

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.

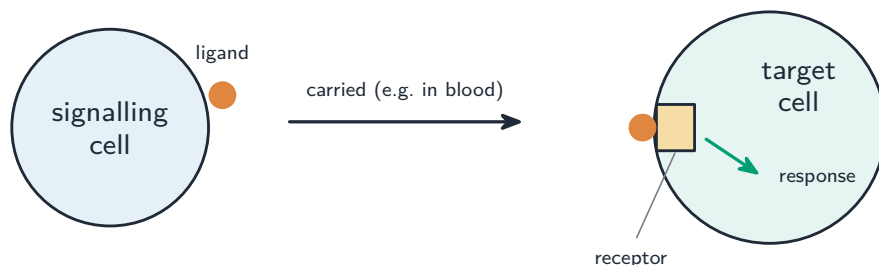
1 Key knowledge and worked examples

■ 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.

2 Practice

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]

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

3 Exam-style questions

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]

Solutions

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 fold change= $50/10=5$.

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.

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

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