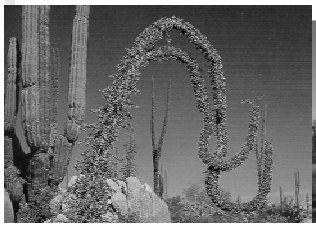
Next few lectures are on *plant form and function*

Today: Plant Structure

Exam II is on F March 31



Outline – Plant structure

I. Plant Cells – structure & different types

II. Types of meristems

- Apical meristems: primary growth
- Lateral meristems: secondary growth

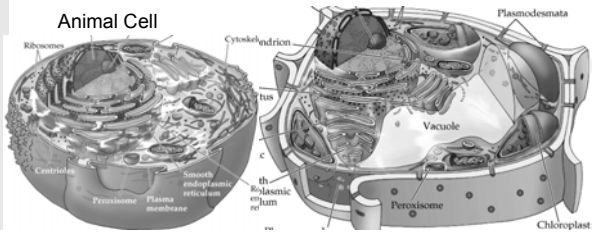
III. Tissues in cross sections

IV. Leaves: regulation of gas exchange and water loss

Plant Cells: Distinguishing features (Ch. 4 – refresher)

- Chloroplasts - photosynthesis
- Vacuoles - sacs of liquid
- Cellulose cell wall

Animal Cell



Plant Cell Walls

- Neighboring cells are glued together: **middle lamella**
- **Primary cell wall** - **cellulose** as the cell grows
- **Secondary cell wall –** cellulose impregnated with **lignin** or **suberin**:

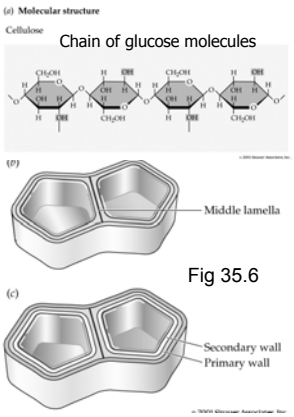
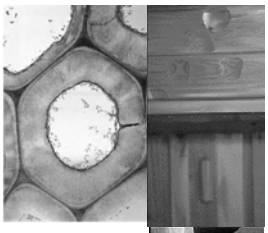


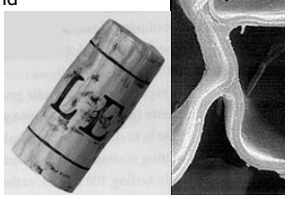
Fig 35.6

Secondary Cell Walls

Some cells produce a thick secondary wall. Contains:

- **Lignin -** is **hard** and **woody**.
- Or **suberin**, which is **corky** and **waterproof**.

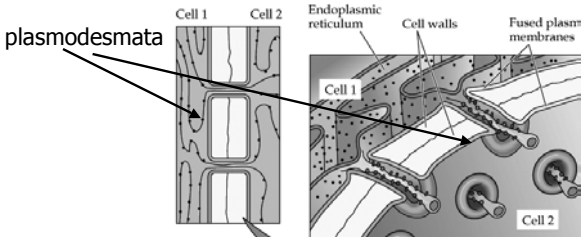




Plant Cell Walls

- **Plasmodesmata: thin spots** where **strands of cytoplasm** pass through the cell walls
- Allows direct communication between neighboring cytoplasms.

Fig 35.7



Plant Cell Walls

- **Pits -** interruptions of the secondary wall for plasmodesmata

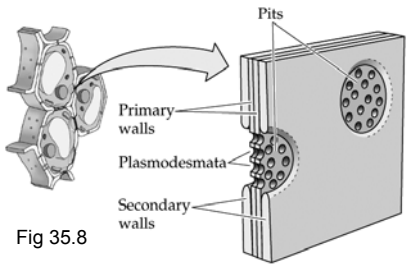


Fig 35.8

Common Plant Cell Types

There's several types of plant cells – each with different structures and functions

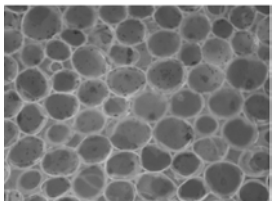
1. Parenchyma
2. Collenchyma
3. Sclerenchyma

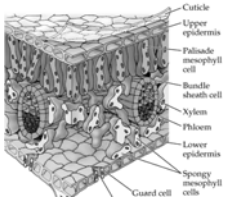
4. Xylem (tissues)
5. Phloem

Common Plant Cell Types

(1) Parenchyma cells have thin cellulose walls with **no secondary wall.**

- Green cells - photosynthesis in leaves.
- Function when **alive**

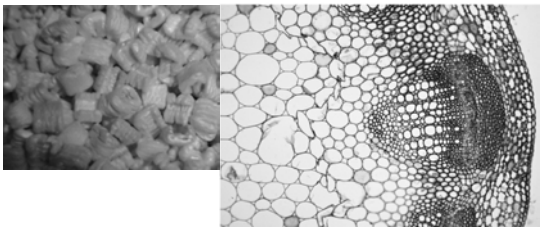




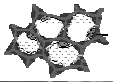
Common Plant Cell Types

Parenchyma

- Photosynthetic
- Storage (starch or lipids.)
- Some bulk/structure

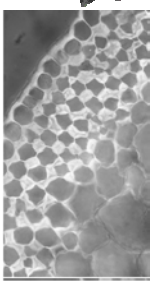


Common Plant Cell Types



(2) Chollenchyma cells:
have primary walls with thick corners (no secondary wall).

- Usually long and narrow.
- Function when alive



Common Plant Cell Types

Chollenchyma

- "**Flexible support**", e.g., leaf stalks, non-woody stems
- Support for **young growing organs**
  E.g., Celery "strings"

Common Plant Cell Types

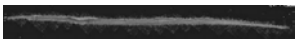
(3) Sclerenchyma cells:
have thick, often **lignified** **secondary** walls.

- Greek *skleros* = **"hard"**
- Usually **dead** at maturity when functioning
- Rigid support

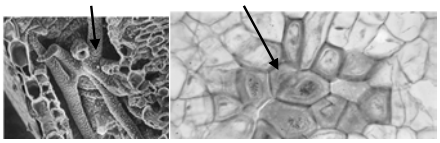
Common Plant Cell Types

Sclerenchyma

- Strengthen tissues that have ceased growing.
- Two kinds:
  - Fibers- long thin, e.g., flax or hemp fiber, bark



  - Sclereids- shorter, may be branched, e.g., shells of nuts, peach pit, grit in pears



Plant Cells

Vascular plants have specialized conducting tissues:

(4) Xylem for water transport

(5) Phloem for sugar and nutrient transport

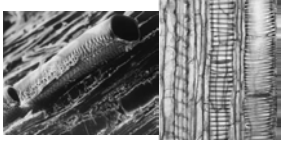
Plant Cells

(4) Xylem for water transport

- Move water roots → aboveground
- Function when dead

2 kinds:

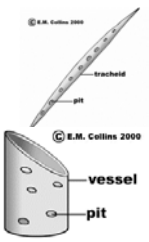
- **Tracheids** and **vessel elements**



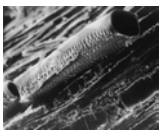
Plant Cells

Tracheids and **vessel elements** - lignified secondary walls.

- **Tracheids** connected with **pits**
  - found in all vascular plants



- **Vessel elements** have **big holes.**
  - restricted to angiosperms.



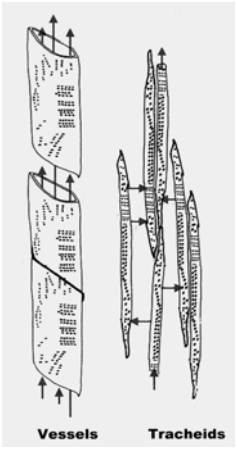
Plant Cells

Vessel elements:

- stack to form long open tubes
- A bubble will ruin the whole tube

Tracheids:

- pits block even the smallest bubble
- damage is localized to only one cell.

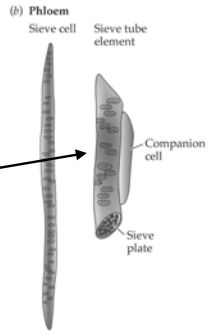


Plant Cells

(5) Phloem for moving sugars around.

- Transport carbohydrates and nutrients
- Function when living:

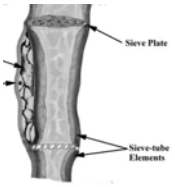
Sieve tube elements

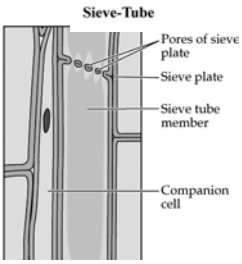


Plant Cells

(5) Phloem

- **Sieve tubes** stack end to end forming a long tube.
- **Companion cells** regulate it:
  Linked by plasmodermata
  Retain organelles





Review of Plant Cells

Which of the following is most correct?

a. Only the primary cell walls are made of cellulose
b. Only the secondary cell walls are made of cellulose
c. Only the primary cell walls contain lignin or suberin
d. Only the secondary cell walls contain lignin or suberin

Review of Plant Cells

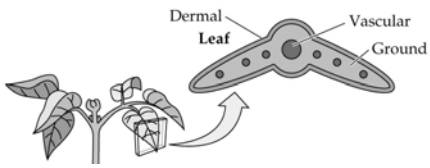
- **Which cells function when dead?**
- **Which cells provide flexible support?**

•Parenchyma
•Chollenchyma
•Sclerenchyma

Plant Tissues and Tissue Systems

3 tissue systems in plants:

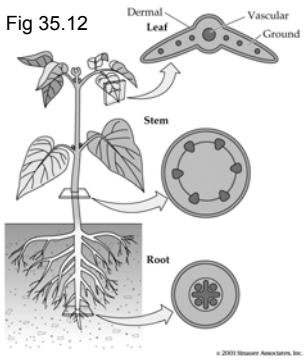
- vascular tissue
- dermal tissue
- ground tissue



Plant Tissues and Tissue Systems

- Vascular tissue:
  conducts water, minerals, and the products of photosynthesis.
- Dermal tissue:
  protects the body surface.
- Ground tissue:
  produces and stores food

Fig 35.12



Forming the Plant Body

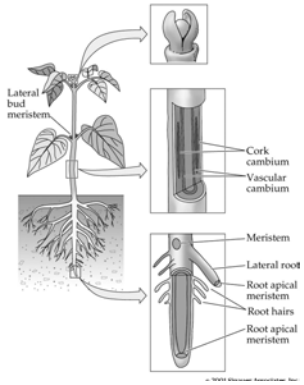
Plants grow from localized regions: **meristems** where cells divide.

- **apical meristems**

Growth of the **primary plant** body

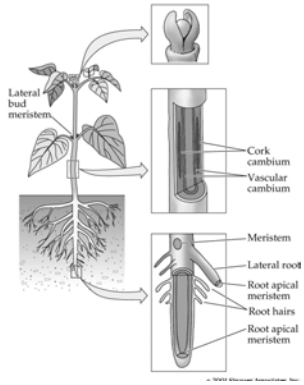
- **lateral meristems**

Growth of the **secondary plant** body



Forming the Plant Body

- **Root** and **shoot apical meristems** give rise to the <u>entire plant body</u> of herbaceous plants.
- **<u>Woody plants</u> show secondary growth.** Secondary 'body' is wood and bark



Apical meristems

- Plants grow only vertically from these growing tips:
  - Hammer a nail 5 feet from the ground into a 10 ft. sequoia sapling.
  - In a thousand years when the tree is 300 ft., how high will the nail be?

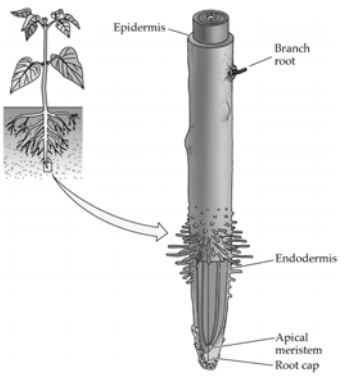
Apical meristems

Give rise to:

- Roots
- Shoots
- Plant organs

Roots

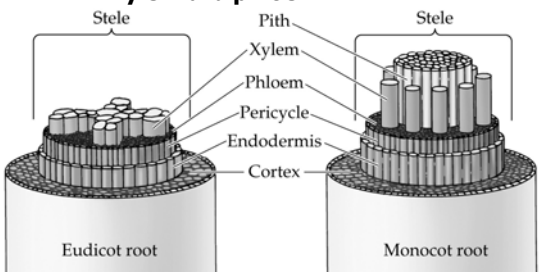
- Root cap
- Root hairs
- Epidermis
- Mycorrhizae are associated with epidermis and root hairs



Roots

- The **cortex** – food storage
- **Endodermis** – waterproof layer keeps water from moving inside without passing through the cytoplasm.
- **Xylem** and **phloem**

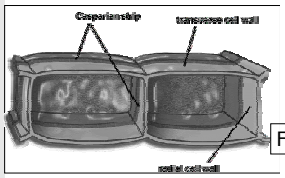
Fig 35.17



Roots – Water uptake

Casparian strip – Suberin

- Makes waterproof ring
- Water cannot go between cells
- Osmotic Regulation



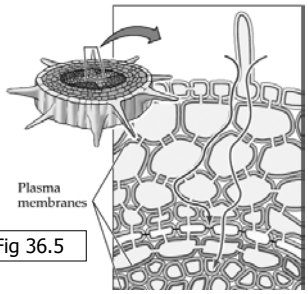
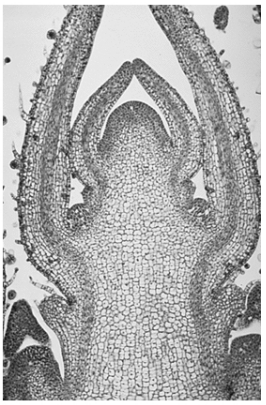


Fig 36.5

Shoots

The **shoot apical meristem** gives rise to **leaf primordia:**

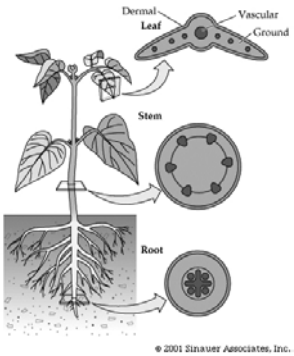
- **Leaves** and
- **buds**



Shoots

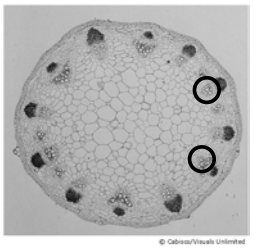
Vascular tissue:
Roots - the center

Young stems –
<u>bundles in a ring or scattered</u>.

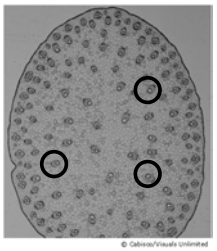


Shoots

Eudicot



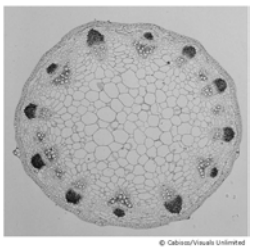
Monocot



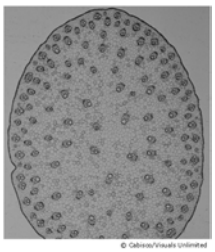
Vascular tissue is in bundles in a ring or scattered. (Fig 35.18)

Shoots

Eudicot



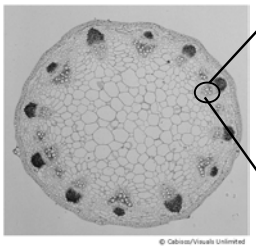
Monocot

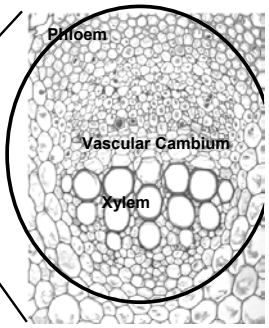


Rest is **parenchyma** ~~with some~~ **strengthening**
collenchyma ~~around the outside.~~ **storage**

- **Epidermis** secretes a **waxy cuticle**

Shoots

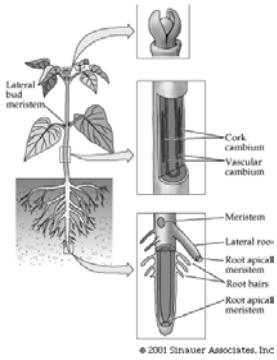




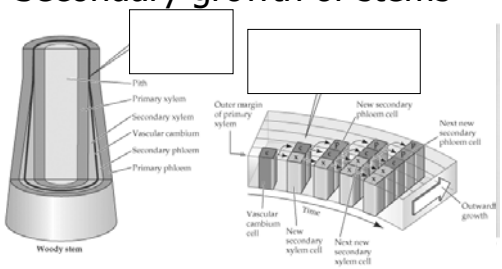
- Vascular <u>bundle</u> of a young eudicot stem
- **<u>Primary growth</u>**: growth from apical meristems

Lateral Meristems → secondary growth of stems

- Thicken to **wood** and **bark**
- This is **<u>secondary growth</u>** resulting from the two lateral meristems: **vascular** and **cork cambium.**



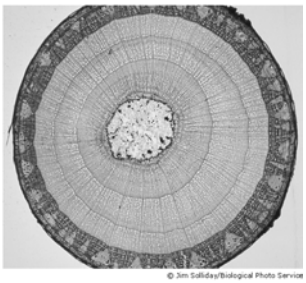
Secondary growth of stems



- **Vascular cambium** in the vascular bundles becomes a **continuous cylinder**
- **secondary xylem** to the inside
- **secondary phloem** to the outside

Secondary growth of stems

- **Secondary xylem:** mostly vessel elements, fibers and parenchyma **<u>WOOD</u>**
- **Secondary phloem:** mostly sieve tubes members, companion cells, fibers and parenchyma part of **<u>BARK</u>**

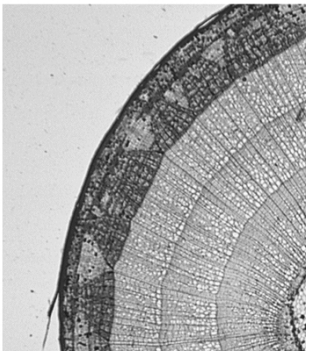


Secondary growth of stems

<u>Annual rings:</u>

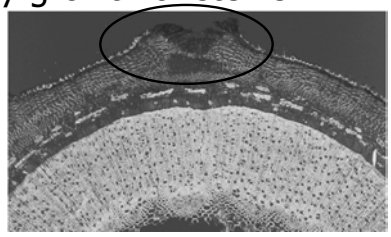
Plants growing in <u>seasonal environments</u> often produce

- **wide, thin-walled** vessels or tracheids in the **spring**
- and **narrower, thick-walled** cells in the **summer.**



Secondary growth of stems

Lenticels

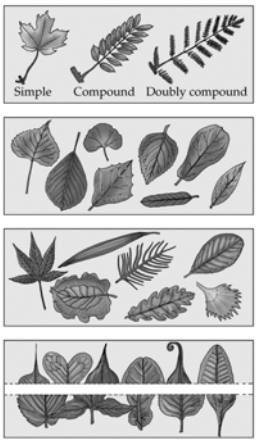


Bark

- Tissues outside the phloem
- The **cork cambium** produces new protective tissue: **Cork** – suberized

Leaves

- **Where photosynthesis occurs**
- Bring together the precursors: H_2O, CO_2.
- Export the products: sugar, O_2.



Leaves

Conflicting needs:

1. Avoid desiccation.
2. Obtain CO2.

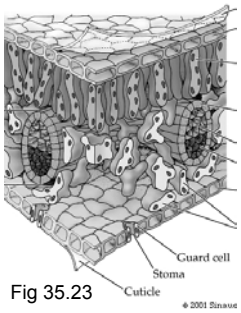


Fig 35.23

- **Epidermis –** Flat cells covered by a waxy cuticle. Good at 1. but not 2.
- **Stomata –** Regulated pores that let CO_2 in

Leaves

Mesophyll –

Green parenchyma where photosynthesis occurs.

Open - easy access for CO_2.

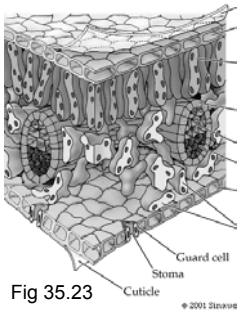


Fig 35.23

Review of Structure

Which meristem causes elongation?
Which meristem causes thickening?

How to leaves balance the conflicting need for CO2 and the negative effects of desiccation?