

Exercise walk-through

2.1

Cell ultrastructure and microscopy (statements 3.1–3.7, core practical 5)

Pearson Edexcel · International A-Level · Biology

A eukaryotic cell is a set of compartments

Structure	Function
Nucleus	stores DNA behind a double membrane
Rough ER	folds and transports proteins from its ribosomes
Golgi	modifies, packages and exports proteins
Mitochondrion	aerobic respiration and ATP

Mitosis preserves chromosome number

Prophase : chromosomes condense, spindle forms



Metaphase : chromosomes line up on the equator



Anaphase : chromatids pulled to opposite poles



Telophase : nuclear membranes reform

Check yourself

Your turn

A pond sample has counts 60, 20, 15 and 5. What is the index of diversity?

- A. $N(N-1)$ over the sum of $n(n-1)$: 9900 over $4150 = 2.39$
- B. add the species counts first, then divide by four
- C. the largest count over the smallest count
- D. species richness times total individuals

Exercises 2.1·2.3

2.1 Name the organelle that modifies and packages proteins for export, and the organelle that produces ATP. [2]

2.2 Give two structures present in a prokaryotic cell that are absent from a eukaryotic cell's nucleus, and one structure common to both cell types. [3]

2.3 Explain why staining is needed before cells can be usefully examined under a light microscope. [2]

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2.1 Golgi apparatus; mitochondrion.

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2.2 Cell wall (murein) and capsule; also a single circular DNA strand without a nuclear membrane or plasmids (any two, B1, B1). Common: ribosomes / cell-surface membrane / cytoplasm.

2.3 Explain why staining is needed before cells can be usefully examined under a light microscope. [2]

2.3 Most cell structures are transparent and colourless, so contrast is near zero; stains bind different structures selectively, raising contrast so they can be distinguished.

Exercise 3.1

3.1 The table gives four measurements from a photograph of a liver cell taken with an electron microscope. The photograph's magnification is $\times 8\,000$.

Feature	Width on photograph / mm
Nucleus	28
Mitochondrion	6.4
Lysosome	2.4
Cell membrane (single)	0.16

Calculate the actual width of each feature in μm , giving each answer to 2 significant figures, and state which feature could not have been resolved with a light microscope. [6]

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3.1 Nucleus = $28\,000/8\,000 = 3.5\,\mu\text{m}$; mitochondrion = $6\,400/8\,000 = 0.80\,\mu\text{m}$; lysosome = $2\,400/8\,000 = 0.30\,\mu\text{m}$; membrane = $160/8\,000 = 0.020\,\mu\text{m}$. A light microscope resolves about $0.2\,\mu\text{m}$: the membrane ($0.02\,\mu\text{m} = 20\,\text{nm}$) could not be resolved; (the lysosome at $0.30\,\mu\text{m}$ is just resolvable).

Exercises 3.2-3.3

3.2 Explain how the structures of a rough endoplasmic reticulum and a Golgi apparatus are suited to producing and exporting an extracellular enzyme, naming the route the enzyme takes. [5]

3.3 A student observes a cell with a cell wall but no mitochondria. The cell swims using a rotating filament. Identify the cell type, name three further structures you would expect to find in it, and explain why the absence of mitochondria does not mean the cell has no respiration. [5]

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3.2 Rough ER carries ribosomes on its surface, so the enzyme's polypeptide is synthesised and folded into the ER lumen; transport vesicles bud off to the Golgi; the Golgi's stacked cisternae modify (e.g. add sugar groups) and package the enzyme into secretory vesicles; the vesicles fuse with the cell-surface membrane and release the enzyme outside the cell.

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3.3 A prokaryotic (bacterial) cell. Expected structures: plasmids, single circular DNA (nucleoid), 70S ribosomes, capsule (any three, B1, B1, B1). Respiration in prokaryotes happens on the cell-surface membrane and in the cytoplasm (glycolysis), which carry the same chemistry without mitochondria.