FREE NOTES · NCERT + NEET LEVEL

Cell: The Unit of Life

Cell theory, prokaryotic cell, eukaryotic cell membrane (fluid mosaic model), cell wall, endomembrane system, mitochondria, plastids, ribosomes, cytoskeleton, cilia, centrosome and nucleus.

01 Cell theory and cell types
02 Prokaryotic cell
03 Cell membrane and cell wall
04 Endomembrane system
05 Mitochondria, plastids, ribosomes
06 Cytoskeleton, cilia, centrosome, nucleus
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11 Quick revision

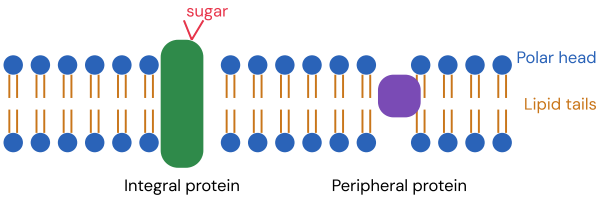
01 Cell theory and cell types

- Schleiden (plants) and Schwann (animals): all living things are made of cells. **Rudolf Virchow** (1855): *omnis cellula-e cellula* (cells arise from pre-existing cells).
- Smallest cells: mycoplasma (0.3 µm); bacteria 3–5 µm; largest single cell: ostrich egg. Nerve cells are among the longest.
- **Prokaryotes** (bacteria, blue-green algae, mycoplasma, PPLO): no membrane-bound nucleus or organelles.
- **Eukaryotes**: membrane-bound nucleus and organelles.

02 Prokaryotic cell

- Cell envelope: **glycocalyx** (slime layer or capsule) + cell wall + plasma membrane. Gram +ve retain the stain, Gram -ve do not.
- **Mesosome**: infolding of membrane; helps in wall formation, DNA replication, respiration, secretion.
- Nucleoid: single circular naked DNA; **plasmids** (extra DNA, e.g. antibiotic resistance).
- Ribosomes 70S (50S + 30S); polysome = chain on mRNA. Inclusion bodies: phosphate granules, glycogen granules, gas vacuoles.
- Flagella (filament, hook, basal body), pili, fimbriae (attachment).

03 Cell membrane and cell wall

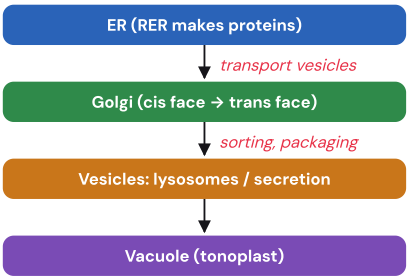


Fluid mosaic model (Singer & Nicolson, 1972)

- Lipid bilayer with proteins; quasi-fluid nature allows lateral movement of proteins. Human RBC membrane: ~52% protein, 40% lipid.
- Transport: passive (diffusion, osmosis), active (uses ATP, e.g. Na^+/K^+ pump).
- Plant cell wall: primary wall (growing), secondary wall (inner), **middle lamella** (calcium pectate, glues cells). Plasmodesmata connect cytoplasm. Algae walls: cellulose, galactans, mannans, $CaCO_3$.

04 Endomembrane system

- ER, Golgi, lysosomes, vacuoles work together (mitochondria, chloroplasts, peroxisomes are not part of it).
- **RER**: ribosomes, protein synthesis and secretion. **SER**: lipid/steroid synthesis.
- **Golgi** (Camillo Golgi, 1898): cisternae with cis (forming) and trans (maturing) faces; packages materials, site of glycoprotein and glycolipid formation.
- **Lysosomes**: hydrolytic enzymes (lipases, proteases, carbohydrases), active at acidic pH.
- **Vacuole**: tonoplast; up to 90% of plant cell volume; contractile vacuole (*Amoeba*) for excretion, food vacuoles in protists.



Route through the endomembrane system

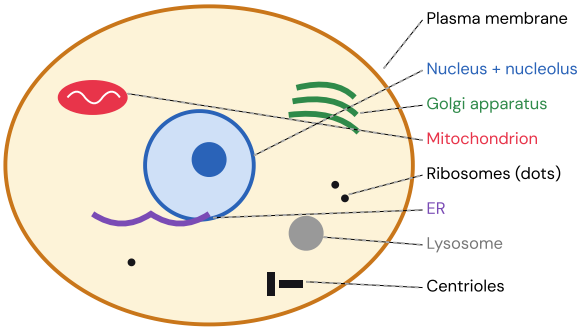
05 Mitochondria, plastids, ribosomes

Organelle	Structure	Function
Mitochondria	Double membrane; inner folds = cristae; matrix with circular DNA, 70S ribosomes	Aerobic respiration, ATP ("powerhouse"); divide by fission
Chloroplast	Double membrane; grana (stacks of thylakoids), stroma lamellae, stroma with DNA, 70S ribosomes	Photosynthesis
Chromoplast	Carotene, xanthophyll	Yellow/orange/red colour
Leucoplast	Colourless: amyloplast (starch), elaioplast (oil), aleuroplast (protein)	Storage
Ribosomes	Non-membranous; RNA + protein; 80S (60S+40S) in eukaryotes	Protein synthesis

06 Cytoskeleton, cilia, centrosome, nucleus

- **Cytoskeleton**: microtubules, microfilaments, intermediate filaments; support, motility, shape.
- **Cilia/flagella**: axoneme with **9+2** microtubule arrangement, from basal body. Cilia short (oar-like), flagella longer.
- **Centrosome**: two centrioles, each with **9+0** triplet peripheral fibrils (cartwheel); forms spindle in animal cells.
- **Nucleus** (Robert Brown, 1831): double nuclear envelope with pores, nucleoplasm, nucleolus (rRNA synthesis), chromatin. Chromosome: centromere, kinetochore; metacentric, sub-metacentric, acrocentric, telocentric. Satellite on some chromosomes.
- **Microbodies**: small vesicles with enzymes (peroxisomes, glyoxysomes).

07 Extra + tricks



Animal cell (simplified)

Organelle	Discovered / named by
Cell	Robert Hooke (1665, cork)
Nucleus	Robert Brown (1831)
Golgi apparatus	Camillo Golgi (1898)
Ribosome	George Palade (1953)
Lysosome	Christian de Duve
Mitochondria (term)	Benda

- Plant vs animal cell: cell wall, plastids, large central vacuole in plants; centrioles mostly in animal cells.
- Lysosomes = "suicidal bags"; ribosomes = "protein factories"; mitochondria = "powerhouse".

08 Important Q&A

Q1. Which organelles have their own DNA? Why is this significant?

Mitochondria and chloroplasts: they have circular DNA and 70S ribosomes, so they are semi-autonomous (supports the endosymbiotic origin idea).

Q2. What is the function of the middle lamella?

Layer of calcium pectate that cements neighbouring plant cells together.

Q3. Name a chromosome type with the centromere at the tip.

Telocentric.

09 Common mistakes

- Including mitochondria in the endomembrane system.
- Writing 9+2 for centriole (centriole is 9+0; cilia 9+2).
- Saying prokaryotic ribosomes are 80S.
- Confusing cis face (receiving) with trans face (shipping) of Golgi.

10 Practice (NEET style)

1. Who gave omnis cellula-e cellula?
2. Infolding of prokaryotic membrane?
3. Site of rRNA synthesis?
4. Plastid storing oil?
5. Fluid mosaic model given by?

ANSWERS

1) Rudolf Virchow · 2) Mesosome · 3) Nucleolus · 4) Elaioplast · 5) Singer and Nicolson

11 Quick revision: 5 minutes before the exam

PROKARYOTE

- Nucleoid, plasmid
- Mesosome
- 70S ribosome

MEMBRANE

- Fluid mosaic
- Middle lamella: Ca pectate
- Plasmodesmata

ORGANELLES

- RER protein, SER lipid
- Golgi packaging
- Lysosome acidic enzymes

NUMBERS

- Cilia 9+2, centriole 9+0
- 80S = 60S+40S
- 70S = 50S+30S

Have a doubt? Ask the AI Doubt Solver at padhaiadda.netlify.app, or take the mock test on this chapter.