Primary plant cell wall
Topics

diversity of the plant cell wall
  cell wall structure
  cell wall sugars
molecular model of the cell wall
  orientation of microfibrils
  cellulose synthesis
  antibody techniques in cell wall analysis
  cell growth and the cell wall
  acid growth of the cell wall and expansins
  enzymatic cell wall degradation
Lecture PBPM - Diversity of the plant cell wall: cross section of clover (*Trifolium*)

- Epidermis
- Cortex
- Phloem fibers
- Phloem
- Cambium
- Xylem
- Pith
Lecture PBPM - Plant cell wall structure in the electron microscope (*Trifolium*)

**surface view: fibrils**

**cross section: layers**

- cuticle
- outer wall layers
- inner wall layers
### TABLE 15.1
Structural components of plant cell walls

<table>
<thead>
<tr>
<th>Class</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cellulose</td>
<td>Microfibrils of **(1→4)**β-D-glucan **(1→4)<strong>β-D-glucan [grasses only]</strong></td>
</tr>
<tr>
<td><strong>Matrix Polysaccharides</strong></td>
<td>Homogalacturonan, Rhamnogalacturonan, Arabinan, Galactan, Xyloglucan, Xylan, Glucomannan, Arabinoxylan, Callose (1→3)β-D-glucan, (1→3,1→4)β-D-glucan [grasses only]</td>
</tr>
<tr>
<td>Hemicelluloses</td>
<td>Xyloglucan, Xylan, Glucomannan, Arabinoxylan, Callose (1→3)β-D-glucan, (1→3,1→4)β-D-glucan [grasses only]</td>
</tr>
<tr>
<td>Lignin</td>
<td>(see Chapter 13)</td>
</tr>
<tr>
<td>Structural proteins</td>
<td>(see Table 15.2)</td>
</tr>
</tbody>
</table>

**Starch:**

1,4-α-D-glucose

**Helical structure**
Lecture PBPM - Common sugars of plant cell walls
Lecture PBPM - Schematic diagram of the plant cell wall
Lecture PBPM - Structural model of the plant cell wall: cellulose structure
Lecture PBPM - Structural model of the plant cell wall: cellulose linkage

\[ \beta-1\rightarrow 4 \text{ Glycosidic linkage} \]

Celllobiose repeating unit

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Lecture PBPM - Orientation of microfibrils and the direction of cell growth

(A) Randomly oriented cellulose microfibrils

(B) Transverse cellulose microfibrils
Lecture PBPM - Orientation of cellulose microfibrils

diffuse orientation

parallel orientation
(C) Wall matrix

(1→4)β-glucan chains in a cellulose microfibril

Xyloglucans

Outer leaflet

Cellulose-synthesizing complex

Intemicrotubule bridge

Microtubule

Microtubule bridged to plasma membrane

Cellulose microfibril emerging from rosette

Lipid bilayer of plasma membrane

Cell wall

Microfibril

Inner leaflet
Lecture PBPM - Antibodies for *in situ* cell wall analysis

Cell wall stained in blue by calcofluor

two monoclonal antibodies against different epitopes of pectic homogalcturonan
Lecture PBPM - Structure of a sclereid from *Podocarpus*
Lecture PBPM - Tip growth vs. diffuse growth of plant cells

1. Cell wall grows at tip by introduction of secretory vesicles

2. Marks on cell surface

(A) Tip growth

3. Cell expansion

(B) Diffuse growth
Lecture PBPM - Role of proteins (expansins) in acid growth of plant cell walls

1. Etiolated seedling
2. Excise growing region
3. Freeze, thaw, abrade
4. Inactivate with heat
5. Apply protein to wall
7. Wall specimen
8. Electronic transducer
9. Constant force

Graph:
- Length (%) vs. Time
- Control line
- pH 4.5 buffer line
- Expansin added line

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Lecture PBPM - Mechanism of expansin function in plant cell walls

Diagram showing the interaction between XET, expansins, cross-linking glycans, and cellulose microfibrils.
Lecture PBPM - Enzymatic cell wall degradation in plant/pathogen interaction