

4.1 Fluid mosaic membranes

Name: _____ Class: _____ Date: _____ **Total: 14 marks**

KEY WORDS cell surface membrane

- cholesterol
- protein
- phospholipid
- bilayer

Objective

Build the skills to answer exam questions on **fluid mosaic membranes** – the structure and roles of the membrane components, and the stages of **cell signalling**

You must be able to:

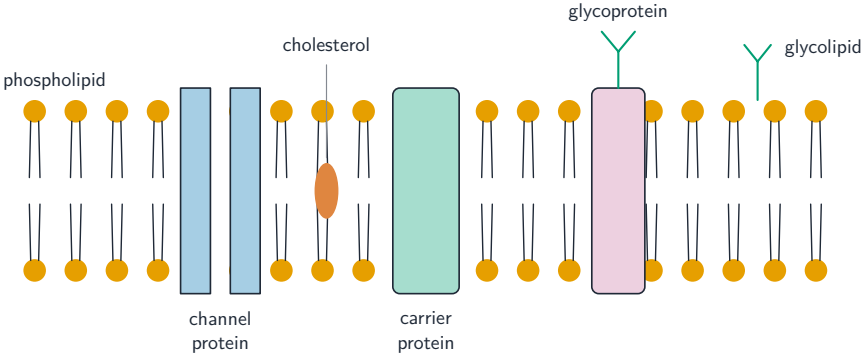
- describe the **fluid mosaic model** and the hydrophobic/hydrophilic interactions that form the **bilayer**
- describe the roles of phospholipids, **cholesterol**, proteins and **glycoproteins**
- outline the stages of cell signalling (ligand → receptor → response)

1 Key knowledge and worked examples

■ The fluid mosaic model

The membrane is a **bilayer** of **phospholipids**: **hydrophilic** heads face the water, **hydrophobic** tails hide inside. It is “fluid” because the phospholipids slide past each other, and a “mosaic” because proteins are dotted through it.

outside the cell



inside the cell (cytoplasm)

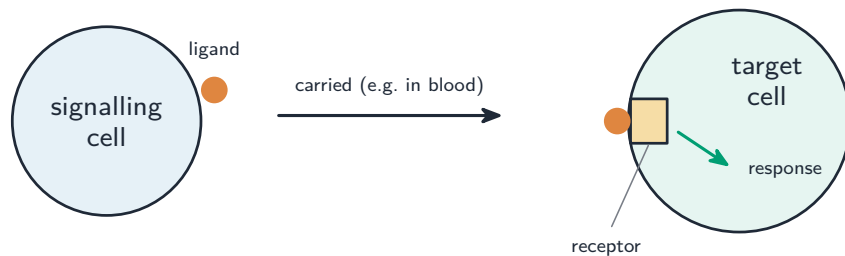
Proteins, cholesterol and carbohydrate chains sit in a fluid phospholipid bilayer

■ Roles of the components

component	role
phospholipids	form the basic barrier
channel/carrier proteins /	transport substances across
cholesterol	controls fluidity and adds strength
glycoproteins / glycolipids	cell recognition; some act as antigens
surface receptor proteins	bind signalling molecules (cell signalling)

■ Cell signalling

A cell secretes a **ligand** (e.g. a **hormone**); it travels to a **target cell**; it binds a **receptor** of matching shape, triggering a response inside.



The ligand fits one receptor shape only, so only cells with that receptor respond

2 Practice

2.1 State the role of each membrane component. [3]

component	role
cholesterol	
carrier protein	
glycoprotein	

2.2 Explain why the phospholipids form a bilayer in water. [2]

3 Exam-style questions

3.1 Which part of the membrane is responsible for cell recognition? [1]

- ☐ A cholesterol
☐ B glycoproteins
☐ C the hydrophobic tails
☐ D channel proteins

3.2 Why does only the target cell respond to a particular hormone? [1]

- ☐ A only the target cell is near the gland
☐ B only the target cell has a receptor with a complementary shape
☐ C the hormone is only made near the target cell
☐ D the hormone is hydrophobic

3.3 An electron micrograph shows a cell surface membrane that is 7.0 mm thick at a magnification of $\times 1\,000\,000$.

(a) Calculate the actual thickness of the membrane, in nm. [2]

(b) Explain why a phospholipid bilayer forms a good barrier to ions and large polar molecules. [2]

3.4 Describe the main stages of cell signalling that lead to a response in a target cell. [3]

Solutions

Each answer shows the steps, then the **result**.

2.1

- cholesterol – controls fluidity / adds strength; carrier protein – carries specific molecules across; glycoprotein – cell recognition / receptor / antigen

2.2

- the hydrophilic heads are attracted to water on both sides while the hydrophobic tails are repelled by water; so the tails face inward and heads outward, forming two layers

3.1 B

- Glycoproteins (carbohydrate chains) are used for cell recognition

3.2 B

- The receptor's shape is complementary to that ligand only

3.3

(a)

- $\frac{7.0 \text{ mm}}{1\,000\,000} = 7.0 \times 10^{-6} \text{ mm} = 7.0 \text{ nm}$

(b)

- the hydrophobic tail region repels charged/polar molecules, so ions and large polar molecules cannot pass straight through

3.4

- a cell secretes a ligand; it is carried to and binds a complementary receptor on the target cell's membrane; binding triggers a specific response inside the target cell