

# Introduction to Botany. Lecture 13

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# Outline

- 1 Questions and answers
- 2 Anatomy of stem
  - Diversity of wood
- 3 Morphology of stem and shoot
  - Plant body
  - Components of shoot
  - Branching
  - Phyllotaxis



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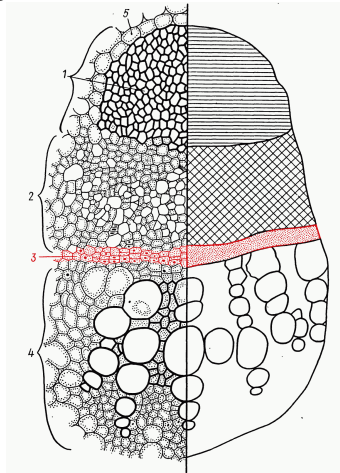
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## Previous final question: the answer

Where is a cambium?

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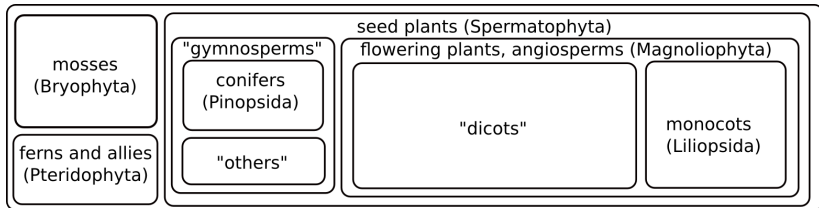
Where is a cambium?



# Anatomy of stem

## Diversity of wood

## Two obsolete (but widely used) taxonomic terms



**"Gymnosperms"** All seed plants except angiosperms =  
Spermatophyta – Magnoliopsida

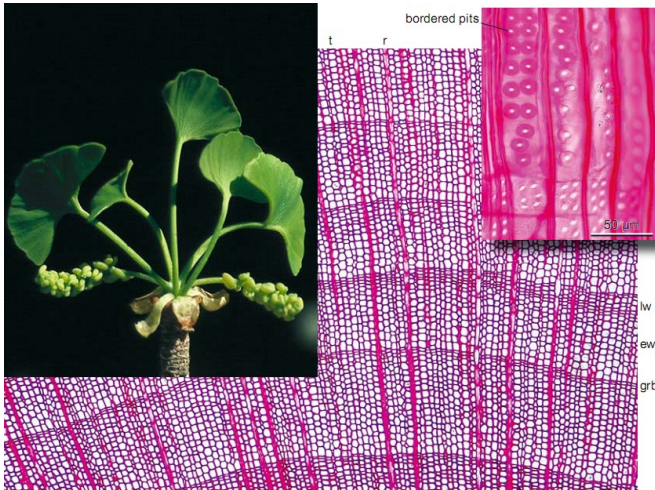
**"Dicots"** All angiosperms except monocots =  
Magnoliopsida – Liliidae



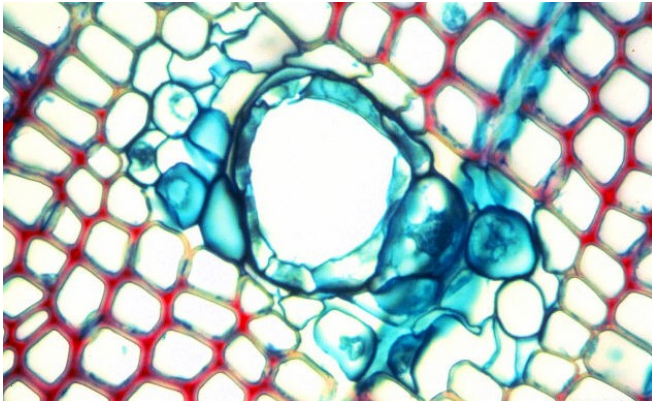
# Conifer wood

- Simpler structure, few cell types
- Simple rays
- Sometimes have **resin ducts**; resin secreted by epithelial cells

# Ginkgo (*Ginkgo biloba*) wood (not a conifer, but gymnosperm)



# Resin duct in pine wood (©BSA)

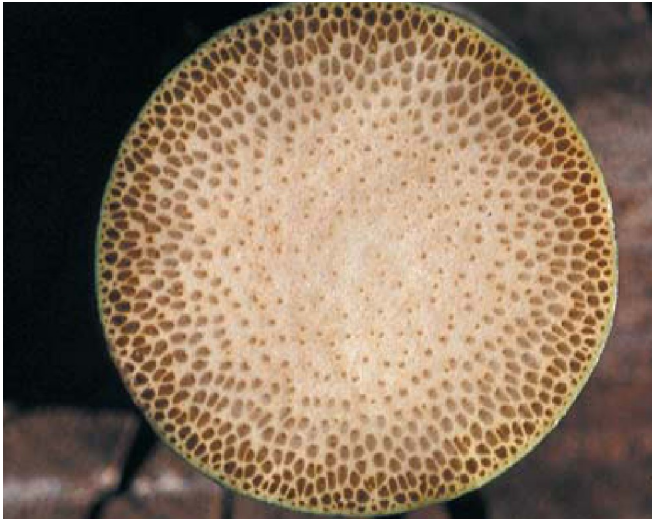


# Monocot “wood”

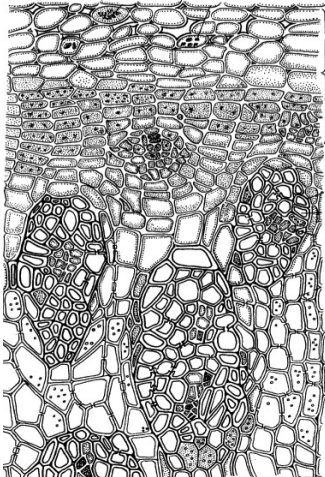
- Most of monocots do not have lateral meristems and therefore have no true wood
- Palms have only primary tissues; their trunk widens from bottom to top
- Some monocots (dragon trees) have **anomalous secondary growth**



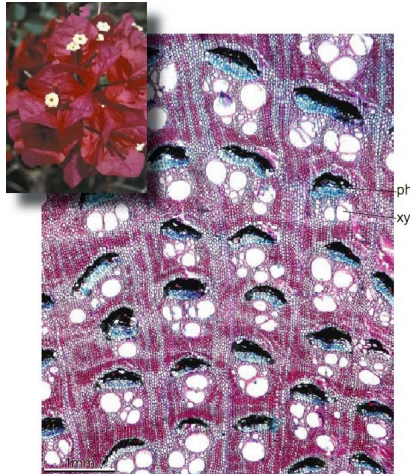
# Cross section of palm (*Phoenix canariensis*) trunk



# Dragon tree (*Dracaena draco*)



# Anomalous secondary growth in Bougainvillea (*Bougainvillea spectabilis*)



# Morphology of stem and shoot

## Plant body



# Types of plant body

- **Thallous** (flat, with non-differentiated organs)
- **Shoot** body (roots are absent)
- **Bipolar** body (root and shoot systems)

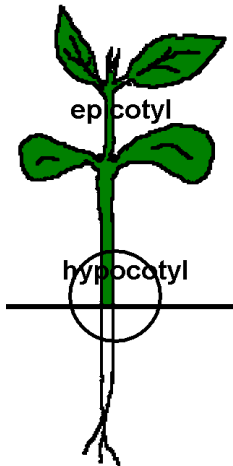


# Organs of bipolar plant

- **Leaf:** flat lateral organ with restricted growth
- **Stem:** axial aerial organ with continuous growth
- **Root:** soil organ modified for absorption
- **Floral unit (FU):** stable element of generative system



# Not organs



- *Hypocotyl*: transition between stem and root
- *Epicotyl*: first internode of plant
- *Bud*: shoot “embryo”
- *Fruit*: temporary structure, ripe FU
- *Seed*: chimeric structure, has two or three genotypes

# Organ systems

- Vegetative shoot system
- Generative shoot system
- Root system

# Organs vs. organ systems

...	Vegetative shoot system	Generative shoot system	Root system
Leaf	+	+	—
Stem	+	+	±
Root	±	±	+
FU	—	+	±



# Morphology of stem and shoot

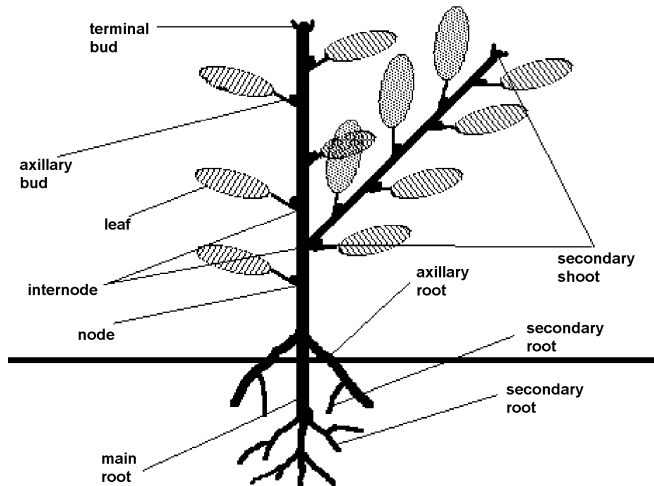
## Components of shoot

# Components of vegetative shoot system

- 1 Main and secondary shoots
- 2 Terminal and axillary (lateral) buds
- 3 Nodes and internodes
- 4 Leaves



# Components of shoot



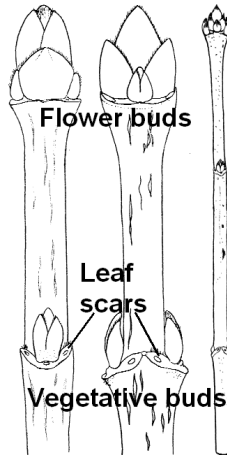


# Winter shoot

- 1 Vegetative, flower, and mixed buds
- 2 Leaf and bud scars
- 3 Leaf traces



# Winter shoot of maple (*Acer platanoides*)



# Morphology of stem and shoot

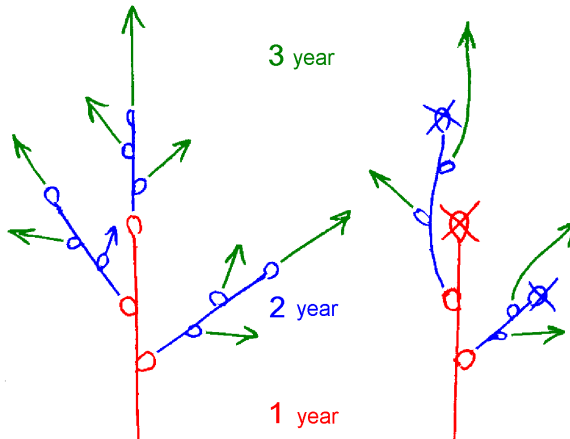
## Branching

# Types of branching

- **Monopodial:** buds do not degrade, all shoots continue to grow
- **Sympodial:** terminal buds degrade, the lateral shoot closest to terminal bud becomes terminal shoot



# Monopodial (left) and sympodial branching



# Morphology of stem and shoot

## Phyllotaxis

# Arrangement of leaves: phyllotaxis

- One leaf per node: **spiral**, or **alternate** arrangement
- Two leaves per node: **opposite** arrangement, they may be:
  - All in same plane
  - Each pair will rotate on  $90^\circ$
- $> 2$  leaves per node: **whorled** arrangement (each whorl can also rotate)
- Each type of phyllotaxis has its own *angle of divergence*



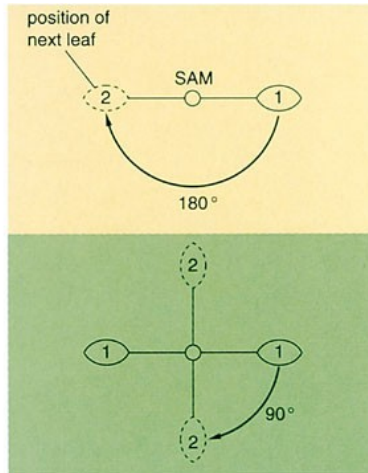
# Alternate and opposite phyllotaxes



alternate



opposite





## Final question (1 point)

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What is the difference between monopodial and sympodial branching?



# Summary

- It is possible to divide plant body to different **organs** and/or **organ systems**
- Bud, fruit and seed are **pseudo-organs**
- **Sympodial** branching is evolutionary more advanced than **monopodial**
- Spiral arrangement of leaves follows **Fibonacci** rule



## 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.*

