Text

General characteristics of green Algae: Chlorophyceae is characterized by the presence of chlorophyll a and b, starch as reserve food, pyrenoids which are surrounded by starch sheath, cellulosic cell wall, sexual reproduction is isogamous to oogamous. The thallus ranges from single unicellular motile form to complex heterotrichous form. Most of the green algae are aquatic, about 90% of which are fresh water. Chlorophyceae have been divided into nine orders: Volvocales, Chlorococcales, Ulotrichales, Cladophorales, Chaetophorales, Oedogoniales, Conjugales, Siphonalesales and Charales. All the members of Oedogoniales and Conjugales are fresh water. Members of the two groups Siphonales and Ulvaceae, are marine. Members of Volvocales, Cladophorales and Chaetophorales are found both in the fresh water and marine waters. *Vaucheria* and *Ulothrix* are usually found in damp soil, in the form of sheets. Sexual reproduction occurs by isogamy, anisogamy and oogamy. The sex organs are usually unicellular. Zygote represents the diploid phase. The life cycle in different genera may be haplontic (e.g *Chlamydomonas*), diplontic (e.g *Codium*), isomorphic (e.g. *Cladophra*), or heteromorphic (e.g. *Urospora*).

Range of thallus structure in green algae Green algae show great variety in the vegetative organization, life cycle and habitat, than any other group of algae. There is great variation in thallus structure in green algae, which ranges from simple, but primitive motile unicells, to complex, but highly evolved large multicellular forms. Thalli vary from a few microns to several feet in length. Volvocales form the most primitive order of the Chlorophyceae; the most primitive and simple thallus is represented by their motile unicells. All other forms of thalli can be derived from motile unicells:

a) Motile colonies: When motile unicells combine together loosely, a motile colony is formed. This is the first line of evolution in algae being called the volvocine line, and culminates in *Volvox*.
b) Nonmotile colonies: When the motile cells lose their flagella and combine together, a nonmotile colony is formed. This line of evolution is called the chlorococcine line.
c) Filamentous forms: If the cells are held tightly after transverse divisions by the middle lamella, a filament is formed.
d) Membranous body: It is formed when orientation of the cell divisions is controlled

precisely, such that all the new walls occur in only two planes. A thin sheet of cells is thus formed.

e) Parenchymateous body. If the cell divisions occur in all the three planes, a bulky three dimensional parenchymatous body is formed.

f) Siphonous body: If the nuclear division is not followed by cytokinesis, multinucleate cells get formed. This is the siphonalean line of evolution.

The different kinds of thalli of green algae can be described as follows:

(i) **Unicellular thallus**: It comprises of a single cell and is the simplest thallus, which can be motile or non motile.

(a) **Motile unicellular thallus**: Such algal forms are unicellular, spherical or oval, and flagellated, e.g., *Chlamydomonas* and *Haematococcus. Chlamydomonas* is a unicellular motile alga, which has spherical or ellipsoidal body, with two flagella placed at its anterior end.

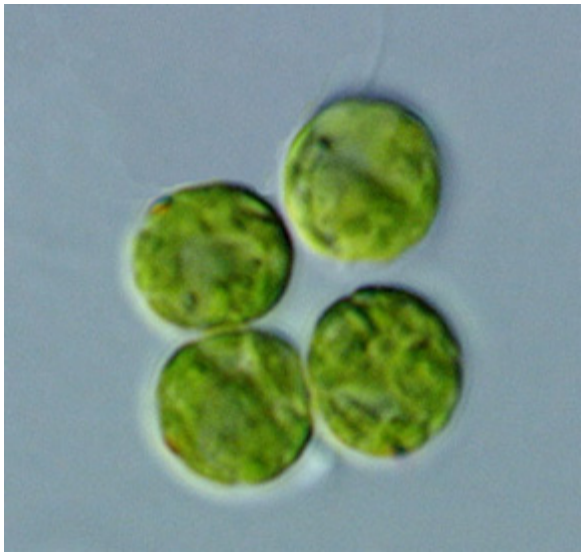
(b) **Non-motile unicellular thallus**: Such algae are unicellular, but lack the flagella, eye spot and contractile vacuole. They are also called coccoid forms, e.g. *Chlorella* and *Chlorococcum.*

(ii) **Colonial thallus**: If the unicells adhere together loosely, the resulting structure is a colony. All the cells are simple and unspecialized. The colonial thallus may be motile or non motile.

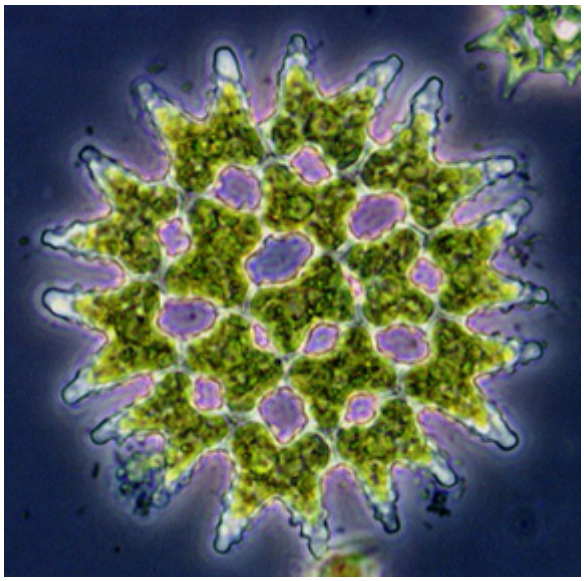
(a) **Motile colonial forms** : When a definite number of flagellated unicells unite together, they form a motile colony. It may consist of 4,8,16 or more flagellated unicells, united by mucilage. All the cells of a colony are physiologically independent, and each resembles *Chlamydomonas* and behaves as one unit. If the cells in a colony are definite in number, arrangement and having an anterior, posterior polarity, the colony is called coenobium, e.g *Gonium, Volvox* and *Pandorena*. *Gonium* colony contains only a few cells, and the only sign of being organized is that all the flagella beat in a coordinated fashion. *Pandorina* is of about the same size as *Gonium,* but is more advanced, because some differentiation of cells between the anterior and posterior end has taken place. In *Volvox,* the coenobium is spherical and consists of about 50,000 *Chalamydomonas* type, biflagellate cells. It is visible to the naked eye. *Volvox* is a multicellular colony, but not a

multicellular individual, because individual cells in the colony coordinate only for the movement of the colony; otherwise they show complete individuality or non interdependence in the matters of nutrition, respiration and other life supporting activities. *Volvox* on maturity shows polarity, because it shows two different types of cells, viz. *Chalamydomanas* type cells (95%) present in the anterior part, and gonidial cells (10%), confined to posterior part of the colony.

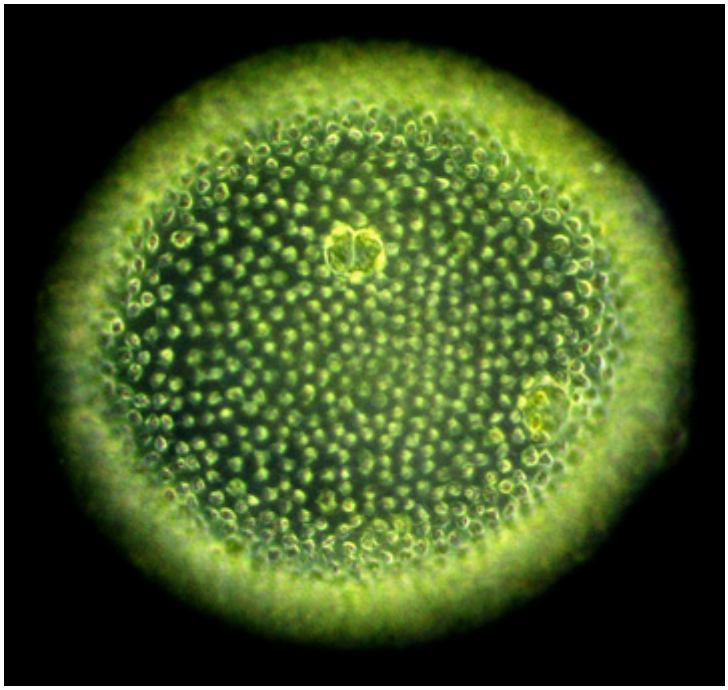
Pandorena



Gonium

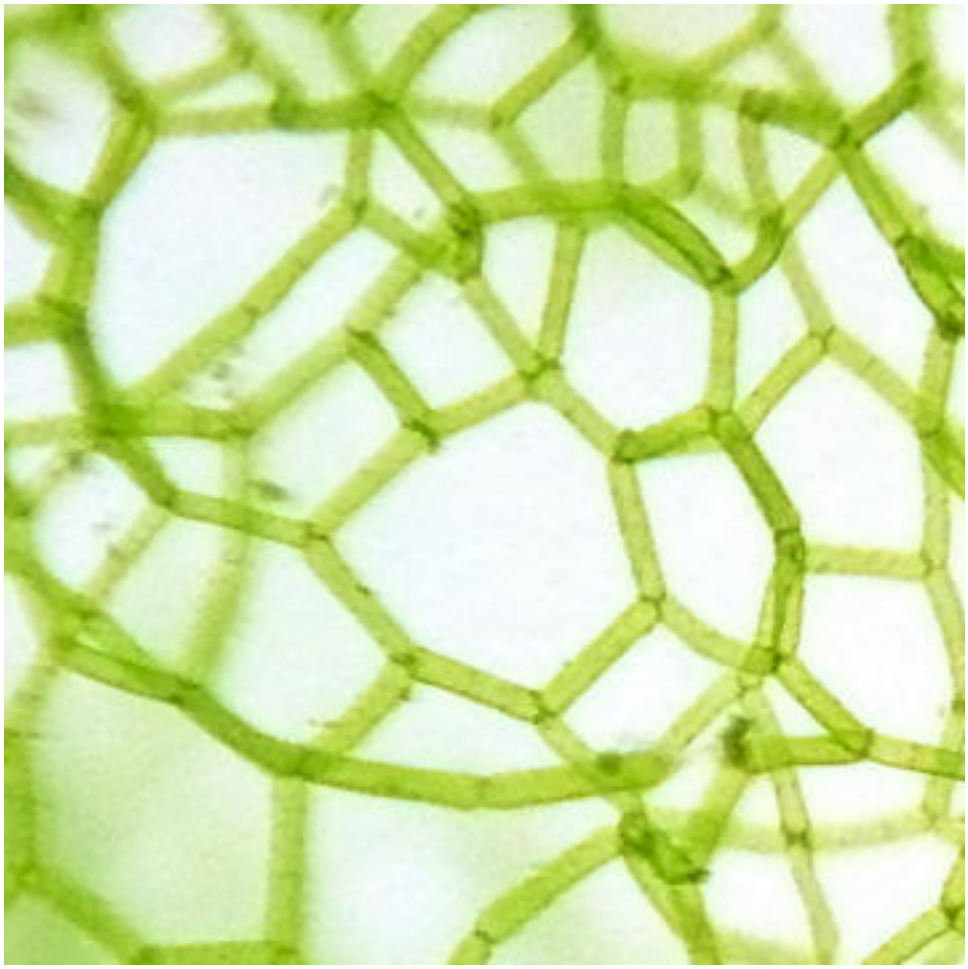


Pediasterium



Volvox colony

(b) **Non motile colonial forms**: If the unicells loose their flagella, or do not develop flagella, and then aggregate together, a non motile colony results, e.g. *Hydrodictyon*. A mature colony of *Hydrodictyon* (waternet) consists of elongated cells joined at their ends to make polygonal shapes. These cells are coenocytic and contain many nuclei. The whole colony is a hollow cylinder that can grow up to 75 cm in length.



Hydrodictyon (water net)

(iii) **Siphonaceous or coenocytic thallus:** Some single celled algae elongate to form a nonseptate multinucleate, tubular or sac like structure. This condition is called coenocytic condition, which is the result of karyokinesis without cytokinesis, e.g. *Codium* and *Vaucheria.* The latter has a long and branched, coenocytic and siphonaceous thallus. The thallus is aseptate; and the septa are formed only at the time of reproduction or at the site of injury. Internally,

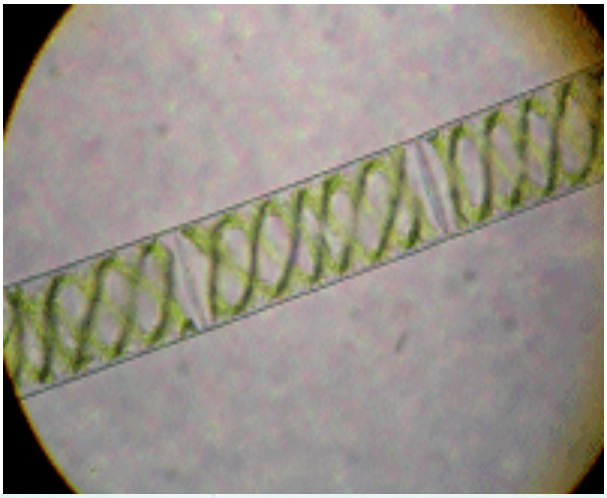
there is a siphon like central vacuole, which gives the order the name Siphonales. *Acetabularia* is a siphonaceous alga, which consists of a stalk ending in an umbrella shaped cap. The stalk bears the only nucleus present in thallus. In *Caulerpa,* a large coenocytic thallus consists of a branched creeping rhizome and erect assimilatory shoots of various shapes.

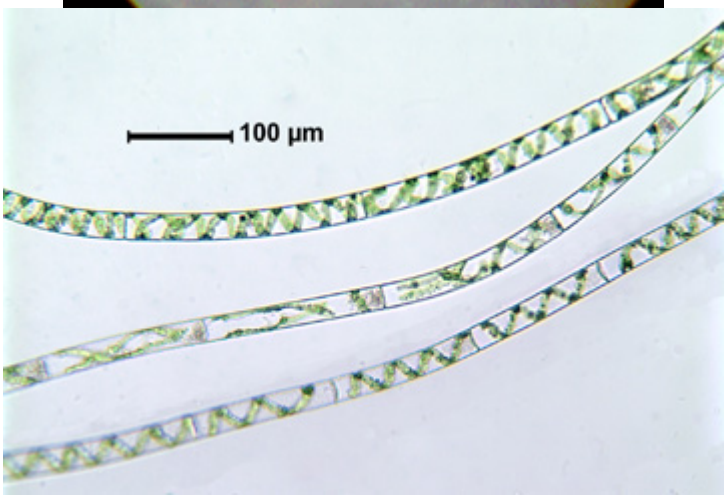
Acetabularia

(iv) **Filamentous thallus:** It results if the cells are held tightly by the middle lamella after multiple transverse divisions, i.e., when a unicell divides several times in a single plane. When the filamentous cells undergo longitudinal divisions, the filament branches. The filamentous forms are of the following two main types:

(a) **Simple filament**: Such type of thallus consists of a straight row of cells. In *Spirogyra,* the cells

are arranged from end to end in a single row or file. Such filaments are unbranched and such a thallus is regarded as advanced filamentous thallus. In *Ulotrix*, the cells are arranged in a single row as in Spirogyra, but it has a rhizoidal cell at one end, by which it gets attached, to substratum and at other end it has an apical cell. In *Oedogonium*, there is division of labour between various cells. It shows apical-basal polarity. The thallus is a long unbranched filament. This alga has a rhizoidal cell for attachment. The filament consists of green vegetative cells which are photosynthetic, cap cells for cell division, specialized anthredia and oogonia for reproduction .





Spirogyra

Oedogonium

(b) **Branched filament:** If some cells in a filament divide in a second plane (longitudinally), a branched filament results. The branches arise from the main axis as lateral outgrowths, e.g. *Cladophora*. It shows bush like thallus, and is attached to rocks. The individual cells are large, multinucleate, and cylindrical and placed end to end. The thallus is attached to the substratum by rhizoidal outgrowths arising from the base of the plant. In *Aegagropila* group growing in water, rolling wave action leads to the aggregation of young branches to form balls floating on water.

(v) **Chara like forms**: It has a plant like body. It resembles *Equisetum* in having nodes and internodes on the axis. From the node arise three types of appendages:

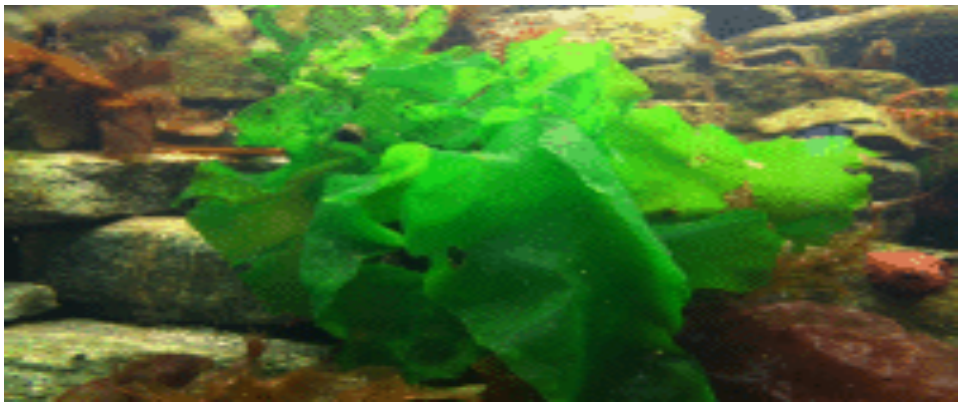
i. **Branches of limited growth**: These branches arise in whorls of 6-16 at the nodes of the main axis and branches of unlimited growth. They stop their growth after some time. They are also called primary laterals, leaves or branchlets.

Reproductive structures are borne on these branches.

ii. **Branches of unlimited growth**: These branches arise from the axils of the branches of limited growth. They also bear nodes and internodes besides, a whorl of primary laterals at the node. They grow indefinitely.

iii. Stipulodes: The basal nodes of the branches of limited growth develop some unicellular outgrowths, called stipulodes. Main axis shows apical growth. The plant is attached to the substratum by awell developed rhizoidal system.

(vi) **Foliaceous Thallus** : A membranous or foliaceous body results if the cells of a filament divide in two planes (transversely and longitudinally). Such forms appear as a green paper sheet, e.g. *Ulva*. It has a lettuce leaf like shape, hence called sea lettuce. Basal part of the thallus forms a stalk.



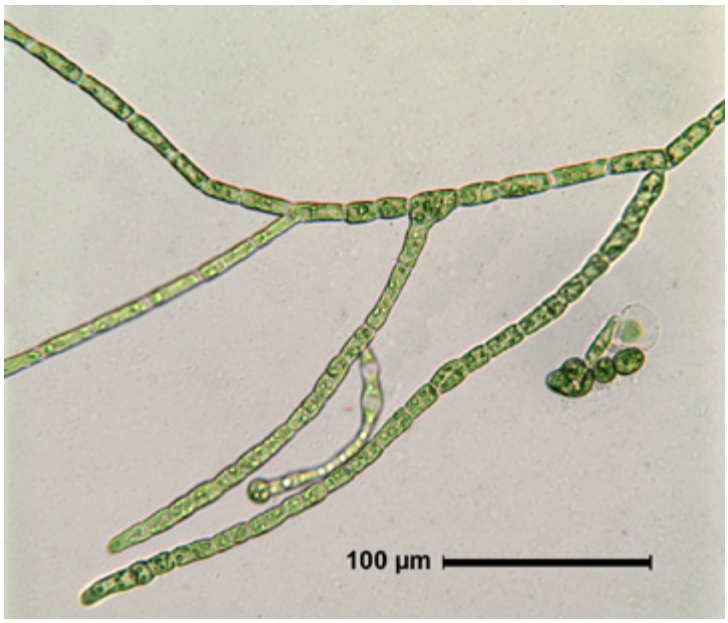
Ulva

(vii) **Massive parenchymatous thallus:** If the cell divisions occur regularly in all 3 planes, a bulky three dimensional parenchymatous body results, e.g., *Enteromorpha*.

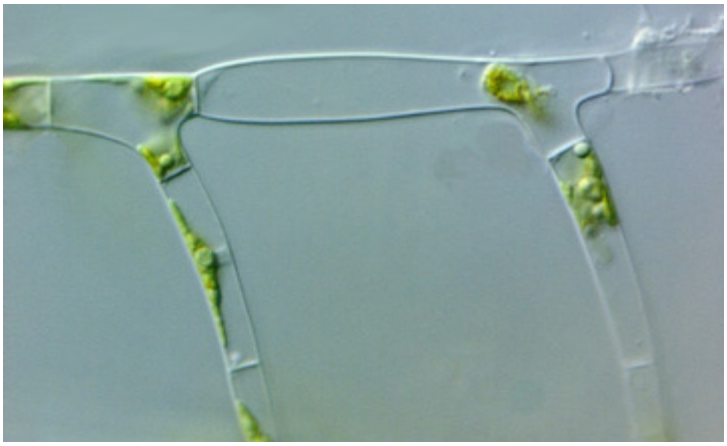
(viii) **Heterotrichous filament**: Heterotrichy means presence of two types of branching, prostrate branching forming the prostrate system and erect branches forming the erect system. It is the most highly evolved and advanced type of thallus found in the Chaetophorales. The prostrate system creeps along the substratum and sends rhizoids to fix the thallus. From the prostrate system arise the upright filaments, forming the erect system.

In some algae, both the prostrate and the upright systems may be well developed (e.g. *Stigeoclonium* and *Fritschiella*). In *Coloeochaet* the erect system is reduced to a few hairs. In *Chaetophora*, the erect system is better developed. In *Fritschiella,* the prostrate system consists of a rounded cluster of cells buried in the mud, while the erect system consists of two regions, a lower primary projecting system, and upper secondary projecting system. By

modification of the heterotrichous habit the other thalli were formed. In *Draparnaldia,* the prostrate system is reduced to the hold fast, and the erect system is differentiated in to the main axis, from which lateral branches arise. In *Drapernaldiopsis,* the main branches bear short and long cells, alternately, nodes and internodes are also present. The main axis is meant for support, while the laterals perform photosynthesis and reproduction.



Fritschiella



Stigeoclonium