CYANOBACTERIA

Blue-green algae, the most primitive organisms in the plant world, are not actually "true" algae.

Prokaryotes: Their structure makes them more like bacteria, and they are in fact classed as cyanobacteria, a large group of mostly phototrophic bacteria.

Cyanobacteria cells are single-celled and therefore have a simpler structure than the multicellular eukaryotic cells of plants and animals.

Prokaryotic oxygenic phototrophs that contain a green pigment called chlorophyll and a blue photosynthetic pigment called phycobilins

More than 150 genera

Cell Structure:

Singly (as unicellular organisms) or in colonies (forming filaments). Anabaena, Oscillatoria, and Spirulina are examples of filamentous genera.

Filamentous cyanobacterial cells may differentiate into akinetes (spores resistant to harsh environmental conditions) or heterocysts (cells capable of nitrogen fixation by producing the enzyme nitrogenase). Heterocyst formation occurs when the environment is anoxic and fixed nitrogen is scarce. cyanobacteria are capable of nitrogen fixation through heterocysts. Eg Nostoc, Anabaena

A typical cyanobacteria cell consists of an outer cellular covering, a cytoplasm and nucleic material. The outer cellular covering consists of a mucilaginous layer, which protects the cell from environmental factors, a complex, multi-layered cell wall made of polysaccharides and mucopeptides, and an inner living plasma membrane. These are the basics of cyanobacteria structure.

The cytoplasm has pigmented lamellae (membraneous folds) around its periphery, derived from plasma membrane. The pigments include chlorophylls, carotenes, xanthophylls, c-phycoerythrin and c-phycocyanin. C-phycoerythrin and c-phycocyanin are unique to blue-green algae.

Some cyanobacterial species (e.g. Prochlorothrix, Prochlorococcus, Prochloron) lack phycobilisomes but they have chlorophyll b.

Phycobilisomes are embedded in the intracytoplasmic membranes (thylakoids). The phycobiliproteins are components of the phycobilisomes (light-harvesting antennae for cyanobacterial photosystems).

They have microcompartments, such as the carboxysome. A carboxysome is a compartmentalized cage-like structure surrounded by a protein shell. Cyanobacteria use it for concentrating CO2 and therefore increase the efficiency of RuBisCo (the CO2-fixing enzyme).

Some of them are nonmotile whereas others can move by gliding motility. Motile filaments of cyanobacterial cells are called hormogonia. Individual cells may break away from this filament to start a new colony elsewhere

In order to float, they form a gas vesicle (a vesicle bounded by a protein sheath and not by a lipid membrane). Many planktonic cyanobacteria use them for floating toward the surface to collect light or for sinking toward the sediments to avoid the harsh effects of UV radiation.

Cyanobacteria reproduce by binary fission. Some species are capable of multiple fission to form cyanobacterial endospores (also called baeocytes) eg *Planktothrix*

The nucleoplasm, where the DNA is located, is made up of lots of threadlike fibers or filaments and is in the center of the cell. There is no nuclear boundary or nucleolus

Classification

Under Phylum Cyanobacteria (or Cyanophyta), the major taxonomic orders that are presented here are as follows:

Chroococcales

Pleurocapsales

Oscillatoriales

Nostocales

Stigonematales

Significance

1. Planktons: Food chains

2.Cyanobacteria produce toxic secondary metabolites, cyanotoxins, which they release into the environment, especially during cyanobacterial cell death and lysis.

3. Spirulina sp., a filamentous species, however, is grown because of therapeutic claims on human health and its high nutritional content, such as calcium, iron, magnesium, potassium, sodium, and essential amino acids. Spirulina spp. are grown and harvested for consumption as human and animal dietary supplements.

4. Cyanobacterial bloom is also induced by mass cultivation for bioremediation, and biofuel production.

5. Biofertilizers: Nitrogen-fixing cyanobacteria can fix the atmospheric nitrogen into another form (e.g. ammonia, nitrites, or nitrates) that other living cells and organisms (e.g. plants and animals) can readily use and convert into proteins and nucleic acids. Thus, they may form a symbiosis with other organisms. *Anabaena* sp. is an example of a cyanobacterial species that fix nitrogen. In the Anabaena colony, some cells of the colony transform into heterocysts. *Anabaena* cells may develop symbiosis with the water fern *Azolla*. Inside the host cell of *Azolla*, they form a colony and develop heterocysts that fix atmospheric nitrogen for their host. Nitrogen-fixing cyanobacteria are grown in rice paddies as alternative nitrogen fertilizers as opposed to chemical nitrogen fertilizers.

6. Oxygen Cycle: *Prochlorococcus* sp. alone is credited for contributing much oxygen (about half) as they perform oxygenic photosynthesis in the open ocean. Early cyanobacteria play a role in the Great Oxygenation Event by releasing oxygen as a byproduct of photosynthesis.

-7. Cause disease by production of cyanotoxins- in fish

8. According to the Endosymbiotic theory, they formed symbiotic associations with other organisms where they participated as endosymbionts of larger primitive host cells. Eventually, the endosymbiont cyanobacteria turned into plastids of the photosynthetic eukaryotic cells of today.

References

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