Plant Cell Components

I- Cell Wall (extra cellular matrix):

1- Rigid structure that defines shape of cell.
2- Provides rigidity and strength to plants.
3- Allows plants to grow tall and withstand forces such as wind & gravity.
4- Allows cells to build up internal (turgor) pressure which adds stiffness to cell/plant.

Primary & Secondary Cell Walls (CW):
1- All cells have primary CW
2- Some mature cells develop secondary cell wall.

Cell plate:

The cell plate is a thin layer of largely pectic materials laid down across the phragmoplast, the microtubular structure that forms midway between the two nuclei and disassembling spindle during cytokinensis. The cell plate grows in the region of the phragmoplast where the ends of the microtubules overlap and eventually is in continuity with the already existing wall. Cell plate formation consists of the creation of a plate like membranous network that is derived from the fusion of Golgi-derived vesicles in the equatorial plane. As more pectic substances are synthesized by the dictyosomes (Golgi apparatus) and transported to the cell plate in vesicles, the cell plate is transformed into the middle lamella.

The middle lamella:

Acts as an intercellular to bind the walls of daughter cells together. It is regarded as the first true cell wall layer. This layer consists largely of highly hydrated, pectinaceous substances and can be identified as an extremely thin layer between two adjacent cells. The middle lamella is optically isotropic, which means that it is composed of substances having the same optical properties along all axes.

The Primary Wall:

The primary wall is the first readily visible layer of the cell wall, and its formation accompanies extension growth. It develops on either side of the middle lamella when two cells are adjacent and largely determines cell shape and size during plant growth and development. It is composed of a continuous interconnected, fortifying system of aggregated, threadlike cellulosic microfibrils that result from the simultaneous polymerization and crystallization of cellulose molecules.

Primary Cell Walls are made of:

1) Cellulose (linear chains of glucose) , ~ 30% dry weights
2) Hemicelluloses (branched matrix of complex polysaccharides), ~25% dry weight

3) Pectin (branched polysaccharides (rich in galactose), ~35% dry weight, and principally in middle lamella between cells.
4) Extension (glycoprotein's that form rod-like structures) , ~ 10% dry weights.

Secondary Cell Wall

Some cells, particularly those with strengthening and supporting functions, continue to add wall material inside the primary wall during cell expansion before the cell has reached its final size. This additional wall material is called the secondary wall and is represented by the further deposition of cellulose upon the primary wall. The cellulose microfibrils are laid down by successive deposition of layer upon layer in a process known as **apposition**. The proportion of cellulose in secondary walls is typically higher than in primary walls. Secondary walls also are strongly anisotropic.

Secondary Cell Walls are:

• Deposited after cells have stopped growing.

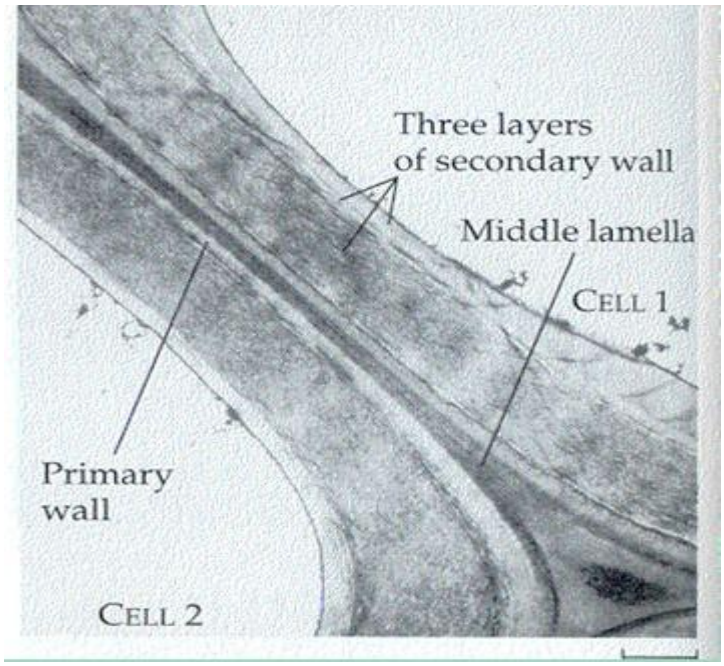
• Cellulose microfibrils are oriented (not random)

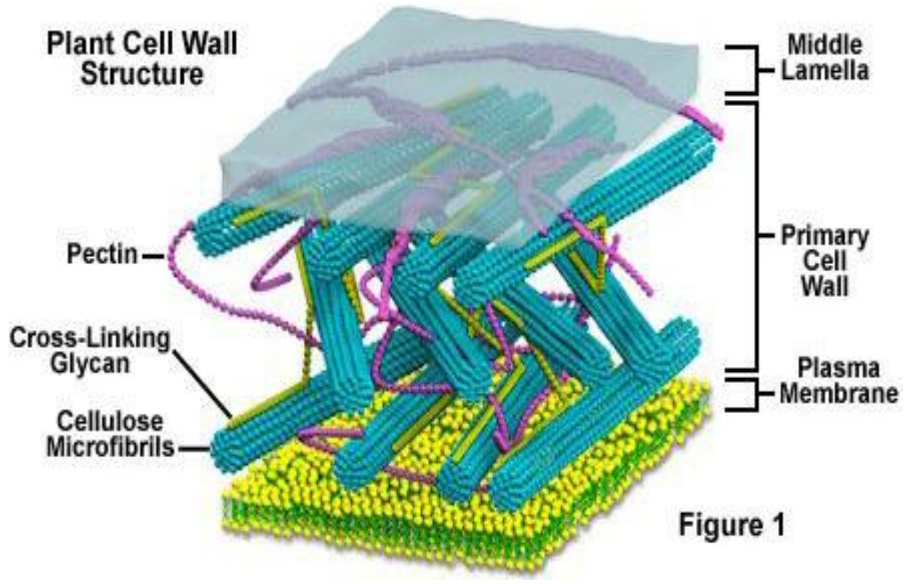
• Composition is different from Primary CW

• More rigid than Primary CW

• Allows for specialized structures.

Secondary Cell Walls are made of:
1) Cellulose, ~45% dry weight
2) Hemicelluloses, ~10% dry weight
3) Lignin, ~35% dry weight
- Branched phenolic compounds
- Stronger than cellulose
4) Extension, ~10% dry weight





Plant Cell wall Structure

Plasmodesmata

The primary walls of plant cells are traversed by microscopic strands of cytoplasm called plasmodesmata that form a unique mode of communication between neighboring cells. Plasmodesmata consist of membranes and proteins in the form of structurally complex membrane-lined pores that form cytoplasmic bridges between adjacent cells. Plasmodesmata play an important role in establishing and regulating short-distance cell-to-cell communication. Collectively they form an integrated cytoplasmic system throughout the plant body, from the early stages of embryo development to plant maturity.

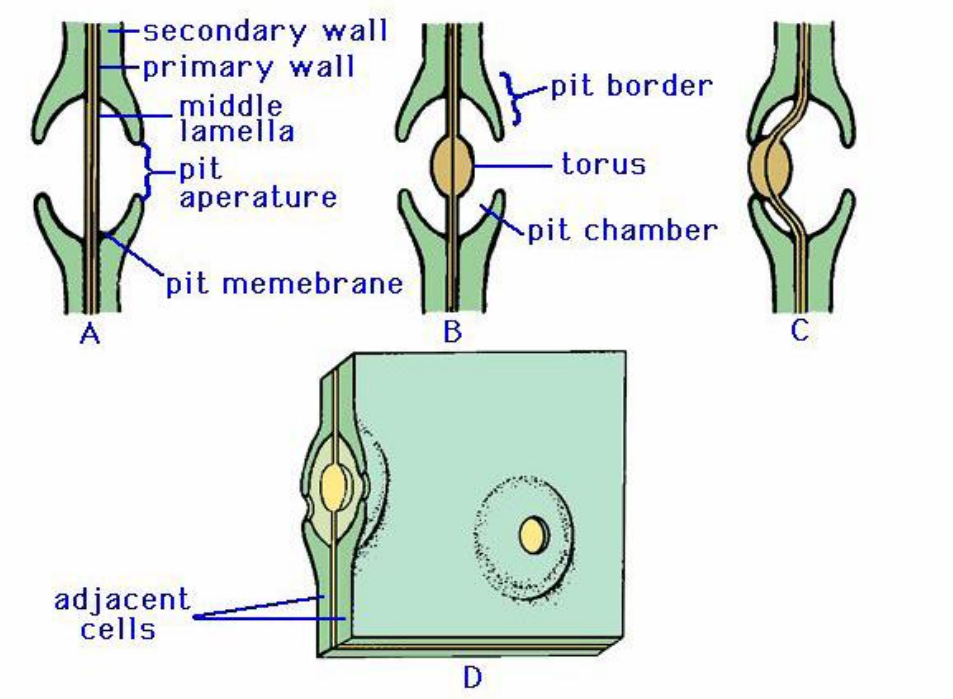
Pits and primary pits-fields

Secondary cell walls are commonly characterized by the presence of cavities called **pits.** A pit in a cell wall usually occurs opposite a pit in the wall of an adjoining cell, and the two opposing pits constitute a **pit-pair**. The middle lamella and the two primary walls between the two pit cavities are called the **pit membrane**. Pits are result from differential deposition of secondary wall material; none is deposited over the pit membrane so that the pits are actual discontinuities in the secondary wall. Whereas secondary walls have pits, primary walls have **primary pits**, which are thin areas, not interruptions, in the primary wall. In this book the term **primary pit-field.** During the deposition of the secondary wall, the pits are formed over the primary pit-fields.

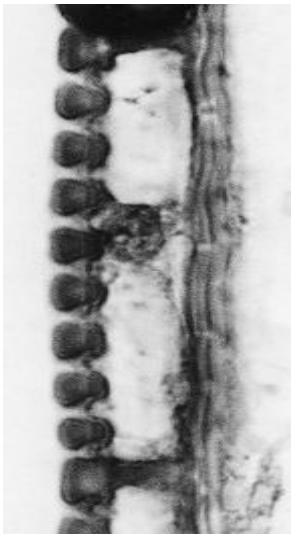
Several pits may arise over one primary pit field. Plasmodesmata are commonly aggregated in the primary pit fields. When a secondary wall develops, the plasmodesmata remain in the pit membrane as connections between the protoplasts of the adjoining cells. Plasmodesmata are not restricted to primary pit-fields. A scattering of plasmodesmata through a wall of uniform thickness is of common occurrence. Pits vary in size and detailed structure, but two principal types are recognized in cells with secondary walls: **simple pits** and **bordered pits**. The basic difference between the two kinds of pit is that, in the bordered pit, the secondary wall arches over the pit cavity and narrows down its

opening to the lumen of the cell. The overarching secondary wall constitutes the **border**. In simple pits, no such overarching occurs. In bordered pits, the part of the cavity enclosed by the border is called the **pit chamber**, and the opening in the border is the **aperture**.

A combination of simple pits is termed a ***simple pit pair***, and of two opposing bordered pits a ***bordered pit-pair***. Combinations of simple pits and bordered pits, called ***halfbordered pit-pairs***, are found in the xylem. A pit may have no complementary structure, for example, as when it occurs opposite an intercellular space. Such pits are called ***blind pits***. In addition two or more pits may oppose a single pit in an adjoining cell, a combination that has been named ***unilaterally compound pitting***.



Bordered pits as “check-valve” for flow



Primary pit fields