#### **Transpiration stream**

Vascular bundles

<u>Transpiration</u> is the evaporation of water at the surfaces of the spongy mesophyll cells in leaves, followed by loss of water vapour through the stomata.



Xylem and phloem tissues are found in groups called vascular bundles. The position of these bundles varies in different parts of the plant. In a leaf, for example, the phloem is usually found closer to the lower surface.



Xylem vessels are tough and strong, so the vascular bundles are in the centre of the root to resist forces that could pull the plant out of the ground.

#### Stem

The stem has to resist compression (squashing) and bending forces caused by the plant's weight and the wind. The vascular bundles are arranged near the edge of the stem, with the phloem on the outside and the xylem on the inside.

Water moves through the xylem vessels in a continuous transpiration stream:

root  $\rightarrow$  stem  $\rightarrow$  leaf

Transpiration produces a tension or 'pull' on the water in the xylem vessels by the leaves. Water molecules are cohesive so water is pulled up through the plant.

The transpiration stream has several functions. These include:

priant priant <u>restion</u> <u>r</u>

Water passes from the soil water to the root hair cell's cytoplasm by osmosis. This happens because the soil water has a higher water potential than the root hair cell cytoplasm:

Solution	Water potential	Concentration of dissolved solutes
Soil water	High	Low
Root hair cell cytoplasm	Low	High



Osmosis causes water to pass into the root hair cells, through the root cortex and into the xylem vessels

**Transportation** in Plants

## Rate of transpiration

If the rate of transpiration increases, the rate of absorption of water by the root increases too. Factors that affect the rate of transpiration also affect water uptake by the plant. If water is scarce, or the roots are damaged, a plant may wilt.

#### Factors affecting rate

The rate of transpiration is affected by several factors, including:

factors are increased.

This table shows the effects on the

rate of transpiration when certain

• temperature

- humidity
- wind speed light intensity

## Plants wilt

and may die if they lose too much water

cytoplasm, and this goes through holes from one cell to the next.

Phloem transports sucrose and amino acids up and down the plant. This is called translocation. In general, this happens between where these substances are made (the sources) and where they are used or stored (the <u>sinks</u>).

This means, for example, that sucrose is transported:

• from sources in the root to sinks in the leaves in spring time • from sources in the leaves to sinks in the root in the summer

Applied chemicals, such as pesticides, also move through the plant by translocation.

## Rate of transpiration

Factor	Effect	Explanation
Temperature	Increased	Evaporation and diffusion are faster at higher temperatures
Humidity	Decreased	Diffusion of water vapour out of the leaf slows down if the leaf is already surrounded by moist air
Wind speed	Increased	Moving air removes water vapour, increasing the rate of diffusion of water vapour from the leaf
Light intensity	Increased	The stomata open wider to allow more carbon dioxide into the leaf for photosynthesis

# Xylem and phloem

Plants have tissues to transport water, nutrients and minerals.

Xylem transports water and mineral salts from the roots up to other parts of the plant, while phloem transports sucrose and amino acids between the leaves and other parts of the plant.



(tubes).

Mature xylem vessels:

- contain no cytoplasm
- are impermeable to water
- have tough walls containing a woody material called lignin

### Phloem

What is moved Process   Xylem Water and minerals Transpiration st	
Xylem Water and minerals Transpiration st	
	eam
Phloem Sucrose and amino Translocation acids	1

Mature xylem consists of elongated dead cells, arranged end to end to form continuous vessels

Phloem consists of living cells arranged end to end. Unlike xylem, phloem vessels contain