

Exercise walk-through

Energy Flow Through Ecosystems ■ 8.2

eXercise

You must be able to

- describe **trophic levels** 营养级 and the **10% rule**
- draw/read an **energy pyramid** 能量金字塔
- explain why food chains are short

Method — Trophic levels

Energy flows from **producers** (make their own food) to **primary consumers** (herbivores), to **secondary** and **tertiary consumers** (carnivores). Each is a **trophic level**.

Method — The 10% rule

Only about **10%** of the energy at one trophic level passes to the next. The other ~90% is lost as **heat** and used for life processes.

Method — A worked calculation

If producers store 10 000 kJ: primary consumers get ~1000 kJ; secondary ~100 kJ; tertiary ~10 kJ.

Method — Why food chains are short

Because so much energy is lost at each step, there is **too little** energy left to support many levels — so food chains rarely exceed 4-5 links.

Practice 2.1 ■ 1 mark

What percentage of energy passes to the next trophic level?

Solution 2.1

Method: The 10% rule

Worked steps

About 10% **B1**.

Practice 2.2 ■ 1 mark

Where does the “lost” energy go?

Solution 2.2

Worked steps

Lost as heat (and used in life processes) **B1**.

Practice 2.3 ■ 1 mark

If producers have 8000 kJ, how much reaches primary consumers?

Solution 2.3

Method: A worked calculation

Worked steps

About 800 kJ **B1**.

Exam-style 3.1 ■ 1 mark

Roughly how much energy passes from one trophic level to the next?

A 1%

B 10%

C 50%

D 90%

Solution 3.1

Method: The 10% rule

A 1%

B 10% 

C 50%

D 90%

Worked steps

B — 10%.

Exam-style 3.2 ■ 3 marks

An ecosystem's producers store 20 000 kJ.

- (a) Estimate the energy reaching the secondary consumers.
- (b) Explain why so little energy reaches the top level.

Solution 3.2

Worked steps

(a) Primary consumers: 2000 kJ; secondary consumers: 200 kJ **M1** **M1** **A1**. (b) About 90% of the energy is lost at each transfer, so very little remains after several steps **B1**.

Exam-style 3.3 ■ 2 marks

Explain why food chains rarely have more than four or five trophic levels.

Solution 3.3

Method: Why food chains are short

Worked steps

So much energy is lost ($\sim 90\%$) at each level that after a few levels there is too little left to support another, limiting chain length **M1** **A1**.