

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. Original classroom practice for IB HL; not an official IB paper.

1 Key knowledge and worked examples

■ What would explain this observation?

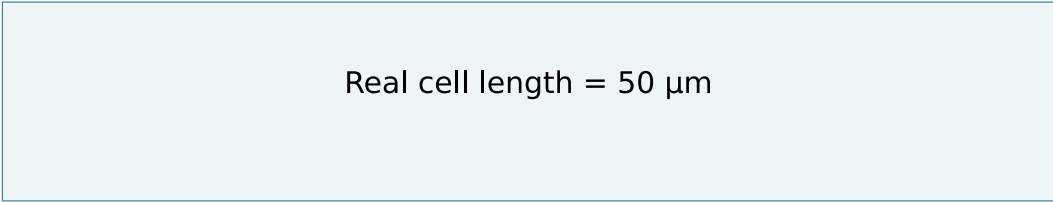
- A cell can look larger on a screen without changing its real size. Two photographs at different zoom settings cannot be compared by eye alone.
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■ Build the model

- 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.

In the lab: 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.

■ Work from known quantities

- Known: a cell image is 30 mm long and represents a 50 micrometre cell.
- Use $\text{magnification} = \text{image size} / \text{actual size}$.

- Convert 30 mm to 30,000 micrometres.
- Magnification = $30,000 / 50 = 600$.
- A separate 10 mm scale bar representing 20 micrometres gives $10,000 / 20 = 500$, and that magnification applies to every object in its image.

Your turn: An image is 12 mm long; the cell is 40 micrometres long. Calculate magnification.

■ 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.

Not true: Every bacterial cell has a membrane-bound nucleus. Bacterial cells are prokaryotic: their genetic material lies free in the cytoplasm, not inside a membrane-bound nucleus. Only eukaryotic cells have a true nucleus.

Key:

- Eukaryotic cells contain a nucleus.
- A scale bar provides a known real distance in the same image.
- Watch for: A nucleus is not the only cell structure.

■ **Write from a magnification of 750**

- An image of a cell is 15 mm long. The cell is 20 micrometres long.

- Find the magnification. A scale bar is a real distance, not a decoration.
-

Exercises 2.1·2.3

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

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

[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** Assume both images have the same zoom
- **C** Convert both lengths using their own scale bars

[1]

2.1 C Reliable comparison needs a shared real scale. Converting each image length with its own scale bar gives real sizes that can be compared; screen lengths alone depend on zoom, which differs between the images.

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: $12\text{ mm}=12,000\text{ micrometres}$. Magnification= $\text{image}/\text{actual}=12,000$

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

[2]

2.3 False. Bacterial cells are prokaryotic: their genetic material lies free in the cytoplasm, not inside a membrane-bound nucleus. Only eukaryotic cells have a true nucleus.

Exercises 2.4·3.1

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

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]

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.