

Vegetative System of Angiosperm: The Root, Stem and Leaf

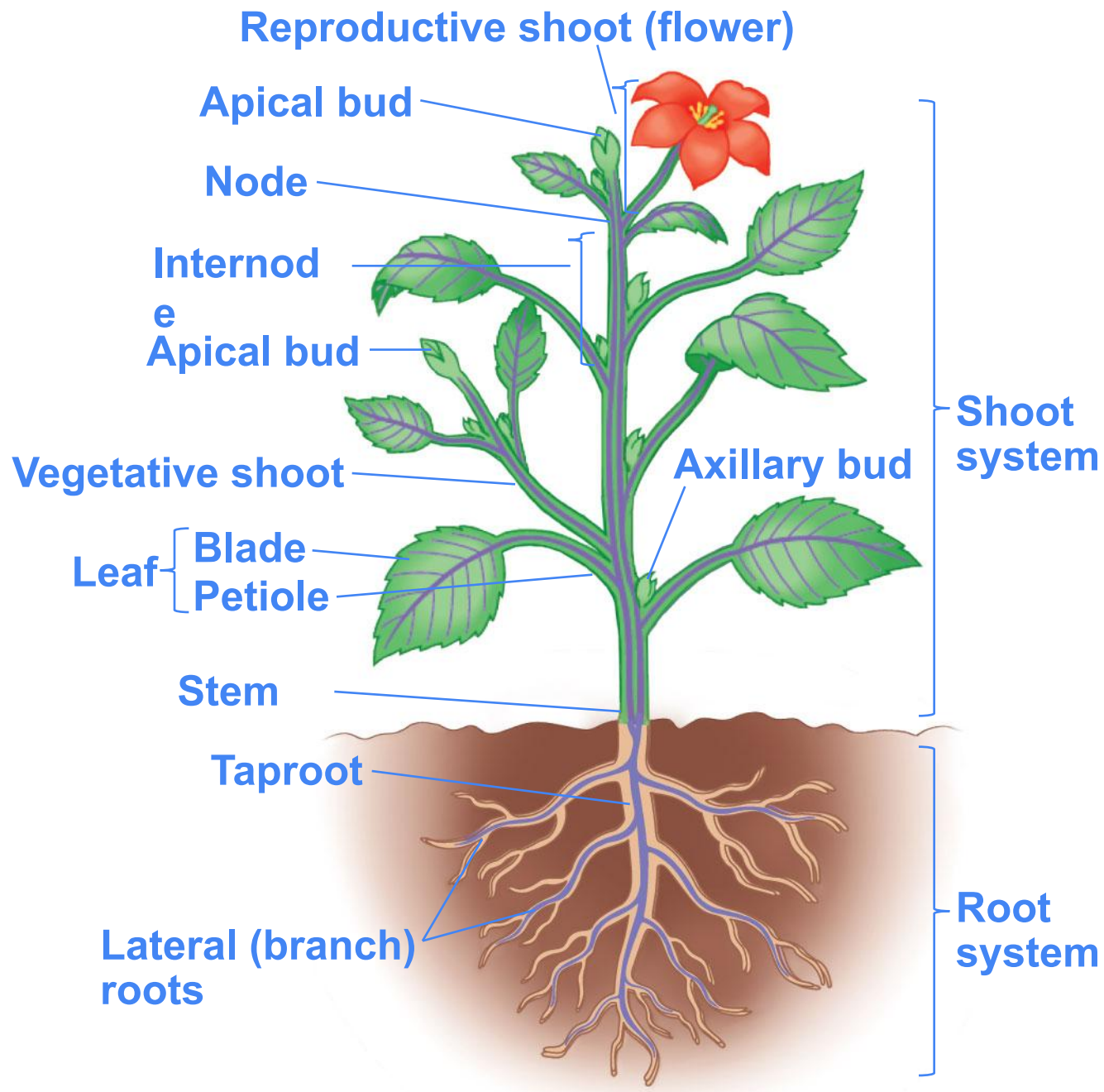


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The Three Basic Plant Organs: Roots, Stems, and Leaves

- Basic morphology of vascular plants reflects their evolution as organisms that draw nutrients from below ground and above ground
- Plants take up water and minerals from below ground
- Plants take up CO₂ and light from above ground

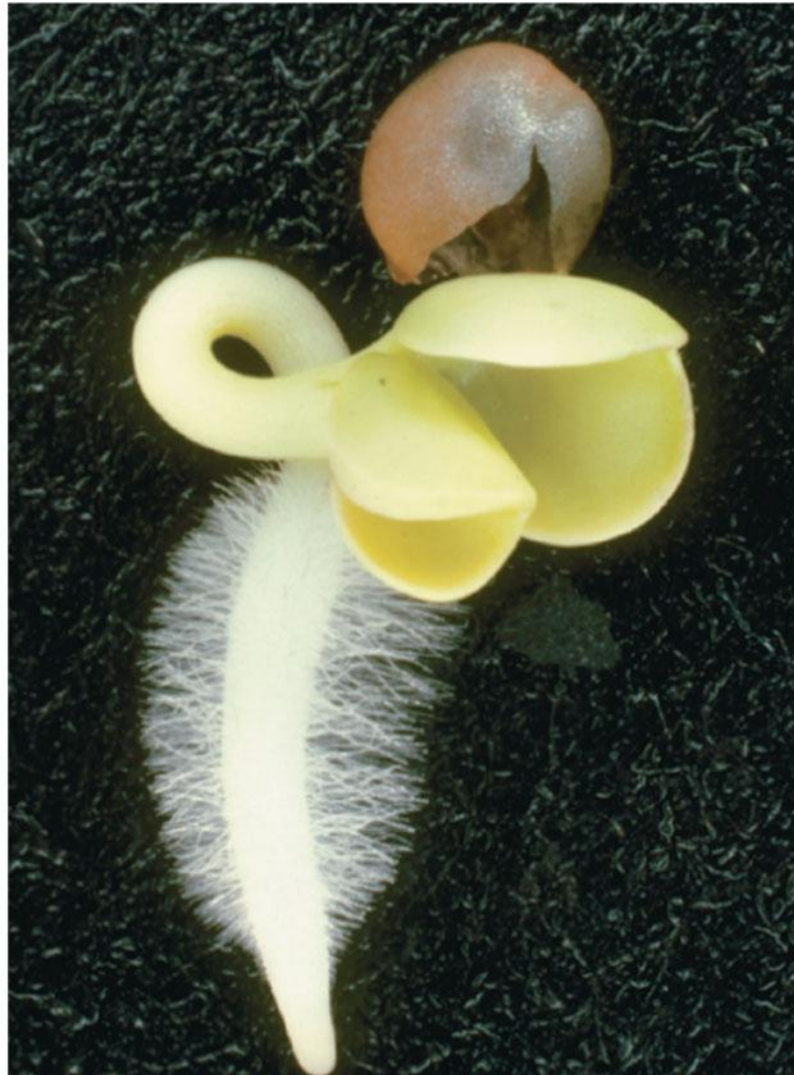
- Three basic organs evolved: roots, stems, and leaves
- They are organized into a **root system** and a **shoot system**



- Roots rely on sugar produced by photosynthesis in the shoot system, and shoots rely on water and minerals absorbed by the root system
- Monocots and eudicots are the two major groups of angiosperms

Roots

- A **root** is an organ with important functions:
 - Anchoring the plant
 - Absorbing minerals and water
 - Storing carbohydrates
 - In most plants, absorption of water and minerals occurs near the **root hairs**, where vast numbers of tiny root hairs increase the surface area



Root hairs of radish seedling

- Many plants have root adaptations with specialized functions



▲ Prop roots



◀ Storage roots



◀ “Strangling”
aerial roots



▲ Pneumatophores

▼ Buttress roots



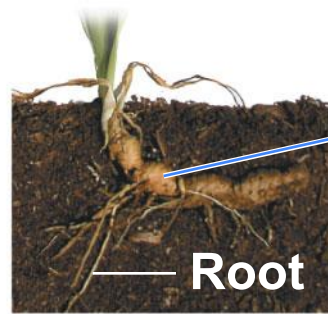
Stems

- A **stem** is an organ consisting of
 - An alternating system of **nodes**, the points at which leaves are attached
 - **Internodes**, the stem segments between nodes

- An **axillary bud** is a structure that has the potential to form a lateral shoot, or branch
- An **apical bud**, or terminal bud, is located near the shoot tip and causes elongation of a young shoot

- Many plants have modified stems (e.g., rhizomes, bulbs, stolons, tubers)

◀ Rhizomes



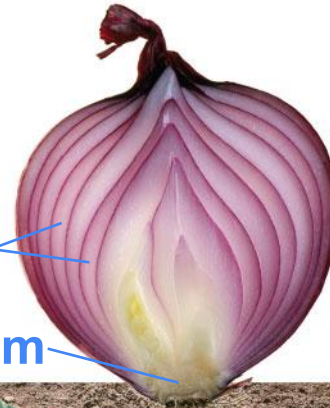
Rhizome

Root

▶ Bulbs

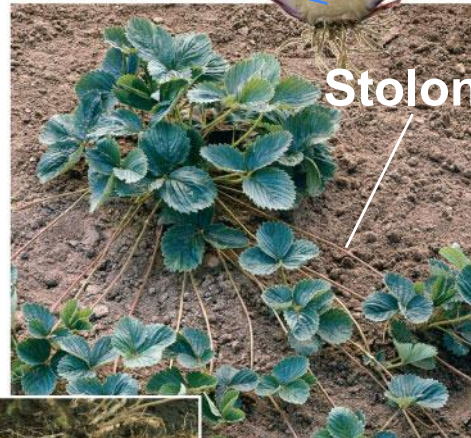
Storage leaves

Stem



▶ Stolons

Stolon



◀ Tubers

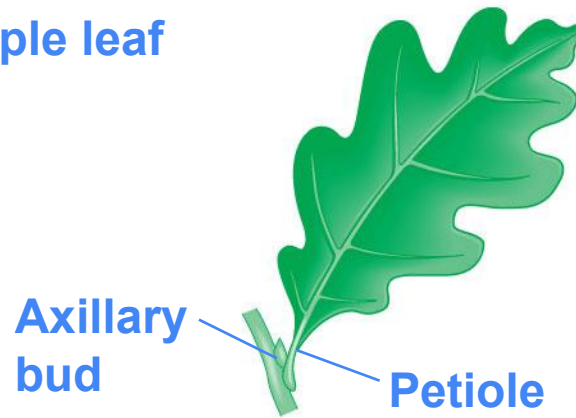


Leaves

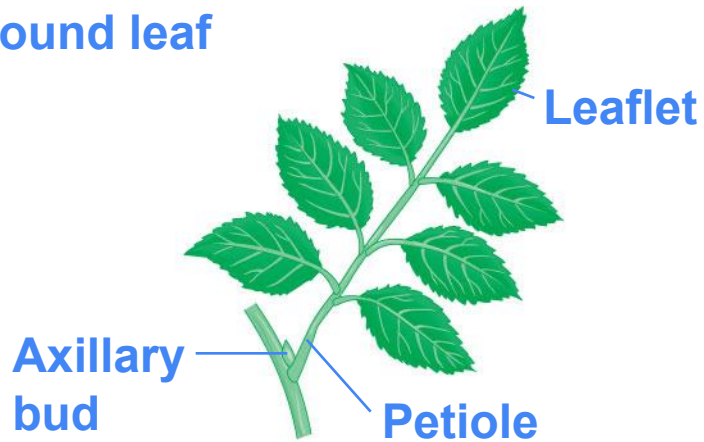
- The **leaf** is the main photosynthetic organ of most vascular plants
- Leaves generally consist of a flattened **blade** and a stalk called the **petiole**, which joins the leaf to a node of the stem

- Monocots and eudicots differ in the arrangement of **veins**, the vascular tissue of leaves
 - Most monocots have parallel veins
 - Most eudicots have branching veins
- In classifying angiosperms, taxonomists may use leaf morphology as a criterion

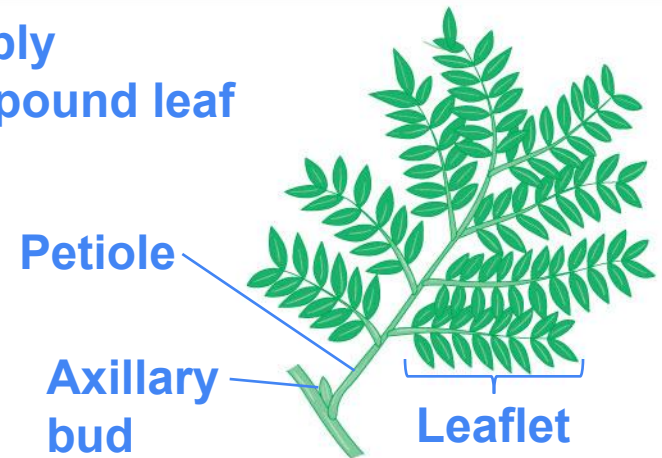
Simple leaf



Compound leaf



Doubly compound leaf



► **Tendrils**



◄ **Spines**



◄ **Storage
leaves**



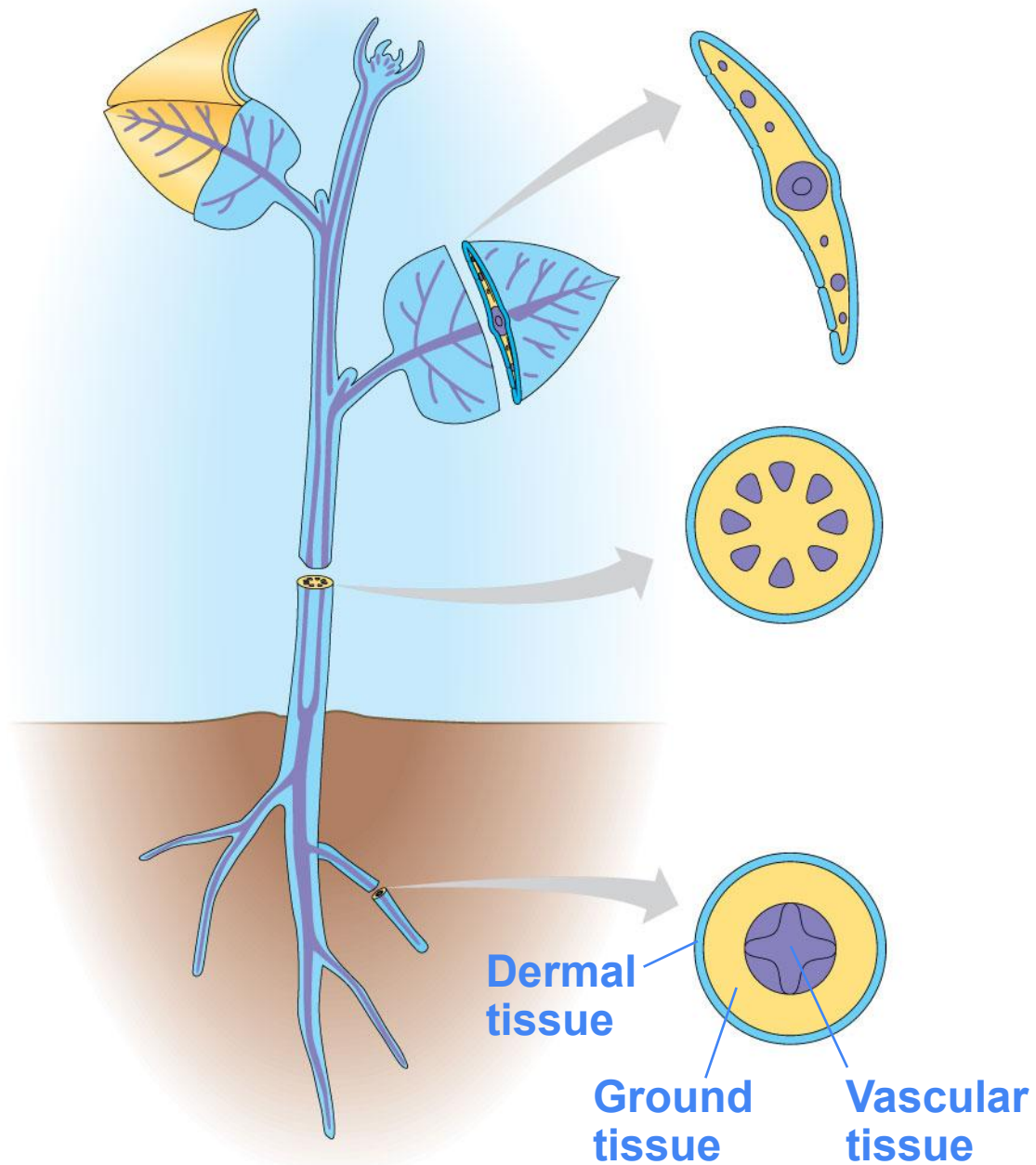
◄ **Reproductive
leaves**

► **Bracts**



Dermal, Vascular, and Ground Tissues

- Each plant organ has dermal, vascular, and ground tissues
- Each of these three categories forms a **tissue system**
- Each tissue system is continuous throughout the plant



- In nonwoody plants, the **dermal tissue system** consists of the **epidermis**
- A waxy coating called the **cuticle** helps prevent water loss from the epidermis
- In woody plants, protective tissues called **periderm** replace the epidermis in older regions of stems and roots
- Trichomes are outgrowths of the shoot epidermis and can help with insect defense

EXPERIMENT



Very hairy pod
(10 trichomes/
 mm^2)



Slightly hairy
pod
(2 trichomes/
 mm^2)



Bald pod
(no trichomes)

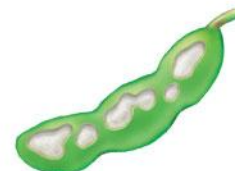
RESULTS



Very hairy pod:
10% damage



Slightly hairy
pod:
25% damage



Bald pod:
40% damage



- The **vascular tissue system** carries out long-distance transport of materials between roots and shoots
- The two vascular tissues are xylem and phloem
- **Xylem** conveys water and dissolved minerals upward from roots into the shoots
- **Phloem** transports organic nutrients from where they are made to where they are needed

- Tissues that are neither dermal nor vascular are the **ground tissue system**
- Ground tissue internal to the vascular tissue is **pith**; ground tissue external to the vascular tissue is **cortex**
- Ground tissue includes cells specialized for storage, photosynthesis, and support

“Ground” tissue

Includes various cells specialized for functions such as storage, photosynthesis, and support

Parenchyma: cells which occur in all 3 tissue systems, usually photosynthesis, elongated, loosely packed, thin, flexible cell walls

Collenchyma: primary wall (in cells) thickened at corners, irregular shapes, provide support

Sclerenchyma: 2 types, support and strengthen the plant, thick, even cell walls, dead cells provide framework for additional cells

1. fibers- elongated, elastic strands or bundles associated with the vascular tissue

2. sclereids- form hard outer covering of seeds, nuts, and fruit stones

Parenchyma, collenchyma, and sclerenchyma cells

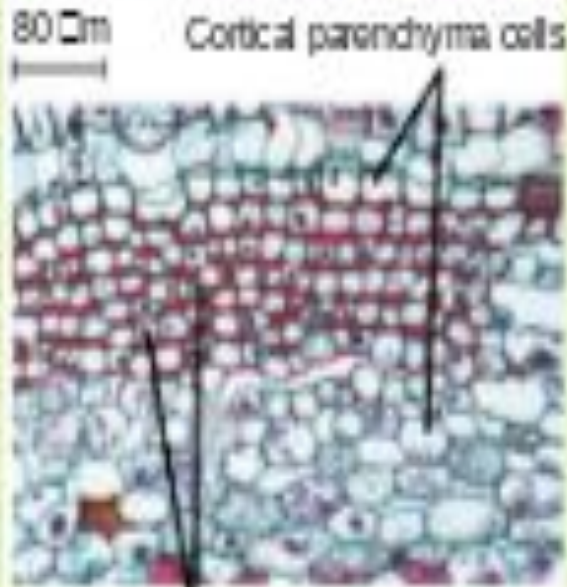
PARENCHYMA CELLS



Parenchyma cells

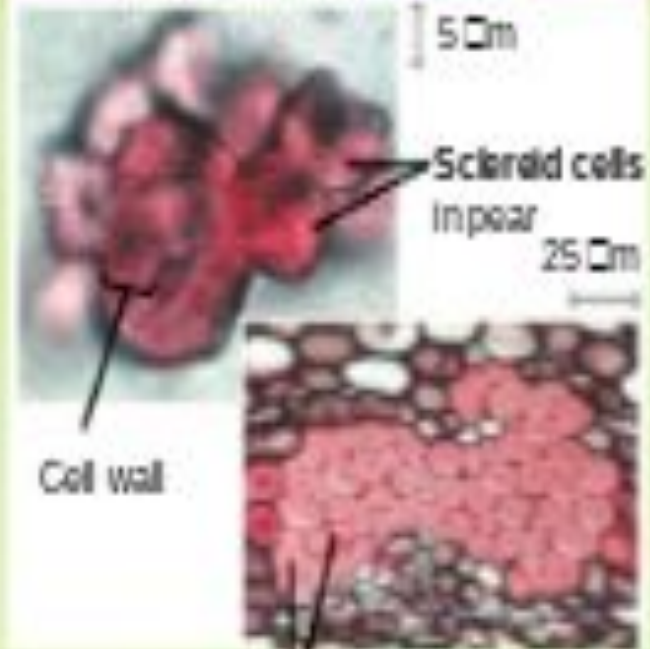
60 μ m

COLLENCHYMA CELLS



Collenchyma cells

SCLERENCHYMA CELLS



Fiber cells