1.3 Cells: Membrane Structure & Transport

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Course	DP IB Biology
Section	1. Cell Biology
Topic	1.3 Cells: Membrane Structure & Transport
Difficulty	Medium

To be used by all students preparing for DP IB Biology SL
Students of other boards may also find this useful

1

The correct answer is **C** because vesicles transport substances within the cell that are to be released at the cell surface membrane by exocytosis.

A is incorrect because facilitated diffusion is not an active process and so does not require ATP (ATP is produced in the mitochondria).

B is incorrect because lysosomes are not involved in DNA synthesis or DNA replication.

D is incorrect because ribosomes are involved in the production of polypeptides, not phospholipids.

2

The correct answer is **B** (for animal cells).

- In a solution with higher osmolarity (known as a hypertonic solution), water **leaves** cells by osmosis, causing the cytoplasm to **shrink** in volume. As the area of the cell membrane doesn't change, it develops indentations as the cytoplasm shrinks; this can be seen in the cells of image II.
- In a solution with lower osmolarity (known as a hypotonic solution), water **enters** cells by osmosis, causing them to **swell** up and eventually burst. The cells in image III can be seen to be swollen, though bursting has not yet occurred.

3

The correct answer is **C**.

- The role of cholesterol is to maintain the correct fluidity of the cell membrane.
- Glycoproteins are proteins with a carbohydrate chain attached. They are specific in structure and act as antigens in cell recognition, recognising and **binding** with Some glycoproteins act as **hormone receptors**.
- Membrane proteins have various roles, one of which is to act as a **receptor** for **hormones**.

Note that while the specification doesn't necessarily cover the roles of all of these molecules in great detail (e.g. you may not know the specifics of glycolipid function), there are enough obviously wrong statements here for you to work out the correct answer.

4

The correct answer is **B**.

- Chloride ions are negatively charged, so can only cross the membrane by facilitated diffusion or active transport
- If a chloride ion is moving **down** its concentration gradient (by facilitated diffusion) it will travel through a **channel protein**
- If a chloride ion is moving **against** its concentration gradient (by active transport) it will travel through a **pump protein**

A is incorrect because the role of cholesterol is to maintain the correct fluidity of the membrane; it does **not** transport ions.

C is incorrect because glycolipids (and glycoproteins) are used in cell recognition, signalling and adhesion but do **not** transport ions.

D is incorrect because chloride ions are **charged** and therefore cannot pass through the **hydrophobic** middle section of the **phospholipid bilayer**.

5

The correct answer is **D**.

- **Integral proteins** are amphipathic, meaning that their hydrophilic region can sit outside the membrane and their hydrophobic region can sit within the membrane; this can result in proteins that **span the whole width of the membrane**, like W, or that are **embedded halfway** into the membrane, like X
- **Glycoproteins** are proteins with attached carbohydrates, and are found on the extracellular side of the membrane.
- **Phospholipids** consist of a hydrophilic phosphate head and two hydrophobic fatty acid tails. They are the most abundant molecule in the membrane.

Note that peripheral proteins are hydrophilic, so they do not extend into the central region of the membrane at all, but are bound to the surface of the membrane. This means that X cannot be a peripheral protein.

6

The correct answer is **A**.

- Only the small hydroxyl (-OH) group at one end of the cholesterol molecule is hydrophilic. The rest of the molecule is hydrophobic. This means that most of the cholesterol molecule is attracted to the hydrocarbon tails at the centre of the membrane, as these are also hydrophobic.
- Cholesterol restricts molecular motion of the membrane and therefore reduces its fluidity. As it is a largely hydrophobic molecule, it also reduces the permeability of the membrane to particles such as sodium ions and hydrogen ions, which are hydrophilic.

Note that it could also be argued that cholesterol **increases** membrane fluidity, as it prevents the phospholipids from crystallising at lower temperatures, meaning that statement **II** of option **B** would be correct at low temperatures. This doesn't affect the answer to this question, however, as statement **I** of option **B** is incorrect.

7

The correct answer is **C**.

- In distilled water, the water molecules will move from the pure water, which acts as a hypotonic solution (low osmolarity), **into** the cell (higher osmolarity) via osmosis, causing **animal cells** to **swell** and **burst.**
- However, the **cell wall** of **plant cells** is **strong** and withstands the pressure of increased water in the cell cytoplasm, therefore plant cells swell and become **turgid.**

A is incorrect because **both** plant and animal cell surface membranes are **partially permeable**, which means that they let **some** molecules across, but **not** all.

B is incorrect because the presence of a **vacuole** does **not** affect the movement of water into the cell causing cell bursting.

D is incorrect because while plant cell walls are freely permeable, this does not explain why animal cells burst but plant cells do not.

8

The correct answer is **C**.

- Seawater has a very high osmolarity and this would normally cause water to move **out** of cells via **osmosis.**
- This movement of water out of plant cells would cause them to become **plasmolysed** and may eventually lead to **cell death.**
- The root hair cells of halophytes need to **increase** their own osmolarity by **increasing** their internal concentration of **solutes**, such as salts, in order to create a concentration **equilibrium** with the surrounding saltwater and stop the movement of water by osmosis.

A is incorrect because if root hair cells had a low osmolarity then this would actually **increase** the rate of osmosis of water out of the cell.

B is irrelevant to the presence of saltwater.

D is incorrect; we might expect a root hair cell to have **many** mitochondria in order to actively transport salts, but a low number of mitochondria is unlikely to be an adaptive feature.

9

The correct answer is **A**; in the 1950s and 1960s, experimental evidence accumulated that did not fit with the Davson-Danielli model.

- Membrane proteins are globular.
- Membrane proteins are free to move.

Statements relating to the properties and arrangement of phospholipids(**B** and **D**) here are not relevant to the study of membrane proteins.

Statement **C** is incorrect; the surface of the membrane is hydrophilic, while the inside is hydrophobic.

10

The correct answer is **C**.

- For certain particles, simple diffusion can occur across the entire cell surface membrane, e.g. non-polar particles such as oxygen.
- Ions and certain other particles, e.g. large and/or polar molecules, cannot diffuse between phospholipids. They must pass through protein channels or carriers in the plasma membrane.

A is incorrect because the diffusion rate increases as the concentration rate increases for both simple diffusion and facilitated diffusion (i.e. both should be directly proportional).

B is incorrect because simple diffusion can occur across a membrane.

D is incorrect because both simple and facilitated diffusion are passive processes that do not require ATP.