



# **BOTANY REVIEW**

**by**

**Dr. Sirwa A. Qadir**

– Cells

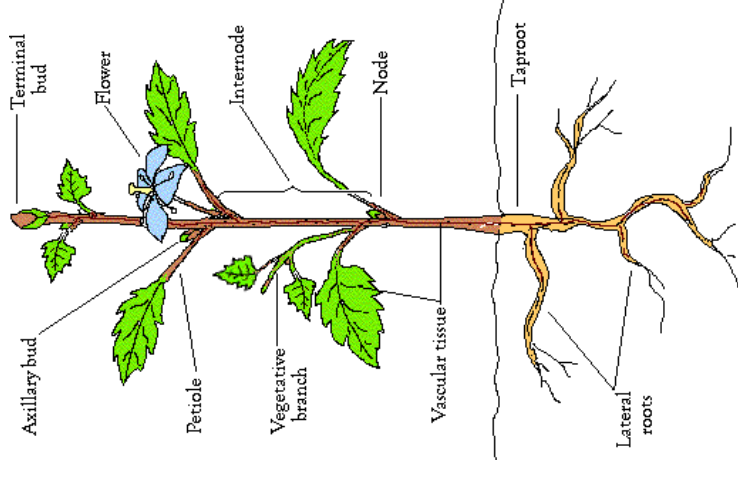
– Tissues

– Organs

- **Plant Physiology**

- Water & sugar transport

- Plant hormones



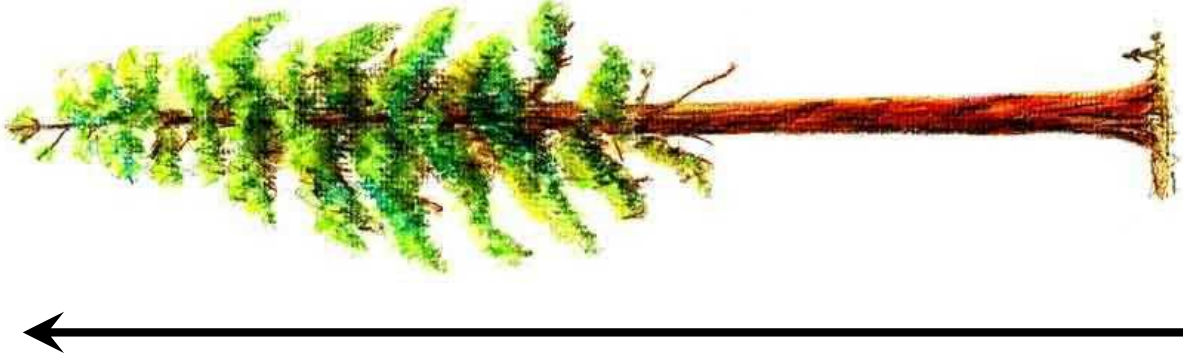
From smallest to largest plants



# What is plant physiology?

- **PHYSIOLOGY**: study of the **function** of cells, tissues, organs of living things; and the **physics/chemistry** of these functions...

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



# 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 plant > pop.



# Plant Tissues Types

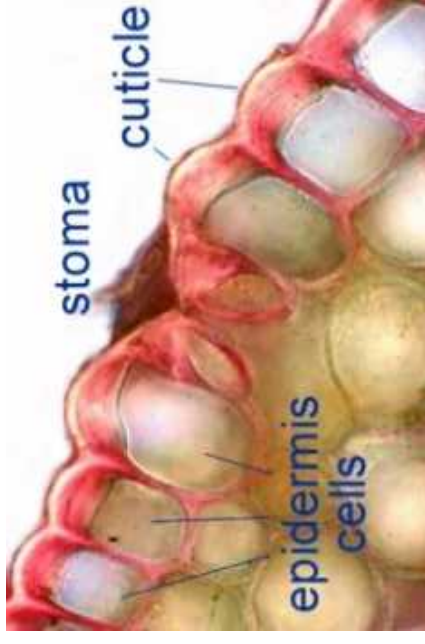
All plant organs (roots, stems, leaves) are composed of the same tissue types.

There are three types of tissue:

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

# 1. Dermal tissue

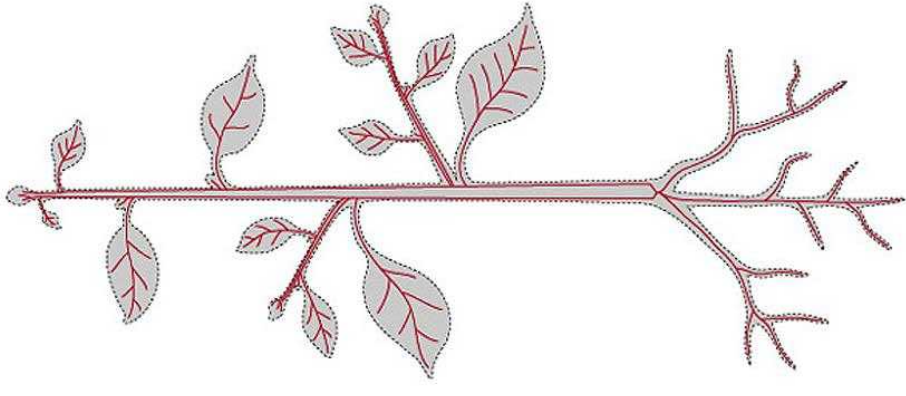
- **Epidermis** is the outermost layer of cells
- Like the “skin” of animals
- In stems and leaves, epidermis has **cuticle**, a waxy layer that prevents water loss.
- Some have **trichomes**, hairs.
- Root epidermis has **root hairs**, for water and nutrient absorption





## 2. Vascular tissue

- Transports water and organic materials (sugars) throughout the plant
- **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

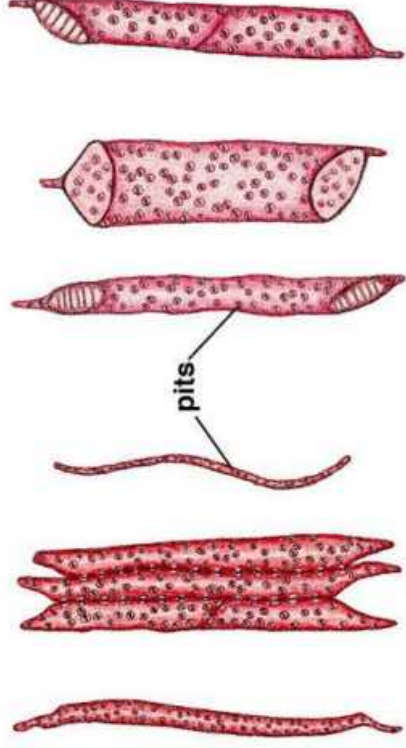


# Xylem

- Transports water and dissolved minerals
- **Tracheids:** long, thin tube like structures without perforations at the ends
- **Vessel elements:** short, wide tubes perforated at the ends (together form a pipe, called vessel).
- Both cells have **pits** (thin sections) on the walls

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## Water-conducting Cells of Xylem

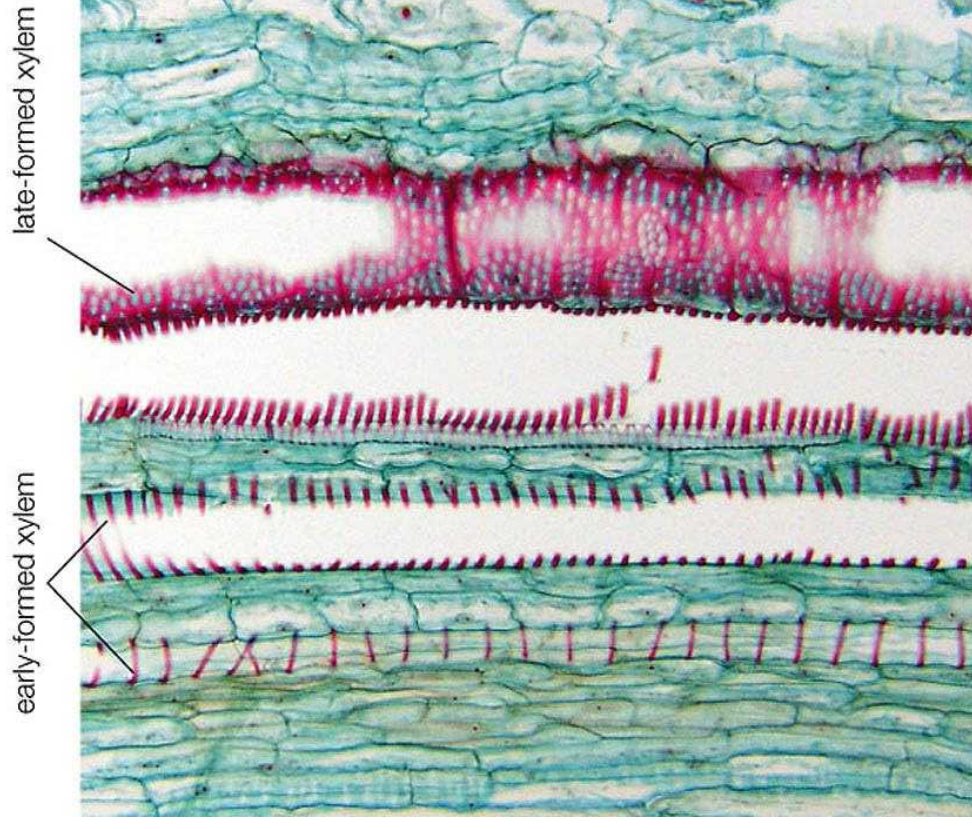


A. Tracheids

B. Vessel elements

# Xylem cells

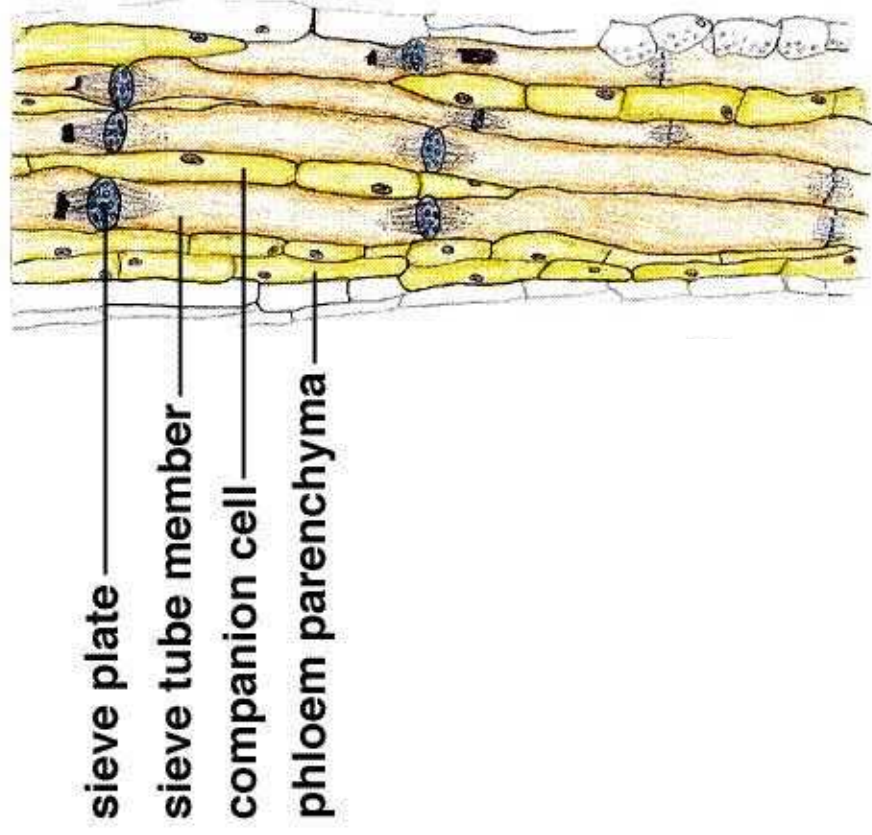
- **Xylem** cells are dead!
- They are hollow cells and consist only of cell wall



# Phloem

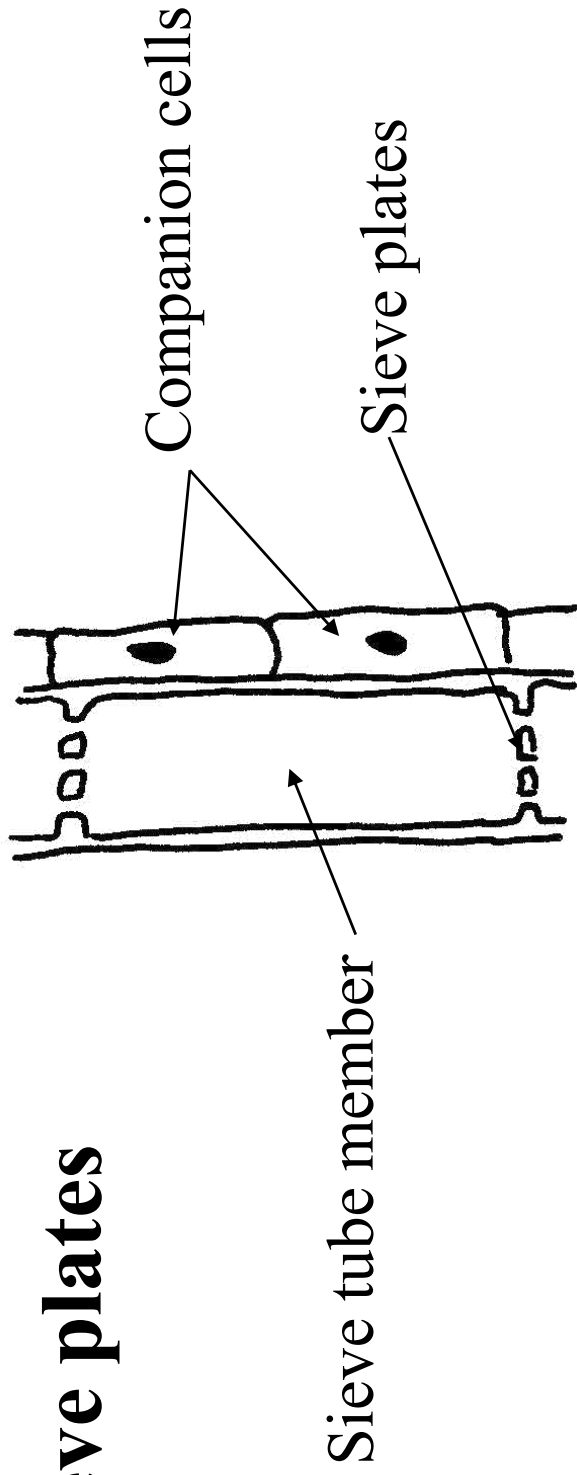
- Cells that transport organic materials (sugars)
- Phloem cells are **ALIVE!** (unlike xylem)
- However, they lack nucleus and organelles

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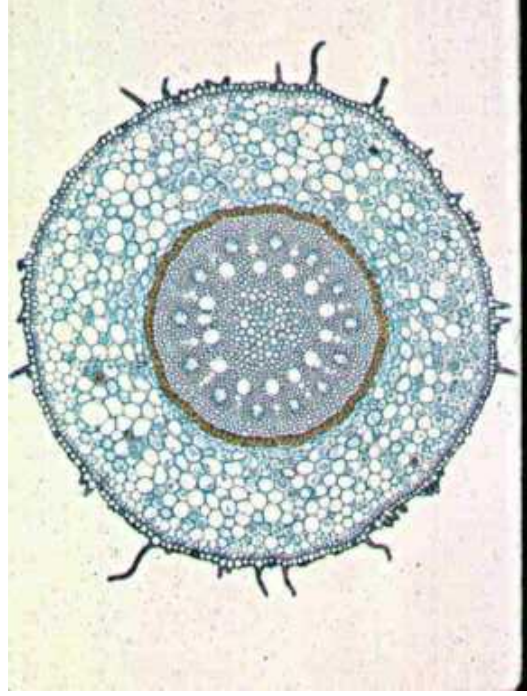
# Phloem: transports sugars

- Phloem composed of cells called **sieve tube members**, **sieve tube members (STM)**
- **Companion cells** join sieve tube members, are related, and help to load materials into STM
- End walls of STM have large pores called **sieve plates**

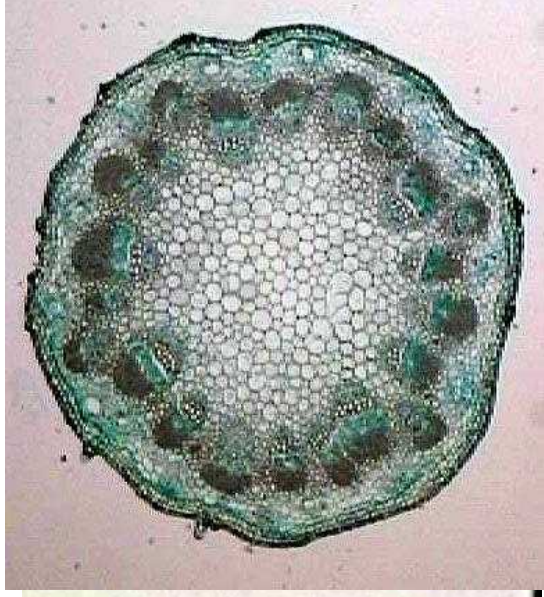


### 3. Ground tissue

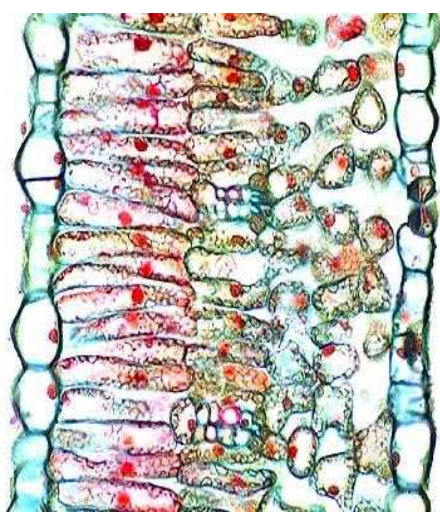
- Makes up the bulk of plant organs.
- Functions: Metabolism, storage and support.



Root



Stem



Leaf

# Plant Organs

Organs: tissues that act together to serve a specific function

- **Roots**

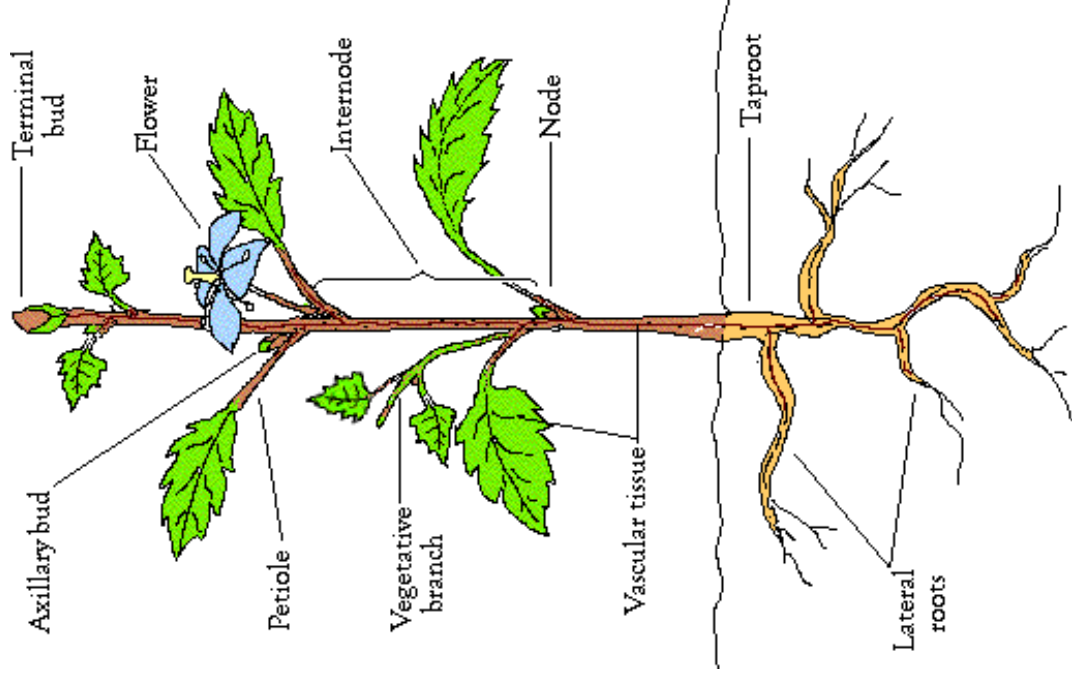
{  
Dermal  
Vascular  
Ground

- **Stems**

{  
Dermal  
Vascular  
Ground

- **Leaves**

{  
Dermal  
Vascular  
Ground

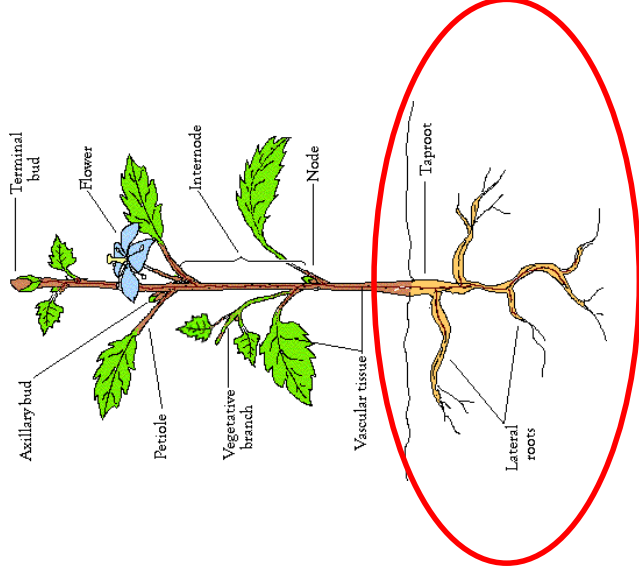


# Functions of plant organs:

- **ROOTS:** Anchorage, water/nutrient absorption  
from soil, storage, water/nutrient transport
- **STEMS:** Support, water/nutrient transport
- **LEAVES:** Photosynthesis (food production)



# ROOTS



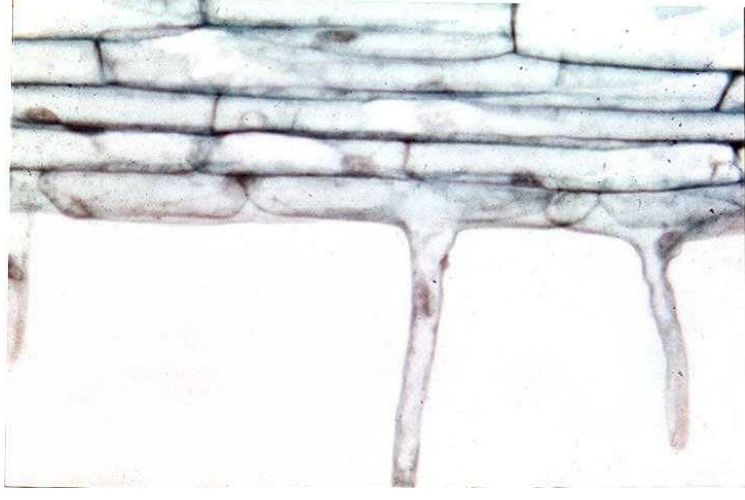
- **ROOTS** “the hidden half”
- Functions of roots:
- Ancorage
- Absorption of water & dissolved minerals
- Storage (surplus sugars, starch)
- Conduction water/nutrients

# Root Epidermis

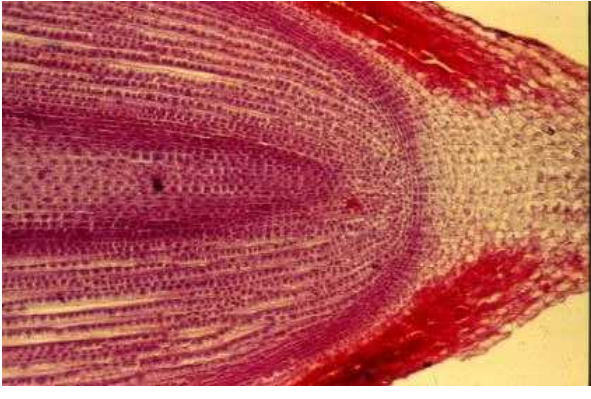
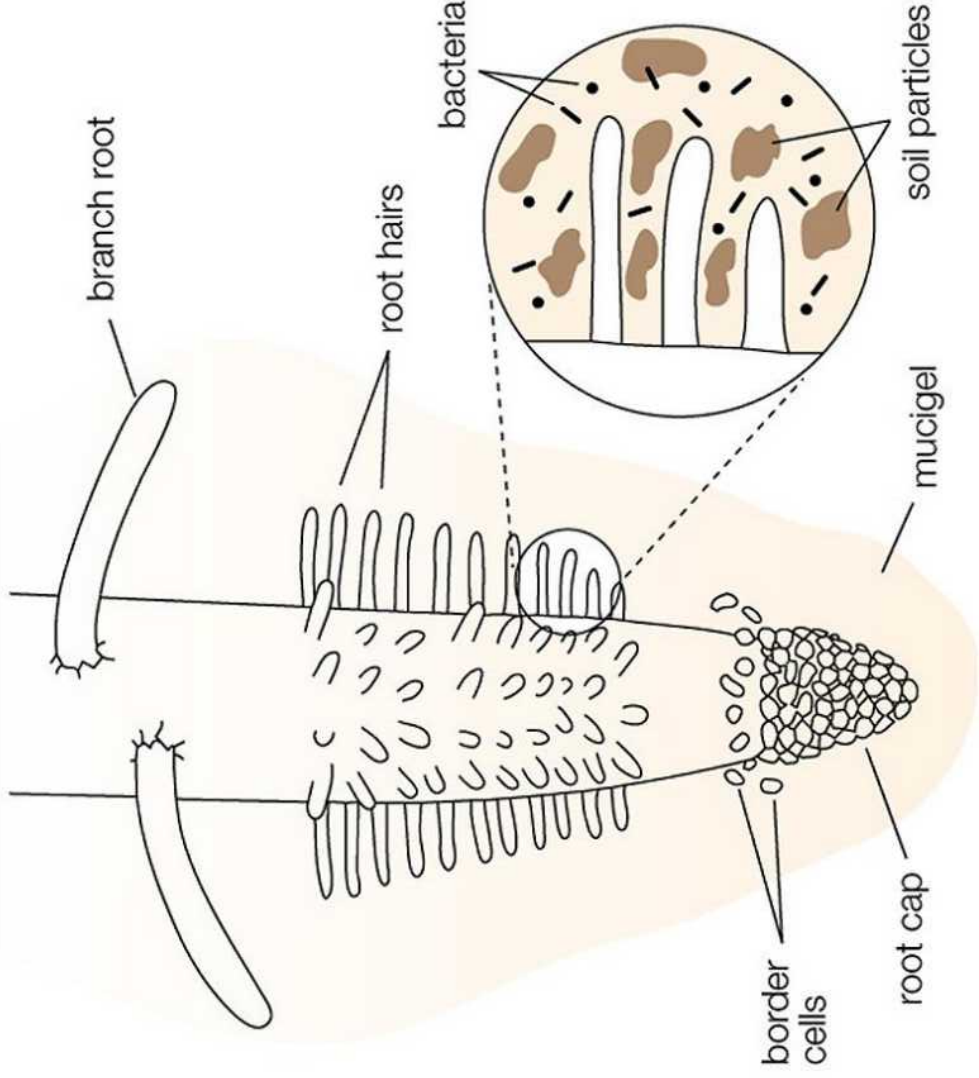
- Outermost, single layer of cells that:
  - Protects (from diseases)
  - Absorbs water and nutrients



- **ROOT HAIRS:** tubular extensions of epidermal cells.
- Increase surface area of root, for better water/nutrient absorption



# Root Hairs: water and mineral absorption

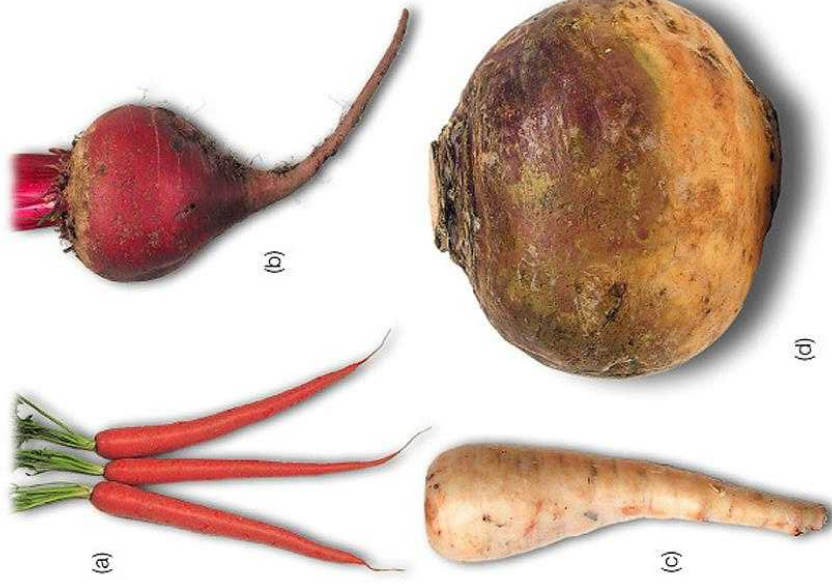


Root tip - cap & apical meristem

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

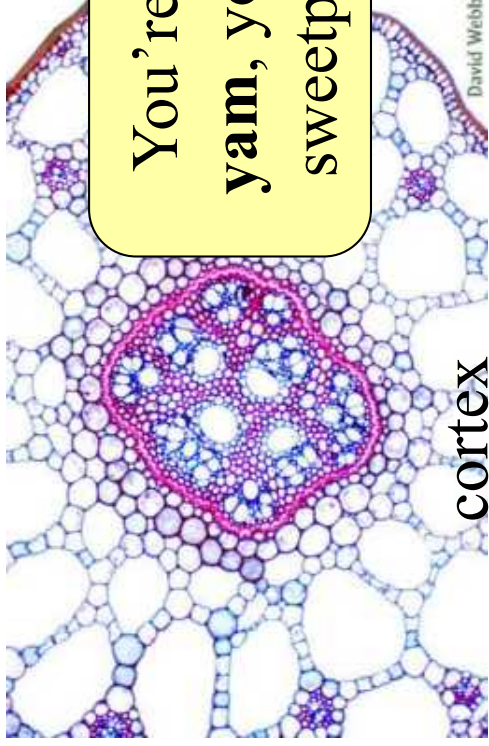
# Root Cortex

- Stores starch, sugars and other substances



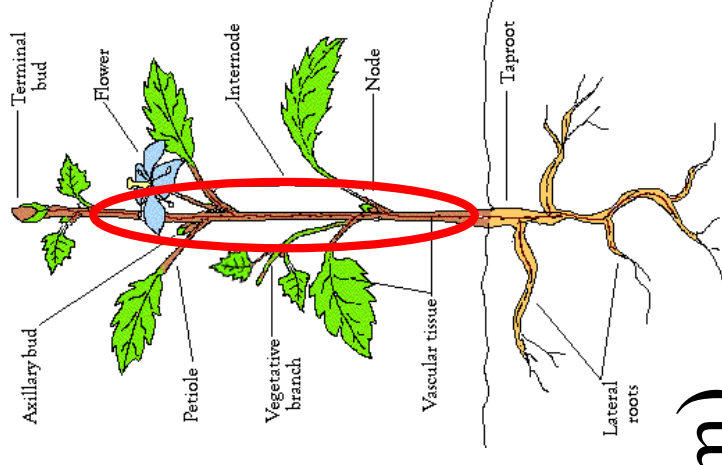
# Root Ground tissue

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



# STEMS

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



# Types of stems

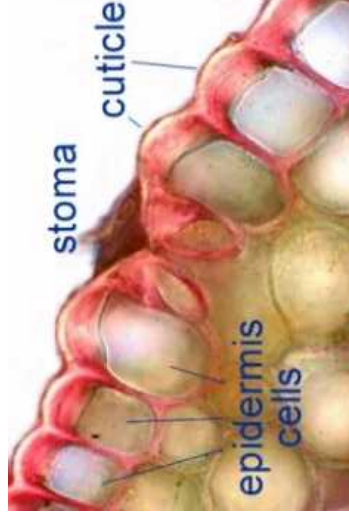
- Herbaceous

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

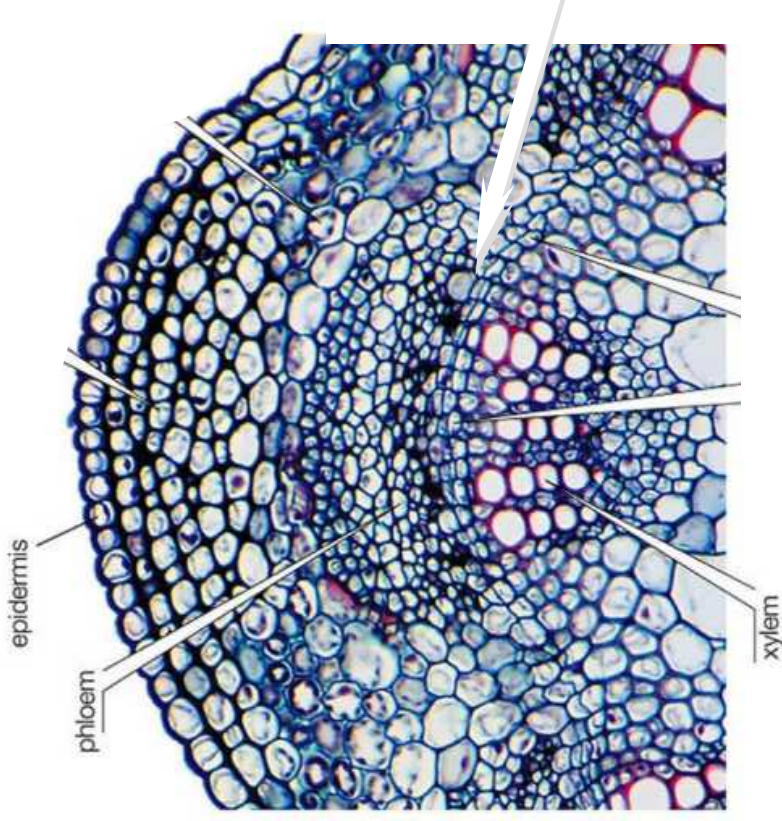
- **Vascular bundles** – composed of both xylem and phloem

- **Xylem**

- Conducts water
- Support

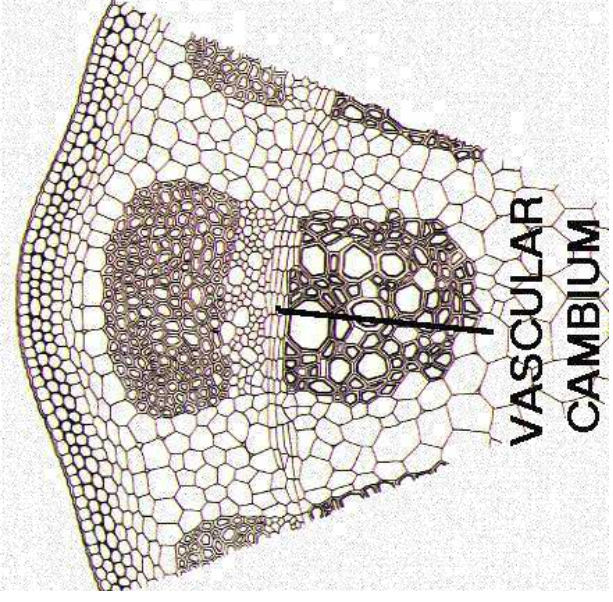
- **Phloem**

- Conducts food
- Support



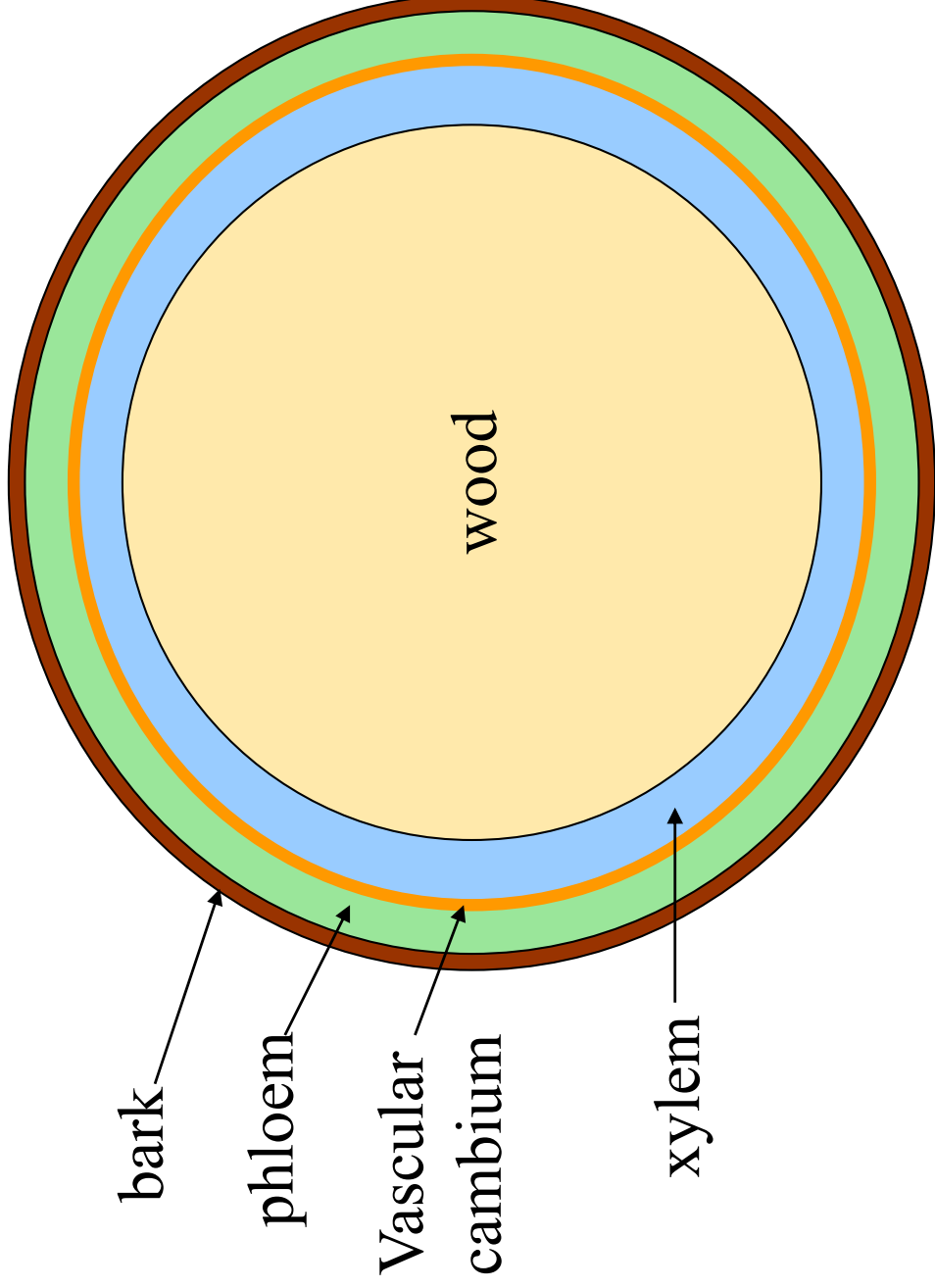
# Vascular cambium

- Occurs in woody stems
- Vascular cambium located in the middle of the vascular bundle, between xylem and phloem



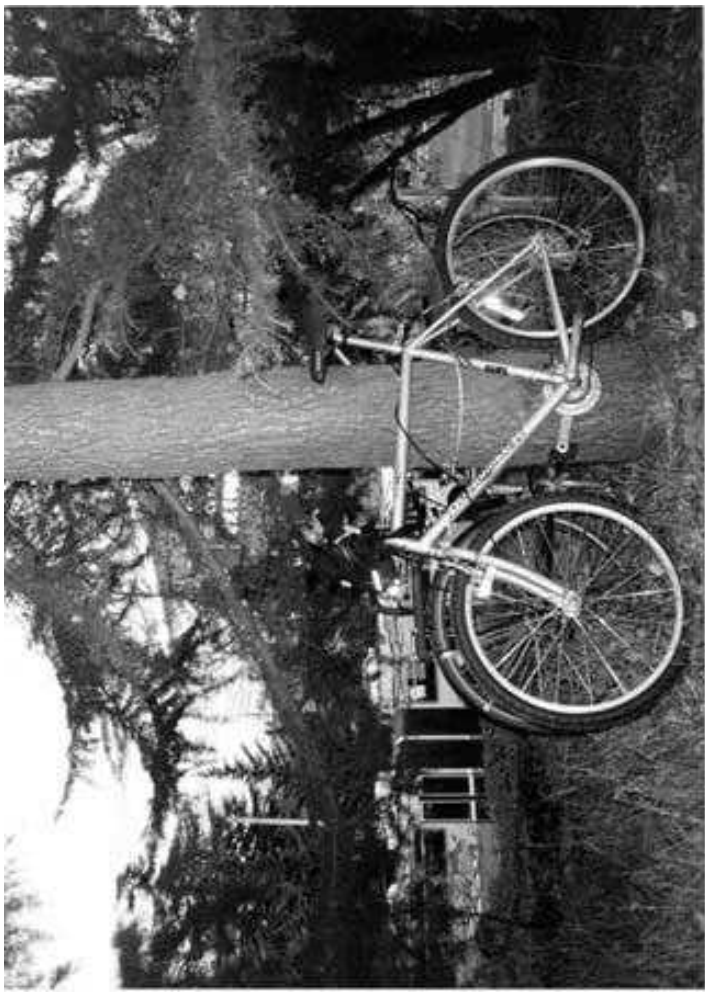
# Vascular tissue: Trees

- Vascular tissue is located on the outer layers of the tree.



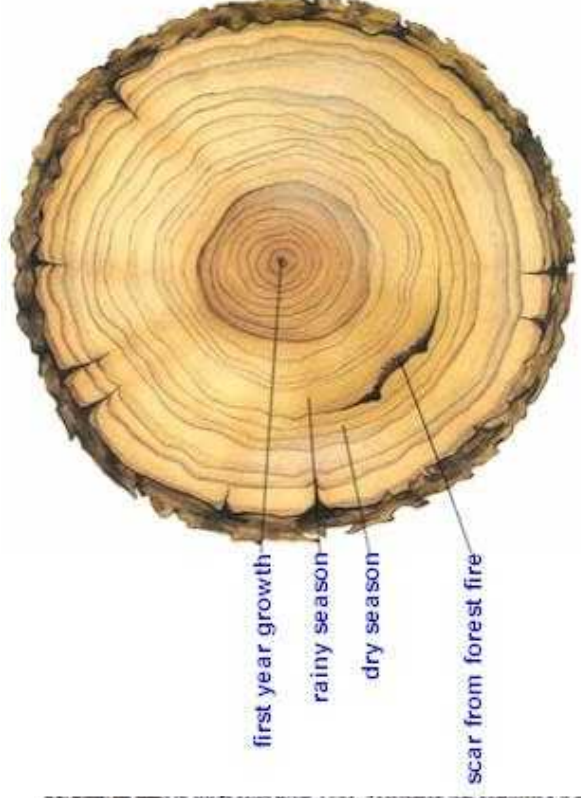
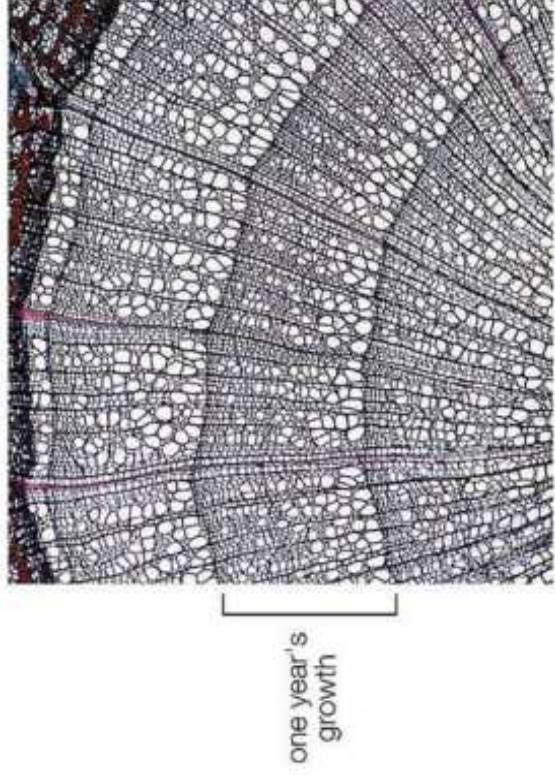
# Girdling: cutting around a tree

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



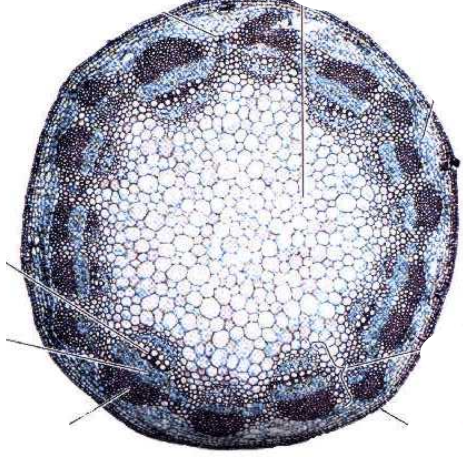
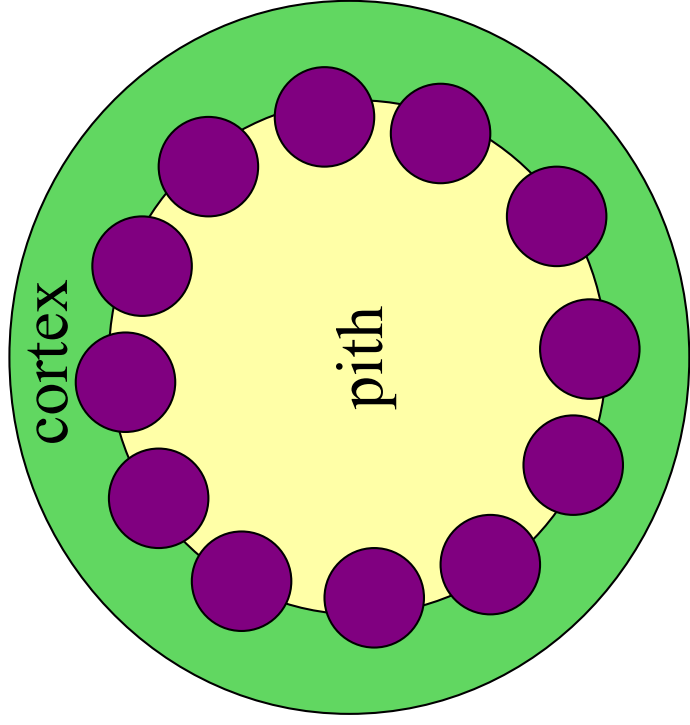
# Vascular tissue forms rings in trees

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



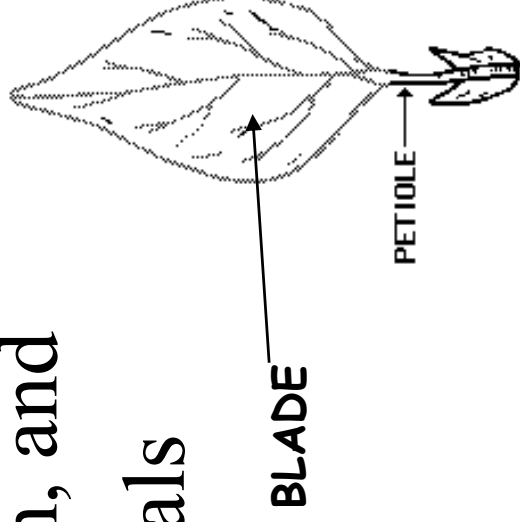
# Ground tissue: Cortex & pith

- Stores food (e.g. potato)
- Site of Photosynthesis (when green)
- Support cells



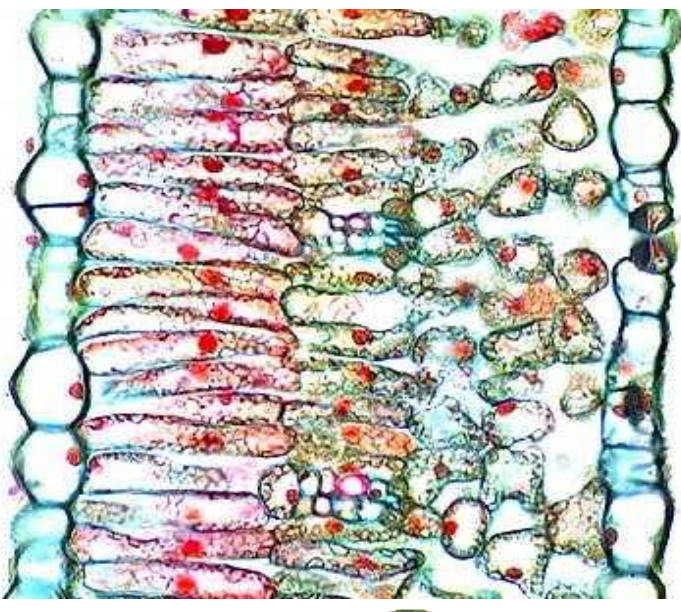
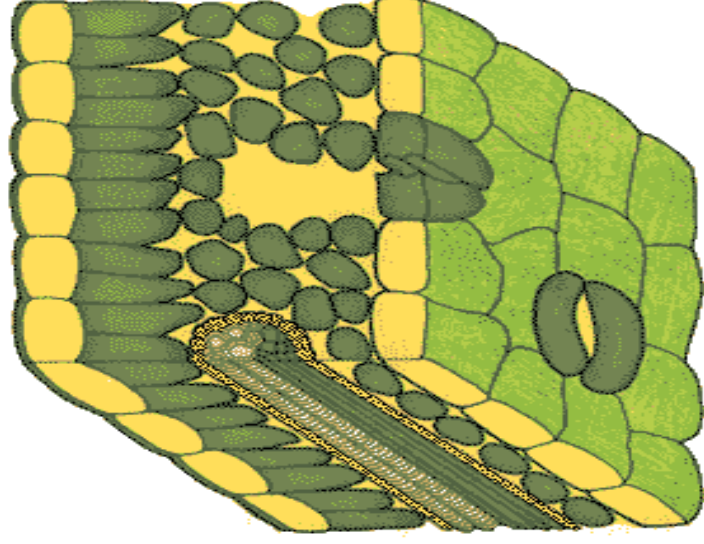
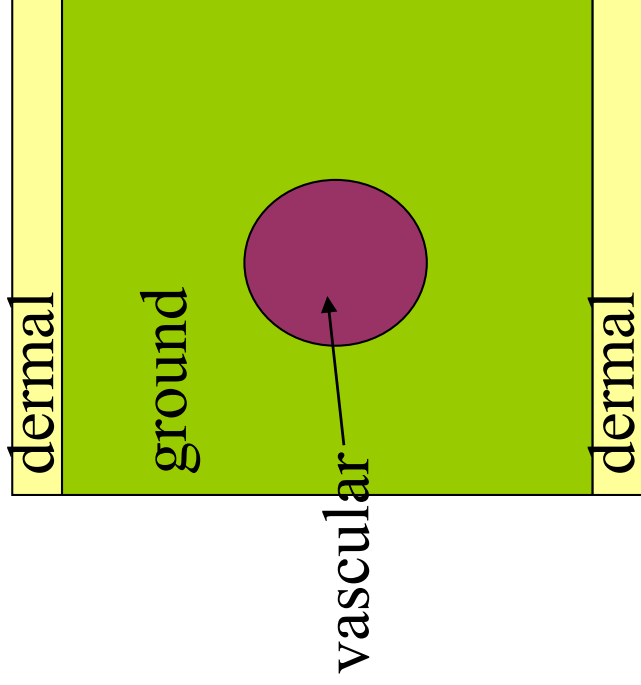
# LEAVES:

- ‘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



# Leaf Anatomy

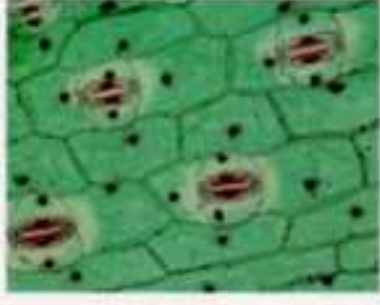
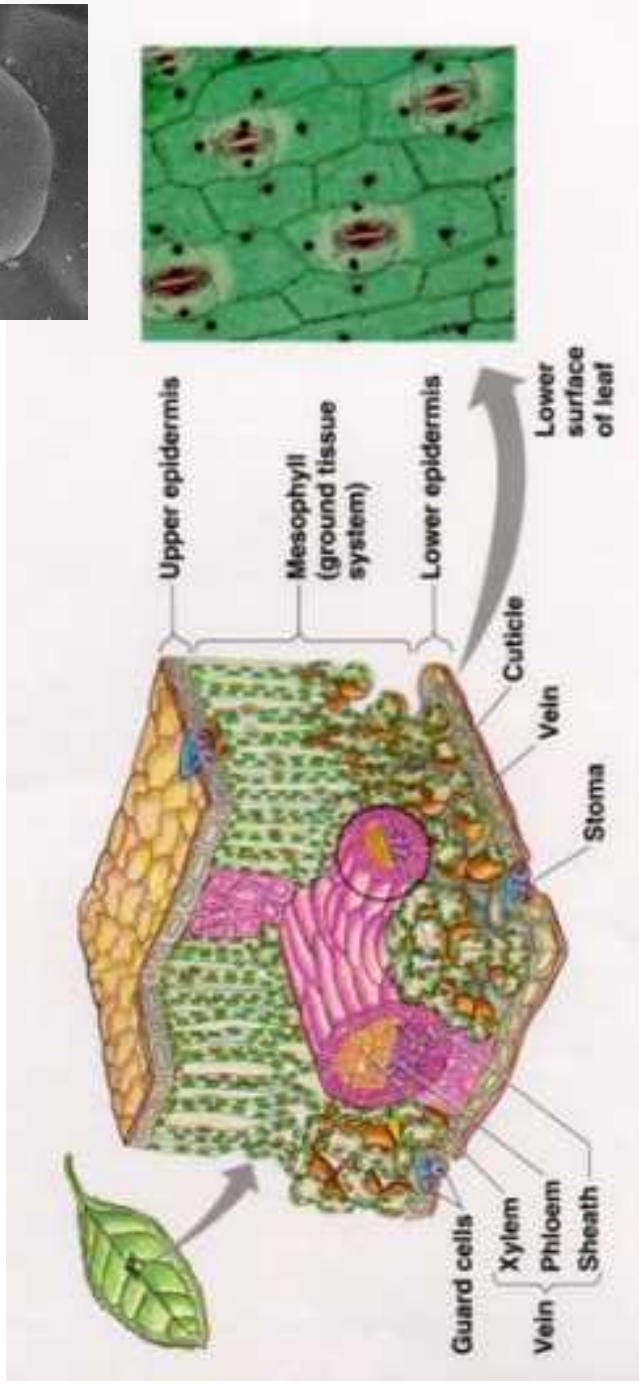
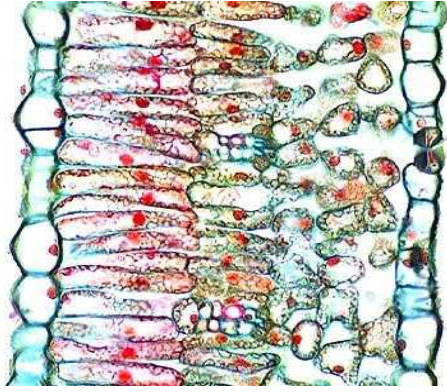
- Leaf anatomy is correlated to photosynthesis:  
Carbon dioxide + Water → sugars + oxygen





# Leaf epidermis

- Is transparent – so that sun light can go through.
- Waxy cuticle protects against drying out
- Lower epidermis: **stomata** with **guard cells** –  
for gas exchange ( $\text{CO}_2$ ,  $\text{H}_2\text{O}$  in;  $\text{O}_2$  out)



# Leaf epidermis

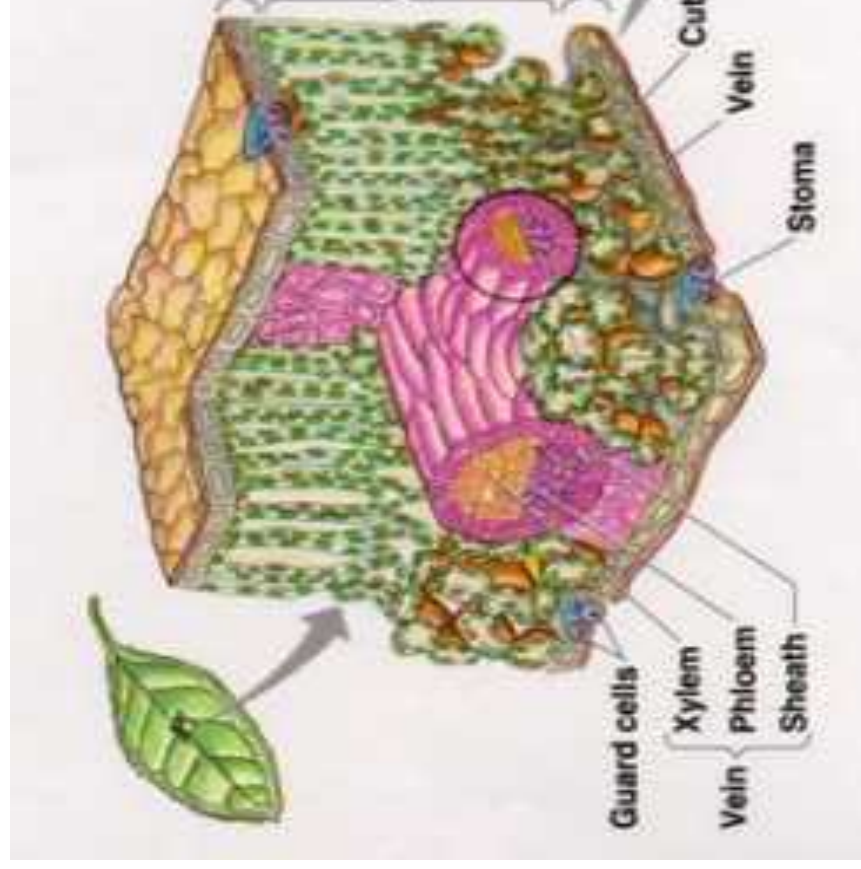
- Trichomes (give fuzzy texture)



(“Panda plant”)

# 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



# Leaf Mesophyll

- Middle of the leaf (meso-phyll)
- Composed of photosynthetic ground cells:

- **Palisade parenchyma**

(long columns below epidermis;  
have lots chloroplasts for  
photosynthesis)

- **Spongy parenchyma**

(spherical cells)

with **air spaces** around,

(for gas exchange)

