The Plant Kingdom: origin, evolution & characteristics

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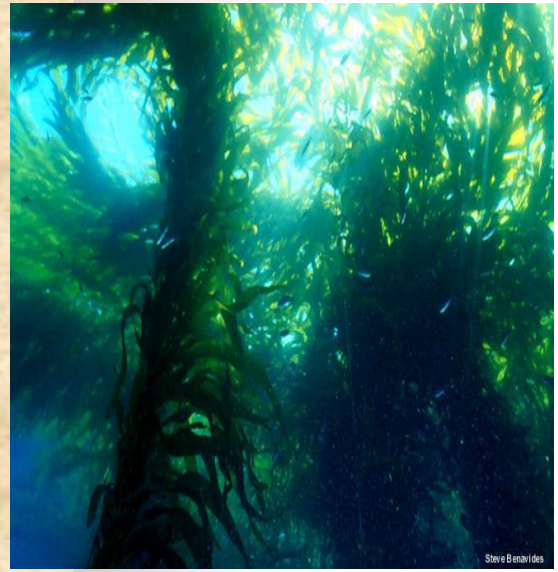
Plant Origin

- First plants
  1. 500 mya
  2. Looked like mosses
  3. Probably evolved from green algae
     - Cellulose cell walls
     - Same type of chlorophyll
     - Store excess food as starch

The Plant Kingdom: Algae

- The oldest and most simple photosynthetic organisms on earth are algae.
- The multicellular algae are separated into divisions based on their photosynthetic pigments, food storage products, and cell-wall components.

The three major groups include:



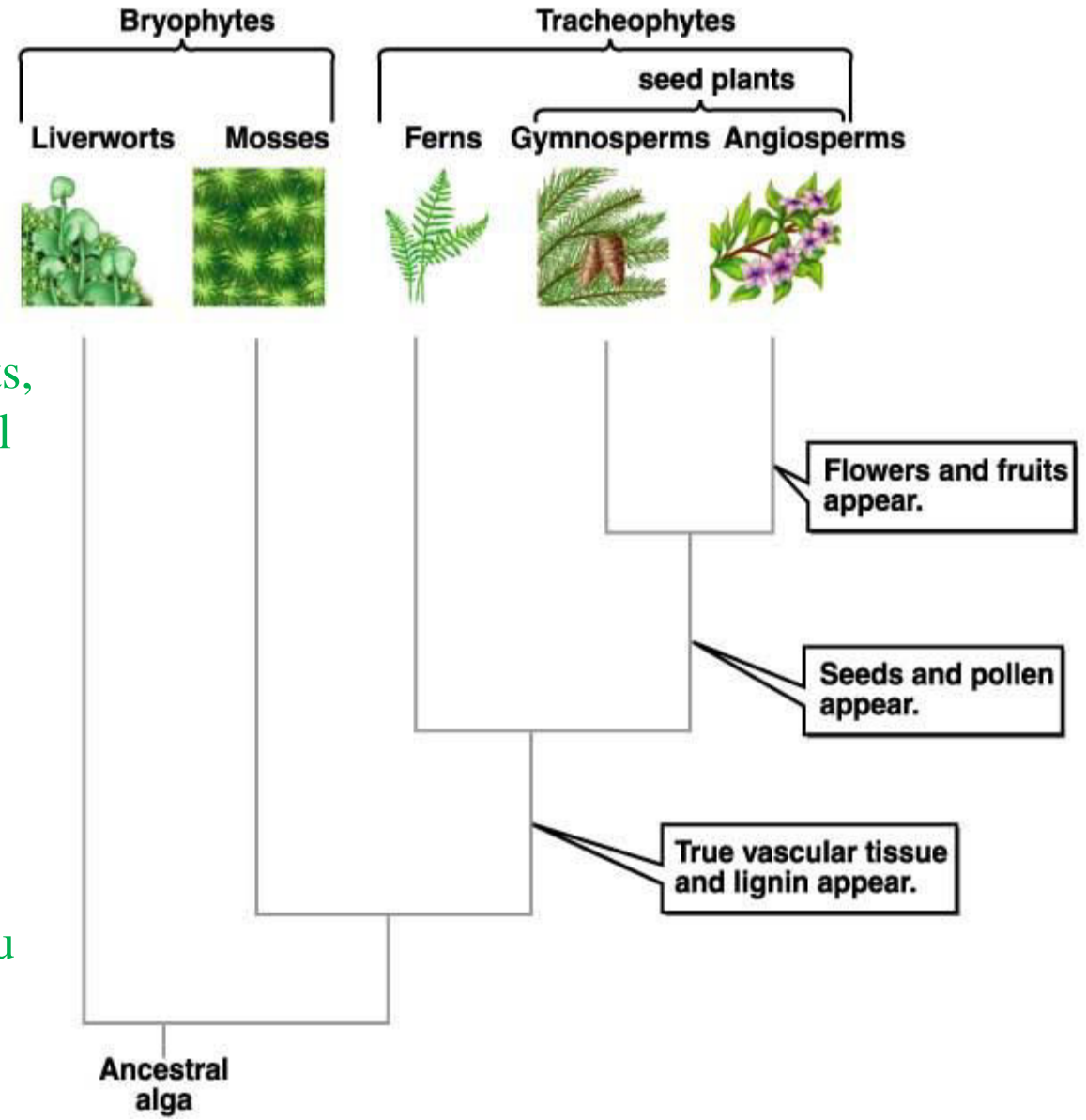
Brown algae

Red algae

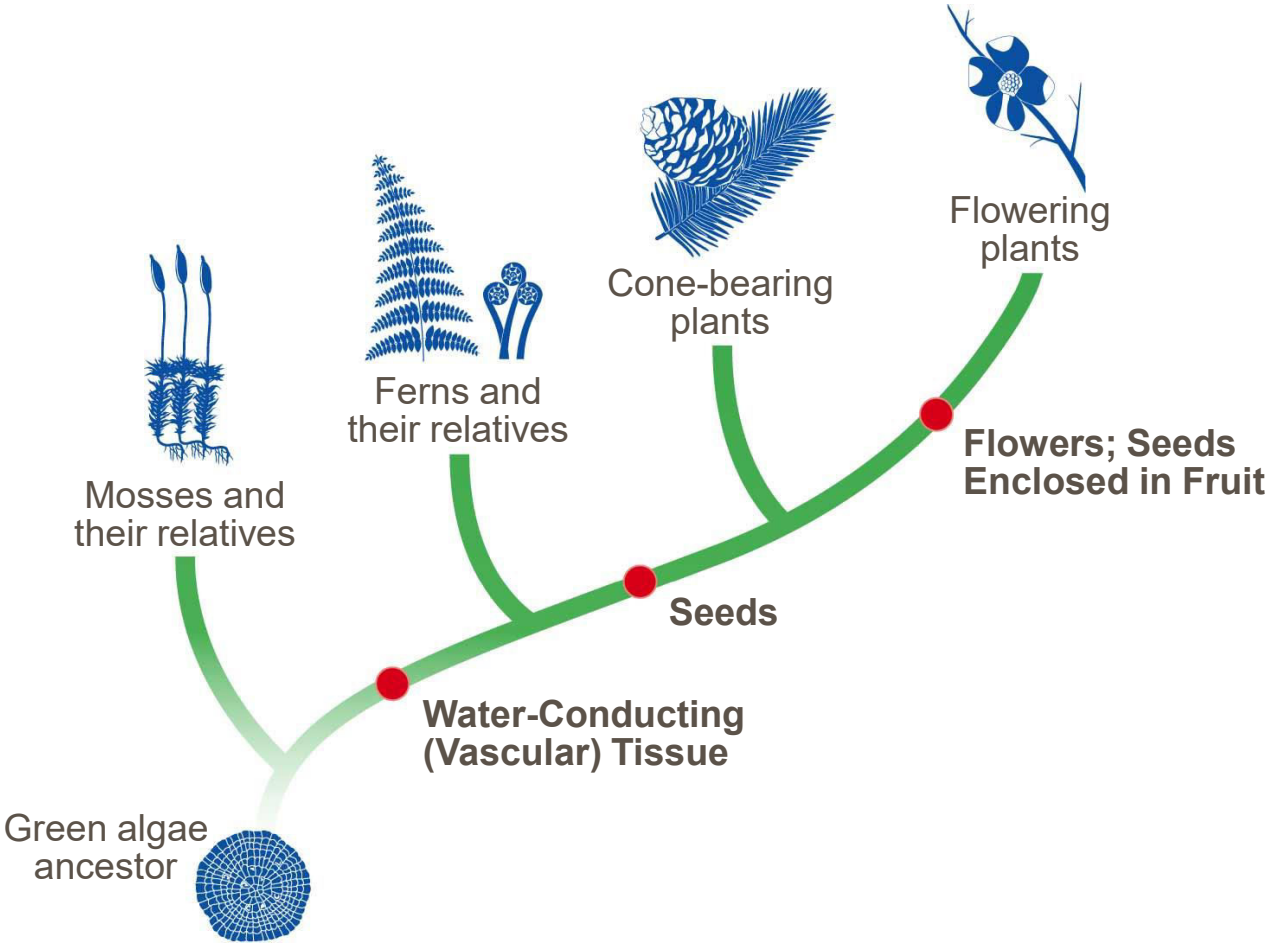
Green algae

The Plant Kingdom

- Green algae are thought to have given rise to the "higher" plants.
- They have the same pigments, storage products, and cell-wall type. Also, many of them live in fresh water…
- The different plants selected for adaptations that allowed them to exploit more of the terrestrial regions…
- What adaptations would you need for transition of life on to land?



Evolution of Plants (Cladogram)



The Plant Kingdom

- This kingdom has organisms that are
  multi-cellular,
  have cell walls and chlorophyll,
  produce their own food, and
  don't physically move from one place to another.

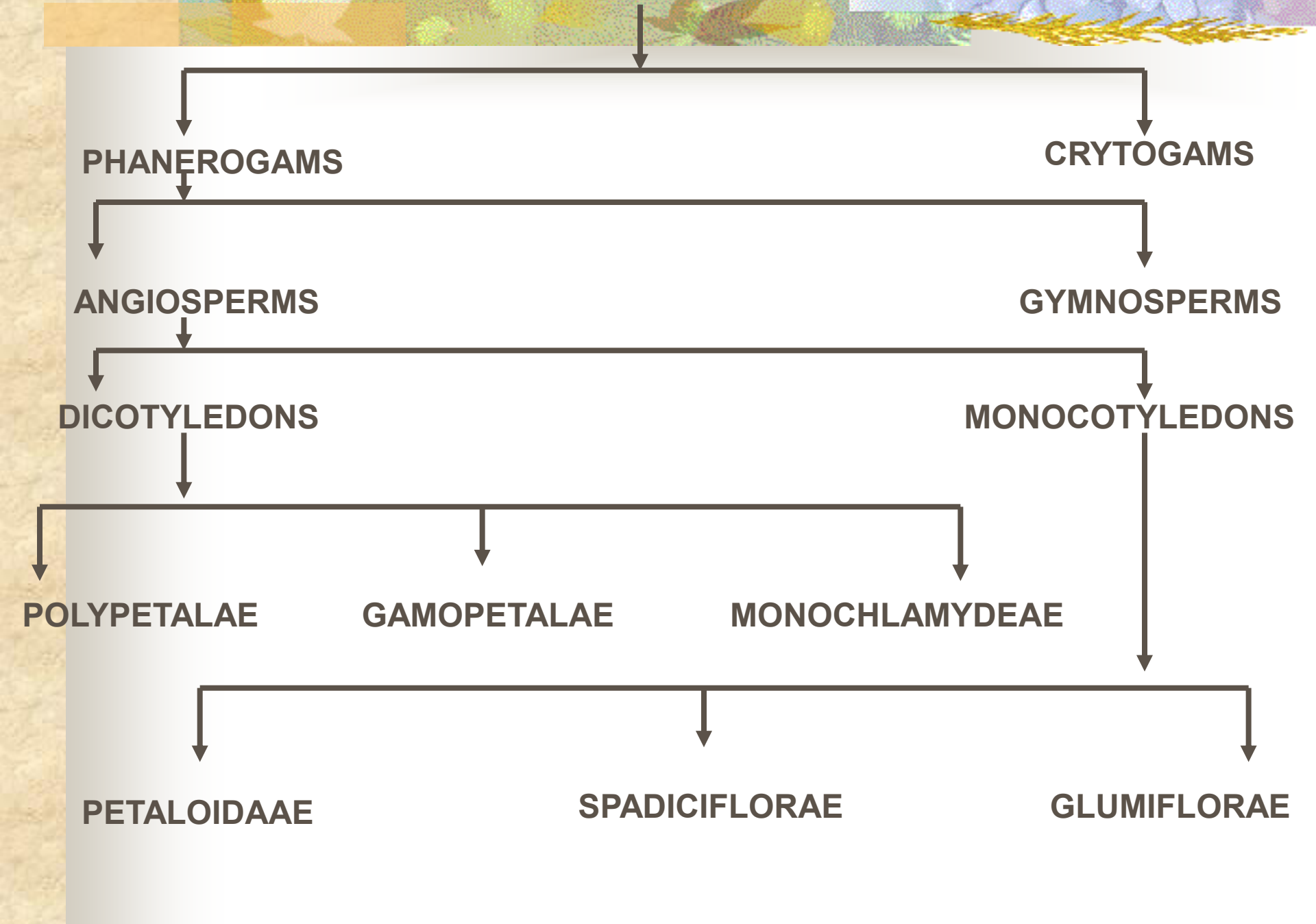
Plant Classification

- Domain: Eukaryota
- Kingdom: Plantae
- Cell type: eukaryotic
- Cell number: multicellular
- Feeding: autotrophic (photosynthesis)
- Reproduction: sexual (seeds)

Plant Classification

- Plants evolved from green algae (protists)
- They are first classified as
  - Nonvascular – short plants with no transport tissue (like veins), e.g. moss
  - Vascular – taller plants with veins, e.g. trees
    - Xylem – veins for water
    - Phloem – veins for food

PLANT KING DOM



THE PLANT KINGDOM

PHANEROGAMS/SPERMATOPHYTE/ HIGHER PLANTS

- Flowering or seed-bearing plants

CRYTOGAMS/THALLOPHYTE/LOWER PLANTS

- A plant that reproduces by spores, without flowers or seeds.

Pteridophytes

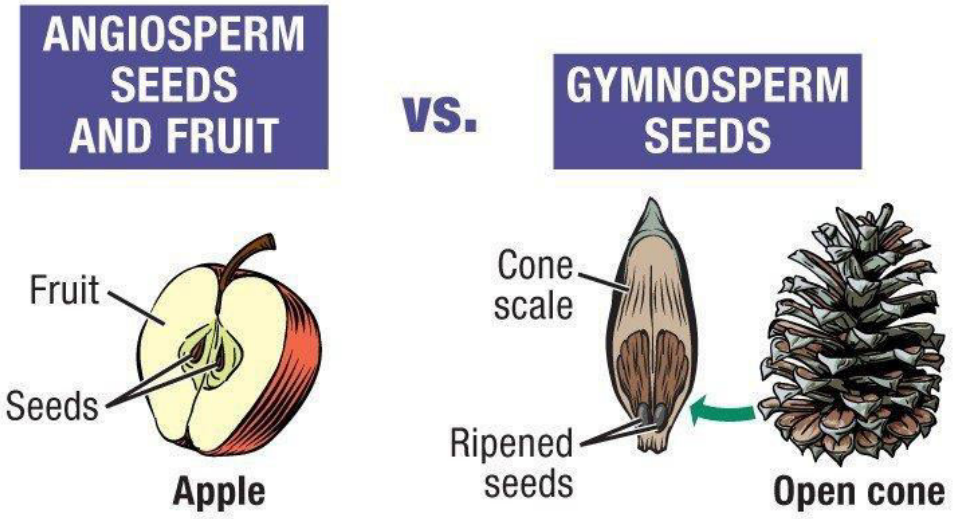
Plants with Feather-like Leaf

PHANEROGAMS /SPERMATOPHYTE

ANGIOSPERMS

GYMNOSPERMS

- Vascular Plants can further be classified as
  - Gymnosperms – cone bearing plants, e.g. pine trees
  - Angiosperms – flowering plants, e.g. roses



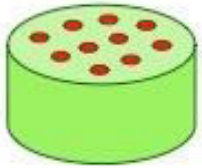
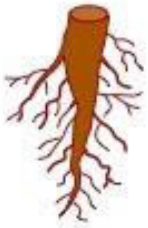
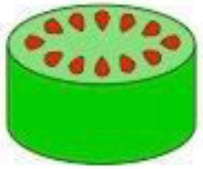
ANGIOSPERMS

DICOTYLEDONS

Trees, shrubs, climbers

MONOCOTYLEDONS

Grasses, orchids etc

	Seed	Root	Vascular	Leaf	Flower
Monocot					
	One cotyledon	Fibrous roots	Scattered	Parallel veins	Multiples of 3
Dicot					
	Two cotyledon	Tap roots	Ringed	Net-like veins	4 or 5

DICOTYLEDONS

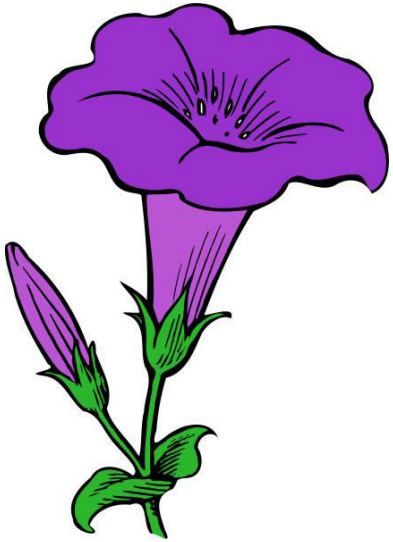
POLYPETALAE

• Plants with the petals free from the base or only slightly connected

Argemone mexicana

GAMOPETALAE

• Plants with the petals fused from the base

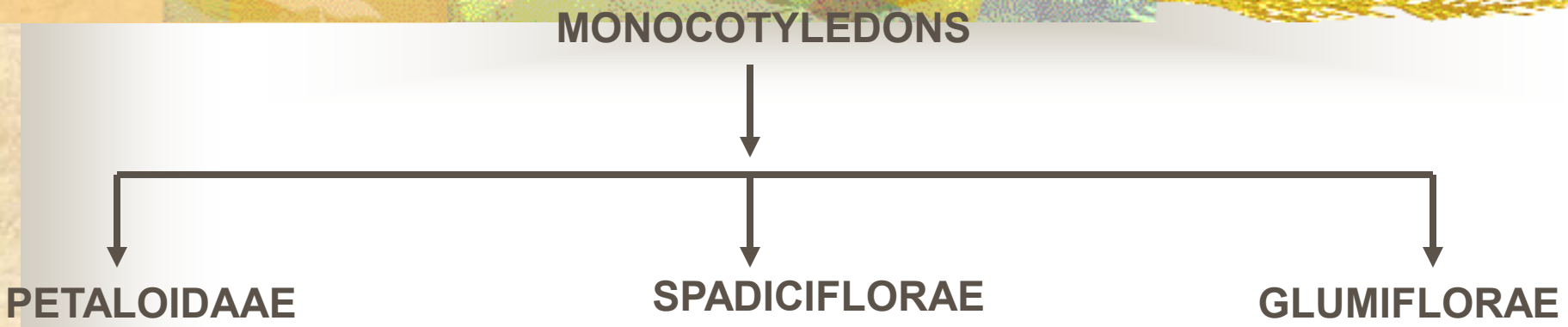


Ipomoea

MONOCHLAMYDEAE

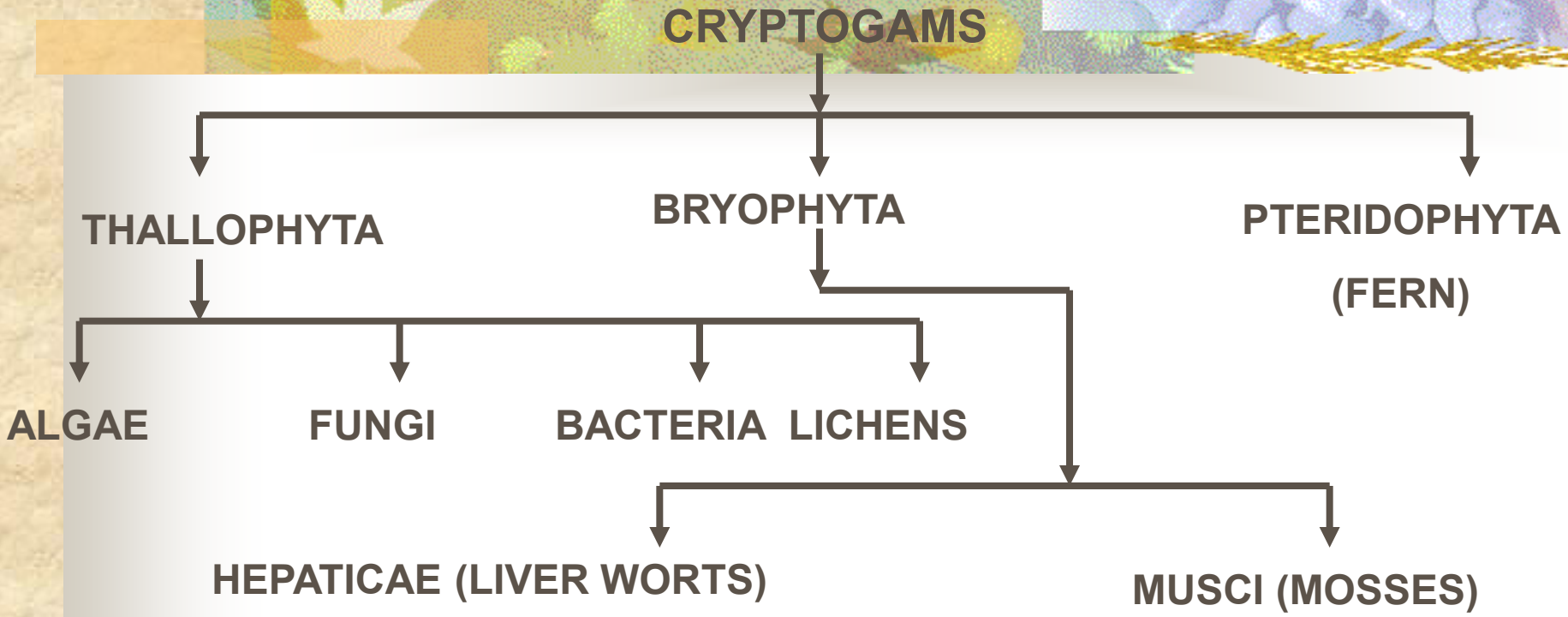
• Plants with flowers that had either a calyx or corolla, but not both.

Pyrularia


MONOCOTYLEDONS
PETALOIDAAE
SPADICIFLORAE
GLUMIFLORAE

GYMNOSPERMS

- CONIFEARLES
- CYCADALES
- GINKGOALES
- GNETALES


CRYPTOGAMS
THALLOPHYTA
BRYOPHYTA
PTERIDOPHYTA
(FERN)
ALGAE
FUNGI
BACTERIA
LICHENS
HEPATICAE (LIVER WORTS)
MUSCI (MOSSES)

CRYPTOGAMS

- THALLOPHYTA
- BRYOPHYTA
- PTERIDOPHYTA (FERN)

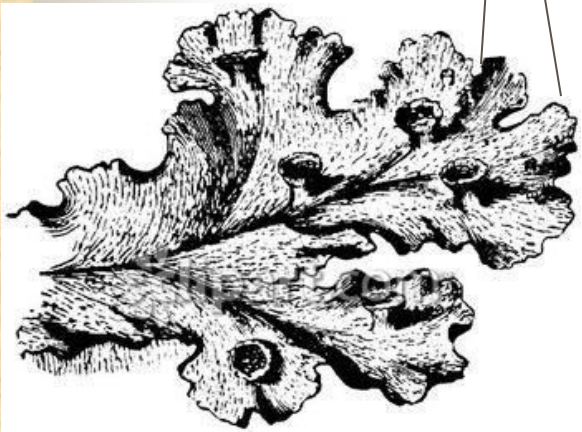
THALLOPHYTA

- ALGAE
- FUNGI
- BACTERIA
- LICHENS

BRYOPHYTA

HEPATICAE (LIVER WORTS)

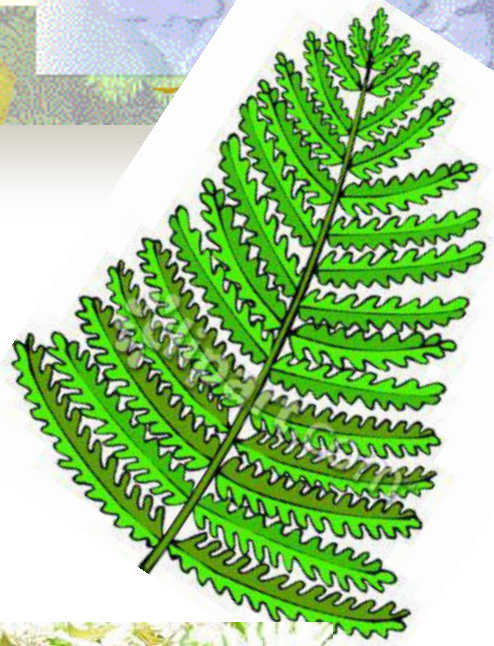
MUSCI (MOSSES)



Non-Vascular

Non-Vascular

- PTERIDOPHYTA: Ferns



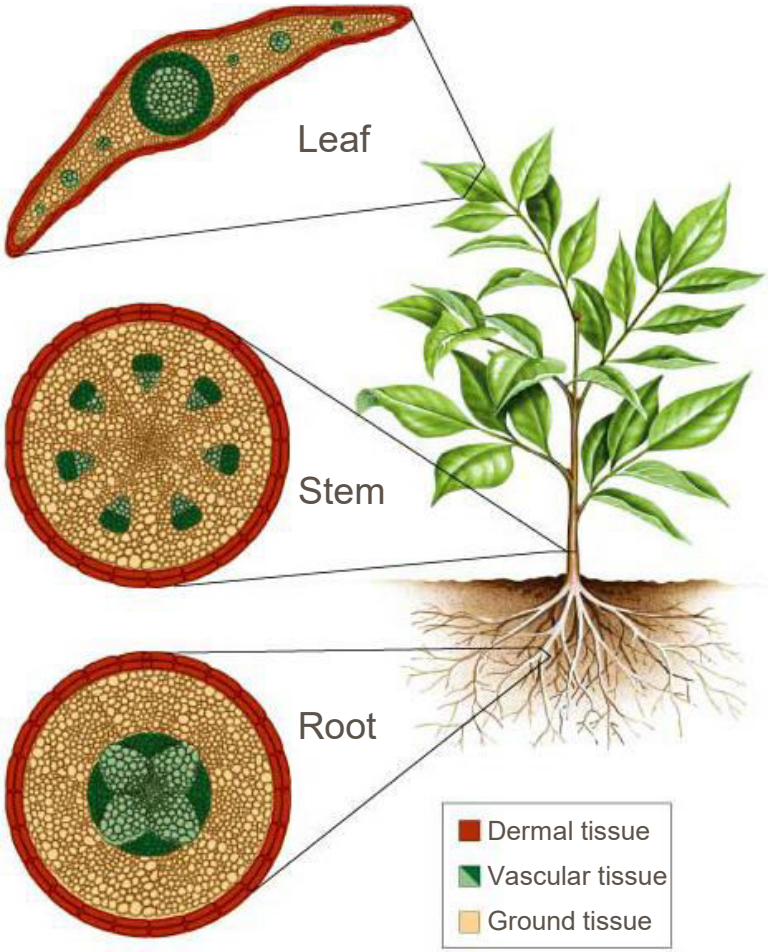
Adaptations of Plants to Land

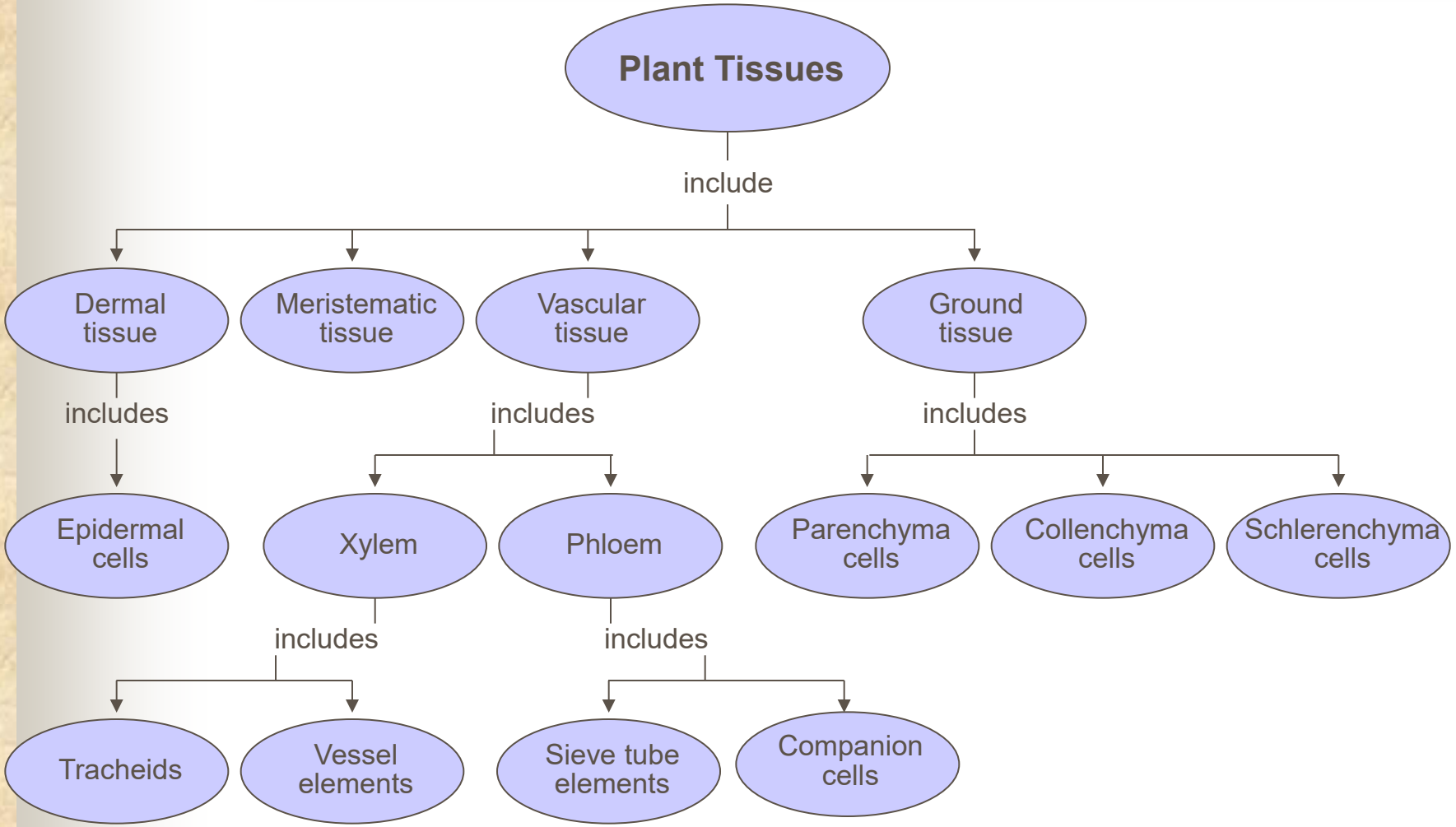
- Seeds (Dormant until water added)
- Roots
- Stems
- Leaf – Autotrophic Organisms
- Must Conserve Water (Stomata)
- Reproductive Strategies

Roots, Stems, and Leaves

Plant Tissues

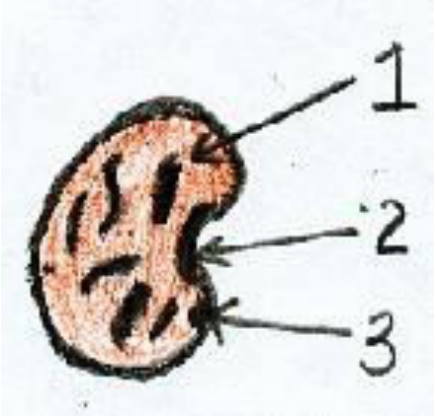
Root, Stem, and Leaf Tissues

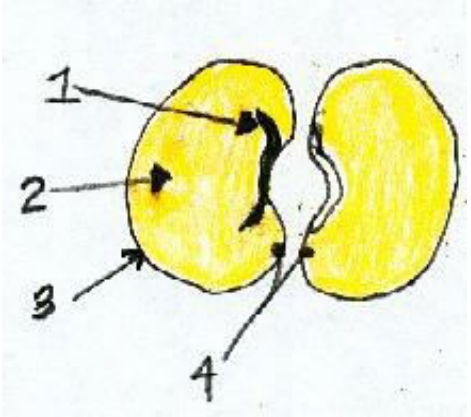



Plant Tissues
include
Dermal tissue
Meristematic tissue
Vascular tissue
Ground tissue
includes
includes
includes
Epidermal cells
Xylem
Phloem
Parenchyma cells
Collenchyma cells
Schlerenchyma cells
includes
includes
Tracheids
Vessel elements
Sieve tube elements
Companion cells

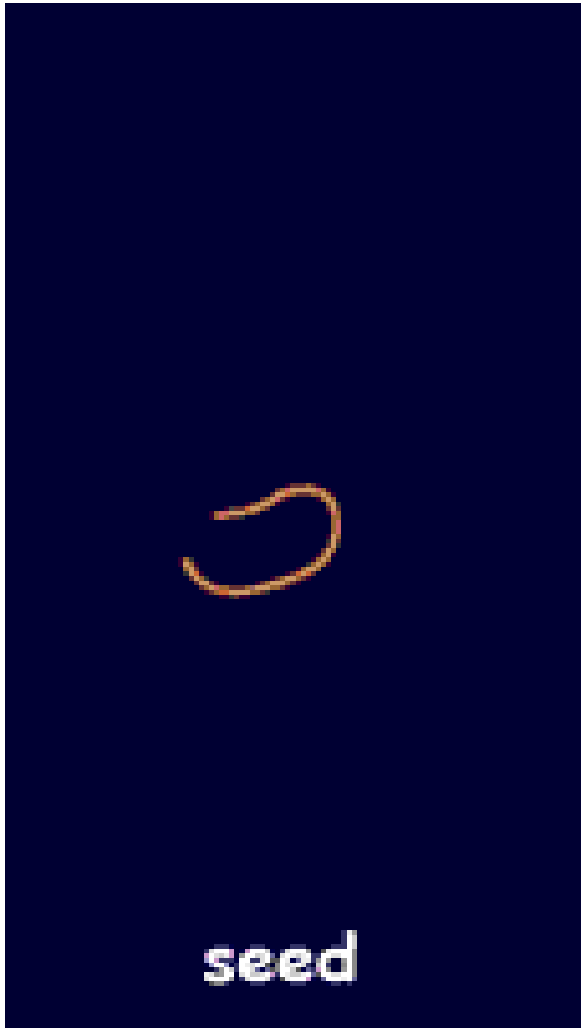
1. The Seed

- External Structures
- 1. Seed coat
- 2. Hilum
- 3. Micropyle
- Internal Structures
- 1. Embryo plant
- 2. Cotyledon





Germination – To Begin to Grow



2. Roots: Anchors Away

- Functions
  - Anchors the plant
  - Absorbs water and minerals from soil
  - Stores food

Primary Root

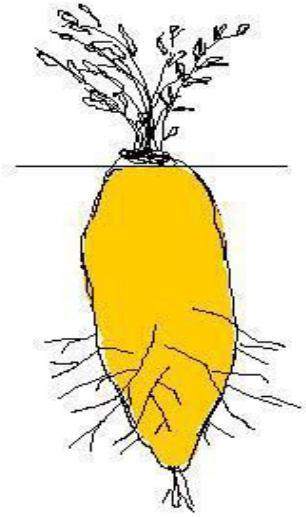
- The first root to develop from the seed.

Secondary Roots

- Develop from the primary root and from themselves.

Tap Root System

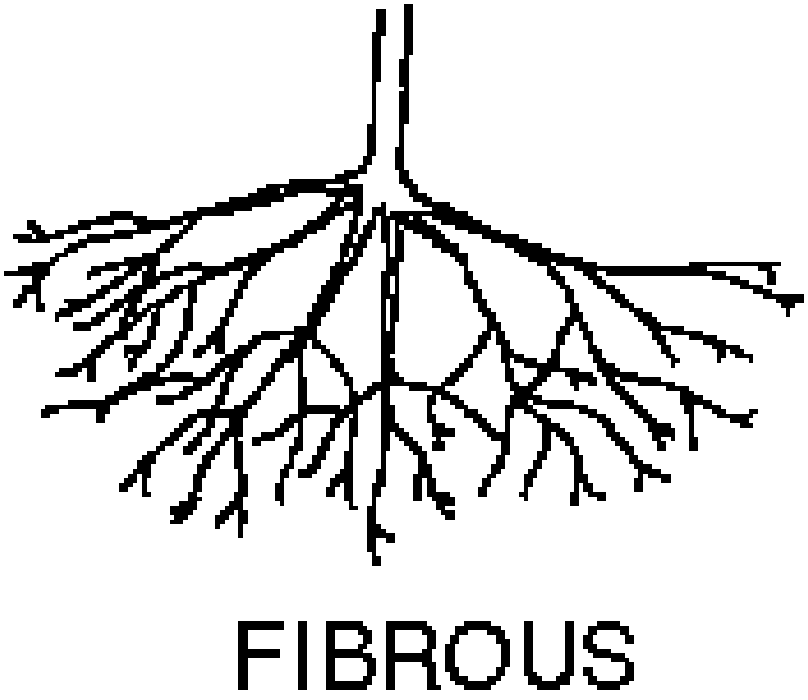
- Develops from the primary root.
- Reaches deep into the ground
- Helps the plant during periods of drought.

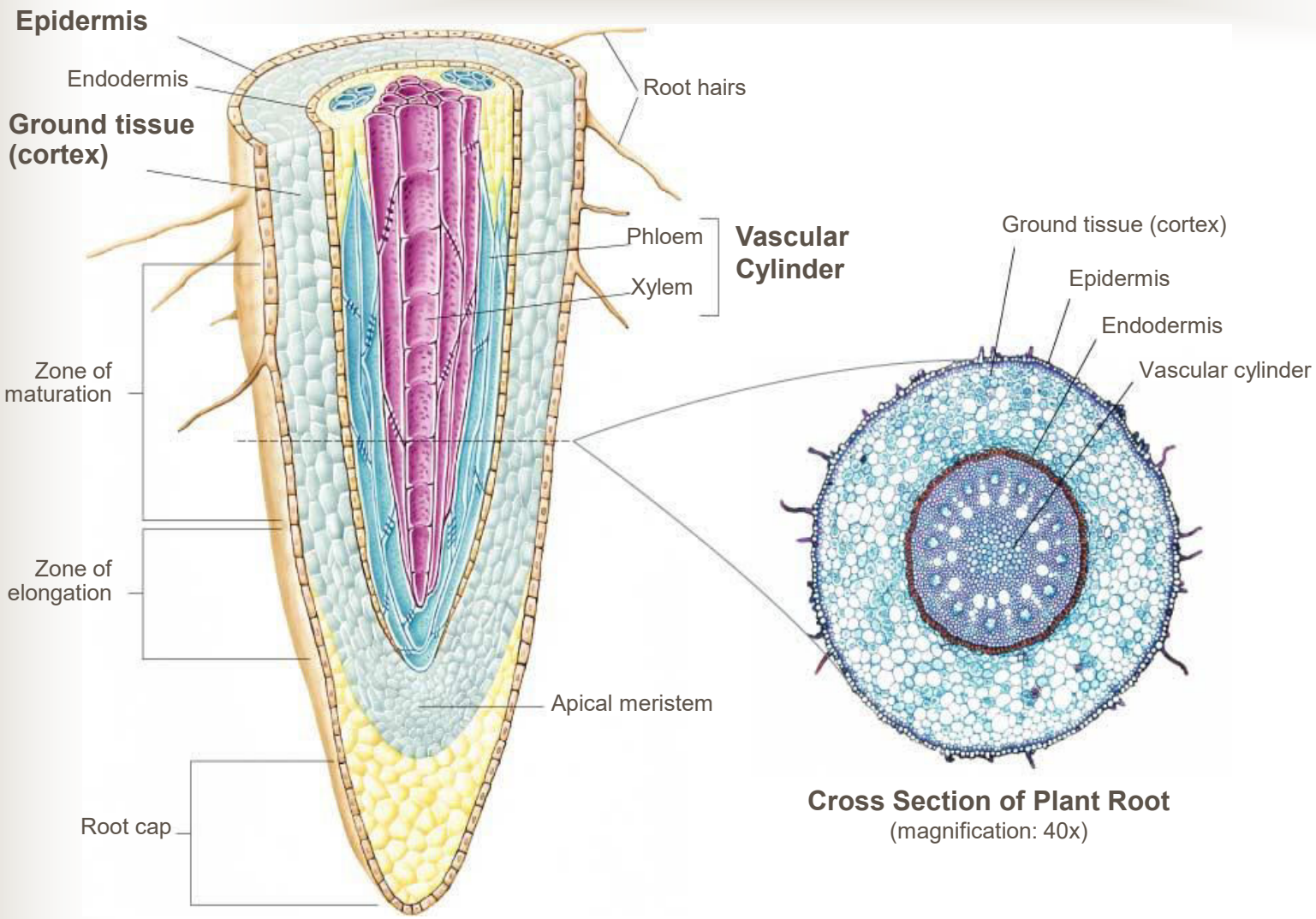


Tap Root System

Fibrous Root System

- Develops when the secondary roots become the main roots.
- Shallow roots but spread over a broad area.
- Helps prevent erosion.

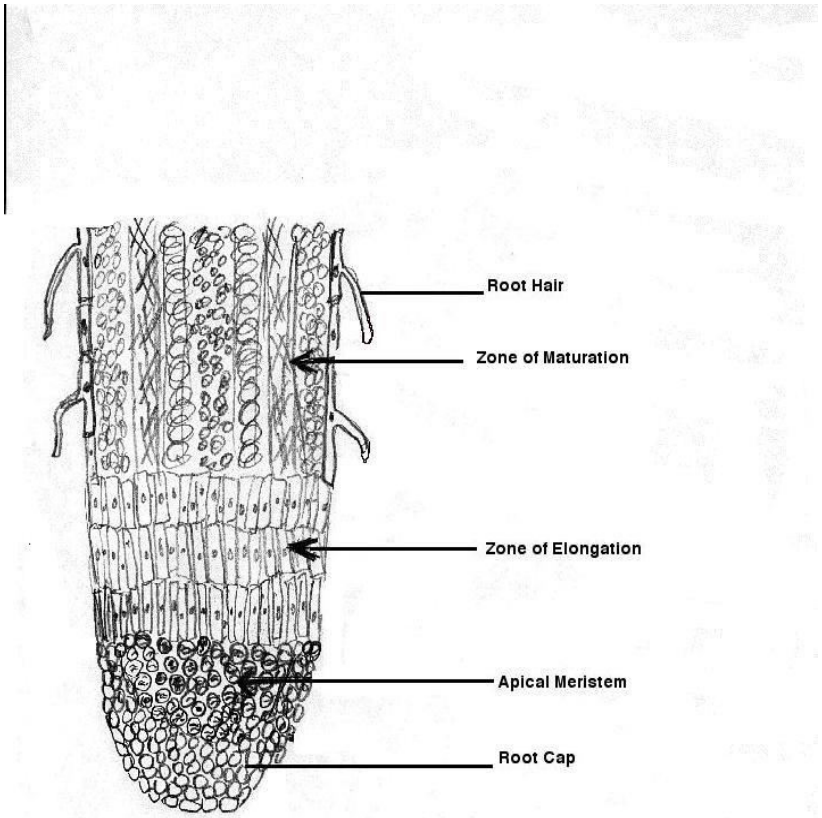




Cross Section of Plant Root
(magnification: 40x)

The Root Tip

- Root cap
  (Protects the root from abrasion)
- Apical Meristem
  (Produces new cells for growth)
- Zone of Elongation
  (Cells elongate allowing the root to grow longer)
- Zone of Maturation
  (Cells develop into tissues)

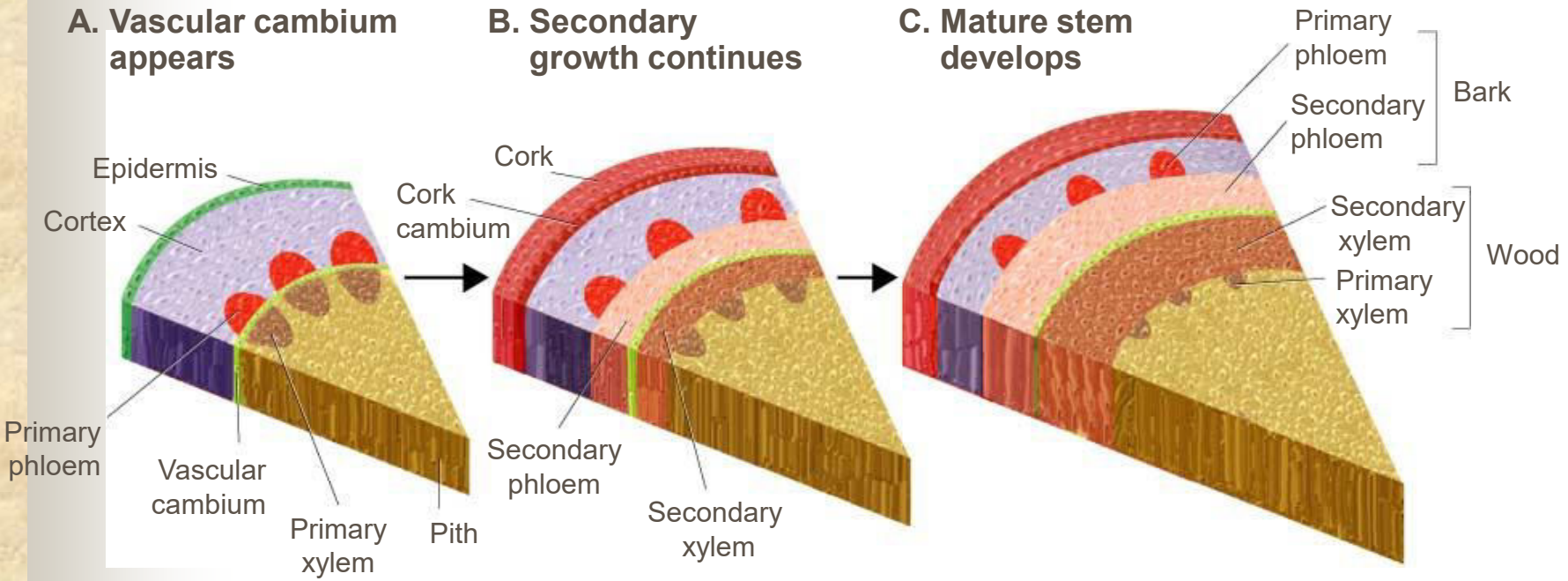


3. Stems: The Connector

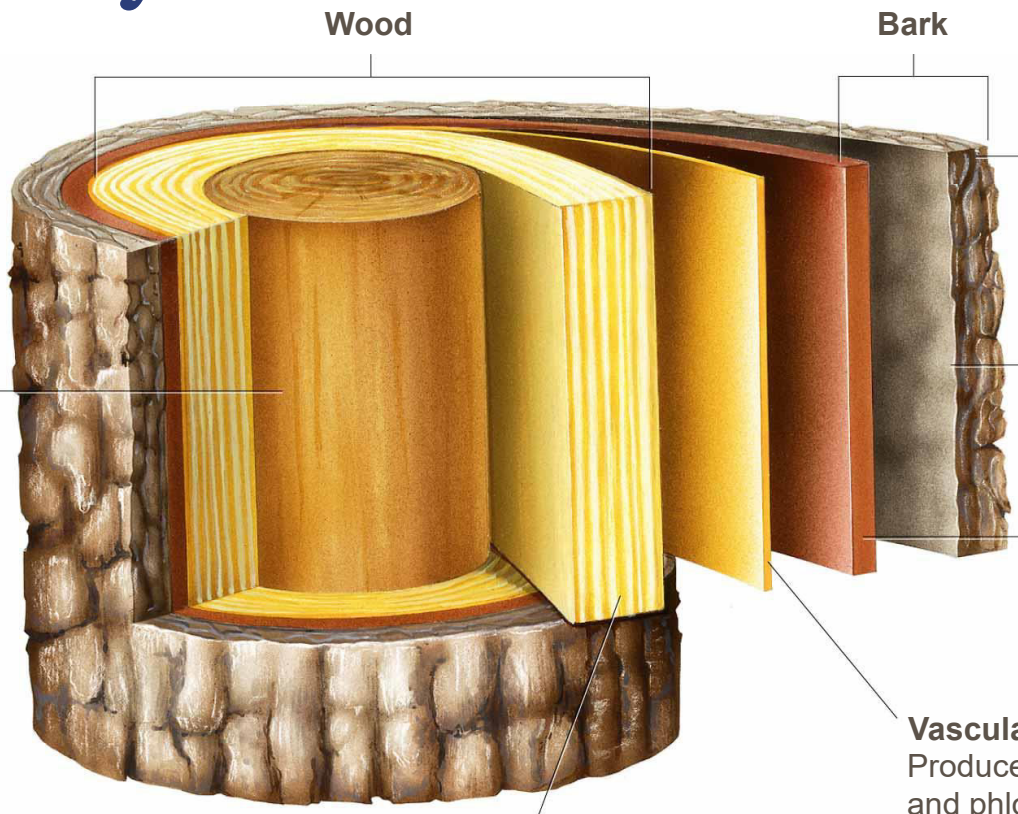
- Functions
  - Connects the leaves with the roots
  - Displays the leaves for maximum sunlight exposure.
  - Stores food
  - Minor photosynthetic ability
  - Contains vascular tissue
    - Phloem – transports sugars from leaves
    - Xylem – transports water and minerals from roots

Comparing Primary and Secondary Growth of Stems		
Characteristics	**Primary Growth**	**Secondary Growth**
Where It Occurs	At ends of plants	In stem
Effect on Plant	Increases plant length	Increases stem width
How It Is Produced	By cell division in the apical meristem	By cell division in meristems other than the apical meristem

Secondary Growth in Stems



Layers of a Tree Trunk



Xylem: Heartwood
Contains old, nonfunctioning xylem that helps support the tree

Cork
Contains old, nonfunctioning phloem that protects the tree

Cork Cambium
Produces protective layer of cork

Phloem
Transports sugars produced by photosynthesis

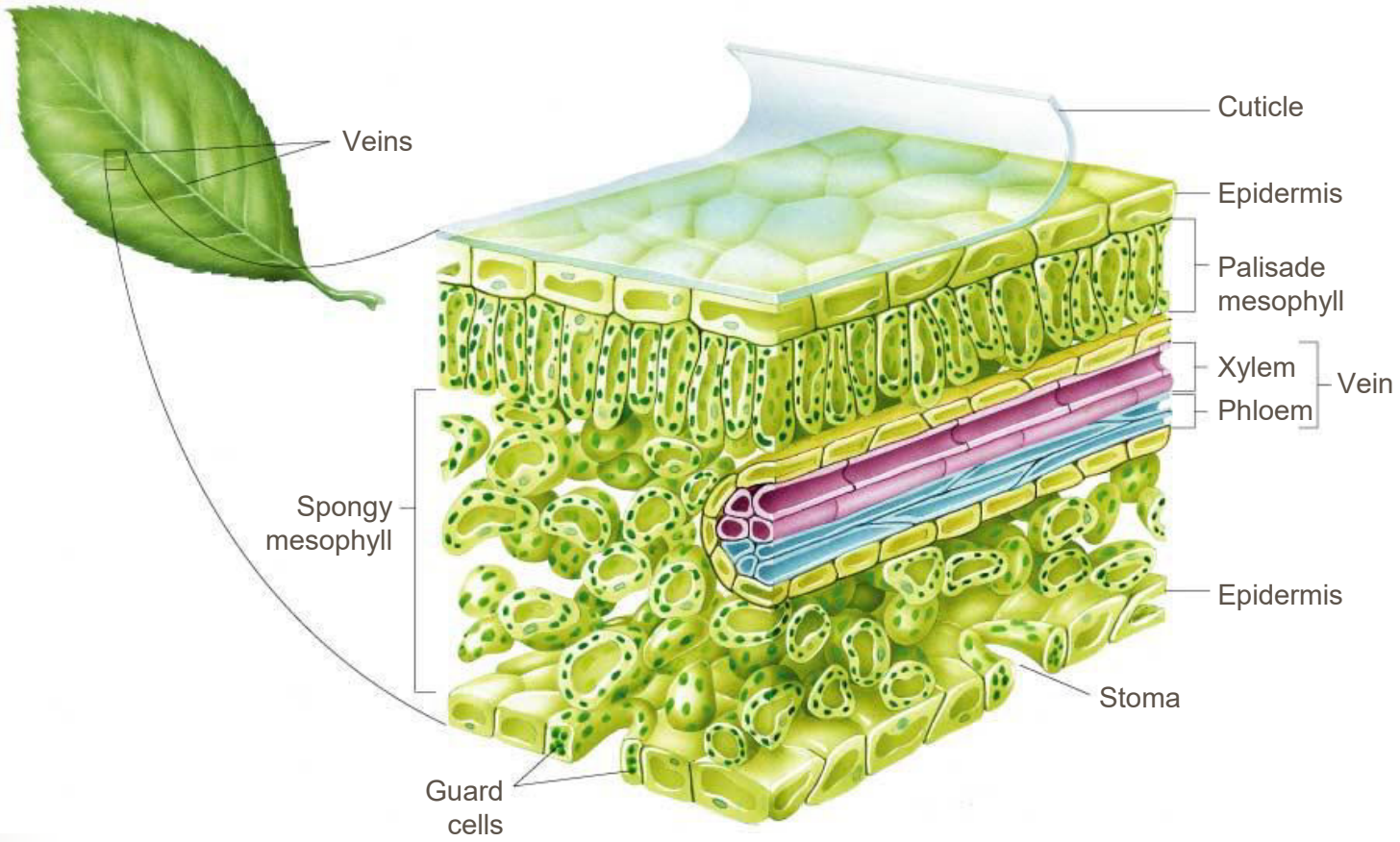
Vascular Cambium
Produces new xylem and phloem, which increase the width of the stem

Xylem: Sapwood
Contains active xylem that transports water and minerals

4. Leaf - Autotrophic

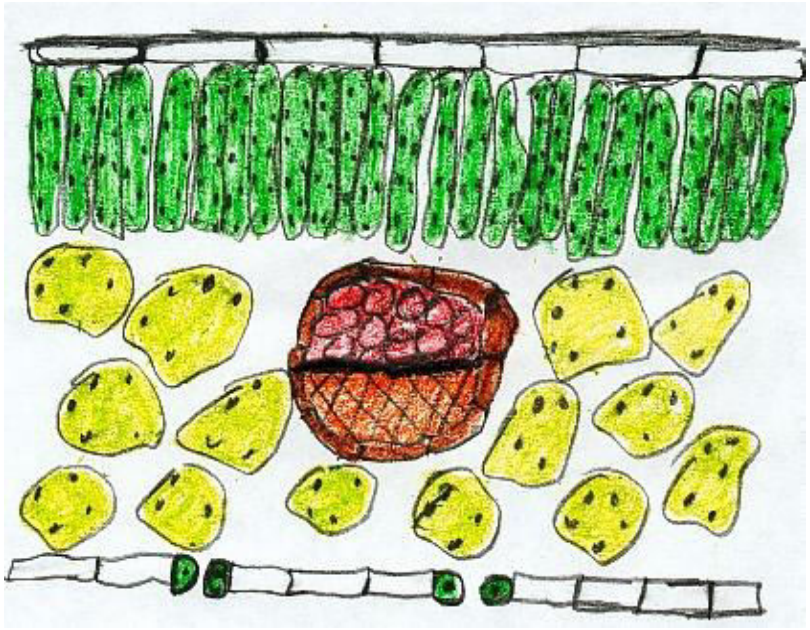
- Functions
  - Carries on Photosynthesis
  - Stores food
  - Regulates transpiration through stomata

Internal Structure of a Leaf



Internal Leaf Anatomy

- Cuticle
- Epidermis
- Palisade Mesophyll (chloroplasts)
- Spongy Mesophyll
- Vein (xylem and phloem)
- Air Spaces
- Lower Epidermis
- Stomata
- Guard cells



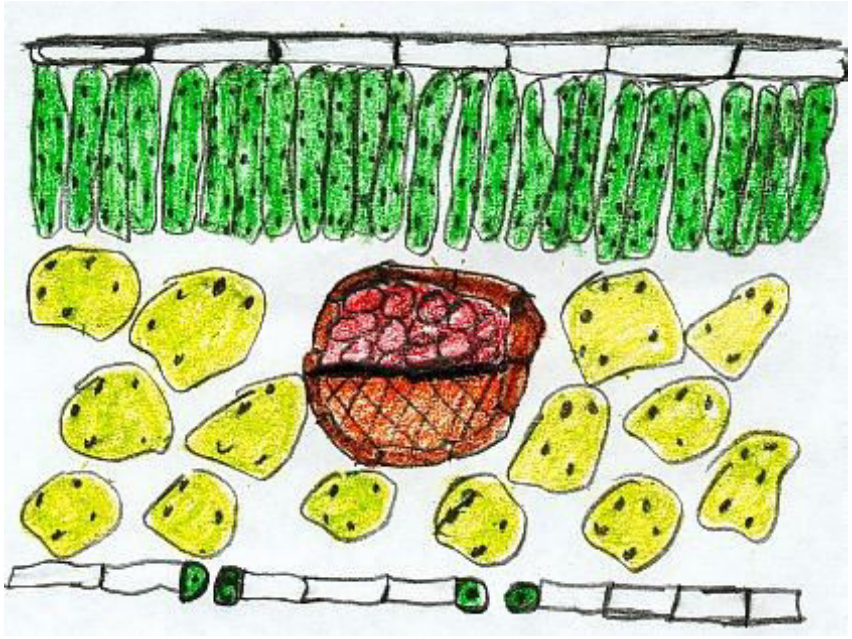
Sugar Transport in Phloem

Nutrient Transport

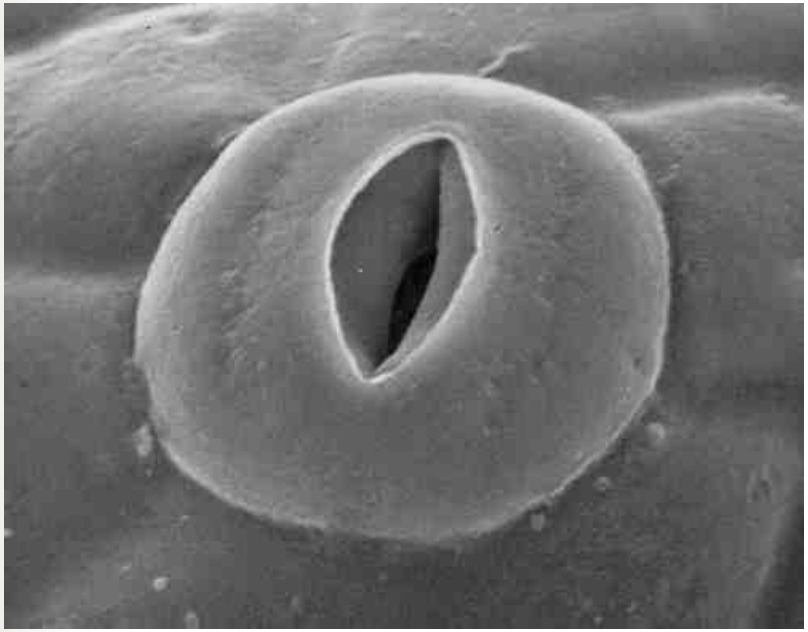
- Occurs in PHLOEM
- Pressure-flow hypothesis

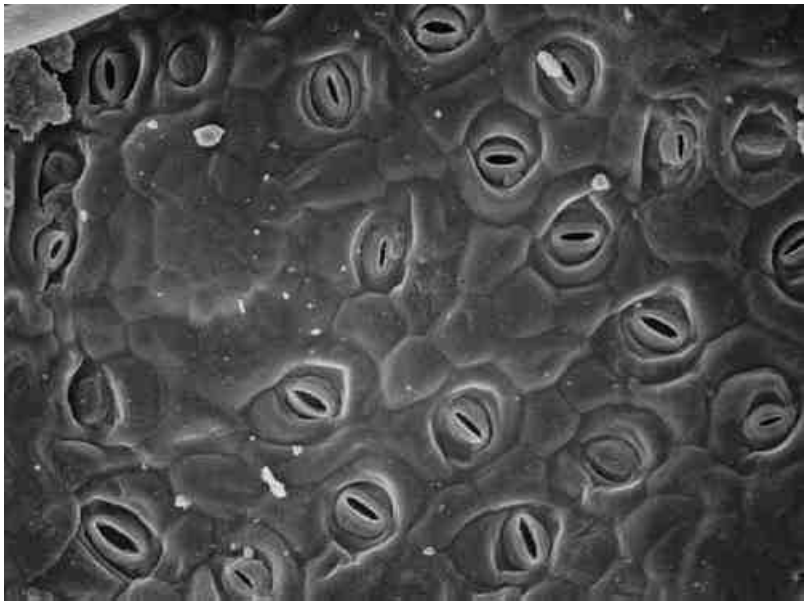
5. Water Conservation

- Cuticle
  - Waxy outer coating that prevents water loss
- Stomata
  - Openings for gas exchange
  - Open to release water, Close to conserve



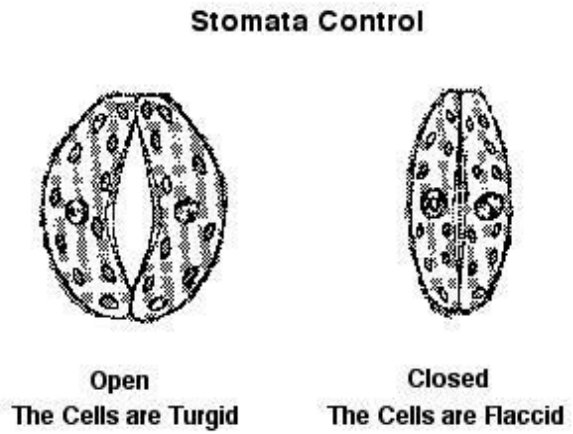
Stomata

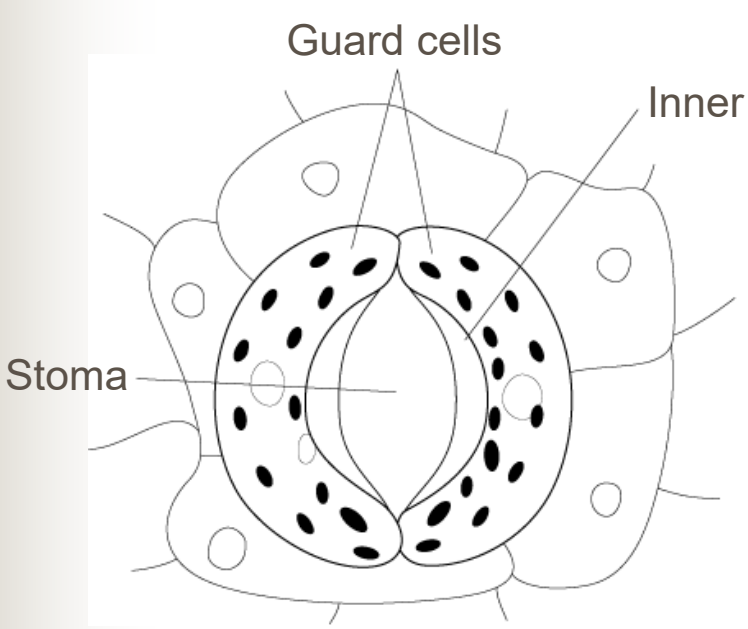




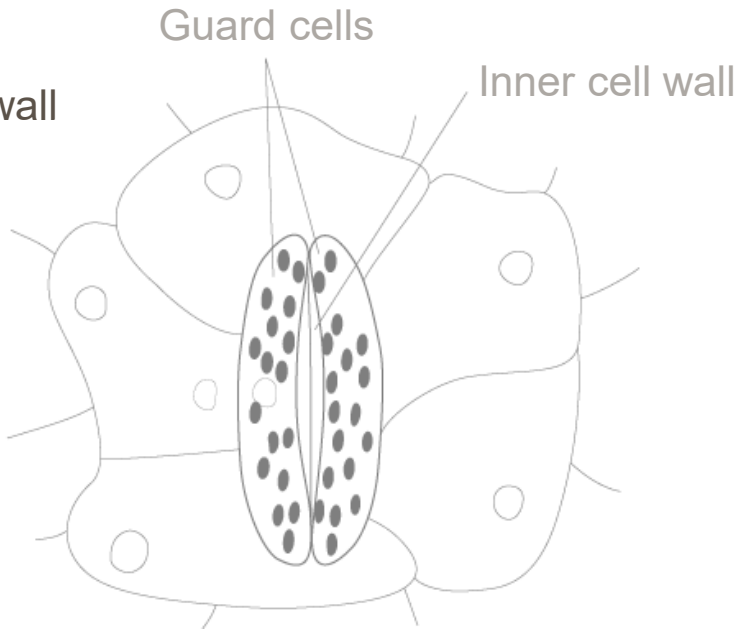
Stomata

- Guard cells regulate the size of the stoma.
- K+ (potassium ions) enter the cells causing them to fill with water.
- This opens the stoma when they become turgid.
- A loss of K+ causes the opposite to occur, and they close when they become flaccid.

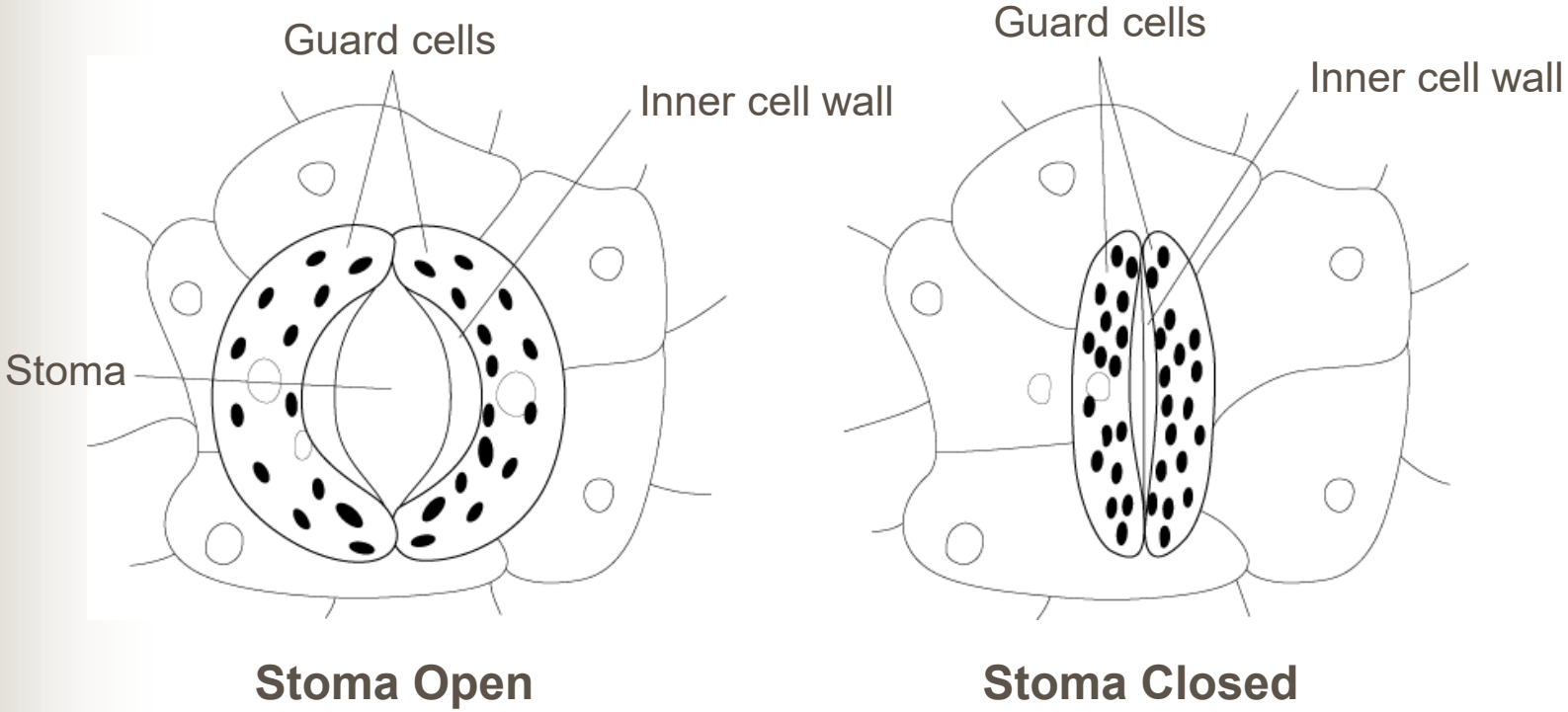




Stoma Open



Stoma Closed



Stoma Open **Stoma Closed**

Transpiration

Water Transport

1. Root Pressure
2. Capillary Action
   - Adhesion – attraction between unlike
   - Cohesion – attraction between like
3. Transpirational Pull
   - Pulling water up through the vascular tissue due to evaporation and capillary action

6. Reproductive Strategies

1. Seeds
   - Contains an embryo
   - Contains a food supply
   - Covered by a protective coat
2. Spores
   - Single haploid cell with hard outer wall

Elaborate

- Xylem Demonstration
- The Magic Toothpick
- Linking Up Demonstration
- Stomata Lab
- Transpiration Lab

Evaluate