

Introduction to Botany. Lecture 20

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October 20, 2017



1 Questions and answers

- Quiz

2 Tissues

- Step two: skeleton. Supportive tissues
- Step three: construction sites. Meristems
- Origin of tissues
- Step four: pipes. Vascular tissues
 - Xylem



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Questions and answers

Quiz



Final question (2 points)

What is the complex tissue?



Final question (2 points)

What is the complex tissue?

- Tissue which has more than one cell type.



More about plants₂ classification

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



Tissues

Step two: skeleton.
Supportive tissues

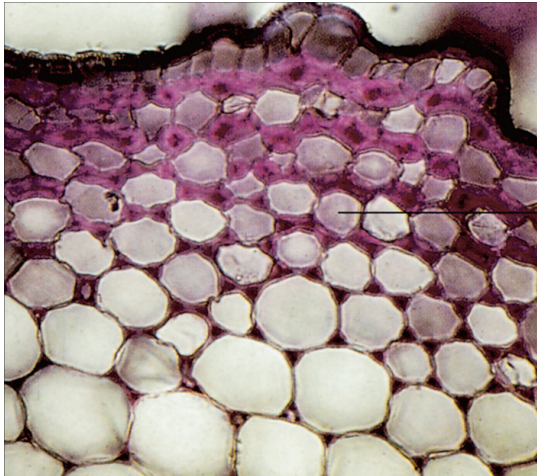


Collenchyma: living supportive tissue

- Elongated cells
- Thick primary cell wall (pectins + cellulose)
- Main functions: mechanical support of young stems and leaves



Angled collenchyma



collenchyma cell

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Collenchyma cells of marigold (*Calendula officinalis*)

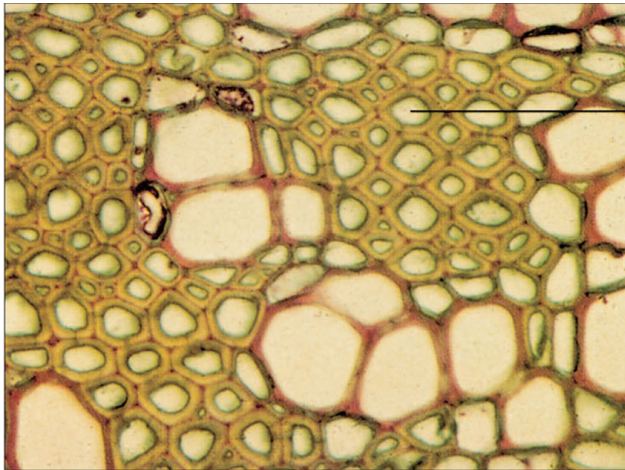


Sclerenchyma: dead supportive tissue

- Long cells (sclerenchyma fibers) or short crystal-like cells (sclereids)
- Dead cells with thick secondary cell wall, rich of lignin
- Supports weight of older plant organs, makes fruits non-edible before they become rip, makes stems firm



Sclerenchyma fibers



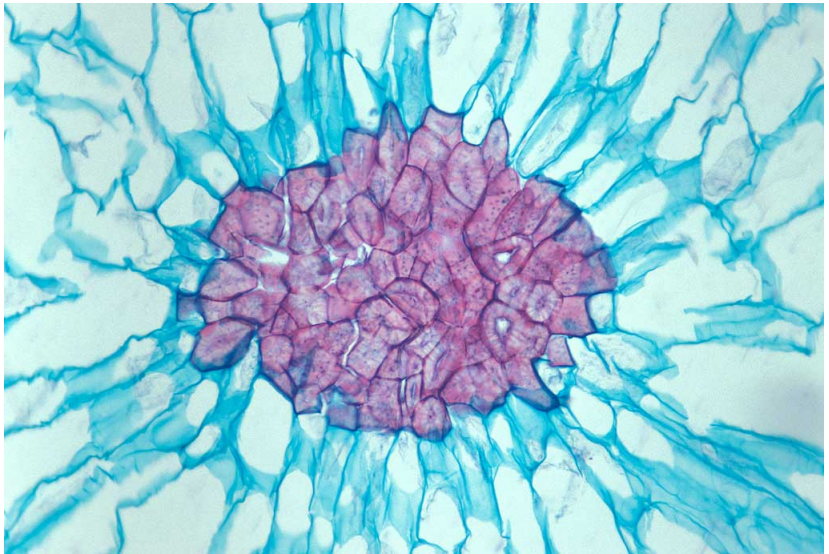
fiber

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Cross-section of sclerenchyma fibers in geranium (*Pelargonium* sp.)



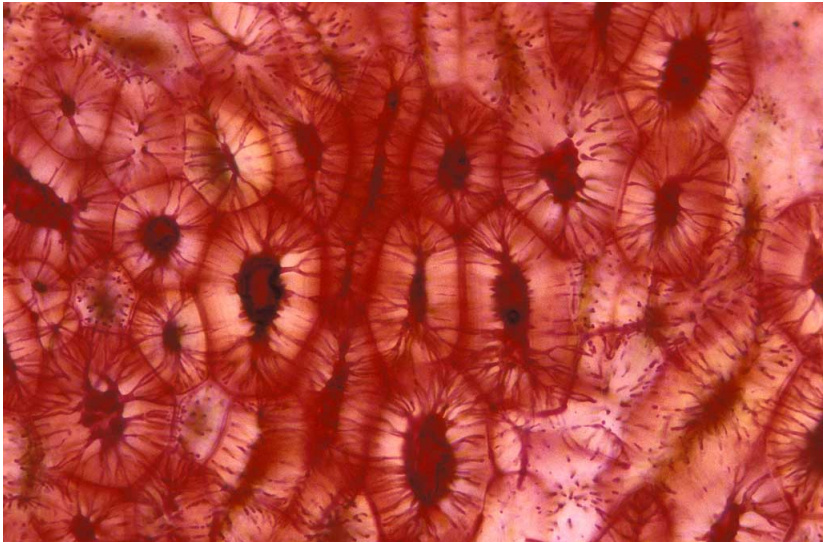
Stone cells



Stone cells (kind of sclereids) in pear fruit (*Pyrus communis*)



Sclereids from cherry pit



Sclereids from cherry (*Prunus* sp.) pit (LM $\times 400$)



Tissues

Step three: construction sites. Meristems

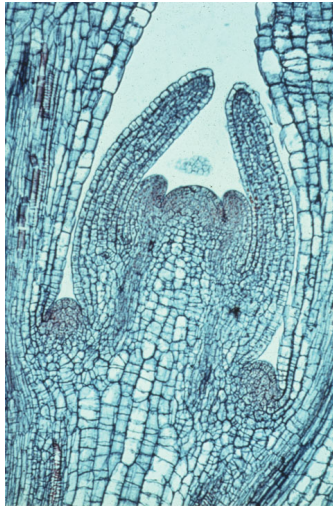


Meristems: apical

- 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

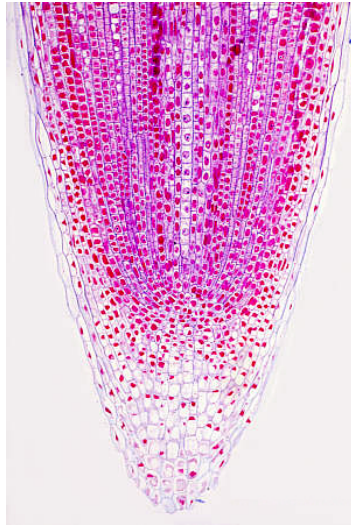


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Coleus sp. stem apical meristem (LM $\times 100$); primordia (embryonic leaves) are visible.



RAM



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



Lateral meristem: cambium

- Originates from procambium which in turn originates from apical meristems
- Usually arises between two vascular tissues
- Main function: thickening. 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



Additional meristems

- **Intercalary** meristems: locate in stems, regulates stem elongation
- **Marginal** meristems are leaf-specific, they regulate leaf shape
- **Repair** meristems help to cure wounds, they form buds and roots in unusual places



Tissues

Origin of tissues

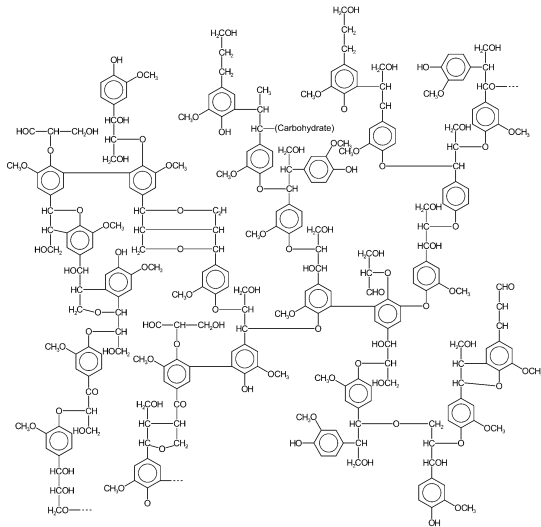


Origin of tissues and organs of plants: first steps

- 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 and other “plastic” compounds (e.g., lignin) were initially developed for spore distribution with a wind, then used in cuticle, then in the secondary



Tissues

Step four: pipes. Vascular tissues

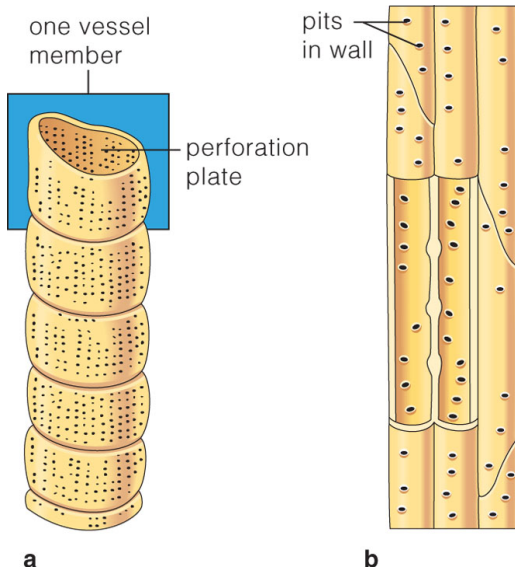


Vascular tissues: Xylem

- 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



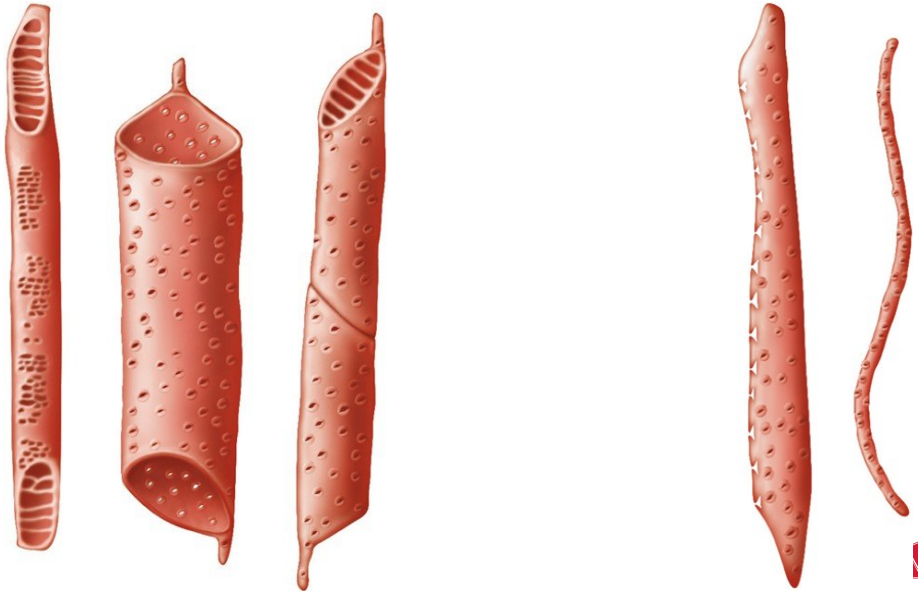
Vessel members vs. Tracheids



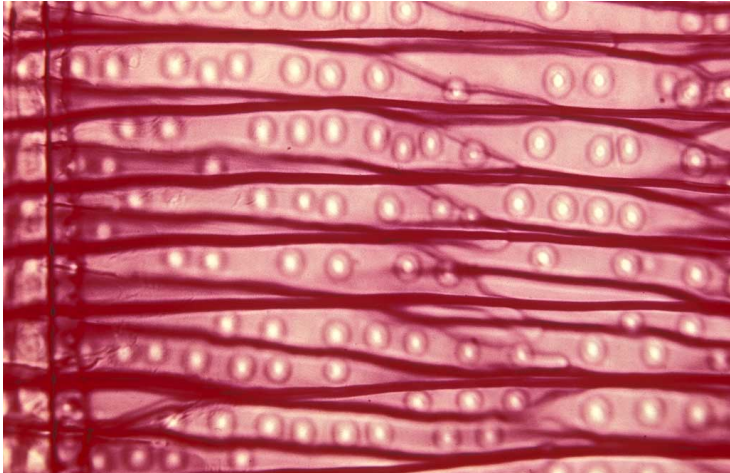
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Vessel members vs. Tracheids



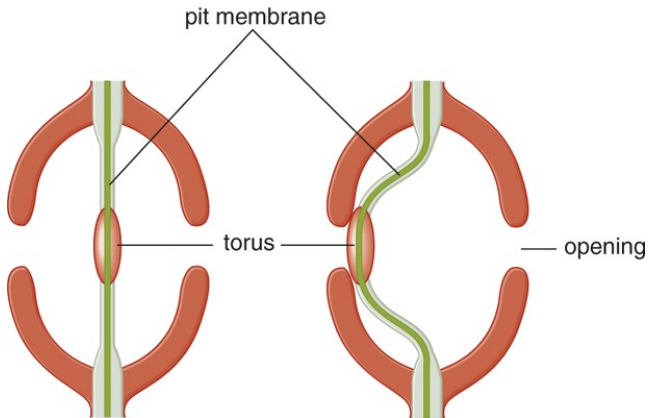
Tracheids



Pine (*Pinus* sp.) tracheids with pits



Pit is NOT a direct connection



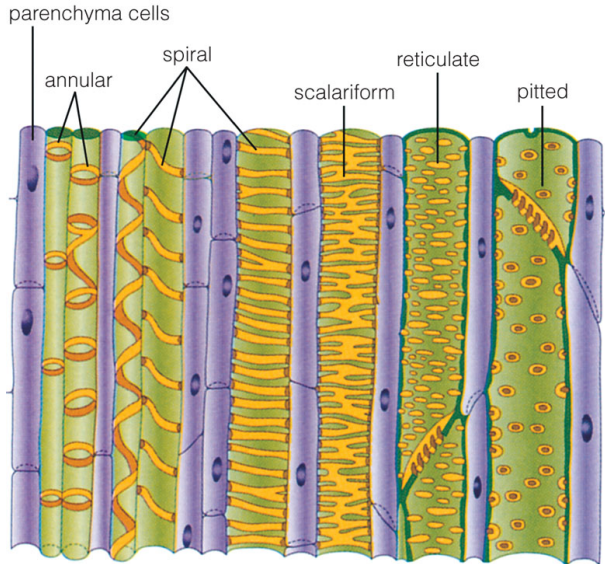
Vessels



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



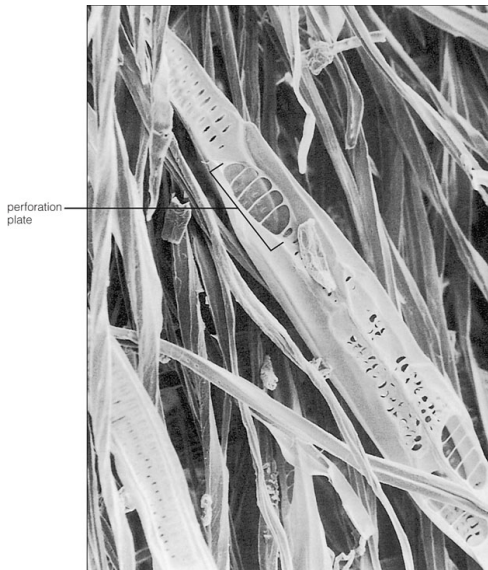
Perforations



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Scalariform perforations: direct connections



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Summary

- **Epidermis** is a complex tissue which includes stomata
- **Collenchyma** and **sclerenchyma** are simple supportive tissues
- **Secondary tissues** originate from lateral meristems (i.e., cambium)
- **Xylem vs. phloem:**
 - **State:** dead vs. living cells
 - **Transport:** water vs. sugar
 - **Direction:** up vs. down
 - **Biomass:** big vs. small



Final question (2 points)



Final question (2 points)

What are secondary tissues?



For Further Reading



A. Shipunov.

Introduction to Botany [Electronic resource].

Mode of access:

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

