Botany of Trees

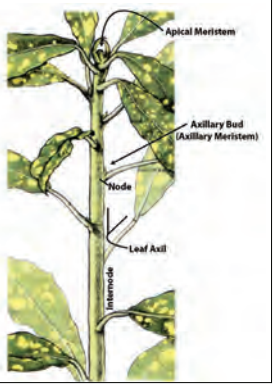
Dr. Matt Ritter

CAL POLY

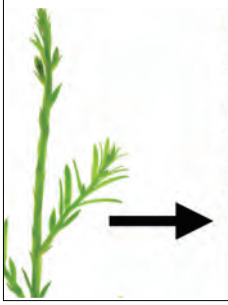
Botany of Trees

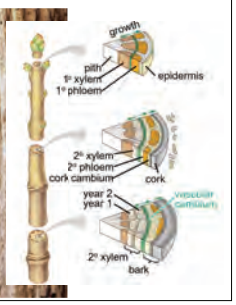
- Five part series -Tuesdays, 11 AM to 12:30 PM
- Each will be ~1 hour with 30 minutes of questions

Tuesday, April 14th: Introduction to trees, growth, development, leaves, and morphology

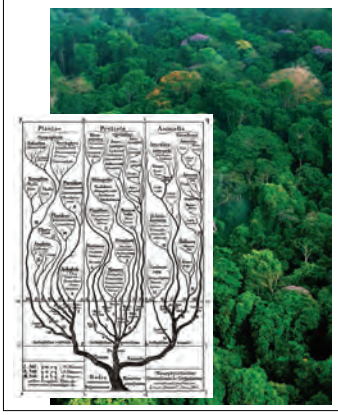


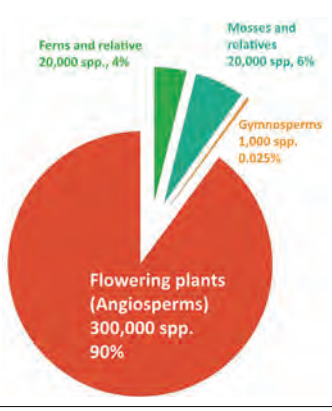
Tuesday, April 21st: Trunks, branches, tree form, branching patterns, and shape, and how wood forms





Tuesday, April 28th: Tree names, diversity, and why names change





Tuesday, May 5th: Water in trees, photosynthesis, and respiration

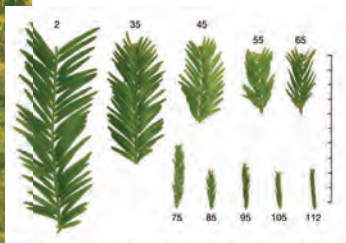
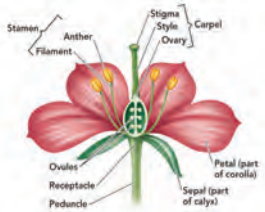


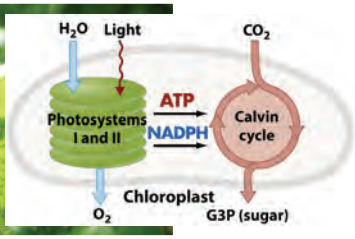
Figure 2 Variation in leaf structure with height in redwood. Leaf length and the angle between the long axis of the leaf and supporting stem segment both decrease with height. Numbers denote the sample height in m. Scale divisions are cm.

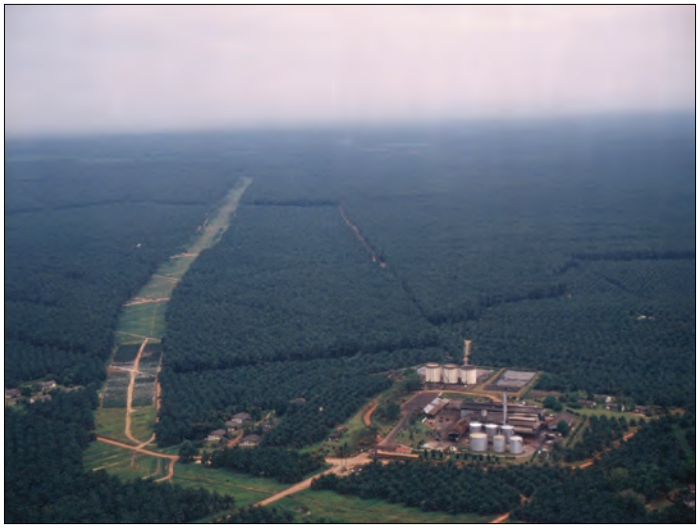
Tuesday, May 12th: Reproduction, flower formation, fruit, and seeds



The Importance of Plants

- Basic human needs are all directly or indirectly provided by plants






Marijuana!
HEY, AT LEAST IT'S NOT CRACK!
DARING DRUG EXPOSE
SHAME HORROR DESPAIR
MARIHUANA
WEED WITH ROOTS IN HELL
MISERY
LUST
CRIME
SORROW
HATE
SHAME
DESPAIR
WEIRD ORGIES WILD PARTIES
UNLEASHED PASSIONS

An Introduction to Trees

Seasonal Growth Patterns

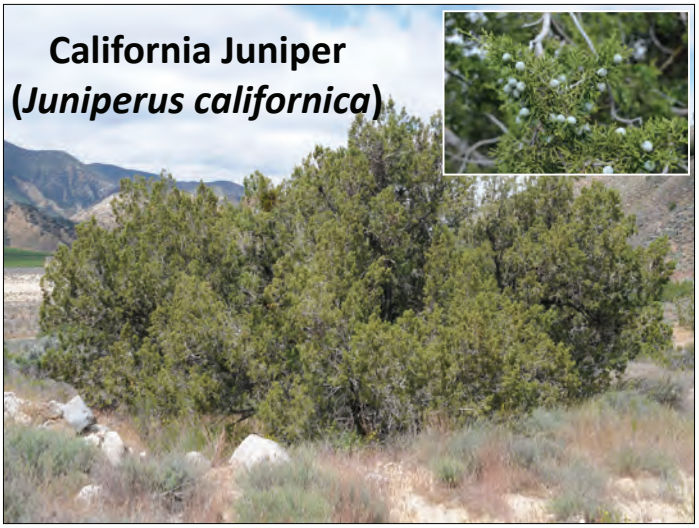
- **Annuals:**
  - most herbaceous plants that demonstrate only primary growth
  - entire life cycle takes place in one growing season.

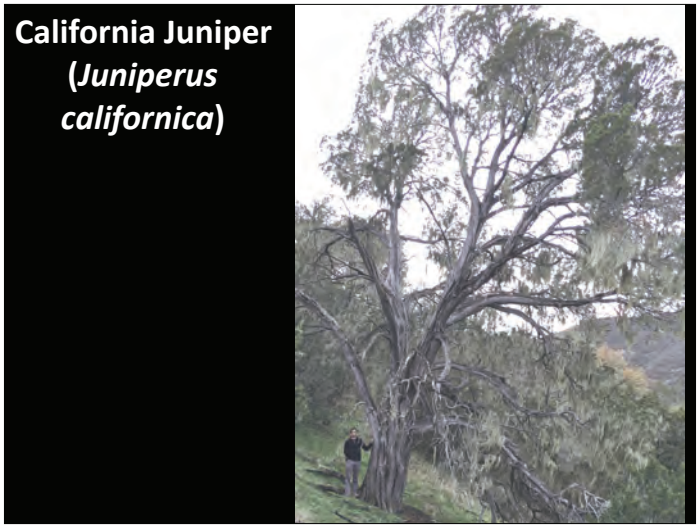
Seasonal Growth Patterns

- **Biennials:**
  - need two seasons from germination to seed formation.
- **Perennials:**
  - plants that live year after year.
  - woody plants that display secondary growth (wood formation) in their stems.
  - monocots have NO true secondary growth.

Trees are Hard to Define

- Trees - large, single stem (trunk), raised canopy
- Shrubs - smaller, multi-stemmed, low canopy
- Bushlands, shrublands, scrublands, forests, woodlands, savannas


California Juniper
(*Juniperus californica*)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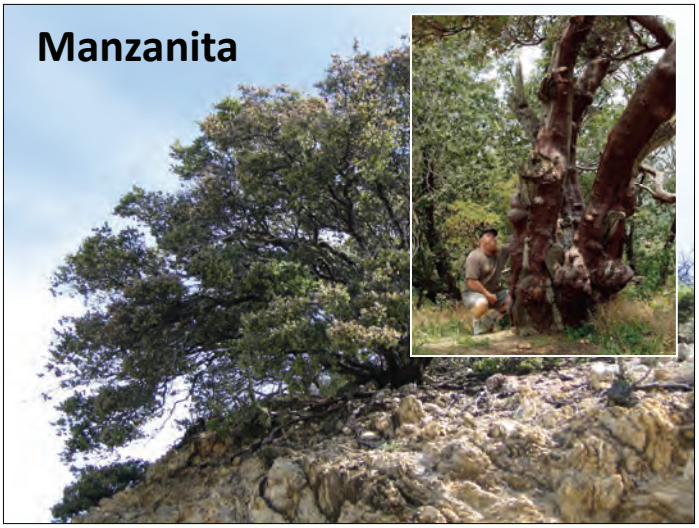
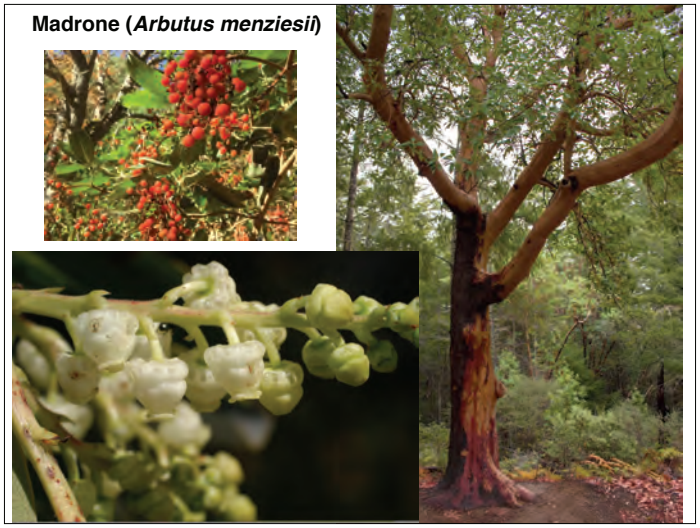

Manzanita


Madrone (*Arbutus menziesii*)


Madrone (*Arbutus menziesii*)


California Sycamore
(*Platanus racemosa*)

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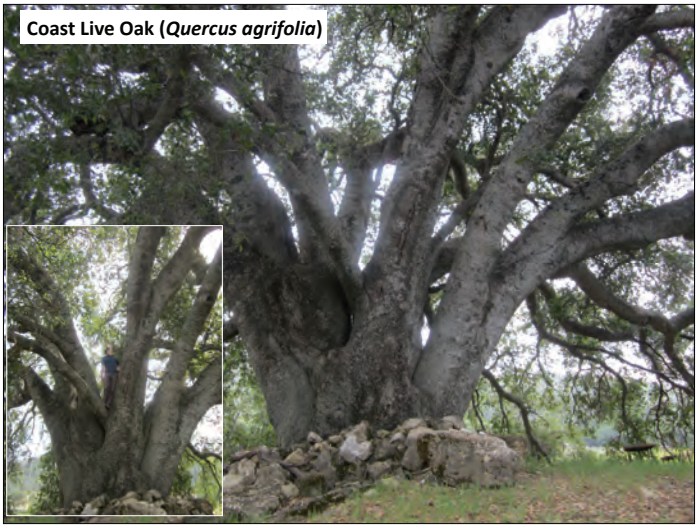
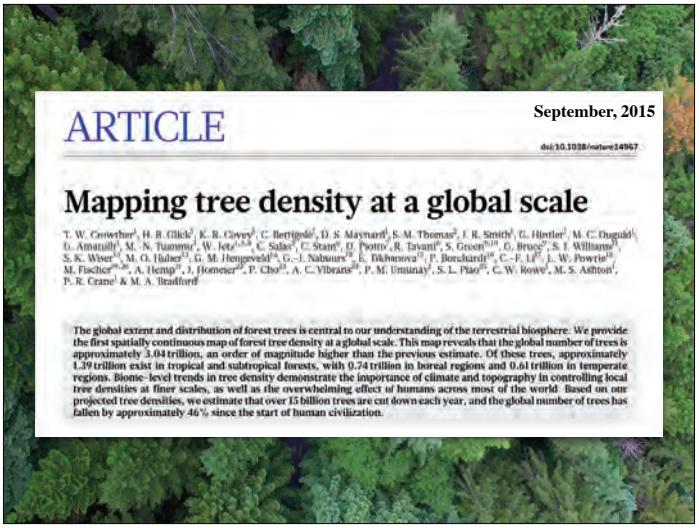
(*Platanus racemosa*)



Bluegum (*Eucalyptus globulus*)

How Many Trees Are There?



Terrestrial biome (number of ground-sourced density estimates)	Total trees (billions) ± 95% CI
Boreal forests (*n* = 8,688)	749.3 (± 50.1)
Deserts (*n* = 14,637)	53.0 (± 2.9)
Flooded grasslands (*n* = 271)	64.6 (± 14.2)
Mangroves (*n* = 21)	8.2 (± 0.3)
Mediterranean forests (*n* = 16,727)	53.4 (± 1.2)
Montane grasslands (*n* = 138)	60.3 (± 24.0)
Temperate broadleaf (*n* = 278,395)	362.6 (± 2.9)
Temperate conifer (*n* = 85,144)	150.6 (± 1.3)
Temperate grasslands (*n* = 17,051)	148.3 (± 4.9)
Tropical coniferous (*n* = 0)	22.2 (± 0.4)
Tropical dry (*n* = 115)	156.4 (± 63.4)
Tropical grasslands (*n* = 999)	316.0 (± 35.5)
Tropical moist (*n* = 5,321)	799.4 (± 24.0)
Tundra (*n* = 2,268)	94.9 (± 8.3)
n = 429,775	3,041.2 (± 96.1)

3.041 trillion trees total = 398 trees per person worldwide

Each year 15 billion trees cut down and not replaced

6.1 trillion trees before the advent of human civilization.

3.04 trillion trees remain.

1.39T tropical and subtropical | **0.61T** temperate | **0.74T** boreal

- ~ 300, 000 plant species
- 60,065 tree species
- ~ 1,500 species used in worldwide urban forestry

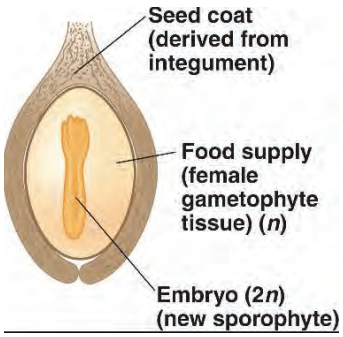
60,065 Total Tree Species

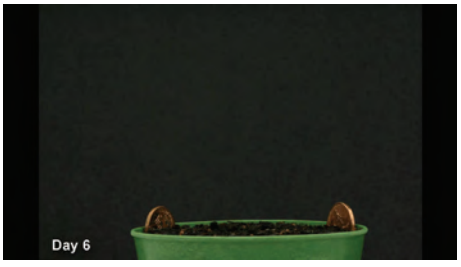
Tree Species in Cultivation ~1.7%

The Beginning of Every Tree

Tree Seeds

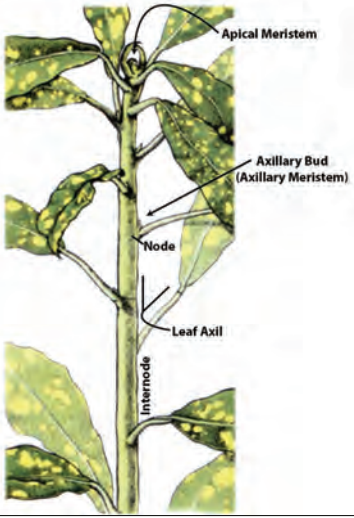
- **A seed has 3 parts**
  - Embryo - made from fusion of sperm and egg
  - Nutritive tissue
  - Seed coat





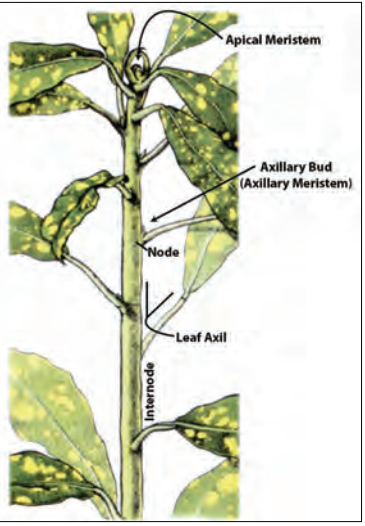
Plant Structure

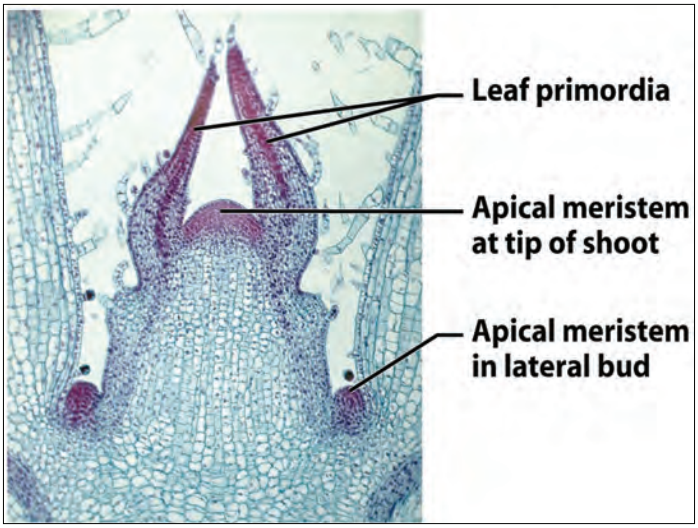
- Leaves are attached at **nodes**.
- One or more leaves occur at each node.
- **Internodes** are the space between each node.



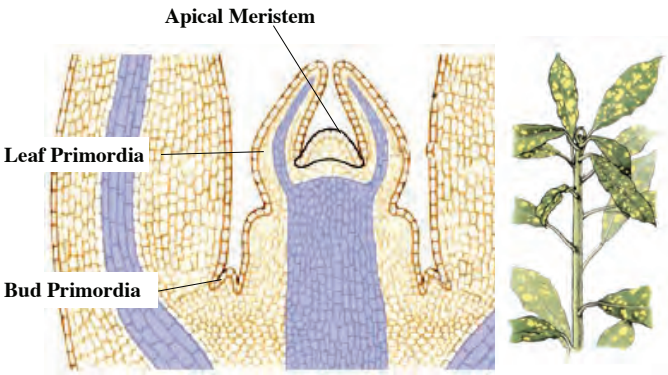
Plant Structure

- The **apical meristem** produces tissues that grow into mature stem and leaf tissues.
- A bud (also a meristem) occurs in the axil of each leaf, called the **axillary bud**.
  - Axillary buds grow into new leafy stems or flowers.

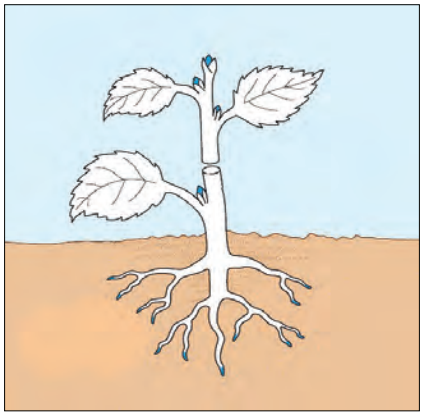




Stem, leaves, buds, stem leaves, buds

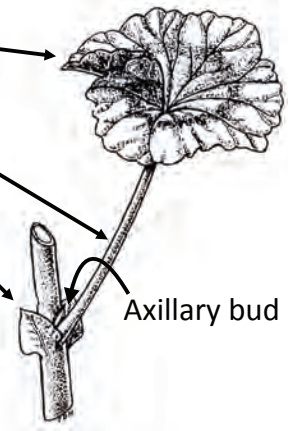


Meristems: where growth occurs



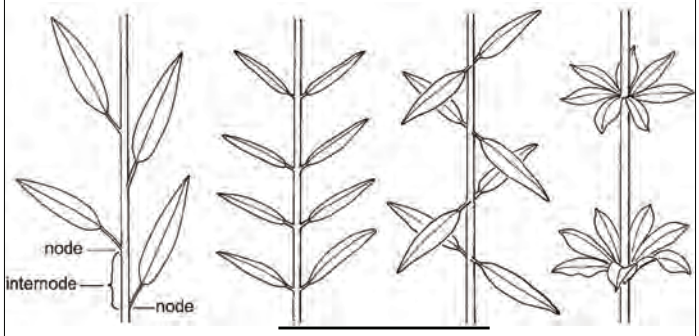
Morphology of a Leaf

- Blade – expanded portion of the leaf
- Petiole – leaf stalk
- Stipules – appendages at the base of the petiole

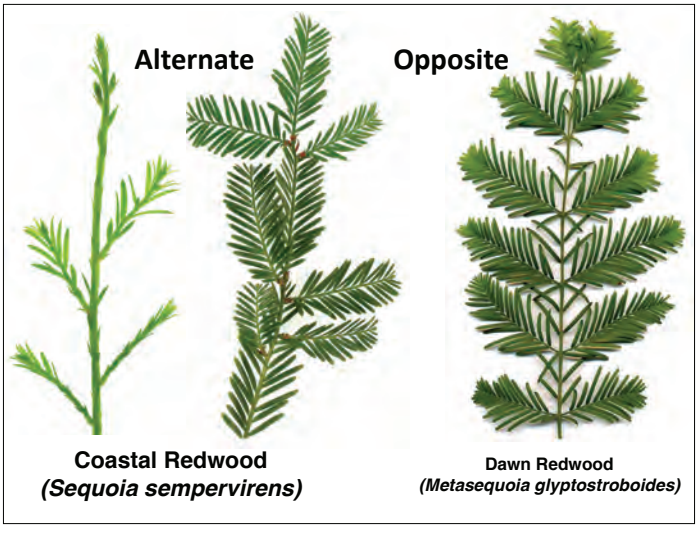


Coastal Redwood
(Sequoia sempervirens)

Leaf Attachment (Phyllotaxy)

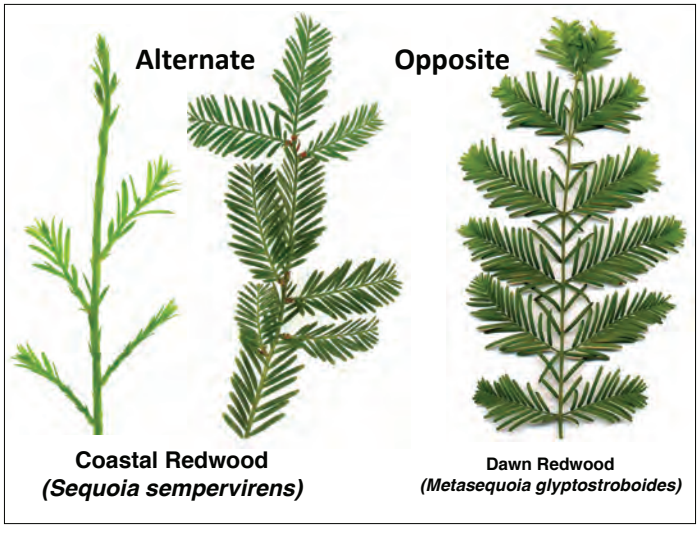


Alternate Opposite Whorled



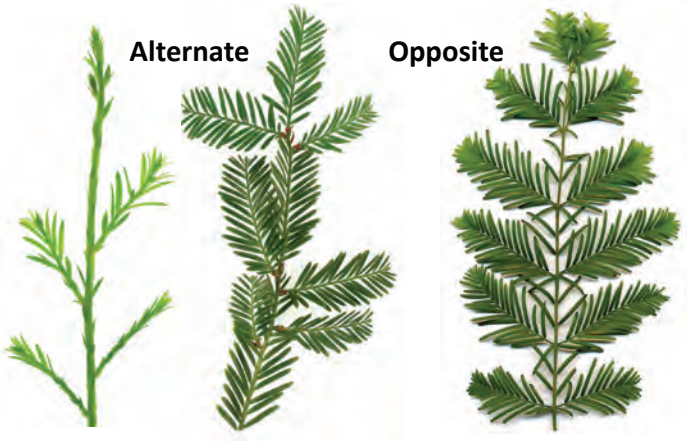
Coastal Redwood
(Sequoia sempervirens)

Dawn Redwood
(Metasequoia glyptostroboides)



Coastal Redwood
(Sequoia sempervirens)

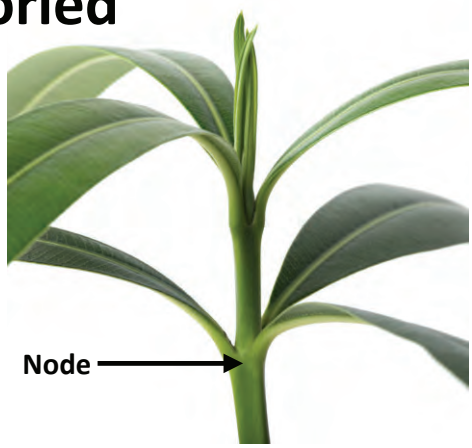
Dawn Redwood
(Metasequoia glyptostroboides)



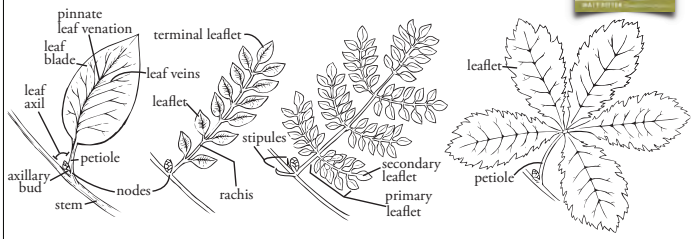
Coastal Redwood
(Sequoia sempervirens)

Dawn Redwood
(Metasequoia glyptostroboides)

Whorled



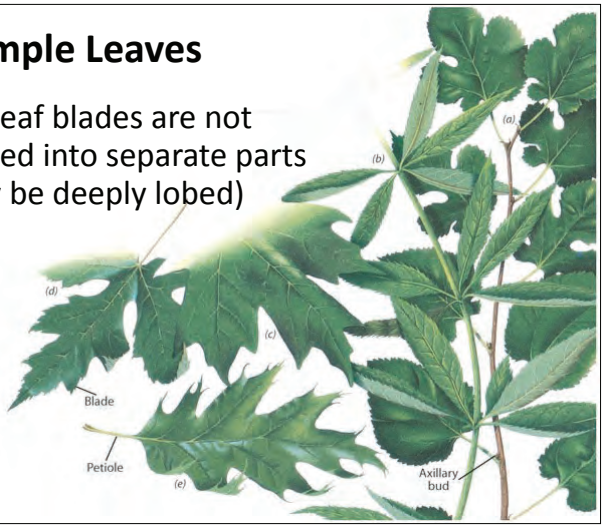
Leaf Form (Shape)



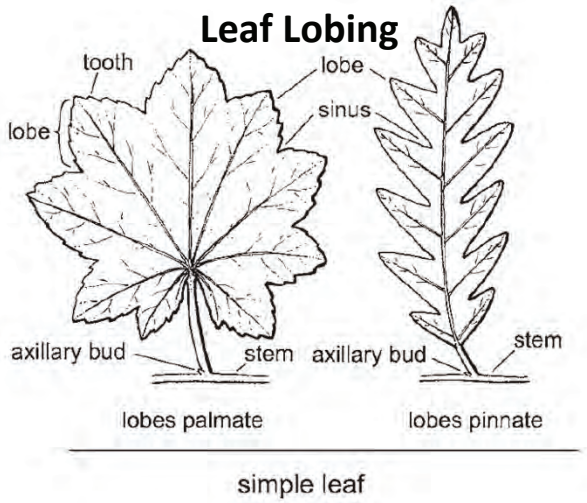
Simple **Pinnately Compound** **Bipinnately Compound** **Palmately Compound**

Simple Leaves

The leaf blades are not divided into separate parts (may be deeply lobed)

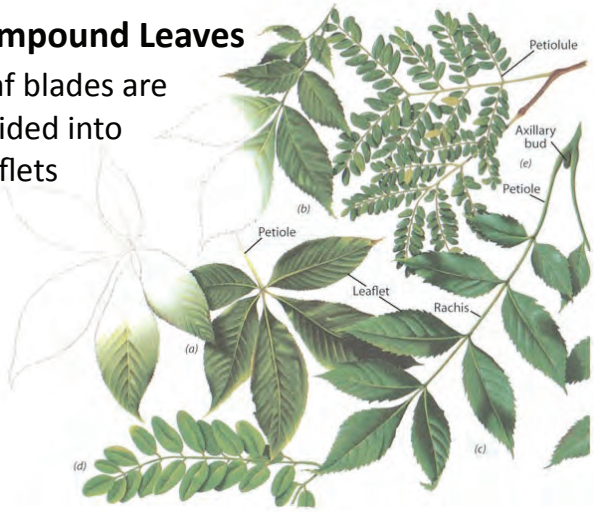


Leaf Lobing



Compound Leaves

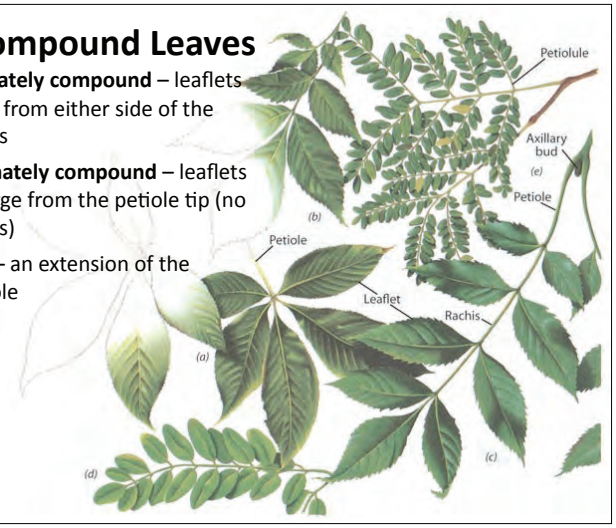
Leaf blades are divided into leaflets



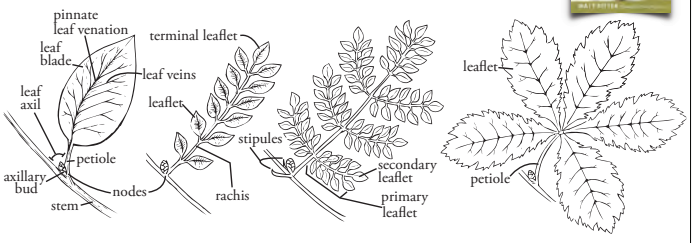
Compound Leaves

1. **Pinnately compound** – leaflets arise from either side of the rachis
2. **Palmately compound** – leaflets diverge from the petiole tip (no rachis)

Rachis – an extension of the petiole

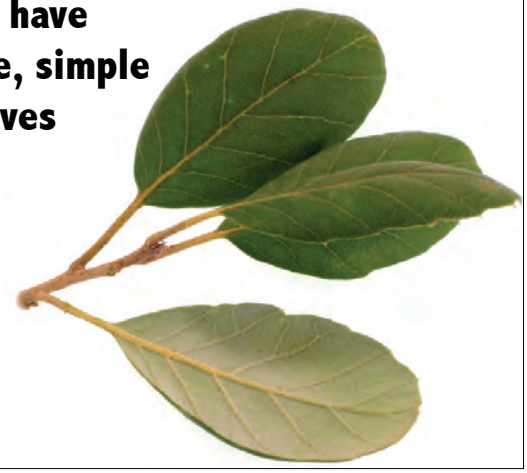


Leaf Form (Shape)

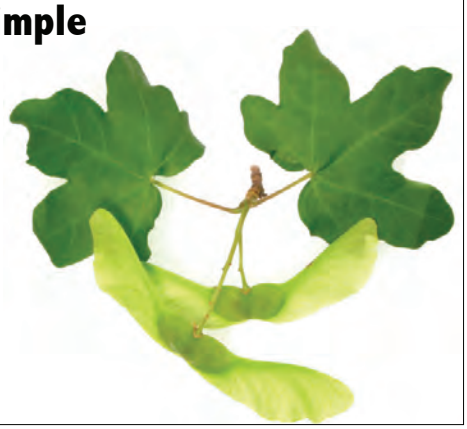


Simple | **Pinnately Compound** | **Bipinnately Compound** | **Palmately Compound**

Oaks have alternate, simple leaves

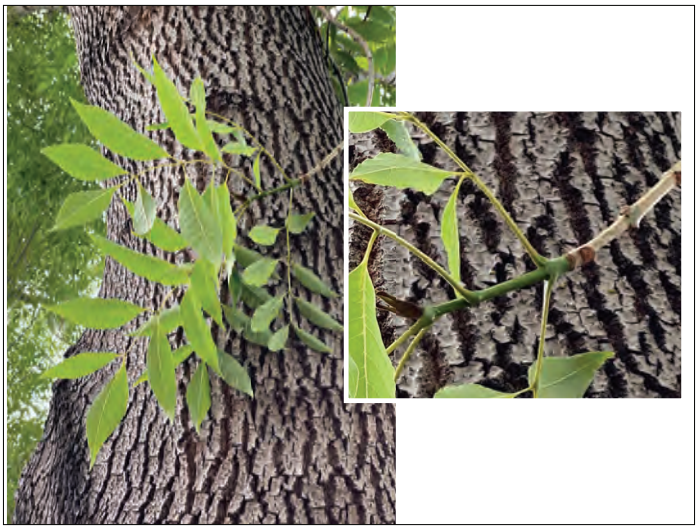


Maples have opposite, simple leaves



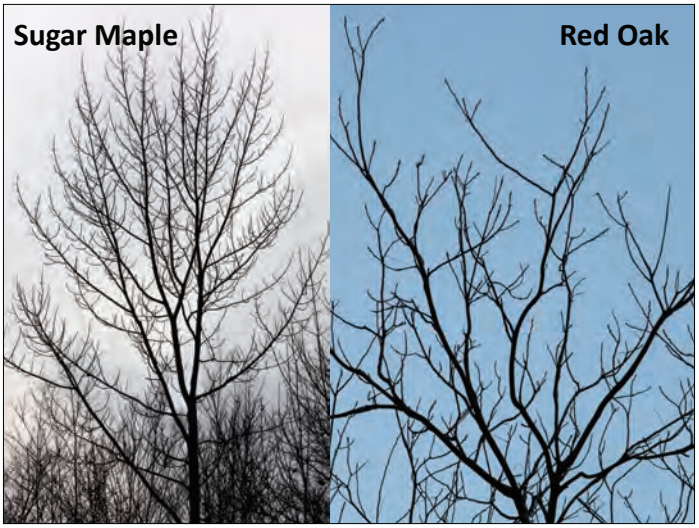
Ashes have opposite, pinnate leaves

Leaf blade is divided into leaflets



Trumpet trees have opposite, palmate leaves

Acacias have alternate, bipinnate leaves



Summary

- Plants are wonderful organisms that carry out complicated chemistry
- Trees are perennial, single-trunked, woody organisms with a raised canopy (or just big plants)
- Everything about the form of a tree is determined by the development of the apical meristem
- Genetically determined characteristics (leaf attachment and leaf shape) are crucial for tree identification