



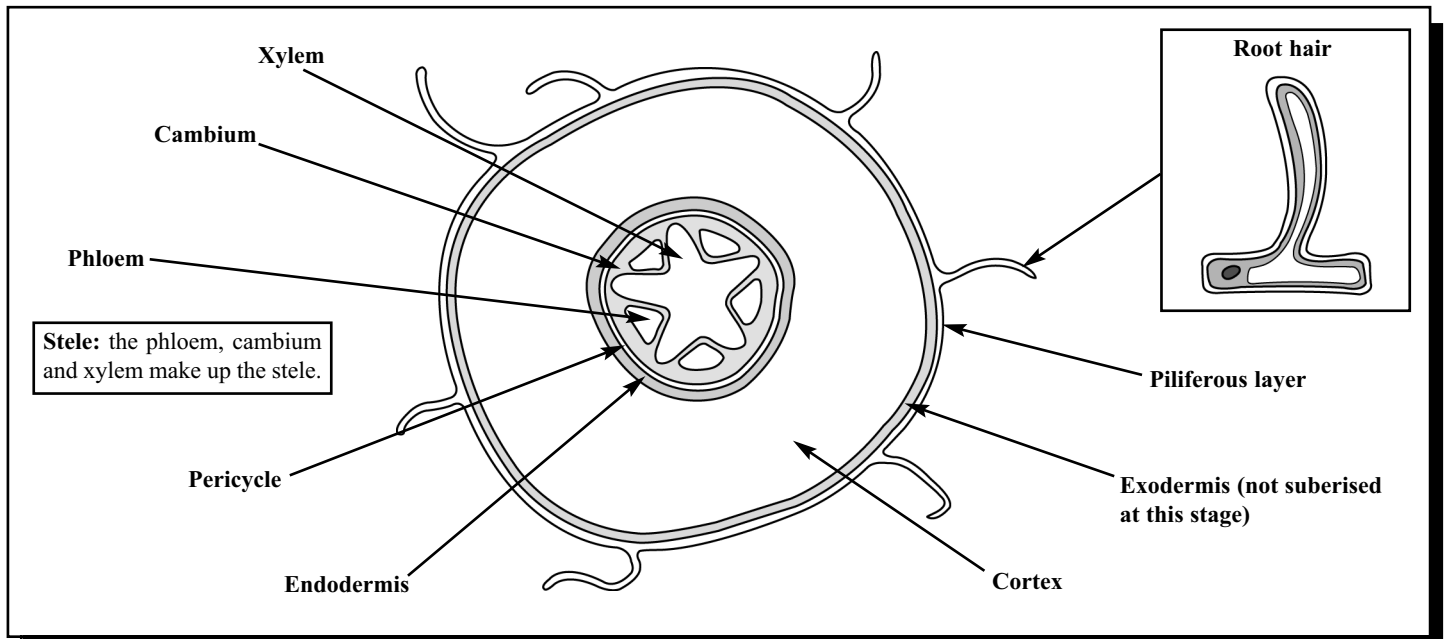
Water movement across the root

1. From soil to root hair

Water enters roots mainly through the root hairs. A root hair is simply an extension of an epidermal cell. The cell sap and cytoplasm inside the root hair contain ions, proteins and sugar. These solutes reduce the water potential inside the root hair.

The water in the soil has a higher water potential than the cell sap and cytoplasm so, because water moves from a region of high water potential to a region of lower water potential, water moves from the soil, across the partially permeable plasma membrane, into the cytoplasm and vacuole of the root hair.

Fig. 1 Tissue distribution in a root.



2. From root hair to xylem

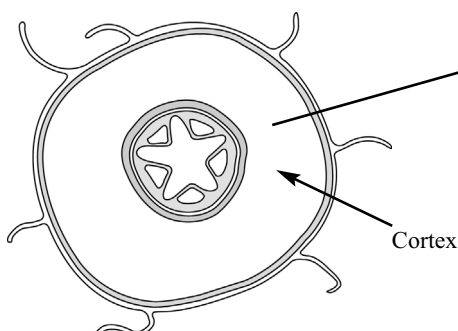
To get to the xylem from the root hair, water must cross the cortex, which consists of parenchyma. Water crosses the cortex by two routes (Fig. 2 and 3):

Fig. 2 The apoplast pathway.

(i) Apoplast pathway

Water effectively soaks into the parenchyma cell walls and seeps along the walls towards the xylem in the centre of the root. In this pathway, the water never enters the cytoplasm or the vacuoles of the cells. It simply moves directly from cell wall to cell wall or from a cell wall into the air spaces between cells and then on to the next cell.

Transverse section of a root



Cells in the cortex

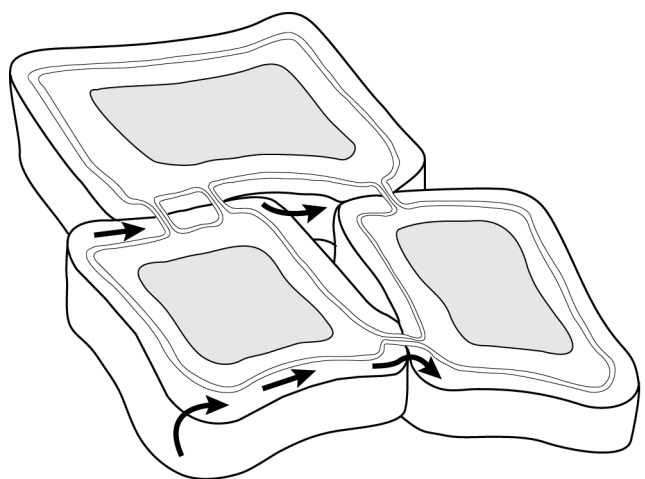


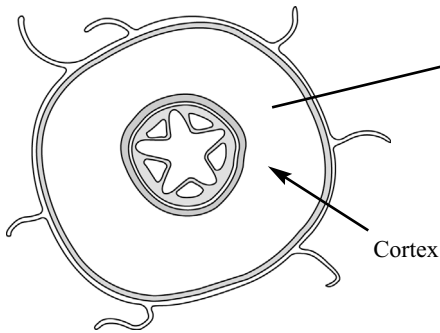
Fig. 3 The symplast pathway.

(ii) Symplast pathway

Water moves through the plasma membrane into the cytoplasm of the parenchyma cell. From there, it moves through the tonoplast into the vacuole of the cell. Water then moves to the next cell by either:

- moving through adjacent cell walls
- moving through the plasmodesmata (strands of cytoplasm that run through pores in the cell wall)

Transverse section of a root



Cells in the cortex

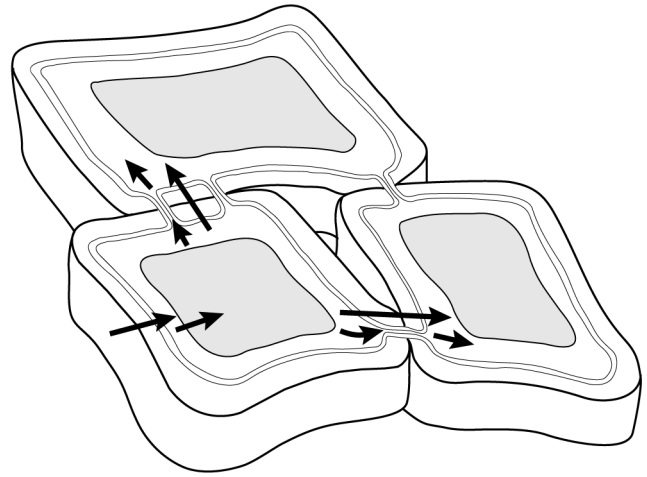
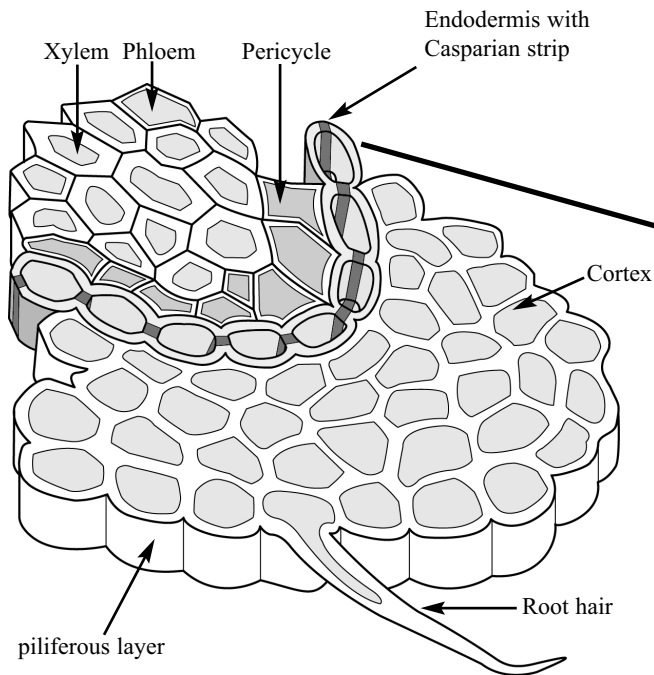
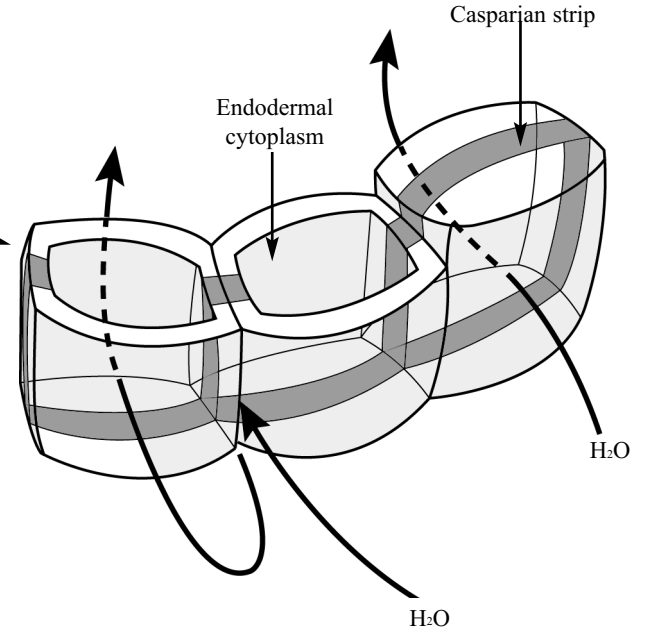


Fig. 4 The casparian strip

Cross section of a root



Endodermal cells



Keep in mind that, whether it be via the apoplast or the symplast pathway, water is moving from the root hair across the cortex to the centre of the root because the water potential at the centre of the root is lower than the water potential at the root hair.

3. Entering the stele

To get to the xylem, the water now has to cross the endodermis and then the pericycle. The endodermis stops the apoplast (cell wall) pathway. This is because the walls of the cells of the endodermis contain a thick, waxy, waterproof band of suberin. The band is called the Casparian strip (Fig. 4). It stops water moving through the walls. The water is therefore forced to enter the cytoplasm of the endodermis cells. The cytoplasm is under

the control of the nucleus. Thus, it is possible that by forcing water out of the cell walls and into the cytoplasm, the Casparian strip gives the cell control over substances – e.g. ions – that enter the xylem. Once water has crossed the endodermis it can cross the pericycle and enter the cells of the xylem.

Acknowledgements

This Factsheet was written by Kevin Byrne.
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