Department of biology

2025-2026

((Plant groups))

Stage (2)

Third lecture

Cyanobacteria (Blue Green Algae) part2

By

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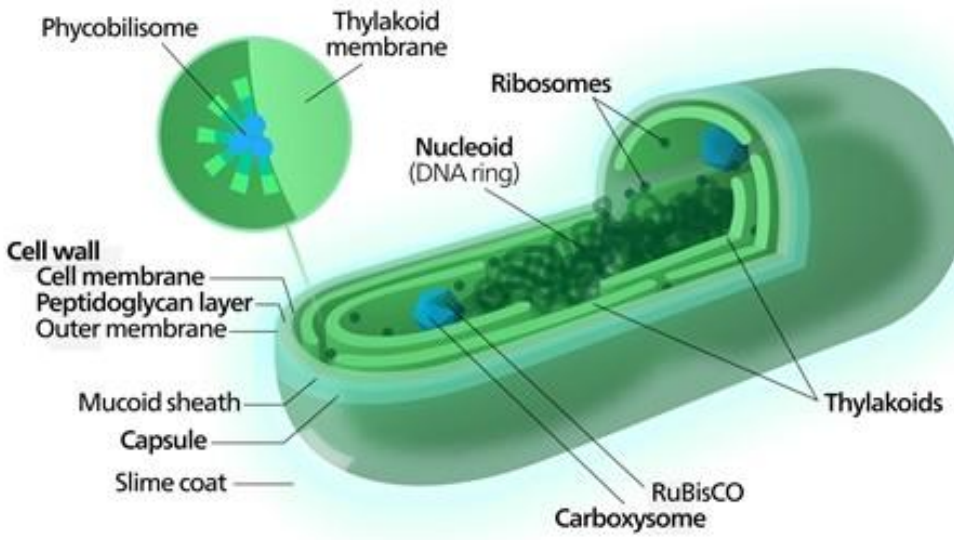
Characteristics of Cyanobacteria

- 1-Prokaryote, the nuclear material is not surrounded by a membrane.
- 2-It lacks the presence of plastids, but the pigments are spread on the photosynthesis plates in the peripheral protoplast.
- 3- It lacks the presence of cell organelles such as Golgi bodies, mitochondria, true vacuoles.
- 4-Stores food in the form of starch.
- 5-Lack of whips or cilia in vegetative and reproductive forms.
- 6- They do not contain sexual reproductive organs and sexual reproduction does not occur in them.



Vegetative Form

- Blue - Green algae include multiple vegetative forms. Some are unicellular, which is rare. This is because, during normal division, a single cell often does not separate from the two dividing cells, but rather remains within the same gelatinous sheath of the parent cell, as in ***Chroococcus*** multicellular. Other multicellular vegetative forms may also exist, such as ***Gloeocapsa*** When cells divide in one direction, a row of cells called trichomes. These trichomes are surrounded by a gelatinous sheath to form filaments, as in ***Oscillatoria, Lyngbya,*** **and** ***Phormidium .***

Cell structure

- Under a light microscope, the blue-green algae cell appears surrounded by a cell wall and an outer layer of gelatinous material that is transparent, thin, or thick, multi-layered as for the protoplast.
  - It is divided into two areas:
  - ❑ **1-** A colored outer area called **chromoplast**.
  - ❑ **2-** A central, granular, colorless inner area called the **Centroplasm**.

Cell wall

- ✓ It is located inside the gelatinous sheath and has a complex structure. It usually consists of four layers. The components of these layers are made up of mucopeptid components made up of several amino acids, including muramic acid and glutamine acid.
- ✓ The protoplast is surrounded externally by the plasma membrane. The peripheral part of the protoplast contains single photosynthetic plates, composed of two membranes, each 7-8 angstroms thick, separated by a short distance. Phycobilosomes, which are bioprotein pigments composed of multiple proteins with the blue-green pigments phycocyanin and chlorophyll, are concentrated on these plates, Phycoerythrin red.

Centoplasm appears as a colorless, granular substance made up of DNA fibrils and may appear as a network.

Ribosomes circulate freely in the cytoplasm due to the absence of the endoplasmic

reticulum. Ribosomes contain RNA and protein. Polyphosphate bodies are also believed to contain photosynthetic enzymes. The algal cell also contains lipid granules. In some planktonic species, the cell contains gas vacuoles or pseudovacuoles. The appearance and disappearance of these vacuoles is thought to be due to molecular pressure. It is also attributed to the lack of oxygen in the cell, which helps it float close to the water surface, i.e., they help the algal body float.

Motility

- Members of this phylum do not possess special locomotion structures such as flagella or cilia, so they are non-motile. However, some members of this phylum can glide or creep, as in *Oscillatoria* and *Spirulina*. Some members that live in spherical aggregates and are found on solid surfaces can perform a rotational or pendulum motion.

Pigment adaptation

(Giadkoff phenomenon)

- Members of this phylum can appear in more than one color. They may be **blue-green, red, brown, or black**. This may be due to the color of the gelatinous sheath surrounding the algae's body. Another reason is the presence of large quantities of blue-green or red bioprotein pigments within the cells. Scientist Jade Cove observed that lighting has a significant effect on the appearance and disappearance of pigments. He found that the red pigment increases in quantity within the cells and the blue-green pigment disappears the lower the light. However, in cases of intense

lighting, the blue-green pigment dominates and the red pigment decreases or disappears, so the algae appears blue-green. The presence of the blue-green algae Trichothecium in large quantities and at great depth (low-light zone) in the waters of the Red Sea gives the waters of its coasts a red color.

Reproduction

- Blue-green algae reproduce vegetatively and asexually. Sexual reproduction has not been observed in members of this phylum.
- **Vegetative reproduction**
- This type of reproduction occurs in two ways:
- **A- Simple cell division:** It occurs in unicellular species such as *Gloeocapsa* and *Chroococcus*.
- **B- Fragmentation:** It usually occurs in filamentous species. Some of the intermediate vegetative cells may die due to age or any other intermediate factor, and they become separating discs for the group of vegetative cells that are trapped between these dead cells. These living cells move away from the body of the mother alga and move in a gliding motion to form a new alga. These dead cells are called hormogonia. However, in species that form colonies, some of the colony cells may fragment to begin forming new colonies.
- **Asexual reproduction**
- This type of reproduction occurs by the formation of motile cells or spores, as follows:

1- **Akinete:** It is a vegetative cell that grows in size and is filled with stored food grains. It contains large amounts of DNA and surrounds itself with a thick wall that may be colored. This cell remains in a resting or dormant period that may

last for many years, after which it grows into a new alga. Its contents may divide, forming a number of spores, each of which grows after being released into a new alga. This cell is found in filamentous genera such as Anabaena and Anabaenopsis and is usually close to the heterocyst.

2- **Heterocyst**: It is a modified vegetative cell surrounded by a three-layered wall. It has a dense, homogeneous content, devoid of cyanophycean granules, contains chlorophyll, and lacks biloprotein pigments. The photosynthetic plates appear in the form of a network spread throughout the cytoplasm. It has one or two polar nodes that represent its contact areas with neighboring vegetative cells. The heterocyst may be terminal, in which case it contains a single polar node and is either apical or basal. The heterocyst may be intercalary, in which case it contains two polar nodules. These channels are considered to be connections between neighboring cells and the heterocyst.

3- **Exospores** : In some species, such as Chamaesiphon and Stichosiphon, a type of external asexual reproductive spores is formed. These spores arise by the apex of the cell wall being shortened and detached to form a spherical structure with part of the contents of the parent cell, similar to the way conidia are formed in fungi. These spores may remain attached to the parent cell to form a confluent chain, which then falls off, each of which grows into a new alga.

4- **Endospores**: These spores are formed by the division of the cell's protoplast, along with the nuclear material, into two or several parts. These parts are released from the parent cell into a new alga, as in Dermocarpa.

5- **Nannospores or Nannocysts**

In some genera, as a result of the availability of suitable conditions, simple cell

division occurs rapidly and repeatedly, forming cells smaller than the parent cells, called Nanopores or Nann cysts. These cells then grow in size, forming an alga resembling the parent alga.

6- **Homocysts or Homospores :** In some genera, a group of terminal vegetative cells may surround themselves with a thick wall because the environmental conditions are not suitable for the algae, and they remain vital until suitable conditions are available for them to grow into a new alga.

Classification of cyanobacteria

Division	**Cyanophyta (Cyanphycophyta)**
Class	**Cyanophyceae**
Order	**Chroococcales**
Family	**Chroococcaceae**
Genus	***Chroococcus***

- Freshwater cyanophyta can be divided into several main groups in relation to general morphology:-

❑ 1-Chroococcales: -

- - Solitary cells (no filaments form).
- - Enclosed by a thin layer of mucilage.
- - The cells may remain as single cells or be aggregated into plate like or globular colonies e.g. *Chroococcus , Gloeocapsa , microcytis.*

❑ 2- Oscillatoriales:-

- -Single filamentous forms consisting of a trichome, is a chain of vegetative cells; a cyanobacterial trichome is often surrounded by a slimy sheath, lacking heterocyst's and akinetes, these relatively simple algae occur as planktonic or benthic aggregations. In some cases, they form dense mats on mud or rocky substrata, such as *Oscilatoria sp.*

❑ 3-Nostocales: -

- - Filamentous algae. planktonic or benthic.
- - Uniseriate trichomes, with akinetes or heterocysts unbranched or flashbacking. *e.g. Anabaena sp.*

❑ 4-Stigonematales: -

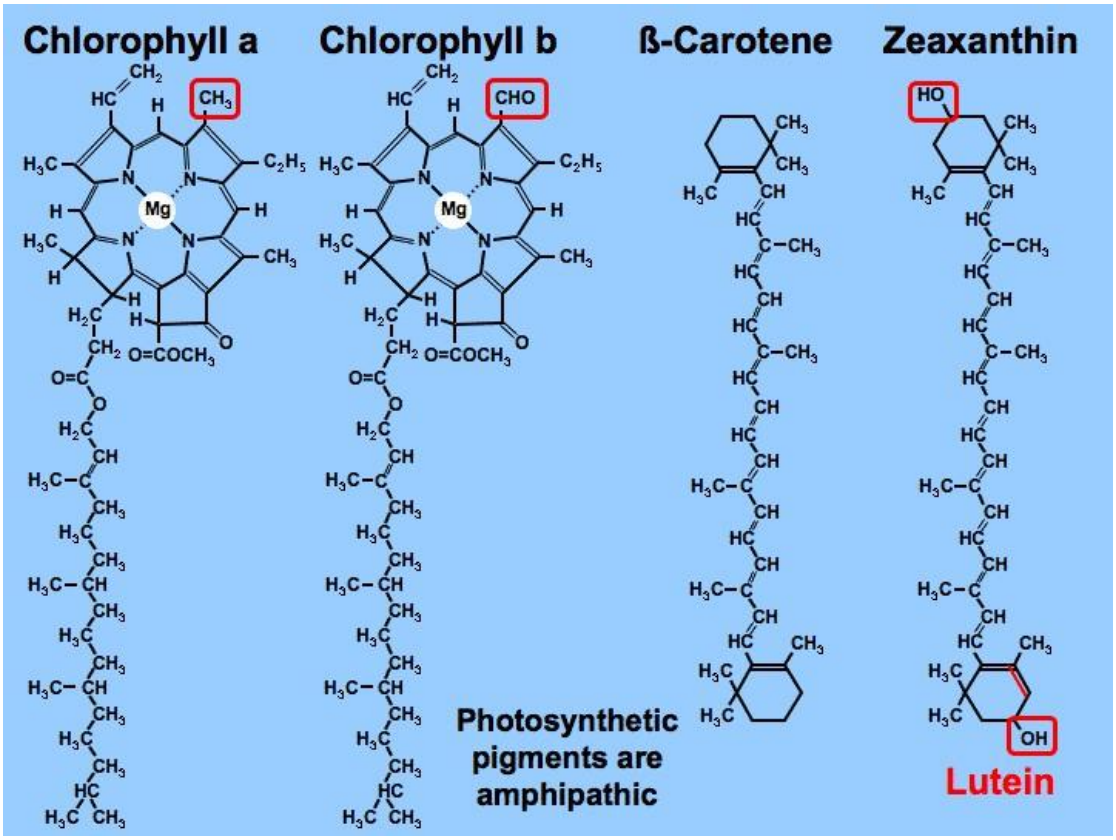
- - Multiseriate trichomes, with akinetes and heterocyst, true branching such as stigonema.

Trichome	Filament
A row of cells without the sheath in the cyanobacteria.	**One or more trichomes enclosed in a sheath.**

Differences between bacteria and blue - green algae

- 1- The difference in the chemical composition of the chlorophyll pigment, as the composition of this molecule in blue-green algae is similar to that of plants and differs from the chlorophyll found in bacteria that carry out photosynthesis.

- 2-The difference in inputs and outputs in the photosynthesis process, as blue-green algae take water in the presence of sunlight and the green pigment represented by chlorophyll and the product of the process sugars and energy in addition to oxygen.
- 3- Bacteria are more sensitive to antibiotics than what is found in blue-green algae.

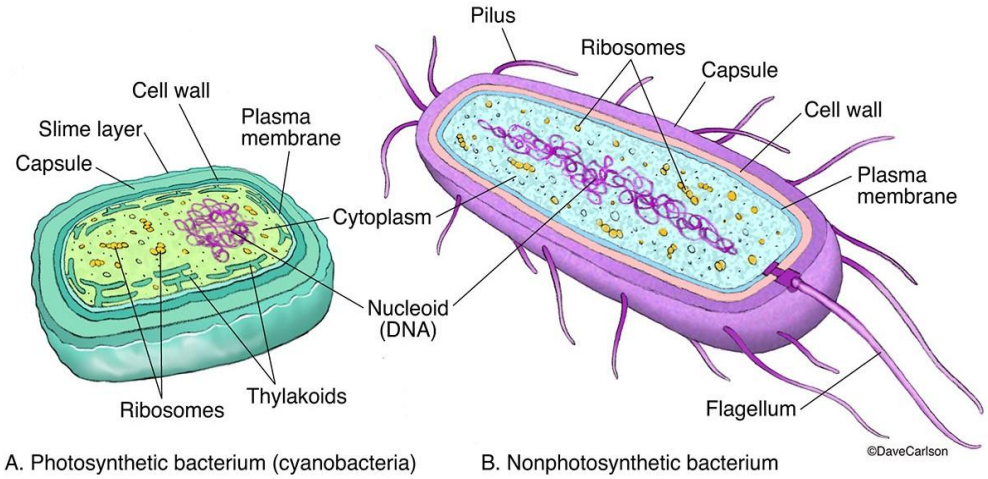


C H O N Mg
55 70 6 4

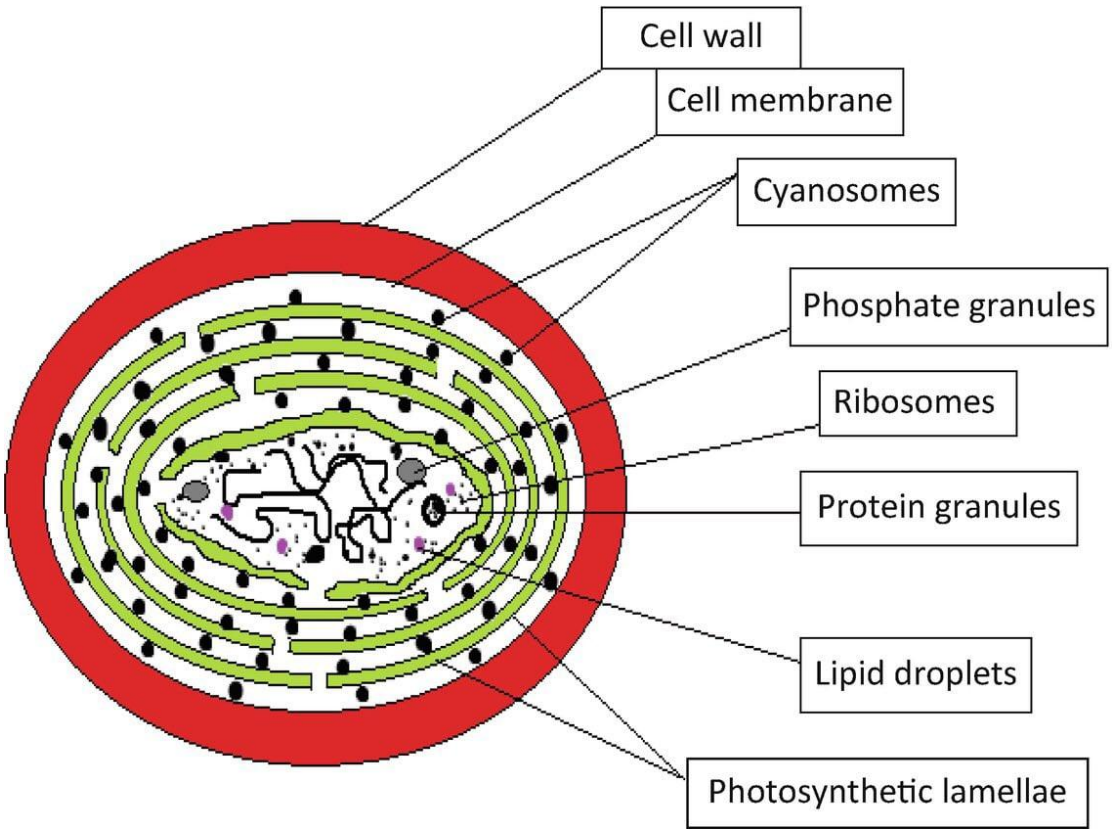
Chlorophyll b

C H O N Mg
55 72 5 4

Chlorophyll a



A. Photosynthetic bacterium (cyanobacteria) B. Nonphotosynthetic bacterium



(Sheaths) composed of mucilage capsule or extracellular polymeric substances , the sheath protects cells From drying.