4.1.1.3 Cell Specialisation

Recap

We previously went through the organelles found in animal, plant and bacterial cells, as well as comparing the function of each organelle. We also covered the typical sizes expected from all three types of cells.

Key Aims

1. *Definition of Specialisation*
2. *Examples of Specialised Cells*

AQA Specification

Students should be able to, when provided with appropriate information, explain how the structure of different types of cell relate to their function in a tissue, an organ or organ system, or the whole organism.

AQA Specification

Cells can be specialised to cary out a particular function: Sperm cell, nerve cells and muscle cells in animals. Root hair cells, xylem and phloem cells in plants.

Specialisation

- **Cells can specialise.** Cell **specialise**, which means that they develop as the organism does, in order to perform a specific function. The cells become adapted to a particular function.

- **Cells can work by themselves or as part of a team**. Cells can work with other similar specialised cells to form a **tissue**. They can also work with other types of specialised cells and tissues to form an **organ**. Many different organs work to form an **organ system.**

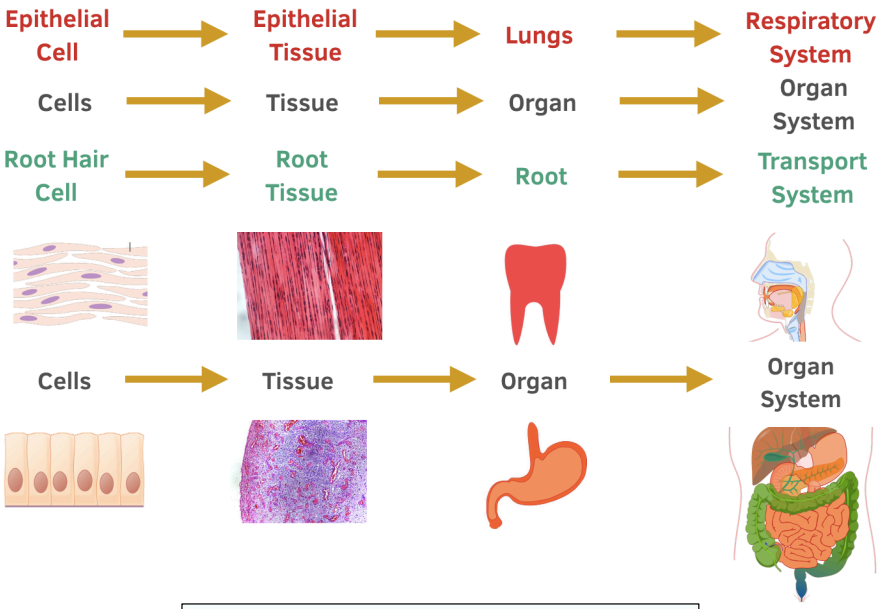


Fig 1. Cell Specialisation and Order of Function.

Examples of Specialised Cells

Sperm Cells

- **Sperm cells are used in reproduction.** Sperm cells transfer genetic information from the male parent to the female parent.

- **Sperm cells are adapted to fertilisation.**

Knowledge Recall

1. *What is a tissue?*
2. *What are specialised cells?*
3. *What is the function of sperm cells?*

- **Acrosome** - a sperm has an acromsome at its head. This contains enzymes that are used for the digestion of the outer layers of the egg cell, to allow the sperm to fuse with the egg cell.
- **Long tail** - They also have a long tail to help it swim through the the female reproductive system.
- **Mitochondria** - The sperm cell requires energy to move. This is provided by mitochondria in the mid piece.
- **Big nucleus** - a sperm cell has a big nucleus, which holds the genetic information

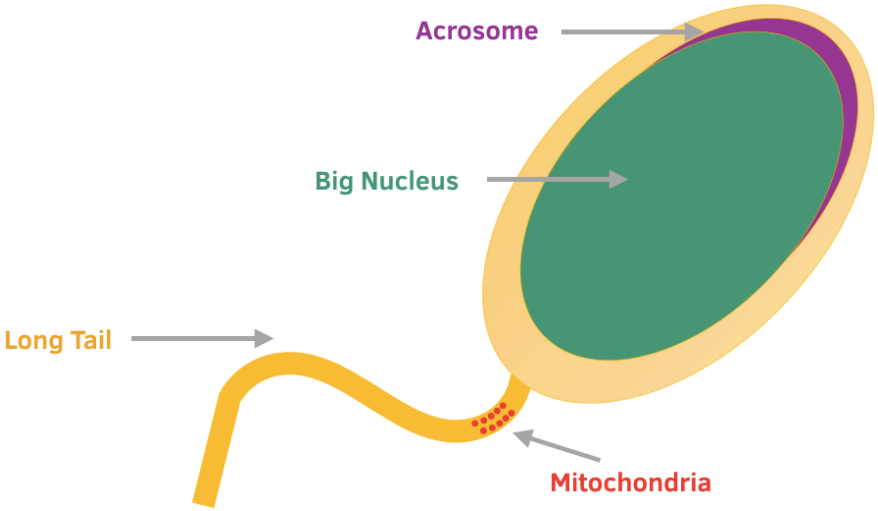


Fig 2. Sperm Cell. Note the long flagellum for movement.

Nerve Cells

- **Nerve cells are required for the transmission of electrical impulses.** Nerve cells send impulses around the body of animals in order to aid sensation and movement.
- **Nerve cells are adapted to carrying impulses.**
  - **Long axon** - they have a long axon to move the impulse from one part of the body to another.

Knowledge Recall

1. *What is the function of a nerve cell?*
2. *What are the adaptations of a sperm cell that make it suited to carrying impulses?*
3. *What are muscle cells used for?*
4. *What is the difference between striated and smooth muscle?*

- **Dendrites** - They also have many dendrites that contact other nerves. This happens at special junctions called synapses, using neurotransmitters.

- **Mitochondria** - making these neurotransmitters requires energy, which is provided by the large number of mitochondria in synapses.

- **Insulation** - nerves have a myelin coat (sheath) which insulates them.

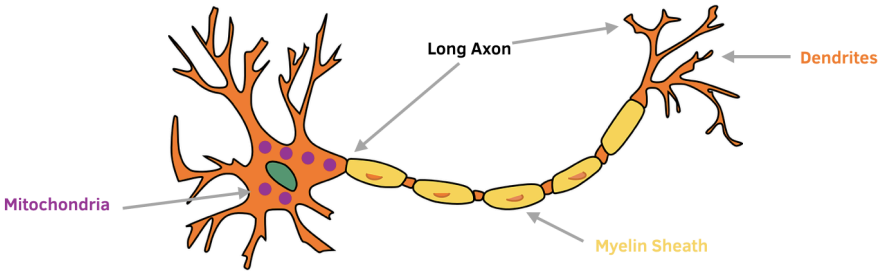


Fig 3. Nerve Cell. The long axon reduces the number of cells needed for transmission, so makes the transmission of a nerve impulse much faster.

Muscle Cells

- **Muscle cells are used for movement.** Muscle cells contract and relax, allowing different types of movement.

- **There is striated and smooth muscle. Striated** (striped) muscle is the muscle you usually think of. It it found in muscles like your biceps, allowing you to move. **Smooth** muscle is found in some vessels and your digestive system. This moves food through your gastrointestinal tract, through a process called peristalsis.

- **Muscle cells are adapted for contraction.**

  - **Many mitochondria -** Striated muscle has many mitochondria to provide energy, proteins that aid movement by sliding over one another and glycogen, to provide a substrate for respiration.

Knowledge Recall

1. *Why do muscle cells have many mitochondria?*
2. *Why are root hair cells needed in plant cells?*
3. *How are root hair cells adapted for absorption?*

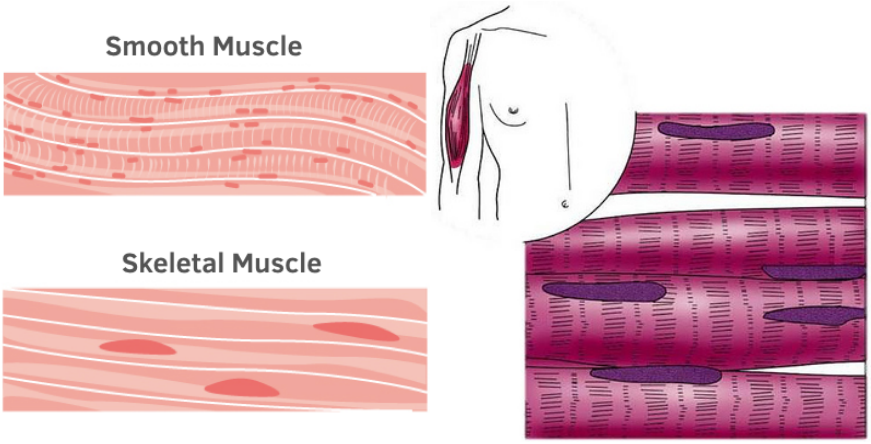


Fig 4. Muscle Cell Structure.

Root Hair Cells

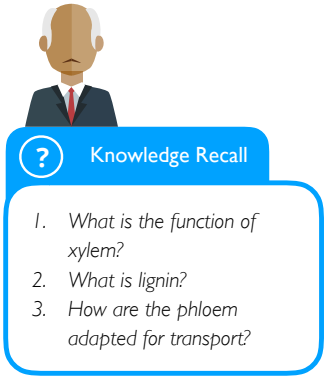
- **Root hair cells are required for absorption of water and mineral ions in plant cells.** Root hair cells are found on the surface of roots, and are involved in absorption of water and mineral ions from the soil, which the plant needs for photosynthesis and survival.

- **Root hair cells are adapted to absorption.**

    - **Surface area** - root hair cells greatly increase the surface area of the roots, in order to increase the movement of water into the cell.

    - **Permanent vacuole** - speed of osmosis is also increased by the presence of a permanent vacuole in these cells.

    - **Mitochondria** - the root hair cells have many mitochondria, to increase the energy available for the active transport of mineral ions.



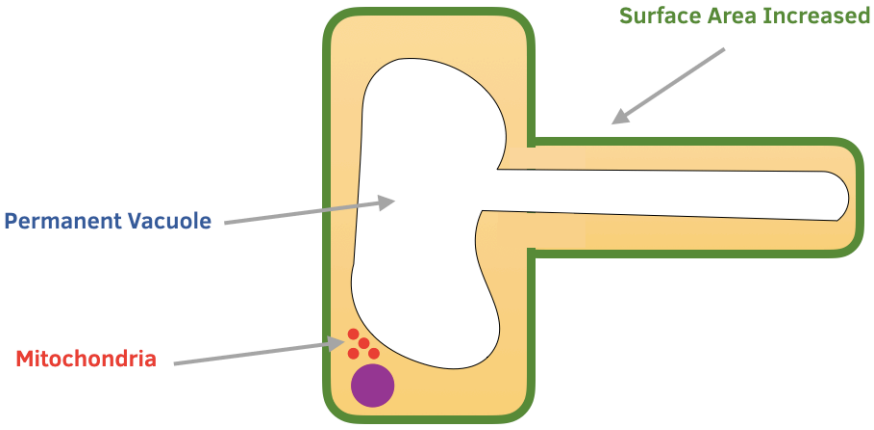


Fig 5. Root Hair Cell Structure.

Xylem

- **Xylem is involved in support and transport in plants.** The xylem provides support for the plant and aids the movement of mineral ions and water from the roots to the leaves and stem of the plant.

- **The xylem is adapted to support and transport.**

    - **Spiral shape -** the spiral shaped buildup of lignin in the xylem cell walls kills the tissue. This then leaves hollow tubes for the water and mineral ions to move through, from the roots upwards.

    - **Lignin** - The lignin strengthens the xylem, aiding its job as support.

Phloem

- **The phloem is involved in transport in plants.** Whilst the xylem transports water and mineral ions, the phloem transports the products of photosynthesis through the plant.

- **The phloem is adapted to transport.**

    - **Sieve plate** - the phloem cell walls form a sieve plate, as they disintegrate. These sieve plates allow the movement of food.

- **Companion cells** - phloem is kept alive by companion cells, which have mitochondria for energy transfer. This energy is used to move the food through the phloem.

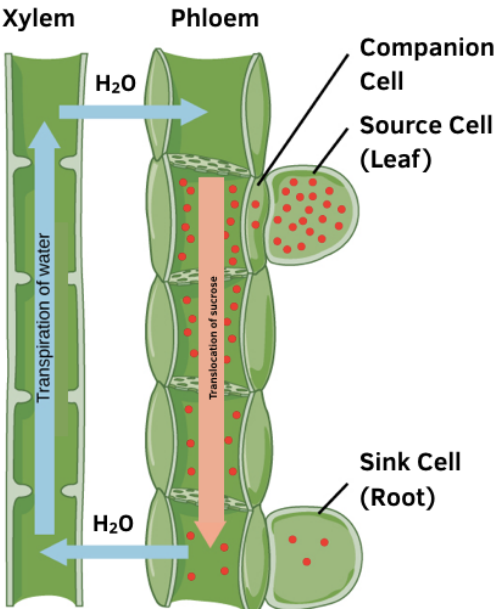


Fig 6. The Structure of Xylem and Phloem.