Tree Basics

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Basic Tree Biology

I. Overview - The Role of Plants in our Environment

II. Natural & Man-Made Problems (How Do Trees Cope?)

- *CODIT vs. IMMUNITY*
- *INSECTS / DISEASE PATHOGENS*
- *CULTURAL DISTURBANCES*
- *THE HUMAN CONDITION* II.

III. Lets Talk Parts!

General → **Specific**

Physiological Components

Specific Functions and Contributions To The Working System

IV. Conclusion / Goal

Understanding how the individual components work together will allow us as managers to make better decisions in the protection and care of our tree resources.

Plants and the Environment

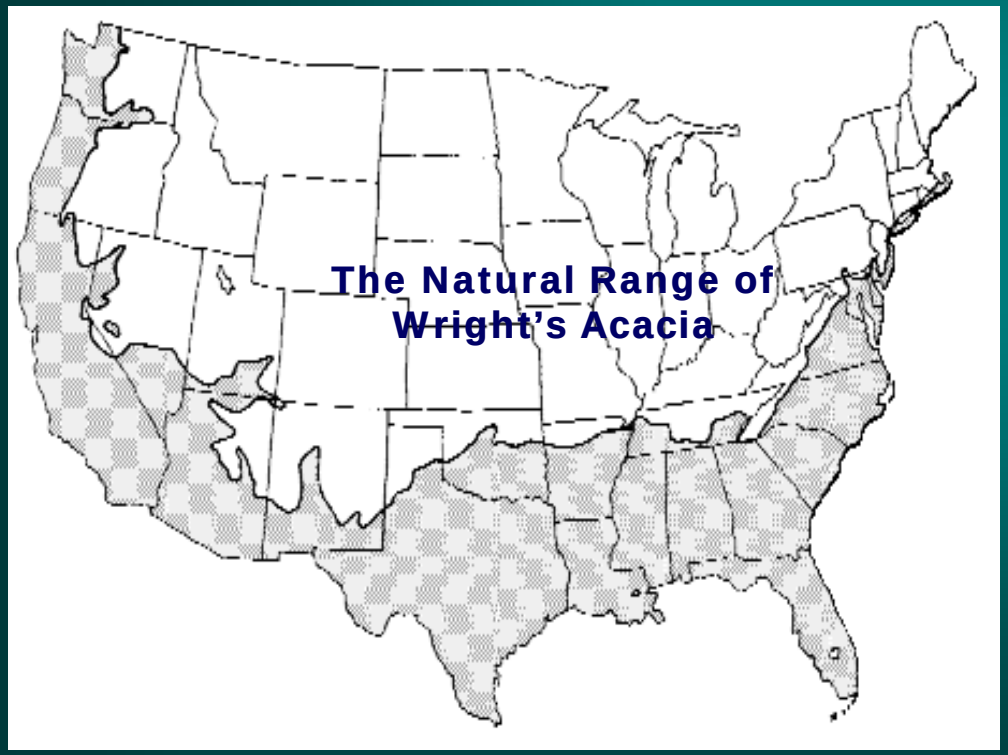
Plants play a vital role in our everyday lives that we often take for granted. They are an essential part of a very complex natural process. This process not only enhances and improves the quality of our daily lives, it allows us to SURVIVE.

- ***Essential part of the natural Carbon Cycle.***
- ***Improve air quality by capturing $C0^2$ particles from the atmosphere and recycling them into essential O^2.***
- ***Control runoff (conserves soil and H^2O).***
- ***Aesthetically pleasing (with serious economic returns).***
- ***Cooling effect (conserves energy).***
- ***Food and Raw Materials.***
- ***Driving force behind entire ecosystems.***

Plants of Texas

- *Extremely Diverse Due to Wide Variety of Ecological Regions.*
- *Have Adapted to Extremes in Average Temperature and Precipitation.*
- *People Have Adapted well to the Plant Communities (Instead of Adapting the Plants to the People.)*

Factors That May Limit the Natural Range of Plant Communities:



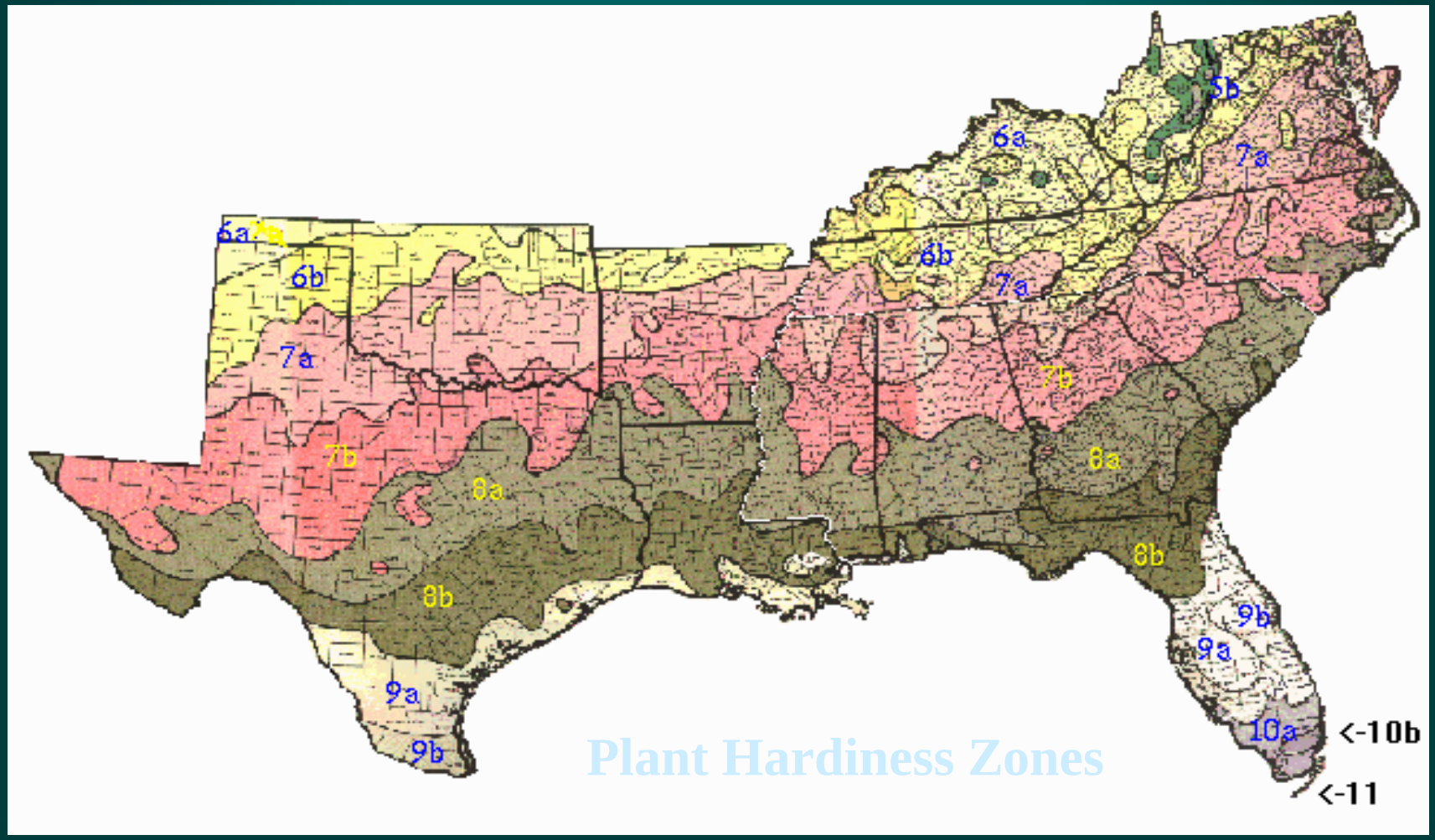
1) Average Temperature

2) Annual Precipitation

3) Soil Profiles (pH)

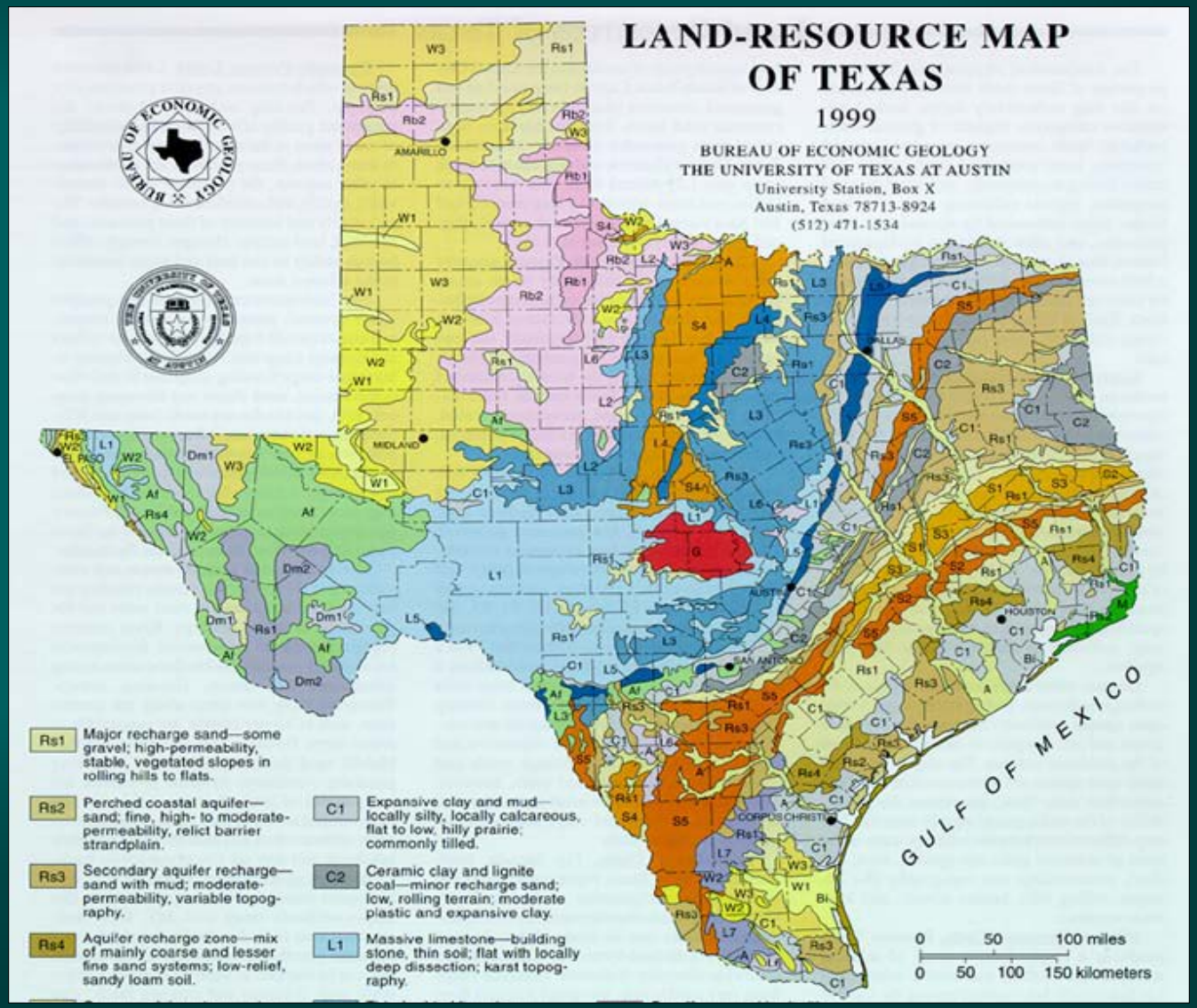
What Grows Where & Why

Large scale controlled by Climate



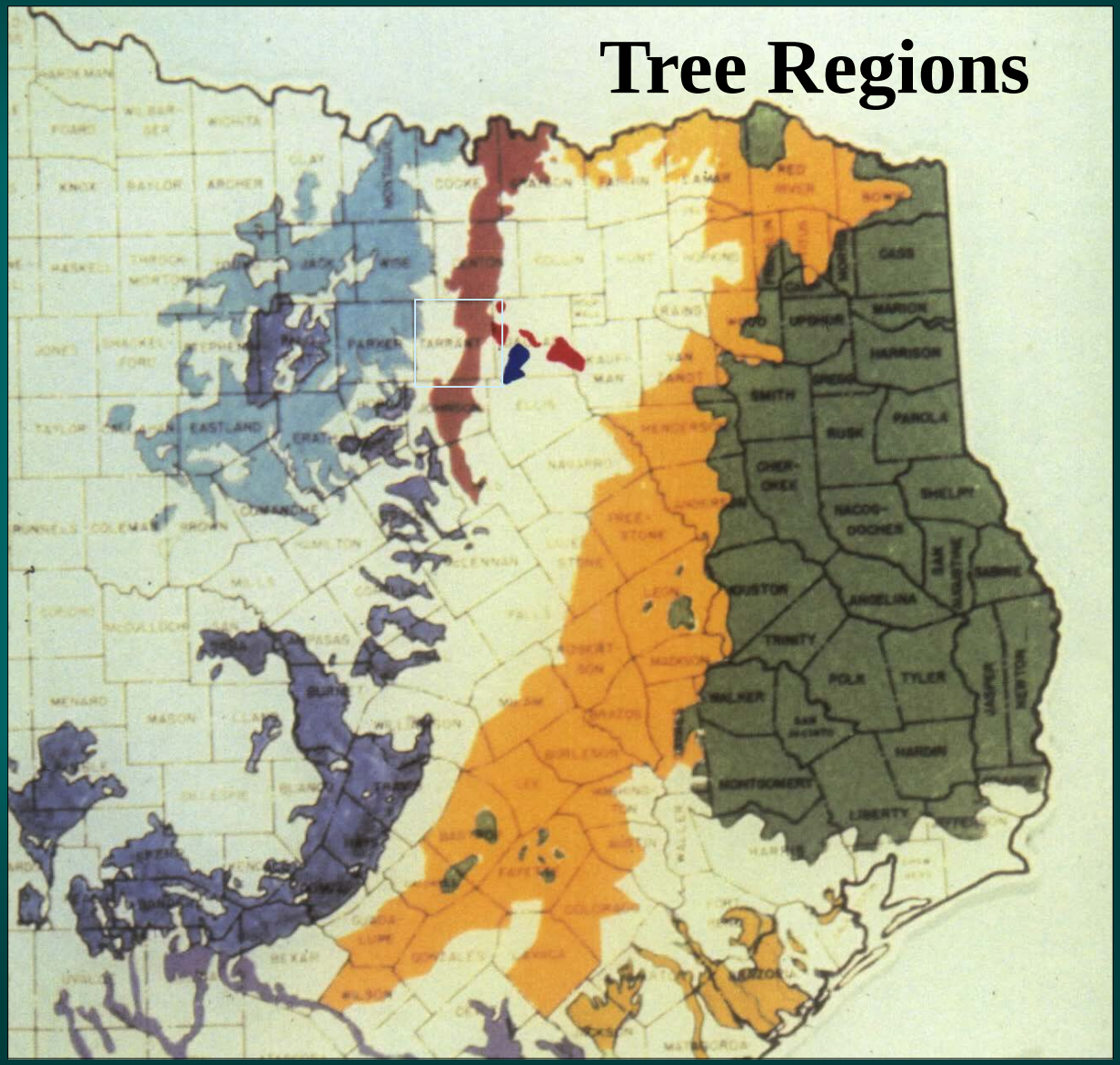
What Grows Where & Why

Small scale controlled first by Dirt (Soils)



What Grows Where & Why

<u>… then by climate</u>




Leaf
Adaptation

A Natural Defense Mechanism

Natural & Man Caused Problems

How Do Trees Cope?

NATURAL: **Naturally Occurring Factors That Impact Plant Health.**

- ***Drought***
- ***Heat***
- ***Fire***
- ***Insects***
- ***Disease (Oak Wilt)***
- ***Wind***
- ***Flood***
- ***Freezes***
- ***Ice***

MAN_MADE: **Factors That Influence Plant Health That Do Not Occur Naturally (Man Made)...**

- ***Chemical Damage***
- ***Soil Compaction***
- ***Vandalism***
- ***Firewood***

Let’s Talk Parts

What is a Tree?

“ A Tree is a single stemmed, woody plant at least 3 inches in diameter and 8 feet in height with a perennial canopy” ***Author Unknown***

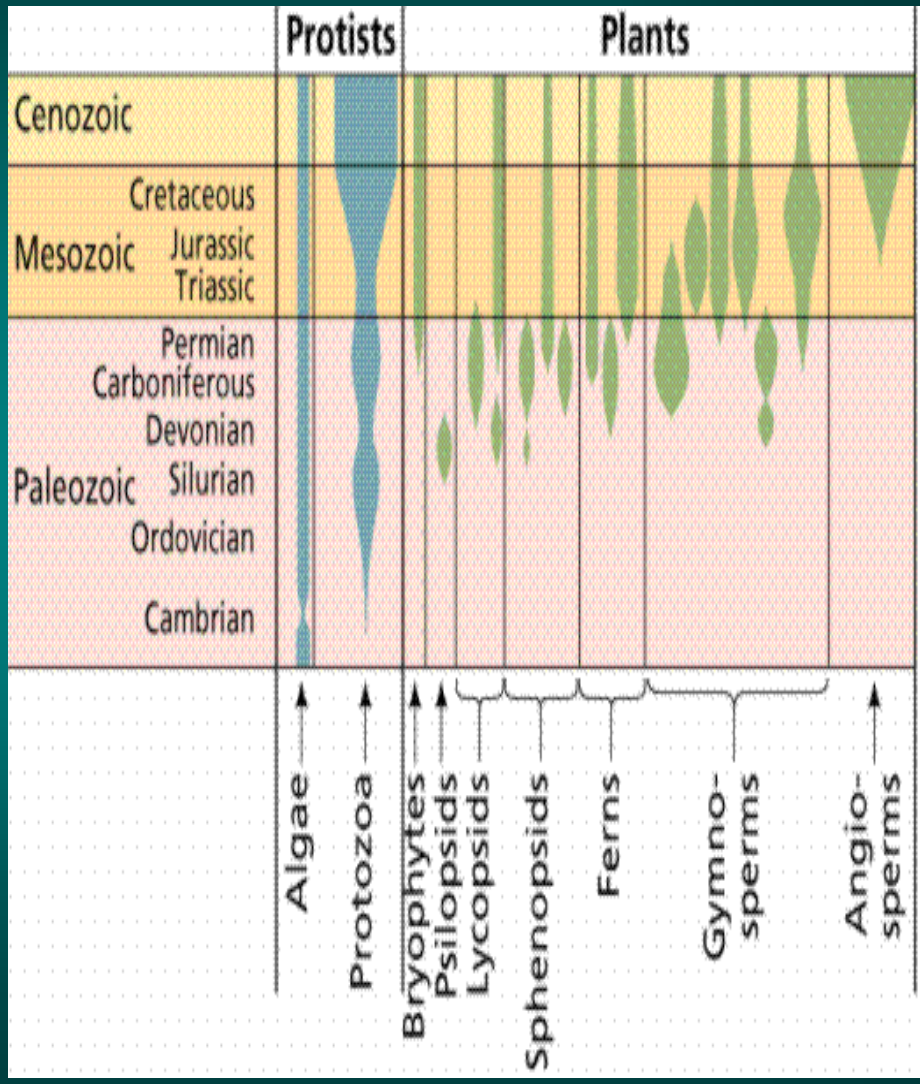
What is a Tree….Really?

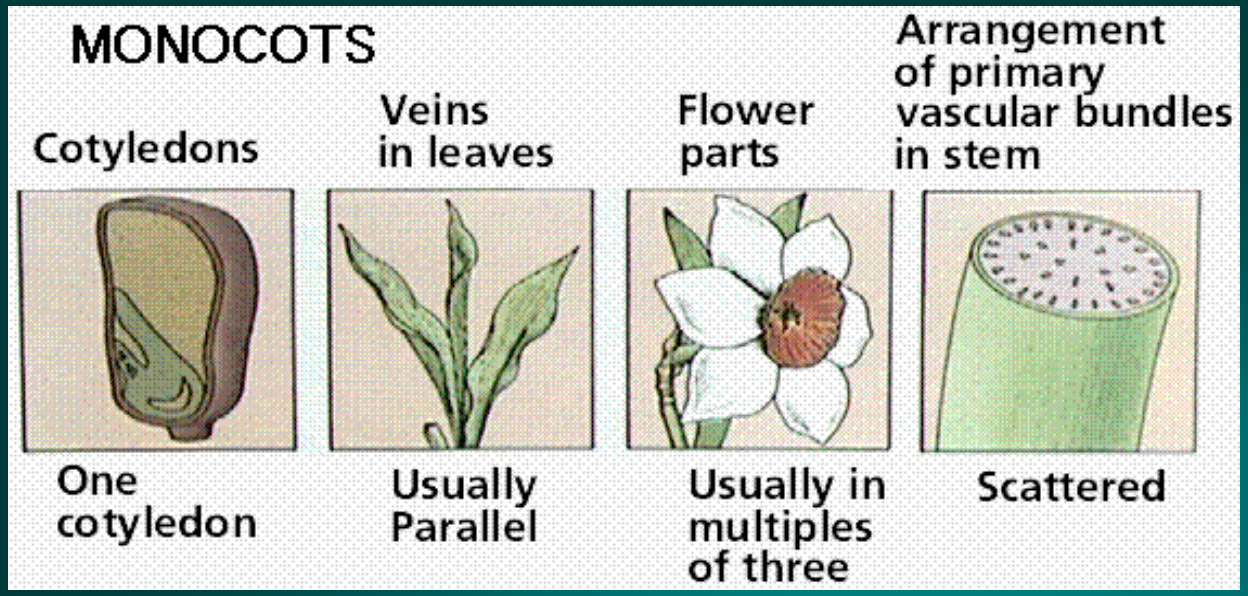
REALLY…..??

All trees fall into two distinct categories:

ANGIOSPERMS (flowering plants): Most recent, appearing approx. 110 million years ago (Mesozoic) from an unknown (Gymnosperm) ancestor. Has risen to dominance in most of the flora communities of the world.

GYMNOSPERMS (flowerless plants): The first seed-bearing land plants dating back in excess of 300 million years. Living groups include: Pines and Gingko.





Flowering plants are again divided into two distinct types:

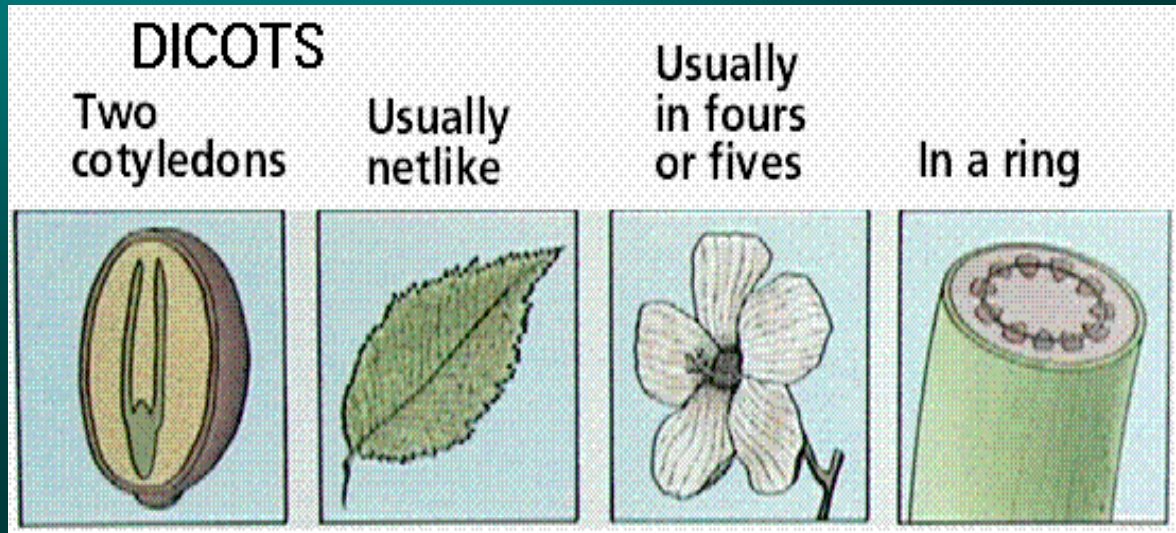
"DICOTS"

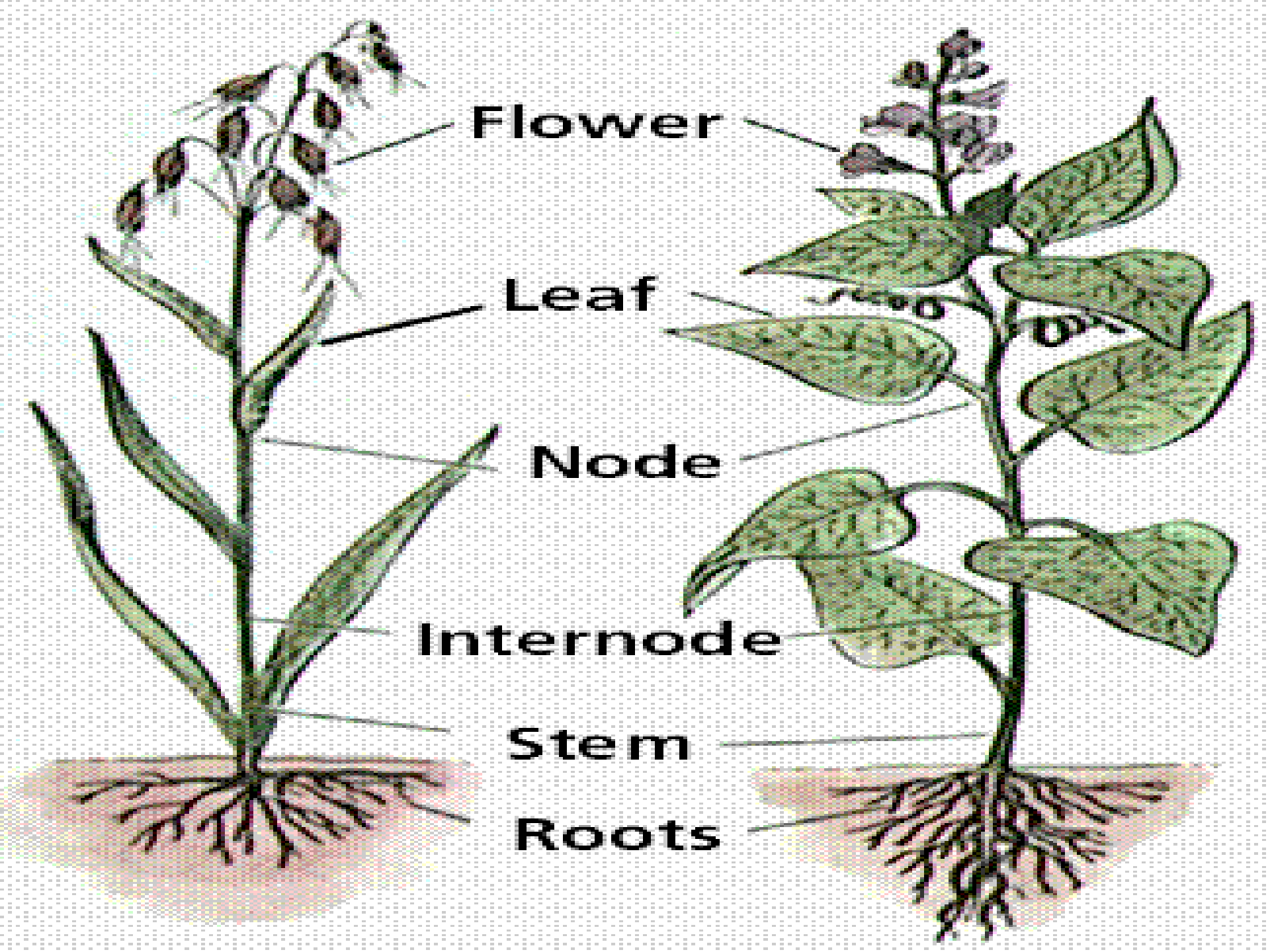
and

"MONOCOTS"

Examples of a Monocot would be Grasses, Corn and Bamboo.

Most common tree species are classified as Dicots.




Flower
Leaf
Node
Internode
Stem
Roots

More On Parts....

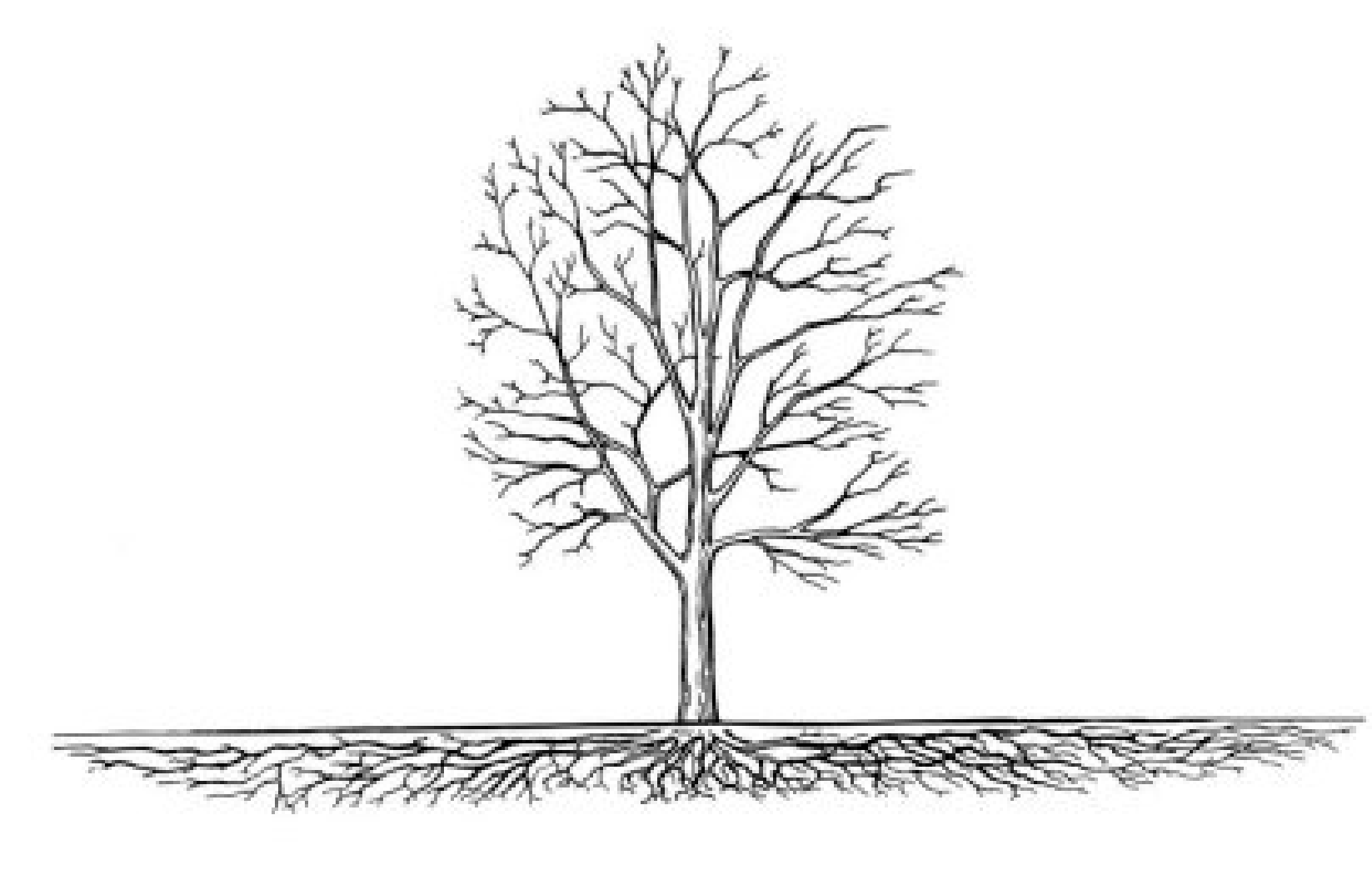
The Root System → **Anchors the plant.**

H_2O and nutrient absorption, storage and transport.

The Stem → **Main H_2O and Nutrient Transport System (Storage). Also, support.**

The Leaf → **Uses radiant energy (sunlight) to convert CO_2 and H_2O, into useable fuels (sugars/carbohydrates are synthesized into useable fuel for the system)**

The Root System



Functions of Tree Roots

- Anchorage
- Absorption and transport
- Storage

Anchorage

Trees need healthy roots for support and stability

Tree roots and anchorage fail due to:

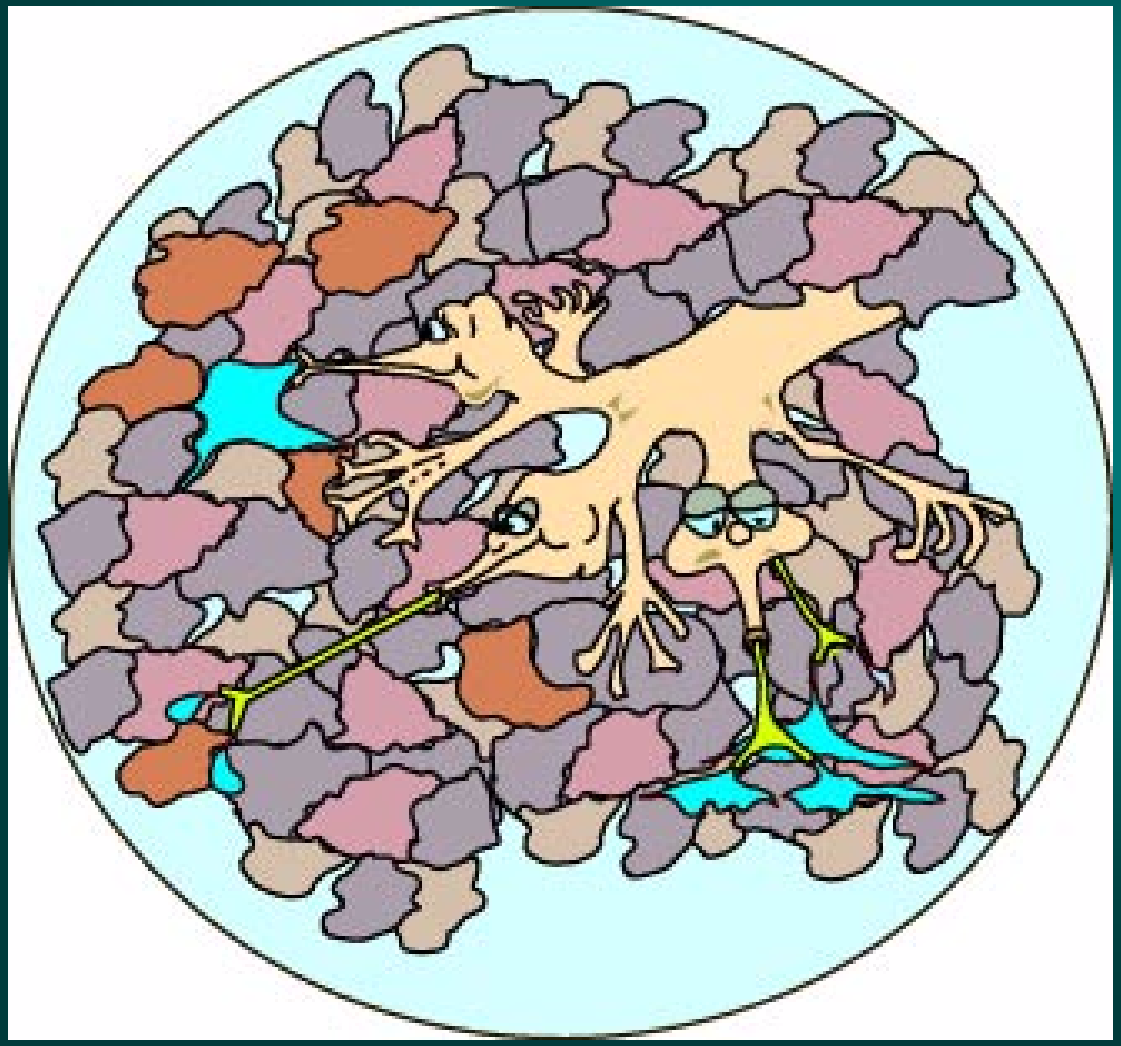
Diseased roots

Excessive fill or compacted soil

Excess water

Severed roots

Absorption and Transport

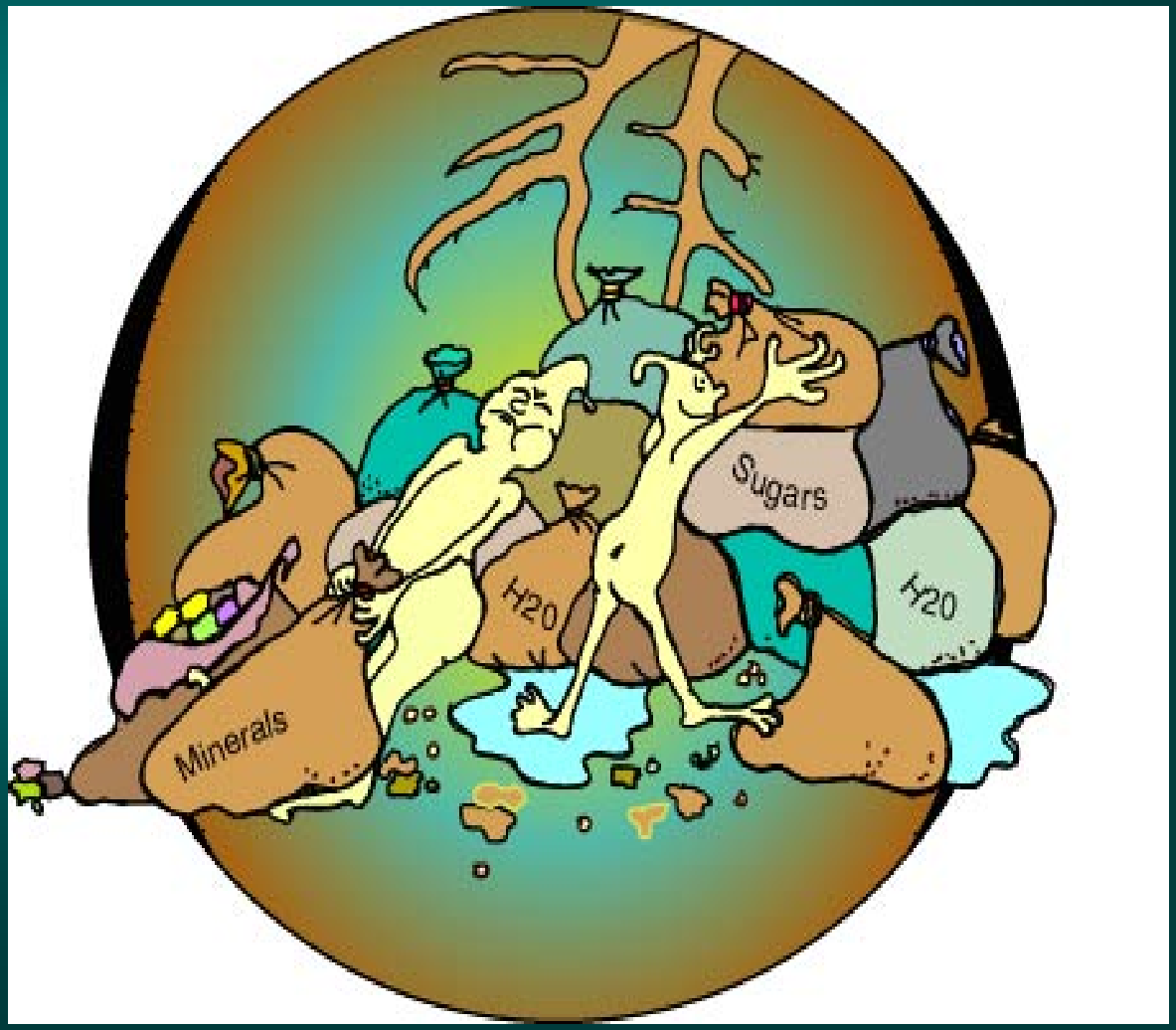


- Roots absorb water and nutrients from the soil
- Roots translocate (move) water and dissolved nutrients to other tree parts


Small absorbing roots are covered with fine root hairs

Storage

- Roots store reserves of sugars, starches and other materials
- Trees use stored reserves for growth and repair



Where Tree Roots are Located

Tree Root Depth

Deep enough to avoid sunlight and to stay moist shallow enough to absorb adequate oxygen.

In medium textured soils most fine, non-woody tree roots grow in the upper 6” of soil with 80% of all roots in the upper 12” to 36” of soil.

Tree Root Spread

Whether a younger or an older tree, roots may extend ...

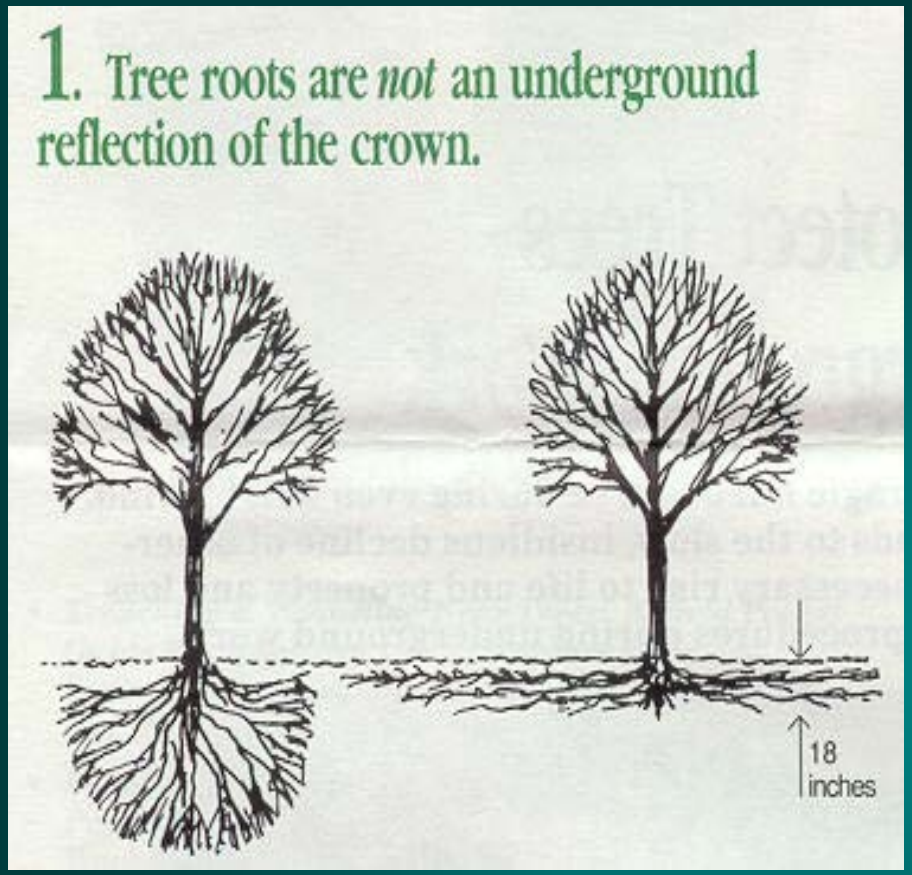
... 2 to 4 times beyond the drip line.

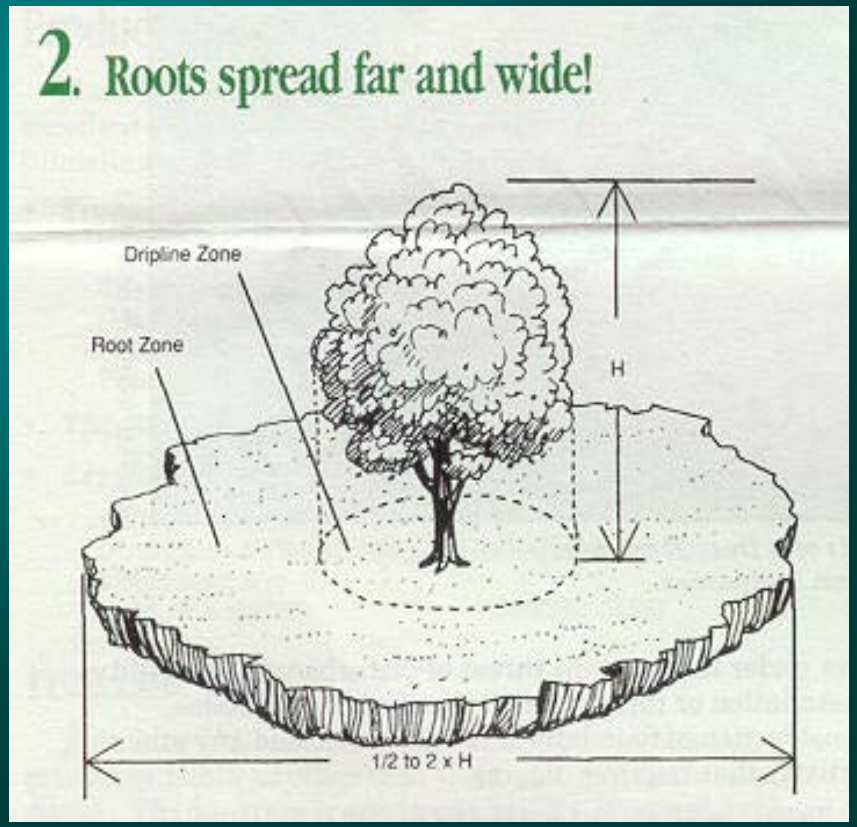
This red maple root is 60 feet long in one direction, yet the tree is only 30 feet high

Root Spread Limitations

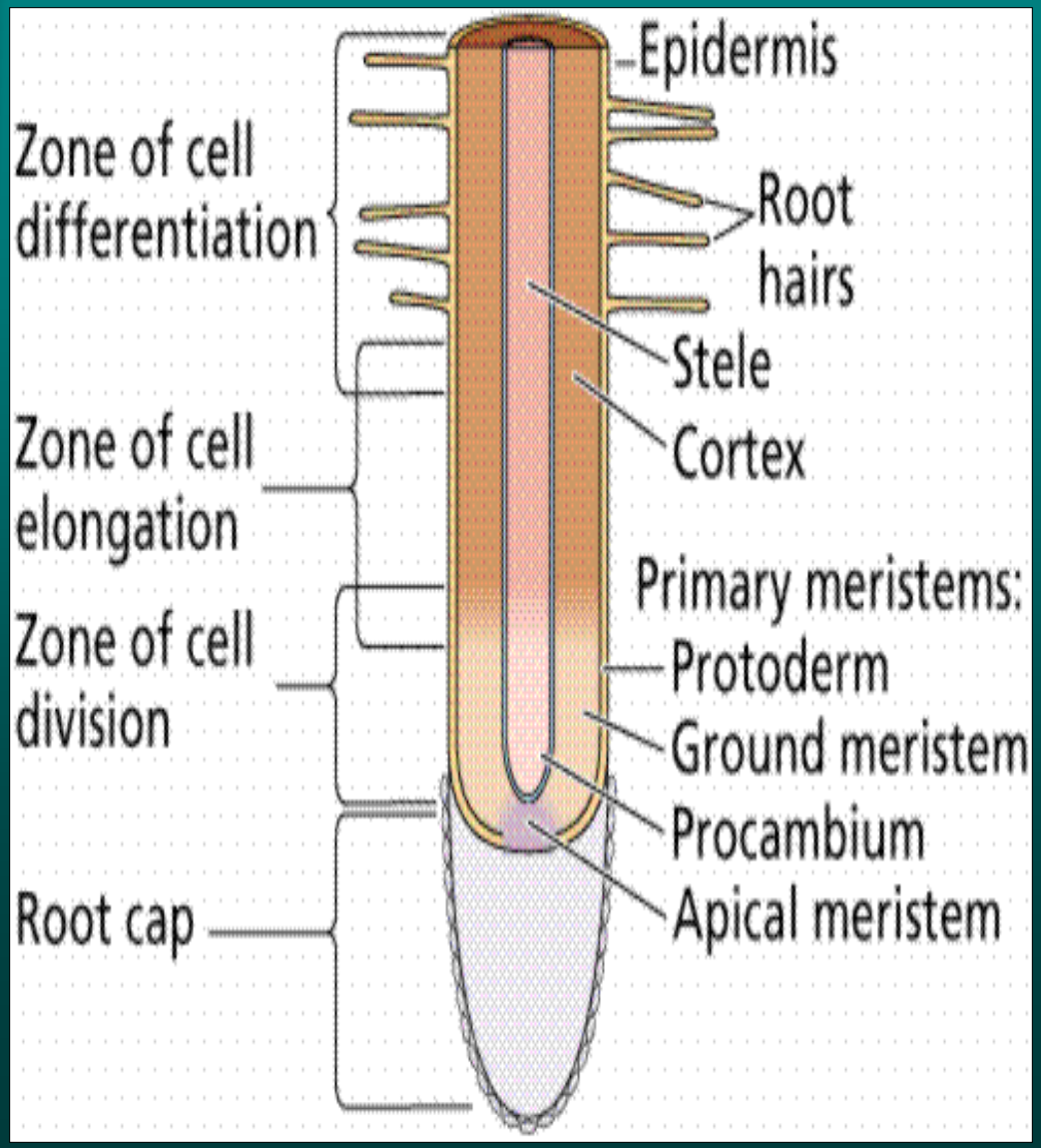
(buildings, containers, curbing, median strips, parking islands, tree pits and other obstacles)

Root Spread


1. Tree roots are *not* an underground reflection of the crown.
18 inches


2. Roots spread far and wide!
Dripline Zone
Root Zone
H
1/2 to 2 x H

The Root System



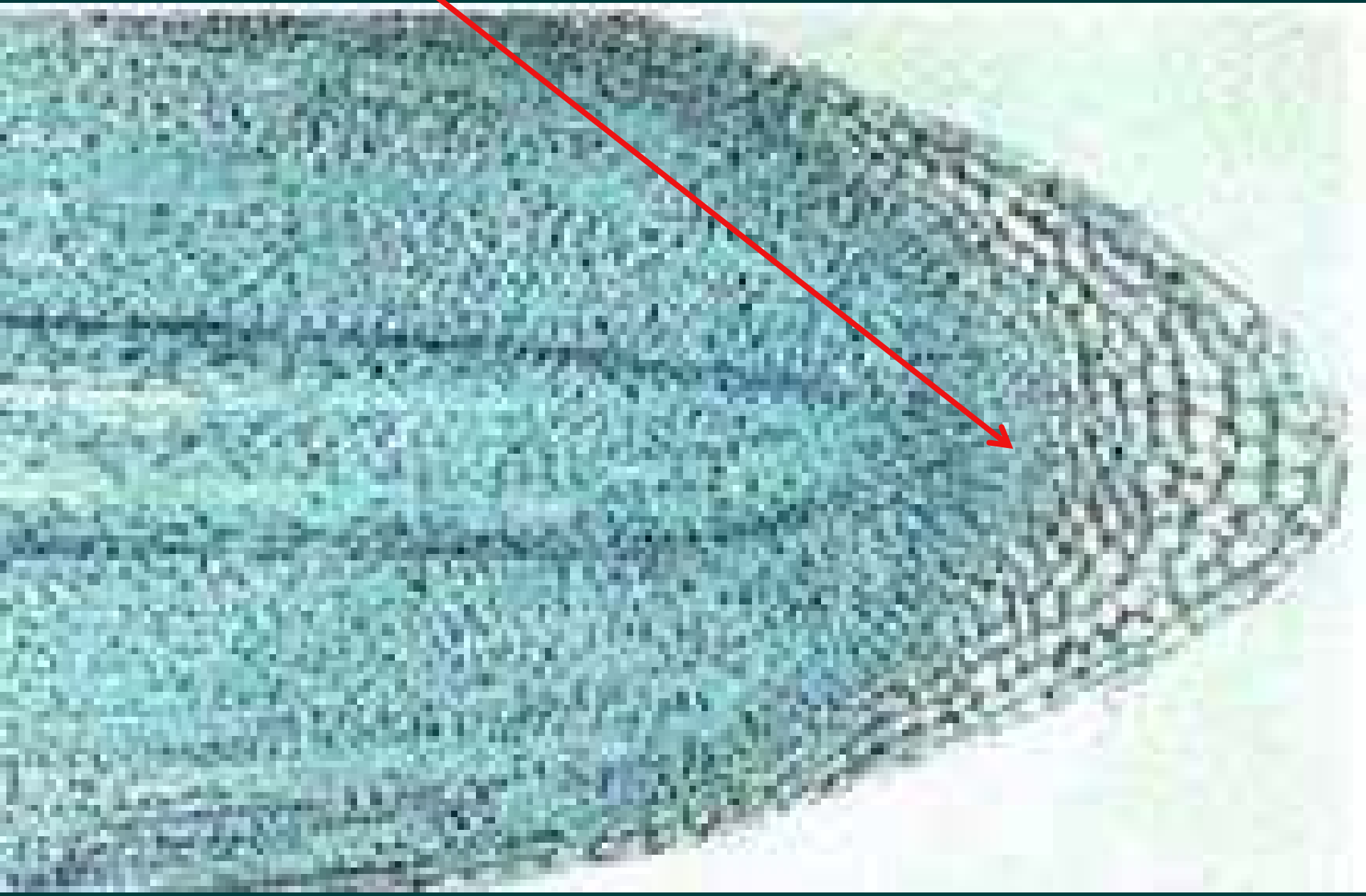
The most significant parts to remember about the root system are:

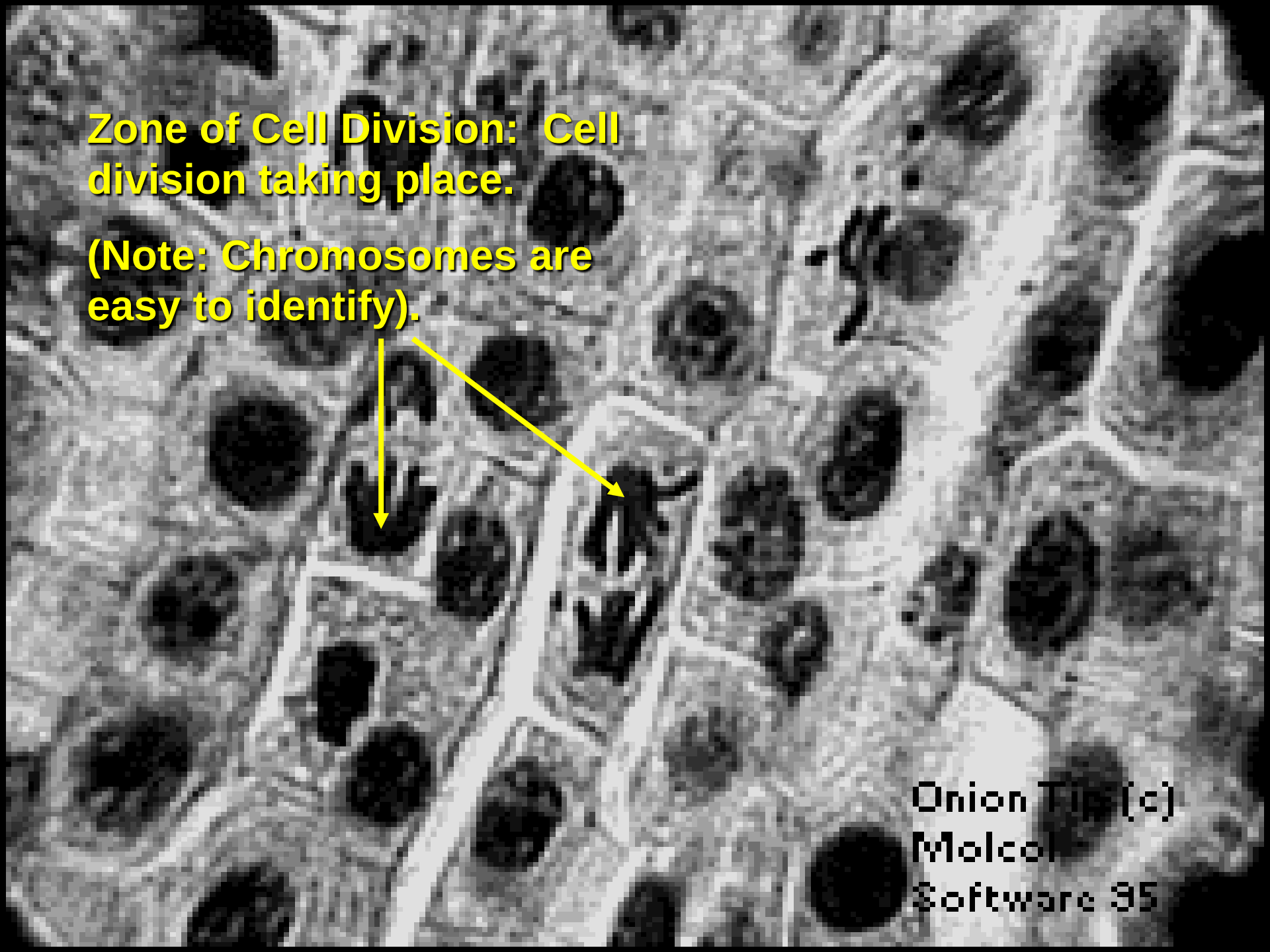
***ROOT HAIRS:* Die and regenerate throughout the life of the plant. MAJOR surface area designed to absorb water and minerals.**

***ZONES OF CELL DIVISION:* Root Cap, Zones of Cellular Division, Elongation and Differentiation.**

STABILIZES THE PLANT!

Apical meristem




Zone of Cell Division: Cell division taking place.
(Note: Chromosomes are easy to identify).
Onion Tip (c)
Molcol
Software 95

The Stem

Key Elements of the vascular system that make up the STEM.

VASCULAR CAMBIUM: **Area of rapid cell division that is responsible for secondary growth (girth). Separates the Xylem & Phloem.**

XYLEM: **Grows to the *INSIDE* of the cambium. Prominent cells (Tracheids & Vessels), comprise annual growth rings. H^2O & nutrient transport from roots to canopy.**

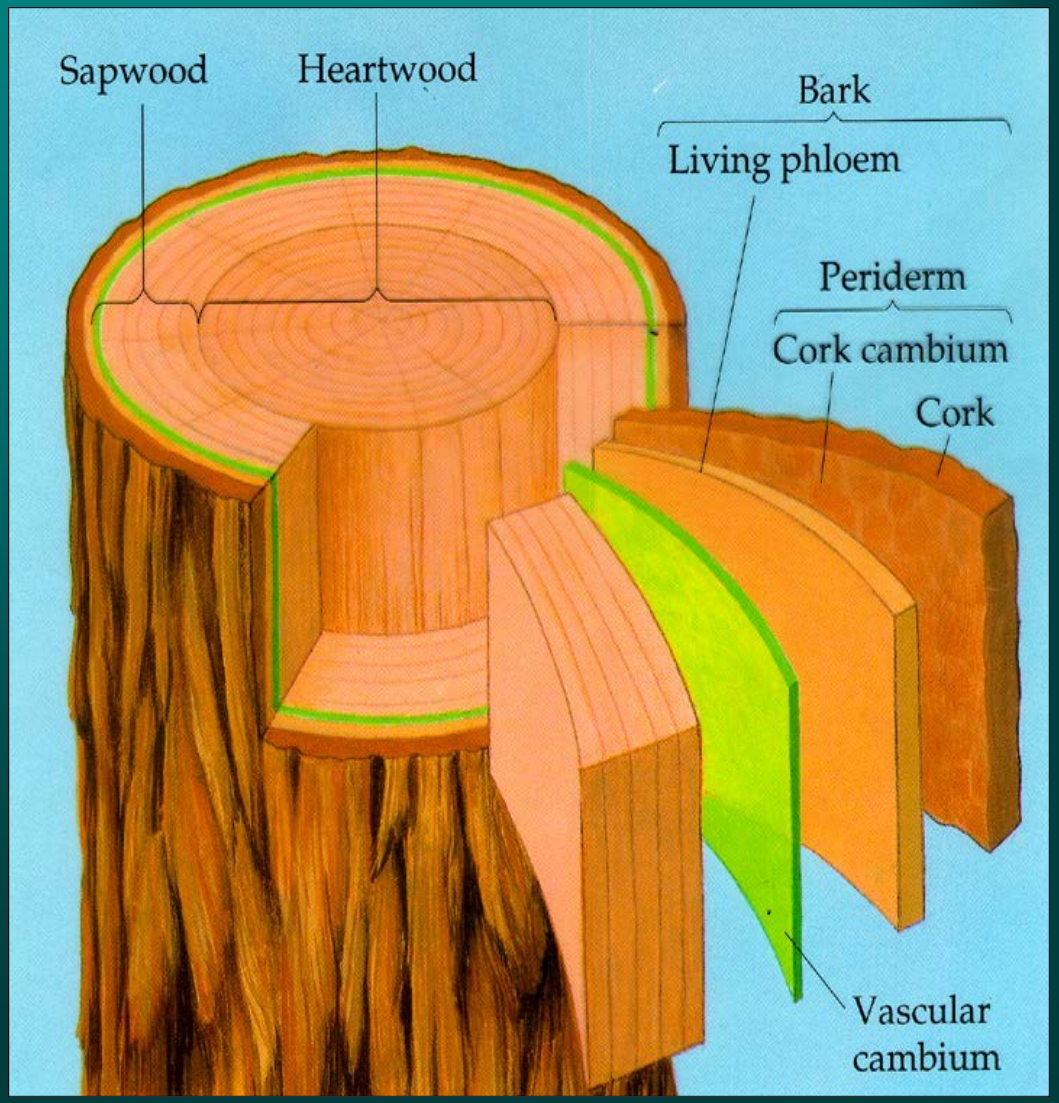
PHLOEM: **Very thin layer growing on the *OUTSIDE* of vascular Cambium. Prominent cells (Sieve Tubes and Companion Cells), transport nutrients downward from the canopy to root system and rest of tree.**

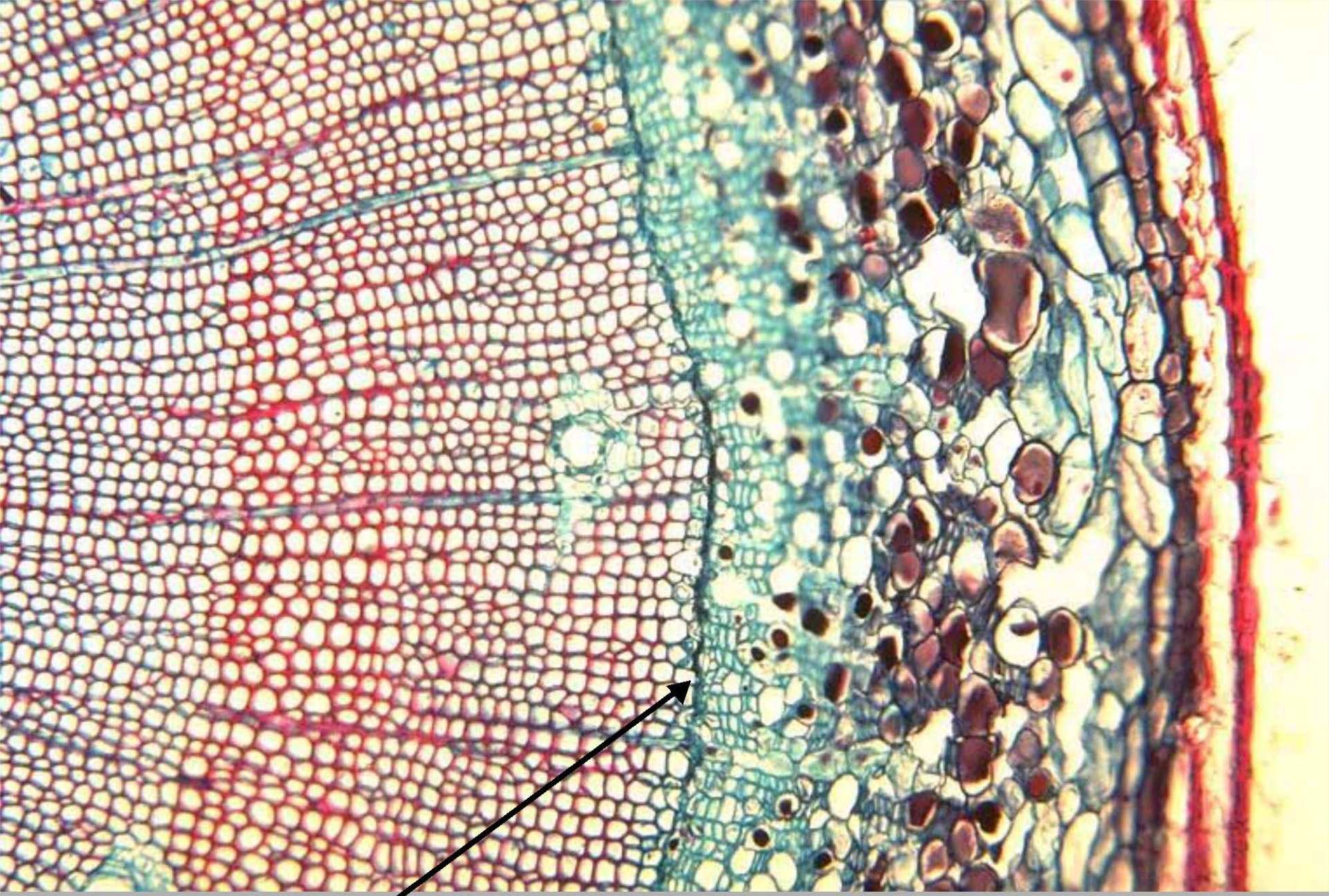
CORK CAMBIUM: **Outermost component. Essentially non functional except in formation of the outer bark layer and formation of loose bark cells called *LENTICELS*, that are produced to facilitate gaseous exchange from the atmosphere to internal living cells.**

The Stem

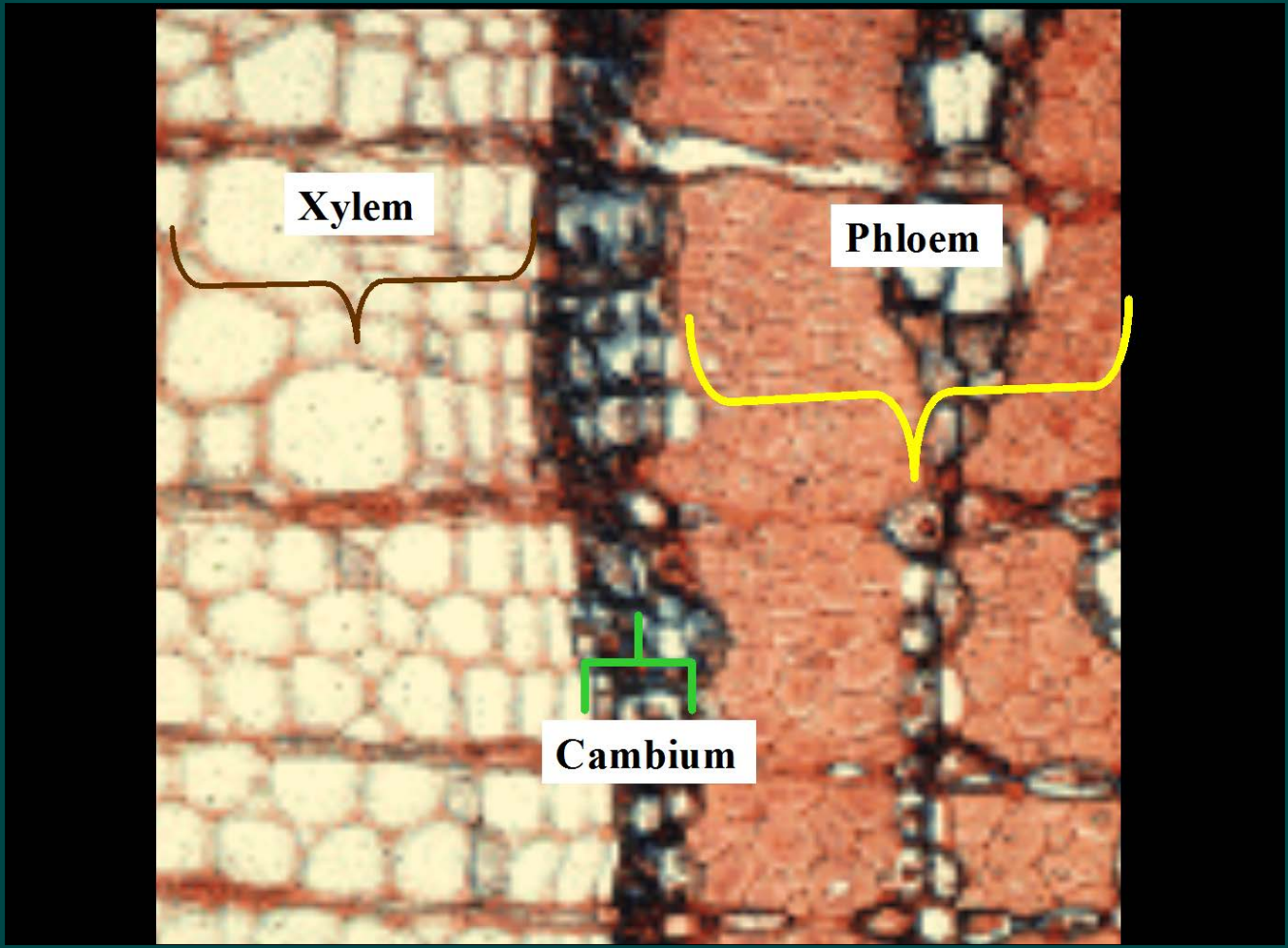
Definition:

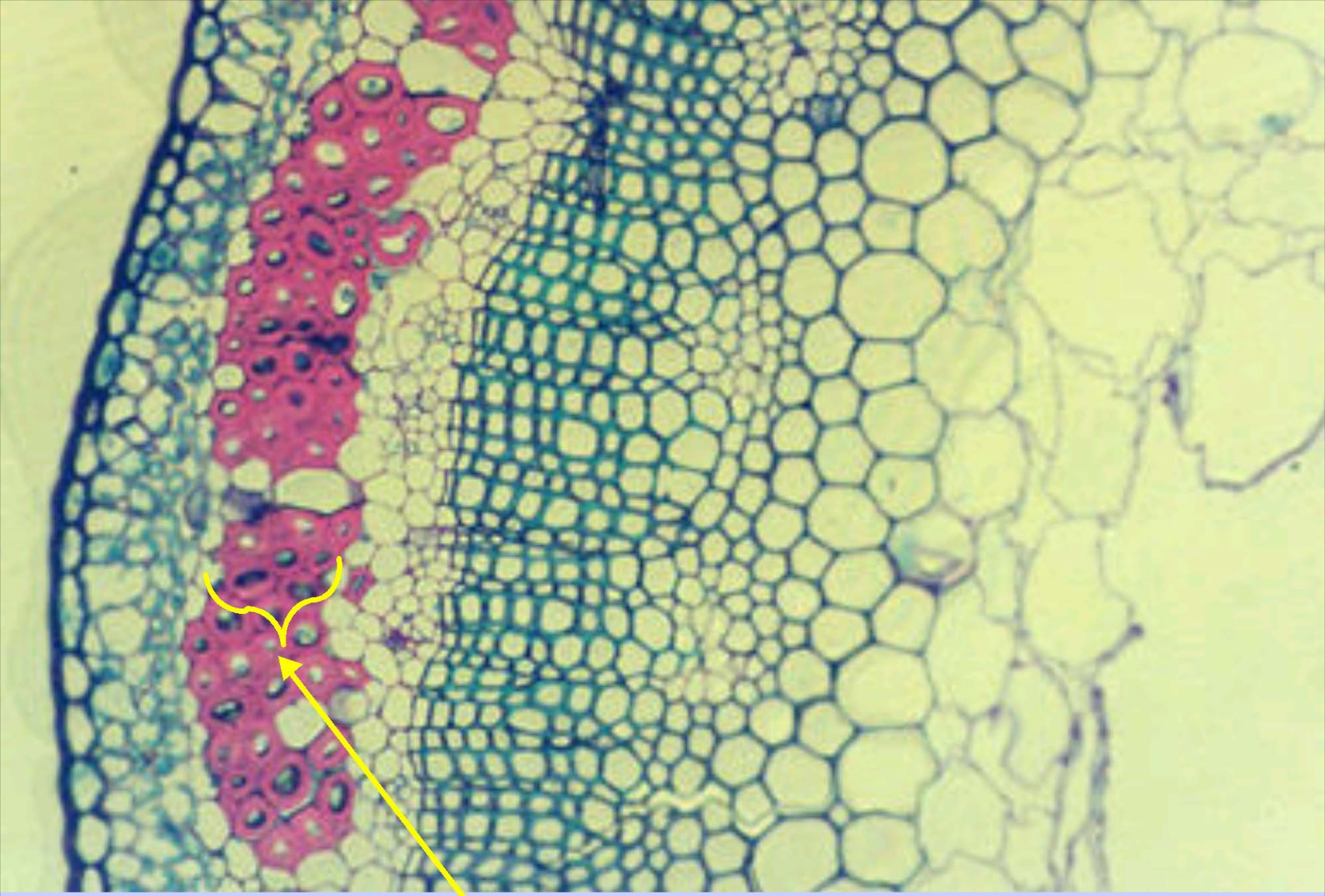
The cells of the plant body that are formed and differentiated directly from the Apical Meristems (major growth areas of the roots and shoots). The STEM constitutes the primary tissues of the plant.





Vascular cambium


Xylem
Phloem
Cambium



Phloem

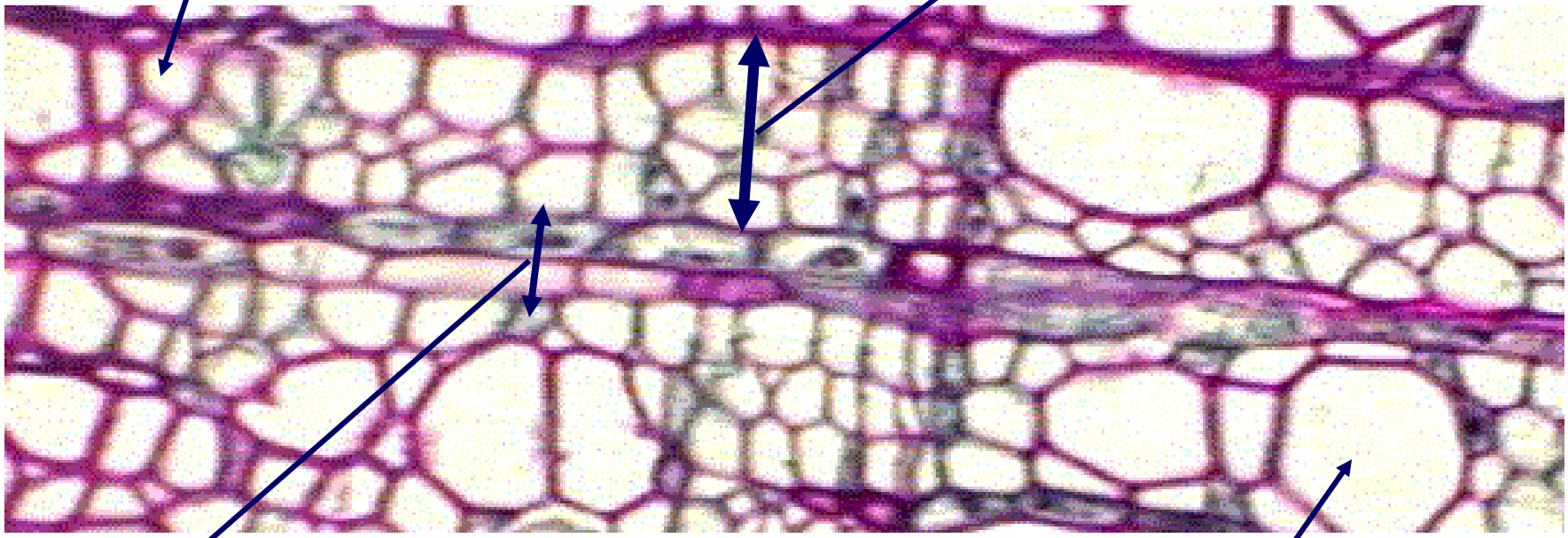
Annual Growth Ring

(The Xylem)

Spring Wood

(also called Early Wood)

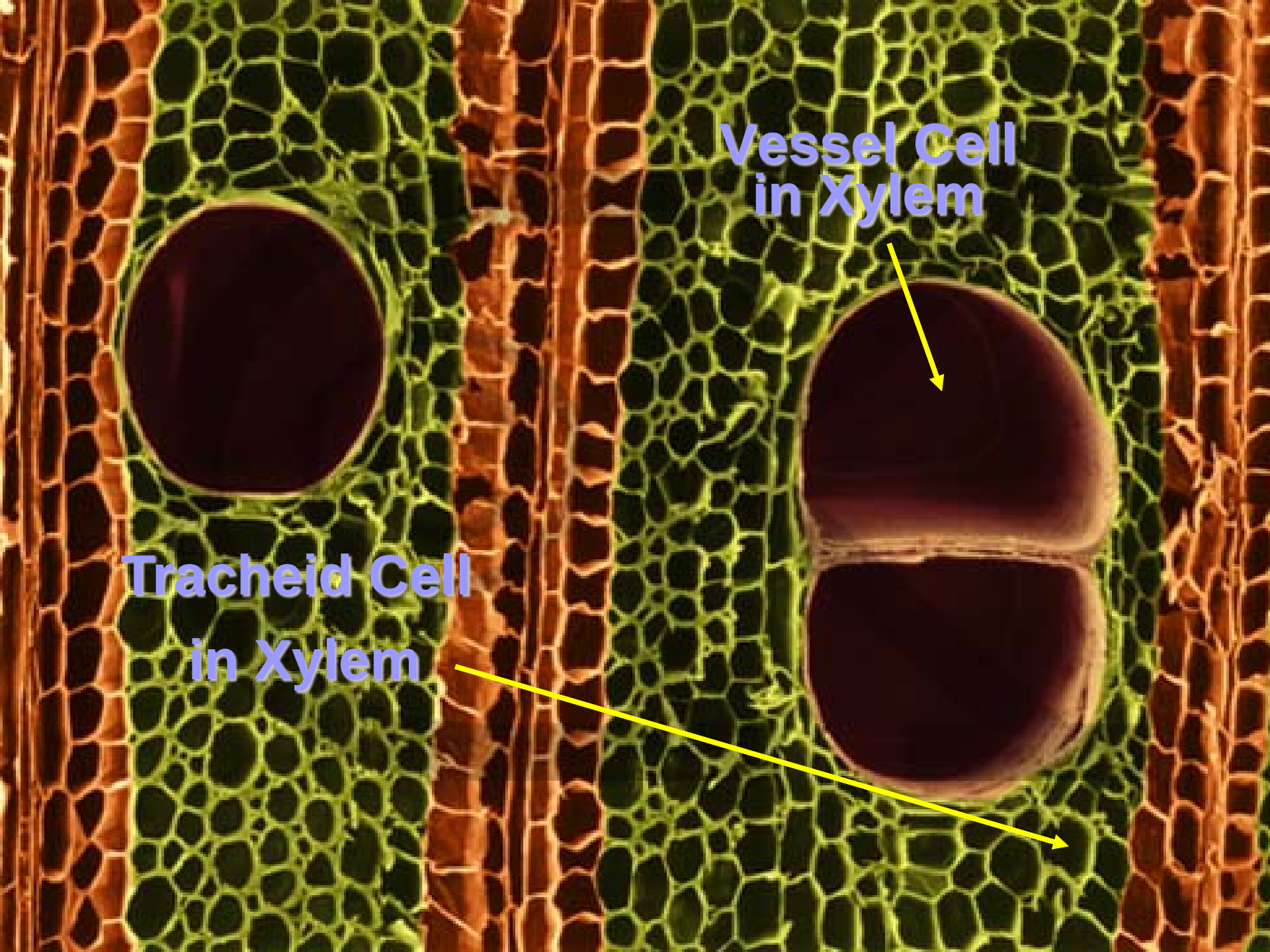
Tracheid Cell



Summer Wood

(also called Late Wood)

Vessel Cell


Vessel Cell
in Xylem
Tracheid Cell
in Xylem

The Transport System

Terms you need to understand: ***(good luck!)***

The movement of substances into a plant from it's surroundings is accomplished through a process known as ***DIFFUSION:*** ***It is simply the movement of liquid (or gas) through a semi- permeable membrane (cell wall).***

OSMOSIS: Movement of liquids (gases) from cells containing high concentrations of solutes, into cells containing low solute concentrations, until an equilibrium is reached. **The movement of these liquids from cell to cell is achieved by the process called diffusion.**

The TREE functions much like a Wick….In moving water and solutes from roots to crown.

The Leaf

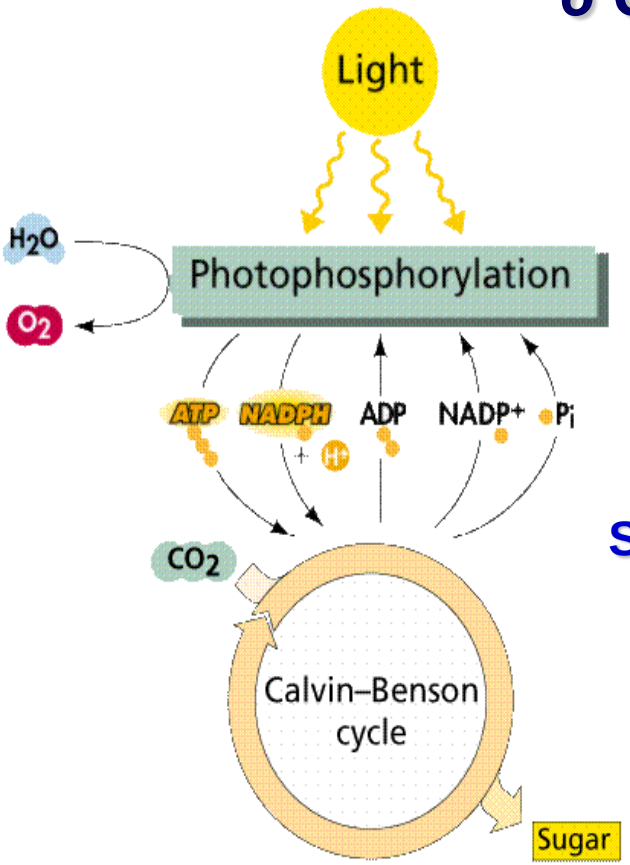
The leaf plays a vital role in the metabolic functions of a plant.

Perhaps the most vital is that of *PHOTOSYNTHESIS* where the plant captures radiant energy (sun light) and uses it to convert elements naturally occurring in it's system *(CO^2 & H^2O)* into sugars known as *GLUCOSE.* A second process further processes sugars into useable energy commonly referred to as starches.

Photosynthesis

Glucose

$$6\ CO_2 + 6\ H_2O\ (Sunlight) \Rightarrow C_6H_{12}O_6 + 6O_2$$

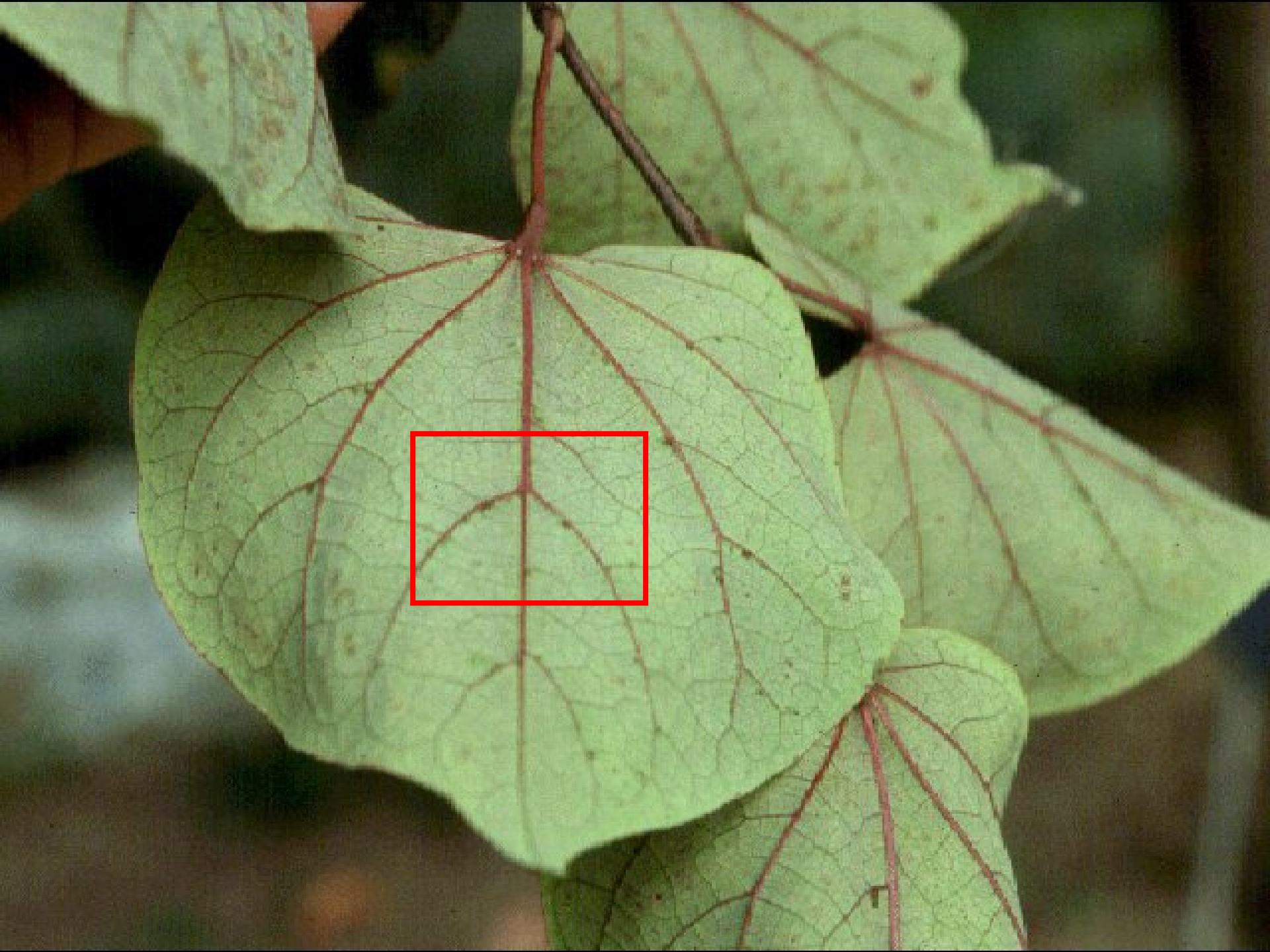


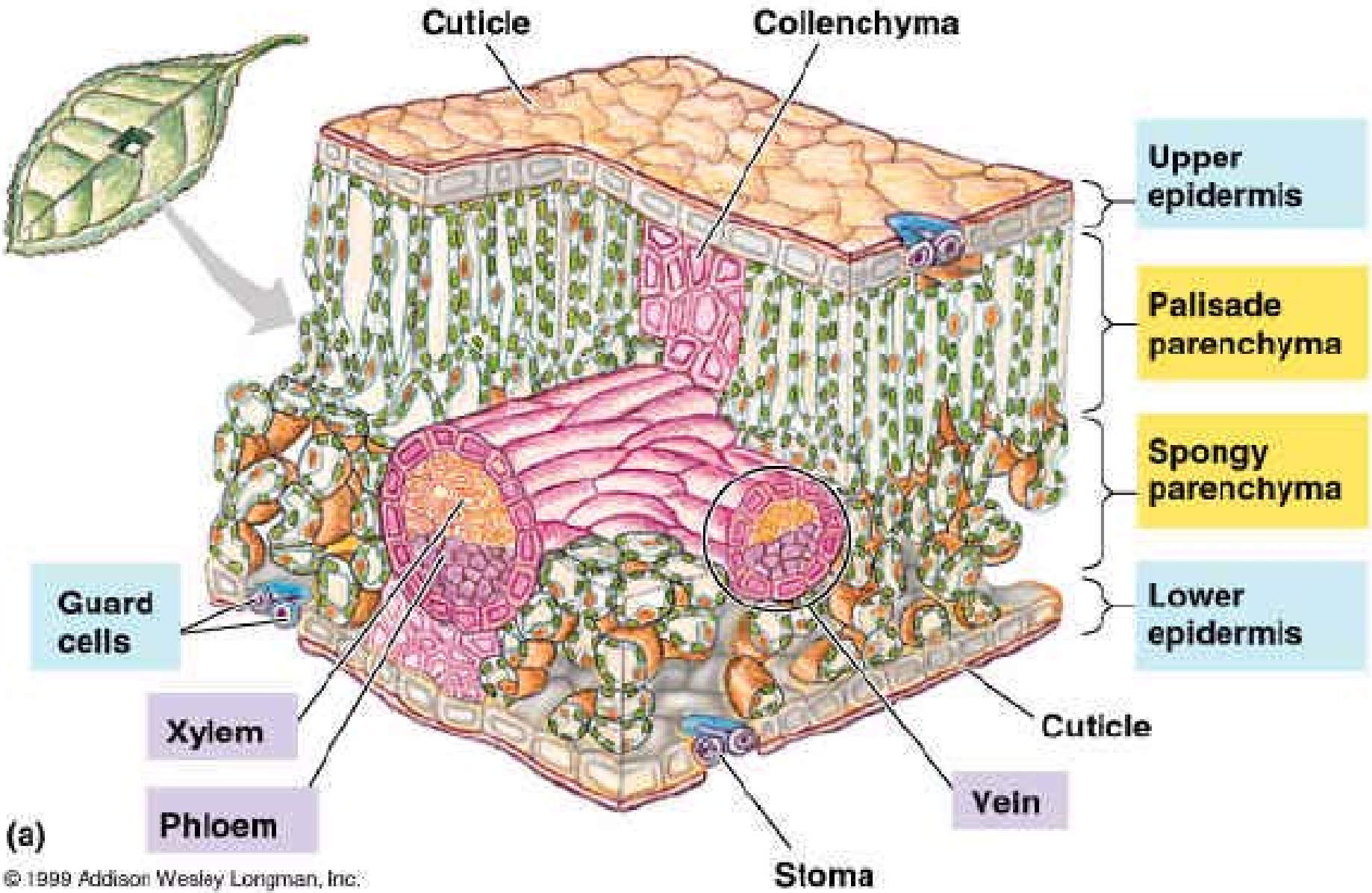
Six Oxygen Molecules Are Released into The Atmosphere

Some Factors That Can Effect Photosynthesis:

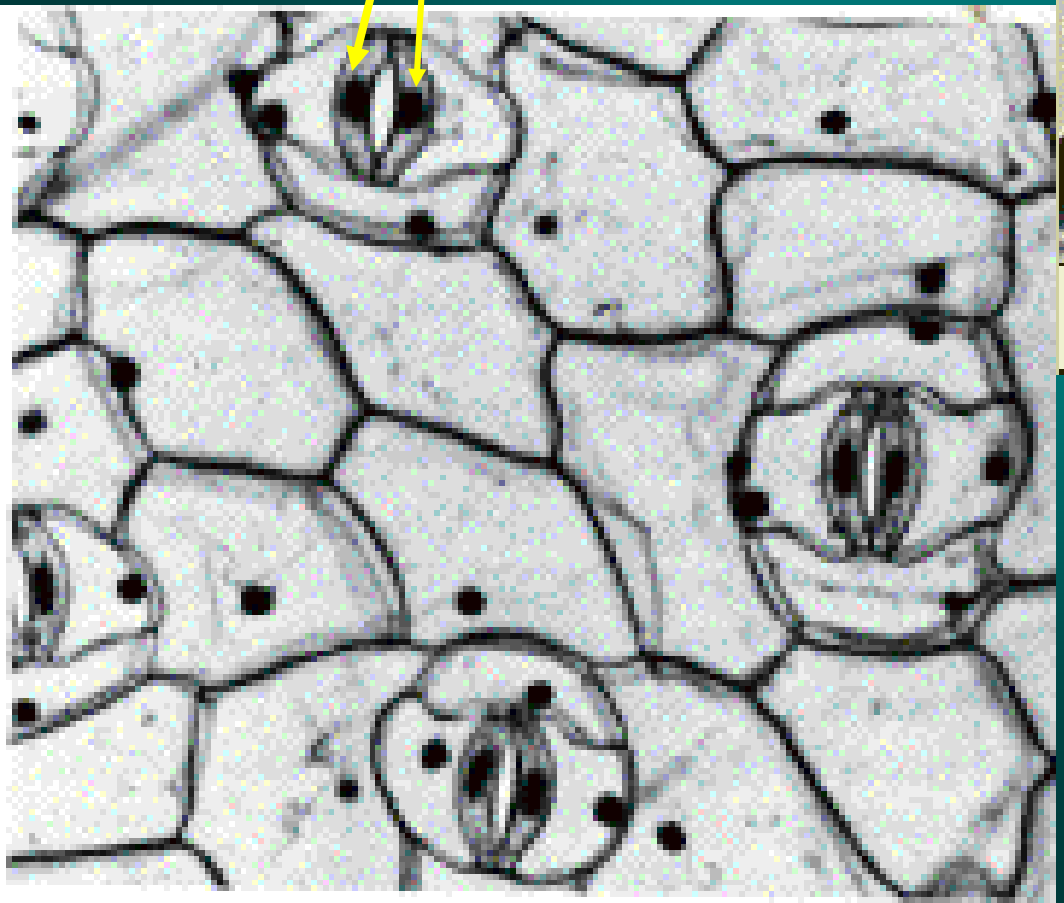
* ***Amount of Light***
* ***CO_2 Availability***
* ***Temperature***
* ***H_20 Availability***

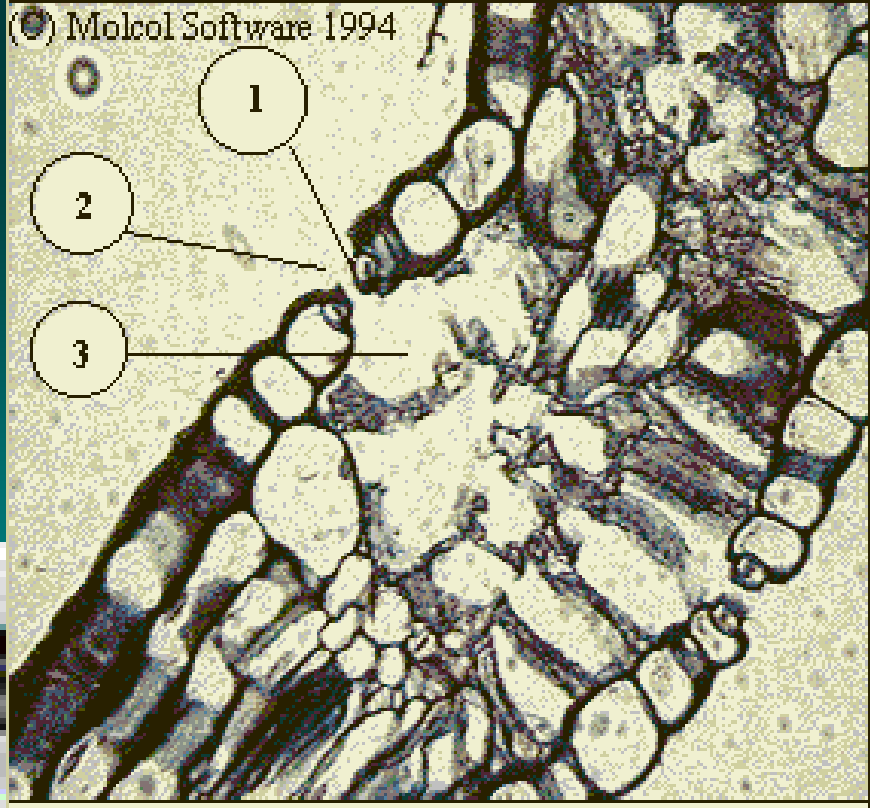
Don't forget about "Respiration"





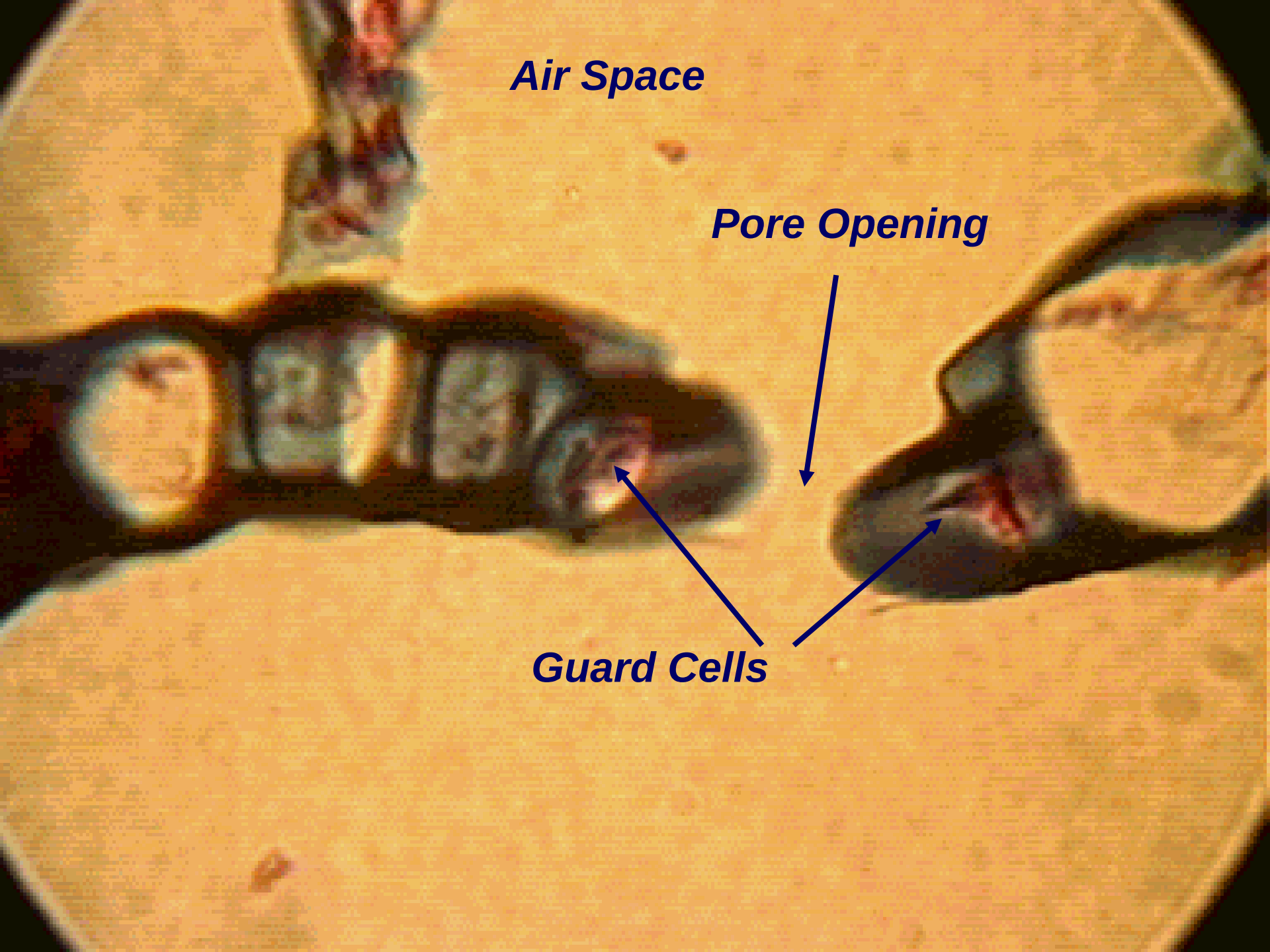
2 guard cells, one on each side of the opening.



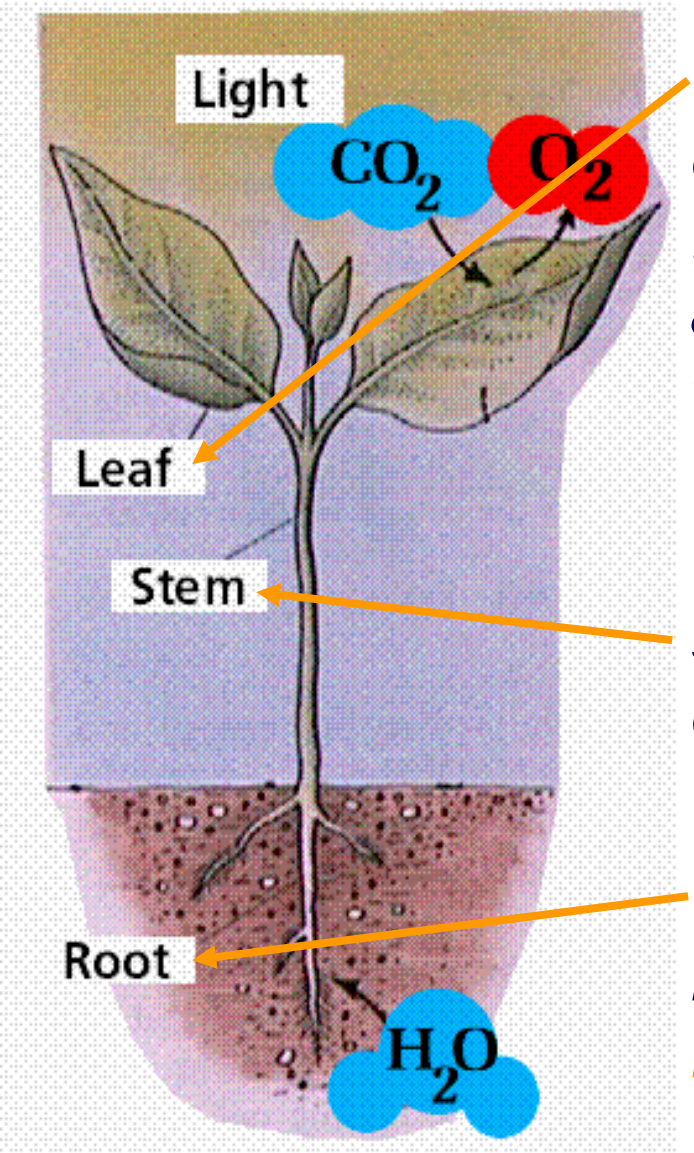


Two stomata are visible - one on each side of this leaf section. A Stoma consists of the pore itself -(2) and the two surrounding guard cells - only 1 indicated -(1). The air space -(3) is also visible. (Image from Molcol Software)

Stomata


Air Space
Pore Opening
Guard Cells

The Tree Thing..Summary



The Leaves process water and carbon dioxide (Photosynthesis) to form complex sugars (fuel), which are sent back through (Phloem) the tree for storage and use.

The Stem transports water and solutes (Diffusion & Osmosis), to crown via the Xylem.

The Roots absorb water and nutrients with help from Root Hairs.

***Tree Health*: Is the key when dealing with Biotic and/or Abiotic Stresses.**

- ***High Energy Reserves to recover after defoliation from non - infectious diseases, insects or environmental stresses.***

  Examples:

  - ***Drought / Heat***
  - ***Fungal Leaf Spots***
  - ***Anthracnose***
  - ***Web Worm, Bag Worm***

BUT… How do Trees Deal with Injuries?

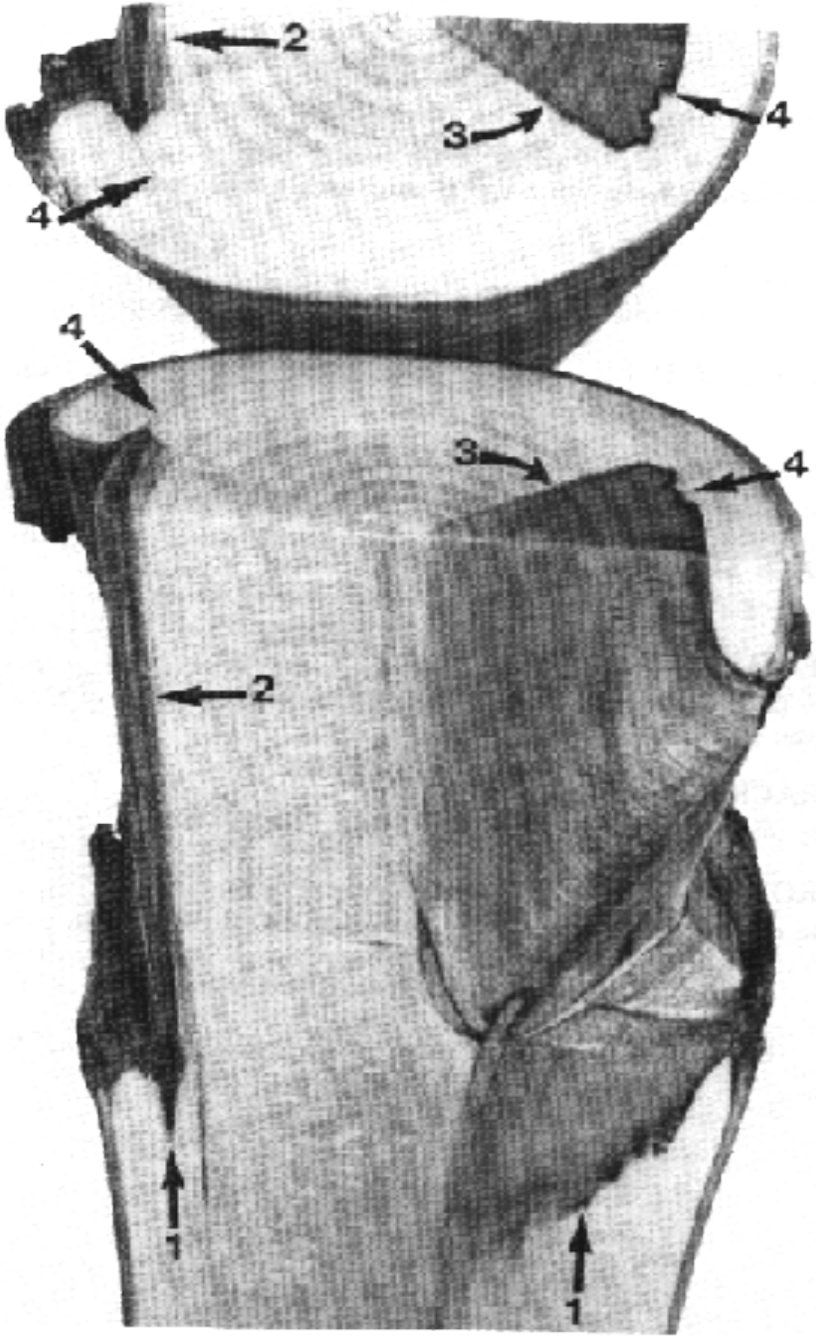
CODIT

"Compartmentalization of Decay in Trees."

COMPARTMENTALIZATION

Vascular plants differ from us greatly when faced with wounding or infectious diseases. Unlike us, they lack *IMMUNE* systems. Instead, they have developed a process to cope known as,

COMPARTMENTALIZATION.



A wounded tree will NOT be capable of healing a wound by regenerating destroyed tissue.

Instead, the wound is "walled" off from the rest of the vascular system by the formation of *"TYLOSES"* thus, not allowing decay to spread into the rest of the system.

There are FOUR walls or boundaries:

Wall 1: Stops VERTICAL Spread by plugging vessel & tracheid cells in the xylem ***(weakest boundry).***

Wall 2: Stops INWARD spread toward the pith.

Wall 3: Stops LATERAL movement by plugging parenchyma and ray cells that are primarily for energy storage (strong).

Wall 4: Separates NEW wood from that which was present from the time of the damage ***(the strongest boundary).***

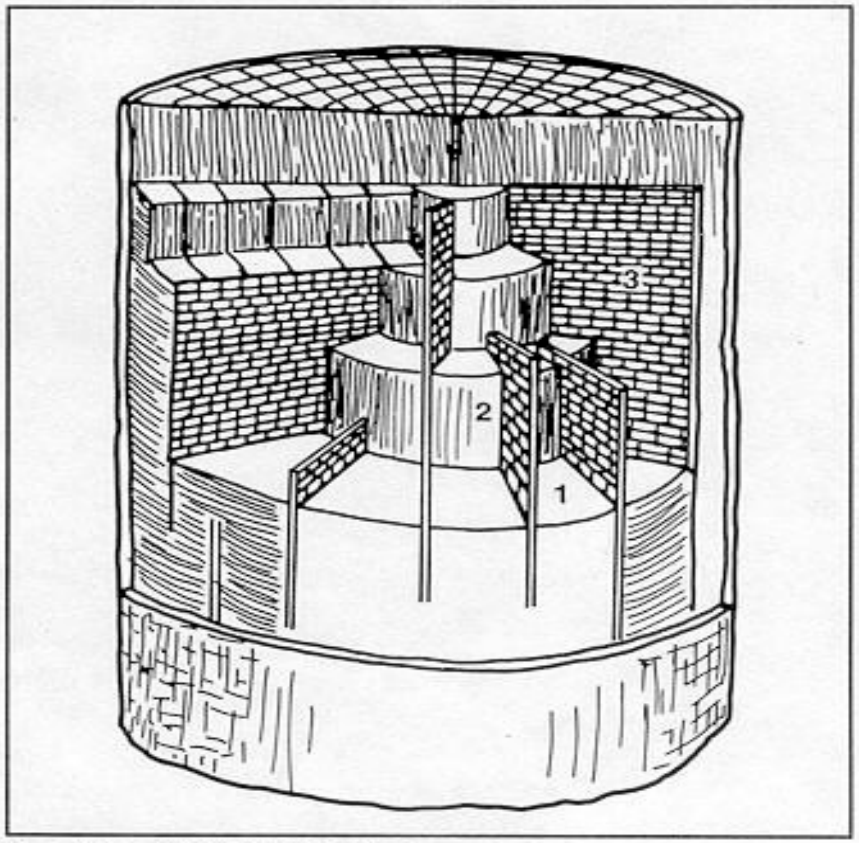


Fig. 1.16 CODIT. Wall 1 is formed when the tree responds to wounding by "plugging" the upper and lower vascular elements to limit vertical spread of decay. Wall 2 is formed by the last cells of the growth ring limiting inward spread. Wall 3 is the ray cells that compartmentalize decay by limiting lateral spread. Wall 4 (not shown), the strongest wall, is the new growth ring that forms

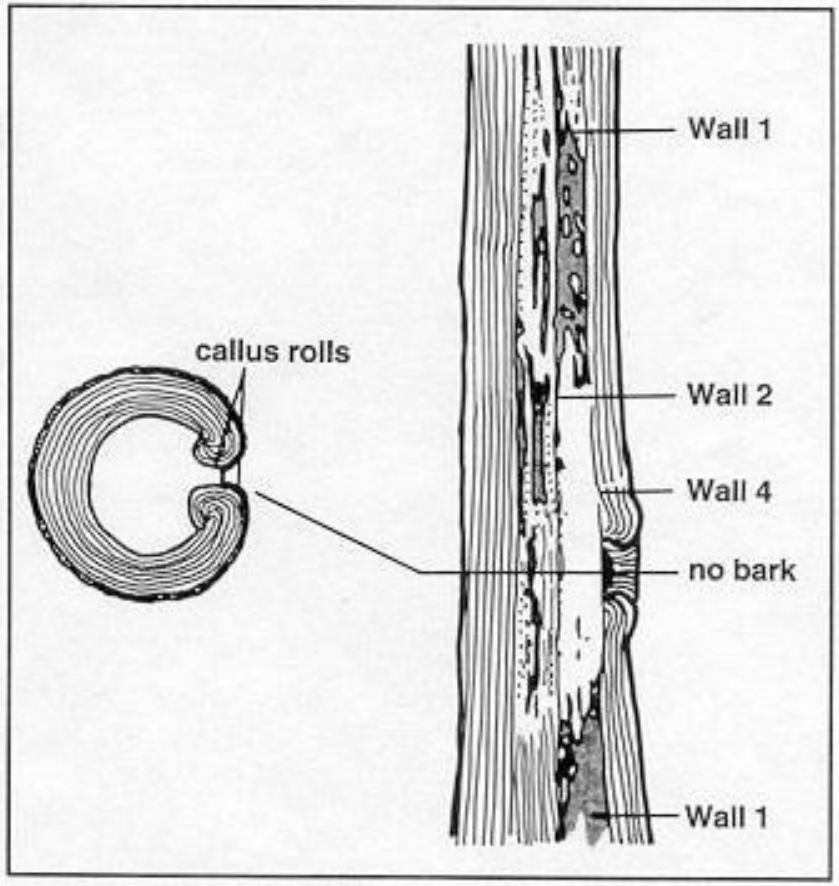


Fig. 1.17 Compartmentalization of decay. Wall 4 prevents decay from entering new wood. Wall 3, not shown, and Wall 2 have failed to prevent the decay from spreading laterally and internally.

C O D I T = compartmentalization of decay in trees

CODIT - continued

Compart-mentaliza tion helps contain the spread of decay within a tree

Conclusion

"It's only by understanding how a plant functions as a living, breathing and working organism, that we as managers can begin to make proper decisions regarding the protection and care of our tree resources." **- Jim Rooni**

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