PIPADOR REVISION

MRCOG Part 1 Revision Notes

Cellular Structure and Function

BIOCHEMISTRY • LECTURE 203

VISUAL EXAMINATION REVISION NOTES

2026 Edition

MRCOG PART 1 REVISION NOTES | BIOCHEMISTRY

203 Cellular Structure and Function

The eukaryotic cell, plasma membrane, membrane transport, resting potential, cytoskeleton and extracellular matrix

≈ 37 trillion	7–10 nm	≈ −70 to −90 mV	3 Na^+ : 2 K^+
Cells in the human body	Plasma membrane thickness	Resting membrane potential	Na^+/K^+-ATPase stoichiometry

■ KEY FACTS: Learning objectives

- Describe the general organisation of eukaryotic cells and the structure of the plasma membrane.
- Describe membrane transport mechanisms and the basis of the resting membrane potential.
- Describe the cytoskeleton and the extracellular matrix.
- Relate cell structure to clinical examples in O&G.

203.1 The eukaryotic cell

Eukaryotic cells contain a membrane-bound **nucleus** and **organelles** (Lecture 204) within cytoplasm, bounded by the **plasma membrane**, supported by a **cytoskeleton** and surrounded by **extracellular matrix**. Specialisation (e.g. syncytiotrophoblast, oocyte, myometrial cell) reflects differences in organelles, receptors, junctions and gene expression.

203.2 The plasma membrane

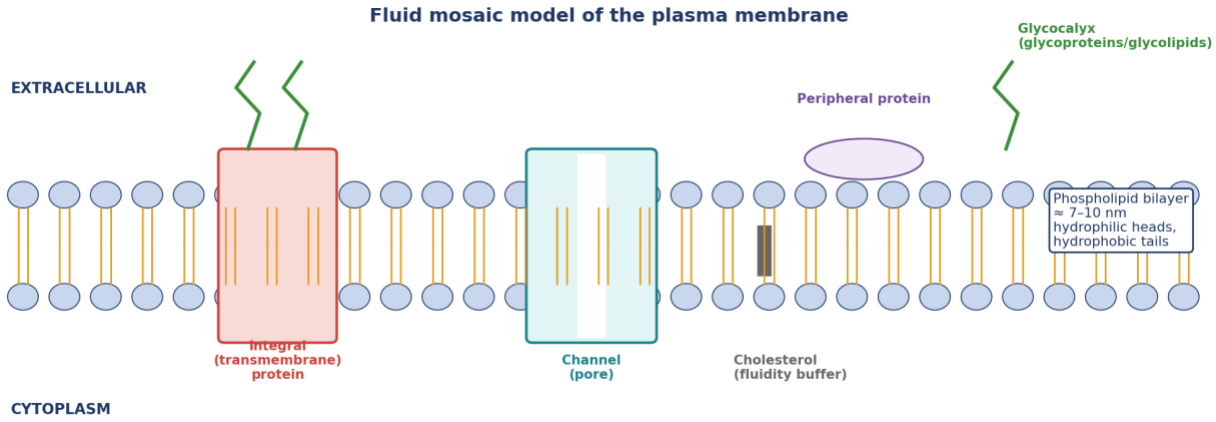


Figure 203.1 — The fluid mosaic model

Component	Function
Phospholipids (phosphatidylcholine, -ethanolamine, -serine, sphingomyelin)	Bilayer barrier to ions/polar molecules; asymmetric distribution (phosphatidylserine inner leaflet — exposed in apoptosis and on activated platelets for coagulation)
Cholesterol	Buffers fluidity; forms lipid rafts (signalling platforms); precursor of steroid hormones
Integral proteins	Channels, carriers, pumps, receptors, adhesion molecules
Peripheral proteins	Cytoskeletal attachment, enzymes
Glycocalyx	Glycoproteins/glycolipids — cell recognition, ABO blood group antigens, protection; endothelial glycocalyx (Starling forces)

203.3 Membrane transport

Mechanism	Energy	Examples
Simple diffusion	Passive (down gradient)	O_2, CO_2, steroids, lipophilic drugs, anaesthetic gases (placental transfer)
Facilitated diffusion — channels	Passive	Na^+, K^+, Ca^{2+} channels; aquaporins
Facilitated diffusion — carriers	Passive; saturable	GLUT1 (placenta, RBC), GLUT2, GLUT4 (insulin-regulated)
Primary active transport	ATP	Na^+/K^+-ATPase, Ca^{2+}-ATPase (PMCA, SERCA), H^+/K^+-ATPase (parietal cell)
Secondary active transport	Uses Na^+ gradient	SGLT1/2 (glucose), Na^+/Ca^{2+} exchanger, placental amino acid transport (system A)
Vesicular transport	ATP	Endocytosis (receptor-mediated — LDL, transferrin, IgG via FcRn), exocytosis (hormones, neurotransmitters), transcytosis

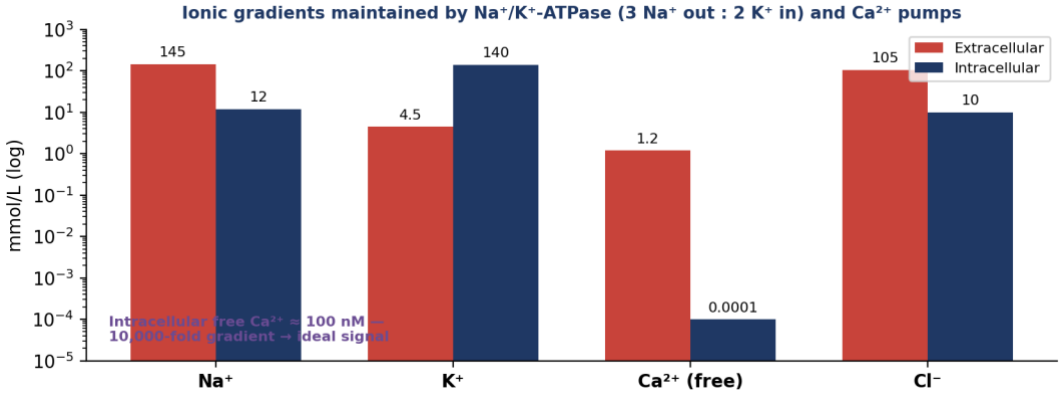


Figure 203.2 — Ionic gradients across the plasma membrane

The **resting membrane potential** arises mainly from **K^+ leak** through K^+ channels down its gradient (approaching the K^+ equilibrium potential, Nernst ≈ −90 mV), maintained by the **electrogenic Na^+/K^+-ATPase** (≈ ⅓ of resting energy use). Digoxin inhibits it; hyperkalaemia depolarises cells (cardiac arrest).

203.4 Cytoskeleton and extracellular matrix

Element	Composition	Functions / clinical
Microfilaments	Actin (7 nm)	Cell shape, migration, cytokinesis, muscle contraction (with myosin), microvilli
Intermediate filaments	Keratins (epithelia), vimentin (mesenchymal), desmin (muscle), lamins (nuclear)	Mechanical strength; immunohistochemistry markers of tumour origin (cytokeratin = carcinoma; vimentin = sarcoma)
Microtubules	Tubulin (25 nm), centrosome	Mitotic spindle, vesicle transport (kinesin, dynein), cilia/flagella (9+2 axoneme); targets of paclitaxel (stabilises) and vinca alkaloids (prevent assembly)
Extracellular matrix	Collagens (I, III, IV — basement membrane), elastin, fibronectin, laminin, proteoglycans	Support, signalling via integrins; remodelling by MMPs (cervical ripening, implantation, invasion)

■ CLINICAL CORRELATION

- **Ciliary dyskinesia** (Kartagener syndrome): defective dynein arms → bronchiectasis, situs inversus, male infertility and **ectopic pregnancy/subfertility** (tubal cilia).
- **Taxanes** (paclitaxel) in ovarian/endometrial cancer act on microtubules → neuropathy.
- Cystic fibrosis: **CFTR** chloride channel defect (CBAVD in men; thick cervical mucus).

203.5 Must-know summary

■ EXAM TIP

- Fluid mosaic membrane: phospholipid bilayer + cholesterol + proteins + glycocalyx.
- Transport: diffusion (gases, steroids), facilitated (GLUT1), primary active (Na^+/K^+-ATPase), secondary active (SGLT), vesicular (IgG via FcRn).
- Resting potential = K^+ leak + Na^+/K^+-ATPase (3 Na^+ out : 2 K^+ in).
- Microtubules: spindle, cilia (taxanes, vinca); intermediate filaments: tumour markers (keratin, vimentin).

■ MNEMONIC / MEMORY AID

Cytoskeleton — 'Actin Acts, Intermediates hold, Microtubules Move (cargo & chromosomes)'.