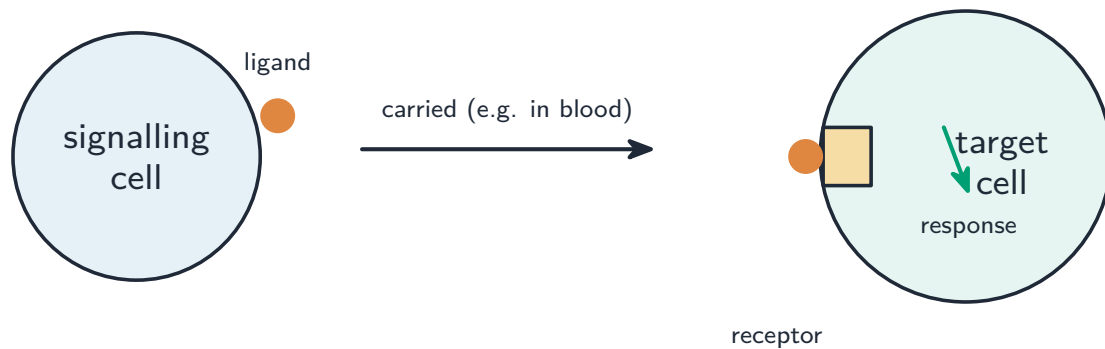


# Cell Communication and Cell Cycle

AP Biology

## Cell Communication

Cells coordinate by sending and receiving chemical **signals** 信号. A signaling cell releases a **ligand** 配体 that binds a **receptor** 受体 on a target cell. Signals travel over different ranges: **direct contact** (cell junctions), **local** signaling (nearby cells, like neurotransmitters), and **long-distance** signaling (**hormones** 激素 through the blood).



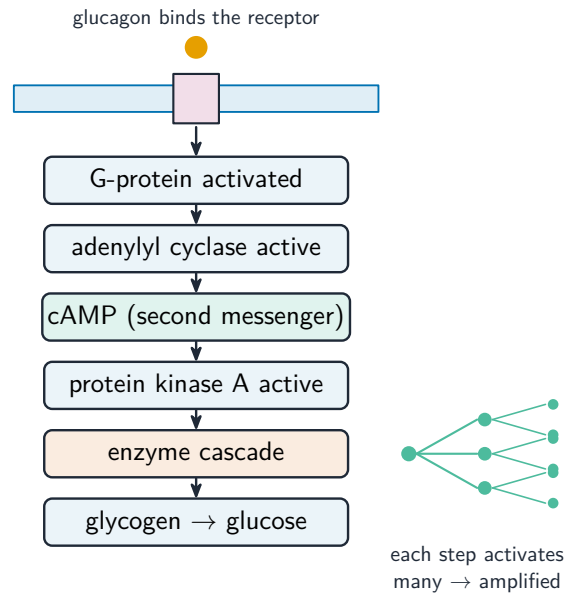
*A signal molecule (ligand) binds a matching receptor on the target cell*

## Introduction to Signal Transduction

**Signal transduction** 信号转导 converts an outside signal into a cellular response in three stages: **reception** (ligand binds receptor), **transduction** (a relay of molecules inside the cell), and **response** (a change in the cell's activity, such as switching on a gene). Receptors are specific, so a cell only responds to signals it can receive.

## Signal Transduction Pathways

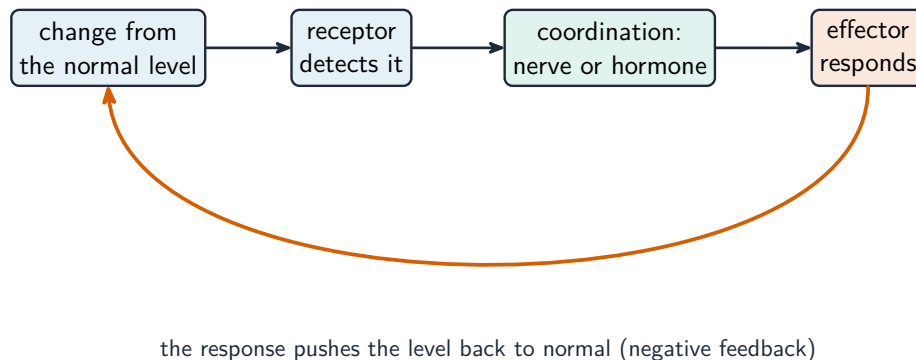
In the transduction stage, the signal passes through a **pathway** –often a cascade of proteins that activate one another, frequently amplifying the signal so a few ligands trigger a large response. **Second messengers** (like cyclic AMP or calcium ions) spread the signal quickly through the cell. A change in one step can alter the whole outcome.



*A signalling cascade amplifies the message inside the cell*

## Feedback

**Feedback** 反馈 keeps systems balanced:



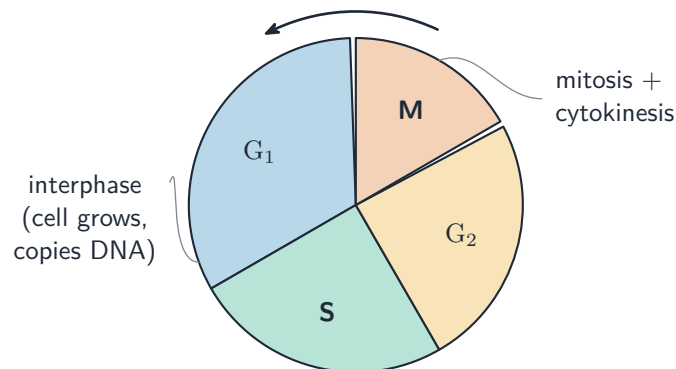
*Negative feedback detects and corrects a change*

- **Negative feedback** 负反馈 counteracts a change to restore a set point (like a thermostat) –it maintains **homeostasis** 稳态.
- **Positive feedback** 正反馈 amplifies a change to push a process to completion (like childbirth contractions or blood clotting).

## Cell Cycle

The **cell cycle** 细胞周期 is the life of a cell from one division to the next: **interphase** 间期 (G1 growth, S DNA replication, G2 preparation) followed by **mitosis** 有丝分裂

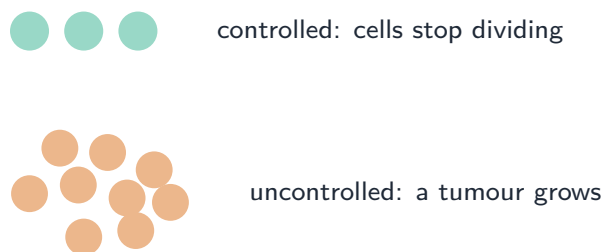
(M) and cytokinesis, which produce two identical daughter cells. Interphase takes most of the time; DNA is copied only in S phase.



*The cell cycle: interphase, then mitosis and cytokinesis*

## Regulation of Cell Cycle

The cycle is controlled at **checkpoints** 检查点 that verify conditions before proceeding (Is the DNA intact? Are chromosomes attached?). Internal signals (cyclins and their kinases) and external signals drive the cycle forward. When this control fails—for example, a mutation that ignores a checkpoint—cells divide uncontrollably, which underlies **cancer** 癌症.



*Uncontrolled division from failed checkpoints forms a tumour*

## Exam tips

- In signal transduction name the three stages: **reception** → **transduction** → **response**.
- **Negative** feedback reverses a change to keep conditions steady (homeostasis); **positive** feedback amplifies a change to completion (childbirth, clotting).
- Order the **cell cycle**: interphase (grow, copy DNA in S phase) then mitosis → two **identical** daughter cells.
- The DNA is copied **once**, in S phase, so each daughter gets a full copy.
- Failed **checkpoints** allow uncontrolled division → cancer.