

The Plant Body

Chapter 31

Why It Matters

- Plant parts as resources for animals



Overview

- Plants are **photosynthetic autotrophs**
- Shoot system** aboveground
 - Photosynthetic leaves, stems
- Root system** belowground
 - Nonphotosynthetic roots
- Each system consists of various **organs**—leaves, stems, and roots, among others
- Each organ is composed of two or more types of **tissues**

Plant Tissues

- **All plant cells share certain features:**
 - Primary cell wall around **protoplast**
 - **Cellulose** fibers embedded in a matrix of other polysaccharides called hemicelluloses
 - Middle lamella with **pectin**, binding cells in tissues together
- **Some plant cells have secondary cell wall**
 - Cellulose fibers anchored with **lignin (lignification)**
 - Stronger and more rigid
 - Creates waterproof barrier

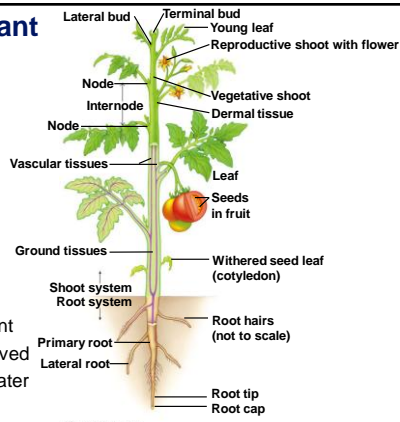
Vascular Plant Body

▪ Shoot system

- Stems
- Leaves
- Buds
- Flowers/Fruits

▪ Root system

- Roots
- Anchor the plant
- Absorbs dissolved minerals and water

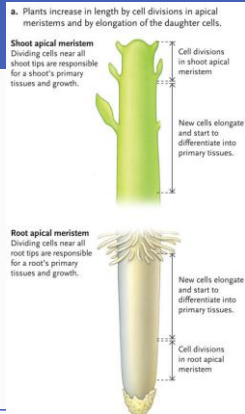


Growth

- **Determinate growth** common in animals
- **Indeterminate growth** in plants
 - **Meristems**, at the tips of roots and shoots
 - This plasticity of growth gives some flexibility since plants cannot move around; allows them to adapt
- **Plants grow by:**
 - Increase in number of cells
 - Increase in size of cells

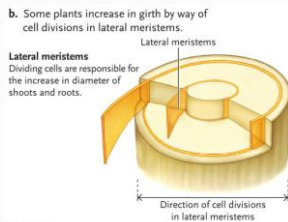
Primary Growth

- **Apical meristems** at root and shoot tips
 - Increases height of shoot, length of roots
- Some species only have **primary growth**
- Growth of the primary plant body



Secondary Growth

- **Lateral meristems**
 - Self-perpetuating cylinders of tissue
 - Increases diameter of older stems and roots
- Plants with woody bodies typically exhibit secondary growth
- Secondary tissues make up the woody secondary plant body we see in trees and shrubs



Two Major Classes of Flowering Plants

- **Monocots**
 - One cotyledon
 - Grasses, daylilies, irises, cattails, palms
- **Eudicots**
 - Two cotyledons
 - Maples, willows, oaks, cacti, roses, poppies, sunflowers, beans, peas

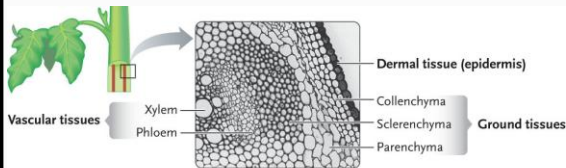
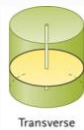
Lifespans

- **Annual**
 - Complete life cycle in **one growing season**
- **Biennial (two growing seasons)**
 - Roots, stems, and leaves first season
 - Flowers, fruits, and seeds second season
- **Perennial (growth continues year after year)**
 - Vegetative and reproductive growth

Ground, Vascular, and Dermal Tissues

Major Tissue Systems:

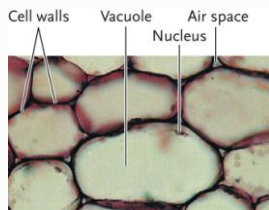
- **Vascular** – Xylem and Phloem
- **Ground** – Collenchyma, Sclerenchyma, and Parenchyma
- **Dermal** (epidermis)



Ground Tissues: Parenchyma

Soft primary tissues

- Make up the bulk of the soft, moist primary growth of roots, stems, leaves, flowers, and fruits
- Most have thin primary cell walls, pliable and permeable
- Specialized for a variety of tasks, such as storage, secretion, photosynthesis

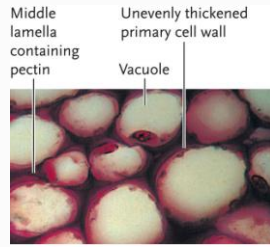


a. Parenchyma tissues consist of soft, living cells specialized for storage, other functions.

Ground Tissues: Collenchyma

▪ Flexible support

- Strengthens plant parts that are still elongating
- Thicker primary cell walls; thicken and stretch as the cell enlarges
- Typically elongated cells in strands or a sheathlike cylinder



b. Collenchyma tissues provide flexible support.

© Thomson Higher Education

Ground Tissues: Sclerenchyma

▪ Rigid support and protection

- Thick secondary cell walls that are commonly *lignified* and perforated by pits for the passage of water
- 1) **Sclereids** (protective casings) and 2) **fibers** (support) – differ in their shape and arrangement



c. Sclerenchyma tissues provide rigid support and protection.

© Thomson Higher Education

a. Sclereids



Thick secondary wall

b. Fibers



- Sclereids typically form a protective coat around seeds
- Fibers are long tapered cells that resist stretching

Vascular Tissues Conduct Fluids

▪ Xylem

- Conducts water and dissolved minerals absorbed from the soil upward from the roots to shoots
- Thick, lignified secondary walls
- **Dead when functional**

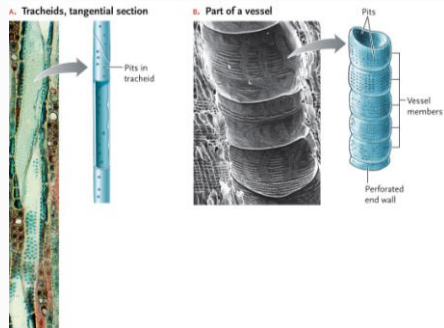
▪ Tracheids

- Elongated, with tapered, overlapping ends
- Lateral connections through pits – movement of water

▪ Vessel members

- Shorter cells joined together in tubelike columns
- Lateral connections through pits and perforations

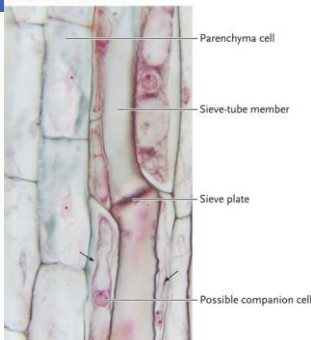
Tracheids and Vessel Members



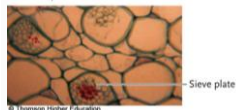
Vascular Tissues

- **Phloem**
 - Conduct sugars from photosynthesis and other solutes throughout the plant body
 - **Living when functional!**
- **Sieve tube members – main conducting cells**
 - Joined end to end in **sieve tubes**
 - End walls of cells are called **sieve plates**, studded with pores
 - Sieve tube cells assisted by **companion cells**, specialized parenchyma cells

a. Sieve-tube members



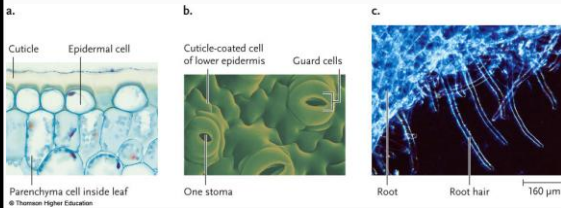
b. Sieve plate



Dermal Tissue

- **Epidermis** covers primary plant body in a single, continuous layer
 - Sometimes multiple layers of tightly packed cells
 - Waxy **cuticle**
 - Pairs of **guard cells** in leaf epidermis create **stomata** (openings) for gas exchange
- **Epidermal specializations**
 - **Trichomes** (hairs) – may exude sugars to attract pollinators; provide protection via toxins
 - Absorbent **root hairs**

Epidermal Tissue



Three Plant Tissue Systems

Table 31.2 Summary of Flowering Plant Tissues and Their Components

Tissue System	Name of Tissue	Cell Types in Tissue	Tissue Function
Ground tissue	Parenchyma	Parenchyma cells	Photosynthesis, respiration, storage, secretion
	Collenchyma	Collenchyma cells	Flexible strength for growing plant parts
	Sclerenchyma	Fibers or sclereids	Rigid support, deterring herbivores
Vascular tissue	Xylem	Conducting cells (tracheids, vessel members); parenchyma cells; sclerenchyma cells	Transport of water and dissolved minerals
	Phloem	Conducting cells (sieve tube members); parenchyma cells; sclerenchyma cells	Sugar transport
Dermal tissue	Epidermis	Undifferentiated cells; guard cells and other specialized cells	Control of gas exchange, water loss; protection
	Periderm	Cork; cork cambium; secondary cortex	Protection

Primary Shoot System

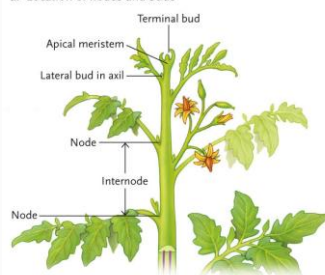
- Consists of main stem, leaves, and buds
 - Plus any attached flowers and fruits
- Functions of stems:**
 - Mechanical support
 - House vascular tissues
 - May store food and water
 - Buds and meristems that give rise to new cells of the shoot (growth)

Stems

- Organized into modular segments
 - Nodes**
 - Internodes**
 - Terminal bud**
 - Lateral buds**
 - Terminal buds release a hormone that inhibits nearby lateral bud growth – **apical dominance**
 - Why would a plant do this???**
 - Lateral bud growth can be stimulated by periodically cutting off the terminal bud*

Stem Structure

a. Location of nodes and buds



b. Leaves at a terminal bud



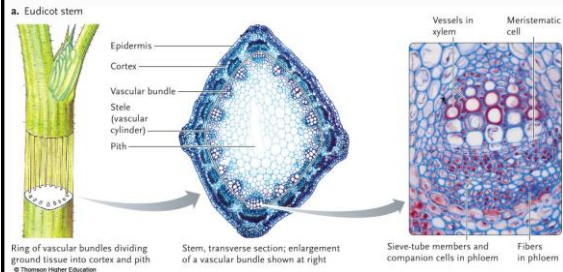
© Thomson Higher Education

Organization of Vascular Tissues in Stems

- Organized into **vascular bundles**
 - Primary phloem and xylem in each bundle
 - Wrapped in sclerenchyma
 - And thread lengthwise through parenchyma

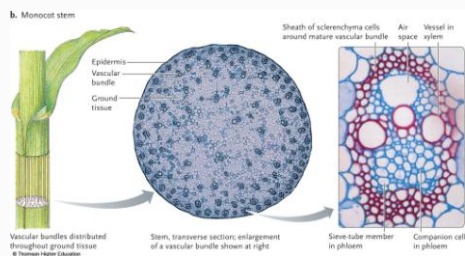
Eudicot Vascular Bundles

- Vascular bundles form a **stele** (cylinder)
 - Vertically divides the column of ground tissue into an outer **cortex** and an inner **pith**

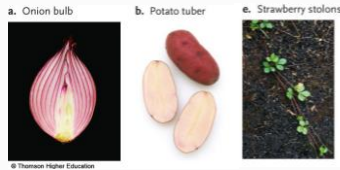


Monocot Vascular Bundles

- Scattered throughout ground tissue of stem



Modified Stems (Some examples)



- Onion is a **bulb** – a modified shoot, consisting of a bud with fleshy leaves
- **Tubers** – stem regions enlarged by the presence of starch storing parenchyma cells
- **Stolons** – slender stems that grow along the soil surface

Leaves

- **Blade**
 - Large surface area for photosynthesis and gas exchange
 - In general, leaves of flowering plants are oriented on the stem axis to maximize capture of sunlight
- **Petiole** (in eudicots)
 - Attaches leaf to stem

Leaf Forms

- **Simple leaves** have a single blade
- **Compound leaves** are divided into multiple leaflets
- Leaf edges may be smooth, toothed or lobed



Leaf Adaptations

- Responses to environmental and herbivore pressures
 - Spines of a cactus or supportive tendrils of the sweet pea plant

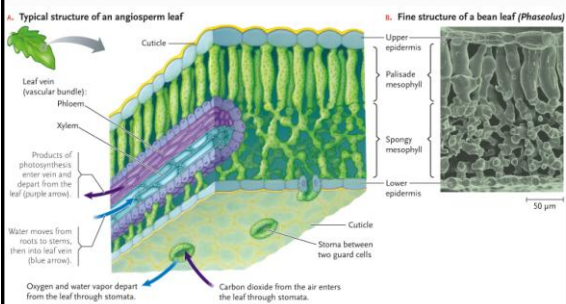
a. Cactus spines



b. Tendrils



Leaf Internal Anatomy

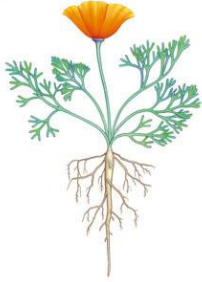


Root Systems

- Absorb enough water and dissolved minerals to sustain growth and routine cellular maintenance
- Conduct water and minerals to aerial plant parts
- Anchor and support aboveground parts
- Often store food** – roots of carrots and beets

Types of Roots

a. Taproot system



b. Fibrous root system



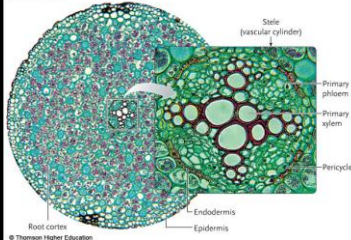
c. Adventitious roots



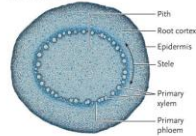
Eudicot and Monocot Root Tissues

- Xylem and phloem arranged as central stele

a. Eudicot root



b. Monocot root



Other Root Tissues

- **Exodermis**
 - Outer layer of root cortex cells – may limit water losses from the roots and help regulate the absorption of ions
- **Endodermis**
 - Inner layer of root cortex cells
 - Thin, selectively permeable barrier that helps control the movement of water and dissolved minerals into the stele
- **Pericycle**
 - Between stele and endodermis – one or more layers
 - Can function as meristem
 - Can give rise to lateral roots, **root primordia** (rudimentary roots)
