

# The Plant Kingdom

[Resource Link](#)

# **There are many plant species on Earth.**

- **Between 260,000 and 300,000 plant species have been discovered.**
- **Many scientists believe that there are many more species to be found.**



# The Plant Kingdom

Kingdom Plantae

## Non-Vascular Plants

Bryophytes

## Vascular Plants

Tracheophytes

Liverworts  
*Marchantiophyta*



Hornworts  
*Anthocerotophyta*



Mosses  
*Bryophyta*



Spore-Producing Plants  
*Pteridophyte*



Seed-Producing Plants  
*Spermatophytes*



Club Mosses  
*Lycopodiophyta*



Horsetails  
*Equisetophyta*



Ferns  
*Pteridophyta*



Non-Flowering Plants  
*Gymnosperms*



Flowering Plants  
*Angiosperms*



Conifers  
*Pinophyta*



Cycads  
*Cycadophyta*



Ginkgo  
*Ginkgophyta*



Plants with One Seed Leaf  
*Monocotyledon (Monacots)*



Plants with Two Seed Leaves  
*Dicotyledon (Dicots)*



# Plants are vascular or nonvascular.

**Vascular plants have tube-like structures that carry water & nutrients.**

**Nonvascular plants do not have these tube-like structures and use other ways to move water and substances.**



# Nonvascular plants (Mosses Liverworts and Hornworts)

- A few cells thick and only 2 cm to 5cm in height.
- Instead of roots, thread like stems structures called rhizoids.



**Ferns and horsetails are vascular seedless plants that reproduce using spores.**

**Ferns produce spores in structures that usually are found on the underside of their fronds.**

**Spores from horsetails are produced in a cone-like structure at the tips of some stems.**



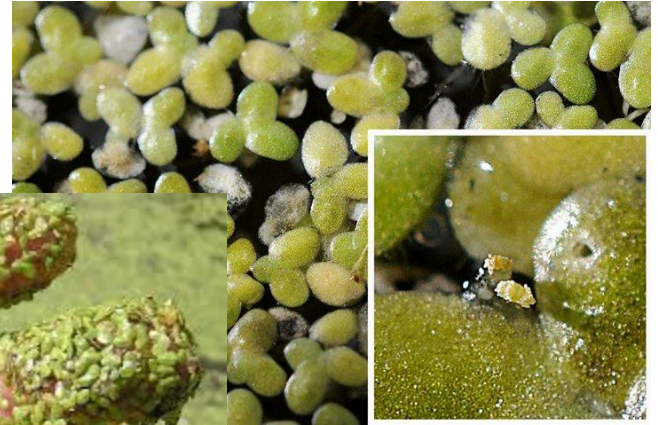
**Gymnosperms include conifer trees that produce seeds inside cones (instead of fruit).**

**Gymnosperms are vascular plants that produce seeds that are not protected by fruit.**

**Many gymnosperms are called evergreens because some green leaves always remain on their branches.**



**Angiosperms (plants that have flowers and produce fruit) can vary in size.**



**The flowers of angiosperms vary in size, shape, and color.**



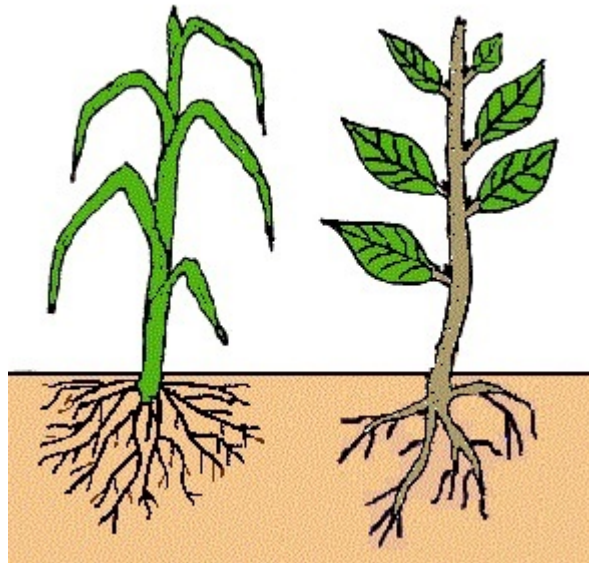
**Duckweed, an aquatic plant, has a flower that is only 0.1 mm long. A plant in Indonesia has a flower that is nearly 1 m in diameter and can weigh up to 9 kg.**





# Flowering plants can either be monocots or dicots.

**Many important foods come from monocots, including corn, rice, wheat, and barley.**



**Dicots also produce familiar foods such as peanuts, green beans, peas, apples, and oranges.**

The first major way plants are classified is by whether or not they are vascular. Examples of nonvascular plants include:

- A) Mosses, Liverworts, and Hornworts
- B) Conifers and other evergreens
- C) Gymnosperms
- D) Corn, Rice, Wheat, and Barley

Nonvascular plants are very thin because:

- A) They don't have enough nutrients to grow tall
- B) Animals eat the tops off of them keeping them very short
- C) Without a means of moving water they must transport it via osmosis
- D) That's just the way they are

Gymnosperms are unique because:

- A) They don't have seeds
- B) Their seeds are inside of fruits
- C) They have giant seeds
- D) Their seeds are found in cones

Seedless vascular plants reproduce  
via:

A) Seeds

B) Flowers

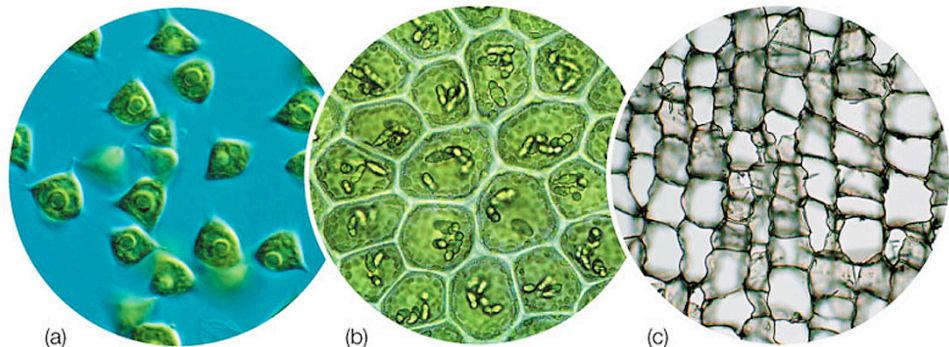
C) Spores

D) They don't

# Plant Anatomy: Cells

- Plant cells are basic building blocks
- Can specialize in form and function
- By working together, forming tissues, they can support each other and survive
- Levels of organization

atoms > molecules > cells > tissues > organs > whole organism > pop.



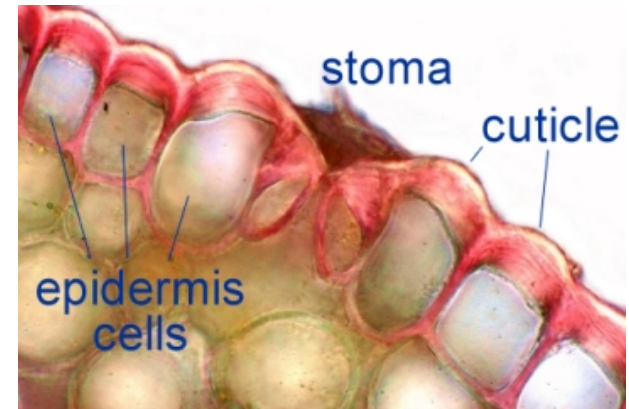
# Plant Tissues Types

All plant organs are composed of the same three tissue types:

- **1. Dermal** – outermost layer
- **2. Vascular** – conducting tissue, transport
- **3. Ground** – bulk of inner layers

# 1. Dermal tissue

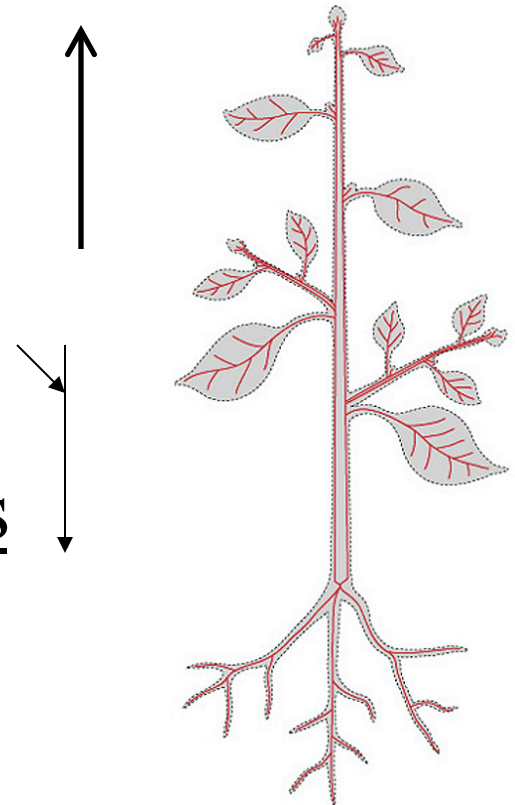
- Epidermis is the outermost layer of cells
- Like the “skin” of animals
- In stems and leaves, epidermis often has cuticle, a waxy layer that prevents water loss.





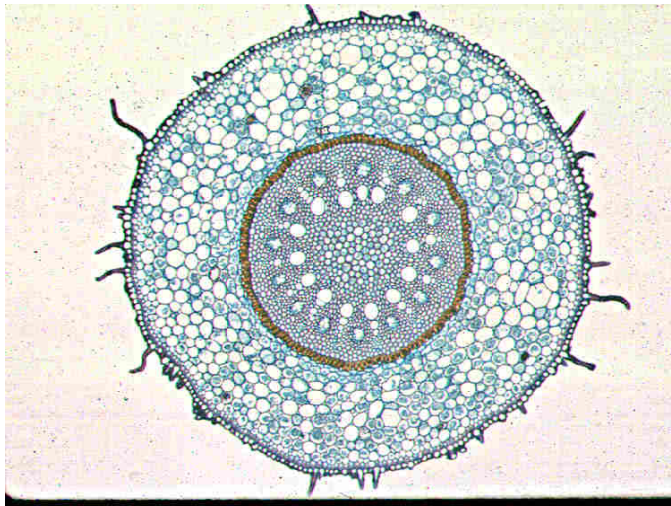
## 2. Vascular tissue

- Transports water and organic materials (sugars) throughout the plant. There are two main subclasses of vascular tissue
- Xylem – transports water and dissolved ions from the root to the stem and leaves.
- Phloem – carries dissolved sugars from leaves to rest of the plant

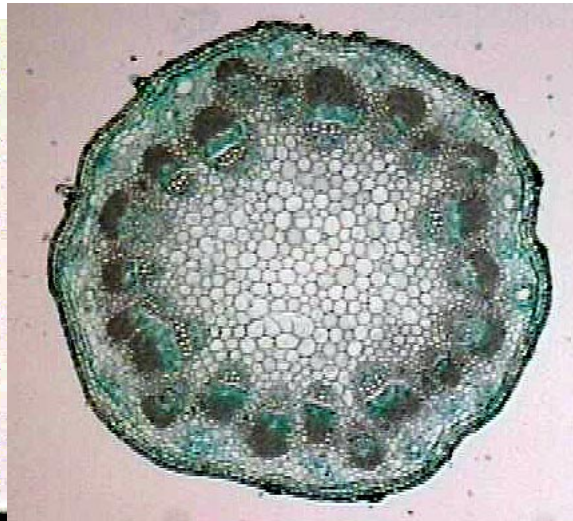


# 3. Ground tissue

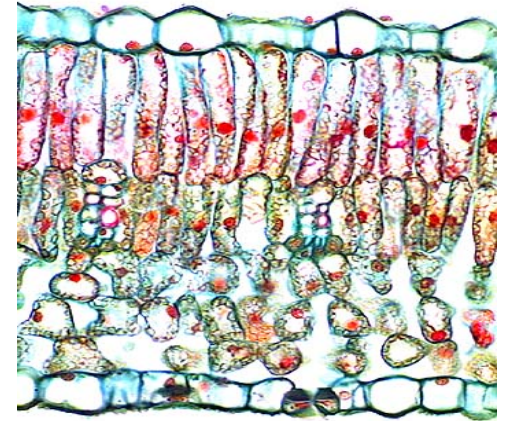
- Makes up the bulk of plant organs.
- Functions: Metabolism, storage and support.
- Two main types Cortex and Pith



Root



Stem



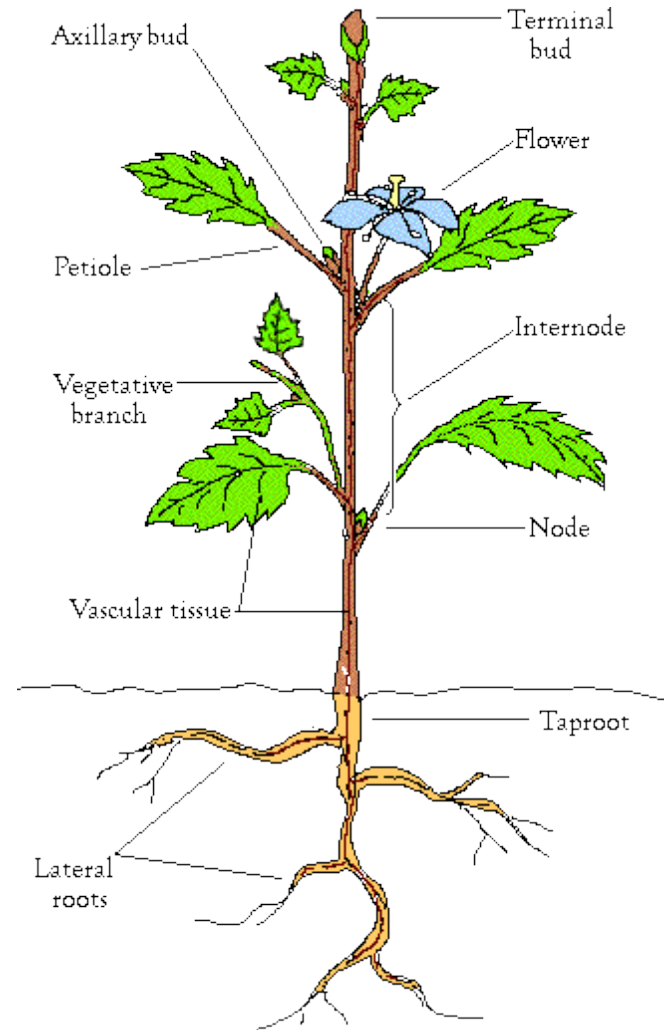
Leaf

# Plant Organs

Organs: tissues that act together to serve a specific function

-- Shoots! --

- Leaves { Dermal  
Vascular  
Ground
- Stems { Dermal  
Vascular  
Ground
- Roots { Dermal  
Vascular  
Ground

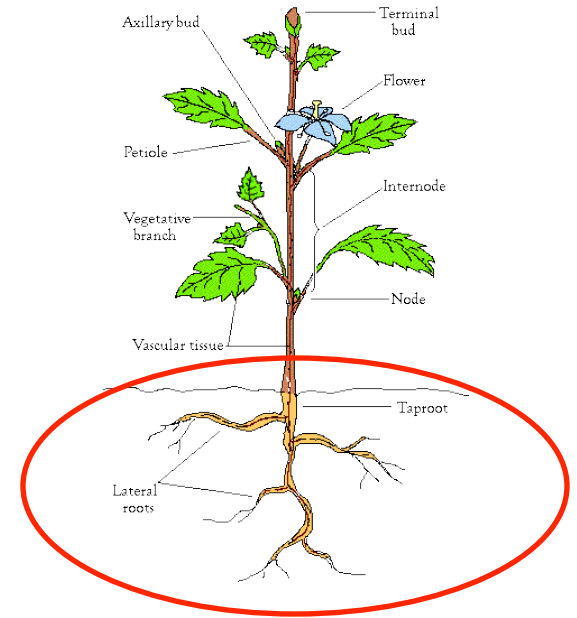


# ROOTS

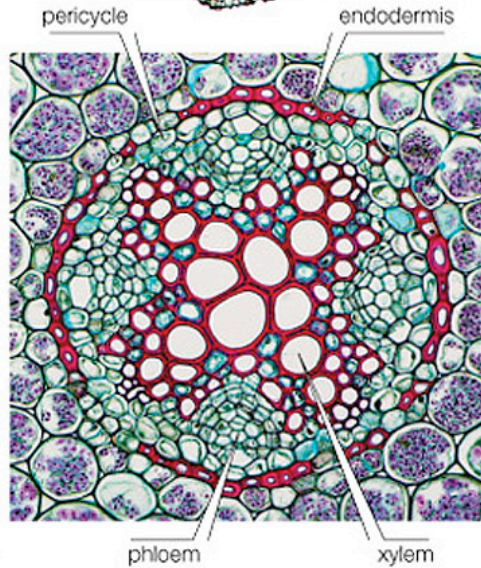
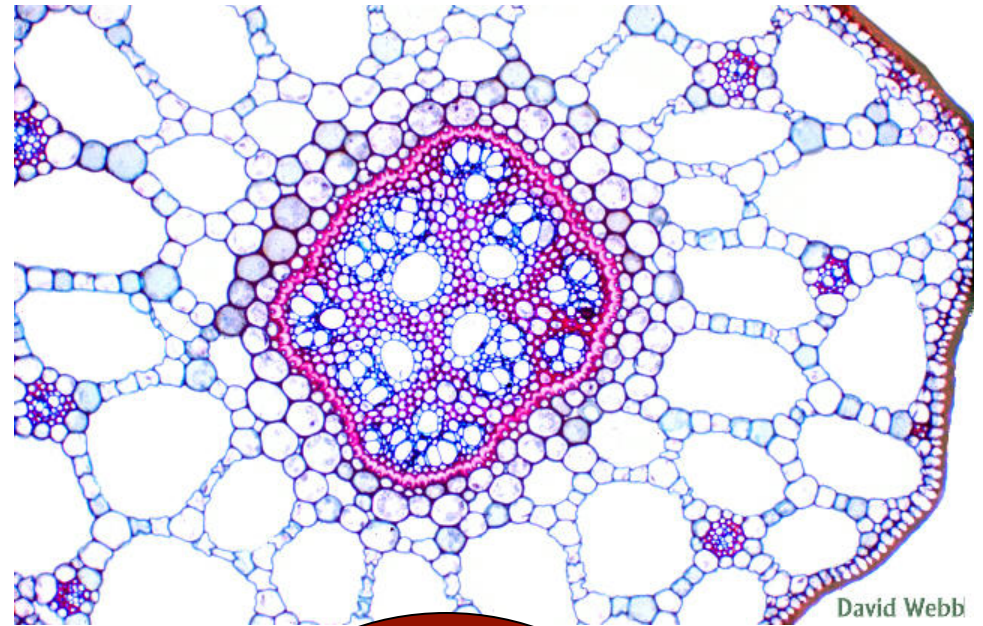
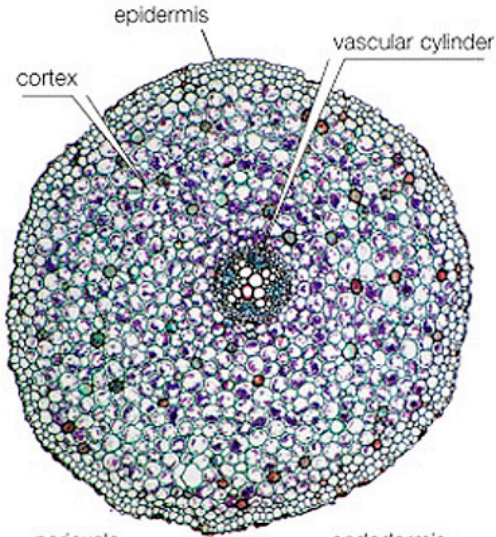
## ROOTS “the hidden half”

Functions of roots:

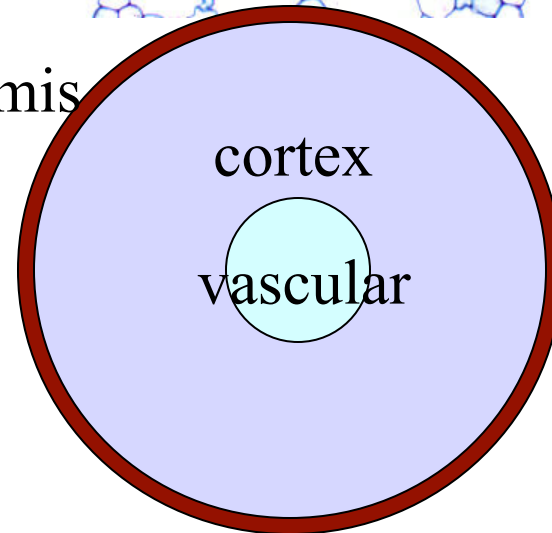
- Anchorage
- Absorption of water & dissolved minerals
- Storage (surplus sugars, starch)
- Conduction water/nutrients



# Anatomy of a root

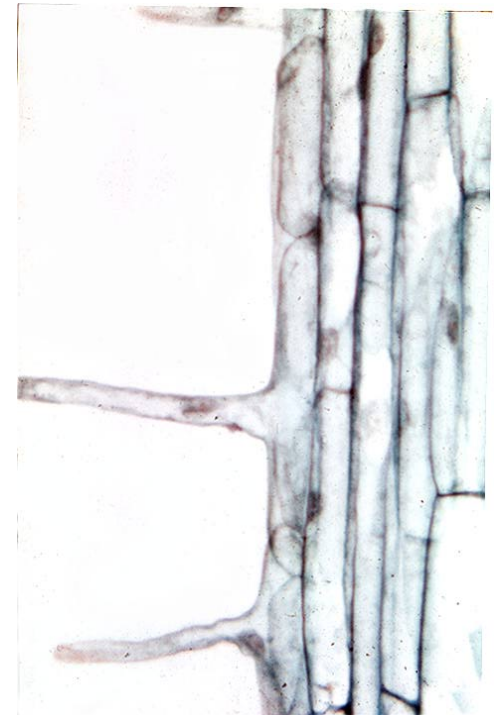


epidermis

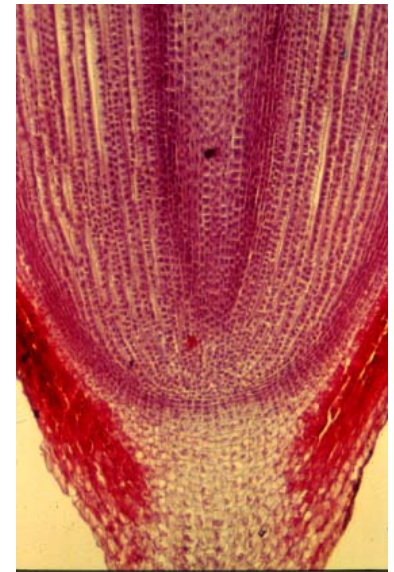
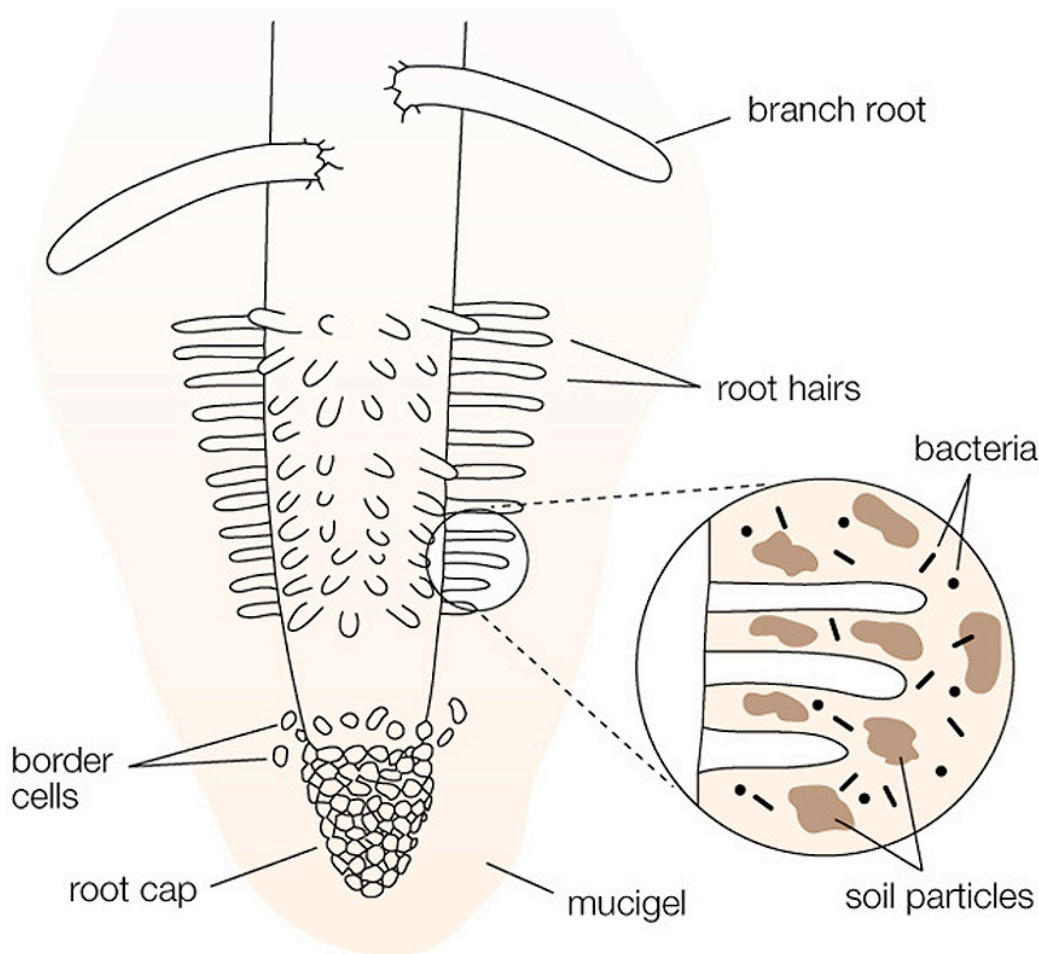


# Root Epidermis

- Outermost, single layer of cells that:
  - Protects (from diseases)
  - Absorbs water and nutrients
- **ROOT HAIRS:** tubular extensions of epidermal cells.
- Increase surface area of root, for better water/nutrient absorption



# Root Hairs: water and mineral absorption

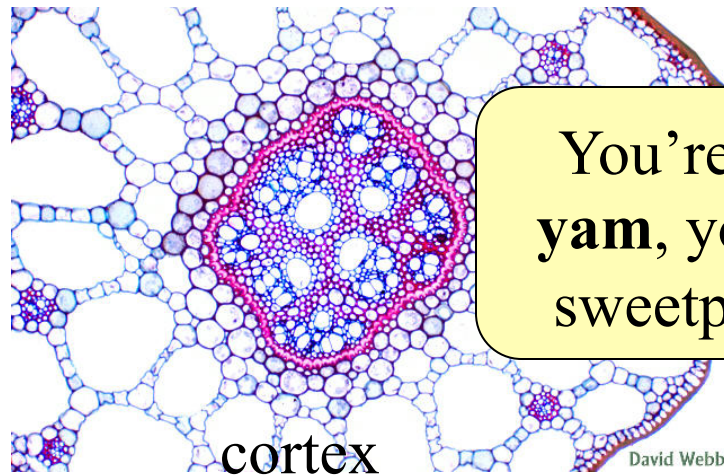


Root tip - cap & apical meristem

**Root hairs**  
increase surface  
area for better  
absorption

# Root Ground tissue

- In roots, ground tissue (a.k.a. cortex) provides support, and often stores sugars and starch (for example: yams, sweet potato, etc.)



You're not a yam, you're a sweetpotato!

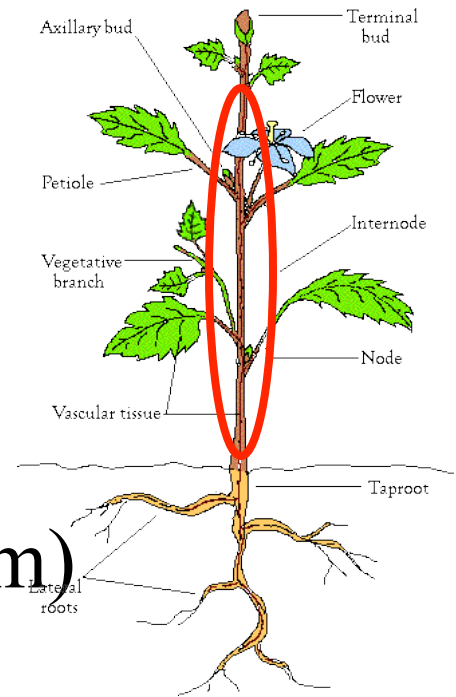


Hey!  
I yam  
what I  
yam,  
man!



# STEMS

- Above-ground organs (usually)
- Support leaves and fruits
- Conduct water and sugars throughout plant (xylem and phloem)

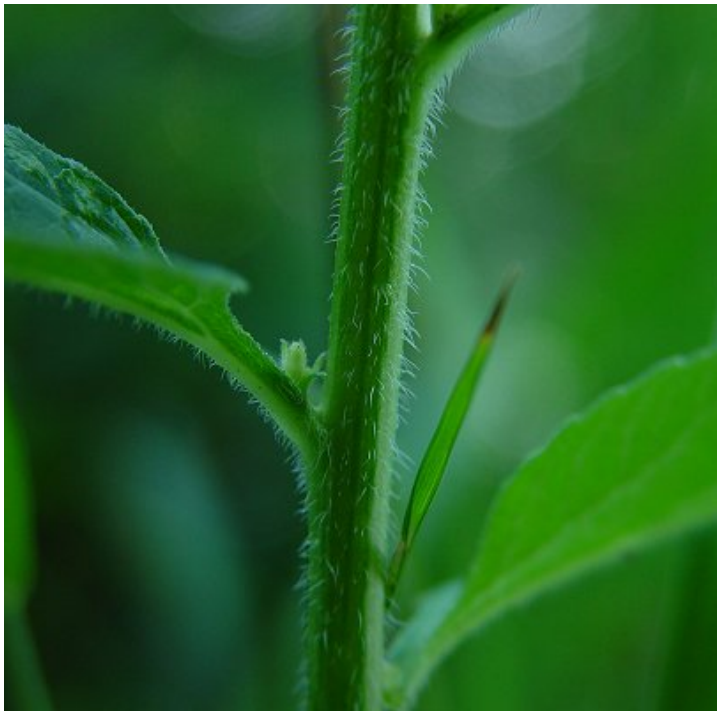


# Types of stems

**Herbaceous**

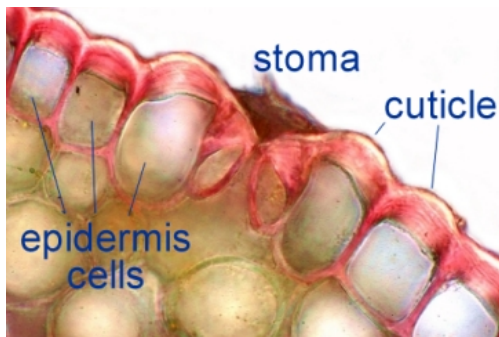
*vs.*

**Woody stems**



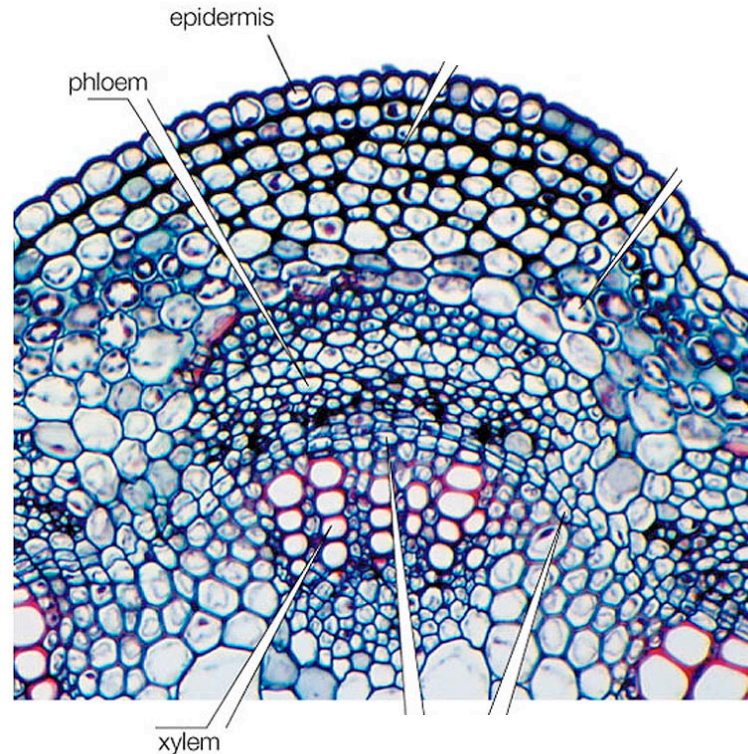
# Tissues of stems

- **Epidermis** (Dermal tissue type)
- Provides protection
- Has **cuticle** (wax) prevents water loss
- Trichomes (hairs) for protection, to release scents, oils, etc.



# Stem Vascular tissue

- **Vascular bundles** – composed of both xylem and phloem
- **Xylem**
  - Conducts water
  - Support
- **Phloem**
  - Conducts food
  - Support



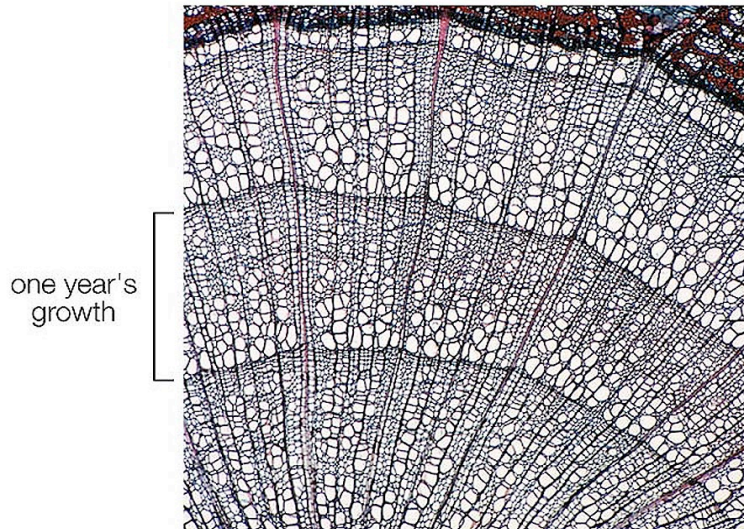
# Girdling: cutting around a tree

- Damages the phloem and xylem, eventually killing the tree!



# Vascular tissue forms rings in trees

- **Annual rings:** xylem formed by the vascular cambium during one growing season
- One ring = one year

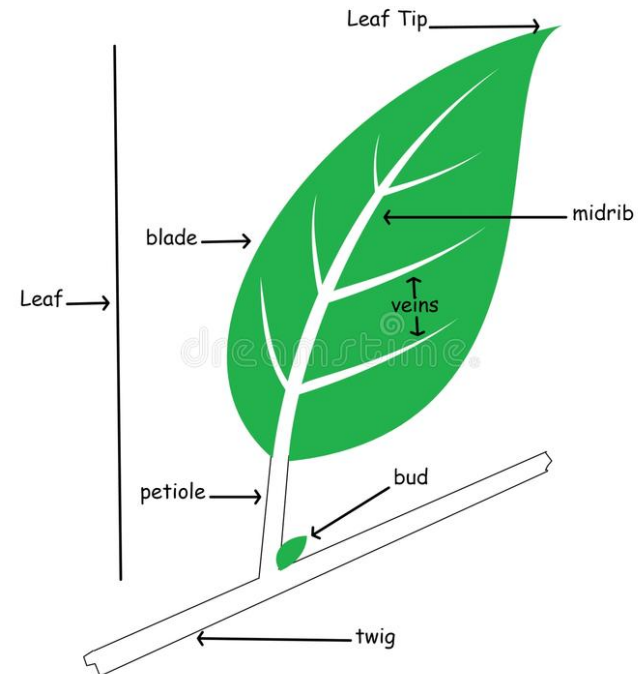


# LEAVES:

‘Photosynthetic factories’ of the plant...

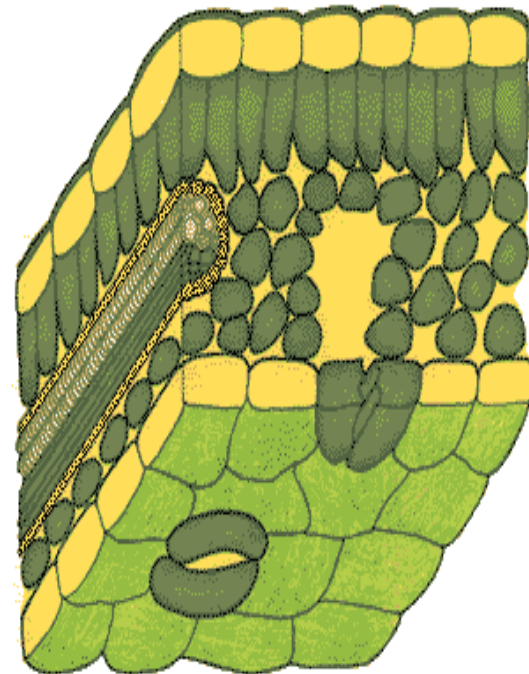
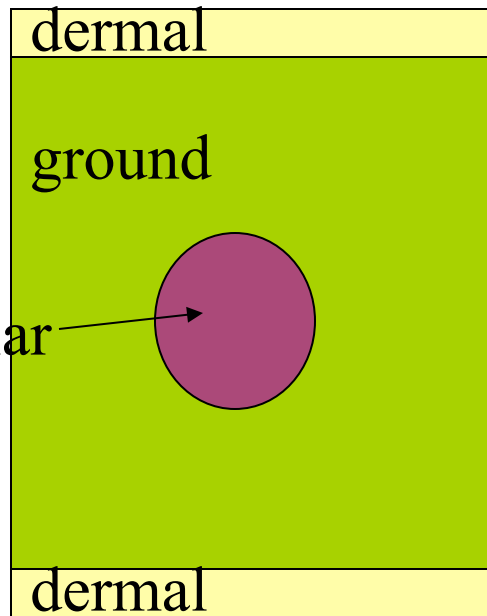
Function: Photosynthesis – food production for the whole plant

- **Blade:** Flat expanded area
- **Petiole:** stalk that connects leaf blade to stem, and transports materials
- **Bud:** undeveloped shoot



# Leaf Anatomy

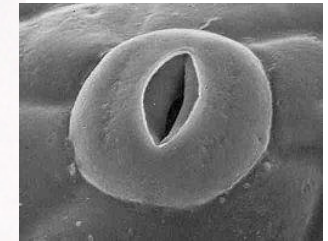
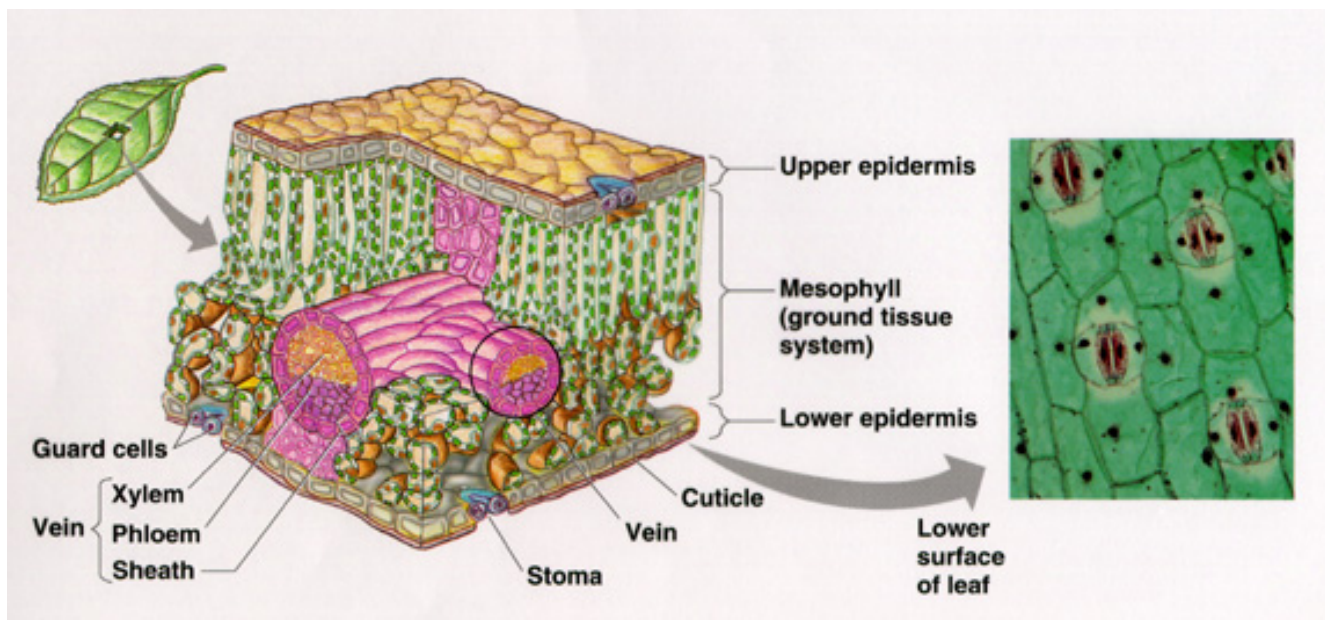
- Leaf anatomy is correlated to photosynthesis:  
Carbon dioxide + Water  $\rightarrow$  sugars + oxygen





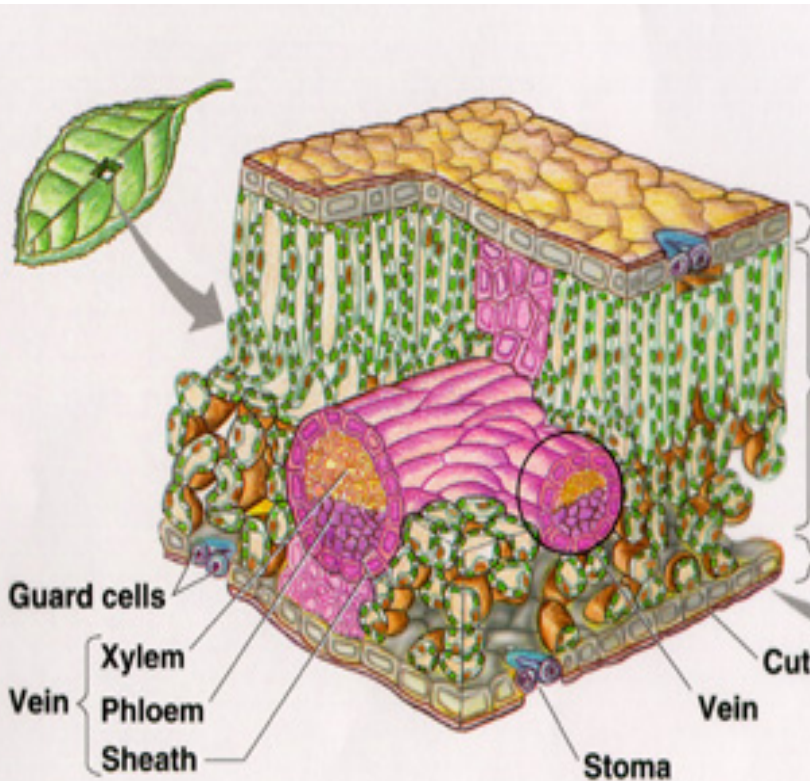
# Leaf epidermis

- Is transparent – so that sun light can go through.
- Waxy cuticle protects against drying out
- Lower epidermis has **stomata** (pores allowing gas exchange) with **guard cells** (cells which change shape to open and close the stomata)



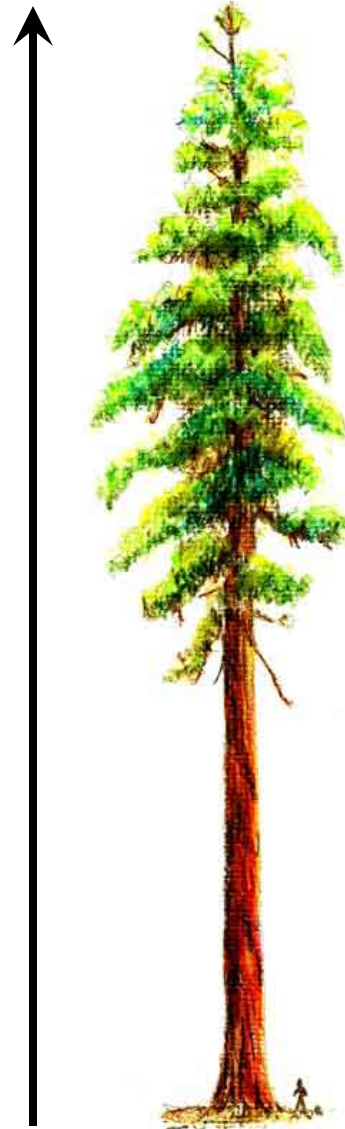
# Leaf vascular tissue

- **VEINS** → vascular tissue of leaves.
  - Veins are composed of **xylem** (water transport) **phloem** (food transport) and **bundle sheaths**, cells surrounding the xylem/phloem for strength & support



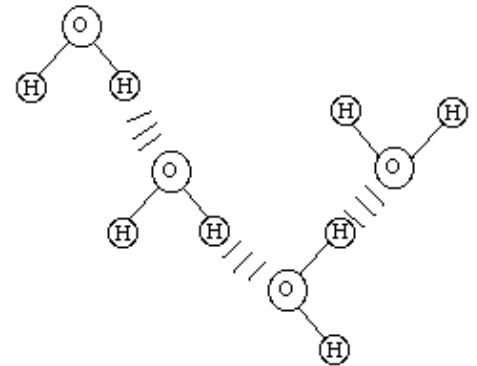
# Plant water transport

- How can water move from the ground all the way to the top of a 100 m tall redwood tree?



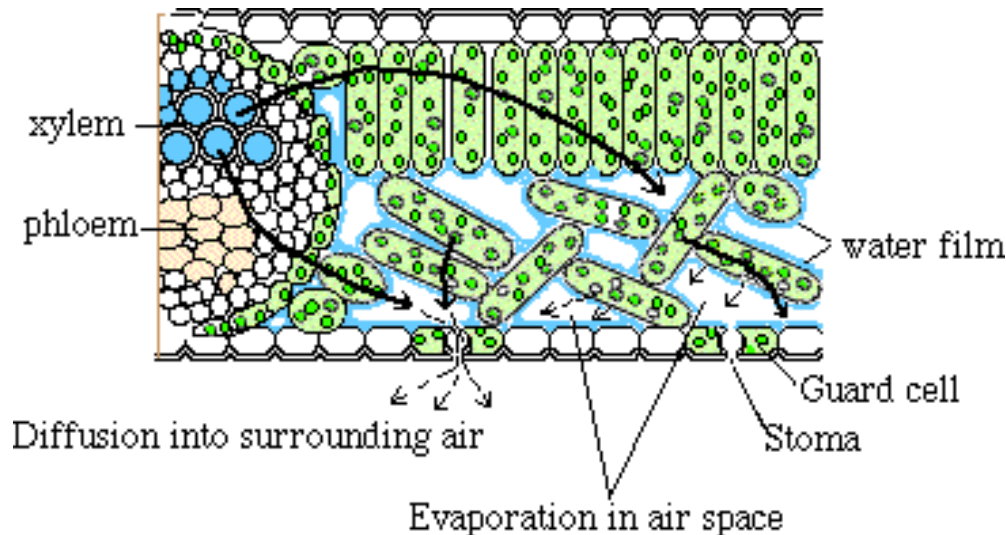
# Water transport in plants:

- The same way we drink soda from a straw!
- Water's great cohesive forces (molecules sticking to each other) and adhesive forces (attaching to walls of xylem cells)



# Transpiration-cohesion Theory for water transport in the xylem

- **Evaporation** of water in the leaves (through stomates) generates the ‘sucking force’ that pulls adjacent water molecules up the leaf surface



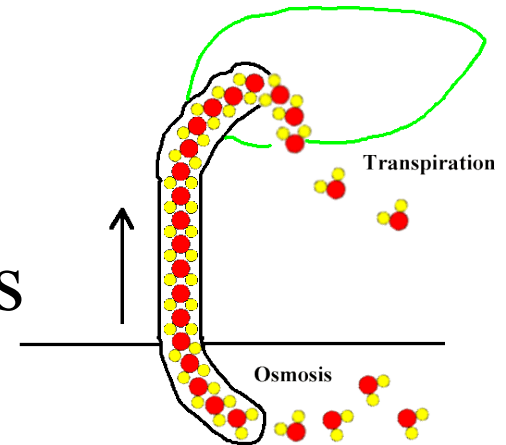
# Water transport (cont.)

- Like a long chain, water molecules pull each other up the column.

- The column goes from roots → leaves.



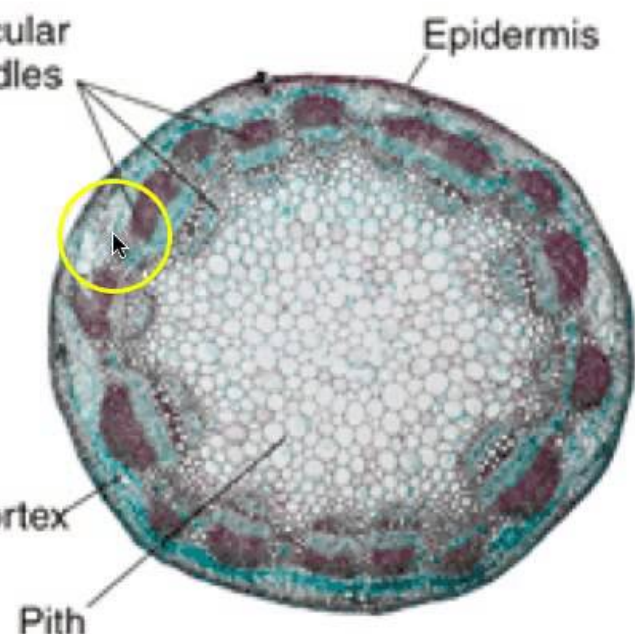
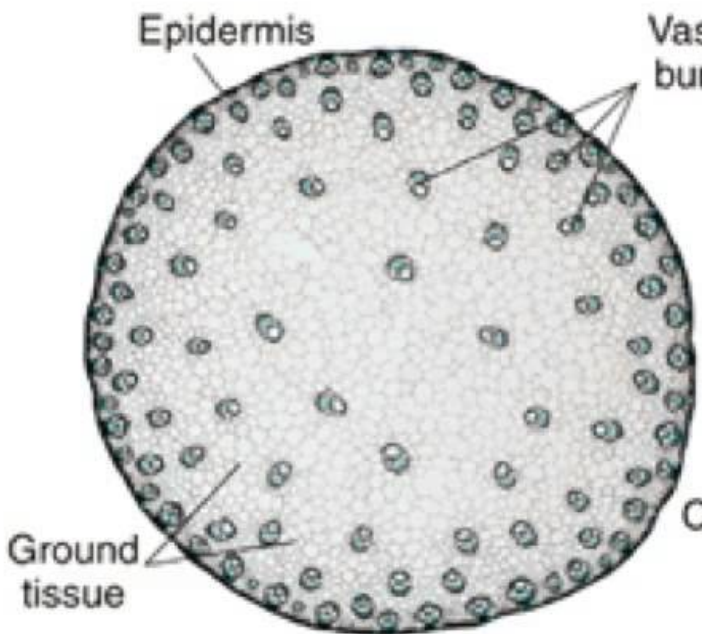
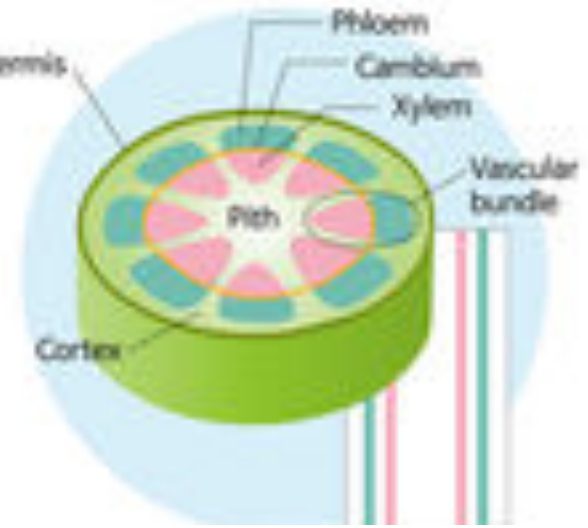
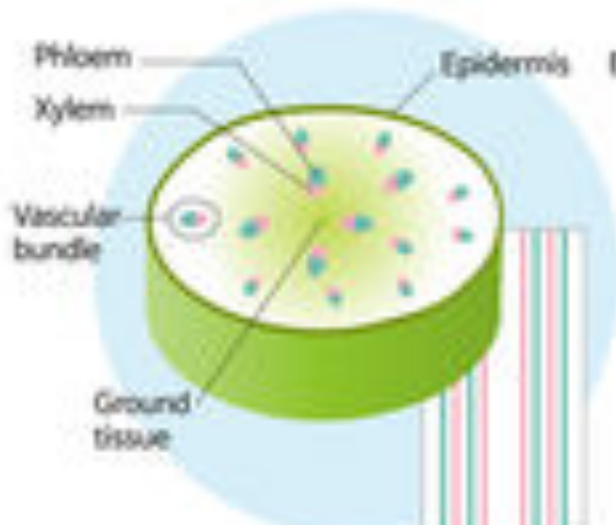
- What's amazing is that the water moves up by using the sun's evaporative energy...



- Plants control transpiration by opening/closing stomata

# Monocot

# Dicot



Monocot

Dicot

(magnification: 10x)

(magnification: 12x)

What are stomata?

A) The area in a chloroplast between thylakoid stacks

B) The openings on leaves allowing for gas exchange

C) The vascular tissue of leaves

D) Waxy layer on the outside of leaves



Transpiration-cohesion describes the process by which....

- A) Water is pulled up through the plant due to evaporation and the cohesive forces of water
- B) Water is pulled up through the plant due to gravity
- C) Water is pulled through the plant via pumps in the Xylem
- D) Water evaporates from the leaves resulting in drying out of the leaves

The petiole is :

- A) The very edge of the leaf blade
- B) An undeveloped shoot at the base of the leaf
- C) The very tip of the leaf
- D) The stalk that attaches the leaf blade to the stem

# Plant Hormones

- Chemical compounds produced by plants
- Effective at very low concentrations
- Five major hormone groups are:
  1. Auxins
  2. Gibberellins
  3. Cytokinins
  4. Abscisic Acid
  5. Ethylene

# 1. AUXINS

- Promote cell growth
- Involved in gravitropism



and phototropism

- Control fruit development



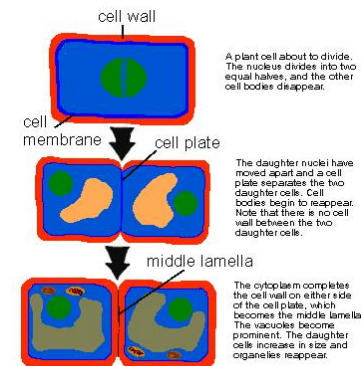
## 2. Gibberellins

- Promote stem elongation



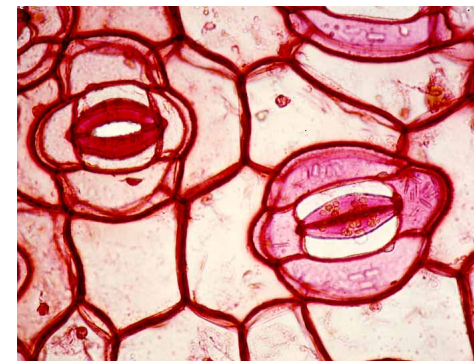
## 3. Cytokinins

- Promote cell division and organ differentiation



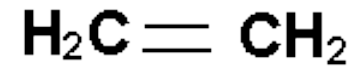
## 4. Abscisic Acid

- Promotes seed dormancy
- Causes stomata closing



# 5. ETHYLENE

- Gaseous hormone,  
very simple formula ( $C_2H_4$ )
- Ethylene promotes  
**fruit ripening!**



Ethylene



Air

Ethylene

# “One rotten apple spoils the barrel”

## Apple Barrel



- Why?  
Probably due to ethylene!  
Rotten apple producing  
lots of ethylene!
- Autocatalytic
- As a response to injury

# Avocado ripening...



- Place in a paper bag, with a ripe banana!

