

Cell specialisation

4.1.1.3 · Cell biology · revision notes

How the structure of a specialised cell is adapted to its job: sperm, nerve and muscle cells in animals, and root hair, xylem and phloem cells in plants. The most common question is 'Explain how this cell is adapted to its function', often with a diagram and sometimes about a cell you have not met before.

Key facts

- Specialised cell: structure adapted to carry out a particular function
- Nerve cell: long, with branched endings; carries electrical impulses
- Root hair cell: large surface area; many mitochondria; no chloroplasts
- Phloem: living cells, pores in end walls; carries dissolved sugars up and down
- Sperm: tail, many mitochondria, enzymes in the head, half the number of chromosomes
- Muscle cell: protein fibres that slide to contract; many mitochondria
- Xylem: dead cells, hollow tubes, lignin; carries water and mineral ions upwards

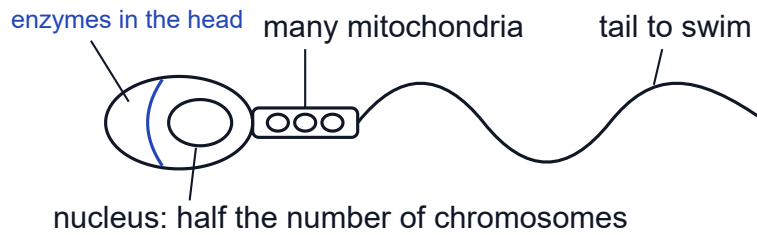
Notes

What a specialised cell is

- A **specialised cell** has a structure adapted to carry out a particular function.
- Its shape and its sub-cellular structures suit its job. Specialised cells work together in tissues, organs and organ systems.

Specialised animal cells

- **Sperm cell** (reaches and fertilises an egg): a tail to swim; many mitochondria to release energy for swimming; enzymes in the head to digest a way into the egg; a nucleus with half the normal number of chromosomes.

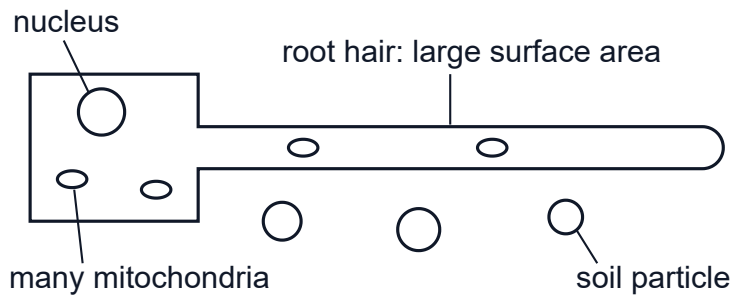


Sperm cell

- **Nerve cell** (carries electrical impulses around the body): long, to carry impulses over long distances; branched endings to connect with many other cells.
- **Muscle cell** (contracts to cause movement): protein fibres that slide over each other to shorten the cell; many mitochondria to release energy for contraction; can store glycogen, which is broken down to glucose for respiration.

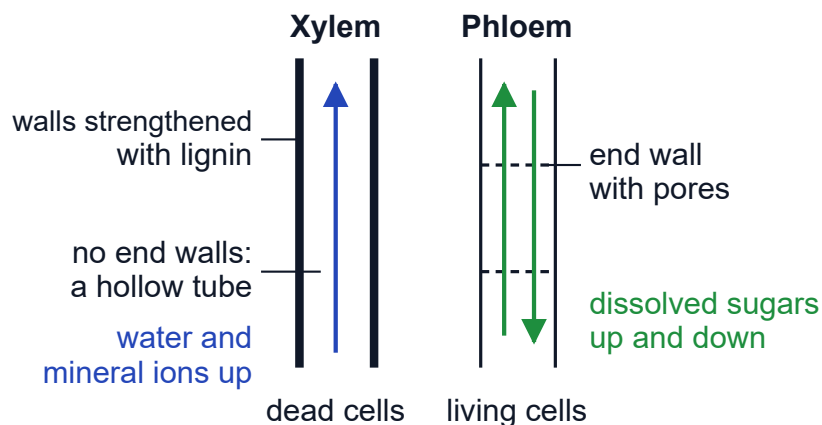
Specialised plant cells

- **Root hair cell** (absorbs water and mineral ions from the soil): a long hair-like projection gives a large surface area; many mitochondria release energy for the active transport of mineral ions; no chloroplasts, as there is no light underground.



Root hair cell. There are no chloroplasts, because no light reaches the roots.

- **Xylem cells** (carry water and mineral ions up from the roots): dead cells that form long hollow tubes with no end walls, so water flows through easily; walls strengthened with **lignin**.
- **Phloem cells** (carry dissolved sugars up and down the plant): living, elongated cells joined end to end, with pores in the end walls so the cell sap can flow from one cell to the next.



Xylem and phloem

How to answer each type of question

Identify a specialised cell from its function

1 mark

Grade 3

1. Read the function carefully: what is carried, absorbed or done?
2. Match it to one cell: water and mineral ions in the soil (root hair), water up the stem (xylem), sugars (phloem).
3. Tick only the number of boxes asked for.

Example. Which type of cell carries dissolved sugars around a plant?

Tick (✓) **one** box.

- ☐ Palisade cell
- ☐ Phloem cell
- ☐ Root hair cell
- ☐ Xylem cell

Model answer. Phloem cell (1)

Don't lose marks

- ✗ Listing features without saying what each one is for. Most marks need the feature **and** its purpose.
- ✗ Saying mitochondria 'make energy'. Say they release energy by respiration.
- ✗ Swapping xylem and phloem: xylem carries water and mineral ions; phloem carries dissolved sugars.
- ✗ Saying xylem cells are living or that phloem cells are dead.
- ✗ Saying a root hair cell has chloroplasts. It is underground, so it has none.

More tips

Memory tricks

- Most adaptations are one of four ideas: a large surface area, many mitochondria (energy), a shape that suits the job, or structures that are missing because they would get in the way.
- **Phloem** carries food (sugars): 'ph' and 'food' both start with an 'f' sound. Xylem carries water.
- Wood is mostly xylem: dead, hollow and stiffened with lignin.

Exam technique

- Use 'so that' after every feature: 'many mitochondria, so that more energy is released for swimming'.
- If a diagram is given, use features you can see on it and name them precisely.
- For an unfamiliar cell, ask: does it absorb (surface area), use a lot of energy (mitochondria) or carry something (shape)?

What each grade needs

What you need to be able to do, from the first marks up to the top grade.

Grade 3

Name specialised animal and plant cells

Sperm, nerve and muscle cells in animals; root hair, xylem and phloem cells in plants.

Grade 4

State the function of each specialised cell

e.g. a nerve cell carries electrical impulses; phloem carries dissolved sugars.

Grade 5

Describe the adaptations of each specialised cell

e.g. a sperm cell has a tail, many mitochondria and enzymes in its head.

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