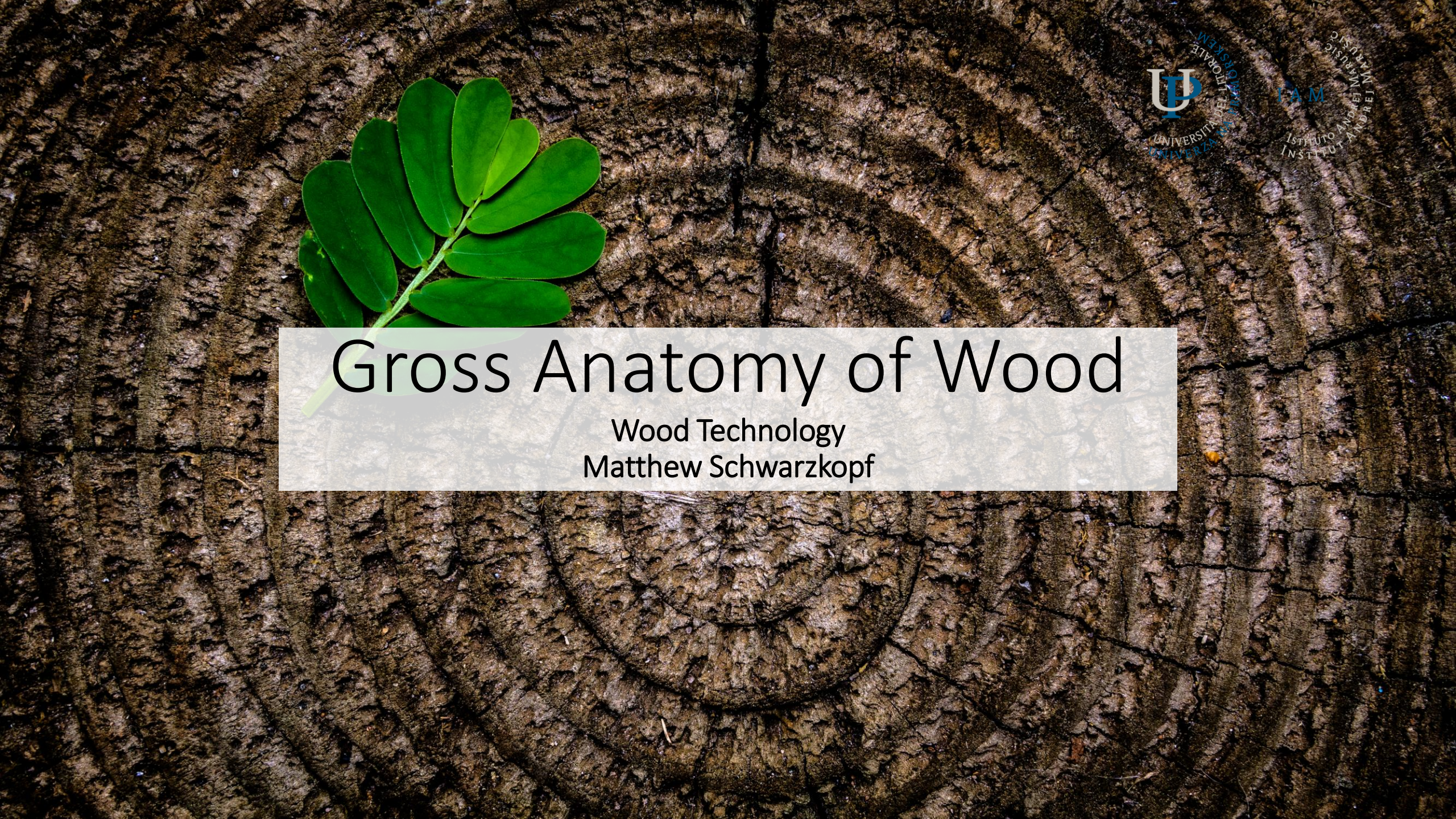


# Gross Anatomy of Wood

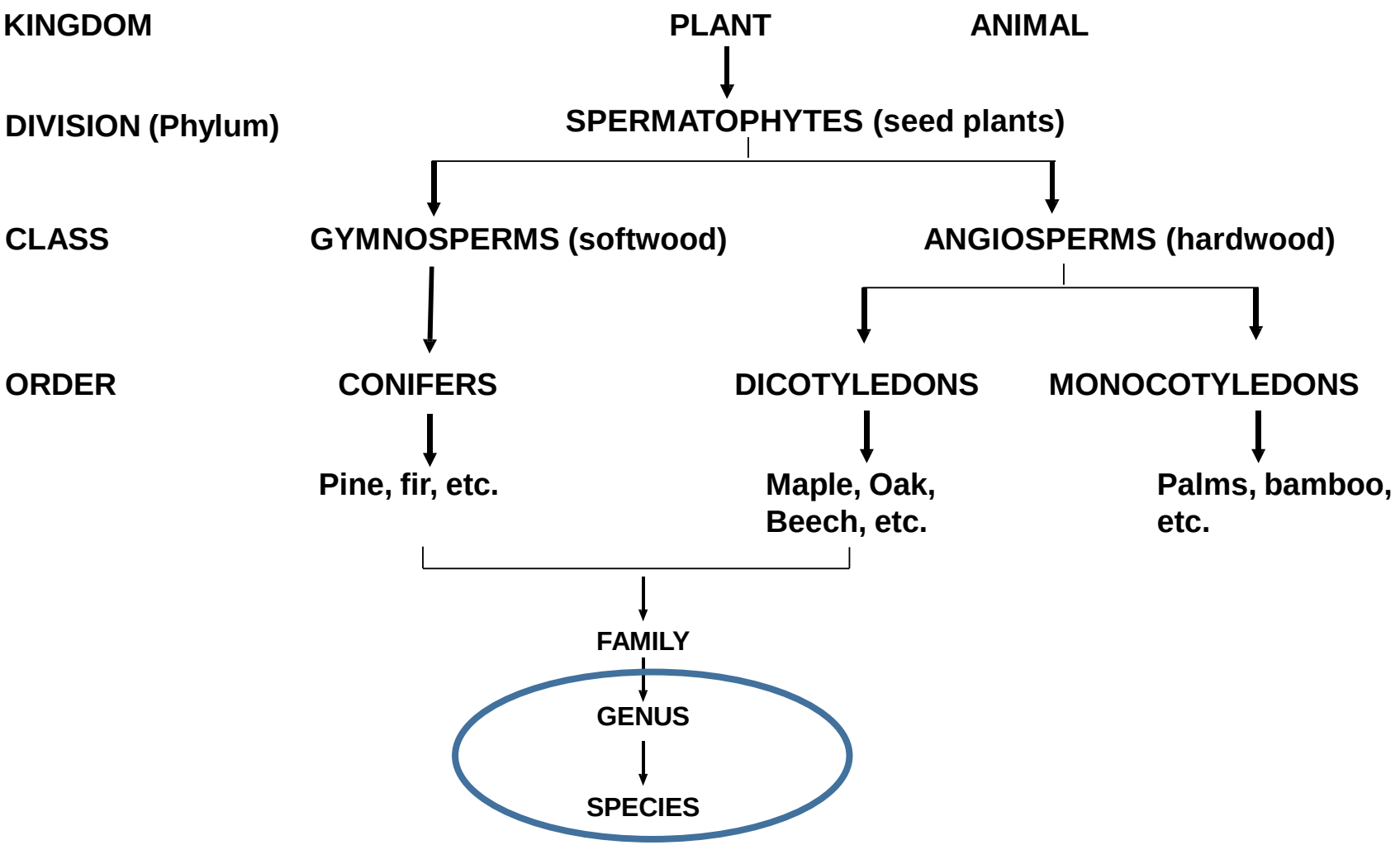
Wood Technology

Matthew Schwarzkopf

# Gross anatomy of wood

- Learning objectives
  - Describe the taxonomy of wood plants
  - Properly use scientific names
  - Associate genus (and some species) names with a common name
  - In a very general sense, describe how wood and bark are formed
  - Identify gross characteristics of hardwoods and softwoods
  - Describe how heartwood differs from sapwood

# Taxonomy of Woody Plants



# Taxonomy of Woody Plants

- SPERMATOPHYTES: seed bearing plants
  - GYMNOSPERMS
    - Greek for ‘naked seed’
    - CONIFERS: needlelike or scale-like foliage (softwoods, such as pine (*Pinus)* and cedar (*Juniperus*)
  - ANGIOSPERMS
    - Greek for ‘vessel/container seed’
    - DICOTYLEDONS: two initial seed leaves (hardwoods, such as oak *(Quercus),* chestnut *(Castanea),* and walnut *(Juglans)*
    - MONOCOTYLEDONS: one initial seed leave (corn, palm, bamboo, *Arundo donax*)





# Taxonomy - Scientific names

*Fagus sylvatica* L.

Genus is capitalised, italicised

Species is lowercase, italicised

Abbreviation of taxonomist who discovered or was honoured with the new species, is capitalised and non-italicised.

If you are handwriting the name, underline it

# Taxonomy of European beech

Generic

- Kingdom
  - Division
    - Subdivision
      - Order
        - Family
          - Genus
            - Species

*Fagus sylvatica* L.

- Plantae
  - Spermatophyte (seed plants)
    - Angiosperm (Hardwood)
      - Fagales
        - Fagaceae
          - Fagus
            - Sylvatica

Author citation, “authority” of the botanical name. Here it is Linnaeus

# Taxonomy of Norway spruce

Generic

- Kingdom
  - Division
    - Subdivision
      - Order
        - Family
          - Genus
            - Species

*Picea abies* (L.) Karst.

- Plantae
  - Spermatophyte (seed plants)
    - Gymnosperm (Softwood)
      - Pinales (pines)
        - Pinaceae
          - Picea
            - Abies

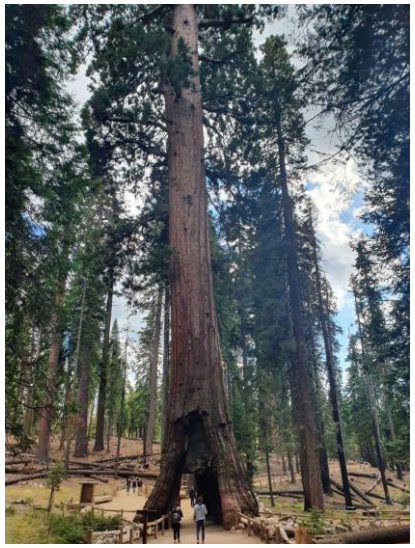
# Common names

- Can be misleading
- Different in different languages
- Same common name applied to different species
  - The name “mahogany” applies to over 60 different species, some of which are even in different families
- Different common name used for the same species
  - Red gum and sweetgum both used for *Liquidambar styraciflua* L.
- Species list to be familiar with
  - We will focus on approximately 20

# Hardwood vs Softwood

## Gymnosperms (Softwoods)

- ~500 species worldwide
- Exposed seeds
- Cones
- Needle-like leaves



## Angiosperms (Hardwoods)

- Tens of thousands of species
- Encapsulated seeds
- Flowers, fruit
- Broad leaves with veins



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## Angiosperms (Hardwoods)

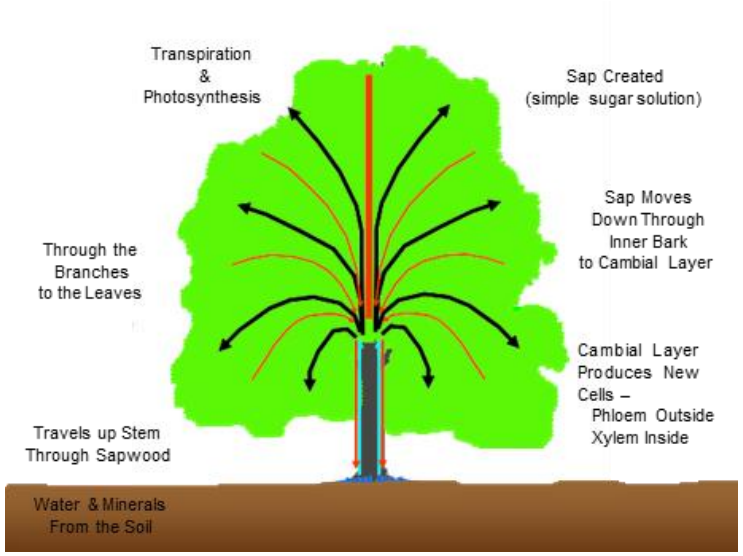
- Tens of thousands of species
- Encapsulated seeds
- Flowers, fruit
- Broad leaves with veins



# Wood Production

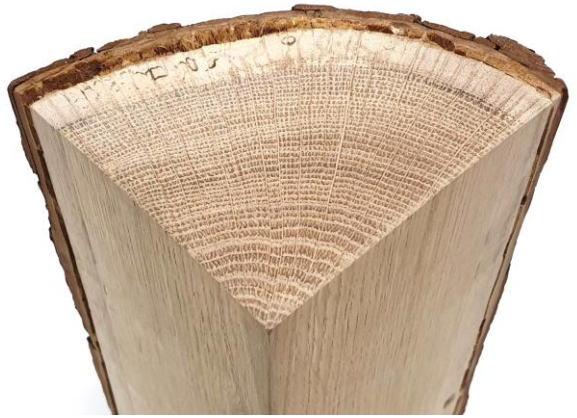
## Needs of a tree

- Air
- Food
- Water



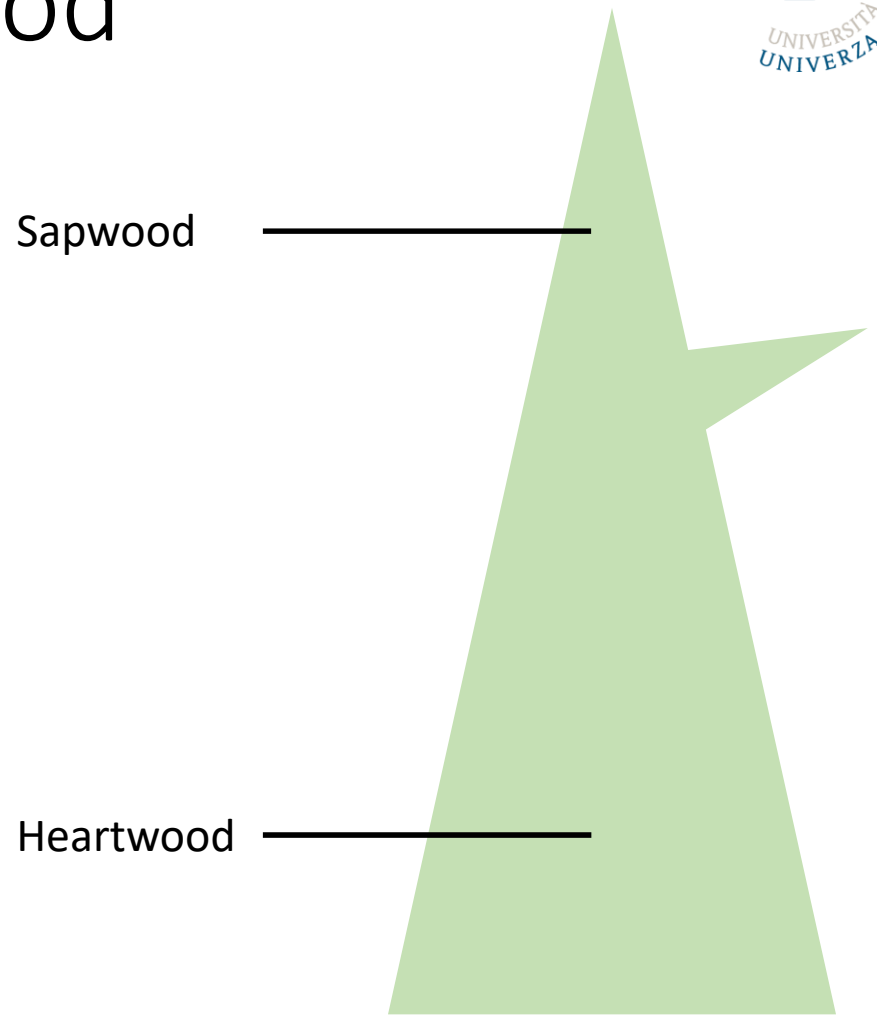

## How it is achieved

- Transpiration and gas exchange through leaves
- Photosynthesis
- Conduction via capillary forces
- Production of xylem/phloem



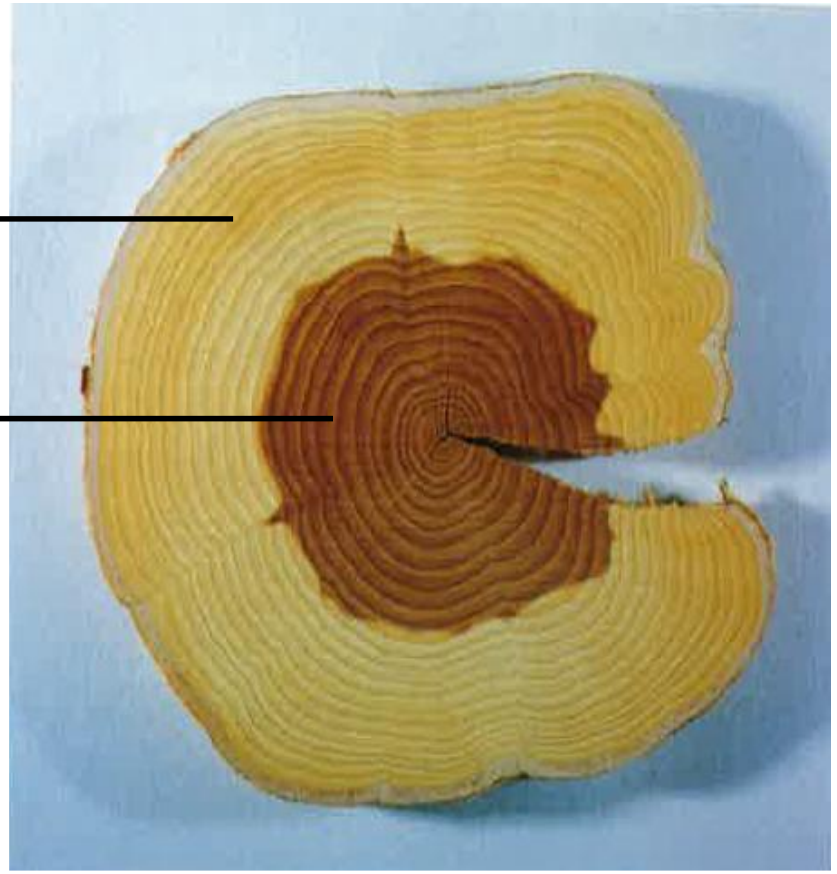
# Heartwood and sapwood

- When a tree grows, it initially forms sapwood
  - Conductive cells for fluids
  - Parenchyma cells, food storage
- Later in life it transitions to heartwood
  - No longer needs all sapwood and transitions the oldest, inner part to heartwood
  - All heartwood was sapwood



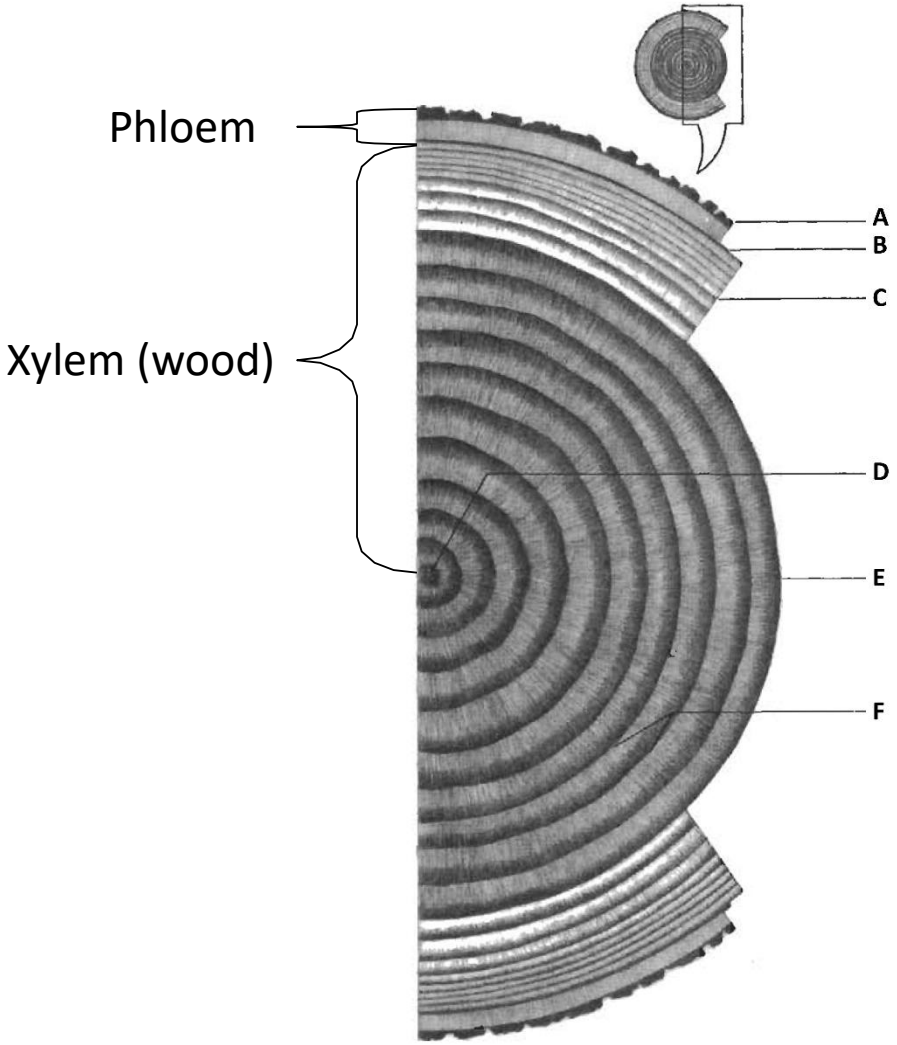
# Heartwood and sapwood

- Heartwood formation has no impact on the anatomy
- No liquid conduction in heartwood portion of the stem
- Parenchyma cells die during heartwood formation
- No significant difference in mechanical properties
  - Juvenile wood is a different issue
- Physical properties change
  - Color and decay resistance change
  - Permeability
  - EMC
  - Electrical conductivity
  - Others?




Hoadley, p. 9

# Gross anatomy




A – Bark (phloem)

B – Vascular cambium

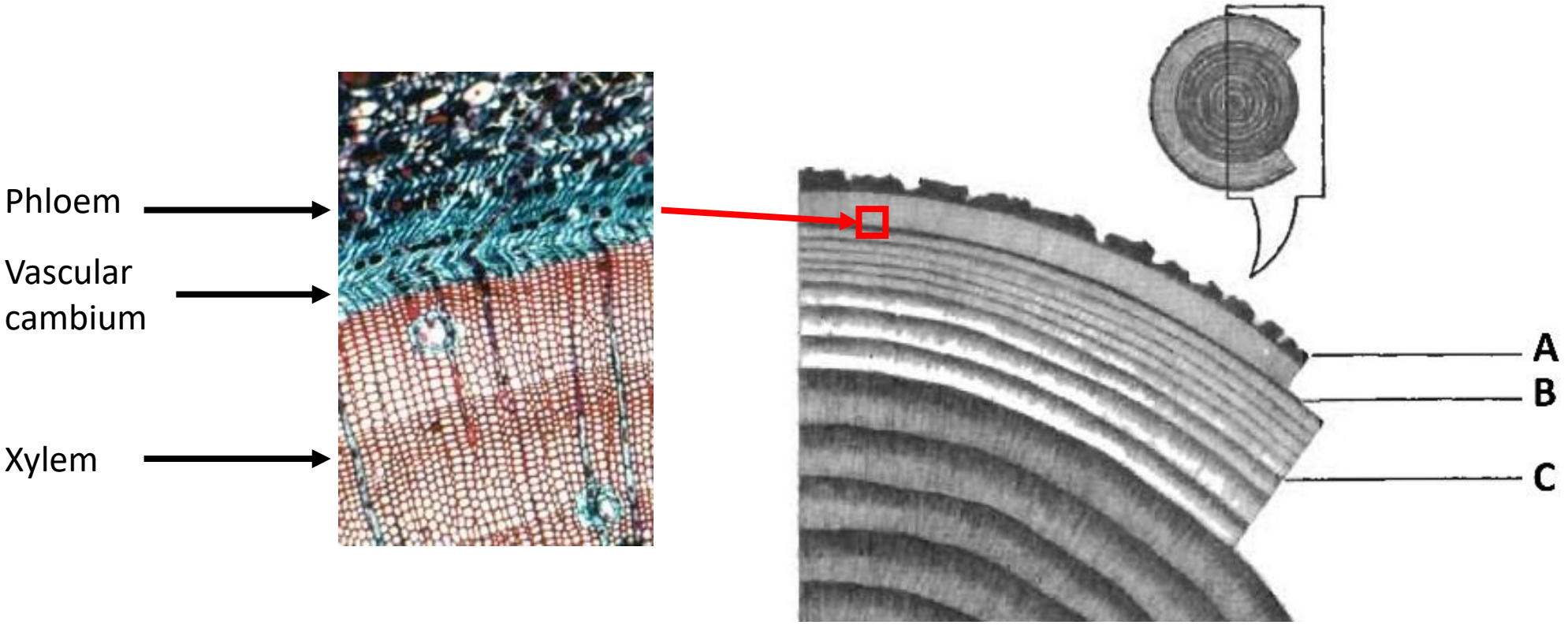
C – Sapwood

D – Pith

E – Heartwood

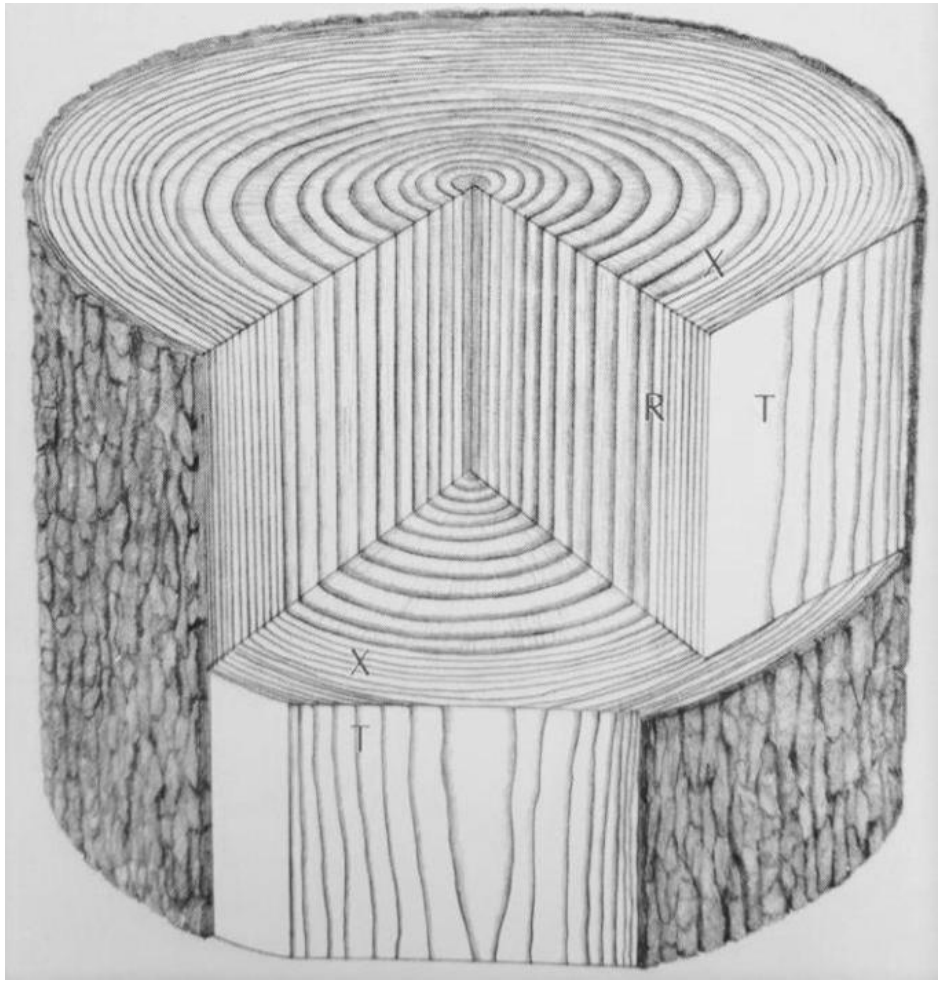
F – Growth ring

# Gross anatomy



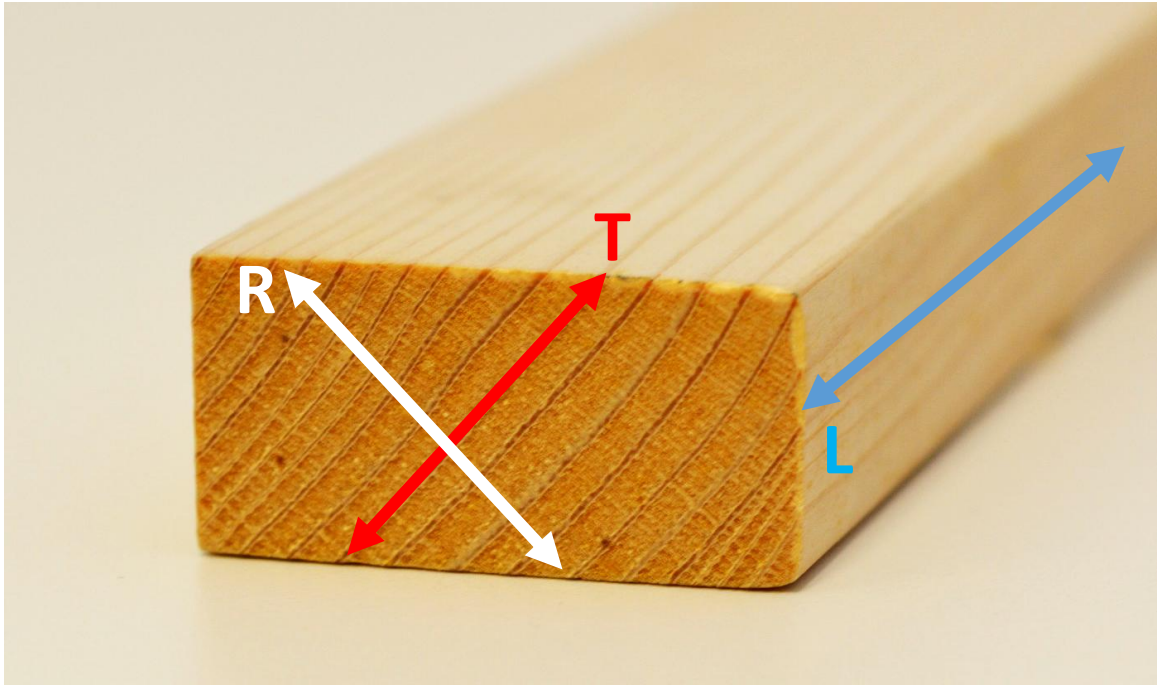
# Cylindrical, Orthogonal, Anisotropic

- Different properties in different directions
  - (X) Cross-sectional plane
    - Also called, transverse plane
    - Sometimes written X-section
  - (R) Radial plane
  - (T) Tangential plane
    - Tangent to the cylinder
- When looking at sawn boards they often have a mixture of R and T planes



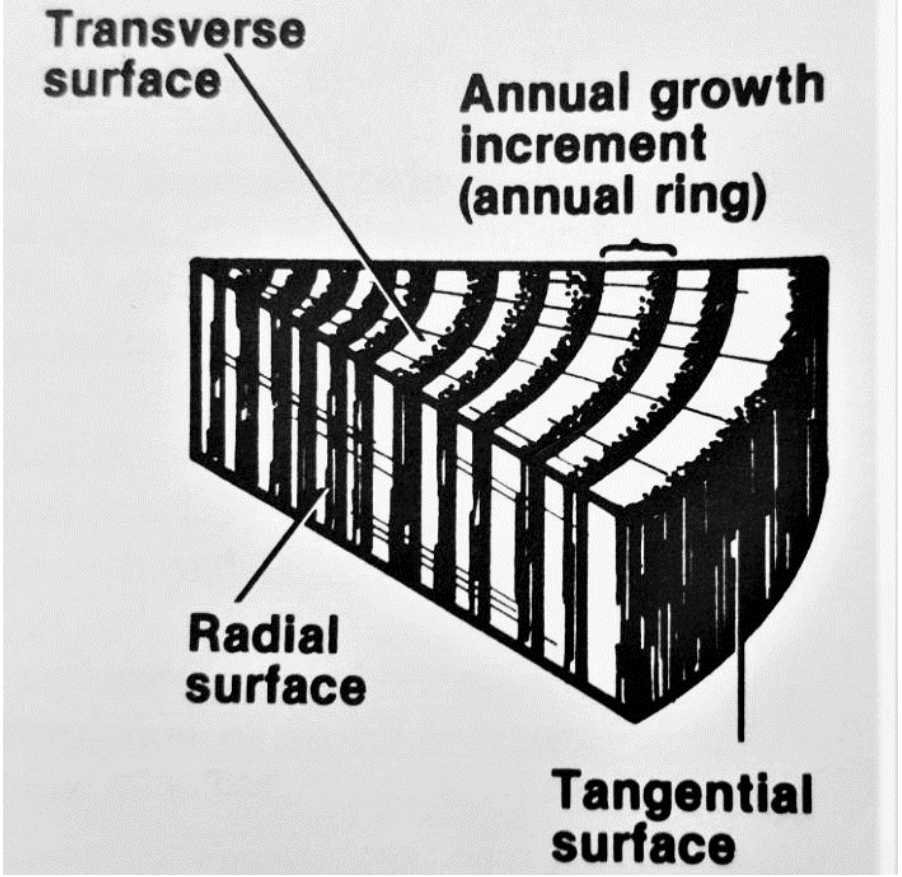
# Cylindrical, Orthogonal, Anisotropic

- Different properties in different directions
  - Longitudinal – parallel with the trunk
  - Tangential – tangent to the trunk
  - Radial – radiating from the pith
- When looking at sawn boards they often have a mixture



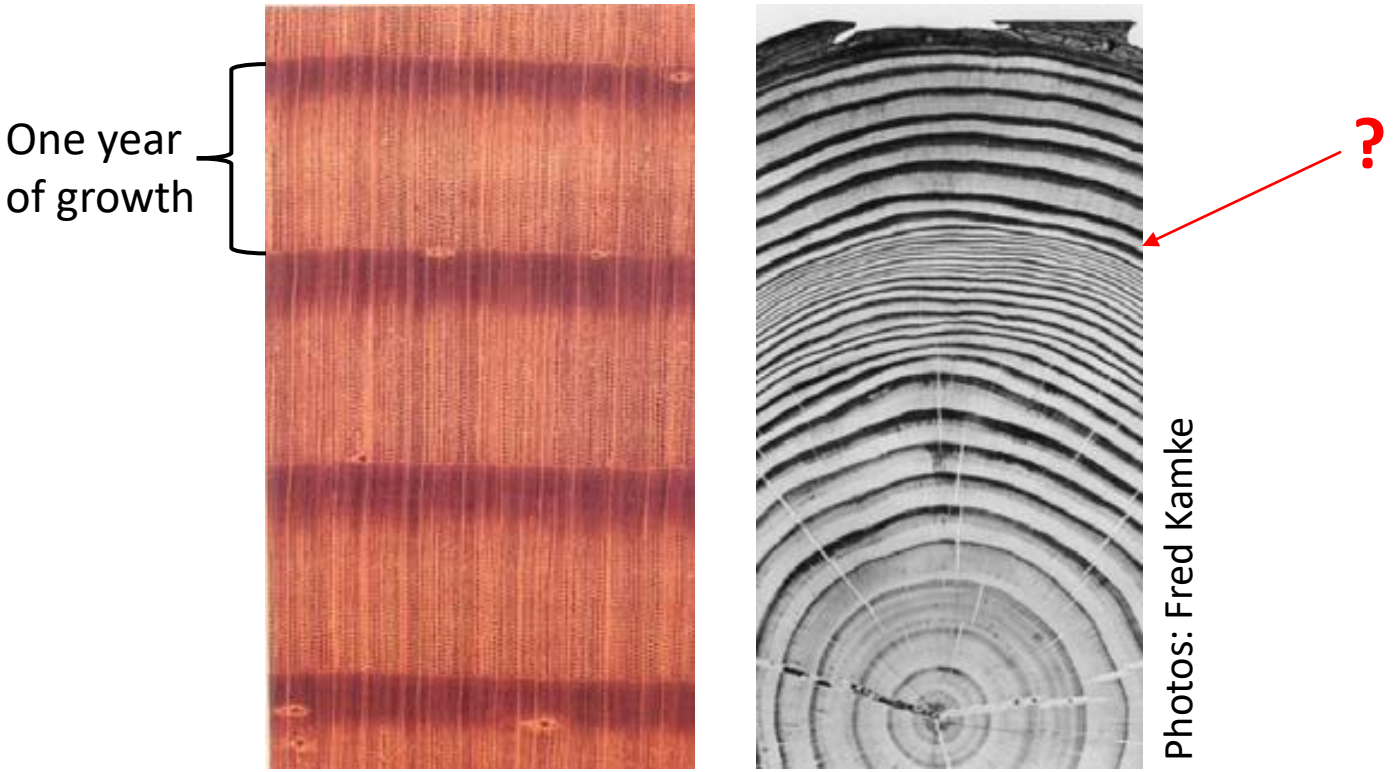
# Growth rings

- Annual growth rings appear due to
  - Change in cell size
  - Frequency of cell occurrence
  - Presence of certain types of cells
- Differences occur due to
  - Climates – growth rate
    - Temperate
    - Tropical



# Annual growth

- Growth rings
  - Change in cell size
  - Frequency of cell occurrence
- Variations between years
  - Climactic
  - External forces
    - Competition
    - Aspect of landscape
    - Fire
    - Drought



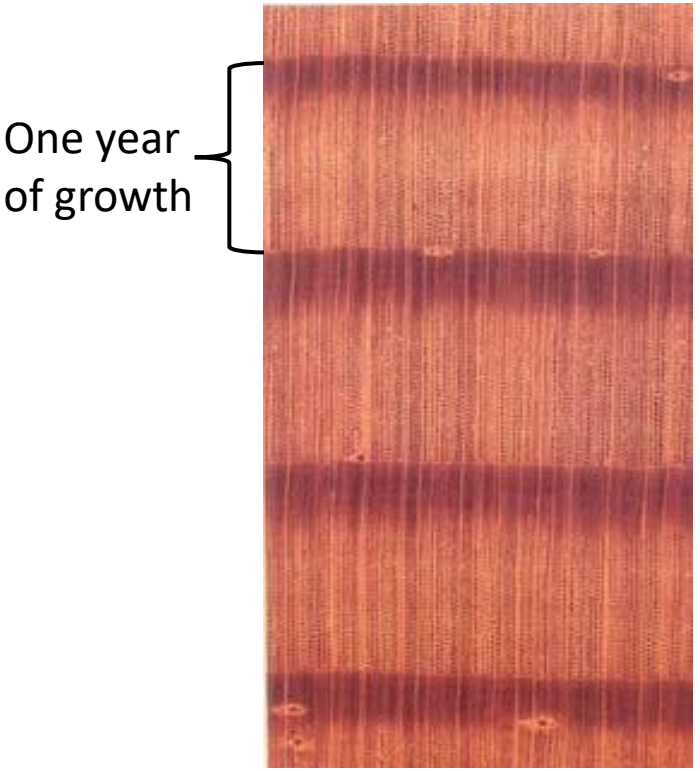

Photos: Fred Kamke

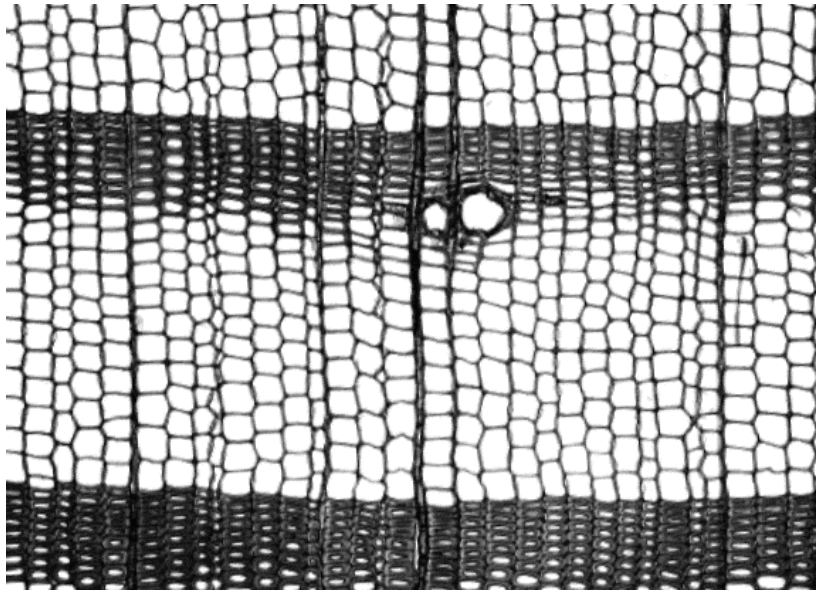
*Pseudotsuga menziesii*

Douglas-fir

# Annual growth

- Growth rings
  - Change in cell size
  - Frequency of cell occurrence
- Variation within the year
  - Temperature change
  - Growth rate
  - Availability of nutrients



Micrograph: Callum Hill

*Pseudotsuga menziesii*

Douglas-fir

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