



### Recap

We previously learnt about cell specialisation by covering the process and timing of cell differentiation. We concluded by learning the importance of cell differentiation in making a cell specialised.



### Key Aims

1. Magnification and Resolution
2. Calculating Magnification
3. Light Microscopes
4. Electron Microscopes

## 1.1.5. Microscopy

### Light and Electron Microscopes

- **Cells can be seen with microscopes.** Microscopes magnify small things that can't usually be seen by the naked eye. This allows us to view cells within organisms
- **Light microscopes were created first.** **Light microscopes** have a magnification power of up to x2000. They use the beams of light and lenses in order to magnify a living object to create an image. They are cheap and portable and can be used to see cells and large organelles, or sub-cellular structures, such as nuclei.
- **Electron microscopes changed the field of biology.** **Electron microscopes** have a much higher magnifying power than light microscopes, and so could be used to see more sub-cellular structures, improving our understanding of biology.

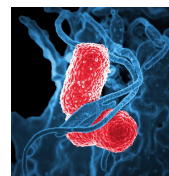
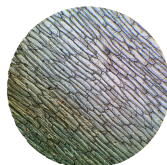
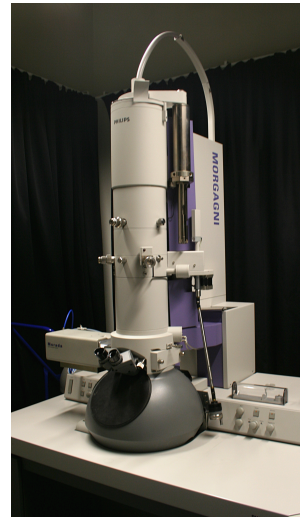
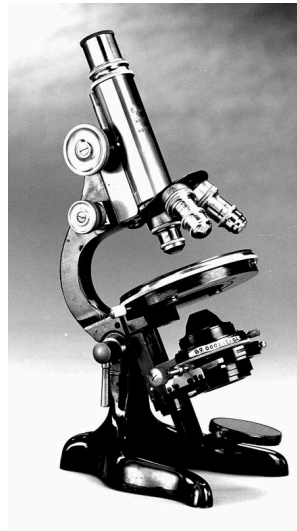


Fig 1. Light Microscope (left) and Electron Microscope (right).





#### AQA Specification

The differences in magnification and resolution.

## Magnification and Resolution

- **Resolution is the ability to tell the difference between two points.** The greater the **resolution** of a microscope, the more detailed the image. In an image with a low resolution, two nearby objects may look like one.
- **Magnification is the size of the image compared to the real size of the object.** **Magnification** tells you how big an image is compared to the real object.
- **Both resolution and magnification are important.** Resolution is a key factor in the quality of an image taken by a microscope, whilst magnification determines the objects you can see. The higher the magnification of the microscope, the smaller the object that can be seen through it.



#### AQA Specification

An electron microscope has a much higher magnification and resolving power than a light microscope.

## Electron microscopes

- **Electron microscopes have a higher magnification.** Electron microscopes provide a more magnified image than a light microscope. Electron microscopes use beams of electrons to make a magnified image. They have the magnifying power of around x2,000,000.
- **Electron microscopes also have a higher resolution.** Electron microscopes also have a higher resolution, so provide a sharper image.
- **But electron microscopes have drawbacks.** However, electron microscopes are huge machines and are expensive, as they require specific operating conditions. Moreover, they can only be used to view non-living cells.



#### AQA Specification

The electron microscope can be used to study cells in a much finer detail. This has enabled biologists to see and understand many more sub-cellular structures.

## Calculating Magnification

**Magnification** is defined as the size of the image divided by the size of the real object.

Use a ruler to measure the size of the real object and the image. Make sure to use the same units for both.



#### AQA Specification

Students should be able to carry out calculations involving magnification, real size and image size using the formula:  
$$\text{magnification} = \frac{\text{size of image}}{\text{size of real object}}$$





#### Knowledge Recall

1. What is resolution?
2. What is magnification?
3. How would 0.0036 be represented in standard form?



#### AQA Specification

Students should be able to express answers in standard form if appropriate.

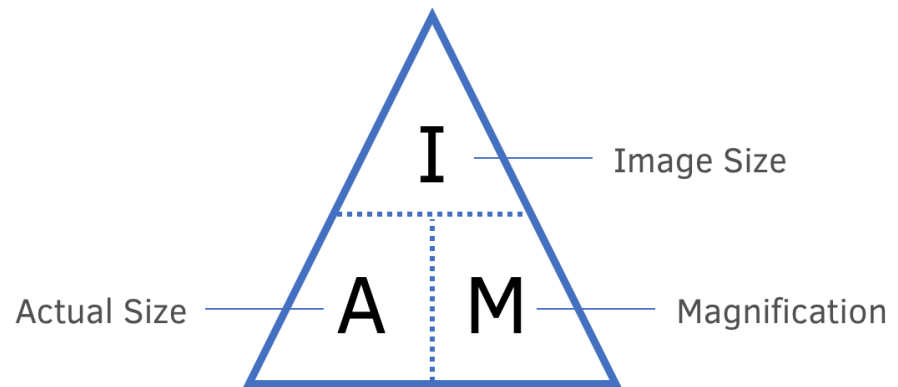


Fig 2. Formula Triangle for Magnification.

- **Standard form makes calculations easier.** Standard form allows you to remove decimal points and compare values more easily. You represent your values with a  $\times 10^x$  dependent on the number you have.

For example, 0.005 can be represented as  $5 \times 10^{-3}$ .

The power is The number of places the decimal place moves to reach the key number, is the number given as the power, with a minus sign for numbers less than 1.

