Exercise walk-through

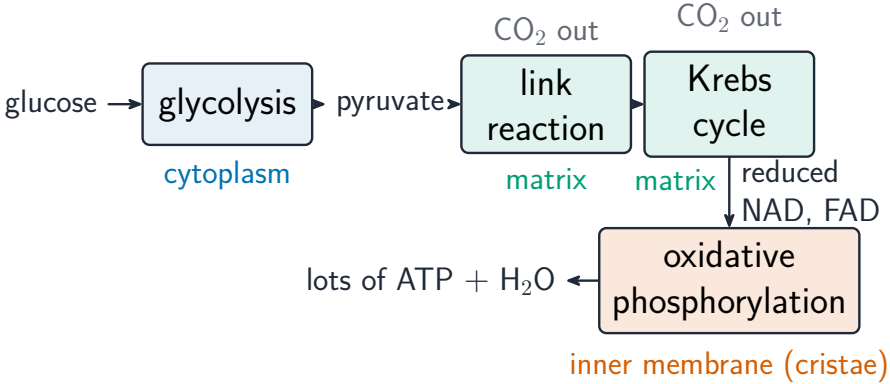
Respiration ▪ 12.2

eXercise

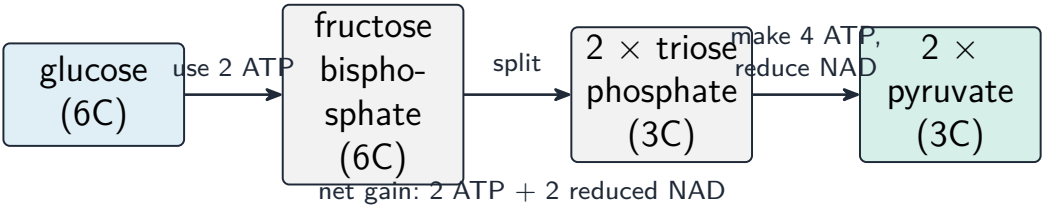
You must be able to

- state where glycolysis, the link reaction, the Krebs cycle and oxidative phosphorylation occur
- outline each stage, including decarboxylation, dehydrogenation and chemiosmosis
- relate mitochondrial structure to function and describe anaerobic respiration

Method — The four stages and where they happen



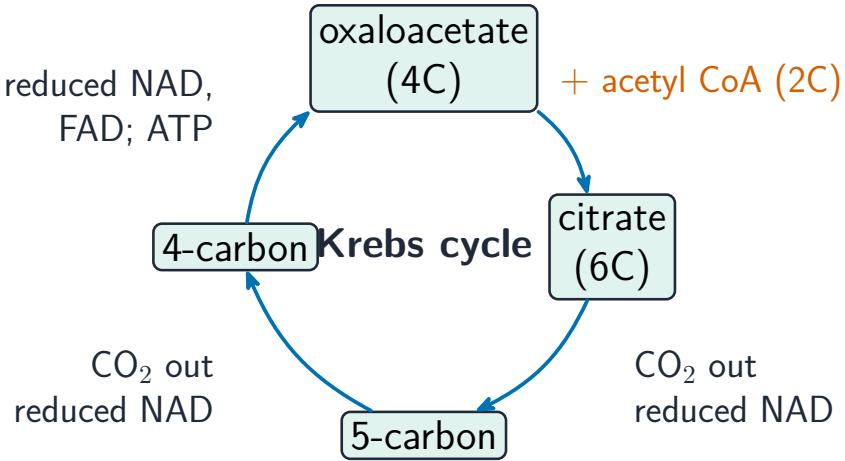
Method — Glycolysis



Method — The link reaction and Krebs cycle

Link reaction (matrix): pyruvate (3C) loses CO $\rightarrow$ acetyl (2C), carried by **coenzyme A** 辅酶 A; NAD is reduced. **Krebs cycle** (matrix): acetyl (2C) + oxaloacetate (4C) $\rightarrow$ citrate (6C), converted back with **decarboxylation** and **dehydrogenation**.

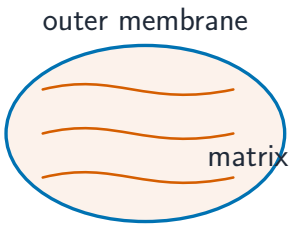
Method — The link reaction and Krebs cycle

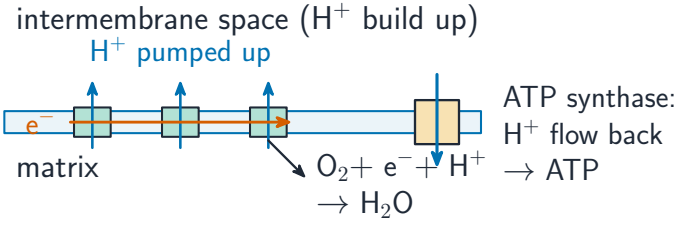


Method — Oxidative phosphorylation

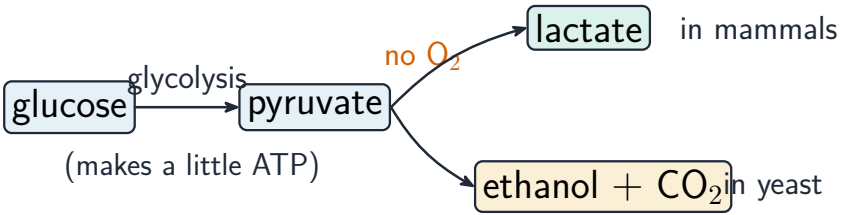
Energetic electrons pass along the **electron transport chain** 电子传递链; the energy pumps protons across the inner membrane; protons flow back through **ATP synthase** to make ATP; **oxygen** is the final electron acceptor, forming water. **Cristae** 嵴 give a large surface for this.

Method — Oxidative phosphorylation





Method — Anaerobic respiration



this regenerates NAD so glycolysis can keep running (far less ATP than aerobic)

Without oxygen: glycolysis → pyruvate → lactate (mammals) or ethanol + CO2 (yeast)

Practice 2.1 ▪ 3 marks

State where in a eukaryotic cell each stage occurs: glycolysis; Krebs cycle; oxidative phosphorylation.

Solution 2.1

Method: The four stages and where they happen

Worked steps

glycolysis — cytoplasm; Krebs cycle — mitochondrial matrix; oxidative phosphorylation — inner mitochondrial membrane B1 *each*.

Practice 2.2 ▪ 1 mark

State the net number of ATP molecules made directly in glycolysis.

Solution 2.2

Method: The four stages and where they happen

Worked steps

2 (a net gain of 2 ATP) B1.

Exam-style 3.1 ▪ 1 mark

In which stage does oxygen act as the final electron acceptor?

A glycolysis

B the link reaction

C the Krebs cycle

D oxidative phosphorylation

Solution 3.1

Method: Oxidative phosphorylation

A glycolysis

B the link reaction

C the Krebs cycle

D oxidative phosphorylation ✓

Worked steps

D. In oxidative phosphorylation oxygen is the final electron acceptor.

Exam-style 3.2 ▪ 1 mark

What is produced when pyruvate undergoes lactate fermentation in a muscle?

A ethanol and carbon dioxide

B lactate

C acetyl coenzyme A

D citrate

Solution 3.2

Method: Anaerobic respiration

A ethanol and carbon dioxide

B lactate ✓

C acetyl coenzyme A

D citrate

Worked steps

B. In mammals, anaerobic respiration converts pyruvate to lactate.

Exam-style 3.3 ▪ 3 marks

(a) Describe what happens in the link reaction.
(b) Explain how the folding of the inner mitochondrial membrane into cristae helps respiration.

Solution 3.3

Method: The four stages and where they happen

Worked steps

pyruvate enters the mitochondrial matrix **B1**; it loses a CO (decarboxylation) and is oxidised to a 2C acetyl group, reducing NAD **B1**; the acetyl group joins coenzyme A to form acetyl coenzyme A **B1**.
(b) cristae give a large surface area **B1** for more electron carriers and ATP synthase, so more ATP is made **B1**.

Exam-style 3.4 ▪ 4 marks

(a) Explain how ATP is made during oxidative phosphorylation, with reference to protons and ATP synthase.
(b) Explain why anaerobic respiration releases far less energy than aerobic respiration.

Solution 3.4

Method: Oxidative phosphorylation

Worked steps

(a) energetic electrons pass along the electron transport chain, releasing energy B1; this pumps protons across the inner membrane into the intermembrane space B1; the protons flow back into the matrix through ATP synthase B1; this flow provides energy to make ATP (chemiosmosis) B1.
(b) anaerobic respiration uses only glycolysis M1, without the link reaction, Krebs cycle and oxidative phosphorylation that release most of the ATP A1.