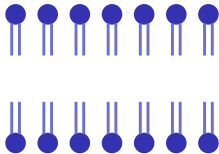


Cell Membranes & Transport

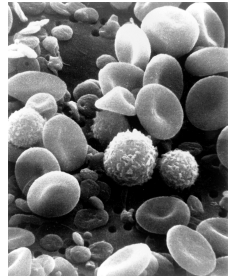
A-Level Biology ■ Topic 4

A-Level Biology



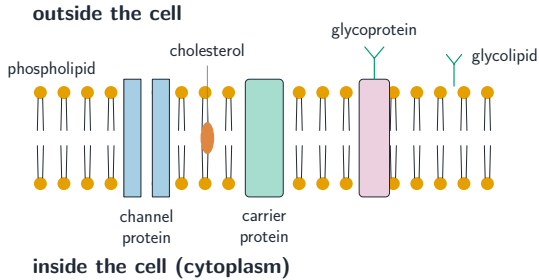
What we will cover

- 1 The fluid mosaic model
- 2 Cell signalling
- 3 Diffusion & osmosis
- 4 Active & bulk transport
- 5 Surface area : volume
- 6 Cells in solutions



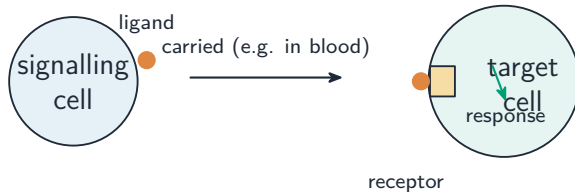
each cell has a membrane

The fluid mosaic model



potato osmometer

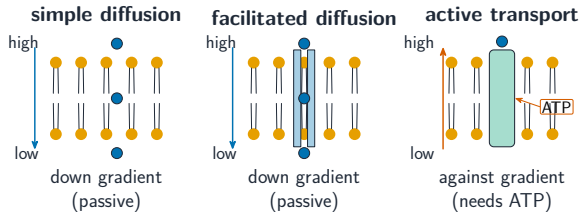
Cell signalling



In **cell signalling** 细胞信号传递:

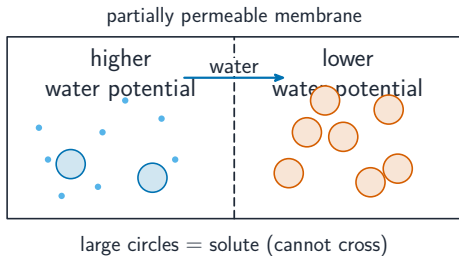
- a cell secretes a **ligand** 配体 (e.g. a **hormone** 激素)
- it binds a matching **receptor** 受体 on the **target cell** 靶细胞
- only cells with that receptor respond

Crossing the membrane



- **simple diffusion** 简单扩散 – small/non-polar straight through (passive)
- **facilitated diffusion** 易化扩散 – ions & glucose via proteins (passive)
- **active transport** 主动运输 – **against** the gradient, needs ATP

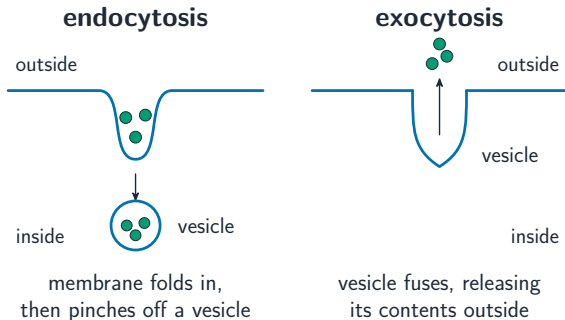
Osmosis and water potential



Osmosis 渗透 is the diffusion of water across a partially permeable membrane.

Water moves from a **higher** to a **lower water potential** 水势. Pure water is highest; a **solute** 溶质 lowers it.

Bulk transport



These move material in bulk, using ATP:

- **endocytosis** 胞吞作用 – the membrane folds in to form a **vesicle** 囊泡
- **exocytosis** 胞吐作用 – a vesicle fuses & releases its contents

Surface area to volume ratio



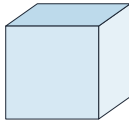
side $L = 1$

SA:V = 6 : 1



side $L = 2$

SA:V = 3 : 1



side $L = 3$

SA:V = 2 : 1

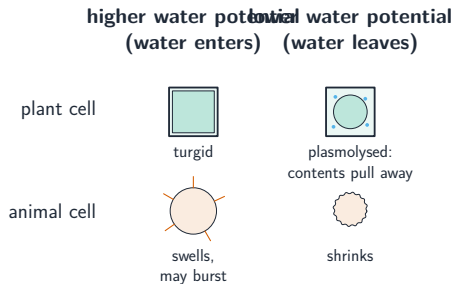
a bigger cube (or cell) has a **smaller** surface area : volume ratio

For a cube of side L :

$$\frac{SA}{V} = \frac{6L^2}{L^3} = \frac{6}{L}$$

As a cell grows, the ratio **falls**
– so small or thin, flat cells
exchange materials fastest.

Cells in solutions



- plant cell: **turgid** 膨胀 (water in) or **plasmolysed** 质壁分离 (water out)
- animal cell: bursts (**haemolysis** 溶血) or shrinks – no wall to protect it

Worked example – surface area : volume

Compare the surface area : volume ratio of a cube of side 4 with one of side 10.

- Side 4: $SA = 6 \times 4^2 = 96$; $V = 4^3 = 64$; ratio = $96/64 = 1.5$
- Side 10: $SA = 6 \times 10^2 = 600$; $V = 10^3 = 1000$; ratio = $600/1000 = 0.6$
- The **smaller** cube has the **larger** ratio.
- SA scales with length^2 but volume with length^3 , so **ratio falls as size rises**.

This is why cells are small and why big organisms need **gas-exchange and transport systems**: diffusion alone cannot serve a low SA:V.

Topic 4 – key takeaways

1 Fluid mosaic

a fluid bilayer dotted with proteins

2 Passive vs active

diffusion down gradient; active needs ATP

3 Osmosis

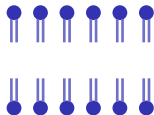
water moves to lower water potential

4 Water balance

turgid/plasmolysed; burst/shrink

Check yourself

- 1 Why is the model called “fluid”?
- 2 Which transport process needs ATP and goes against the gradient?
- 3 Osmosis moves water towards which water potential?
- 4 What is a plant cell called when it loses water and plasmolyses?



Answers 1. phospholipids slide past each other 2. active transport 3. lower water potential 4. plasmolysed