AP BIOLOGY • EXERCISE SHEET

4.3 Signal Transduction Pathways

Name: _____ Class: _____ Date: _____ **Total: 10 marks**

Objective

Build the skills to answer exam questions on **signal transduction pathways**.

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

1 Worked examples

Study these first. Each one shows the method for a question type used later —follow the steps and you can do the Practice and Exam-style questions yourself.

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.

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**.

Second messengers

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

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.

2 Practice

Now apply the methods above.

2.1 What is a signal cascade? [1]

2.2 How does a small signal cause a large response? [1]

2.3 Give an example of a second messenger. [1]

3 Exam-style questions

3.1 Signal amplification means that one signal molecule can lead to [1]

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

3.2 The same hormone triggers different responses in two cell types.

(a) Explain how this is possible. [2]

(b) State one advantage of amplifying a signal. [1]

3.3 Describe how a cascade relays and amplifies a signal from the receptor to the response. [3]

4 Go further

You are now ready for the real exam questions on this subtopic:

- work through the **4.3 Signal Transduction Pathways** lesson on the **Learn** page;
- read the **Signal Transduction Pathways** section of the AP Biology handout on the **Know** page.

Solutions

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

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

2.3 Cyclic AMP (or calcium ions).

3.1 C —many activated molecules.

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

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