

Transport in Plants

A-Level Biology ■ Topic 7

A-Level Biology



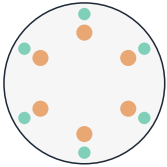
What we will cover

- 1 Xylem & phloem
- 2 Vessel & sieve-tube structure
- 3 Water across the root
- 4 Transpiration
- 5 Xerophytes
- 6 Translocation



wood is xylem – one ring a year

The two transport tissues



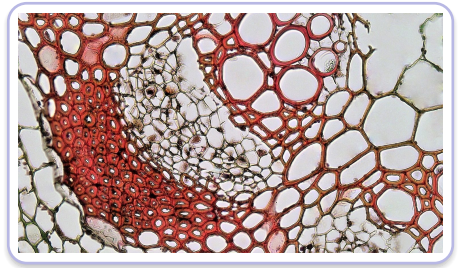
stem: bundles in a ring root: xylem in a central star



xylem



phloem



stem vascular bundle

Xylem vessels and phloem sieve tubes

xylem vessel



dead, empty cells;
thick lignified walls;
no end walls →
one open pipe

phloem

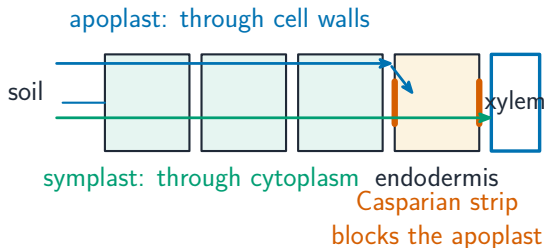


sieve plate (holes)
sieve tube (no nucleus)
companion cell
(nucleus, mitochondria)

- **xylem vessels** 导管 – dead, hollow, **lignin** 木质素-strengthened pipes
- **sieve tubes** 筛管 – living, with **sieve plates** 筛板 & a **companion cell** 伴胞

Structure suits the job.

Water across the root

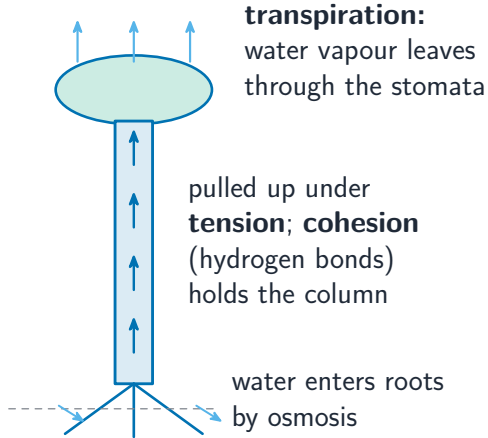


Water enters a **root hair cell** 根毛细胞 by osmosis, then crosses by:

- **apoplast** 质外体途径 – through the walls (fast)
- **symplast** 共质体途径 – through the cytoplasm

The **Casparian strip** 凯氏带 blocks the apoplast, so the plant controls entry.

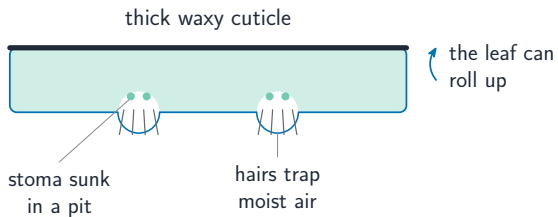
Transpiration



Transpiration 蒸腾作用: water evaporates inside the leaf and diffuses out of the **stomata** 气孔.

This pulls a continuous water column up the xylem – held together by **cohesion** 内聚力 (hydrogen bonds) under **tension** 张力.

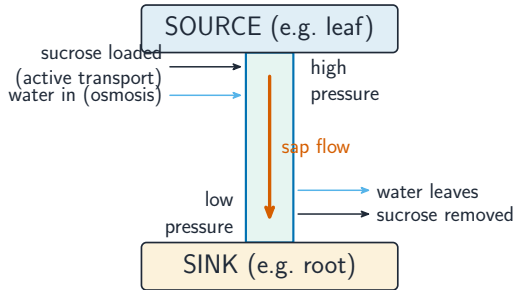
Xerophytes



A **xerophyte** 旱生植物 is adapted to live where water is scarce. Its leaves cut water loss with:

- a thick waxy **cuticle** 角质层
- **sunken stomata** 下陷气孔 & trapped moist air
- leaves that roll up

Translocation by mass flow



Translocation 运输 carries sugars from a **source** 源 to a **sink** 库.

Loading sucrose (active transport) lowers water potential, so water enters & pressure rises – sap then flows to the sink by **mass flow** 集流.

Worked example – how water reaches the leaf

Explain how water moves from root to leaf against gravity, with no pump.

- Water **evaporates** from the mesophyll cell walls and diffuses out of the stomata: transpiration.
- That lowers the **water potential** at the top, putting the xylem column under **tension**.
- **Cohesion** 内聚力 (hydrogen bonds) holds the column together, so it is pulled up as one.
- **Adhesion** 附着力 to the walls stops it breaking ⇒ **cohesion-tension theory**.

The pull comes from the **leaf**, not a push from the root. Evidence: the trunk narrows by day (tension) and a broken xylem stops the flow – the column must be continuous.

Topic 7 – key takeaways

1 Tissues

xylem carries water up; phloem carries sugars

2 Root

apoplast & symplast; Casparian strip controls entry

3 Transpiration

cohesion–tension pulls the column up

4 Translocation

source to sink by mass flow

Check yourself

- 1 Which tissue carries water up the plant?
- 2 What blocks the apoplast at the endodermis?
- 3 What keeps the xylem water column together?
- 4 Phloem carries sugars from a source to a what?



Answers 1. xylem 2. the Casparian strip 3. cohesion (hydrogen bonds) 4. a sink