3.1 Cell measurements and scale

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

KEY WORDS magnification • resolution

Objective

Cell measurements and scale. Original classroom practice for IB SL; not an official IB paper.

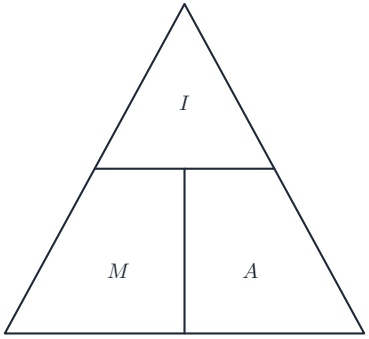
1 Key knowledge and worked examples

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.

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.



I = image size
M = magnification
A = actual size

$$M = \frac{I}{A}$$

cover a letter to get its formula

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 magnification = image size / 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 720

- An image is 18 mm long and the cell is 25 micrometres long.
- Find the magnification. A bacterial cell has no membrane-bound nucleus.

2 Practice

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]

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]

Solutions

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 Convert image size: 12 mm=12,000 micrometres. Magnification=image/actual=12,000/40=300.

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.

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

3.1 Length=18/6×20=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.