NON-LIVING INCLUSIONS OF THE CELL

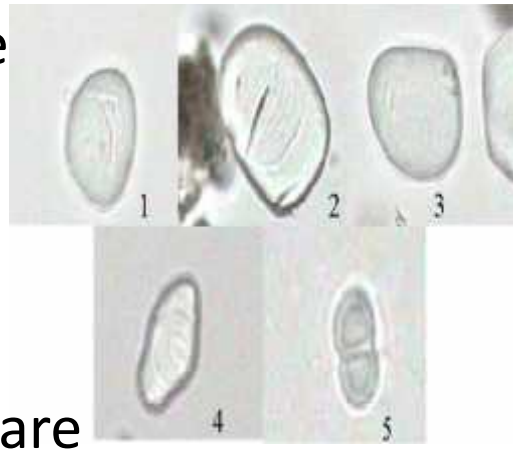
- Cell contents are divided into two:
  - **Living inclusions-** all the cell organelles like nucleus, ER, chloroplasts, mitochondria etc.
  - **Non-living inclusions-** the organic or inorganic substances that are metabolic by-products of the cell- also called non-protoplasmic inclusions or **ERGASTIC SUBSTANCES**

Starch

- Most of the living cells of stem and root contain starch grains
- It is a long chain polysaccharide formed of glucose units
- Two types of glucose polymers are present
  - Alpha amylose
    - Unbranched water soluble
  - Beta amylose (amylopectin)
    - Branched and water insoluble

Starch

- Starch occurs in the form of variously shaped grains
- Stains bluish black with iodine
- Each starch grain has a central portion called the **hilum**
- Starchy materials are arranged around the hilum as various striations
- Sometimes they are deposited in the form of concentric rings and hence called **concentric starch grains. Eg., Rice, Pea**
- In **Potato** they are arranged towards one side in the form of eccentric rings and hence called **eccentric starch grains**
- The starch grain may have only one hilum (**Simple starch grain)** or may have more than one hilum (**Compound starch grain**). Compound starch grains are formed by fusion of more than two grains
- Satrch is deposited in the leucoplast (amyloplasts)in cells



Mineral Crystals

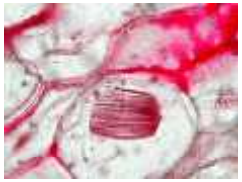
- Mineral crystals are formed by the reaction between acids produced by plants (oxalic acid, carbonic acid etc.) and the alkaline matters like calcium, magnesium and potash
- Most important crystals in plants
  - Calcium oxalate
  - Calcium carbonate crystals
  - Silica crystals
- They lie loose in the cell or may be aggregated into groups and found hanging from cell walls

Calcium Oxalate Crystals

- Most common types of crystals
- They are of different forms
  - Prisms
  - Raphides
  - Druses or Sphaeroraphides

- Prisms- Crystals of calcium oxalate which are rectangular or pyramidal in shape
  - Found in leaves of lemon, Begonia

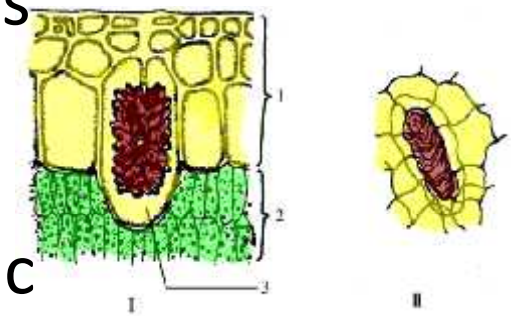
- Raphides
  - Thin elongated needle like crystals of calcium oxalate- found in raphide sacs
  - Sometimes they are found in bundles
  - Occurs in special mucilage coverings
  - Present in rhizome of Colocasia
  - The raphides at times induce irritation- a means of protection from animals
  - These crystals are destroyed on boiling
  - Stellate crystals found in sclerenchyma of aquatic plants- Idioblasts



- Druses
  - Sphaeroidal groups of calcium oxalate crystals

Calcium carbonate crystals

- Calcium carbonate crystals form grape like clusters hanging from a stalk like projection into the cell cavity from the wall and crystals are deposited on this stalk
- This is called a cystolith
- The cystolith is an extension of the cellulosic cell wall with calcium carbonate deposited in the form of granules
- Found in Ficus benghalensis
- A pair of cystolith is seen together in Momordica – called Double cystolith



Crystals of Silica

- Silica is a constituent of the cell wall of many plants
- They are embedded in the cell wall or forms an encrustation on the cell wall
- The silica deposition makes the leaves and stems rough
- Found in grasses, wheat, sugarcane, rice etc.