

OVERVIEW: Your objective in this assignment should be to acquire an introductory knowledge of *simple tissues* and *complex tissues* of vascular plants.

PROCEDURE: First, skim over Chapter 4 and note that it has two major parts – “Meristematic Tissues” and “Tissues Produced by Meristems” Here we will focus on the second part and return to “Meristematic Tissues” in SA #28. Consult the STUDY OUTLINE before carefully reading the chapter in detail.

THEME: The vascular plant body can be normally be divided into three *organs* which are composed of *tissues*, groups of cells that can be distinguished according to their (a) location, (b) shape, (c) wall thickness, (d) cytoplasmic contents, and (e) function.

LECTURE DISCUSSION QUESTIONS:

1. You may choose to make a concept map to test your understanding of the relationships among tissues discussed in Chapter 4. Such a map would be another way of presenting the outline of Chapter 4 (next pages) but with linking phrases between "bubbles" to show relationships.
2. How would you distinguish *parenchyma*, *collenchyma*, and *sclerenchyma*? What are *aerenchyma* and *chlorenchyma*, and how do they relate to parenchyma?
3. Epidermis, xylem, and phloem are considered "complex tissues" by some botanists because these tissues are a composite of several tissue types. What are the types and roles of the tissues composing each of the complex tissues?

STUDY OUTLINE:

I. SIMPLE TISSUES:

A. PARENCHYMA

1. Less specialized cells forming matrix around more specialized cells
2. Round, thin-walled cells; air spaces between cells; living cytoplasm; [primary (I^o) c.w. only]
3. Functions:
 - > Basic metabolism – *e.g.* photosynthesis (in *chlorenchyma*), energy storage (pith, cortex)
 - > Can *dedifferentiate* and *redifferentiate* -- *e.g.* wound healing
 - > Transfer cells -- invaginated outer walls -- *e.g.* phloem parenchyma

B. COLLENCHYMA

1. Like parenchyma, but thicker 1° walls with thickened corners (shadowy appearance)
2. Function:
 - > flexible strength for elongating tissues, especially stems
 - > Is enhanced by mechanical stress --e.g. shaking, wind
3. Personal contact: celery "strings" are composed of collenchyma

C. SCLERENCHYMA

1. Thick-walled cells; lignified, except *soft fibers* (see below); dead at maturity
2. Provide rigid support for non-elongating tissues
3. *Sclerids* form the hard layers of seed coats, nuts, pear fruit (endocarp)
4. Fibers (x-sec. and l. sec.) are elongated sclerenchyma cells associated with vascular tissue
 - > *Soft fibers -- nonlignified as in flax phloem fibers -> linen
 - > Hard fibers -- lignified as in hemp for making twine and rope

II. COMPLEX TISSUES – those with multiple cell types as follows:

A. DERMAL TISSUE -- Epidermal covering of primary plant body

1. Functions
 - a. Protection -- against water loss, herbivory
 - b. Secretion -- of cuticle and wax
 - c. Absorption -- of water and minerals (*i.e.* root hairs)
 - d. Gas Exchange -- via guard cells
 - e. Cellular recognition -- of presence of pathogens, or pollen grains on stigma
 - f. Prevents organs from “grafting” to one another during apical development
2. *Cuticle*
 - a. Covers epidermis and reduced evaporative water loss
 - b. Composed of *cutin* and *epicuticular wax*
3. *Guard Cells* -- paired epidermal cells that form *stomata* (pores)
 - a. Regulate the size of stomates to regulate exchange of CO₂, O₂, H₂O
 - b. Respond to environmental cues that would cause water loss
 - c. Stomata are also sites of pathogen invasion
4. *Trichomes* -- single- or multicellular outgrowths of the epidermal cells
 - a. *Root hairs* absorb nutrients and water
 - b. *Leaf hairs* protect from herbivory; capture/digest insect prey
 - c. Personal contact -- cotton (seed trichomes), stinging nettle; fragrances

- C. VASCULAR TISSUE -- functions in long-distance transport via two components:
1. Xylem -- conducts water and dissolved nutrients
 2. Phloem -- conducts sugars and other organic compounds
- D. Xylem
1. Two developmental types
 - a. Primary xylem -- differentiates from procambium (derived from meristems)
 - b. Secondary xylem -- differentiates from vascular cambium
 Note: *vascular cambium* arises from *latent procambium* and *interfascicular cambium*
 2. Composition -- tracheids, xylem vessels (Magnoliophyta), fibers, rays, parenchyma
- E. Phloem
1. Two developmental types as with xylem
 - a. Primary phloem -- differentiates from procambium
 - > Protophloem -- phloem formed in elongating regions
 - > Metaphloem -- phloem formed after elongation stops
 - b. Secondary phloem -- differentiates from vascular cambium
 2. Composition:
 - a. Sieve elements -- either sieve cells (primitive?) or sieve tube members
 - b. Accessory cells -- albuminous cells (primitive?) or companion cells
 - c. Other -- transfer cells (parenchyma), fibers, rays
- F. Secretory Structures
1. Nectaries -- secrete sugary exudate to attract...
 - a. Animal pollinators
 - b. Animal protectors
 2. Hydathodes -- modified stomata that release excess water from leaves
 3. Digestive glands -- secrete digestive enzymes; carnivorous plants
 4. Salt glands -- in plants of saline environments; secrete salts
 5. Canals, ducts, cavities, or lactifers -- oils, resins, or latex to provide...
 - a. Protection from herbivores
 - b. Healing from wounds