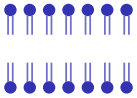
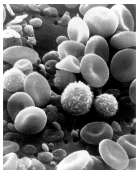
Cell Membranes & Transport

A-Level Biology ▪ Topic 4

A-Level Biology



What we will cover



each cell has a membrane

1 The membrane

The fluid mosaic model

A phospholipid bilayer with proteins floating in it.

fluid

phospholipids and proteins can move sideways

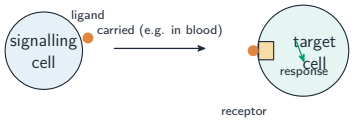
mosaic

proteins scattered like tiles – channels, carriers, receptors

bilayer

hydrophobic tails inside; hydrophilic heads face water

Cell signalling



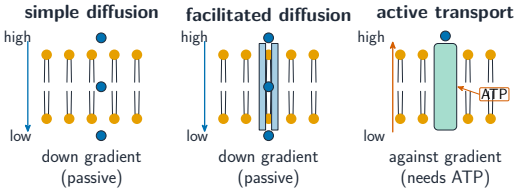
In **cell signalling** 细胞信号传递:

- 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

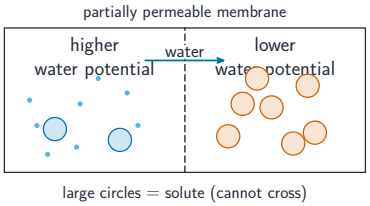
2 Transport

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

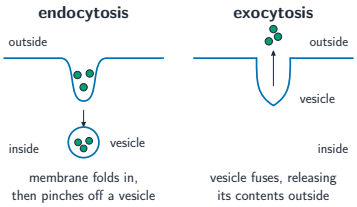


large circles = solute (cannot cross)

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:

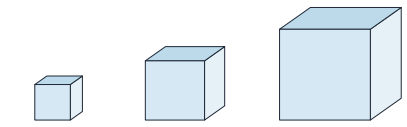
- **endocytosis** 胞吞作用 – the membrane folds in to form a **vesicle** 囊泡
- **exocytosis** 胞吐作用 – a vesicle fuses & releases its contents

3 Size and water

Surface area to volume ratio

For a cube of side L: $\frac{\text{SA}}{\text{V}} = \frac{6L^2}{L^3} = \frac{6}{L}$.

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

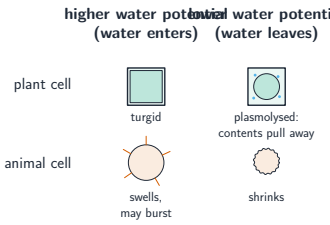


side $L = 1$
SA : V $= 6 : 1$

side $L = 2$
SA : V $= 3 : 1$

side $L = 3$
SA : V $= 2 : 1$

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

4 Recap

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