To understand how plants behave, we need to focus on the units. What do plant cells do? How do they do it?

Outline:
- Cells are dynamic units of life. Cells differ in their shape and function. All cells are derived from meristems. Thus all cells share basic structural and functional traits.
- Structure: What are the subcellular parts? How is each formed?
- Function: What are the major roles of each organelle?
- What are unique structures and functions? Plastid, vacuole, cell wall, cytoskeleton, plasmodesmata

Cells divide, elongate & differentiate
All cells are derived from meristems. Thus all cells share basic structural and functional traits.

There is no “Typical” Plant Cell.

1-4. Plant leaf cell

Membranes
- Regulate passage of ions and nutrients.
- Separate organelles from cytoplasm.
- Generate energy.
Double membrane organelles

- Nucleus
- Mitochondria
- Plastid

- Have 2 membranes
- Contain DNA and RNA
- DNA synthesis and transcription
- Nuc is unique to eukaryotes
- Mitochondria and plastid are of prokaryotic origin

Other Plastids:
- Chromoplast
- Amyloplast
Single membrane organelles

ER- source of other membranes,
membrane and secreted proteins are made here
site of p-lipid synthesis
Golgi- proteins are modified and sorted to destination
synthesis of cell wall material in plants
Vacuole- unique and multifunctional in plants

- Very dynamic- membrane trafficking

Endoplasmic reticulum:
source for other membranes
site of synthesis- p-lipids
membrane proteins
secreted proteins

Golgi and Vesicle mediated transport
A. Proteins synthesized in the ER are
-modified and
-sorted in the Golgi,
-secreted at the PM or delivered to vacuole.
B. Cell wall polysaccharides are synthesized, modified and secreted
to cell wall.

16-13. Shoot apical meristem cells are much smaller than other
cells. Cell expansion is due to vacuole enlargement

Vacuoles
Small in meristem cells.
Large in mature cells, up to 90% of cell volume.

Functions:
1. Needed for cell expansion
2. Transport ions, water, many molecules
   Storage depot- sugar (sugar cane)
4. Recycling center: contains enzymes

Cytoplasm
• Contains most metabolites, ions
• Enzymes for biosynthesis and for breakdown.
  1. Sugar breakdown: glucose 6C ---\rightarrow 2 (3C) sugar
  2. Synthesis of sugars, amino acids, lipid precursors
  3. Synthesis of proteins in cytoplasm
     synthesis of mitochondrial and chloroplast proteins

• An interconnected network of filamentous proteins -cytoskeleton
The cytoskeleton
(Farabee-5)

Actin and tubulin filaments of the cytoskeleton

Dynamic states of Microtubules and Microfilaments

1-25
1-5, Taiz. Plant cell wall:

**Functions:**
cell shape
Support
Protection
Conductance
Cell adherence
Molecules can penetrate
Water & ions flow
Gas can diffuse

Chemical components that make up the cell wall.
Taiz = Table 15-1

<table>
<thead>
<tr>
<th>Wall main components</th>
<th>Primary</th>
<th>Secondary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polysaccharides</td>
<td>90%</td>
<td>65-85%</td>
</tr>
<tr>
<td>Cellulose</td>
<td>30</td>
<td>50-80</td>
</tr>
<tr>
<td>Hemicellulose</td>
<td>30</td>
<td>5-30</td>
</tr>
<tr>
<td>Pectin</td>
<td>30</td>
<td>---</td>
</tr>
<tr>
<td>Proteins</td>
<td>10%</td>
<td>---</td>
</tr>
<tr>
<td>Lignin</td>
<td></td>
<td>15-35</td>
</tr>
</tbody>
</table>

15-4. Model of cell wall

Crystalline array of molecules in a micelle
Cellulose microfibril
Individual cellulose molecules
Cellulose molecules
Polysaccharides (other than cellulose)

Cell Wall Model
= Taiz 15-4 & 15-6

Hydrogen bonding to other cellulose molecules can occur at these points


15-11, 15-12
Pectin is a mixture of polymers. E.g. Gal acid + Rha.
Branched or linear
15-12. Ca ions bridge carboxyl groups of GalA in pectin. Thus pectins act as a glue.

Cellulose microfibrils-SEM

Cellulose microfibrils align with microtubules

How is the primary wall formed?

Pectins and hemicellulose are synthesized in the Golgi, and transported to the cell wall

Cell-cell communication via plasmodesmata

Taiz 15-7. Cellulose microfibrils align with microtubules

Cellulose is synthesized at the plasma membrane

Taiz 1-30. Plasmodesmata connect cytoplasm of adjacent cells.