

Exercise walk-through

4.1

Cell measurements and scale

International Baccalaureate · IB Diploma · Biology · HL

4.1 Cell measurements and scale

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

KEY WORDS magnification • resolution

Objective

Cell measurements and scale. 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?

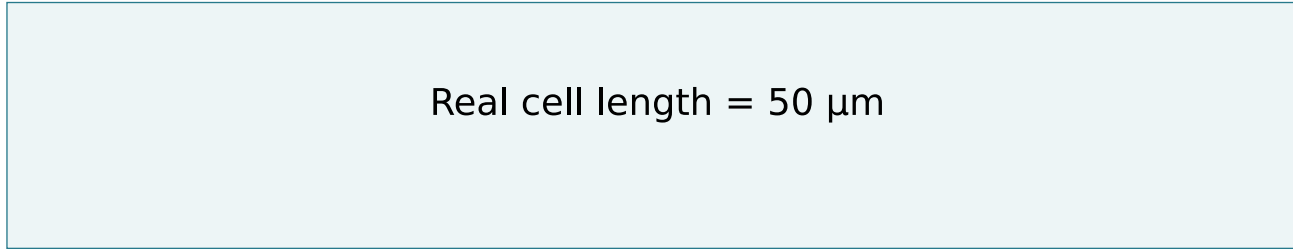
- A cell can look larger on a screen without changing its real size. Two photographs at different zoom settings cannot be compared by eye alone.
 - Start with a prediction. State the quantities or features you would compare, then decide what evidence could distinguish two explanations.
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■ Build the model

- Eukaryotic cells contain a nucleus. Prokaryotic cells have genetic material but no membrane-bound nucleus. A bacterial cell is a living cell; a virus depends on a host cell to reproduce.

- **magnification** : Image length divided by actual length; **resolution** : Ability to distinguish two close points.

Measured image length = 30 mm



Real cell length = 50 μm



Scale must be stated



■ **Choose evidence that can test it**

- A scale bar provides a known real distance in the same image. Convert the image length and real length to the same unit before dividing. Magnification is a ratio and has no unit.
 - Focus a prepared slide at low power first. Move to a higher power and use fine focus. Make a clear line drawing, label structures with straight lines, and record the scale rather than shading the image.
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■ **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: a cell image is 30 mm long and represents a 50 micrometre cell. Use magnifica-

tion = image size / actual size. Convert 30 mm to 30,000 micrometres. Magnification = $30,000 / 50 = 600$. A 10 mm scale bar representing 20 micrometres gives the same ratio of 500 for every object in that image.

Example:

An image is 12 mm long; the cell is 40 micrometres long. Calculate magnification. Use the same sequence: known quantities $\rightarrow$ model $\rightarrow$ relation $\rightarrow$ substitution $\rightarrow$ unit and interpretation.

■ Check the conclusion and its limits

- A nucleus is not the only cell structure. Do not claim bacteria have no DNA, or that more magnification always means better resolution.

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

Warn:

Every bacterial cell has a membrane-bound nucleus. This claim is false: A nucleus is not the only cell structure. Do not claim bacteria have no DNA, or that more magnification always means better resolution.

Key:

Cell measurements and scale: A scale bar provides a known real distance in the same image. Convert the image length and real length to the same unit before dividing.

Magnification is a ratio and has no unit.

Exercises 2.1·2.3

2.1 Which comparison of two cell images is reliable? Choose one answer.

- **A** Compare screen lengths only
- **B** Convert both lengths using their own scale bars
- **C** Assume both images have the same zoom

[1]

2.2 An image is 12 mm long; the cell is 40 micrometres long. Calculate magnification. Show the relation, substitution and units.

[2]

2.3 Decide whether this claim is true and justify: Every bacterial cell has a membrane-bound nucleus.

[2]

Exercises 2.1-2.3

2.1 Which comparison of two cell images is reliable? Choose one answer.

- **A** Compare screen lengths only
- **B** Convert both lengths using their own scale bars
- **C** Assume both images have the same zoom

[1]

2.1 B A scale bar provides a known real distance in the same image. Convert the image length and real length to the same unit before dividing. Magnification is a ratio and has no unit.

2.2 An image is 12 mm long; the cell is 40 micrometres long. Calculate magnification. Show the relation, substitution and units.

[2]

2.2 Convert image size: 12 mm=12,000 micrometres. Magnification=image/actual=12,000

2.3 Decide whether this claim is true and justify: Every bacterial cell has a membrane-bound nucleus.

[2]

2.3 False. A nucleus is not the only cell structure. Do not claim bacteria have no DNA, or that more magnification always means better resolution.

Exercises 2.4·3.1

2.4 Image length divided by actual length: write the technical term.

[1]

3 Exam-style questions

3.1 A displayed cell is 18 mm long and its scale bar is 6 mm for 20 micrometres. Find cell length. The display is enlarged by 50%; does the real length change?

[4]

Exercises 2.4·3.1

2.4 Image length divided by actual length: write the technical term. [1]

3 Exam-style questions

2.4 magnification. magnification means Image length divided by actual length.

3.1 A displayed cell is 18 mm long and its scale bar is 6 mm for 20 micrometres. Find cell length. The display is enlarged by 50%; does the real length change? [4]

3.1 $\text{Length} = 18/6 \times 20 = 60$ micrometres. Both image and bar enlarge together; their ratio and inferred real length stay unchanged. An isolated image length without its scale would be insufficient.