

Biology Top-Up

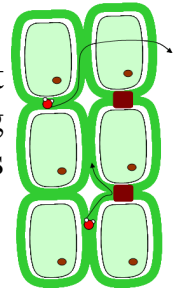
Plant Physiology

Plants require water as a reactant for photosynthesis, to maintain cell turgidity (for support), and also to transport dissolved minerals into the roots. Root systems are adapted for absorption of substances by having root hair cells in the epidermis to increase the surface area available.

Once water molecules have passed into the root cells, there are two pathways which they may follow to the transport system: the apoplast or symplast pathway.

The apoplast pathway

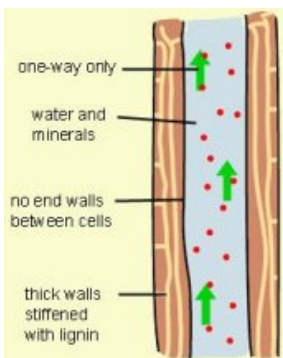
Most water entering the roots of a plant moves along this pathway. It follows the cell walls and the small spaces between cells before reaching the Casparian strip - a layer that surrounds the cells of the endodermis and forces water to pass through the cytoplasm of the cells.



The symplast pathway

A much smaller proportion of water that enters the roots moves along this pathway. It moves through the cytoplasm of the root cells. The cell membranes can be used to regulate the movement of water molecules and dissolved mineral ions.

Cohesion tension theory of transpiration



Water moves through the xylem vessels of plants. These are made up of dead cells which are waterproof and hollow. There are three forces that act together to pull the water up through the xylem: cohesion, tension and adhesion.

When water evaporates from the inside of the leaf, it is replaced by water from the xylem vessels by osmosis. Cohesion is a force that sticks water molecules together by hydrogen bonds, and so pulls the whole column of water up. Evaporation drives the upwards pull on the water column while gravity is exerting a downwards force on it - this results in tension. Adhesion is hydrogen bonding between the walls of the xylem vessel and the water molecules, and prevents the column of water breaking.

The role of phloem

The phloem vessels are the other transport system in plants. They move the sugars produced by photosynthesis and other inorganic compounds by a process called translocation. Transport in the phloem vessels can be in both directions at once.

Phloem tissue contains sieve tubes, which are another group of hollow cells. Unlike xylem vessels, these are living tissue and have cells next to them known as companion cells. These actively transport sugars into the phloem vessels, which causes water molecules to move into the tubes by osmosis.

