

Exercise walk-through

23.1

Cell signalling: a receptor selects the response

International Baccalaureate · IB Diploma · Biology · HL

23.1 Cell signalling: a receptor selects the response

Name: _____ Class: _____ Date: _____

Total: 10 marks

KEY WORDS receptor • signal transduction

Objective

Cell signalling: a receptor selects the response. Original classroom practice for IB HL; not an official IB paper.

1 Key knowledge and worked examples

■ What would explain this observation?

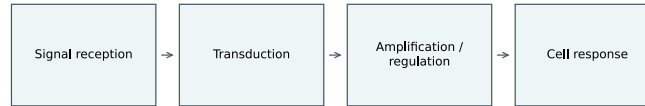
- Two cell types encounter the same signal but respond differently. Their **receptors** and internal pathways determine what follows.

■ Build the model

- A signalling molecule binds a compatible receptor.
- Receptor activation can initiate **signal transduction** through intracellular molecules.
- The resulting response may change enzyme activity, transport or gene expression.
- A signal need not enter the cell to cause an effect.
- receptor: A molecule that binds a compatible signal.

- signal transduction: Conversion of signal reception into intracellular changes.





■ **Choose evidence that can test it**

- Distinguish signal reception, transduction and response.
- Amplification can allow a small extracellular change to produce a larger intracellular effect.
- Different receptors or pathways can give different responses to one signal.

In the lab: Use an attributed dataset comparing signal concentration and response. Include an untreated control and, where supplied, receptor-blocking evidence. Do not infer the whole pathway from a concentration-response graph alone.

■ **Work from known quantities**

- Known: response increases from 20 to 80 units.
- Fold change = $80/20 = 4$.
- Percentage increase = $(80-20)/20 \times 100 = 300\%$.
- A fourfold final value is not a 400% increase.

Your turn: Response rises from 10 to 50 units. Calculate the fold change.

■ **Check the conclusion and its limits**

- A receptor is not interchangeable with every signalling molecule.
- Greater signal concentration does not imply unlimited response once the system saturates.

Not true: Fourfold final response means a 400% increase from baseline. A fold change is a ratio of final to initial; a percentage increase is the change relative to the initial value. A fourfold final value means a 300% increase, so “fourfold” and “400%” are not interchangeable.

Key:

- A signalling molecule binds a compatible receptor.
 - Distinguish signal reception, transduction and response.
-

- Watch for: A receptor is not interchangeable with every signalling molecule.

■ **Write from a threefold rise**

- A response rises from 12 units to 36 units.
- Find the fold change and the percentage increase. A threefold value is not a 300 percent increase.

Exercises 2.1·2.3

2.1 Why can one signal produce different effects in two cell types? Choose one answer.

- **A** Their receptors or internal pathways differ
- **B** Every cell must give the same response
- **C** Signals always act without receptors

[1]

2.2 Response rises from 10 to 50 units. Calculate the fold change. Show the relation, substitution and units.

[2]

2.3 Decide whether this claim is true and justify: Fourfold final response means a 400% increase from baseline.

[2]

Exercises 2.1-2.3

2.1 Why can one signal produce different effects in two cell types? Choose one answer.

- **A** Their receptors or internal pathways differ
- **B** Every cell must give the same response
- **C** Signals always act without receptors [1]

2.1 A A signal's effect is decided by the receiving cell: different receptors or different internal pathways turn the same signal into different responses. The signal molecule itself carries no instruction beyond binding.

2.2 Response rises from 10 to 50 units. Calculate the fold change. Show the relation, substitution and units. [2]

2.2 fold change= $50/10=5$.

2.3 Decide whether this claim is true and justify: Fourfold final response means a 400% increase from baseline. [2]

2.3 False. A fold change is a ratio of final to initial; a percentage increase is the change relative to the initial value. A fourfold final value means a 300% increase, so “fourfold” and “400%” are not interchangeable.

Exercises 2.4·3.1

2.4 A molecule that binds a compatible signal: write the technical term. [1]

3.1 A fictional response changes from 20 to 60 units with ligand dose. Find fold change and percentage increase. Why does this not show that three times as many receptors exist? [4]

Exercises 2.4·3.1

2.4 A molecule that binds a compatible signal: write the technical term. [1]

2.4 receptor. receptor means A molecule that binds a compatible signal.

3.1 A fictional response changes from 20 to 60 units with ligand dose. Find fold change and percentage increase. Why does this not show that three times as many receptors exist? [4]

3.1 Threefold final value and 200% increase. Signal amplification, saturation and normalization can alter response; receptor abundance needs its own measurement.