

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. 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?

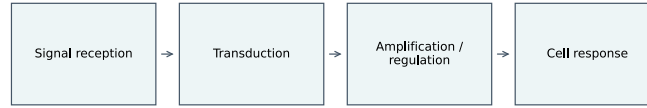
- Two cell types encounter the same signal but respond differently. Their **receptors** and internal pathways determine what follows.
- Start with a prediction. State the quantities or features you would compare, then decide what evidence could distinguish two explanations.

■ 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.

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** 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]

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

[1]

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

Exercises 2.4·3.1

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]

Exercises 2.4·3.1

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

3 Exam-style questions

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.