PowerLecture:
Chapter 29
Plant Tissues
Section 29.0: Weblinks and InfoTrac

See the latest Weblinks and InfoTrac articles for this chapter online or click highlighted articles below (articles subject to change)

- Section 29.0: Drought—A Paleo Perspective
- Section 29.0: NOAA Drought Information Center
- Section 29.0: National Drought Mitigation Center
- Section 29.0: How the Akkadian Empire Was Hung out to Dry. Ann Gibbons. *Science,* Aug. 20, 1993.
- Section 29.0: Cultural Responses to Climate Change during the Late Holocene (Mayans, Akkadians, etc.). Peter deMenocal. *Science,* Apr. 27, 2001.

How Would You Vote?

The following is the question for this chapter. See national results below.

Should farmers' water allotments be cut to supply urban areas?

Impacts, Issues: Drought Versus Civilization

- Drought – significantly less rainfall than expected in a given region
- Bad droughts have crippled civilizations throughout history
- Akkadian civilization in northern Mesopotamia experienced a 200 year drought – and collapsed
- Mayan civilization suffered from a 150 year drought - and collapsed
- Afghanistan's recent drought – the worst in 100 years – has wiped out crops and livestock, bringing desperation to the region

Impacts, Issues: Drought Versus Civilization

- During even a brief drought, plants conserve water by closing their stomata, reducing photosynthesis
- Plants produce fewer flowers that may not open all the way, leaving them unfertilized
- To comprehend how drought affects plants, we must understand plant physiology

Section 29.1: Weblinks and InfoTrac

See the latest Weblinks and InfoTrac articles for this chapter online or click highlighted articles below (articles subject to change)

- Section 29.1: Botany Basics

- Section 29.1: Virtual Crops Project

- Section 29.1: Restoration of Juvenility in Maize Shoots by Meristem Culture. Erin Irish et al. *International Journal of Plant Sciences,* Sept. 1998.

Mount Saint Helens Eruption

- Volcano is located in southwestern Washington state
- In 1980 it erupted, blowing 500 million metric tons of rock and ash outward
- Ash and lava devastated about 40,500 acres of what had been forest

Recovery

- Plants moved into the empty habitat almost immediately
- Fireweed and blackberry were early colonists
- In less than ten years, willow and alders were on the scene

Success of the Angiosperms

- The angiosperms are seed-bearing vascular plants
- In terms of distribution and diversity, they are the most successful plants on Earth
- The structure and function of this plant group help explain its success

Shoots and Roots

- Shoots
  - Produce food by photosynthesis
  - Carry out reproductive functions
- Roots
  - Anchor the plant
  - Penetrate the soil and absorb water and dissolved minerals
  - Store food

Angiosperm Body Plan

Monocots and Dicots:

Section 29.2: Weblinks and InfoTrac

See the latest Weblinks and InfoTrac articles for this chapter online or click highlighted articles below (articles subject to change)

- Section 29.2: Plant Anatomy Laboratory

- Section 29.2: Methods in Plant Histology

- Section 29.2:Evolution of Water Transport and Xylem Structure. John Sperry. *International Journal of Plant Sciences,* May 2003.

Simple Tissues
Made up of only one
type of cell

Parenchyma
Collenchyma
Sclerenchyma
Cutting Specimens
Parenchyma: A Simple Tissue

- Most of a plant's soft primary growth
- Pliable, thin walled, many sided cells
- Cells remain alive at maturity and retain capacity to divide
- Mesophyll is a type that contains chloroplasts

Collenchyma: A Simple Tissue

- Specialized for support for primary tissues
- Makes stems strong but pliable
- Cells are elongated
- Walls thickened with pectin
- Alive at maturity

Collenchyma: A Simple Tissue

- Supports mature plant parts
- Protects many seeds
- Thick, lignified walls
- Dead at maturity
- Two types:
  - Fibers: Long, tapered cells
  - Sclereids: Stubbier cells

Complex Tissues
Composed of a mix of cell types

Xylem
Phloem
Epidermis
Xylem

Phloem:
A Complex Vascular Tissue

- Transports sugars
- Main conducting cells are sieve-tube members
- Companion cells assist in the loading of sugars

Epidermis:
A Complex Plant Tissue

- Covers and protects plant surfaces
- Secretes a waxy, waterproof cuticle
- In plants with secondary growth, periderm replaces epidermis

Section 29.3: Weblinks and InfoTrac

See the latest Weblinks and InfoTrac articles for this chapter online or click highlighted articles below (articles subject to change)

- Section 29.3: Authorware Teaching Module—Stems

- Section 29.3: Better Bent than Broken (use of flexible materials in nature). Steven Vogel. *Discover,* May 1995.

Meristems

- Regions where cell divisions produce plant growth
- Apical meristems
  - Lengthen stems and roots
  - Responsible for *primary* growth
- Lateral meristems
  - Increase width of stems
  - Responsible for *secondary* growth

Apical Meristems

Tissue Differentiation

Protoderm
Ground meristem
Procambium

Lateral Meristems

- Increase girth of older roots and stems
- Cylindrical arrays of cells

Shoot Development

Tissue Differentiation

Vascular cambium
Cork cambium

Internal Structure of a
Dicot Stem

- Outermost layer is epidermis
- Cortex lies beneath epidermis
- Ring of vascular bundles separates the cortex from the pith
- The pith lies in the center of the stem

Internal Structure of a Monocot Stem

Section 29.4: Weblinks and InfoTrac

See the latest Weblinks and InfoTrac articles for this chapter online or click highlighted articles below (articles subject to change)

- Section 29.4: Manual of Leaf Architecture:

- Section 29.4: The Leaf

- Section 29.4: Power Plants (leaf growth & physiology). John Dale. *The Sciences,* Sept.–Oct. 1994.

- Section 29.4: A World of Leaves: Familiar Forms and Surprising Twists. Kjell Sandved et al. *Smithsonian,* Apr. 1985.

Common Leaf Forms
Adapted for Photosynthesis

- Leaves are usually thin
  - High surface area-to-volume ratio
  - Promotes diffusion of carbon dioxide in, oxygen out
- Leaves are arranged to capture sunlight
  - Are held perpendicular to rays of sun
  - Arranged so they don't shade one another

Leaf Structure

Mesophyll:
Photosynthetic Tissue

- A type of parenchyma tissue
- Cells have chloroplasts
- Two layers in dicots
  - Palisade mesophyll
  - Spongy mesophyll

Leaf Veins: Vascular Bundles

- Xylem and phloem; often strengthened with fibers
- In dicots, veins are netlike
- In monocots, they are parallel

Section 29.5: Weblinks and InfoTrac

See the latest Weblinks and InfoTrac articles for this chapter online or click highlighted articles below (articles subject to change)

- Section 29.5: Stem and Root Anatomy

- Section 29.5: Root Images

- Section 29.5: Journey to the Bottom of a Tree. Gary Watson et al. *American Forests,* Sept.–Oct. 1989.

- Section 29.5: Miracle Plants Withstand Flood and Drought. Don Comis. *World and I,* Feb. 1998.

Root Systems

Root Structure

- Root cap covers tip
- Apical meristem produces the cap
- Cell divisions at the apical meristem cause the root to lengthen
- Farther up, cells differentiate and mature

Internal Structure of a Root

- Outermost layer is epidermis
- Root cortex is beneath the epidermis
- Endodermis, then pericycle surround the vascular cylinder
- In some plants, there is a central pith

Function of Endodermis

- Ring of cells surrounds vascular cylinder
- Cell walls are waterproof
- Water can only enter vascular cylinder by moving through endodermal cells
- Allows plant to control inward flow

Root Hairs and Lateral Roots

- Both increase the surface area of a root system
- Root hairs are tiny extensions of epidermal cells

- Lateral roots arise from the pericycle and must push through the cortex and epidermis to reach the soil

Section 29.6: Weblinks and InfoTrac

See the latest Weblinks and InfoTrac articles for this chapter online or click highlighted articles below (articles subject to change)

- Section 29.6: The EcoTree
- Section 29.6: The University of Trees
- Section 29.6: Why Woodiness? Kathryn Brown. *Natural History,* Dec. 1999.
- Section 29.6: Bonsai: A Way of Looking at Trees with Different Eyes. Ogden Tanner. *Smithsonian,* Oct. 1989.

Secondary Growth

- Occurs in all gymnosperms, some monocots, and many dicots
- A ring of vascular cambium produces secondary xylem and phloem
- Wood is the accumulation of these secondary tissues, especially xylem

What Happens at
Vascular Cambium?

- Fusiform initials give rise to secondary xylem and phloem
- Ray initials give rise to horizontal rays of parenchyma

Secondary Growth

Section 29.7: Weblinks and InfoTrac

See the latest Weblinks and InfoTrac articles for this chapter online or click highlighted articles below (articles subject to change)

- Section 29.7: Ultimate Tree-Ring Web Page

- Section 29.7: Inside Wood
- Section 29.7: The Anatomy of Wood
- Section 29.7: The WVU Tree Bark Web Page
- Section 29.7: Andrew Ellicott Douglass and the Big Trees (tree-ring dating). *American Scientist,* Sept. 2000.
- Section 29.7: Secrets of Bark. Dwight Smith. *World and I,* Mar. 2004.
- Section 29.7: How Wood Characteristics Affect Finishing (wood as a biological product). Daniel Cassens. *Industrial Paint & Powder,* Mar. 2003.

Formation of Bark

- All tissues outside vascular cambium
- Periderm
  - Cork
  - New parenchyma
  - Cork cambium
- Secondary phloem

Annual Rings

- Concentric rings of secondary xylem
- Alternating bands of early and late wood
- Early wood
  - Xylem cells with large diameter, thin walls
- Late wood
  - Xylem cells with smaller diameter, thicker walls

Types of Wood

- Hardwood (oak, hickory)
  - Dicot wood
  - Xylem composed of vessels, tracheids, and fibers
- Softwood (pine, redwood)
  - Gymnosperm wood
  - Xylem composed mostly of tracheids
  - Grows more quickly