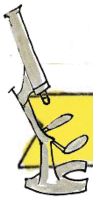
MICROSCOPY: BASICS



MICROSCOPES use **lenses** to **magnify** and increase the **resolution** of images.

magnify: To make bigger.

resolution: The degree of detail. The resolution of a microscope is how well it distinguishes between two points that are close together.

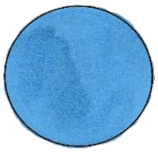
● = actual size of blue dot to be magnified below...

Microscopes are used to view samples that may not be visible by the naked human eye.

Microscopes allow us to resolve detail that cannot be seen by the naked human eye.

MAGNIFICATION

HIGH MAGNIFICATION



High ↑ Image is **much bigger** than the actual size

Low ↓ Image is **several times bigger** than the actual size

LOW MAGNIFICATION

RESOLUTION

HIGH RESOLUTION

High ↑ Image is **clearer**
Image is **more detailed**

Low ↓ Image is **less clear**
Image is **less detailed**

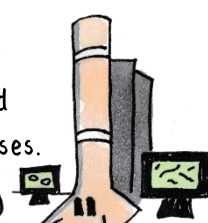
LOW RESOLUTION

A brief HISTORY of MICROSCOPY

The **LIGHT** microscope was **invented**. → 1590's

Uses a light source and glass lenses.

1930's ← The **ELECTRON** microscope was **invented**.



Uses electrons and electromagnetic lenses.

MICROSCOPY: BASICS

LIGHT vs. ELECTRON MICROSCOPES

MAIN DIFFERENCES

Light Microscope

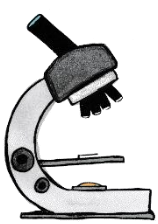
- **Light** passes through the specimen.
- **Lower magnification.**
- Can view **living** cells or organisms.
- **Lower resolution**; can distinguish between organelles.

Electron Microscope

- **Electrons** pass through the specimen.
- **Higher magnification.**
- Specimen must be **dead.**
- **Higher resolution**; can distinguish between internal structures of organelles.

ADVANTAGES & DISADVANTAGES

LIGHT MICROSCOPE



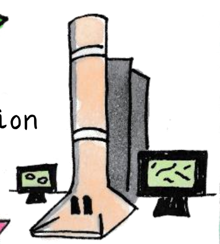
Advantages:

- Can be used to study living cells.
- Cheap
- Portable

Disadvantages:

- Lower magnification.
- Lower resolution.

ELECTRON MICROSCOPE



Advantages:

- Higher magnification
- Higher resolution

Disadvantages:

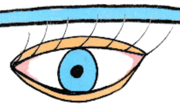
- Cannot be used to study living cells (high pressure, no oxygen)
- Expensive
- Not Portable

Q. **HOW** did the invention of the **ELECTRON MICROSCOPE** change research?

A. The electron microscope allowed scientists to study **smaller specimens** with **more clarity and in greater detail**. This led to a **greater understanding** of how cells and their subcellular structures work.

MICROSCOPY: BASICS

SCALE AND SIZE

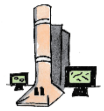


THE HUMAN EYE can see things as small as 50-100 µm. You can see a large cell by eye.

LIGHT MICROSCOPE

Max resolution of 200 nm.
Max magnification of X2,000.
Used to study large organelles such as nuclei.

ELECTRON MICROSCOPE



Max resolution of 50 pm.
Max magnification of X10,000,000.
Used to study tiny subcellular structures such as ribosomes and plasmid DNA.

METER	CENTIMETER	MILLIMETER	MICROMETER	NANOMETER	PICOMETER
10^0 m	10^{-2} m	10^{-3} m	10^{-6} m	10^{-9} m	10^{-12} m
1 m	0.01 m	0.001 m	0.000001 m	0.000000001 m	0.000000000001 m
	1/100 m	1/1,000 m	1/1,000,000 m	1/1,000,000,000 m	1/1,000,000,000,000 m
	1 cm	1 mm	1 µm	1 nm	1 pm
	Hundredth of a meter	Thousandth of a meter	Millionth of a meter	Billionth of a meter	Trillionth of a meter

METER → (÷100) → CENTIMETER → (÷10) → MILLIMETER → (÷1000) → MICROMETER → (÷1000) → NANOMETER → (÷1000) → PICOMETER

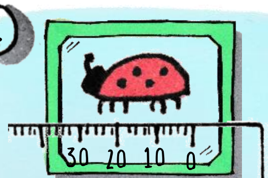
PICOMETER → (X1000) → NANOMETER → (X1000) → MICROMETER → (X1000) → MILLIMETER → (X10) → CENTIMETER → (X100) → METER

SCALE BARS

A scale bar is a length, drawn on a magnified image that represents a convenient "actual length".

EXAMPLE Draw a 50 µm scale bar on the image (D). The actual size of the specimen is 150 µm.

A. **Measure** the **length of the image** in mm (note this image is not to scale).



Size of image.
30 mm : 150 µm
Actual size of specimen.

B. **Fill in the actual size of the specimen.**

C. Work out what you need **to divide the actual size of the specimen** (B) **by to get the length of the scale bar you need to represent** (C) (i.e. 3, make sure the units are the same in B and C).

÷3 ÷3

10 mm : 50 µm

Length the scale bar needs to represent.

D. **Divide the size of the image by the same number** (3) **to get the length of the scale bar you need to draw on the image** (make sure the units are the same in A and D).

Drawn length of scale bar on image.