

Exercise walk-through

Signal Transduction Pathways ■ 4.3

eXercise

You must be able to

- describe a pathway as a **cascade** of activated molecules
- explain **amplification** 放大 of the signal
- explain how the same signal can give different responses in different cells

Method — A cascade

A transduction pathway is a **cascade**: molecule A activates B, which activates C, and so on, each step relaying the signal toward the response.

Method — Amplification

At each step one active molecule can activate **many** of the next, so a **small** signal produces a **large** response — the signal is **amplified**.

Method — Second messengers

Small molecules (like cyclic AMP or Ca^{2+}) can spread the signal quickly through the cell as **second messengers**, reaching many targets.

Method — Different responses

The **same** signal can cause **different** responses in different cell types, because each cell has a different set of internal proteins and genes to act on.

Practice 2.1 ■ 1 mark

What is a signal cascade?

Solution 2.1

Method: A cascade

Worked steps

A series of molecules that each activate the next, relaying the signal **B1**.

Practice 2.2 ■ 1 mark

How does a small signal cause a large response?

Solution 2.2

Method: Amplification

Worked steps

Each step activates many of the next molecule, amplifying the signal **B1**.

Practice 2.3 ■ 1 mark

Give an example of a second messenger.

Solution 2.3

Worked steps

Cyclic AMP (or calcium ions) **B1**.

Exam-style 3.1 ■ 1 mark

Signal amplification means that one signal molecule can lead to

- A** no response
- B** exactly one product
- C** many activated molecules
- D** the receptor breaking down

Solution 3.1

Method: Amplification

- A no response
- B exactly one product
- C many activated molecules 
- D the receptor breaking down

Worked steps

C — many activated molecules.

Exam-style 3.2 ■ 2 marks

The same hormone triggers different responses in two cell types.

- (a) Explain how this is possible.
- (b) State one advantage of amplifying a signal.

Solution 3.2

Method: Different responses

Worked steps

(a) Each cell type has a different set of internal proteins and genes, so the same signal is acted on differently **M1 A1**. (b) A small amount of signal can produce a large, fast response **B1**.

Exam-style 3.3 ■ 3 marks

Describe how a cascade relays and amplifies a signal from the receptor to the response.

Solution 3.3

Method: A cascade

Worked steps

The receptor activates the first molecule, which activates the next, and so on (a cascade) **M1**; at each step one active molecule activates many of the next **M1**, so the signal grows and reaches the response amplified **A1**.