

# Science of Pharmacology

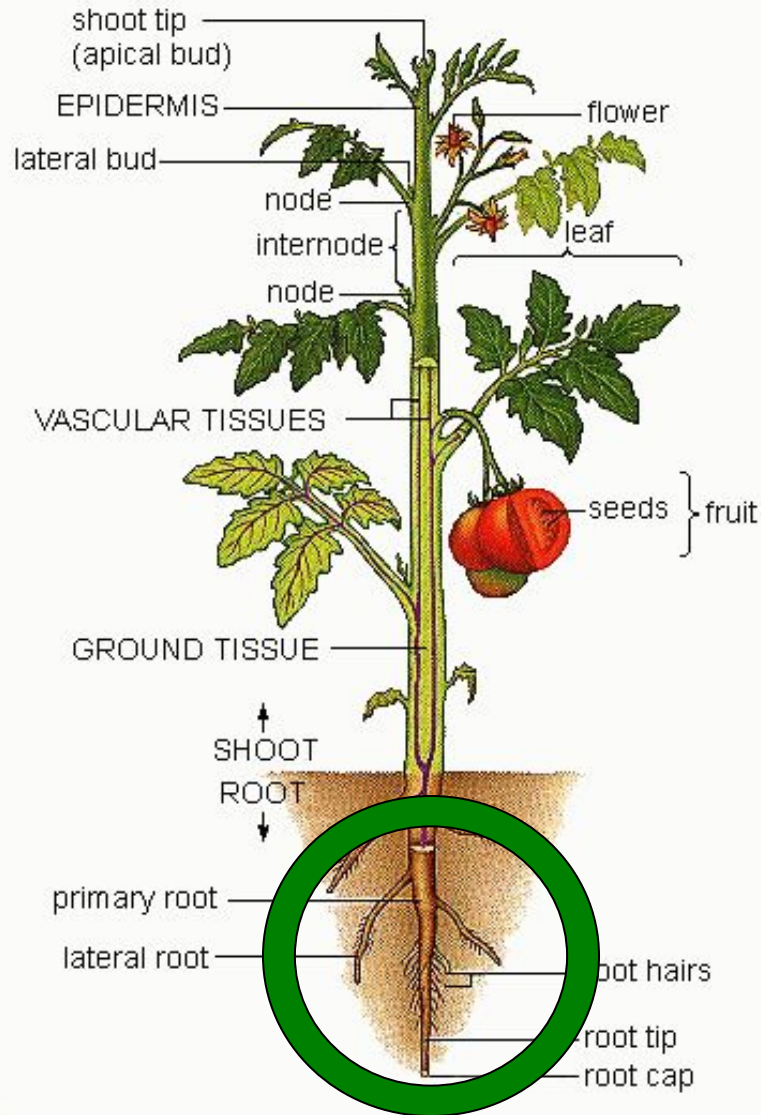
**Grammar: Modal auxiliaries (must have, can't have, may have, was, were to have)**

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**Group: 207 a PhR**

**Senior Teacher : Korolevskaya S.A.**

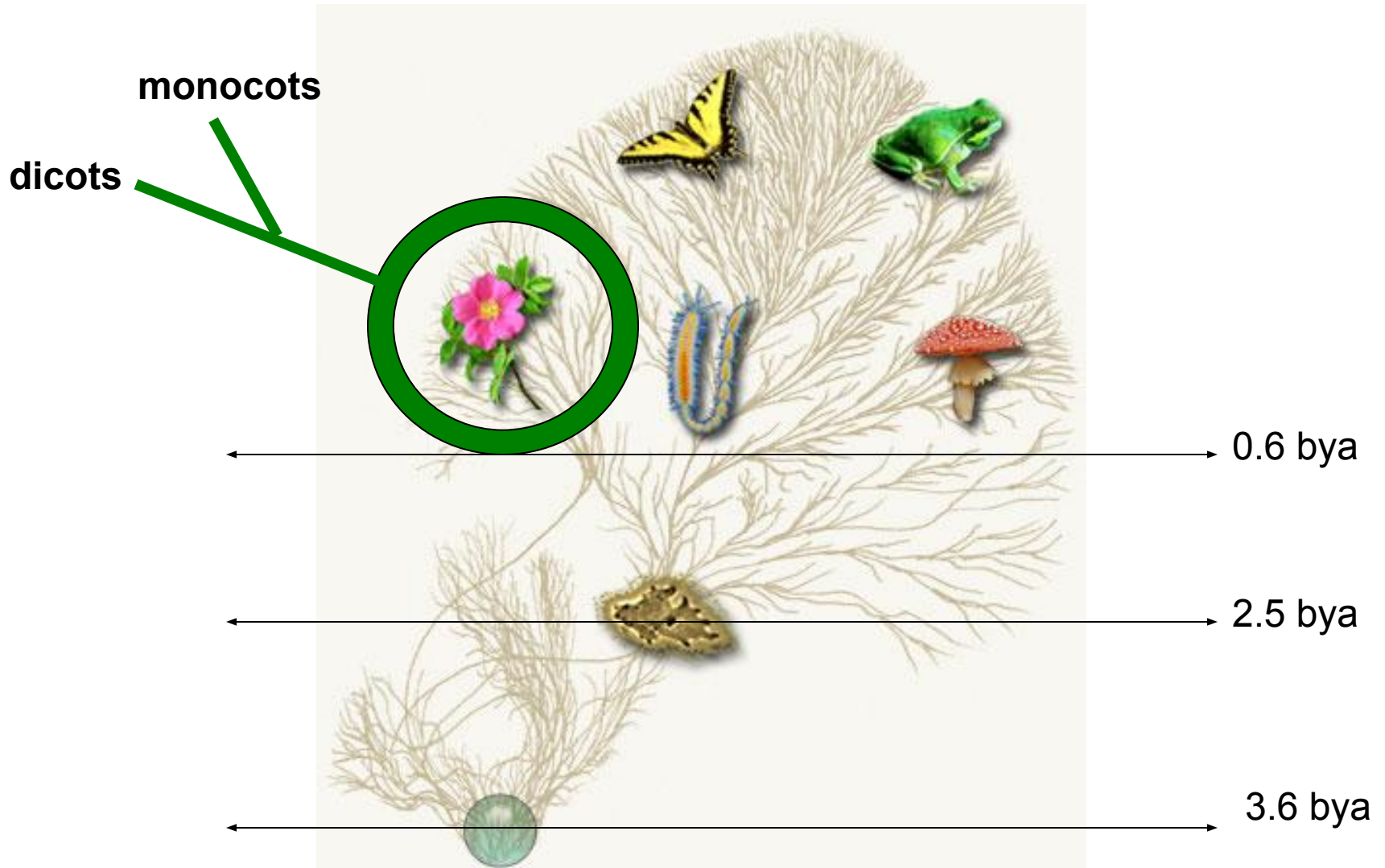
# The Plant Body



# ROOTS IN FLOWERING PLANTS











- Origin (Radicle or Adventitious)
- Function
- External Anatomy
- Internal Anatomy
- Specialized Roots
- Roots and Plant Nutrition

# Evolutionary Lineages of Life



# Monocotyledonous & Dicotyledonous Flowering Plants

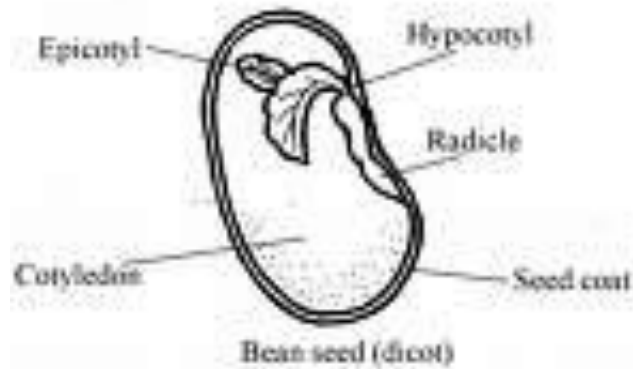
## Monocots and Dicots

MONOCOTS				
EMBRYOS	LEAF VENATION	STEMS	ROOTS	FLOWERS
 <p>One cotyledon</p>	 <p>Veins usually parallel</p>	 <p>Vascular bundles usually complexly arranged</p>	 <p>Fibrous root system</p>	 <p>Floral parts usually in multiples of three</p>
DICOTS				
 <p>Two cotyledons</p>	 <p>Veins usually netlike</p>	 <p>Vascular bundles usually arranged in ring</p>	 <p>Taproot usually present</p>	 <p>Floral parts usually in multiples of four or five</p>

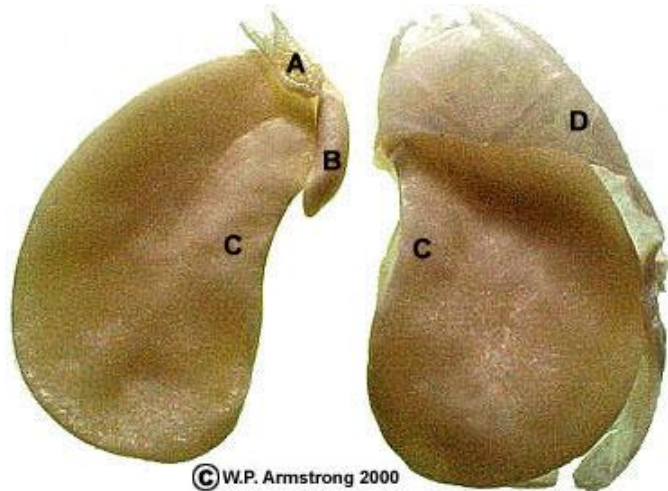
### Examples

- Grasses
- Lilies
- Orchids
- Palms
  
- Oaks
- Bean
- Spinach
- Rose

# Embryonic root or radicle



Radish - radicle



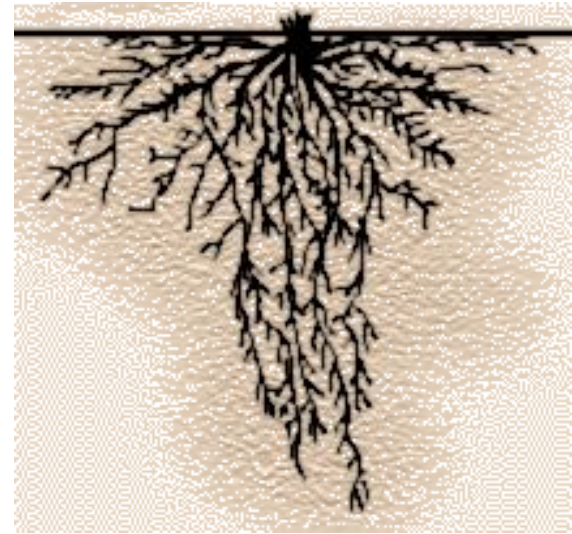
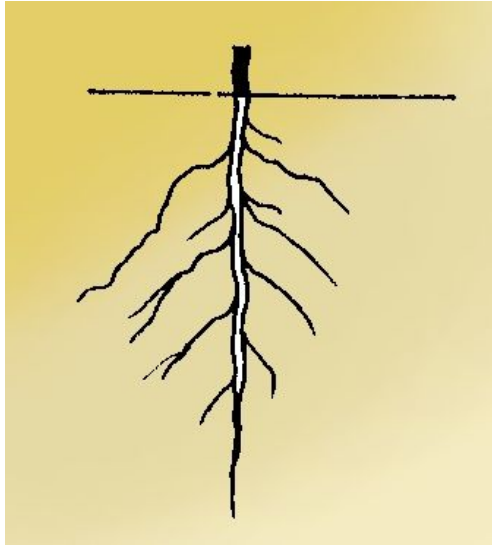


# World's Biggest Seed with Embryonic Root or Radicle

- The Royal Botanic Garden in Edinburgh germinated this bowling-ball-like coco de mer (*Lodicea maldivica*) palm.
- The seed weighs 35lb (16kg) and can produce a tree that will live up to 300 years.
- Scottish botanists put in a dark case, and now a root has developed. It will produce one leaf a year for the next few years. The tree will begin to flower in 20-30 years and produce its own seeds after another five to seven years (10-09-03).
- Source: <http://www.crocus.co.uk/whatsgoingon/regionalscotland/>

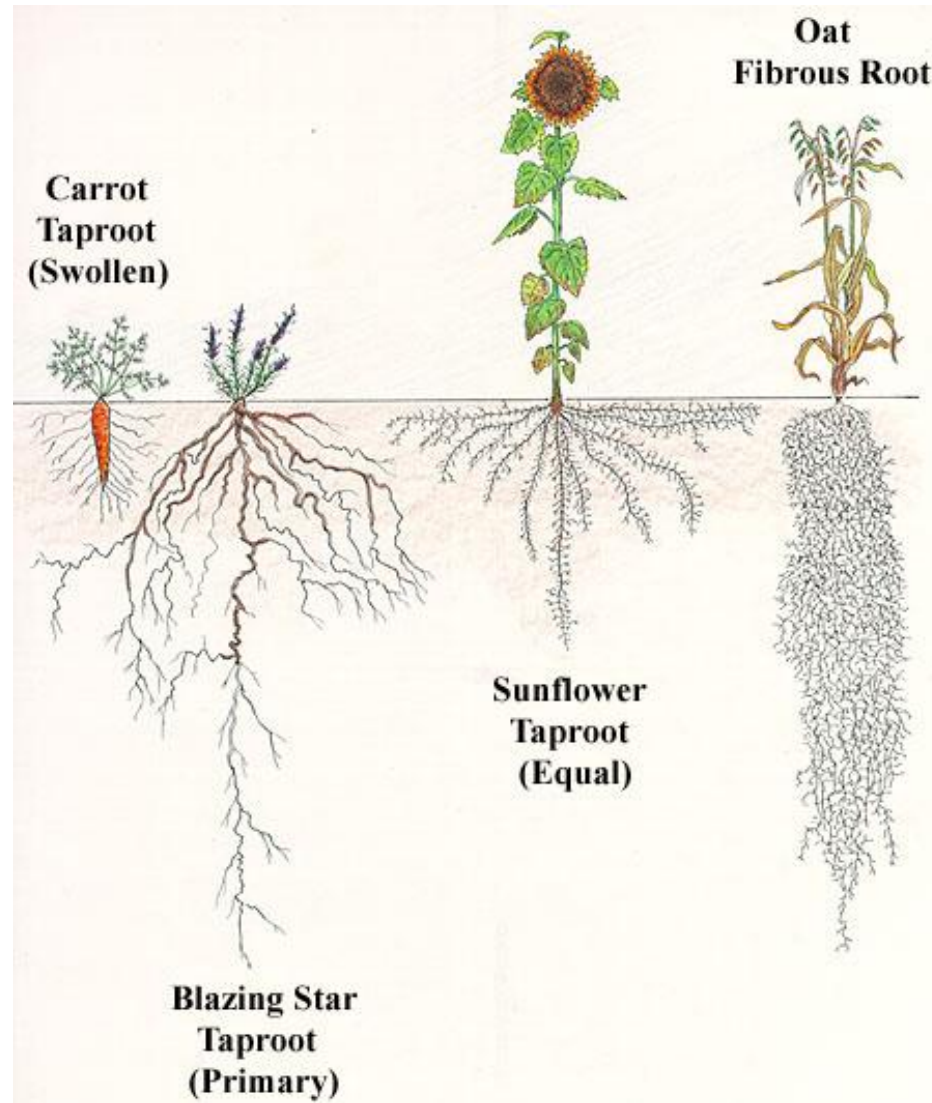


# Tap root and Fibrous (Diffuse) Root Systems – Both arise from radicle





# Comparison of Root Systems



**Adventitious Roots: roots that arise from anything other than the radicle**





# Adventitious Roots: roots that arise from anything other than the radicle



# Roots of the Future?

Carrot Man from “Lost in Space”



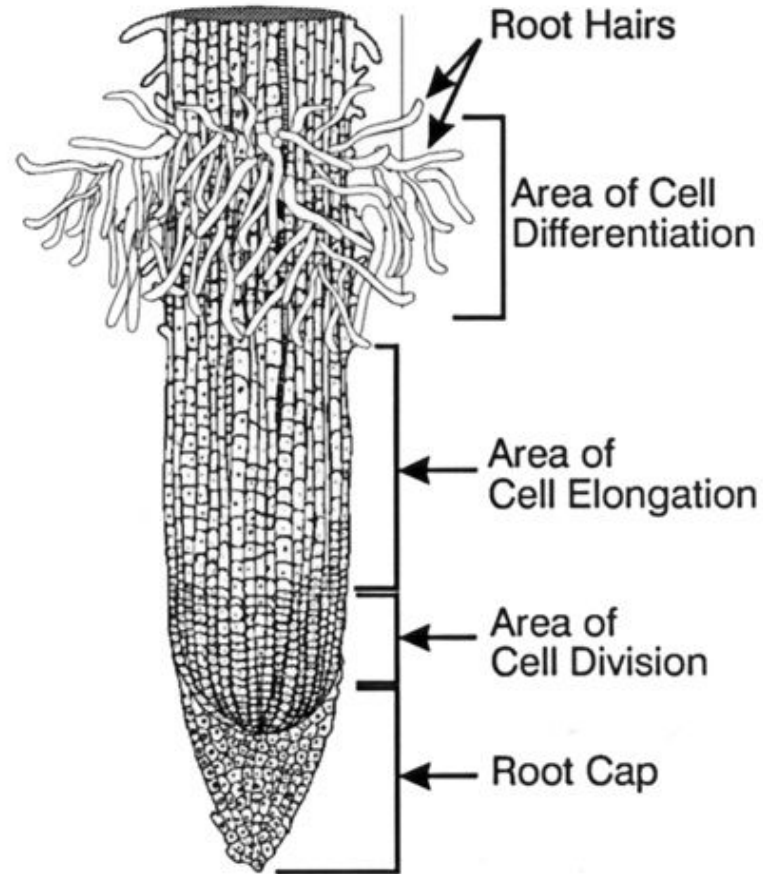
# Roots: Function

- Roots anchor the plant in the substratum or soil.
- Roots absorb water and dissolved nutrients or solutes (nitrogen, phosphorous, magnesium, boron, etc.) needed for normal growth, development, photosynthesis, and reproduction.
- In some plants, roots have become adapted for specialized functions.

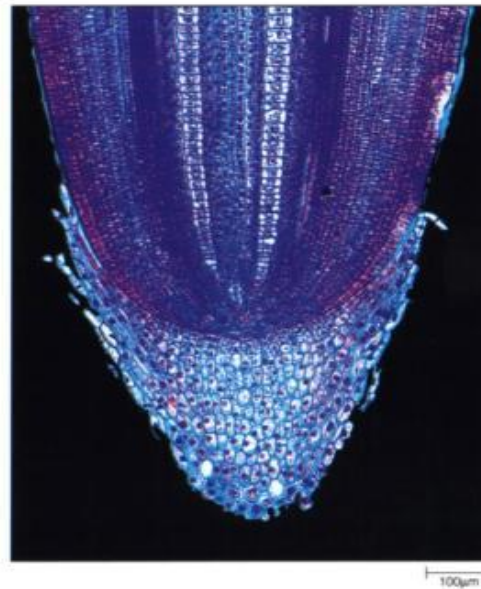
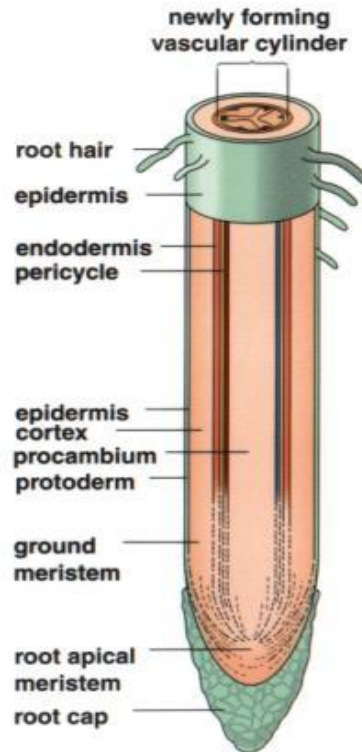


# EXTERNAL ANATOMY

- Root cap
- Region of cell division
- Region of elongation
- Region of differentiation or maturation



# Root Cap



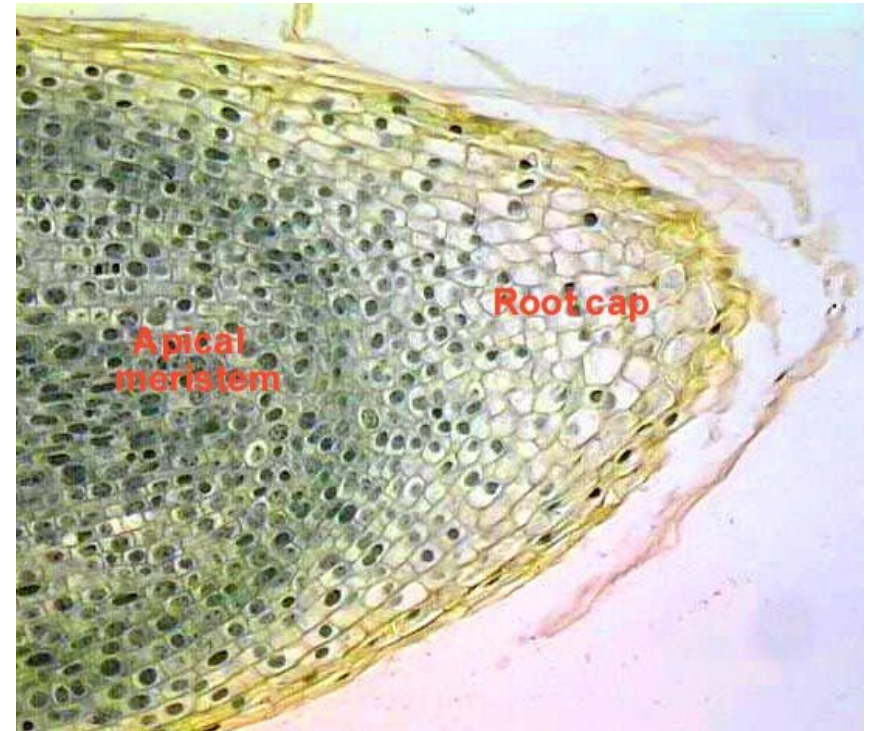
# Root Cap

- thimble-shaped mass of parenchyma cells at the tip of each root
- protects the root from mechanical injury
- Dictyosomes or Golgi bodies release a mucilaginous lubricant (mucigel) cells lasts less than a week, then these die
- possibly important in perception of gravity (i.e., geotropism or gravitropism)
- amyloplasts (also called statoliths) appear to accumulate at the bottom of cells

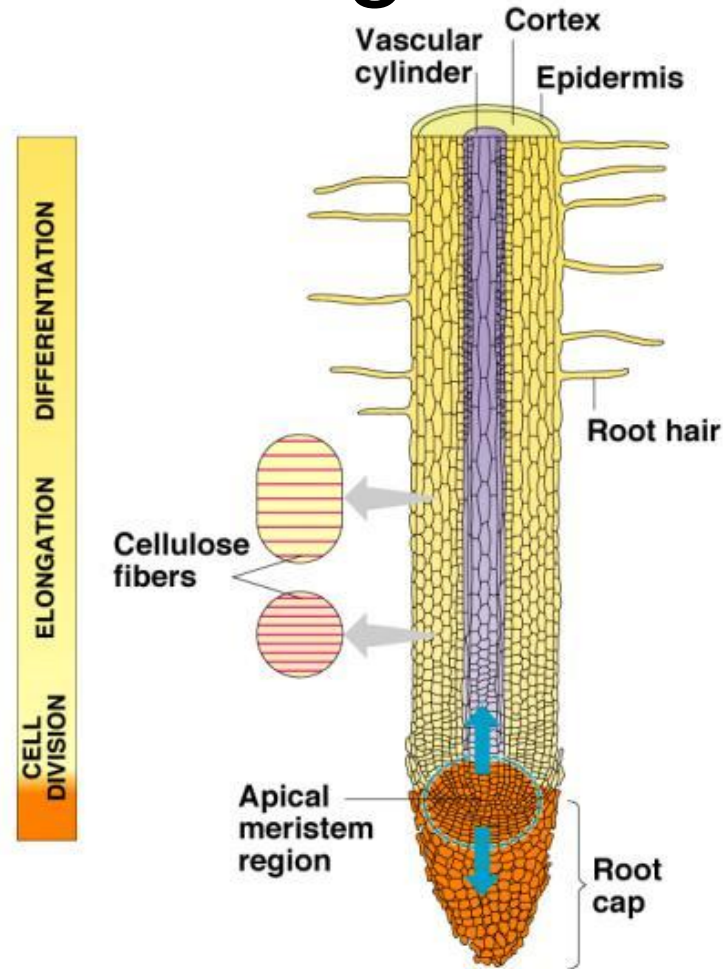


# Region of Cell Division

- Apical meristem - cells divide once or twice per day.
- The transitional meristems arise from the tips of roots and shoots. These include:
  - the protoderm (which forms the epidermis)
  - the ground meristem (which forms the ground tissue)
  - the procambium (forms the primary phloem and xylem).

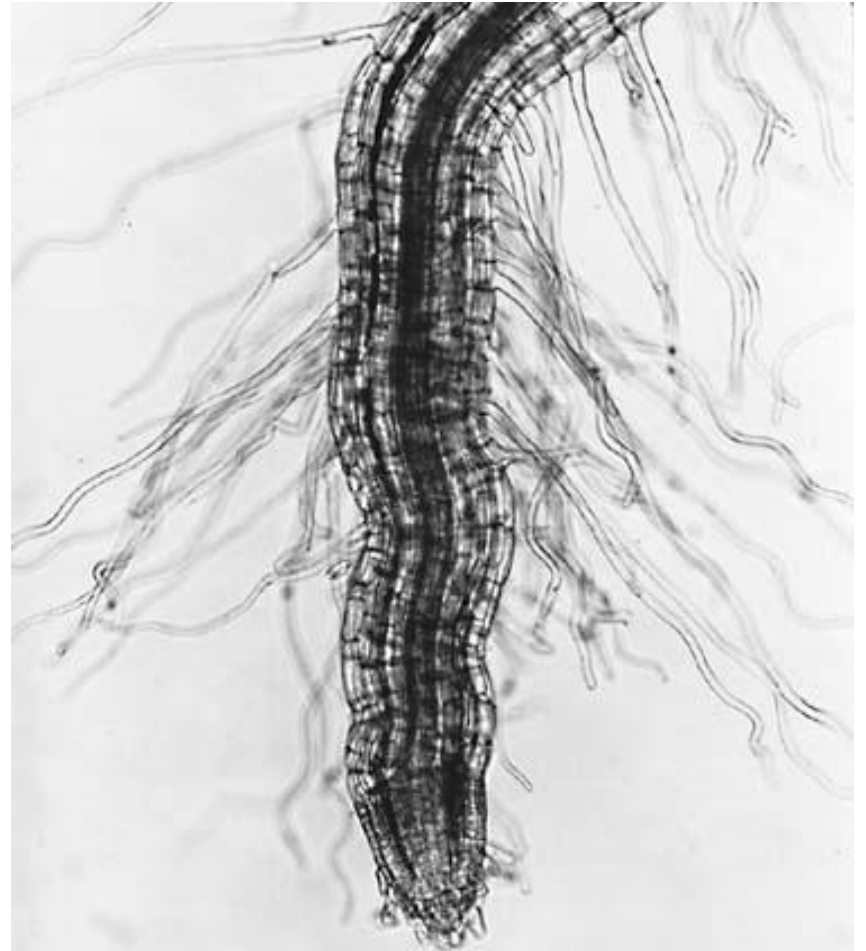
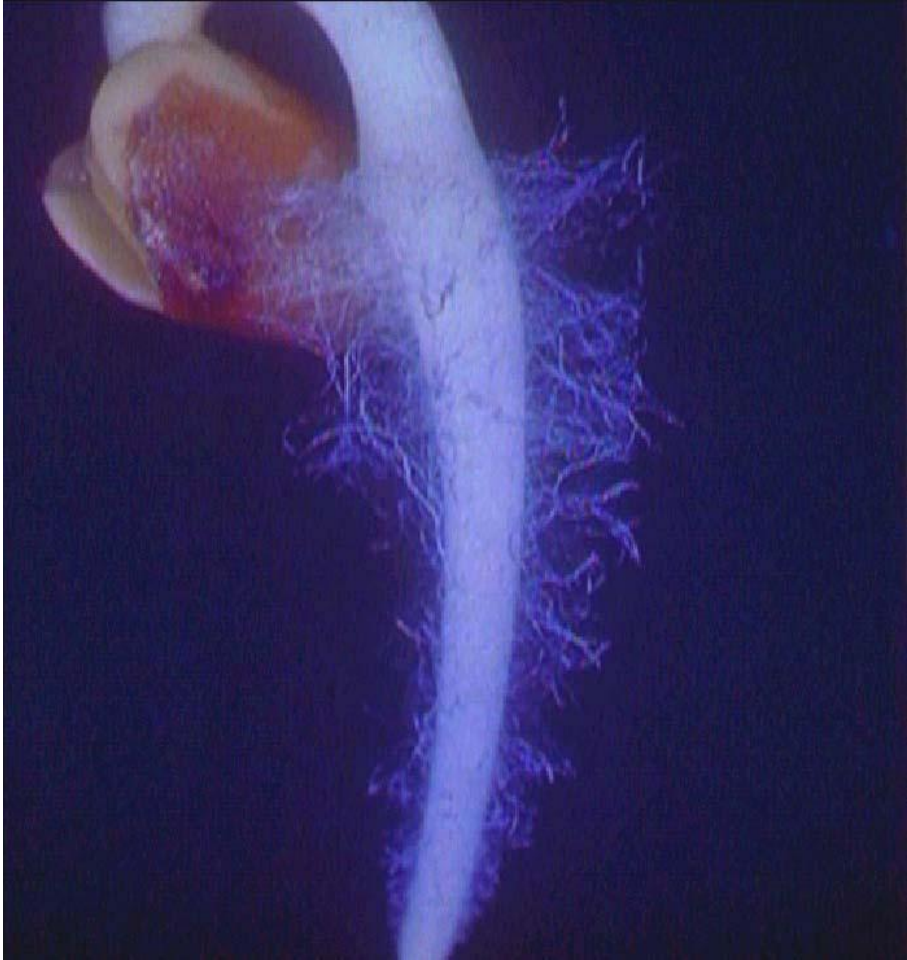


# Region of Elongation - cells become longer and wider



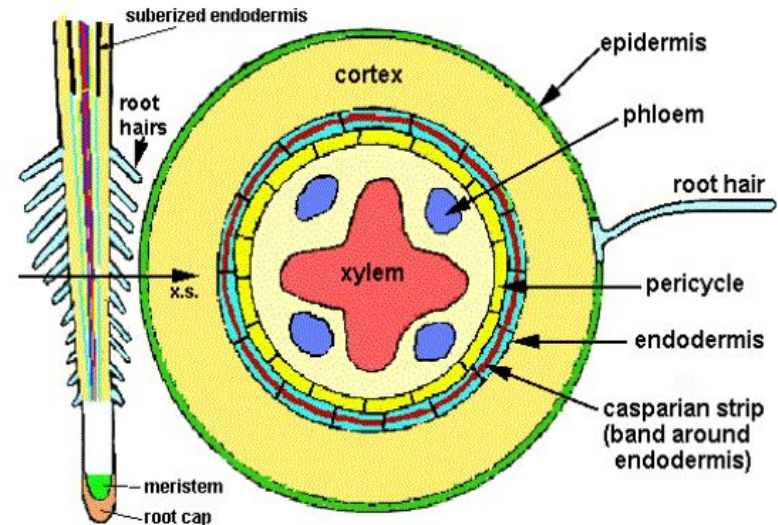


# Region of Maturation or Differentiation

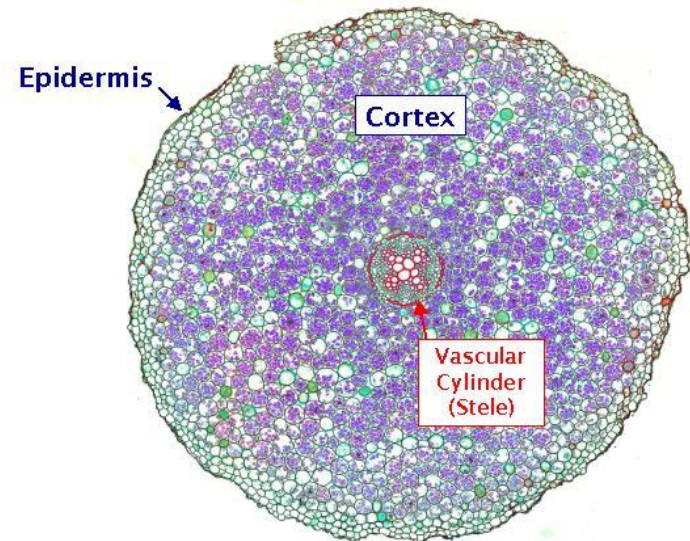
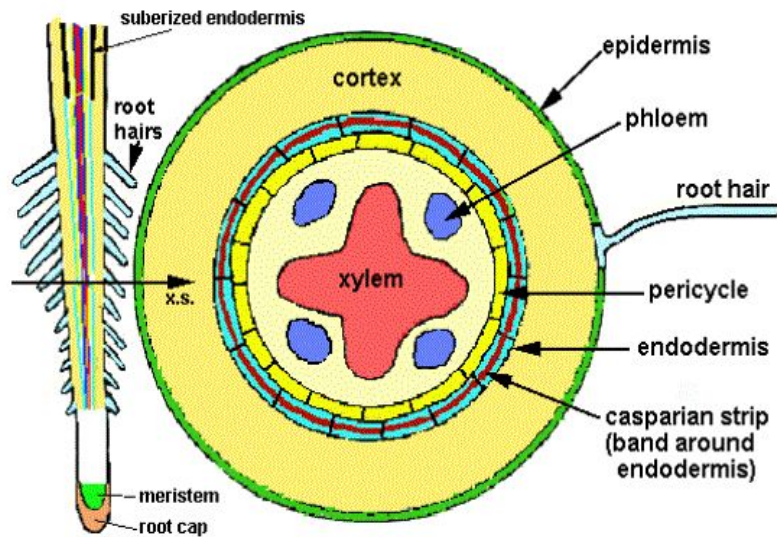


# Region of Maturation or Differentiation

- root hairs develop as protuberances from epidermal cells
- increase the surface area for the absorption of water
- cuticle exists on root but not on root hairs

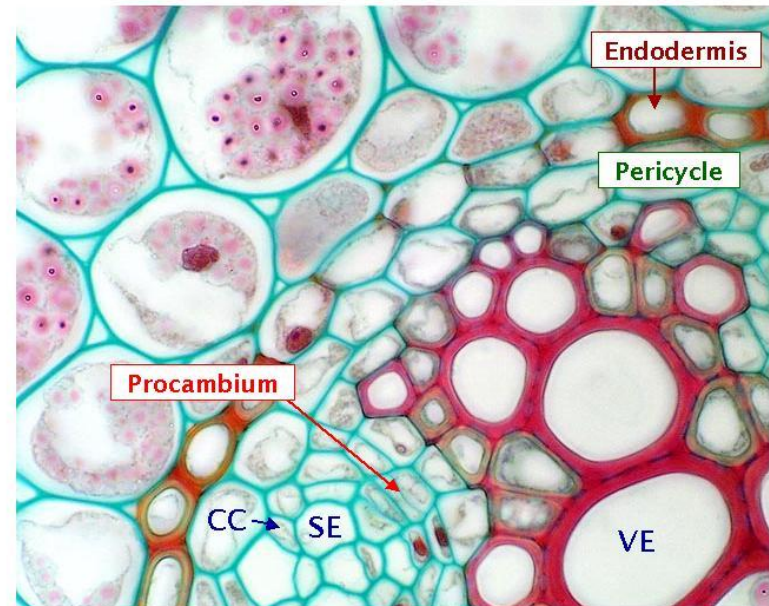
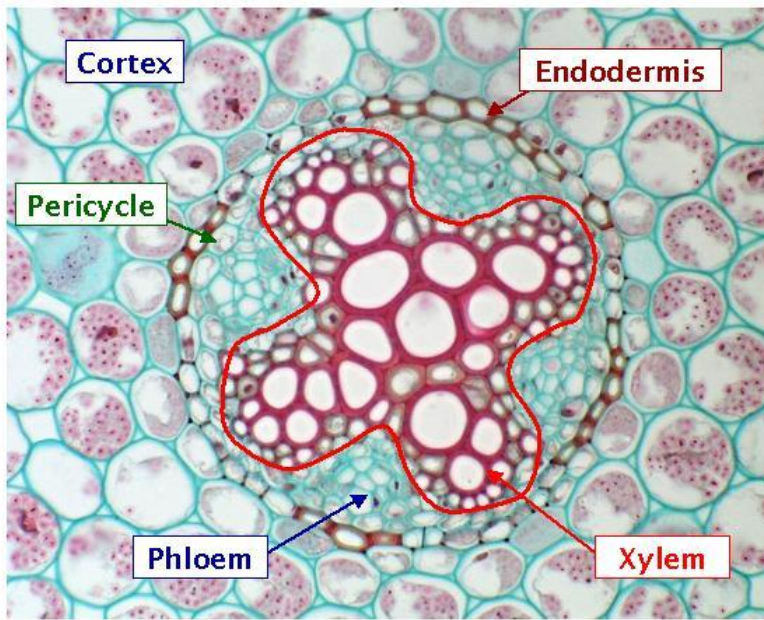


# Dicot Root in Cross Section

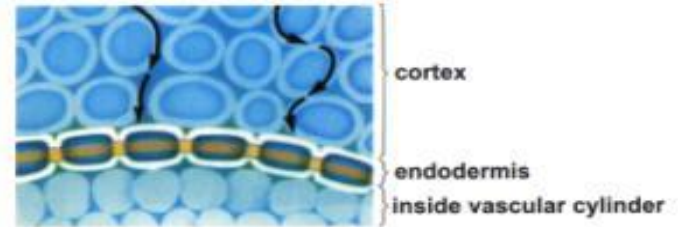
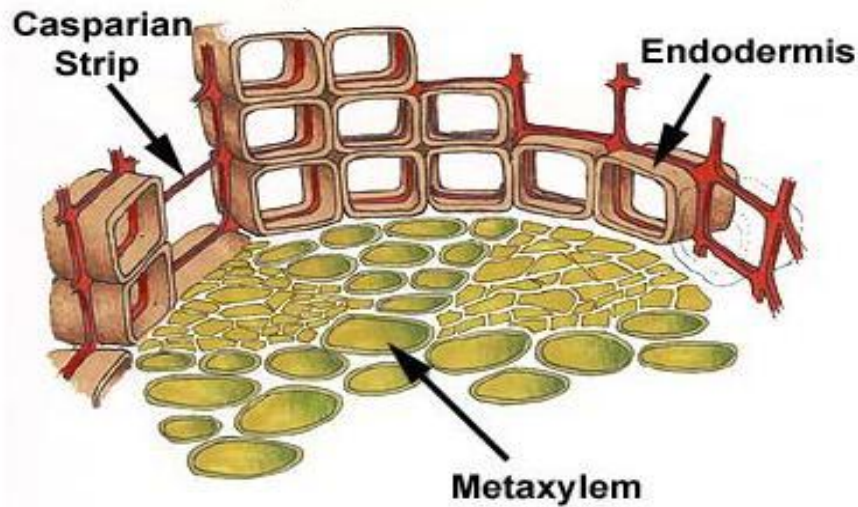




# Dicot root in Cross Section

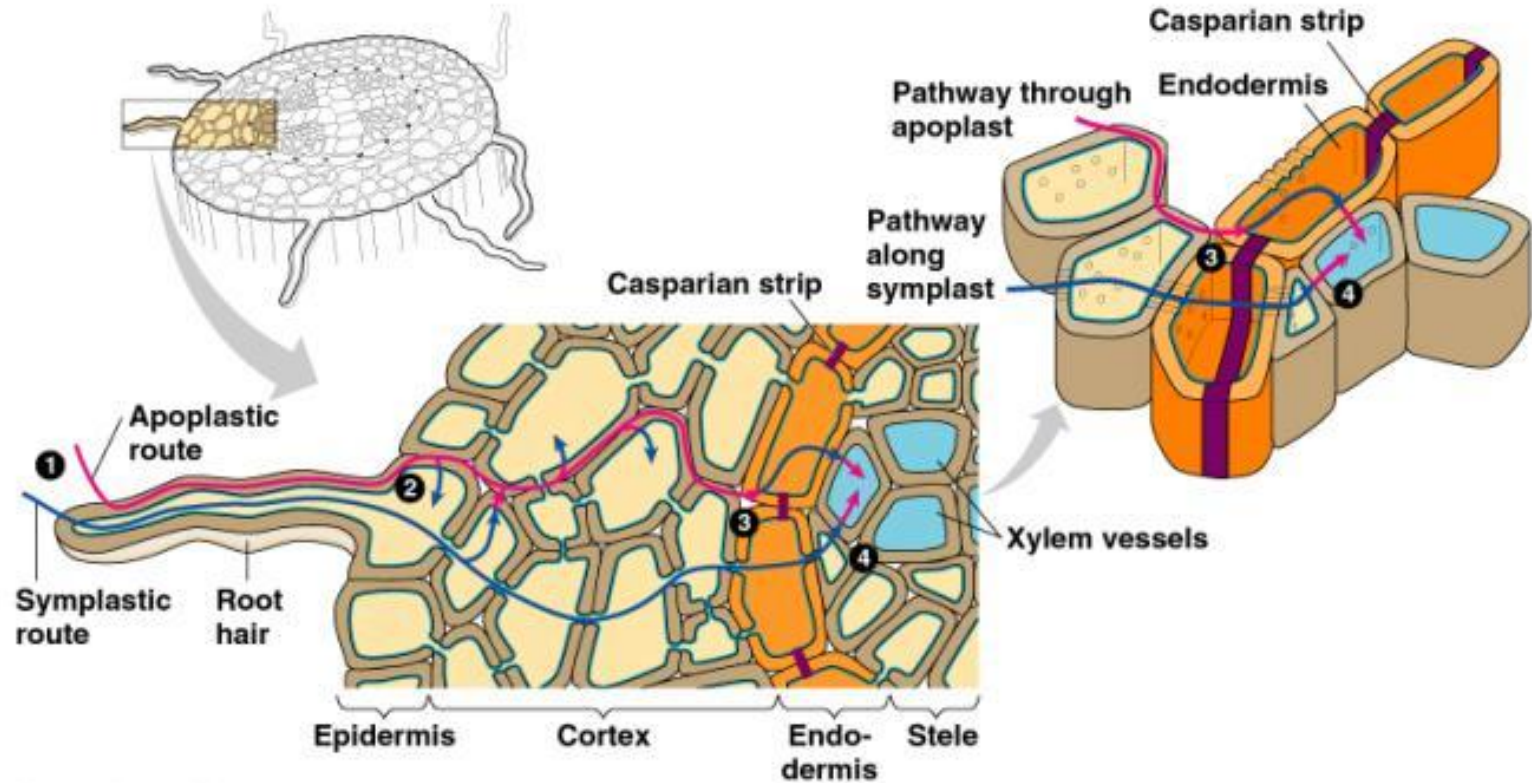


# The Casparian Strip



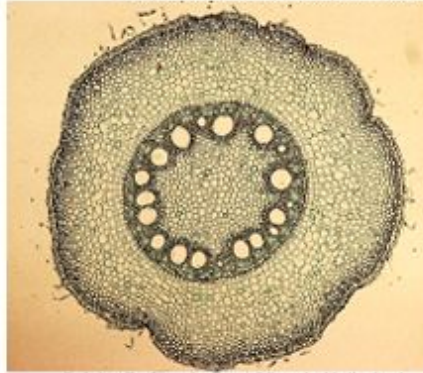


# The Path of Water into Roots



# Monocot Root in Cross Section

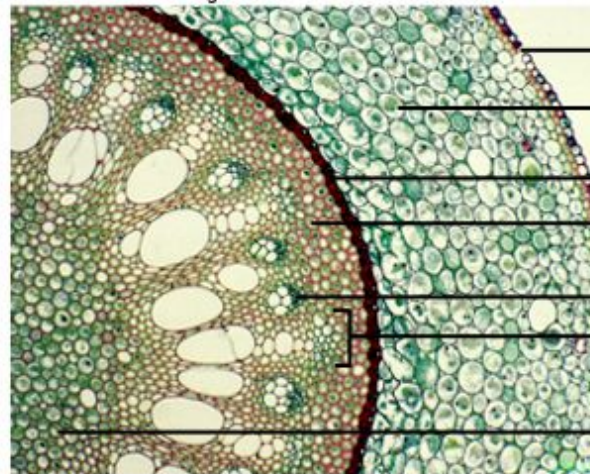
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## Monocot root

a.

© John D. Cunningham/Visuals Unlimited



epidermis

cortex

endodermis

pericycle

primary phloem

primary xylem

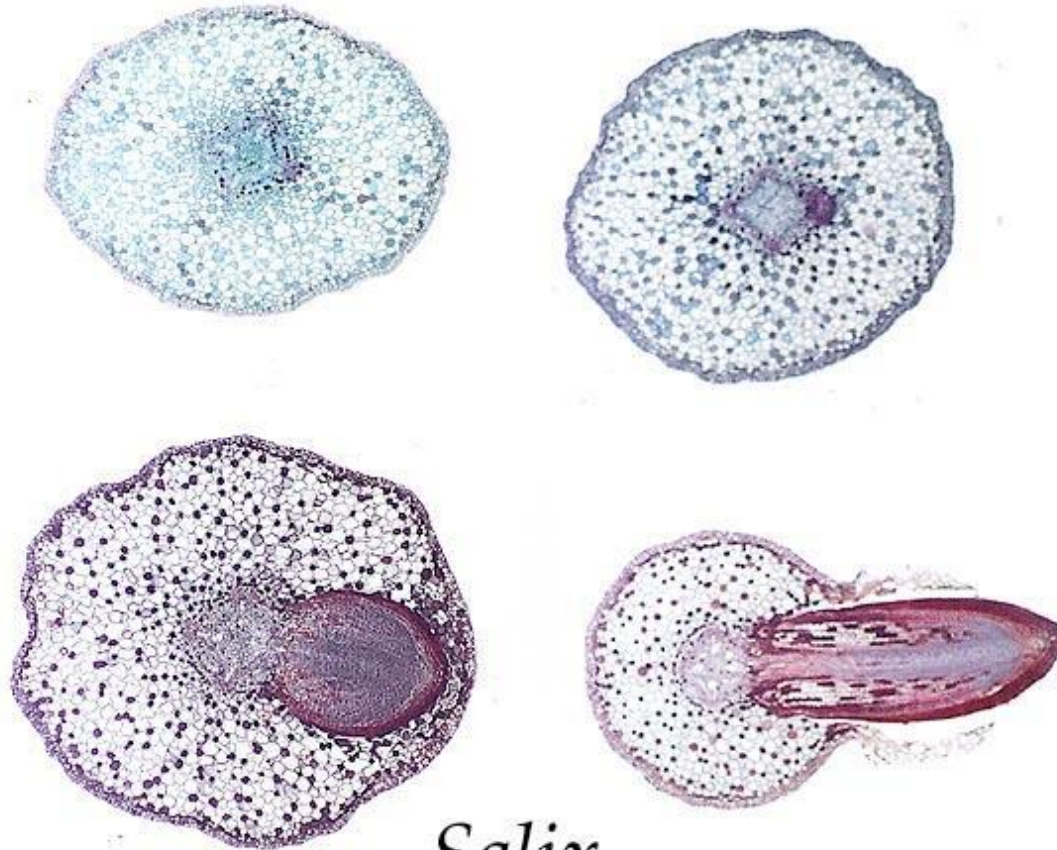
pith

b.

Courtesy of George Ellmore,  
Tufts University

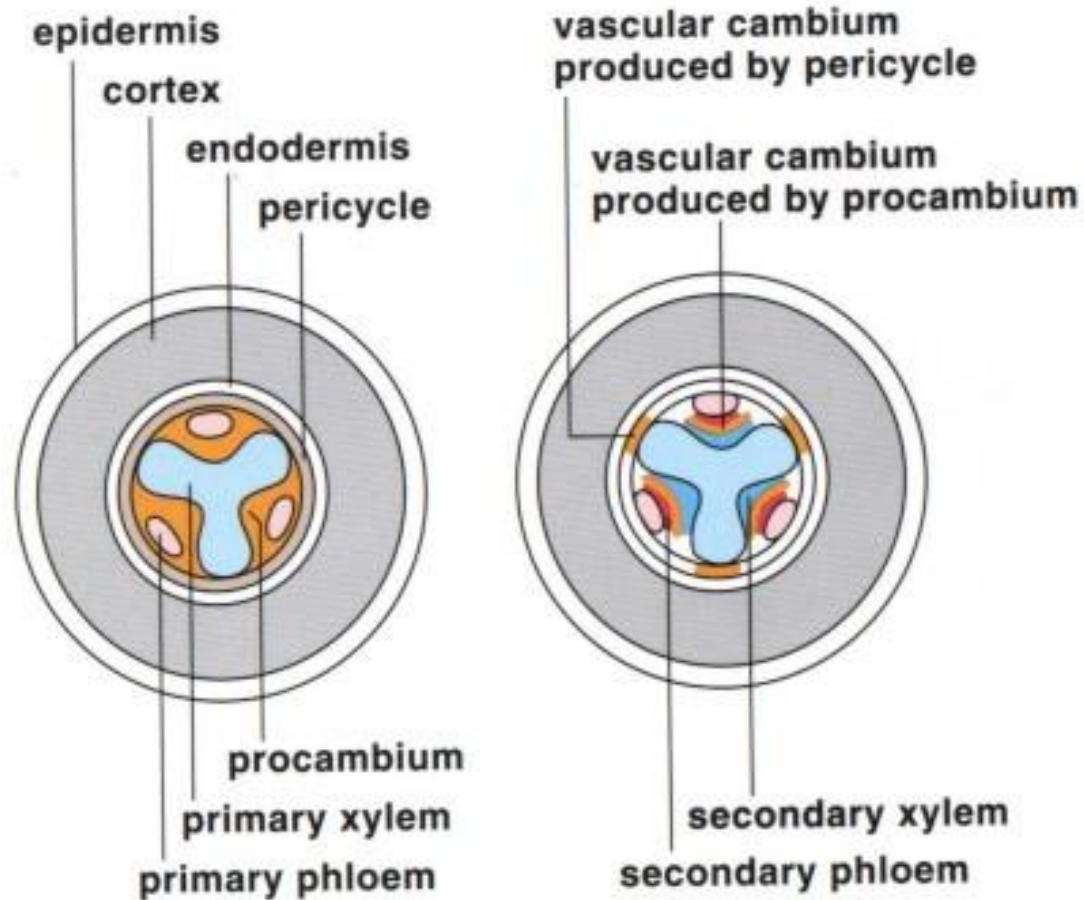
100  $\mu$ m

# Lateral Roots Arise from the Pericycle of the Stele



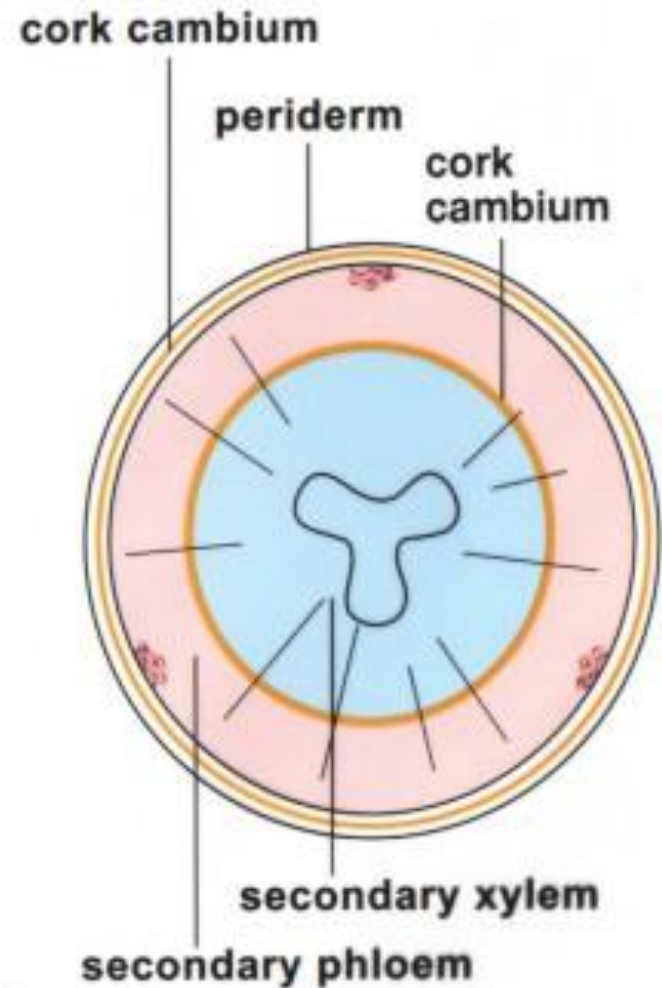
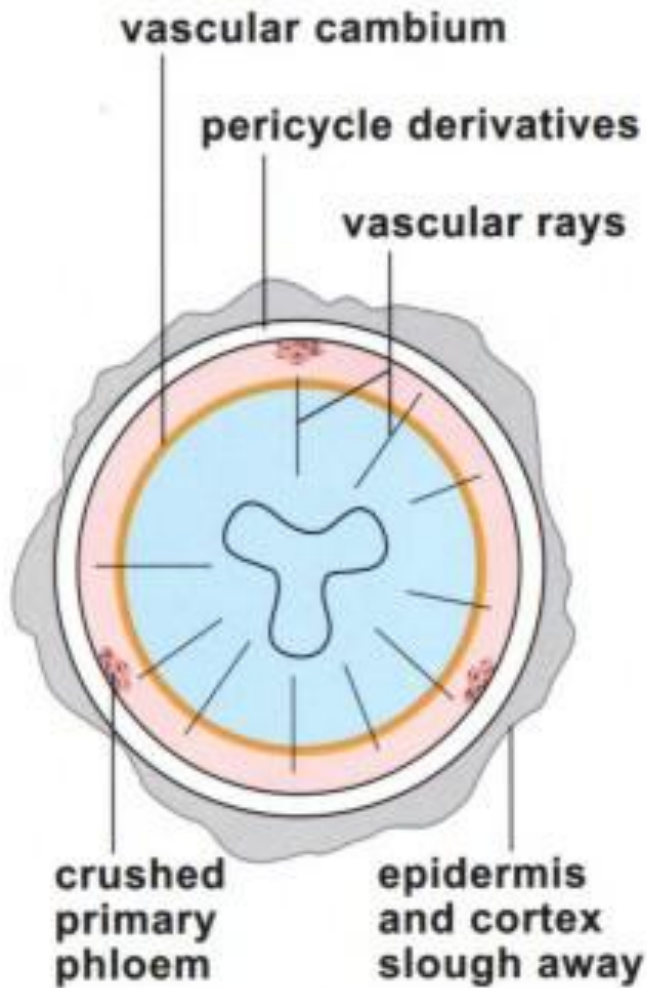
*Salix*

# Secondary Growth in Dicot Roots

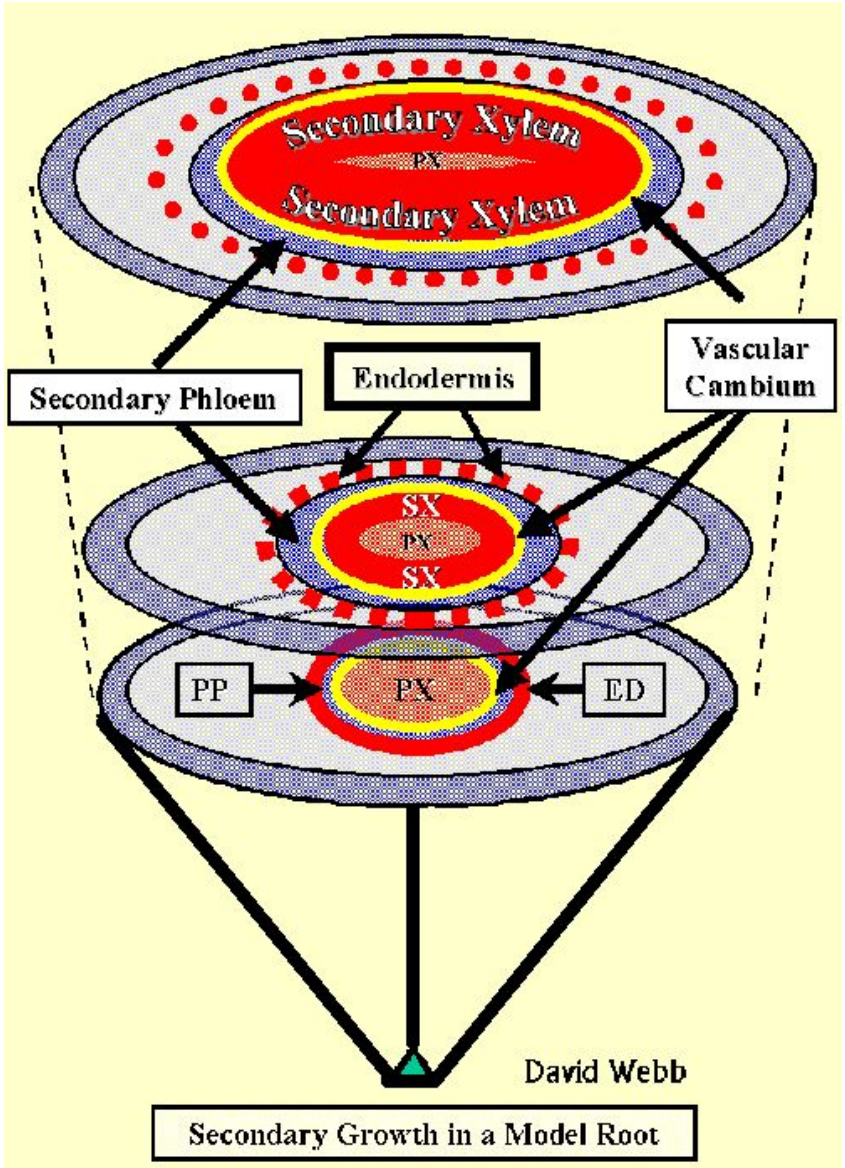
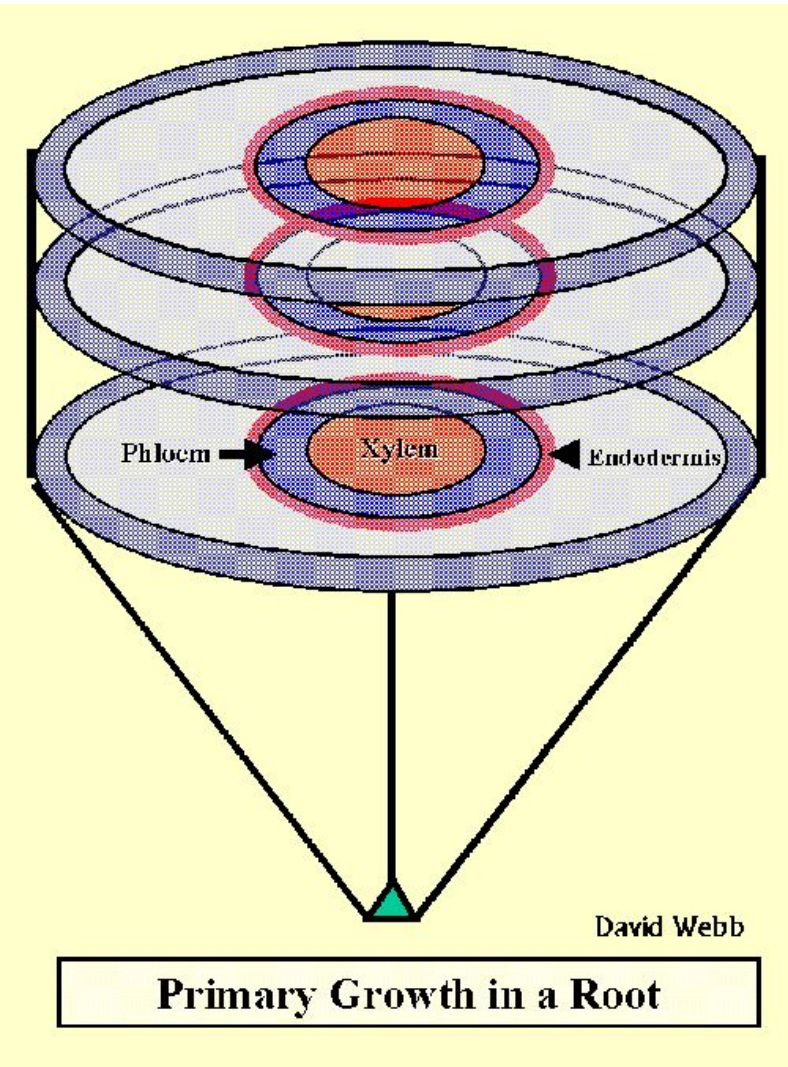




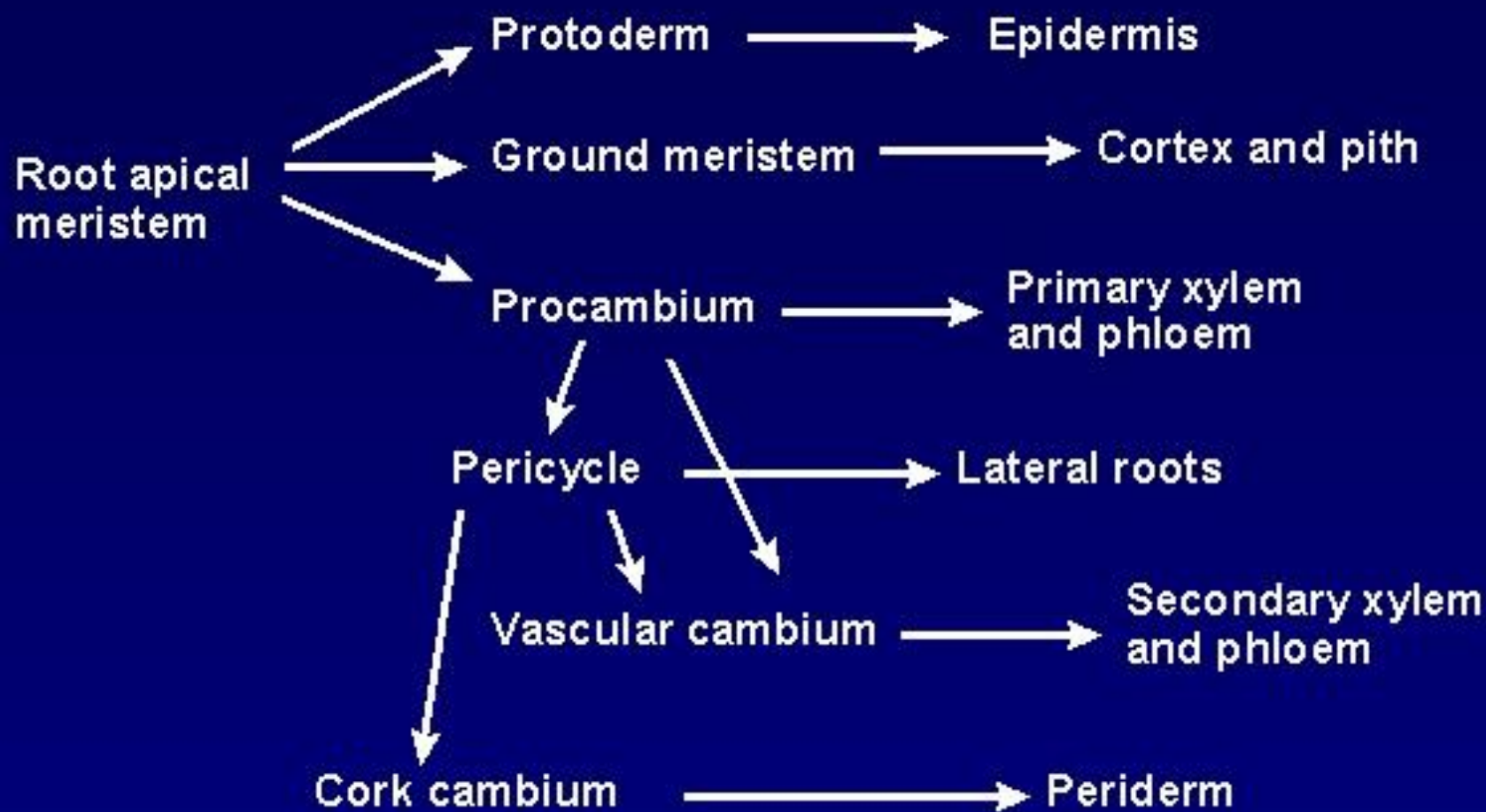
# Secondary Growth in Dicot Roots



# Primary and Secondary Growth in Roots







# Modified Roots

- Food storage
- Propagative roots
- Pneumatophores
- Aerial Roots
- Photosynthetic roots of some orchids
- Contractile roots some herbaceous dicots and monocots
- Buttress roots looks
- Parasitic roots
- Symbiotic roots
  - mycorrhizae or “fungus roots”
  - Legumes (e.g., pea, beans, peanuts) and bacterium form root nodules.

# Food Storage Roots



# HISTORY OF THE JACK O' LANTERN

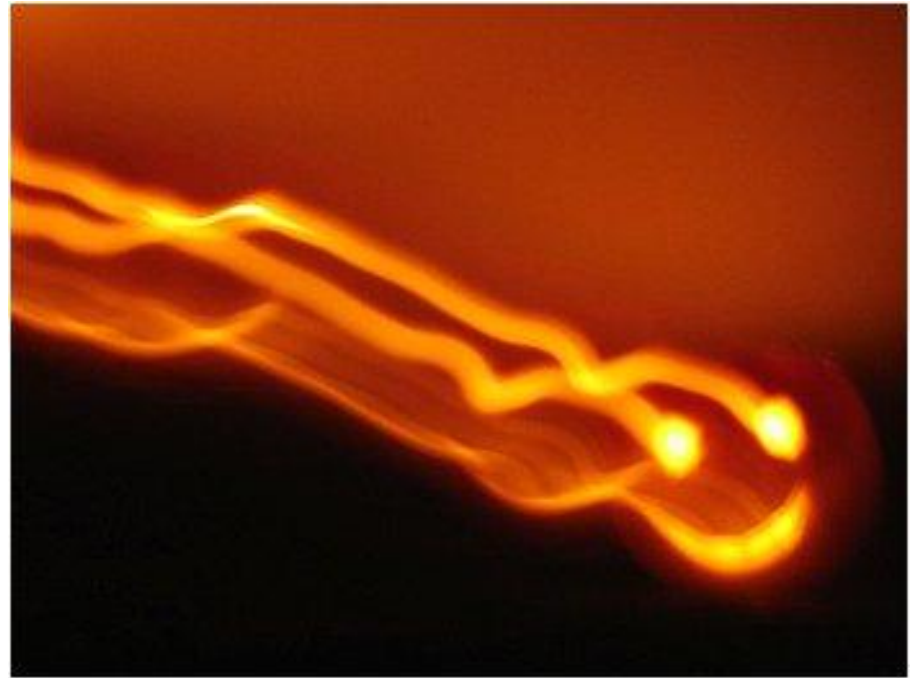




# Jack-o'-lanterns from Turnips



# Jack-o'-lanterns from Turnips



# Turnip + Cabbage = Rutabaga





# Pneumatophores - black mangrow





# Cypress Knees



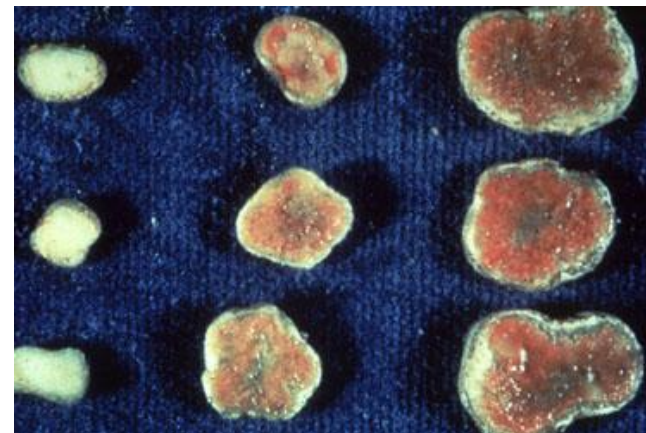


# Buttress Roots



# Symbiotic Roots

- Legumes (e.g., pea, beans, peanuts) form root nodules. Mutualism between a plant and bacterium which allows for the fixation of atmospheric nitrogen to form that the plant can utilize. The bacterium is reward with food and a place to live





# Symbiotic Roots

- Mycorrhizae or "fungus roots" where a symbiotic relationship forms between a plant and a fungus.
- In this partnership the fungus provides protection against some types of pathogens and increase the surface area for the absorption of essential nutrients (e.g. phosphorous) from the soil. The plant in return provides food for the fungus in the form of sugar and amino acids

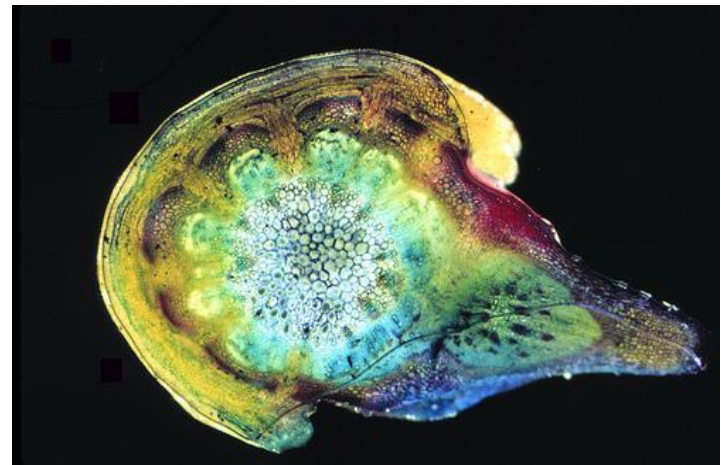




# Photosynthetic Roots



# Parasitic roots - Dodder



# Propagative Roots with Adventitious Buds/Stems

