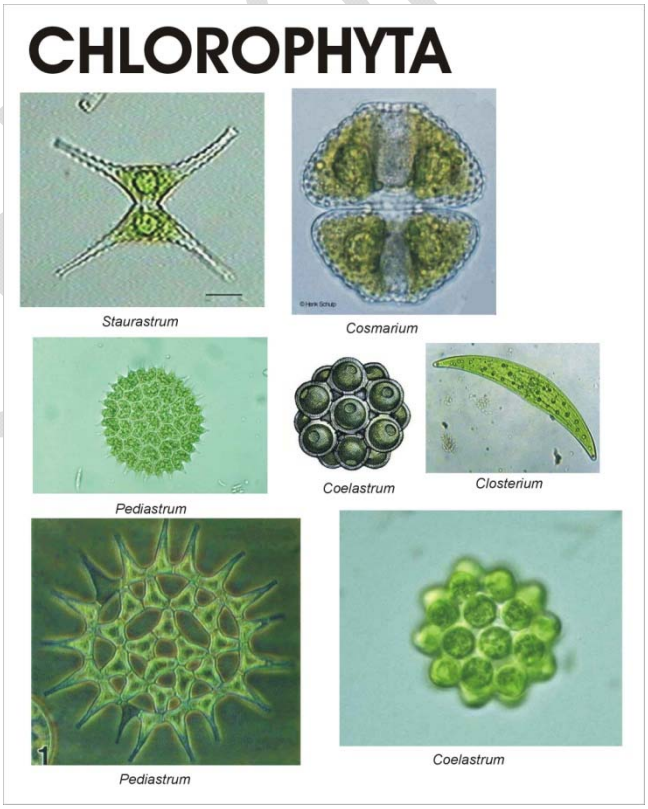
Lecture -3-

Chlorophyta

Chlorophyta is a division of green algae contain chlorophylls a and b, and store food as starch in their plastids.

There are many different species belonging to Chlorophyta; some are unicellular, some are multicelluar. The genome structures within Chlorophyta are all different. However, there are some common characteristics across species.

Chlorophyta inhabit freshwater, marine and terrestrial habitats. Conditions for survival include light, carbon, essential nutrients, water quality, temperature and tidal exposure. Certain intertidal species such as the ulva, or sea lettuce, can tolerate a range of temperatures and survive drying at low tide. While most chlorophyta are aquatic,



1- General characteristics

1-Tend to grow well in summer, with ample light and nutrients and high temperature

2-Some filamentous forms may be inedible

3-Flagella may reduce tendency to sink

4-Many shapes and sizes but planktonic Chlorophyta tend to share a characteristic: rapid growth potential

2-Cell Structure and Metabolism

Most Chlorophyta are unicelluar, but there are some multicelluar species. Some are free-living, some are colonial, others are coenocytic. Filamentous sporophytes have singluar lenticular nuclei, which are embedded in a thick cytoplasm. Chlorophyta usually have biflagellated gametes. Like other green plants, Chlorophyta contain chlorophylls a and b, although the major pigment is chlorophyll b. In addition, some tropical species are pigmented by siphonoxanthin and siphonein. They store starches made from photosynthesis in double-membrane bounded chloroplasts. Cell walls are made of cellulose.

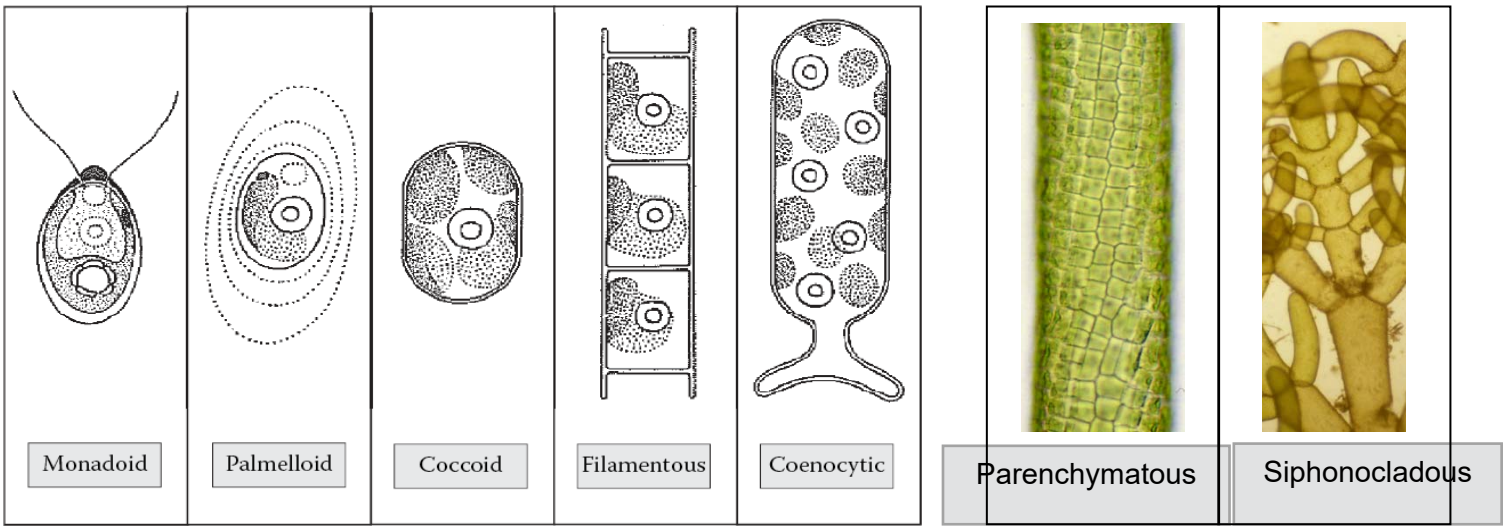


Figure 1: General Forms of Chlorophyta

Chlorophyta are photosynthetic organisms, obtaining starch from photosynthesis. They are autotrophic.

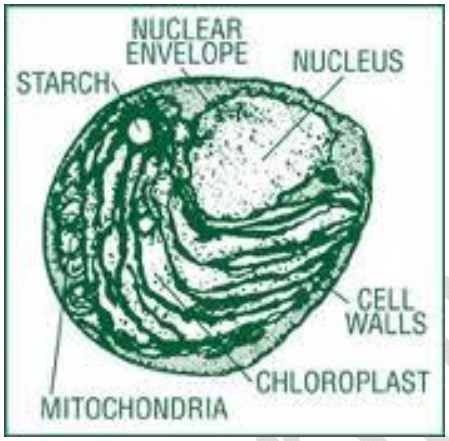


Figure 2: General structure of Chlorophyta

3- Reproduction and Life cycle

Chlorophyta reproduce both sexually and asexually, but usually sexually. Asexual reproduction can occurs by fission, fragmentation, or zoospores. Sexual reproduction can be isogamous, anisogamous, or oogamous. The species *Ulva lobata* experiences alternation of generations, alternating between haploid and diploid phases. In the haploid phase, gametes are formed; in the diploid phase, zoospores are formed. Not all species have this, however. For the species without alternation, meiosis occurs in the zygote.

Chlorophyta can exist as single cells, multi-cellular filaments or colonies. As single cells, green algae may be motile or moving, or non-

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motile. An example of this unicellular organism is the fast growing chlorella that live inside animals.

Multi-cellular filaments can involve a life cycle that includes both sexual and asexual reproduction. The ulva, for example, goes through the process of alternation of generations or alternate forms of reproduction. Parents' characteristics are recombined through the fusion of gametes, but reproduction also occurs through spores.

Colonies may consist of loose aggregates of single cells or an arrangement of cells in a pattern. These cells lack specialized functions. Reproduction occurs more rapidly with nearby mating cells. An example of a colony is the volvox, which has strands of cytoplasm-bonding individual cells. Hundreds of thousands of bright green cells form a sphere-shaped colony that uses its flagella to spin in the water.

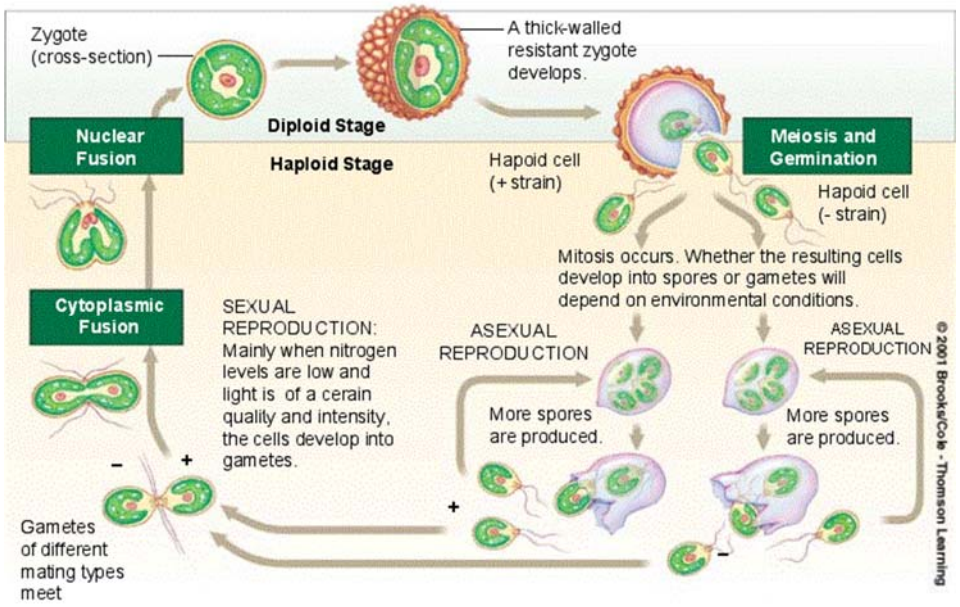

Figure 3: General Life cycle of Chlorophyta

3-1 Oedogonium Life Cycle

Asexual Reproduction

Oedogonium is a form of filamentous green algae. It is capabable of reproducing asexually, which means that each oedogonium has both male and female reproductive organs. In asexual reproduction, the oedogonium fragments and produces zoospores. Zoospores are able to move spontaneously through the water. Once the zoospore is produced, it is released and is free to find a viable substrate. Once found, the zoospore's cells are able to divide and form a new filament of oedogonium.

Sexual Reproduction: Zygote Production

In addition to being able to reproduce asexually, the oedogonium is capable of reproducing sexually. In sexual reproduction, the filament portion of the oedogonium, called the antheridium, produces and releases sperm. The sperm sinks through the water until it meets with the filament portion of the oedogonium, called the oogonium, which contains a large egg. If the sperm successfully fertilizes the egg, a zygote is produced.

Sexual Reproduction: Zoospores

After the zygote is produced, it is released into the water and develops zoospores. The zoospores are similar to those created through asexual reproduction. Once the zoospores mature, the zygote splits open, releasing the zoospores. The zoospores then attach to the bottom of the sea and the cells in the zoospores divide to produce a new filament of oedogonium.

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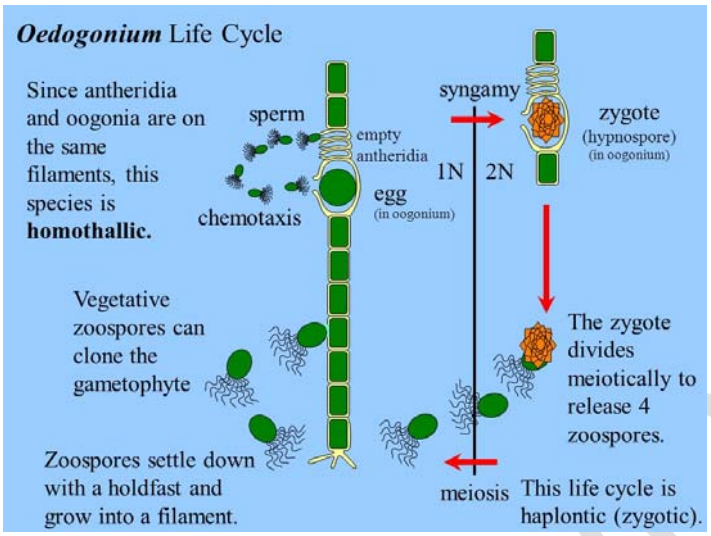


Figure 4: Life cycle of Oedogonium

4- Ecology

Cholorophyta are adapted to shallow water, and live in both freshwater and marine habitats. 90% of Chlorophyta are freshwater species. Those that live in marine habitats largely inhabit tropical environments. There are a small number of terrestrial species; these largely dwell on rocks or trees. Some species form symbiotic relationships with fungi, producing lichens. There are a few instances in which Chlorophyta have formed symbiotic relationships with animals.

The Chlorophyta species *Caulerpa racemosa* was introduced to the Mediterranean Sea in 1990. It was first observed in France in 1997, and has continued spreading. Many of the invaded locations are fishing areas. The Mediterranean Sea has many environmental factors that encourage the growth of *Caulerpa racemosa*, such as an ideal climate and substrata.

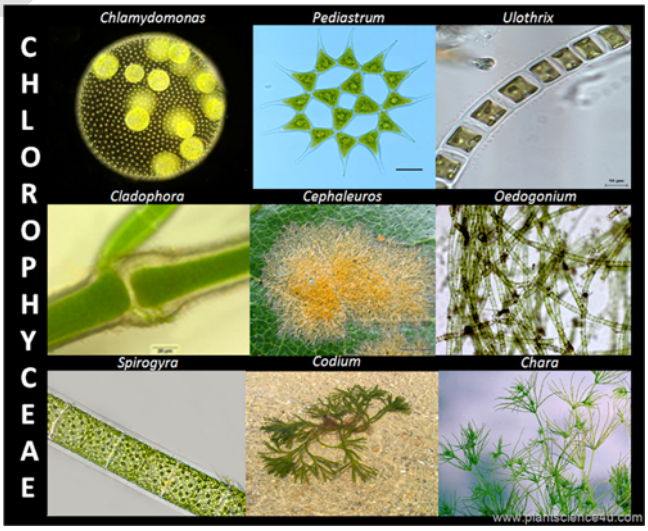
The species *Spirogyra insignis* is known to adapt to harsh conditions through spontaneous mutation. Flores-Moya et. al. (2005) studied the adaptation of this species in sulpherous waters. At first, its growth and reproduction was inhibited. However, the culture survived due to the

growth of a resistant variant that formed before the culture was introduced to these sulfurous waters. This type of spontaneous mutation is what allows the species to survive.

5- **Class Chlorophyceae**

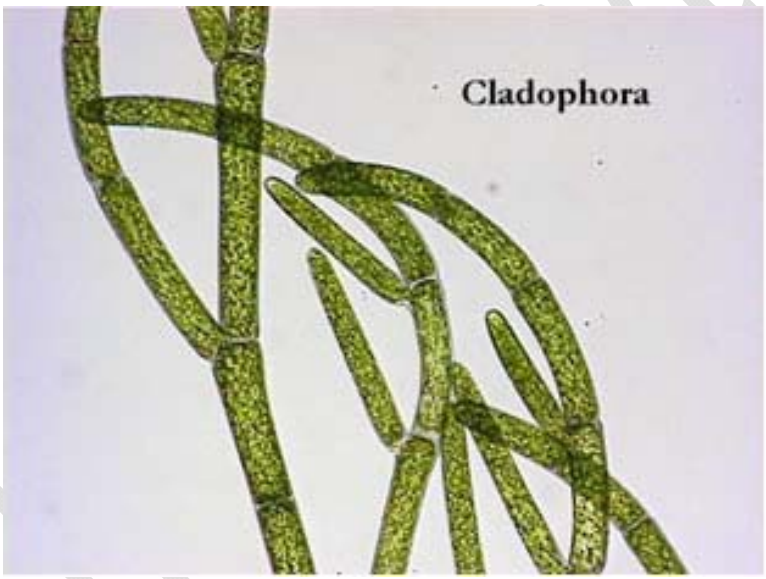
This group contains the largest number of species of the division. They can have two or more flagella, near the apex of the cell. Mitosis in this class involves phycoplasts, microtubules that develop between and separate the daughter nuclei. This characteristic is not seen in any other organism, implying that no organisms have descended from this class. There are a variety of asexual and sexual reproductive techniques. Sexual reproduction is characterized by the formation of a zygospore (a dormant diploid zygote protected by a thick wall) that later undergoes meiosis.

The class includes unicellular organisms such as those in the genus *Chlamydomonas* with their two apical flagella and nonmotile organisms such as *Chlorella,* which is being cultivated for use as a dietary supplement. Colonial genera of Chlorophyceae include *Hydrodictyon* (the "water net") and the so-called volvocine line of flagellated specimens that range from simple colonies of *Gonium* to the intricate spinning spheres of *Volvox,* which can consist of up to 60,000 cells and exhibit some cellular specialization. The most complex of the class are the filamentous members.



6- **Class Ulvophyceae**

Ulvophyceae contains marine organisms that take a variety of shapes that may consist of a few cells, long filaments, thin sheets of cells, or coenocytic cells. Most approach being radially symmetrical. They have an alternation of generations and unlike in the other classes, meiosis occurs in the spores rather than the zygotes. When present, there can be two or more apical flagella. During mitosis, the nuclear envelope and the mitotic spindle persist, as they do in the Charophyceae.

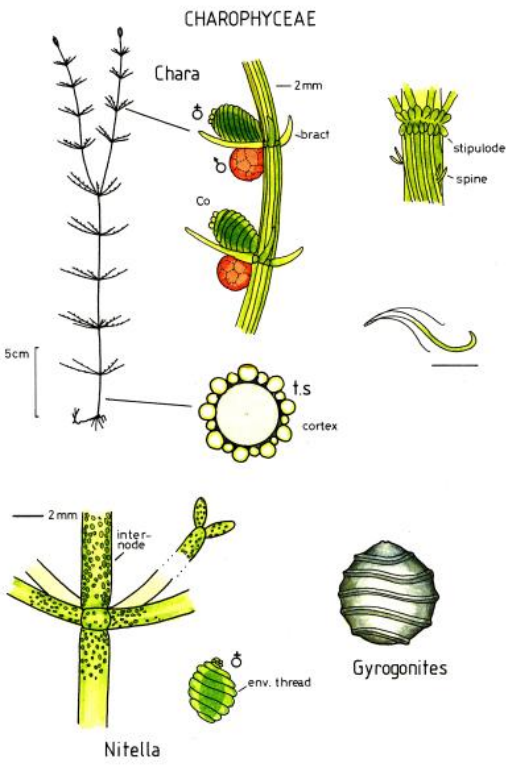


7- **Class Charophyceae**

Charophyceae are of great fossil age; the stoneworts date as far back as the late Silurian period. Cells of this class are asymetrical. Those that are motile have two flagella, at right angles near the apex of the cell. Sexual reproduction in this class, as in Chlorophyceae, is characterized by the formation of a zygospore and zygotic meiosis. Unlike in the other two common classes of green algae, but as with plants, the nuclear envelope disintegrates when mitosis begins. During cell division the mitotic spindle

is present; in some a phragmoplast similar to those seen in plants aids in the formation of a cell plate. Plants are thought to have evolved from early species of Charophyceae.

The class includes *Spirogyra*, familiar filamentous algae that float on ponds and lakes in slimy masses. The desmids are single cells noted for their extraordinary symmetry and geometrical beauty. They are found only in fresh (usually still) water and often take an important place in the food chains of small nutrient-poor ponds and peat bogs. The stoneworts consist of a complex branched thallus with an erect stemlike structure and many whorls of short branches.



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