GENERAL FEATURES AND MORPHOLOGY OF PHANEROGAMS

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Course outline

- **Module 1**
- **General characteristics and morphology of phanerogams**

- **Module 2**
- **Primary plant organs and their functions**

- **Module 3**
- **Plant tissue systems**

- **Distribution of outline**
  - **Basics description of phanerogams**
  - **Classes or types of phanerogams**
  - **Characteristics features of angiosperms**
  - **Morphology of angiosperms**
  - **Anatomy of shoot and root**

MODULE 1

GENERAL CHARACTERISTICS AND MORPHOLOGY OF PHANEROGAMS

Objectives of the class

- **Learners should be exposed to the following about phanerogams:**
- **Basics description**
- **Classes or types**
- **Characteristics features of angiosperms**
- **Morphology of angiosperms and primary function of organs**
- **Anatomy of shoot and root**

Learning outcomes

- **Learners must be able to describe and differentiate different types of phanerogams**
- **Learners must have gained knowledge with clear understanding of characteristics and different forms of phanerogams**

General characteristics and morphology of phanerogams

- **Phanerogams are seed bearing plants and are most advanced plants.**
- **The word Phanerogams (or Phanerogamae) is made up of two Greek words "*FANEROS*" which means evident or visible and "*GAMOS or GAMEO*" which means marriage or to marry.**
- **These are also known as spermatophytes.**
- **The word spermatophyte is also made from two Greek words "*SPERMA*" which means seed and "*PHYTON*" which means plant.**
- **These terms distinguished those plants with hidden sexual organs (cryptogamae) from those with visible sexual organs (phanerogamae).**

- **Phanerogams are vascular plants.**
- **This type of vascular plant reproduces from the seeds, hence also named as seed plants.**
- **Phanerogamae is terrestrial plants and is more advanced than cryptogams**
- **They are flowering plants, and they produce their food by photosynthesis process.**
- **Phanerogams are classified as Angiosperm and gymnosperm.**

Division of phanerogams

- The extant phanerogams (spermatophytes) form five divisions or groups.

- The first four of which are traditionally grouped as gymnosperms.

- These are plants that have unenclosed, "naked seeds"
- The fifth extant division is the angiosperms

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Members of gymnosperms

i. Cycadophyta, the cycads, a subtropical and tropical group of plants

ii. Ginkgophyta, which includes a single living species of tree in the genus *Ginkgo*

iii. Pinophyta, the conifers, which are cone-bearing trees and shrubs,

iv. Gnetophyta, the gnetophytes, various woody plants in the relict genera *Ephedra*, *Gnetum*, and *Welwitschia*.

ANGIOSPERMS

- **The flowering plants, also known as angiosperms or magnoliophytes, which is the largest and most diverse group of spermatophytes.**

- **Angiosperms are covered seed plants**
- **They are flowering plants producing flowers and fruits.**
- **They have stem, roots, and leaves.**
- **The seeds of Angiosperm are available in the flower**
  - **The flowers have male reproductive organs called stamen**
  - **Female reproductive organs called a pistil.**
- **Angiosperms undergo a pollination process.**
- **The angiosperms are further subdivided into Dicots and Monocots.**

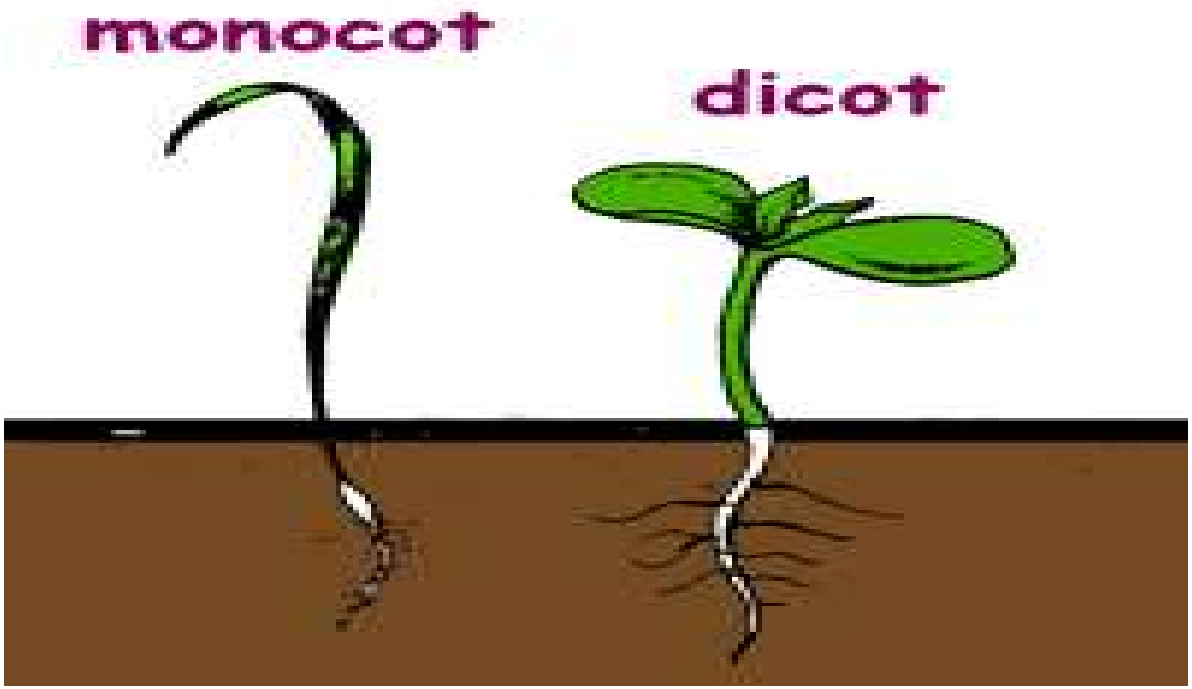
Monocot vs. dicot

- **As the zygote grows into the embryo, the first leaves of the young sporophyte develop and are called as cotyledons (seed leaves)**

- **Monocots have one cotyledon (corn, lily, etc).**

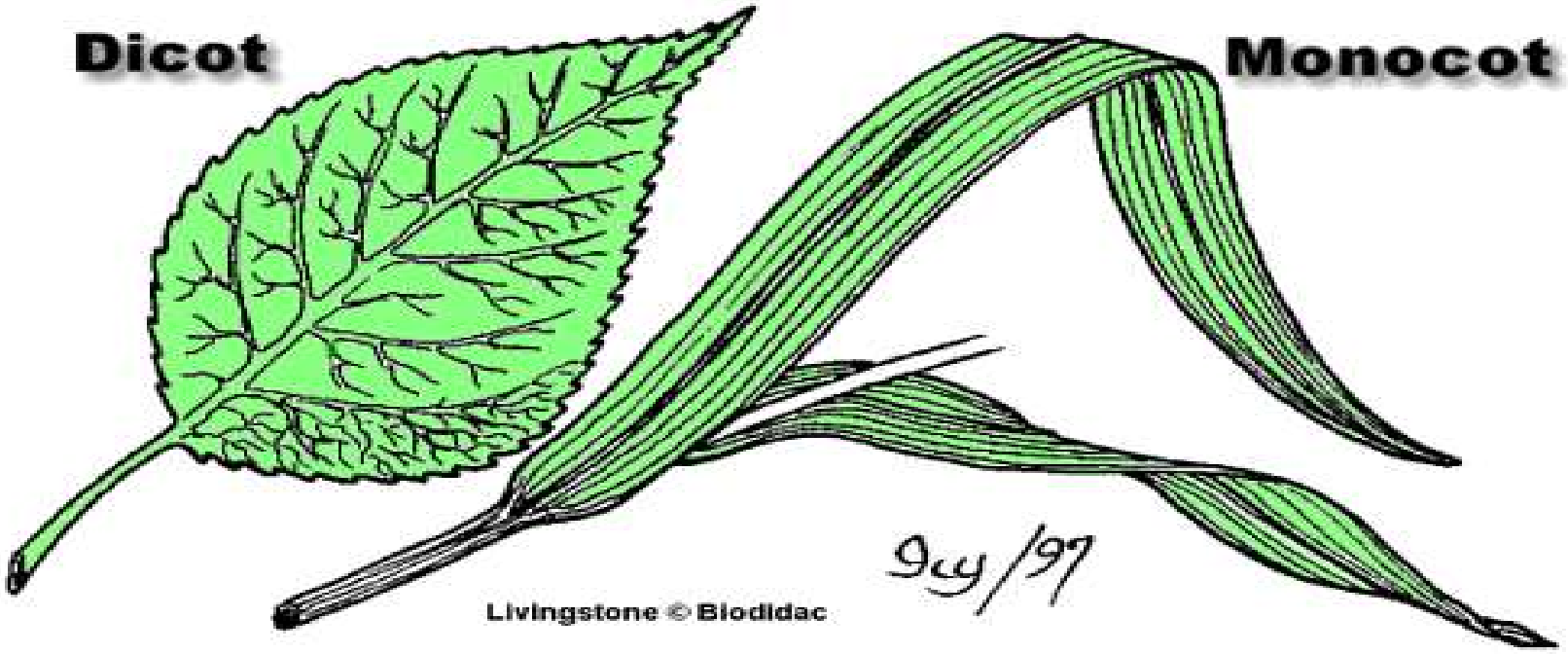
- **Dicots have two cotyledons (bean, oak, etc).**

- Number of cotyledons:
- Monocot has one cotyledon
- Dicot has two cotyledons



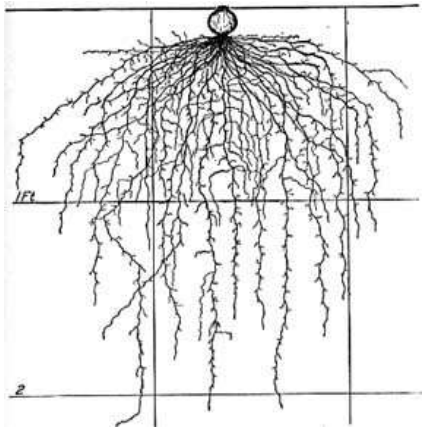
Leaf venation pattern

- Monocot has parallel venation
- Dicot is net pattern venation



Monocot vs. dicot root

- Monocot: Fibrous root



- Dicot: Tap root

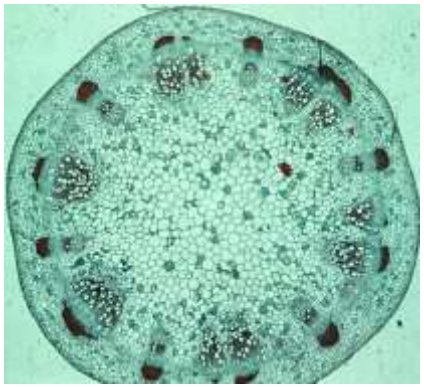
Flower parts

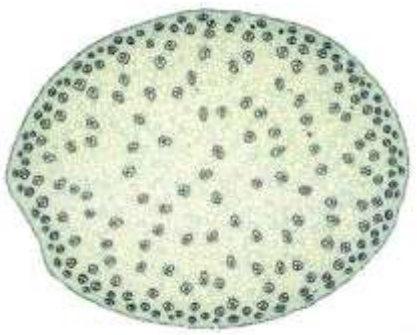
- **Monocot flowers are in groups of three**

- **Dicot flower parts in groups of four or five**

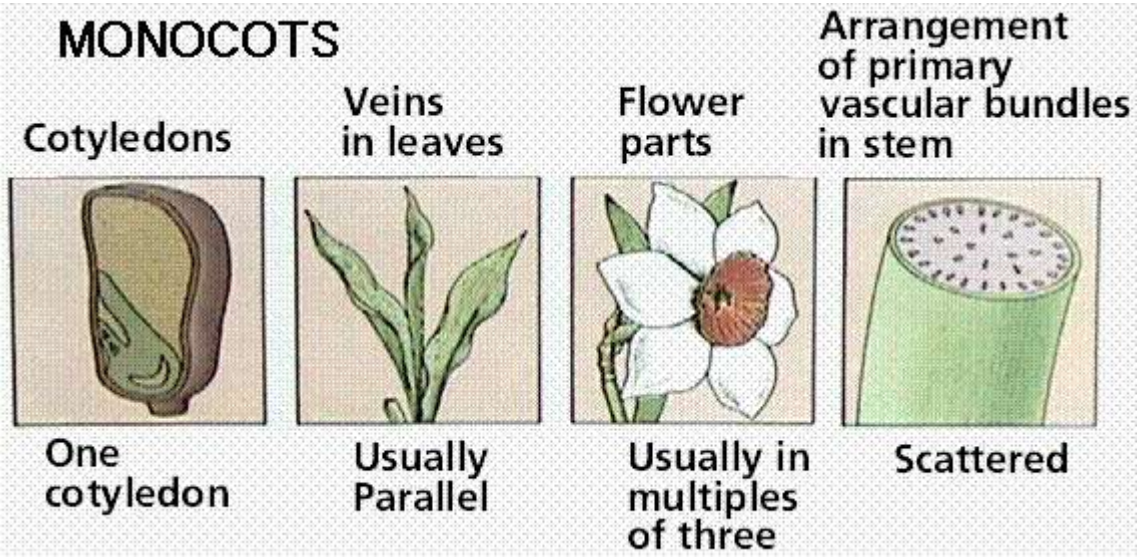
Position of vascular bundles

- **Monocot: Vascular bundle are scattered within the stem, leaves and roots structure**
- **Dicot: vascular bundles are arranged in ring or a circle**





Groups of Angiosperms



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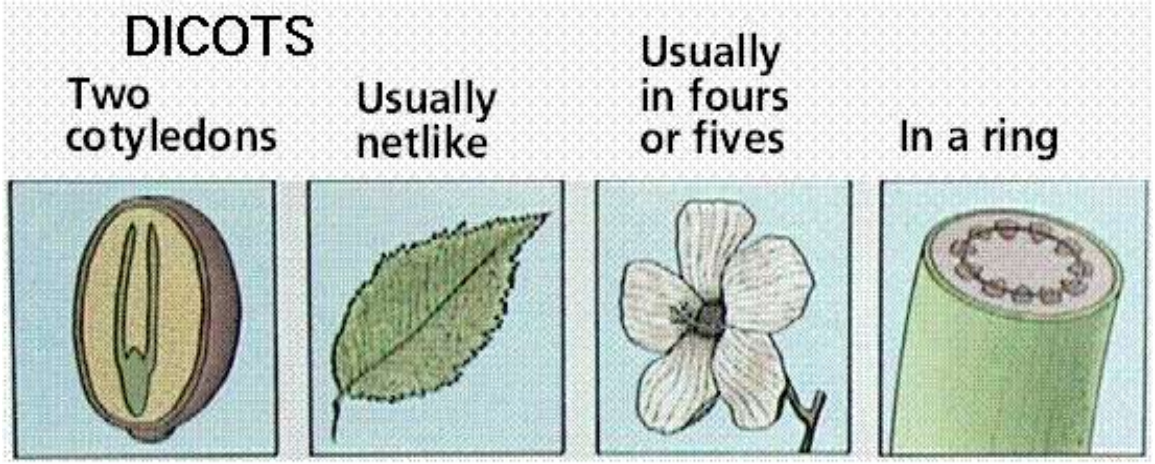
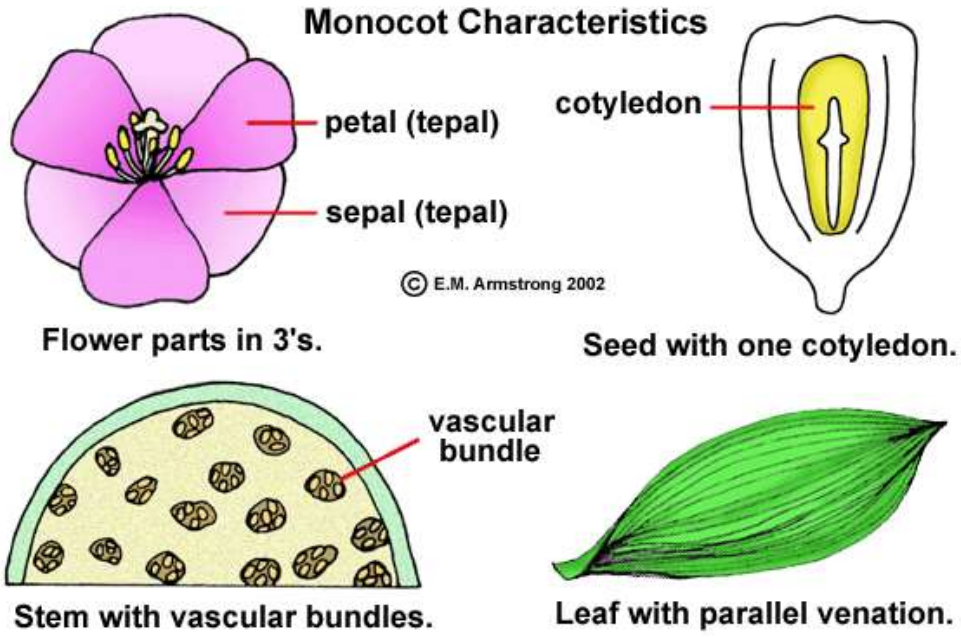
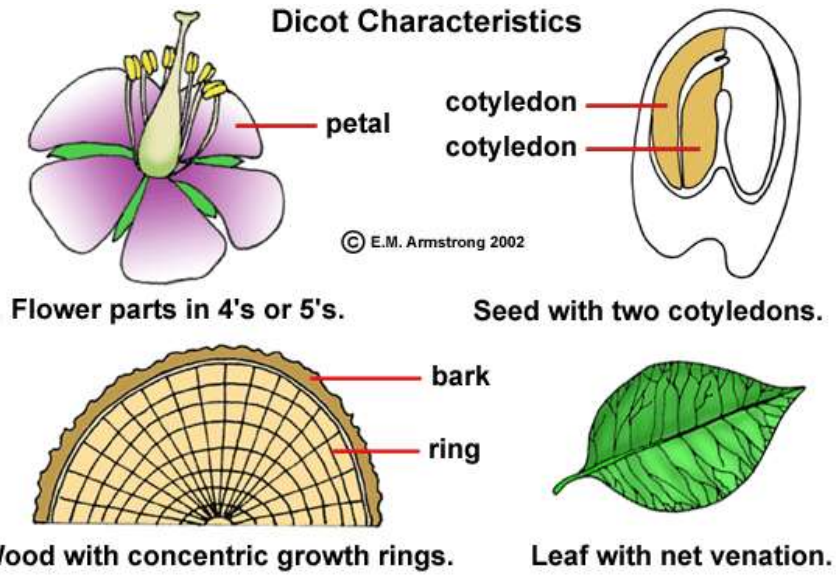


Summary:
Monocot vs. dicot





Module 2

PRIMARY PLANT ORGANS

Primary plant organs

- **Three organs in plants:**
  - Stem
  - Leaves
  - Root

} Shoot system

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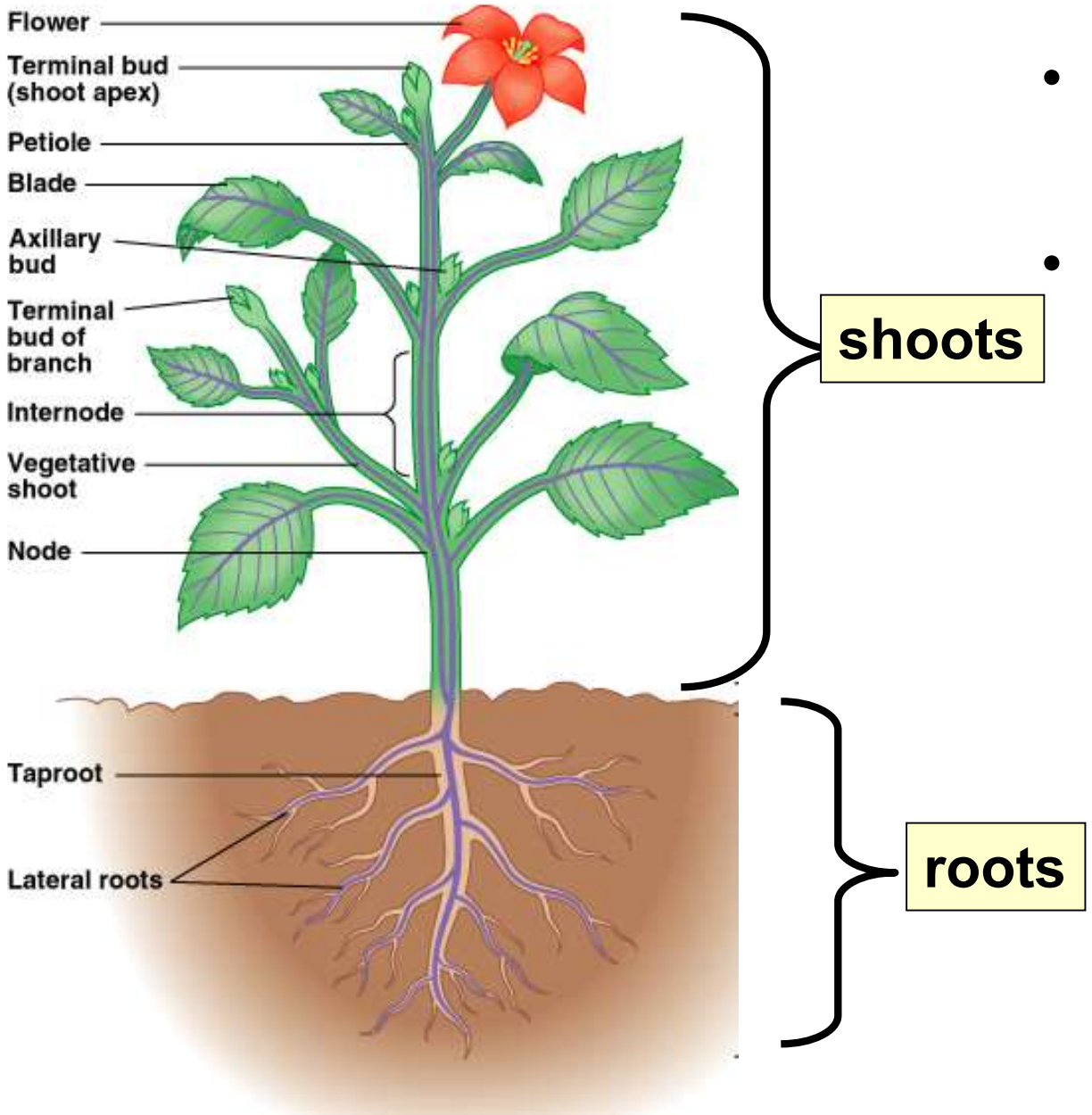
Plants have evolved two systems:

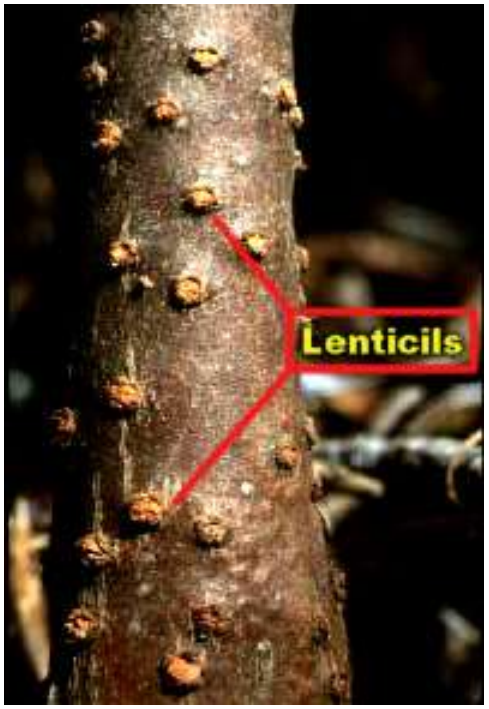
- subterranean **root system**
- aerial **shoot system** of stems and leaves.



Roots

- Roots anchor the plant in the soil
- Store food
- Absorb minerals and water
- Most absorption of water and minerals in occurs near the root tips.


Proproots



Black Mangrove with Pneumatophore

Shoots consist of stems and leaves.

- **Stem:** Raises leaves and flowers above ground (safer from herbivores and allow leaves to better photosynthesize). Path by which water, minerals, and food are transported.
- **Leaves:** Site of photosynthesis, i.e. food production

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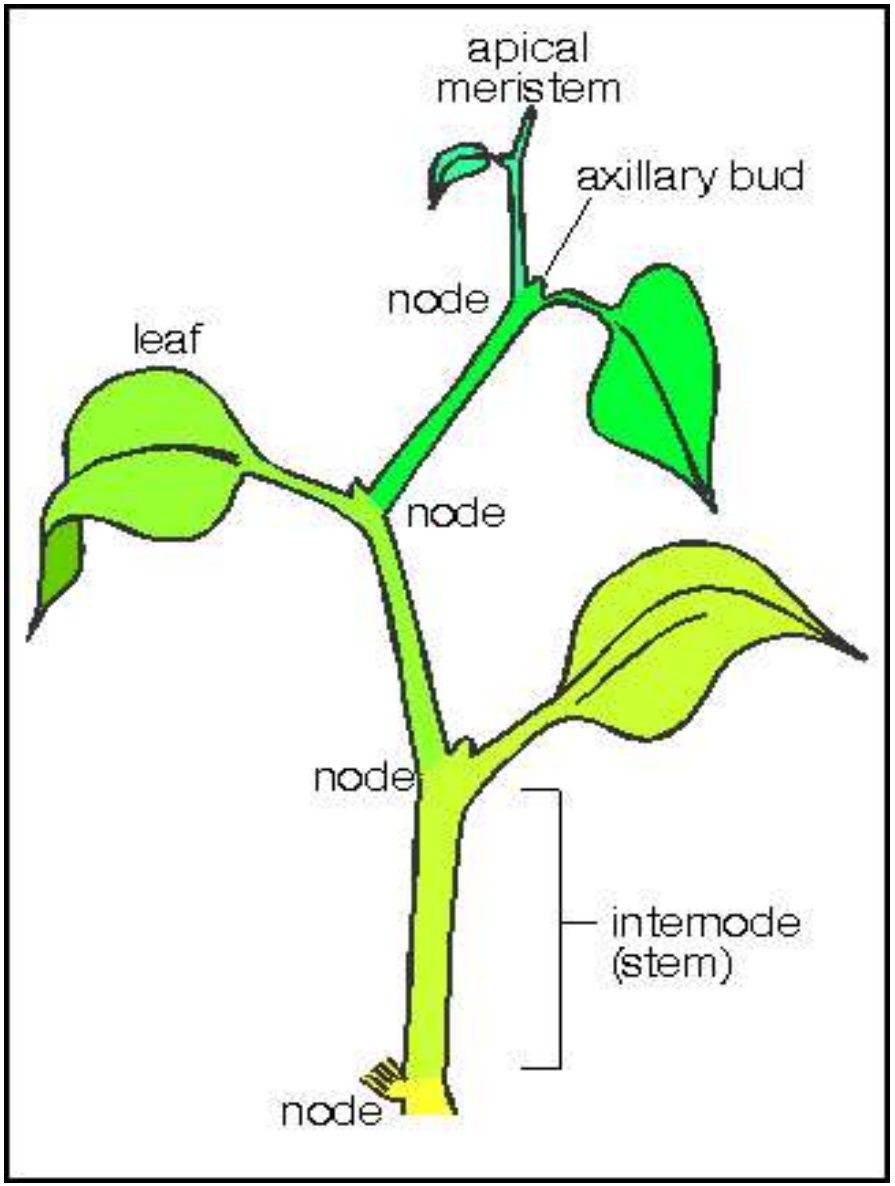
Shoots System: stems and leaves

- Stems
  - May be vegetative (leaf bearing) or reproductive (flower bearing).
  - **Node**- area of stem where leaf is born
  - **Internodes**- stem area between nodes
  - **Buds:** Stem elongation. Embryonic tissue of leaves and stem (not flower bud)
    - **Terminal bud**-Located at tip of stems or branches.
    - **Axillary bud-** Gives rise to branches
  - **Apical Dominance:** Prevention of branch formation by terminal bud

Shoots System:

- Leaves:**Photosynthesis**
  - **Petiole:** Stalk of leaf, joins leaf to node of stem
  - **Blade:** Flattened, expanded portion of leaf. Site of photosynthesis

Shoot System



- Modified shoots:
  - Include stolons, rhizomes, tubers, and bulbs, are often mistaken for roots.
  - **Stolons**: allow plants to colonize large area and to reproduce asexually

Pohuehue

- **Rhizomes**: horizontal stems that grow underground.
- **Tubers**: are the swollen ends of rhizomes specialized for food storage.
- **Bulbs**: vertical, underground shoots consisting mostly of the swollen bases of leaves that store food.

rhizomes

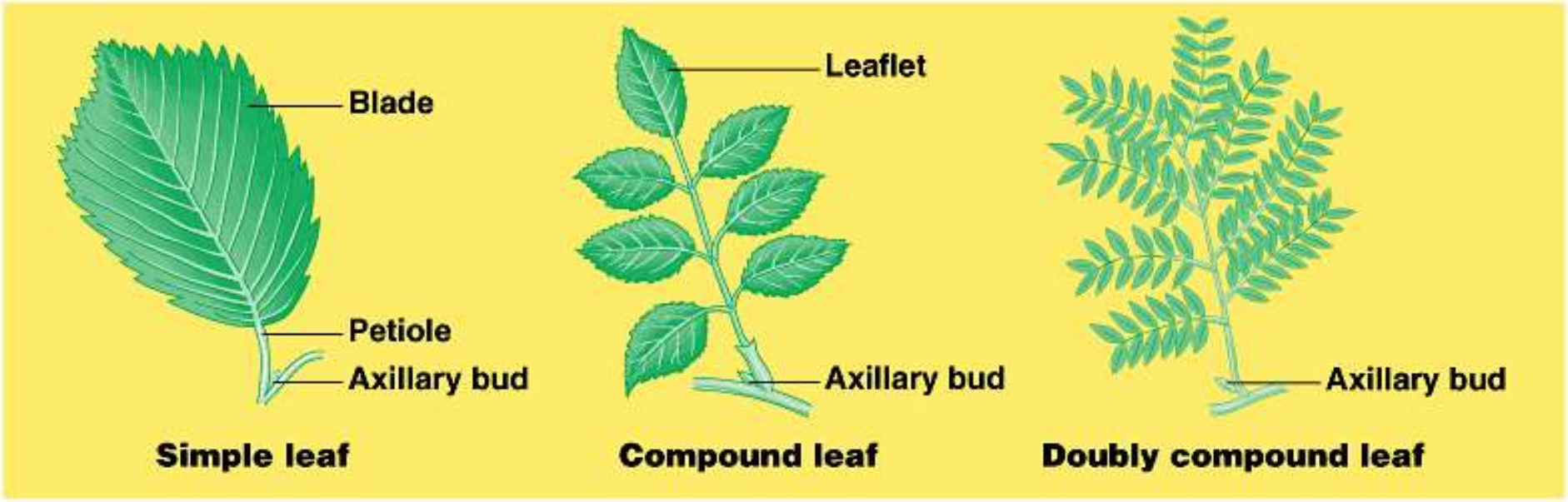
tubers

bulbs

Classification of Leaves

- Arrangement on the stem
- Simple vs. compound
- Overall leaf shape
- Leaf margin shape
- Leaf venation

Leaf Taxonomy



Leaf Arrangement on the Stem

Opposite: 2 leaves at a node, on opposite sides of the stem

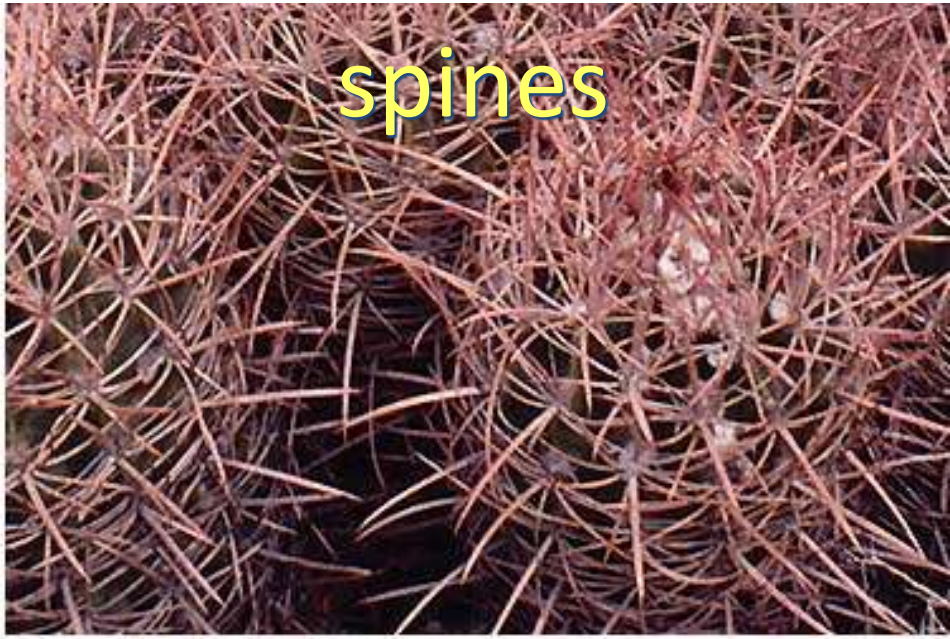
Spiral: 1 leaf per node, with the second leaf being above the first but attached on the opposite side of the stem

Whorled: 3 or more leaves at a node

Leaf Modifications

- Tendrils
- Spines
- Storage
- Petal-like
- Insectivorous leaves

Leaf Modifications



Module 3

PLANT TISSUE SYSTEMS

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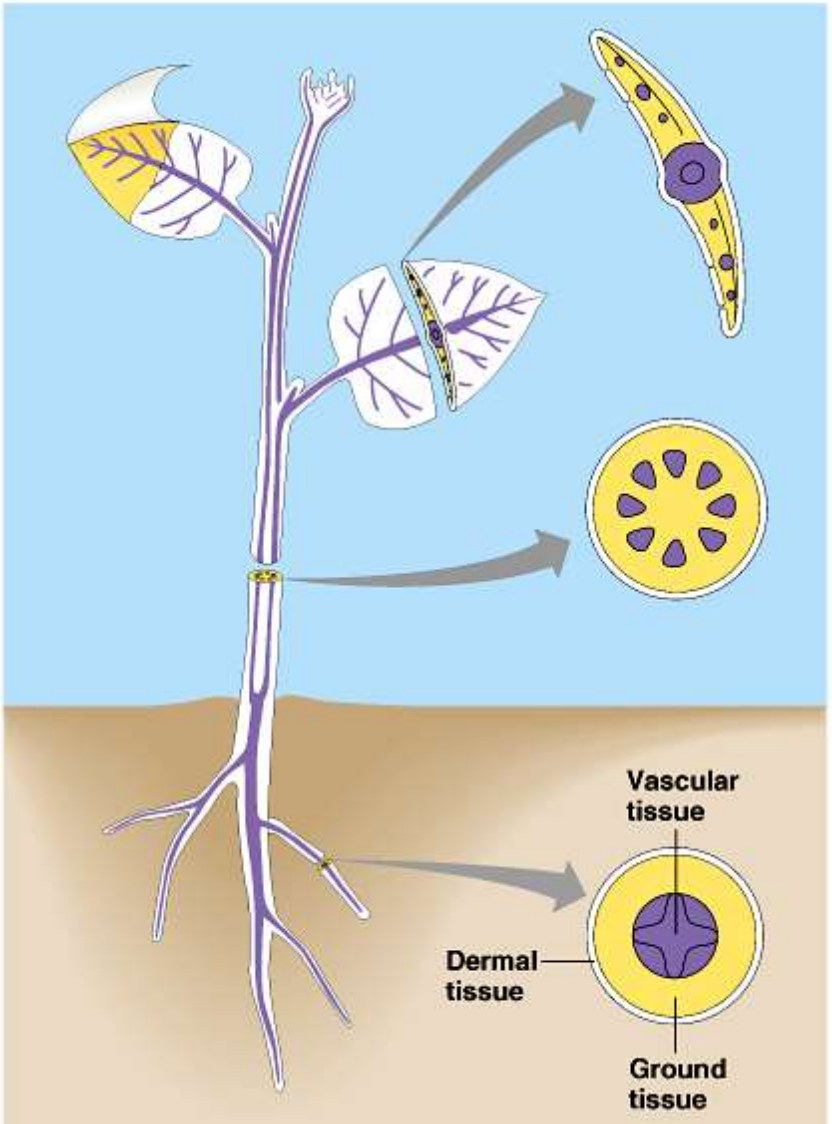
Plant tissue systems

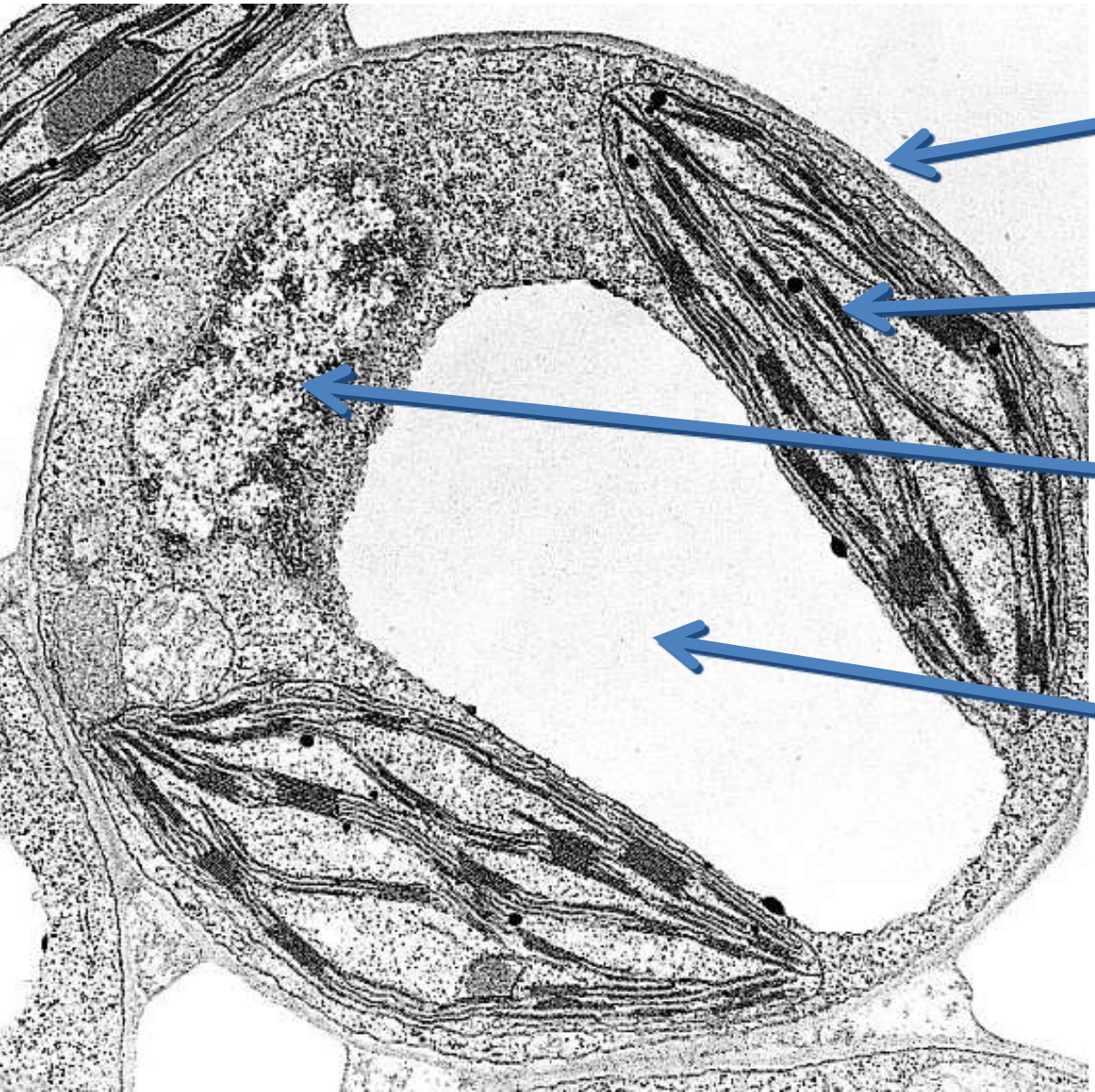
1. Dermal tissue
2. Vascular tissue
3. Ground tissue



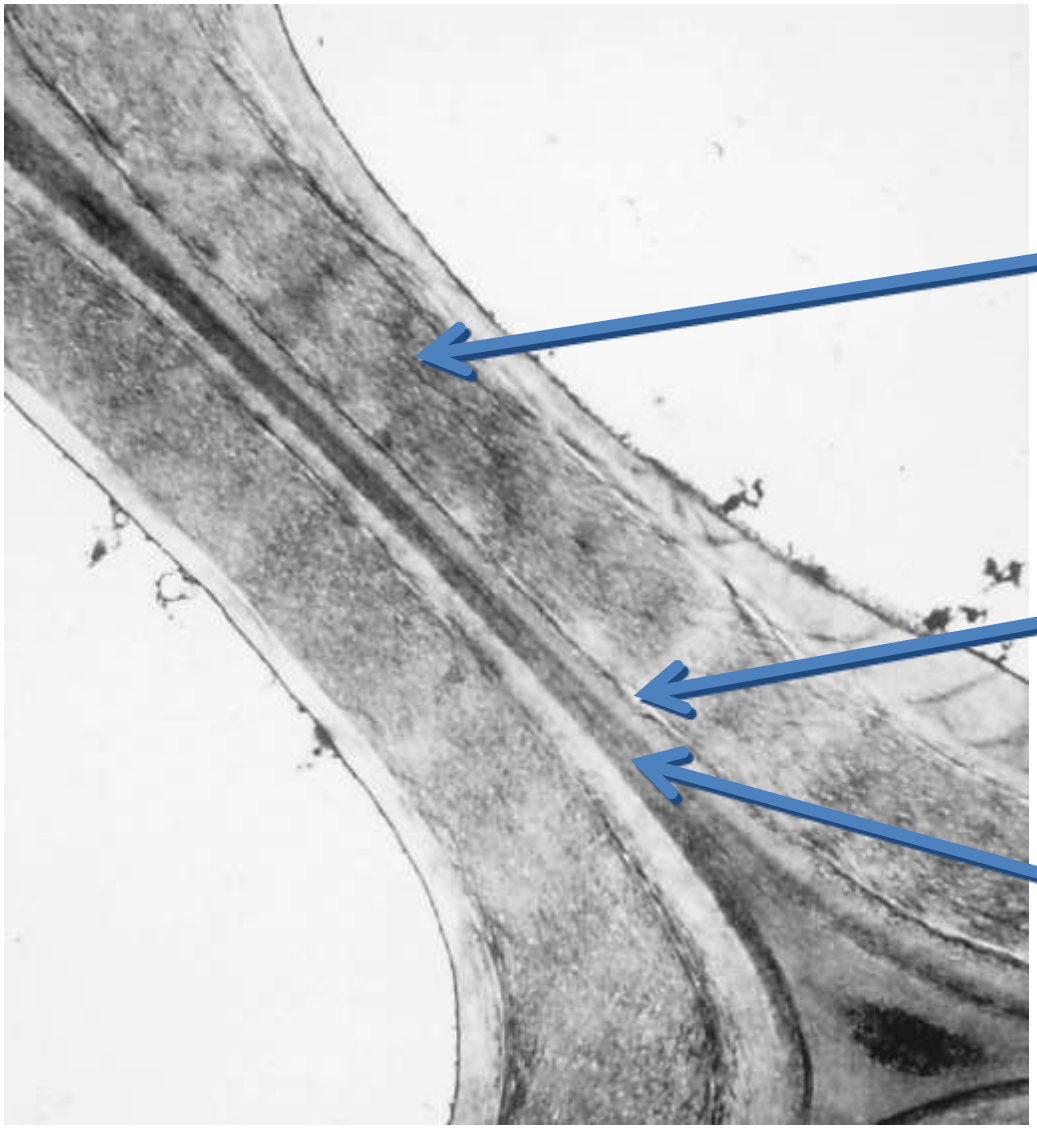
Dermal Tissue

- The **dermal tissue**, or **epidermis**, is generally a single layer of tightly packed cells that covers and protects all young parts of the plant.
- Other specialized characteristics :
  - **Root hairs:** increased absorption
  - **Cuticle:** waxy coating, prevents water loss

Plant Cell Structure

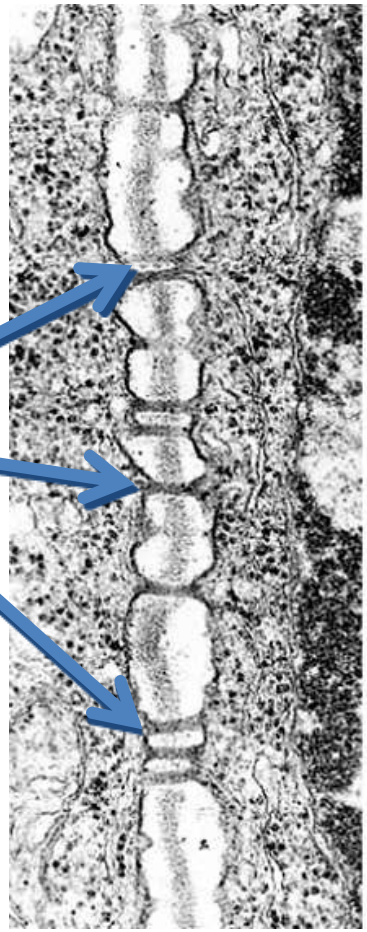


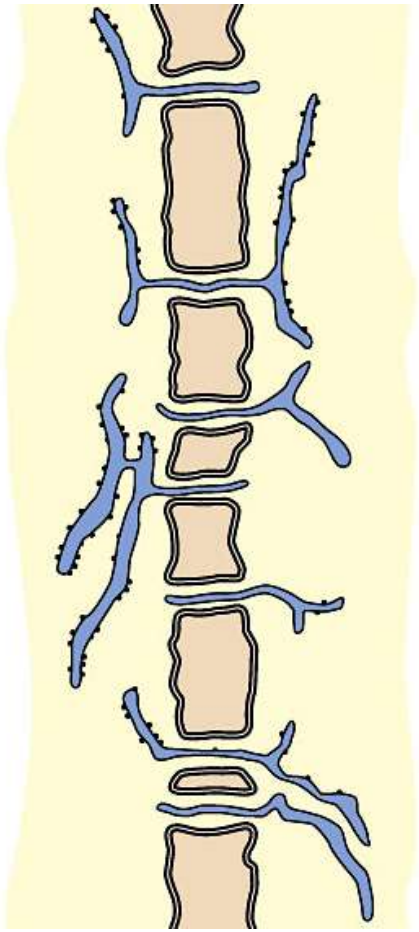
Cell Wall Structure



Cell Wall Structure

plasmodesmata





Plant Cell Types

- Xylem
  - Tracheids
  - Vessel elements
- Phloem
  - Sieve-tube members
  - Companion cell

Vascular Tissue

Vascular tissue:

- runs continuous throughout the plant
- transports materials between roots and shoots.
  - **Xylem** transports water and dissolved minerals upward from roots into the shoots.
    (water the xylem)
  - **Phloem** transports food from the leaves to the roots and to non-photosynthetic parts of the shoot system.
    (feed the phloem)

Xylem

The water conducting elements of xylem are the **tracheids** and **vessel elements.**

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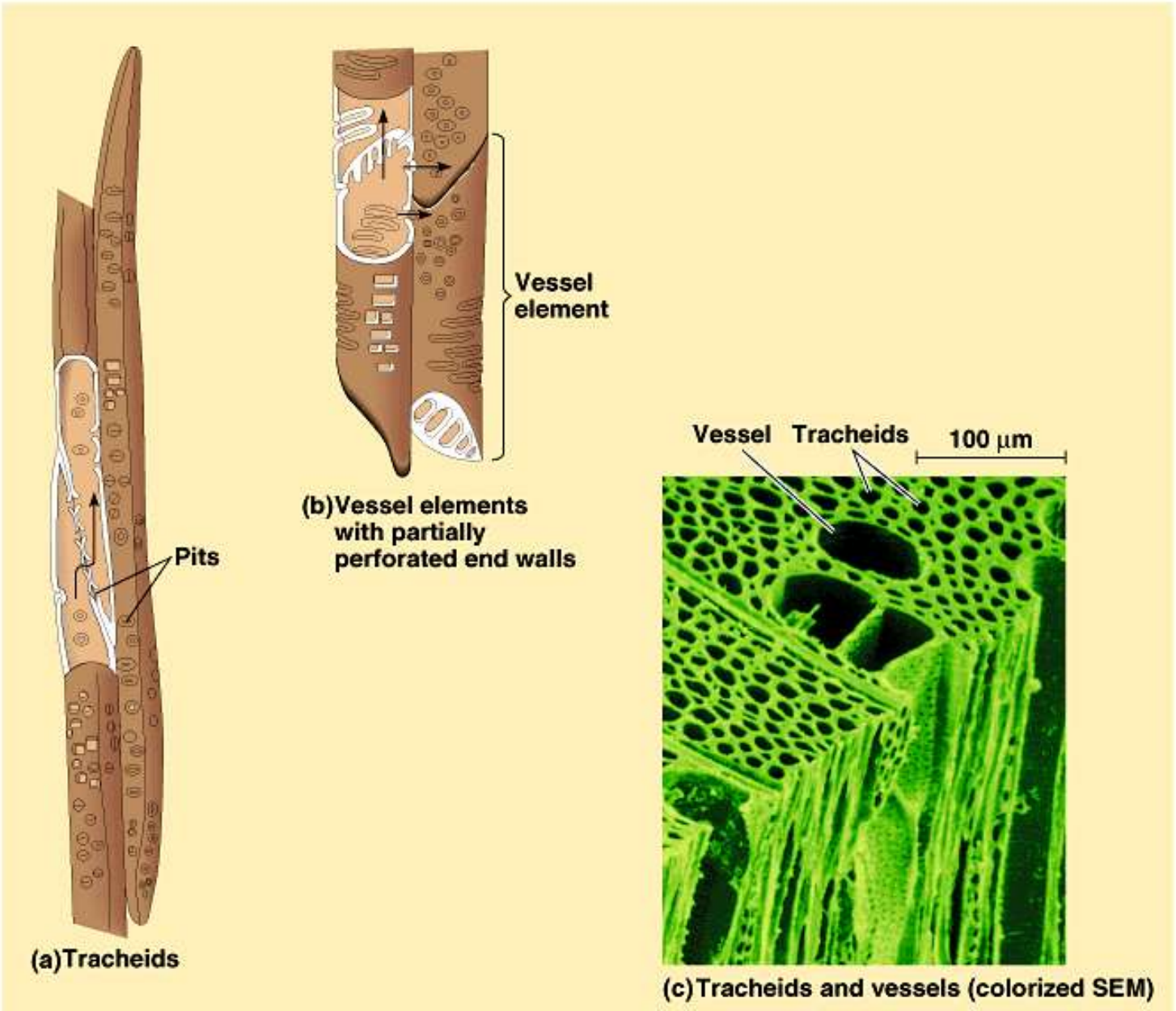
Xylem

- Tracheids
  - Characteristics
    - tapered elongated cells
    - connect to each other through pits
    - secondary cell walls strengthened with lignin
    - dead at functional maturity
  - Functions
    - transport of water plus dissolved minerals
    - support

Xylem

- Vessel Elements
  - Characteristics
    - shorter and wider than tracheids
    - possess thinner cell walls than tracheids
    - Aligned end-to-end to form long micropipes
    - dead at functional maturity
  - Functions
    - transport of water plus dissolved minerals
    - support

Water conducting cells of the xylem



Phloem

- Food and minerals move through tubes formed by chains of cells, **sieve-tube members**.
  - **sieve plates**
  - **companion cell**

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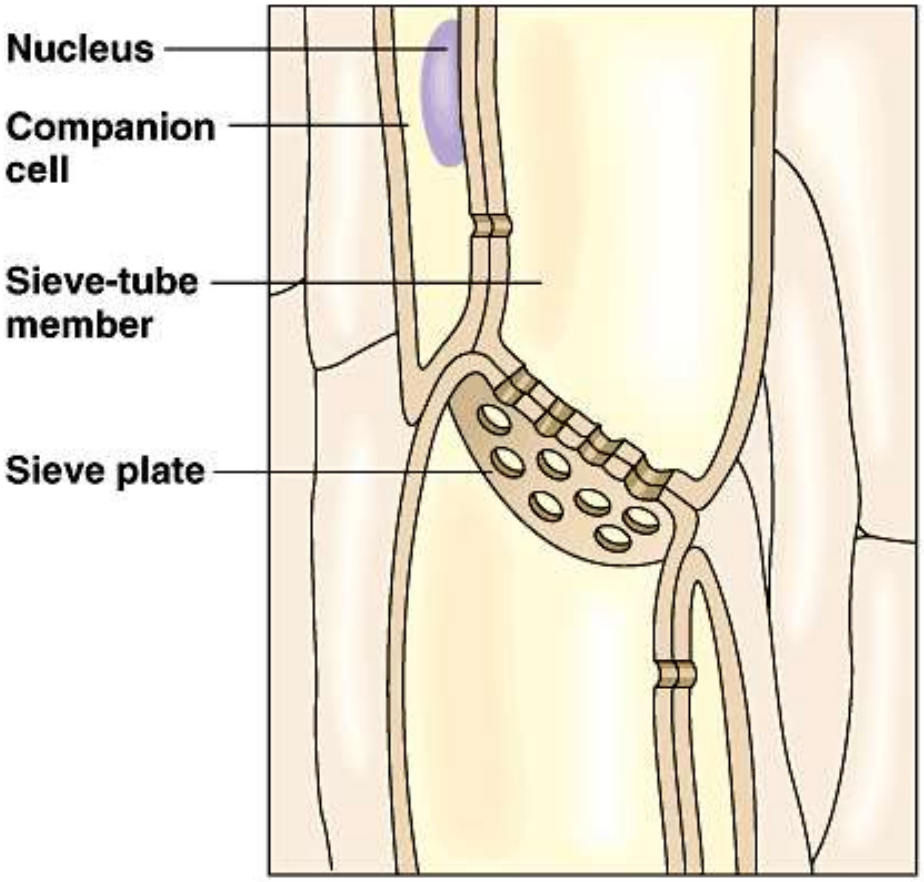
Phloem

- Sieve-tube Members
  - Characteristics
    - living cells arranged end-to-end to form food-conducting cells of the phloem
    - lack lignin in their cell walls
    - mature cells lack nuclei and other cellular organelles
    - alive at functional maturity
  - Functions
    - transport products of photosynthesis

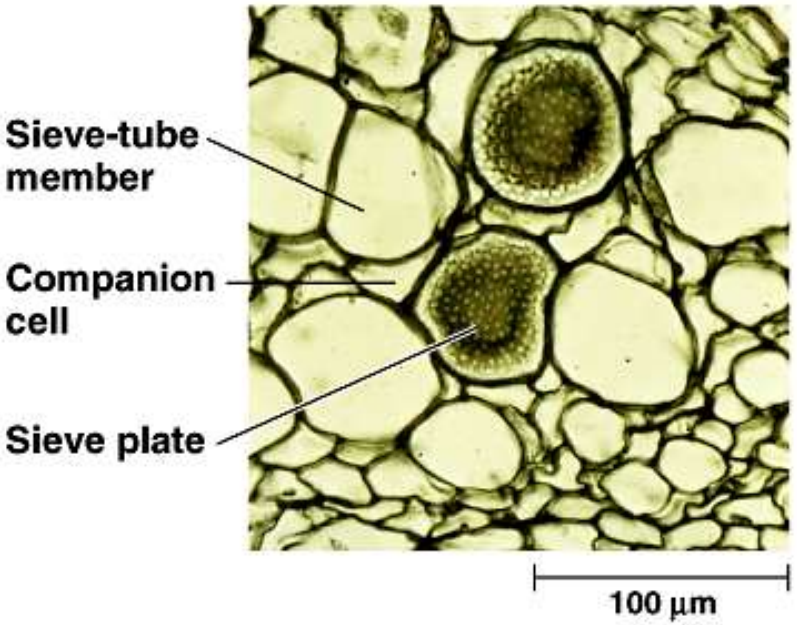
Phloem

- Companion Cells
  - Characteristics
    - living cells adjacent to sieve-tube members
    - connected to sieve-tube members via plasmodesmata
  - Functions
    - support sieve-tube members
    - may assist in sugar loading into sieve-tube members

Food conducting cells of the phloem



(a) Longitudinal view

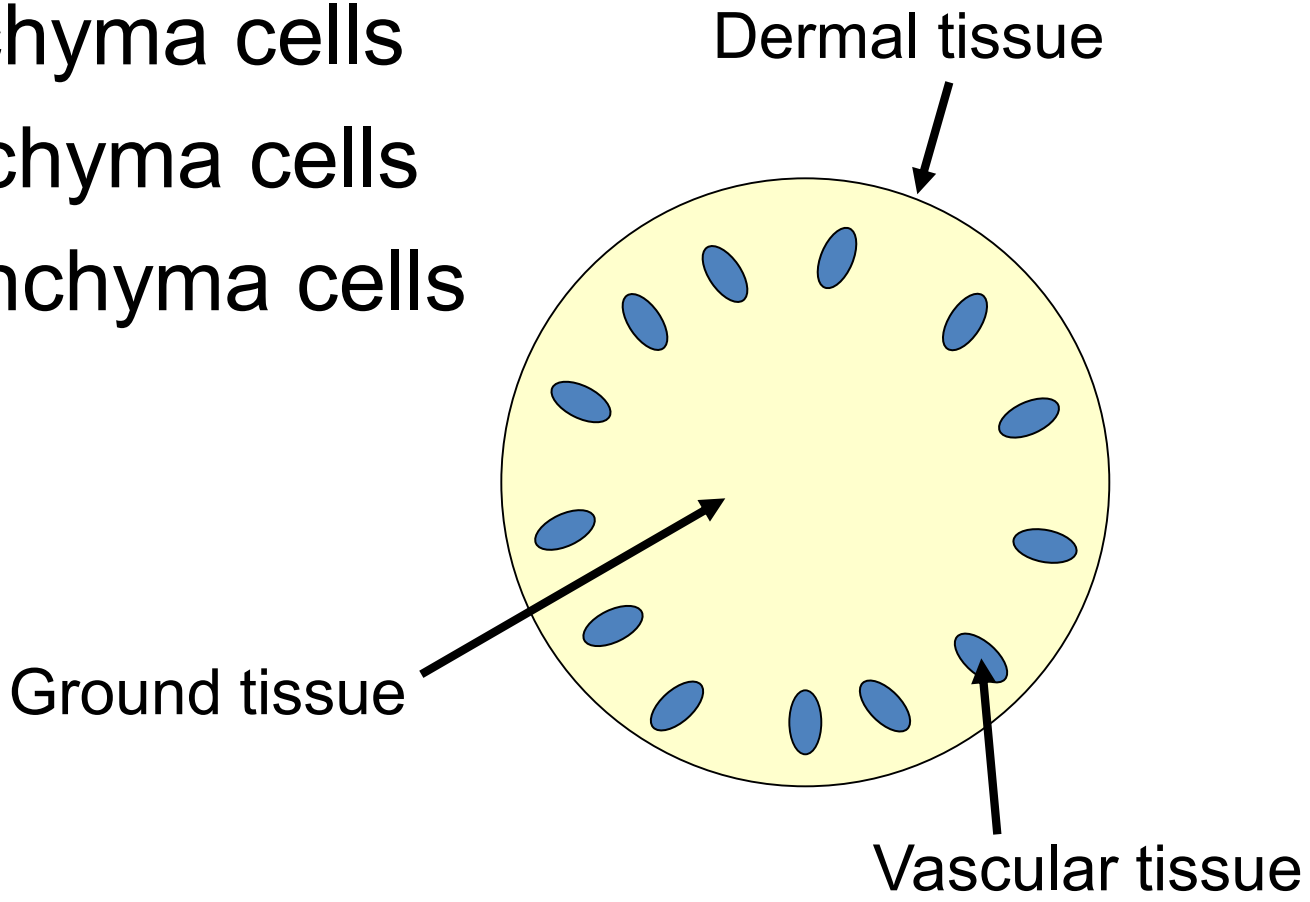


(b) Transverse section (LM)

Ground Tissue

Ground tissue fills the interior of the plant. It contains three basic cell types:

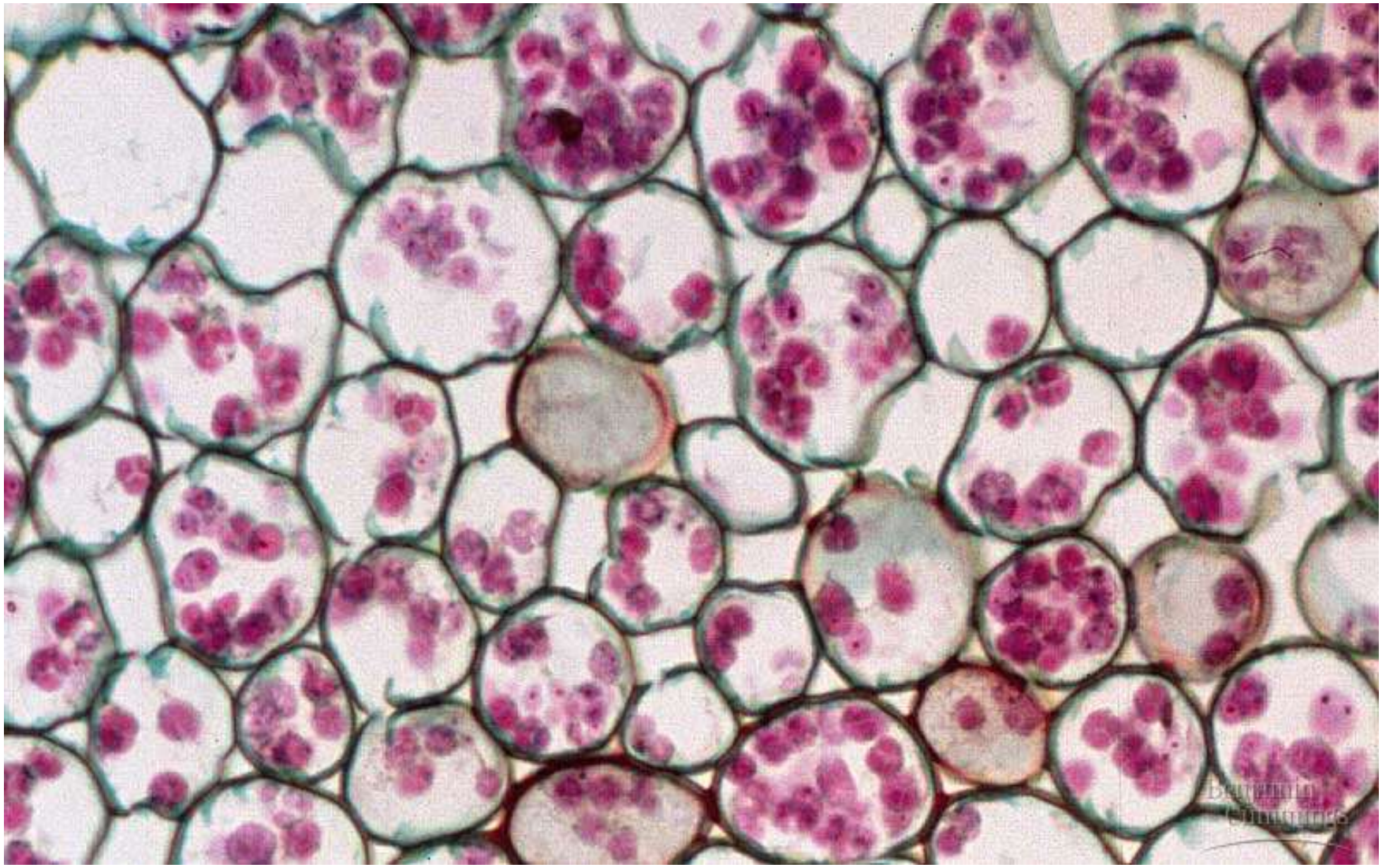
- Parenchyma cells
- Collenchyma cells
- Sclerenchyma cells



Parenchyma

- Characteristics
  - least specialized cell type
  - only thin primary cell wall is present
  - possess large central vacuole
  - generally alive at functional maturity
- Functions
  - make up most of the ground tissues of the plant
  - storage
  - photosynthesis
  - can help repair and replace damaged organs by proliferation and specialization into other cells

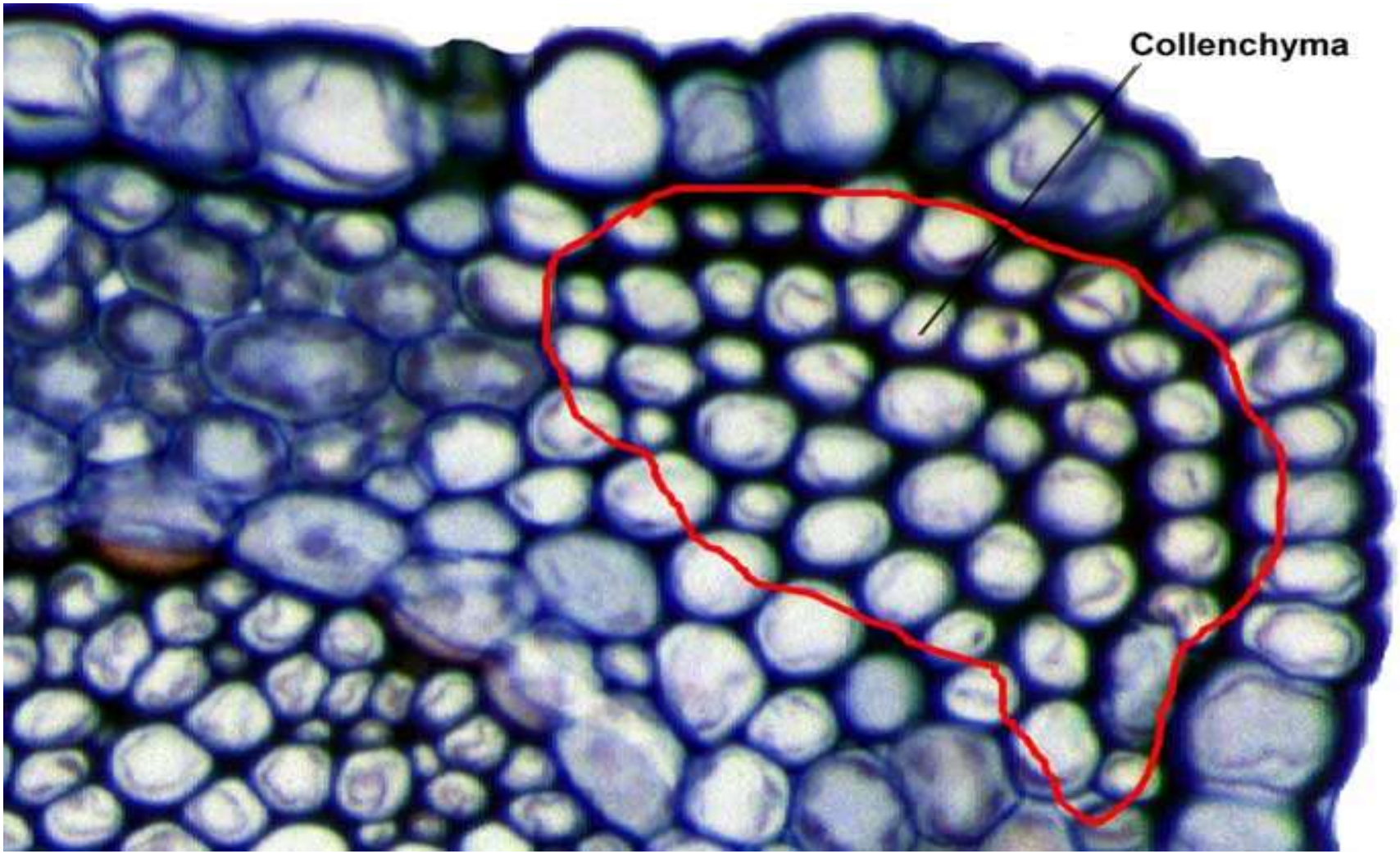
Parenchyma



Collenchyma

- Characteristics
  - possess thicker primary cell walls than that of parenchyma
  - no secondary cell wall present
  - generally alive at functional maturity
- Functions
  - provide support without restraining growth

Collenchyma



Sclerenchyma

- Characteristics
  - have secondary cell walls strengthened by lignin
  - often are dead at functional maturity
  - two forms: **fibers and sclereids**
- Functions
  - rigid cells providing support and strength to tissues

- Two other sclerenchyma cells, **fibers** and **sclereids**, are specialized entirely in support.
  - **Fibers** are long, slender and tapered, and usually occur in groups.
    - Those from hemp fibers are used for making rope and those from flax for weaving into linen.
  - **Sclereids**, shorter than fibers and irregular in shape, impart the hardness to nutshells and seed coats and the gritty texture to pear fruits.

Fiber Cells

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Sclereids