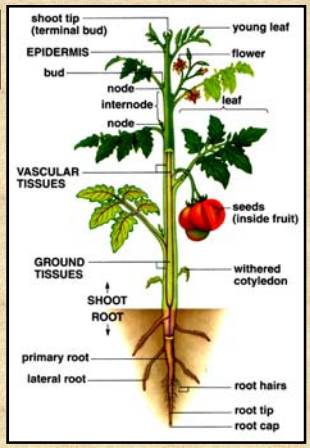
Organs

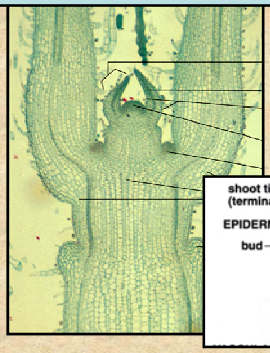
- Stems
- Leaves
- Roots



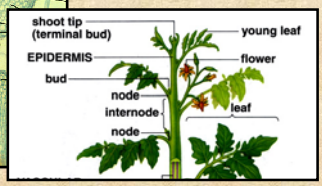
Variation in Leaves

- Number of leaflets
- Venation
- Pattern of attachment on stem

Leaves

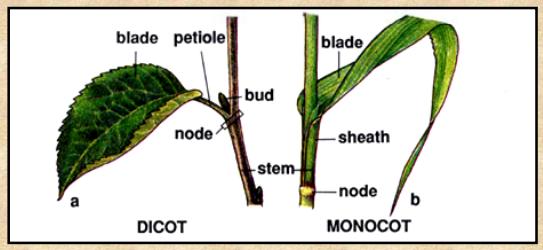


- All leaves originate as primordia at the apex of a stem



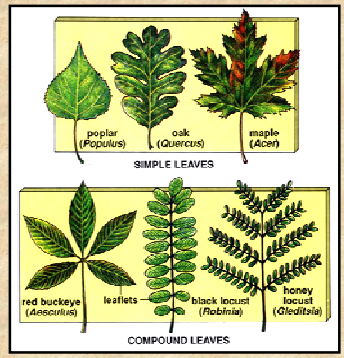
Leaves

- At maturity, most leaves have a stalk (petiole) and a flattened blade (lamina) with a network of veins (vascular bundles).



Leaves

- Simple (single blade)
- Compound (divided into leaflets).
  - Palmately compound leaflets attached at the same point at end of petiole
  - Pinnately compound leaflets in pairs along the rachis
  - Bipinnately compound leaflets subdivided further

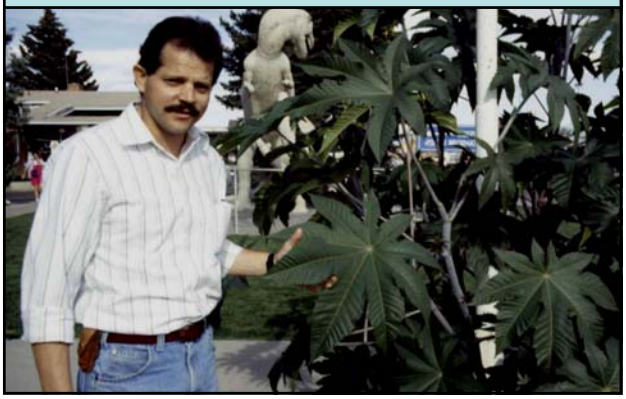


Notice location of axillary bud

Simple

Compound

Simple or Compound?



Simple or Compound?

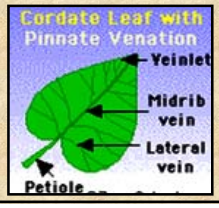
Simple or Compound?

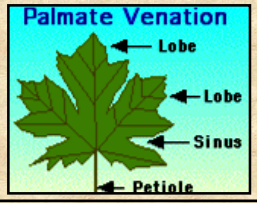
Simple or Compound?

Simple or Compound?

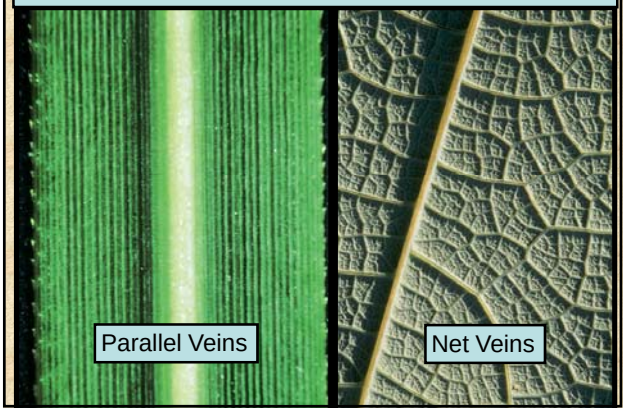
Leaves – Net venation

- Arrangement of veins in a leaf or leaflet blade may also be pinnate or palmate.
  - Pinnately veined leaves have a main midvein.
    - Secondary veins branch from midvein.
  - Palmately veined leaves have several primary veins that fan out from the base of the blade.

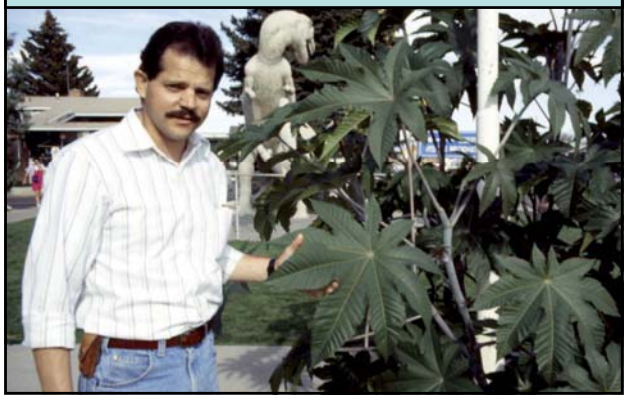




Leaves - Parallel Venation



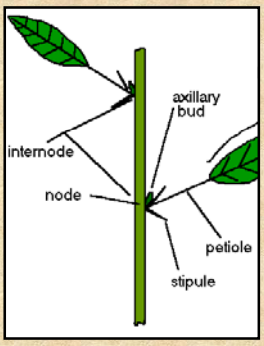
Palmate Venation



Pinnate Venation

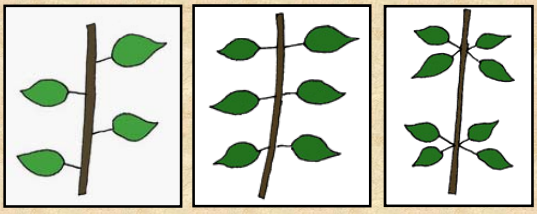
Leaves

- Nodes are where leaves are attached to stems
- Internodes are regions of stem between nodes
- Buds are very young stems
- Axillary buds grow in the axil of a leaf



Leaves

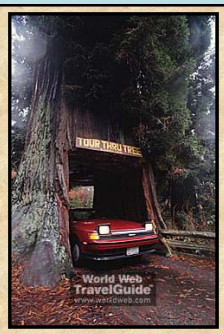
Three main ways leaves are attached to stems

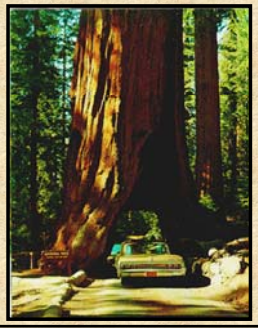


Alternate | Opposite | Whorled

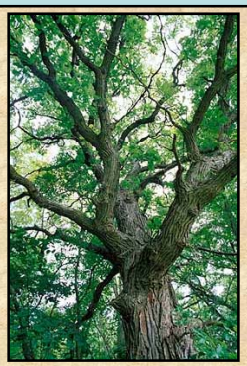
Leaf Attachment Pattern?

Stems

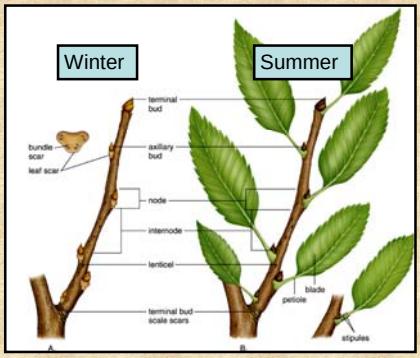




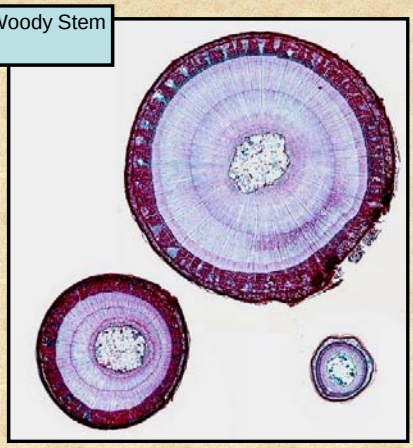
Herbaceous and Woody Stems



Woody Twigs



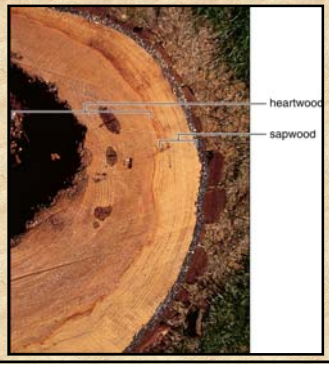
Woody Stem



Herbaceous Stem

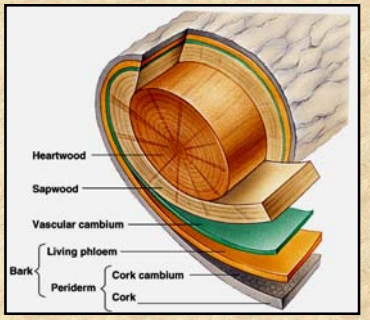
Woody Dicotyledonous Stems

- Older, darker wood at the center is called heartwood, while the lighter, still-functioning xylem closest to the cambium is called sapwood.



Woody Dicotyledonous Stems

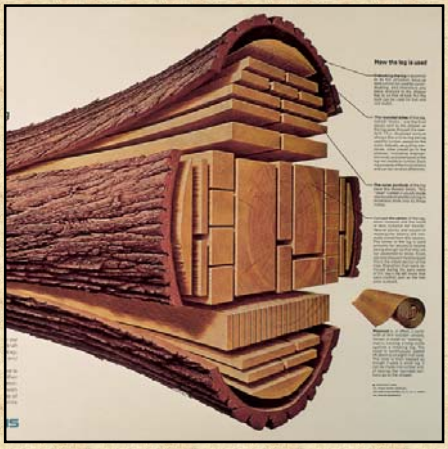
- **Bark** - Refers to all the tissues outside the cambium, including the phloem.
  - Mature bark may consist of alternating layers of crushed phloem and cork.



Woody Dicotyledonous Stems

- Vascular cambium produces more secondary xylem than phloem, thus bulk of a tree trunk consists of annual rings of wood.

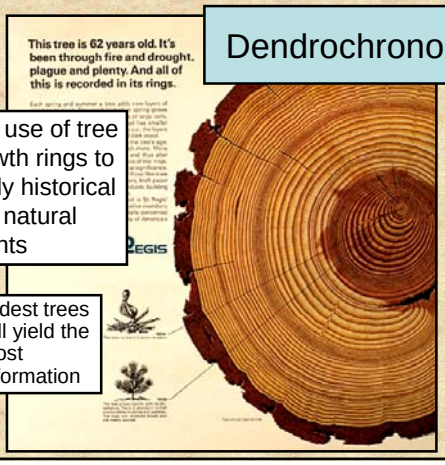
Wood – A very important renewable resource



Woody Dicotyledonous Stems

- Examining rings can determine the age of a tree, and provide some indications of climatic conditions.

Dendrochronology



The use of tree growth rings to study historical and natural events

Oldest trees will yield the most information

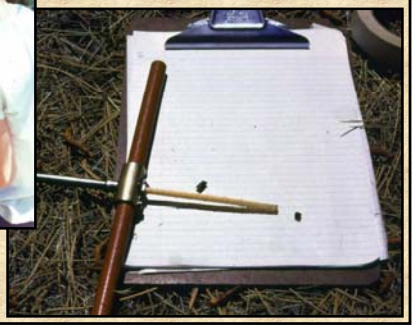
Are the biggest trees the oldest?

Bristlecone Pine

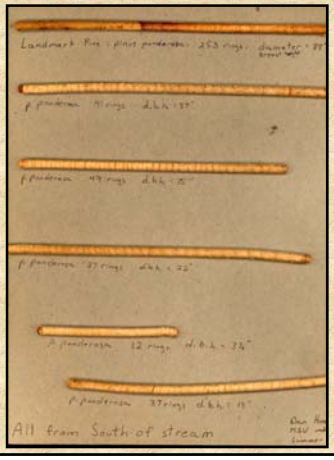
The Oldest Trees

Oldest specimen is 4900

Gathering Tree Ring Data



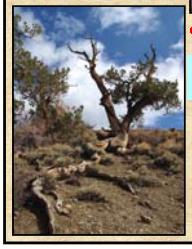
The age of each tree in a forest stand can be determined



Tree rings can tell us more than the age of a tree

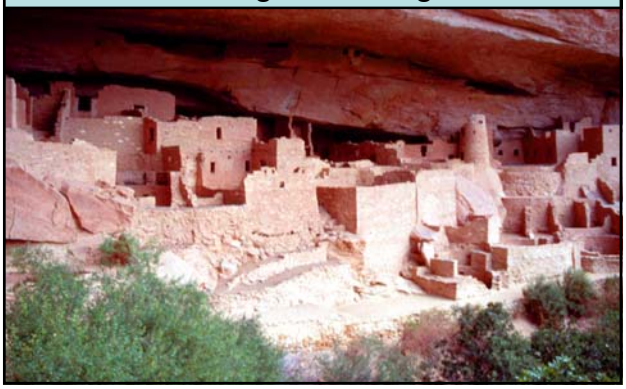
- The width of rings reflects environmental conditions in sensitive trees
- Rings may be affected by
  - Rainfall
  - Temperature
  - Sunspot activity
  - Fire
  - Geological events

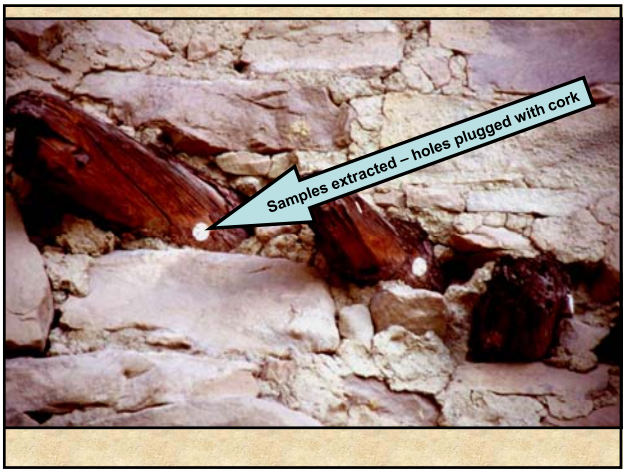
Building a Tree Ring Chronology



A tree ring record of 8200 years has been established for the bristlecone pines of California

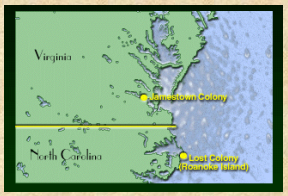
Archeological sites can be dated with tree ring chronologies





The "Lost Colony" of Virginia and the Jamestown Settlement

- First English settlers arrive at Roanoke Island August, 1587
  - Found abandoned when supply ships return 3 years later
  - Attributed to poor planning and conflicts with natives
- Jamestown Settlement established April, 1607
  - 80 % mortality
  - Attributed to malnutrition



Tree Ring Evidence for Drought

- 1587- 1589 was the worst drought in the last 700 years
- 1606- 1612 were equally bad
- The "Lost Colony" and Jamestown Settlement disasters were tied to climate

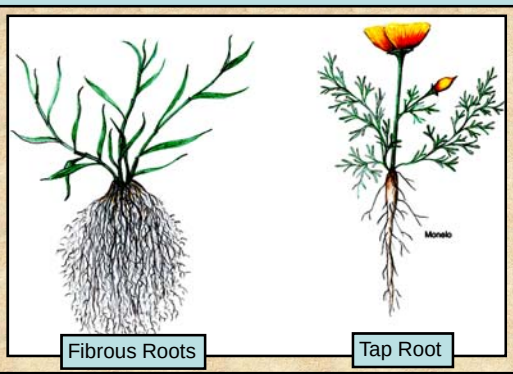
Bald Cypress tree ring record of historic SE US drought.

Roots

Their importance is often underestimated

Function in anchorage and absorption

Root systems



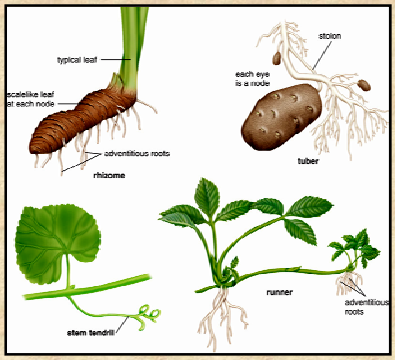
Specialization of Stems, Leaves and Roots

Plants may adapt to their environment through modification of organs

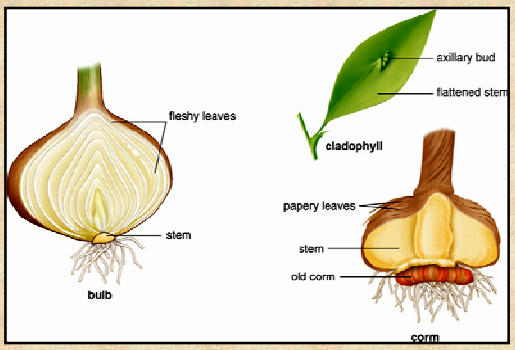
This plant is adapted to life in arid regions of Baja California Mexico

- Thick stem stores water
- Leaves modified as spines for water conservation and reduction of predation

Specialized Stems



Specialized Stems



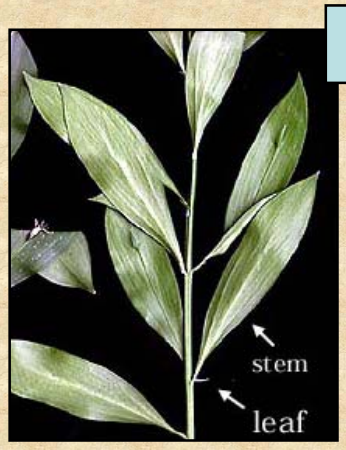
Specialized Stems

- Rhizome – a thick underground stem

Specialized Stems

- Tuber – underground stem

Specialized Stems



- Cladophyll – stem flattened and resembles a leaf

Specialized Stems

Bulb – very reduced stem with fleshy leaves attached

Corm – thick underground stem

Specialized Leaves

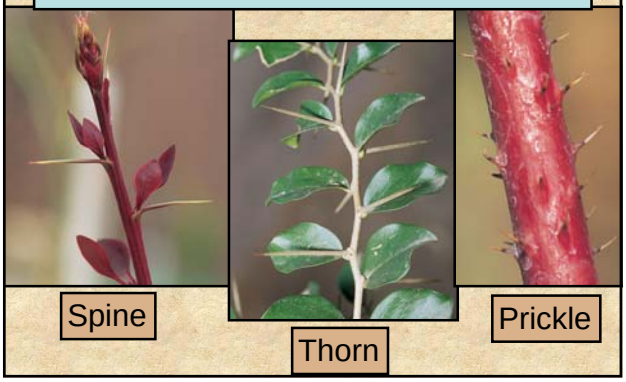
Specialized Leaves

- Tendrils
  - Modified leaves that curl around more rigid objects helping the plant to climb or support weak stems.

Specialized Leaves

- **Spines**
  - Spines - Modified leaves designed to reduce water loss and protect from herbivory.
- **Thorns and Prickles** (look like spines but they are not modified leaves)
  - Thorns - Modified stems arising in the axils of leaves of woody plants.
  - Prickles - Outgrowths from the epidermis.

Which one is which?

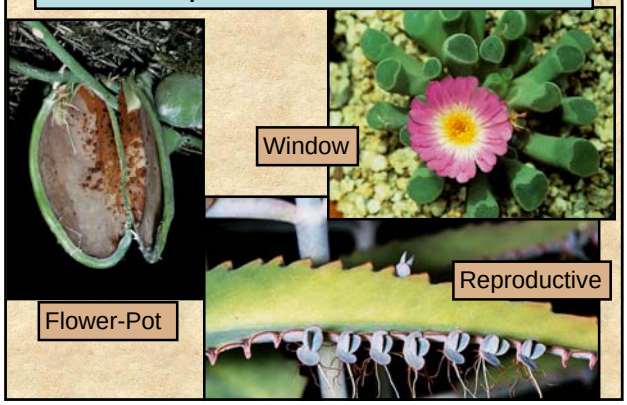


Specialized Leaves

- Storage Leaves - Succulents
- Flower-Pot Leaves - Urn-Like Pouches
- Window Leaves - Leaves buried in ground.
- Reproductive Leaves - New plants at tips.
- Floral Leaves - Bracts

Storage leaves

Specialized Leaves



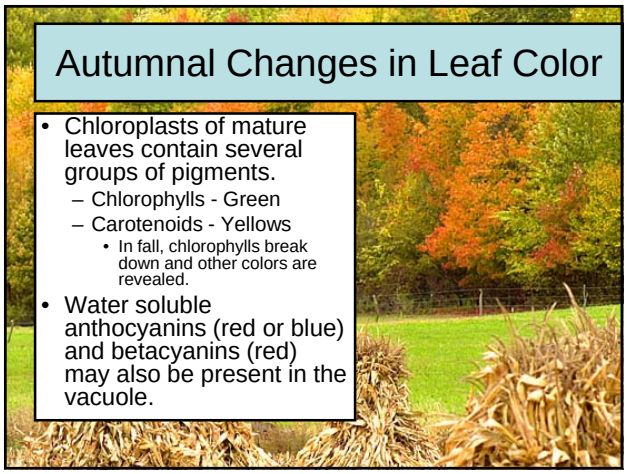
Specialized Leaves

- Insect-Trapping Leaves
  - Pitcher Plants
  - Sundews

Specialized Leaves

- Insect-Trapping Leaves
  - Venus's Flytraps
  - Bladderworts

Autumnal Changes in Leaf Color



- Chloroplasts of mature leaves contain several groups of pigments.
  - Chlorophylls - Green
  - Carotenoids - Yellows
    - In fall, chlorophylls break down and other colors are revealed.
- Water soluble anthocyanins (red or blue) and betacyanins (red) may also be present in the vacuole.

Specialized Leaves

Floral Leaves

Specialized Leaves

Floral Leaves

Specialized Roots

- Contractile Roots
  - Pull plant deeper into the soil – Lilly Bulbs
- Buttress Roots
  - Stability - Tropical Trees.
- Food Storage Roots
  - Sweet Potatoes
- Prop Roots
  - Support - Corn
- Pneumatophores
  - Mangrove and Bald Cypress - Extend above water's surface and enhance gas exchange between the atmosphere and subsurface roots.

Specialized Roots

Contractile Roots

Specialized Roots

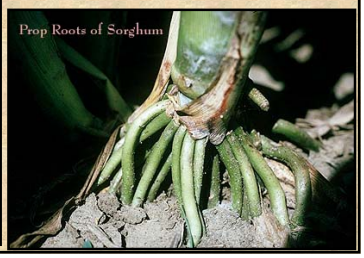
Buttress Roots

Specialized Roots

Food Storage Roots

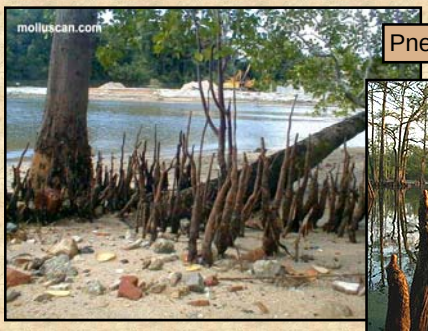
Specialized Roots

Prop Roots



Specialized Roots

Pneumatophores




Cypress knees. (Photo: Steve Twaddle)