Basic Tree Biology – a quick look

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Objectives

- What are trees – cool facts
- What do trees need
- How do trees grow
- Tree parts and their function
- Tree defense

What is a tree ?

- At least 149 definitions (Lund, JOF 2002)
- Upright woody perennial plant, usually single-stemmed, which is intended to be grown to a mature height of at least 5 meters or 15 feet (Connecticut DEP rule of thumb).
- Plants that are perennial, woody, shedding, compartmented (Shigo, Tree Basics).
- A plant that you can climb into (my dad)

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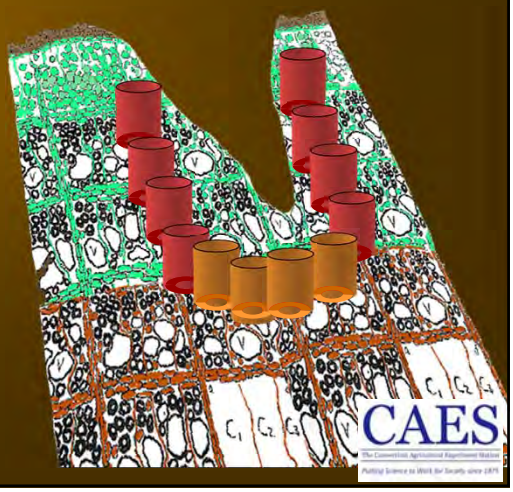
You can not age a tree by its size

CODIT

COmpartmentalization of Decay In Trees

Trees do not heal wounds, they compartmentalize (or wall off) the injured tissues



CAES

SOME CHAMPIONS

COASTAL REDWOOD
SOME OVER 360 FEET TALL!

CAES

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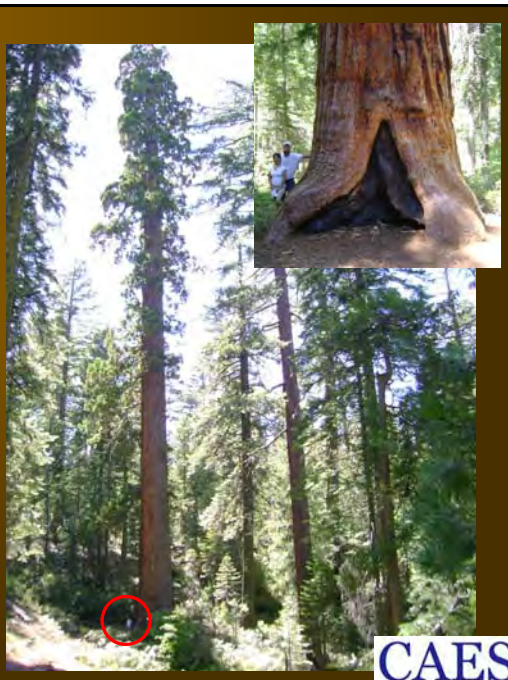
GIANT SEQUOIA
SOME OVER 2000 TONS!



CAES

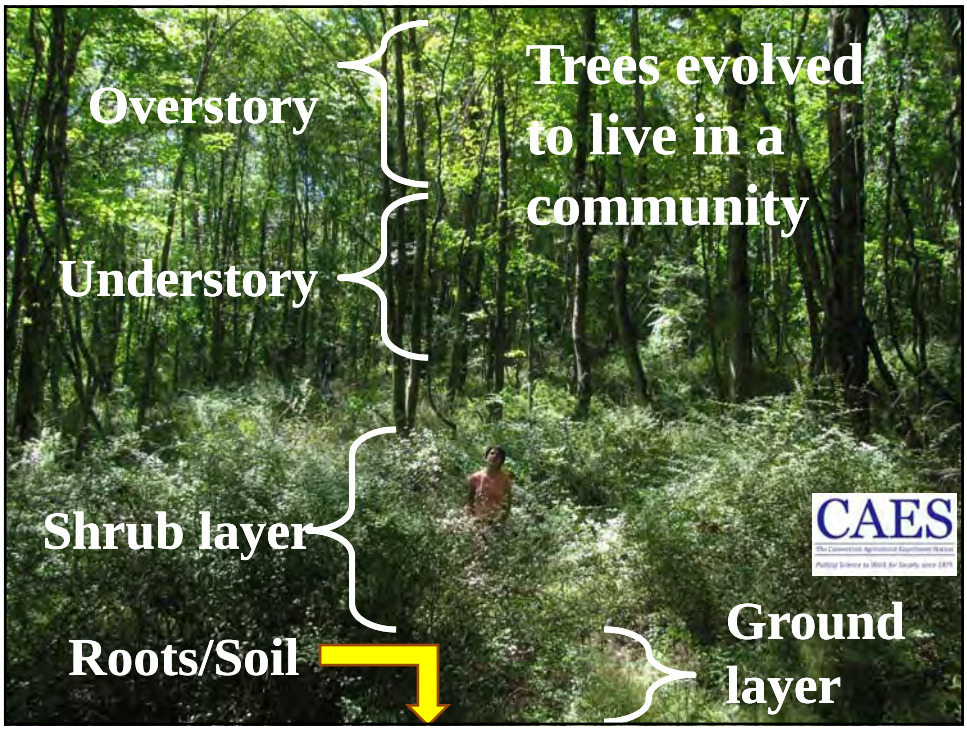
SOME CHAMPIONS

COASTAL REDWOOD
SOME OVER 360 FEET TALL!

GIANT SEQUOIA
SOME OVER 2000 TONS!

BRISTLECONE PINE
SOME ALMOST 4,800 YEARS OLD!

CAES



Landscape trees do not have the supporting community

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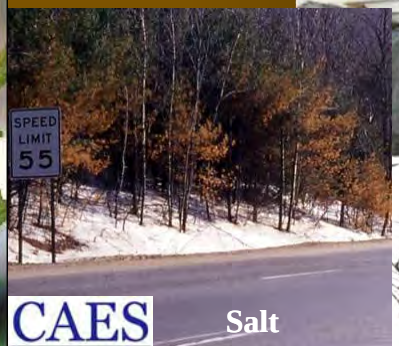
Oranges don't grow in Connecticut

- How much sun/shade
- Soil moisture (wet/dry)

pH



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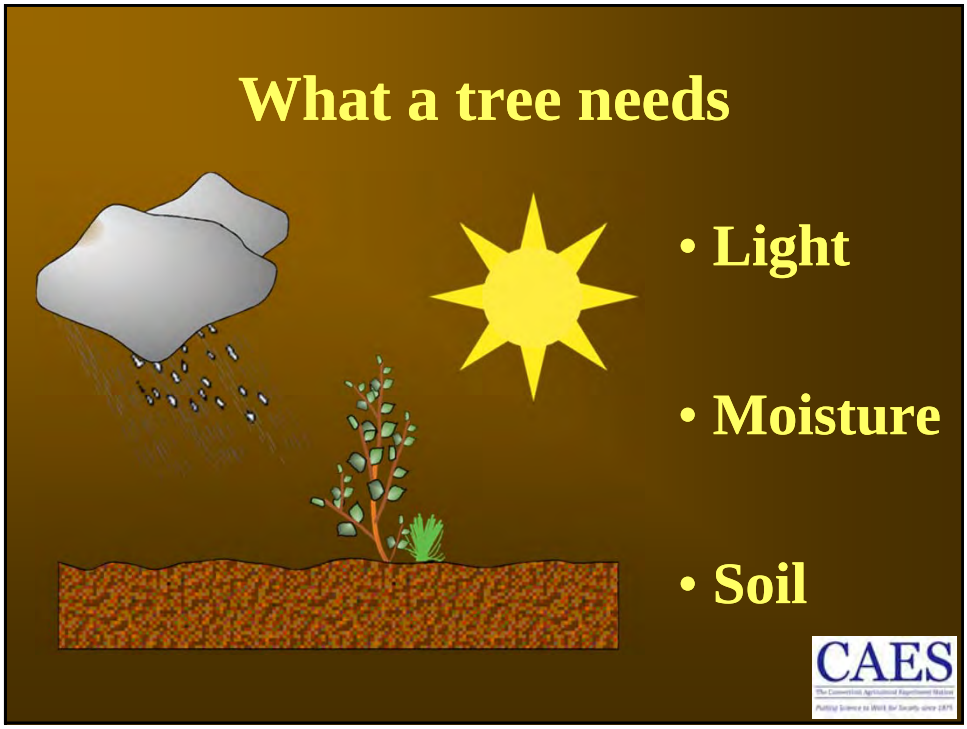
Salt

Deer


What a tree needs
• Light
• Moisture
• Soil
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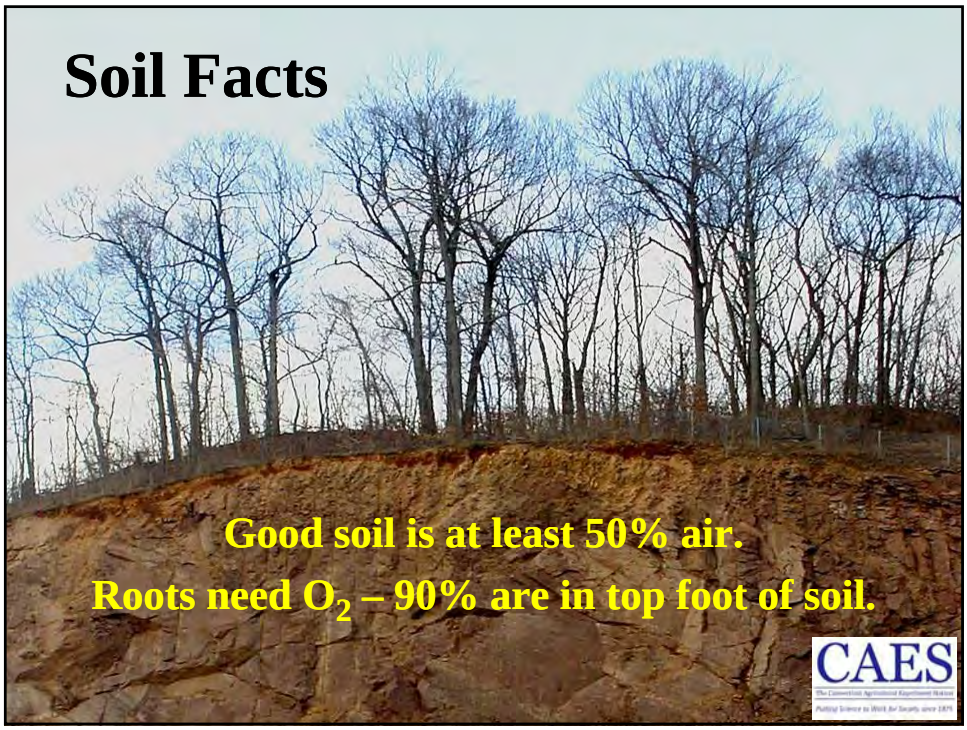
Soil Facts
Good soil is at least 50% air.
Roots need O_2 – 90% are in top foot of soil.
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Soil nutrients

- Macro - nitrogen, phosphorus, potassium
- Minor – calcium, iron, sulfur, magnesium
- Trace minerals

C HOPKN'S CaFe MnMg B CuZn Mo

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Water facts

- Mature trees use up to 100 gallons/day.
- Too much water is as bad as too little.

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Water functions

Transport medium for sugars, nutrients, and plant hormones (auxins, gibberellins, etc.).

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Water functions

Water is a reagent in photosynthesis (O_2 comes from two H_2O molecules).

$$H_2O + CO_2 \rightarrow$$

$$O_2 + \text{Sugar}$$

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Water functions

Cools plants via transpiration.

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Water functions

Adds structural strength (e.g., wilting plants) and causes cell expansion.

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Light Facts

Light is necessary for photosynthesis and life as we know it.

Planting under established trees can cause growth defects in new trees.

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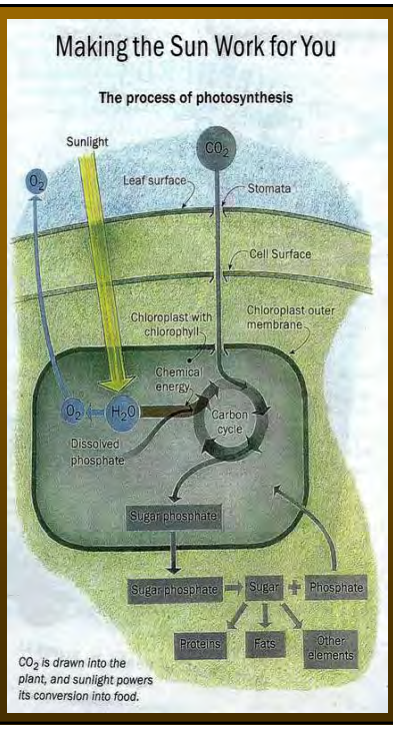

Photosynthesis

The process in green leaves (and yellow stems) where solar energy is used to combine CO_2 from the air with H_2O from the soil to produce sugar and O_2.

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Photosynthesis

These sugars are the energy source and building blocks for other compounds found in the plant.

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AVERAGE TREE LIFE

FOREST TREE
80-120 YEARS

RESIDENTIAL TREE
30-50 YEARS

URBAN TREE
7-10 YEARS

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Kirsten Hintze
http://lsv1.la.asu.edu/q/b108/khintze/meristem.jpg

Meristems

Primary (apical) meristem produces cells that result in shoot and root elongation.

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Lateral meristems (cambium)

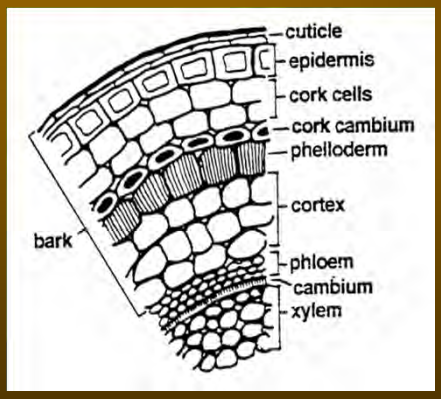

Illustration from Lilly et al. 1991.

http://europa.eu.int/comm/research/quality-of-life/image/root.jpg

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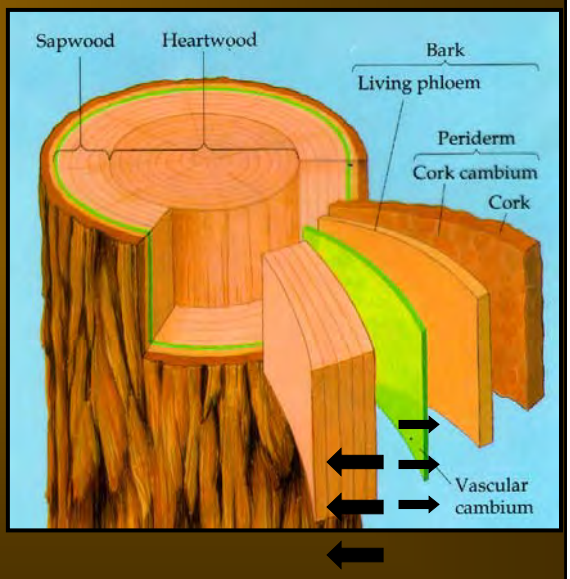
VASCULAR CAMBIUM

Meristematic tissue where sapwood (xylem) & inner bark (phloem) form



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Each year, a new tree grows over the old one.
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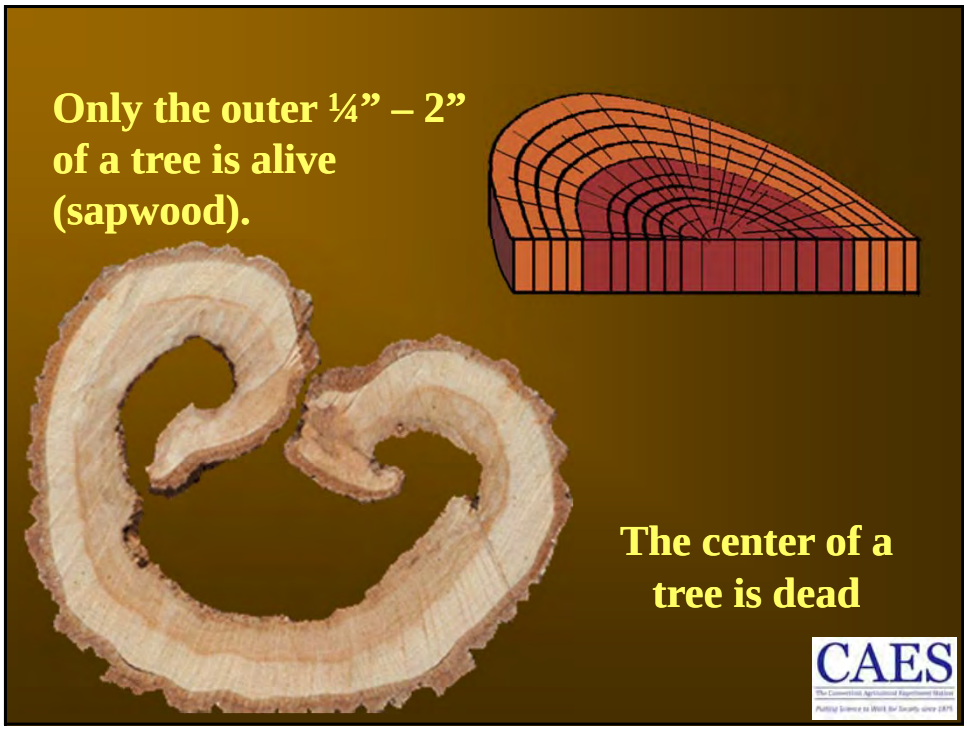
Illustration from Shigo, A.L. 1979


Only the outer ¼" – 2" of a tree is alive (sapwood).
The center of a tree is dead
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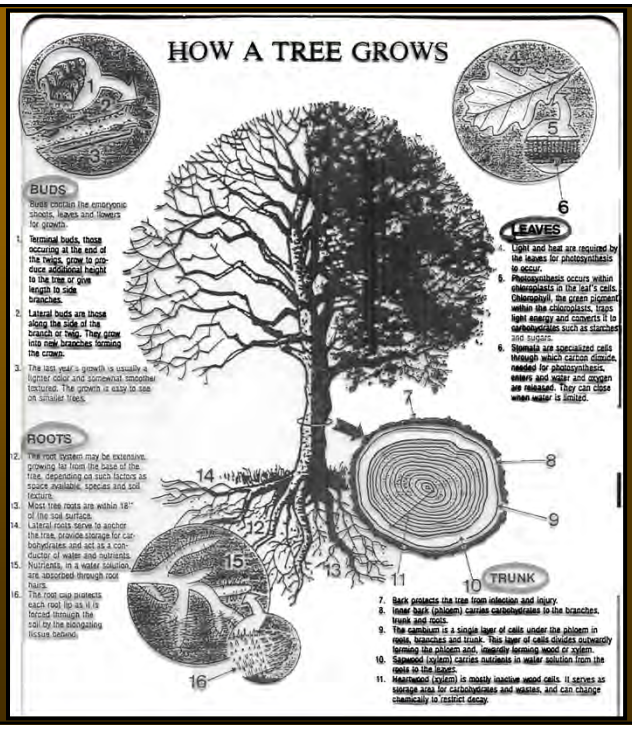
CAES



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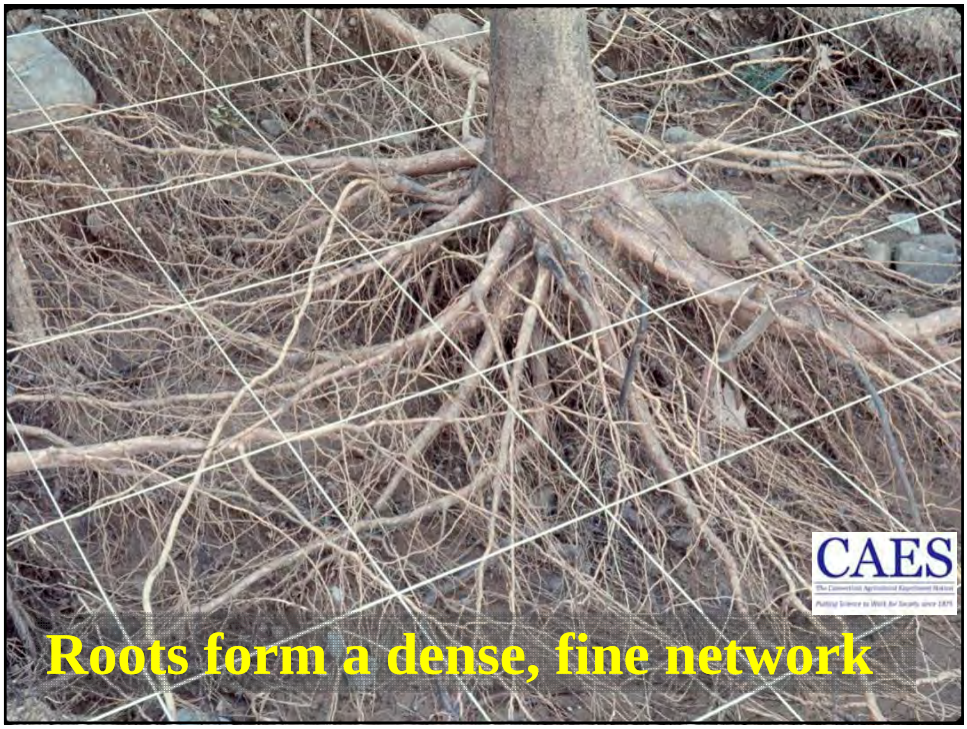
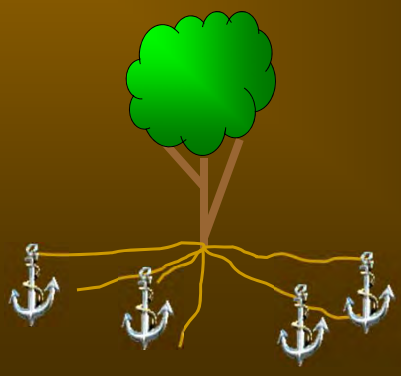


Root function

Anchorage – hold the tree in place.



Root function

Storage – healthy trees have one years starch reserves in the roots.

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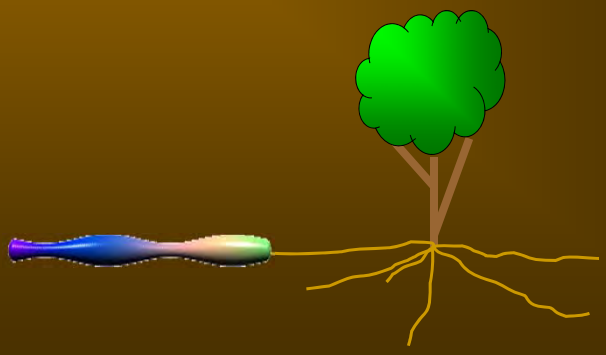
Root function

Absorption – uptake of mineral nutrients and water.



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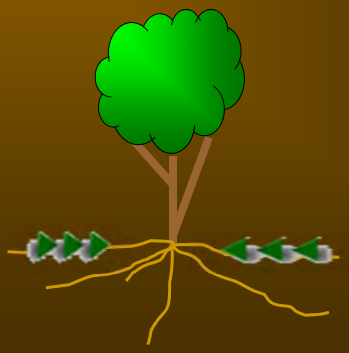
Root function

Conduction – transporting mineral nutrients and water to the stems and leaves.



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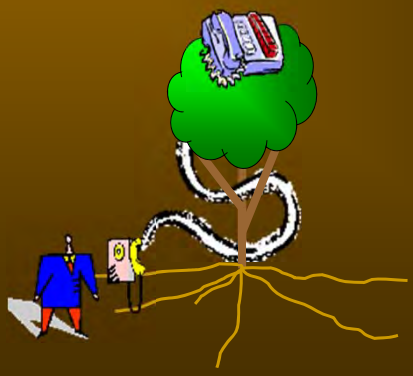
Root function

Growth – roots produce auxins.



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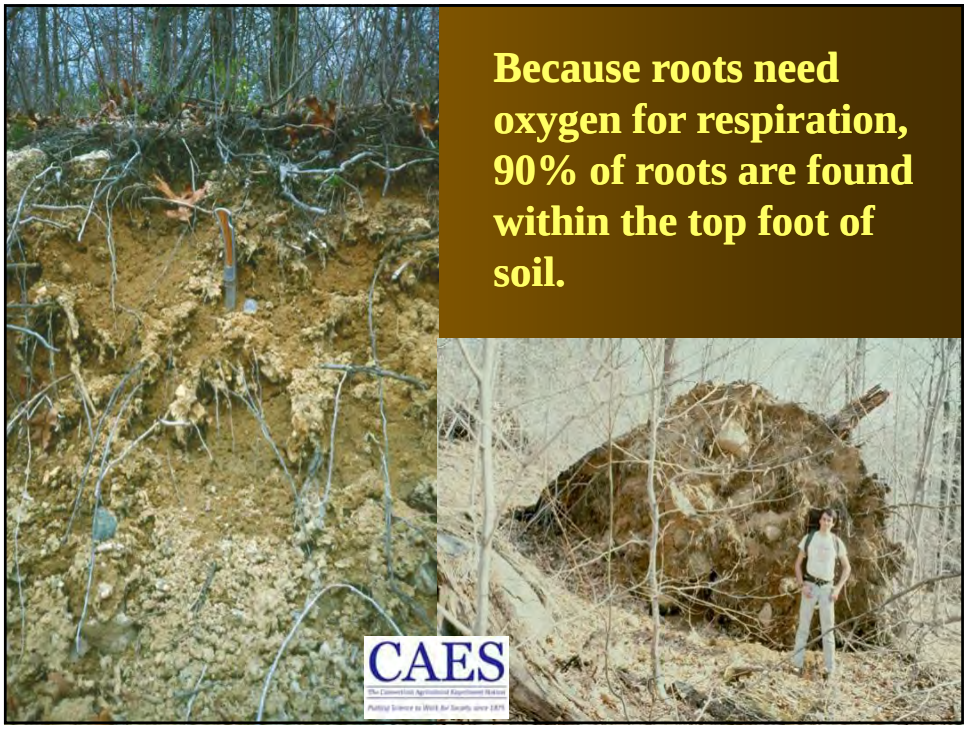
Because roots need oxygen for respiration, 90% of roots are found within the top foot of soil.
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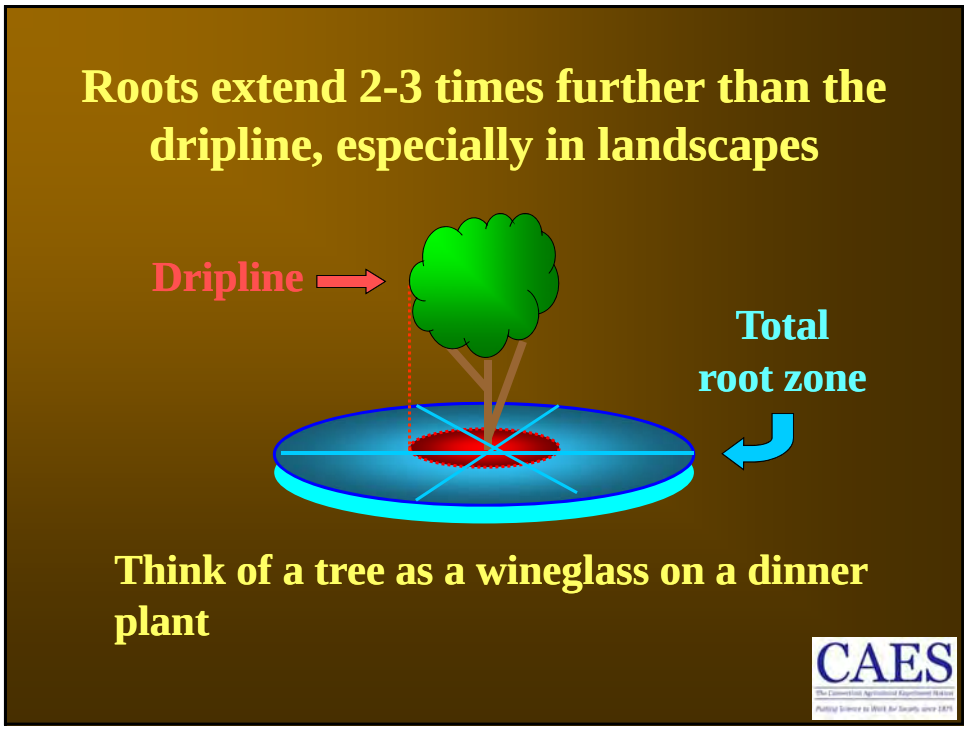
Roots extend 2-3 times further than the dripline, especially in landscapes
Dripline
Total root zone
Think of a tree as a wineglass on a dinner plant
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Bark

Shagbark hickory

Yellow birch

American beech

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Bark functions

Moderates stem temperature by insulating and reflecting

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Bark functions

Reduces water loss by forming a moisture barrier

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Bark functions

First line of defense against insect and diseases

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Stems:

- Trunk, branches, twigs
- Support, storage & transport

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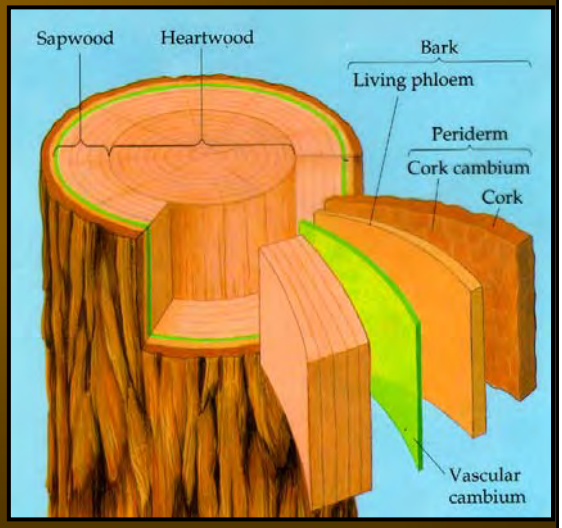
TRUNK: Support, Storage & Transport



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Wood tissues
Phloem – transports sugars from the leaves to other part of the tree for storage or use.
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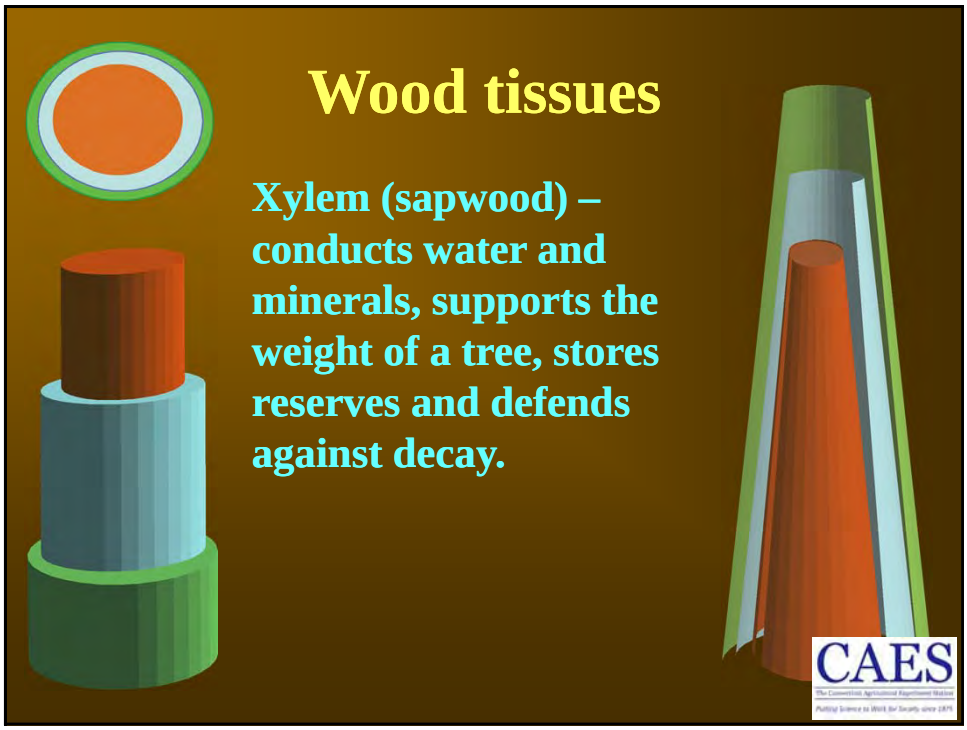
Wood tissues
Xylem (sapwood) – conducts water and minerals, supports the weight of a tree, stores reserves and defends against decay.
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Wood tissues
Heartwood – dead xylem, often dark colored.
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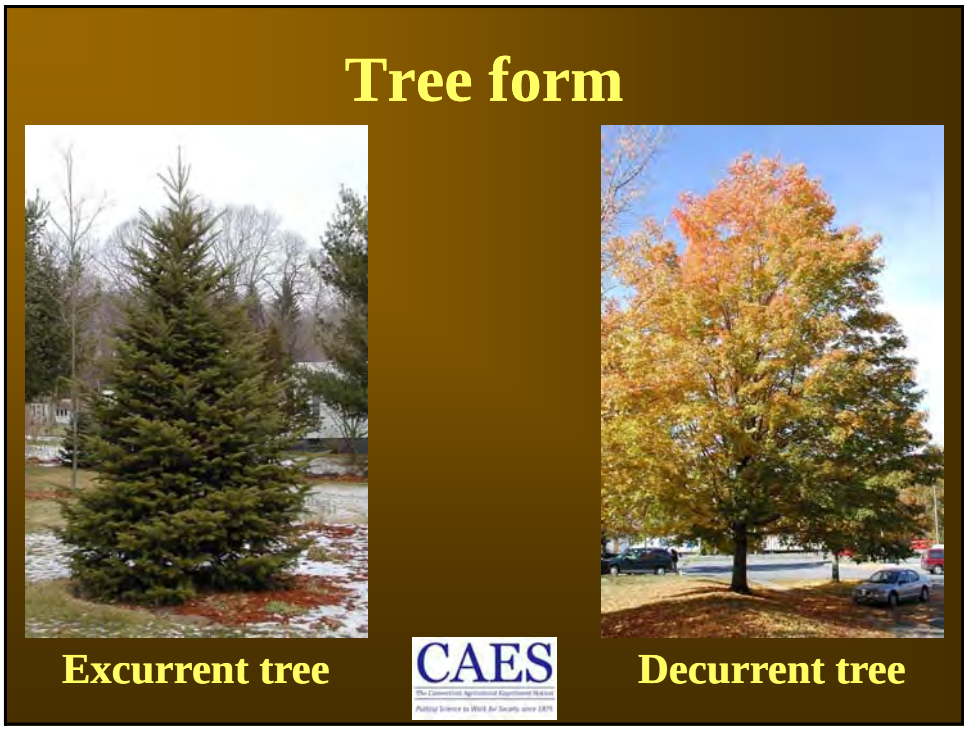
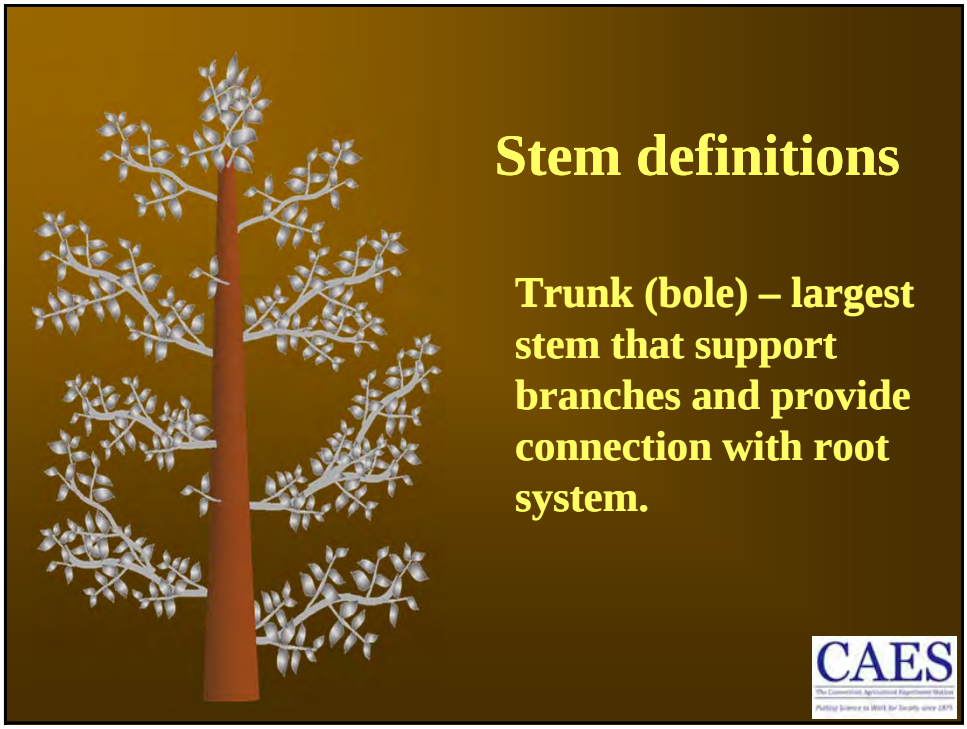

Tree form
Excurrent tree
CAES
Decurrent tree


Stem definitions
Trunk (bole) – largest stem that support branches and provide connection with root system.
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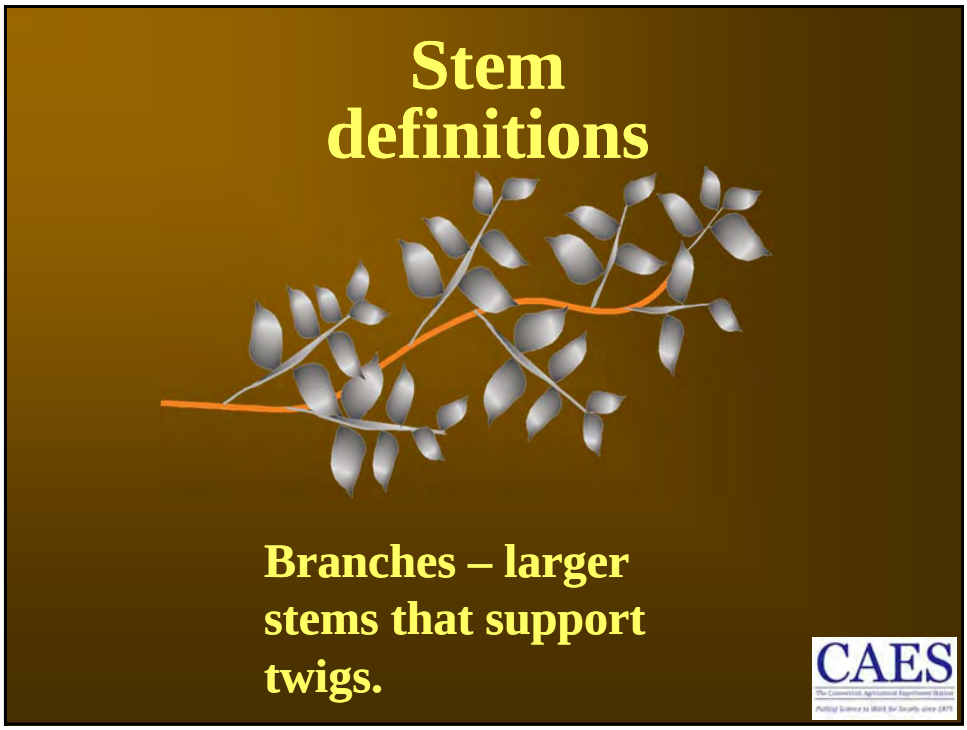
Stem definitions
Branches – larger stems that support twigs.
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Stem definitions

Twigs – small stems that support leaves, flowers, and fruit.

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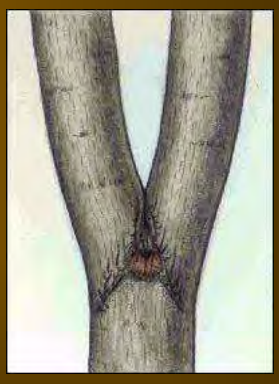
Branch attachment types

U-shaped union
Wide crotch
Strong



V-shaped union
Tight crotch
Weak

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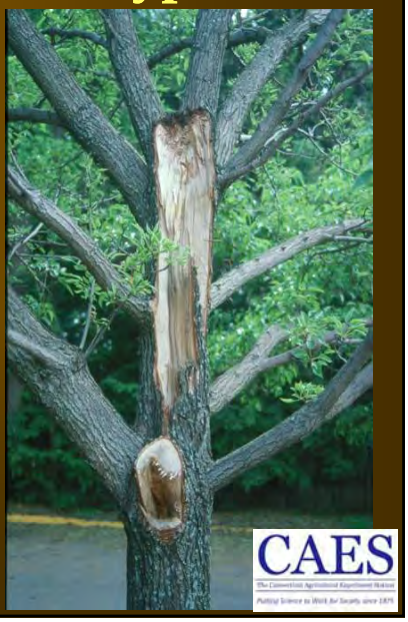
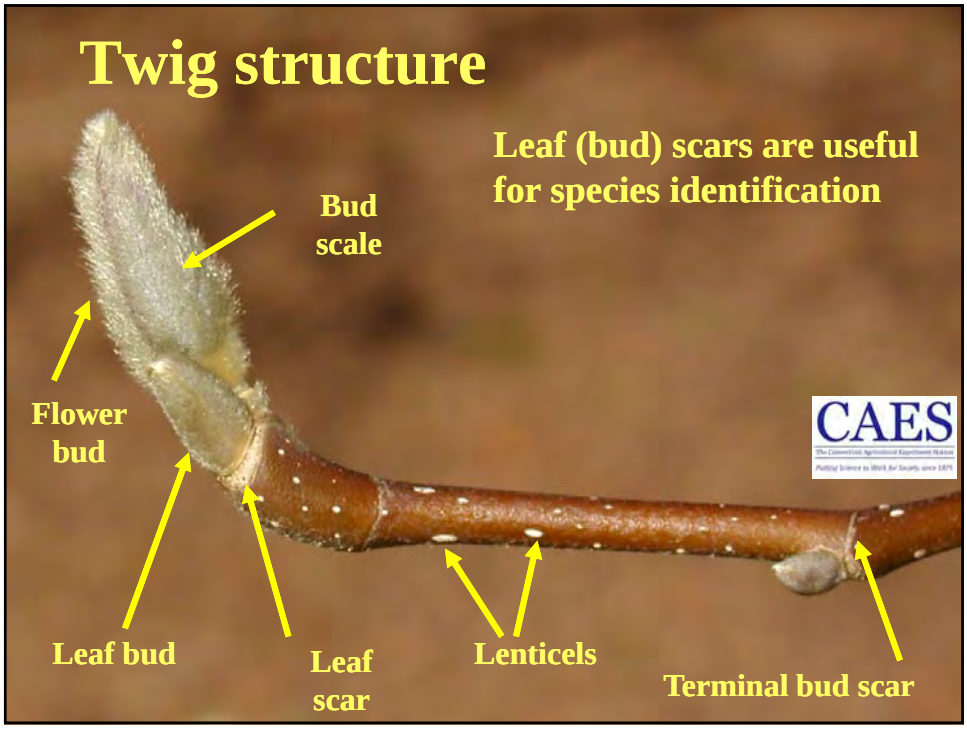
Branch attachment types

Branch attachment types




Twig structure
Leaf (bud) scars are useful for species identification
Bud scale
Flower bud
Leaf bud
Leaf scar
Lenticels
Terminal bud scar
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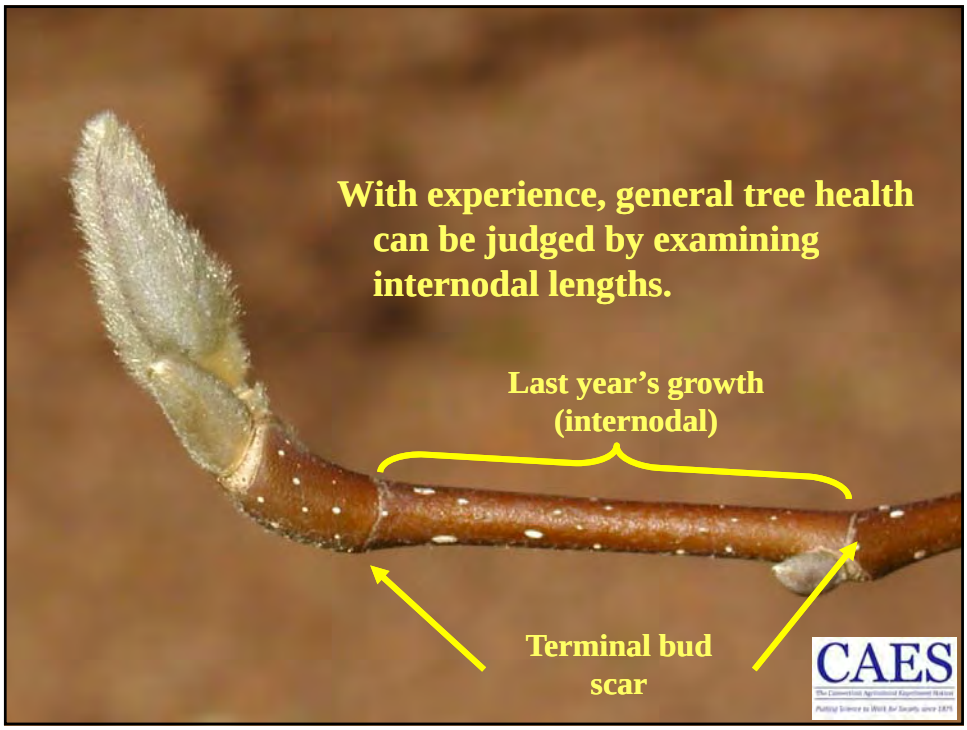
With experience, general tree health can be judged by examining internodal lengths.
Last year's growth (internodal)
Terminal bud scar
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Buds

Miniature shoot contained within an outer covering of scales or modified leaves.

Northern red oak

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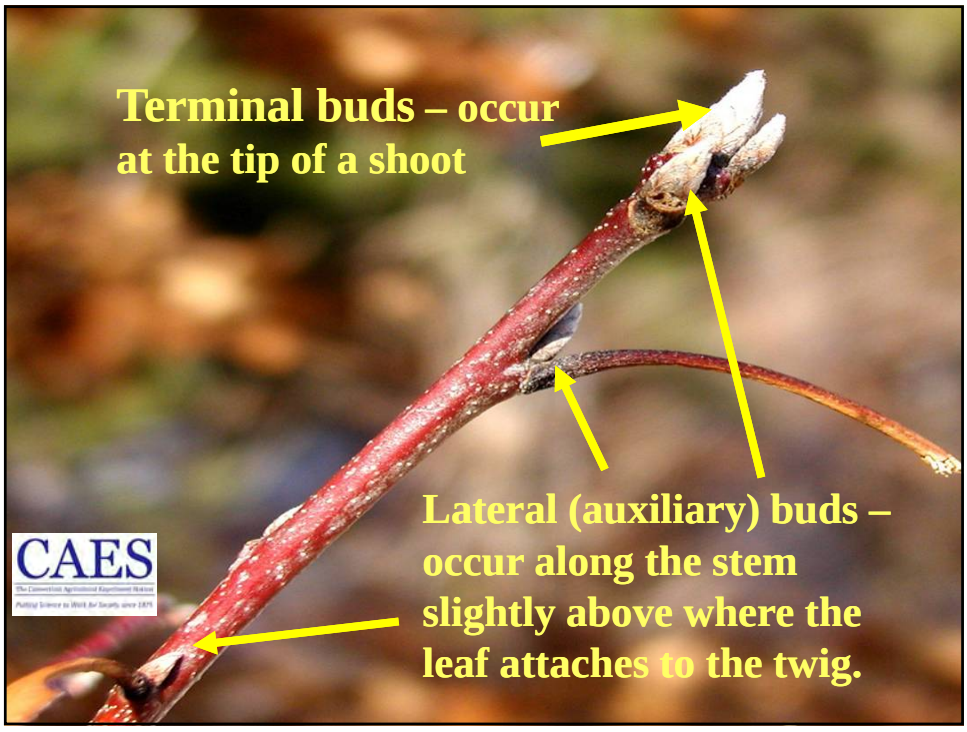
Colorado blue spruce



Leaf Shapes

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Hardwoods – broad leaves

Consists of blade with several layers of different cells (tissues) and a petiole (stalk)

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Conifers – needles

Conifer needles have a thick cuticle and small, thick-walled epidermal cells

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Leaves

Leaves produce the sugars that provide energy for the tree to grow, survive, and reproduce.

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Leaves & sugars

1. Produce defensive compounds (resin, tannins, cyanide, etc.)
2. Secondary compounds that add strength (cellulose, lignin) and decrease desiccation (waxes)
3. Uptake nutrients
4. Produce flowers and seeds

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Objectives

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TREE DEFENSE

IS THE RESPONSE TO STRESSORS:

INSECTS

DISEASES

ENVIRONMENTAL CONDITIONS

COMPETITION
&
WOUNDING

CAES

CODIT

COmpartmentalization of Decay In Trees

Trees do not heal wounds, they compartmentalize the injured tissues

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TREE DEFENSE

Trees Don't Heal They Seal

- **This process is dependent upon the trees stored energy reserves.**
- **Energy that is accessible to the tree can only be stored in living tissue.**

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COMPARTMENTALIZATION:

CHEMICAL

-chemical boundaries are created around wounds that help stop the spread of decay.

PHYSICAL

-callus tissue (wound wood), produced from the cambial zone, physically walls off or seals off the wound.

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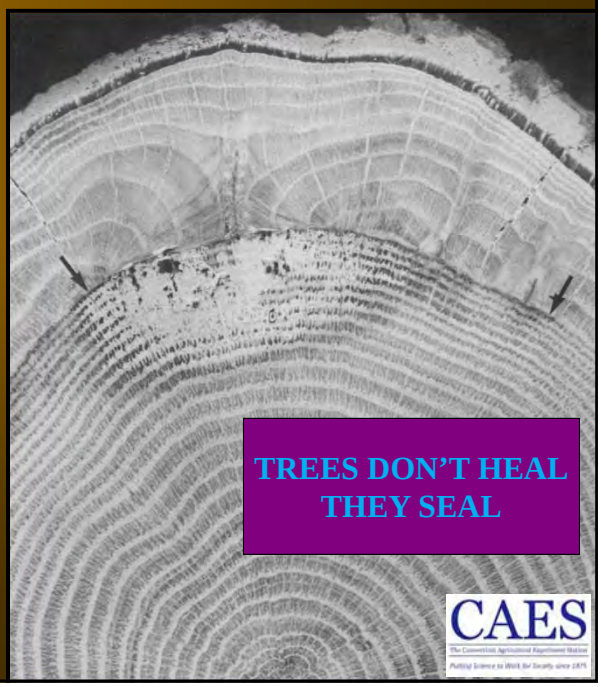
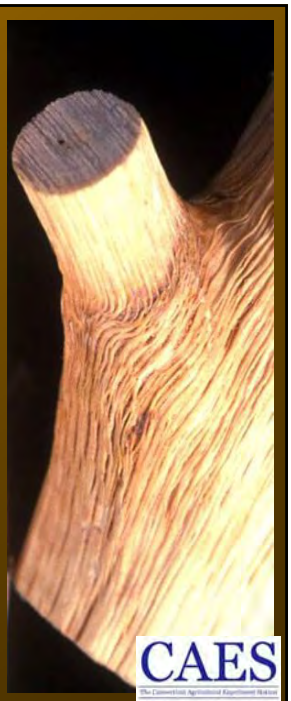
CHEMICAL boundaries resist the spread of decay



PHYSICAL boundaries seal off the wound

Branch collar has physical and chemical defenses to resist decay.



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Do NOT fill cavities

Do NOT drain cavities

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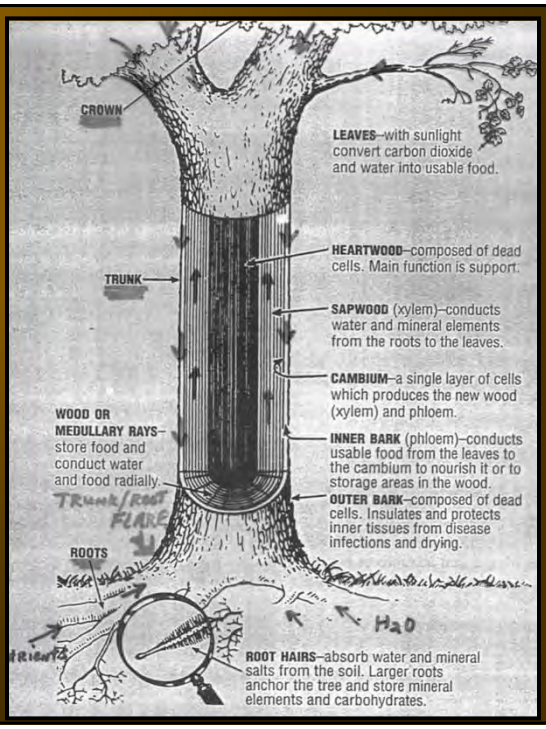
All parts of a tree must be kept healthy for a tree to thrive.



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Every part of the tree is important, none more than the other
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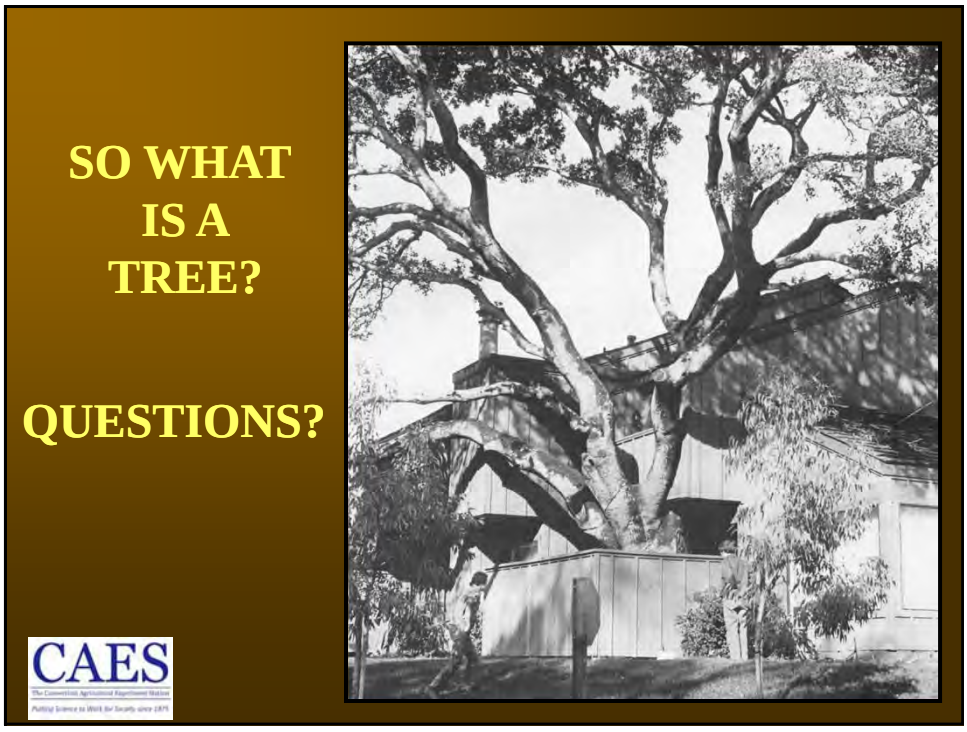
SO WHAT IS A TREE?
QUESTIONS?
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