

4.1 Fluid mosaic membranes

Name: _____ Class: _____ Date: _____

Total: 14 marks

KEY WORDS cell surface membrane 细胞膜 • phospholipid 磷脂 • bilayer 双层 • protein 蛋白质 • cholesterol 胆固醇

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** 细胞信号传递.

You must be able to:

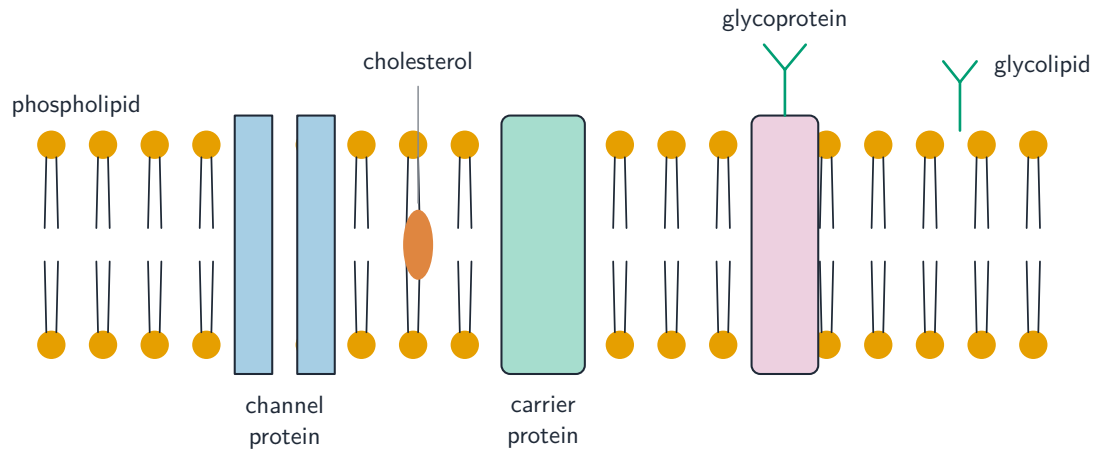
- describe the **fluid mosaic model** 流动镶嵌模型 and the hydrophobic/hydrophilic interactions that form the **bilayer** 双层
- describe the roles of phospholipids, **cholesterol** 胆固醇, proteins and **glycoproteins** 糖蛋白
- outline the stages of cell signalling (ligand → receptor → response)

1 Worked examples

■ The fluid mosaic model

The membrane is a **bilayer** of **phospholipids** 磷脂: **hydrophilic** 亲水 heads face the water, **hydrophobic** 疏水 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)

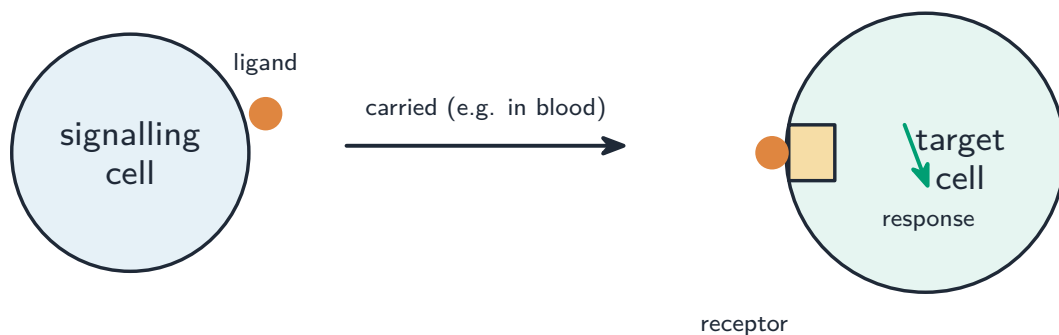
Proteins, cholesterol and carbohydrate chains sit in a fluid phospholipid bilayer

■ Roles of the components

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

■ Cell signalling

A cell secretes a **ligand** 配体 (e.g. a **hormone** 激素); it travels to a **target cell** 靶细胞; it binds a **receptor** 受体 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
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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
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3.3 An electron micrograph shows a cell surface membrane that is 7.0 nm 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

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.