

Exercise walk-through

Energy ■ 12.1

eXercise

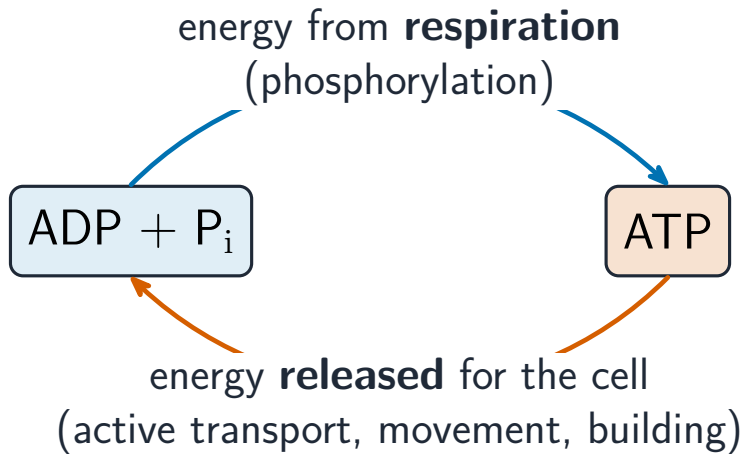
You must be able to

- state why living organisms need energy and the features that suit ATP as the energy currency
- compare the energy values of carbohydrates, lipids and proteins
- calculate RQ values from respiration equations and use a **respirometer** 呼吸计

Method — ATP — the energy currency

Cells need energy for **active transport** 主动运输, movement and **anabolic** 合成 reactions. ATP suits the job: it releases energy in small usable amounts, is quickly re-made, and is small and soluble. It is made by **phosphorylation** 磷酸化 (direct transfer) and **chemiosmosis** 化学渗透.

Method — ATP — the energy currency



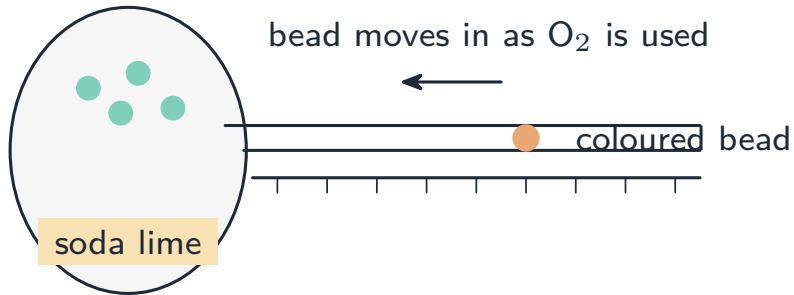
Method — Respiratory quotient (RQ)

$$\text{RQ} = \frac{\text{molecules of CO}_2 \text{ produced}}{\text{molecules of O}_2 \text{ taken in}}$$

For glucose: $\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O}$, so $\text{RQ} = \frac{6}{6} = 1.0$. Carbohydrates give ≈ 1.0 , lipids ≈ 0.7 , proteins ≈ 0.9 (lipids release the most energy per gram).

Method — The respirometer

germinating seeds



Practice 2.1 ■ 2 marks

State **two** features of ATP that make it a good energy currency.

Solution 2.1

Method: ATP — the energy currency

Worked steps

any two: releases energy in small usable amounts; quickly made and re-made; small and soluble (moves easily) **B1** *each, max 2.*

Practice 2.2 ■ 1 mark

State which respiratory substrate releases the most energy per gram.

Solution 2.2

Method: Respiratory quotient (RQ)

Worked steps

lipids **B1**.

Exam-style 3.1 ■ 1 mark

What is the RQ of a substrate that produces 8 molecules of CO_2 and uses 10 molecules of O_2 ?

A 0.6

B 0.8

C 1.0

D 1.25

Solution 3.1

A 0.6

B 0.8



C 1.0

D 1.25

Worked steps

B. $RQ = 8/10 = 0.8$.

Exam-style 3.2 ■ 1 mark

Why is the soda lime needed in a respirometer that measures oxygen uptake?

- A** to release oxygen
- B** to absorb the carbon dioxide produced
- C** to keep the seeds warm
- D** to colour the liquid

Solution 3.2

Method: The respirometer

- A to release oxygen
- B to absorb the carbon dioxide produced** 
- C to keep the seeds warm
- D to colour the liquid

Worked steps

B. Soda lime absorbs the CO_2 , so the gas volume falls only by the oxygen used.

Exam-style 3.3 ■ 2 marks

A lipid respire according to: $2C_{51}H_{98}O_6 + 145O_2 \rightarrow 102CO_2 + 98H_2O$.

- (a) Calculate the RQ for this lipid. Give your answer to 2 significant figures.
- (b) State what this RQ value tells you about the substrate being respired.

Solution 3.3

Worked steps

(a) $RQ = \frac{102}{145} = 0.70$ **M1** **A1**.

(b) it shows a lipid is being respired **B1**.

Exam-style 3.4 ■ 2 marks

In a respirometer, the coloured bead moves 45 mm in 15 minutes. The capillary tube has a cross-sectional area of 1.0 mm^2 .

- (a) Calculate the rate of oxygen uptake, in mm^3 per minute.
- (b) Explain why this apparatus measures oxygen uptake rather than the total gas change.

Solution 3.4

Method: The respirometer

Worked steps

(a) volume = $45 \text{ mm} \times 1.0 \text{ mm}^2 = 45 \text{ mm}^3$ (M1); rate = $45/15 = 3.0 \text{ mm}^3 \text{ min}^{-1}$ (A1).

(b) the soda lime absorbs all the CO_2 released (M1), so the only change in gas volume is the oxygen taken in (A1).