

Introduction to Botany. Lecture 7

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Outline

- 1 Questions and answers
- 2 Poikilo- and homoiohydricity (again)
- 3 Roots and root systems
 - Root morphology
 - Anatomy and development of roots
 - Development of root tissues
 - Anatomy of root

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Previous final question: the answer

What is common between xylem and phloem?

Previous final question: the answer

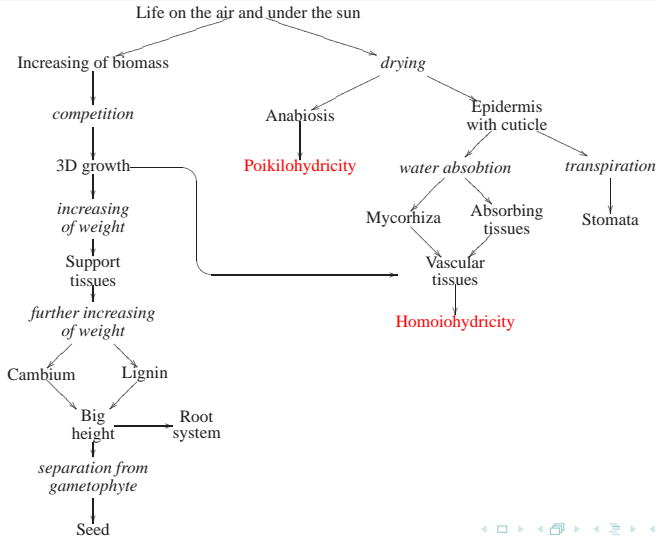
What is common between xylem and phloem?

- Vascular
- Transport
- Compound
- Primary and secondary

Poikilo- and homoiohydricity

- **Poikilohydric** plants do not save water, they survive even complete desiccation
- **Homoiohydric** plants save water, they always have similar water content and do not survive after desiccation
- Compare with poikilo- and homoiothermic animals (reptiles vs. mammals)

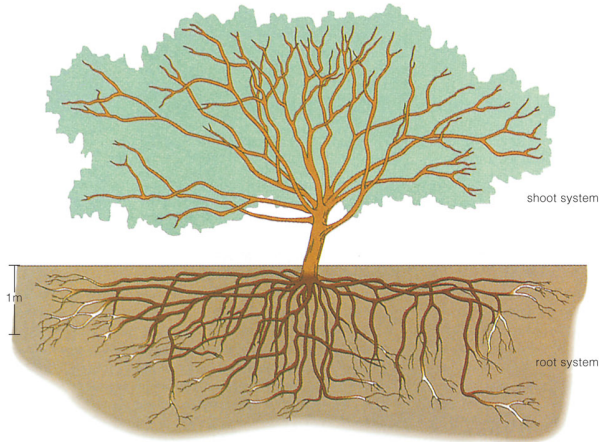
Origins of poikilo- and homoiohydricity



More about plant classification

- Mosses (Bryophyta)
- Ferns and allies (Pteridophyta)
- Seed plants (Spermatophyta)
 - Conifers (Pinopsida)
 - Other classes of seed plants
 - Angiosperms (Magnoliopsida)
 - Monocots (Liliidae)
 - Other subclasses of angiosperms (“dicots”)

Root system and shoot system



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Definition and functions

- Axial vegetative organ with a function of soil nutrition
- Other functions:
 - ① Anchor
 - ② Synthesis
 - ③ Storage
 - ④ Communication
- Features:
 - ① No leaves
 - ② Geotropic growth
 - ③ Locates in soil or water

Types of roots

- Primary root: originates from root of seedling
- Secondary (lateral) roots: originate from primary roots
- Adventitious roots: originate from stems

Primary root



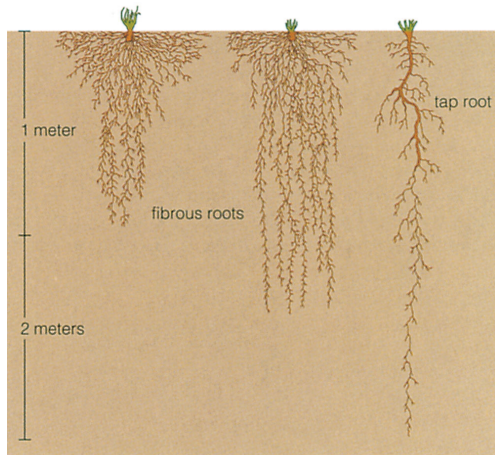
Adventitious root



Root systems

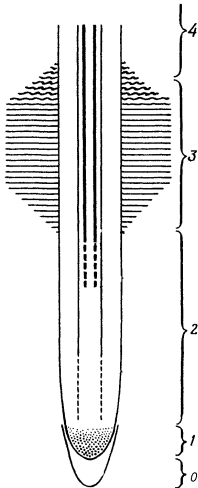
- Tap root system: with well developed primary root (most seed plants)
- Fibrous root system: without clearly visible primary root (monocots, ferns)

Fibrous and tap root systems



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Root zones

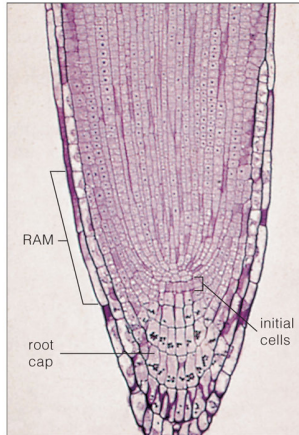


- Root cap
- Root meristem
- Elongation zone
- Absorption zone
- Maturation zone

Structure of root tip

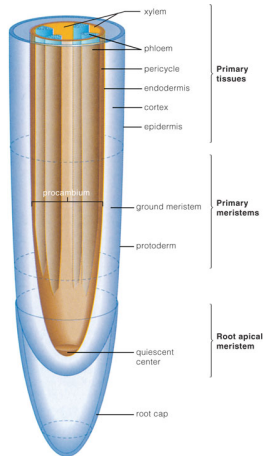
- Initial cells (quiescent center)
- RAM
- Primary meristems
- Root tip growing both forward (root cap) and backward (other root tissues), initial cells determine the direction of growth
- If root tip touch barrier, it starts to make rotating movements

Root tip



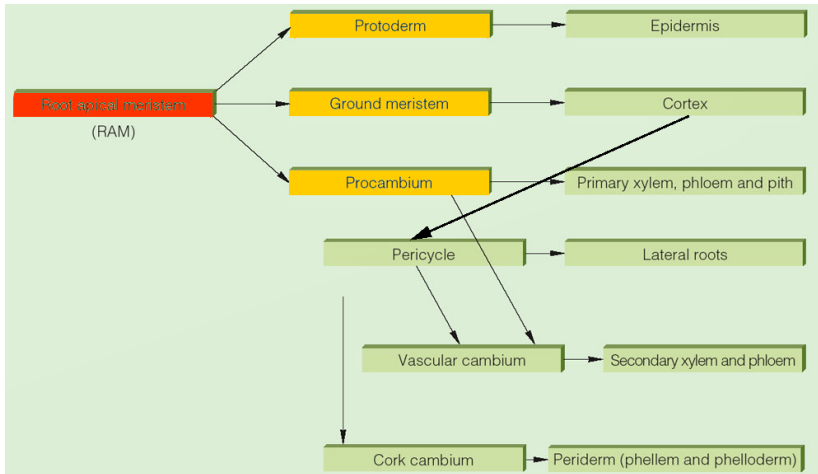
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Development of tissues



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Origins of tissues



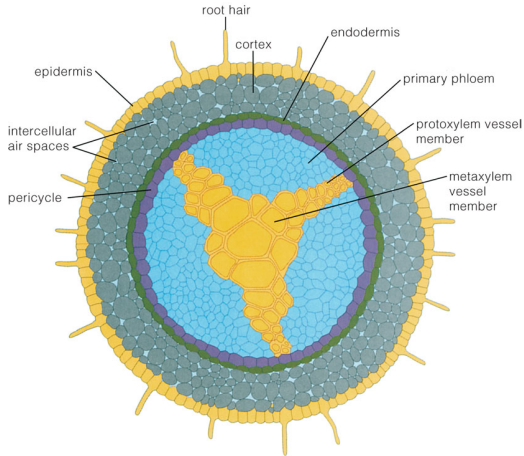
Periphery of root

- Rhizoderm (root epidermis): fast-degrading cells
- Cortex, which includes also:
 - Endoderm: 1-cell layer with specialized cell walls, located on the border with vascular cylinder
 - And (sometimes) exoderm: similar to endoderm but located just under rhizoderm
- In some plants (i.e., orchids), cortex modified into velamen

Root center: vascular cylinder

- Pericycle
- Vascular tissues located in the center
- No central hollow, central parenchyma presents in monocot roots

Anatomy of root



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- Long-lived parenchyma cells served as half-meristem
- Initiates development of lateral roots
- Contributes to vascular cambium
- Contributes to cork cambium

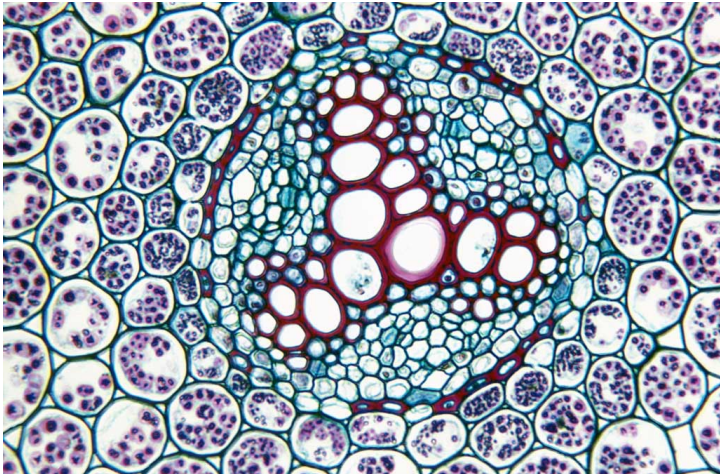
Development of lateral roots



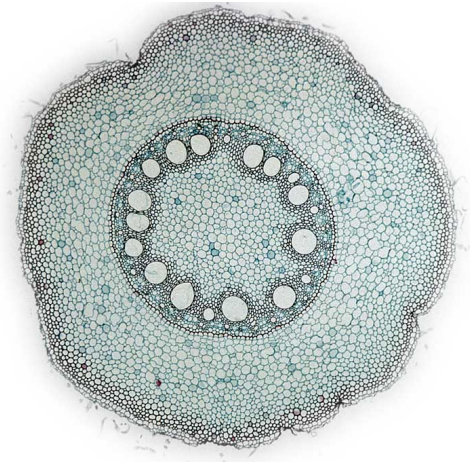
Vascular bundle

- Only one!
- Has radial (star-like) symmetry
- Protoxylem arranged in rays, multiple in monocots, 2-4 in other plants

Radial structure of root vascular bundle in buttercup (*Ranunculus* sp.)



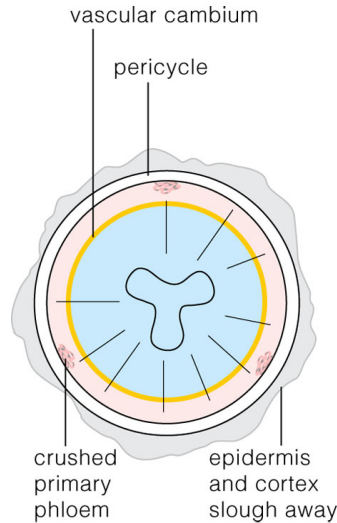
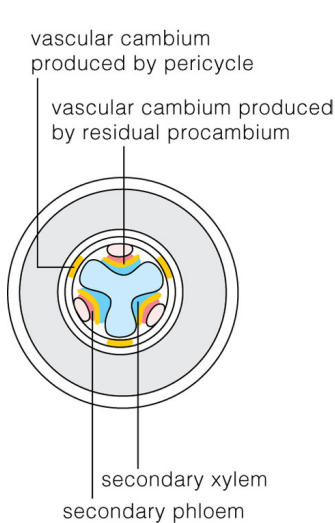
Root of monocot (*Zea mays*)



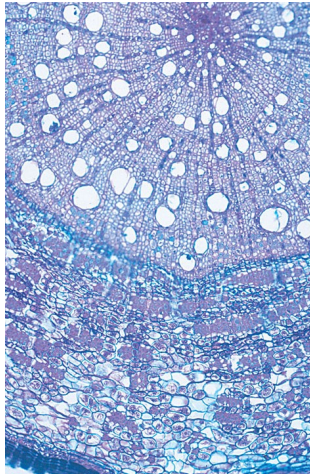
Secondary thickening

- Vascular cambium is produced by both pericycle and residual procambium (located between xylem and phloem)
- Cork cambium appears in cortex

Root thickening



Secondary root (*Quercus* sp.)



Summary

- **Root** is an axial vegetative organ with a function of soil nutrition
- **Rhizoderm** and **absorption zone** are the most physiologically important parts of root
- Root differs from stem having rhizoderm, thick cortex, endoderm, long-lived pericycle and radially arranged primary vascular tissues
- Secondary thickening make root more similar to stem

Final question (1 point)

Final question (1 point)

What are adventitious roots?

For Further Reading



J. E. Bidlack, Sh. H. Jansky.
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