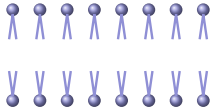


Cell Structure and Function

AP Biology ■ Unit 2

AP Biology



What we will cover

1 Organelles and the endomembrane system

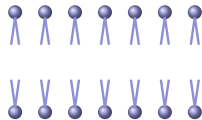
2 Surface area-to-volume ratio

3 The fluid mosaic membrane

4 What crosses the membrane

5 Passive and active transport

6 Tonicity and endosymbiosis

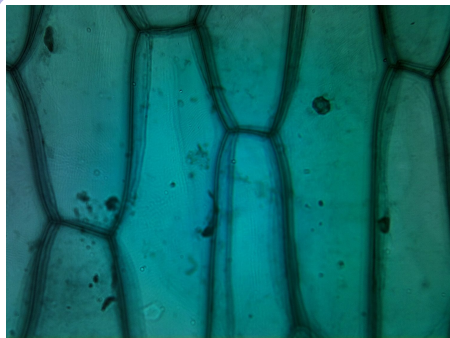


Organelles and the endomembrane system

A **eukaryotic** 真核的 cell divides work among **organelles** 细胞器:

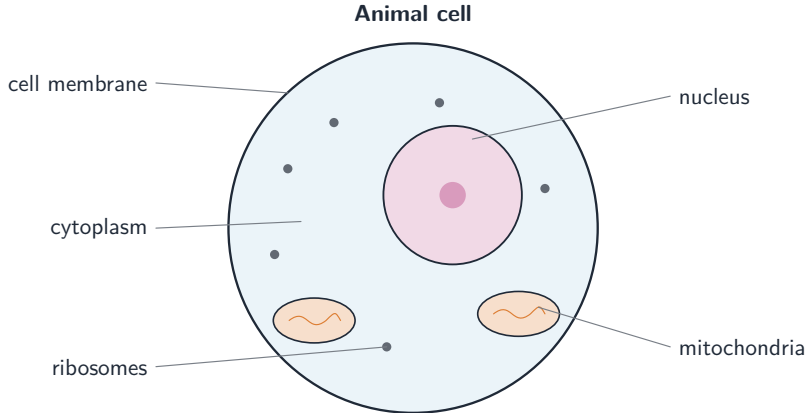
- **nucleus** 细胞核 – stores DNA
- **mitochondria** 线粒体 – make ATP
- **ribosomes** 核糖体 – build proteins
- **ER** 内质网 + **Golgi** 高尔基体 – pack and ship

The endomembrane team traces a protein: nucleus → rough ER → Golgi → vesicle → membrane.



Organelles divide labour inside the cell

Organelles and the endomembrane system



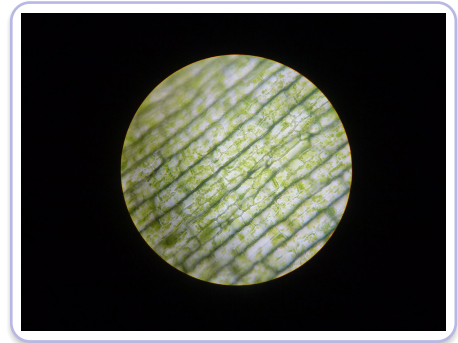
Surface area-to-volume ratio

Materials cross the **surface** 表面积; the **volume** 体积 must be served. As a cell grows, volume outpaces surface:

A cube of side s

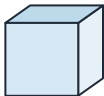
$$\frac{\text{area}}{\text{volume}} = \frac{6s^2}{s^3} = \frac{6}{s}$$

The ratio **shrinks** as s grows – so cells stay small (or add **folds** 褶皱).

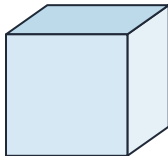


leaf cells micrograph

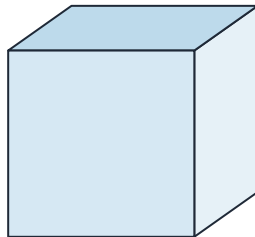
Surface area-to-volume ratio



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



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



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

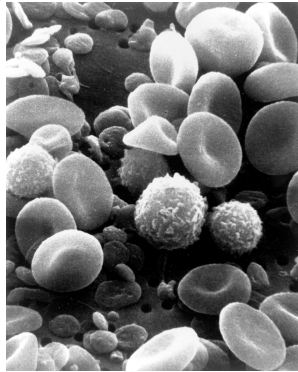
a bigger cube (or cell) has a **smaller** surface area : volume ratio

The fluid mosaic membrane

The **fluid mosaic model** 流动镶嵌模型: a **phospholipid bilayer** 磷脂双分子层 (hydrophilic heads out, hydrophobic tails in) with drifting proteins.

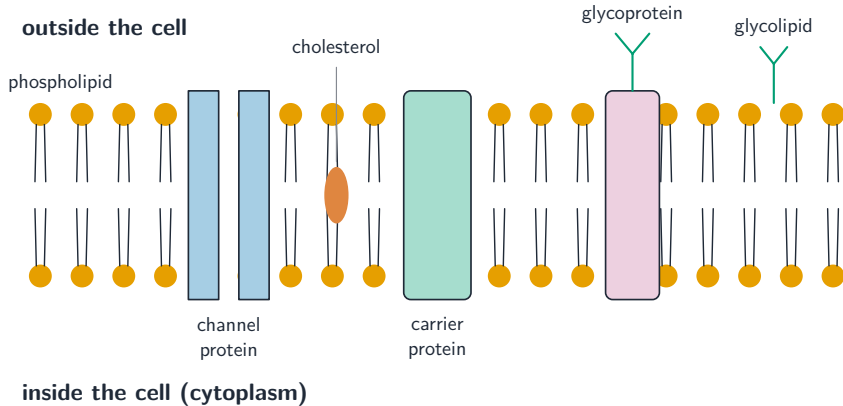
- **membrane proteins** 膜蛋白 – channels, pumps, receptors
- **cholesterol** 胆固醇 – steadies the fluidity

Selectively permeable 选择性通透的 – it maintains **homeostasis** 稳态.



rbc sem

The fluid mosaic membrane



What crosses, and how

The hydrophobic core decides what crosses directly:

- cross easily – small **nonpolar** (O_2 , CO_2), and water
- blocked – large or charged (**glucose** 葡萄糖, Na^+)

Facilitated diffusion 易化扩散:

channel 通道蛋白/**carrier** 载体蛋白 proteins – passive, but **saturates**.

Passive: down the gradient,
no ATP

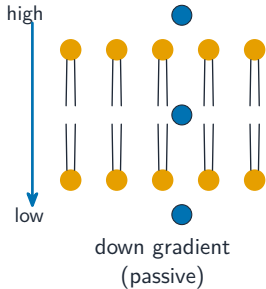
Active: against the gradient,
uses *ATP*

Osmosis 渗透 = diffusion of water.

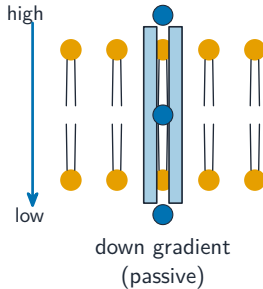
Endo/exocytosis move bulk cargo.

What crosses, and how

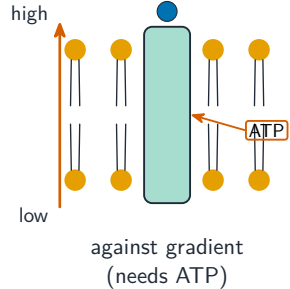
simple diffusion



facilitated diffusion



active transport



Tonicity and endosymbiosis

Water moves toward the **saltier** side. **Water potential** 水势 $\Psi = \Psi_S + \Psi_P$.

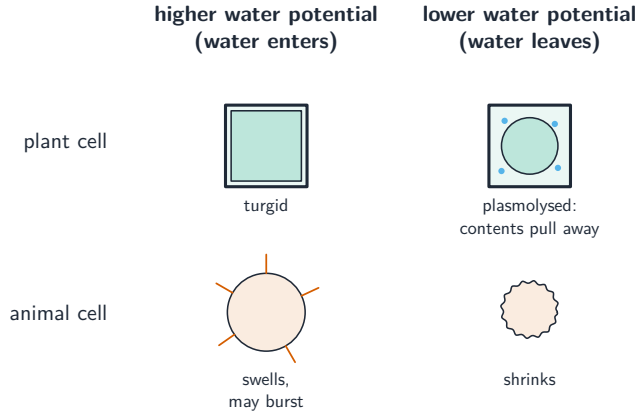
- **hypertonic**: cell shrinks
- **hypotonic**: cell swells
- **isotonic**: steady volume

Endosymbiotic theory 内共生学说:
mitochondria & chloroplasts were once bacteria – own circular DNA, double membranes, own ribosomes.



Water leaves cells in a hypertonic solution

Tonicity and endosymbiosis



Unit 2 – key takeaways

1

Organelles

compartments for parallel reactions; endomembrane ships proteins

2

SA:V

ratio $6/s$ shrinks with size – cells stay small

3

Membrane

fluid mosaic bilayer; selectively permeable

4

Transport

passive down / active up the gradient; osmosis

Check yourself

1

As a cell grows, does its surface-to-volume ratio rise or fall?

2

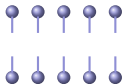
Why can O_2 cross the membrane but Na^+ cannot?

3

Does active transport use ATP?

4

Name one piece of evidence for endosymbiosis.



Answers 1. it falls 2. Na^+ is charged; O_2 is nonpolar 3. yes 4. own circular DNA (or double membrane)