

## Resolution and Magnification

### Resolution

This is not an easy term to understand so try this simple experiment.

Look at the two dots on the right.

Prop the book vertically and slowly move backwards. At some point, maybe around two or three metres away the dots merge into one. This is resolution – **the distance between two objects such that they can be seen as two objects.**

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For the human eye this is about 0.1mm, for the light microscope it is about 0.2µm, but for the electron microscope it is about 1nm.

Magnification is making bigger, but not clearer. To illustrate this look at the electronmicrographs alongside of a fungus. The one on the right is magnified but is not any clearer.

Define organelle.



What do you understand by the cell theory?

What do you understand by the organismal theory?

## Size Units

### Size Units

You need to know the relative units. Start with 1 metre and go down 1000, or  $10^{-3}$ , each time.

$10^{-3}$  of a metre = a **millimetre** or **mm**.

$10^{-6}$  of a metre or  $10^{-3}$  of a millimetre = a **micrometre** or **µm**.

$10^{-9}$  of a metre or  $10^{-6}$  of a millimetre or  $10^{-3}$  of a micrometre = a **nanometre** or **nm**.

## Relative Sizes

Molecules	Membrane thickness	Viruses	Bacteria	Organelles	Cells
1nm	10nm	100nm	1µm	Upto 10µm	Upto 100µm

## Calculating Magnification

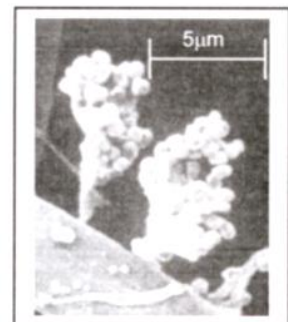
### Magnification

A scale bar is a short line usually drawn on an electron micrograph that will allow you to calculate the magnification of the photograph. An example is shown on the right.

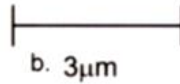
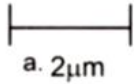
Using a scale bar to calculate magnification. (See photo on right.)

1. Measure the scale bar on the photograph in mm with your ruler.  
15mm
2. Convert these mm into the same units as the scale bar using the information above.  
15mm = 15000µm
3. Divide this number by the number on the scale bar.  
15000 : 5 = 3000

Therefore magnification = 3000x.



Determine the magnification of these scale bars. The answers are at the bottom of the page.



How many micrometres in a millimetre?

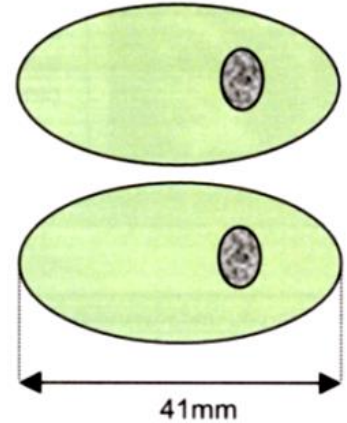
22mm =            µm

An alternative is that the electron micrograph states the magnification. From this you can calculate the actual size.

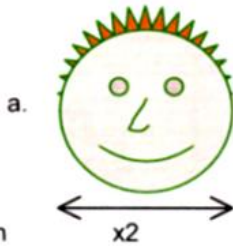
Example.

The 'cell' on the right has been magnified 750x. Calculate its actual size.

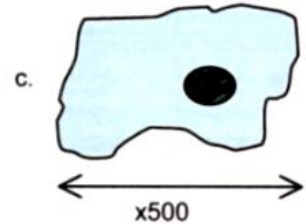
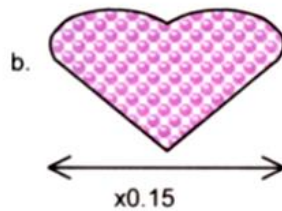
1. Measure a dimension of the cell.  
41mm
2. Divide this by the magnification.  
 $41 \div 750 = 0.055\text{mm}$
3. Convert to a sensible unit.  
 $0.055\text{mm} \times 1000 = 55\mu\text{m}$



Calculate the size of these. The answers are at the bottom of the page.



Magnification



State what a virus is.

What is resolution?

List 4 differences between a light microscope and an electron microscope.

Answers  
a. 1mm b. 200µm c. 0.2 micrometres

Answers  
a. 7500x b. 7000x c. 5000x