

**Class- B.Sc.
Semester I
Subject- Botany
Unit III - Phycology**

**Topic - Classification and Life Cycle of -
*Chlorella, Hydrodictyon***

Class - Chlorophyceae

Order- Chlorococcales

Chlorella

Classification and Life Cycle of -
Chlorella, Hydrodictyon

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Class - Chlorophyceae

1. This class include the **eukaryotic** algae.
2. Members of chlorophyceae have the same photosynthetic pigments as in higher plants (**chlorophyll-a, chlorophyll-b, various carotenes and xanthophylls**).
3. The pigments are located in definite .
4. The excess photosynthates are commonly stored in the form of **starch**.
5. Inner layer of the cell wall is completely or partly **cellulosic**.
6. The flagella, when present, are usually two or four in number, equal in length and of **whiplash** type.

Order- Chlorococcales

Members of this order are **exclusively freshwater**.

This order includes **unicellular** and **colonial forms (Coenobium)**

The **vegetative thallus is non-motile**.

Vegetative cells lack flagella, contractile vacuoles and eye spot.

The colonial members arise as a consequence of the union of zoospores or autospores inside the parent cell wall or soon after their liberation from the parent cell.

Asexual reproduction is through **aplanospores (Chlorella)** or **zoospores (Hydrodictyon)**.

Sexual reproduction is **isogamous, anisogamous or oogamous**.

Genus- *Chlorella*

Classification:

Older classification

Phylum Chlorophyta

Class Chlorophyceae

Order Chlorococcales

Family Chlorellaceae

Genus Chlorella

Revised classification

Phylum Chlorophyta

Class Trebouxiophyceae

Order Chlorellales

Family Chlorellaceae

Genus Chlorella

(Most members of Trebouxiophyceae are coccoid unicellular or colonial algae propagating asexually by autospores or zoospores.)

Genus- *Chlorella*

Occurrence-

It is a cosmopolitan, ubiquitous alga occurring in [freshwater, brackish water and terrestrial habitats](#). Most of the species are free living but some form symbiotic or parasitic associations.

C. lichinia is an [algal symbiont](#) of the lichen *Calicium chlorina*.

Some chlorellas, e.g., ***Zoochlorella***, grow as [symbionts in *Hydra*](#) or other aquatic animals.

C. parasitica is found as a [parasite](#) on Paramecium, Spongilla and Ophrydium.

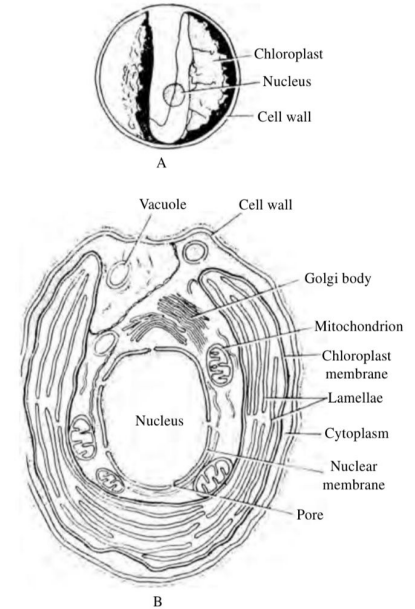
Genus- *Chlorella*

Thallus structure - *Chlorella* is a unicellular non-motile alga.

The spherical or ellipsoidal cells are bound by a true cellulosic wall.

Each cell has a large cup-shaped, parietal chloroplast with or without a pyrenoid. The photosynthetic thylakoids do not show grana-like organization but in *C. pyrenoidosa*, thylakoids are stacked and arranged in grana.

In the colourless central cytoplasm, are located the single nucleus, the mitochondria, endoplasmic reticulum and the Golgi bodies and few vacuoles.

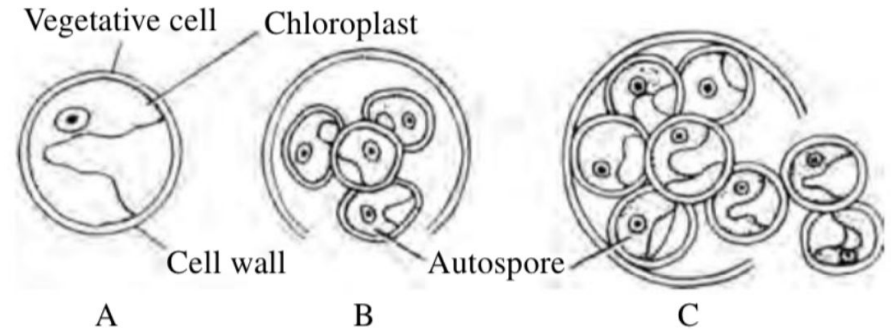


A. Cell under light microscope B. Cell under electron microscope

Genus- *Chlorella*

Reproduction and Life Cycle

It reproduces exclusively by the formation of **four asexual autospores**. Motile cells, zoospores or gametes are not produced.

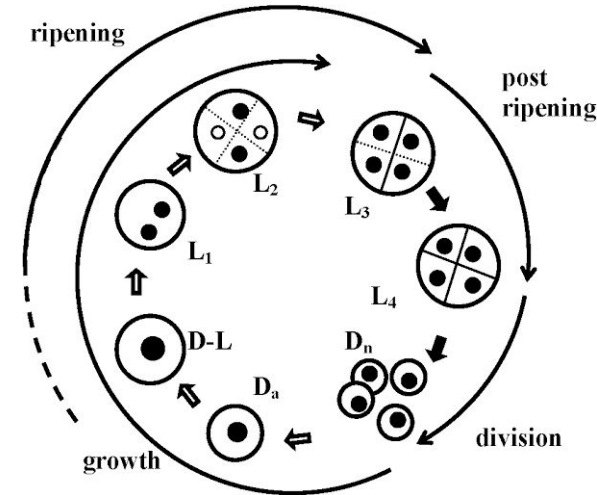


Autospore formation in *Chlorella*

Genus- *Chlorella*

Four phases in the **life cycle of Chlorella** were identified (Tamiya et al., 1953) :

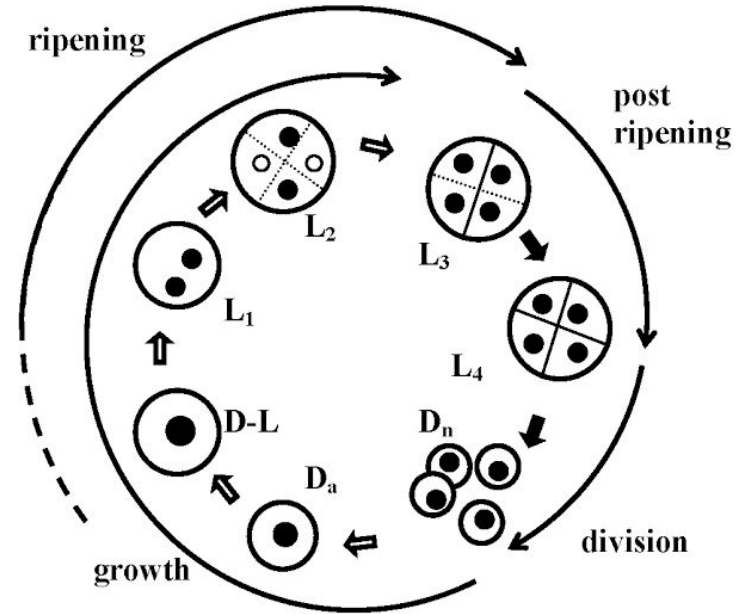
- (1) the **growth phase** autospores grow in size at the expense of the photosynthetic products;
- (2) the **early ripening phase** cells prepare themselves for cell division;
- (3) the **post-ripening phase** cells divide twice either in the dark or light; and
- (4) the **division phase** the parent wall gelatinizes liberating the autospores which in the very young stage are known as dark nascent cells (D_n).



Genus- *Chlorella*

The **growth and early ripening phases** are both **light- and temperature- dependent**.

The **post-ripening and autospore liberation** phases are **only temperature-dependent**.



Genus- *Chlorella* Importance:

1. The alga grows very fast and **used to study the mechanism of photosynthesis and respiration** as its photosynthetic pigments and reserve products are similar to those of higher plants.
2. Chlorella is rich in proteins (about 50%), fats (about 20%), carbohydrates (about 20%), amino acids, vitamins (riboflavin, B₁₂) and minerals. Because of the nutritive value , Chlorella is **used as a health supplement**.
3. Another possible use is in the regulation of oxygen and CO₂ supply in nuclear submarines and space vehicles and is used as **air purifier**.
4. **Antibiotic chlorellin** is produced from Chlorella which is effective against many bacteria.
5. Chlorella removes CO₂ and restores O₂ in photosynthetic process. Thus it is used in sewage treatment tanks to **help in aerobic decomposition of sewage**.

Class - Chlorophyceae

Order- Chlorococcales

Hydrodictyon

Genus *Hydrodictyon*

Popularly known as '**water net**'.

It grows in the **plankton** and **benthos** of freshwater ponds and lakes.

The common species are

H. reticulatum and *H. indicum*



https://commons.wikimedia.org/wiki/File:Hydrodictyon_from_Munich.jpg



https://commons.wikimedia.org/wiki/File:Hydrodictyon_reticulatum.jpg

Genus *Hydrodictyon*

The alga is a **macroscopic non-motile coenobium** consisting of a network of **pentagons or hexagons**.

At each corner of the polygon three large cylindrical cells are united.

Each coenobium is typically cylindrical, closed at both ends, and may consist of a few hundred to several thousand cells in different species. The mature coenobium may sometime be as long as 30 cm.

Genus *Hydrodictyon*

The **young cells** are **uninucleate** with a **parietal, band-shaped chloroplast** having a **single pyrenoid**.

Mature cells enlarge and become **coenocytic** and the **band-shaped chloroplast** becomes **reticulate and forms many pyrenoids**.

Mature cells, contain a **large central vacuole** which displaces the cytoplasm toward the periphery of the cell.

Genus *Hydrodictyon*

Reproduction

Vegetative- by fragmentation of a net into two or three nets.

Asexual - by daughter coenobium

Sexual - isogamous

Genus *Hydrodictyon*

Asexual.

It is brought about by the production of a large number (up to 20,000) of tiny **biflagellate zoospores** within any vegetative cell of the thallus.

These are **not liberated but remain within the mother cell** and for a short while may exhibit some movement.

Zoospores **withdraw their flagella** and come together in groups of five or six and **form a daughter net (coenobium)**.

The parental cell wall ultimately softens, **liberating the young Hydrodictyon coenobium which later grows to adult size without undergoing any cell division.**

Genus *Hydrodictyon*

Sexual -

1. It is **isogamous** and involves the **fusion of biflagellate isogametes** produced in large numbers from vegetative cells.
2. The gametes are liberated from the parent cell through a hole in the wall and **gametic fusion takes place in water**.
3. The **zygote** is thin-walled and green in colour. It undergoes almost immediate germination by **dividing meiotically and produces four haploid zoospores** .
4. Sometimes, however, the zygote may perennate.

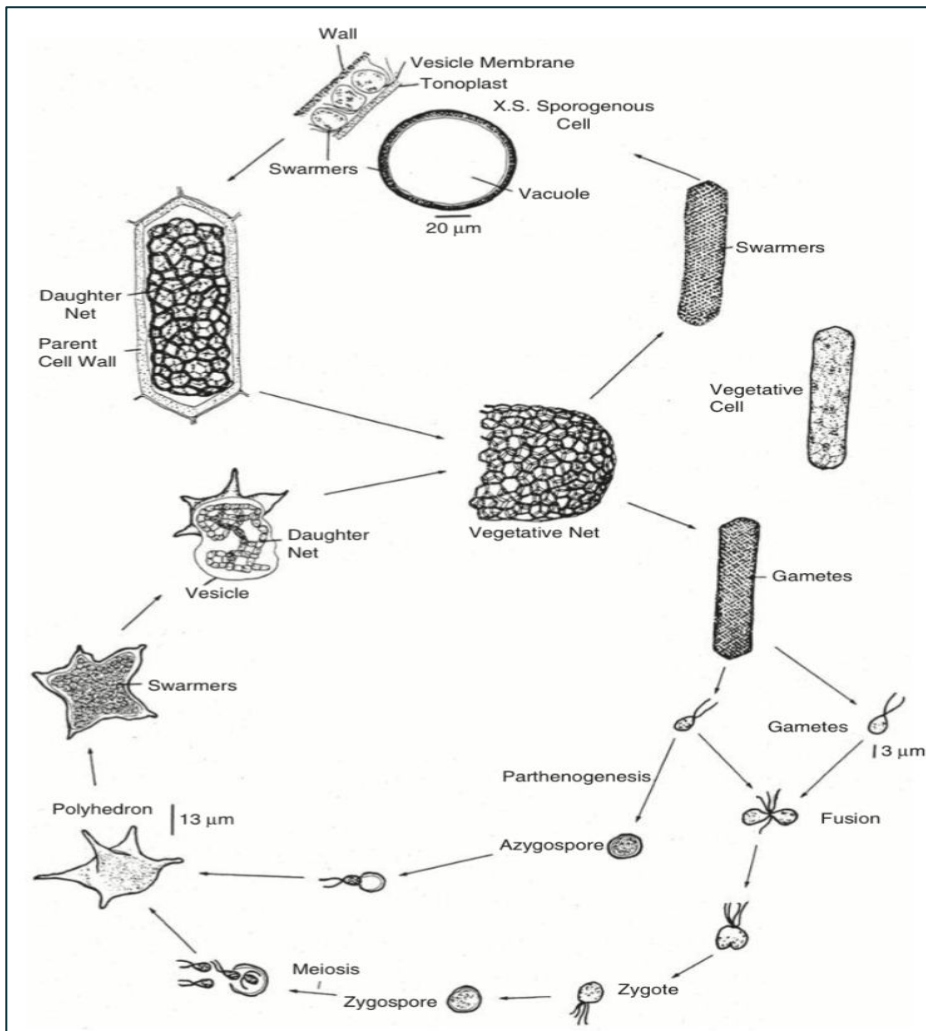
Genus *Hydrodictyon*

Sexual-

The zoospores escape from the zygote wall and develop individually into non-motile polyhedral cells called polyhedron.

With the advent of a favourable growing season each zygote or polyhedron divides to produce numerous zoospores which arrange themselves appropriately so as to form a daughter Hydrodictyon net.

The cells of the net are observed to grow in size only after they have established contacts with adjacent cells.



Life cycle of Hydrodictyon

Let's revise

Q.1 Give the characters of class chlorophyceae.

Q.2 Discuss the reproduction and life cycle of Chlorella.

Q.3 Write a note on importance of chlorella in food, research and sewage disposal.

Q.4 Discuss the thallus structure and cell structure of Hydrodictyon.

Q.5 Give an illustrated account of life cycle of Hydrodictyon.