

Premium Handwritten Notes Series

NCERTXTRACT

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CHAPTER 2

CELL

The Building Block of Life

Class IX • Science • NCERT Aligned

● Main content ● Explanations ● Definitions ● Examples & Diagrams

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Index – What's Inside

Foundation

Learning Outcomes	3
2.0 Origin of Life · First Cell · Basic Unit	4
Levels of Organisation & Key Questions	5
2.1 How to Study Cells? (Microscopy)	6
Discovery of Cell · Light Microscope	7
Activity 2.1 Estimate Size of a Cell	8

Structure of a Cell

2.2 Structure of a Cell	9
2.2.1 Cell Membrane (Osmosis & Diffusion)	10
Fluid Mosaic Model	11
Activity 2.2 Osmosis in Potato	12
Activity 2.3 Plant vs Animal Cells · Plasmolysis	13
2.2.2 Cell Wall	14

The Cell Interior

2.3 Coordinated Working System	15
2.3.1 Why Organelles? (Cell as Factory)	16
Nucleus — House of Coded Instructions	17
Ribosomes · ER · Golgi · Lysosomes	18
Mitochondria — The Powerhouse	19
Plastids · Colours in Plants	20
Vacuoles — Storage & Support	21

Cell Cycle & Theory

2.4 How Cells Grow & Divide	22
2.4.1 Cell Division · Mitosis · Meiosis	23
2.5 Cell Theory	24

2.5.1 Do Cells Live Forever? (Cancer)	25
<i>Revise & Score</i>	
NCERT Exercise — Full Solutions	26
One-Page Mind Map	27
Quick Revision Sheet	28
Last-Minute Revision & Exam Booster	29

Learning Outcomes

After finishing this chapter, you will be able to...

- Explain that **all living organisms are made of cells** — the basic unit of life.
- Describe **how cells are studied** using microscopes and why cells are invisible to the naked eye.
- State the **limit of resolution** of the human eye and estimate cell size under a microscope.
- Identify the three main parts of a cell: **membrane, cytoplasm, nucleus**.
- Explain **osmosis, diffusion & plasmolysis** through activities.
- Compare **plant, animal & bacterial** cells (prokaryotic vs eukaryotic).
- Describe the structure & function of each **cell organelle**.
- Explain **cell division** — mitosis & meiosis — and the **cell theory**.
- Understand **contact inhibition** and how its loss leads to cancer.

How to read these notes

Blue = main content **Black** = explanation **Red** = definitions & key points **Green** = examples & diagrams. Watch for the  Exam Alert,  Remember,  NCERT Line,  Common Mistake,  Activity,  FAQ &  Memory Trick boxes.

2.0 The Story Begins – Where Did Life Start?

1 Origin of Life in Water

- Scientists believe life started in water.
- Some think it began in small hot water pools, not oceans.
- Example: hot springs like the Puga Valley hot springs.

These places have very high temperature and are similar to early Earth (3.5 billion years ago). Organisms found here are thermophiles (heat-loving bacteria), mostly unicellular.

✦ Thermophiles

Heat-loving bacteria that survive in extreme heat — mostly single-celled (unicellular) organisms.

2 Formation of the First Cell

Scientists from the Birbal Sahni Institute of Palaeosciences found that calcium carbonate deposits formed quickly in hot springs. These deposits:

- Protected molecules from radiation.
- Helped form the first cell membrane.

✦ Cell membrane

The protective boundary of a cell — its formation marked the start of cellular life.

3 Cell – The Basic Unit of Life

All living organisms are made of cells. Cell = smallest unit of life.

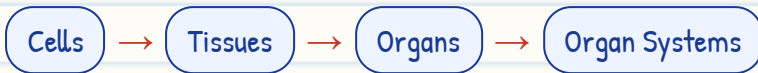
Unicellular → one cell — e.g. bacteria, yeast

Multicellular → many cells — e.g. plants, animals, humans

💡 Memory Trick – PUMA

Puga valley · Unicellular · Membrane from CaCO_3 · All life = cells. Four pegs that hold this whole opening section together.

4 Levels of Organisation



Example: Nose + trachea + lungs → Respiratory system.

Key idea

Systems work together to **maintain life**. The order **Cell** → **Tissue** → **Organ** → **System** is asked again and again.

5 Questions This Chapter Explores

- How do cells perform many functions?
- What are cell components?
- How do cells communicate?
- Do cells live forever?

MCQs

1. Life is believed to have originated in: (a) Air (b) Water (c) Soil (d) Space
2. Thermophiles are: (a) Cold-loving (b) Heat-loving bacteria (c) Plants (d) Animals
3. Cell membrane acts as: (a) Energy source (b) Protective boundary (c) Nucleus (d) Tissue
4. Unicellular organisms have: (a) Many cells (b) One cell (c) No cell (d) Two cells
5. Which is correct? (a) Cell not important (b) Cell is basic unit of life (c) Tissue is basic unit (d) Organ is basic unit
6. Multicellular organisms consist of: (a) One cell (b) Many cells (c) No cells (d) Only tissues

✓ Answers

1-(b), 2-(b), 3-(b), 4-(b), 5-(b), 6-(b)

Assertion – Reason & Paragraph

Key: (a) both true, R explains A · (b) both true, R not explain · (c) A true R false · (d) A false R true

1. **A:** Thermophiles live in hot environments. **R:** They are heat-loving organisms.
2. **A:** Cell is the basic unit of life. **R:** All organisms are made of cells.
3. **A:** Organs are formed directly from cells. **R:** Cells first form tissues.
4. **Para Q:** Where did life originate? · Role of calcium carbonate? · How are cells organised?

✓ Answers

A-R: 1-(a), 2-(a), 3-(d) | Para: Water · Protected molecules & helped membrane formation ·
Cells→tissues→organs→systems

2.1 How to Study Cells?

1 Limit of Resolution of the Human Eye

✦ Limit of Resolution

The ability of the eye to see two nearby objects **separately**. At the near point of **25 cm**, the eye can distinguish objects only if they are at least **0.1 mm** apart. If closer → they appear as one.

- Limit of resolution = **0.1 mm**
- Near point of eye = **25 cm**
- Below this limit → objects merge.

2 Why Cells Can't Be Seen With the Naked Eye

Cells are **much smaller than 0.1 mm**, so they cannot be seen with the unaided eye — we need a **microscope**.

Most cells → 10–100 μm (1 mm = 1000 μm)

3 Role of the Microscope

A microscope is used to **magnify** small objects and make them visible. It uses **convex lenses** — an **objective lens** and an **eyepiece lens** — that increase image size and improve visibility.

🎯 Exam Alert

Two numbers are guaranteed marks: **limit of resolution = 0.1 mm** and **near point = 25 cm**. Don't swap them!

4 Discovery of the Cell

NCERT Line – Robert Hooke (1665)

Robert Hooke first observed cells in **1665** using a self-designed microscope. He looked at a thin slice of **cork**, saw box-like structures and named them “cells.” Magnification ~ 200–300x.

5 Structure of a Light Microscope

- **Eyepiece** → where you look
- **Objective lens** → magnifies the object
- **Stage** → place the slide
- **Mirror** → reflects light
- Adjustment knobs — **coarse** (rough focus) & **fine** (sharp focus)

Uses **visible light**, lenses like 10x / 40x, used in school labs.

6 Estimating Size Under the Microscope

Actual size formula

The image you see is magnified.

Actual size = Image size ÷ Magnification

e.g. image = 100 μm , magnification = 10x → actual size = **10 μm** .

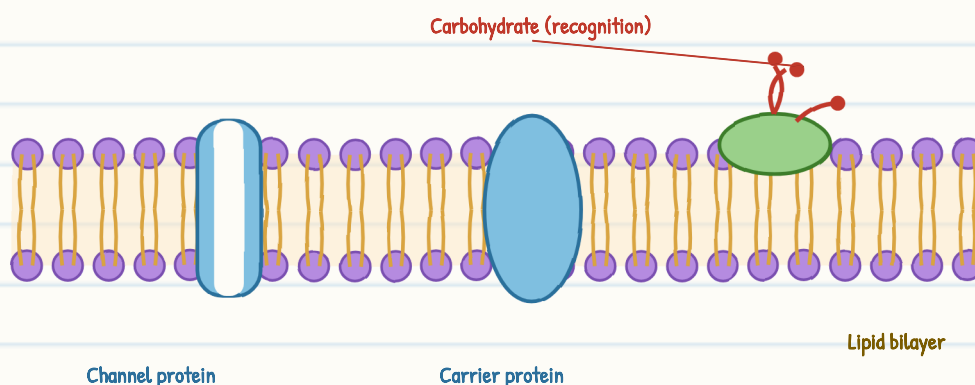


Fig. 2.7 (preview): the membrane you'll meet soon — Fluid Mosaic Model

Common Mistake

Image size $\neq$ actual size. Always **divide** by magnification — never multiply.

Diagram – Stomata on a Colocasia Leaf (Electron Microscope)

Stomata are small openings on the leaf surface, surrounded by **guard cells**. Function: **gas exchange** (CO_2 in, O_2 out) and water-vapour loss (transpiration).



Why an electron microscope?

Very **high resolution**, shows surface details clearly — much better than a light microscope. That's how we can see something as tiny as a stoma in fine detail.



MCQs – Microscopy

1. Limit of resolution of human eye: (a) 1 mm (b) 0.1 mm (c) 10 mm (d) 0.01 mm
2. Near point of human eye: (a) 10 cm (b) 25 cm (c) 50 cm (d) 100 cm
3. Cells cannot be seen because they are: (a) Too large (b) Too small (c) Too bright (d) Too dark
4. Microscope uses: (a) Concave (b) Convex lens (c) Mirror only (d) Prism
5. Robert Hooke observed cells in: (a) Leaf (b) Blood (c) Cork (d) Water
6. Light microscope uses: (a) UV (b) Visible light (c) X-rays (d) Infrared

✓ Answers

1-(b), 2-(b), 3-(b), 4-(b), 5-(c), 6-(b)



A-R & Objective Quiz

1. **A:** Cells can't be seen with naked eye. **R:** Size smaller than resolution limit.
2. **A:** Limit of resolution of eye is 0.1 mm. **R:** Eye can't distinguish closer objects.
3. **A:** Microscope increases size of object. **R:** It uses convex lenses.
4. **Quiz:** Cell discovered by? · Resolution means? · Microscope helps? · Cells are?

✓ Answers

A-R: 1-(a), 2-(a), 3-(a) | Quiz: Hooke · ability to distinguish · magnify · microscopic

2.2 Structure of a Cell

Every cell — plant, animal or microbe — has **three basic parts**:

Cell Membrane + Cytoplasm + Nucleus

✦ The three parts

1. **Cell membrane** → outer covering, controls entry/exit.
2. **Cytoplasm** → jelly-like fluid holding organelles.
3. **Nucleus** → control centre carrying genetic material.

1 Prokaryotic vs Eukaryotic Cells

Feature	Prokaryotic	Eukaryotic
Nucleus	No true nucleus (no membrane)	True membrane-bound nucleus
Membrane-bound organelles	Absent	Present
Size	Small (1–10 μm)	Larger (10–100 μm)
Examples	Bacteria, blue-green algae	Plants, animals, fungi

💡 Memory Trick

PRO = **PR**imitive, **O**ne open room (no walls inside → no membrane-bound nucleus).
EU = **TRUE** nucleus.

🎯 Exam Alert

The defining difference is the **nucleus**: prokaryotes have **no nuclear membrane**; eukaryotes have a **true, membrane-bound nucleus**.

2.2.1 Cell Membrane (Plasma Membrane)

✦ Cell Membrane

The **outermost living layer** of a cell (in animals it is the outer boundary). It is **selectively permeable** — it allows only certain substances in and out.

- Made of **lipids & proteins**.
- Controls movement of materials → **selectively permeable**.
- Gives the cell **shape & protection**.

1 Diffusion

✦ Diffusion

Movement of substances from **high concentration** → **low concentration**. Example: exchange of O_2 and CO_2 across the membrane.

2 Osmosis

✦ Osmosis

Movement of **water molecules** across a **selectively permeable membrane**, from a region of **more water** → **less water** (i.e. high → low water potential).

Three situations of osmosis

Solution outside	Water moves	Effect on cell
Hypotonic (dilute)	Into cell	Cell swells
Hypertonic (concentrated)	Out of cell	Cell shrinks
Isotonic (equal)	No net movement	No change

⚠ Common Mistake

Osmosis moves **water only** — not salt or sugar. Diffusion can move any particle; osmosis is water across a selectively permeable membrane.

3 Fluid Mosaic Model

✦ Fluid Mosaic Model

Proposed by **Singer & Nicolson (1972)**. The membrane is a **fluid** lipid bilayer with **proteins floating like a mosaic**. "Fluid" → molecules can move sideways; "Mosaic" → scattered protein pattern.

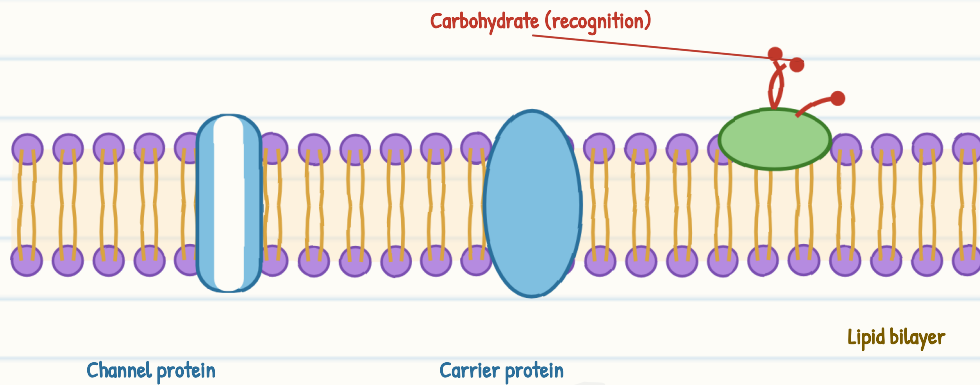


Fig. 2.1 — Fluid Mosaic Model of the plasma membrane

- Phospholipid bilayer → **heads outside (water-loving), tails inside (water-fearing)**.
- Proteins act as **channels & carriers** for transport.
- Carbohydrates help in **cell recognition**.

💡 Memory Trick

Fluid = things flow · **Mosaic** = scattered tiles (proteins). Picture icebergs (proteins) drifting in a sea of lipids.



Activity 2.2 – Osmosis in a Potato



NCERT Activity 2.2

Take two peeled potato cups. **Cup A:** fill with plain water and place in plain water. **Cup B:** fill with salt/sugar solution and place in plain water. Observe after a few hours.



Osmosis demonstrated in potato cavities

Cup	Inside cup	Observation	Reason
A	Plain water	No rise in level	No concentration difference
B	Salt/Sugar solution	Water level rises in cavity	Water enters by osmosis (high→low water)



NCERT Conclusion

Water moves into the cavity containing the concentrated solution through the potato cells — a living tissue acts as a **selectively permeable membrane**. This proves **osmosis**.



Frequently Asked

Why does a boiled potato show no osmosis? → Boiling **kills the cells**, destroying the selectively permeable membrane, so osmosis stops.

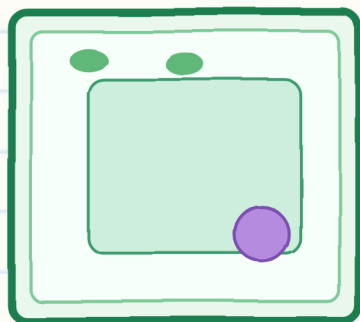


Activity 2.3 – Plant vs Animal Cells

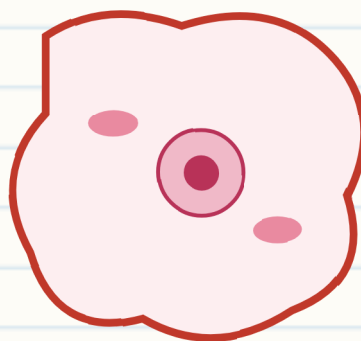


NCERT Activity 2.3

Peel a thin layer from an **onion** (plant) and gently scrape the inner lining of your **cheek** (animal). Stain, mount on slides and observe under the microscope.



Onion (plant) – box-like



Cheek (animal) – rounded

Onion cells (box-like) vs Cheek cells (rounded)

Feature	Onion (Plant) cell	Cheek (Animal) cell
Shape	Rectangular / box-like	Rounded / irregular
Cell wall	Present	Absent
Large vacuole	Present	Absent / very small
Arrangement	Compact, regular	Loose, scattered

1 Plasmolysis



Plasmolysis

When a **living plant cell** is placed in a **concentrated (hypertonic) solution**, water leaves the cell by osmosis and the **protoplasm shrinks away from the cell wall**. This shrinking is called **plasmolysis**.



Why only living cells?

Only a **living cell** can undergo plasmolysis, because only it has an intact, working selectively permeable membrane. A dead cell cannot.

2.2.2 Cell Wall

✦ Cell Wall

A **rigid outer covering** present in **plant cells** (outside the membrane), made mainly of **cellulose**. It gives shape, strength and protection.

- Found in **plants, fungi, bacteria** — **not in animal cells**.
- Made of **cellulose** in plants.
- **Fully permeable** — lets most substances pass.
- Allows cells to withstand changes — resists bursting in dilute solution.

🎯 Exam Alert

Cell **wall** = non-living, fully permeable, cellulose, plants only. Cell **membrane** = living, selectively permeable, all cells. Don't mix them up!

📌 MCQs — Membrane, Osmosis & Wall

1. Cell membrane is: (a) Fully permeable (b) Selectively permeable (c) Impermeable (d) Non-living
2. Osmosis is the movement of: (a) Salt (b) Water (c) Sugar (d) Gas
3. Shrinking of protoplasm is called: (a) Diffusion (b) Osmosis (c) Plasmolysis (d) Endocytosis
4. Cell wall is made of: (a) Protein (b) Lipid (c) Cellulose (d) Starch
5. Fluid Mosaic Model was given by: (a) Hooke (b) Singer & Nicolson (c) Schleiden (d) Virchow
6. Cell wall is: (a) Selectively permeable (b) Fully permeable (c) Impermeable (d) Living

✓ Answers

1-(b), 2-(b), 3-(c), 4-(c), 5-(b), 6-(b)

📌 A-R & Paragraph

1. **A:** Plasmolysis occurs only in living cells. **R:** Only living cells have a working membrane.
2. **A:** Cell wall is fully permeable. **R:** It is made of cellulose.
3. **Para Q:** Define osmosis · Why does a potato cup show water rise? · Difference between cell wall & membrane?

✓ Answers

A-R: 1-(a), 2-(b) | Para: see definitions above · osmosis into concentrated solution · wall = non-living/fully permeable, membrane = living/selectively permeable

2.3 A Cell – A Coordinated Working System

A cell is like a **busy factory**. Different parts (organelles) do different jobs but work together to keep the cell alive.



Big picture

Each organelle has a special role, yet all are **coordinated** — like departments in a factory cooperating to make a final product.

2.3.1 Why Does a Cell Need Organelles?

- To **divide work** — each organelle handles a specific task.
- To keep reactions **separate** so they don't interfere.
- To work **efficiently**, like separate rooms in a factory.



Cell = factory | Organelles = departments

Factory part	Cell organelle
Manager's office	Nucleus
Power house	Mitochondria
Packing & dispatch	Golgi apparatus
Assembly line	Ribosomes / ER
Waste disposal	Lysosomes



Memory Trick

Keep the **factory analogy** in mind — if you can place each organelle into a “department,” you can answer any function question.

1 Nucleus – The Control Centre

✦ Nucleus

A large, membrane-bound organelle that contains the genetic material (DNA) and controls all activities of the cell – the “house of coded instructions.”

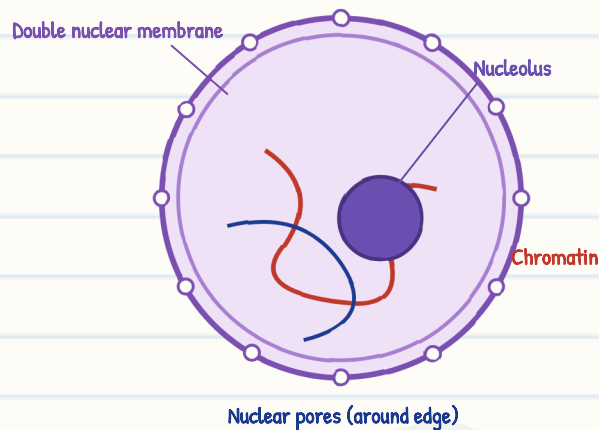


Fig. 2.2 – Structure of the nucleus

- **Nuclear membrane** → double layer with **pores** for exchange.
- **Nucleoplasm** → fluid inside the nucleus.
- **Chromatin** → network of DNA + protein; condenses into **chromosomes** during division.
- **Nucleolus** → makes ribosomes.

📖 NCERT Line

Chromosomes carry **genes**, the units of **heredity**, which transfer characters from parents to offspring. DNA contains all the coded information to build and run the cell.

🎯 Exam Alert

Nucleus functions = **control centre + carries hereditary info + directs cell division**.
Nucleolus makes **ribosomes** — a favourite one-mark question.

2 Cytoplasmic Organelles

Ribosomes

✦ Ribosomes

Tiny granular structures (on ER or free in cytoplasm) that are the **site of protein synthesis** — the “protein factories” of the cell.

Endoplasmic Reticulum (ER)

→ **Rough ER (RER)** → has ribosomes → makes **proteins**.

→ **Smooth ER (SER)** → no ribosomes → makes **fats/lipids**.

→ Acts as a **transport channel** inside the cell.

Golgi Apparatus

✦ Golgi Apparatus

A stack of flattened sacs that **modifies, packs and dispatches** materials (proteins & lipids). It also forms lysosomes. Discovered by **Camillo Golgi**.

Lysosomes

✦ Lysosomes — “Suicide Bags”

Membrane sacs filled with **digestive enzymes**. They digest waste, worn-out organelles and foreign material. On cell damage they burst and digest the cell → **“suicide bags.”**

💡 Memory Trick

Ribosome = pRotein · Golgi = Gift packing · Lysosome = Law & order / clean-up squad.

3 Mitochondria – The Powerhouse

✦ Mitochondria

Double-membraned organelles that release energy as ATP through respiration — the “powerhouse of the cell.”

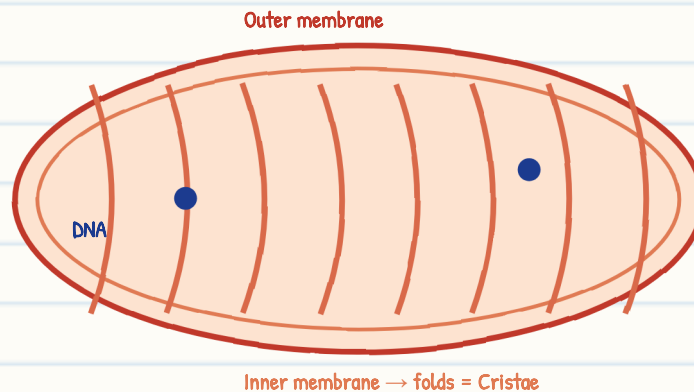


Fig. 2.3 – Mitochondrion (note the folded inner membrane = cristae)

- **Outer membrane** → smooth.
- **Inner membrane** → folded into **cristae** to increase surface area.
- Has its **own DNA & ribosomes** → can make some of its own proteins.

✦ ATP

ATP (adenosine triphosphate) is the **energy currency** of the cell — it stores and supplies energy for cellular activities.

🎯 Exam Alert

Why does mitochondria have its own DNA? → It can synthesise some of its own proteins. Cristae **increase surface area** for more ATP production.

4 Plastids (Plant Cells Only)

✦ Plastids

Double-membraned organelles found **only in plant cells**. They give colour and store food. Three types: chloroplasts, chromoplasts, leucoplasts.

Plastid	Colour / Pigment	Function
Chloroplast	Green (chlorophyll)	Photosynthesis
Chromoplast	Red, yellow, orange	Colour to flowers & fruits
Leucoplast	Colourless	Store starch, oil, protein

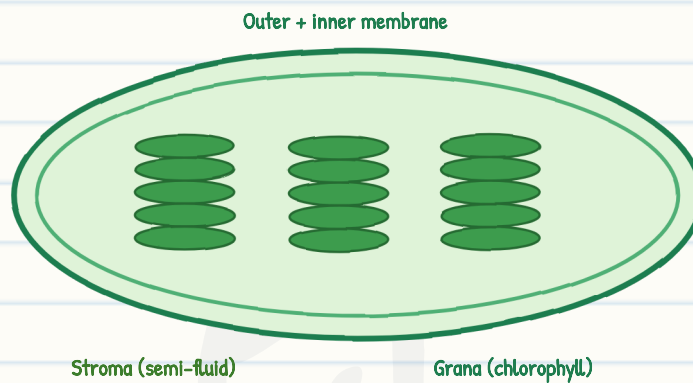


Fig. 2.4 – Chloroplast with grana & stroma

📖 NCERT Line

Chloroplasts contain **chlorophyll**, trap sunlight and carry out **photosynthesis**. Like mitochondria, they have their own **DNA & ribosomes**.

🧠 Memory Trick – “3 C”s of colour

Chloro = green/kitchen (food) · **Chromo** = colour (fruits/flowers) · **Leuco** = colourless store-room (Leuco = white).

5 Vacuoles

✦ Vacuole

A fluid-filled sac bound by a membrane (**tonoplast**). In **plant cells** it is **large & central**; in animal cells small or absent. Stores water, food, waste and gives turgidity (firmness).

→ Plant cell → **one big central vacuole** (up to 90% of cell).

→ Animal cell → **small or absent**.

→ Provides **turgidity & support** to the cell.

Cytoplasm

✦ Cytoplasm

The **jelly-like fluid** between the membrane and the nucleus that holds all organelles and is the site of many chemical reactions.

📌 MCQs – Organelles

1. Powerhouse of the cell: (a) Nucleus (b) Mitochondria (c) Golgi (d) ER
2. Site of protein synthesis: (a) Lysosome (b) Ribosome (c) Vacuole (d) Plastid
3. Suicide bags of the cell: (a) Golgi (b) Lysosomes (c) Ribosomes (d) Plastids
4. Found only in plant cells: (a) Mitochondria (b) Plastids (c) Ribosomes (d) Nucleus
5. Large central vacuole is found in: (a) Animal cell (b) Plant cell (c) Bacteria (d) None
6. Golgi apparatus helps in: (a) Respiration (b) Packing & dispatch (c) Photosynthesis (d) Digestion of food

✓ Answers

1-(b), 2-(b), 3-(b), 4-(b), 5-(b), 6-(b)

📌 A-R & Paragraph

1. **A:** Mitochondria is the powerhouse. **R:** It releases energy as ATP.
2. **A:** Lysosomes are called suicide bags. **R:** They contain digestive enzymes.
3. **A:** Chloroplast performs photosynthesis. **R:** It contains chlorophyll.
4. **Para Q:** Name organelle with own DNA · Function of RER vs SER · Why is vacuole large in plants?

✓ Answers

2.4 How Do Cells Grow and Divide?

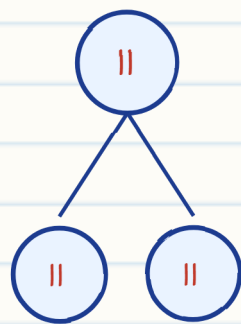
- Cells **grow** by taking in nutrients and making more material.
- When large enough, they **divide** to form new cells.
- Division helps in **growth, repair & reproduction**.



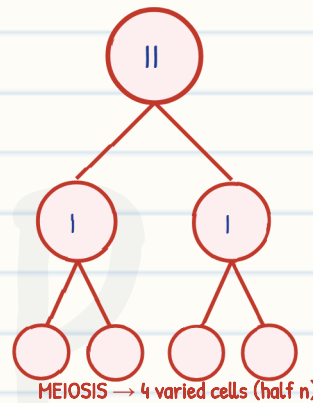
Why do cells divide?

For **growth** (more cells), **repair** (replace damaged cells) and **reproduction** (formation of new individuals).

2.4.1 Cell Division



MITOSIS → 2 identical cells



MEIOSIS → 4 varied cells (half n)

Fig. 2.5 — Mitosis vs Meiosis

Feature	Mitosis	Meiosis
Daughter cells	2	4
Chromosome number	Same as parent ($2n$)	Half of parent (n)
Occurs in	Body (somatic) cells	Reproductive (germ) cells
Purpose	Growth & repair	Formation of gametes
Cells produced	Identical	Genetically varied



Memory Trick

Mitosis = **M**aintain (same number, 2 cells) · **Meiosis** = **M**inus / halve (n number, 4 cells).



Exam Alert

Mitosis → 2 identical diploid cells (growth/repair). Meiosis → 4 varied haploid cells (gametes). The numbers **2 & 4** and **2n & n** are the scoring points.

2.5 Cell Theory

✦ Cell Theory

Proposed by **Schleiden & Schwann (1838–39)** and extended by **Virchow (1855)**.

- All living organisms are made of **cells**.
- The cell is the **basic structural & functional unit** of life.
- All cells arise from **pre-existing cells** — *Omnis cellula e cellula* (Virchow).

📖 NCERT Line – who said what

Schleiden → plants are made of cells. **Schwann** → animals are made of cells. **Virchow** → new cells come from existing cells.

2.5.1 Do Cells Live Forever?

No. Cells have a fixed lifespan and divide a limited number of times. Their growth is controlled by **contact inhibition**.

✦ Contact Inhibition

Normal cells **stop dividing** when they touch neighbouring cells. This keeps growth controlled.

✦ Cancer

When cells **lose contact inhibition**, they keep dividing uncontrollably and form a **tumour**. Such uncontrolled growth is called **cancer**.

💡 Link to remember

Loss of **contact inhibition** → uncontrolled division → **tumour** → **cancer**.



NCERT Exercise – Full Solutions



Q1. Make a sketch of a human nerve cell. What functions do nerve cells perform?

Nerve cell (neuron) has a cell body, dendrites and a long axon. **Function:** receives stimuli and conducts impulses/messages from one part of the body to another — enabling quick response and coordination.



Q2. State the differences between eukaryotic and prokaryotic cells.

Prokaryotic	Eukaryotic
No true nucleus (no nuclear membrane)	True membrane-bound nucleus
No membrane-bound organelles	Membrane-bound organelles present
Single chromosome	More than one chromosome
e.g. bacteria, blue-green algae	e.g. plants, animals, fungi



Q3. Where are proteins synthesised inside the cell?

Proteins are synthesised on the **ribosomes** (found on rough ER or free in cytoplasm).



Q4. Make a comparison and write down ways in which plant cells are different from animal cells.

Plant cell	Animal cell
Cell wall present	Cell wall absent
Plastids present	Plastids absent
Large central vacuole	Small or no vacuole
Fixed rectangular shape	Irregular/rounded shape

 Q5. How is a prokaryotic cell different from a eukaryotic cell?

Prokaryotic cells have no true nucleus and no membrane-bound organelles, while eukaryotic cells have a true nucleus with membrane-bound organelles. (See the full table in Q2.)

 Q6. What would happen if the plasma membrane ruptures or breaks down?

The membrane controls entry and exit of substances. If it ruptures, the cell **cannot regulate exchange**, its contents leak out, and the cell dies.

 Q7. What would happen to the life of a cell if there was no Golgi apparatus?

Without Golgi, the cell could **not modify, pack or dispatch** proteins and lipids. Secretion and storage would fail, and the cell's working would be badly disturbed.

 Q8. Which organelle is the powerhouse of the cell? Why?

Mitochondria — because it releases energy in the form of ATP through respiration, which powers all cell activities.

 Q9. Where do the lipids and proteins constituting the cell membrane get synthesised?

Lipids → synthesised in the **smooth ER (SER)**. **Proteins** → synthesised on the **ribosomes / rough ER (RER)**.

 Q10. How does an Amoeba obtain its food?

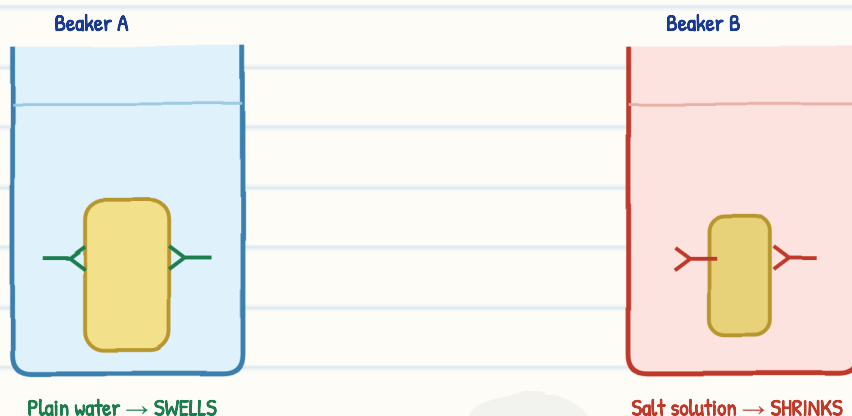
Amoeba captures food using **pseudopodia** (false feet) by a process called **endocytosis** — the flexible plasma membrane engulfs the food particle to form a food vacuole, where it is digested.

 Q11. What is osmosis?

Osmosis is the movement of water molecules across a **selectively permeable membrane** from a region of higher water concentration to lower water concentration.

 **Q12.** Carefully study the diagram of the human nervous – the egg/potato osmosis experiment. Label A, B, C, D and answer.

Set up four hollowed potato cups (A – kept dry/empty; B – one cup with sugar/salt solution; C – boiled potato cup with solution; D – cup with plain water), each placed in a trough of water.



Osmosis experiment with potato cavities

Cup	Observation	Reason
A (empty/dry)	No water collects	No concentration gradient
B (solution, living)	Water rises in cavity	Osmosis — water enters concentrated solution
C (boiled potato)	No osmosis	Boiling kills cells → membrane destroyed
D (plain water)	No rise	No concentration difference

 Frequently Asked

(a) Why is cup A important? → It is the **control**. (b) Why does B show osmosis but C does not? → B is living with an intact membrane; C is boiled (dead) so osmosis cannot occur.

 **Q13.** Which type of cell division is required for growth and repair of body?
Which type is involved in formation of gametes?

Growth & repair → **Mitosis**. Formation of gametes → **Meiosis**.



One-Page Mind Map



CELL – Basic Unit of Life

Branch	Remember as...
Discovery	Hooke (1665), cork, “cells”
Study	Microscope; eye limit 0.1 mm @ 25 cm
3 Parts	Membrane + Cytoplasm + Nucleus
Membrane	Selectively permeable; Fluid Mosaic (Singer & Nicolson)
Movement	Diffusion (any particle) / Osmosis (water) / Plasmolysis
Wall	Plants; cellulose; fully permeable
Organelles	Nucleus · Mito · Plastid · ER · Golgi · Ribosome · Lysosome · Vacuole
Powerhouse	Mitochondria → ATP
Division	Mitosis (2, 2n) / Meiosis (4, n)
Theory	Schleiden, Schwann, Virchow
Cancer	Loss of contact inhibition



Organelle chain – one breath

“Nucleus **M**anages, Mitochondria **P**owers, Plastids **C**olour, ER **T**ransports, Golgi **P**acks, Ribosome **B**uilds protein, Lysosome **C**leans, Vacuole **S**tores.”



Quick Revision Sheet

- Life originated in **water**; first cell linked to CaCO_3 in hot springs.
- Cell = **basic structural & functional unit** of life.
- Discovered by **Robert Hooke (1665)** in **cork**.
- Eye limit of resolution = **0.1 mm**; near point = **25 cm**.
- **Actual size = Image size $\div$ Magnification**.
- 3 parts: **membrane, cytoplasm, nucleus**.
- Membrane = **selectively permeable**; Fluid Mosaic Model (Singer & Nicolson, 1972).
- Diffusion = any particle high $\rightarrow$ low; Osmosis = **water** across selectively permeable membrane.
- Plasmolysis = protoplasm shrinks in hypertonic solution (living cells only).
- Cell wall = **cellulose**, fully permeable, plants only.
- Mitochondria = **powerhouse** (ATP); has own DNA; cristae increase surface area.
- Plastids (plants): chloroplast (green), chromoplast (colour), leucoplast (storage).
- Lysosome = **suicide bag**; Golgi = packing & dispatch; Ribosome = protein.
- Vacuole = large & central in plants $\rightarrow$ turgidity.
- Mitosis $\rightarrow$ 2 identical ($2n$); Meiosis $\rightarrow$ 4 varied (n).
- Cell theory: Schleiden, Schwann, Virchow ("cells from pre-existing cells").
- Cancer = loss of **contact inhibition**.

Last-Minute Revision & Exam Booster

Top one-mark scorers

Hooke-cork-1665 · 0.1 mm / 25 cm · selectively permeable · osmosis = water only · mitochondria = ATP · lysosome = suicide bag · plastids only in plants · mitosis 2 / meiosis 4 · cancer = loss of contact inhibition.

Don't lose marks here

Wall ≠ Membrane · Diffusion ≠ Osmosis · Chromoplast ≠ Chloroplast · image size ≠ actual size · mitosis number same, meiosis number halved.

Rapid Fire (cover answers & test yourself)

Question	Answer
Who discovered cells?	Robert Hooke (1665)
Powerhouse of cell?	Mitochondria
Suicide bags?	Lysosomes
Site of protein synthesis?	Ribosomes
Movement of water across membrane?	Osmosis
Plastid for photosynthesis?	Chloroplast
Cell division for gametes?	Meiosis
Loss of contact inhibition leads to?	Cancer
Cell wall made of?	Cellulose
Fluid Mosaic Model proposed by?	Singer & Nicolson

Final tip

Revise the **four-colour mind map** + this rapid-fire table the night before. These cover almost every objective question asked from this chapter.

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