

Introduction to Botany. Lecture 19

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1 Questions and answers

2 Tissues

- Origin of tissues
- Step four: pipes. Vascular tissues
 - Xylem
 - Phloem



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2 Tissues

- Origin of tissues
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 - Xylem
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Previous final question: the answer

What is the difference between collenchyma and sclerenchyma?



Previous final question: the answer

What is the difference between collenchyma and sclerenchyma?

- Alive vs. dead
- Primary vs. secondary cell walls



Tissues

Origin of tissues

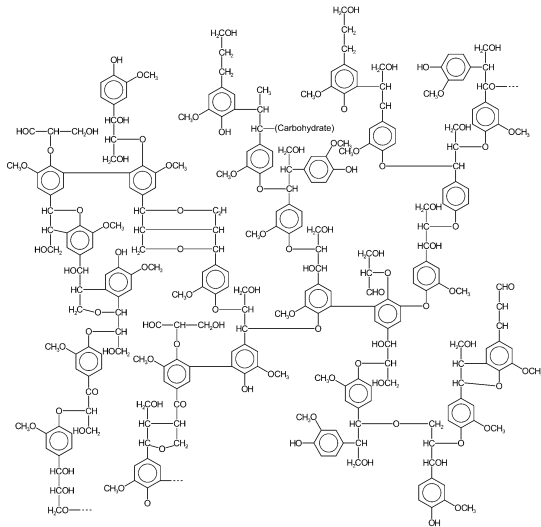


Origin of tissues and organs of plants: first steps

- Plants were pushed on land for many reasons, including competition
- First challenge: drying. Response: **epidermis** and **parenchyma**.
- Second challenge: new level of competition. Response: growing up!
- Problem: big weight. Response: **collenchyma**.
- Competition grows, plants growing even higher. Weight grows. They also need to get rid of turgor dependency. Response: use lignin not only for epidermis surface (cuticle) but also for secondary cell walls—**sclerenchyma**.
- Competition grows again, plants need to grow faster. Solution: **meristems**.
- Size of plant is too big for plasmodesmata transportations. Solution: vascular tissues, **xylem** and **phloem**.



Lignin



Phenolic compounds (e.g., lignin) were initially developed for spore distribution with a wind, then used in cuticle, then in the secondary cell walls.



Tissues

Step four: pipes. Vascular tissues

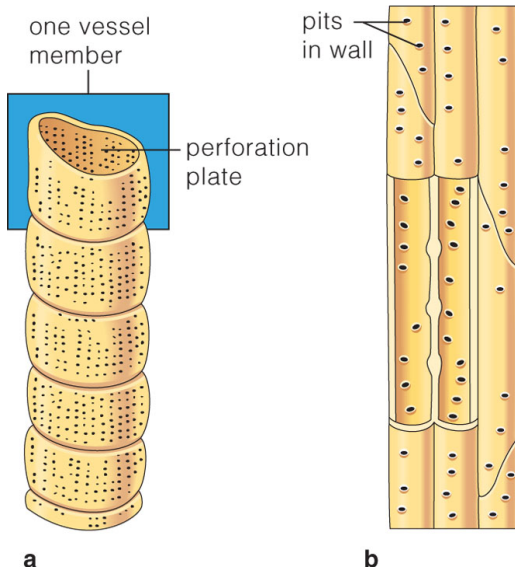


Vascular tissues: Xylem

- Occurs in vascular bundles or vascular cylinder
- Types of cells: tracheary elements (tracheids and vessel members), fibers, and parenchyma
- Tracheids have pits; vessel members have perforations; all of them are dead cells
- Gymnosperms have only tracheids; flowering plants have tracheids + vessel elements together
- In flowering plants, primary xylem has mostly tracheids and vessels with scalariform perforations; secondary xylem has mostly vessels with open perforations
- Xylem elements (except parenchyma) are rich of lignin and are main components of wood
- Main functions: water transport and mechanical support



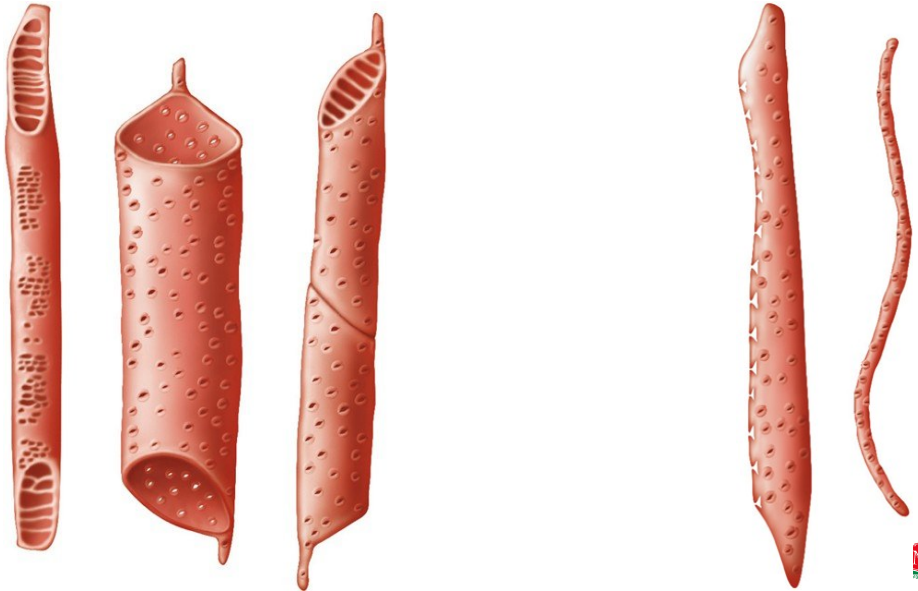
Vessel members vs. Tracheids



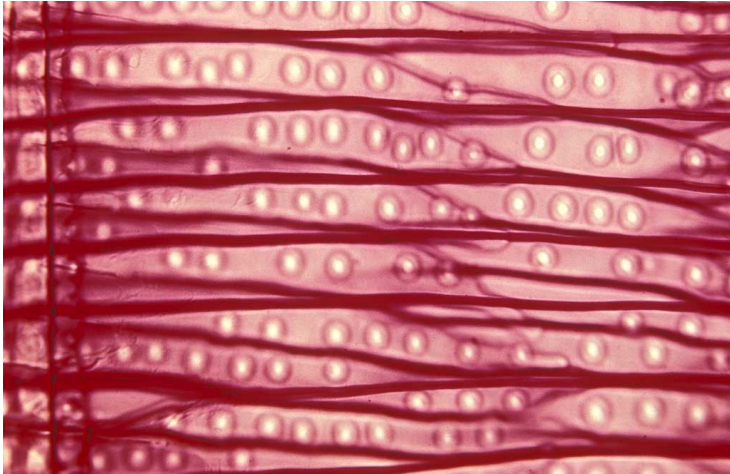
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Vessel members vs. Tracheids

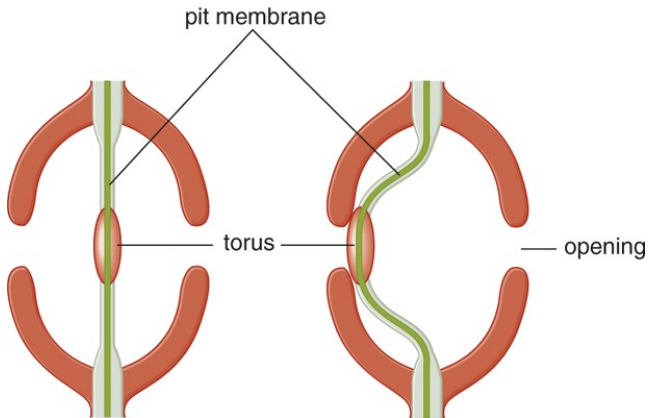


Tracheids



Pine (*Pinus* sp.) tracheids with pits

Pit is NOT a direct connection

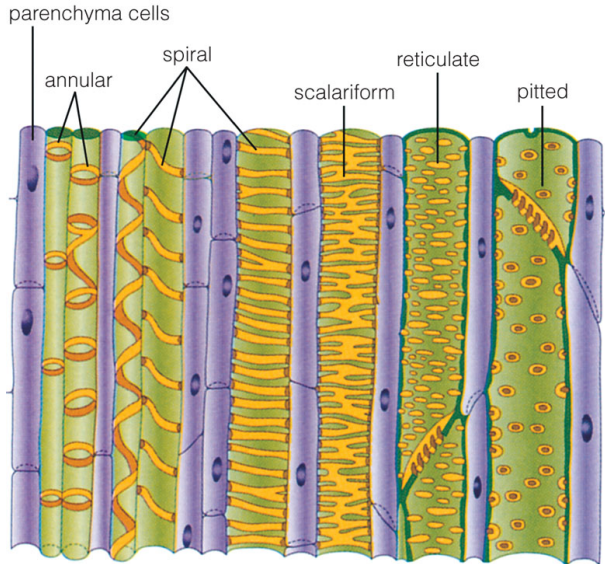


Vessels



Ash (*Fraxinus americana*) secondary xylem
with vessels (LM $\times 26$)

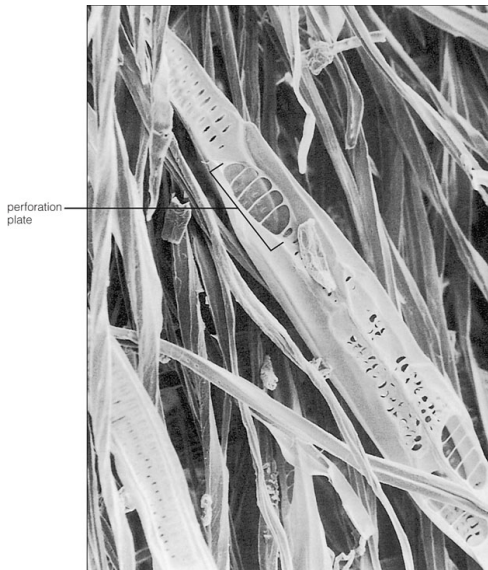
Perforations



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Scalariform perforations: direct connections



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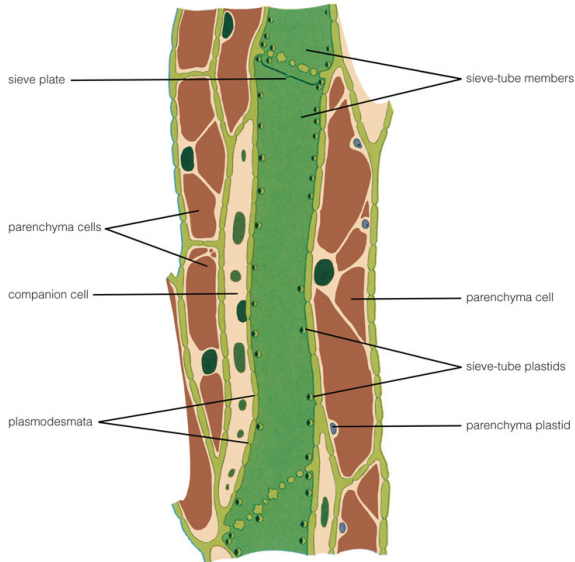


Phloem

- Usually occurs adjacent to a xylem
- Types of cells: sieve tube cells, companion cells, fibers and parenchyma
- Sieve tube cells have plastids and perforation (sieve) plates between cells but no nuclei, companion cells have nuclei
- However, in gymnosperms there are *no* companion cells and sieve tube cells *have* nuclei
- Secondary phloem usually has more fibers than primary phloem
- Main functions: sugar transport and mechanical support



Phloem cell types



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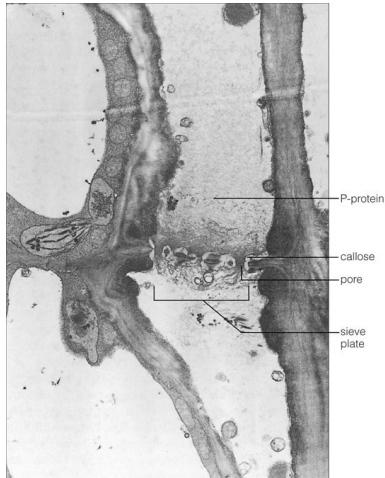
Sieve tubes and phloem parenchyma



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Perforation (sieve) plate

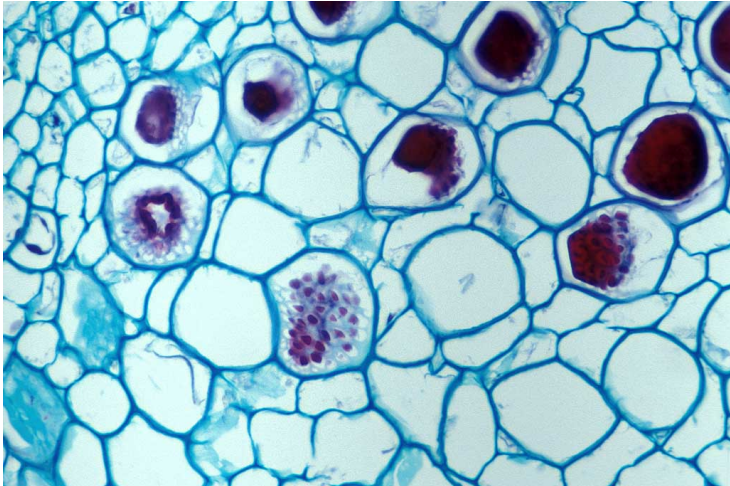


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Cross-section (TEM)

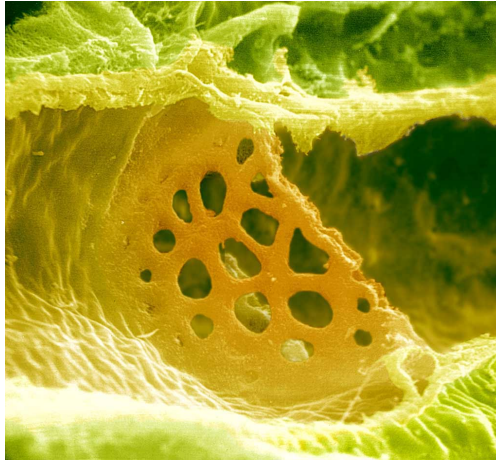


Plates: frontal view



Frontal view (LM)

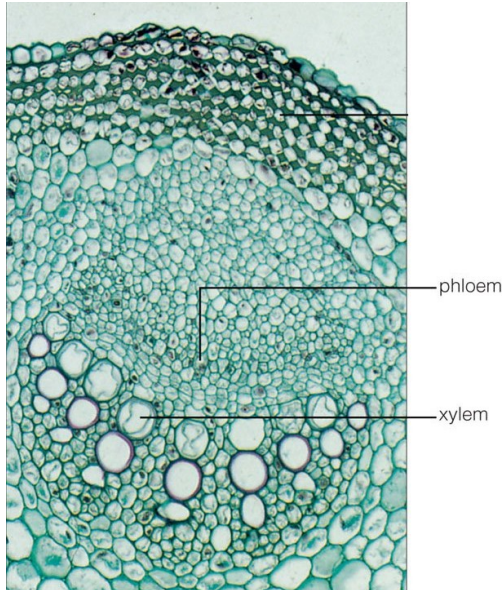
Plates: pores



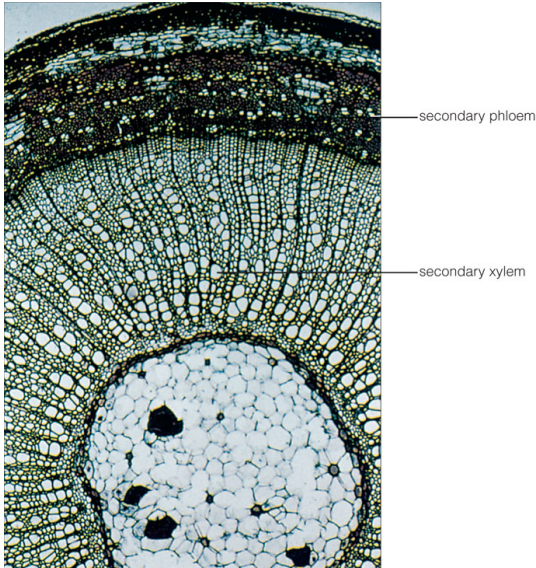
Sieve plate, a pore in the end wall of a sieve-tube member, through which phloem sap flows (SEM $\times 4800$)



Primary vascular tissues



Secondary vascular tissues



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Final question (2 points)



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What are more primitive states for xylem and phloem, respectively?



Summary

Xylem vs. phloem:

- **State:** dead vs. living cells
- **Transport:** water vs. sugar
- **Direction:** up vs. down
- **Biomass:** big vs. small



For Further Reading



A. Shipunov.

Introduction to Botany [Electronic resource].

2010—onwards.

Mode of access:

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



Th. L. Rost, M. G. Barbour, C. R. Stocking, T. M. Murphy.

Plant Biology. 2nd edition.

Thomson Brooks/Cole, 2006.

Chapter 4.