

Introduction to Botany. Lecture 7

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Outline

1 Questions and answers

2 Tissues

- Dermal tissues
- Meristems

3 Tissues: vascular

- Xylem
- Phloem



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Previous final question: the answer

How plant tissues are different from animal tissues?

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How plant tissues are different from animal tissues?

- Plant tissues are an adaptation to the life on land whereas animal tissues are adaptation for hunting
- Animals do not have complex tissues, meristems, stomata, cell walls, photosynthesis etc.



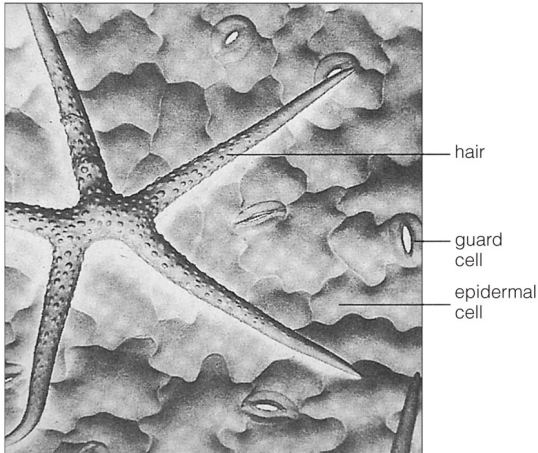
Tissues

Dermal tissues

Epidermis: the complex tissue

- Complex tissue of different cell types:
 - 1 Epidermal cells
 - 2 Stomata cells:
 - Guard cells
 - Subsidiary cells
 - 3 Trichomes
- Shapes and chemical compounds vary
- Main functions: gas exchange, transpiration, defense

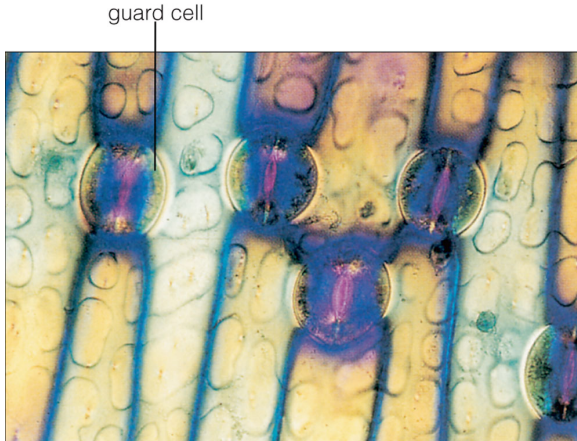
Epidermal cells



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Three kinds of Shepherd's purse (*Capsella bursa-pastoris*) epidermal cells

Stomata



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Stomata with guard cells and pores (*Iris* sp.)

Tissues

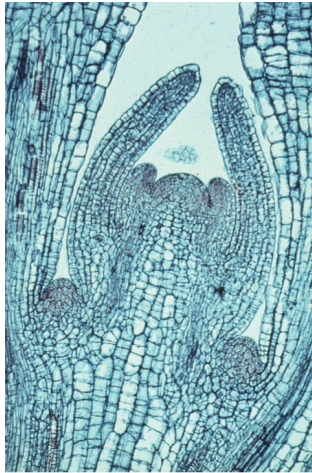
Meristems

Meristems: apical

- Centers of plant development
- Locate on the very ends of roots (RAM) and shoots (SAM)
- Produce intermediate primary meristems which form all primary tissues



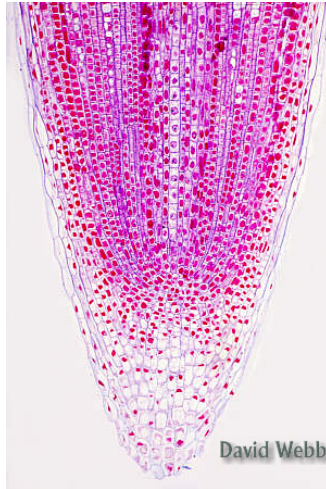
SAM



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Coleus sp. stem apical meristem (LM $\times 100$)

RAM



Corn (*Zea mays*) root apical meristem (© D. Webb)

Lateral meristem: cambium

- Originates from procambium which in turn originates from apical meristems
- Usually arises within vessel bundle or vessel cylinder, right between two vascular tissues
- Main function: produces secondary vascular tissues



Primary and secondary tissues

- Primary tissues originate from stem or root apex through primary meristems
- Secondary tissues originate from lateral meristems



Tissues: vascular

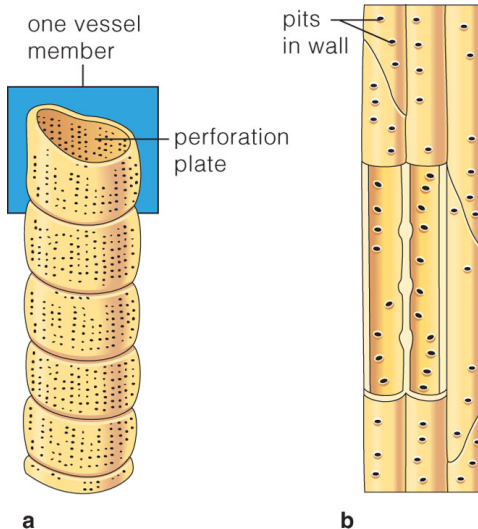
Xylem

Vascular tissues: Xylem

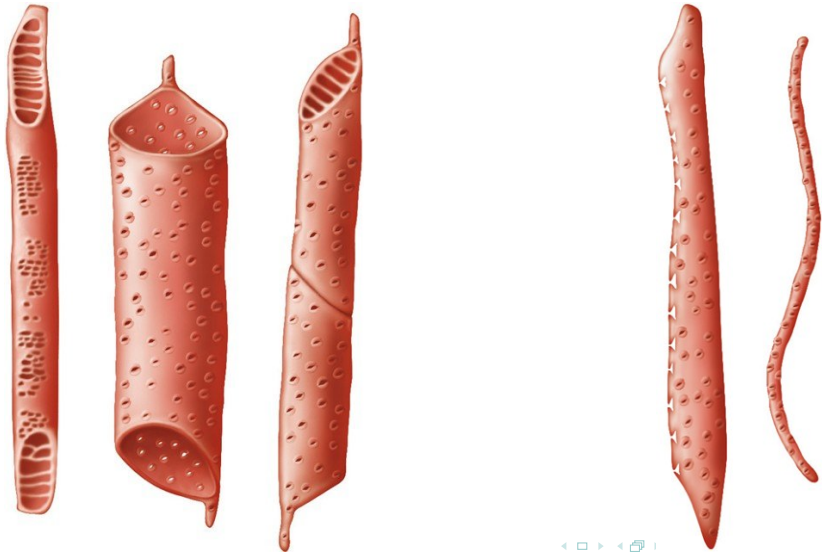
- Occurs in vascular bundles or vascular cylinder
- Types of cells: tracheary elements (tracheids and vessel members), fibers, and parenchyma
- Tracheids have pits; vessel members have perforations; all of them are dead cells
- Gymnosperms have only tracheids; flowering plants have tracheids + vessel 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



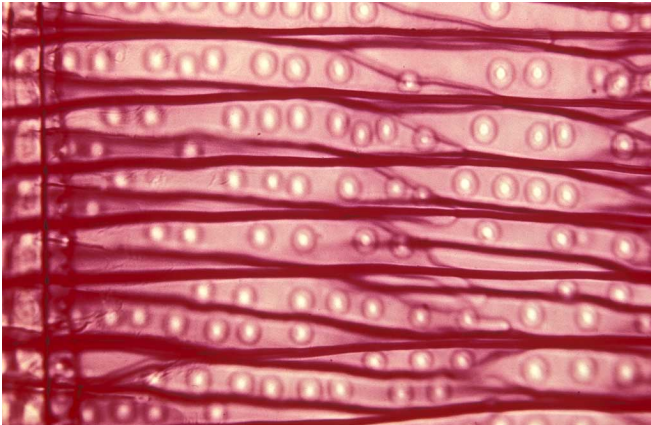
Vessel members vs. Tracheids



Vessel members vs. Tracheids

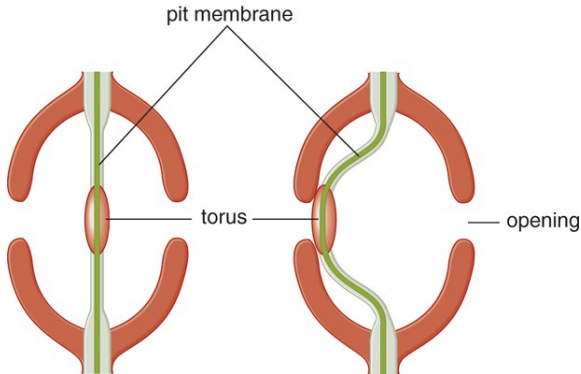


Tracheids



Pine (*Pinus* sp.) tracheids with pits

Pit is NOT a direct connection

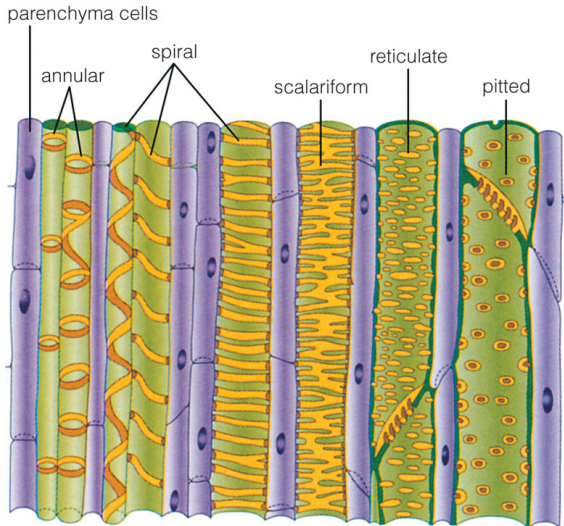


Vessels



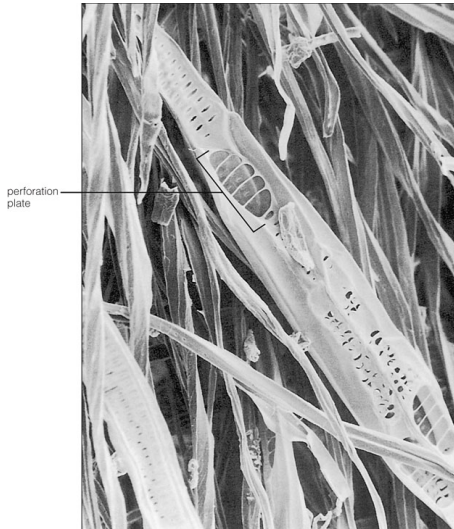
Ash (*Fraxinus americana*) secondary xylem
with vessels (LM $\times 26$)

Perforations



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Scalariform perforations: direct connections



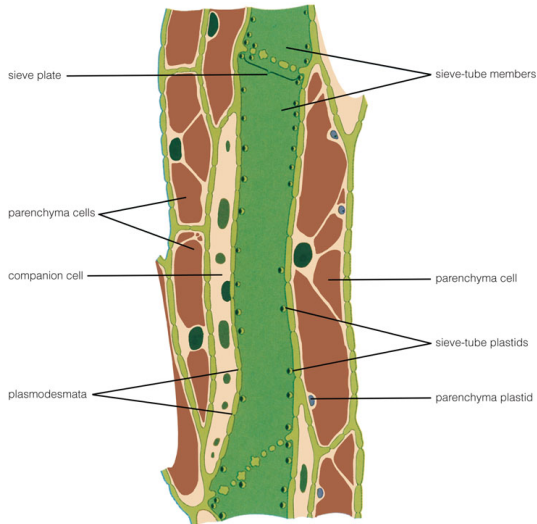
Tissues: vascular Phloem

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

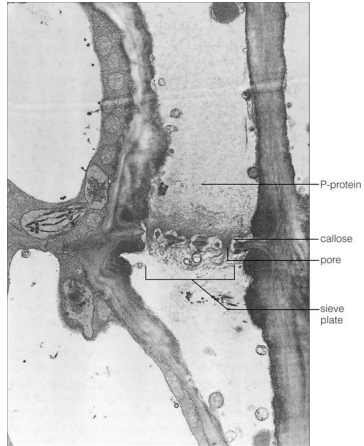


Sieve tubes and phloem parenchyma



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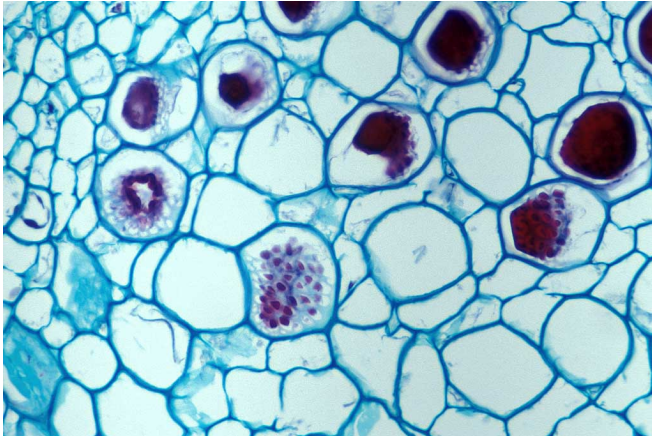
Perforation (sieve) plate



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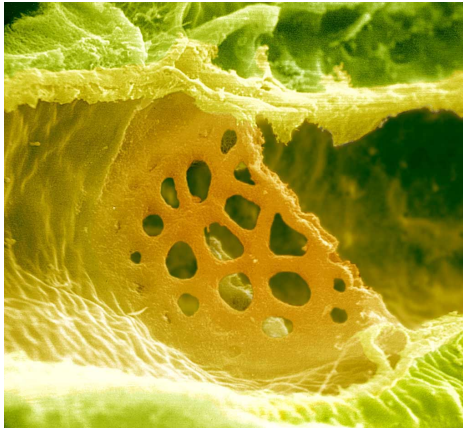
Cross-section (TEM)

Plates: frontal view



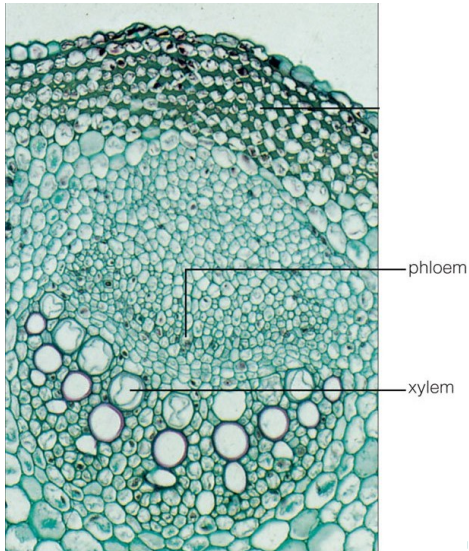
Frontal view (LM)

Plates: pores

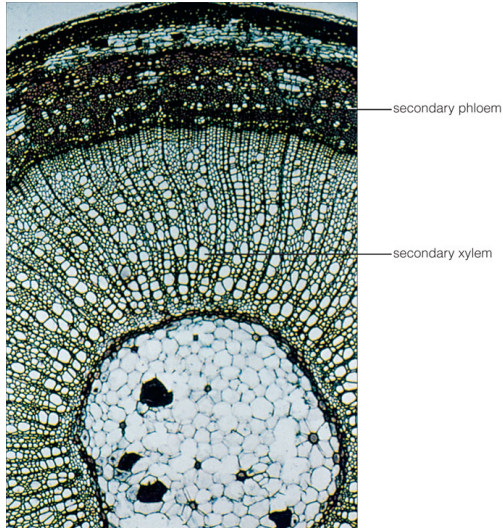


Sieve plate, a pore in the end wall of a sieve-tube member, through which phloem sap flows (SEM $\times 4800$)

Primary vascular tissues



Secondary vascular tissues



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Xylem vs. Phloem

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



Final question (2 points)

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What is common between xylem and phloem?

Summary

- **Meristems** produce all other primary and secondary tissues
- **Vascular** tissues transport water and sugars

For Further Reading



J. E. Bidlack, Sh. H. Jansky.
Stern's introductory plant biology. 12th edition.
McGraw-Hill, 2011.
Chapter 4.



Th. L. Rost, M. G. Barbour, C. R. Stocking, T. M. Murphy.
Plant Biology. 2nd edition.
Thomson Brooks/Cole, 2006.
Chapter 4.

