B.2.2 · Organelles and compartmentalization · supported focus

International Baccalaureate · IB Diploma · Biology · HL

Scope and prerequisites

Supported HL/SL core focus. First assessment 2025; current subject brief acquired; full Biology guide not acquired. Remaining guide, assessment and practical requirements retain their recorded holds.

Prerequisites: cell structure from A.2.2 and membrane transport from B.2.1. Each lesson develops its own method before independent transfer.

These are original or explicitly fictional teaching examples, not actual measurements or completed assessed learner investigations.

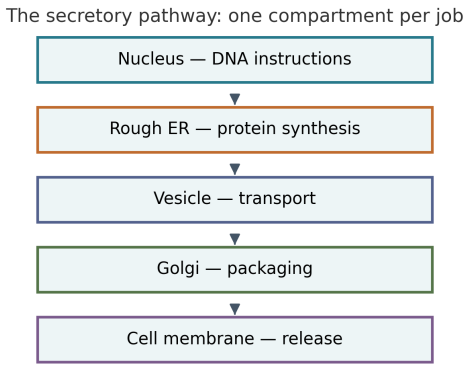
Organelles and compartmentalization

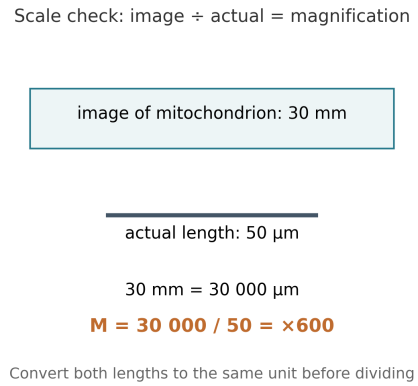
■ What would explain this observation?

- A pancreatic cell that secretes enzymes is packed with rough endoplasmic reticulum and Golgi bodies, while a skin cell has very few. Why should a cell's contents reflect its job?
- Start with a prediction. State the quantities or features you would compare, then decide what evidence could distinguish two explanations.

■ Build the model

- A eukaryotic cell divides its work among membrane-bound **organelles**: the nucleus stores the DNA instructions, the rough endoplasmic reticulum synthesises proteins for export, the Golgi body modifies and packages them, vesicles carry them, and mitochondria release energy by respiration.
- **Compartmentalization** keeps each process at its own conditions: enzymes and substrates are concentrated in one place, damaging reactions are contained, and incompatible pH or chemistry can coexist in one cell. Lysosomes, for example, hold digestive enzymes away from the cytoplasm.
- organelle: A membrane-bound structure in a cell with a specific function.
- compartmentalization: The division of a cell into membrane-bound regions, each with its own conditions.





■ Choose evidence that can test it

- Compare electron micrographs of a secretory cell and a non-secretory cell: the model predicts far more rough ER and Golgi in the secretory one. Identify each organelle from its membranes and shape, not from colour – micrographs are greyscale.
- Use a scale bar or the stated magnification to measure an organelle: convert the image length and the real length to the same unit before dividing, so the comparison is of real sizes.

■ Work from known quantities

- State the known values and their units. Choose the relation because its assumptions fit this case, then rearrange before substitution.
- Known: a mitochondrion's image is 30 mm long and the scale information says the real length is 50 µm. Use magnification = image size / actual size. Convert: 30 mm = 30,000 µm. Substitution: M = 30,000 / 50 = ×600. The image is 600 times the real organelle; the ratio has no unit.

Example:

On the same micrograph, a vesicle image measures 4 mm. Find its real diameter using the same sequence: known quantities → model → relation → substitution → unit and interpretation. (Answer: actual = image / magnification = 4 mm / 600 = 0.0067 mm ≈ 6.7 µm. Keep the units with every value.)

■ Check the conclusion and its limits

- A static micrograph shows structure, not movement: the vesicle pathway is inferred from many images and labelling experiments, not seen in one frame. Magnification arithmetic assumes the stated scale is accurate; a misread scale bar corrupts every measurement from that image.

- Return to the original observation. Explain what the result supports, which conditions it assumes, and one way to test a competing explanation.

Warn:

Every cell contains the same organelles in the same amounts. This claim is false: cells are specialised – a secretory cell invests in rough ER and Golgi while a red blood cell abandons its nucleus entirely to carry more haemoglobin. Organelle content follows the cell's role.

Key:

Organelles and compartmentalization: organelles divide the cell's work, and this division lets each process run at its own conditions. The secretory pathway runs nucleus → rough ER → vesicle → Golgi → membrane; measure structures with image ÷ actual in one unit.