

This is the **Higher Separate** version — includes all Higher Tier content (marked ★) and all Separate Science content.

Microscopes allow us to view cells and sub-cellular structures in detail. The two main types are the light microscope and the electron microscope.

Required Practical: Using a light microscope to observe and draw cells. Calculating actual cell size from drawings using magnification formula.

- Light microscope: uses visible light, can magnify up to $\sim \times 1500$, resolution ~ 200 nm. Can be used to view living cells.
 - Electron microscope: uses a beam of electrons, much higher magnification ($\times 500,000+$) and resolution (~ 0.1 nm). Samples must be dead and in a vacuum.
 - Because electrons have a shorter wavelength than light, electron microscopes can resolve much finer detail — revealing ribosomes, mitochondria cristae, and cell membranes.
 - Magnification formula: $\text{Magnification} = \text{Image size} \div \text{Actual size}$. Rearranged: $\text{Actual size} = \text{Image size} \div \text{Magnification}$.
 - Units: $1 \text{ mm} = 1000 \mu\text{m}$. Always convert to the same unit before calculating.
 - To prepare a slide: cut a thin section, place on slide, add stain (iodine for starch/plant cells, methylene blue for animal cells), lower coverslip at 45° to avoid bubbles.
 - When drawing cells: use pencil, smooth continuous lines, label lines should not cross, no shading, draw what you see (not from memory).
- ★ **HT Resolution vs magnification:** resolution is the ability to distinguish two separate points as distinct. More magnification without better resolution gives a larger but blurry image.
- **Sep Eyepiece graticule:** a scale inside the eyepiece, calibrated against a stage micrometer, used to measure the actual size of cells under the microscope.

Key Terms

Magnification	How much larger the image appears compared to the real object
Resolution	The ability to distinguish two separate points as distinct — determines the detail visible
Staining	Adding a coloured dye to make cell structures more visible under a microscope
Eyepiece graticule	A scale built into the eyepiece of a microscope used to measure specimens

■ **Exam Tip:** Always show working in magnification calculations: write the formula, substitute values, calculate, then state the unit. A common error is forgetting to convert mm to μm before calculating.