

## 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.

#### ■ 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  $\mu\text{m}$

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.

#### ■ 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 magnification = 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.

## 2 Practice

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**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]

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

[1]

## 3 Exam-style questions

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**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]