NEET BIOLOGY · CLASS 11 · CHAPTER 8

Cell: The Unit of Life

Every organelle, drawn and explained

A cell is a tiny factory. Learn what each part does, and you can answer questions you have never seen.

11 diagrams | 14 worked questions | 22 quick-review cards | Fact sheet

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0 How to Read This Set

- Read each section once, slowly. Then look at its diagram and name every part without the labels.
- Orange boxes are traps. NEET loves them. Read every one.
- Questions after each section are NEET level. Try each one before reading the answer.
- The Quick Review at the end lists what NEET repeats. Use it in the last week, not the first.
- The Fact Sheet is one page. Keep it for the night before the exam.

WHAT NEET 2026 ASKS FROM THIS CHAPTER

The NMC syllabus for NEET UG 2026 starts with cell theory and the cell as the basic unit of life. It then lists prokaryotic and eukaryotic cells, and plant and animal cells. It names the cell envelope, cell membrane and cell wall. It covers the structure and function of organelles.

Organelles named are ER, Golgi bodies, lysosomes, vacuoles, mitochondria, ribosomes, plastids and microbodies. Cytoskeleton, cilia, flagella, centrioles and the nucleus are also included. These notes cover all of it, and nothing outside NCERT.

PYQ ANALYSIS **See how NEET tested this chapter from 2015 to 2025** →

We analysed 55 NEET questions from 2015 to 2025. This chapter gave about 4 to 5 questions a year. Prokaryotic cell structure was the most tested topic.

01 What Is a Cell, and Cell Theory

IN NEET REPEATS OFTEN *6 cell theory questions; Virchow's credit alone, 3 times.*

Points

- A cell is the smallest unit that can live on its own.
- A one-celled organism does every job of life inside that single cell.
- Anything less than a full cell cannot live independently.
- Antonie Von Leeuwenhoek first saw and described a live cell.
- Robert Brown later discovered the nucleus.

Who added what

- **Matthias Schleiden (1838), a German botanist.** He studied many plants. He saw that all plants are made of different kinds of cells. These cells form the tissues of the plant.
- **Theodore Schwann (1839).** He studied many animal cells. He reported a thin outer layer on cells, now called the plasma membrane.
- Schwann also concluded that the cell wall is unique to plant cells.
- He proposed that the bodies of animals and plants are made of cells and products of cells.
- Schleiden and Schwann together formulated the cell theory.
- **Their gap:** the theory did not explain how new cells are formed.
- **Rudolf Virchow (1855)** explained it. Cells divide, and new cells form from pre-existing cells.
- He wrote it as *Omnis cellula-e cellula*.
- Virchow modified the cell theory into its final form.

Cell theory as understood today

1. All living organisms are composed of cells and products of cells.
2. All cells arise from pre-existing cells.



TRAP ALERT

TRAP ALERT

- "Cells arise from pre-existing cells" is Virchow's idea, not Schleiden's or Schwann's. NEET has tested this exact credit swap more than once.



THINK IT THROUGH

SANITY CHECK

- The current NCERT calls Schwann "a German Zoologist". Older editions said British. In the exam, go with the current NCERT sentence. It is the source NEET follows.

Q1 Assertion-Reason

LEVEL 2

Assertion (A): The cell theory of Schleiden and Schwann could not explain how new cells are formed.

Reason (R): Rudolf Virchow showed that cells divide and new cells form from pre-existing cells.

1. Both A and R are true and R is the correct explanation of A
2. Both A and R are true but R is not the correct explanation of A
3. A is true but R is false
4. A is false but R is true

Answer: 2

CORE PRINCIPLE Both are NCERT facts. But R is later work that filled the gap. It does not explain why the gap existed.

TRAP Option 1 is the shortcut answer. Two true statements that sound linked are not always cause and effect. Ask: "Does R tell me *why* A is true?" Here it does not.

02 An Overview of Cells: Size and Shape

IN NEET

Points

- Onion cells, a plant cell, have a distinct cell wall outside the cell membrane.
- Human cheek cells, an animal cell, have only an outer membrane as the boundary.
- Inside each cell is a dense, membrane-bound structure called the **nucleus**.
- The nucleus holds the chromosomes, which carry the genetic material, DNA.
- **Eukaryotic cells** have a membrane-bound nucleus.
- **Prokaryotic cells** lack a membrane-bound nucleus.
- In both, a semi-fluid matrix called **cytoplasm** fills the cell.
- Cytoplasm is the main arena of cell activity in plant and animal cells.
- Eukaryotic cells also have membrane-bound organelles: ER, Golgi complex, lysosomes, mitochondria, microbodies and vacuoles.
- Prokaryotic cells lack such membrane-bound organelles.
- **Ribosomes** are non-membrane-bound. They occur in all cells, prokaryotic and eukaryotic.
- In eukaryotes, ribosomes are found in the cytoplasm, chloroplasts, mitochondria and on rough ER.
- Animal cells have another non-membrane-bound organelle, the **centrosome**, which helps in cell division.

Size

CELL	SIZE GIVEN IN NCERT
Mycoplasma (smallest cells)	0.3 µm in length
Bacteria	3 to 5 µm
Human red blood cell	about 7.0 µm in diameter
Ostrich egg	largest isolated single cell
Nerve cells	some of the longest cells

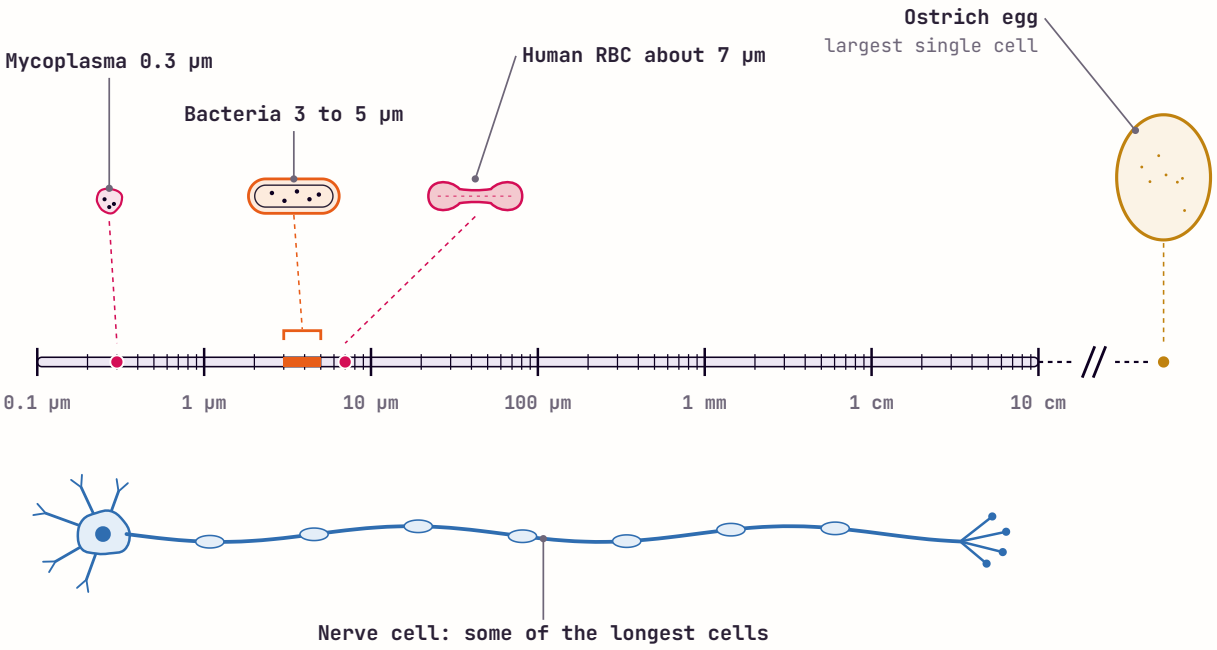


Fig 1 · Cell size scale. Mycoplasma is smallest, the ostrich egg is the largest single cell.

Shape

- Cells may be disc-like, polygonal, columnar, cuboid, thread-like or irregular.
- Shape varies with function.



THINK IT THROUGH

SANITY CHECK

- "Smallest cell" is Mycoplasma at 0.3 µm. "Largest single cell" is the ostrich egg. "Longest cells" are nerve cells. Three superlatives, three different cells.

Q2 Numerical

LEVEL 2

A student places Mycoplasma cells in a straight line, end to end, across one human red blood cell. Use NCERT sizes. About how many Mycoplasma cells fit across the RBC's diameter?

1. 0.04
2. 2
3. 23
4. 230

Answer: 3

CORE PRINCIPLE Mycoplasma is 0.3 µm long. A human RBC is about 7.0 µm across. Math: 7.0 ÷ 0.3 ≈ 23.

TRAP Option 1 divides the wrong way round, 0.3 ÷ 7.0. Option 2 uses a bacterium's 3 µm instead of Mycoplasma. Option 4 slips a decimal place.

03 Prokaryotic Cells

IN NEET | ALMOST EVERY YEAR *13 questions, the most tested topic in this chapter.*

Who they are

- Prokaryotic cells are bacteria, blue-green algae, mycoplasma and PPLO (Pleuro Pneumonia Like Organisms).
- They are usually smaller than eukaryotic cells.
- They multiply more rapidly.
- They vary greatly in shape and size.
- Bacteria have four basic shapes: bacillus (rod), coccus (spherical), vibrio (comma) and spirillum (spiral).

Inside the cell

- All prokaryotes have a cell wall around the cell membrane. Mycoplasma is the exception.
- The fluid matrix filling the cell is the cytoplasm.
- There is no well-defined nucleus.
- The genetic material is basically naked. It is not enveloped by a nuclear membrane.
- Many bacteria also have small circular DNA outside the genomic DNA. These are **plasmids**.
- Plasmids give bacteria special traits. One example is resistance to antibiotics.
- Plasmid DNA is used to monitor bacterial transformation with foreign DNA. (You will meet this again in Biotechnology.)
- There are no membrane-bound organelles like those in eukaryotes. Ribosomes are present.

The mesosome

- A **mesosome** is a special membranous structure. It forms when the cell membrane folds inward.
- It takes the form of vesicles, tubules and lamellae.
- **Functions:** cell wall formation, DNA replication and distribution to daughter cells, respiration and secretion.
- It also increases the surface area of the plasma membrane and its enzymatic content.



TRAP ALERT

TRAP ALERT

- A mesosome is an infolding of the plasma membrane. It is not a separate membrane-bound organelle. Mesosome functions are the single most repeated concept in this chapter: 5 questions in our data.

- In some prokaryotes like cyanobacteria, membranous extensions into the cytoplasm contain pigments. These are **chromatophores**.

The cell envelope

- Most prokaryotes, especially bacteria, have a chemically complex cell envelope.
- It has three tightly bound layers, from outside in:

  1. **Glycocalyx**, the outermost layer
  2. **Cell wall**
  3. **Plasma membrane**

- Each layer has a distinct function, but together they act as one protective unit.
- The glycocalyx differs between bacteria in composition and thickness.
  - A loose sheath is called a **slime layer**.
  - A thick, tough layer is called a **capsule**.
- The cell wall decides the cell's shape. It gives strong structural support so the bacterium does not burst or collapse.
- The plasma membrane is semi-permeable. It interacts with the outside world.
- It is structurally similar to the membrane of eukaryotes.

- **Gram staining.** Bacteria differ in their cell envelopes and in how they respond to Gram's stain.
  - Bacteria that take up the stain are **Gram positive**.
  - Those that do not are **Gram negative**.

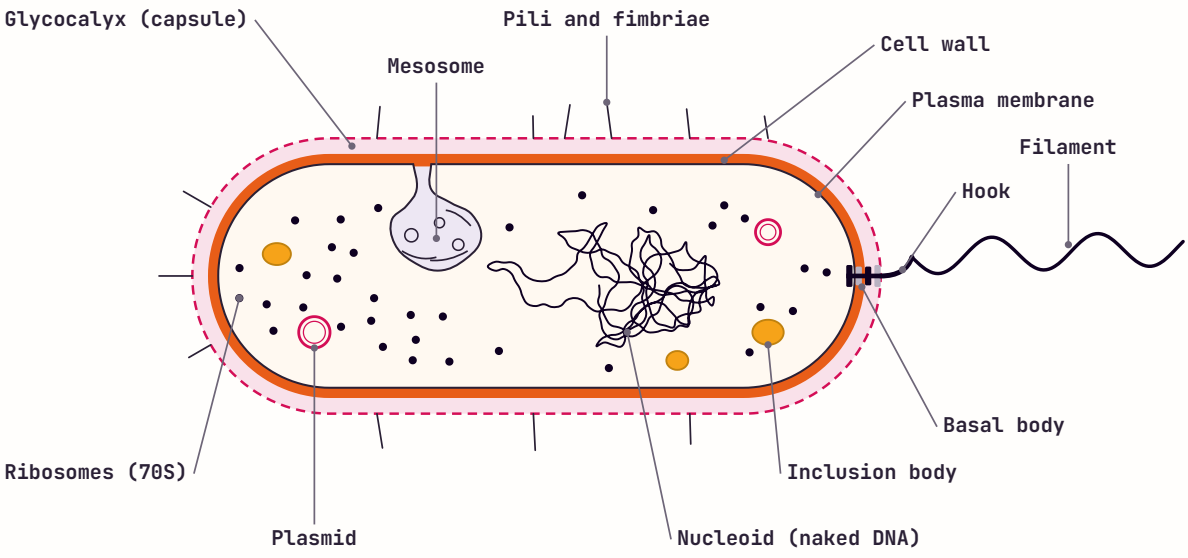


Fig 2 · Bacterial cell in cross-section. Three envelope layers act as one protective unit.



HAVING DIFFICULTY VISUALISING THE ENVELOPE LAYERS?

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SCAN

Surface structures

- Motile bacteria have thin filamentous extensions called **flagella**.
- A bacterial flagellum has three parts: **filament, hook and basal body**.
- The filament is the longest part. It extends from the cell surface outward.
- **Pili** are elongated tubular structures made of a special protein.
- **Fimbriae** are small bristle-like fibres sprouting out of the cell.
- In some bacteria, fimbriae help attach to rocks in streams and to host tissues.



TRAP ALERT

TRAP ALERT

- Pili and fimbriae do not help in movement. Only flagella do.

Ribosomes and inclusion bodies

- Prokaryotic ribosomes are associated with the plasma membrane.

- Each is about 15 nm by 20 nm in size.
- Each has two subunits, 50S and 30S, which together form a **70S** ribosome.
- Ribosomes are the site of protein synthesis.
- Several ribosomes may attach to a single mRNA and form a chain called a **polyribosome** or **polysome**.
- The ribosomes of a polysome translate the mRNA into proteins.
- Reserve material is stored in **inclusion bodies**.
- Inclusion bodies are not bound by any membrane. They lie free in the cytoplasm.
- Examples: phosphate granules, cyanophycean granules and glycogen granules.
- **Gas vacuoles** are found in blue-green, purple and green photosynthetic bacteria.

Q3 Multi-statement

LEVEL 2

Read these statements about mesosomes.

(a) They are infoldings of the plasma membrane.

(b) They help in cell wall formation.

(c) They help in DNA replication and its distribution to daughter cells.

(d) They are bounded by a double membrane, like mitochondria.

(e) They increase the surface area of the plasma membrane.

Choose the correct answer from the options given below.

1. (a), (b), (c) and (e) only
2. (a), (b), (c) and (d) only
3. (b), (c), (d) and (e) only
4. (a) and (d) only

Answer: 1

CORE PRINCIPLE A mesosome is a fold of the plasma membrane. NCERT lists its jobs: wall formation, DNA replication and distribution, respiration, secretion and more surface area.

TRAP (d) is false. Students link "respiration" to mitochondria and wrongly give mesosomes a double membrane. Options 2, 3 and 4 all include (d).

Q4 Match the Column

LEVEL 2

COLUMN I	COLUMN II
A. Glycocalyx as a loose sheath	I. Attachment to rocks in streams and host tissues
B. Cell wall	II. Slime layer
C. Fimbriae	III. Stores reserve material without a membrane
D. Inclusion body	IV. Decides cell shape and prevents bursting

Choose the correct answer from the options given below.

1. A-II, B-IV, C-III, D-I
2. A-IV, B-II, C-I, D-III
3. A-II, B-IV, C-I, D-III
4. A-I, B-IV, C-II, D-III

Answer: 3

CORE PRINCIPLE A loose glycocalyx is a slime layer. The wall gives shape and support. Fimbriae help attachment. Inclusion bodies store reserves, with no membrane.

TRAP Option 1 swaps fimbriae and inclusion bodies. Option 2 swaps glycocalyx and cell wall, the two outer layers. Option 4 treats the slime layer as an attachment structure.

READ NEXT **how cell structure separates the five kingdoms** →

04 Eukaryotic Cells: Plant vs Animal

IN NEET

Points

- Eukaryotic cells are found in protists, plants, animals and fungi.
- Membrane-bound organelles divide the cytoplasm into compartments.
- They have an organised nucleus with a nuclear envelope.
- They have a complex locomotory and cytoskeletal structure.
- Their genetic material is organised into chromosomes.

Plant cell vs animal cell

FEATURE	PLANT CELL	ANIMAL CELL
Cell wall	Present	Absent
Plastids	Present	Absent
Large central vacuole	Present	Absent
Centrioles	Absent in almost all plant cells	Present

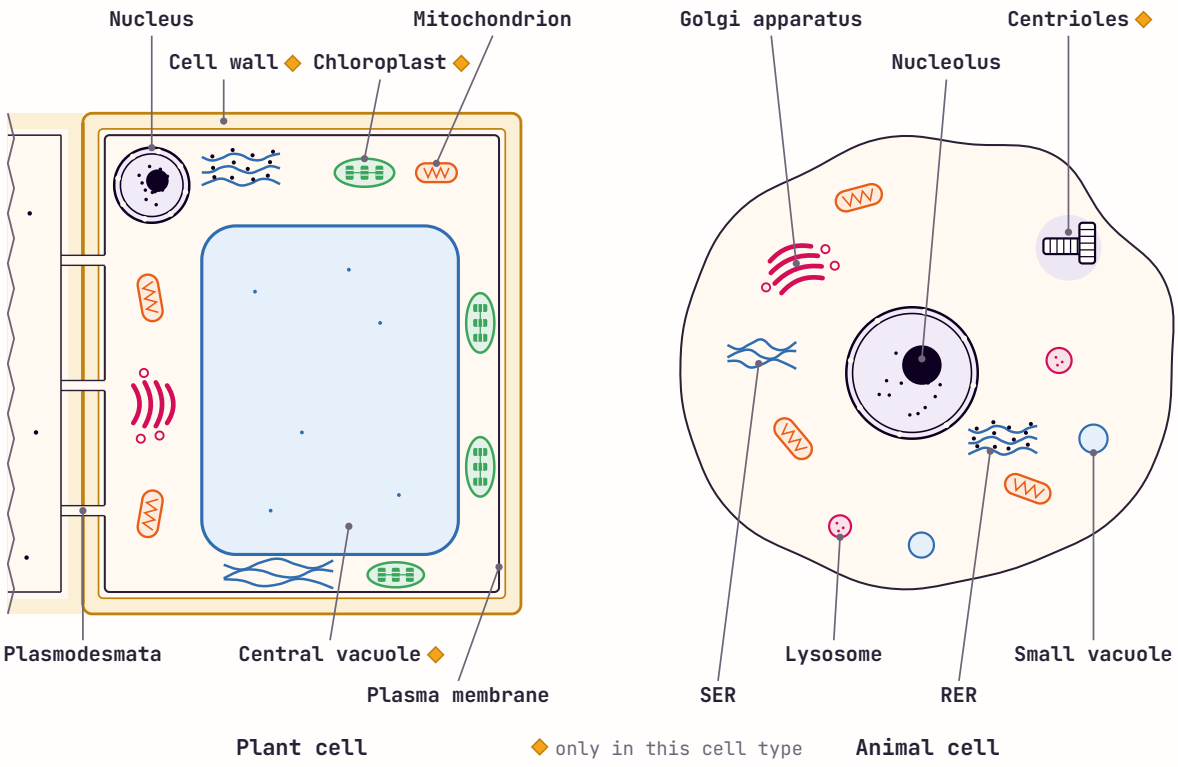


Fig 4 · Plant cell and animal cell. Wall, plastids and a big vacuole mark the plant cell; centrioles mark the animal cell.



TRAP ALERT

TRAP ALERT

- NCERT says centrioles are absent in **almost all** plant cells, not all. An option saying "never present in any plant cell" is an absolute claim. Treat such options with suspicion.

05 The Cell Membrane

IN NEET | SEEN SEVERAL TIMES | *3 questions.*

Composition

- Its detailed structure was studied after the electron microscope arrived in the 1950s.
- Chemical studies used human red blood cells (RBCs).
- They showed the membrane is mainly lipids arranged in a **bilayer**.
- The polar heads face the outer sides. The hydrophobic tails face the inside.
- So the non-polar tails stay protected from the watery surroundings.
- The lipids are mainly phosphoglycerides.
- The membrane also has cholesterol.
- It also has proteins and carbohydrates.
- The ratio of protein to lipid varies in different cell types.
- In the human erythrocyte membrane: about **52% protein and 40% lipids**.
- **Peripheral proteins** lie on the membrane surface.
- **Integral proteins** are partly or totally buried in the membrane.

The fluid mosaic model

- Proposed by **Singer and Nicolson (1972)**. It is the widely accepted model.
- The lipid is quasi-fluid in nature.
- This lets proteins move sideways within the overall bilayer.
- This ability to move is called the membrane's **fluidity**.
- Fluidity matters for cell growth, intercellular junctions, secretion, endocytosis and cell division.

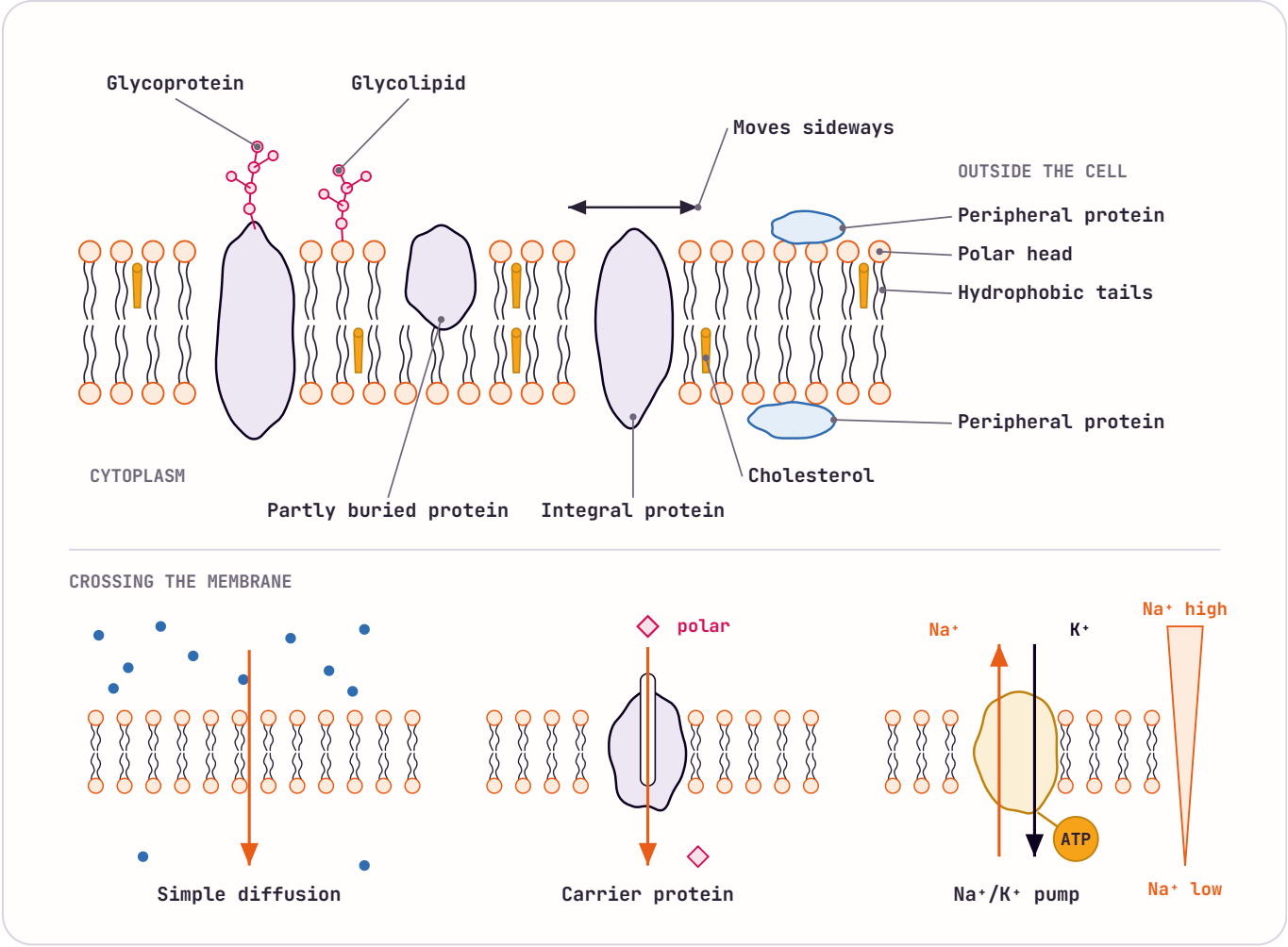


Fig 5 · Fluid mosaic membrane. Proteins drift sideways in a quasi-fluid lipid bilayer.

MYTH

A membrane is a fixed, rigid wall.

SCIENCE

Its lipids are quasi-fluid. Proteins drift sideways through the bilayer, which is exactly why it is called "fluid".

Transport across the membrane

- The membrane is **selectively permeable**. Some molecules cross it; others do not.
- **Passive transport:** molecules move without using energy.
- Neutral solutes may cross by simple diffusion, from higher to lower concentration.
- Water also moves by diffusion, from higher to lower concentration. Movement of water by diffusion is **osmosis**.
- Polar molecules cannot pass through the non-polar lipid bilayer. They need a **carrier protein**.
- **Active transport:** a few ions or molecules move against the concentration gradient.
- This uses energy from ATP. Example: the **Na^+/K^+ pump**.

Q5 Statement I / Statement II

LEVEL 2

Statement I: Polar molecules cross the lipid bilayer easily by simple diffusion.

Statement II: The Na^+/K^+ pump moves ions against their concentration gradient using ATP.

1. Both Statement I and Statement II are true
2. Both Statement I and Statement II are false
3. Statement I is true but Statement II is false
4. Statement I is false but Statement II is true

Answer: 4

CORE PRINCIPLE The bilayer's core is non-polar. So polar molecules need carrier proteins. Moving against a gradient needs energy, which ATP supplies.

TRAP Option 1 assumes everything small diffuses freely. Only neutral solutes cross by simple diffusion.

06 The Cell Wall

IN NEET WATCH LIST *Cross-chapter link to Biomolecules flagged in our data.*

Points

- The cell wall is a non-living, rigid structure.
- It covers the plasma membrane of fungi and plants from outside.
- It gives shape to the cell and protects it from mechanical damage and infection.
- It helps in cell-to-cell interaction.
- It is a barrier to unwanted macromolecules.
- **Algal cell wall:** cellulose, galactans, mannans and minerals like calcium carbonate.
- **Other plants:** cellulose, hemicellulose, pectins and proteins.
- The **primary wall** belongs to a young plant cell and can grow.
- This growth slowly stops as the cell matures.
- The **secondary wall** then forms on the inner side, towards the membrane.
- The **middle lamella** is a layer mainly of calcium pectate. It holds neighbouring cells together.
- **Plasmodesmata** cross the cell wall and middle lamella. They connect the cytoplasm of neighbouring cells.



TRAP ALERT

TRAP ALERT

- The secondary wall forms on the **inner** side, between the primary wall and the membrane. Students often place it outside, because "secondary" sounds like "added on top".

Q6 Multi-statement

LEVEL 2

Which of these statements about the plant cell wall are correct?

(a) The middle lamella is made mainly of calcium pectate.

(b) The secondary wall forms on the outer side of the primary wall.

(c) The primary wall of a young cell is capable of growth.

(d) Plasmodesmata connect the cytoplasm of neighbouring cells.

(e) Algal cell walls may contain calcium carbonate.

Choose the correct answer from the options given below.

1. (a), (b) and (d) only
2. (b), (c) and (e) only
3. (a), (c) and (d) only
4. (a), (c), (d) and (e) only

Answer: 4

CORE PRINCIPLE NCERT gives the middle lamella's chemistry, the growing primary wall, plasmodesmata and the algal wall minerals.

TRAP (b) is the classic position error. Option 3 is the "stopped early" answer: it misses (e), the algal-wall detail.

07 The Endomembrane System

IN NEET

What is in it, and what is not

- Many membranous organelles are distinct in structure and function.
- Some of them have **coordinated functions**. These form the **endomembrane system**.
- **Included:** endoplasmic reticulum (ER), Golgi complex, lysosomes and vacuoles.
- **Not included:** mitochondria, chloroplasts and peroxisomes.
- Why? Their functions are not coordinated with the four above.



TRAP ALERT

TRAP ALERT

- "Membrane-bound" does not mean "endomembrane". Mitochondria and chloroplasts have two membranes, yet they are outside the system. Peroxisome exclusion has appeared as a NEET question on its own.

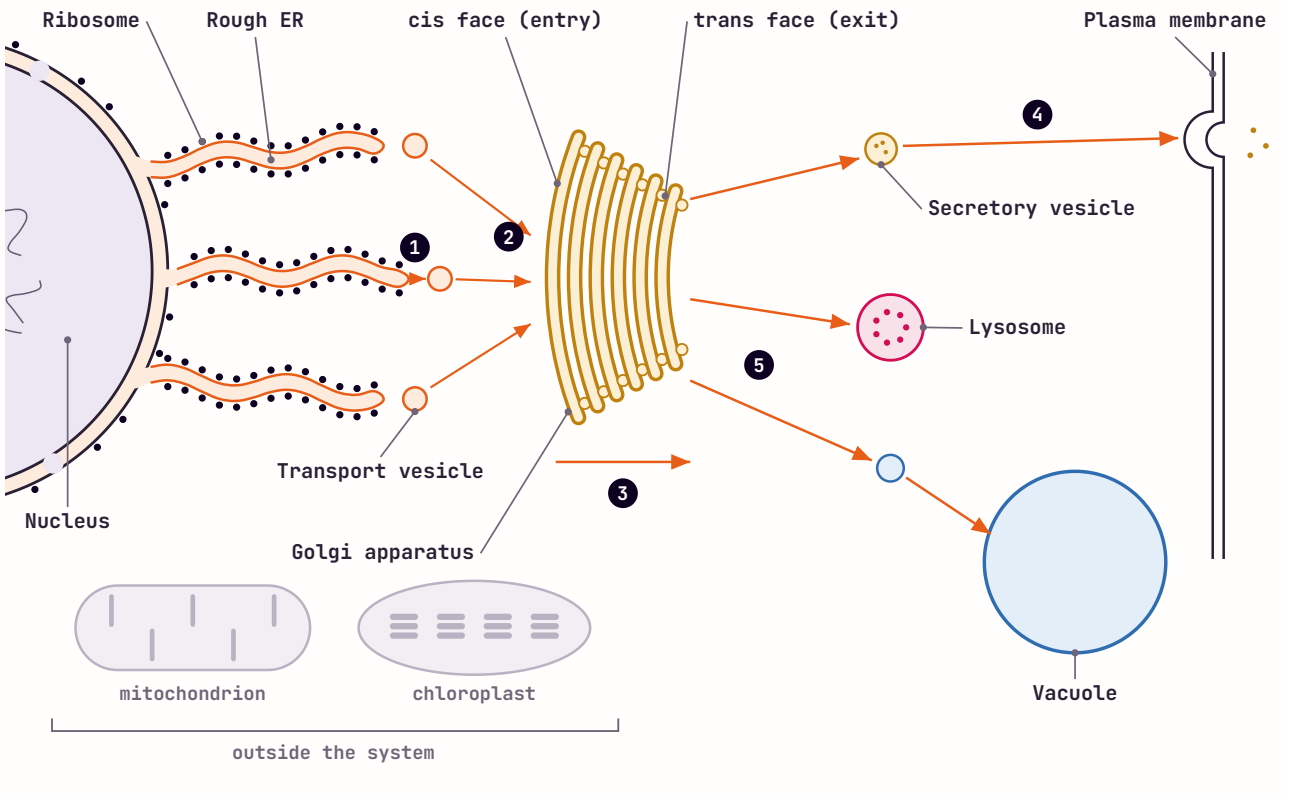


Fig 6 · Endomembrane flow. Vesicles enter at the cis face and leave from the trans face.



HAVING DIFFICULTY VISUALISING HOW A PROTEIN TRAVELS FROM ER TO OUTSIDE THE CELL?

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SCAN

Endoplasmic reticulum (ER)

REPEATS OFTEN *5 questions.*

- The ER is a network of tiny tubules scattered in the cytoplasm.
- It divides the space inside the cell into two compartments.
  - **Luminal:** inside the ER.
  - **Extra luminal:** the cytoplasm.
- ER with ribosomes on its outer surface is **rough ER (RER)**.
- ER without ribosomes looks smooth. It is **smooth ER (SER)**.
- RER is common in cells busy with protein synthesis and secretion.
- RER is extensive and continuous with the outer membrane of the nucleus.
- SER is the major site for **lipid synthesis**.
- In animal cells, lipid-like **steroidal hormones** are made in SER.



THINK IT THROUGH

SANITY CHECK

- Ribosomes make proteins, so RER is the protein line. SER has no ribosomes, so it makes lipids. Structure tells you function.

Golgi apparatus

REPEATS OFTEN *9 questions, second most tested topic.*

- **Camillo Golgi (1898)** first saw densely stained net-like structures near the nucleus. These were later named Golgi bodies.
- They are many flat, disc-shaped sacs called **cisternae**.
- Each cisterna is 0.5 µm to 1.0 µm in diameter.
- The cisternae are stacked parallel to each other.
- The number of cisternae in a Golgi complex varies.
- They are arranged concentrically near the nucleus.
- The stack has a convex **cis face** (forming face) and a concave **trans face** (maturing face).

- The cis and trans faces are entirely different, but they are interconnected.
- **Main job:** packaging materials, for delivery inside the cell or for secretion outside it.
- Vesicles from the ER fuse with the **cis face**.
- The materials then move towards the **trans face**.
- So the Golgi stays closely associated with the ER.
- Proteins made by ribosomes on the ER are modified in the cisternae, then released from the trans face.
- The Golgi is the important site where **glycoproteins and glycolipids** are formed.



TRAP ALERT

TRAP ALERT

- ER vesicles enter at the **cis** face and leave from the **trans** face. Remember: **c**is **c**omes in. In our data, Golgi glycoprotein and glycolipid formation was tested 4 times.

Lysosomes

- Lysosomes are membrane-bound vesicles formed by packaging in the Golgi.
- Isolated lysosomes are rich in almost all types of hydrolytic enzymes, the **hydrolases**: lipases, proteases and carbohydrases.
- These enzymes work best at **acidic pH**.
- They can digest carbohydrates, proteins, lipids and nucleic acids.

Vacuoles

WATCH LIST *Tonoplast transport is in our NEET 2026 predictions.*

- A vacuole is a membrane-bound space in the cytoplasm.
- It contains water, sap, excretory products and materials the cell does not need.
- It is bound by a single membrane called the **tonoplast**.
- In plant cells, vacuoles can occupy up to **90%** of the cell's volume.
- In plants, the tonoplast moves ions and other materials **against** their concentration gradient into the vacuole.
- So their concentration is much higher in the vacuole than in the cytoplasm.
- In Amoeba, the **contractile vacuole** helps in osmoregulation and excretion.
- In many protists, **food vacuoles** form when they engulf food particles.

Q7 Counting

LEVEL 2

How many of the following are part of the endomembrane system?

Endoplasmic reticulum, Golgi complex, lysosome, vacuole, mitochondrion, chloroplast, peroxisome, ribosome

1. Three
2. Four
3. Five
4. Six

Answer: 2

CORE PRINCIPLE Only ER, Golgi, lysosomes and vacuoles have coordinated functions. That makes four.

TRAP Option 3 adds the peroxisome because it is membrane-bound. Option 4 adds mitochondria and chloroplasts for the same reason. Option 1 forgets the vacuole. The ribosome has no membrane at all.

Q8 Statement I / Statement II

LEVEL 2

Statement I: Vesicles from the ER fuse with the trans face of the Golgi apparatus.

Statement II: The Golgi apparatus is an important site for forming glycoproteins and glycolipids.

1. Both Statement I and Statement II are true
2. Both Statement I and Statement II are false
3. Statement I is true but Statement II is false
4. Statement I is false but Statement II is true

Answer: 4

CORE PRINCIPLE ER vesicles fuse with the cis (forming) face. Products leave from the trans (maturing) face.

TRAP Option 1 is for students who mix up cis and trans. Statement II is a direct NCERT line.

Q9 Concept application

LEVEL 2

In a plant cell, some ions are far more concentrated in the vacuole than in the cytoplasm. Which explains this best?

1. Ions diffuse freely into the vacuole through the tonoplast.
2. Water leaves the vacuole by osmosis, which concentrates the ions.
3. The tonoplast transports ions against their concentration gradient into the vacuole.
4. The contractile vacuole pumps ions into the central vacuole.

Answer: 3

CORE PRINCIPLE NCERT states the tonoplast moves ions against the gradient. That is how the vacuole builds up a higher concentration.

TRAP Option 1 is impossible: diffusion only moves things down a gradient. Option 2 confuses water movement with ion movement. Option 4 borrows the contractile vacuole from Amoeba and puts it in a plant cell.

08 Mitochondria and Plastids

IN NEET | REPEATS OFTEN | *Mitochondria 6, plastids 6.*

Mitochondria

- Mitochondria are hard to see under the microscope unless specially stained.
- Their number per cell depends on the cell's physiological activity.
- They are sausage-shaped or cylindrical.
- Diameter: 0.2 to 1.0 µm (average 0.5 µm). Length: 1.0 to 4.1 µm.
- Each mitochondrion is a **double membrane-bound** structure.
- The outer and inner membranes divide its space into two watery compartments.
  - The **outer compartment**.
  - The **inner compartment**, called the **matrix**.
- The outer membrane forms a continuous boundary around the organelle.
- The inner membrane folds into the matrix. These folds are **cristae**.
- Cristae increase the surface area.
- Each membrane has its own specific enzymes.
- Mitochondria are the sites of **aerobic respiration**.
- They produce cellular energy as ATP. So they are called the "power houses" of the cell.
- The matrix has a single **circular DNA** molecule, a few RNA molecules and **70S ribosomes**.
- It also has the components needed to make proteins.
- Mitochondria divide by **fission**.

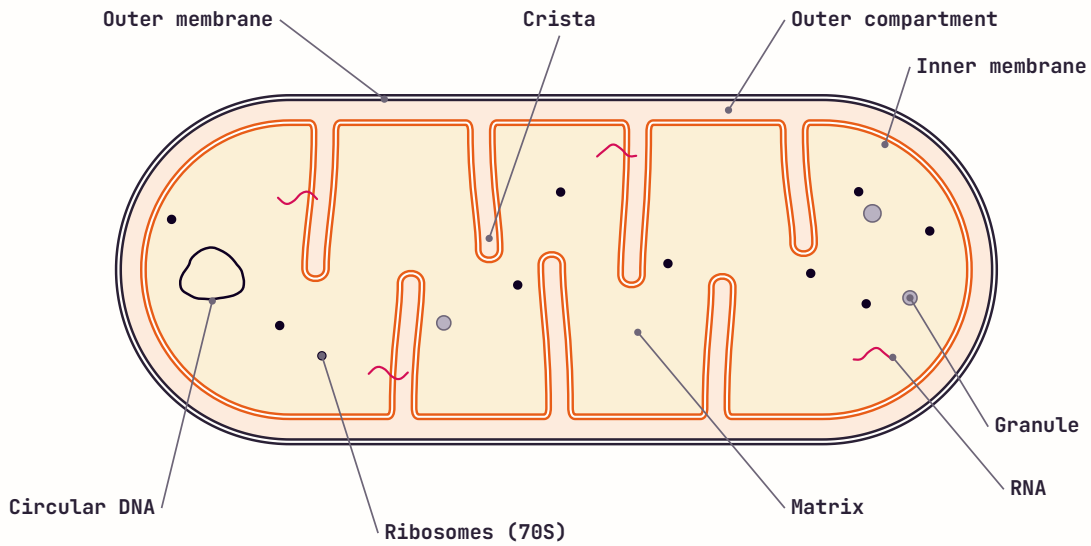


Fig 7 · Mitochondrion cut open. Cristae fold the inner membrane to increase surface area.

Plastids

- Plastids are found in all plant cells and in euglenoides.
- They are easily seen under the microscope, as they are large.
- Each type bears specific pigments, which give plants their colours.
- There are three types by pigment:

TYPE	WHAT IT HOLDS	EXAMPLE OR ROLE
Chloroplasts	Chlorophyll and carotenoid pigments	Trap light energy for photosynthesis
Chromoplasts	Fat-soluble carotenoids: carotene, xanthophylls	Yellow, orange or red colour
Leucoplasts	Colourless; store nutrients	See below

- **Leucoplasts by what they store:**
  - **Amyloplasts** store carbohydrates (starch). Example: potato.
  - **Elaioplasts** store oils and fats.
  - **Aleuroplasts** store proteins.



THINK IT THROUGH

SANITY CHECK

- Link each store to its word: **amyl**o = starch, **elaio** = oil, **aleur**o = protein.

Chloroplasts in detail

- Most chloroplasts of green plants lie in the **mesophyll cells** of leaves.
- They may be lens-shaped, oval, spherical, discoid or ribbon-like.
- Length: 5 to 10 µm. Width: 2 to 4 µm.
- Their number varies. Chlamydomonas, a green alga, has **one per cell**.
- Mesophyll cells have **20 to 40 per cell**.
- Chloroplasts are double membrane-bound.
- The inner membrane is relatively less permeable.
- The space inside the inner membrane is the **stroma**.
- The stroma holds flattened membranous sacs called **thylakoids**.
- Thylakoids are stacked like piles of coins. Each stack is a **granum** (plural: grana).
- Flat membranous tubules called **stroma lamellae** connect thylakoids of different grana.
- The thylakoid membrane encloses a space called the **lumen**.
- The stroma holds enzymes needed to make carbohydrates and proteins.
- It also holds small, double-stranded circular DNA and ribosomes.
- **Chlorophyll pigments are in the thylakoids.**
- Chloroplast ribosomes are **70S**. They are smaller than cytoplasmic ribosomes, which are 80S.

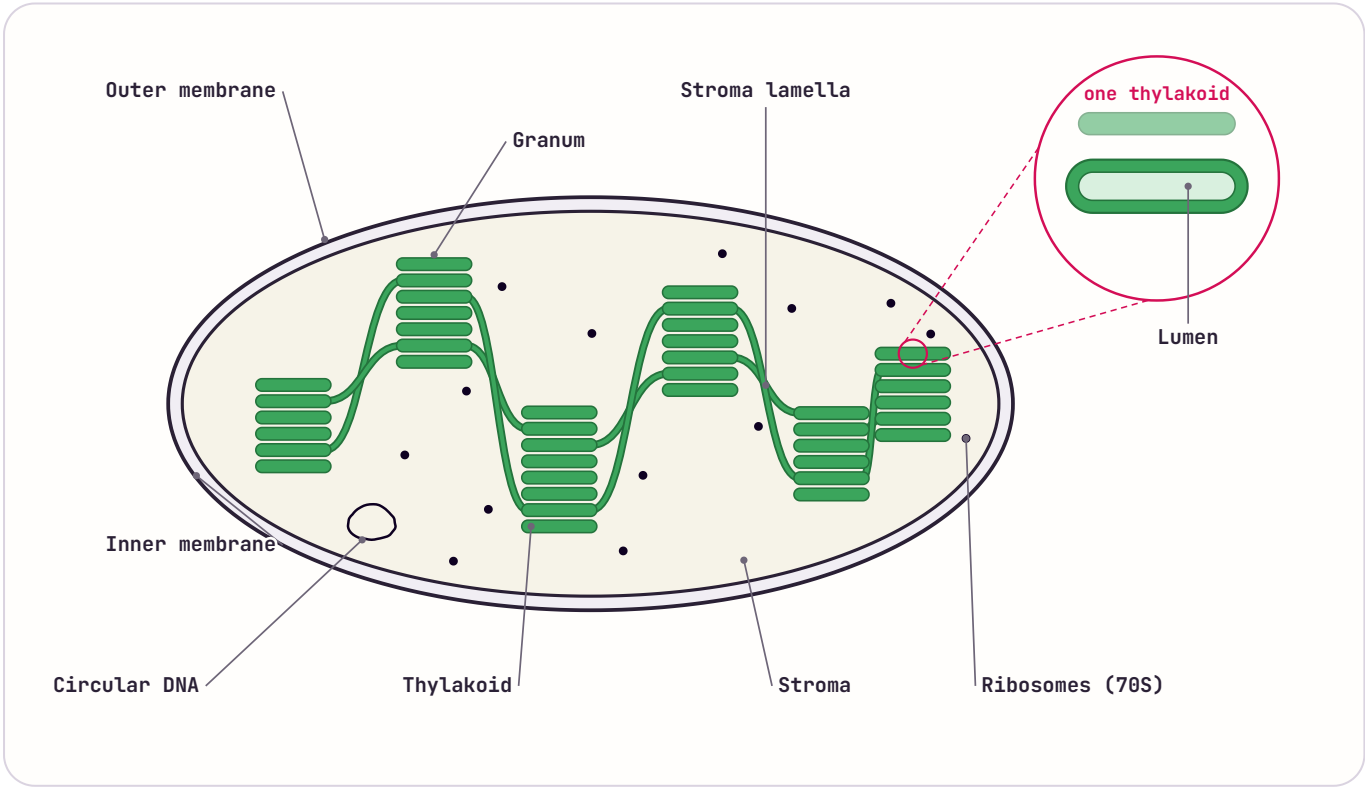


Fig 8 · Chloroplast cut open. Chlorophyll sits in the thylakoids; enzymes and DNA sit in the stroma.

Q10 Multi-statement

LEVEL 2

Which features are common to **both** mitochondria and chloroplasts?

(a) A double membrane

(b) Their own circular DNA

(c) 70S ribosomes

(d) An inner membrane folded into cristae

(e) Membership of the endomembrane system

Choose the correct answer from the options given below.

1. (a), (b) and (c) only
2. (a), (b), (c) and (d) only
3. (a) and (d) only
4. (b), (c) and (e) only

Answer: 1

CORE PRINCIPLE Both organelles are double membrane-bound. Both carry circular DNA and 70S ribosomes, so both can make some of their own proteins.

TRAP Cristae belong only to mitochondria; chloroplasts have thylakoids instead. Neither organelle is in the endomembrane system.

NOTES **Biomolecules Class 11 notes: what these organelles are built from** →

09 Ribosomes and the Cytoskeleton

IN NEET | REPEATS OFTEN | *Ribosomes, 8 questions. Cytoskeleton, seen several times (4 questions).*

Ribosomes

- Ribosomes are granular structures.
- **George Palade (1953)** first saw them under the electron microscope as dense particles.
- They are made of **RNA and proteins**.
- They are **not surrounded by any membrane**.
- Eukaryotic ribosomes are **80S**. Prokaryotic ribosomes are **70S**.
- Each ribosome has two subunits, a larger one and a smaller one.

RIBOSOME	LARGER SUBUNIT	SMALLER SUBUNIT
80S (eukaryotic cytoplasm)	60S	40S
70S (prokaryotes, mitochondria, chloroplasts)	50S	30S

- "S" stands for the **Svedberg unit**. It is the sedimentation coefficient.
- It is an indirect measure of density and size.

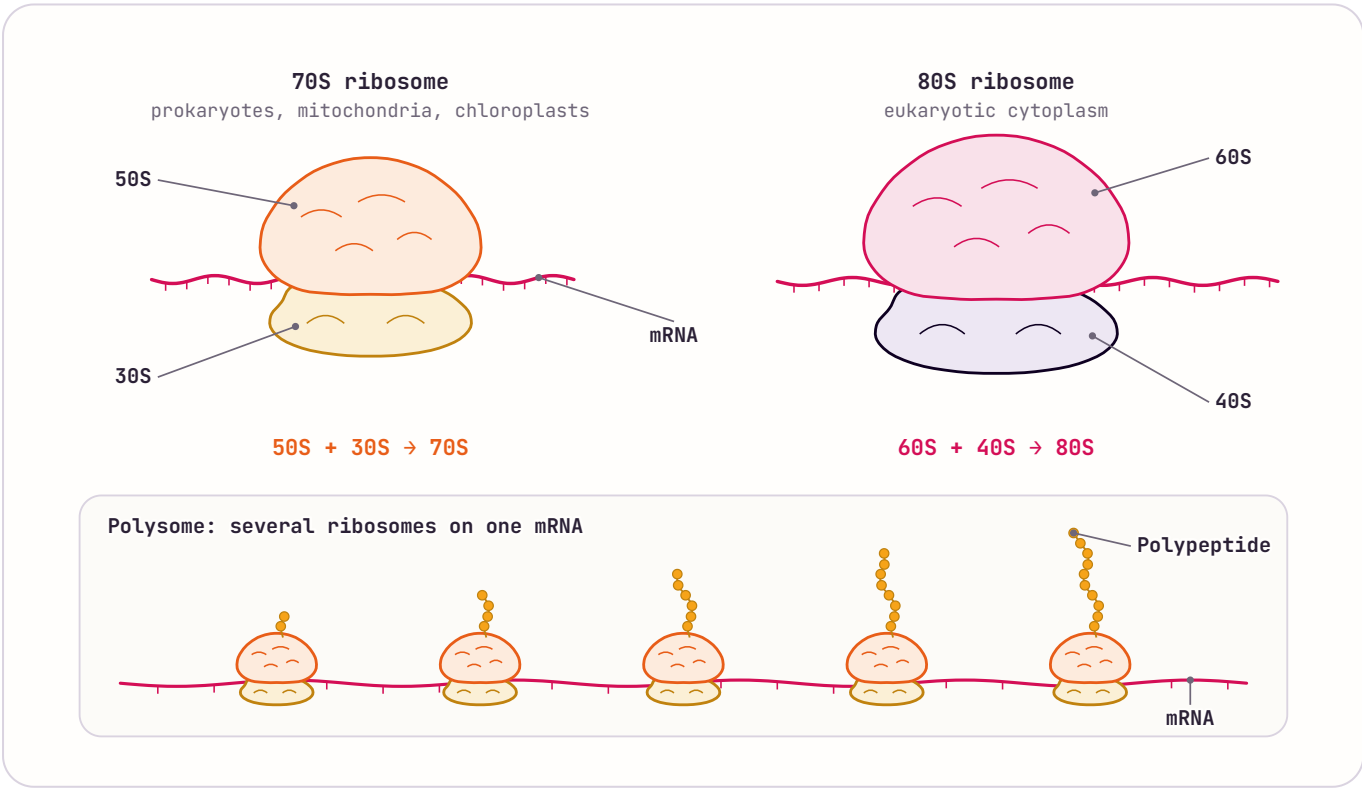


Fig 3 · Ribosome subunits. S values do not add: 50S plus 30S makes 70S.

MYTH

50S + 30S = 80S, so S values must add up.

SCIENCE

S measures how fast a particle settles, which depends on size and shape. So subunit values do not add. 50S and 30S make a 70S ribosome.

Cytoskeleton

- The cytoskeleton is a detailed network of filament-like protein structures in the cytoplasm.
- It has three parts: **microtubules, microfilaments and intermediate filaments**.
- **Functions:** mechanical support, motility, and keeping the cell's shape.

Q11 Multi-statement

LEVEL 2

Read these statements about ribosomes.

(a) A 70S ribosome is made of 50S and 30S subunits.

(b) The S values of the two subunits add up to the S value of the whole ribosome.

(c) Ribosomes in mitochondria and chloroplasts are 70S.

(d) Several ribosomes on one mRNA form a polysome.

(e) Ribosomes are bounded by a single membrane.

Choose the correct answer from the options given below.

1. (a), (b) and (c) only
2. (c), (d) and (e) only
3. (a), (b), (c) and (d) only
4. (a), (c) and (d) only

Answer: 4

CORE PRINCIPLE S is a sedimentation coefficient, not a mass you can add. Organelle ribosomes match prokaryotic ones.

TRAP (b) catches students who check 50 + 30 and expect 80. (e) catches students who assume every organelle has a membrane.

10 Cilia, Flagella, Centrosome and Centrioles

IN NEET WATCH LIST

Cilia and flagella ultrastructure is our top NEET 2026 prediction; a 2024 question tested the axoneme and cartwheel pattern.

Cilia and flagella

- Cilia and flagella are hair-like outgrowths of the cell membrane.
- **Cilia** are small. They work like oars and move the cell or the fluid around it.
- **Flagella** are longer. They move the cell.
- Prokaryotic flagella are structurally different from eukaryotic flagella.
- Electron microscopy shows each is covered by the plasma membrane.
- Its core is the **axoneme**. It has many microtubules running parallel to the long axis.
- The axoneme has **nine pairs of doublets** of peripheral microtubules, arranged in a ring.
- It also has a **pair of centrally located microtubules**.
- This is the **9+2 array**.
- The central tubules are joined by bridges and enclosed by a **central sheath**.
- The central sheath connects to one tubule of each peripheral doublet by a **radial spoke**. So there are nine radial spokes.
- The peripheral doublets are also joined to each other by **linkers**.
- Both cilia and flagella emerge from centriole-like structures called **basal bodies**.

Centrosome and centrioles

- The **centrosome** usually contains two cylindrical structures called **centrioles**.
- Amorphous pericentriolar material surrounds them.
- The two centrioles lie **perpendicular** to each other.
- Each centriole looks like a **cartwheel**.
- It has nine evenly spaced peripheral fibrils of **tubulin** protein.
- Each peripheral fibril is a **triplet**. Adjacent triplets are linked.
- The central part of the proximal region is also protein. It is called the **hub**.
- The hub connects to the peripheral triplets through **radial spokes** made of protein.
- **Jobs:** centrioles form the basal body of cilia or flagella.
- They also form the spindle fibres of the spindle apparatus during cell division in animal cells.

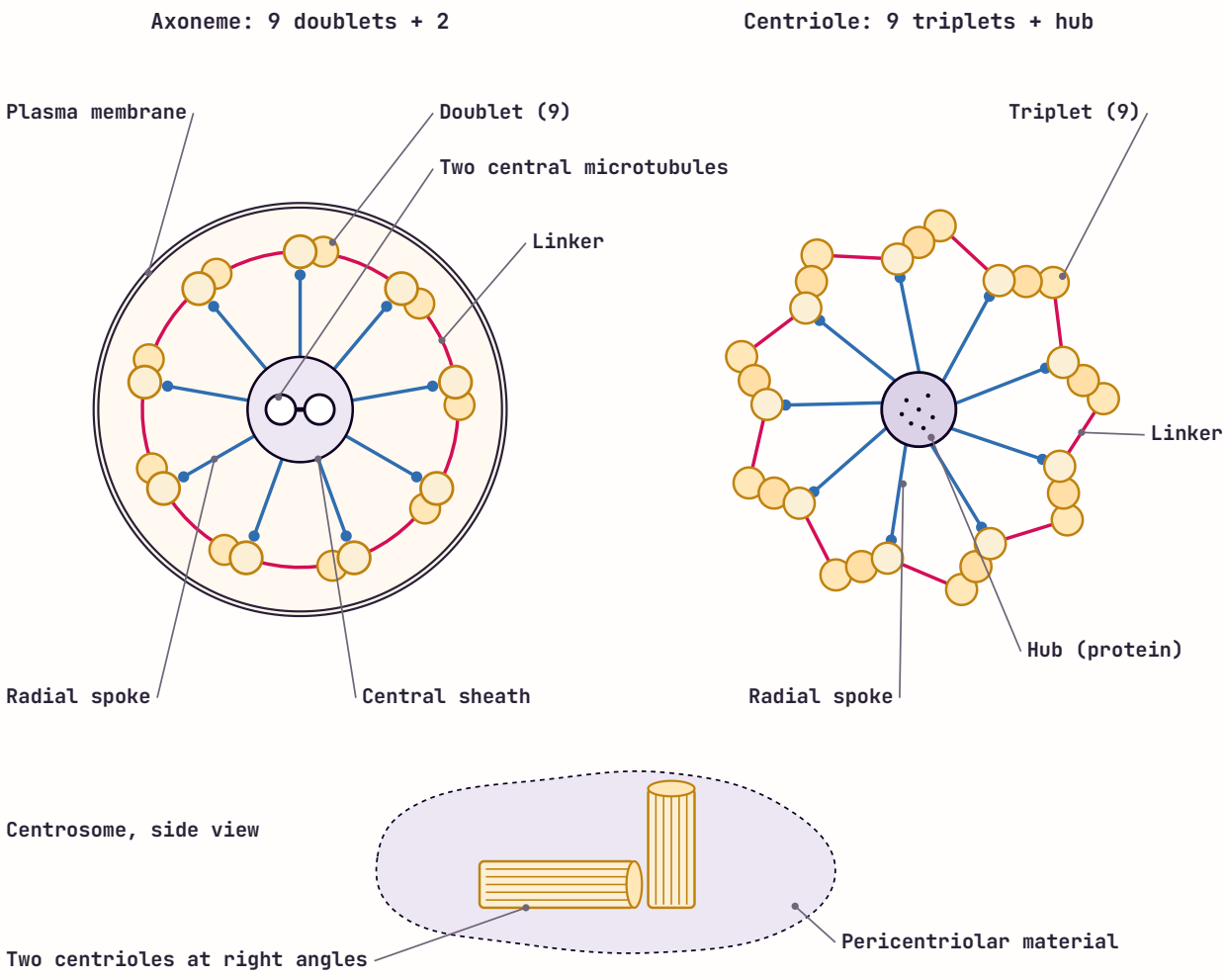
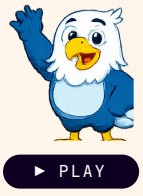


Fig 9 · Axoneme 9+2 beside centriole cartwheel. Doublets plus two in the axoneme; triplets around a hub in the centriole.



HAVING DIFFICULTY VISUALISING DOUBLETS VS TRIPLETS?

Play it.

This chapter is a set of short games in the Logic Bloom app.
logicbloom.co.in/download · Free to start.

SCAN



TRAP ALERT

TRAP ALERT

- Axoneme ring: **doublets**. Centriole ring: **triplets**. The axoneme has two central microtubules; the centriole has a protein hub and no central microtubules.

Q12 Match the Column

LEVEL 2

COLUMN I	COLUMN II
A. Peripheral ring of the axoneme	I. Proteinaceous hub
B. Peripheral ring of a centriole	II. Two microtubules in a central sheath
C. Centre of the axoneme	III. Nine doublets
D. Centre of a centriole (proximal region)	IV. Nine triplets

Choose the correct answer from the options given below.

1. A-III, B-IV, C-II, D-I
2. A-IV, B-III, C-II, D-I
3. A-III, B-IV, C-I, D-II
4. A-IV, B-III, C-I, D-II

Answer: 1

CORE PRINCIPLE The axoneme is 9 doublets plus 2 central microtubules. A centriole is 9 triplets around a protein hub.

TRAP Option 2 swaps doublets and triplets, the most common slip. Option 3 swaps the two centres. Option 4 makes both errors at once.

PYQ ANALYSIS Cell Cycle and Division NEET PYQ analysis →

11 The Nucleus and Chromosomes

IN NEET REPEATS OFTEN *8 questions.*

Nucleus

- **Robert Brown** first described the nucleus, as early as 1831.
- Its material stains with basic dyes. **Flemming** named it **chromatin**.
- The interphase nucleus (a nucleus not dividing) has three things.
  - Highly extended nucleoprotein fibres called **chromatin**.
  - The **nuclear matrix**.
  - One or more spherical bodies called **nucleoli** (singular: nucleolus).
- The **nuclear envelope** has two parallel membranes.
- The space between them is the **perinuclear space**, 10 to 50 nm wide.
- The envelope is a barrier between the nucleus and the cytoplasm.
- The **outer membrane** usually stays continuous with the ER. It also bears ribosomes.
- At many places, the two membranes fuse to form **nuclear pores**.
- RNA and protein molecules move both ways through these pores, between nucleus and cytoplasm.
- Normally, there is only one nucleus per cell. The number can vary.
- Some mature cells even lack a nucleus. Examples: the erythrocytes of many mammals and the sieve tube cells of vascular plants.
- **Nucleoli are not membrane-bound.** Their content is continuous with the rest of the nucleoplasm.
- The nucleolus is the site of active **ribosomal RNA (rRNA) synthesis**.
- Cells busy with protein synthesis have larger and more nucleoli.

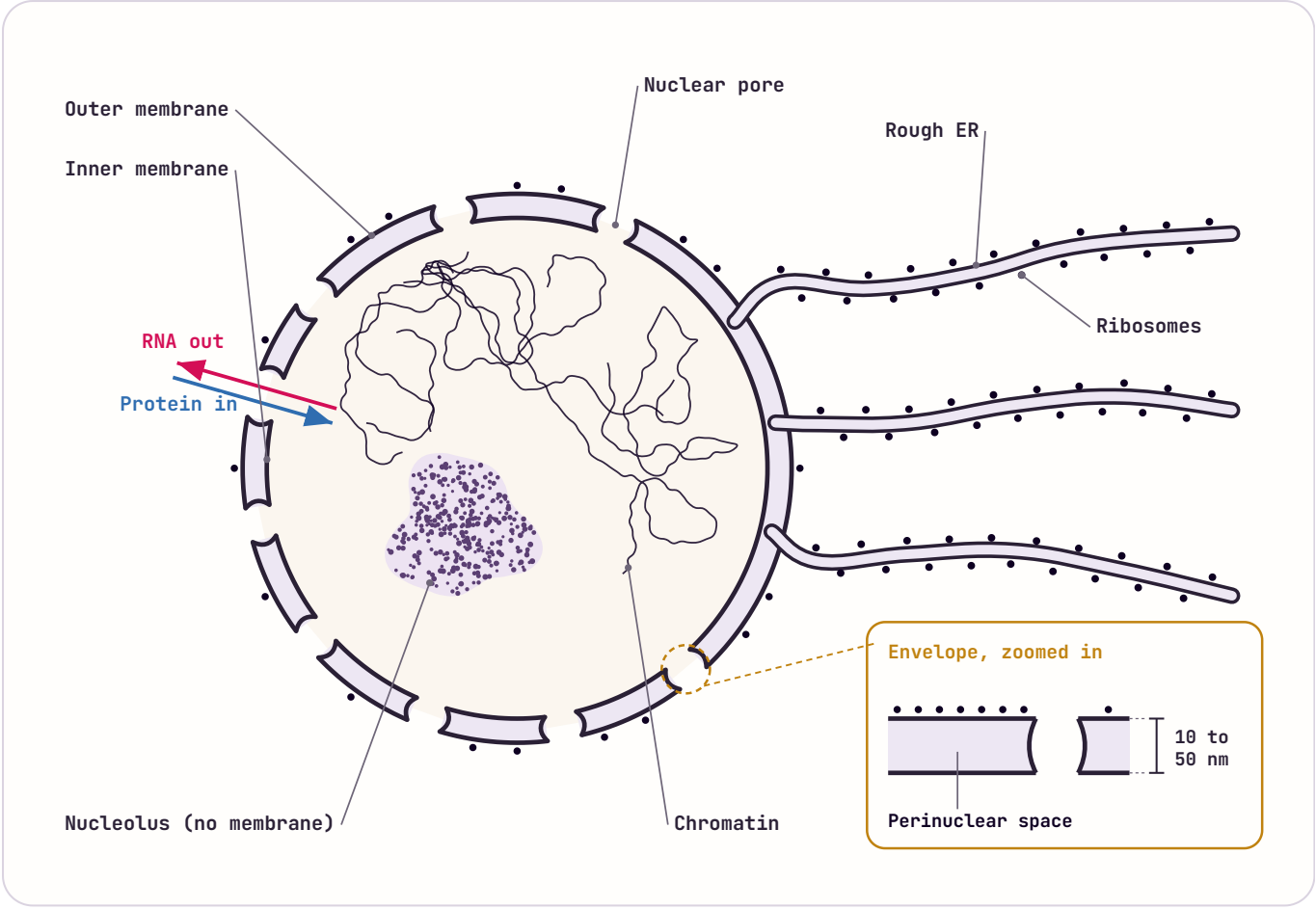


Fig 10 · Nucleus. Pores join the two membranes; the nucleolus has no membrane.



TRAP ALERT

TRAP ALERT

- "Every organelle-like body has a membrane" is false twice in this chapter. Ribosomes and nucleoli both lack one. Nucleolar rRNA synthesis was tested 3 times in our data.

Chromatin and chromosomes

- In interphase, the nucleus shows a loose, indistinct network of chromatin.
- During cell division, separate **chromosomes** appear in place of the nucleus.
- Chromatin contains DNA, basic proteins called **histones**, some non-histone proteins and RNA.
- A single human cell has about **two metres** of DNA.
- It is spread over **46 chromosomes (23 pairs)**.
- Every chromosome has a **primary constriction**, the **centromere**.
- On its sides are disc-shaped structures called **kinetochores**.

Types by centromere position

TYPE	CENTROMERE POSITION	ARMS
Metacentric	Middle	Two equal arms
Sub-metacentric	Slightly away from the middle	One shorter, one longer arm
Acrocentric	Close to one end	One extremely short, one very long arm
Telocentric	At the end (terminal)	Effectively one arm

- Some chromosomes have non-staining **secondary constrictions** at a constant place.
- This gives the look of a small fragment called the **satellite**.

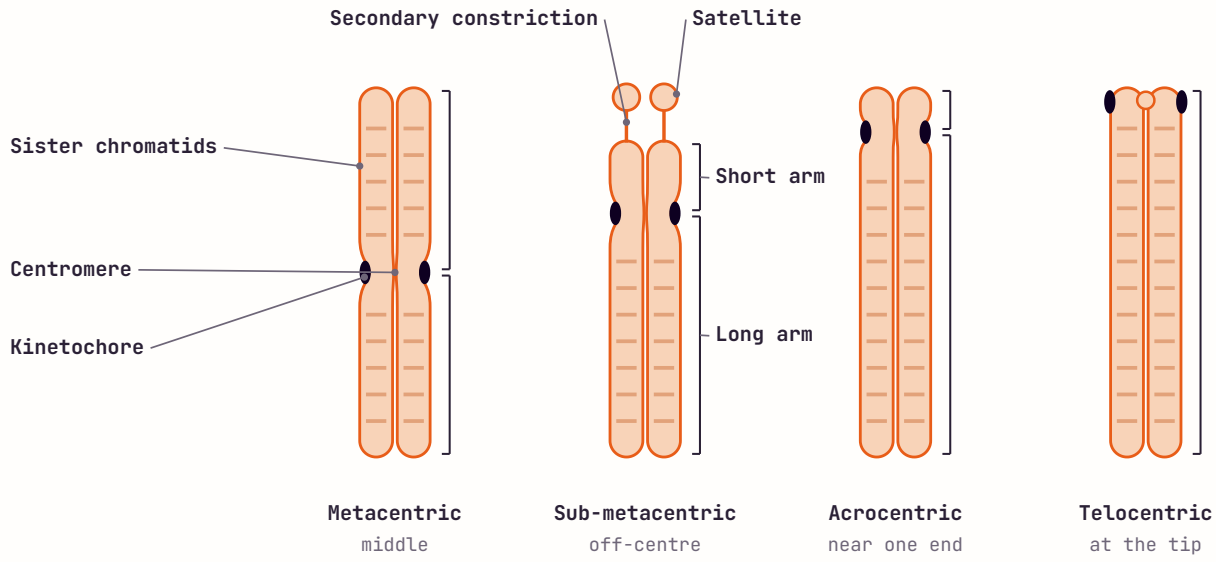


Fig 11 · Four chromosome types. The centromere's position names the chromosome.



THINK IT THROUGH

SANITY CHECK

- Order by centromere moving from centre to tip: **M**eta, **S**ub-meta, **A**cro, **T**elo.

Q13 Multi-statement

LEVEL 2

Which statements about the nucleus are correct?

(a) The outer nuclear membrane is continuous with the ER and bears ribosomes.

(b) The perinuclear space is 10 to 50 nm wide.

(c) The nucleolus is bounded by a single membrane.

(d) The nucleolus is the site of active rRNA synthesis.

(e) Mammalian erythrocytes and sieve tube cells of vascular plants lack a nucleus.

Choose the correct answer from the options given below.

1. (a), (b) and (c) only
2. (a), (b), (d) and (e) only
3. (b), (c), (d) and (e) only
4. (a), (d) and (e) only

Answer: 2

CORE PRINCIPLE Statements (a), (b), (d) and (e) are NCERT lines. The nucleolus has no membrane at all.

TRAP (c) is false. Option 4 is the "stopped early" answer: it drops the perinuclear space number.

Q14 Statement I / Statement II

LEVEL 2

Statement I: An acrocentric chromosome has its centromere close to one end. So it has one very short and one very long arm.

Statement II: The satellite of a chromosome is formed by its primary constriction.

1. Both Statement I and Statement II are true
2. Both Statement I and Statement II are false
3. Statement I is true but Statement II is false
4. Statement I is false but Statement II is true

Answer: 3

CORE PRINCIPLE Acrocentric means a near-end centromere. The satellite comes from a **secondary** constriction.

TRAP Option 1 catches students who mix up the primary constriction (centromere) with the secondary one.

12 Microbodies

IN NEET WATCH LIST

- Many membrane-bound, minute vesicles called **microbodies** occur in plant and animal cells.
- They contain various enzymes.



THINK IT THROUGH

SANITY CHECK

- Microbodies are named in the NEET 2026 syllabus line, even though NCERT gives them only two lines. One direct question is possible.

13 Quick Review: What NEET Repeats

Use this in the last week. Each card shows how often NEET repeats it, the topic and the question. The answer and the reason it recurs come next.

ALMOST EVERY YEAR

ALMOST EVERY YEAR — PROKARYOTIC CELL

Name three functions of mesosomes.

> **Cell wall formation, DNA replication and distribution to daughter cells, respiration (also secretion, more surface area).**

Why it recurs: The most repeated concept: 5 questions.

ALMOST EVERY YEAR — PROKARYOTIC CELL

List the three layers of the bacterial cell envelope, outside in.

> **Glycocalyx, cell wall, plasma membrane.**

Why it recurs: Order questions are easy to set and easy to get wrong.

ALMOST EVERY YEAR — PROKARYOTIC CELL

Slime layer vs capsule?

> **Slime layer is a loose sheath; capsule is thick and tough.**

Why it recurs: Both are glycocalyx; NEET tests the difference.

ALMOST EVERY YEAR — PROKARYOTIC CELL

Which structure helps bacteria attach to rocks and host tissues?

> **Fimbriae.**

Why it recurs: Pili, fimbriae and flagella get swapped in options.

ALMOST EVERY YEAR — PROKARYOTIC CELL

Name the three parts of a bacterial flagellum.

> **Filament, hook, basal body.**

Why it recurs: A clean match-the-column item.

ALMOST EVERY YEAR PROKARYOTIC CELL

Give three examples of inclusion bodies.

Phosphate, cyanophycean and glycogen granules.

Why it recurs: "No membrane" is the trap.

ALMOST EVERY YEAR PROKARYOTIC CELL

Which prokaryote has no cell wall, and how big is it?

Mycoplasma, about 0.3 µm.

Why it recurs: Tested 3 times as the "smallest cell" profile.

REPEATS OFTEN

REPEATS OFTEN CELL THEORY

Who said cells arise from pre-existing cells?

Rudolf Virchow (1855).

Why it recurs: Credit swaps with Schleiden and Schwann: 3 times.

REPEATS OFTEN GOLGI

Where are glycoproteins and glycolipids formed?

Golgi apparatus.

Why it recurs: Tested 4 times.

REPEATS OFTEN GOLGI

Which Golgi face receives ER vesicles?

The cis (forming) face.

Why it recurs: Moved from recall to assertion-reason in 2025.

REPEATS OFTEN ER

What is the major site of lipid and steroid hormone synthesis?

Smooth ER.

Why it recurs: Tested 3 times.

REPEATS OFTEN RIBOSOMES

Give the subunits of 70S and 80S ribosomes.

> **70S = 50S + 30S; 80S = 60S + 40S.**

Why it recurs: Now asked as multi-statement items.

REPEATS OFTEN RIBOSOMES

What is a polysome?

> **Several ribosomes on one mRNA, translating it.**

Why it recurs: Flagged as due for a return.

REPEATS OFTEN RIBOSOMES

Are ribosomes membrane-bound?

> **No. They are found in prokaryotes and eukaryotes.**

Why it recurs: Tested 2 times as a direct fact.

REPEATS OFTEN MITOCHONDRIA

Why are mitochondria called semi-autonomous?

> **They have their own circular DNA and 70S ribosomes.**

Why it recurs: Tested 3 times, with chloroplasts.

REPEATS OFTEN PLASTIDS

Where is chlorophyll located in a chloroplast?

> **In the thylakoids.**

Why it recurs: Diagram-based chloroplast questions appear.

REPEATS OFTEN PLASTIDS

Amyloplast, elaioplast, aleuroplast: what does each store?

> **Starch, oils and fats, proteins.**

Why it recurs: A ready-made match-the-column.

REPEATS OFTEN NUCLEUS

What is the nucleolus the site of?

> **Active rRNA synthesis.**

Why it recurs: Tested 3 times.

REPEATS OFTEN

NUCLEUS

Name two kinds of mature cells without a nucleus.

> **Erythrocytes of many mammals; sieve tube cells.**

Why it recurs: A favourite "exception" item.

REPEATS OFTEN

NUCLEUS AND CHROMOSOMES

Where is the centromere in an acrocentric chromosome?

> **Close to one end.**

Why it recurs: Tested 2 times.

SEEN SEVERAL TIMES

SEEN SEVERAL TIMES

CYTOSKELETON

Name the three parts of the cytoskeleton.

> **Microtubules, microfilaments, intermediate filaments.**

Why it recurs: Tested 3 times for motility and shape.

WATCH LIST

WATCH LIST

CILIA AND CENTRIOLES

Axoneme ring vs centriole ring?

> **Axoneme: 9 doublets + 2 central. Centriole: 9 triplets + hub.**

Why it recurs: Our top prediction for NEET 2026.

READ NEXT the NEET traps in this chapter, explained →

★ Cell: The Unit of Life · Fact Sheet

One page for the night before the exam.

NAMES AND YEARS

Virchow (1855): Omnis cellula-e cellula

Leeuwenhoek: first saw a live cell
Robert Brown: nucleus (1831)
Schleiden (1838) plants
Schwann (1839) animals, plasma membrane
Camillo Golgi (1898) · George Palade (1953) ribosomes
Singer and Nicolson (1972): fluid mosaic model
Flemming: named chromatin

SIZES

Mycoplasma 0.3 µm

Bacteria 3 to 5 µm · Human RBC about 7.0 µm
Prokaryotic ribosome about 15 nm x 20 nm
Golgi cisternae 0.5 to 1.0 µm across
Mitochondria: 0.2 to 1.0 µm wide (avg 0.5), 1.0 to 4.1 µm long
Chloroplast: 5 to 10 µm long, 2 to 4 µm wide

COUNTS AND SHARES

RBC membrane: 52% protein, 40% lipid

Chloroplasts per cell: 1 (Chlamydomonas), 20 to 40 (mesophyll)
Vacuole: up to 90% of plant cell volume
Perinuclear space: 10 to 50 nm
Human cell: about 2 m of DNA in 46 chromosomes (23 pairs)

RIBOSOMES

S values do not add

80S = 60S + 40S (eukaryotic cytoplasm)
70S = 50S + 30S (prokaryotes, mitochondria, chloroplasts)
S = Svedberg unit

MICROTUBULE PATTERNS

Axoneme 9+2

Nine doublets, two central
Centriole: nine triplets + hub, cartwheel

ENDOMEMBRANE SYSTEM

In: ER, Golgi, lysosomes, vacuoles

Out: mitochondria, chloroplasts, peroxisomes

NO MEMBRANE

Ribosomes, nucleolus

Inclusion bodies, centrosome

DOUBLE MEMBRANE

Nucleus

Mitochondria, chloroplasts

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★ CELLS STILL A LIST OF PARTS TO MEMORISE?

Play it. Then practice it.

Open Cell: The Unit of Life in the Logic Bloom app. Play the chapter as short games, then practise the questions NEET repeats. Free to start.

SCAN → DO · READ · VERIFY