

This is the **Higher Combined** version — includes Higher Tier content. Some Separate-only details are omitted.

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.

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

■ **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.