

Introduction to Botany. Lecture 12

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Outline

- 1 Questions and answers
- 2 Anatomy of stem
 - Anatomy of mature stem
 - Structure of wood

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Previous final question: the answer

What is ataktostele?

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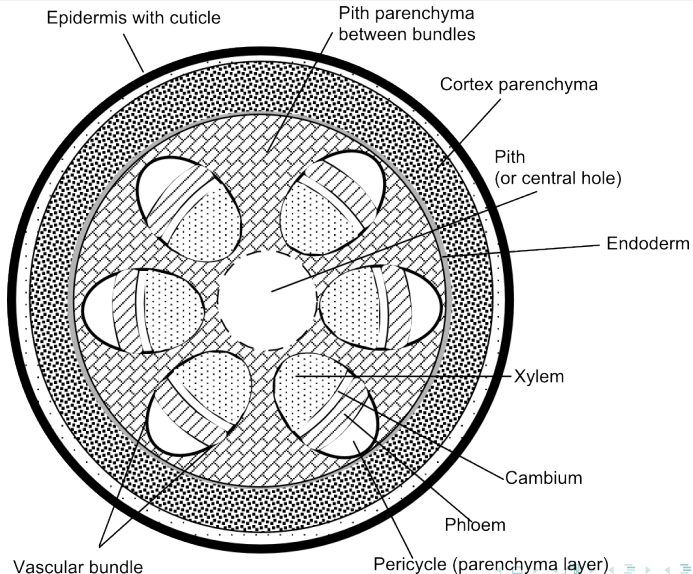
- Dispersed (scattered) vascular bundles of monocots

Anatomy of stem

Anatomy of mature stem



Primary structure of stem



Cork cambium and origin of bark

- **Bark** is everything outside vascular cambium, therefore, bark = secondary phloem + periderm
- Each year new layer of cork cambium appear from parenchyma cells of secondary phloem
- Consequently, bark consists of multiple and mostly uneven layers

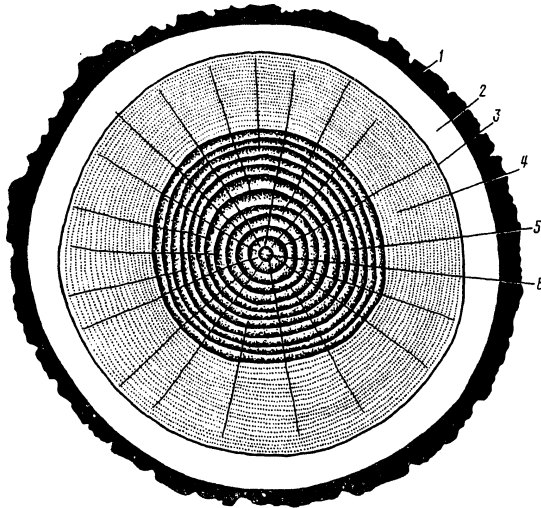


Bark, cork, periderm and wood

- **Bark** = secondary phloem + periderm
- **Periderm** = phellem + cork cambium + phelloderm
- **Cork** = phellem
- **Wood** = trunk — bark, or simply secondary xylem

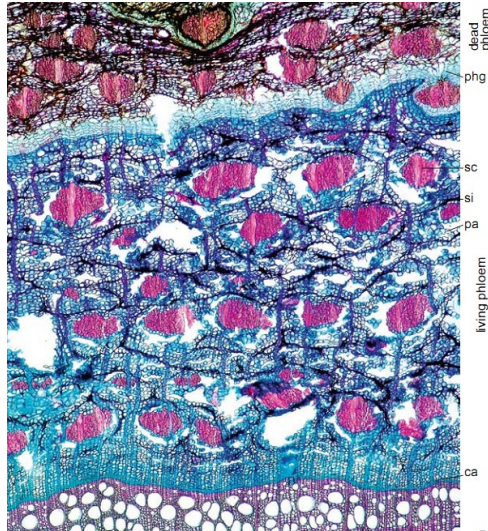


Bark and wood



Bark = 1 + 2, wood is 5 (heartwood) and 6 (sapwood)

Renewal of bark in sea buckthorn (*Hippophaë rhamnoides*)

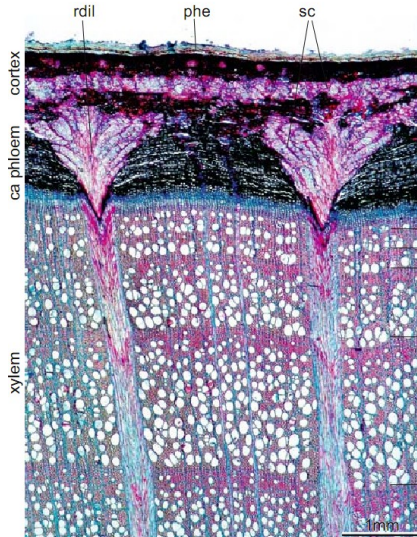


Secondary phloem

- Forms outside vascular cambium
- Rich of fibers
- Does not form annual rings
- Has rays of parenchyma cells, sometimes wedge-shaped (**dilated**)



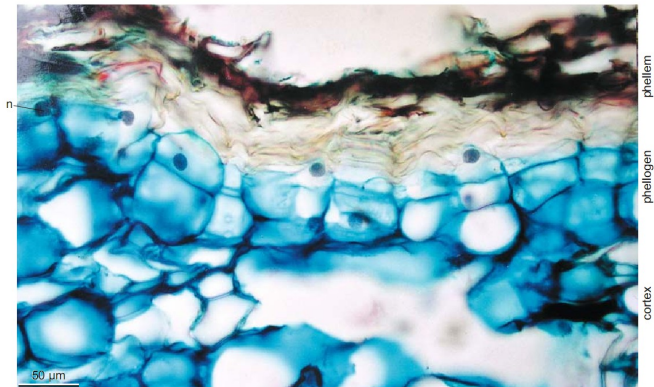
Dilated rays of beech (*Fagus* sp.)



Periderm

- Periderm is the product of cork cambium
- 99% of periderm is a **phellem** (cork), thick outside layer
- **Phelloderm** is a tiny layer of living cells inside of cork cambium

Formation of bark zone in medlar (*Mespilus germanica*)

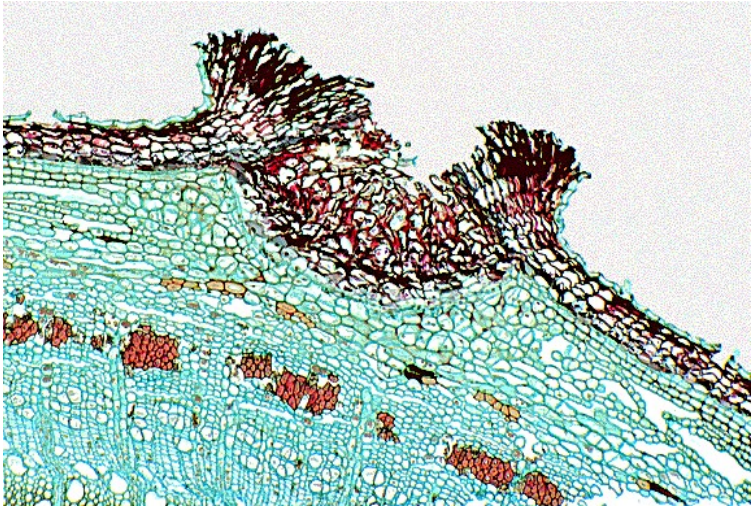


Lenticels

- **Lenticels** are specialized regions of periderm; they supply stem cells with oxygen
- In order to produce lenticel, some cells of cork cambium divide and grow much faster than others



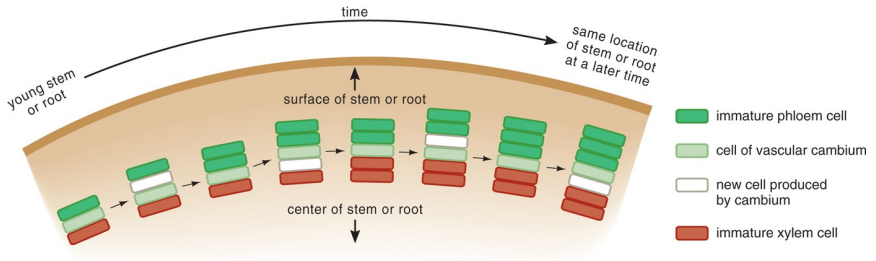
Lenticel of elderberry (*Sambucus* sp.)



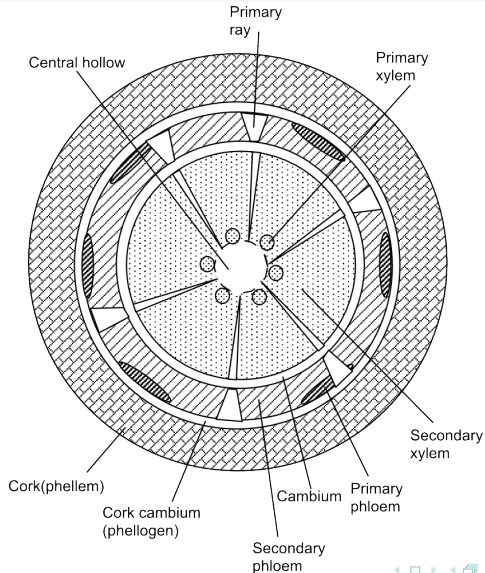
Anatomy of stem

Structure of wood

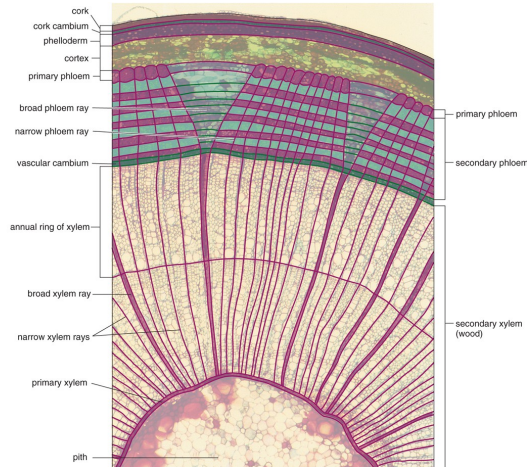
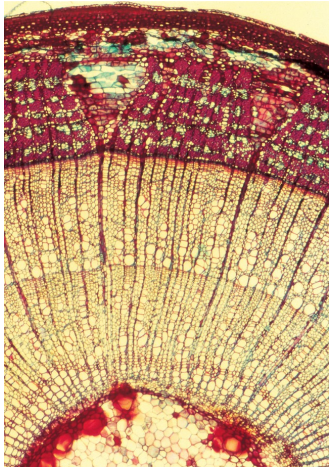
How cambium is working



Secondary structure of stem (scheme)



Secondary structure of stem (photo and explanations)

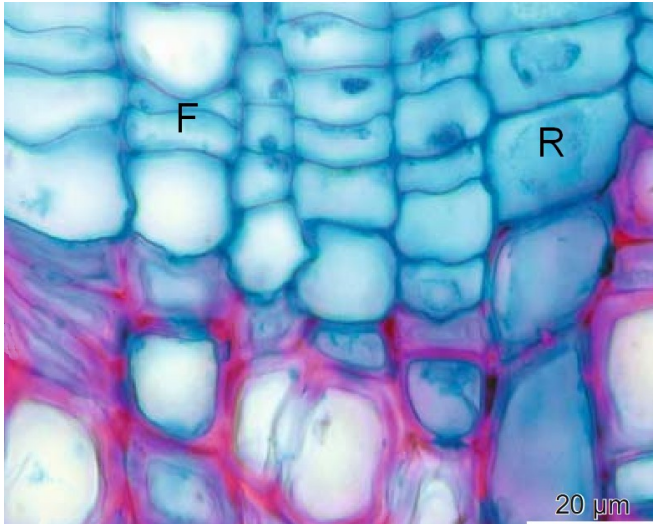


Secondary xylem and rays

- Secondary xylem, or wood, is the product of vascular cambium
- Some cambium cells are **fusiform initials**; they form axial vessel elements
- Other cambium cells are **ray initials**; they form rays (parenchyma + tracheids)
- **Rays** provide horizontal transport of water; **axial system** provide vertical transport



Fusiform and ray initials

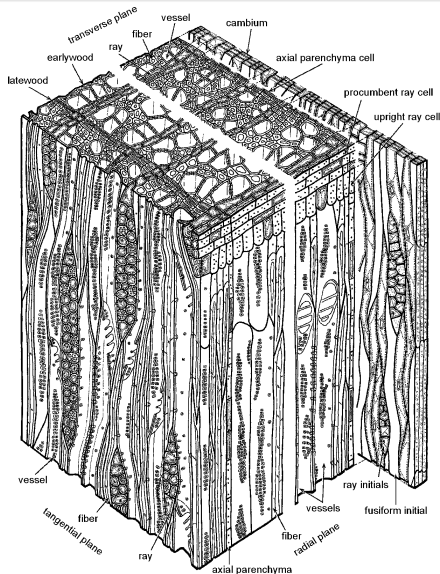


Three planes of view

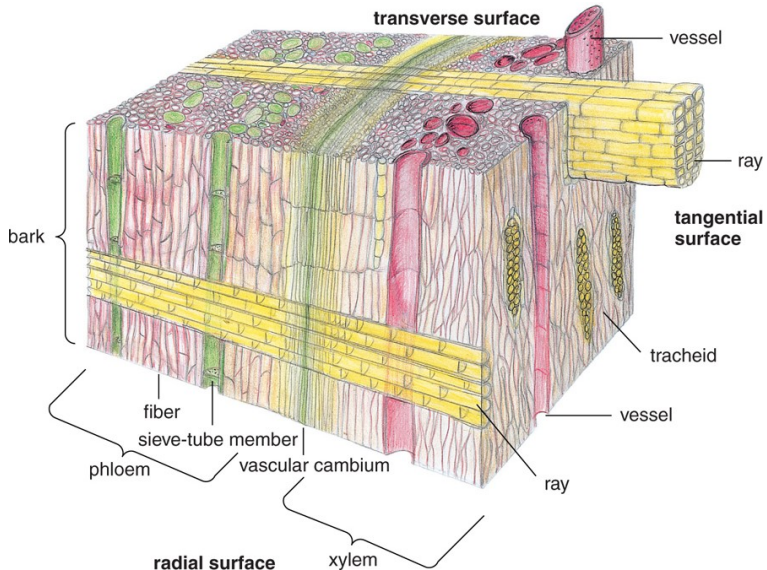
- **Transverse*** (cross-section)
- **Radial** (longitudinal section from center to periphery and perpendicular to stem surface)
- **Tangential** (longitudinal section parallel to stem surface)



Three plains of maple (*Acer* sp.) wood



Three planes again (the scheme)



Earlywood and latewood

- **Earlywood** (springwood) contains more parenchyma and often have larger vessel elements
- **Latewood** (summerwood) often have small vessel elements and looks darker

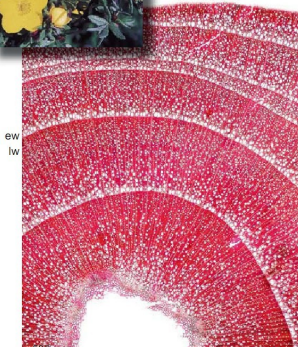


Diffuse and ring porous wood

- In **ring porous** wood (like in red oak) bigger vessel elements concentrate in earlywood
- In **diffuse porous** wood larger vessel elements spread across early- and latewood (American elm)



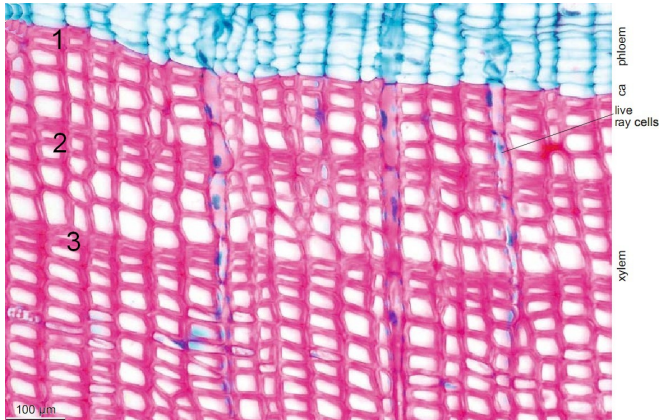
Diffuse and ring porous wood in two species of cinquefoil (*Potentilla* spp.)



Annual rings

- Interleaving early- and latewood from to sequential years form an impression of annual ring
- “Ring” is just a layer of darker (i.e., smaller) cells
- Tropical trees do not form annual rings

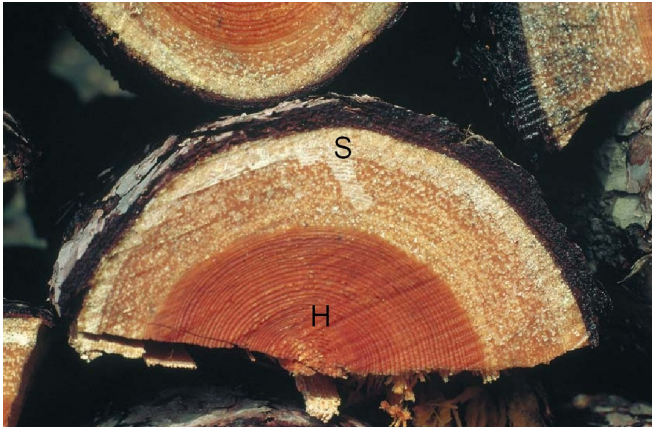
Annual rings in juniper (*Juniperus* sp.)



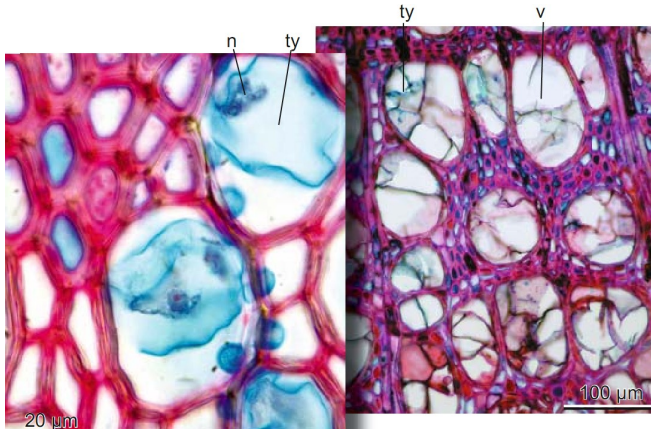
Sapwood and heartwood

- **Sapwood** is a peripheral layer of working xylem, it usually has relatively light color
- **Heartwood** is a central, non-functional, old, dark-colored xylem

Sapwood and heartwood of European pine (*Pinus sylvestris*)



Tyloses

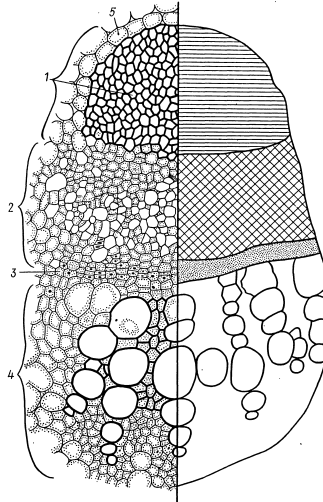


Tyloses control the winter functioning of vessels

Final question (1 point)

Final question (1 point)

Where is a cambium?



Summary

- **Bark** consists of secondary phloem and cork
- **Wood** is a secondary xylem

For Further Reading



J. E. Bidlack, Sh. H. Jansky.
Stern's introductory plant biology. 12th edition.
McGraw-Hill, 2011.
Chapter 6.



Th. L. Rost, M. G. Barbour, C. R. Stocking, T. M. Murphy.
Plant Biology. 2nd edition.
Thomson Brooks/Cole, 2006.
Chapter 5.

