

# 4.1 Fluid mosaic membranes

Name: \_\_\_\_\_ Class: \_\_\_\_\_ Date: \_\_\_\_\_ **Total: 14 marks**

**KEY WORDS** cell surface membrane 细胞膜 • protein 蛋白质 • phospholipid 磷脂 • bilayer 双层  
• 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:

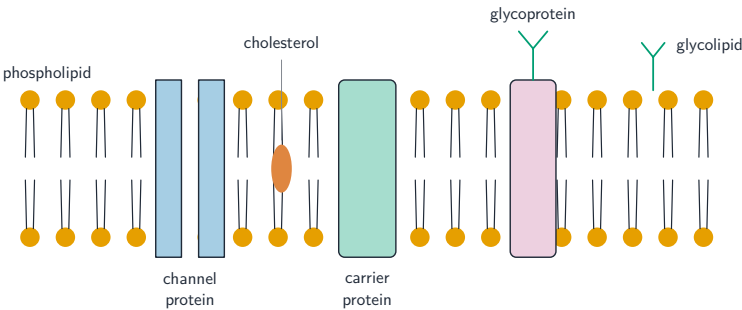
- describe the **fluid mosaic model** 流动镶嵌模型 and the hydrophobic/hydrophilic interactions that form the **bilayer** 双层
- describe the roles of phospholipids, **cholesterol** 胆固醇, proteins and **glycoproteins** 糖蛋白
- outline the stages of cell signalling (ligand → receptor → response)

## 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)

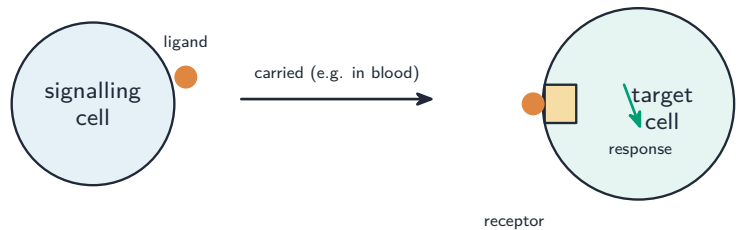
*Proteins, cholesterol and carbohydrate chains sit in a fluid phospholipid bilayer*

### ■ 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 <b>fluidity</b> 流动性 and adds strength   |
| glycoproteins / glycolipids      | cell recognition; some act as <b>antigens</b> 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]

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## 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]

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

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## Solutions

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**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** 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.