functions efficiently.

Questions :

- (a) Bacteria belong to :
 (i) Eukaryotic cells (ii) Prokaryotic cells
 (iii) Multicellular (iv) Complex cells
- (b) Eukaryotic cells have :
 (i) No nucleus
 (ii) Primitive nucleus
 (iii) Well-defined nucleus
 (iv) No cytoplasm
- (c) Which of the following is absent in prokaryotic cells ?
 (i) Cell membrane (ii) Cytoplasm
 (iii) Organelles (iv) Ribosomes
- (d) Prokaryotic cells are:
 (i) Large (ii) Complex
 (iii) Small and simple (iv) Multicellular

89. Cell Membrane and Transport

The cell membrane is made of lipids and proteins arranged in a fluid mosaic pattern. It allows only certain substances to pass through it, maintaining the internal balance of the cell. Gases like oxygen and carbon dioxide move freely across the membrane by diffusion, while water moves by osmosis. The selective permeability of the membrane ensures that harmful substances are kept out while essential nutrients enter the cell.

**Questions :**

- (a) The cell membrane is :
 (i) Impermeable
 (ii) Freely permeable
 (iii) Selectively permeable
 (iv) Rigid
- (b) Oxygen enters the cell by :
 (i) Osmosis (ii) Diffusion
 (iii) Active transport (iv) Endocytosis
- (c) Water movement across membrane is :
 (i) Diffusion
 (ii) Osmosis
 (iii) Respiration
 (iv) Transpiration
- (d) Fluid mosaic model describes :
 (i) Nucleus (ii) Membrane
 (iii) Cytoplasm (iv) ER

90. Cell Division and Cancer

In a healthy human body, cells grow, divide, and die in a controlled manner. This process helps in growth, repair, and replacement of cells. However, sometimes this control fails, and cells begin to divide

uncontrollably, forming masses of cells called tumors. Some tumors remain localised (benign), while others spread to different parts of the body (malignant), causing cancer. Mechanisms like contact inhibition normally prevent uncontrolled growth.

Questions :

- (a) Controlled cell division helps in :
 (i) Digestion (ii) Growth
 (iii) Respiration (iv) Excretion
- (b) Uncontrolled division leads to :
 (i) Repair (ii) Growth
 (iii) Tumors (iv) Energy production
- (c) Malignant tumors :
 (i) Do not spread
 (ii) Spread to other parts
 (iii) Are harmless
 (iv) Are temporary
- (d) Contact inhibition means :
 (i) Cells divide rapidly
 (ii) Cells stop dividing on contact
 (iii) Cells die
 (iv) Cells grow faster

**Answers****Multiple Choice Questions**

1. (c) 2. (c) 3. (b) 4. (b) 5. (c) 6. (b) 7. (c) 8. (b) 9. (c) 10. (b)
 11. (c) 12. (b) 13. (b) 14. (b) 15. (c) 16. (c) 17. (b) 18. (b) 19. (c) 20. (b)
 21. (c) 22. (c) 23. (c) 24. (b) 25. (b)

**Fill in the Blanks**

26. Cell 27. Pre-existing 28. 0.1 29. Microscope 30. Selectively
 31. Diffusion 32. Osmosis 33. Cellulose 34. Nucleus 35. Jelly-like
 36. Ribosomes 37. Mitochondria 38. Lipids 39. Packaging 40. Digestive
 41. Colour 42. Food 43. Water 44. Well-defined 45. Totipotency

**True or False**

46. False 47. True 48. False 49. True 50. True 51. False 52. True 53. True 54. True 55. True
 56. False 57. True 58. False 59. True 60. True 61. True 62. False 63. True 64. True 65. True

**Match the Columns**

66. (a) 67. (b) 68. (d) 69. (a) 70. (b)

**Assertion-Reason Type Questions**

71. (a) 72. (a) 73. (c) 74. (a) 75. (a) 76. (a) 77. (a) 78. (a) 79. (a) 80. (a)
 81. (c) 82. (a) 83. (a) 84. (a) 85. (a)

**Case Study Based Questions**

86. (a) (ii), (b) (iii), (c) (iii), (d) (ii) 87. (a) (iii), (b) (iii), (c) (ii), (d) (i)
 88. (a) (ii), (b) (iii), (c) (iii), (d) (iii) 89. (a) (iii), (b) (ii), (c) (ii), (d) (ii)
 90. (a) (ii), (b) (iii), (c) (ii), (d) (ii)