

Introduction to Botany. Lecture 28

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Outline

1 Questions and answers

- Quiz

2 Root

- Anatomy and development of roots
- Origins of root tissues
- Water transport in roots
- Diversity of roots
- Diversity of roots

3 Plant diversity

- Systematics
- Kingdom Vegetabilia, land plants



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Questions and answers

Quiz



Final question (2 points)

What are adventitious roots?



Final question (2 points)

What are adventitious roots?

- Roots which grow out of stem.

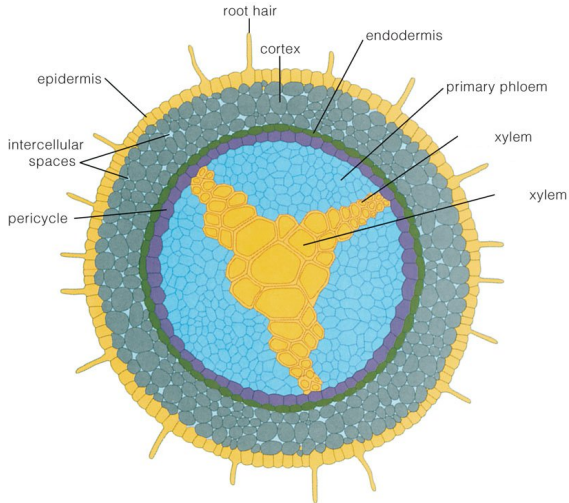


Root

Anatomy and development of roots



Anatomy of root



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Pericycle

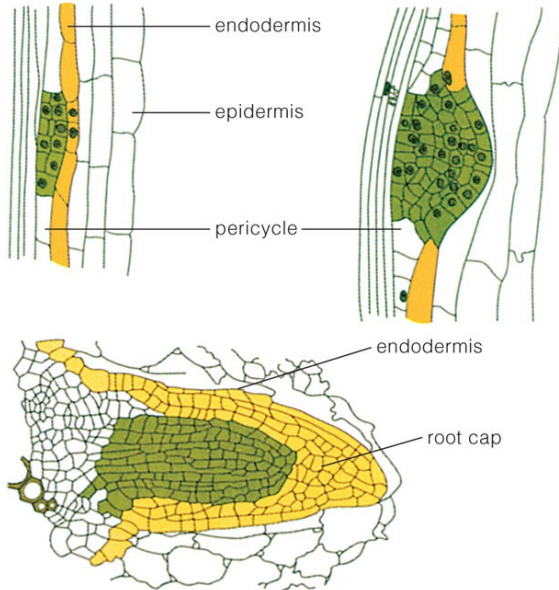
- Long-lived parenchyma cells served as half-meristem
- Initiates development of lateral roots
- Contributes to vascular cambium
- Contributes to cork cambium



Development of lateral roots



Development of lateral roots (step by step)

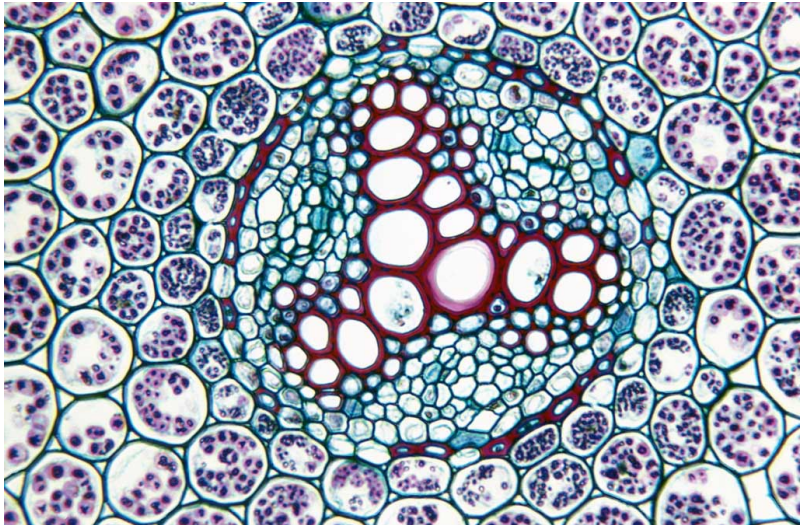


Vascular bundle

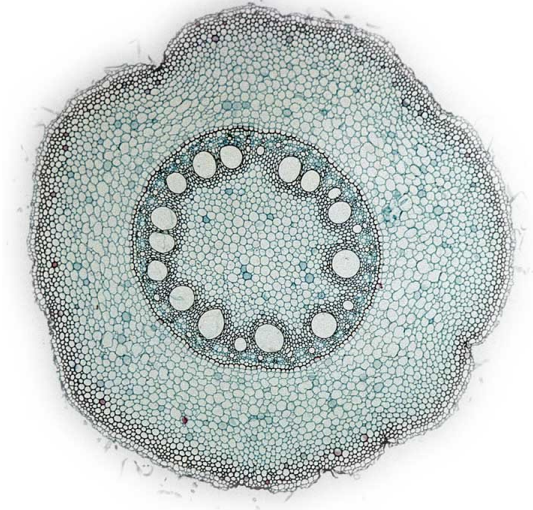
- Only one!
- Has radial (star-like) symmetry
- Xylem arranged in rays, multiple in monocots, 2-4 in other plants



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



Root of monocot (*Zea mays*)

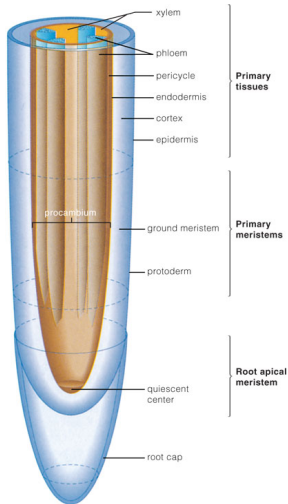


Root

Origins of root tissues



Development of tissues



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In essence, development of tissues in root is analogous to stem.



Root

Water transport in roots



Rhizodermis 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

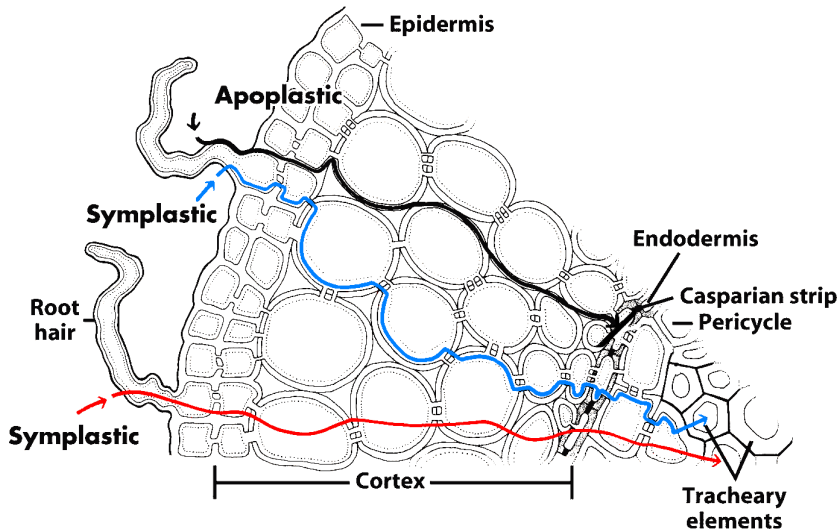


Endodermis and root pressure

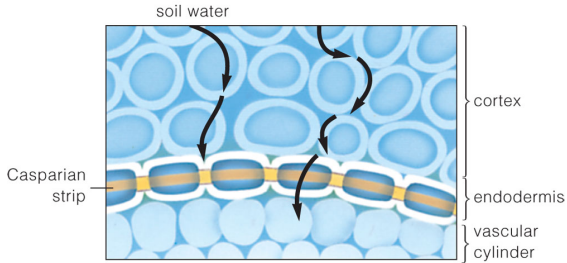
- From rhizodermis to endodermis, transport of water is both symplastic and apoplastic
- In the endodermis cells, Caspari stripes stop apoplastic transport and therefore forced symplastic transport
- This is a high-energetic process requires ATP
- As a result, water will be pushed up from root: this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



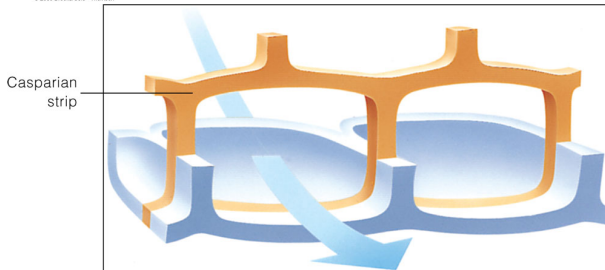
Apoplastic and symplastic transport in the root



Casparian strips



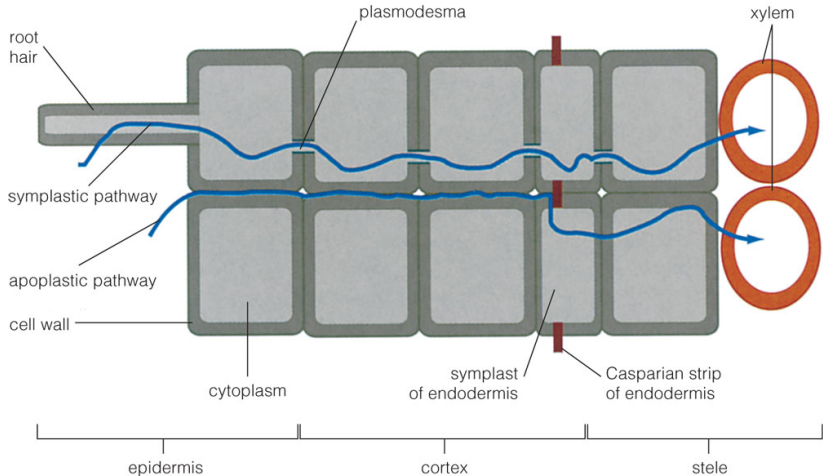
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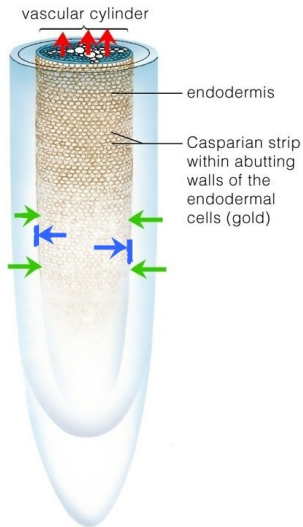
How Casparian strips are working



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Origin of root pressure



Water flow in plants

- Plants need water:
 - To supply photosynthesis
 - To cool via transpiration
 - To obtain required minerals
- Water flows because of:
 - Root pressure
 - Capillarity force
 - Transpiration “suction”



Root

Diversity of roots



Modifications of roots

- Adventive buds with root origin (many plants)
- Mycorrhizae: endotrophic (grasses, orchids) and ectotrophic (trees)
- Haustoria (parasites like *Cuscuta*—dodder plant)
- Root nodules (legumes, Fabaceae family)
- Contractile roots (*Hyacinthus* spp.—hyacinth, *Taraxacum* spp.—dandelion)
- Storage roots (*Daucus carota*—carrot, *Armoracia officinalis*—horseradish)
- Supportive roots (many tropical plants)
- Defensive, spiny roots (ivy)
- Photosynthetic roots (some orchids)

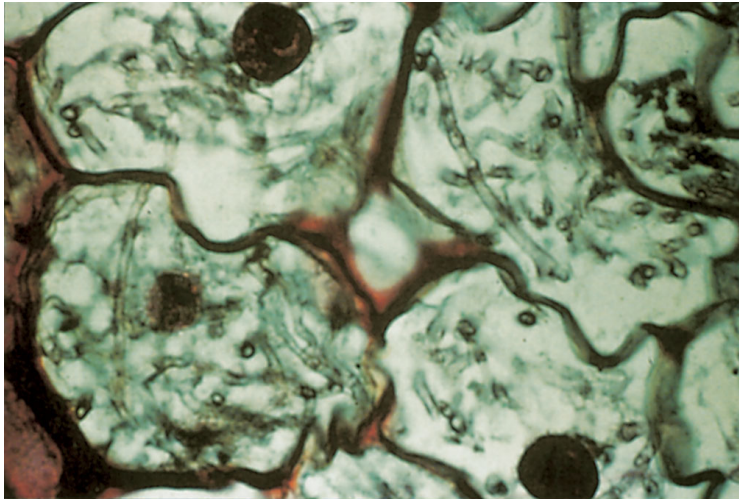


Root

Diversity of roots



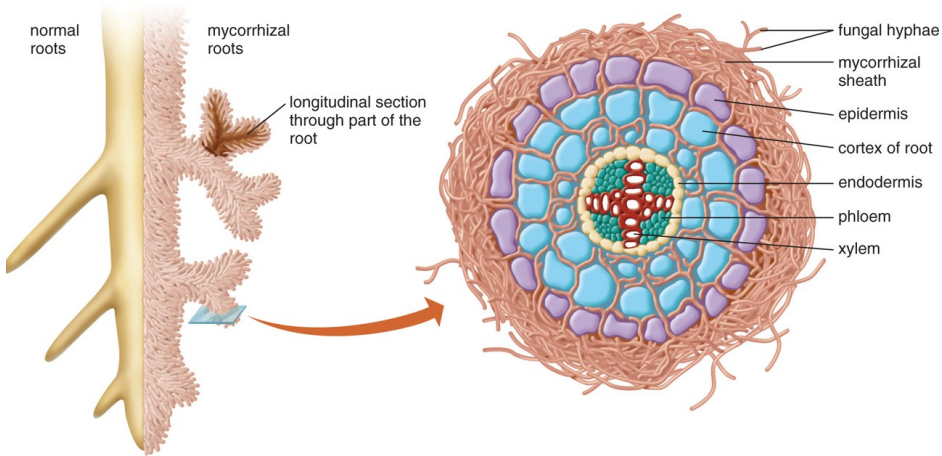
Endotrophic mycorrhizae in *Corallorhiza* orchid



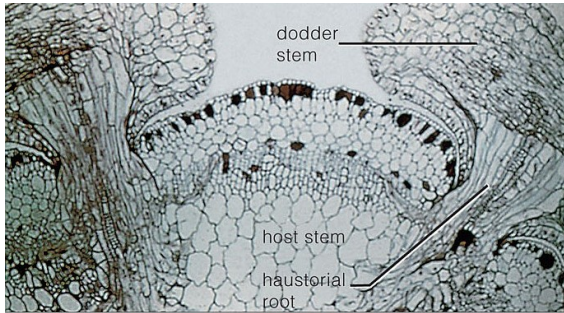
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Ectotrophic mycorrhizae of trees



Haustoria of *Cuscuta* (dodder)



Nodulated roots of soybean (*Glycine max*)



Contractile roots of *Hyacinthus orientalis*



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Supportive roots of mangrove plants



Supportive roots of *Pandanus* sp.



Defensive spiny roots of ivy (*Hedera* sp.)



Photosynthetic aerial roots of orchids



Table of modifications

Function	Stem	Leaf	Root
Expansion	...	Plantlets	Adventive buds
Storage	...	Succulent leaves	Storage roots
Photosynthesis	...	DEFAULT	Some aerial roots
Defense	...	Spines, scale	Root spines
Support	DEFAULT	Leaf tendrils	Aerial and contractile roots
Interactions	...	Traps, "sticky tapes", urns	Mycorrhizae, haustoria, nodulated roots



Summary

- Vascular tissues of root is a modified protostele or solenostele (monocots).
- Root hairs, Casparian strips, capillarity and transpiration work together to make water flow in plant.
- Root-related part of water flow is the **root pressure**.
- Roots have not less modifications than leaves.



Plant diversity

Systematics



Basics of systematics

Terms covered:

- Systematics = taxonomy
- Species, taxonomic hierarchy
- Taxon, rank = category, classification
- Kingdom, phylum, class, order, family, genus, species
- Subclass, subfamily and other intermediate ranks
- Subspecies and cultivars



Biological nomenclature

Terms covered:

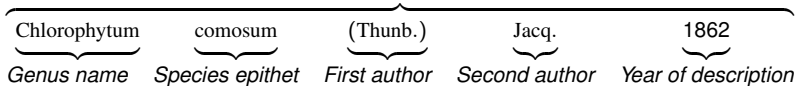
- Binomial name, species epithet, reference = citation
- Synonyms, priority (older names have preference), starting dates (1753 for plants)



Examples

		Example 1	Example 2
Kingdom	Regnum	Vegetabilia	Animalia
Phylum	Phylum	Spermatophyta	Chordata
Class	Classis	Angiospermae (Magnoliopsida)	Mammalia
Order	Ordo	Liliales	Primates
Family	Familia	Asparagaceae	Hominidae
Genus	Genus	<i>Chlorophytum</i>	<i>Homo</i>
Species	Species	<i>Chlorophytum comosum</i> (Thunb.) Jacq. 1862	<i>Homo sapiens</i> L.

Species name

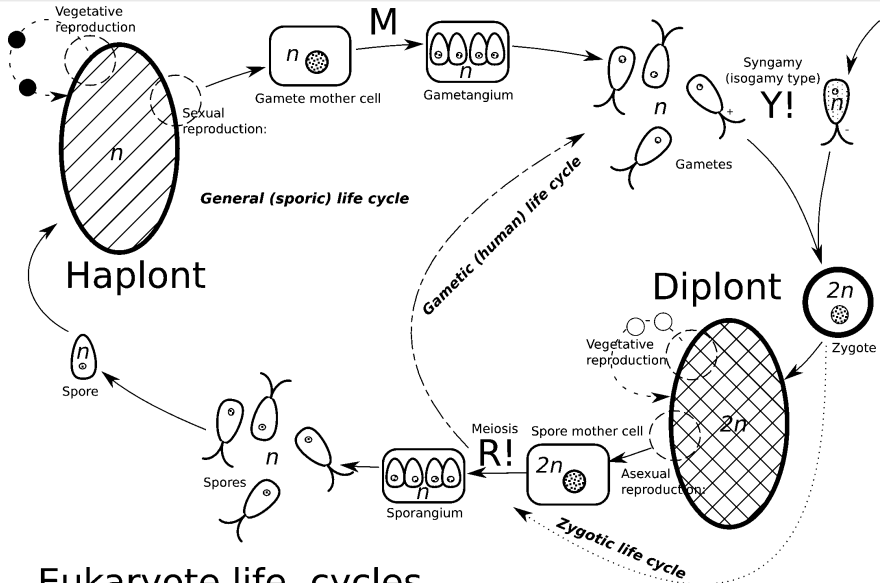


Plant diversity

Kingdom Vegetabilia, land plants



General life cycle



Eukaryote life cycles



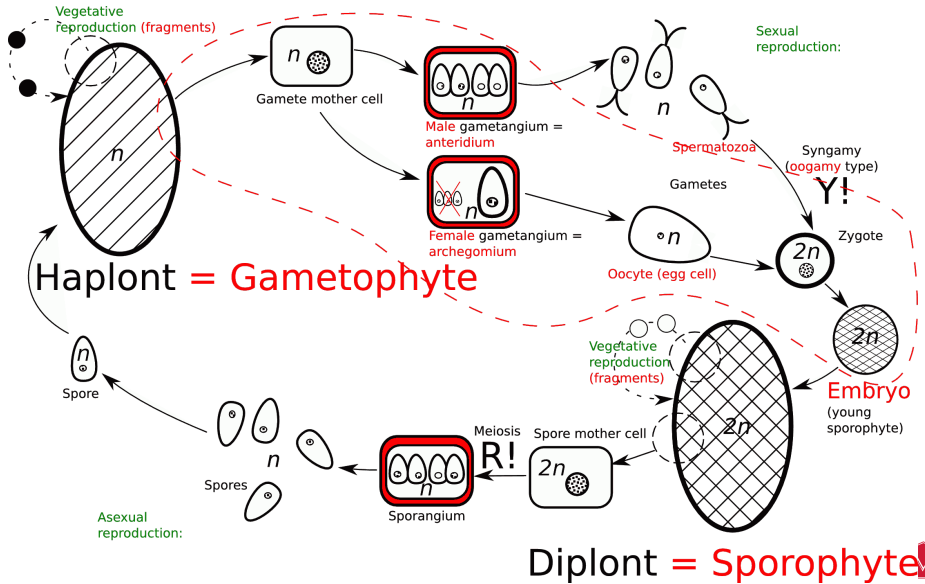
Life cycle of land plants

Terms covered:

- Sporophyte and gametophyte
- Gametangia: archegonium and antheridium
- Spermatozoa and oocyte (egg cell)
- Embryo and parasitic sporophyte
- Predominance of sporophyte or gametophyte



Life cycle of land plants: differences



Final question (2 points)



Final question (2 points)

What is endoderm?



For Further Reading



A. Shipunov.

Introduction to Botany [Electronic resource].

Mode of access:

http://ashipunov.info/shipunov/school/biol_154

