Lecture (3)

The cell

The body of organasim (plants and animals) may be made up of a single cell(Unicellular) or many cells (multicellular). In unicellular organisms the characteristic features of life are expressed by single cell. In multicellular organisms, all the functions of life are carried out by one or other group of cells. In fact, the cells are the binding blocks of life. A cell is a structural and functional unit of life.

Size of the cell

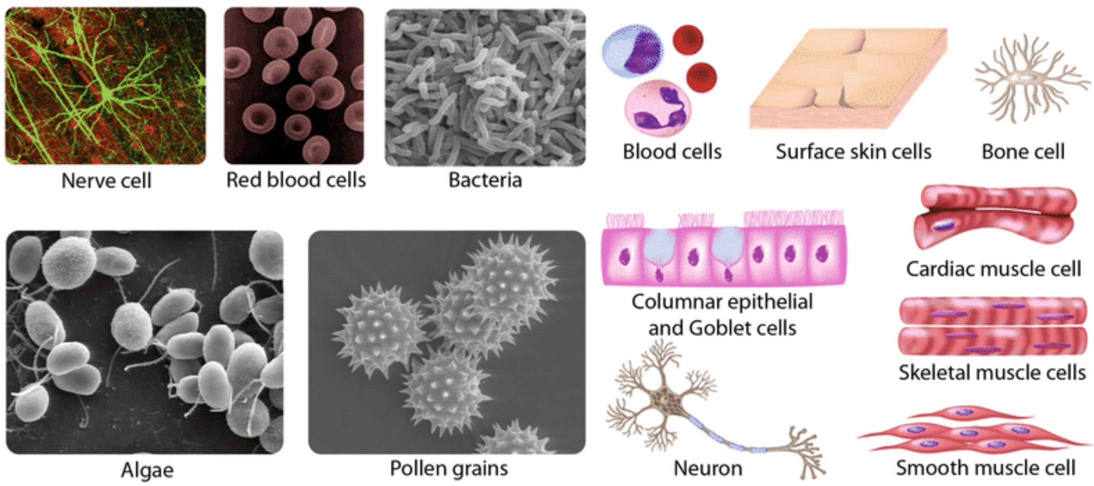
Size of the cell varies widely within and between organisms. Most of the cells are microscopic. The basic units that are normally used to describe the size of the cell are angstrom (A°), millimicron (mμ) and micron (μ).

The smallest cells are found in agroup of organisms called PPLO (pleura-pneumonia like organisms-0.1μ in diameter). In contrast, the largest cell in the world is the egg of an ostrich about 16 cm across. In the plants, the plant producing fibers (Jute, Cotton and Rmie) have the largest cell.

Shape of the cells (Fig-7)

Shape of the cells varies widely both within and between organisms. In the multicellular organisms, the shape of cells depend on their location and nature of function. Some types od shapes of cells are flat (skin cells), elongated (muscle cells), columnar (absorbing cells) elongated and branched (nerve cells), circular disc shaped (Red blood cells RBCs), long tubular cells(xylem and phloem), oval (Chlamydomonas) and irregular (amoeba).

Fig-7 different shape of the cells



Types of cells

The living organism have two type s of cells

1- Prokayotic cells
2- Eukaryotic cells

Prokaryotic cells

The cells are primitive. An organized nucleus is absent in the protoplasm. In these cells the nuclear materials remains diffused with cytoplasm.

Kingdom of Bacteria

1- Bacteria are single celled prokaryotes
2- No organelles
3- Cell wall- composed of peptidoglycan and lipopolsaccharides.
4- DNA-single loop of DNA and not enclosed in nuclear membrane.
5- Aerobic and an aerobic
6- Reproduce through binary fission
7- Motile bacteria posses one or more flagella
See Fig-10

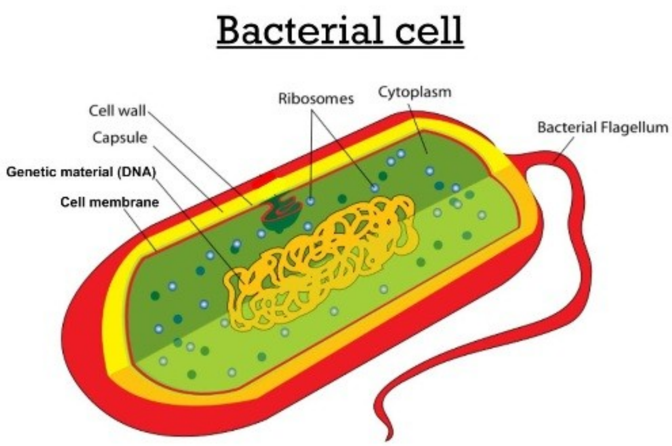


Fig- 10 Bacteria cell

<u>Photoautotrophs:</u> Cyanobacteria :

Synthesis their own organic compounds using sunlight as the energy source.

<u>Chemotrophs: sulfur-loving bacteria</u>

- Need CO_2 as carbon source.
- Obtained energy not from light, but from oxidation of H_2S, NH_4 or Fe^{+}.

<u>Heterotrophs:</u>

Obtain their energy from organic compounds made by the photo- and chemotrophs.

According to the cell wall structure bacteria divided in to two types

1- Gram –Positive (blue-black)
2- Gram negative (Pink)

Shape of the bacteria (Fig-8)

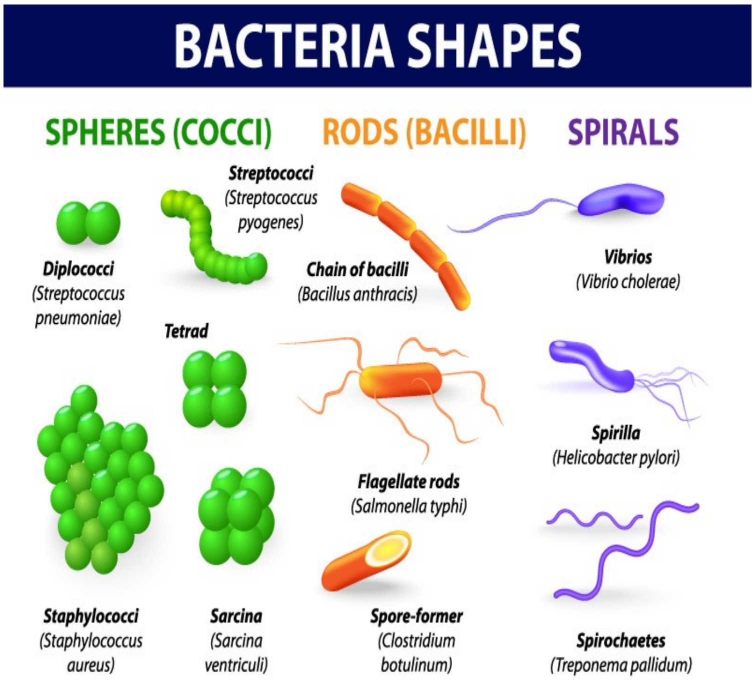
Cocci
Bacilli
Vibrios

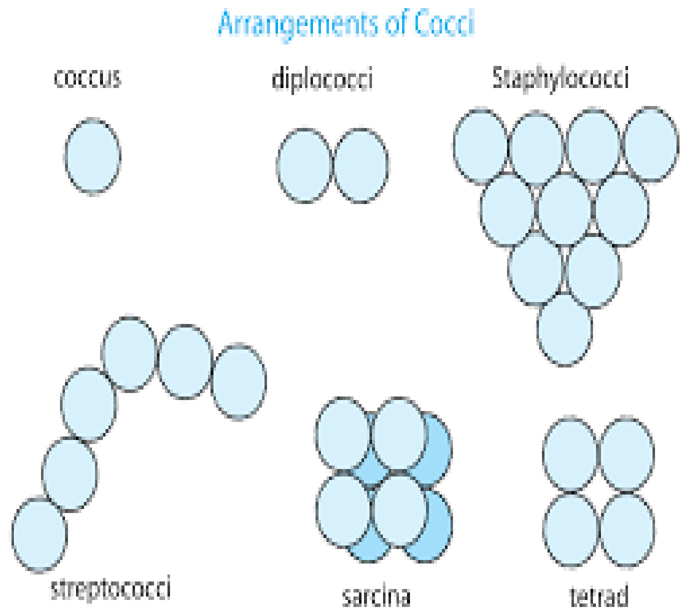
Classification of Cocci (Fig-9)

Streptococcus
Diplococcus
Staphylococcus
Sarcine

Fig-8 Shapes of bacteria

Fig-9 Classification of Cocci bacteria





Economic importance of bacteria

1- Soil fertility- nitrogen fixation by Rhizobium
2- Food production- Synthesis of Cheese by Lactobacillus
3- Production of organic compounds- Synthesis of Acetone Clostridium
4- Production of antibiotics- like streptomycin = Streptomyces
5- Production of enzymes- like amylase = Bacillus

Pathogenic Bacteria:

1- Staphylococcus → wound infections
2- Streptococcus → Tonsillitis
3- Streptococcus → Pneumonia
4- Corynebacterium → Diphtheria
5- Vibrio → Cholera

Eukaryotic cells

These cells contain organized, highly evolved and complex nucleus which always remains enclosed by the nuclear membrane. Nucleus of this type called true nucleus. A part from organized nucleus various cell organelles (e.g , mitochondria, plastids etc.) are also present in the kinds of cells.

The vast majority of organiss are composed of eukaryotic cells. They are of two basic types

1- Plant cells
2- Animal cells

Living compounds of cell

Cell Membrane: In BOTH types of cells. Controls what goes in and out of the cell.

Chloroplast: In a PLANT CELL. Captures energy from sunlight. Uses energy to produce cell food, which is sugar. Process called photosynthesis.

Cytoplasm: In BOTH types of cells. Houses gel-like fluids that support cell organelles.

Microfilaments and Microtubules: Cell structure and movements, form the cytoskeleton

Endoplasmic Reticulum: In BOTH types of cells. Carries substances, like proteins, to various parts of the cell.

Golgi Body/Complex: In BOTH types of cells. Receives materials from endoplasmic reticulum, distributes materials.

Large Vacuole: In a PLANT CELL. Stores water, food, waste and more for a plant cell.

Lysosome: In an ANIMAL CELL. Contain chemicals that break down certain materials. Breaks down dead cells.

Mitochondria: In BOTH types of cells. Organelle that produce most of the cells energy, which is ATP.

Nuclear Envelope: In BOTH types of cells. Protects the Nucleus. Lets things in and out of the Nucleus.

Nucleolus: In BOTH types of cells. Makes Ribosomes.

Nucleus: In BOTH types of cells. Directs all cell actions, including reproduction.

Ribosome: In BOTH types of cells. Produces proteins.

Small Vacuole: In an ANIMAL CELL. Transport and stores materials, including waste.
Vacuole: Temporary storage and transport, digestion (food vacuoles), water balance (contractile vacuoles).

Cell Wall: In a PLANT cell. Helps protect and support the cell. Gives a plant cell a shape.

Pellicle: Strengthen and give shape to the cell.
Cilia and flagella: Cell movement

Ergastic Compounds (non-living inclusions)

Eragstic compounds include:
(A) Carbohydrates,

(B) Nitrogenous matters, and

(C) Fats and Oils.

A- Carbohydrates

1- Cell Wall (See Fig- 10 and 11)

Definintion: cell wall is the outer rigid, porous, non-living covering of plant cell of plant. Cell wall is present only in plant cells.

Structure: the cell wall of of mature plant cell consist of two parts

i)) primary cell wall and ii)) secondary cell wall

Primary cell wall: the external part of the cell which forms first is known as the primary cell wall. The primary cell wall made up of cellulose which is a carbohydrate. It is also contains pectin, lignin and etc. In the young cell, the cell wall is thin and elastic. With age the cell wall gradually comes thicker as a result of deposite of fresh layers of cellulose.

Secondary cell wall: The inner parts of the cell wall formed after the formation of the primary cell wall is known as secondary cell wall. The cell wall of wood trunks are lignified by impregnation of lignin. Cell walls may be cutinized or subernized by the impregnation of certain waxy and faty substances called cutting and suberin. However, the secondary cell wall is much thicker than primary cell wall. The maturity of cell that contained secondary cell wall are dead cell e.g (vessels, trachieds and fibers).

<u>*Middle lamella*</u>: the original wall between two adjacent, on which the thickening layers deposited is called middle lamella.

<u>*Plasmodesmata*</u>: there are some extremely minute pores in the cell wall through which a delicate threades of cytoplasm pass and cytoplasmic connections between two adjacent cell areestablished (see Fig-12)

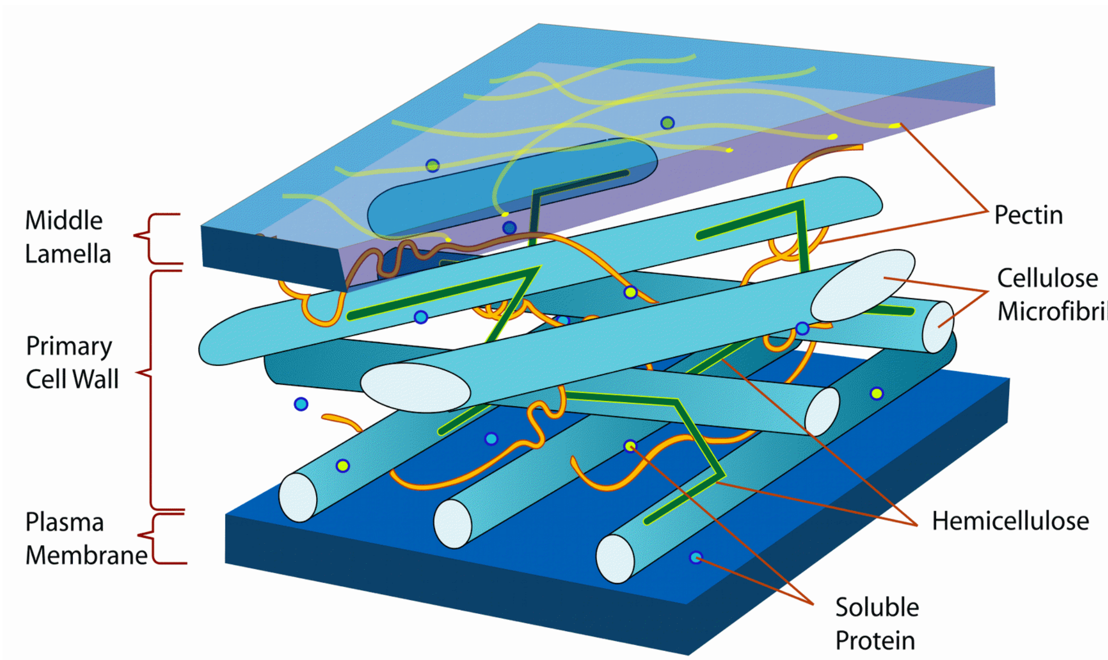


Fig- 10 The plant Cell Wall

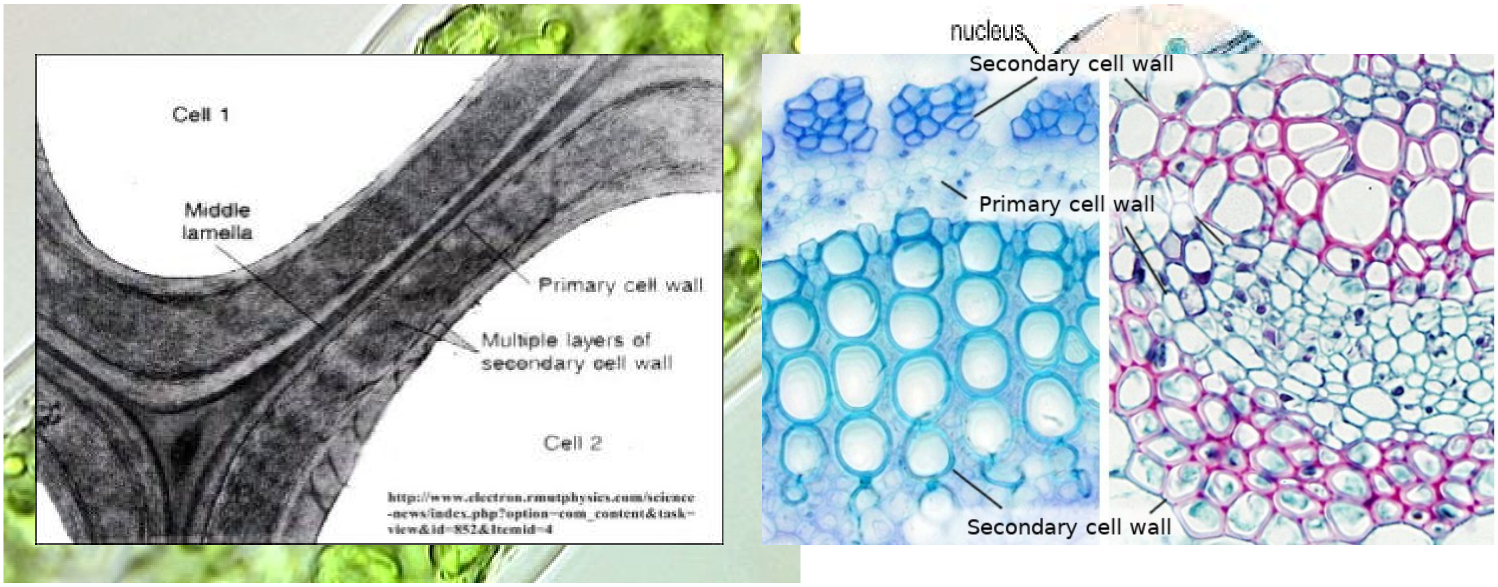


Fig-11 Primary and Secondary cell wall

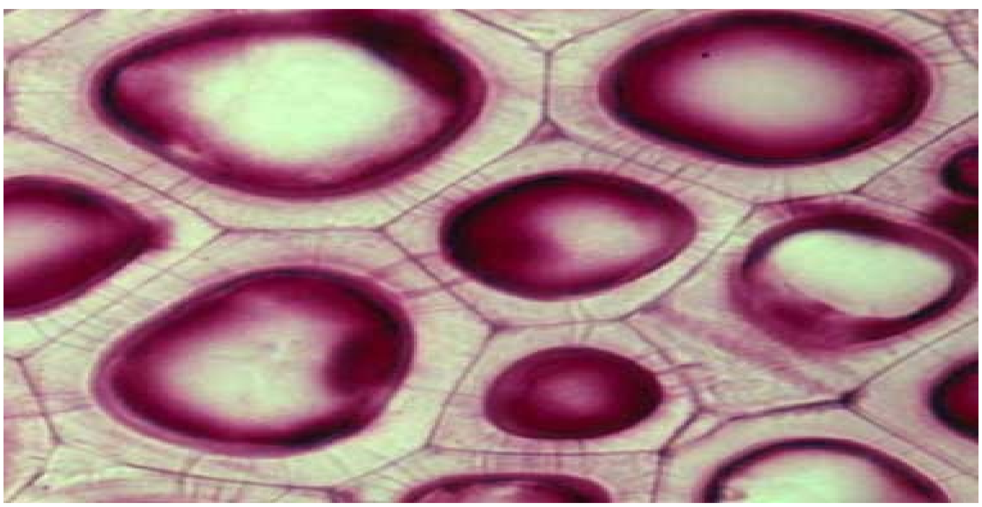


Fig-12 The plamodesmata

2. Starch Grains

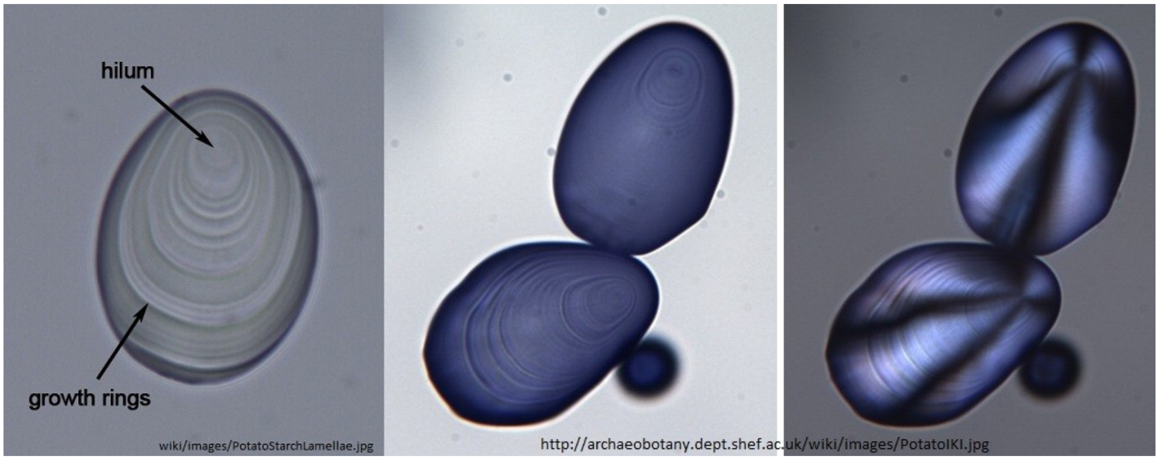
Starch grains are the complex plant food and are universally found in all plant groups with the exception of fungi and bacteria. Starch grains formed by the chloroplasts are called assimilatory starch, which are converted into sugar soon. Reserve starch grains are produced by the amyloplasts out of simple sugar.

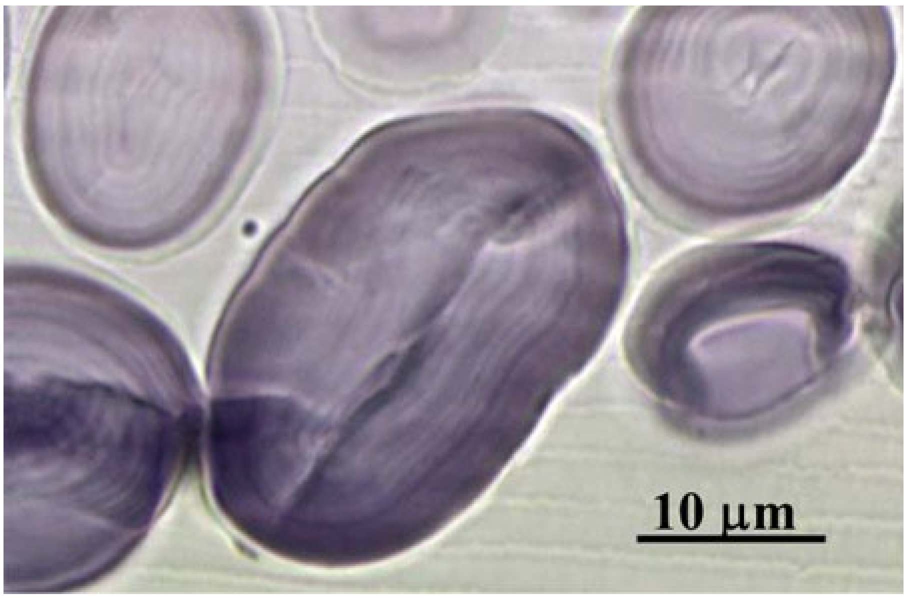
When we speak about starch, we usually mean the reserve starch grains. They are abundantly present in the cotyledons, endosperm, roots, underground stems, etc. Starch grains are of varying shapes. Every grain has a shiny point, called the hilum, which is the centre of formation. When we speak about starch, we usually mean the reserve starch grains. They are abundantly present in the cotyledons, endosperm, roots, underground stems, etc. Starch grains are of varying shapes. Every grain has a shiny point, called the hilum, which is the centre of formation. Around the helium starchy matters are deposited layer after layer, giving the grain a stratified appearance. The layers are known as lines of stratifications. In the starch grains of potato tuber the hilum is located at one end of the grain due to unequal deposition.

They are called eccentric grains; whereas those in the cotyledons of pea are known as concentric, as they have lines of stratifications around the hilum. Starch grains are simple, when they have one hilum with lines of stratifications.

More than one simple grain may be depressed together to form a compound grain. An intermediate form is noticed where the grain has two hila, their own stratified lines, but they are ultimately surrounded by common lines of stratifications. Such grains are called semi-compound or half-compound.

As the plants cannot take solid food, starch grains are converted into sugar before assimilation. Starch grains have a very characteristic test, viz. they turn blue when treated with iodine solution. The formula of starch grain is $(C_6H_{10}O_5)_n$, where value of ‘n’ is not known

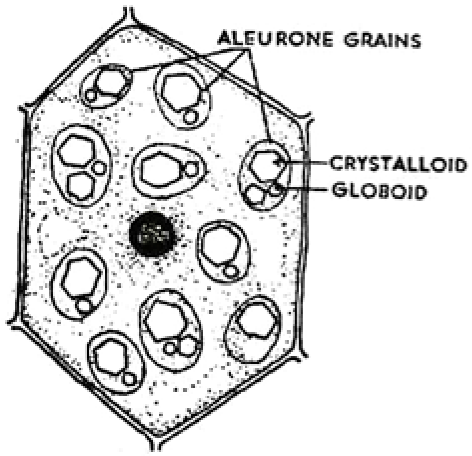




3- Nitrogenous Reserve Materials:

These are very complex chemically. They have nitrogen, usually sulphur and often phosphorus in addition to carbon, hydrogen and oxygen. They are mainly of two types, viz. complex insoluble proteids and their simple soluble forms, amino acids.

Proteids may be present in many parts of the plants. They are usually insoluble in water but dissolve readily in strong acids and alkalies. A common form of aleurone grains proteid, called aleurone grain, is found in the endosperm of castor- oil seed. Each aleurone grain is more or less round in shape which encloses a large crystalline body called crystalloid and a small rounded one celled globoid.



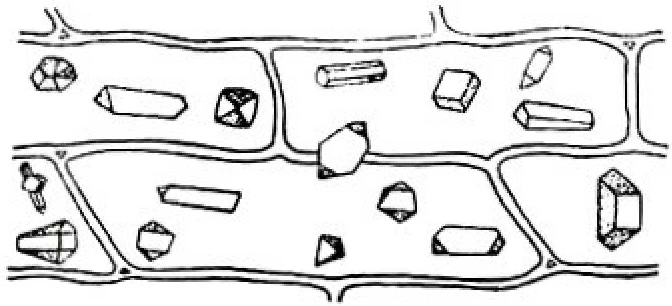
Of the two, the crystalloid only is the nitrogenous matter, the globoid chemically being a double phosphate of calcium and magnesium. The occurrence of crystalloid and globoid is not always constant in aleurone grains.

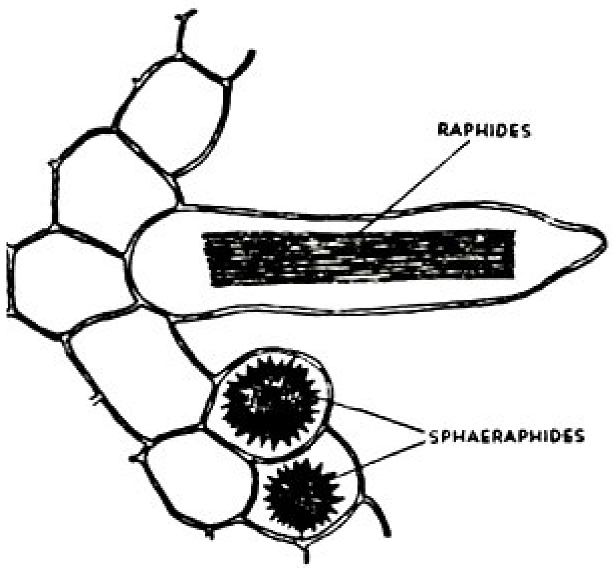
Proteid grains are converted into simple soluble amino-acids for assimilation, and as such they travel to the different parts of the plants. That proteid grains are very complex chemically, is evident from the formula of a common proteid, known as gliadin, present in wheat.

3- Mineral Crystals:

Crystals of various forms are present in the cells. They may occur singly or a large number of them may remain conglomerated together attaining peculiar shapes. Calcium oxalate crystals are abundant in the plants, particularly in the underground organs.

Solitary crystals of calcium oxalate may be rod-like, cubical, prismatic, octahedral, etc. They are common in the dry scales of o n i o n (Fig.). Raphides are the crystal-bundles which look like a bunch of needles inside a sac. Sphaeraphides are beautiful crystal- aggregates which have star-like appearance. Raphides and sphaeraphides are present in Pistia (Fig. 128), arum etc.





Calcium carbonate crystals are often aggregated together on the epidermis of leaves of banyan, India-rubber. Here cells of innermost layer of epidermis often enlarge to accommodate crystals of calcium carbonate deposited on a peg-like projection of the cell wall. This crystal-aggregate, called cystolith, looks like a bunch of grapes (Fig.). Cystoliths of irregular shape are present in the leaves of Momordica