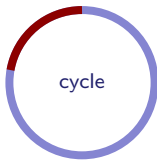


Cell Communication and Cell Cycle

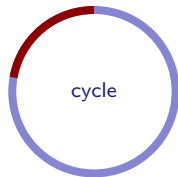
AP Biology ■ Unit 4

AP Biology



What we will cover

- 1 Cell communication
- 2 Signal transduction
- 3 Feedback and homeostasis
- 4 The cell cycle
- 5 Regulation of the cell cycle

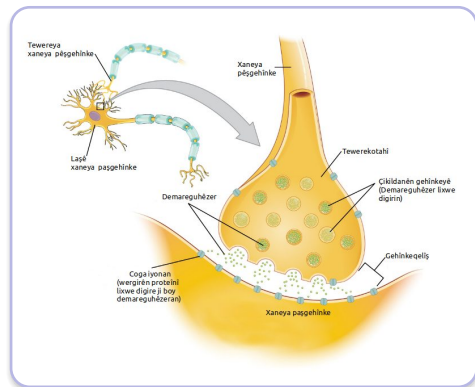


Cell communication

Cells talk with chemical **signals** 信号 over three distances:

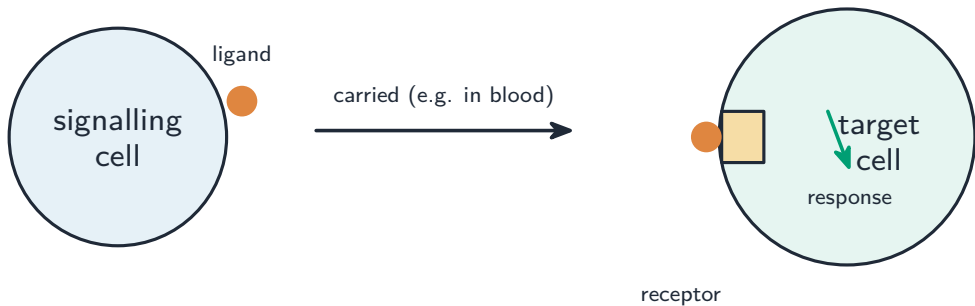
- **direct contact** 直接接触 – through channels
- **paracrine** 旁分泌 – to nearby cells
- a **hormone** 激素 – far away via blood

A **ligand** 配体 fits its **receptor** 受体 like a key in a lock – giving signaling its **specificity** 特异性.



Chemical signals cross synapses and tissues

Cell communication



Signal transduction

Turning an outside message into an inside action, in three stages:

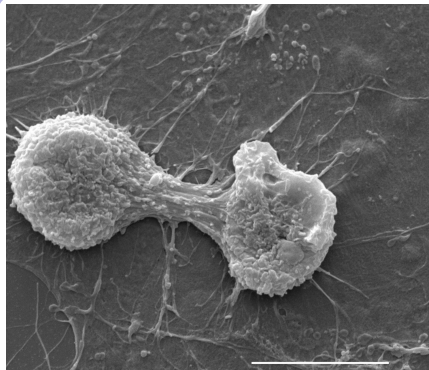
reception

ligand binds

transduction

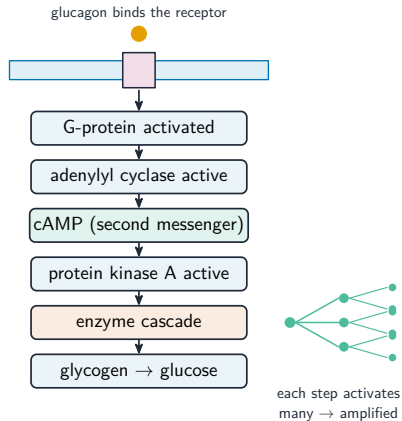
a relay of molecules

Second messengers 第二信使 (cAMP, Ca^{2+}) and a **phosphorylation cascade** 磷酸化级联 give huge **amplification** 放大:
 $1 \rightarrow 100 \rightarrow 10,000 \rightarrow \text{millions.}$



cytokinesis fibroblast

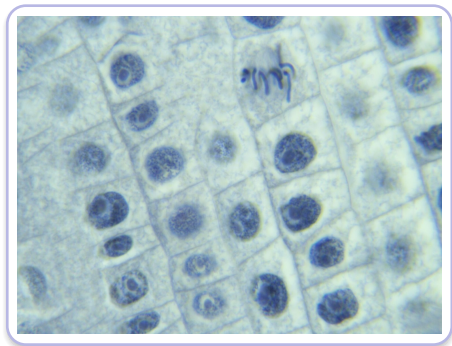
Signal transduction



Feedback and homeostasis

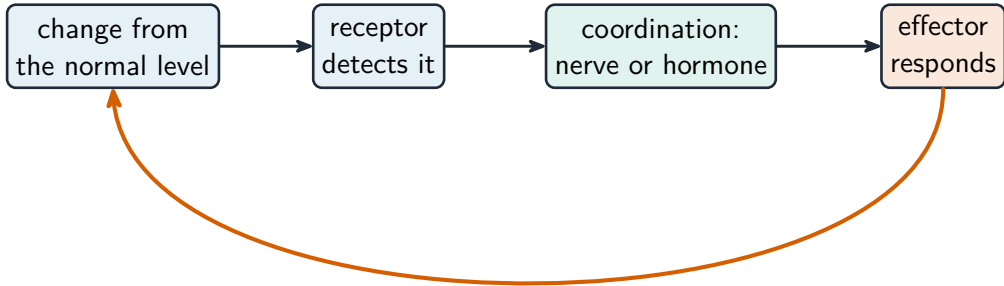
Feedback 反馈机制 keeps the body steady (homeostasis 稳态):

- **negative feedback** 负反馈 reverses a change back to a **set point** 设定点 (temperature, **blood glucose** 血糖)
- **positive feedback** 正反馈 amplifies to finish an event (childbirth, clotting)



mitosis onion metaphase

Feedback and homeostasis

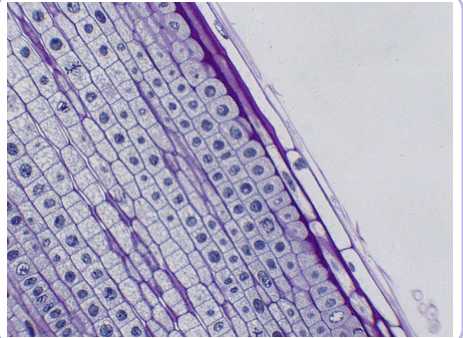


the response pushes the level back to normal (negative feedback)

The cell cycle

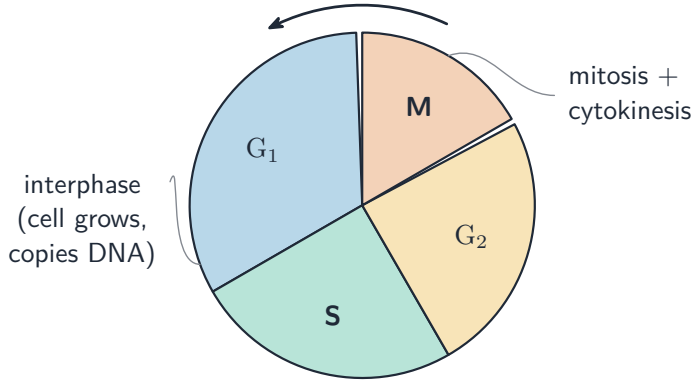
- **interphase** 间期 – grow and copy DNA
- **mitosis** 有丝分裂 (M) – split the nucleus: **P**rophase, **M**etaphase, **A**naphase, **T**elophase
- **cytokinesis** 胞质分裂 – split the cytoplasm

Two identical **diploid** 二倍体 **daughter cells** 子细胞; n divisions $\Rightarrow 2^n$ cells.



Mitosis produces two identical daughter nuclei

The cell cycle



Regulation of the cell cycle

Checkpoints 检查点 stop and check before each step: cell size, DNA copied correctly, chromosomes aligned.

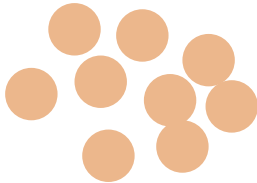
Cyclins 周期蛋白 +
CDKs 周期蛋白依赖性激酶 push the cycle past checkpoints.

Lose control $\Rightarrow$ endless division = **cancer** 癌症. Guard genes (p53) halt the cycle for DNA repair – if they fail, damage is copied.

Regulation of the cell cycle



controlled: cells stop dividing



uncontrolled: a tumour grows

Unit 4 – key takeaways

1

Signaling

ligand-receptor specificity; three stages; amplification

2

Feedback

negative returns to a set point; positive amplifies

3

Cell cycle

interphase + mitosis (PMAT); two identical cells

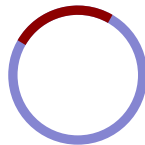
4

Control

checkpoints + cyclin/CDK; failure causes cancer

Check yourself

- 1 Why does only a target cell respond to a hormone?
- 2 Which feedback returns a value to its set point?
- 3 Name the four stages of mitosis.
- 4 What controls whether the cell cycle advances?



Answers 1. only it has the matching receptor 2. negative 3. prophase, metaphase, anaphase, telophase 4. checkpoints (cyclin/CDK)