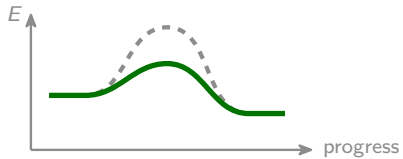


Cellular Energetics

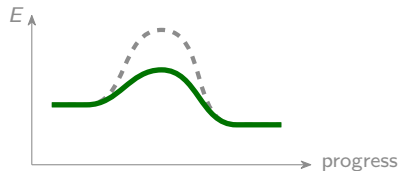
AP Biology ■ Unit 3

AP Biology



What we will cover

- 1 Enzymes as catalysts
- 2 Enzyme conditions and inhibitors
- 3 ATP and energy coupling
- 4 Photosynthesis
- 5 Cellular respiration



Enzymes as biological catalysts

Enzymes 酶 speed reactions by **lowering the activation energy** – without being used up.

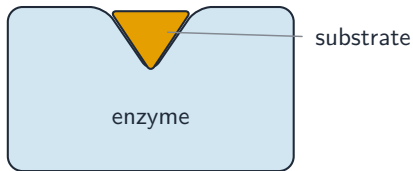
- the **substrate** 底物 binds the **active site** 活性位点
- **induced fit** 诱导契合模型 – the site reshapes to grip it
- each enzyme is **specific** 专一的 to one reaction



Enzymes lower activation energy in living systems

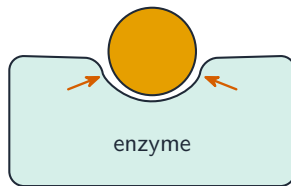
Enzymes as biological catalysts

lock-and-key



active site is a
fixed shape

induced fit



active site moulds
to fit the substrate

Conditions and inhibitors

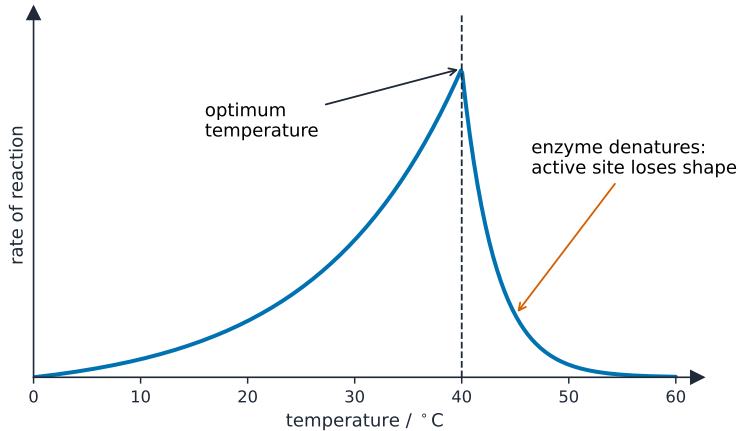
Each enzyme has an **optimum** 最适 temperature and pH; too far and it **denatures** 变性. Adding substrate speeds it up until it **saturates** 饱和的.

Competitive: blocks the active site
(more substrate helps)

Noncompetitive: binds elsewhere,
reshapes it

Feedback inhibition: the product
shuts off step 1

Conditions and inhibitors



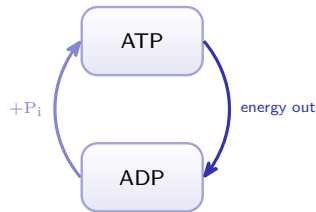
ATP and energy coupling

Exergonic 放能反应 reactions release **free energy** 自由能; **endergonic** 吸能反应 ones absorb it.

The cell's energy currency

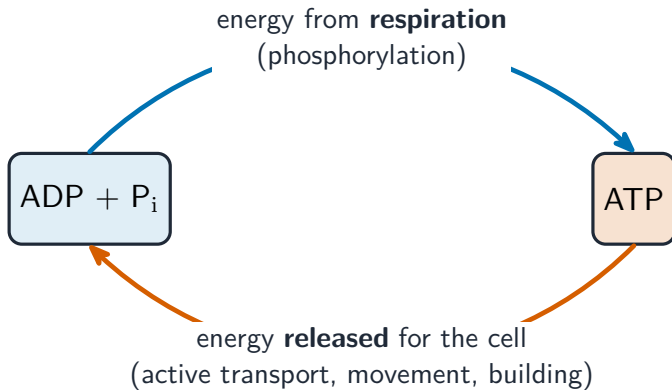


A **coupled reaction** 偶联反应 links ATP breakdown to an uphill step – powering it.



Constantly recycled; order needs a steady energy supply.

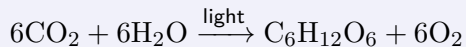
ATP and energy coupling



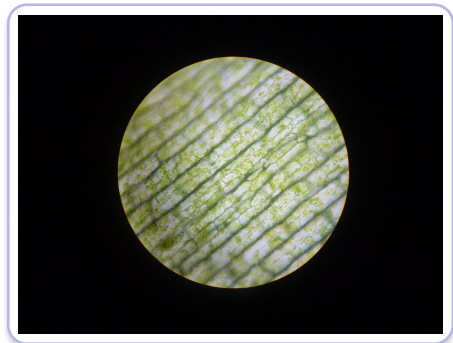
Photosynthesis

In the **chloroplast** 叶绿体, light energy becomes sugar:

Overall

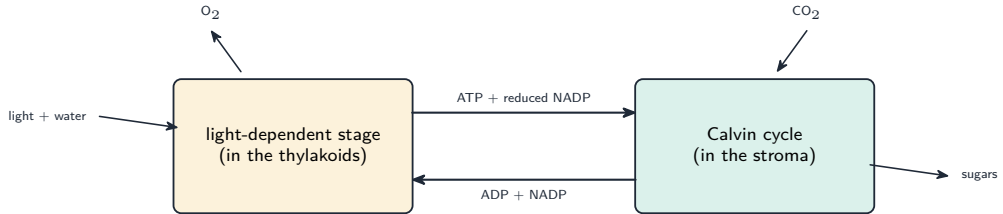


- **light reactions** – thylakoid: split H_2O , make O_2
- **Calvin cycle** – stroma: fix CO_2 into sugar



Chloroplasts capture light and fix carbon

Photosynthesis



Cellular respiration

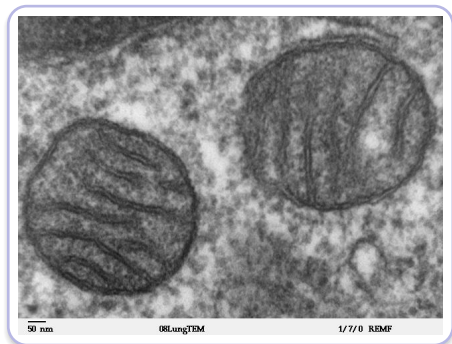
In the **mitochondrion** 线粒体, glucose is broken down to make ATP:

Overall



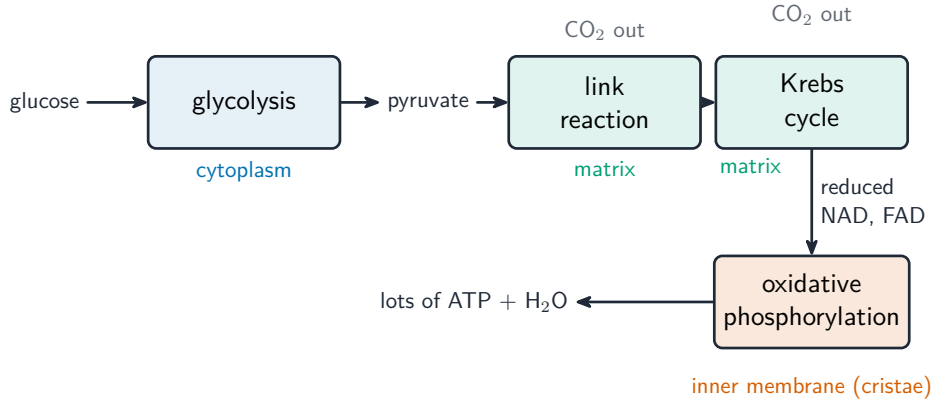
glycolysis → Krebs → oxidative phosphorylation;
aerobic $\approx$ 30–32 ATP.

Chemiosmosis 化学渗透: H^+ flows back through ATP synthase.



Mitochondria oxidise fuel to make ATP

Cellular respiration



Unit 3 – key takeaways

1

Enzymes

lower activation energy; specific active site; denature

2

ATP

$\text{ATP} \rightarrow \text{ADP} + \text{P}_i$; couples to uphill steps

3

Photosynthesis

light reactions + Calvin cycle
build glucose

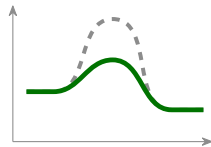
4

Respiration

glycolysis, Krebs, oxidative phosphorylation

Check yourself

- 1 How does an enzyme speed up a reaction?
- 2 What molecule carries energy for the cell?
- 3 Which organelle carries out photosynthesis?
- 4 Aerobic respiration yields how many ATP vs fermentation?



Answers 1. it lowers the activation energy 2. ATP 3. the chloroplast 4. ~30 vs 2