

- Tonoplast is the membrane surrounding the permanent vacuole which is filled with cell sap. Cell sap is a solution of water and various dissolved substances which keeps water entering the cell by osmosis Maintains turgidity. Also it stores waste material.
- Chloroplasts and amyloplasts are examples of plastids. Plastids are double membraned organelles. Amyloplast stores starch grains while chloroplasts perform photosynthesis.
- Chloroplasts are the site of photosynthesis; they convert light energy to chemical energy. Chloroplasts are double membraned organelles.
- Granum is a stack of thylakoids in a chloroplast. Plural: (grana). Thylakoids contain chlorophyll which is a green pigment which traps light energy.
- The cytoplasm of chloroplasts are called stroma.
- Chloroplasts have their own DNA and contain 70S ribosomes.
- Stem is surrounded by single layer of cells called epidermis which protects cells beneath it against invasion by pathogens.
- Vascular bundles help support stem and leaves
- Xylem transports water and mineral ions from roots to stem and leaves. Dead tissue. Movement UP the plant only.
- Phloem distributes sucrose and amino acids to growing parts in the whole plant. Living tissue. Movement UP and DOWN the plant.
- Parenchyma: unspecialized cells, some modified into collenchyma and sclerenchyma. It is considered as packing tissue
- Collenchyma have thick, uneven primary cell wall (thicker at the corners) which gives strength. Collenchyma is found just beneath the epidermis, they provide mechanical support. Also it provide flexibility.
- Collenchyma and parenchyma support stems as they are turgid.
- Sclerenchyma provides structural support only
- Sclerenchyma cells are elongated with pointy ends. Strong thick secondary walls with cellulose microfibrils laid down at right angles.... for strength. Lignin is embedded in the thick secondary cell wall, so cells die forming long hollow fiber tubes..... Waterproof and strong. More rigid than collenchyma. Have pits in their walls. They are light because of lack of cytoplasm, no cell content....hollow
- Cambium: unspecialized cells that can develop into xylem or phloem, located between phloem and xylem (stem cells)
- Xylem: dead cells, all cell components are gone. Cells on top of each other, end cell walls break down forming hollow tubes which transports water and mineral ions. Walls are lignified. There are pits in xylem wall which allows lateral movement of water. Lignin is distributed in a helical way in the cell walls of xylem.
- Phloem: For translocation of sucrose. Movement up and down the plant. No lignin in cell walls so living cells. Cells joined end to end, to make long tubes, the walls between cells become perforated creating sieve plates, where the phloem sap flows through holes in it.
- Mature phloem cells have no nucleus , they survive because of companion cells which are linked to them by many plasmodesmata ,these companion cells have a typical plant cell structure but also has much more mitochondria than usual to provide a lot of ATP by