

Introduction to Botany. Lecture 16

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Monday test (5 points)

- 1 Roots are involved in all the following activities except:
- A support
 - B food storage
 - C food production
 - D anchorage
 - E absorption and conduction

Monday test (5 points)

2 Select the mismatch

- A protoderm: epidermis
- B ground meristem: cortex
- C ground meristem: protophloem and metaphloem
- D procambium: protoxylem and metaxylem
- E protoderm: root hairs

Monday test (5 points)

- 3 Who performed an experiment with a willow branch disproving the idea that plants derive their bulk from soil?
- A van Helmont
 - B Priestly
 - C Engelmann
 - D Blackman

Monday test (5 points)

4 In the C3 pathway, CO₂ first combines with:

- A NADPH
- B PGAL
- C RuBP
- D ATP

Monday test (5 points)

5 The oxygen released in photosynthesis comes from:

- A carbon dioxide
- B glucose
- C ribulose biphosphate
- D water
- E atmospheric oxygen

Outline

- 1 Water transport
 - Water transport in roots
 - Water transport in stems
 - Water transport in leaves

- 2 Pre-exam questions

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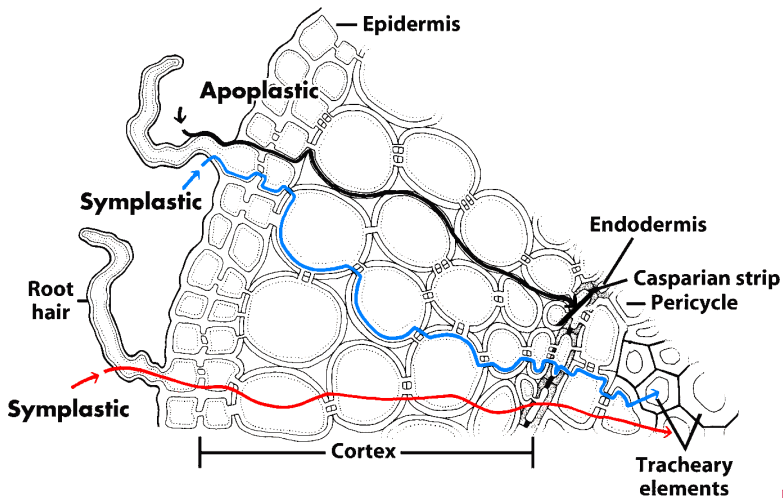
Rhizoderm and osmosis

- The existence of root hairs dramatically increases the surface of absorption
- Every root hair cell increase the internal concentration of large molecules, typically organic acids
- Process of concentration requires ATP
- As a result, osmosis water flow starts from soil to root cells

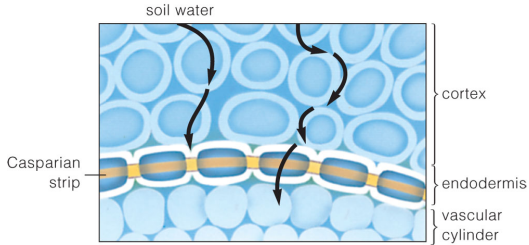
Endoderm and root pressure

- From rhizoderm to endoderm, transport of water is both symplastic and apoplastic
- In the endoderm cells, Caspari stripes stop apoplastic transport and therefore forced symplastic transport
- This is a high-energetic process requires ATP
- As a result, water will be pushed up from root: this is the root pressure

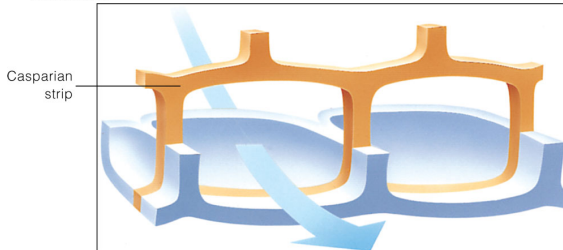
Apoplastic and symplastic transport in the root



Casparian strips

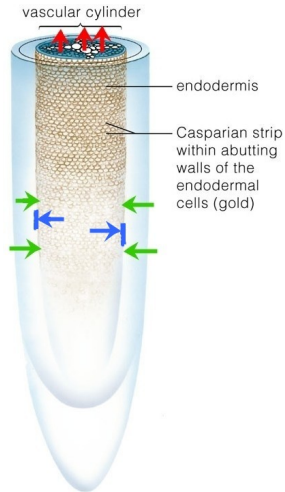


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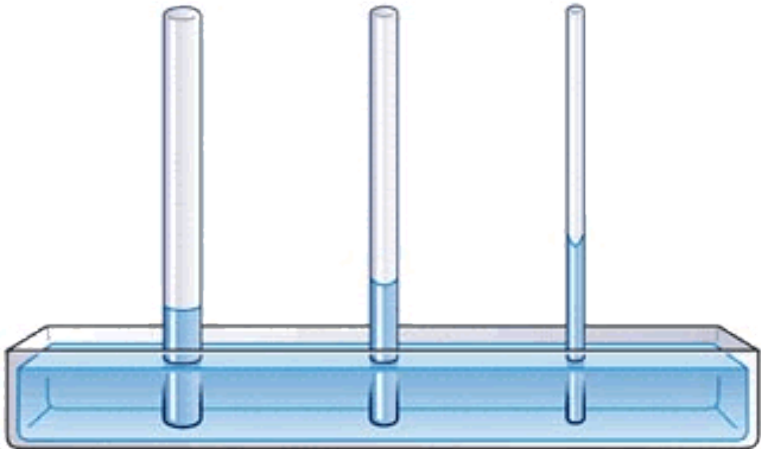
Origin of root pressure



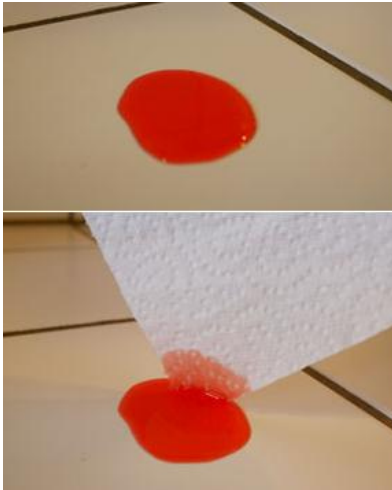
Xylem and capillarity

- Capillarity is a physical effect of attaching water molecules to the walls of thin vessel (capillar)
- The more narrow vessel elements are, the higher is capillarity
- However, wide vessel elements could take much more water. As a result, there is a trade-off between wide and narrow vessel elements.

Capillarity



Experiment with capillarity



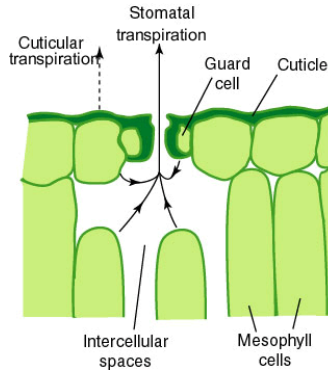
From vascular tissues to mesophyll

- Vascular bundles become leaf traces, and leaf traces become veins
- Vein xylem cells transfer water apoplastically to mesophyll cells

From mesophyll to stomata and leaf surface

- Mesophyll cells and stomata control transpiration
- Stomatal chambers and epidermis hairs will hold water because they provide spaces with higher humidity
- Common epidermal cells also transpire, even with cuticle. In stems, lenticels will transpire.

Transpiration



Any questions before exam?

Summary

- Taking nutrients to roots is the result of **osmosis**.
- **Root pressure** is the result of forced symplastic transport (due to Caspari strips) in endoderm cells.
- The height of trees is controlled mostly by the **capillarity** of xylem vessel elements.
- **Water transport** in plants regulates by: (1) osmosis in root hairs, (2) root pressure in endoderm, (3) capillarity in vessels or tracheids and (4) transpiration in leaves.

For Further Reading



Th. L. Rost, M. G. Barbour, C. R. Stocking, T. M. Murphy.
Plant Biology. 2nd edition.
Thomson Brooks/Cole, 2006.
Chapters **6, 7 and 10**.



Lecture notes 9–16.