

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. Supported HL concept preparation; original classroom practice, not an official IB paper or assessed learner work.

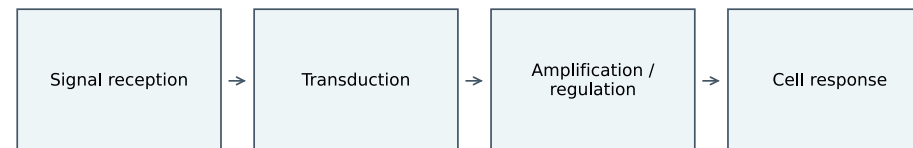
1 Key knowledge and worked examples

■ What would explain this observation?

- Two cell types encounter the same signal but respond differently. Their **receptors** and internal pathways determine what follows.
- Start with a prediction. State the quantities or features you would compare, then decide what evidence could distinguish two explanations.

■ 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.
- 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

- State the known values and their units. Choose the relation because its assumptions fit this case, then rearrange before substitution.
- 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.

Example:

Response rises from 10 to 50 units. Calculate the fold change. Use the same sequence: known quantities → model → relation → substitution → unit and interpretation.

■ 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.
- Return to the original observation. Explain what the result supports, which conditions it assumes, and one way to test a competing explanation.

Warn:

Fourfold final response means a 400% increase from baseline. This claim is false: A receptor is not interchangeable with every signalling molecule. Greater signal concentration does not imply unlimited response once the system saturates.

Key:

Cell signalling: a receptor selects the response: 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.

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** Signals always act without receptors
 - **C** Every cell must give the same response
- [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 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.

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

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

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.