Chapt. 35 – Plant Structure, Growth & Development

Flowering plants: 2 main groups: **Monocots** and **Eudicots** **[See Fig. 30.12]**

Monocot (*e.g.*, corn) **seedlings** each have 1 **cotyledon** (**seed leaf**);
in **monocots** the **cotyledon** often remains within the confines of the **seed**

Eudicot (*e.g.*, bean & peanut) **seedlings** each have 2 **cotyledons** (**seed leaves**)

ORGAN SYSTEMS OF FLOWERING PLANTS **[See Fig. 35.2]**

Root System

Primary root – first to appear

Eudicot – Taproot system
Monocot – Fibrous root system

Root hairs are extensions of **epidermal cells**
Root hairs dramatically increase a root's surface area for absorbing water and nutrients

Food storage is a function of all roots, but some (*e.g.*, carrot taproots) are highly modified for storage
Aboveground (aerial or prop) roots give extra support
"Breathing" roots conduct oxygen to waterlogged roots
The roots of many orchids are photosynthetic

Shoot System

Some plants (*e.g.*, baobab tree, saguaro cactus) have specialized **water-storage stems**
Stolons ("runners") are horizontal, wandering, aboveground stems (*e.g.*, strawberries)
Rhizomes (*e.g.*, edible base of a ginger plant) are horizontal, belowground stems
Tubers (*e.g.*, potatoes, yams) are the swollen ends of rhizomes, specialized for food storage
Bulbs (*e.g.*, onions) are vertical, underground stems consisting mostly of the swollen bases of leaves specialized to store food
Thorns are rigid, sharp branches that deter potential herbivores (especially mammalian browsers)

Terminal buds generally exercise **apical dominance** over **axillary buds**

Simple vs. **compound leaves** **[See Fig. 35.6]**

Some arid-adapted plants have **succulent leaves**
Leaves specialized into **spines** help defend against herbivores

Tendrils are specialized leaves or stems that twist around structures to lend support
Leaves specialized to trap animals occur in **carnivorous plants**
Leaf hairs (trichomes) help reduce water loss and provide some protection against herbivores

Undifferentiated meristematic cells occur in **buds**

Whole plant growth is **indeterminate**, but growth of some organs is **determinate**

When a cell divides, the daughter cells grow… and they may **differentiate (specialize)**, depending especially on where they are located during **development**

Differentiated cells contribute to **3 tissue systems [See Fig. 35.8]**

Dermal tissue (epidermis)

Generally a single cell layer that covers the plant
Absorption in root system
Water retention in shoot system, aided by **waxy cuticle**

Vascular tissue [See Fig. 35.9]

Xylem – transports water and dissolved minerals
Cells are dead at functional maturity
Phloem – transports sugars dissolved in water
Cells are alive at functional maturity

Ground tissue

All non-epidermal, non-vascular tissue
Three principal cell types:

Parenchyma
Thin-walled, live cells
Perform most metabolic functions of plant
photosynthesis, food storage, synthesis and secretion

Collenchyma
Cells with unevenly thickened walls that lack lignin
Alive at maturity
Grouped into strands or cylinders to aid support without constricting growth

Sclerenchyma
Very thick walls, hardened with **lignin**
Dead at maturity
Give strength and support to fully grown parts of the plant

Fibers occur in groups
Sclereids impart hardness to nutshells and the gritty texture to pears

Primary growth in **roots [See Fig. 35.12]**

Primary growth in roots lengthens roots from the tips
The **root cap** continually sloughs off
The **apical meristem** produces three **primary meristems**
The cells are produced… then elongate, and finally mature & differentiate
Protoderm cells become the **epidermis**
Ground meristem cells become the **cortex**
Procambium cells become the vascular **stele**

Pericycle
Outermost layer of **stele**
These cells retain meristematic capabilities, and can produce **lateral roots**

Endodermis
Innermost layer of **cortex**
These cells regulate the flow of substances into the vascular tissues of the **stele**
Casparian strip disallows flow of substances except through the endodermal cells themselves

Primary growth in **shoots [See Fig. 35.15]**
Primary growth in shoots lengthens shoots from the tips
The **apical meristem** produces the same three **primary meristems** as in the roots: **Protoderm, Ground meristem, Procambium**
Leaves arise from **leaf primordia** on the flanks of the **apical meristem**
Axillary buds (that could produce **lateral branches**) develop from islands of **meristematic cells** left at the bases of **leaf primordia**
Procambium cells develop into **vascular bundles [See Fig. 35.16]**
E.g., The "**veins**" in leaves **[See Fig. 35.17]**
Protoderm cells develop into **epidermis**
Some epidermal cells are **guard cells** surrounding **stomata**
Ground meristem cells develop into **ground tissues**
In **dicot stems** these are the **pith** and **cortex**

Secondary growth in **stems [See Fig. 35.18]** a.k.a "Girth growth"

Primary growth at a branch tip lays down **apical** and **axillary meristems** for further lengthening, as well as a **lateral meristem**: the **vascular cambium**

The **vascular cambium** produces **secondary xylem** to the inside and **secondary phloem** to the outside

A second **lateral meristem** develops from the **cortex**: the **cork cambium**

Cork cambium produces **cork cells** that replace the **epidermis**

As the **stem** continues to expand its girth, the tissues outside the **cork cambium** rupture and slough off

As the **stem** continues to expand its girth, the **cork cambium** reforms in deeper layers of **cortex** tissue, and then in **secondary phloem** when the primary **cortex** is gone

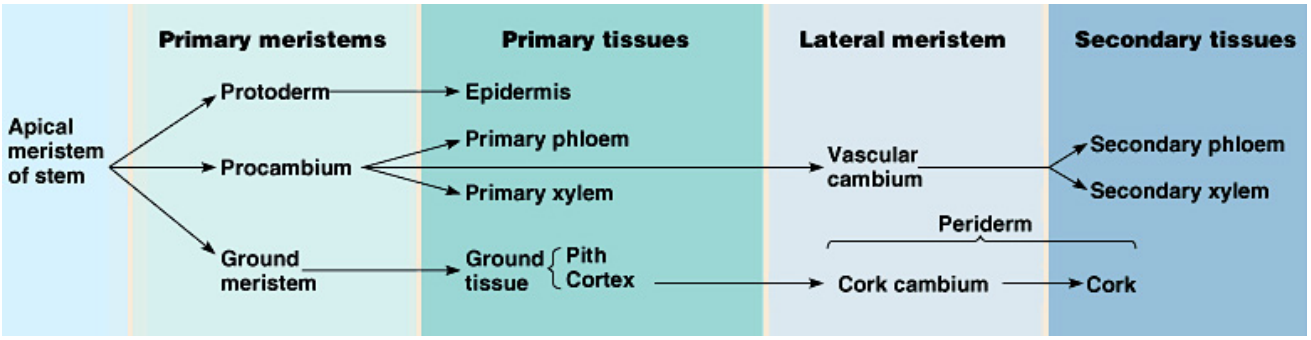
Periderm: **Cork cambium** and **cork** **[Fig. 35.22]**
Bark: All tissue outside **vascular cambium**

What is "**wood**"? **[See Fig. 35.20]**

wood = secondary xylem
Heartwood: No longer conducts water, but strengthens stem
Sapwood: Conducts water and minerals

Why do trees have **rings**?
Seasonal differences in the rate of xylem production produce annual rings

Summary of 1^o and 2^o growth in a woody stem



Growth – increase in mass by **cell division** and **cell expansion**
Differentiation – **specialization**
Morphogenesis – the development of body form and organization
Development – all the changes that progressively produce an organism's body (growth, differentiation, *etc*.)

If all cells of a body contain the same set of genes, how do they differentiate, and how does morphogenesis occur? **Differential expression** of **genes** and differences in the **environment** each cell experiences. For example, **positional information** determines whether the cells produced by an **apical meristem** become **protoderm, ground meristem, or procambium**.

Every step in **development** requires input from both **genes** and the **environment**!